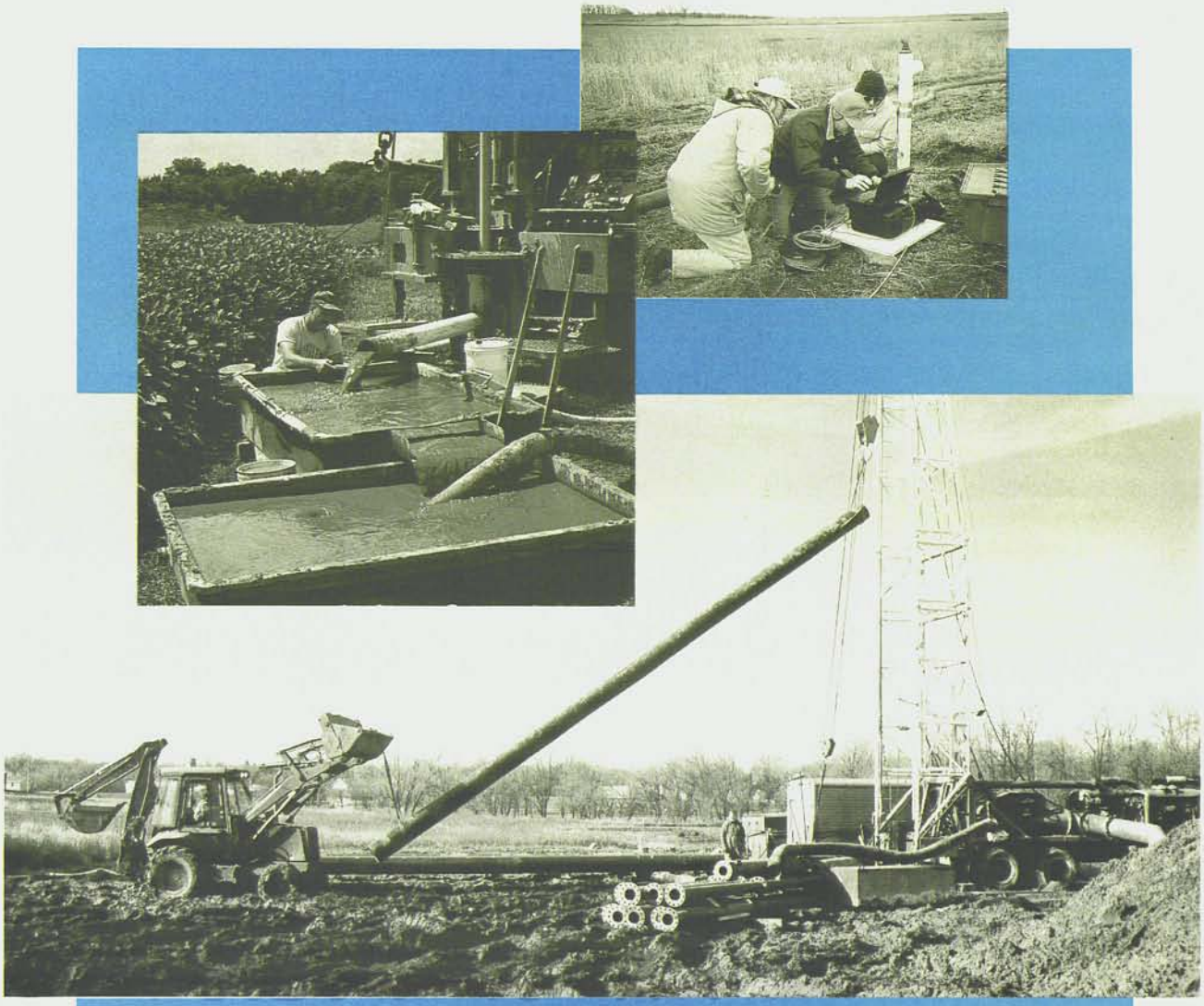
Coop 17A

Hydrogeology and Groundwater Availability in Southwest McLean and Southeast Tazewell Counties

Part 1: Aquifer Characterization (Appendixes)



1995
Cooperative Groundwater Report 17A

Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
ILLINOIS STATE WATER SURVEY

Hydrogeology and Groundwater Availability in Southwest McLean and Southeast Tazewell Counties

Part 1: Aquifer Characterization (Appendixes)

Beverly L. Herzog
Steven D. Wilson
David R. Larson
Edward C. Smith
Timothy H. Larson
Michael L. Greenslate

With contributions by

John P. Kempton
Samuel V. Panno
Keith C. Hackley
Philip C. Reed
Timothy C. Young
Stephen L. Burch
Robert D. Olson
Thomas R. Holm

1995
Cooperative Groundwater Report 17A

ILLINOIS STATE GEOLOGICAL SURVEY
615 East Peabody Drive
Champaign, IL 61820-6964

ILLINOIS STATE WATER SURVEY
2204 Griffith Drive
Champaign, IL 61820

Cover photos Clockwise from upper left. Collecting geologic samples during test drilling. Monitoring water levels during aquifer test. Installing well for aquifer test near Mackinaw. Well discharge at Mackinaw aquifer test: gas in the water causes the turbulence.

ILLINOIS
DEPARTMENT OF
NATURAL
RESOURCES

Printed by authority of the State of Illinois/1995/800

Printed with soybean Ink on recycled paper

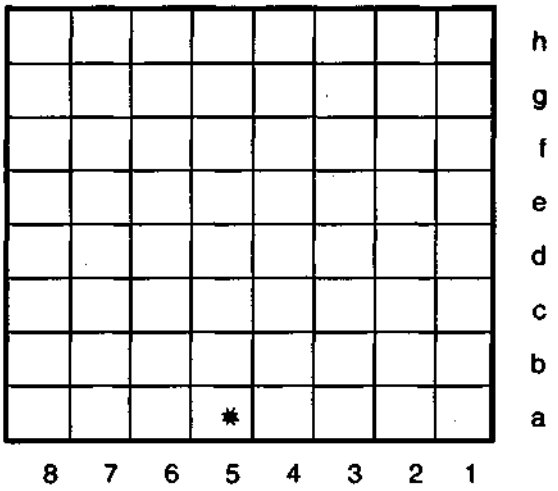
CONTENTS

APPENDIXES

APPENDIX A WELL LOCATION SYSTEM

The well location system used in this report uses township, range, and section for identification. The location system consists of as many as four parts: township, range, section, and coordinates within the section. Normal sections of one square mile contain eight rows of 1/8-mile squares; odd-shaped sections contain more or fewer rows or columns of squares. Each 1/8-mile square contains 10 acres and corresponds to a quarter of a quarter of a quarter section. Rows are numbered from east to west and lettered from south to north, as shown in the diagram below. The location of the well shown is identified as 23N02W10.5a. This well is at site SWS-2 (fig. 11).

Tazewell County
Township 23N, Range 2W
Section 10



APPENDIX B COMPOSITE WELL LOGS
Composite Test Hole Logs with Drillers' Logs and Details of Observation Well Construction

MTH-1
Location: Tazewell County, T24NR03W28.4a
Elevation: 650 feet **Total Depth:** 215 feet **Date drilled:** 9/7/93
Depths corrected to natural gamma log. Logged interval 1.7 to 210.7 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-5	Sandy clayey silt to sandy silt, very dark brown to very dark grayish brown (10YR 2/2 to 10YR 3/2), leached.
5-9	Sandy clayey silt, strong brown (7.5YR 5/6), oxidized, leached.
	Wedron Group
9-11	Diamicton, slightly pebbly sandy clayey silt, brownish yellow (10YR 6/6), slightly calcareous.
11-16	Diamicton, as above, dark yellowish brown (10YR 4/4).
16-20	Diamicton, pebbly sandy clayey silt, grayish brown (10YR 5/2), calcareous.
20-49	Diamicton, as above, gray to dark grayish brown (10YR 5/1 to 10YR 4/2), with very fine to coarse grained sand and fine to medium gravel, calcareous.
	Tiskilwa Formation—Delavan Member
49-55	Diamicton, pebbly sandy clayey silt to pebbly clayey sandy silt, dark gray (10YR 4/1), with organic fragments, slightly to moderately calcareous.
55-65	Diamicton, pebbly clayey sandy silt to clayey pebbly silty sand, dark gray to dark grayish brown (10YR 4/1 to 10YR 4/2), calcareous.
	Roxana Silt—Robein Member
65-67	Silt, very dark grayish brown to very dark brown (10YR 3/2 to 10YR 2/2), abundant fibrous organic fragments, leached.
	Glasford Formation—Radnor Member
67-77	Sandy clayey silt and silty clay, in layers, very dark gray to olive gray (5Y 3/1 to 5Y 4/2), abundant organic matter, leached.
77-83	Sandy clayey silt, olive gray to olive (5Y 4/2 to 5Y 4/4), leached, some organic fragments.
83-85	Sand and gravel, very fine sand to medium gravel, poorly sotted, possibly oxidized.
	Glasford Formation—Vandalia Member
85-91	Diamicton, pebbly sandy clay with clayey sand, gray (1 OYR 5/1), with very fine to coarse grained sand and fine gravel, slightly to moderately calcareous.
91-102	Diamicton, pebbly silty sandy clay grading to clayey silt, dark gray and dark grayish brown to brown (10YR 4/1 and 10YR 4/2 to 10YR 4/3), calcareous.
102-106	Sand and gravel, very fine sand to medium gravel, silty, poorly sorted, subrounded to subangular.
	Banner Formation—Hillery Member
106-111	Diamicton, sandy clayey silt, yellowish brown to dark grayish brown (1 OYR 5/6 to 10YR 4/2), some organic fragments.
111-118	Diamicton, pebbly sandy clayey silt, gray (10YR 5/1), calcareous.
118-120	Sand and gravel, very fine sand to fine gravel, predominantly medium and coarse sand, silty, poorly sorted, subrounded to subangular.
120-138	Diamicton, pebbly clayey sandy silt, dark grayish brown to dark brown (10YR 4/2 to 10YR 3/3), with very fine to coarse grained sand and fine gravel, calcareous, some organic matter in upper few feet.
	Banner Formation—lacustrine
138-146	Clayey silty sand, dark grayish brown (10YR 4/2),with some fine to medium gravel, predominantly medium sand, poorly sorted.
	Sankoty Sand
146-165	Sand, very fine to coarse sand, predominantly fine sand with occasional fine gravel, moderately to well sorted, rounded to subrounded.
165-183	Sand and gravel, very fine sand to medium gravel, predominantly medium and coarse sand, poorly sorted, rounded to subangular.

Depth (ft)	Unit/Description *(continued)*
	Sub-Sankoty sand
183-185	Cobbles and silt.
185-188	Diamicton, pebbly clayey sandy silt, olive gray to olive (5Y 4/2 to 5Y 4/4), with very organic muck, very reactive to HCI.
188-200	Sand and gravel, very fine sand to coarse gravel, silty to very silty, with organic fragments, predominantly medium and coarse sand, poorly sorted, calcareous, subrounded to subangular.
	Pennsylvanian bedrock
200-201	Coal, black (10YR 2/1), friable.
201-215	Shale, greenish gray (5BG 6/1), with thin limestone and yellowish brown (10YR 5/4) clay layers.

DRILLER'S LOG—MTH-1

Depth (ft)	Description
0-13	soft yellow clay
13-17	sandy yellow clay
17-62	gray clay, some sandy
62-63	peat
63-80?	dark gray to green clay
80?-84	light green and brown clay
84-87	sand, yellow
87-89	sandy gray clay
89-103	hard gray clay
103-107	yellow sand
107-113	yellow clay (old soil)
113-116	Jac (sic) clay
116-119	sandy clay
119-122	sand(?)
122-138	hard gray clay
138-145	soft sandy clay
145-183	#12-#20 sand and few rocks
183-187	boulders and black clay
187-200	clay and sand streaks and boulders
200-201	coal
201-215	gray shale

OBSERVATION WELL CONSTRUCTION: MTH-1

Set 5 feet of #20 slot 2-inch PVC screen and 170 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, sand packed screen. Filled annulus with pea gravel to depth of 137 feet and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel—bridged at 27 feet; filled annulus with bentonite chips to land surface and set protective casing. Depth to bottom of screen is 172 feet below land surface.

MTH-2
Location: Tazewell County, T24NR03W36.4h
Elevation: 639 feet **Total Depth:** 265 feet **Date drilled:** 9/1/93
Depths corrected to natural gamma log. Logged interval 0.50 to 260.35 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-3	Silty clay, very dark grayish brown to black (10YR 3/2 to 10YR 2/1), highly organic, leached.
3-5	Clayey silt, dark brown (10YR 3/3), leached.
5-11	Clayey silt, brownish yellow to olive brown (10YR 6/6 to 2.5Y 4/4), oxidized, leached.
11-15	Sand and gravel, very fine sand to medium gravel, about 25% gravel, slightly silty, moderately to poorly sorted.
	Wedron Group
15-19	Diamicton, clayey silt, slightly sandy and pebbly, dark brown to gray (10YR 3/3 to 10YR 5/1), with very fine to coarse sand and fine to medium gravel, slightly to moderately calcareous.
19-26	Diamicton, sandy clayey silt, grayish brown (10YR 5/2), calcareous, with a thin gravelly layer from 24 to 25 feet.
	Tiskilwa Formation—Oakland facies
26-32	Diamicton, pebbly clayey sandy silt, dark grayish brown to gray (10YR 4/2 to 10YR 5/1), calcareous.
32-38	Diamicton, as above, very dark brown (10YR 2/2), possible laminations?
	Roxana Silt—Robein Member
38-43	Silty clay, very dark gray (10YR 3/1), abundant black organic fragments, leached.
43-48	Clayey silt to silt, yellowish brown to dark grayish brown (10YR 5/4 to 2.5Y 4/2), common organic fragments, leached to slightly calcareous.
	Glasford Formation—diamicton
48-49	Rock, dark igneous or metamorphic.
49-61	Diamicton, slightly pebbly sandy clayey silt, grayish brown (10YR 5/2) and some greenish gray (5G 5/1) gley, with very fine to very coarse sand and fine gravel, calcareous.
61-76	Diamicton, pebbly sandy clayey silt, dark grayish brown (10YR 4/2 to 2.5Y 4/2), calcareous.
76-80	Sand and gravel, very fine sand to fine gravel, predominantly medium sand, with calcareous silt, poorly sorted, approximately 15% gravel, rounded to subangular.
80-86	Diamicton, pebbly sandy clayey silt, dark grayish brown (10YR 4/2 to 2.5Y 4/2), calcareous.
86-92	Sand and gravel, very fine sand to fine gravel, predominantly medium sand, with calcareous silt, poorly sorted, approximately 15% gravel, rounded to subangular.
92-98	Diamicton, pebbly sandy clayey silt to silty sand, possibly lacustrine, dark grayish brown to olive gray (2.5Y 4/2 to 5Y 5/2), calcareous.
98-158	Diamicton, slightly pebbly clayey sandy silt to sandy clayey silt, grayish brown to dark grayish brown (10YR 5/2 to 2.5Y 4/2), with thin very sandy zones, calcareous.
	Banner Formation—Hillery Member
158-169	Diamicton, sandy silty clay, very dark grayish brown to brown (1 OYR 3/2 to 10YR 5/3) with some greenish gray (5G 5/1) gley, common organic and woody flakes, moderately calcareous.
169-179	Silty clay, brown to very dark grayish brown (10YR 5/3 to 10YR 3/2), lacustrine?, leached.
	Sankoty—lacustrine?
179-193	Slightly clayey silty sand, very fine to fine grained sand, well sorted, organic fragments throughout, lacustrine?, calcareous.
193-207	Diamicton, sandy silty clay, brown to very dark gray (1 OYR 4/3 to 10YR 3/1), very reactive to HCI.
	Sankoty Sand
207-213	Silty sand, very fine to fine grained sand, olive brown (2.5Y 4/4), predominantly silty fine sand, well sorted, slightly to moderately calcareous.
213-250	Sand, very fine to very coarse sand, moderately to well sorted, silty, rounded to subrounded, little organic matter throughout.
	Pennsylvanian bedrock
250-251	Limestone, very dark grayish brown (2.5Y 3/2), calcareous.

Depth (ft)	Unit/Description *(continued)*
	Pennsylvanian bedrock
251-255	Coal, black (10YR 2/1), very hard, slightly to moderately friable.
255-261	Shale, black (10YR 2/1), slightly silty, noncalcareous.
261-265	Shale, gray (5Y 6/1), noncalcareous.

DRILLER'S LOG—MTH-2

Depth (ft)	Description
0-3	topsoil
3-12	yellow clay
12-15	gravel
15-25	light gray clay
25-25	4" gravel
25-33	gray sandy clay
33-40?	peat
40?-48	dark gray clay
48-49	black boulder
49-51	very soft gray to blue clay
51-77	gray clay
77-81	gravel
81-87	rocky gray clay
87-93	fine gravel
93-115	rocky clay
115-159	very hard gray clay
159-182	soft fine pinkish gray clay
182-191	.006 sand
191-195	very shaley and very dark gray clay
195-207	soft sandy clay
207-215	.008-010 sand Sankoty
215-250	#12-#15 sand Sankoty
250-251	limestone
251-255	coal and black shale
255-256	shale
256-261?	hard coal
261?-265	blue shale

OBSERVATION WELL CONSTRUCTION: MTH-2

Set 10 feet of #10 slot 2-inch PVC screen and 230 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 207 feet and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to 23 feet with 2 annular seals in clay units of 20 pounds of bentonite chips. Filled annulus with bentonite chips to land surface; set protective casing. Depth to bottom of screen is 237 feet below land surface.

MTH-3
Location: Tazewell County, T24NR02W04.8C
Elevation: 600 feet **Total Depth:** 270 feet **Drilled:** 9/17/93 and 9/20/93
Depths corrected to gamma ray-neutron log. Logged interval +0.6 to 260.8 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
	Cahokia Formation
0-5	Sandy silty clay, strong brown to dark yellowish brown (7.5YR 5/6 to 10YR 4/4), oxidized, leached.
5-36	Sand and gravel, medium sand to medium gravel, approximately 60% gravel, poorly sorted, rounded to subrounded.
	Glasford Formation
36-39	Diamicton, clayey sandy silt, gray (10YR 5/1), calcareous, few organic fragments.
39-64	Diamicton, pebbly sandy clayey silt, gray to olive gray (10YR 5/1 to 5Y 4/2), with fine sand to fine gravel, calcareous.
64-65	Silty sand, very fine to fine sand.
	Banner Formation
65-71	Sandy silty clay, dark gray (10YR 4/1), sand is fine to coarse grained, calcareous.
71-72	Sand and gravel, silty, very fine sand to fine gravel, predominantly fine gravel, poorly sorted.
72-78	Sandy clayey silt, dark gray (10YR 4/1), calcareous.
78-99	Diamicton, pebbly clayey sandy silt, grayish brown to dark grayish brown (2.5YR 5/2 to 2.5Y 4/2) becoming dark brown (10YR 3/3) toward the base, noticeable pinkish cast, with very fine to coarse sand and fine gravel, some organic fragments throughout, vigorously reactive to HCI.
99-103	Diamicton, pebbly silty sandy clay, grayish brown to dark grayish brown (2.5YR 5/2 to 2.5Y 4/2), calcareous.
103-136	Sand and gravel, very fine sand to fine gravel, predominantly fine sand, poorly sorted, subangular to subrounded.
136-186	Sand and gravel, as above with coarse gravel.
186-218	Sand, very fine to medium sand, with slight pinkish cast, well sorted, rounded to subrounded.
218-229	Clayey silty sand, very fine to fine sand, very dark gray (5Y 3/1), abundant shell fragments.
229-232	Sandy silty clay, very dark gray to olive gray (5Y 3/1 to 5Y 4/2), abundant coarse shell fragments.
232-254	Sand and gravel, fine sand to coarse gravel, predominantly coarse sand, with cobbles, subrounded to subangular, coarser rock fragments are angular, noticeable chert content.
	Pennsylvanian bedrock
254-258	Coal, black (10YR 2/1), overlain by very thin limestone.
258-266	Shale, very dark gray (2.5Y N3/) with green cast, becomes gray (2.5Y N6/) toward base of unit, with yellowish brown (10YR 5/6) clay bands.
266-270	Coal, same as above.

DRILLER'S LOG—MTH-3

Depth (ft)	Description
0-6	clay (fill?)
6-36	gravel
36-39	very hard gray clay
39-65	rocky gray clay
65-65	small streak of gravel
65-72	rocky clay
72-73	gravel
73-103	hard gray clay
103-130	fine sand
130-170	gray gravel
170-210	Sankoty with up to 3/8" gravel
210-220	#12-#15 sand with 3/8" gravel
220-221	lake clay with shells
221-255	very clean #40 slot with 3/8" gravel
255-259	coal
259-[270]	light gray shale

OBSERVATION WELL CONSTRUCTION: MTH-3
Set 30 feet of 2-inch PVC schedule 40 pipe below screen, 5 feet of #20 slot 2-inch PVC screen, and 235 feet of 2-inch PVC schedule 40 pipe above screen; backfilled test hole with pea gravel to depth of 245 feet and backflushed with water until discharge cleared. Backfilled with pea gravel to depth of 78 feet, sealed annulus with bentonite chips to depth of 67 feet, filled annulus with pea gravel to depth of 20 feet, and filled annulus to land surface with bentonite chips; set protective casing. Depth to bottom of screen is 237 feet below land surface.

MTH-4
Location: Tazewell County, T24NR02W14.4a
Elevation: 773 feet **Total Depth: 448** feet **Date drilled:** 9/22/93-9/23/93
Depths corrected to gamma ray-neutron log. Logged interval 0.5 to 441.1 feet.
* Indicates intervals used for grain-size distribution analysis.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-5	Sandy clayey silt, very dark brown (10YR 2/2), leached.
5-10.5	Sandy silty clay, yellowish brown to light olive brown (10YR 5/6 to 2.5Y 5/4), slightly calcareous.
10.5-13	Clayey silty sand, light olive brown (2.5Y 5/6), with very fine to fine sand.
	Wedron Group
13-17	Diamicton, pebbly sandy silty clay, yellowish brown to olive brown (10YR 5/6 to 2.5Y 4/4), oxidized, moderately calcareous.
17-20	Diamicton, same as above, dark brown (10YR 4/3), calcareous.
20-71*	Diamicton, same as above, reddish gray (5YR 5/2), with very fine to coarse sand and fine to medium gravel.
71-109	Diamicton, same as above, gray to dark grayish brown (10YR 5/1 to 10YR 4/2).
109-112	Sand and gravel, very fine sand to fine gravel, predominantly fine and medium sand, poorly sorted.
112-148*	Diamicton, pebbly sandy silty clay, brown to dark reddish gray (1 OYR 4/3 to 5YR 4/2), grain size as above, calcareous as above.
148-151	Silty clayey sand, very fine to medium sand, dark grayish brown (2.5Y 4/2) poorly sorted, with organic fragments.
	Roxana Silt—Robein Member
151-155	Clayey silt, olive gray to olive (5Y 4/2 to 5Y 4/3), with black (5Y 2.5/1) organic fragments, leached.
155-161*	Clayey silt, black (5Y 2.5/2), slightly calcareous.
	Glasford Formation—diamicton
161-165	Sandy silty clay, olive (5Y 4/4), slightly calcareous.
165-170*	Sandy clayey silt, olive (5Y 5/3), sand is very fine to fine grained, very slightly calcareous.
	Glasford Formation—Radnor Member
170-178	Diamicton, pebbly clayey sandy silt, dark gray to olive brown (5Y 4/1 to 2.5Y 4/4), calcareous.
178-183	Sand and gravel, very fine sand to medium gravel, predominantly coarse sand, poorly sorted, subangular to subrounded.
183-186	Clayey silt, light olive brown (2.5Y 5/4), with organic fragments, slightly calcareous.
	Glasford Formation—Vandalia Member
186-192*	Diamicton, pebbly silty sandy clay, gray to grayish brown (10YR 5/1 to 2.5Y 5/2), some organics fragments, calcareous.
192-196	Sandy clayey silt to sandy silty clay, brown to light olive brown (1 OYR 5/3 to 2.5Y 5/4), with organic fragments, slightly calcareous.
196-201	Sand and gravel, very fine sand to fine gravel, predominantly fine sand, light brownish gray (10YR 6/2), silty, poorly sorted.
201-207*	Sandy silty clay, light brownish gray (2.5Y 6/2), calcareous.
207-213	Sand and gravel, very fine sand to medium gravel, silty, poorly sorted, rounded to subrounded.
	Banner Formation
213-219*	Sandy clayey silt, grayish brown (2.5Y 5/2), calcareous.
219-230*	Diamicton, pebbly sandy clayey silt, olive to dark gray (5Y 5/3 to 5Y 4/1), strongly reactive to HCI.
230-240	Diamicton, pebbly silty sandy clay, dark gray (5Y 4/1), strongly calcareous.
240-244	Sand and gravel, very fine sand to fine gravel, predominantly medium sand, silty, poorly sorted.
	Banner Formation—Hillery Member
244-291*	Diamicton, slightly pebbly sandy silty clay, grayish brown to dark grayish brown (10YR 5/2 to 2.5Y 4/2), with many thin very sandy layers from 253 to 275 feet, more pebbles below 280 feet, calcareous.
291-317*	Sand and gravel, very fine sand to fine gravel, predominantly medium sand, silty, poorly sorted.

Depth (ft)	Unit/Description *(continued)*
	Sankoty Sand
317-331 *	Sand, very fine to coarse sand, predominantly fine grained, moderately to well sorted, rounded to subrounded.
331-363*	Sand, very fine to medium sand, predominantly very fine grained, well sorted.
363-365	Clayey silt, not described, possibly containing organic fragments.
365-367	Sand, same as above.
	Sub-Sankoty sand
367-370	Sand and gravel, very fine sand to fine gravel, predominantly fine grained sand, moderately sorted.
370-393*	Sand, as above.
393-398*	Diamicton, bouldery sandy silty clay, light olive brown (2.5Y 5/6).
398-411 *	Sand and gravel, very fine sand to fine gravel, slightly silty, poorly sorted.
411-433*	Clay and sand, in layers, medium to coarse sand with some fine gravel, poorly sorted. Sandy clay, brown (10YR 5/3), with organic fragments and wood fibers.
	Pennsylvanlan bedrock
433-436	Coal, black (10YR 2/1) to black shale.
436-448	Limestone and shale, light brownish gray to yellowish brown (10YR 6/2 to 10YR 5/5).

DRILLER'S LOG—MTH-4

Depth (ft)	Description
0-5	black
5-13	yellow clay
13-20	rocky clay
20-33	gray sandy clay
33-152	pinkish gray clay
152-157	brown clay
157-180	dark green clay
180-185	nearly white clay with gravel
185-190	soft dark gray clay
190-193	white clay and gravel
193-196	dark gray clay
196-196	gravel
196-210	gray clay
210-230	white clay and gravel
230-245	fine gravel with some clay
245-303	gray sandy clay
303-315	very sandy clay or steaks
315-330	#12-#15 Sankoty
330-360	#10 sand
360-365	#12-#15sand
365-367	#15 sand
367-368	wood, clay
368-375	fine sand up to #12, some peat
375-385	#10-#20 sand, some peat
385-395	#15-#40sand
395-396	clay
396-398	boulders
398-410	#40 sand
410-424	clay with sand streaks
424-427	shale (or clay?)
427-433	shale (or clay?)
433-436	coal
436-448	shale

OBSERVATION WELL CONSTRUCTION: MTH-4

Set 5 feet of #20 slot 2-inch PVC screen and 385 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to clay overlying the aquifer and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to depth of 20 feet with several annular seals of 20 pounds of bentonite chips in clay units. Filled annulus with bentonite chips from depth of 20 feet to land surface; set protective casing. Depth to bottom of screen is 387 feet below land surface.

MTH-5
Location: Tazewell County, T24NR02W32.5a
Elevation: 660 feet **Total Depth:** 294 feet **Date drilled:** 9/16/93
Depths corrected to gamma ray-neutron log, run one. Logged interval +0.5 to 283.8 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
	Peoria Silt
0-6	Clayey silt, very dark grayish brown (10YR 3/2), leached.
6-8	Silty clay, yellowish brown to light olive brown (10YR 5/8 to 2.5Y 5/6), with little fine sand and pebbles, leached.
	Henry Formation
8-17	Silty clayey sand and gravel, yellowish brown to light olive brown (10YR 5/8 to 2.5Y 5/6), very fine sand to medium gravel, leached.
	Equality Formation (?)
17-19	Silty clay, dark grayish brown (10YR 4/2), with little very fine sand and fine pebbles, slightly calcareous.
	Wedron Group
19-34	Diamicton, pebbly clayey sandy silt, dark grayish brown (10YR 4/2), with very fine sand to fine gravel, calcareous.
34-38	Sand and gravel, very fine sand to medium gravel, poorly sorted.
38-52	Diamicton, pebbly sandy clayey silt, dark grayish brown (10YR 4/2), "pinkish," with very fine sand to fine gravel, calcareous.
	Roxana Silt—Robein Member
52-59	Clayey silt, very dark grayish brown (10YR 3/2), common wood fragments, leached.
59-64	Slightly clayey silt, very dark gray (5Y 3/1), leached.
	Glasford Formation—diamicton
64-70	Diamicton, sandy silty clay, olive gray to olive (5Y 4/2 to 5Y 4/4), slightly calcareous.
70-82	Diamicton, pebbly sandy silty clay, dark brown (10YR 4/3), with some thin very fine to coarse sand layers, slightly calcareous.
82-84	Sand and gravel, very fine sand to fine gravel, rounded to subrounded, poorly sorted, oxidation cast?.
84-86	Diamicton, same as above.
86-102	Sand and gravel, very fine sand to medium gravel, predominantly coarse sand with 50% gravel, subrounded to subangular, poorly sorted, coarser below 95 feet.
	Banner Formation
102-114	Diamicton, silty sandy clay, gray to grayish brown (10YR 5/1 to 10YR 5/2), sand grains range from very fine to coarse, calcareous.
114-116	Sand and gravel, silty very fine sand to fine gravel, poorly sorted.
116-132	Diamicton, same as above.
132-134	Sand and gravel, same as above.
134-140	Diamicton, silty sandy clay, brown (7.5YR 5/2), sand is fine to coarse grained, calcareous.
140-145	Sand and gravel, very fine sand to medium gravel, predominantly fine sand, 10% gravel, moderately sorted, rounded to subrounded.
145-161	Sand and gravel, same as above, 50% gravel, with occasional very thin clay layers.
161 -165	Sand, very fine to fine grained, well sorted.
165-167	Sandy clay, gray (10YR 5/1), leached.
167-185	Sand and gravel, very fine sand to fine gravel, predominantly fine sand, moderately to well sorted, rounded to subrounded, more coarse sand below 178 feet.
	Banner Formation—lacustrine
185-201	Diamicton, pebbly clayey sandy silt, gray to dark grayish brown (10YR 5/1 to 2.5Y 4/2), calcareous.
	Sankoty-Mahomet Sand
201-256	Sand and gravel, fine sand to medium gravel, poorly sorted, subrounded to subangular.
256-258	Clayey sandy silt, brown (7.5YR 5/2) to gray (10YR 5/1), calcareous.
258-279	Sand and gravel, very fine sand to medium gravel, poorly sorted, subrounded to subangular, more fine sand in 265 to 270, with abundant red and black grains.
	Pennsylvanian bedrock
279-294	Shale and clay, gray and olive yellow (2.5Y N5/ and 2.5Y 6/6), noncalcareous.

DRILLER'S LOG—MTH-5

Depth (ft)	Description
0-8	yellow clay
8-16	yellow gravel
16-18	mixed yellow/gray clay, rocky
18-33	gray clay
33-35	hard gray clay
35-37	gray gravel (possible artesian gravel in sample)
37-50	hard pinkish gray clay
50-60	hard brown clay
60-65	dark green clay
65-81	sandy lighter green day
81-83	yellow sand and gravel
83-86	clay
86-95	fine gravel
95-101	large gravel and rocks
101-110	bluish light gray clay
110-130	light gray clay to pinkish
130-131	gravel
131-140?	pink sandy clay with small gravel
1407-145	.006 sand
145-149	clay with sand streaks
149-167	fine gravel
167-185	sand and gravel
185-187	hard clay
187-210?	soft sandy clay with gravel
2107-240	gravel
240-256	#30-#40 sand
256-259	clay with rocks
259-270	gravel, 3/8" Muscatine
270-279	#18 sand with few 3/8" gravel
279-294	shale

OBSERVATION WELL CONSTRUCTION: MTH-5

Set 5 feet of #20 slot 2-inch PVC screen and 240 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 199 feet and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to depth of 101 feet, added bentonite chips to annulus, filled annulus with pea gravel to depth of 59 feet, added bentonite chips, backfilled with pea gravel to depth of 17 feet, and added bentonite chips to land surface; set protective casing. Depth to bottom of screen is 242 feet below land surface.

MTH-6
Location: Tazewell County, T23NR03W02.8g
Elevation: 564 feet **Total Depth:** 197 feet **Date drilled:** 10/25/93-10/26/93
Depths corrected to gamma ray-neutron log. Logged interval 0.0 to 187.4 feet.
* Indicates intervals used for grain-size distribution analysis.

COMPOSITE LOG

Depth (ft)	Unit/Description
	Cahokia Formation
0-5	Slightly sandy clayey silt, very dark brown (10YR 2/2), leached.
5-13	Sandy silty clay to clayey silt, yellowish brown to light olive brown (10YR 5/6 to 2.5Y 5/6), oxidized, slightly calcareous.
	Henry Formation
13-21*	Diamicton, pebbly sandy clayey silt, olive brown to light olive brown (2.5Y 4/4 to 2.5Y 5/4), with very fine to medium sand and fine gravel, calcareous.
21-26*	Sand and gravel, very fine sand to fine gravel, moderately to poorly sorted, predominantly coarse sand, some shells and organic matter.
	Banner Formation
26-29	Diamicton, pebbly sandy silty clay, yellowish brown (10YR 5/4), leached.
29-40*	Diamicton, pebbly sandy clayey silt, grayish brown to dark grayish brown (10YR 5/2 to 2.5Y 4/2), with very fine to very coarse sand and fine gravel, calcareous.
40-43	Clayey silt, brown (10YR 4/3), organic fragments, moderately calcareous.
43-47*	Diamicton, slightly pebbly clayey sandy silt, yellowish brown to grayish brown (10YR 5/4 to 2.5Y 5/2), with very fine to medium grained sand and fine gravel, moderately calcareous.
47-51*	Sand and gravel, very fine sand to medium gravel, silty, clayey, poorly sorted, oxidized?, olive (5Y 5/3) with lighter (5Y 5/6) cast.
51-61*	Sand and gravel, very fine sand to fine gravel, poorly sorted, approximately 10% gravel, with thin silty clay layers, abundant organic matter fragments.
	Sankoty Sand
61-81*	Sand, very fine to coarse sand, silty, poorly to moderately sorted, common organic fragments, rounded to subrounded with some angular rock flakes.
81-107*	Sand and gravel, very fine sand to medium gravel, predominantly coarse to very coarse sand, poorly sorted, subrounded to subangular.
	Banner Formation—lacustrine
107-110	Clayey silt, dark grayish brown to olive brown (10YR 4/2 to 2.5Y 4/4), slightly calcareous to rapidly reactive to HCI, abundant organic matter.
	Sub-Sankoty sand
110-150*	Sand and gravel, very fine sand to medium gravel, predominantly coarse sand to fine gravel, with cobble layers, poorly sorted, subrounded to subangular.
150-159*	Sand and gravel, very fine sand to medium gravel, predominantly fine and medium grained sand, approximately 80% sand, moderately to poorly sorted.
159-177*	Sand and gravel, very fine sand to coarse gravel, predominantly coarse sand, approximately 50% sand, poorly sorted, coarser fraction is subrounded to subangular.
	Pennsylvanian bedrock
177-197	Shale, gray to light greenish gray (10YR 6/1 to 5G 7/1), slowly reactive to HCI, with little organic matter.

SPLIT SPOON SAMPLES—MTH-6

Depth (ft)	Recovery (in.)
78	13¼
118	11
158	**0**

DRILLER'S LOG—MTH-6

Depth (ft)	Description
0-4	black
4-21	**yellow clay**
21-27	**gravel**
27-32	rocky yellow clay
32-47	hard gray clay
47-49	gravel and yellow clay
49-65	gray clay
65-90	#10-#15sand
90-100	#15-#20 sand with gravel
100-111	3/8" gravel
111-113	light gray clay
113-150	gravel
150-160	#10 sand, reddish Sankoty
160-177	#30-#40 sand and gravel
177-197	light blue shale

OBSERVATION WELL CONSTRUCTION: MTH-6
Set 5 feet of #20 slot 2-inch PVC screen and 135 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 130 feet and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to depth of 20 feet with annular seals of 20 pounds of bentonite chips at depths of 114 feet and 46 feet. Filled annulus with bentonite chips from depth of 20 feet to land surface; set protective casing. Depth to bottom of screen is 137 feet below land surface.

MTH-7
Location: Tazewell County, T23NR03W18.3h
Elevation: 623.5 feet **Total Depth:** 266 feet **Date drilled:** 9/8/93
Depths corrected to natural gamma log. Logged interval 2.0 to 259.4 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
	Peoria Silt
0-5	Clayey silt, yellowish brown to dark yellowish brown (10YR 5/4 to 10YR 4/4), with organic matter, oxidized, leached.
5-11	Clayey sandy silt, light olive brown (2.5Y 5/4), oxidized, leached.
	Wedron Group
11-15	Diamicton, slightly pebbly clayey sandy silt, yellowish brown (10YR 5/4), oxidized, with very fine to coarse grained sand and little fine gravel, some organic matter, calcareous.
15-22	Diamicton, slightly pebbly sandy clayey silt, gray to olive brown (10YR 5/1 to 2.5Y 4/4), calcareous.
22-26	Diamicton, sandy clayey silt with little fine gravel, dark gray to dark grayish brown (10YR 4/1 to 2.5Y 4/2), some organic fragments, calcareous.
	Roxana Silt—Robein Member (or Berry Clay?)
26-29	Clayey silt to silt, olive gray to olive (5Y 4/2 to 5Y 5/3), leached.
	Glasford Formation—Radnor Member
29-34	Diamicton, sandy silty clay, olive brown to light olive brown (2.5Y 4/4 to 2.5Y 5/4), oxidized, with organic matter and black mineral flakes, leached.
	Glasford Formation—Vandalia Member
34-52	Diamicton, pebbly sandy clayey silt to pebbly clayey sandy silt, yellowish brown to light olive brown (10YR 5/6 to 2.5Y 5/6), oxidized?, with very fine to coarse grained sand and fine to medium gravel, moderately calcareous.
52-81	Sand and gravel, very fine sand to medium gravel, approximately 25% to 30% gravel, poorly sorted, subrounded to angular fragments.
	Banner Formation—alluvium
81-101	Sand, very fine to coarse grained, predominantly fine sand, well sorted, overall olive brown color, organic fragments throughout.
101 -135	Sand, very fine to coarse grained, predominantly medium sand, well to moderately sorted, dark yellowish brown color above 110 feet, light yellowish brown color to 135 feet.
	Sankoty Sand
135-150	Sand and gravel, very fine sand to coarse gravel, predominantly coarse sand, approximately 50% gravel, poorly sorted, subrounded to subangular, common organic matter in upper 10 feet.
150-193	Sand and gravel, very fine sand to medium gravel, primarily medium and coarse sand, moderately to poorly sorted.
193-200	Sand and gravel, very fine sand to coarse gravel, primarily medium grained sand, roughly 50% sand, poorly sorted, subrounded to subangular.
200-232	Sand and gravel, very fine sand to medium gravel, predominantly fine to medium sand, moderately sorted.
232-251	Sand and gravel, very fine sand to coarse gravel, roughly 50% gravel, poorly sorted, cobbles and boulders at base.
	Pennsylvanian bedrock
251-258	Shale, gray (10YR 6/1).
258-263	Sandstone, gray (5Y 5/1), slightly friable, slightly calcareous.
263-266	Shale, gray (2.5Y N6/), with clay, yellowish brown (10YR 5/4).

DRILLER'S LOG—MTH-7

Depth (ft)	Description
0-16	soft yellow clay
16-23	dark gray clay
23-26	hard smooth gray clay
26-29	dark green clay
29-33	yellow clay
33-53	rocky yellow clay with small gravel streaks
53-79	rock and gravel
79-100	#10 sand with few rocks (yellow)
100-121	#10 sand lot of black (gray)
121-135	#12-#18 sand gray
135-150	1" gravel—lost circulation 150'
150-160	#30-#40 sand and 20% 1/8" gravel
160-170	up to 0.5" gravel
170-175	#10 sand
175-193	#15-#30sand
193-200	1" gravel
200-223	#10-#12 sand
223-232	#15-#20 sand with 10% #60 gravel
232-245	1/4" gravel and rocks
245-251	1"-4" gravel and lost circulation
251-258	sky blue shale
258-266	siltstone

OBSERVATION WELL CONSTRUCTION: MTH-7

Set 30 feet of 2-inch PVC schedule 40 pipe below the screen, 5 feet of #20 slot 2-inch PVC screen, and 227.5 feet of 2-inch PVC schedule 40 pipe above the screen; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 45 feet and sealed annulus with bentonite chips. Filled annulus with cuttings to depth of 20 feet and with bentonite chips to land surface; set protective casing. Depth to bottom of the screen is 230 feet below land surface.

MTH-8
Location: Tazewell County, T23NR03W30.3a
Elevation: 637 feet **Total Depth:** 256 feet **Date drilled:** 9/15/93
Depths corrected to gamma ray-neutron log. Logged interval 0.0 to 240.8 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-2	Sandy silty clay, very dark grayish brown (10YR 3/2), leached.
2-7	Clayey silt to silt, very dark grayish brown to dark yellowish brown (10YR 3/2 to 10YR 3/6), leached.
	Wedron Group
7-15	Diamicton, slightly pebbly sandy silty clay, dark grayish brown to yellowish brown (10YR 4/2 to 10YR 5/6), slightly to moderately calcareous.
15-36	Diamicton, pebbly sandy silty clay, gray to very dark grayish brown (10YR 5/1 to 2.5Y 3/2), calcareous.
36-37	Sand and gravel, very fine sand to fine gravel, predominantly medium sand to fine gravel, poorly sorted, subrounded to subangular.
37-40	Diamicton, pebbly clayey silty sand, grayish brown (2.5Y 5/2), slightly oxidized, leached.
40-63	Diamicton, pebbly sandy clayey silt, grayish brown (10YR 5/2), calcareous.
63-65	Sand and gravel, very fine sand to fine gravel, poorly sorted, subrounded to subangular.
	Roxana Silt—Robein Member
65-80	Clayey silt to silt, very dark brown to olive brown (10YR 2/2 to 2.5Y 4/4), highly organic with wood fibers present, leached to slightly calcareous.
	Glasford Formation—Radnor Member
80-95	Diamicton, gray to olive gray (5Y 5/1 to 5Y 4/2), with very fine to fine sand, leached to slightly calcareous, gravel layer at 90 feet.
95-97	Clayey silty sand, with very fine to coarse grained sand, poorly sorted, some organic fragments.
97-115	Sand, very fine to medium grained sand with little coarse sand and fine gravel, primarily medium sand, moderately to well sorted.
	Banner Formation—Sankoty Sand Member
115-169	Sand and gravel, very fine sand to fine gravel, primarily fine sand with approximately 15% to 25% gravel, moderately to well sorted rounded to subrounded.
169-172	Sand and gravel, very fine sand to medium gravel, poorly to moderately sorted.
172-183	Sand, very fine to medium grained sand with little coarse sand and fine gravel, primarily medium sand, moderately to well sorted.
183-198	Sand and gravel, very fine sand to fine gravel, primarily medium sand with approximately 25% gravel, moderately to well sorted rounded to subrounded.
	Sub-Sankoty sand
198-204	Diamicton, pebbly sandy clayey silt, reddish gray to dark grayish brown (5YR 5/2 to 2.5Y 4/2), calcareous.
204-214	Sand, very fine to fine grained, well sorted, possibly silty toward base of unit.
214-231	Sand and gravel, very fine sand to medium gravel, predominantly fine to medium sand, poorly to moderately sorted.
231-239	Sand and gravel, very fine sand to coarse gravel with cobbles, approximately 50% sand, poorly sorted, thin clayey silt at 232 feet.
	Pennsylvanian bedrock
239-245	Coal, black (10YR 2/1), hard, brittle.
245-256	Shale, gray (7.5YR N6/), with dark organic fragments?

DRILLER'S LOG—MTH-8

Depth (ft)	Description
0-14	yellow clay
14-31	soft gray clay
31-40	hard gray clay
40-67	soft sandy clay
67-68	peat
68-75	light green clay
75-85	dark gray-greenish clay
85-98	tan-gray clay
98-117	fine sand
117-135	#8-#10 Sankoty
135-168	#12-#15 sand with few rocks
168-172	gravel
172-183	#12 sand
183-199	#15 sand with gravel
199-201	gray clay
201-203	hard sandy clay
203-214	very soft gray clay
214-230	#12-#15 sand with some fine gravel
230-241	gravel and boulders
241-245	coal
245-256	shale

OBSERVATION WELL CONSTRUCTION: MTH-8

Set 5 feet of #20 slot 2-inch PVC screen and 215 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 197 feet and sealed annulus with 35 pounds of bentonite chips. Continued filling annulus with pea gravel and several annular seals of bentonite chip to depth of 20 feet. Filled annulus with bentonite chips from depth of 20 feet to land surface; set protective casing. Depth to bottom of screen is 217 feet below land surface.

MTH-9
Location: Tazewell County, T24NR02W35.4a
Elevation: 671 feet **Total Depth:** 296 feet **Date drilled:** 11/1/93-11/2/93
Depths corrected to gamma ray-neutron log. Logged interval 0.0 to 289.3 feet.
* Indicates intervals used for grain-size distribution analysis.

COMPOSITE LOG

Depth (ft)	Unit/Description
	Peoria Silt
0-5	Silty clay, dark brown (10YR 3/3 to 10YR 4/3), leached.
5-9	Silty clay, yellowish brown (10YR 5/6), calcareous, oxidized.
	Wedron Group
9-41 *	Diamicton, silty pebbly sandy clay, dark yellowish brown to grayish brown (10YR 4/4 to 10YR 5/2), calcareous.
	Wedron Group—Formation 2(?)
41-46*	Silty clay, very dark grayish brown (1 OYR 3/2), leached, organic debris.
46-49	Diamicton, silty pebbly sandy clay, gray (10YR 5/1), calcareous.
	Roxana Silt—Robein Member
49-57*	Silt to clayey silt, dark gray to black (1 OYR 4/1 to 10YR 2/1) becoming olive (5Y 4/3), leached.
	Glasford Formation—Radnor Member
57-65.5	Diamicton, slightly pebbly sandy clayey silt, olive to dark olive gray (5Y 4/3 to 5Y 3/2), calcareous.
65.5-73*	Diamicton, as above, sandier texture, olive (5Y 5/4).
73-78	Diamicton, pebbly sandy clayey silt, grayish brown (10YR 5/2) to olive (5Y 5/3), fine to medium gravel size pebbles, calcareous.
78-84*	Diamicton (Lacustrine?), sandy silt, light olive gray (5Y 6/2), calcareous.
84-86	Sand and gravel, very silty fine sand to fine gravel.
86-98*	Sand and gravel, very fine sand to fine gravel, 20% gravel, poorly sorted.
98-118*	Sand and gravel, same as above, with thin beds of silty clay, calcareous.
	Glasford Formation—Vandalia Member
118-132*	Diamicton, pebbly clayey sandy silt, grayish brown (10YR 5/2), pebbles up to medium gravel size, occasional gravelly layers, calcareous (reacts rapidly to HCI).
132-147*	Sand and gravel, fine sand to medium gravel, 30% gravel, poorly sorted, rounded to subrounded, sedimentary and igneous rock grains.
	Banner Formation—Tilton Member?
147-153*	Diamicton, pebbly sandy clayey silt, dark gray (5Y 4/1), calcareous.
153-161.5*	Sand and gravel, fine sand to medium gravel, 25% gravel, poorly sorted.
	Banner Formation—Hillery Member
161.5-183*	Diamicton, pebbly clayey sandy silt, dark grayish brown (10YR 4/2) to brown (10YR 4/3) with a pinkish tinge, calcareous—rapidly reactive to HCI.
183-187*	Diamicton (lacustrine?), clayey sandy gravelly silt, dark grayish brown (2.5Y 4/2), calcareous.
187-210*	Sand and gravel, very fine sand to medium gravel, 25% to 50% gravel in layers, poorly sorted, subrounded to subangular gravel.
210-220*	Sand and gravel, very fine sand to fine gravel, 25% gravel, poorly sorted, with thin clay layers, becoming more fine to coarse sand at 213 feet.
220-260*	Sand and gravel, very fine sand to medium gravel, layered, well to moderately sorted, wood and organic fragments possibly from 253 to 256 feet and 258 to 260 feet.
	Sub-Sankoty sand
260-279*	Sand and gravel, very fine grained sand to fine gravel, mostly fine to medium sand, moderate to well sorted, with thin gravel layers.
279-280	Diamicton, sandy pebbly clay, numerous organic fragments, dark grayish brown (2.5Y 4/2) with black (10YR 2/1) organics, calcareous—rapidly reactive to HCI.
	Pennsylvanian bedrock
280-286	Sandy shale with clay, olive (5Y 5/3) to black (10YR 2/1), leached.
286-288	Coal, black (1 OYR 2/1).
288-296	Sandy shale with clay, as above.

SPLIT SPOON SAMPLES—MTH-9

Depth (ft)	Recovery (in.)
48	25.5
80	14
140	11.5
200	8
240	9
280	8

DRILLER'S LOG—MTH-9

Depth (ft)	Description
0-3	black
3-14	yellow clay
14-49	sandy gray clay
49-53	peat or brown clay
53-87	shades of green clay
87-113	gravel seemed to have day
113-117	streaks (sand and gravel) and clay
117-133	gray clay
133-147.5	sand and gravel
147.5-157	clay with rocks
157-162	gravel
162-184	hard pinkish tan clay
184-200	gravel
200-220	fine sand
220-260	sand and gravel with streaks of fine sand
260-270	#12 Sankoty sand
270-281	#12-#15 Sankoty sand
281-284	yellow to gray shale, some limestone
284-288	black coal and shale
288-296	hard gray shale

OBSERVATION WELL CONSTRUCTION: MTH-9

Set 5 feet of #20 slot 2-inch PVC screen and 220 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 170 feet and sealed annulus with 20 pounds of bentonite chips. Filled annulus with pea gravel to depth of 20 feet with annular seals of bentonite chips at depths of 120 feet, 80 feet, and 40 feet. Sealed annulus from 20 feet to land surface with bentonite chips; set protective casing. Depth to bottom of screen is 222 feet below land surface.

MTH-10
Location: Tazewell County, T23NR03W12.1d
Elevation: 583 feet **Total Depth:** 232 feet **Date drilled:** 8/30/93-8/31/93
Depths corrected to natural gamma log. Logged interval 4.5 to 211.6 feet.
* Indicates intervals used for grain-size distribution analysis.

COMPOSITE LOG

Depth (ft)	Unit/Description
	Cahokia Formation
0-6	Sandy silty clay, very dark grayish brown to dark yellowish brown (10YR 3/2 to 10YR 4/4), with very fine to very coarse sand, highly organic, leached.
6-9	Sandy silty clay, very dark grayish brown to very dark brown (10YR 3/2 to 10YR 2/2), very slightly calcareous.
	Henry Formation
9-12	Sand and gravel, very fine sand to fine gravel, silty, poorly to moderately sorted, overall brownish yellow color (10YR 6/6), oxidized, little organic matter.
12-14*	Sandy clayey silt, reddish yellow (7.5YR 6/6), slightly calcareous.
	Glasford Formation
14-20*	Diamicton, clayey sandy silt, grayish brown (10YR 5/2), slightly calcareous.
20-30*	Sand and gravel, very fine sand to fine gravel, primarily fine sand, poorly to moderately sorted, subrounded to subangular.
	Banner Formation—Lierle Clay
30-45*	Diamicton, pebbly clayey sandy silt, gray (10YR 5/1), few organic fragments, calcareous, lacustrine(?).
	Banner Formation—Hillery Member
45-68*	Diamicton, slightly pebbly sandy clayey silt, gray (5YR 5/1), with very sandy layers at 45 and 49 feet, becoming sandier toward base, calcareous to strongly reactive to HCI.
68-75*	Sand and gravel, very fine sand to fine gravel, predominantly fine grained sand, poorly sorted, rounded to subangular.
75-99*	Sand and gravel, very fine sand to medium gravel, somewhat layered, poorly to moderately sorted, rounded to subrounded.
99-128*	Diamicton, slightly pebbly sandy clayey silt, gray to very dark grayish brown (10YR 5/1 to 2.5Y 3/2), with very fine to coarse sand and fine gravel becoming more pebbly toward the base, highly reactive to Hcl.
128-130	Sand and gravel, very fine sand to medium gravel, silty, predominantly coarse sand and fine gravel, few organic fragments, poorly sorted.
	Sankoty-Mahomet Sand
130-157*	Sand and gravel, very fine sand to coarse gravel, predominantly gravel, poorly sorted, subrounded to subangular.
157-163*	Sand and gravel, very fine sand to fine gravel, moderately to poorly sorted, subrounded to subangular.
163-179*	Sand, very fine to coarse grained, moderately to well sorted, "salt and pepper" appearance, rounded to subrounded.
179-187*	Sand and gravel, very fine sand to fine gravel, poorly sorted, subrounded to subangular.
187-206*	Sand and gravel, fine sand to coarse gravel, predominantly medium gravel with coarse sand, moderately to poorly sorted.
206-217*	Sand and gravel, fine sand to medium gravel, predominantly coarse sand, moderately to poorly sorted, rounded to subrounded.
	Pennsylvanian bedrock
217-225	Limestone, light gray (1 OYR 7/2), calcareous.
225-232	Shale, gray (1 OYR 6/1).

DRILLER'S LOG—MTH-10

Depth (ft)	Description
0-9	brown till
9-12	gravel (lots of water loss)
12-15	yellow day
15-21	dark gray day
21-32	sand and gravel
32-46	shaley light gray clay
46-65?	rocky pinkish gray day
65?-75	sand
75-100	sand and gravel
100-121	gray day
121-128	soft gravelly day
128-130	day
130-150	gravel
150-155	fine gravel
155-156	boulder
156-217	sand and gravel < 3/8", very dean
217-222	limestone
222-224	shale
224-225	limestone
225-232	shale

OBSERVATION WELL CONSTRUCTION: MTH-10d (west)

Set 20 feet of 2-inch PVC schedule 40 pipe below screen, 10 feet of #20 slot 2-inch PVC screen, and 185 feet of 2-inch PVC schedule 40 pipe above screen. Backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 127 feet and sealed annulus with 40 pounds of bentonite chips. Continued filling annulus with pea gravel and several annular seals of bentonite chips to depth of 20 feet; filled annulus with bentonite chips from 20 feet to land surface; set protective casing. Depth to bottom of screen is 192 feet below land surface.

OBSERVATION WELL CONSTRUCTION: MTH-10S (east)

Drilled to depth of 99 feet; set 5 feet of #10 slot 2-inch PVC screen and 92.5 feet of 2-inch PVC schedule 40 pipe, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 57 feet and sealed annulus with 40 pounds of bentonite chips. Continued filling annulus with pea gravel to depth of 23 feet and bentonite chips from 23 feet to land surface; set protective casing. Depth to bottom of screen is 94.5 feet below land surface.

MTH-11
Location: Tazewell County, T23NR02W19.2e
Elevation: 640 feet **Total Depth:** 278 feet **Date drilled:** 9/21/93
Depths corrected to natural gamma log. Logged interval 1.5 to 274.3 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-4	Debris, cinders and ash.
4-6	Sandy clayey silt, brownish yellow to light olive brown (10YR 6/6 to 2.5Y 5/4), leached.
6-12	Sandy silty clay, as above, calcareous.
	Wedron Group—Formation 1
12-25	Diamicton, sandy clayey silt, pale brown to dark grayish brown (10YR 6/3 to 10YR 4/2), with very fine to coarse sand, calcareous.
25-34	Diamicton, pebbly clayey sandy silt, gray to dark grayish brown (10YR 5/1 to 10YR 4/2), with light gray (2.5Y N7/) shale fragments, calcareous.
34-36	Clayey silt to silt, gray (2.5Y 5/1) with a slight pinkish tinge, calcareous.
	Wedron Group—Formation 2
36-40	Diamicton, pebbly sandy clayey silt, gray to light brownish gray (2.5Y N5/ to 2.5Y 6/2), with gravel up to medium grained, calcareous.
40-41	Sand, very fine to medium sand, poorly sorted.
41-51	Diamicton, pebbly sandy clayey silt, gray to dark grayish brown (10YR 5/1 to 10YR 4/2), with very fine sand to medium gravel, calcareous.
51-58	Diamicton, pebbly clayey sandy silt, yellowish brown to olive brown (10YR 5/4 to 2.5Y 4/4), calcareous.
	Roxana Silt—Robein Member
58-62	Sandy silt, gray (10YR 6/1), many woody fragments, calcareous.
	Glasford Formation—diamicton
62-67	Diamicton, pebbly sandy silty clay, gray to yellowish brown.(10YR 6/1 to 10YR 5/4), calcareous.
67-79	Sand and gravel, very fine sand to fine gravel, predominantly fine to medium sand, silty, poorly sorted, subangular to subrounded.
	Banner Formation—Hillery Member
79-81	Sandy silty clay, brown (1 OYR 5/3) with reddish cast, calcareous.
81-87	Sand and gravel with silty clay layers, very fine sand to medium gravel, poorly sorted, subangular to subrounded, with light olive gray (5Y 6/2) clay, leached to slightly calcareous.
87-133	Sand and gravel, very fine sand to medium gravel, predominantly fine to medium grained sand, poorly to moderately sorted, subrounded to subangular.
133-144	Diamicton?, clayey sandy silt to clayey silty sand, gray to grayish brown (10YR 5/1 to 2.5Y 5/2), with very fine to fine sand, leached to slightly calcareous.
	Sankoty lacustrine
144-156	Diamicton, as above, with little fine gravel and some organic fragments.
156-161	Silt, pale brown (10YR 6/3), very calcareous.
161-170	Diamicton, sandy clayey silt, grayish brown to olive brown (2.5Y 5/2 to 2.5Y 4/4), with very fine to fine sand, leached to slightly calcareous.
	Sankoty-Mahomet Sand
170-222	Diamicton, pebbly sandy clayey silt, dark reddish to gray dark brown (5YR 4/2 to 7.5YR 4/2), pinkish tinge, with fine sand to medium gravel, common wood fragments, calcareous, very reactive to HCl.
222-262	Sand and gravel, very fine sand to medium gravel, predominantly fine grained sand, moderately to poorly sorted, silty, approximately 50% gravel, fines are rounded, other subrounded to subangular, common red and black grains.
	Pennsylvanian bedrock
262-266	Shale, gray (1 OYR 5/1), with thin limestone partings, calcareous.
266-274.	Limestone, light gray (10YR 7/1), with shale partings, calcareous.
274-278	Shale, gray (10YR 5/1), as above.

DRILLER'S LOG—MTH-11

Depth (ft)	Description
0-6	black soil
6-14	soft yellow clay
14-40	gray clay
40-50	hard gray clay
50-67	soft sandy clay
67-75	gravel with boulders
75-100	gravel with possible day seams
100-116	fine gravel (more gray)
116-134	fine sand or sandy clay
134-150	finer sand or sandy clay
150-161	light tan clay
161-170	streaks soft clay and sand
170-180	pinkish gray clay
180-185	harder pinkish gray clay
185-218	very hard, very pink (gray) clay
218-222	soft gray clay
222-234	#15-#20 sand 1/4" gray gravel
234-240	#15-#20 sand, mix Sankoty and ?
240-245	#12-#15 Sankoty sand
245-250	#15-#25 and 10% #40 sand
250-254	#10-#12 sand
254-258	#12-#15 sand
258-262	#20-#40 sand
262-264	boulders
264-277	hard gray shale
277-278	soft nearly white shale

OBSERVATION WELL CONSTRUCTION: MTH-11d (south)

Set 5 feet of #20 slot 2-inch PVC screen and 235 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 200 feet and sealed annulus with bentonite chips. Continued filling annulus with pea gravel to depth of 20 feet with annular seals bentonite chips at depths of 140 feet and 60 feet. Filled annulus with bentonite chips from depth of 20 feet to land surface; set protective casing. Depth to bottom of screen is 237 feet below land surface.

OBSERVATION WELL CONSTRUCTION: MTH-11s (north)

Drilled to a depth of 115 feet; set 5 feet of #20 slot 2-inch PVC screen and 110 feet of 2-inch PVC schedule 40 pipe; backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to above top of aquifer and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to depth of 20 feet with annular seal of bentonite chips at about 40 feet. Filled annulus with bentonite chips from a depth of 20 feet to land surface; set protective casing. Depth to bottom of screen is 112 feet below land surface.

MTH-12
Location: Tazewell County, T23NR02W27.2a
Elevation: 630 feet **Total Depth: 305 feet** **Date drilled:** 8/25/93-8/26/93
Depths corrected to natural gamma log. Logged interval 1.75 to 305.80 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-4	Silty clay, dark yellowish brown (10YR 4/4), leached.
4-7	Clayey silt to silt, dark brown to strong brown (1 OYR 3/3 to 7.5YR 4/6), some organic matter, leached.
7-14	Sand and gravel, very fine sand to fine gravel, poorly sorted, subangular to subrounded.
14-30	Diamicton, sandy clayey silt, gray to brown (10YR 5/1 to 10YR 5/3), with very fine sand and fine gravel and a gravelly between 22 and 24 feet, slightly calcareous.
30-31	Sand and gravel, very fine sand to fine gravel, poorly sorted.
	Wedron Group
31-46	Diamicton, pebbly clayey sandy silt, dark brown (7.5YR 4/2 to 10YR 4/3) with pinkish cast, with very fine to very coarse sand and fine gravel, slightly calcareous.
	Glasford Formation—Radnor Member
46-72	Diamicton, pebbly sandy silty clay, dark gray to dark grayish brown (1 OYR 4/1 to 2.5Y 4/2), calcareous.
72-79	Sand and gravel, very fine sand to fine and medium gravel, moderately to poorly sorted, rounded to subrounded.
	Glasford Formation—Vandalia Member
79-92	Diamicton, pebbly sandy silty clay, gray (10YR 5/1), calcareous, with 6 inch sand and gravel layers below 87 feet.
92-96	Sand and gravel, very fine sand to fine and medium gravel, poorly sorted, rounded to subrounded.
	Banner Formation
96-109	Diamicton, pebbly clayey sandy silt, grayish brown to dark grayish brown (10YR 5/2 to 10YR 4/2), slightly to moderately calcareous.
109-110	Sand, very fine to coarse sand, predominantly fine grained, moderately to well sorted.
	Banner Formation—Hillery Member
110-150	Diamicton, pebbly clayey sandy silt, grayish brown to dark grayish brown(10YR 5/2 to 10YR 4/2), with very fine sand to fine gravel, calcareous.
150-152	Sand, very fine to coarse sand, predominantly very fine to fine grained sand, silty and clayey, poorly sorted.
	Banner Formation—lacustrine
152-202	Diamicton, pebbly clayey sandy silt, gray to dark gray (10YR 5/1 to 10YR 4/1), with very fine to coarse sand and fine gravel, calcareous, with coal? fragments below 190 feet.
202-204	Sand, very fine to medium sand, well sorted, rounded to subrounded.
204-211	Diamicton, pebbly clayey sandy silt, gray to dark gray (10YR 5/1 to 10YR 4/1), with very fine to medium sand and fine gravel, calcareous, with silty clay layers.
211 -220	Sandy clayey silt, grayish brown (1 OYR 5/2), moderately to strongly calcareous, very silty from 217 to 220 feet.
220-235	Sandy silty clay, grayish brown (1 OYR 5/2), strongly calcareous, with silt layers.
	Sub-Sankofy-Mahomet sand
235-236	Clayey silt, grayish brown (1 OYR 5/2), strongly calcareous, with organic fragments and coal? flakes.
236-241	Sandy clayey silt, yellowish brown (10YR 5/4), slightly to moderately calcareous, with organic fragments and coal? flakes.
241-245	Clayey silt, dark grayish brown to very dark grayish brown (10YR 4/2 to 2.5Y 3/2), moderately to strongly calcareous, with organic fragments and coal? flakes.
245-268	Diamicton, pebbly clayey sandy silt, grayish brown to dark grayish brown (1 OYR 5/2 to 10YR 4/2), with very fine sand to fine gravel, moderately to strongly calcareous.
268-280	Sand and gravel, very fine sand to fine gravel, silty and clayey-possibly in thin layers, approximately 50% gravel, poorly sorted.
280-288	Diamicton, slightly pebbly clayey sandy silt, dark grayish brown (10YR 4/2 to 2.5Y 4/2), strongly calcareous.
288-289	Sand and gravel, very fine sand to fine gravel, moderately to poorly sorted.

Depth (ft)	Unit/Description *(continued)*
	Pennsylvanlan bedrock
289-290	Shale, not described; sample return lost in coal return from below.
290-293	Coal, black (10YR 2/1), fissile.
293-296	Limestone, white (2.5Y 8/2), bedded, slightly calcareous.
295-305	Shale, gray (2.5Y N6/), very slightly calcareous, some organic fragments.

DRILLER'S LOG—MTH-12

Depth (ft)	Description
0-3	topsoil
3-8	yellow clay
8-14	gravel
14-31	gray clay
31-32	gravel
32-59	sandy clay
59-73	soft gravelly clay
73-76	gravel
76-98	gravelly clay with possible gravel steaks
98-110	clay
110-111	sand
111-128	clay
128-150	soft clay
150-155	soft sandy clay
155-211	dark gray clay
211-212	possible sand
212-232	clay mixed hard and soft
232-235	sand?
235-236	hard clay
236-240	yellow to brown clay
240-268	gray clay
268-280	sand and gravel?
280-288	gray clay
288-289	gravel
289-290	shale
290-293	coal
293-296	limestone
296-305	shale

No observation well was constructed at this location. Test hole MTH-12 was backfilled with pea gravel and several seals of bentonite chips to a depth of 20 feet below land surface, and with bentonite chips alone from 20 feet to land surface.

MTH-13
Location: Tazewell County, T23NR02W32.6a
Elevation: 650 feet **Total Depth:** 318 feet **Date drilled:** 9/27/93-9/28/93
Depths corrected to gamma ray-neutron log. Logged interval 0.00 to 311.75 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-3	Silty clay, dark brown (10YR 4/3), leached.
3-6	Clayey silt, yellowish brown to olive brown (10YR 5/6 to 2.5Y 4/4), oxidized, slightly calcareous.
6-13	Sand and gravel, very fine sand to fine gravel, predominantly fine sand, silty, poorly sorted, oxidized, light olive brown (2.5Y 5/6), calcareous.
	Wedron Group
13-19	Diamicton, sandy clayey silt, brown to dark grayish brown (10YR 5/3 to 2.5Y 4/2), slowly calcareous.
19-31	Sand and gravel, very fine sand to fine gravel, primarily fine and medium grained sand with 10% gravel, moderately sorted, rounded to subrounded, with thin clay layers at 23 and 26 feet.
	Roxana Silt—Robein Member
31-37	Clayey silt, very dark brown to black (10YR 2/2 to 10YR 2/1), highly organic with numerous wood fragments, leached.
	Glasford Formation—diamicton
37-69	Diamicton, pebbly sandy clayey silt, dark gray to dark grayish brown (10YR 4/1 to 2.5Y 4/2), with very fine to coarse grained sand and fine to medium gravel, slowly calcareous.
69-71	Sand and gravel, very fine sand to fine(?) gravel, silty, clayey, poorly sorted, with organic fragments.
71-93	Diamicton, slightly pebbly sandy clayey silt, dark gray to dark grayish brown (10YR 4/1 to 2.5Y 4/2), calcareous.
93-101	Sand and gravel, very fine sand to fine gravel with some medium gravel, approximately 30% gravel, primarily fine sand, poorly sorted.
	Banner Formation
101 -109	Sand and gravel, as above, with dark grayish brown (10YR 4/2) silty clay interlayered, poorly sorted, leached.
109-114	Sand and gravel, very fine sand to medium gravel, poorly sorted.
114-119	Clayey silt, very dark grayish brown to dark grayish brown (10YR 3/2 to 2.5Y 4/2), abundant organic fragments, leached.
119-125	Diamicton, pebbly clayey sandy silt, brown to grayish brown (7.5YR 5/2 to 10YR 5/2), with very fine to coarse grained sand and fine to medium gravel, calcareous.
125-132	Sand and gravel, very fine sand to fine gravel, primarily fine and medium sand, silty, poorly sorted, subrounded to subangular.
132-136	Clayey silt to sandy silty clay, brown (7.5YR 5/2), strongly reactive to HCl.
136-148	Sand, very fine to coarse, primarily fine and medium grained sand, silty, moderately sorted, rounded to subrounded.
148-166	Sand and gravel, very fine sand to fine gravel, predominantly medium sand, with silty and clayey layers between 147 and 156 feet, poorly sorted.
	Banner Formation—lacustrine
166-175	Clayey sandy silt, dark grayish brown (2.5Y 4/2), pebbly from 169 to 172 feet, abundant organic fragments, strongly calcareous.
	Mahomet Sand
175-189	Sand, very fine to fine grained, silty, well sorted, rounded to subrounded.
189-194	Sand, very fine to coarse grained, predominantly fine grained, moderately sorted, rounded to subrounded.
194-222	Sand and gravel, very fine sand to fine gravel, primarily fine to medium sand, approximately 20% gravel, moderately to well sorted.
222-232	Sand, very fine to fine grained, well sorted, rounded.
232-244	Sand and gravel, very fine sand to fine gravel, primarily fine to medium sand, approximately 30% gravel, moderately to well sorted.
244-255	Sand, very fine to coarse grained, mostly fine grained, with a predominance of reddish grains, well sorted, round to subrounded.
255-270	Sand and gravel, very fine sand to fine gravel, with olive yellow to dark grayish brown (2.5Y 6/6 to 2.5Y 4/2) silty layers, primarily fine to coarse grained sand, about 30% to 40% gravel, poorly to moderately sorted, subrounded to subangular.

Depth (ft)	Unit/Description *(continued)*
70-285	Sand and gravel, very fine sand to fine gravel, predominantly fine sand, moderately to poorly sorted, rounded to subrounded grains.
285-289	Silty sand, very fine to fine grained sand, poorly sorted.
289-291	Sand and gravel, very fine sand to fine gravel, predominantly fine sand, moderately to poorly sorted, rounded to subrounded grains.
291 -293	Silty sand, as above.
293-296	Sand and gravel, very fine sand to fine gravel, predominantly fine sand, moderately to poorly sorted, rounded to subrounded grains.
296-301	Sand and gravel, very fine sand to coarse gravel and cobbles, silty, primarily gravel, poorly sorted.
	Pennsylvanian bedrock
301-308	Shale, very dark gray (10YR 3/1), with dark grayish brown (2.5Y 4/2) clay and organic fragments, clay is strongly calcareous.
308-310	Coal, black (2.5Y N2/), brittle and fissile.
310-318	Shale, gray (10YR 5/1), with dark grayish brown (2.5Y 4/2) clay, appears oxidized.

DRILLER'S LOG—MTH-13

Depth (ft)	Description
0-6	yellow clay
6-12	sand and gravel
12-20	clay
20-23	sand
23-27	streaks of sand and clay
27-37	gray clay—brown streak
37-93	gray clay
93-101	gravel
101-117	hard gray clay
117-122	brown clay
122-129	gray clay
129-140	sand and gravel
140-142	gray clay
142-168	sand and gravel with streaks of clay
168-175?	very hard gray clay
1757-190	.006 sand
190-210	#10-#12 sand
210-225	#15-#20 sand with 20% #40-#60 sand
225-232	fine sand
232-240	#15-#60 Sankoty
240-252	#10 sand
252-252	boulders
252-260	#12-#15 sand
260-268	gravel with boulders
268-272	#20-#40 sand with boulders
272-280	#10-#12 sand
280-285	#12-#15 sand
285-288	#12 sand
288-296	gravel
296-301	boulders
301-302	clay?
302-303	rocks
303-306	shale
306-311	coal
311-318	shale

OBSERVATION WELL CONSTRUCTION: MTH-13

Set 5 feet of #20 slot 2-inch PVC screen and 270 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with gravel to depth of about 170 feet and sealed annulus with bentonite chips. Continued filling annulus with pea gravel and several annular seals of bentonite chips to a depth of 20 feet. Filled annulus with bentonite chips from 20 feet to land surface; set protective casing. Depth to bottom of screen is 272 feet below land surface.

MTH-14
Location: McLean County, T23NR01W15.1a
Elevation: 684 feet **Total Depth:** 334 feet **Date drilled:** 10/13/93-10/14/93
Depths corrected to gamma ray-neutron log. Logged interval 0.0 to 321.4 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-7	Clayey silt, very dark brown to dark brown (10YR 2/2 to 10YR 3/3), leached, becomes siltier and light olive brown (2.5Y 5/6) below 5 feet.
7-9	Silty sand and gravel, calcareous.
	Wedron Group
9-16	Diamicton, pebbly clayey sandy silt, coarse fraction is predominantly coarse sand to fine gravel, yellowish brown to dark grayish brown (10YR 5/6 to 2.5Y 4/2), calcareous.
16-21	Diamicton, same as above, slightly more pebbles, dark gray to dark grayish brown (10YR 4/1 to 2.5Y 4/2), more medium gravel in matrix.
21-23	Sand and gravel, very fine sand to fine gravel, poorly sorted.
23-42	Diamicton, same as above.
42-43	Silty diamicton (inferred from gamma ray-neutron log).
43-65	Diamicton, same as above, gravelly at 58 to 60 feet, and at 61 and 65 feet.
	Roxana Silt—Robein Member (or Berry Clay?)
65-66.5	Silt, slightly clayey, very dark brown (10YR 2/2), leached.
66.5-68	Clayey silt, olive gray (5Y 4/2), leached.
68-70.5	Diamicton, sandy clayey silt, very dark gray (10YR 3/1), leached.
70.5-72.5	Sand and gravel, clayey silty very fine sand to fine gravel, poorly sorted.
	Glasford Formation—diamicton
72.5-96	Diamicton, slightly pebbly sandy clayey silt, grayish brown to dark grayish brown, (10YR 5/2 to 2.5Y 4/2), pebbles are fine to medium gravel, calcareous.
96-97.5	Sand and gravel, silty very fine sand with little fine gravel, poorly sorted.
	Glasford Formation—Vandalia Member
97.5-136	Diamicton, pebbly clayey sandy silt, gray to dark grayish brown (10YR 5/1 to 2.5Y 4/2), with fine to coarse sand and fine gravel in coarse fraction, calcareous, very reactive to HCI.
	Banner Formation—Hillery Member
136-142	Sandy clayey silt, grayish brown to olive gray (10YR 5/2 to 5Y 4/2), becoming olive (5Y 5/3), calcareous, extremely reactive to HCI.
142-143	Sandy silt to silty sand, well sorted.
143-169	Diamicton, pebbly clayey sandy silt, dark grayish brown (10YR 4/2), coarse fraction is fine sand and fine gravel, calcareous, strongly reactive to HCI.
	Banner Formation—lacustrine
169-179	Sandy clayey silt, very dark brown to yellowish brown (10YR 2/2 to 10YR 5/4), leached to slightly calcareous, some organic fragments.
179-184	Diamicton, pebbly silty sandy clay, dark gray to dark grayish brown (10YR 4/1 to 2.5Y 4/2), calcareous.
184-186	Sand, silty very fine to fine sand.
186-190	Clayey sandy silt.
190-193	Sand and gravel, fine sand to medium gravel, moderately to poorly sorted, subangular to subrounded, overall light gray color.
193-199	Sandy silty clay, very dark grayish brown (10YR 3/2), leached.
199-200	Sand, clayey silty fine sand.
200-206	Clayey silt, dark brown (10YR 3/3), leached.
206-208	Clayey silt, very dark brown (10YR 2/2), common wood fragments, leached.
208-209	Silty clay, black (5Y 2.5/2), leached.
209-214	Clay to silty clay, very dark gray (5Y 3/1), leached.
214-221	Sand, very silty very fine to fine sand, rounded, calcareous.
221-227	Wood and clay, very dark gray (5Y 3/1), leached.
	Sankoty-Mahomet Sand
227-235	Sand, very fine to coarse sand, predominantly fine grained, moderately to well sorted.
235-260	Sand and gravel, very fine sand to fine gravel, well sorted, 10% gravel, with some thin silt layers below 250 feet.

Depth (ft)	Unit/Description *(continued)*
	Sub-Sankoty-Mahomet sand
260-263	Silt, dark brown (10YR 3/3), wood fragments, calcareous, highly reactive to HCI.
263-269	Sand, very fine to coarse sand, poorly sorted.
269-275	Clayey sandy silt, light gray (10YR 6/1), calcareous, strongly reactive to HCI.
275-278	Sandy silty clay, same as above.
278-315	Sand, very fine to very coarse sand, predominantly, fine grained.
315-318	Sand and gravel, fine sand to medium gravel, poorly sorted.
	Pennsylvanian bedrock
318-334	Shale, gray (5Y 6/1), with brown silty organic material (10YR 5/3), becoming olive gray (5Y 5/2), limestone at base.

DRILLER'S LOG—MTH-14

Depth (ft)	Description
0-5	black
5-10	yellow clay
10-11	gravel
11-16	yellow clay
16-23	gray clay
23-24.5	gravel
24.5-65	gray hard rocky clay
65-67	peat
67-69	hard greenish gray clay
69-150	soft sandy light gray clay
150-167	hard sandy gray clay
167-170	peat
170-185	hard smooth greenish gray clay
185-195	gravel with streaks of clay
195-198	brown clay
198-200	gravel
200-204	gray clay
204-211	hard peat
211-215	brownish gray clay
215-223	#8-#10 sand
223-225	wood
225-229	tan-gray clay
229-236	#8-#10 sand
236-245	#15-#20 sand and 1/4" gravel
245-250	#15-#20 sand and 10% #30 sand
250-261	#10 sand, possible clay streaks
261-265	sandy light gray clay
265-273	streaks of sand and clay
273-276	light blue-gray clay
276-278	sand?
278-279	rocky clay
279-285	#10-#12 sand
285-308	#12-#15 sand
308-315	#12-#20 sand
315-318.5	#20-#30 sand plus gravel
318.5-334	shale, plus siltstone

OBSERVATION WELL CONSTRUCTION: MTH-14

Set 5 feet of #20 slot 2-inch PVC screen and 305 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 270 feet, sealed annulus with 30 pounds of bentonite chips; continued filling annulus with pea gravel to depth of 127 feet, sealed annulus with 30 pounds of bentonite chips; continued filling annulus with pea gravel to depth of 20 feet with bentonite chip seals every 60 to 80 feet. Filled annulus with bentonite chips from 20 feet to land surface; set protective casing. Depth to bottom of screen is 307 feet below land surface.

MTH-15
Location: McLean County, T23NR01W29.4h
Elevation: 662 feet **Total Depth:** 315 feet **Date drilled:** 10/27/93
Depths corrected to gamma ray-neutron log. Logged interval 1.0 to 305.3 feet.
* Indicates intervals used for grain-size distribution analysis.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-3	Silty clay, very dark brown (10YR 2/2), leached.
3-8	Clayey silt, yellowish brown (10YR 5/4 to 10YR 5/8), oxidized, leached.
	Wedron Group
8-12	Diamicton, clayey silty sand, few pebbles, yellowish brown (10YR 5/8), calcareous.
12-19*	Diamicton, pebbly silty sandy clay, brown to gray (10YR 5/3 to 10YR), calcareous.
19-37*	Diamicton, pebbly sandy clayey silt, dark grayish brown to gray (10YR 4/2 to 10YR 5/1), calcareous.
	Henry Formation—Ashmore tongue
37-40	Sand and gravel, very fine sand to fine gravel, predominantly fine and medium sand, about 15% gravel, moderately sorted.
	Roxana Silt—Robein Member (or Berry Clay?)
40-42	Diamicton, pebbly sandy clayey silt, dark grayish brown to gray (10YR 4/2 to 10YR 5/1), calcareous.
42-45*	Sand and gravel, silty very fine to medium sand, poorly sorted.
	Glasford Formation—diamicton
45-48*	Diamicton (lacustrine), slightly pebbly silty sandy clay, brown (10YR 5/3), calcareous.
48-52	Sand and gravel, fine to medium sand with some fine gravel, poorly sorted.
52-66*	Diamicton (lacustrine), same as above, siltier, olive gray (5Y 4/2) with grayish brown (10YR 5/2) varves.
66-68*	Sand and gravel, very fine sand to medium gravel, poorly sorted.
68-75*	Diamicton, same as above.
75-78	Sand and gravel, same as above, silty.
78-82	Diamicton, gray (10YR 5/1), same as above, probably lacustrine.
82-88	Sand and gravel, as above.
88-97*	Diamicton, sandy silty clay to sandy clayey silt, gray to dark brown (10YR 5/1 to 10YR 3/3), faint pink tinge, calcareous.
97-100	Sand and gravel, clayey silty fine sand to fine gravel, poorly sorted.
100-110*	Diamicton, sandy clayey silt, dark brown (10YR 3/3), calcareous.
110-113	Diamicton, clayey silt, dark grayish brown to olive gray (2.5Y 4/2 to 5Y 4/2), slightly calcareous.
113-114	Sand and gravel, very fine grained sand to fine gravel, poorly sorted.
114-118	Diamicton, pebbly clayey sandy silt, very silty towards base, grayish brown to brown (10YR 5/2 to 10YR 5/3), pebbles are predominantly fine gravel, slightly calcareous.
	Banner Formation
118-127*	Diamicton, silty clay, very silty at base, olive gray (5Y 4/2), calcareous.
127-141*	Diamicton, pebbly clayey sandy silt, grayish brown to brown (10YR 5/2 to 10YR 5/3), pebbles are fine to medium gravel, calcareous, thin layers of sand at 132,134, and 138 feet.
	Banner Formation—lacustrine
141-174*	Diamicton, silty clay to clayey silt, dark grayish brown (10YR 4/2), occasional thin sand layers, calcareous.
174-197*	Diamicton (lacustrine?), sandy clayey silt, dark grayish brown (2.5Y 4/2), highly reactive to HCl.
	Mahomet Sand
197-244*	Sand and gravel, Very fine sand to medium gravel, in layers, moderately to well sorted, subrounded to subangular, predominantly fine sand below 215 feet, becoming about 50% gravel below 230 feet.
	Sub-Mahomet sand
244-280*	Diamicton, pebbly sandy clayey silt, grayish brown to olive gray (10YR 5/2 to 5Y 4/2), calcareous to highly reactive to HCl, with thin pebbly sand layers at 262 and 275 feet.
280-298*	Sand and gravel, very fine to medium gravel, poorly sorted, with thin clay or silt layers, cobbles at 287 feet.
	Pennsylvanian bedrock
298-315	Shale, gray (5Y 6/1), slightly calcareous, becoming darker (5Y 5/1) and having more clay below 310 feet.

SPLIT SPOON SAMPLES—MTH-15

Depth (ft)	Recovery (in.)
54	19.5
100	0
120	11
210*	12
260*	9.5

DRILLER'S LOG—MTH-15

Depth (ft)	Description
0-4	black
4-15	yellow clay, sandy at 9 feet
15-37	sandy gray clay
37-50.5	.50% sand and clay, streaks
50.5-53	gray day
53-53.5	brown clay or peat
53.5-64	brownish gray clay
64-66	gravel
66-86	gray clay with streaks of sand
86-115	light gray clay
115-122	very light greenish gray clay
122-133	hard sandy tan clay
133-134	gravel
134-197	hard gray clay
197-230	fine sand
230-244	up to 1/4" Mahomet gravel
244-280	clay with streaks of sand
280-299	lot of streaks, some #40 Sankoty
299-315	light gray shale

OBSERVATION WELL CONSTRUCTION: MTH-15

Set 5 feet of #20 slot 2-inch PVC screen and 235 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 230 feet and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to depth of 23 feet and with annular seals of bentonite chip at depths of 195,140, 90, and 35 feet. Filled annulus with bentonite chips from 23 feet to land surface; set protective casing. Depth to bottom of screen is 237 feet below land surface.

MTH-16
Location: Tazewell County, T22NR03W22.4d
Elevation: 727 feet **Total Depth:** 391 feet **Date drilled:** 10/18/93-10/20/93
Depths corrected to gamma ray-neutron log. Logged interval 0.0 to 383.5 feet.
* Indicates intervals used for grain-size distribution analysis.

COMPOSITE LOG

Depth (ft)	Unit/Description
	Peoria Silt/colluvium
0-3	Clayey silt, brown to dark brown (10YR 5/3 to 10YR 3/3), leached.
3-5	Gravelly sandy silty clay, yellowish brown (10YR 5/6), with very fine to coarse sand and fine to medium gravel, leached.
5-12	Sandy clayey silt, yellowish brown to dark yellowish brown (10YR 5/6 to 10YR 4/4), oxidized, leached to slightly calcareous.
12-17*	Clayey silt, yellowish brown (10YR 5/4), slightly calcareous.
	Wedron Group
17-21	Sandy silty clay, gray (10YR 6/1 to 5Y 5/1), slightly calcareous.
21-57*	Diamicton, slightly pebbly sandy clayey silt, grayish brown to dark grayish brown (10YR 5/2 to 2.5Y 4/2), with very fine to fine sand and little fine to medium gravel, calcareous.
57-63	Sandy silty clay, very dark gray (5Y 3/1), with very fine to fine grained sand, leached.
63-85*	Diamicton, slightly pebbly clayey sandy silt, dark gray to dark grayish brown (10YR 4/1 to 2.5Y 4/2), with very fine to fine grained sand and little fine gravel, calcareous.
85-87	Clayey silty sand, very fine to fine sand, poorly to moderately sorted.
87-91	Diamicton, lightly pebbly clayey sandy silt, dark gray to dark grayish brown (10YR 4/1 to 2.5Y 4/2), moderately calcareous.
91-93	Clayey silty sand, very fine to fine sand, poorly sorted.
93-99*	Diamicton, slightly pebbly sandy clayey silt, dark grayish brown (2.5Y 4/2), with very fine to coarse grained sand, some organic fragments present, slightly calcareous.
99-104	Sandy clayey silt, dark gray (5Y 4/1), with organic fragments, slightly calcareous.
104-105	Sand and gravel, very fine sand to fine gravel, poorly sorted.
105-133*	Diamicton, pebbly clayey sandy silt, dark grayish brown (10YR 4/2 to 2.5Y 4/2), with very fine to coarse sand and fine gravel, calcareous, organics noted in upper portion of unit.
	Roxana Silt—Robein Member
133-139	Clayey silt, dark grayish brown to very dark grayish brown (10YR 4/2 to 10YR 3/2), with organic fragments, leached.
139-144*	Silt, dark gray to olive (5Y 4/1 to 5Y 4/4), abundant organic fragments, leached.
144-148*	Clayey silt, olive (5Y 5/3), leached.
	Glasford Formation—diamicton
148-165	Diamicton, slightly pebbly sandy clayey silt, gray to olive (5Y 5/1 to 5Y 5/3), with very fine to very coarse sand and little fine gravel, calcareous.
165-173*	Diamicton, sandy clayey silt to sandy silt, gray to olive (5Y 5/1 to 5Y 5/3), minor organic fragments, slightly calcareous.
173-177	Sand and gravel, very fine sand to medium gravel, silty, primarily medium sand, poorly sorted, subrounded to subangular.
177-189*	Clayey sandy silt, dark gray to dark grayish brown (2.5Y N4/ to 2.5Y 4/2), with very fine to coarse grained sand, calcareous.
189-192	Sand and gravel, very fine sand to medium gravel, silty, primarily medium sand, moderately to poorly sorted, subrounded to subangular.
192-203*	Diamicton, pebbly sandy clayey silt, dark grayish brown (10YR 4/2), with very fine to coarse sand and fine to medium gravel, calcareous.
	Banner Formation—Lierle Clay
203-211	Clayey sandy silt, dark brown to very dark brown (10YR 3/3 to 10YR 2/2), with very fine and fine sand, highly organic, poorly sorted.
	Banner Formation—diamicton
211-217*	Diamicton, clayey sandy silt, dark gray to dark grayish brown (10YR 4/1 to 2.5Y 4/2), with very fine to coarse sand, moderately calcareous.
217-223	Diamicton, clayey sandy silt, reddish gray (5YR 5/2), with very fine to fine sand, common organic fragments, calcareous to highly reactive to HCI.

Depth (ft)	Unit/Description *(continued)*
	Banner Formation—diamicton *(continued)*
223-231*	Diamicton, sandy silty clay, gray to olive brown (5Y 5/1 to 2.5Y 4/4), with very fine grained sand, common organic fragments, calcareous.
231-238*	Sandy clayey silt, dark gray to olive (5Y 4/1 to 5Y 5/4), with very fine sand, common to abundant organic fragments, leached.
238-243	Diamicton, pebbly sandy silty clay, dark gray to olive (5Y 4/1 to 5Y 5/4) grading to gray (5Y 5/1), with very fine sand, leached.
243-250*	Diamicton, sandy clayey silt, grayish brown to dark grayish brown (2.5Y 5/2 to 2.5Y 4/2), leached.
250-261*	Silty clay, light brownish gray to light olive brown (10YR 6/2 to 2.5Y 5/4), moderately calcareous.
	Sankoty Sand
261-269*	Sand, very fine to fine sand, with pinkish tinge, few organic fragments, silty, moderately to poorly sorted, rounded grains.
269-279*	Sand, very fine to medium grained, with pinkish tinge, predominantly fine sand, well sorted, rounded to subrounded.
279-358*	Sand and gravel, very fine sand to fine gravel, primarily fine to medium sand, pinkish "Sankoty"-like sands, moderately to well sorted, rounded to subrounded.
358-371*	Sand and gravel, very fine sand to medium gravel, poorly sorted with some moderately sorted layers, oxidized appearance.
371-377*	Sand and gravel, fine sand to coarse gravel and boulders, numerous chert fragments, subangular to angular, appears oxidized, poorly sorted.
	Pennsylvanian bedrock
377-391	Shale, gray to pale green (5G N6/ to 5G 6/2), very slightly calcareous.

SPLIT SPOON SAMPLES—MTH-16

Depth (ft)	Recovery (in.)
42	15
130*	17
206*	8
234*	18
274	6
284	8
296	6
305	4
315	8
325	8
335	9
347	8.5

DRILLER'S LOG—MTH-16

Depth (ft)	Description
0-8	soft yellow clay
8-14	rocky yellow clay
14-21	very dark gray clay
21-86	light gray clay
86-95	very soft gray clay—sandy
95-105	hard dark gray clay
105-106.5	gravel
106.5-130	sandy gray clay
130-139	trace of brown/green clay
139-147	very green hard clay
147-163	light green hard clay
163-174	soft gray clay
174-182	gravel
182-187	hard dark gray clay
187-201	gravel
201-209	peat
209-211	silty gray clay
211-216	gravelly light gray clay
216-218	gray clay
218-230	soft gray clay
230-240	greenish gray clay
240-244	pinkish gray clay
244-250	very soft dark gray clay
250-260.5	very pink clay
260.5-275	#8-#10 sand very pink
275-280	#12-#15 sand very pink
280-295	#10-#12 sand very pink
295-310	#15-#25 sand
310-325	#20-#40 sand with rocks
325-335	#20-#40 sand and 20% 1/4° sand (gravel)
335-370	gray sand and gravel
370-377	gray sand and gravel and boulders
377-391	light blue shale

No observation well was constructed at this location. Test hole MTH-16 was backfilled with pea gravel and several seals of bentonite chips to a depth of 20 feet below land surface, and with bentonite chips alone from 20 feet to land surface.

MTH-17
Location: Tazewell County, T22NR03W29.8a
Elevation: 586 feet **Total Depth:** 239 feet **Date drilled:** 8/19/93
Depths corrected to natural gamma log. Logged interval 2.2 to 232.5 feet.
* Indicates intervals used for grain-size distribution analysis.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-5	Sandy clayey silt, dark yellowish brown to dark brown (10YR 4/4 to 10YR 3/3), leached.
5-8	Sand and gravel, very fine sand to fine gravel, primarily very fine and fine grained sand, moderately sorted.
	Wedron Group
8-14*	Sand and gravel, very fine sand to fine gravel, predominantly fine to medium sand, silty and clayey, poorly to moderately sorted, few shell fragments.
	Roxana Silt—Robein Member
14-25*	Sandy clayey silt, brown to dark brown (10YR 5/3 to 10YR 3/3), leached.
	Glasford Formation—Radnor Member
25-31*	Clayey sandy silt, yellowish brown to light olive brown (10YR 5/4 to 2.5Y 5/6), oxidized, with yellow (10YR 7/8) mottles, with very fine to medium sand, leached.
31-50*	Diamicton, slightly pebbly sandy clayey silt, light yellowish brown to light olive brown (10YR 6/4 to 2.5Y 5/6), oxidized?, calcareous (limestone? boulder at 48 feet).
50-54*	Diamicton, pebbly clayey sandy silt, grayish brown (2.5Y 5/2), with very fine to coarse sand and fine gravel, abundant wood fragments, calcareous.
54-61*	Sand, very fine to very coarse grained, primarily fine and medium sand, moderately to well sorted.
61-65*	Sand and gravel, very fine sand to fine gravel, predominantly sand, moderately sorted.
	Banner Formation
65-67*	Sandy clayey silt, grayish brown (1 OYR 5/2) with a reddish cast, vigorously calcareous.
67-82*	Sand and gravel, very fine sand to medium gravel, silty, poorly sorted, subrounded.
	Banner Formation—lacustrine
82-85*	Diamicton, pebbly sandy clayey silt, dark gray to dark grayish brown (10YR 4/1 to 2.5Y 4/2), calcareous.
85-97	Diamicton, slightly pebbly sandy silty clay, grayish brown to dark grayish brown (10YR 5/2 to 10YR 4/2), with very fine to medium grained sand, strongly calcareous.
	Sankoty Sand
97-125*	Sand and gravel, very fine sand to medium gravel, silty and clayey, primarily very fine to medium sand, poorly sorted.
125-169*	Sand and gravel, very fine sand to medium gravel, with silty and clayey layers, primarily coarse sand and fine gravel, poorly sorted.
	Sub-Sankoty sand
169-176	Diamicton, clayey pebbly silty sand, pinkish gray (5YR 6/2).
176-198*	Sand and gravel, very fine sand to medium gravel, primarily fine to coarse sand, with thin silt and clay layers, poorly sorted.
198-201	Clayey silt, dark gray (10YR 4/1), calcareous.
201-222*	Sand and gravel, very fine sand to medium gravel, primarily medium sand, silty and clayey, poorly sorted.
	Pennsylvanian bedrock
222-224	Limestone, gray to white (2.5Y N7/ to 2.5Y 8/2), with shale partings, calcareous.
224-239	Shale, gray to light gray (5Y 6/1), noncalcareous.

DRILLERS LOG—MTH-17

Depth (ft)	Description
0-5	clay yellow
5-12	yellow sand
12-42	yellow clay
42-48	gray clay
48-48.5	rock limestone
48.5-55	gray clay
55-65.5	sand gravel to 1/8"
65.5-68	pinkish clay
68-80	gravel
80-104	rocky clay
104-155	gravel and clay mix
155-175	cleaner gravel
175-203	pink gravelly clay
203-205	dark gray clay
205-222	gravel some clay
222-224	limestone boulder
224-225	gravel
225-239	light gray shale

OBSERVATION WELL CONSTRUCTION: MTH-17d (north)

Set 5 feet of #10 slot 2-inch PVC screen and 150 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, gravel packed screen but gravel bridged at 96 feet; filled annulus with gravel and two annular seals of bentonite chips to depth of 23. Filled annulus with bentonite chips from 23 feet to land surface; set protective casing. Depth to bottom of screen is 152 feet below land surface.

OBSERVATION WELL CONSTRUCTION: MTH-17S (south)

Drilled to depth of 79 feet; set 5 feet of #10 slot 2-inch PVC screen and 70 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared. Gravel packed screen with pea gravel, but gravel bridged at a depth of 3 feet. Partially opened annulus to a depth of 10 to 15 feet and filled with bentonite chips to land surface; set protective casing. Depth to bottom of screen is 72 feet below land surface.

MTH-18
Location: Tazewell County, T22NR02W18.4d
Elevation: 647 feet **Total Depth:** 317 feet **Date drilled:** 8/20/93-8/23/93
Depths corrected to natural gamma log. Logged interval 1.85 to 314.50 feet.
* Indicates intervals used for grain-size distribution analysis.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-3	Slightly pebbly sandy clayey silt, very dark brown to very dark grayish brown (10YR 2/2 to 10YR 3/2), leached.
3-7	Sandy clayey silt, dark brown to dark yellowish brown (10YR 3/3 to 10YR 4/4), leached.
7-14*	Sand and gravel, very fine sand to fine gravel, predominantly fine to medium sand, moderately sorted, oxidized yellowish brown to light olive brown (10YR 5/6 to 2.5Y 5/6), with few thin silty layers.
14-19	Sandy clayey silt, yellowish brown to light olive brown (10YR 5/6 to 2.5Y 5/6), leached.
19-22	Sandy clayey silt, light olive brown (2.5Y 5/6), some organic fragments, leached.
	Wedron Group
22-42*	Diamicton, pebbly sandy clayey silt, gray to grayish brown (10YR 5/1 to 10YR 5/2), with very fine to fine sand and fine to medium gravel, calcareous.
	Roxana Silt—Robein Member
42-55*	Diamicton, pebbly sandy silty clay, olive brown (2.5Y 4/4), oxidized, with very fine to fine sand and fine to medium gravel, calcareous.
55-59*	Silt and clayey silt, dark brown (1 OYR 3/3), with wood fragments and organic material, leached?.
	Glasford Formation—Radnor Member
59-65*	Diamicton, silty sandy clay, dark grayish brown to olive brown (10YR 4/2 to 2.5Y 4/4), with very fine sand, slightly calcareous.
65-70*	Sand and gravel, very fine sand to fine gravel, predominantly fine to medium sand, moderately to well sorted.
70-77*	Sand and gravel, very fine sand to medium gravel, primarily fine to coarse sand, moderately to poorly sorted, subrounded to subangular.
	Glasford Formation—Vandalia Member
77-83	Diamicton, slightly pebbly sandy clayey silt, light gray to gray (10YR 6/1), with very fine to medium sand and fine gravel, calcareous.
83-85	Sandy clayey silt, brown to yellowish brown (10YR 5/3 to 10YR 5/4), abundant organic fragments, calcareous.
85-94*	Diamicton, slightly pebbly sandy clayey silt, light gray to gray (10YR 6/1), with very fine to medium sand and fine gravel, calcareous.
94-95	Sand and gravel, very fine sand to fine gravel, poorly sorted.
95-106*	Diamicton, pebbly sandy clayey silt, grayish brown (2.5Y 5/2), with very fine to coarse sand and fine to medium gravel, calcareous.
106-107	Sand and gravel, very fine sand to fine gravel, silty, poorly sorted.
107-116*	Diamicton, sandy clayey silt, grayish brown (10YR 5/2), with sandy and gravelly layers at 108 and 112 feet, calcareous.
116-125*	Diamicton, pebbly clayey sandy silt to silty sand, grayish brown (10YR 5/2), calcareous.
	Banner Formation—Lierlie Clay
125-127	Sand and gravel, very fine sand to medium gravel, silty, poorly sorted.
127-131	Diamicton, as above.
131-132	Sand and gravel, as above.
	Banner Formation—Hillery Member
132-141*	Diamictonrpebbly sandy clayey silt, dark gray to dark grayish brown (10YR 4/1 to 10YR 4/2), with very fine to medium sand and fine gravel, abundant organics, very calcareous.
	Mahomet Sand
141-161*	Sand and gravel, very fine sand to fine gravel, predominantly fine to coarse sand, well sorted.
161-168*	Sand and gravel, very fine sand to medium gravel, silty and clayey, approximately 25% gravel, poorly sorted.
168-173	Sand and gravel, very fine sand to fine gravel, silty, primarily fine to medium sand, moderately sorted.

Depth (ft)	Unit/Description *(continued)*
	Banner Formation—lacustrine
173-184*	Sandy silty clay, dark grayish brown (10YR 4/2 to 2.5Y 4/2), moderately to strongly calcareous.
	Mahomet Sand
184-198*	Sand, very fine to fine, silty with thin light gray (10YR 7/2) silty clay layers at 189 and 193 feet, well sorted.
198-232*	Sand and gravel, very fine sand to fine gravel, approximately 25% gravel, silty and clayey, poorly sorted; 210 to 230 foot interval is less silty and clayey, rocks at 230 feet.
232-246*	Sand, very fine to coarse grained, predominantly very fine and fine sand, little fine gravel, moderately to well sorted, noticeable reddish grains.
246-258*	Sand and gravel, very fine sand to fine gravel, primarily fine to medium sand with 10% gravel, rounded to subrounded.
258-271*	Sand, very fine to coarse grained, predominantly very fine sand, well sorted.
271-293*	Sand and gravel, very fine sand to medium gravel, primarily very fine to medium sand with 20% gravel, moderately sorted.
293-301*	Sand and gravel, very fine sand to medium gravel, predominantly medium to coarse sand with 50% gravel, with silty and clayey layers at 293 and 295 feet, noticeable chert, poorly sorted.

Depth (ft)	Unit/Description
	Pennsylvanian bedrock
301-304	Shale, black (7.5YR N2/) to dark brownish gray (10YR 4/2), slightly silty.
304-308	Coal, black (2.5YR N2.5/0), friable, highly organic zone, oily.
308-312	Shale, very dark gray (7.5YR N3/), noncalcareous.
312-317	Shale, gray (1 OYR 5/1) to light gray (10YR 6/1), noncalcareous.

DRILLER'S LOG—MTH-18

Depth (ft)	Description
0-7	yellow clay
7-12	dirty yellow sand
12-31	gray clay
31-54	hard gray clay
54-60	soft green clay
60-65	hard green clay
65-70	Sankoty type fine sand
70-77	sand with yellow gravel
77-95	gray clay—sand
95-143	mixed clay—sand
143-155	fine sand
155-185	hard shaley clay
185-205	clay sand streaks
205-302	#30+ sand
302-307	coal—shale black
307-317	gray shale

OBSERVATION WELL CONSTRUCTION: MTH-18d (north)

Set 5 feet of #10 slot 2-inch PVC screen and 220 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 163 feet and set annular seal of bentonite chips. Continued filling annulus with pea gravel to depth of 23 feet with several annular seals of bentonite chips. Filled annulus with bentonite chips from 23 feet to land surface; set protective casing. Depth to bottom of screen is 222 feet below land surface.

OBSERVATION WELL CONSTRUCTION: MTH-18s (south)

Drilled to depth of 159 feet; set 5 feet of #10 slot 2-inch PVC screen and 155 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. No other details on well construction and completion are noted on the test hole log. Depth to bottom of screen is 157 feet below land surface.

MTH-19
Location: McLean County, **T22NR01W08.8e**
Elevation: 651 feet **Total Depth:** 313 feet **Date drilled:** 9/30/93
Depths corrected to natural gamma log. Logged interval 1.6 to 306.7 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-5	Clayey silt, very dark brown (10YR 2/2), leached.
5-9	Clayey silt, yellowish brown (10YR 5/6), slightly calcareous.
	Wedron Group
9-17	Diamicton, pebbly sandy silty clay, yellowish brown (10YR 5/6), pebbly with fine gravel, slightly calcareous.
17-23	Diamicton, pebbly sandy clayey silt, brown to olive brown (10YR 5/3 to 2.5Y 4/4), calcareous.
23-25	Silt, dark brown (10YR 3/3) to very dark brown (10YR 2/2), leached, organic fragments.
	Roxana Silt—Robein Member
25-28	Clayey silt, very dark grayish brown (10YR 3/2), leached,
28-31	Silt, same as above, with peat.
31-42	Diamicton, slightly pebbly sandy silty clay, dark grayish brown to gray (2.5Y 4/2 to 10YR 6/1), sandy with very fine to very coarse grained sand, pebbly with occasional fine gravel, calcareous.
42-48	Silty clay, olive to light olive brown (5Y 5/3 to 2.5Y 5/4), slightly calcareous.
	Glasford Formation—Vandalia Member
48-51	Diamicton, same as above. dark yellowish brown (1 OYR 4/4) to yellowish brown (10YR 5/4).
51-54	Clayey silt.
54-57	Diamicton, slightly pebbly silty sandy clay, dark gray (10YR 4/1), calcareous.
57-62	Silty clay, olive gray (5Y 4/2), calcareous.
62-67	Diamicton, same as above, gray (10YR 5/1), sandy with very fine to very coarse grained sand (mostly very fine to fine sand), pebbly with fine gravel, calcareous.
67-71	Sand and gravel, fine sand to fine gravel, predominantly medium sand, poorly sorted, subangular to subrounded.
71-79	Diamicton, same as above, grayish brown to olive gray (10YR 5/2 to 5Y 5/2).
79-81	Sand and gravel, same as above.
81-115	Diamicton, slightly pebbly sandy silty clay, grayish brown to gray (10YR 5/2 to 10YR 5/1), calcareous, sandy layer at 98 feet.
115-118	Sand, very fine to fine sand, with abundant black shale or coal grains, well sorted.
118-120	Silty sand, same as above, poorly to moderately sorted.
120-124	Sand and gravel, very fine sand to fine gravel, poorly sorted, with numerous black grains.
	Banner Formation
124-162	Diamicton, pebbly sandy silty clay, gray to dark gray (10YR 5/1 to 10YR 4/1), with thin silty layers at 141,150, and 156 feet, calcareous
	Banner Formation—lacustrine
162-189	Diamicton, slightly pebbly sandy silty clay, dark gray to dark grayish brown (5Y 4/1 to 2.5Y 4/2), calcareous.
	Sankoty-Mahomet Sand
189-204	Sand, very fine to coarse sand, predominantly fine grained, moderately to well sorted, rounded to subrounded.
204-236	Sand and gravel, very fine sand to fine gravel, with about 10% gravel, predominately fine to medium sand, moderately to well sorted.
236-240	Sand, very fine to coarse sand, predominantly fine grained, moderately to well sorted, rounded to subrounded.
240-253	Sand and gravel, with about 10% gravel, predominately fine to medium sand, moderately to well sorted, becoming silty and clayey below 248 feet.
	Sub-Sankoty-Mahomet sand
253-258	Diamicton, sandy silty clay, light brownish gray (10YR 6/2), calcareous, highly reactive to HCI.
258-262	Sand (lacustrine?), very fine sand, with silt and clay, well sorted.
262-270	Diamicton, same as above, not as calcareous.
270-277	Clayey silty sand, very fine to fine sand, well sorted, some organics, calcareous.

Depth (ft)	Unit/Description *(continued)*
	Sub-Sankoty-Mahomet sand *(continued)*
277-285	Diamicton?, sandy clayey silt, light brownish gray to dark grayish brown (2.5Y 6/2 to 2.5Y 4/2), possibly layered, calcareous, highly reactive to HCI.
285-298	Sand and gravel, very fine sand to fine gravel, silty and clayey, possibly diamicton as above below 293 feet, leached, few organic fragments.
	Pennsylvanian bedrock
298-302	Shale, black to gray (10YR 2/1 to 6/1), with organic muck.
302-305	Coal, black (10YR 2/1).
305-313	Shale, gray to very dark gray (10YR 6/1 to 3/1), with thin very dark brown (10YR 2/2) layer at 309 feet.

DRILLER'S LOG—MTH-19

Depth (ft)	Description
0-3	black
3-11	yellow clay
11-18	yellow rocky clay
18-22	gray sand clay
22-23	some peat
23-38	hard gray clay
38-42	greenish clay
42-50	yellow clay
50-68	mostly gray clay
68-73	yellow gravel
73-78	gray clay
78-82	gravel
82-112	gray clay pinkish
112-115	dirty black sand
115-120	#15-#20 sand 20% black
120-124	gravel lot of black
124-160	hard pinkish gray clay
160-165	very hard shale clay
165-189	very soft shaley clay
189-195	#12 Sankoty sand
195-205	#12 sand
205-210	#20 sand and 15% 1/8" gravel
210-224	#12-#15 sand with 5% 1/8" gravel
224-235	gravel
235-240	#10-#12 sand
240-243	#8-#10 sand
243-252	#40-#60 sand and gravel
252-258	nearly white clay
258-262	.008 sand
262-271	very soft clay
271-298	soft clay?
298-299	black shale
299-302	dark gray shale
302-305	coal
305-313	shale

OBSERVATION WELL CONSTRUCTION: MTH-19

Set 5 feet of #20 slot 2-inch PVC screen and 230 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 170 feet and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to depth of 23 feet with two seals of bentonite chips in this interval. Filled annulus with bentonite chips from depth of 23 feet to land surface; set protective casing. Depth to bottom of screen is 232 feet below land surface.

MTH-20
Location: McLean County, T22NR01W29.1h
Elevation: 646 feet **Total Depth:** 311 feet **Date drilled:** 9/29/93
Depths corrected to gamma ray-neutron log. Logged interval 0.5 to 289.7 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-7	Clayey silt, black (10YR 2/1), leached.
7-10	Silt, brown (7.5YR 5/4), leached.
	Wedron Group
10-23	Diamicton, slightly pebbly sandy silty day, brown to gray (7.5YR 5/4 to 10YR 5/1), calcareous.
	Henry Formation—Ashmore tongue
23-28	Sand and gravel, very fine sand to fine gravel, poorly sorted.
28-33	Diamicton, same as above, gray (10YR 5/1).
	Roxana Silt—Robein Member
33-41	Silt, very dark brown (10YR 2/2), leached, common wood fragments.
	Glasford Formation—Radnor Member
41-52	Diamicton, pebbly sandy silty clay, gray to grayish brown (10YR 5/1 to 2.5Y 5/2), sandy with very fine to very coarse grained sand, pebbly with fine to medium gravel, calcareous.
52-56	Sand and gravel, very fine sand to fine gravel, predominantly coarse sand, poorly sorted, subrounded to subangular grains.
56-59	Diamicton, pebbly sandy silty clay, gray (10YR 5/1), with fine to coarse sand and fine to medium gravel, calcareous, highly reactive to HCI.
59-61	Silt, gray (10YR 5/1).
61-66	Sand and gravel, very fine sand to fine gravel, predominantly coarse sand, poorly sorted, subrounded to subangular grains.
	Glasford Formation—Vandalia Member
66-80	Diamicton, pebbly clayey sandy silt, gray to grayish brown (10YR 5/1 to 2.5Y 5/2), calcareous, very reactive to HCI.
80-90	Diamicton, pebbly silty sand, gray to olive (10YR 5/1 to 5Y 5/3), calcareous, very reactive to HCI.
90-101	Sandy silt (lacustrine), dark grayish brown (2.5Y 4/2), calcareous.
101-107	Silty sand and gravel, very fine sand to fine gravel, moderately to well sorted, dark grayish brown (2.5Y 4/2), calcareous.
	Banner Formation—Lierle Clay
107-113	Clayey silt, very dark brown to very dark grayish brown (10YR 2/2 to 2.5Y 3/2), leached, peaty organics.
	Banner Formation—Hillery Member
113-120	Sand and gravel, very fine sand to fine gravel, about 40% gravel, poorly sorted, clayey layer at 115 feet.
120-140	Diamicton, pebbly silty sandy day, gray (10YR 5/1), pebbly with fine to medium gravel, calcareous, very reactive to HCI.
140-155	Diamicton, pebbly clayey sandy silt, light brownish gray (1 OYR 6/2), calcareous as above, some organic fragments.
	Banner Formation—lacustrine
155-161	Sandy clayey silt, light brownish gray (10YR 6/2), calcareous, very reactive to HCI.
161-163	Silty clay, dark gray (10YR 4/1), calcareous.
163-167	Sandy clayey silt, same as above.
167-181	Silty clay, same as above, with thin pebbly layers.
	Mahomet Sand
181-191	Sand and gravel, very fine sand to fine gravel, predominantly coarse sand with approximately 40% gravel, poorly sorted, subangular to subrounded, with thin clayey silt layers.
191-194	Sand and gravel, very fine sand to fine gravel, predominantly fine sand, well sorted, rounded to subrounded.
194-198	Silty sandy clay, same as above?
198-228	Sand and gravel, very fine sand to medium gravel, about 40% gravel, poorly sorted; layer of pebbles to cobbles at 228 feet.
	Sub-Mahomet sand
228-242	Diamicton, slightly pebbly sandy silty clay, gray (10YR 5/1), with fine to coarse sand and fine gravel, calcareous.
242-253	Sand and gravel, very fine sand to fine gravel, with about 40% gravel, poorly sorted, rounded to subangular.

Depth (ft)	Unit/Description *(continued)*
253-278	Diamicton, slightly pebbly sandy silty clay, dark gray (10YR 4/1), with fine to coarse sand and fine gravel, calcareous.
278-297	Sand and gravel, very fine sand to fine gravel, with about 20% gravel, poorly to moderately sorted.
	Pennsylvanian bedrock
297-303	Shale, very dark gray (10YR 3/1).
303-305	Coal, black (10YR 2/1), friable.
305-311	Shale, same as above.

DRILLER'S LOG—MTH-20

Depth (ft)	Description
0-8	black
8-16	yellow clay
16-23	gray clay
23-27	gravel
27-40	peat
40-45	light gray clay
45-53	hard dark gray clay
53-56	gravel
56-62	gray clay
62-65	gravel
65-105	sandy gray clay
105-111	peat
111-113	gray clay
113-116	possible gravel streaks
116-117	gravel
117-140	hard gray clay
140-150	nearly white clay
150-160	sandy gray clay
160-183	clay and sand seemed mixed
183-185	gravel
185-203	fine dirty silty sand
203-210	#12 Sankoty
210-215	#12-#15 sand
215-220	#15-#20 sand
220-228	#20 sand plus 20% 1/8" gravel
228-228	rocks
228-242	hard clay
242-253	sand and gravel, seemed silty
253-265	clay
265-270	sand or very smooth clay?
270-280	soft clay
280-288	#30-#40 sand—very nice
288-292	#20-#30 sand plus 10% 1/8" gravel—very nice
292-297	#1 gravel—very nice
297-303	shale
303-305	coal
305-311	shale

OBSERVATION WELL CONSTRUCTION: MTH-20

Set 5 feet of #20 slot 2-inch PVC screen and 220 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel—bridged at depth of 142 feet. Sealed annulus with bentonite chips at depth of 142 feet. Continued filling annulus with pea gravel to depth of 23 feet with several seals of bentonite chips. Filled annulus with bentonite chips from depth of 23 feet to land surface; set protective casing. Depth to bottom of screen is 222 feet below land surface.

MTH-21
Location: McLean County, T22NR01W23.1h
Elevation: 672 feet **Total Depth:** 325 feet **Date drilled:** 10/12/93
Depths corrected to gamma ray-neutron log. Logged interval 0.0 to 316.5 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
	Peoria Silt
0-4	Clayey silt, very dark brown (10YR 2/2), leached.
	Wedron Group
4-11	Sandy clayey silt, yellowish brown to light olive brown (10YR 5/6 to 2.5Y 5/4), leached.
11-17	Diamicton, sandy silty clay, yellowish brown (10YR 5/4 to 10YR 5/6), coarse fraction very fine to fine sand, little fine gravel, leached.
17-18	Clay, brown (10YR 5/3), leached.
18-30	Diamicton, sandy silty clay, gray to grayish brown (10YR 5/1 to 5/2), slightly to moderately calcareous.
30-30.5	Sand, very fine to fine sand, well sorted.
30.5-44	Diamicton, slightly pebbly clayey sandy silt, dark gray to dark grayish brown (10YR 4/1 to 2.5Y 4/2), calcareous.
44-50	Clayey silt, dark gray to very dark grayish brown (10YR 4/1 to 2.5Y 3/2), with thin sand at 38 feet, numerous fine organic fragments, leached.
50-53	Sandy clayey silt, gray to olive (5Y 6/1 to 5Y 4/3), leached.
53-56	Silty sand, with some pebbles and cobbles, grayish brown (2.5Y 5/2), slightly calcareous.
56-57	Boulder, dark granitic rock, hard.
57-60	Sandy clayey silt, gray to olive gray (5Y 6/1 to 5Y 5/2), numerous fine wood fragments, slightly calcareous.
60-76	Diamicton, sandy silty clay, grayish brown (10YR 5/2 to 2.5Y 5/2), pinkish tinge, coarse fraction is very fine to very coarse sand, calcareous. Thin gravel at 60.5 feet.
76-77	Sand, very fine to medium sand, predominantly fine grained, moderately to well sorted.
77-85	Diamicton, sandy silty clay, same as above.
85-86	Sand and gravel, medium sand to coarse gravel, poorly sorted.
86-89.5	Diamicton, same as above.
89.5-90	Sand and gravel, medium sand to coarse gravel, poorly sorted.
90-92	Diamicton, clayey pebbly sandy silt to clayey silty sand and gravel, grayish brown (10YR 5/2), with fine to coarse sand and fine gravel, calcareous.
92-100	Diamicton, pebbly sandy clayey silt, dark grayish brown (10YR 4/2 to 2.5Y 4/2), calcareous.
100-101	Sand and gravel, silty fine sand to fine gravel, poorly sorted.
	Glasford Formation
101-106	Sandy silt, dark grayish brown (10YR 4/2 to 2.5Y 4/2), calcareous.
106-107	Clay (lacustrine), olive gray (5Y 4/2), vague laminations, slightly calcareous.
107-119	Silt and clay, dark gray (5Y 4/1), in layers, leached to slightly calcareous.
119-144	Diamicton, pebbly sandy silty clay, dark grayish brown (2.5Y 4/2), coarse fraction consists of fine to coarse sand and fine gravel, calcareous.
	Banner Formation
144-147	Silt, very dark brown (10YR 2/2), calcareous, peatlike.
147-148	Diamicton, clayey sandy silt, brown (10YR 5/3), calcareous.
148-150	Silt, very dark brown (1 OYR 2/2) to very pale brown (10YR 7/3), common wood fragments.
150-151	Diamicton, clayey sandy silt, brown (10YR 5/3), calcareous.
151-155	Silty clay, very dark gray (5Y 3/1), leached.
155-160	Silty clay and silt, interbedded, olive gray to very dark gray (5Y 4/2 to 5Y 3/1), slightly calcareous.
160-162	Silty clay, olive gray (5Y 4/2), calcareous.
162-164	Silt, olive (5Y 5/3), calcareous, with organic fragments.
164-168	Diamicton, silty sandy clay, dark grayish brown (10YR 4/2), leached.
168-184	Diamicton, slightly pebbly clayey sandy silt, grayish brown (10YR 5/2), calcareous.
184-206	Diamicton, pebbly silty sandy clay, very dark grayish brown (10YR 3/2), calcareous, very reactive to HCI.
206-209	Sandy clay, very dark grayish brown (10YR 3/2), calcareous, very reactive to HCI.

Depth (ft)	Unit/Description
	Banner Formation *(continued)*
209-213	Silty sand, very dark grayish brown (10YR 3/2), calcareous, very reactive to HCl.
213-216	Diamicton?, same as above, (gamma ray-neutron log indicates sandy material)
	Sankoty Sand
216-223	Sandy silt and silty sand, interbedded, well sorted in layers, dark grayish brown to olive brown (2.5Y 4/2 to 2.5Y 4/4), calcareous.
223-237	Sand, very fine to fine sand, well sorted.
237-240	Silty sand, poorly sorted.
240-276	Sand, very fine to medium sand, predominantly fine, moderately to well sorted.
276-290	Sand and gravel, Very fine sand to fine gravel, moderately to well sorted, predominantly fine sand.
290-315	Sand, very fine to medium sand, with fine gravel in layers.
	Pennsylvanian bedrock
315-325	Shale, dark gray (10YR 4/1), noncalcareous.

DRILLER'S LOG—MTH-21

Depth (ft)	Description
0-4	topsoil
4-18	yellow clay
18-30	gray clay
30-48	dark gray clay
48-56	greenish gray clay
56-57	granite boulder
57-105	pinkish gray clay
105-147	very hard gray clay
147-149	peat
149-151	sand and gravel
151-180	gray sandy clay
180-205	very hard gray clay
205-240	#6-#8 sand
240-270	#8-#10 sand
270-285	#10-#12 sand
285-290	#12-#15 sand
290-315	#15-#20 sand and gravel
315-325	shale

OBSERVATION WELL CONSTRUCTION: MTH-21

Set 5 feet of #20 slot 2-inch PVC screen and 295 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 200 feet and sealed annulus with bentonite chips. Continued filling annulus with pea gravel to depth of 30 feet with several annular seals of bentonite chips. Filled annulus with bentonite chips from 30 feet to land surface; set protective casing. Depth to bottom of screen is 297 feet below land surface.

MTH-22
Location: Logan County, T22NR02W31.4d
Elevation: 659 feet **Total Depth:** 311 feet **Date drilled:** 8/23/93-8/24/93
Depths corrected to natural gamma log. Logged interval 2.0 to 304.5 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-3	Silty day, olive brown (2.5Y 4/4), oxidized, leached.
3-7	Sandy silt, light olive brown (2.5Y 5/6), slightly calcareous.
7-13	Sandy clayey silt, light olive brown (2.5Y 5/6), calcareous.
	Wedron Group
13-49	Diamicton, slightly pebbly sandy clayey silt, dark grayish brown (2.5Y 4/2), calcareous.
49-56	Sand and gravel, very fine sand to fine gravel, silty predominantly very fine to fine grained sand, with thin silty clay layers, poorly sorted, subrounded to subangular.
56-67	Diamicton, pebbly sandy silty clay, dark grayish brown (2.5Y 4/2), calcareous.
67-74	Sand and gravel, very fine sand to fine gravel, with thin silty clay layers, poorly sorted.
74-78	Diamicton, pebbly sandy clayey silt, dark grayish brown (2.5Y 4/2), calcareous.
	Roxana Silt—Robein Member (or Berry Clay?)
78-85	Silt to clayey silt, very dark brown to black (10YR 2/2 to 10YR 2/1), leached, highly organic.
	Glasford Formation—Radnor Member
85-88	Diamicton, sandy clayey silt, dark gray to very dark grayish brown (2.5Y N4/ to 2.5Y 3/2), leached.
88-89	Sand and gravel, very fine sand to fine gravel, silty and clayey, poorly sorted.
89-95	Diamicton. slightly pebbly sandy clayey silt, light brownish gray (2.5Y 6/2), calcareous.
95-96	Sand and gravel, very fine sand to fine gravel, moderately sorted.
	Glasford Formation—Vandalia Member?
96-106	Diamicton, pebbly sandy clayey silt, light brownish gray to olive gray (10YR 6/2 to 5Y 5/2), calcareous.
106-108	Sand and gravel, very fine sand to fine gravel, moderately sorted.
	Banner Formation—Hillery Member?
108-127	Diamicton, pebbly sandy silty clay, olive brown to dark grayish brown (2.5Y 4/4 to 2.5Y 4/2),
127-147	Diamicton, clayey sandy silt to silty sand, dark grayish brown (2.5Y 4/2), lacustrine?, calcareous.
	Banner Formation outwash
147-152	Sand and gravel, very fine sand to fine gravel, predominantly fine to medium sand, silty, poorly sorted, rounded to., subrounded.
152-167	Sand, very fine to fine grained, well sorted, rounded.
	Banner Formation—lacustrine
167-176	Diamicton, sandy silty clay, grayish brown to olive brown (2.5Y 5/2 to 2.5Y 4/4), slightly calcareous.
176-177	Silty clay, light gray (2.5Y N6/), slightly calcareous.
177-193	Diamicton, slightly pebbly clayey sandy silt, dark grayish brown (2.5Y 4/2), with very fine to coarse sand and little fine gravel, calcareous.
193-195	Clayey silt to silty clay, dark yellowish brown (10YR 4/4), very reactive to HCI.
195-210	Diamicton, clayey sandy silt, dark yellowish brown (10YR 4/4) with pinkish cast, very reactive to HCI.
	Sankoty-Mahomet Sand
210-220	Sand, very fine to medium sand, primarily very fine to fine sand, well sorted, rounded, pinkish gray cast.
220-225	Sand, very fine to coarse grained, primarily coarse sand, moderately sorted, rounded to subrounded.
225-250	Sand, very fine to medium sand, primarily very fine to fine sand, well sorted, rounded, pinkish gray cast.
250-255	Sand and gravel, very fine sand to fine gravel, predominantly medium and coarse sand, moderately sorted, subrounded to subangular.
255-265	Sand, very fine to coarse sand, primarily very fine to fine sand, well sorted, rounded, pinkish gray cast.

Depth (ft)	Unit/Description *(continued)*
	Sub-Sankoty-Mahomet sand
265-280	Sand and gravel, very fine sand to fine gravel, slightly silty, predominantly coarse sand, moderately to poorly sorted, thin clay layer at 271 feet.
280-297	Sand and gravel, very fine sand to medium gravel, predominantly medium sand, poorly to moderately sorted, occasional boulders and cobbles, subrounded to subangular.
297-298	Diamicton, sandy silty clay, grayish brown to olive brown (2.5Y 5/2 to 2.5Y 4/4), strongly reactive to HCI, with white clay? at base of unit.
	Pennsylvanlan bedrock
298-315	Shale, gray (5Y N6/), noncalcareous.

DRILLER'S LOG—MTH-22

Depth (ft)	Description
0-14	yellow clay
14-40	gray day
40-53	soft gray clay
53-70	hard gray clay
70-73	brown clay peat
73-78	hard brown (clay)
78-80	soft dark gray clay
80-85	hard mix clay
85-104	soft clay (water loss)
104-106	gravel?
106-118	soft brown clay, wood
118-120	clay
120-125	sand and gravel
125-150	hard sandy clay
150-168	fine sand
168-174	darker gray clay
174-180?	light gray soft clay
180?-211	some pink clay
211-225	fine sand
225-258	sand with fine gravel, reddish
258-280	sand and gravel (Mahomet)
280-284	#15 sand
284-296	shale, limestone, possibly eroded
296-298	boulders
298-311	light gray shale

OBSERVATION WELL CONSTRUCTION: MTH-22d (west)

Set 5 feet of #10 slot 2-inch PVC screen and 235 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to depth of 231 feet, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 20 feet, sealed annulus with bentonite chips at several intervals between the aquifer and 20 feet. Filled annulus with bentonite chips from 20 feet to land surface; set protective casing. Depth to bottom of the screen is 237 feet below land surface.

OBSERVATION WELL CONSTRUCTION: MTH-22S (east)

Drilled to depth of 160 feet; set 5 feet of #10 slot 2-inch PVC screen and 155 feet of 2-inch PVC schedule 40 pipe; backflushed with water until discharge cleared and sand packed screen. Sealed annulus with bentonite chips on top of sand pack. Filled annulus with pea gravel and bentonite chips. Bentonite chips bridged at depth of 4 feet. Sealed annulus from 4 feet to land surface with bentonite chips; set protective casing. Depth to bottom of the screen is 157 feet below land surface.

MTH-23
Location: Tazewell County, T22NR03W03.8h
Elevation: 660 feet **Total Depth:** 168 feet **Date drilled:** 11/08/93
Depths corrected to natural gamma log. Logged interval 1.40 to 164.15 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-3	Silty clay, very dark brown (10YR 2/2), leached.
3-7	Sandy clayey silt, dark brown to yellowish brown (10YR 3/3 to 10YR 5/8), few organic fragments, leached.
7-9	Sandy silty clay, yellowish brown (10YR 5/6), oxidized, leached.
	Wedron Group
9-14	Sandy clayey silt, light olive brown (2.5Y 5/4), leached.
14-18	Diamicton, slightly pebbly sandy clayey silt, yellowish brown to light olive brown (10YR 5/8 to 2.5Y 5/6), calcareous.
18-33	Diamicton, slightly pebbly sandy silty clay, grayish brown to dark grayish brown (10YR 5/2 to 2.5Y 4/2), with very fine to very coarse sand and little fine gravel, calcareous.
33-43	Diamicton, pebbly silty sandy clay, gray (10YR 5/1), with fine sand to medium gravel, calcareous.
43-49	Diamicton, clayey sandy silt, grayish brown (2.5Y 5/2), moderately calcareous.
49-60	Diamicton, pebbly silty sandy clay, gray (10YR 5/1), with fine sand to medium gravel, thin sand layers at 52 and 54 feet, moderately calcareous.
60-61	Sand and gravel, very fine sand to fine gravel, predominantly medium sand, silty, moderately to well sorted.
	Glasford Formation
61-66	Diamicton, pebbly clayey sandy silt, dark grayish brown (2.5Y 4/2), with fine organic fragments, slightly calcareous.
66-69	Sand and gravel, very fine sand to fine gravel, predominantly medium sand with little fine gravel, moderately to well sorted, subrounded to subangular.
69-78	Diamicton, pebbly sandy silty clay, gray (10YR 5/1), with very fine to very coarse sand and fine to medium gravel, slightly calcareous; thin sand layer at 75 feet.
78-82	Clayey silt to sandy clayey silt, light olive brown (2.5Y 5/4), oxidized, some organic fragments, slightly calcareous.
82-83	Sand and gravel, very fine sand to fine gravel, silty and clayey, predominantly medium grained sand, minor organic fragments, poorly sorted, subrounded to subangular.
83-89	Diamicton, pebbly sandy clayey silt, light olive brown (2.5Y 5/4), with very fine to very coarse sand and fine to medium gravel, slightly calcareous.
89-104	Diamicton, slightly pebbly clayey sandy silt, grayish brown to dark grayish brown (10YR 5/2 to 2.5Y 4/2), with very fine to coarse sand and fine gravel, calcareous.
104-106	Sand and gravel, very fine sand to fine gravel, silty and clayey, predominantly medium grained sand, moderately to poorly sorted, subangular to subrounded.
	Banner Formation
106-126	Diamicton, pebbly clayey sandy silt, grayish brown to dark grayish brown (1 OYR 5/2 to 2.5Y 4/2), with very fine to coarse sand and fine gravel, few organic fragments, calcareous.
126-128	Sand and gravel, very fine sand to fine gravel, silty and clayey, predominantly medium grained sand, moderately to poorly sorted, subangular to subrounded.
	Banner Formation—Hillery Member?
128-153	Diamicton, slightly pebbly clayey sandy silt, grayish brown to olive brown (2.5Y 5/2 to 2.5Y 4/4), highly calcareous, organic material throughout, dark yellowish brown (1 OYR 4/4) horizon at 136 feet.
	Pennsylvanian bedrock
153-168	Shale, gray to grayish brown (2.5Y N5/ to 2.5Y 5/2), very slightly calcareous.

DRILLER'S LOG—MTH-23

Depth (ft)	Description
0-4	sandy black
4-14	yellow clay
14-18	yellow sandy clay
18-63	sandy gray clay
63-78	dirty gravel?
78-127	very sandy gray clay
127-135	possibly gravel
135-153	pinkish gray clay
153-168	light blue shale

No observation well was constructed at this location. Test hole MTH-23 was backfilled with pea gravel and several seals of bentonite chips to a depth of 20 feet below land surface, and with bentonite chips alone from 20 feet to land surface.

MTH-24
Location: Tazewell County, T23NR02W12.1a
Elevation: 654 feet **Total Depth:** 335 feet **Date drilled:** 11/3/93-11/4/93
Depths corrected to natural gamma log; logged through casing. Logged interval 1.5 to 305.4 feet.
* Indicates intervals used for grain-size distribution analysis.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-4	Sandy clayey silt, dark brown (10YR 3/3), leached
4-6	Same as above, yellowish brown (10YR 5/6) to olive brown (2.5Y 4/4), leached.
	Wedron Group
6-12	Sand and gravel, fine sand to medium gravel, poorly sorted, subrounded to subangular, oxidized.
12-16.5*	Diamicton, pebbly sandy clayey silt, yellowish brown (10YR 5/6), leached.
16.5-21	Clayey silty gravelly sand, dark grayish brown (10YR 4/2), calcareous.
21-29*	Clayey sandy silt, dark grayish brown (10YR 4/2), calcareous.
	Wedron Group Formation 2
29-55*	Diamicton, pebbly clayey sandy silt, grayish brown (10YR 5/2), with coarse sand and fine to medium pebbles, calcareous.
	Glasford Formation
55-61*	Diamicton, slightly pebbly sandy silt, with very fine sand to fine gravel, calcareous.
61-75*	Diamicton, pebbly sandy clayey silt, dark grayish brown (2.5Y 4/2), occasional wood fragments possibly from silty clay interval at 69 to 71 feet, calcareous.
75-112*	Sand and gravel, very fine sand to medium gravel, subrounded to subangular, poorly sorted.
112-117	Diamicton, pebbly sandy clay, possibly oxidized, (inferred from natural gamma log and geologist logs).
117-125*	Sand and gravel, very fine sand to medium gravel, poorly sorted as above.
	Banner Formation—Hillery Member
125-128*	Diamicton, pebbly silty sandy clay, grayish brown (10YR 5/2), pinkish tinge, calcareous..
128-134*	Sand and gravel, silty clayey very fine to medium sand with some fine to medium gravel, poorly sorted.
134-139	Diamicton, as above, dark grayish brown (2.5Y 4/2).
139-142	Clayey silty sand and gravel.
142-167*	Diamicton, as above, calcareous and rapidly reactive to HCI.
	Sankoty Sand
167-174*	Sand, some organic fragments, very fine to very coarse sand, moderately sorted, mostly fine grained.
174-177	Sand and gravel, very fine sand to fine gravel, poorly sorted, subrounded to subangular.
177-210*	Sand and gravel, fine sand to medium gravel, some coarse gravel, coarser below 205 feet, moderately to well sorted.
210-235*	Sand and gravel, very fine sand to medium gravel, 25% to 50% gravel, poorly sorted, coarsest between 215 and 230 feet.
235-260*	Sand and gravel, very fine to coarse sand with layers of fine to medium gravel, poorly sorted, rounded to subrounded, pinkish cast, better sorted and coarser 245 to 260 feet.
260-303*	Sand and gravel, very fine sand to medium gravel, predominantly sand with coarser layers, poorly sorted, subrounded, moderately to well sorted below 280 feet.
303-317*	Sand and gravel, fine sand to boulders, predominantly gravel, poorly sorted, subrounded to subangular, some limestone and shale.
	Pennsylvanian bedrock
317-323	Coal, limestone, and shale, friable, olive gray (5Y 5/2 to 5Y 4/2).
323-335	Shale, gray to very dark gray (10YR 6/1 to 10YR 3/1), slightly calcareous.

DRILLER'S LOG—MTH-24

Depth (ft)	Description
0-6	yellow clay
6-14	yellow gravel
14-54	gray clay, harder below 40'
54-57	gravel
57-74	hard pinkish sandy gray day
74-77	clay with a lot of gravel
77-127	gravel with a lot of boulders
127-167	hard pinkish gray clay
167-175	#10 sand
175-177	1/8" gravel
177-210	#10 sand
210-215	#12 sand
215-230	1/8" gravel
230-235	#12 Sankoty
235-260	streaks #12 sand and gravel
260-275	#20-#50 Sankoty
275-303	#12-#15 sand
303-317	boulders and gravel (lost circulation)
317-320	black shale
320-323	coal
323-333	shale

OBSERVATION WELL CONSTRUCTION: MTH-24d (north)

The attempt to construct an observation well in the initial test hole was unsuccessful; could not get the screen past 185 feet due to unstable sand and gravel. Moved south about 12 feet for second attempt.

Drilled to a depth of 310 feet; set 5 feet of #20 slot 2-inch PVC screen and 305 feet of 2-inch PVC schedule 40 pipe; backflushed with water until discharge cleared and sand packed screen. Filled annulus with pea gravel to depth of about 165 feet and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to depth of 23 feet with several annular seals of bentonite chips in the clay units. Filled annulus with bentonite chips from depth of 23 feet to land surface; set protective casing. Depth to bottom of screen is 307 feet below land surface.

OBSERVATION WELL CONSTRUCTION: MTH-24S (south)

Drilled to 124 feet; set 5 feet of #20 slot 2-inch PVC screen and 120 feet of 2-inch PVC schedule 40 pipe; backflushed with water until discharge cleared and sand packed screen. Filled annulus with pea gravel to depth of about 70 feet and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to depth of 23 feet with seals of bentonite chips at depths of 50 and 30 feet. Filled annulus with bentonite chips from 23 to 3 feet and with pea gravel to land surface; set protective casing. Depth to bottom of screen is 122 feet below land surface.

MTH-25
Location: Tazewell County, T24NR02W17.1d
Elevation: 681 feet **Total Depth:** 344 feet **Date drilled:** 11/9/93
Depths corrected to natural gamma log. Logged interval 2.1 to 343.3 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-1	Silty clay, dark brown (10YR 3/3), leached.
1-9	Sandy clayey silt, yellowish brown (10YR 5/4), oxidized, slightly calcareous.
9-17	Clayey sandy silt, yellowish brown to dark grayish brown (10YR 5/4 to 2.5Y 4/2), calcareous.
	Wedron Group
17-37	Diamicton, pebbly sandy clayey silt, gray to dark grayish brown (1 OYR 5/1 to 2.5Y 4/2), with very fine to coarse sand and fine to medium gravel, calcareous.
37-41	Sand and gravel, very fine to medium sand with some fine gravel, poorly sorted, some fine organics.
41-46*	Sand and gravel, same as above with medium gravel.
	Glasford Formation
46-69	Diamicton, slightly pebbly silty sandy clay, dark grayish brown (10YR 4/2 to 2.5Y 4/2), some organic fragments, calcareous.
69-72	Clayey sand, same as above.
72-127	Diamicton, same as above.
127-159*	Sand and gravel, very fine sand to medium gravel, poorly to moderately sorted, possibly with coarse and fine layers.
	Banner Formation
159-163	Sandy clayey silt, very dark brown to dark grayish brown (10YR 2/2 to 2.5Y 4/2), many woody organics, leached.
163-166	Sandy silty clay, very dark gray (10YR 3/1), some organics present.
166-174*	Sand and gravel, very fine sand to coarse gravel, predominantly medium sand with fine gravel, poorly sorted.
	Banner Formation—Hillery Member?
174-182	Diamicton, pebbly clayey sandy silt, dark grayish brown (10YR 4/2), sand is fine to very coarse grained with fine gravel, calcareous.
182-196	Diamicton, pebbly sandy clayey silt, dark grayish brown to brown (10YR 4/2 to 10YR 4/3), more coarse grained materials than above, strongly reactive to HCI.
	Sankoty-Mahomet Sand
196-202	Sand, very fine to coarse, predominantly fine grained, moderately sorted, silty toward base of unit.
202-215*	Sand and gravel, very fine sand to medium gravel, poorly sorted, noticeable content of reddish rock grains.
215-220*	Sand, same as above, no silt.
220-242*	Sand and gravel, same as above.
242-250*	Sand, as above.
250-270*	Sand and gravel, as above, with coal fragments toward base of unit.
270-282*	Sand, fine to medium grained, moderately to well sorted, pinkish cast.
282-293*	Sand and gravel, fine sand to medium gravel, poorly sorted.
293-296*	Sand, as above.
296-305*	Sand and gravel, as above.
305-314*	Sand, as above, possibly more fine grained than above.
314-328*	Sand and gravel, very fine sand to coarse gravel and possibly cobbles, poorly sorted.
	Pennsylvanian bedrock
328-344	Shale, dark grayish brown to dark gray (2.5Y 4/2 to 2.5 N4/), abundant organic fragments in sample, noncalcareous.

DRILLER'S LOG—MTH-25

Depth (ft)	Description
0-8	yellow clay
8-17	yellow sandy clay
17-39	gray sandy clay
39-46	gravel
46-89	very soft sandy pinkish gray clay
89-91	very hard gray clay
91-93	soft sandy gray clay
93-105	hard pinkish gray clay
105-128	greenish gray clay
128-160	fine sandy gravel
160-166	brown peaty clay
166-174	gravel, few streaks clay, boulders
174-198	very hard pink clay
198-204	#6 sand
204-213	#30 sand with gravel
213-218	#6 sand
218-272	very streaked sand and gravel
272-290	#10-#15 Sankoty
290-310	#15-#30 Sankoty
310-329	1/8" gravel greenish
329-344	dark gray shale

OBSERVATION WELL CONSTRUCTION: MTH-25

Set 5 feet of #20 slot 2-inch PVC screen and 305 feet of 2-inch PVC schedule 40 pipe; backfilled test hole with pea gravel to bottom of screen, screen sand packed before backflushing, backflushed with water until discharge cleared, caught sand pack in 5-gallon buckets, repacked screen with sand. Filled annulus with pea gravel to depth of 100 feet and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to depth of 23 feet with annular seals of bentonite chips in clay units. Filled annulus with bentonite chips from depth of 23 feet to land surface; set protective casing. Depth to bottom of screen is 307 feet below land surface.

SWS-9
Location: Tazewell County, T23NR03W26.7g
Elevation: 630 feet **Total Depth:** 257 feet **Date drilled:** 10/21/93
Depths corrected to natural gamma log; logged through casing. Logged interval 0.0 to 254.0 feet.

COMPOSITE LOG

Depth (ft)	Unit/Description
0-5	Sandy clayey silt, very dark brown to black (10YR 2/2 to 10YR 2/1), leached.
	Wedron Group
5-11	Diamicton, slightly pebbly sandy clayey silt, very dark brown to olive brown (10YR 2/2 to 2.5Y 4/4), slightly calcareous.
11-16	Diamicton, pebbly sandy clayey silt, yellowish brown to olive brown (10YR 5/4 to 2.5Y 4/4), with very fine to very coarse sand and fine gravel, moderately calcareous.
16-28	Diamicton, sandy clayey silt, dark brown to dark grayish brown (10YR 3/3 to 2.5Y 4/2), slightly calcareous.
	Roxana Silt—Robein Member
28-30	Silt, very dark brown (10YR 2/2), leached, with wood fibers.
30-34	Clayey silt, very dark gray (5Y 3/1), leached.
34-39	Silty clay, dark gray (10YR 4/1), possibly laminated, leached.
	Glasford Formation—diamicton
39-44	Sandy clayey silt, gray to dark greenish gray (10YR 5/1 to 5G 4/1), appears gleyed, slightly calcareous.
44-84	Diamicton, slightly pebbly sandy clayey silt, grayish brown to dark grayish brown (10YR 5/2 to 2.5Y 4/2), slightly calcareous, limestone boulder at 44 feet.
	Banner Formation
84-87	Sand, very fine to medium grained, silty and clayey, primarily fine sand, moderately well sorted, olive gray (5Y 5/2) cast, abundant organics, oxidized.
87-96	Diamicton, slightly pebbly clayey sandy silt, grayish brown (10YR 5/2), slightly calcareous.
96-99	Sand and gravel, very fine sand to fine gravel, silty and clayey, moderately to poorly sorted.
99-115	Diamicton, slightly pebbly clayey sandy silt, grayish brown (10YR 5/2), highly calcareous, silt layer at 108 feet.
115-125	Sand and gravel, very fine sand to medium gravel, primarily medium sand, silty, poorly sorted.
125-127	Diamicton, sandy silty clay, grayish brown (10YR 5/2), calcareous.
	Sankoty Sand
127-170	Sand, very fine to medium sand, predominantly fine sand, with fine gravel layers, moderately to well sorted, rounded to subrounded.
170-191	Sand and gravel, very fine sand to medium gravel, primarily fine to coarse sand with 30% to 50% gravel, moderately to poorly sorted, with some thin layers of dark brown to dark grayish brown (10YR 3/3 to 10YR 4/2) particularly from 179 to 182 feet.
	Sub-Sankoty sand
191 -197	Sand and gravel, as above, with organic fragments.
197-242	Sand and gravel, as above, no clay, approximately 50% gravel.
	Pennsylvanian bedrock
242-257	Shale, light gray to greenish gray (10YR 6/1 to 5G 6/1), with limestone partings, noncalcareous.

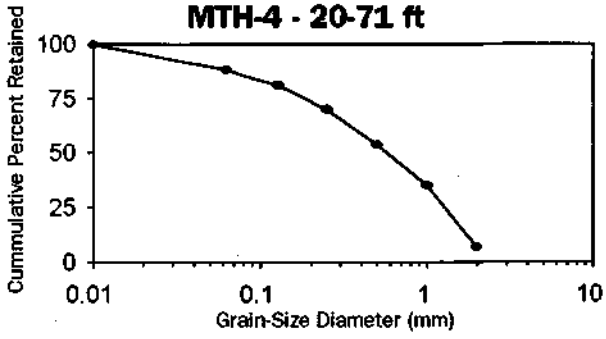
DRILLER'S LOG—SWS-9

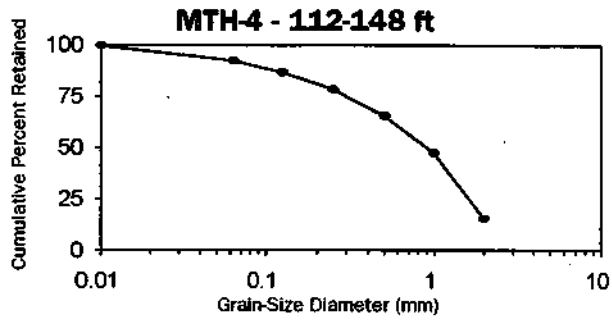
Depth (ft)	Description
0-6	junk-fill
6-27	hard dark gray clay
27-29	peat
29-44	soft sandy gray clay
44-45	limestone boulder
45-70	soft sandy light gray clay
70-84	gray hard clay
84-88	fine sand
88-117	sandy light gray clay
117-130	very streaked gravel and clay
130-160	#6-#8 fine sand
160-170	#12-#15 sand with some gravel
170-180	#30-#40 sand and gravel
180-188	gravel
188-196	clay streaks?
196-200	gravel
200-220	very brown gravel (looked like Merrimac)
220-230	#10-#15 Sankoty
230-242	dark and greenish gravel (find this in Bureau County above rock)
242-257	light blue shale

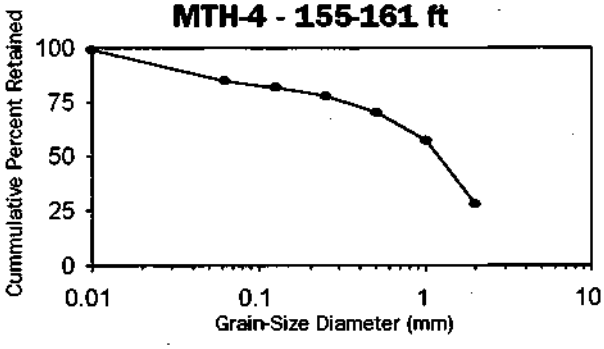
OBSERVATION WELL CONSTRUCTION: SWS-9

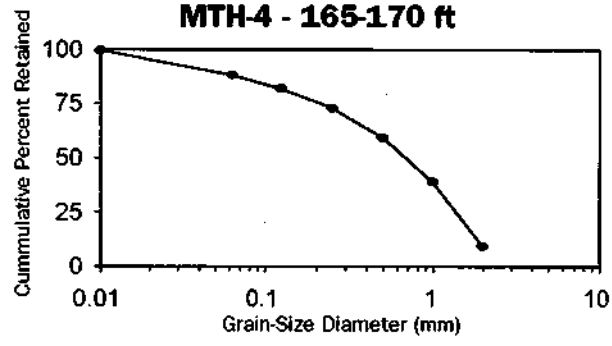
Set 20 feet of 2-inch PVC schedule 40 pipe below the screen, 5 feet of #20 slot 2-inch PVC screen, and 232.5 feet of 2-inch PVC schedule 40 pipe above the screen; backfilled test hole with pea gravel to bottom of screen, backflushed with water until discharge cleared, and sand packed screen. Filled annulus with pea gravel to depth of 120 feet and sealed annulus with 20 pounds of bentonite chips. Continued filling annulus with pea gravel to land surface with annular seals of bentonite chips at depths of 80, 42,17-20, and 7 feet; set protective casing. Depth to bottom of screen is 234.5 feet below land surface.

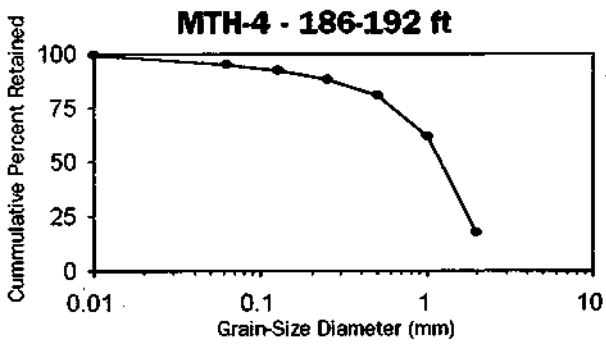
APPENDIX C GRAIN-SIZE DISTRIBUTION CURVES FOR 10 TEST HOLES

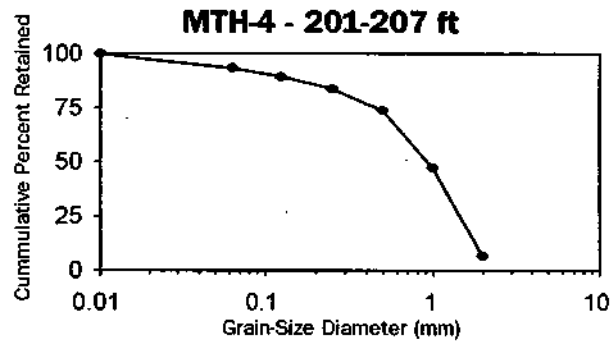


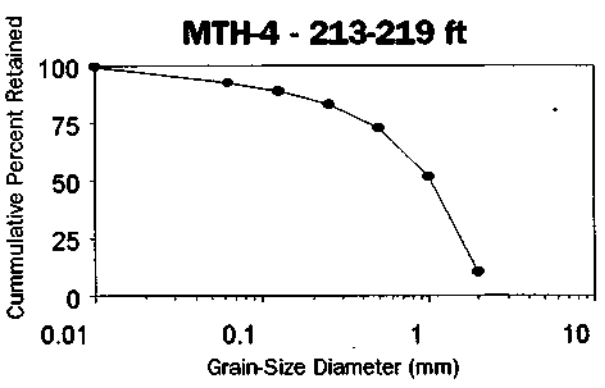


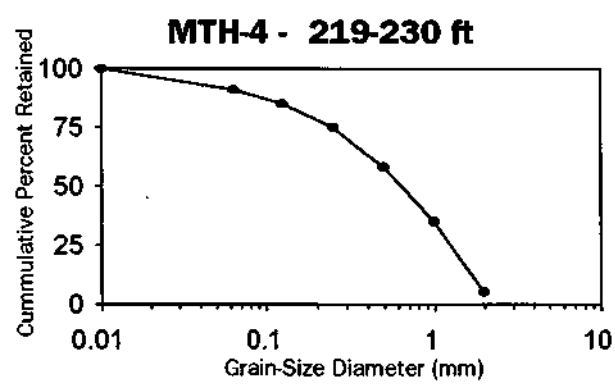


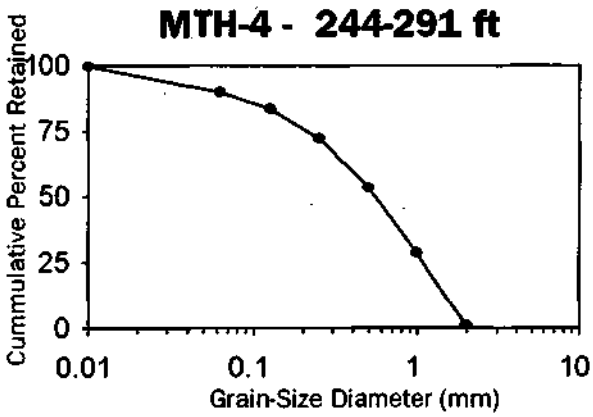


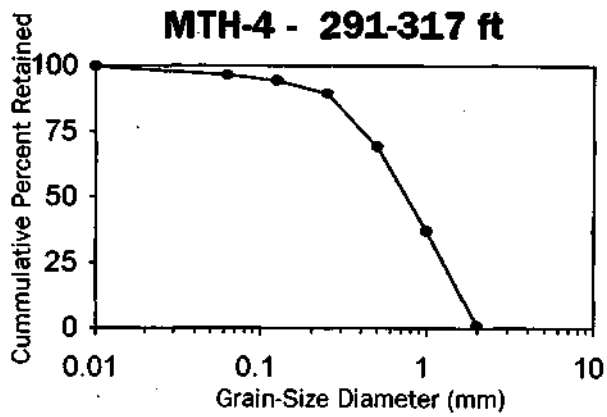


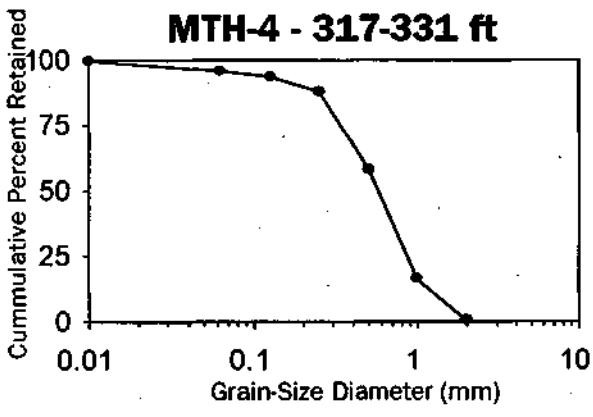


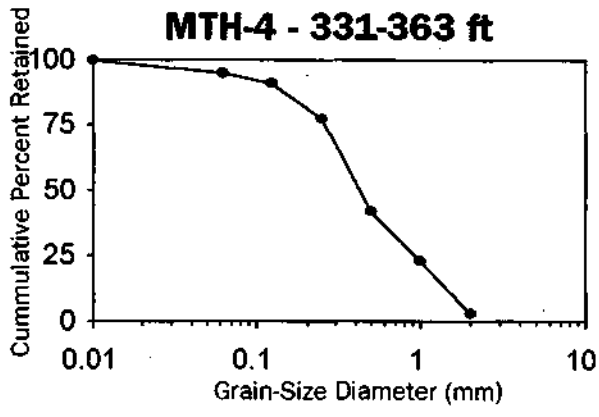


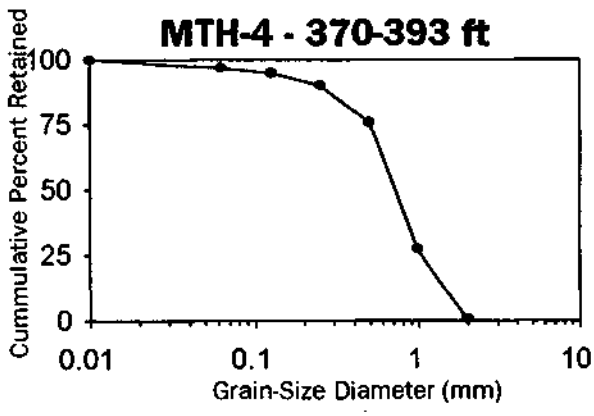


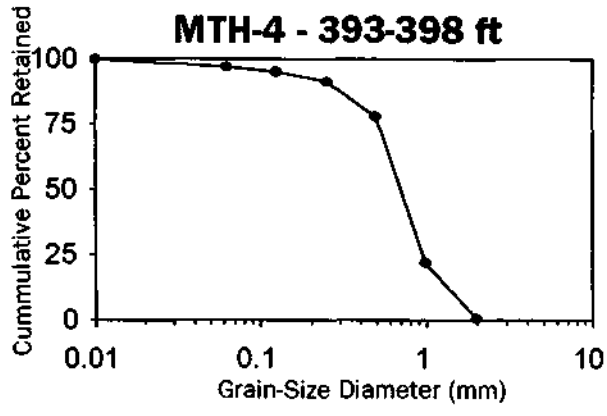

MTH-4 - 244-291 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

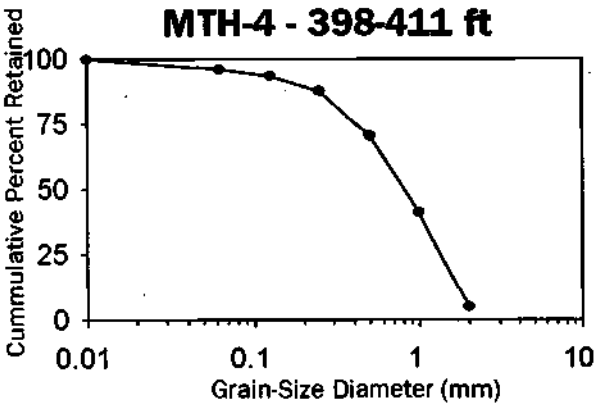

MTH-4 - 291-317 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

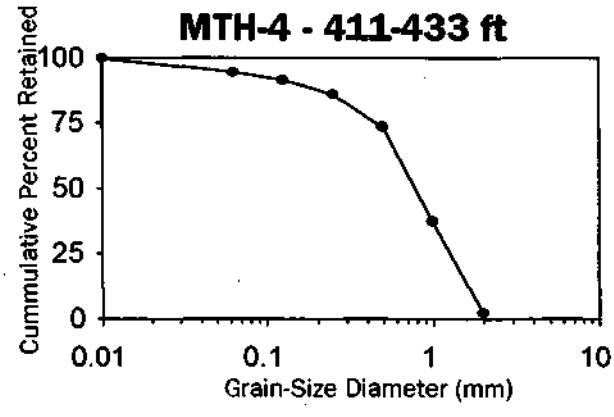

MTH-4 - 317-331 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

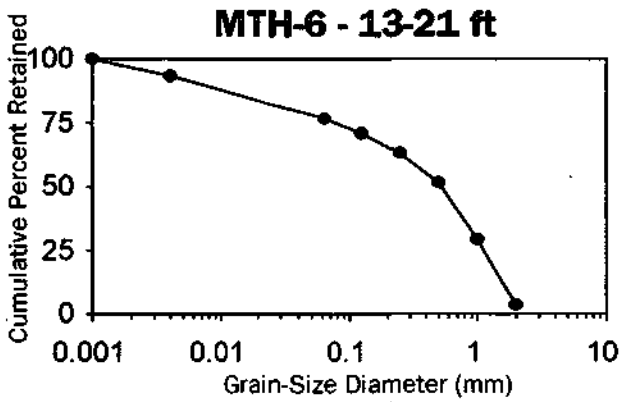

MTH-4 - 331-363 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

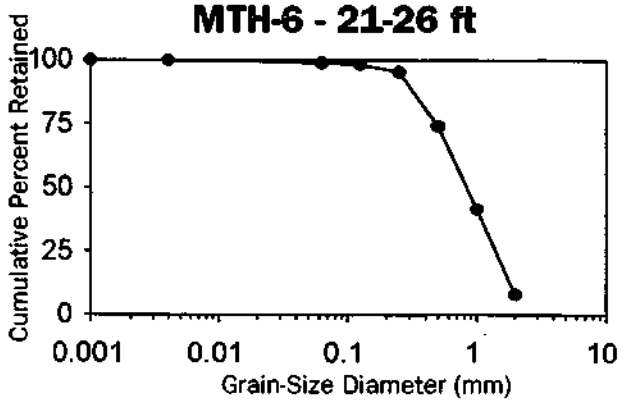

MTH-4 - 370-393 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

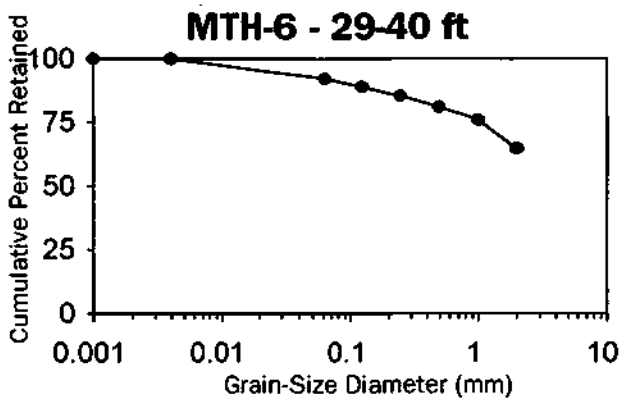

MTH-4 - 393-398 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

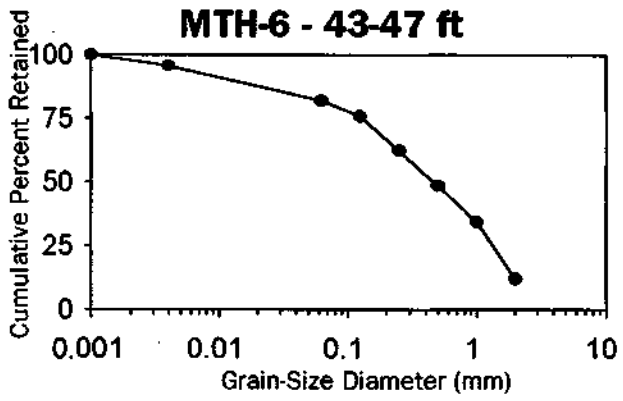

MTH-4 - 398-411 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

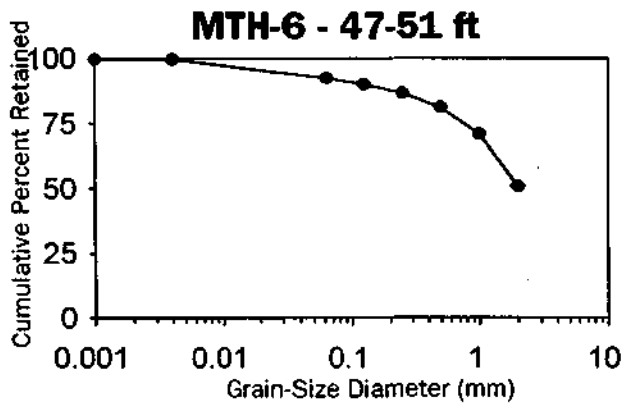

MTH-4 - 411-433 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

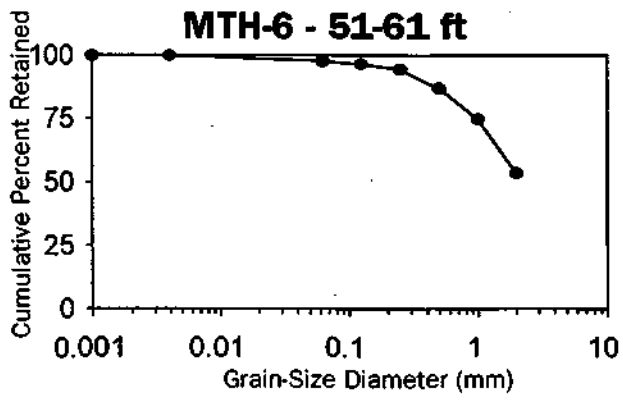

MTH-6 - 13-21 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

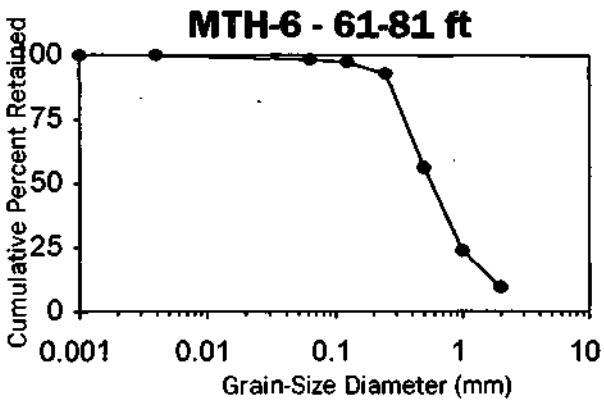

MTH-6 - 21-26 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

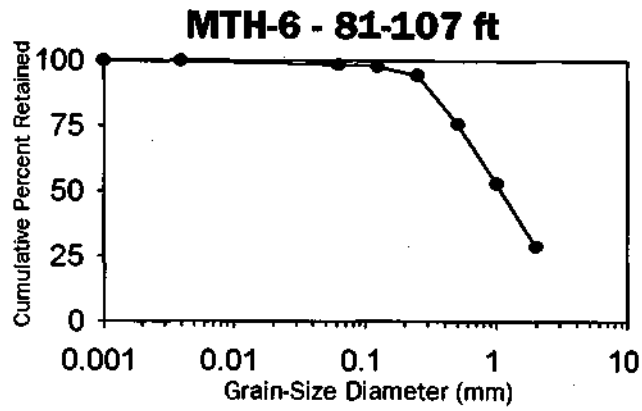

MTH-6 - 29-40 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

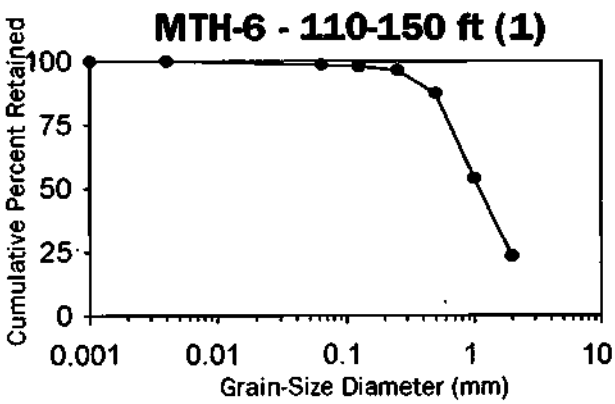

MTH-6 - 43-47 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

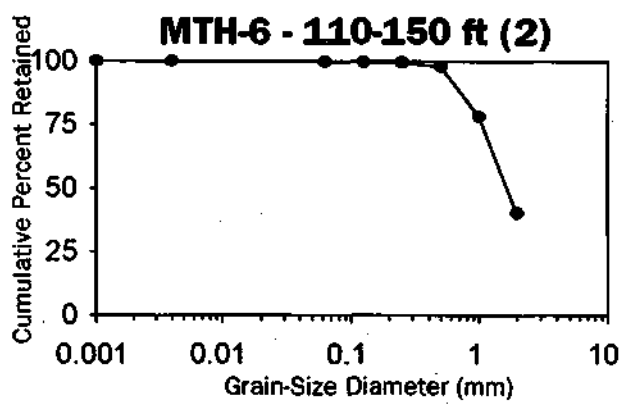

MTH-6 - 47-51 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

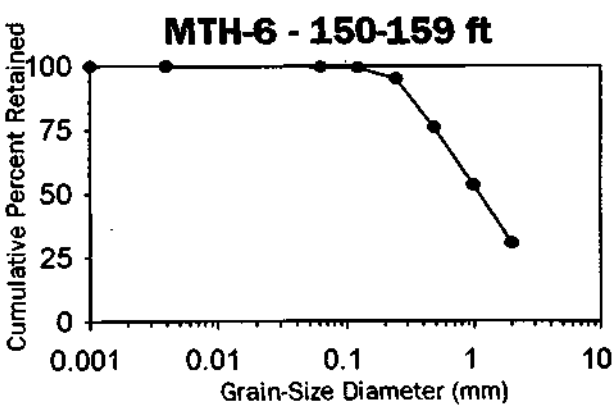

MTH-6 - 51-61 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

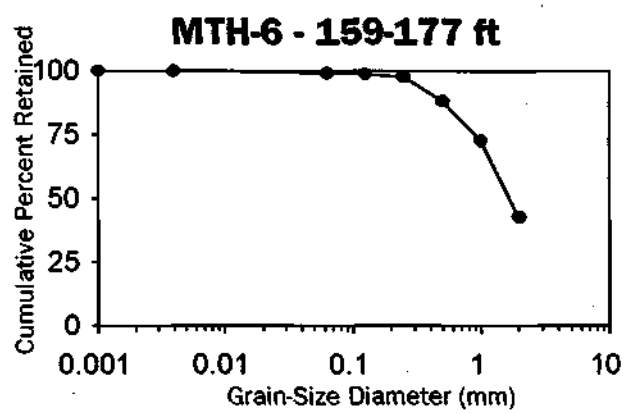

MTH-6 - 61-81 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

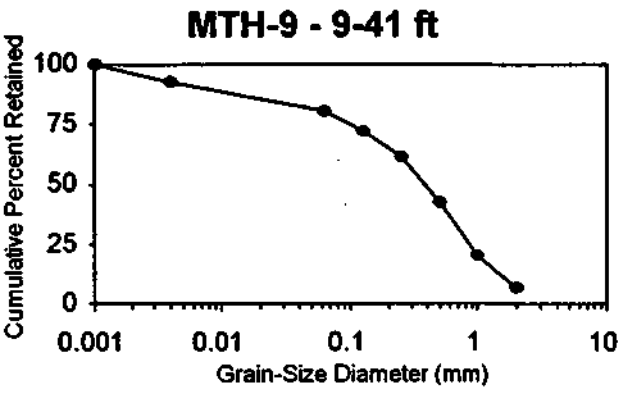

MTH-6 - 81-107 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

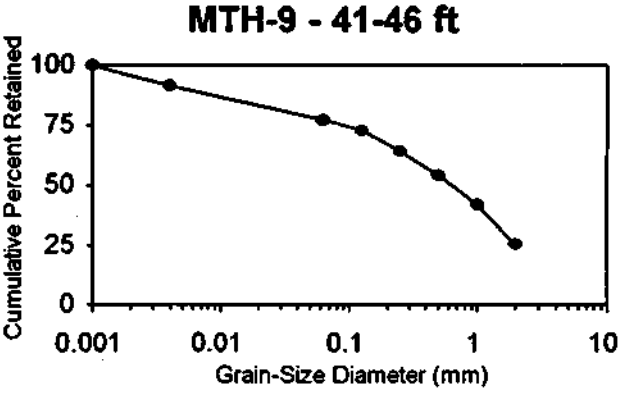

MTH-6 - 110-150 ft (1)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

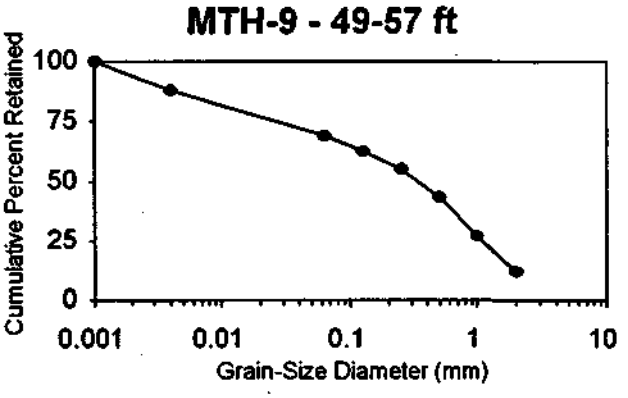

MTH-6 - 110-150 ft (2)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

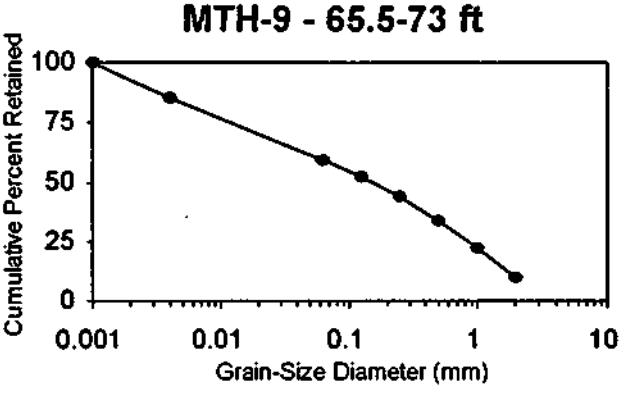

MTH-6 - 150-159 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

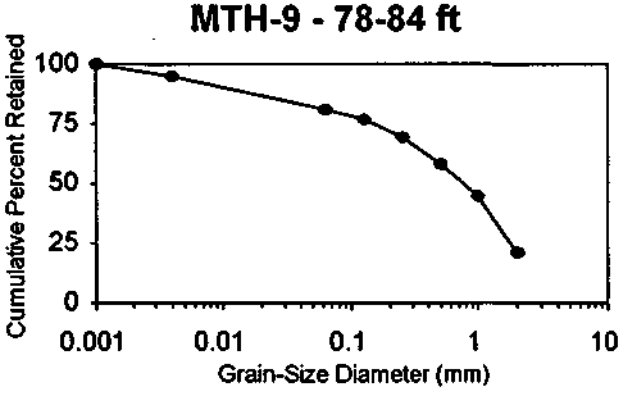

MTH-6 - 159-177 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

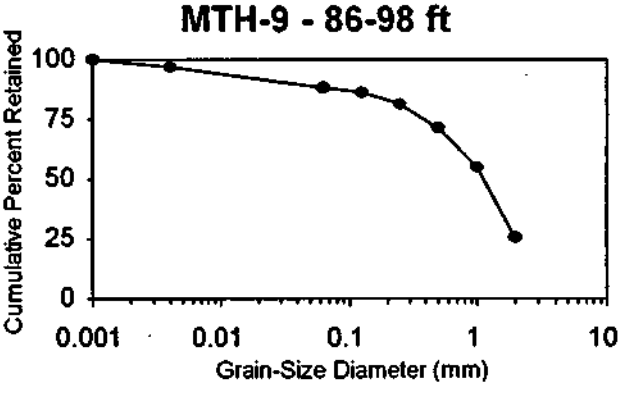

MTH-9 - 9-41 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

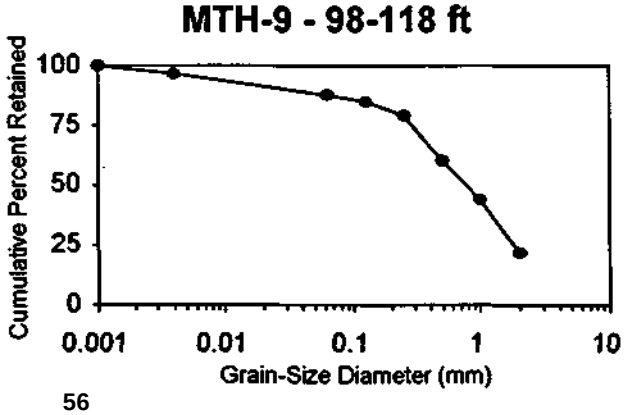

MTH-9 - 41-46 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

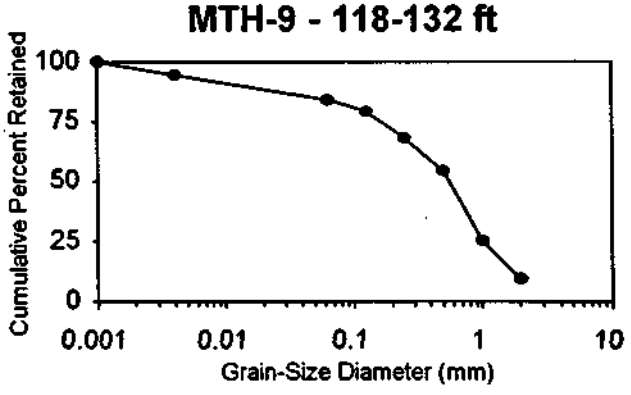

MTH-9 - 49-57 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

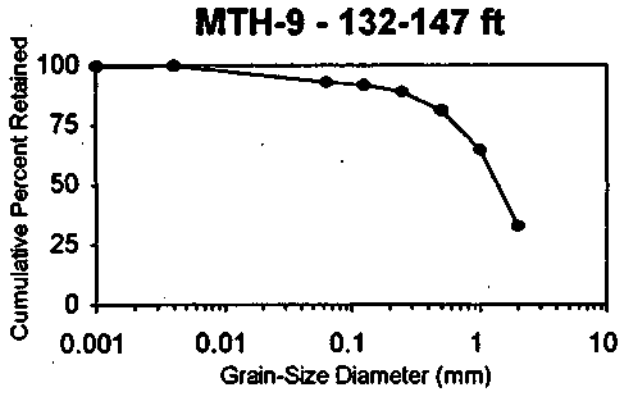

MTH-9 - 65.5-73 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

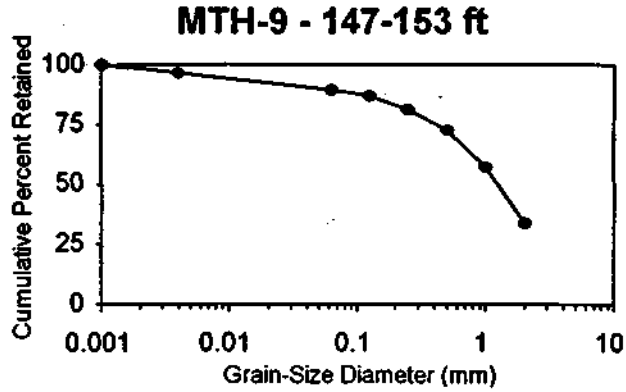

MTH-9 - 78-84 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

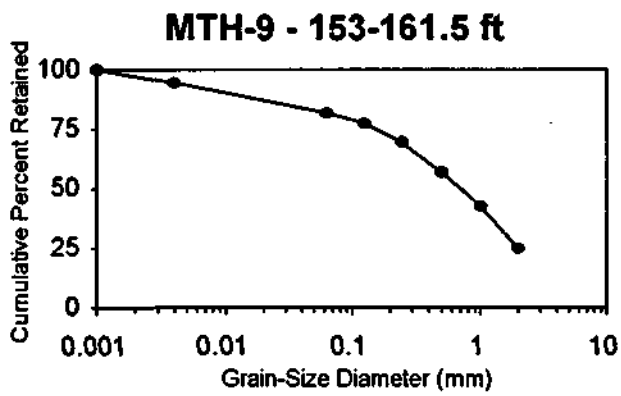

MTH-9 - 86-98 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

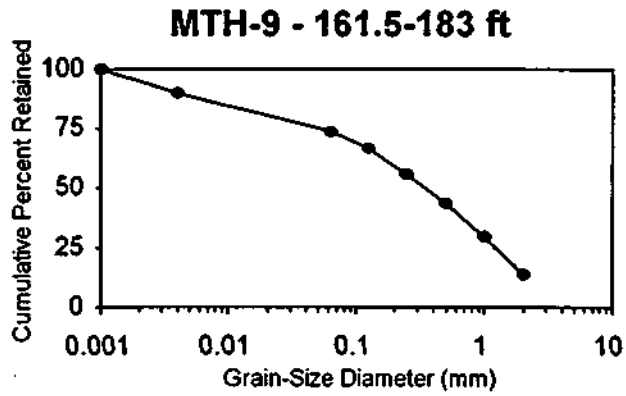

MTH-9 - 98-118 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

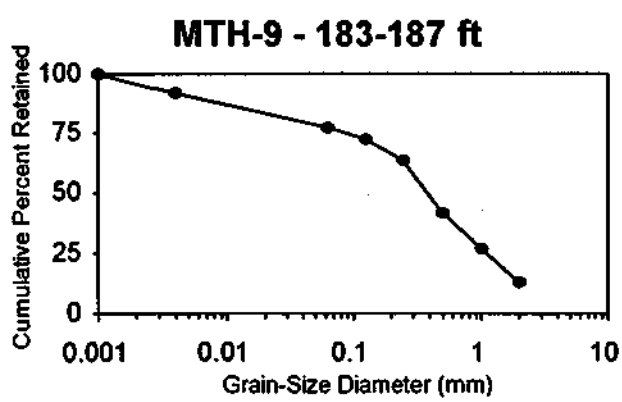

MTH-9 - 118-132 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

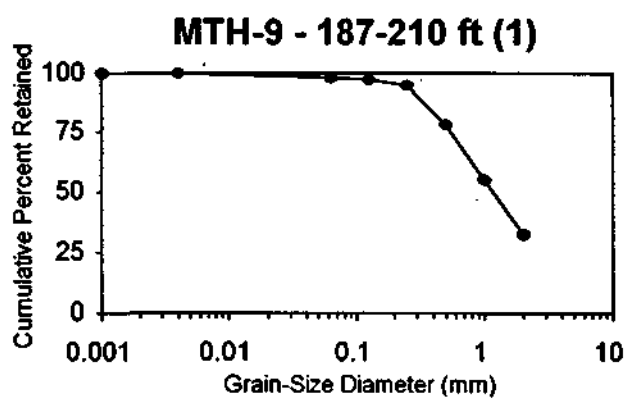

MTH-9 - 132-147 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

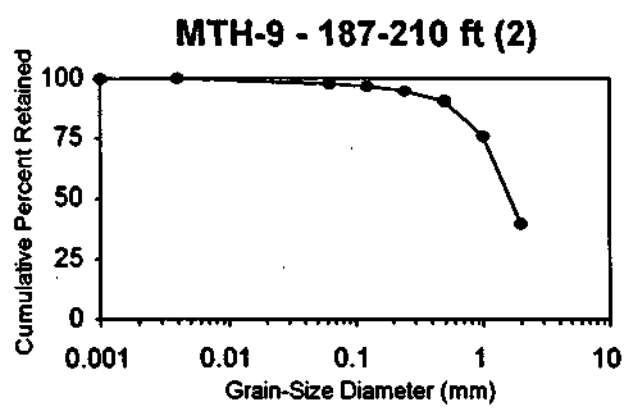

MTH-9 - 147-153 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

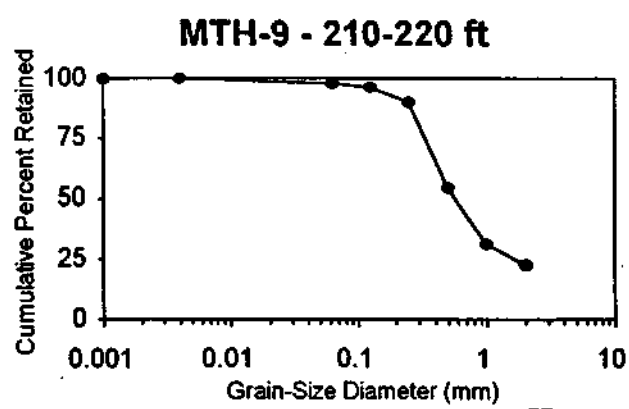

MTH-9 - 153-161.5 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

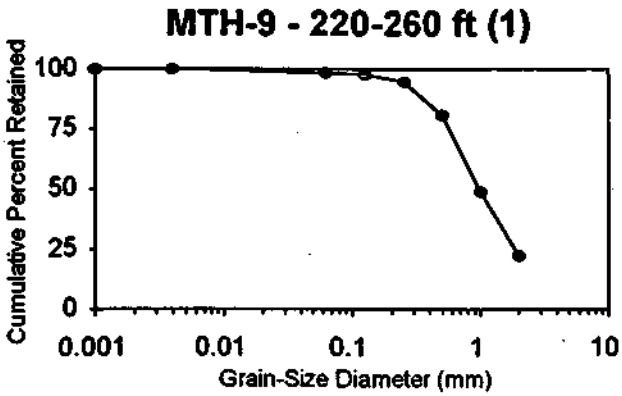

MTH-9 - 161.5-183 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

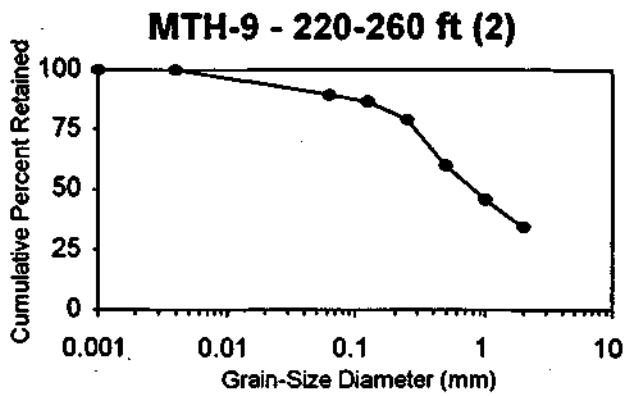

MTH-9 - 183-187 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

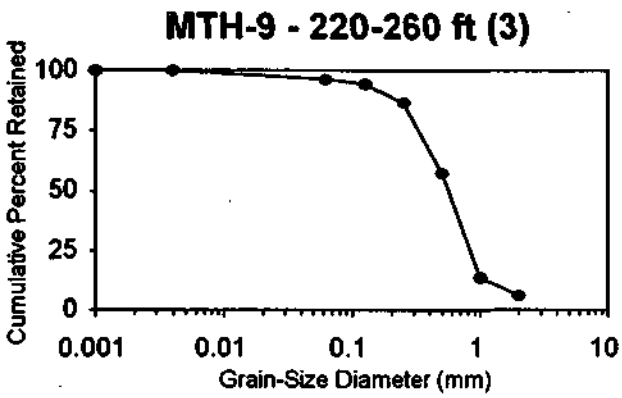

MTH-9 - 187-210 ft (1)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

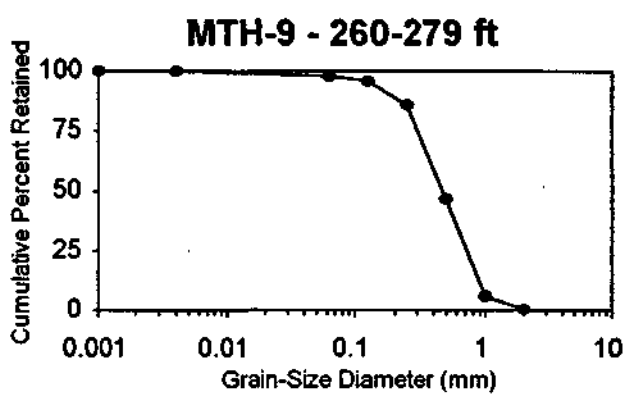

MTH-9 - 187-210 ft (2)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)


MTH-9 - 210-220 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

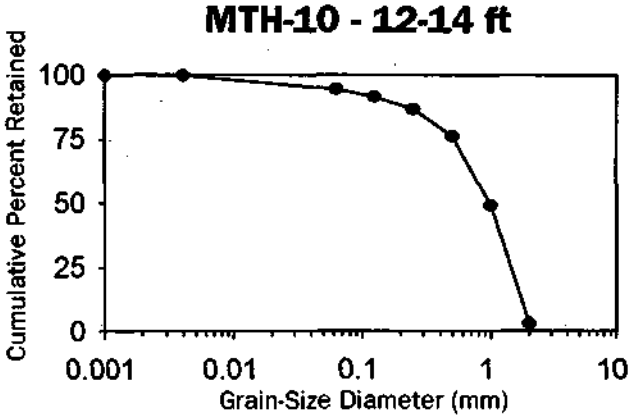

MTH-9 - 220-260 ft (1)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)


MTH-9 - 220-260 ft (2)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

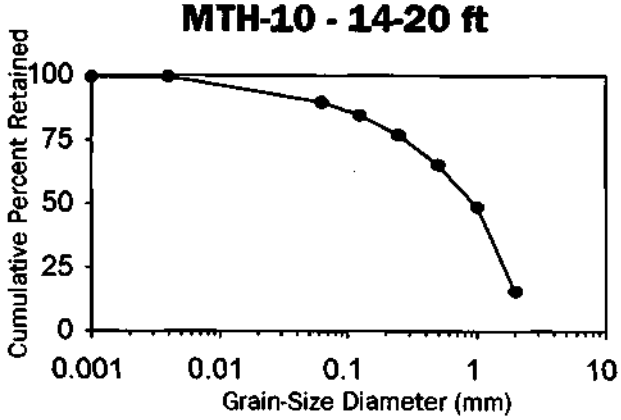

MTH-9 - 220-260 ft (3)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)


MTH-9 - 260-279 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

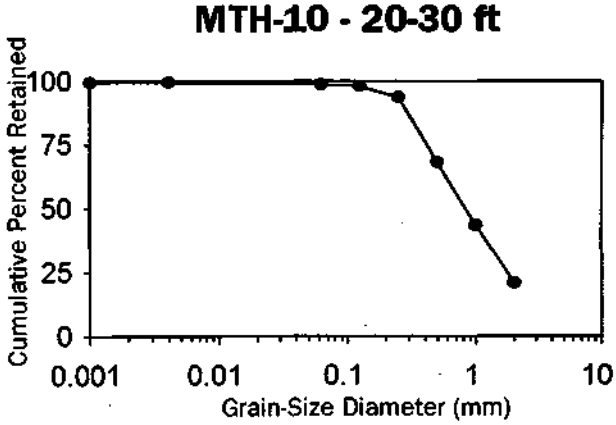
MTH-10 - 12-14 ft



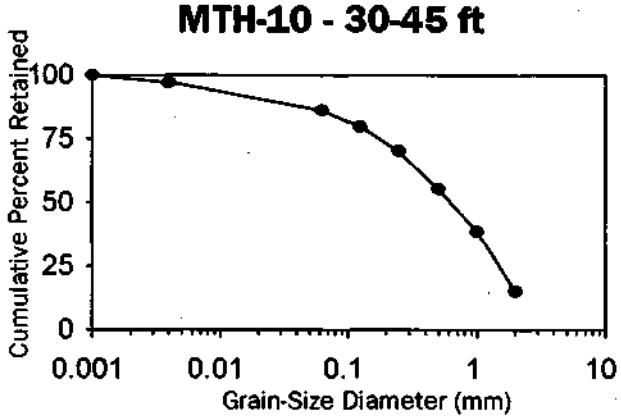
MTH-10 - 14-20 ft



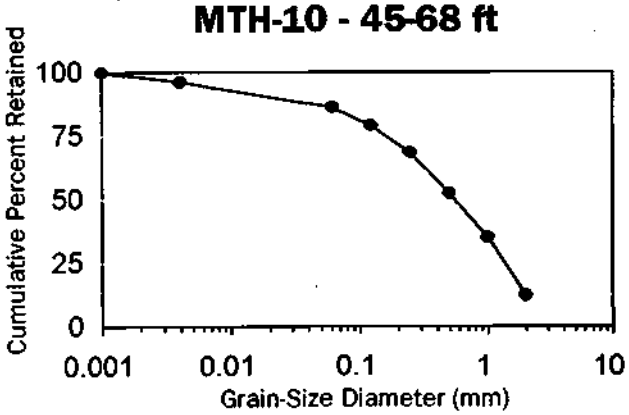
MTH-10 - 20-30 ft



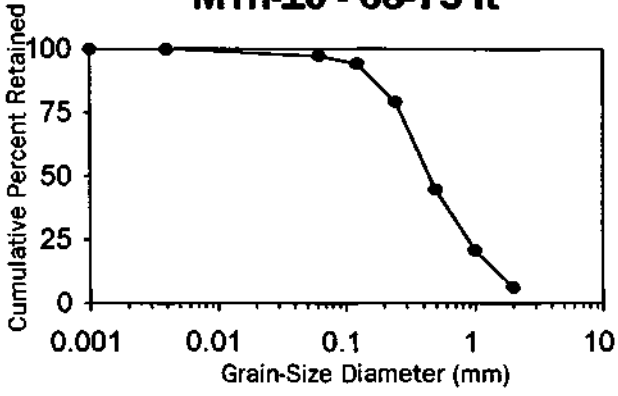
MTH-10 - 30-45 ft



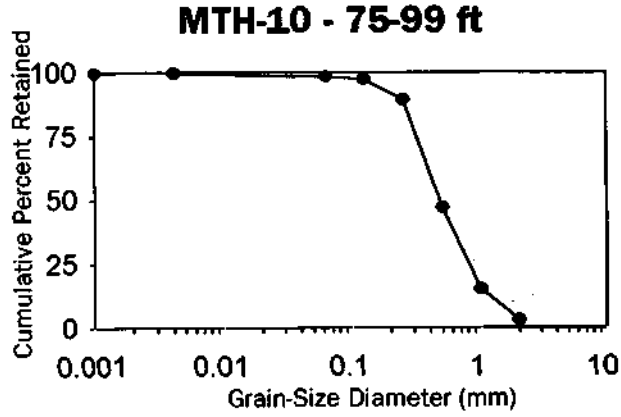
MTH-10 - 45-68 ft



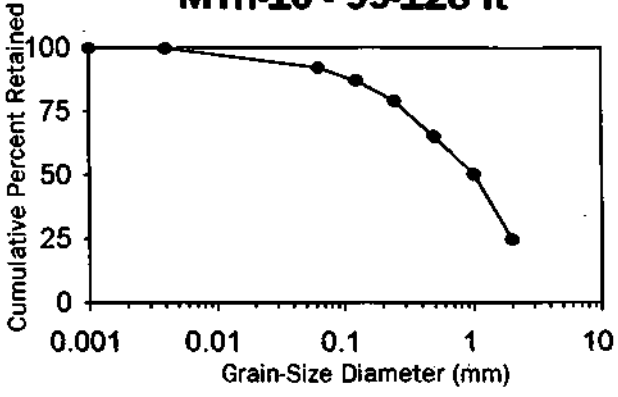
MTH-10 - 68-75 ft

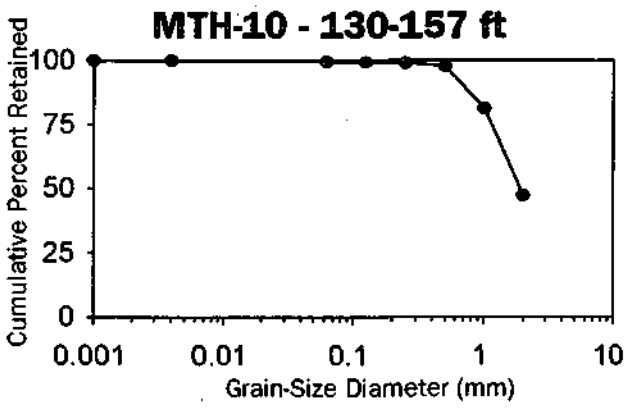


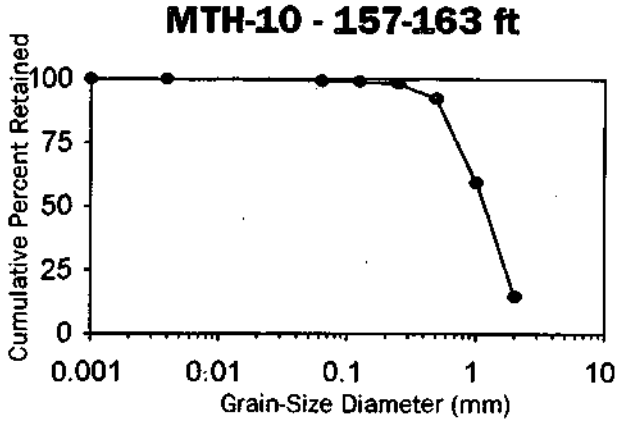
MTH-10 - 75-99 ft

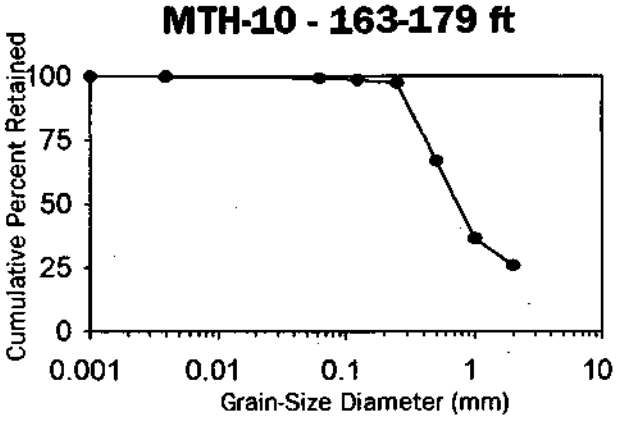


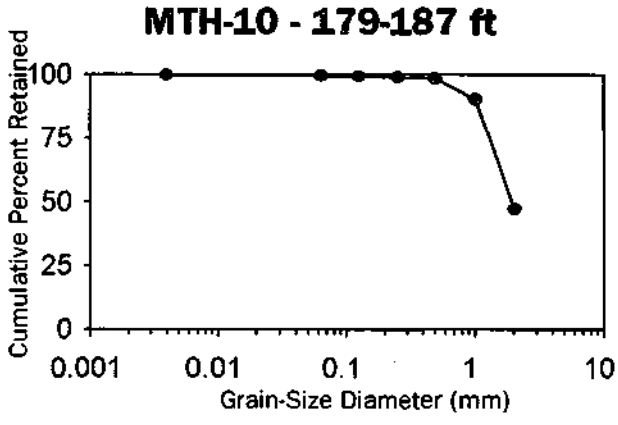
MTH-10 - 99-128 ft

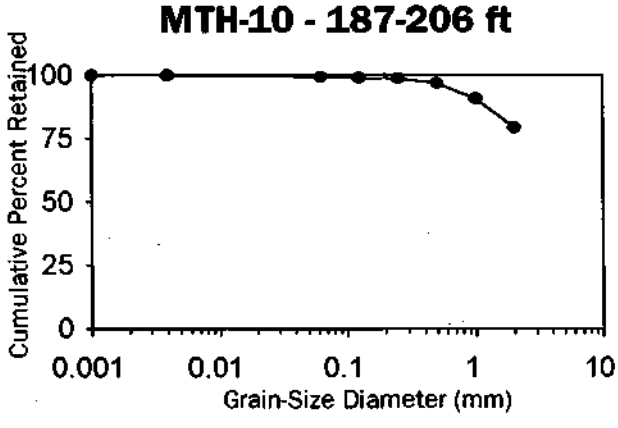


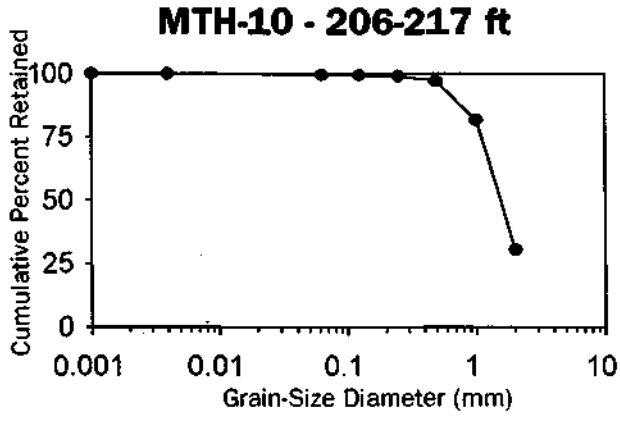

MTH-10 - 130-157 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

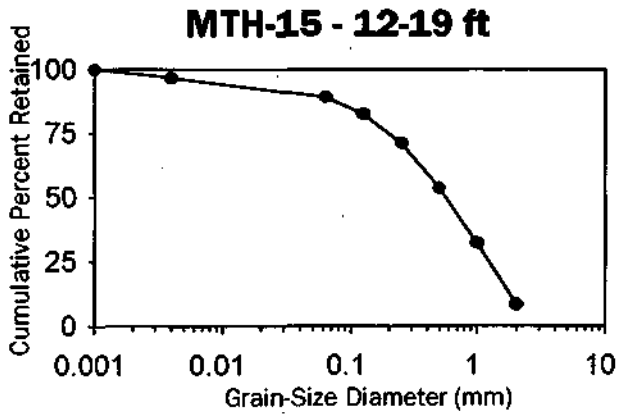

MTH-10 - 157-163 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

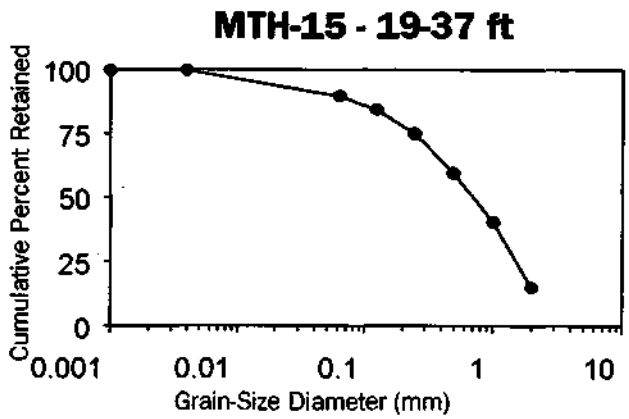

MTH-10 - 163-179 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

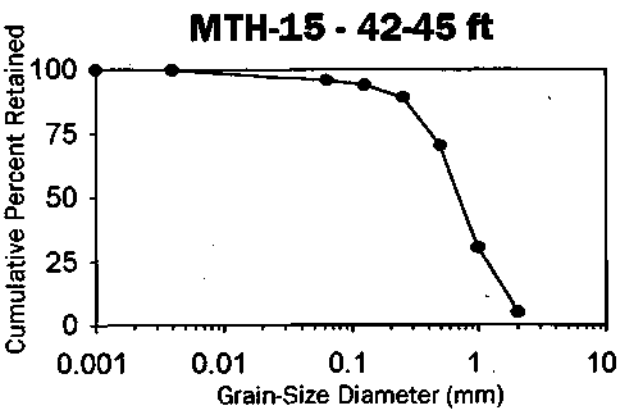

MTH-10 - 179-187 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

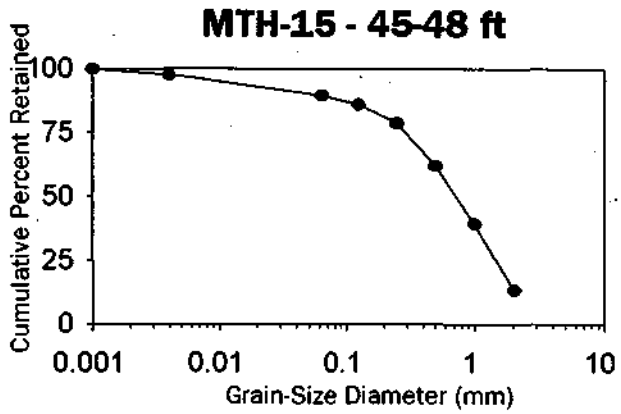

MTH-10 - 187-206 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

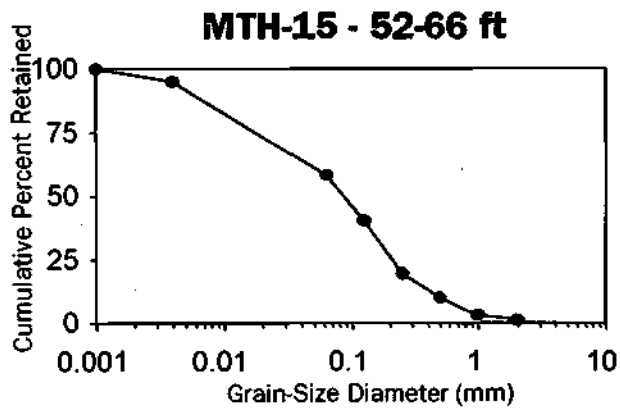

MTH-10 - 206-217 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

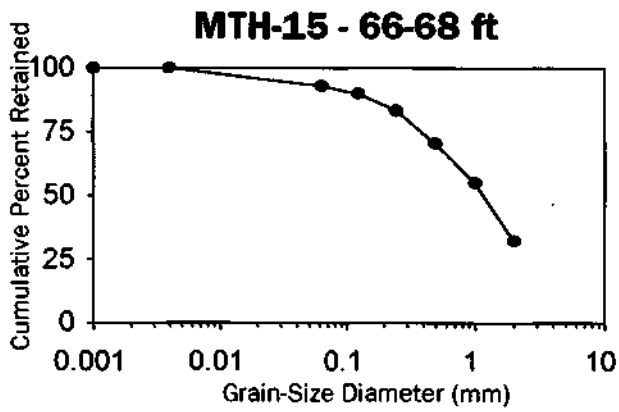

MTH-15 - 12-19 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

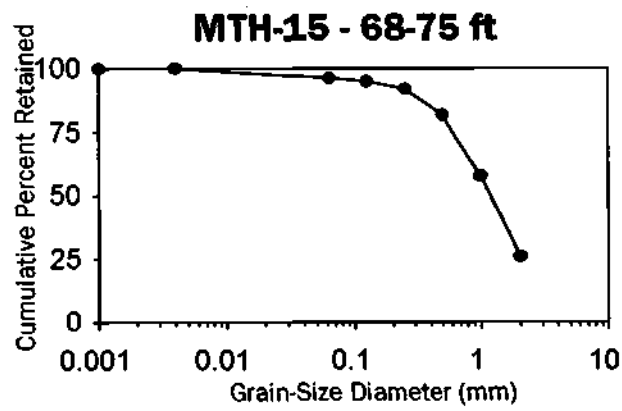

MTH-15 - 19-37 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

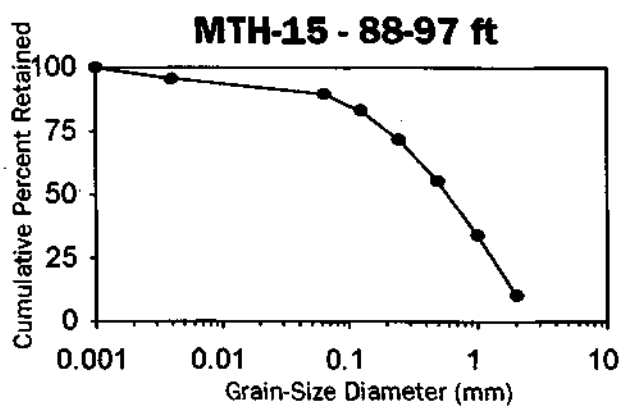

MTH-15 - 42-45 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

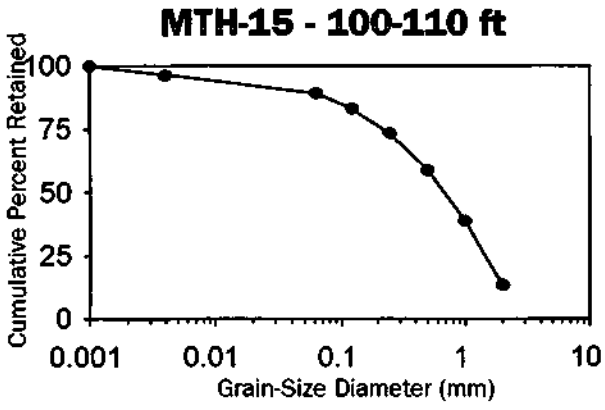

MTH-15 - 45-48 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

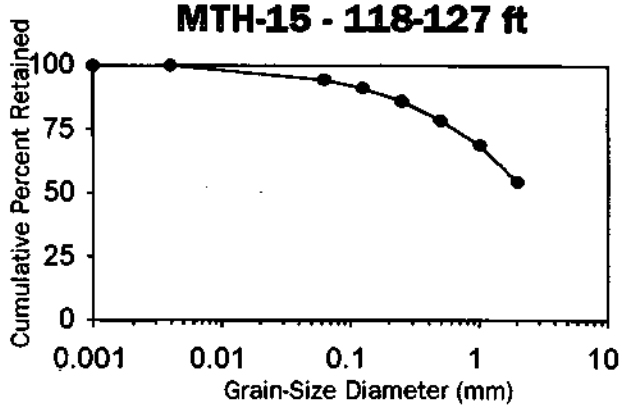

MTH-15 - 52-66 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

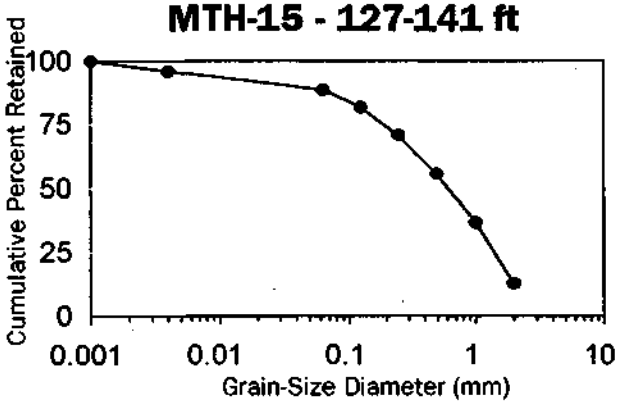

MTH-15 - 66-68 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

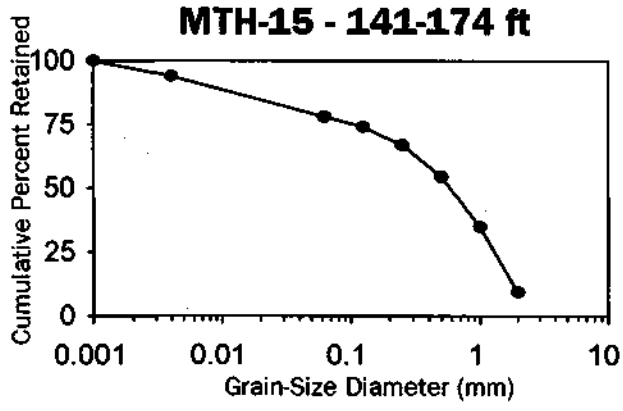

MTH-15 - 68-75 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

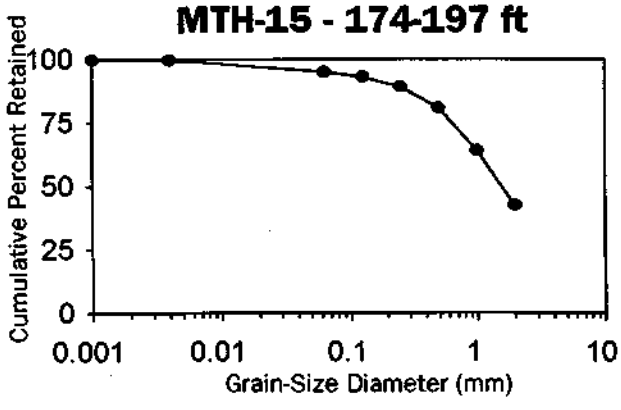

MTH-15 - 88-97 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

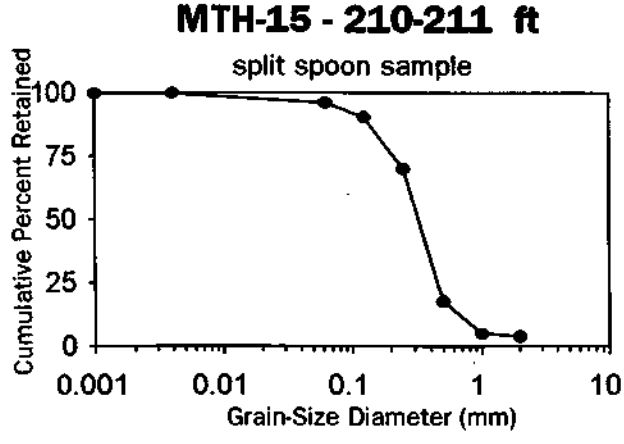

MTH-15 - 100-110 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

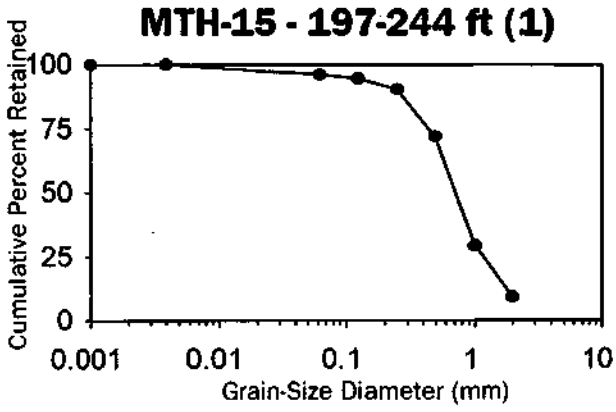

MTH-15 - 118-127 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

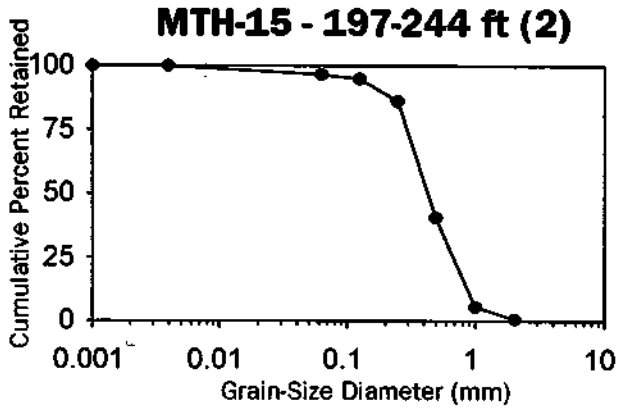

MTH-15 - 127-141 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

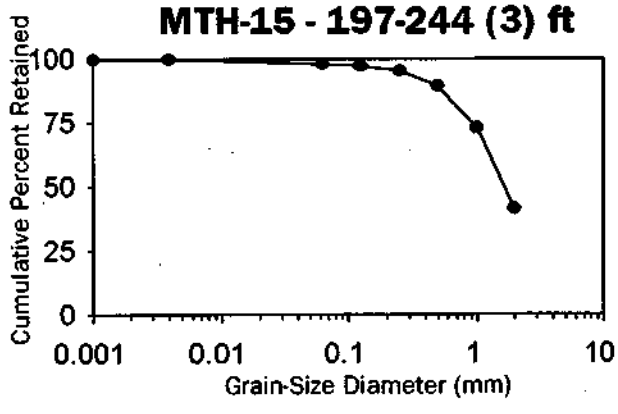

MTH-15 - 141-174 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

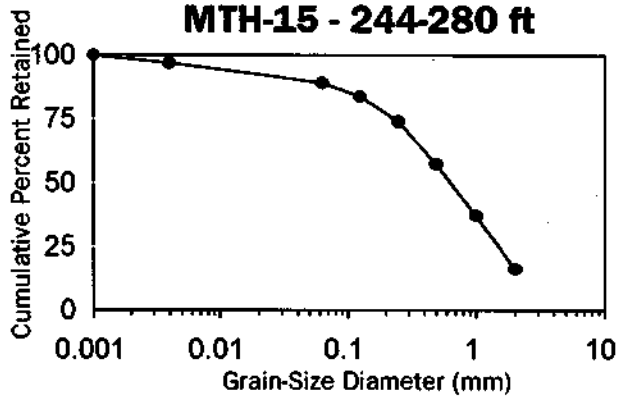

MTH-15 - 174-197 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

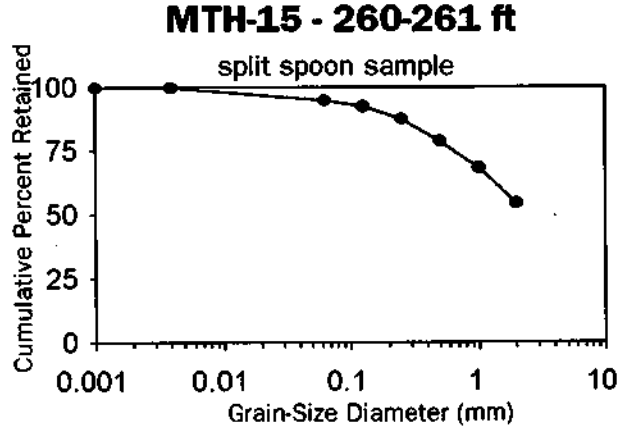

MTH-15 - 210-211 ft
split spoon sample
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

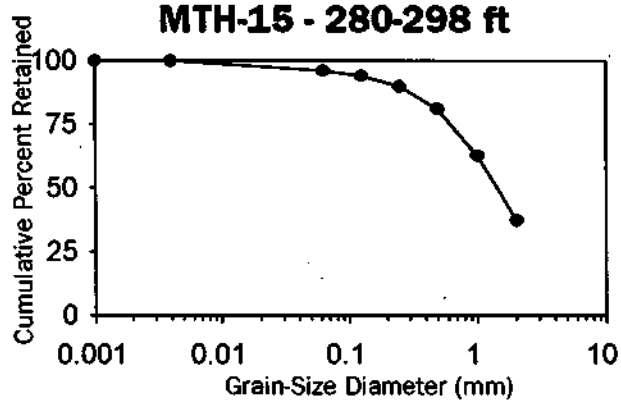

MTH-15 - 197-244 ft (1)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

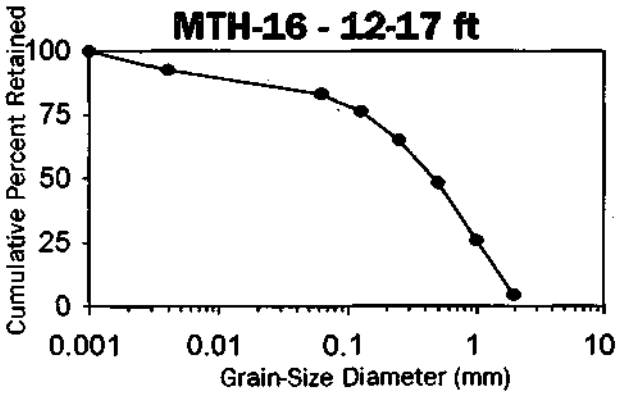

MTH-15 - 197-244 ft (2)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

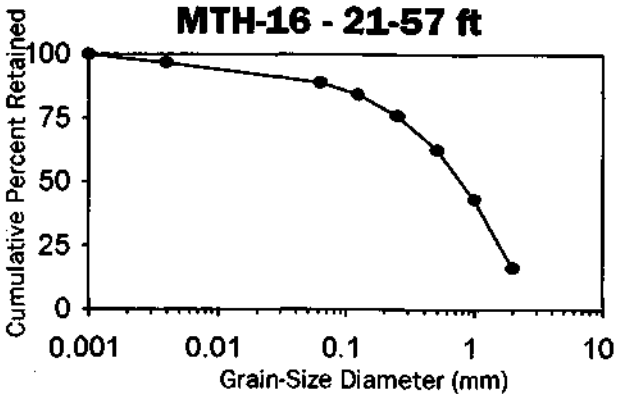

MTH-15 - 197-244 (3) ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

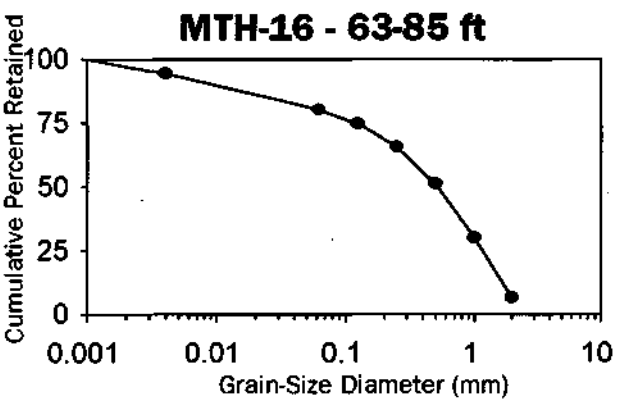

MTH-15 - 244-280 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

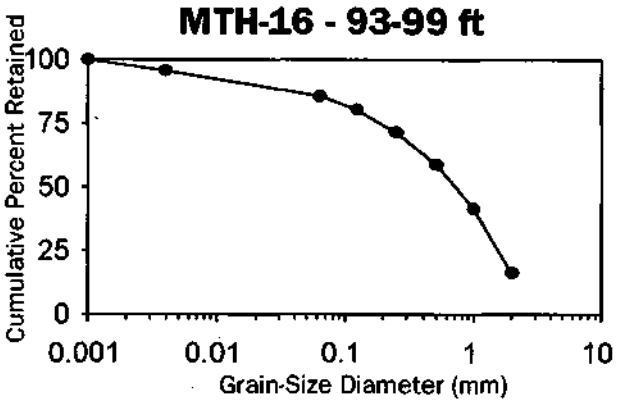

MTH-15 - 260-261 ft
split spoon sample
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

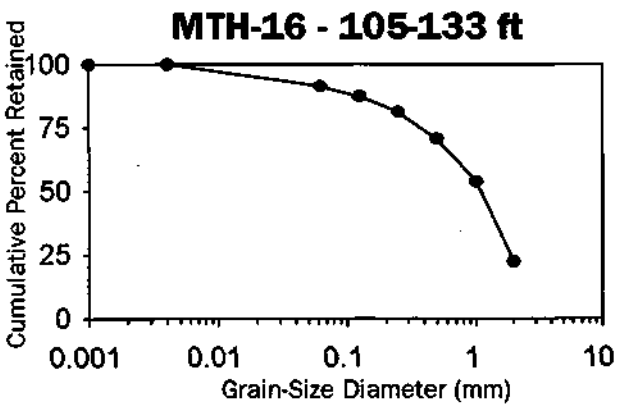

MTH-15 - 280-298 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

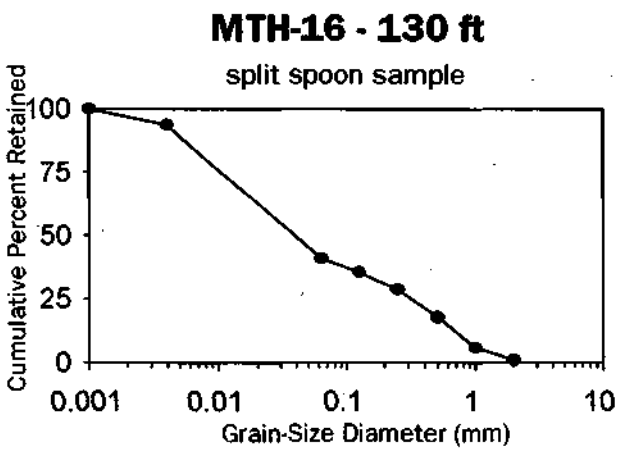

MTH-16 - 12-17 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

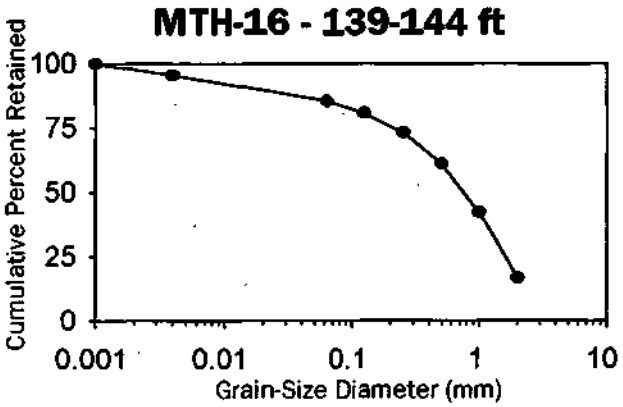

MTH-16 - 21-57 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

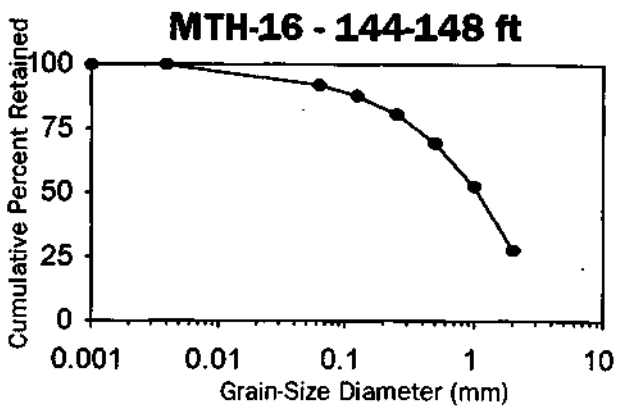

MTH-16 - 63-85 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

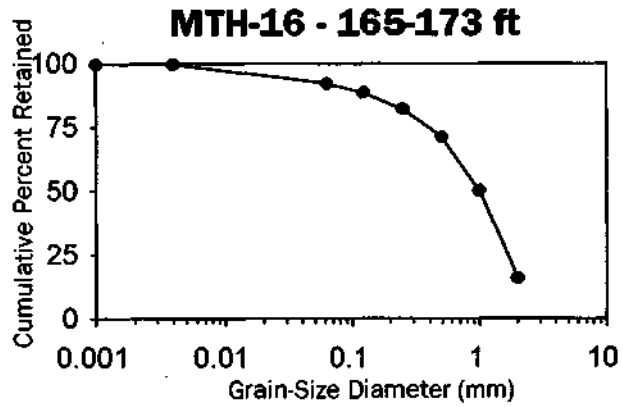

MTH-16 - 93-99 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

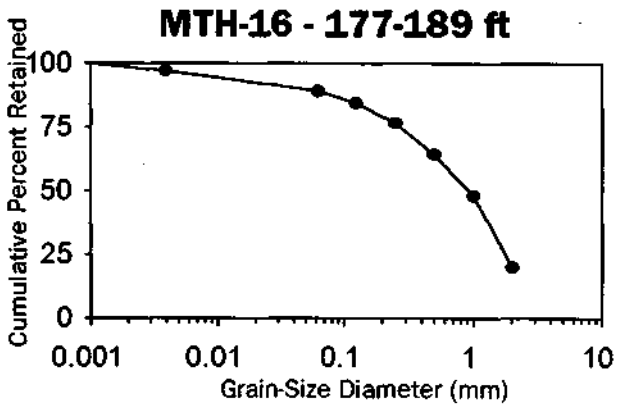

MTH-16 - 105-133 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

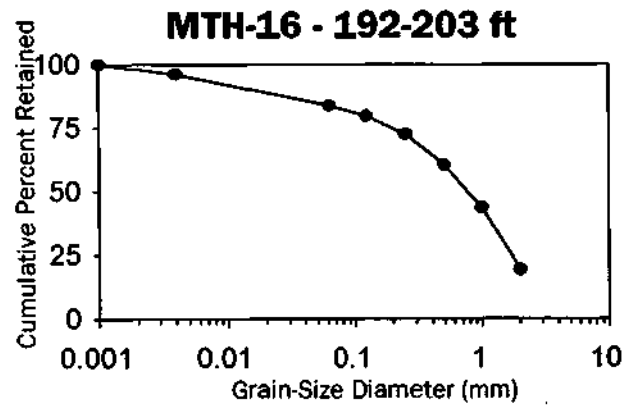

MTH-16 - 130 ft
split spoon sample
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

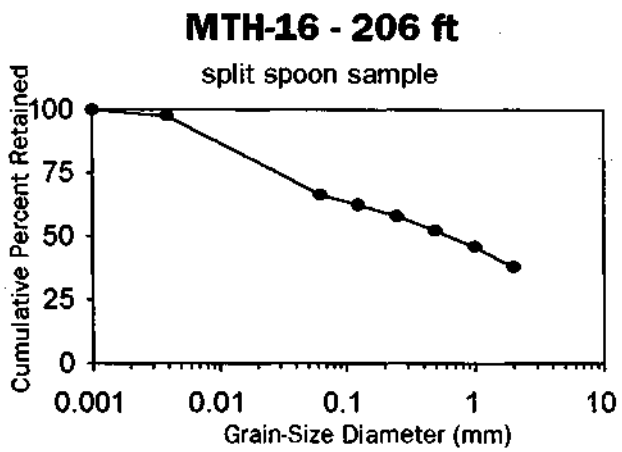

MTH-16 - 139-144 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

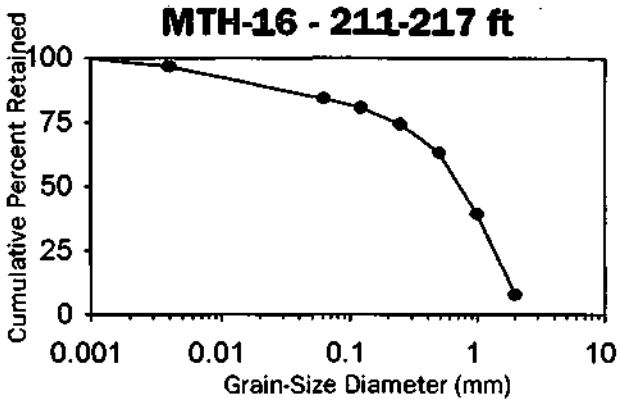

MTH-16 - 144-148 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

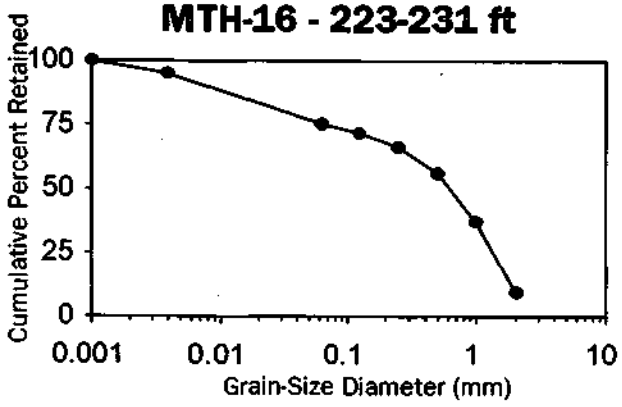

MTH-16 - 165-173 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

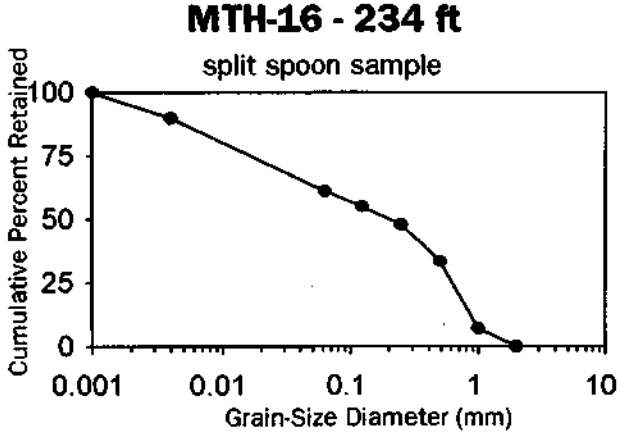

MTH-16 - 177-189 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

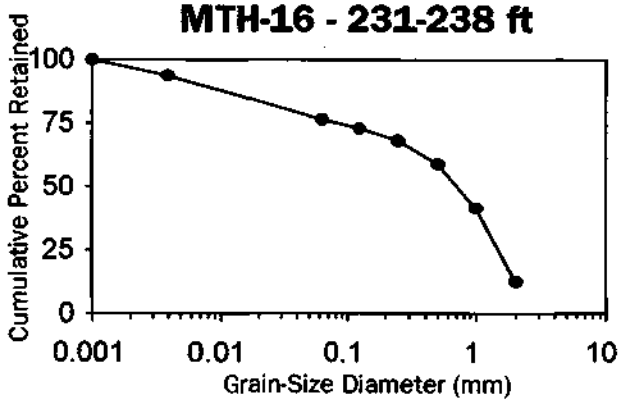

MTH-16 - 192-203 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

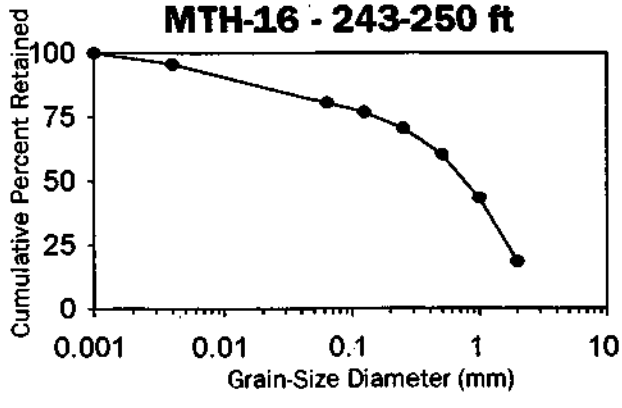

MTH-16 - 206 ft
split spoon sample
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

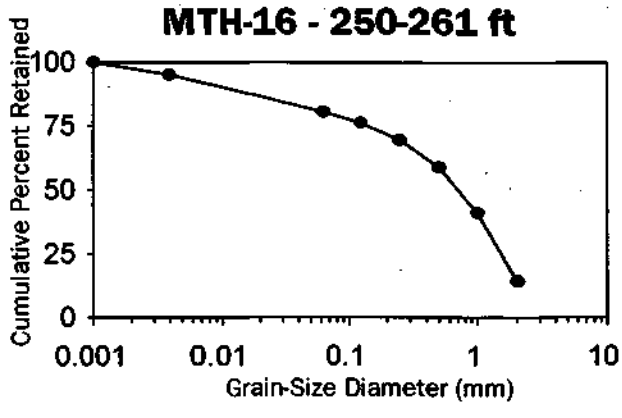

MTH-16 - 211-217 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

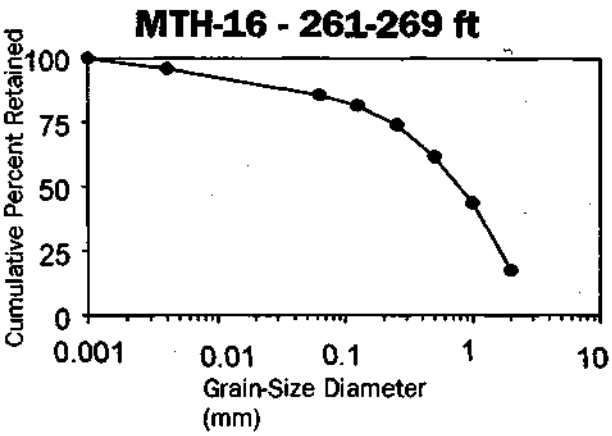

MTH-16 - 223-231 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

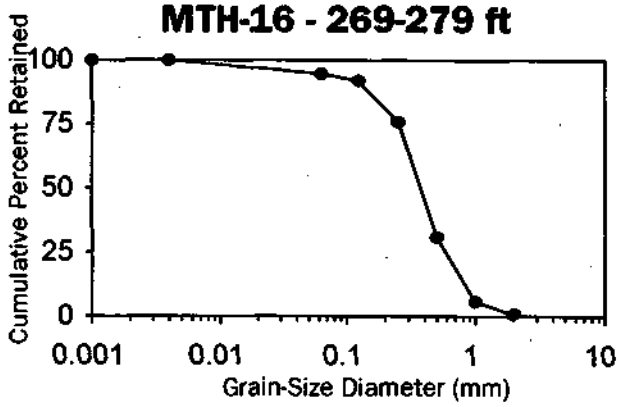

MTH-16 - 234 ft
split spoon sample
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

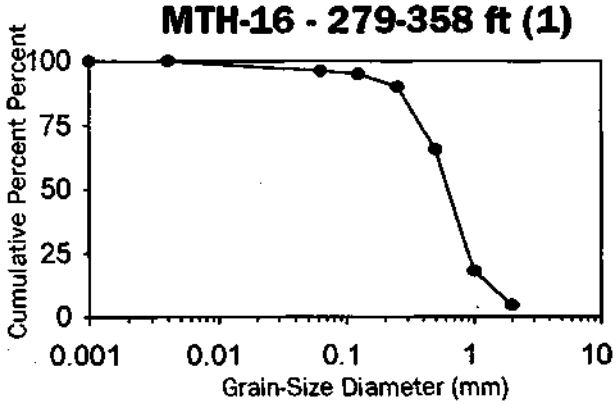

MTH-16 - 231-238 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

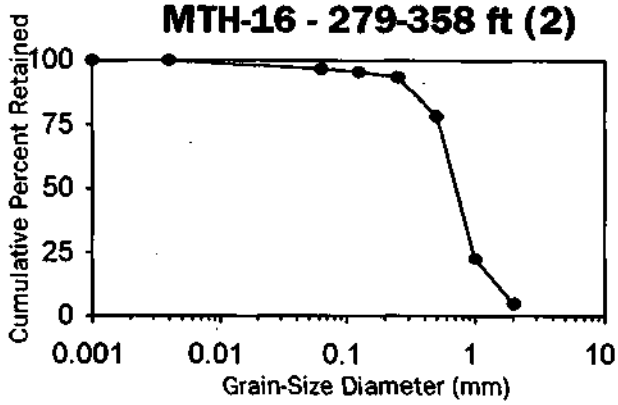

MTH-16 - 243-250 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

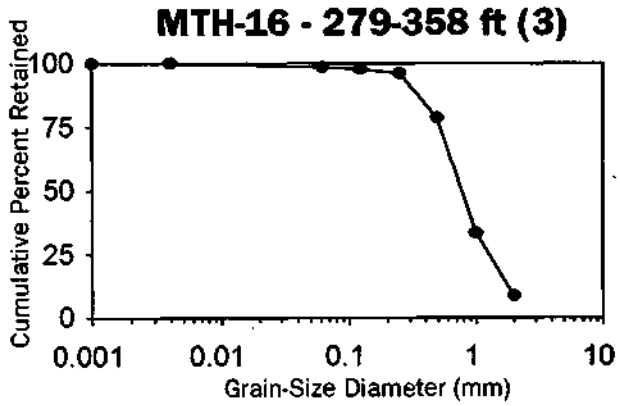

MTH-16 - 250-261 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

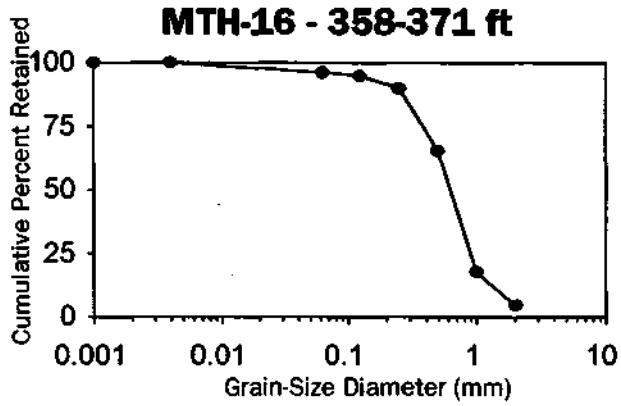

MTH-16 - 261-269 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

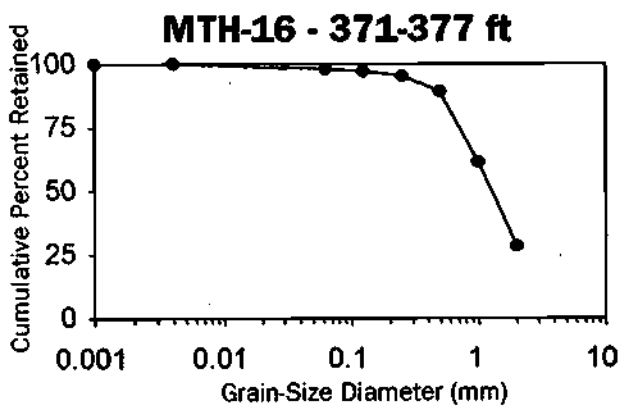

MTH-16 - 269-279 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

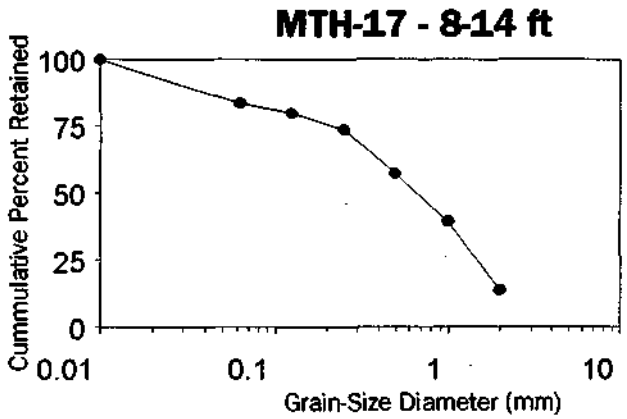

MTH-16 - 279-358 ft (1)
Cumulative Percent Percent
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

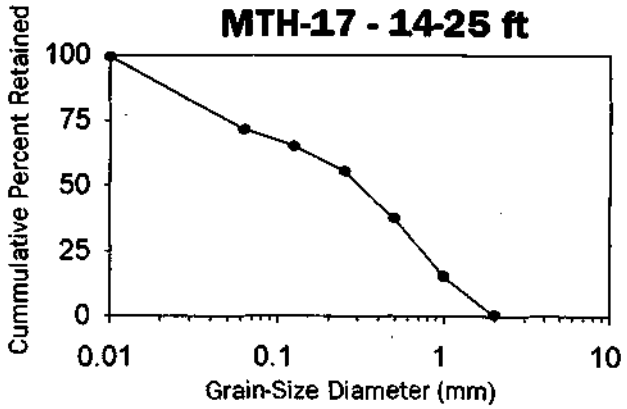

MTH-16 - 279-358 ft (2)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

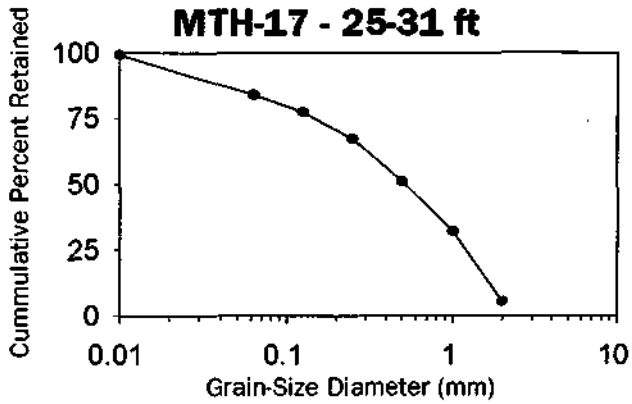

MTH-16 - 279-358 ft (3)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

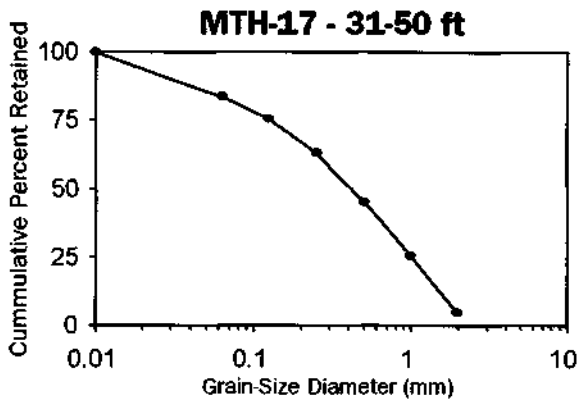

MTH-16 - 358-371 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

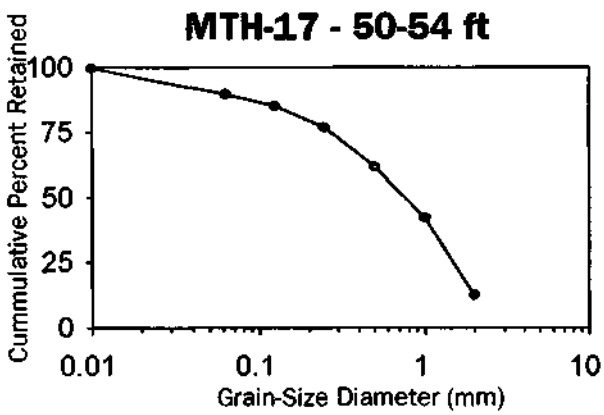

MTH-16 - 371-377 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

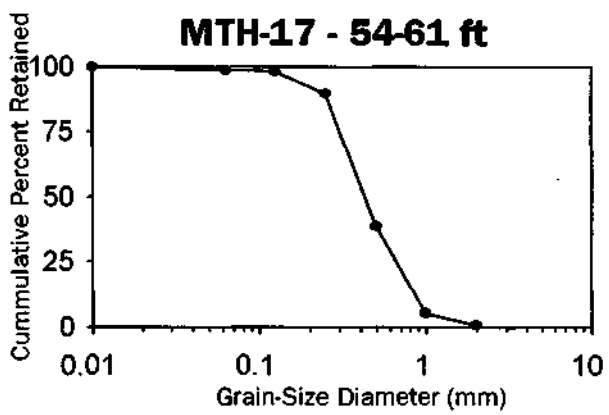

MTH-17 - 8-14 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

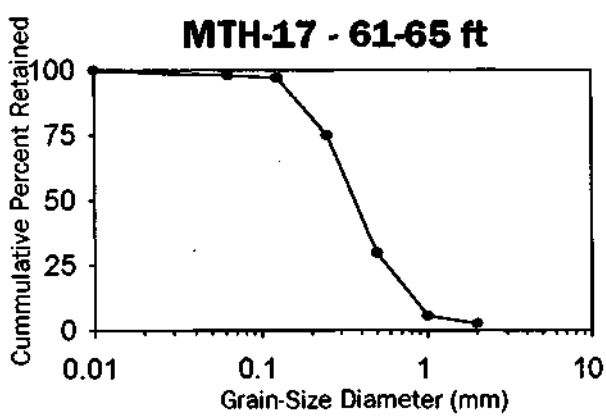

MTH-17 - 14-25 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

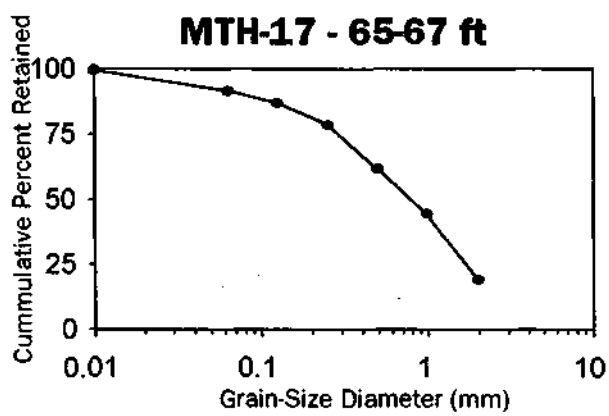

MTH-17 - 25-31 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

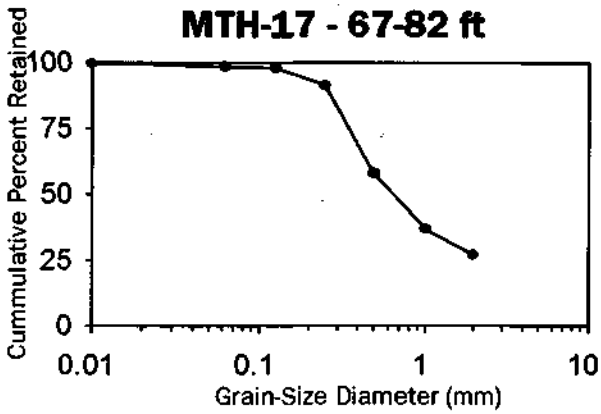

MTH-17 - 31-50 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

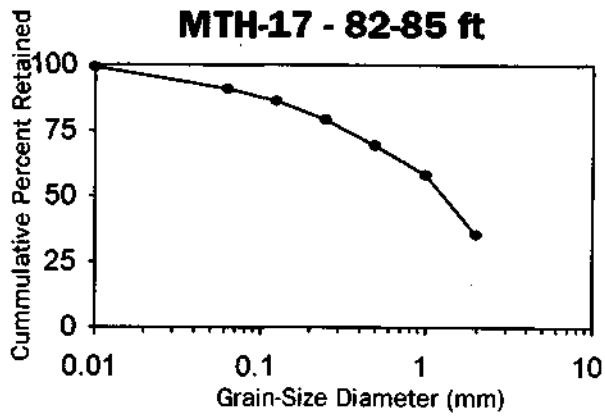

MTH-17 - 50-54 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

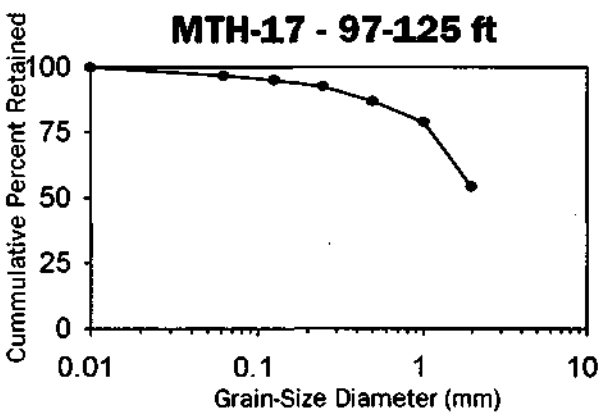

MTH-17 - 54-61 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

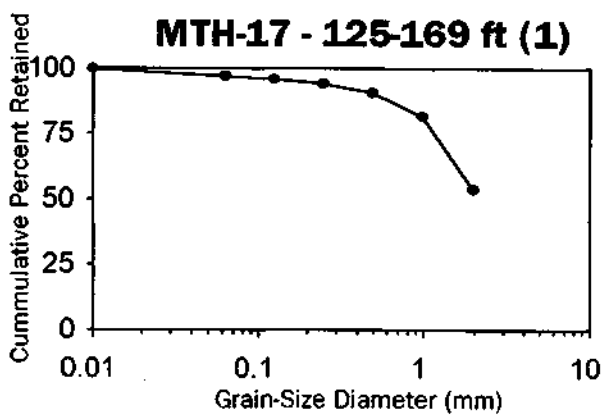

MTH-17 - 61-65 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

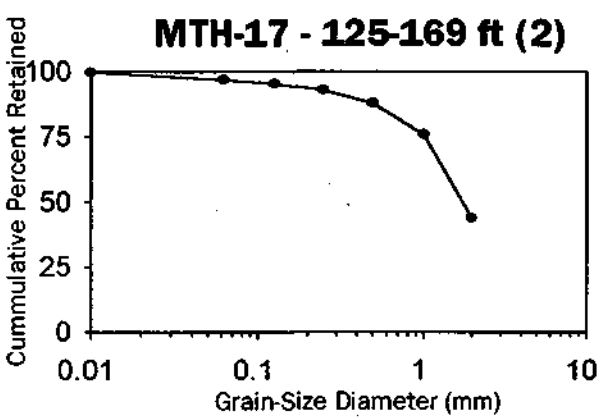

MTH-17 - 65-67 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

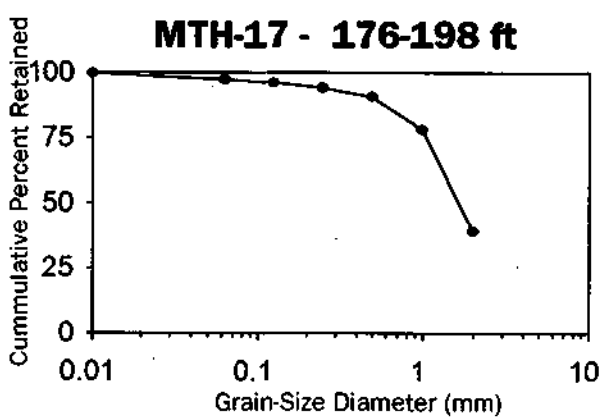

MTH-17 - 67-82 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

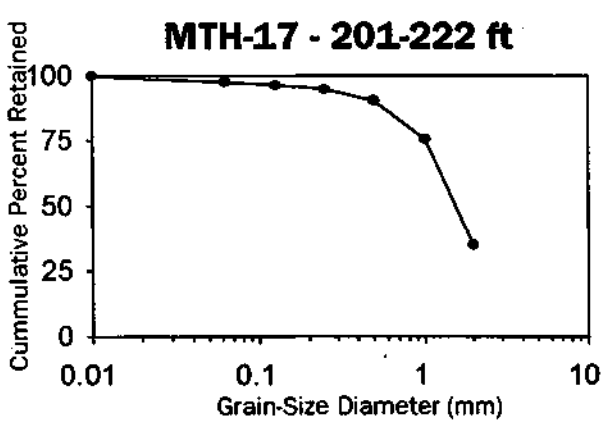

MTH-17 - 82-85 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)


MTH-17 - 97-125 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

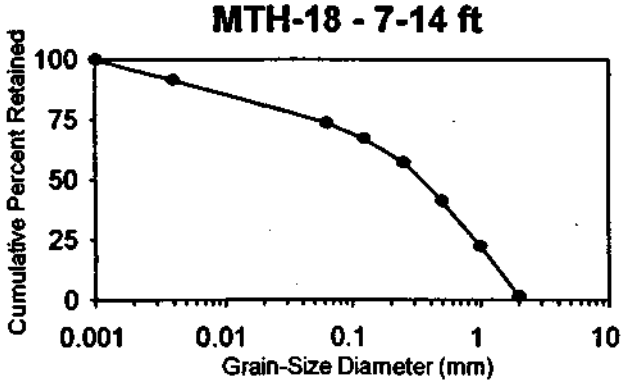

MTH-17 - 125-169 ft (1)
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)


MTH-17 - 125-169 ft (2)
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

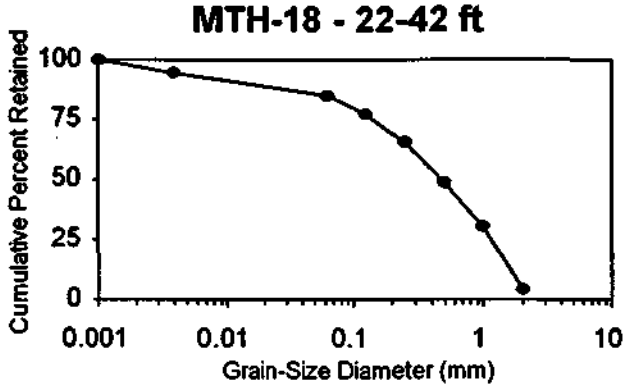

MTH-17 - 176-198 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)


MTH-17 - 201-222 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

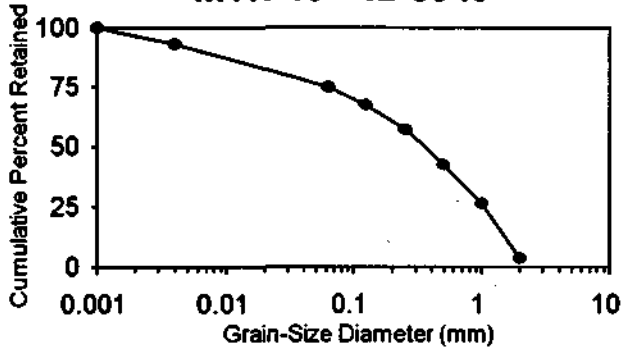
MTH-18 - 7-14 ft



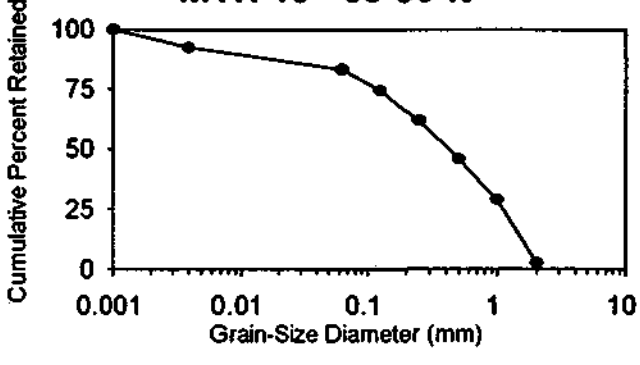
MTH-18 - 22-42 ft



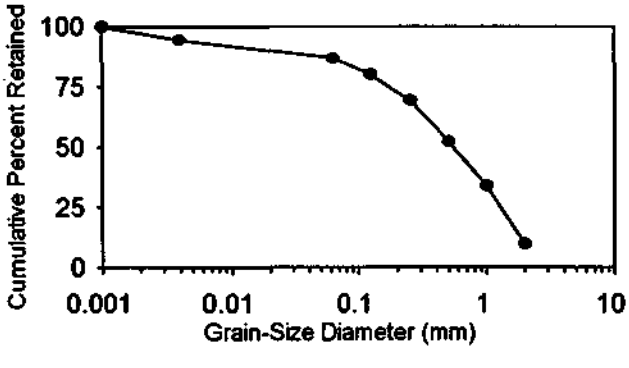
MTH-18 - 42-55 ft



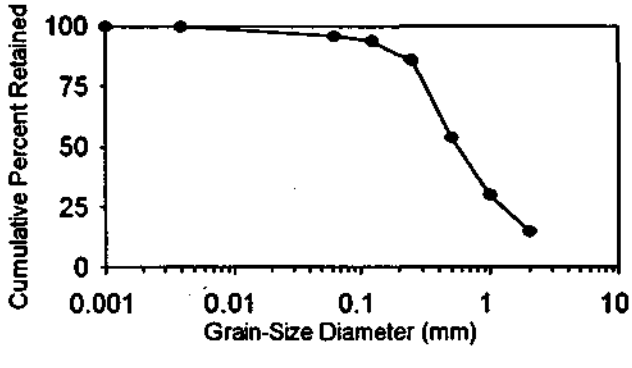
MTH-18 - 55-59 ft



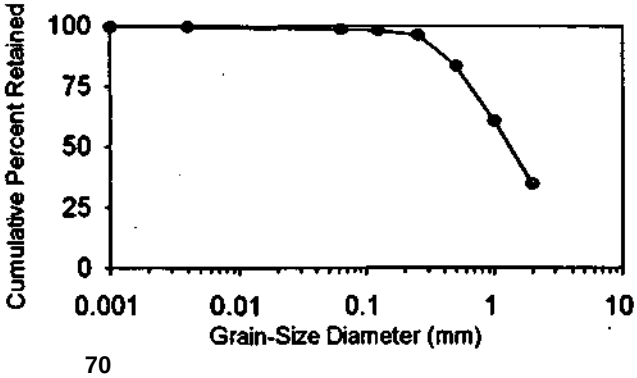
MTH-18 - 59-65 ft



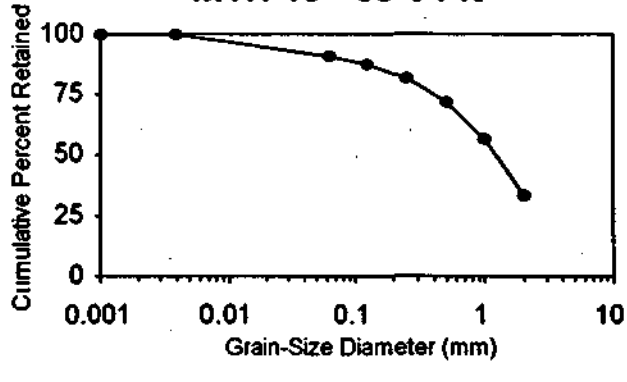
MTH-18 - 65-70 ft

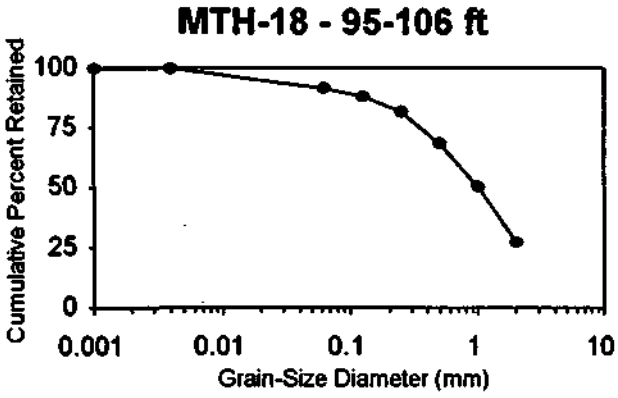


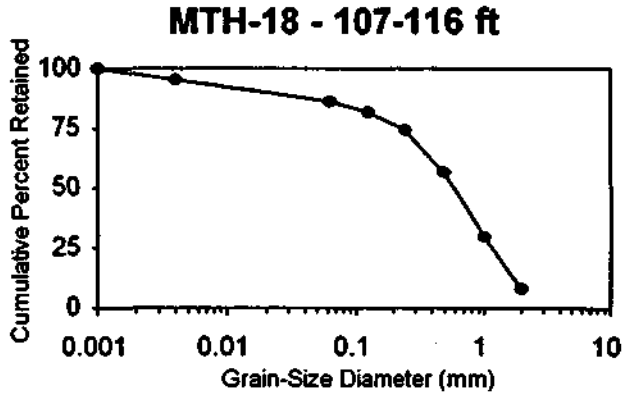
MTH-18 - 70-77 ft

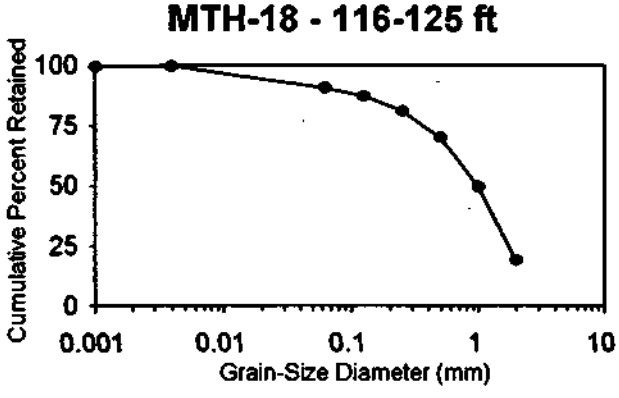


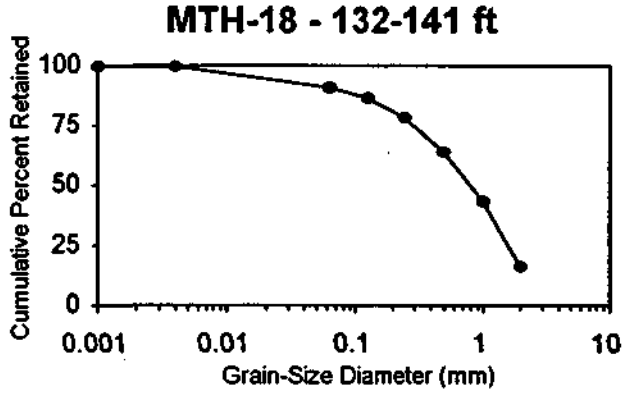
MTH-18 - 85-94 ft

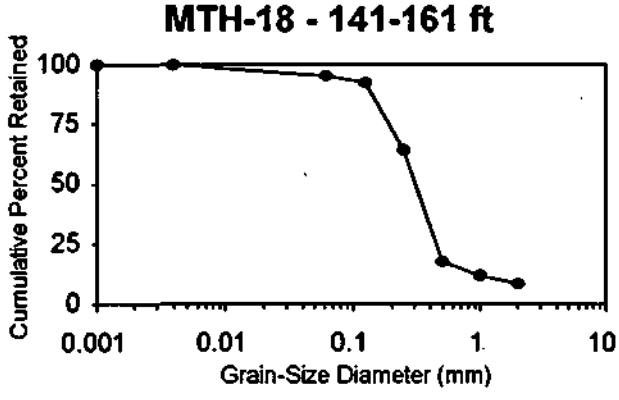


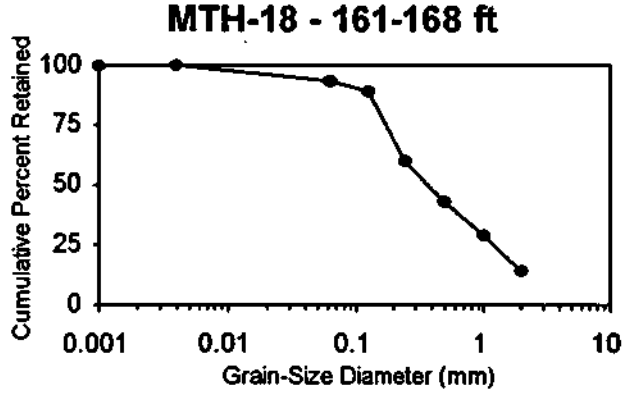

MTH-18 - 95-106 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

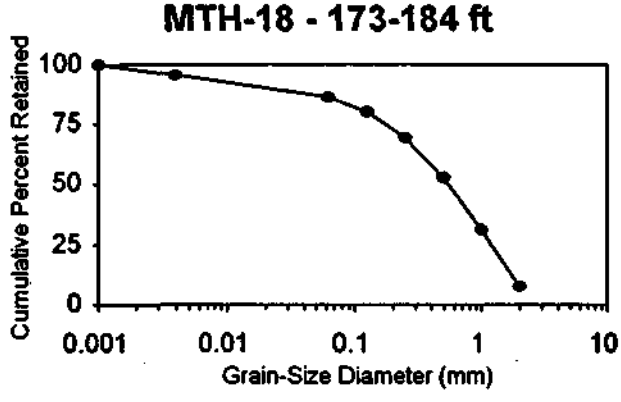

MTH-18 - 107-116 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

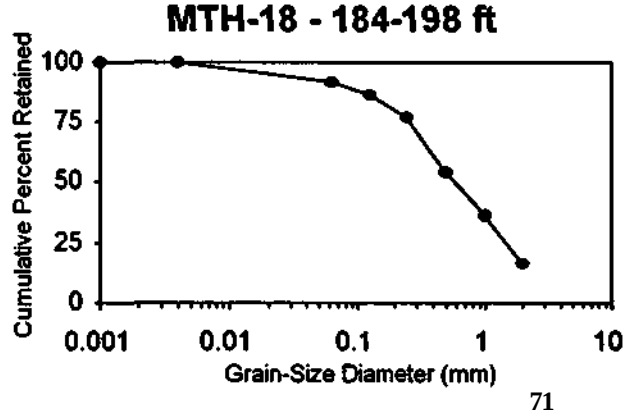

MTH-18 - 116-125 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

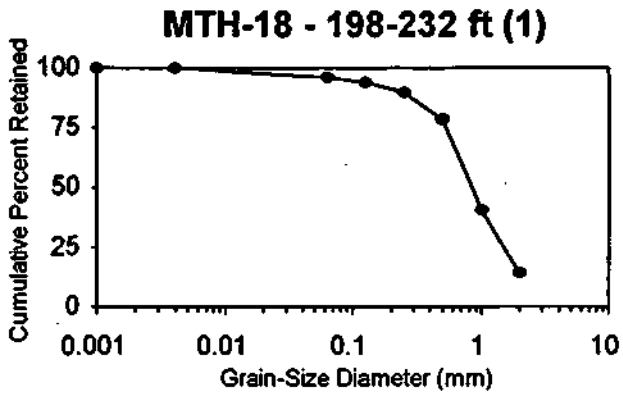

MTH-18 - 132-141 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

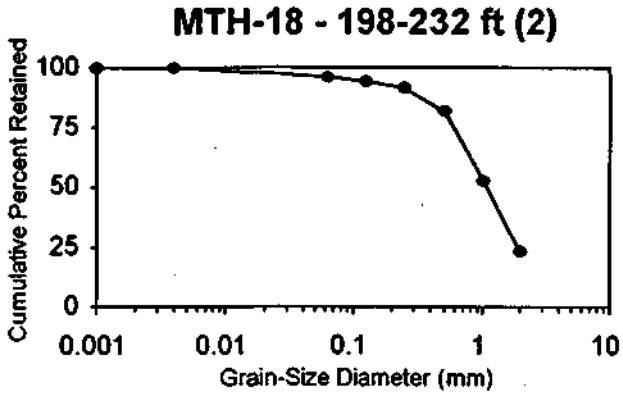

MTH-18 - 141-161 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

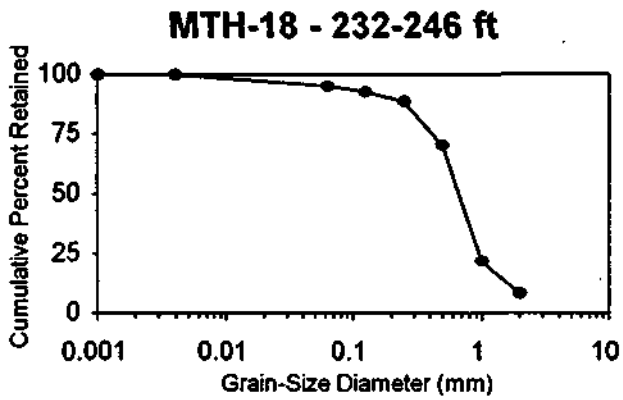

MTH-18 - 161-168 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

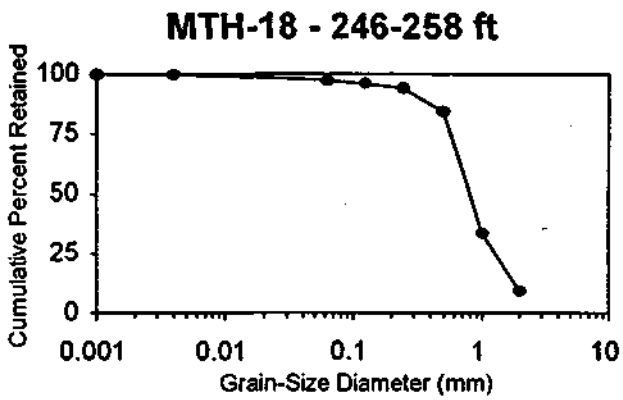

MTH-18 - 173-184 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

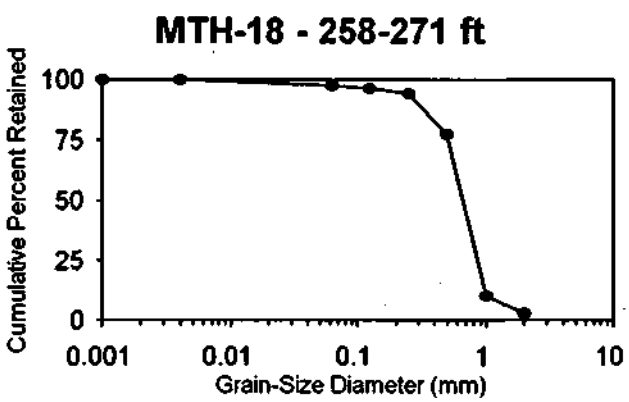

MTH-18 - 184-198 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

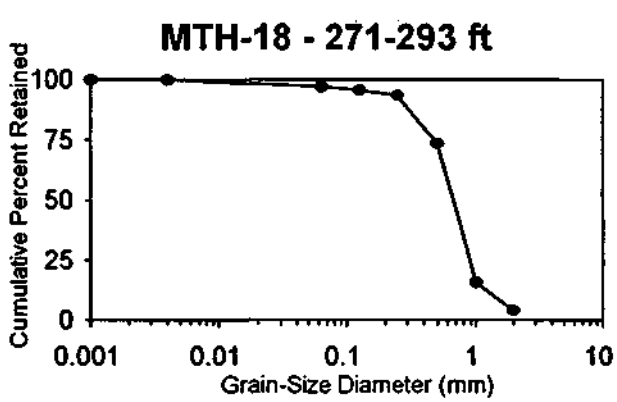

MTH-18 - 198-232 ft (1)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

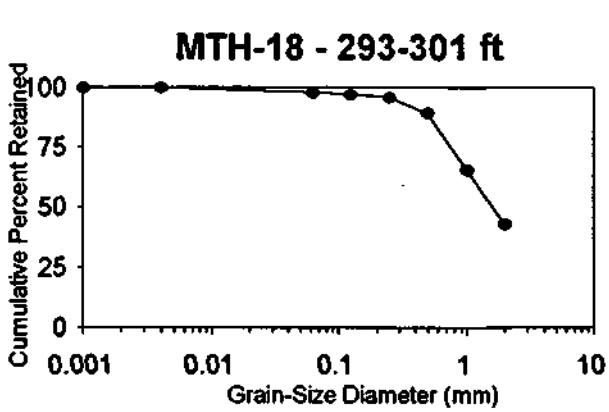

MTH-18 - 198-232 ft (2)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

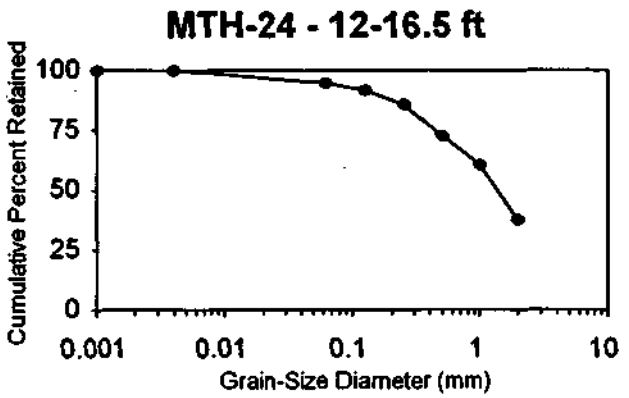

MTH-18 - 232-246 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

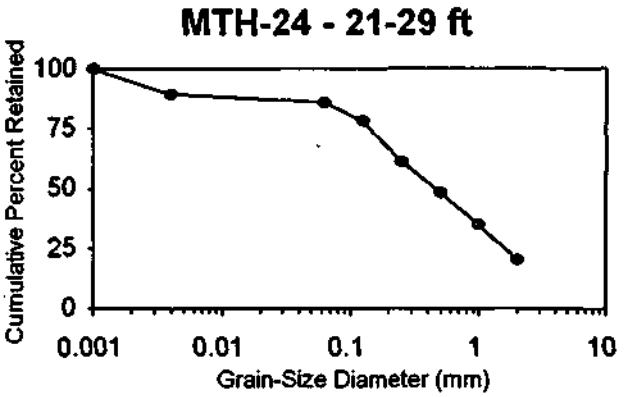

MTH-18 - 246-258 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

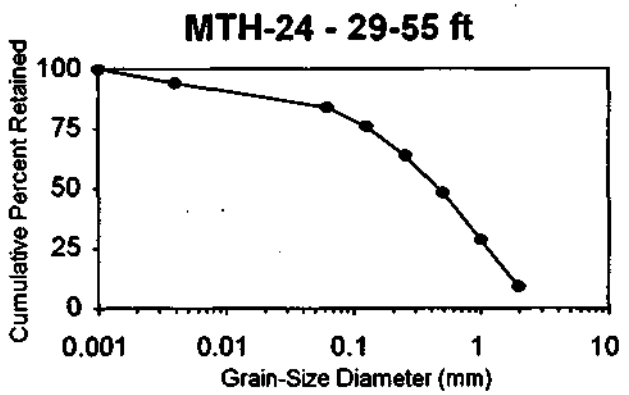

MTH-18 - 258-271 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

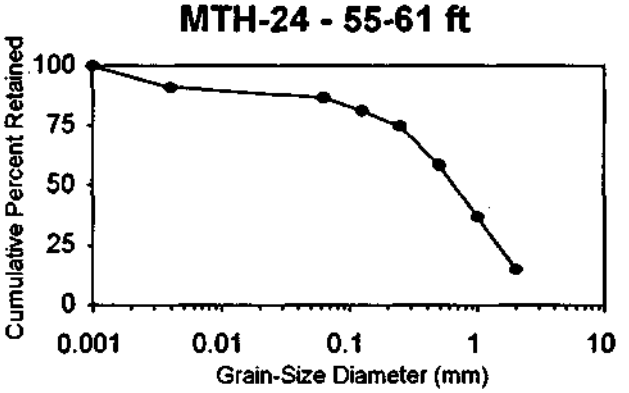

MTH-18 - 271-293 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

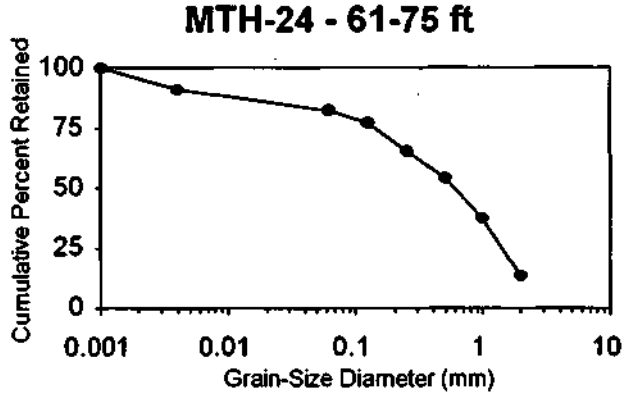

MTH-18 - 293-301 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

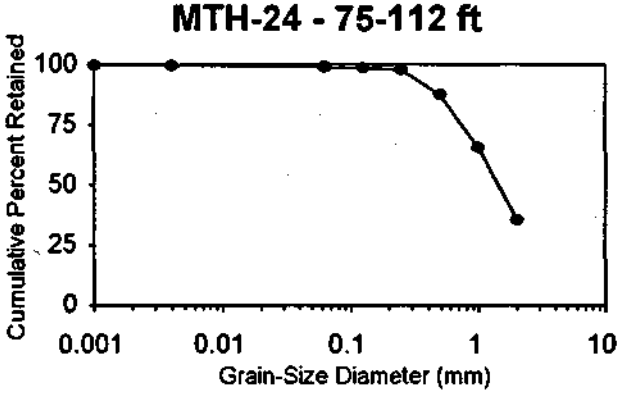

MTH-24 - 12-16.5 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

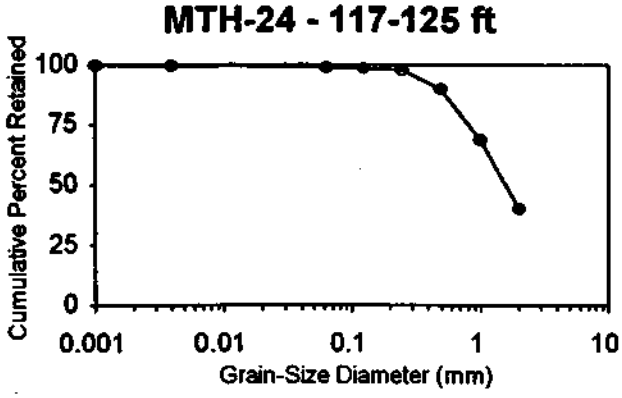

MTH-24 - 21-29 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

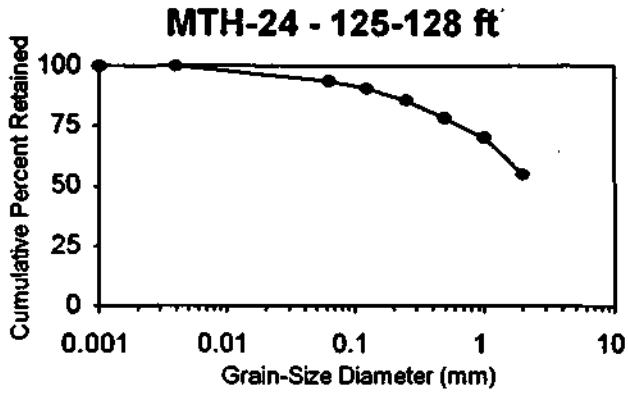

MTH-24 - 29-55 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

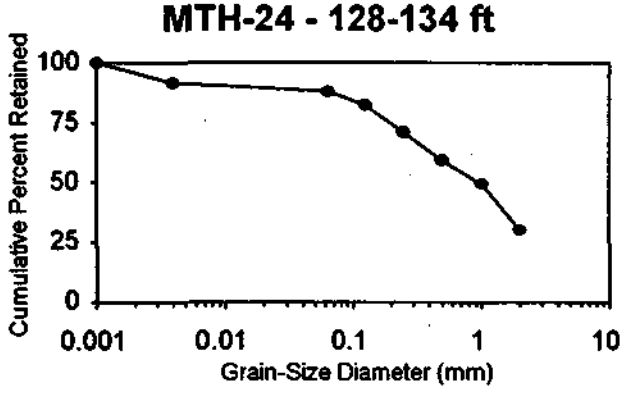

MTH-24 - 55-61 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

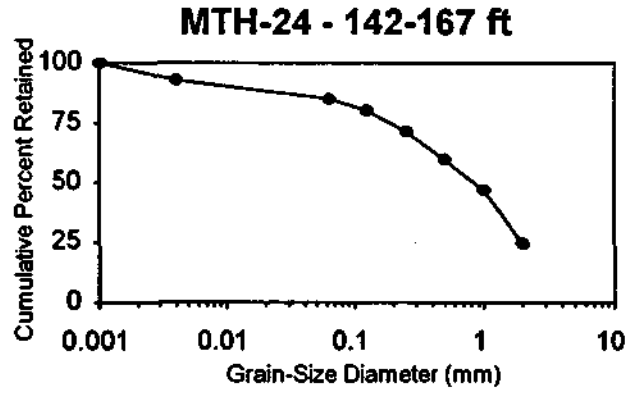

MTH-24 - 61-75 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

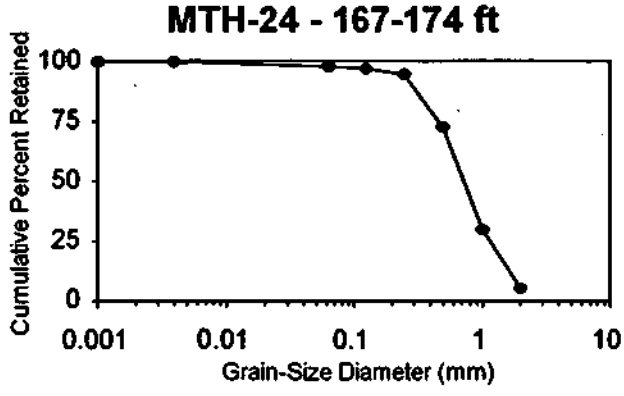

MTH-24 - 75-112 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

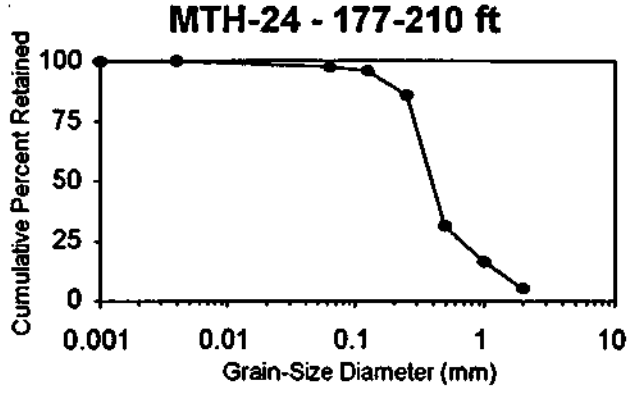

MTH-24 - 117-125 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

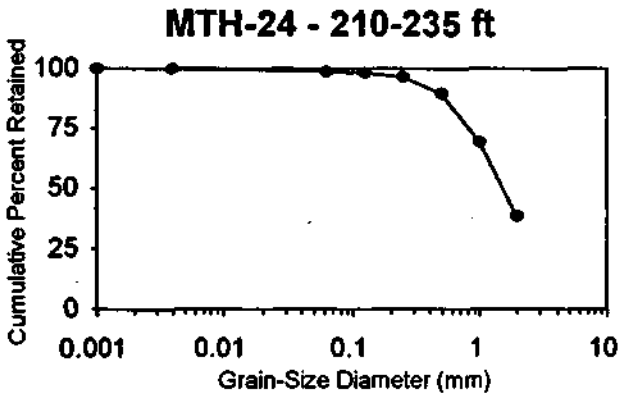

MTH-24 - 125-128 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

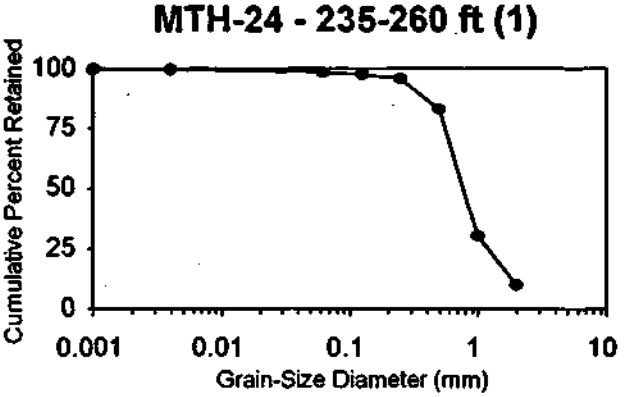

MTH-24 - 128-134 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

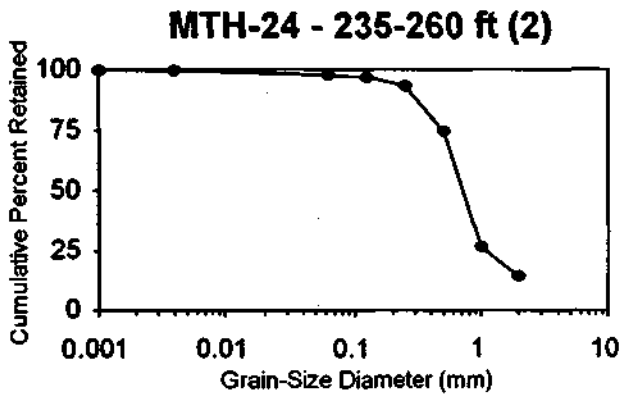

MTH-24 - 142-167 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

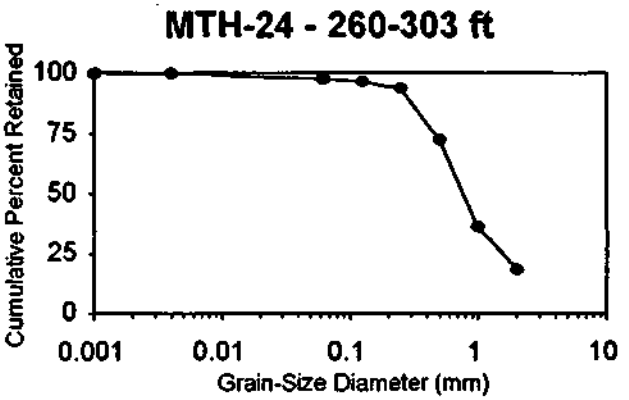

MTH-24 - 167-174 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

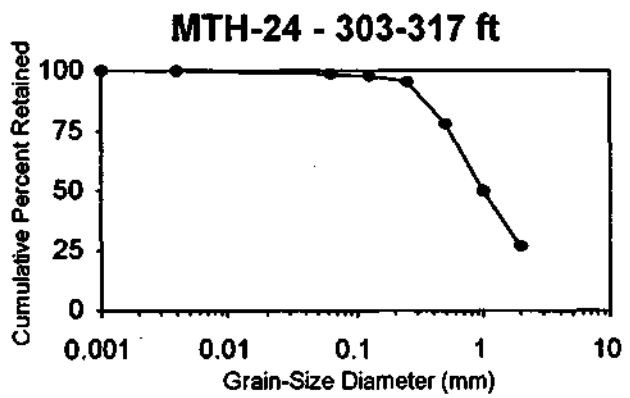

MTH-24 - 177-210 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

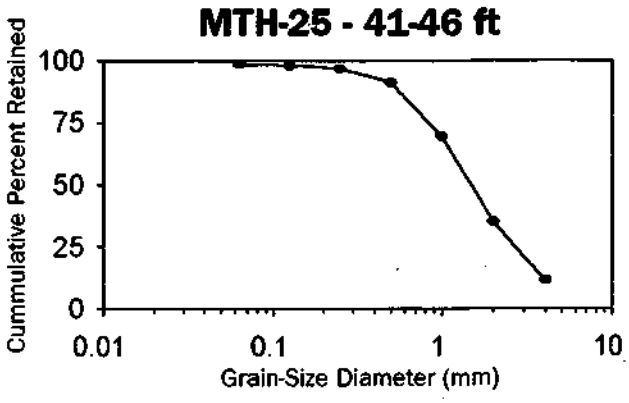

MTH-24 - 210-235 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

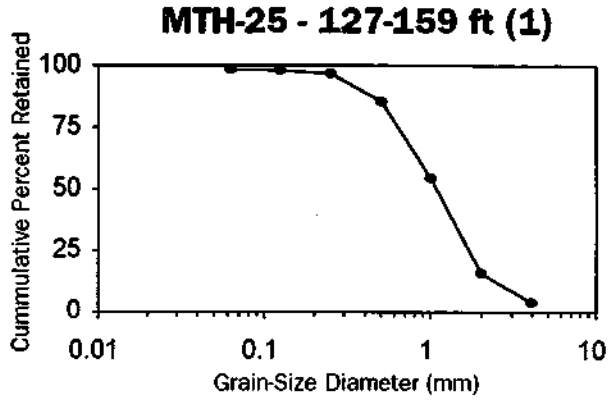

MTH-24 - 235-260 ft (1)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

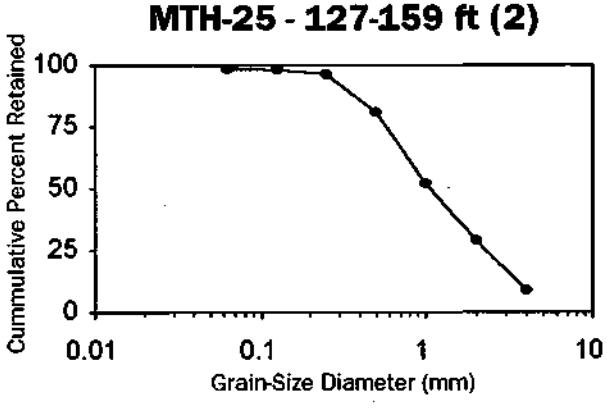

MTH-24 - 235-260 ft (2)
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

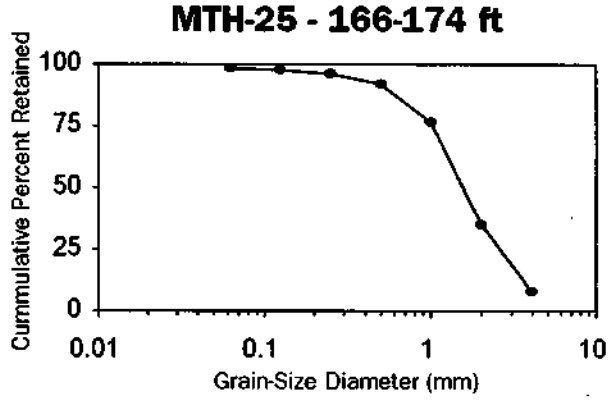

MTH-24 - 260-303 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

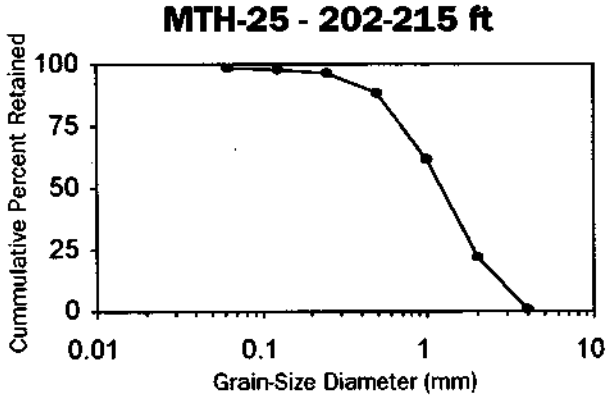

MTH-24 - 303-317 ft
Cumulative Percent Retained
100
75
50
25
0
0.001
0.01
0.1
1
10
Grain-Size Diameter (mm)

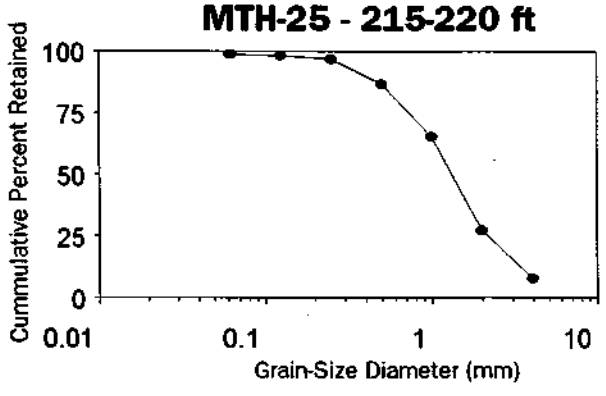

MTH-25 - 41-46 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

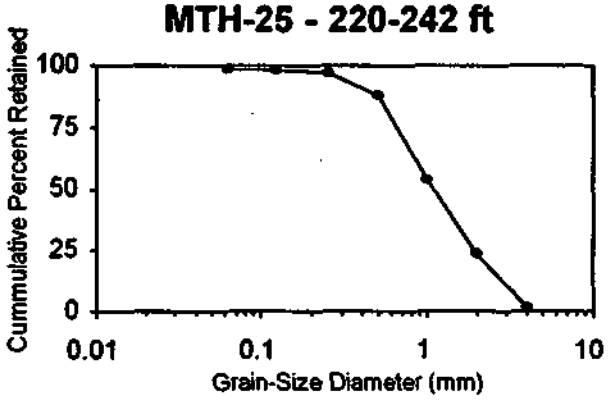

MTH-25 - 127-159 ft (1)
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

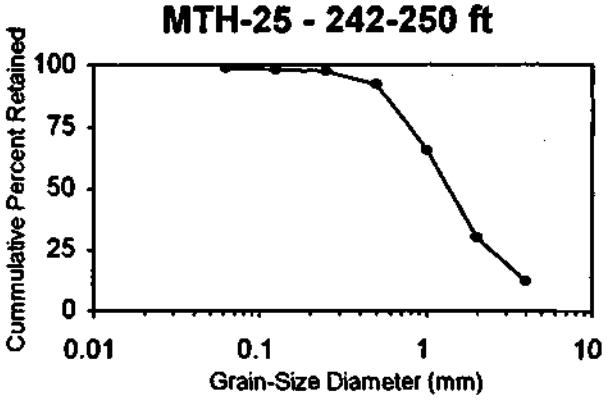

MTH-25 - 127-159 ft (2)
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

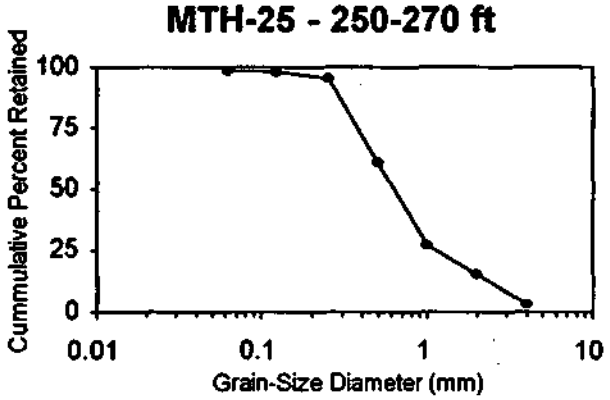

MTH-25 - 166-174 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

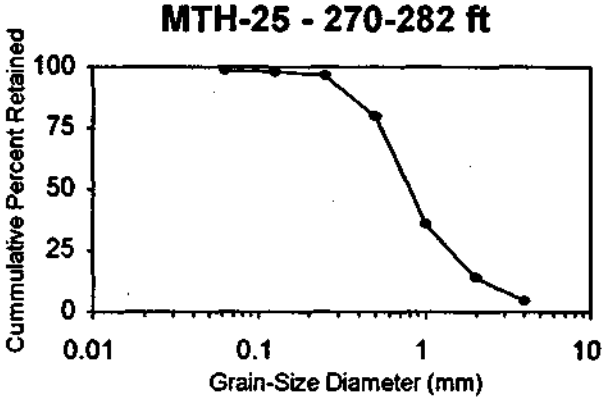

MTH-25 - 202-215 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

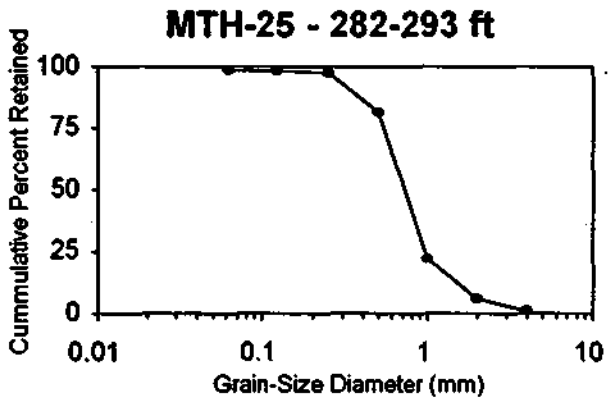

MTH-25 - 215-220 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

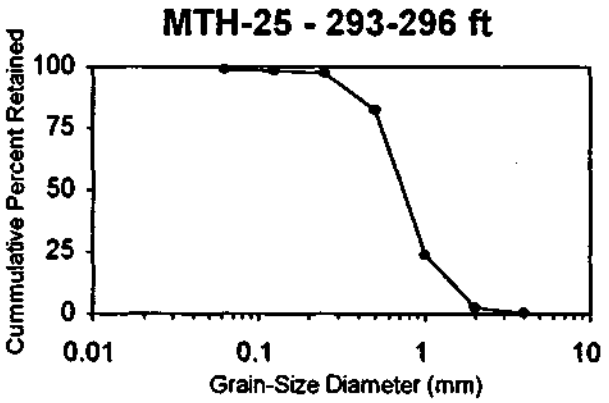

MTH-25 - 220-242 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

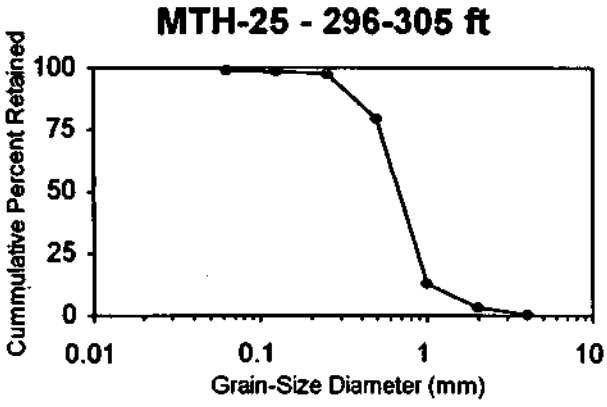

MTH-25 - 242-250 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

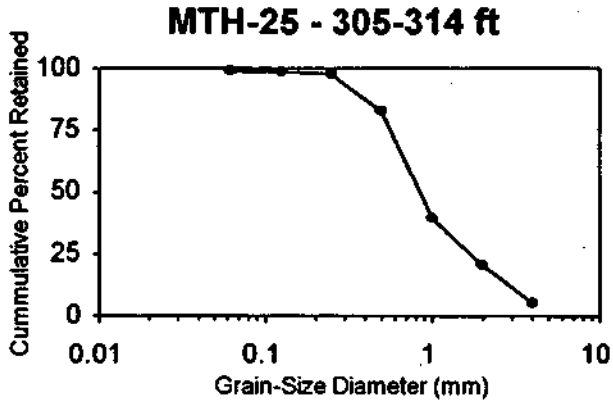

MTH-25 - 250-270 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

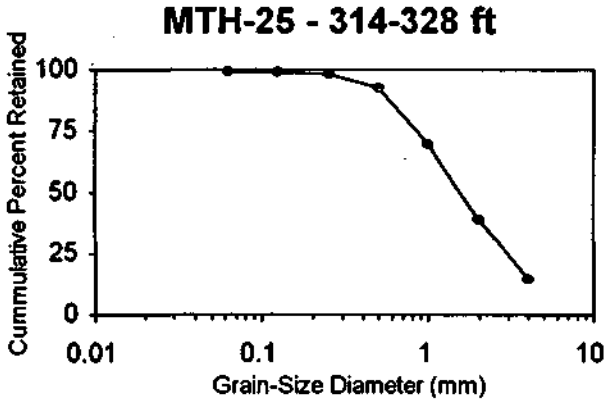

MTH-25 - 270-282 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)


MTH-25 - 282-293 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

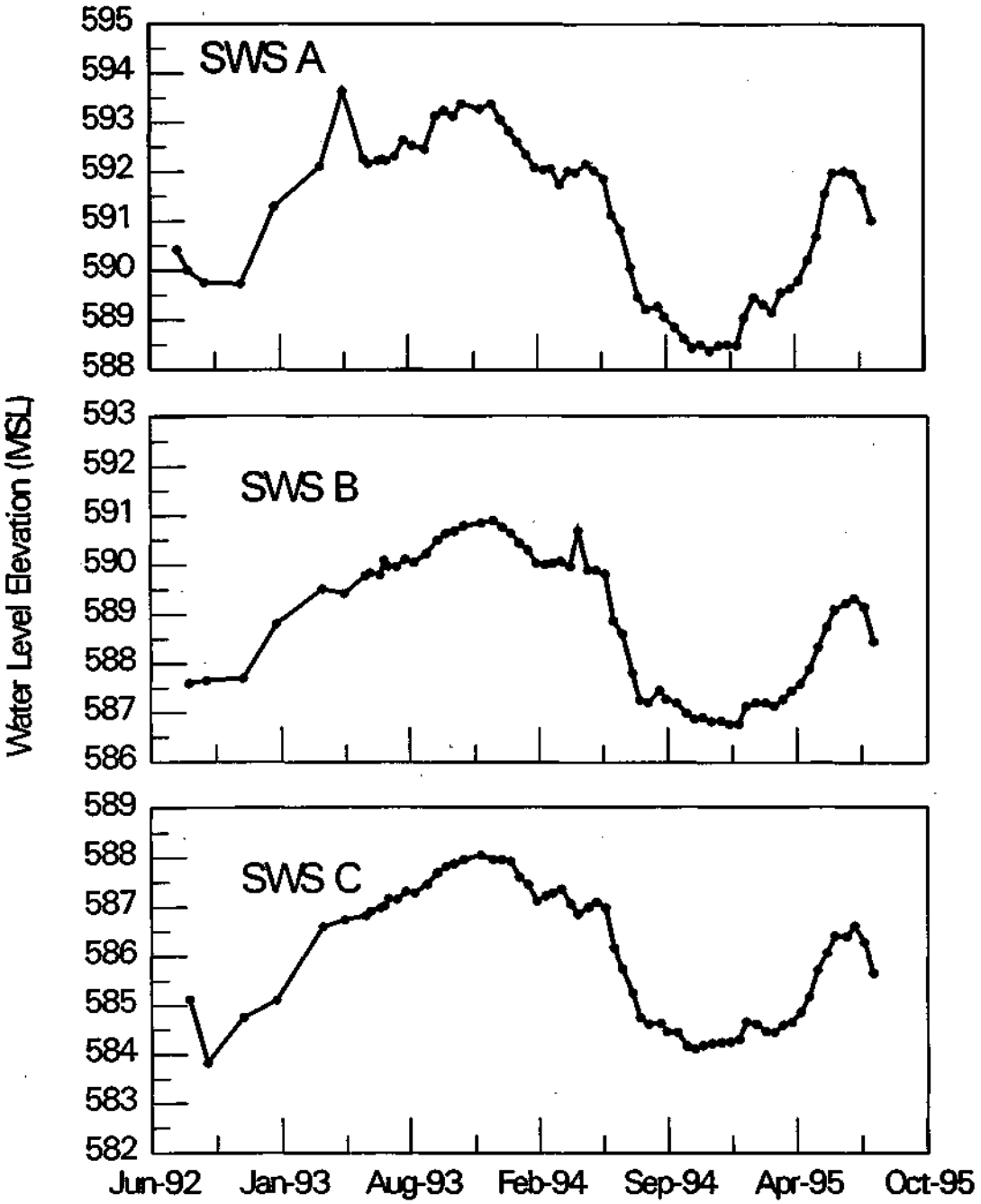

MTH-25 - 293-296 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

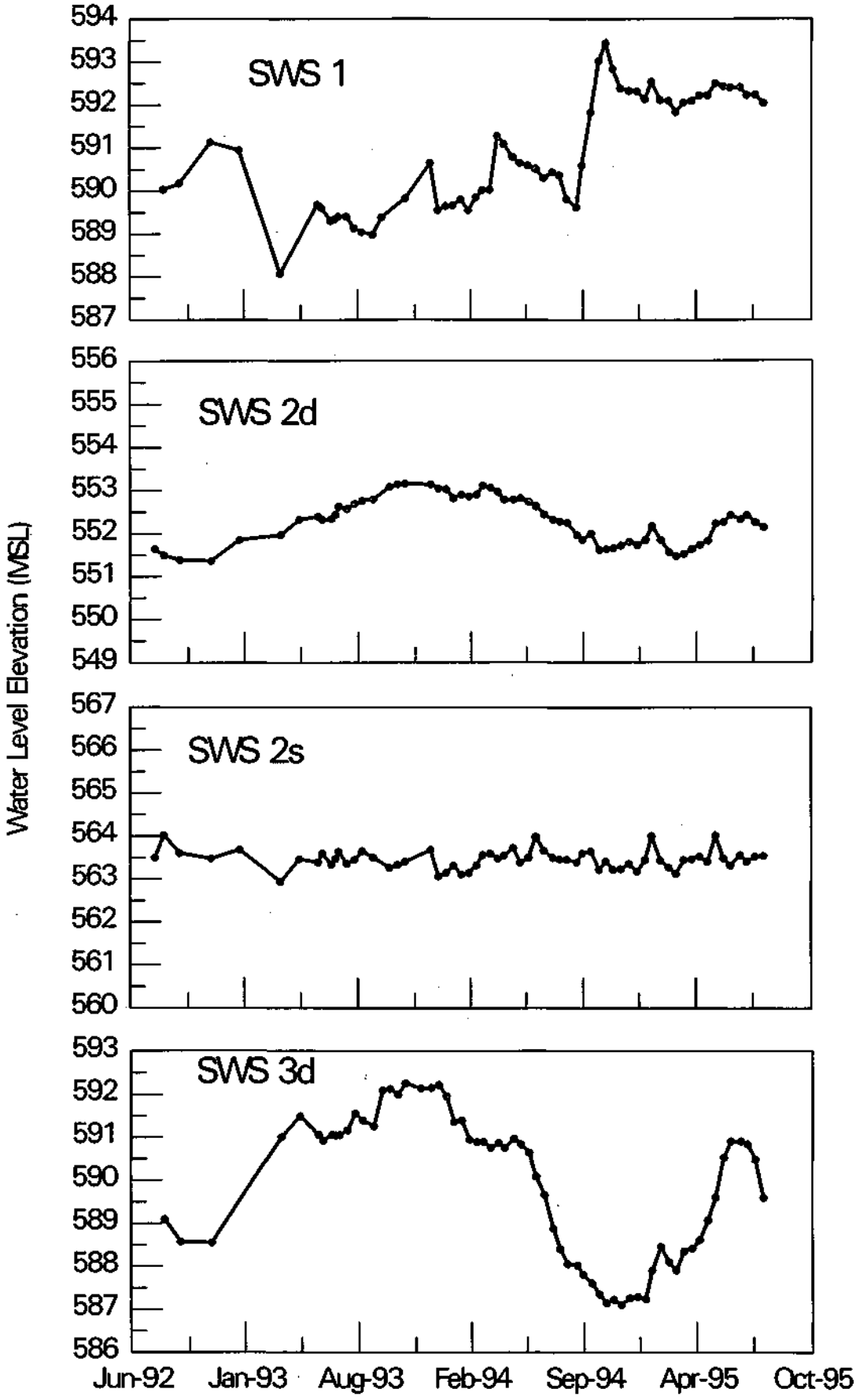

MTH-25 - 296-305 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

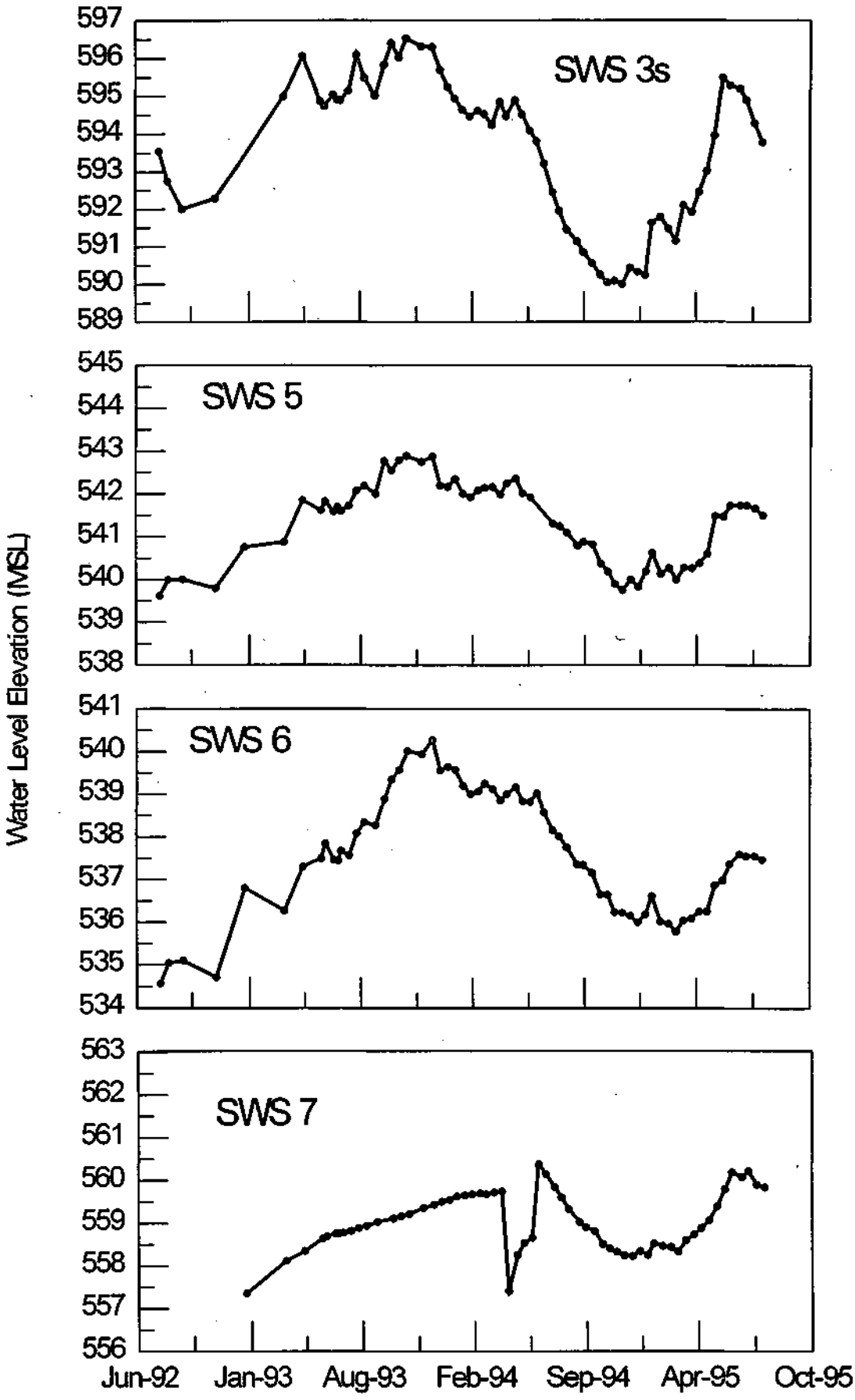

MTH-25 - 305-314 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

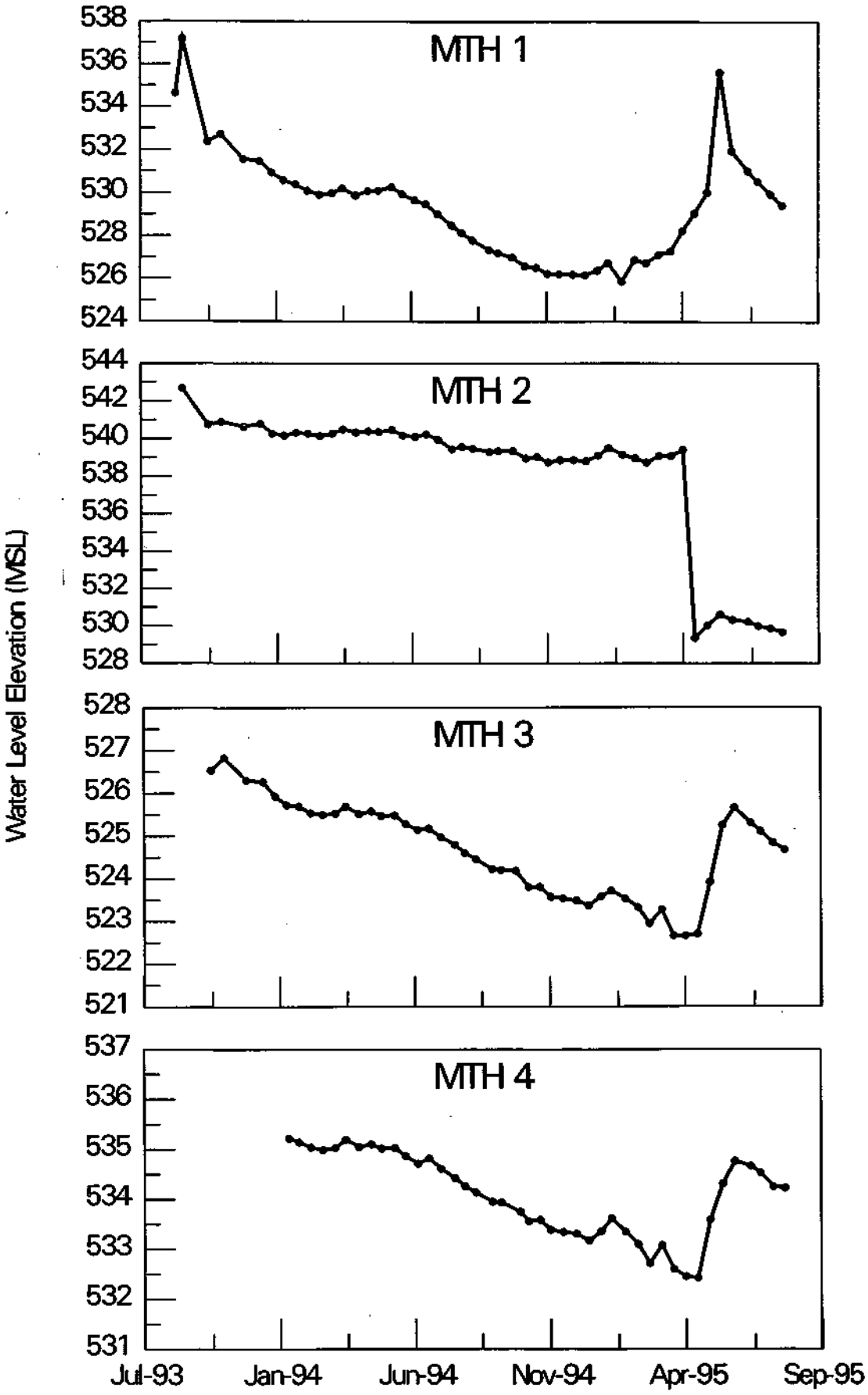

MTH-25 - 314-328 ft
Cummulative Percent Retained
100
75
50
25
0
0.01
0.1
1
10
Grain-Size Diameter (mm)

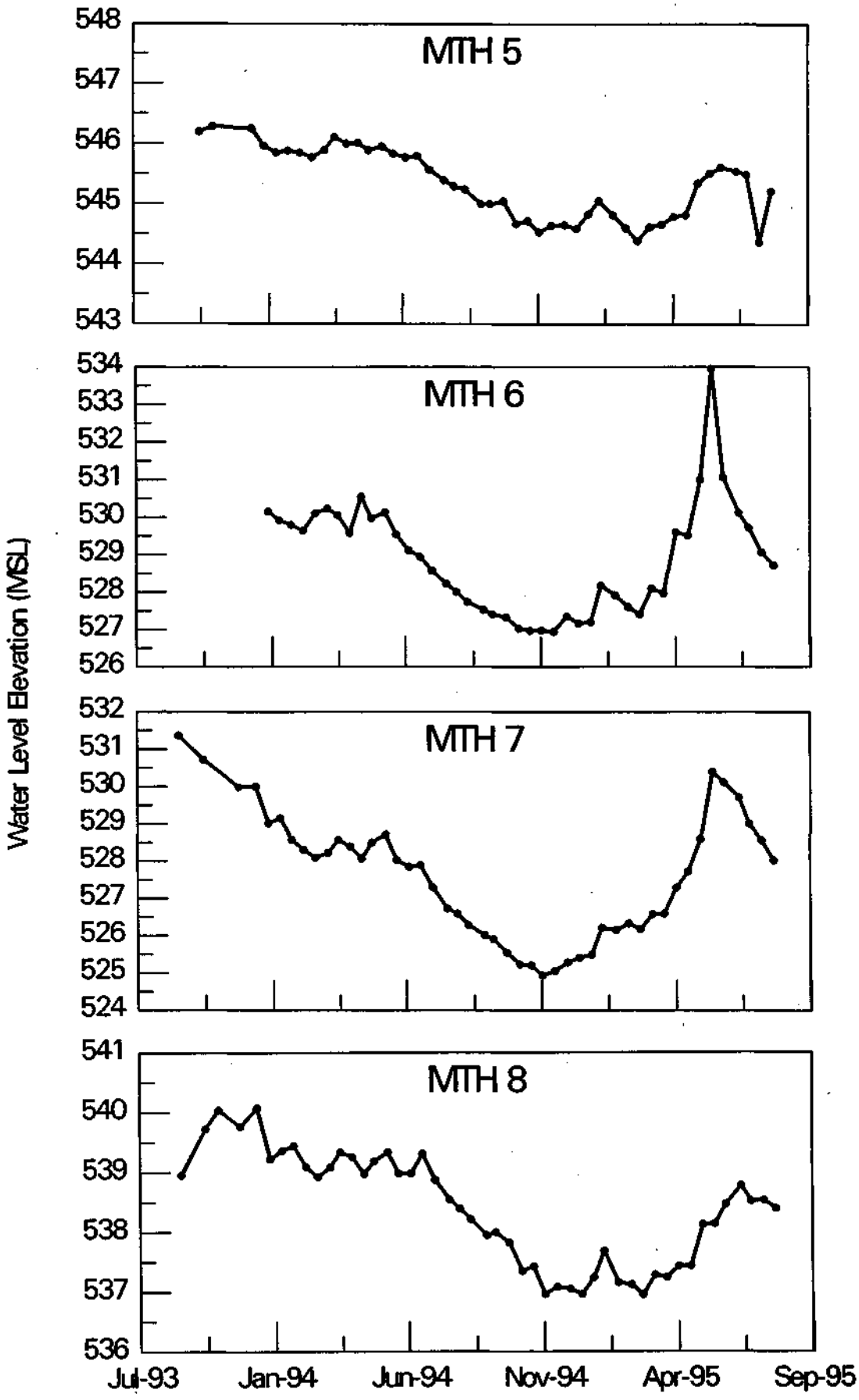
APPENDIX D HYDROGRAPHS FOR THE 39 DEDICATED OBSERVATION WELLS IN THE STUDY AREA

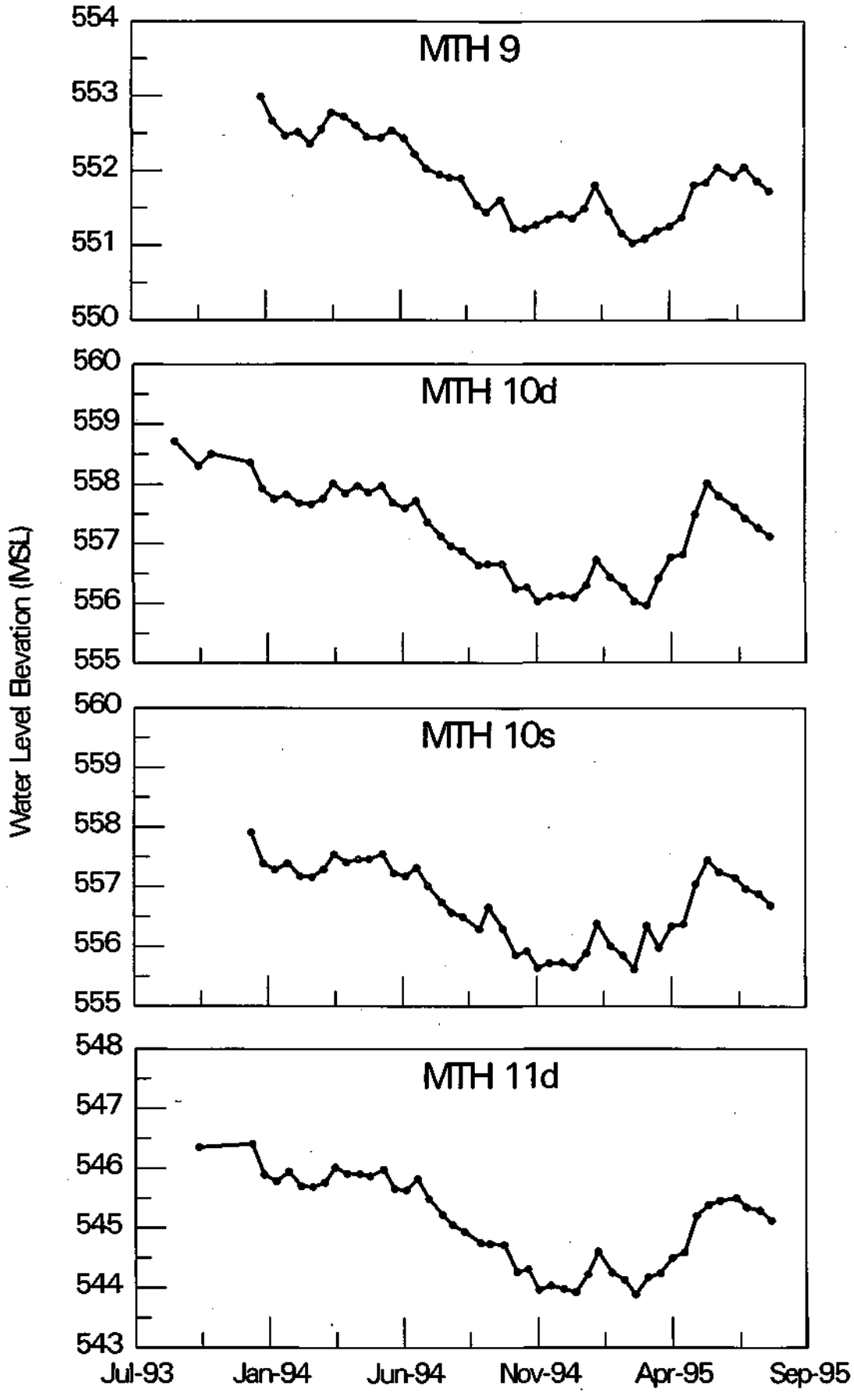


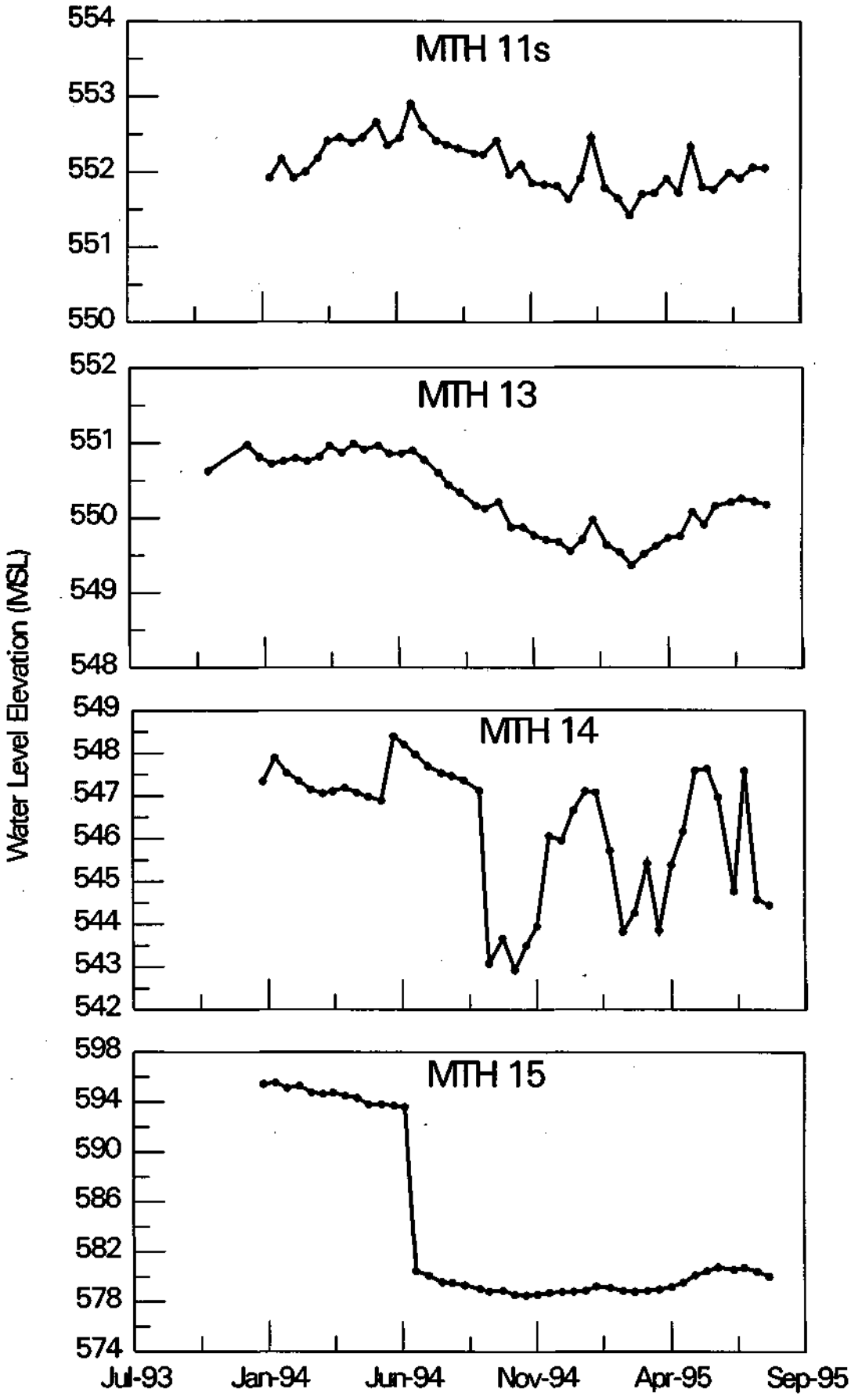

SWS 1
SWS 2d
SWS 2s
SWS 3d
Water Level Elevation (MSL)
594
593
592
591
590
589
588
587
556
555
554
553
552
551
550
549
567
566
565
564
563
562
561
560
593
592
591
590
589
588
587
586
Jun-92
Jan-93
Aug-93
Feb-94
Sep-94
Apr-95
Oct-95

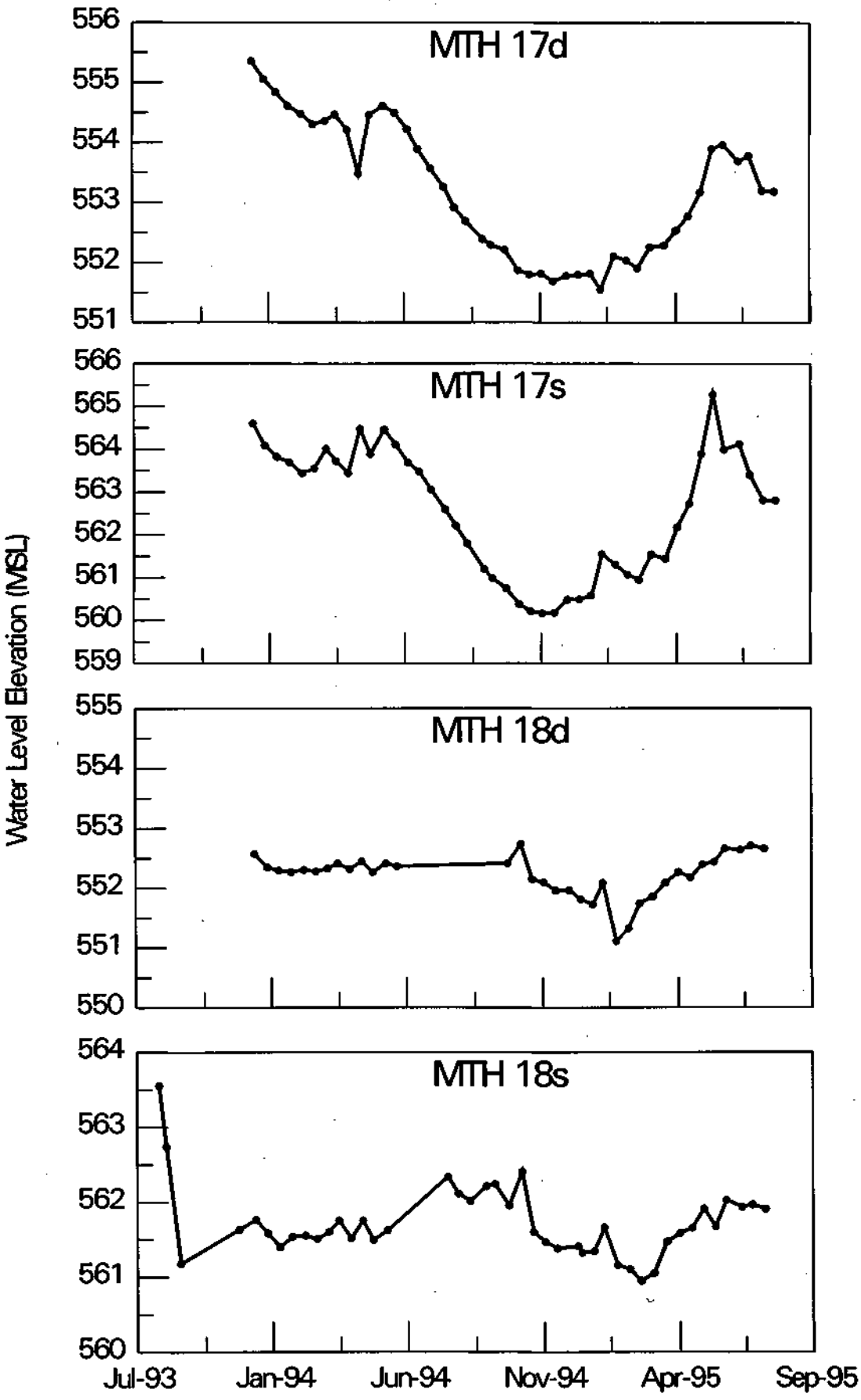

SWS 3s
SWS 5
SWS 6
SWS 7
Water Level Elevation (MSL)
597
596
595
594
593
592
591
590
589
545
544
543
542
541
540
539
538
541
540
539
538
537
536
535
534
563
562
561
560
559
558
557
556
Jun-92
Jan-93
Aug-93
Feb-94
Sep-94
Apr-95
Oct-95

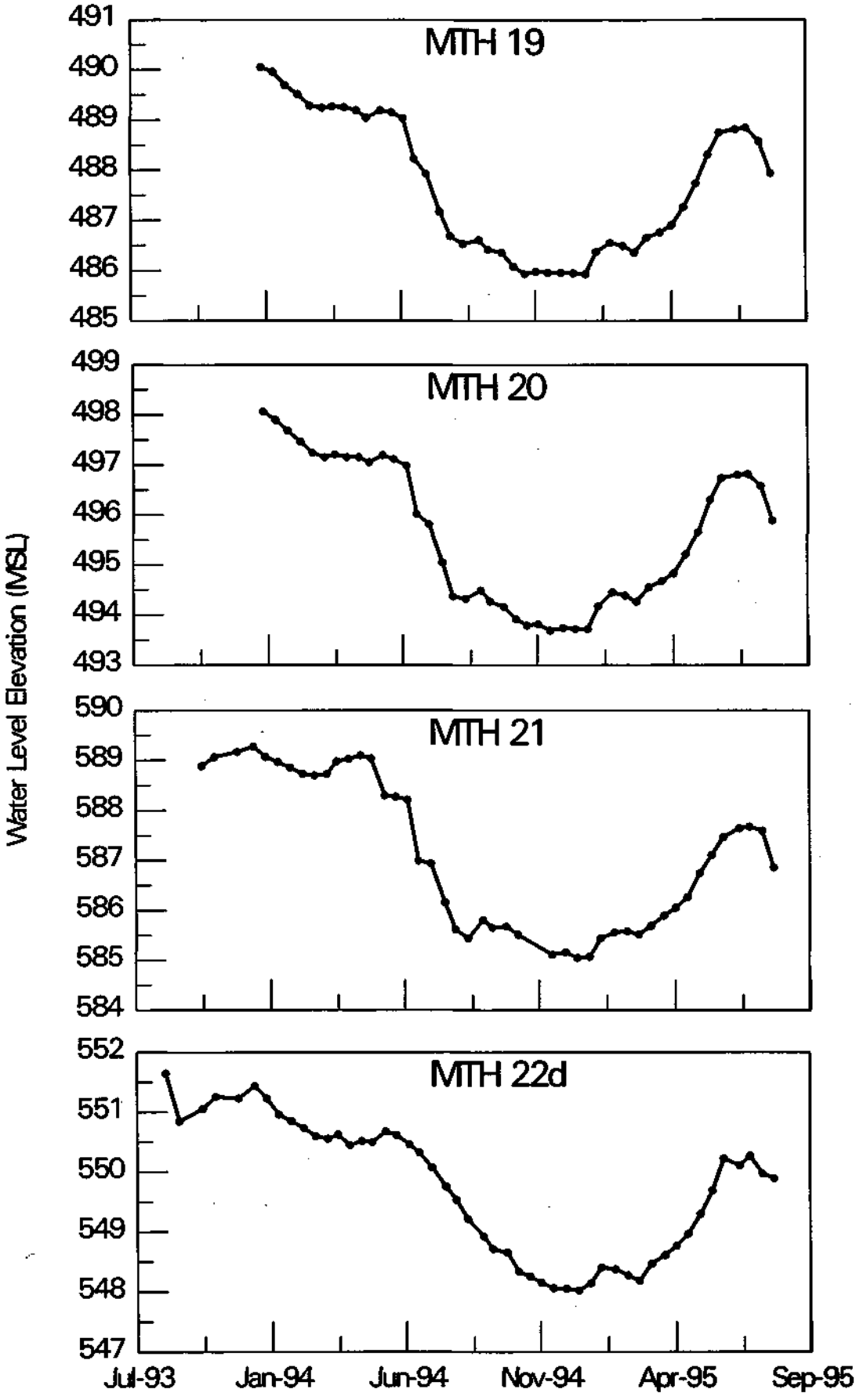

MTH 1
MTH 2
MTH 3
MTH 4
Water Level Elevation (MSL)
538
536
534
532
530
528
526
524
544
542
540
538
536
534
532
530
528
528
527
526
525
524
523
522
521
537
536
535
534
533
532
531
Jul-93
Jan-94
Jun-94
Nov-94
Apr-95
Sep-95

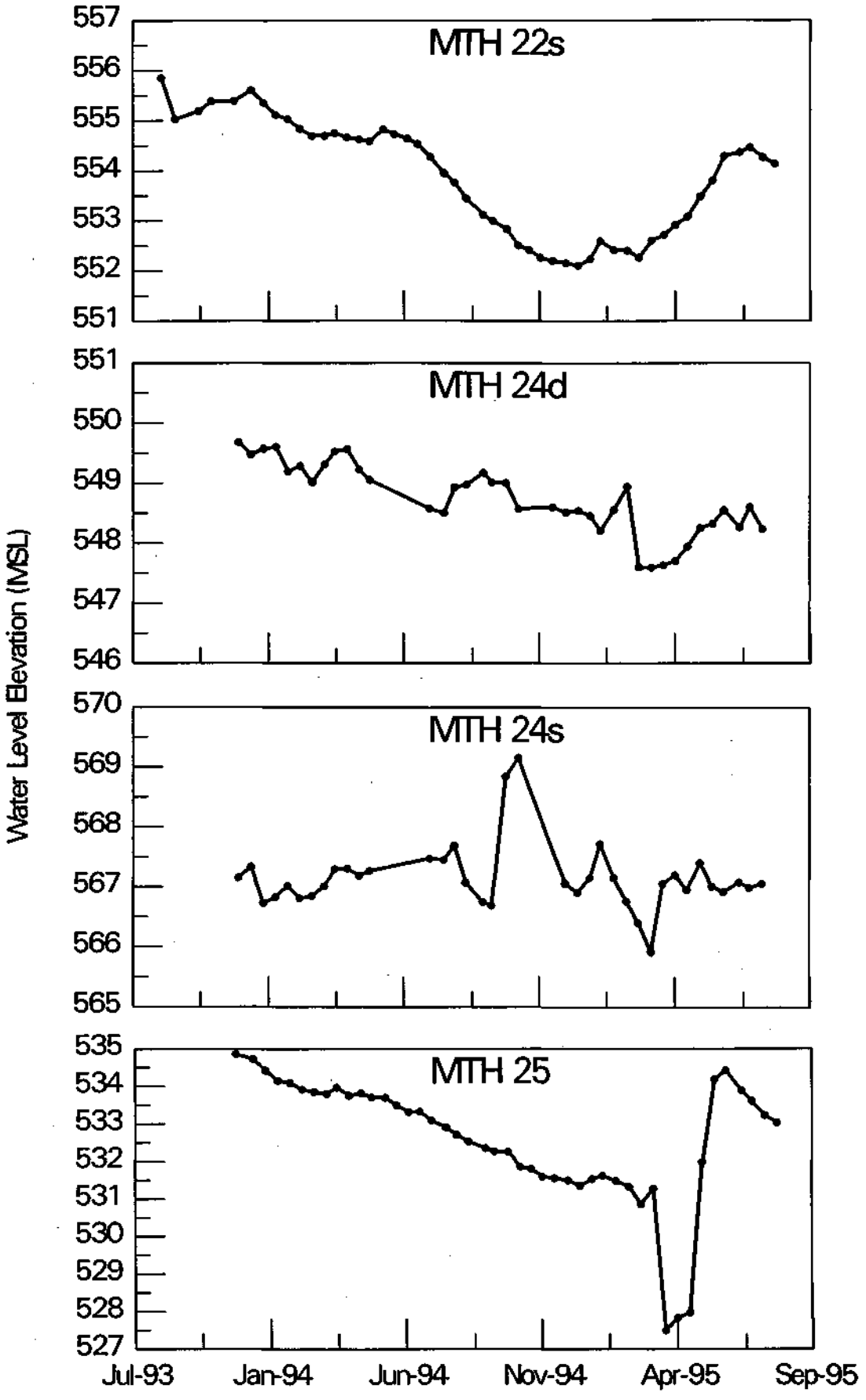

MTH 5
MTH 6
MTH 7
MTH 8
Water Level Elevation (MSL)
548
547
546
545
544
543
534
533
532
531
530
529
528
527
526
532
531
530
529
528
527
526
525
524
541
540
539
538
537
536
Jul-93
Jan-94
Jun-94
Nov-94
Apr-95
Sep-95


MTH 9
MTH 10d
MTH 10s
MTH 11d
Water Level Elevation (MSL)
554
553
552
551
550
560
559
558
557
556
555
560
559
558
557
556
555
548
547
546
545
544
543
Jul-93
Jan-94
Jun-94
Nov-94
Apr-95
Sep-95

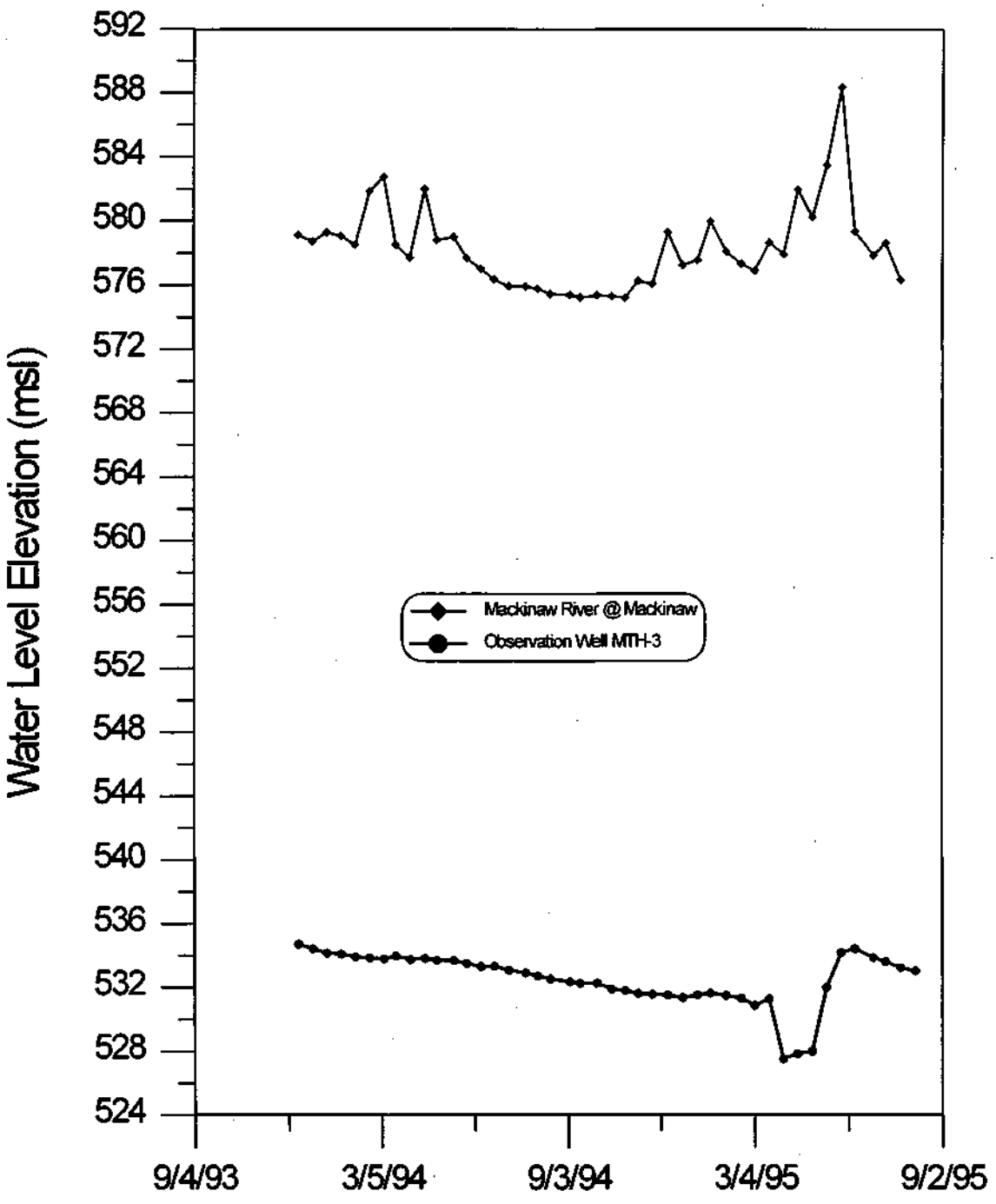

MTH 11s
MTH 13
MTH 14
MTH 15
Water Level Elevation (MSL)
554
553
552
551
550
552
551
550
549
548
549
548
547
546
545
544
543
542
598
594
590
586
582
578
574
Jul-93
Jan-94
Jun-94
Nov-94
Apr-95
Sep-95


MTH 17d
MTH 17s
MTH 18d
MTH 18s
Water Level Elevation (MSL)
556
555
554
553
552
551
566
565
564
563
562
561
560
559
555
554
553
552
551
550
564
563
562
561
560
Jul-93
Jan-94
Jun-94
Nov-94
Apr-95
Sep-95

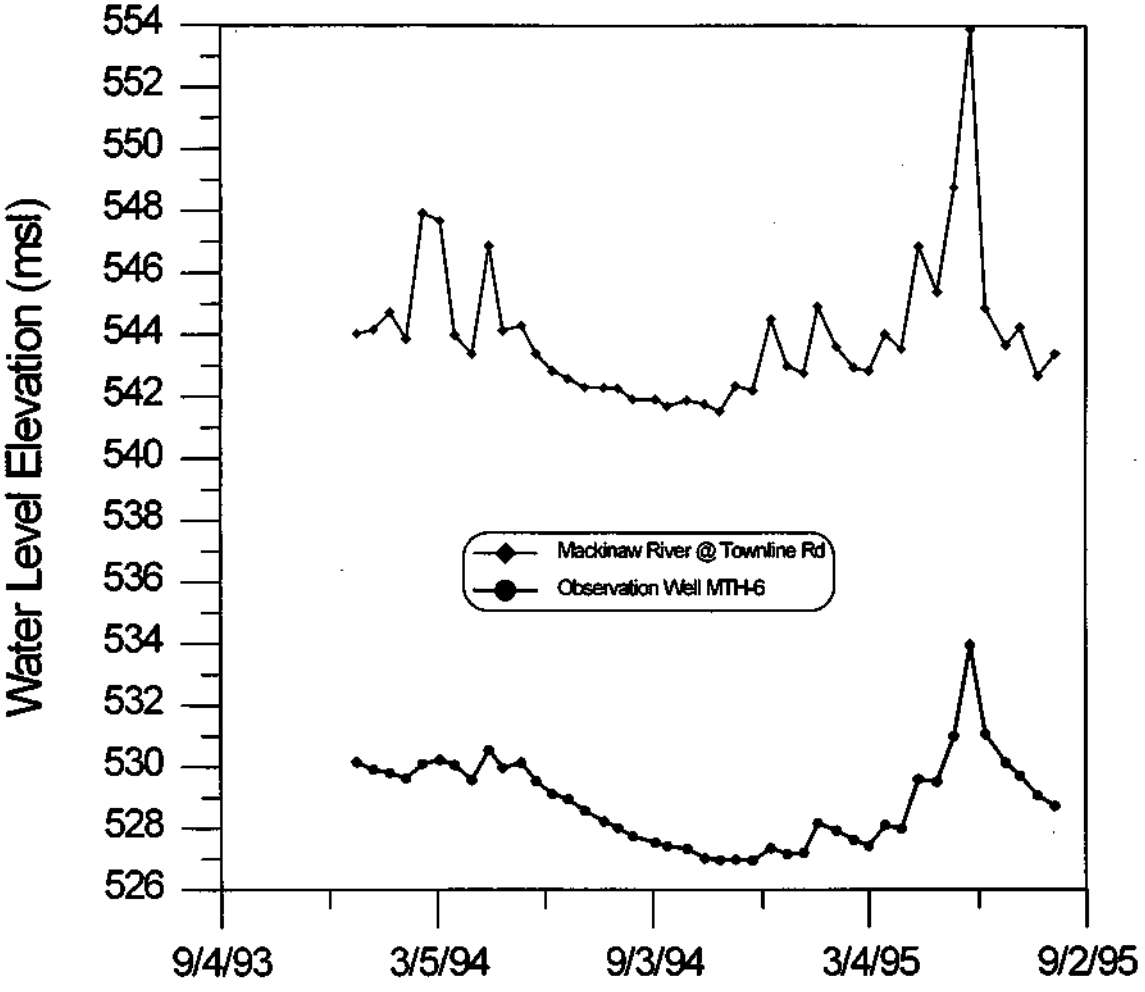

MTH 19
MTH 20
MTH 21
MTH 22d
Water Level Elevation (MSL)
491
490
489
488
487
486
485
499
498
497
496
495
494
493
590
589
588
587
586
585
584
552
551
550
549
548
547
Jul-93
Jan-94
Jun-94
Nov-94
Apr-95
Sep-95


MTH 22s
MTH 24d
MTH 24s
MTH 25
Water Level Elevation (MSL)
557
556
555
554
553
552
551
551
550
549
548
547
546
570
569
568
567
566
565
535
534
533
532
531
530
529
528
527
Jul-93
Jan-94
Jun-94
Nov-94
Apr-95
Sep-95

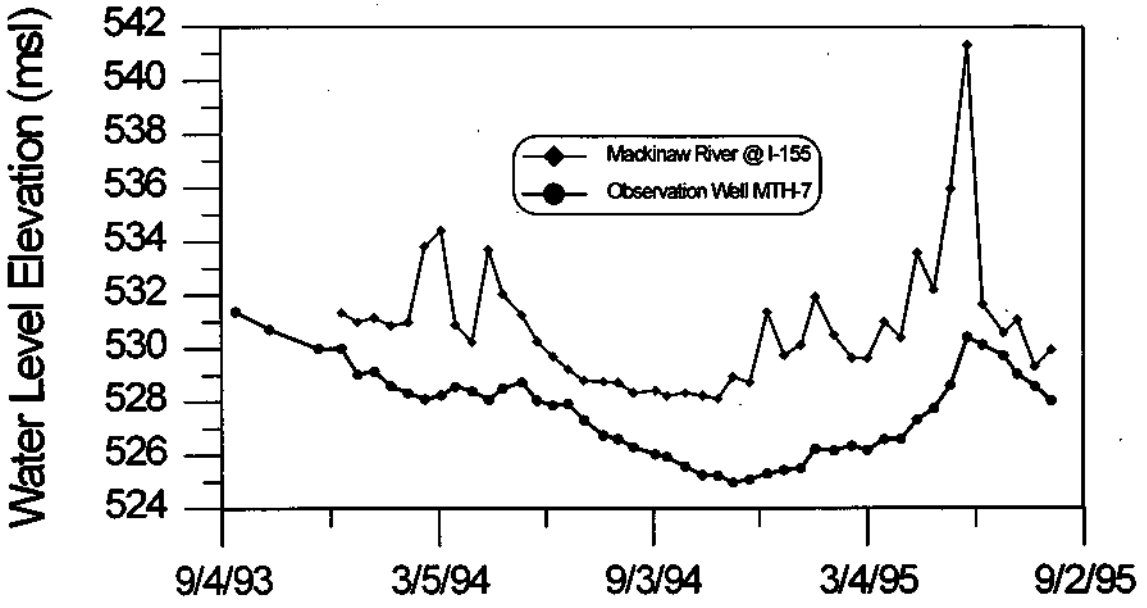
Mackinaw River Stage and Sankoty-Mahomet Sand Aquifer Water Level Near MTH-3



Mackinaw River Stage and Sankoty-Mahomet Sand Aquifer Water Level Near MTH-6



Mackinaw River Stage and Sankoty-Mahomet Sand Aquifer Water Level Near MTH-7



APPENDIX F AQUIFER TEST ANALYSIS METHODS

Analytical Method for Evaluating Artesian Aquifer

Type curve method Theis (1935) introduced an analogy between the nonsteady flow of groundwater and heat conduction. The nonequilibrium formula—popularly known as the Theis equation—describes radial flow toward a well pumping from an artesian aquifer as:

$$s = \frac{Q}{4\pi T} W(u) \tag{1}$$

or in commonly used units,

$$s = \frac{114.6Q}{T} W(u) \tag{2}$$

where:

$$W(u) = \int_u^{\infty} \frac{e^{-u}}{u} du = -0.5772 + \ln u + u - \frac{u^2}{2 \cdot 2!} \tag{3}$$

and

$$u = \frac{2693 r^2 S}{Tt} \tag{4}$$

where:

s = drawdown at distance r from the pumped well (ft)
Q = well discharge (gallons per minute [gpm])
T = transmissivity (gallons per day [gpd]/ft)
r = distance from pumped well to observation point (ft)
S = storage coefficient (decimal fraction)
t = time since pumping began (min.)

W(u), referred to as the *well function for nonleaky artesian aquifers,* has been extensively tabulated.

Theis devised a graphical procedure using superposition to solve for the aquifer properties, T and S. Recall equations 2 and 4, inverting equation 4:

$$s = \frac{114.6Q}{T} W(u) \tag{5}$$

Take the logarithm of both sides of these equations and expand:

$$\frac{1}{u} = \frac{Tt}{2693 r^2 S} \tag{6}$$

$$\log s = \log \left[\frac{114.6Q}{T}\right] + \log W(u) \tag{7}$$

$$\log \frac{1}{u} = \log \left[\frac{T}{2693 r^2 S}\right] + \log t \tag{8}$$

In equation 7, the term log [114.6Q/T] is a constant for a given pumping rate (hence, the need for a constant pumping rate during tests), so log s is directly related to log W(u). Also, in equation 8 the term log [T/2693r^2S] is a constant for a given distance r (a selected observation well), so log 1/u is directly related to log t. Thus,

$$\log s \propto \log W(u)$$

$$\log t \propto \log 1/u$$

From these relationships, one can construct a plot of the well function W(u) versus 1/u on log-log graph paper (fig. F1). Such a plot of a mathematical function is called a type *curve.* Likewise, one can plot on identical log-log paper a plot of drawdown s versus time t from the data collected at each observation well.

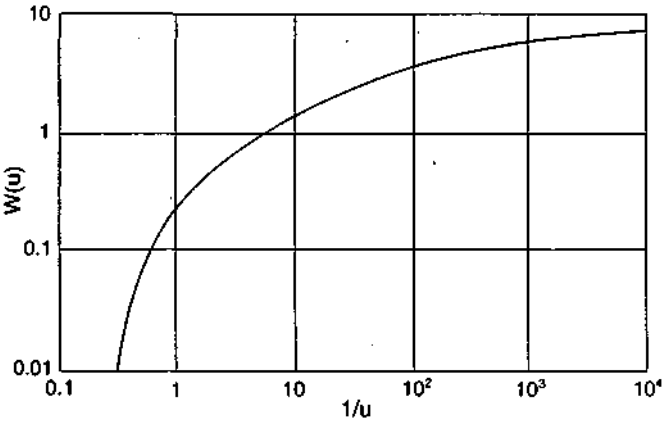


Figure F1 Nonequilibrium type curve (Freeze and Cherry 1979).

The type curve is then superposed over the field data plot, keeping the corresponding ordinate and abscissa axes parallel, until a best fit is obtained. A convenient match point is chosen on the two graphs (usually one that includes the convenient type curve match point of W(u) = 1 and 1/u = 10). The corresponding coordinates of W(u), 1/u, s, and t are then substituted into equations 2 and 4 to solve for T and S.

In the same manner, one could make a type curve of W(u) versus u, noting the relationship between s and W(u) as well as between u and r^2. For an aquifer test in which several observation wells were used, one could fit the new type curve to a field data plot of s versus r^2 for a given time and follow the same procedure of fitting the type curve to the field data plot and selecting a match point.

Jacob straight line method A popular graphical method derived from the Theis method by Cooper and Jacob (1946) is referred to as the *modified nonleaky artesian formula,* or simply the *Jacob straight line method.* The method is based on the fact that when values of u are small (≤0.01), the sum of the series terms in equation 3 beyond In u becomes insignificant. Examination of the terms in equation 4 shows that u becomes small when r becomes small (close in observation wells) or t becomes large (long pumping periods).

When u ≤ 0.01, field data plots of drawdown versus log time on semilog paper will yield a straight line. The straight line portion of the s versus t plot is extrapolated to its intersection with the zero drawdown axis. The slope of the straight line (drawdown per log cycle) is used to solve for the transmissivity, and the zero drawdown intercept is used to solve for the storage coefficient. Expressions for these computations, derived by Cooper and Jacob (1946) are:

$$T = \frac{264Q}{\Delta s} \qquad (9)$$

$$S = \frac{Tt_0}{4790r^2} \quad (10)$$

where:

T = transmissivity (gpd/ft)
S = storage coefficient
Q = well discharge (gpm)
ΔS = drawdown difference per log cycle (ft)
r = distance from pumped well to observation point (ft)
t_0 = intersection of straight line slope with zero drawdown axis (min.)

The method can also be extended to plots of drawdown versus distance for given time values. Field data plots of drawdown versus log distance on semilog paper will yield a straight line in the region where $u \leq 0.01$. The straight line portion of the graph is extrapolated to its intersection with the zero drawdown axis. The slope of the straight line is used to solve for T, and the zero drawdown intercept is used to solve for S, using the following expressions:

$$T = \frac{528Q}{\Delta s} \quad (11)$$

$$S = \frac{Tt}{4790r_0^2} \quad (12)$$

where:

r_0 = intersection of straight line slope with zero drawdown axis (ft)

and all other terms are as defined above.

The Jacob straight line method is popular because of its simplicity; however, its use is restricted to field data that satisfy the "u criterion" of $u \leq 0.01$. Deviation from a straight line becomes appreciable when u exceeds about 0.02 (Walton 1962). The method should be used to supplement, rather than supersede, the type curve method.

Image Well Theory One of the assumptions inherent in the equations used to evaluate hydraulic properties and predict drawdown is that the source aquifer is infinite in lateral extent. While many aquifers are extensive enough that the effects of hydrogeologic boundaries remain negligible even after many years of pumping, clearly no aquifer is laterally infinite. The effects of hydrogeologic boundaries on the water level response of an aquifer to pumping using the theory of images was described by Ferris (1959).

Hydrogeologic boundaries include recharge boundaries, along which there is no drawdown, and barrier boundaries, across which there is no flow. Recharge boundaries consist of rivers, lakes, and other bodies of surface water which are hydraulically connected to the aquifer. Examples of barrier boundaries include fault planes and the lateral edges of lenticular sand and gravel aquifers contained within relatively impermeable confining materials. Both types of boundaries distort cones of depression and affect the time rate of drawdown. The general effect of a recharge boundary is to decrease the drawdown in a well, while that of a barrier boundary is to increase it.

According to the theory of images, the drawdown caused at a pumping well by a single barrier boundary at distance x from the well is equivalent to that caused by an imaginary, or image, well discharging at the same rate as the pumping well and located on the opposite side of the boundary, at a distance 2x, from the pumping well (fig. F2). The rationale for using a discharging image well to simulate the effects of a barrier boundary is that the image well and real well produce a divide in the

hydraulic head distribution of the theoretically infinite aquifer such that no flow may cross the position of the divide. Because the image well and real well discharge at the same rate and on the same schedule, are subject to identical hydraulic properties and conditions, and are separated by a distance twice that of the distance from the real well to the barrier boundary, this flow divide is located at the same distance from the pumped well as is the barrier boundary. If the distance from the real well to the barrier boundary is x, the effect of the barrier boundary manifests itself as the drawdown produced by the image well at distance 2x.

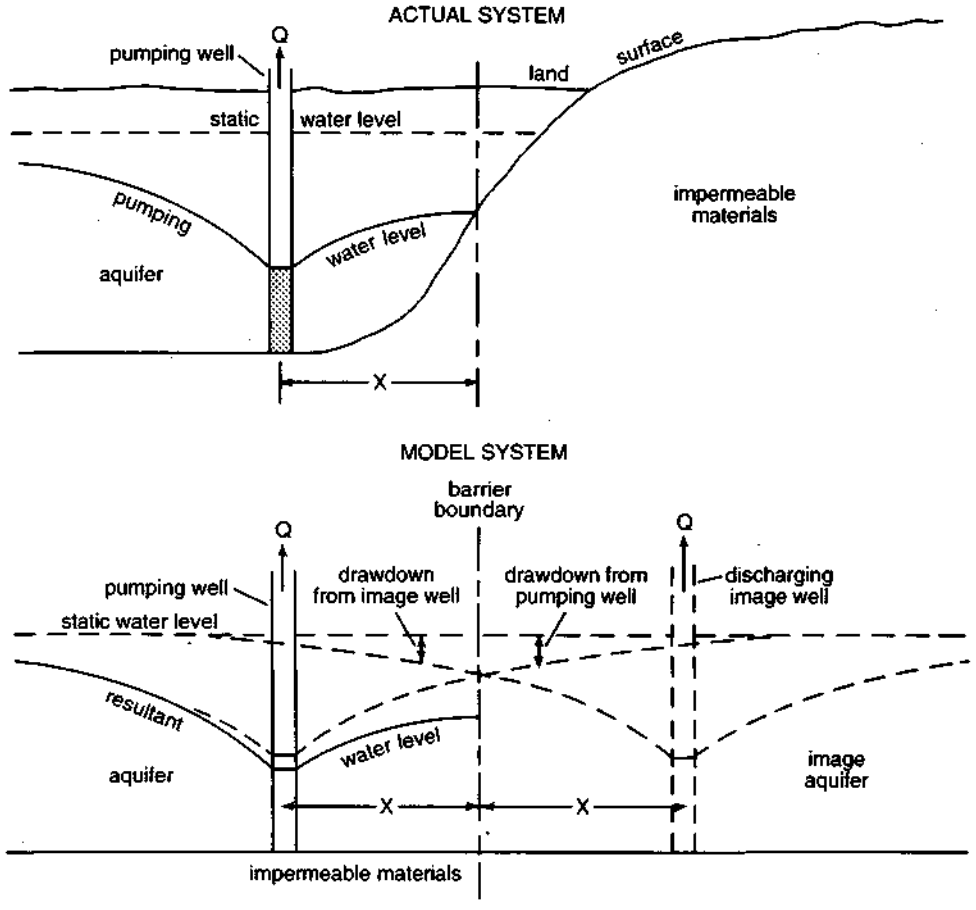


Figure F2 Diagrammatic cross section showing the use of a discharging image well to model the effect of groundwater withdrawals from a single well near a barrier boundary. The effect of a barrier boundary at distance x from a pumping well discharging at a rate of Q is simulated by an image well located opposite the barrier boundary from the pumping well at distance 2x from the pumping well. The image well, like the real well, discharges at a rate of Q. The drawdown in the actual aquifer system is given by the sum of the drawdown produced by the image well and the pumping well in the model system (adapted from Heath 1989).

To estimate the effects of a barrier boundary, then, it is first necessary to construct a theoretical distance drawdown curve for the hydrologic conditions, hydraulic properties, pumping rate, and pumping schedule appropriate for the pumping well. The construction of such a curve for steady state leaky artesian conditions is discussed in the following section of this appendix.

For purposes of this discussion, a strip aquifer consists of a strip of aquifer material of infinite length contained laterally within two parallel barrier boundaries. Analysis of the effects of pumpage on water levels in strip aquifers requires an image well system extending to infinity (fig. F3). This is necessary because the addition of each image well produces a residual effect at the opposite modeled barrier boundary. The residual effect produced by each image well is balanced by adding another image well, which produces an additional small residual effect the correction of which requires yet

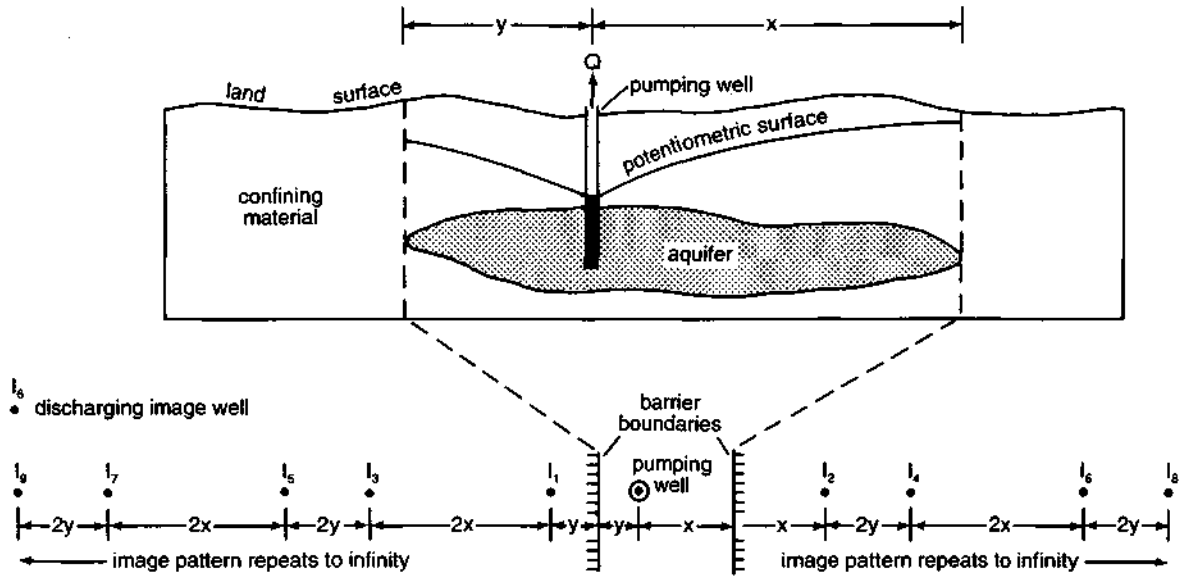


Figure F3 Analysis of the water level response of a strip aquifer to pumpage requires a system of discharging image wells extending to infinity. As shown in figure F2, a discharging image well simulates the effect of a barrier boundary by producing a flow divide in the hydraulic head distribution of the theoretically infinite aquifer at the position of the barrier boundary. A strip aquifer requires two flow divides on opposite sides of the pumped well. Analysis of this system proceeds by appealing to a primary pair of image wells (I_1 and I_2) to produce flow divides at the positions of the lateral barrier boundaries of the strip. The drawdown produced by each of these image wells, however, changes the head distribution at the opposite margin of the model aquifer such that the positions of the flow divides do not correspond to those of the barrier boundaries. Secondary image wells are necessary. Thus, I_4 compensates for the effect of I_1 and I_3 for the effect of I_2. Because I_3 and 1_4 themselves produce an unbalanced residual effect at the opposite margin of the model aquifer, however, still more secondary image wells are necessary. Thus, I_6 compensates for 1_3 and I_5 compensates for I_4. Each successively added image well thus requires an additional compensating image well, and the image well pattern is extended to infinity. Total drawdown at the pumping well due to barrier boundary effects is the sum of the drawdown produced by the individual image wells. In practice, because the drawdown produced by the image wells becomes negligible as the distance from the pumped well increases, the number of image wells required to estimate drawdown at a pumped well in a strip aquifer is limited. Generally the infinite system of image wells is terminated when image well drawdown declines below an arbitrary value such as 0.01 ft (adapted from Walton 1962 and Heath 1989).

another image well. The drawdown at the pumped well due to the barrier boundaries is the sum of the drawdown produced by the individual image wells. In practice, pairs of image wells are added only until the next pair has a negligible effect on the total image well drawdown.

Analytical Methods for Evaluation of Leaky Artesian Aquifers

Because most geologic materials are only capable of impeding the movement of groundwater rather than preventing it, true artesian conditions are rare in comparison to leaky artesian conditions. Leaky artesian or semiconfined conditions exist where significant quantities of water move through the confining units of an artesian aquifer. Use of the Theis graphical procedure is not appropriate for the analysis of pump-test data gathered from wells screened in leaky artesian aquifers. Hantush and Jacob (1955) developed the following equation describing the nonsteady state drawdown distribution in a leaky artesian aquifer:

$$s = \frac{Q}{4\pi T} W(u, r/B) \qquad (13)$$

or in commonly used units,

$$s = \frac{114.6Q}{T} W(u, r/B) \qquad (14)$$

where:

$$u = \frac{2693 r^2 S}{Tt} \tag{15}$$

$$\frac{r}{B} = \frac{r}{\sqrt{T/(K'/m')}} \tag{16}$$

s	=	drawdown in observation well (ft)
r	=	distance from pumped well to observation well (ft)
Q	=	discharge (gpm)
t	=	time since pumping started (min.)
T	=	transmissivity (gpd/ft)
S	=	storage coefficient (decimal fraction)
K'	=	vertical hydraulic conductivity of leaky confining bed (gpd/ft^2)
m'	=	thickness of confining leaky confining bed (ft)

W(u,r/B) is referred to as the *well function for leaky artesian aquifers* and is defined by the following equation:

$$W(r/B) = \int_u^\infty \left(\frac{1}{u}\right) \exp(-u - r^2/4B^2u)\,du \tag{17}$$

or, evaluating the integral,

$$\begin{aligned} W(r/B) = {} & 2K_0(r/B) - I_0(r/B)\left[-Ei\left(-\frac{r^2}{4B^2u}\right)\right] \\ & + \left[\exp\left(-\frac{r^2}{4B^2u}\right)\right]\left\{0.5772 + \ln u + [-Ei(-u)]\right. \\ & \left. - u + u[I_0(r/B) - 1]/\frac{r^2}{4B^2}\right. \\ & \left. - u^2 \sum_{n=1}^{\infty} \sum_{m=1}^{\infty} \frac{(-1)^{n+m}(n-m+1)!}{(n+2)!^2} \left(\frac{r^2}{4B^2}\right)^m u^{n-m}\right\} \end{aligned} \tag{18}$$

where:

K_o (r/B)	=	modified Bessel function of the second kind and zero order
I_o(r/B)	=	modified Bessel function of the first kind and zero order

W(u,r/B) has been extensively tabulated.

Walton (1960) developed a graphical procedure using superposition to solve for the aquifer properties (T and S) and the vertical hydraulic conductivity of the confining bed (K'). Recall equations 14 and 15, inverting equation 15:

$$s = \frac{114.6Q}{T} W(u,r/B) \tag{19}$$

$$\frac{1}{u} = \frac{Tt}{2693\,r^2S} \tag{20}$$

Take the logarithm of both sides and expand:

$$\log s = \log\left(\frac{114.6Q}{T}\right) + \log W(u,r/B) \tag{21}$$

$$\log\left(\frac{1}{u}\right) = \log\left(\frac{T}{2693r^2S}\right) + \log t \tag{22}$$

In equation 21, the term log(114.6Q/T) is a constant for a given pumping rate, so log s is directly related to log W(u,r/B). Also, in equation 22, the term log($T/2693r^2S$) is a constant for a given distance r, so log(1/u) is directly related to log t. Thus, for a given aquifer, observation well, and pumping rate,

$$\log s \propto \log W(u,r/B)$$

$$\log t \propto \log(1/u)$$

The first step in solving for aquifer and confining bed properties using Walton's (1960) method is to construct a series of leaky artesian type curves by plotting W(u,r/B) versus 1/u on logarithmic paper for the practical range of u and r/B (fig. F4). Using logarithmic paper of the same scale as the type curves, observed values of s are then plotted against those of t for a given observation well. The family of type curves is then superposed on the field data plot, keeping the corresponding ordinate and abscissa axes parallel, until a best fit with one of the type curves is obtained. In the matched position a point at any convenient intersection of major axes on the type curve plot is selected and marked on the time drawdown field data curve, noting the values of W(u,r/B) and 1/u represented by the selected axes. The point may be selected anywhere on the type curve plot, but it is most convenient to use a point at the intersection two major axes such as W(u,r/B)=1 and 1/u=10. The coordinates of the match point on both the type curve plot [W(u,r/B) and 1/u] and field data plot (s and t), as well as the appropriate values of Q and r, are substituted into equations 14,15, and 16 to determine the hydraulic properties of the aquifer and confining bed.

Hantush (1956) introduced a graphical technique for determining aquifer and confining bed hydraulic properties in leaky artesian conditions from a semilogarithmic plot of drawdown versus time. Hantush showed that such a curve has an inflection point at which the following relations hold:

$$s_i = \frac{s_m}{2} = \frac{114.6Q}{T} K_0(r/B) \tag{23}$$

$$\frac{2.3s_i}{m_i} = e^{r/B} K_0(r/B) \tag{24}$$

$$m_i = \frac{\Delta s}{\Delta \log_{10} t} = \frac{264Qe^{-r/B}}{T} \tag{25}$$

where:

$$B = \sqrt{Tm'/K'} \tag{26}$$

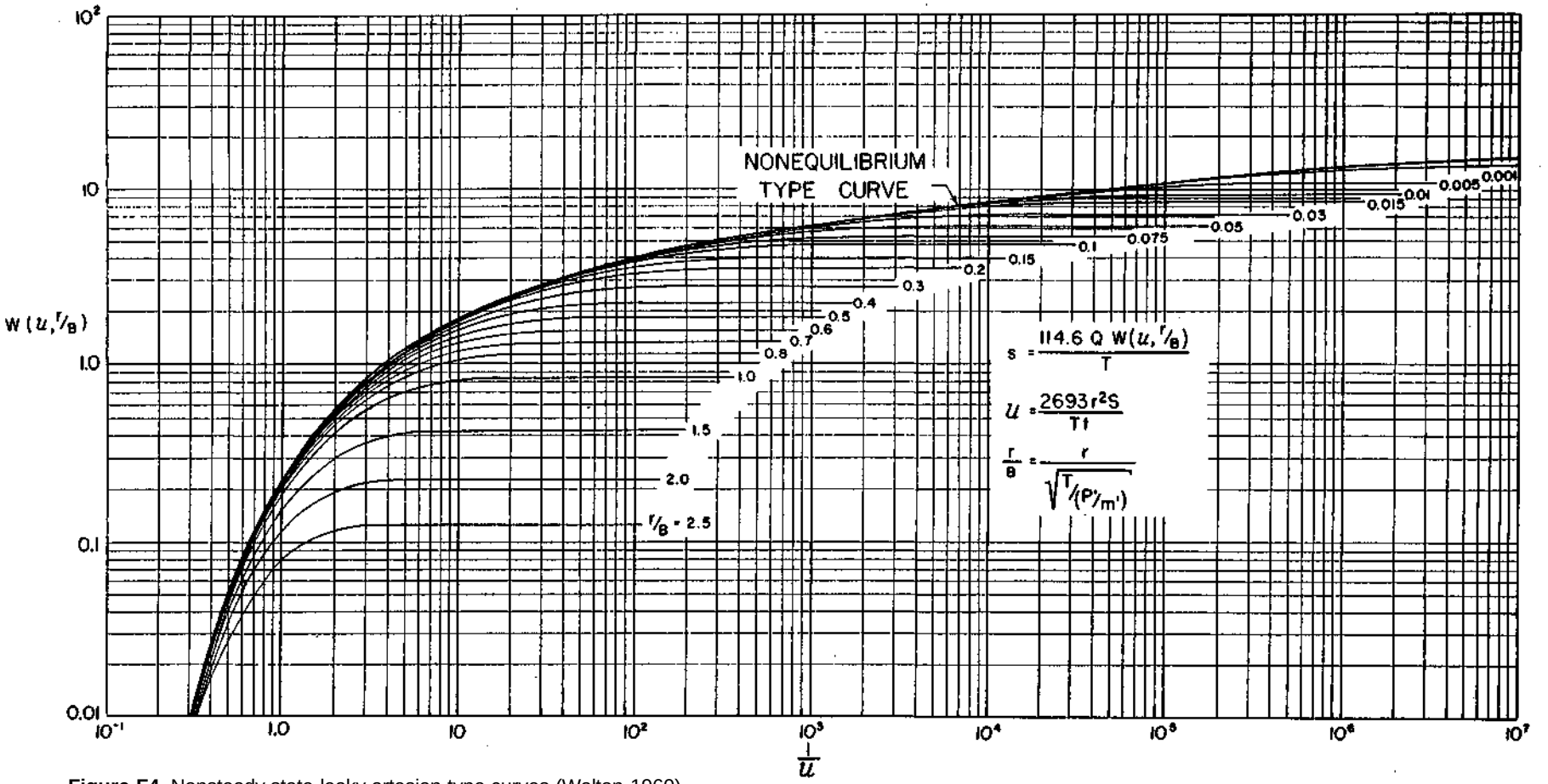


Figure F4 Nonsteady state leaky artesian type curves (Walton 1960).

T	=	transmissivity (gpd/ft)
m'	=	thickness of leaky confining bed (ft)
K'	=	vertical hydraulic conductivity of leaky confining bed (gpd/ft^2)
S_I	=	drawdown at inflection point (ft)
s_m	=	maximum or steady-state drawdown (ft)
Q	=	discharge (gpm)
r	=	distance from pumped well (ft)
m_i	=	slope of curve at inflection point
s	=	drawdown (ft)
t	=	time (day)

If the duration of the constant rate test is adequate, the value of s_m is extrapolated, and s_I is determined from equation 23. The slope of the curve at the inflection point is then determined. This is usually approximated by the slope of the straight part of the curve on which the inflection point lies. Substituting S_i and m_I into equation 24, the value of $e^{r/B}K_o(r/B)$ is determined, and the corresponding value of r/B is then determined from tables (included, for example in Hantush 1956). The constant B, termed the leakage factor by Hantush and Jacob (1954), is given by the quotient of r and r/B. To determine T, the values of s_i, Q, and $K_o(r/B)$ (the latter obtained from tables) are substituted into equation 23. The ratio K7m' is a constant in leaky systems and is known as the "leakance" or leakage coefficient (Hantush and Jacob 1955). By multiplying both the numerator and denominator of this ratio by T/K, and recalling equation 26, we can show that

$$\frac{K'}{m'} = \frac{T}{B^2} \qquad (27)$$

K' is determined by substituting the values for m', T, and B into equation 27 and solving.

Under steady state leaky artesian conditions, discharge is balanced by leakage, and time drawdown data fall onto the flat portions of the family of leaky artesian type curves. The drawdown distribution under steady state conditions is described by the following equation (Jacob 1946):

$$s = \frac{229QK_0(r/B)}{T} \qquad (28)$$

$K_o(r/B)$ = modified Bessel function of the second kind and zero order

Jacob (1946) developed a graphical procedure for determining T and K' under steady state leaky artesian conditions. A steady state leaky artesian type curve is prepared by plotting values of $K_o(r/B)$ against a practical range of r/B on logarithmic paper. Aquifer test data from several observation wells collected under steady state conditions are plotted, using logarithmic paper of the same scale as the type curve, with r as the abscissa and s as the ordinate to describe a distance drawdown field data curve. The corresponding axes of the two graphs are kept parallel, then a best fit is obtained by superposing the type curve on the distance drawdown field data curve, and a match point is marked using any convenient intersection of major axes on the type curve. The match point coordinates $K_o(r/B)$, r/B, s, and r, together with the values of m' and Q, are substituted into equations 16 and 28 to solve for T and K'.

Analysis of aquifer test data using the steady state leaky artesian type curve will yield erroneous results unless sufficient time has elapsed to give reasonable assurance that steady state flow has been established. The type curve is, however, often useful as a predictive tool to forecast long term water level declines in the vicinity of proposed high capacity well installations. Values of T, m', K', Q, r/B, and $K_o(r/B)$ are substituted into equations 16 and 28 to solve for values of s and r, which, together with the assumed values of r/B and Ko(r/B), are used as match point coordinates. The values of T, m', K', and Q employed in these calculations are based on aquifer test and geological data, while the values of r/B and $K_o(r/B)$ are assumed values representing any convenient intersection of major axes on the steady state leaky artesian type curve. A theoretical distance drawdown curve of s plotted against r is prepared by projecting the steady state leaky artesian type curve at the match point coordinates of s, r, r/B, and $K_or/B)$ onto a sheet of logarithmic paper of the same scale. The expected drawdown at any radial distance from the withdrawal point may be read from this curve.

References

Cooper, H.H., Jr., and C.E. Jacob, 1946, A generalized graphical method for evaluating formation constants and summarizing well-field history: Transactions of the American Geophysical Union, v. 27, no. 4, p. 526-534.

Ferris, J.G., 1959, Groundwater, *in* C.O. Wisler and E.F. Brater, editors, Hydrology: John Wiley and Sons, New York, p. 198-272.

Freeze, R.A., and J.A. Cherry, 1979, Groundwater: Prentice Hall, Inc., Englewood Cliffs, N.J., 604 p.

Hantush, M.S., 1956, Analysis of data from pumping tests in leaky aquifers: Transactions of the American Geophysical Union, v. 37, no. 6, p. 702-714.

Hantush, M.S., and C. E. Jacob, 1954, Plane potential flow of ground water with linear leakage: Transactions of the American Geophysical Union, v. 35, no. 6, p. 917-936.

Hantush, M.S., and C.E. Jacob, 1955, Nonsteady radial flow in an infinite leaky aquifer: Transactions of the American Geophysical Union, v. 36, no. 1, p. 95-100.

Heath, R.C., 1989, Basic Ground-Water Hydrology: U.S. Geological Survey Water-Supply Paper 2220, 84 p.

Jacob, C. E., 1946, Radial flow in a leaky artesian aquifer: Transactions of the American Geophysical Union, v. 27, no. 2, p. 198-205.

Theis, C.V, 1935, The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well using Ground-water Storage: Transactions of the American Geophysical Union 16th Annual Meeting, part 2, p. 519-524.

Walton, W. C, 1960, Leaky Artesian Aquifer Conditions in Illinois: Illinois State Water Survey, Report of Investigation 39, 27 p.

Walton, W.C., 1962, Selected Analytical Methods for Well and Aquifer Evaluation: Illinois State Water Survey Bulletin 49, 81 p.

APPENDIX G RESULTS OF HISTORICAL AQUIFER TESTS

Aquifer Tests and Specific-Capacity Data in the Sankoty-Mahomet Sand Aquifer in or near the Study Area

		Sankoty-Mahomet Sand aquifer						
Well location	Well owner	Depth (ft)	Pumping rate (gpm)	Specific capacity (gpm/ft)	Analysis method	Transmissivity (gpd/ft)	Hydraulic conductivity (gpd/ft^2)	Storage coefficient
Dewitt								
21N1E-								
29.7b8	Waynesville(OW1)	217			T	6,200		0.0007
Logan								
21N3W-								
6.7c	Emden	124	205	14.6	S	32,000		
McLean								
22N1E-								
16.7d1	IDOT (Funk's Grove)	322	37	2.9	T	5,900		
22N1W-								
6.1h1	Olympia High School	250	215	21.5	T	153,400	1,870	
35.1b1	McLean County	353			S	1,400		
35.1b3	McLean County	340	203	16.4	R	75,800	2,920	
35.8c4	McLean County	332	203	11.8	T	133,700	2,060	
23N1E-								
6.8h100	Normal	346	1416	128.3	T	340,400	3,660	
6.8h100	Normal (OW1)	268			T	201,800	2,170	0.0050
6.8hTH20	Normal	268	425	153.4	T	298,700	3,280	
6.8hTH20	Normal (OW1)	275			T	266,400	2,930	0.0002
6.8hTH20	Normal (OW2)	269			T	289,900	3,260	0.0020
6.8hTH20	Normal (OW3)	268			T	273,800	2,980	0.0100
6.8hTH20	Normal (OW4)	200			T	289,900		0.0008

Modified from Wilson et al. (1994)

Notes: Four different analysis methods were used: time-drawdown (T), time-recovery (R), specific capacity (S), or a combination (TR). An asterisk indicates that wells may be finished in finer Mahomet or pre-Mahomet deposits.

Well location	Well owner	Depth (ft)	Pumping rate (gpm)	Specific capacity (gpm/ft)	Analysis method	Transmissivity (gpd/ft)	Hydraulic conductivity (gpd/ft^2)	Storage coefficient
3N1W-								
10.1h103	Normal	328	1078	59.5	T	147,400		
10.1h103	Normal (OW1)	253			TR	146,700		0.0004
10.1h103	Normal (OW2)	256			TR	136,200		0.0004
10.1h103	Normal (OW3)	250			TR	138,300		0.0003
10.1hTW21	Normal	324	567	31.2	T	126,700	1,690	
10.1hTW21	Normal (OW1)	325			T	117,900	1,340	0.0002
10.1hTW21	Normal (OW3)	323			T	117,900	1,370	0.0002
10.1hTW21	Normal (OW4)	324			T	127,700		0.0002
21.5c	Stanford (OW4)	235			T	76,700		0.0001
21.5c3	Stanford	247	81	21.8	T	89,100	2,480	
21.7d4	Stanford	246	150	13.0	T	77,600		
24N1E-								
9.7aTH1	D. Grieder Sod Farm	280	55	7.2	R	132,000	4,130	
24N1W-								
23.1g3	Danvers	417	195	9.1	S	16,500		
23.1g4	Danvers	438	120	6.6	T	28,300	620	
35.2a102	Normal	364	1409	107.4	T	470,400	2,630	
35.2a102	Normal (supply)	239	488	22.2	S	45,200		
35.2a102	Normal (OW1)	239			T	173,600		0.0900
36.5a101	Normal	345	1409	143.3	T	516,600		
36.5a101	Normal (supply)	243	480	25.3	S	52,600		
36.5a101	Normal (OW1)	324			T	127,700		0.0002
Tazewell								
22N2W-								
22.5a	Armington	213			S	11,500		

Modified from Wilson et al. (1994)

Notes: Four different analysis methods were used: time-drawdown (T), time-recovery (R), specific capacity (S), or a combination (TR). An asterisk indicates that wells may be finished in finer Mahomet or pre-Mahomet deposits.

Well location	Well owner	Depth (ft)	Pumping rate (gpm)	Specific capacity (gpm/ft)	Analysis method	Transmissivity (gpd/ft)	Hydraulic conductivity (gpd/ft^2)	Storage coefficient
22N3W-								
20.3aTST3	0W1	234			T	291,100	2,300	0.000096
203aTST3	OW3	158			T	296,000		0.000495
22N4W-								
16.8b1	H. Walker Dist.	209	2248	97.7	T	280,200		
16.8d3	H. Walker Dist.	212	199	17.8	T	132,000	770	
24N2W-								
3.4aTW1	IDOC hatchery (OW2)	299			TR	309,700	2,230	0.0005
3.4aTW1	IDOC hatchery (OW3)	300			TR	337,000	2,530	0.0003
10.4hTW1	IDOC hatchery (OW1)	308			TR	249,100	1,850	0.0009
10.4hTH	IDOC hatchery (I-75)	295	1001	23.3	R	283,900		
17.1c6	Mackinaw (OW1)	305			T	349,600	2,670	0.000495
17.1c6	Mackinaw (OW2)	215			T	340,600	2,660	0.000545
17.1c6	Mackinaw (OW3)	215			T	348,300		0.000965
18.4d5	Mackinaw	151	180	41.4	R	71,700		
24N3W-								
19.5g4	Tremont	154	164	7.5	S	7,200		
19.5g6	Tremont	212	424	12.0	T	26,700	1,910	
19.5g7	Tremont	201	398	17.7	S	55,000	1,200	
24N4W-								
			Glasford aquifers					
Logan								
21N1W-								
20.2cTW1-78	Atlanta	134	33	8.1	TR	20,300		
20.3c8	Atlanta	133	101	6.9	T	17,000	1,420	
20.5e1	Atlanta	191	63	2.0	TR	12,300		

Modified from Wilson et al. (1994)

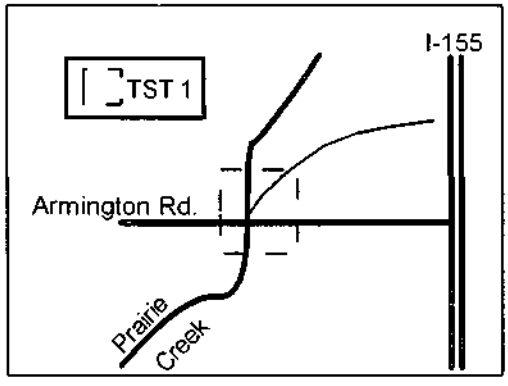
Notes: Four different analysis methods were used: time-drawdown (T), time-recovery (R), specific capacity (S), or a combination (TR). An asterisk indicates that wells may be finished in finer Mahomet or pre-Mahomet deposits.

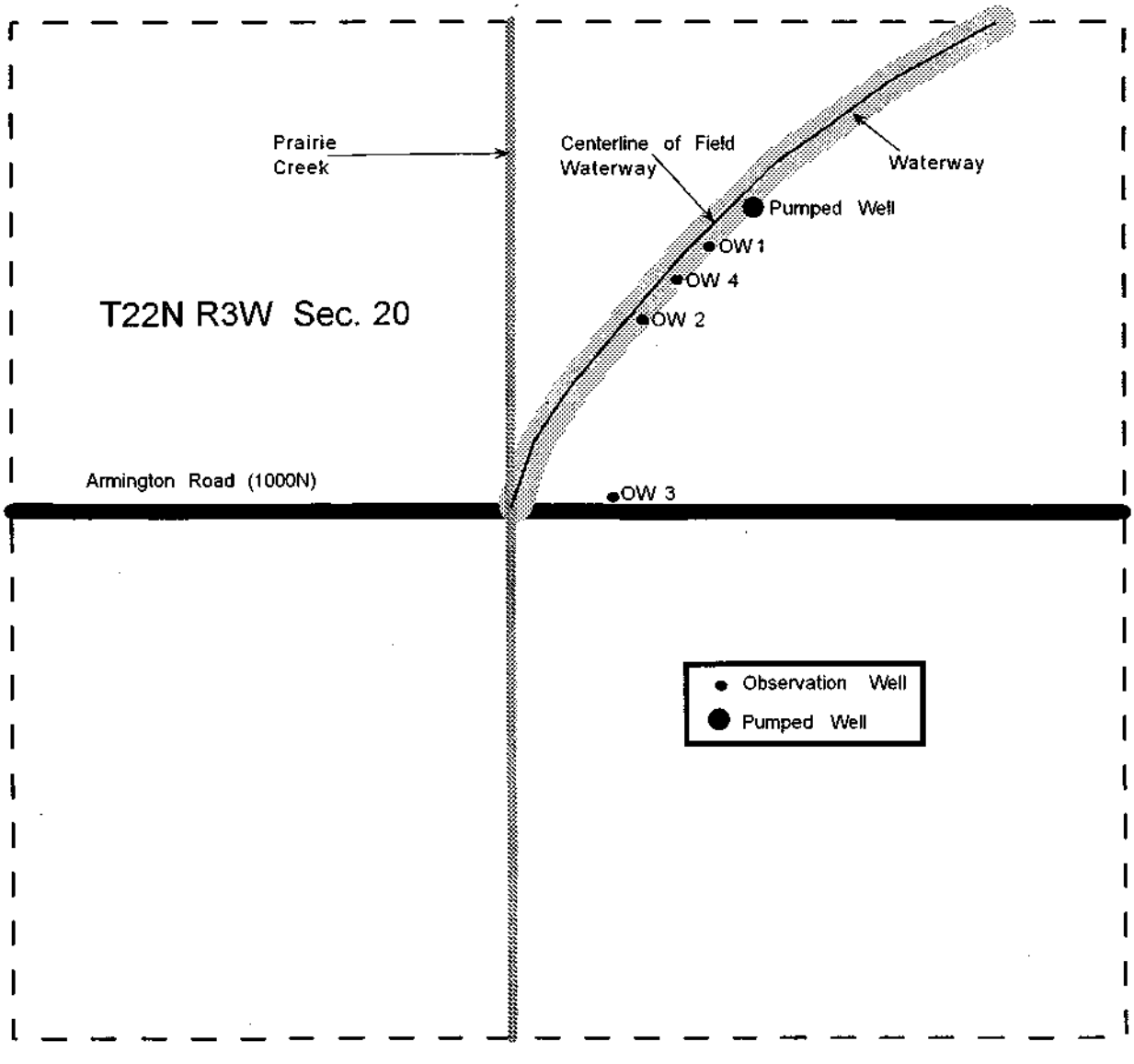
Well location	Well owner	Depth (ft)	Pumping rate (gpm)	Specific capacity (gpm/ft)	Analysis method	Transmissivity (gpd/ft)	Hydraulic conductivity (gpd/ft^2)	Storage coefficient
20.3e2	Atlanta	147	62	3.0	TR	13,900	1,260	
20.3eOW3-2	Atlanta	158			TR	21,200	1,510	.0001
20.3fOW5-2	Atlanta	142			TR	12,700		.00008
20.3e3	Atlanta	158	43	2.9	S	4,000	290	
20.3e9	Atlanta	147	73	6.9	T	24,100		
20.3eOW1-9	Atlanta	147			T	24,600	2,240	.00002
20.3eOW2-5	Atlanta	147			TR	15,000	1,360	.00004
20.3f5	Atlanta	142	49	4.9	TR	16,600		
20.5e1	Willow Farms Dairy	152			S	11,400		
20.5e4	Atlanta	150	110	7.2	T	17,000	940	
20.53TW4	Atlanta	150	21	5.1	T	16,300	910	
20.5e7	Atlanta	186	168	8.1	R	12,100		
20.5eOW1-7	Atlanta	191			T	8,400		.0002
21N3W-								
21.4a2	Hartsburg	105	40	2.0	T	7,000		
21.4a3	Hartsburg	103	51	6.1	TR	29,900		
Tazewell								
24N2W-								
18.4d1	Mackinaw	37			S	25,600		
18.4d3	Mackinaw	39	182	71.4	S	121,900		
18.4d4	Mackinaw	42	180	38.5	T	95,000	9,500	
18.4dOW1-4	Mackinaw	39			T	95,900	8,720	.08
11.3a2	Tazewell Co Health Dept	105	46	4.4	R	7,200		

Modified from Wilson et al. (1994)

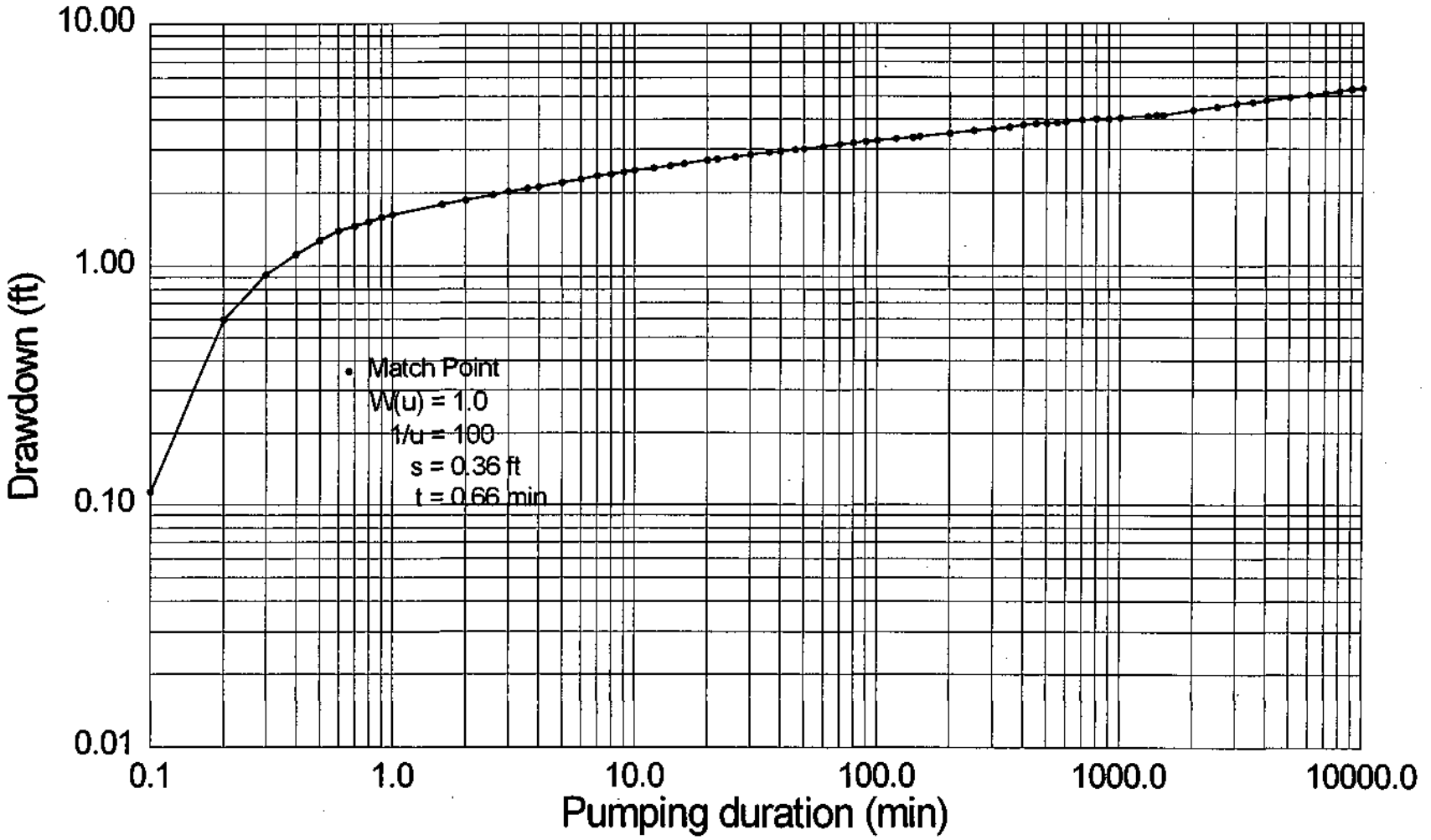
Notes: Four different analysis methods were used: time-drawdown (T), time-recovery (R), specific capacity (S), or a combination (TR). An asterisk indicates that wells may be finished in finer Mahomet or pre-Mahomet deposits.

Location of Aquifer Test Site 1 (TST 1)

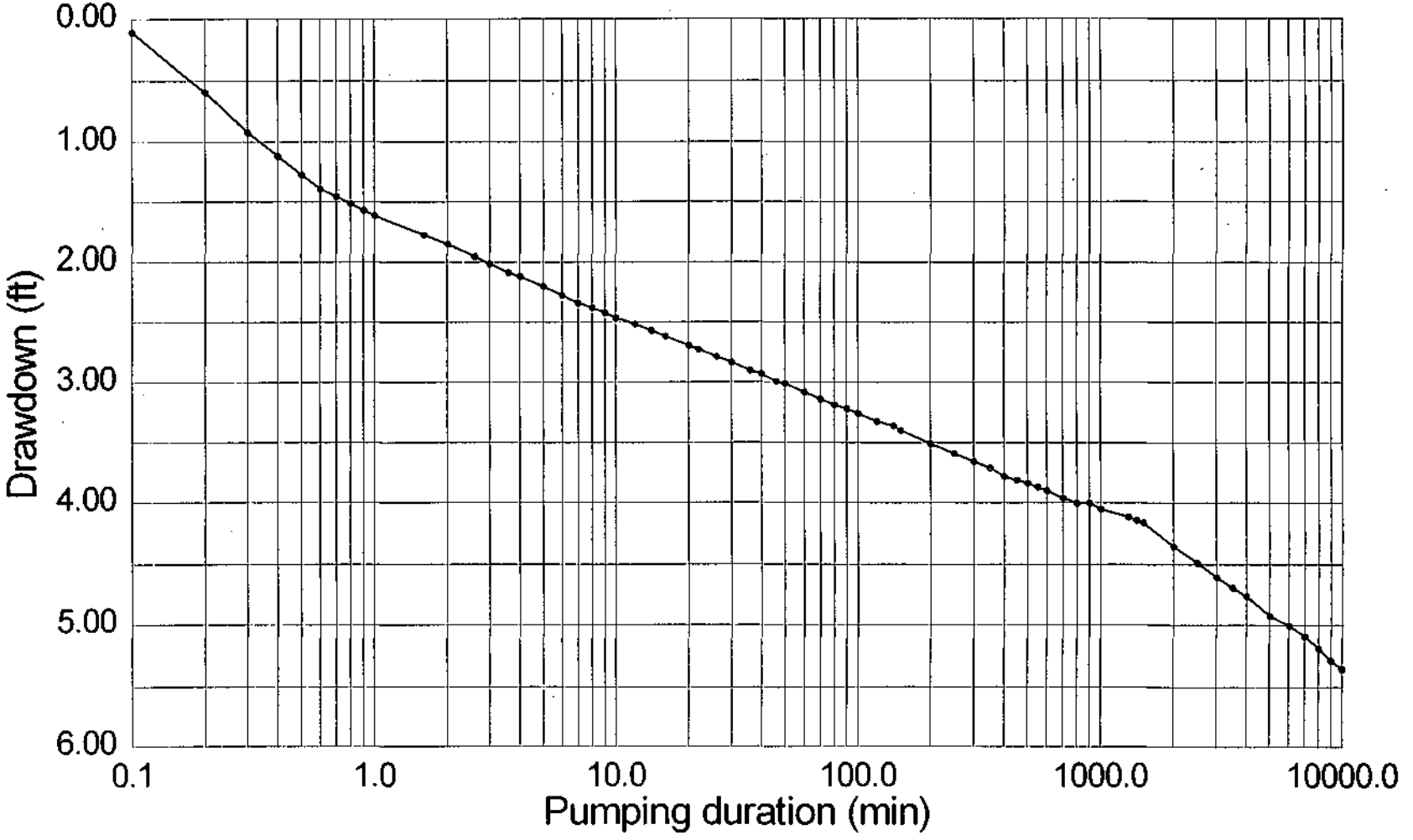




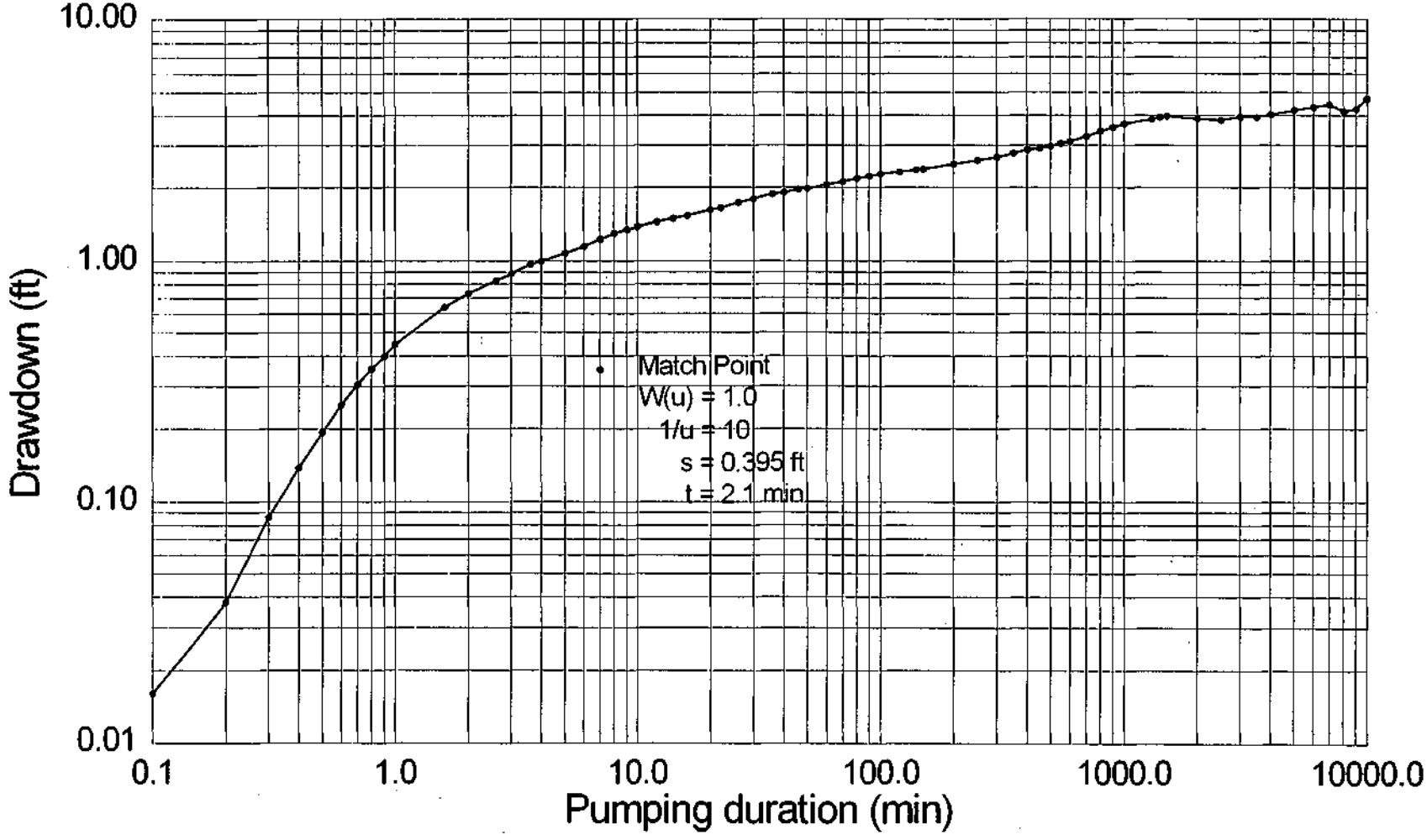
Log-Log Plot of Drawdown vs. Time at TST1 - Observation Well 1



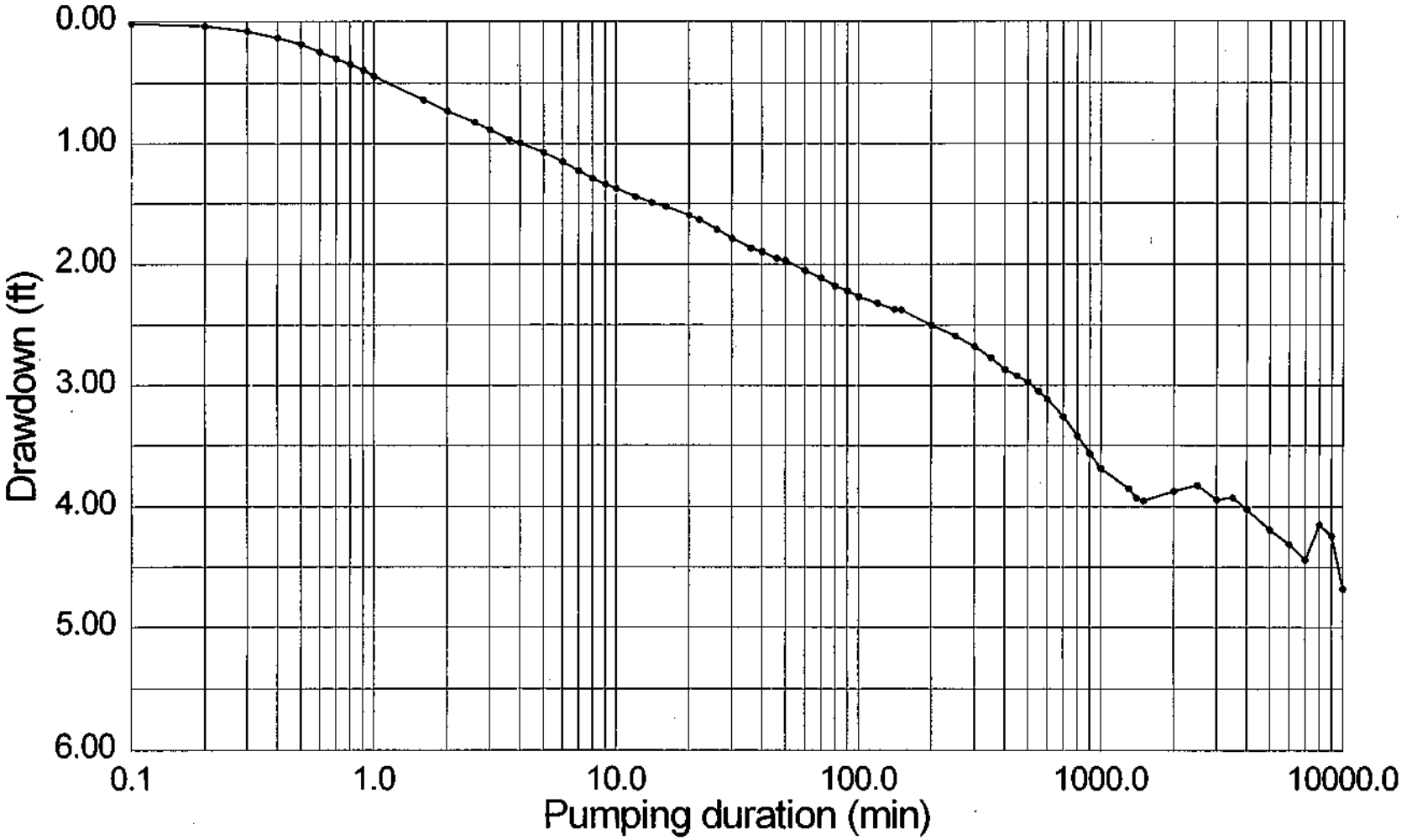
Semi-Log Plot of Drawdown vs. Time at TST1 - Observation Well 1



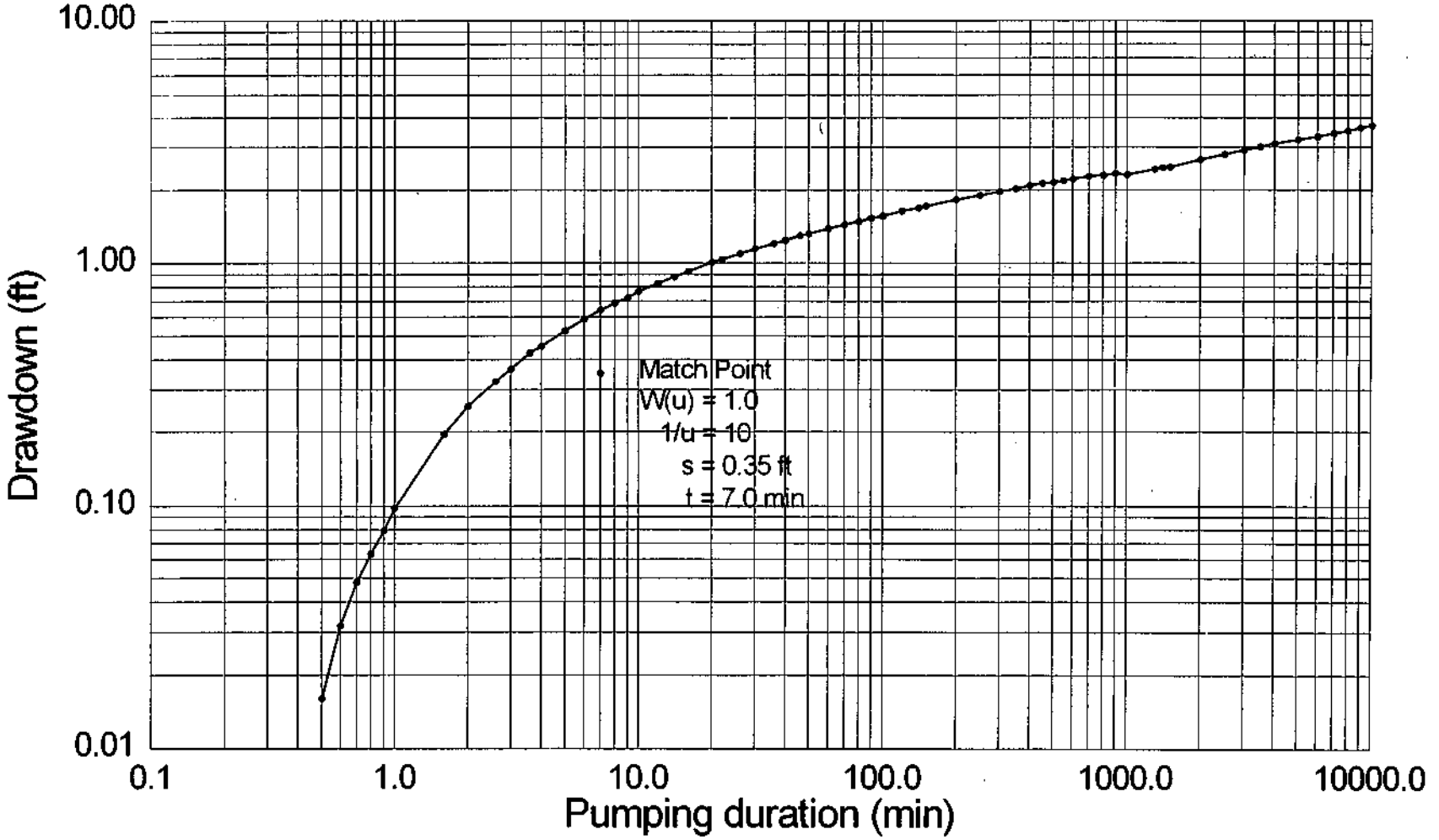
Log-Log Plot of Drawdown vs. Time at TST1 - Observation Well 2



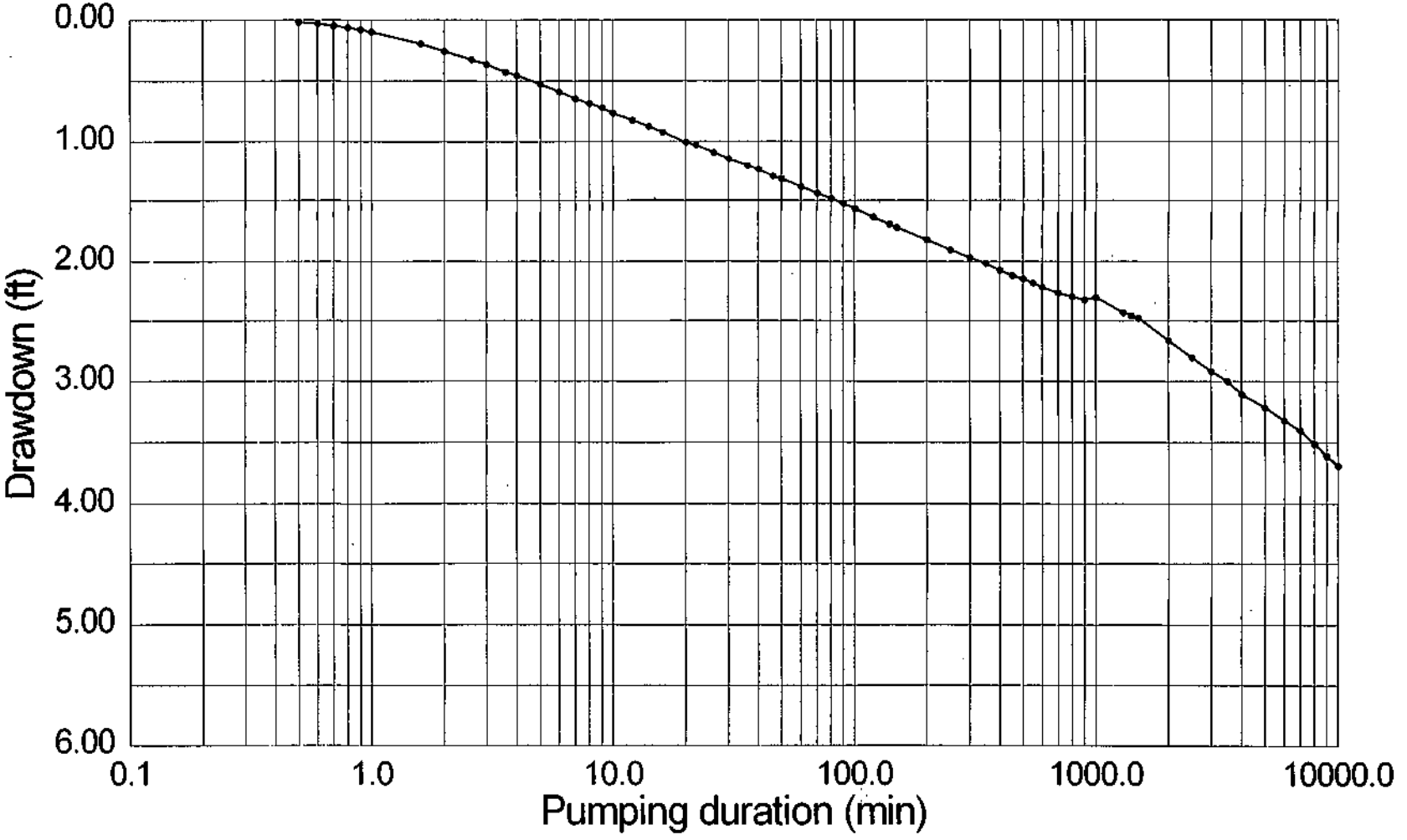
Semi-Log Plot of Drawdown vs. Time at TST1 - Observation Well 2



Log-Log Plot of Drawdown vs. Time at TST1 - Observation Well 3



Semi-Log Plot of Drawdown vs. Time at TST1 - Observation Well 3



Pump Test Data For TST 1

Minutes into Test	OW1 Drawdown (ft)	OW2 Drawdown (ft)	OW3 Drawdown (ft)
0.1	0.11	0.02	0.00
0.2	0.60	0.04	0.00
0.3	0.92	0.09	0.00
0.4	1.12	0.14	0.01
0.5	1.27	0.19	0.02
0.6	1.39	0.25	0.03
0.7	1.45	0.31	0.05
0.8	1.52	0.35	0.06
0.9	1.57	0.40	0.08
1.0	1.62	0.44	0.10
1.6	1.78	0.64	0.20
2.0	1.86	0.73	0.26
2.6	1.96	0.82	0.32
3.0	2.01	0.88	0.37
3.6	2.08	0.96	0.43
4.0	2.11	1.00	0.45
5.0	2.20	1.08	0.53
6.0	2.27	1.15	0.59
7.0	2.34	1.23	0.64
8.0	2.38	1.29	0.69
9.0	2.42	1.34	0.72
10.0	2.46	1.37	0.76
12.0	2.52	1.44	0.82
14.0	2.57	1.49	0.88
16.0	2.62	1.52	0.92
20.0	2.69	1.60	1.01
22.0	2.73	1.64	1.03
26.0	2.79	1.72	1.09
30.0	2.84	1.79	1.15
36.0	2.91	1.87	1.21
40.0	2.93	1.90	1.24
46.0	3.00	1.95	1.30
50.0	3.01	1.97	1.32
60.0	3.08	2.05	1.39
70.0	3.14	2.11	1.44
80.0	3.19	2.18	1.49
90.0	3.22	2.22	1.53
100.0	3.26	2.27	1.56
120.0	3.33	2.32	1.63

Pump Test Data For TST 1

Minutes into Test	OW 1 Drawdown (ft)	OW 2 Drawdown (ft)	OW 3 Drawdown (ft)
140.0	3.37	2.37	1.69
150.0	3.41	2.37	1.72
200.0	3.51	2.50	1.82
250.0	3.59	2.59	1.90
300.0	3.66	2.67	1.97
350.0	3.71	2.77	2.02
400.0	3.78	2.87	2.08
450.0	3.81	2.92	2.12
500.0	3.84	2.97	2.15
550.0	3.87	3.05	2.18
600.0	3.90	3.12	2.22
700.0	3.97	3.27	2.27
800.0	4.00	3.43	2.30
900.0	4.00	3.57	2.33
1000.0	4.05	3.69	2.30
1300.0	4.12	3.85	2.43
1400.0	4.14	3.93	2.46
1500.0	4.16	3.95	2.48
2000.0	4.36	3.87	2.66
2500.0	4.49	3.82	2.80
3000.0	4.61	3.94	2.92
3500.0	4.70	3.93	3.00
4000.0	4.76	4.02	3.11
5000.0	4.92	4.20	3.21
6000.0	5.01	4.32	3.32
7000.0	5.10	4.44	3.41
8000.0	5.20	4.15	3.52
9000.0	5.29	4.25	3.61
10000.0	5.36	4.68	3.69

TEST WELL REPORT

Layne-Western Company, Inc.

TEST HOLE NO. 1

721 Wast Illinois Avenue • Aurora, Illinois 60506-2892 • Phone: 708/397-6941

1. Owner Long Range Water Plan Steering Committee Contract No. (7295T) Date 11/16/94
2. City Delavan State Illinois
3. Driller's Name S. Lumbert Helpers C. Glidewell
4. Static Water Level _____ How Obtained – Washed (X) Pumped (X)
5. Size Mud Pit – Length 5 Width 12

DRILLERS LOG

TOP FT.	BOTTOM FT.	MUD LOSS INCHES	MUD WEIGHT	DESCRIPTION OF FORMATION	REMARKS
0	5			Black topsoil	
5	6			Dark brown silty clay	
6	13			Gray and brown silty clay/sand seams	
13	15			Brownish gray clay with gravel	
15	25			Brown very silty clay to peat	
25	31			Dark brown very silty clay	
31	36			Hard gray silty clay	
36	59			Blue gray sandy silty clay-occasional gravel	
59	71			Fine sand to small gravel	
71	107			Brownish gray sandy silty clay-occasional gravel seam	
107	133	1		Gray fine sand	
133	151	2		Fine sand to small and medium gravel	
151	195	4		Fine sand to medium gravel, some fine layers	
195	227	2		Medium to coarse sand and coarse gravel	
227	233			Coarse gravel (boulder @ 229')	
233	234			Weathered limestone	
234	237			Light gray to blue shale-firm	
				Set 4" pipe with slots from 213'-233'.	

LW-95

TAZEWELL COUNTY HEALTH DEPARTMENT

OFFICE OF ENVIRONMENTAL SERVICES

Food Sanitation
Private Sewage
Potable Water
Solid Waste
Habitation
Nuisance

November 15, 1994

Mr. Steve Wilson
Assistant Hydrologist
Illinois State Water Survey
2204 Griffith Drive
Champaign, IL 61820-7495

RE: Test well

Dear Mr. Wilson:

Per our conversion on November 15, 1994, the test well that is being drilled at the following location does not need a permit: Mark Graber Property at SW 1/4 of SE 1/4 of sec. 20 in Boyton Township. This well is being done for the Illinois State Water Survey and will be a test well only and will be filled in after completion of the testing.

If you have any questions regarding this matter, please feel free to contact this office.

Sincerely,

TAZEWELL CO. HEALTH DEPT.

Patricia K. Welch

Patricia K. Welch, MPA, R.S.
Director of Env. Health

21306 IL Rte 9 - Tremont, IL 61568 - 9252
(309) 925-5511 / 477-2223
Equal Opportunity Employer

Illinois State Water Survey

Chemistry Division
2204 Griffith Drive
Champaign, Illinois 61820-7495
Telephone (217) 333-9321
Telefax (217) 333-6540

WATER SAMPLE DATA
LABORATORY SAMPLE NUMBER: 228337

SOURCE: WELL
OWNER: MARK GRABER
LOCATION: SOUTHEAST OF DELAVAN
COUNTY: TAZEWELL TOWNSHIP: 22N RANGE: 03W SECTION: 20.4A
DATE COLLECTED: 01/25/1995 DATE RECEIVED: 01/27/1995
WELL DEPTH (Ft.): ND TEMPERATURE REPORTED (F): ND
TREATMENT: NONE
COMMENTS: MCTAZ SITE NO. 3. WELL PUMPED FOR 7 DAYS AT 900 GPM BEFORE COLLECTION.

PARAMETER:	mg/L	PARAMETER:	mg/L
Iron (Total Fe):	3.18	Fluoride (F):	0.2
Manganese (Mn):	0.05	Chloride (Cl):	15.5
Calcium (Ca):	85.6	Sulfate (SO4):	< 0.9
Magnesium (Mg):	38.8	Nitrate (NO3-N):	< 0.02
Sodium (Na):	35.2		
Barium (Ba):	0.26		
Beryllium (Be):	< 0.003		
Chromium (Cr):	< 0.007		
Copper (Cu):	< 0.01		
Nickel (Ni):	< 0.031		
Zinc (Zn):	< 0.02		
Turbidity(Lab, NTU):	0.87	Alkalinity (CaC03):	442
Color (PCU):	10	Hardness (as CaC03):	372
pH (Lab):	7.7	Total Dissolved Minerals:	427
Odor:	NONE		

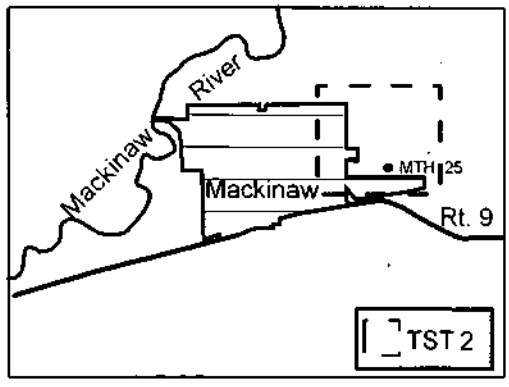
< = Below detection limit (i.e. <1.0 = less than 1.0 mg/L)
mg/L - milligrams per liter mg/L × 0.0584 - grains per gallon
uS/cm = microsiemens per centimeter
ND = Not determined/Information not available

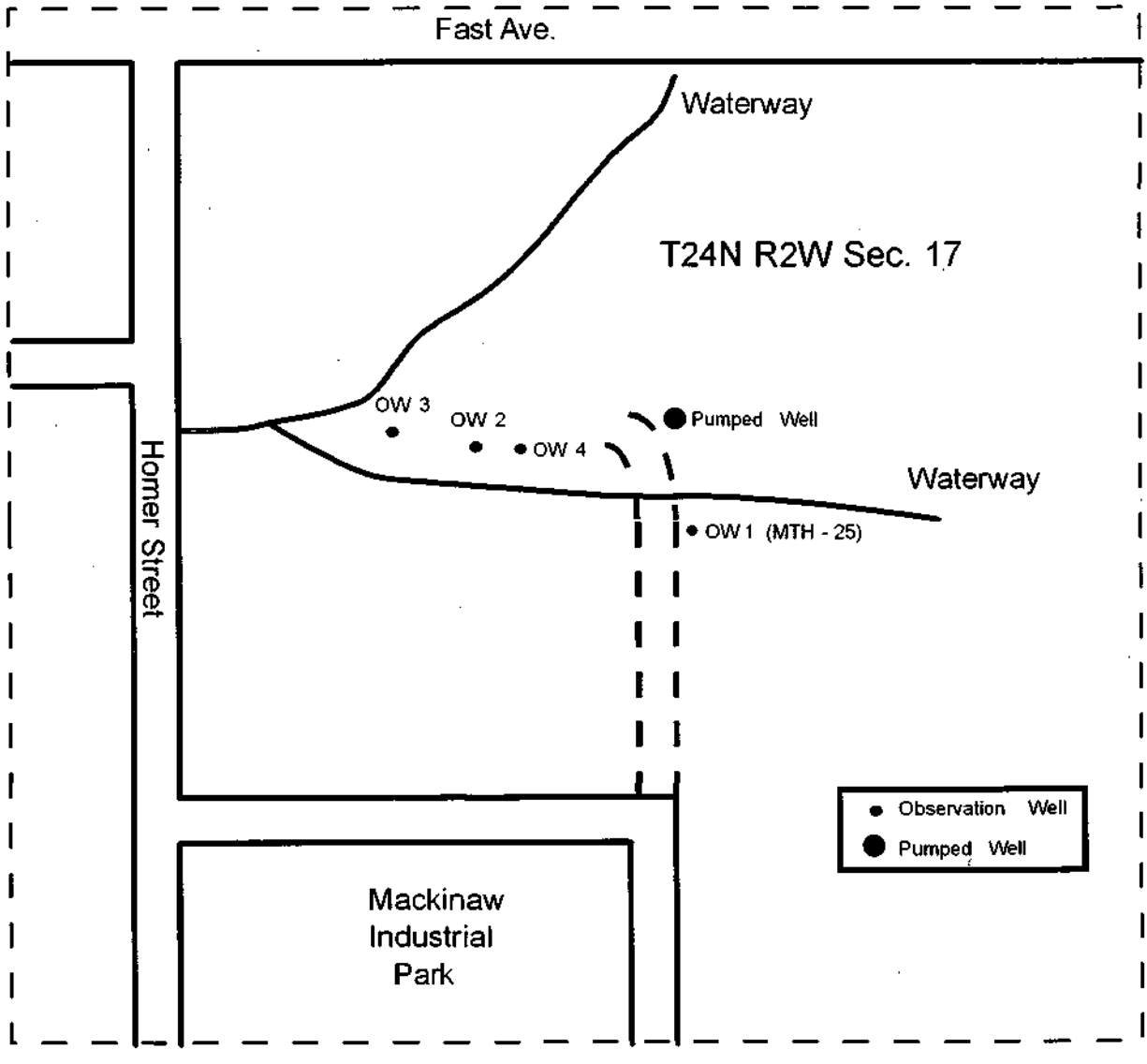
IEPA Certified Environmental Laboratory, Number 100202

Lauren F. Sievers

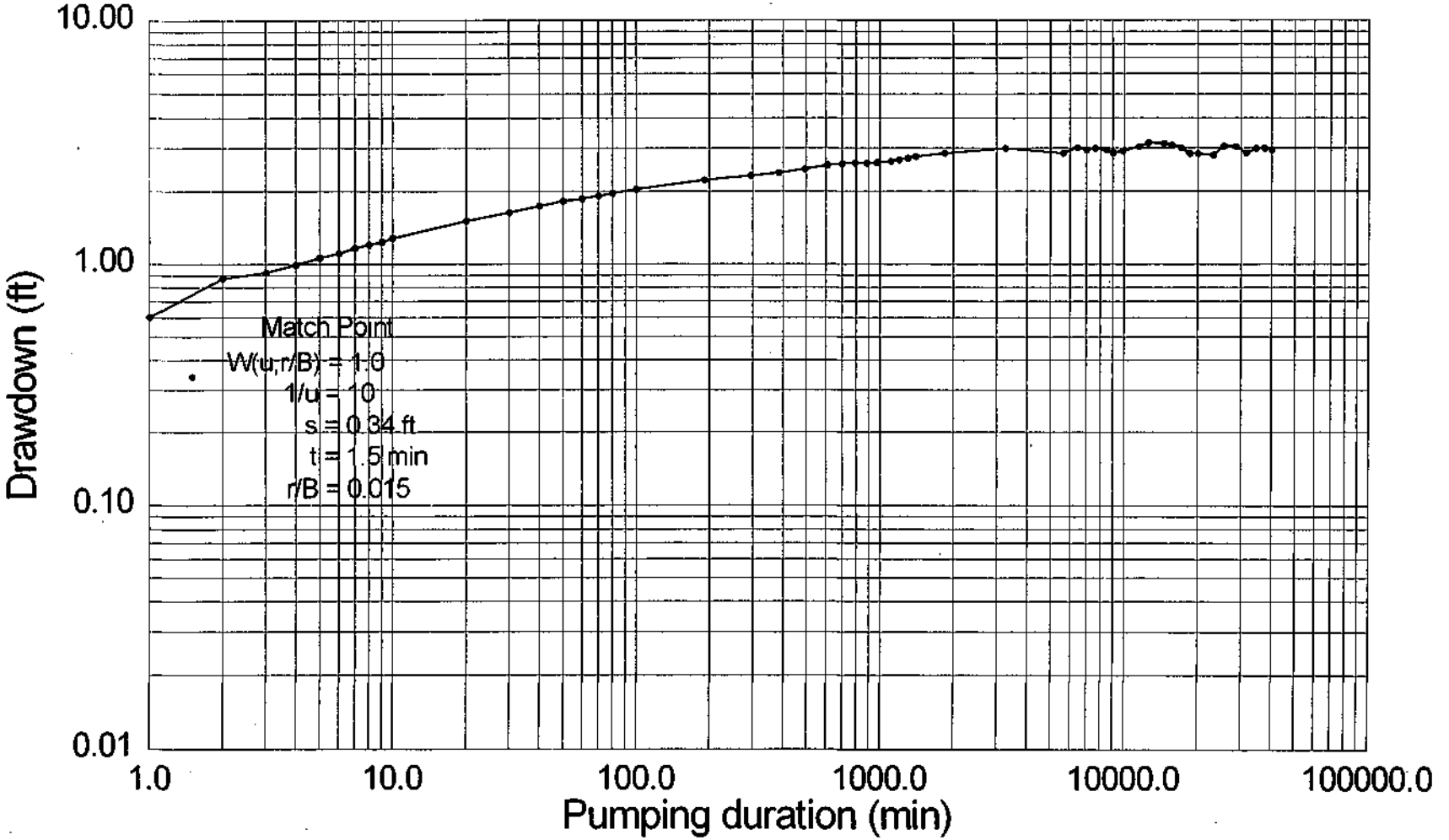
Analyst: Lauren F. Sievers
Assistant Chemist

Location of Aquifer Test Site 2 (TST 2)

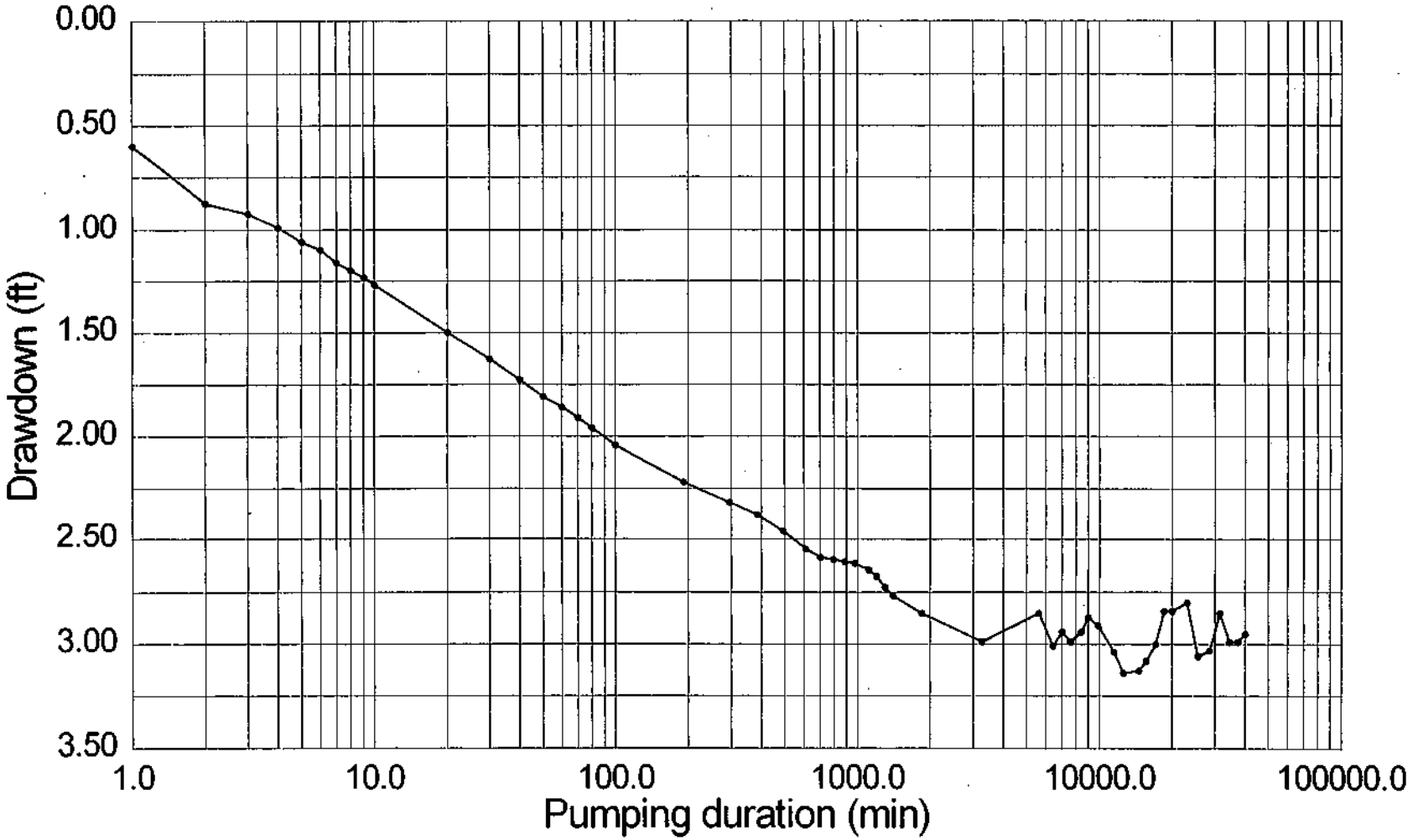




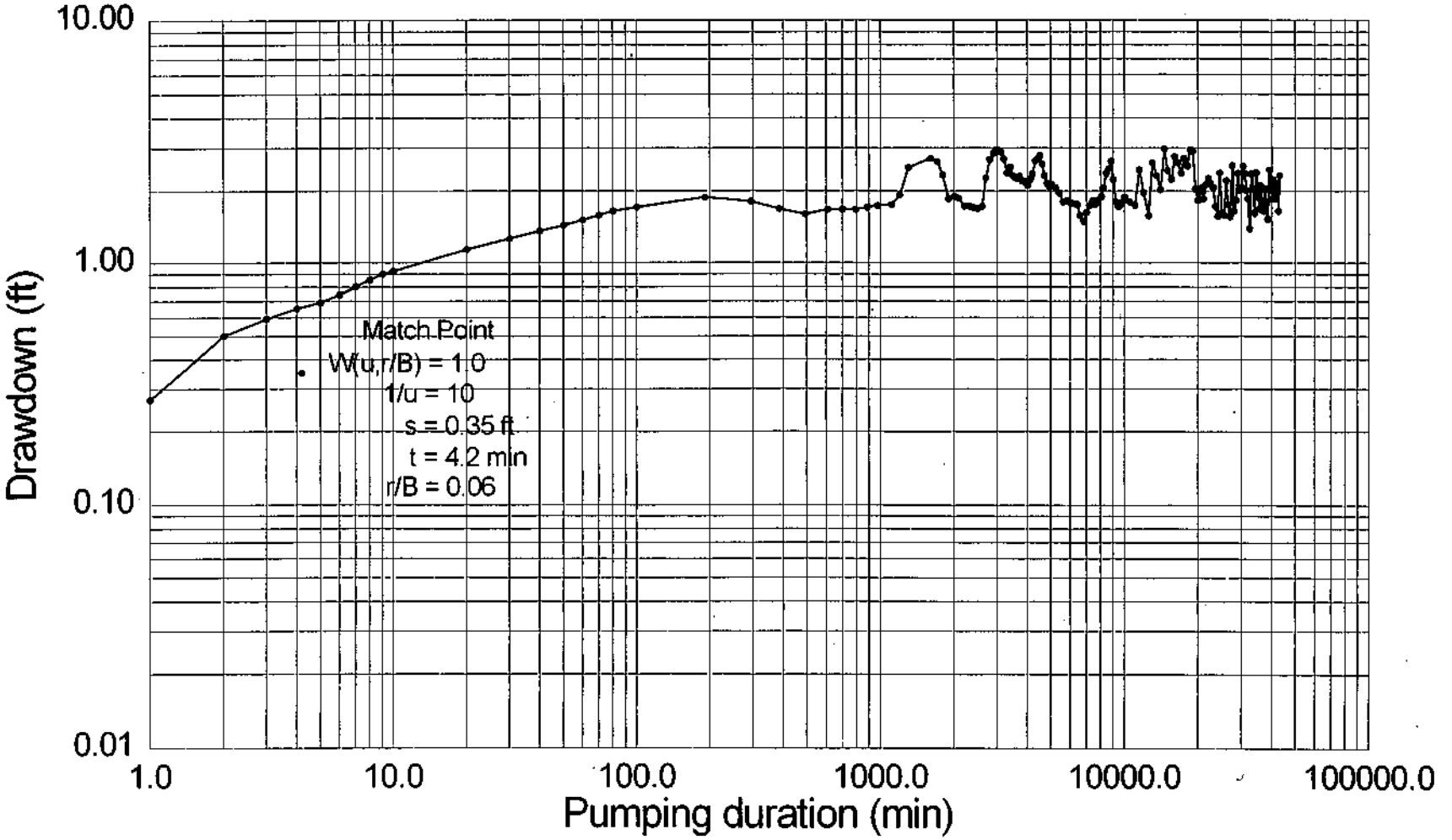
Log-Log Plot of Drawdown vs. Time at TST2 - Observation Well 1



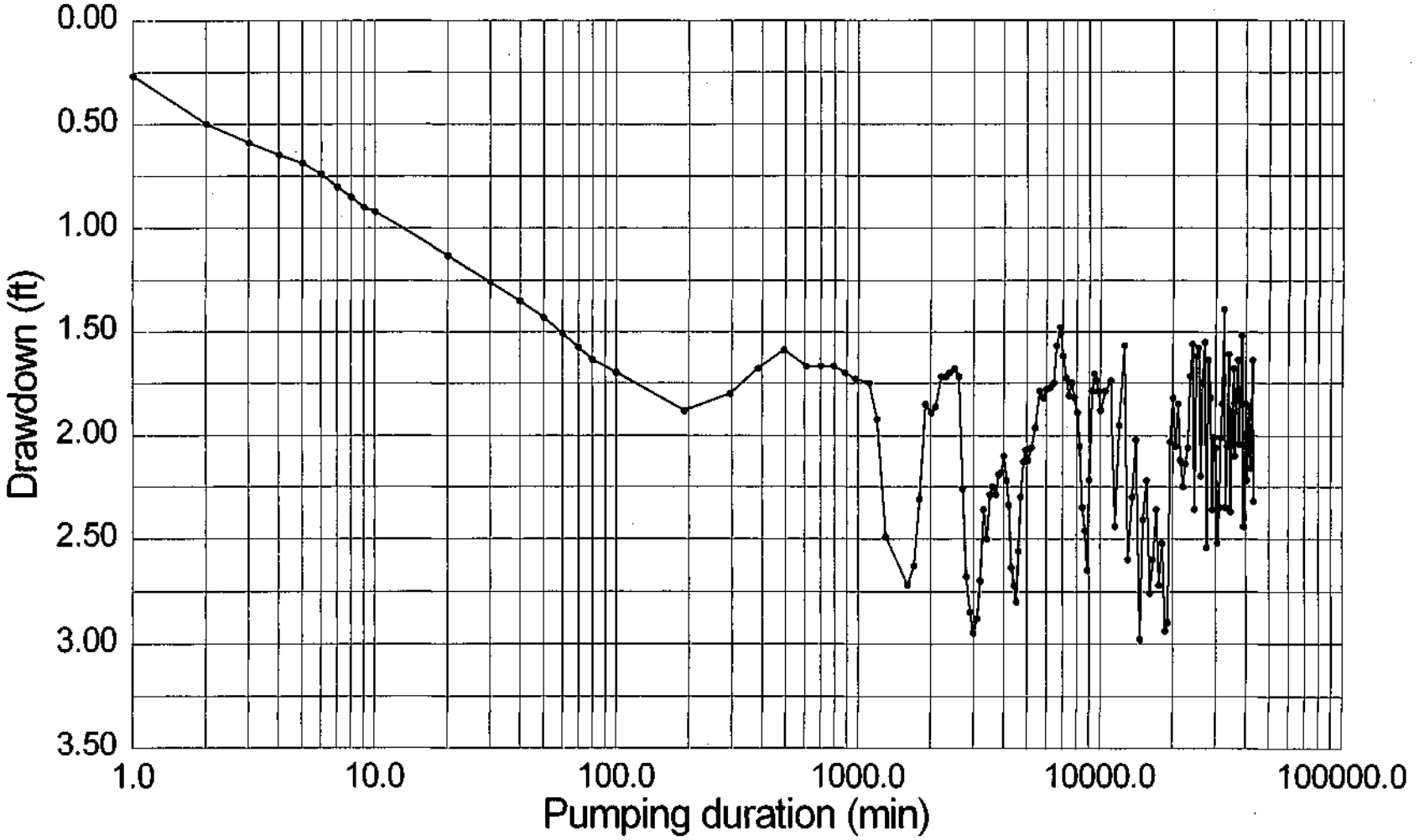
Semi-Log Plot of Drawdown vs. Time at TST2 - Observation Well 1



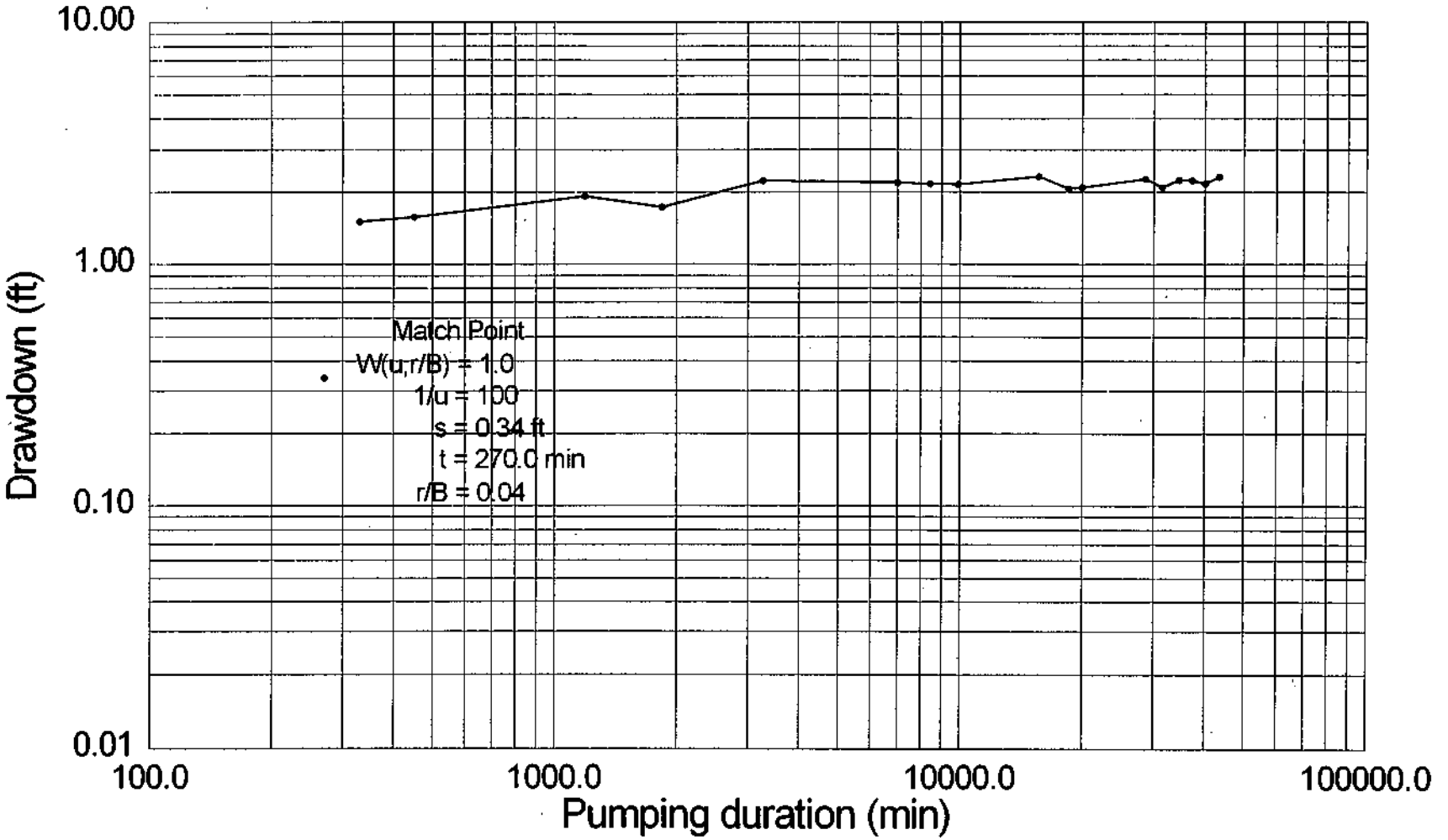
Log-Log Plot of Drawdown vs. Time at TST2 - Observation Well 2



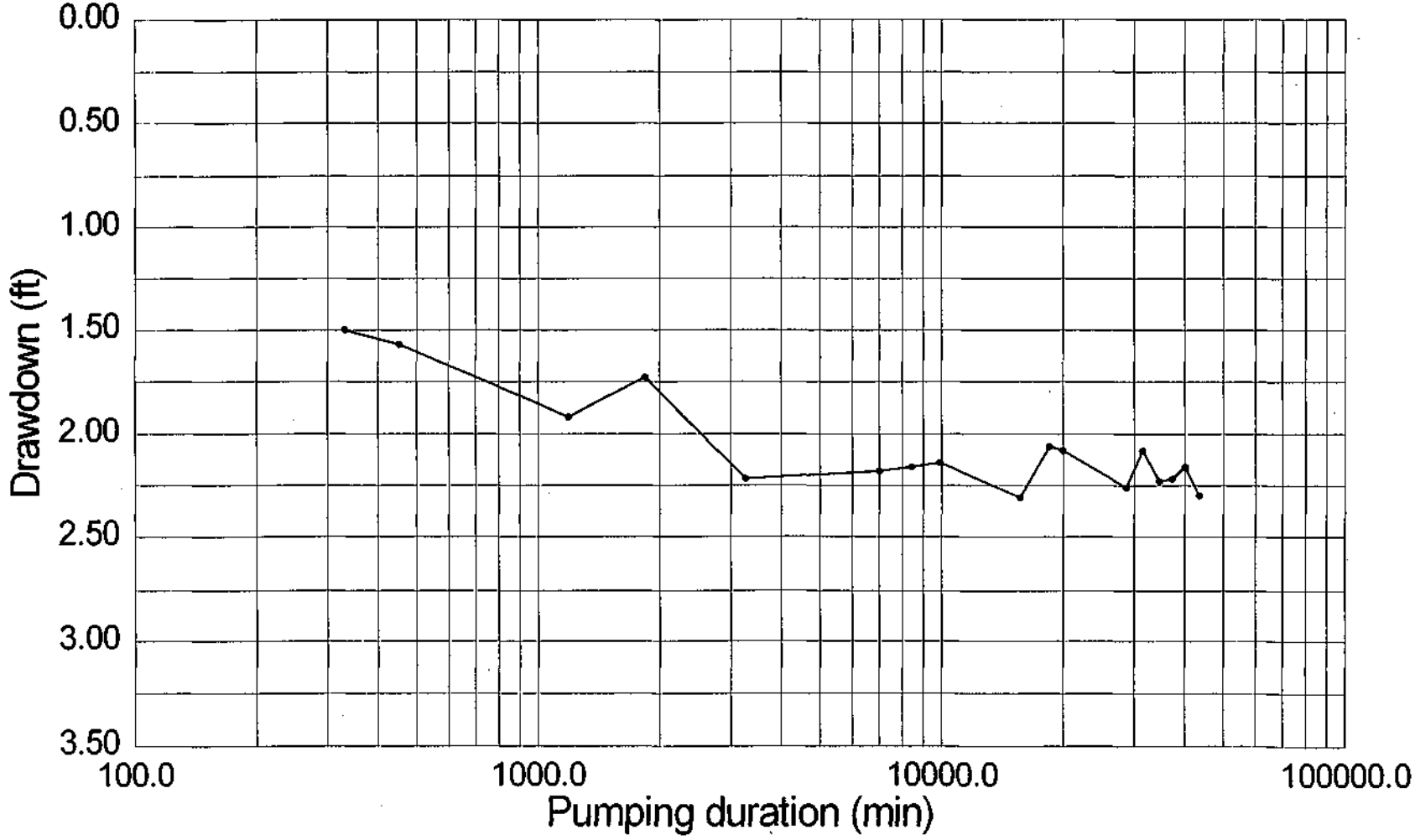
Semi-Log Plot of Drawdown vs. Time at TST2 - Observation Well 2



Log-Log Plot of Drawdown vs. Time at TST2 - Observation Well 3



Semi-Log Plot of Drawdown vs. Time at TST2 - Observation Well 3



Pump Test Data For TST 2

Minutes into Test	OW1 Drawdown (ft)	OW2 Drawdown (ft)	OW3 Drawdown (ft)
1	0.60	0.27	
2	0.87	0.50	
3	0.92	0.59	
4	0.99	0.65	
5	1.06	0.69	
6	1.10	0.74	
7	1.16	0.80	
8	1.20	0.85	
9	1.23	0.90	
10	1.27	0.92	
20	1.50	1.13	
30	1.63	1.26	
40	1.73	1.35	
50	1.81	1.43	
60	1.86	1.51	
70	1.91	1.58	
80	1.96	1.64	
100	2.04	1.70	
190	2.22	1.88	
295	2.32	1.80	
330			1.50
385	2.38	1.68	
450			1.57
490	2.46	1.59	
610	2.55	1.67	
700	2.59	1.67	
790	2.60	1.67	
880	2.61	1.70	
970	2.62	1.73	
1105	2.65	1.75	
1187			1.92
1195	2.68	1.92	
1300	2.73	2.49	
1405	2.77		
1600		2.72	
1705		2.63	
1795		2.31	
1842	2.85		1.73
1900		1.85	

Pump Test Data For TST 2

Minutes into Test	OW 1 Drawdown (ft)	OW 2 Drawdown (ft)	OW 3 Drawdown (ft)
2005		1.89	
2095		1.86	
2200		1.72	
2305		1.72	
2395		1.70	
2500		1.68	
2605		1.72	
2695		2.26	
2800		2.68	
2905		2.85	
2995		2.95	
3100		2.88	
3205		2.70	
3261	2.99		2.22
3295		2.36	
3400		2.50	
3505		2.29	
3595		2.25	
3700		2.29	
3805		2.19	
3895		2.18	
4000		2.10	
4105		2.22	
4195		2.34	
4300		2.64	
4405		2.72	
4495		2.80	
4600		2.56	
4705		2.30	
4810		2.13	
4900		2.07	
5005		2.12	
5200		2.06	
5395		1.96	
5605		1.79	
5625	2.85		
5800		1.82	
5995		1.78	
6205		1.77	

Pump Test Data For TST 2

Minutes into Test	OW 1 Drawdown (ft)	OW 2 Drawdown (ft)	OW 3 Drawdown (ft)
6315	3.01		
6400		1.75	
6595		1.57	
6805		1.48	
6980	2.94		2.18
7000		1.62	
7195		1.73	
7405		1.81	
7575	2.99		
7600		1.75	
7795		1.82	
8005		1.89	
8200		2.05	
8395		2.35	
8422	2.94		2.16
8605		2.46	
8800		2.65	
8995		2.22	
9015	2.87		
9220		1.79	
9400		1.71	
9595		1.74	
9805		1.79	
9865	2.91		2.14
10000		1.88	
10495		1.79	
11005		1.74	
11295	3.04		
11500		2.44	
11995		1.95	
12505		1.57	
12680	3.14		
13000		2.60	
13495		2.30	
14005		2.02	
14333	3.13		
14500		2.98	
14995		2.41	
15505		2.22	

Pump Test Data For TST 2

Minutes into Test	OW1 Drawdown (ft)	0W2 Drawdown (ft)	0W3 Drawdown (ft)
15610			2.31
15750	3.08		
16000		2.76	
16495		2.60	
17005		2.36	
17050	3.00		
17500		2.72	
17995		2.52	
18490	2.84		2.06
18505		2.94	
19000		2.90	
19495		2.03	
19935	2.84		2.08
20005		1.82	
20500		2.05	
20995		1.85	
21505		2.12	
22000		2.25	
22495		2.14	
22810	2.80		
23005		2.06	
23500		1.72	
23995		1.56	
24505		2.36	
25000		1.62	
25480		1.58	
25785	3.06		
26005		2.20	
26500		1.75	
26995		1.55	
27505		2.54	
28000		1.64	
28495		1.82	
28582	3.03		2.26
29005		2.36	
29500		2.01	
29995		2.06	
30505		2.52	
31000		2.35	

Pump Test Data For TST 2

Minutes into Test	OW 1 Drawdown (ft)	OW 2 Drawdown (ft)	OW 3 Drawdown (ft)
31455	2.85		2.08
31495		2.01	
32005		1.85	
32500		1.39	
32995		2.35	
33505		2.05	
34000		1.61	
34495		2.37	
34579	2.99		2.23
35005		1.90	
35500		1.68	
35995		2.10	
36505		1.79	
37000		1.64	
37215	2.99		2.22
37495		2.04	
37990		1.78	
38500		1.52	
38995		2.44	
40000		1.85	
40094	2.95		2.16
40495		2.22	
41005		1.86	
41500		1.96	
41995		2.16	
42505		1.64	
43000		2.32	
43410			2.30

WELL INFORMATION - DRIFT WELLS

Pumping well

Layne-Western Company, Inc.

PROFESSIONAL SERVICES FOR WATER SYSTEMS

721 West Illinois Avenue • Aurora, Illinois 60506-2892 • Phone: 708/897-6941

Name of Job: Long Range Water Plan Steering Committee Date: 2/16/95

City or Village: Mackinaw State: IL

Well No.: 6 Drillers: C. Glidewell, M. Rife

Well Location: _____ ft. (____) and _____ ft. (____) of the _____ corner of

Section 17, Twp. 24 (N), Range 2 (W) Tazewell County.

Otherwise located as _____

Work Began: 1/12/95 Work Completed: 1/26/95 Well Depth: 325'

All measurements made from existing ground level at time well was drilled.

Casing Record:

Amount	Dia.	Wt. or Thickness	Material				
287'	16"	.375	Steel	with welded	joints from 285'	to +2'	
				with	joints from	to	

Screen Record: Type Houston and Johnson

Amount	Dia.	Opening	Material				
40'	16"	.060	S.S.	with welded	joints from 325'	to 285'	
				with	joints from	to	

Type of Seal at Bottom: S.S. plate.

Hole Record:

48"	inch from	0'	to 10'
40"	inch from	10'	to 28'
30"		28'	327'

Gravel Pack Record:

Amount	Size	Source	From	To
APP 20 tons	#2	Northern Gravel	327'	224'

Cementing Record: Redi-Mix - 28' to 8'.

Backfill Record: Backfill sand 224' to 180'; Hole plug 180' to 177'; fill sand 177' to 28'.

TEST WELL REPORT

O.W. 2

TEST HOLE NO. 1-95

Layne-Western Company, Inc.

721 Wast Illinois Avenue ■ Aurora, Illinois 50506-2692 • Phone: 708/897-6941

1. Owner Long Range Water Plan Steering Committee Contract No. (7295T) Date 1/4/95

2. City Mackinaw State Illinois

3. Driller's Name M. Kopp Helpers M. Poppen

4. Static Water Level _____ How Obtained – Washed ( ) Pumped ( )

5. Size Mud Pit – Length 4x12x4 Width _____

DRILLERS LOG

TOP FT.	BOTTOM FT.	MUD LOSS INCHES	MUD WEIGHT	DESCRIPTION OF FORMATION	REMARKS
0	4			Dark brown clay	
4	8			Brown sand and gravel	
8	12			Brown clay	
12	20			Brown clay with sand and gravel layers	
20	86			Gray clay with some gravel imbedded	
86	98			Gray clay-soft-and fully imbedded with sand	
98	105			Gray sand and small gravel	
105	115			Gray sandy clay	
115	165			Gray fine to medium sand and gravel	
165	180			Gray silty clay	
180	215			Fine to medium sand and small gravel	
				Bottom 5' slotted - 0.020", from 210' to 215'.	

LW-95

TEST WELL REPORT

O.W. 3

TEST HOLE NO. 2-95

Layne-Western Company, Inc.

721 West Illinois Avenua • Aurora, Illinois 50506-2392 ■ Phone: 708/397-6941

1. Owner Long Range Water Plan Steering Committee Contract No. (7295T) Date 1/10/95

2. City Mackinaw State Illinois

3. Driller's Name M. Kopp Helpers M. Poppen

4. Static Water Level _____ How Obtained – Washed ( ) Pumped ( )

5. Size Mud Pit – Length 4x12x4 Width _____

DRILLERS LOG

TOP FT.	BOTTOM FT.	MUD LOSS INCHES	MUD WEIGHT	DESCRIPTION OF FORMATION	REMARKS
0	6			Light brown clay	
6	13			Dark brown clay	
13	46			Gray clay with sand and small gravel imbedded	
46	56			Gray coarse sand to small gravel	
56	95			Gray sandy clay with small gravel imbedded and layered with sand seams	
95	100	18"		Coarse sand and gravel	
100	110			Gray clay hard and dry	
110	157	24"		Medium to coarse sand (seam of black shaley clay at 143')	
157	176			Brownish gray sandy clay	
176	215			Gray medium multy colored sand to small gravel	
				Bottom 10' slotted - 0.020", from 205' to 215'.	

TEST WELL REPORT

O.W. 4

TEST HOLE NO. 3-95

Layne-Western Company, Inc.

721 Wast Illinois Avenue • Aurora, Illinois 50506-2892 • Phone: 708/897-6941

1. Owner Long Range Water Plan Steering Committee Contract No. (7295T) Date 1/11/95

2. City Mackinaw State Illinois

3. Driller's Name M. Kopp Helpers M. Poppen

4. Static Water Level _____ How Obtained – Washed ( ) Pumped ( )

5. Size Mud Pit – Length 4x8x4 Width _____

DRILLERS LOG

TOP FT.	BOTTOM FT.	MUD LOSS INCHES	MUD WEIGHT	DESCRIPTION OF FORMATION	REMARKS
0	4			Light brown clay	
4	14			Dark brown clay	
14	65			Gray clay sand and gravel imbedded	
65	121			Gray hard clay with lenses of sand	
121	140	6"		Medium to coarse gray sand to small gravel	
				Bottom 5' slotted - .020", from 135' to 140'.	

LW-95

Illinois State Water Survey

Hydrology Division
2204 Griffith Drive
Champaign, Illinois 61820-7495
Telephone (217) 333-4300
Telefax (217) 333-6540

December 19, 1994

Mr. Tom Healy
Layne Western Company, Inc.
721 West Illinois Avenue
Aurora, IL 60506

Dear Mr. Healy:

We have examined the sieve analysis data and test hole log provided by the Illinois State Geological Survey for Test Site 2 (Mackinaw, Site 25), drilled for the Long Range Water Plan Steering Committee by your firm. This test hole reportedly is located in the NE¼, NE¼, NE¼, SE¼, of Section 17, T. 24N., R. 2W., Tazewell County, Illinois. It is our understanding that a well capable of yielding 1000 to 1500 gpm is desired at this location.

The sieve analysis data, test hole log, and our well design criteria indicate that a gravel packed well can be constructed at this site. Gravel pack material with a size range from about 1.77 to 2.95 mm (0.070 to 0.116 inches) would be ideal for the interval from about 202 to 328 feet. If material from Northern Gravel Company, Muscatine, Iowa is to be used, their No. 2 material (1.40 to 3.40 mm) should be acceptable. A screen with 0.060-inch continuous slots (60-slot) can be used with this material. An 80-foot length of 60-slot screen, 16 or 20 inches in diameter, should be capable of safely transmitting 1500 gpm. The well screen can be set in the interval from about 245 to 325 feet deep. The gravel pack envelope should be 6 inches thick (borehole diameter of 28 or 32 inches).

If you have any questions, please feel free to contact us.

Sincerely,

Robert D. Olson
Associate Hydrologist
Phone: (217) 333-8700

cc: Steve Wilson, ISWS

Illinois State Water Survey

Chemistry Division
2204 Griffith Drive
Champaign, Illinois 61820-7495
Telephone (217) 333-9321
Telefax (217) 333-6540

WATER SAMPLE DATA
LABORATORY SAMPLE NUMBER: 228786

SOURCE: WELL NO. 6
OWNER: VILLAGE OF MACKINAW
LOCATION: NEAR MACKINAW
COUNTY: TAZEWELL TOWNSHIP: 24N RANGE: 02W SECTION: 17.1D
DATE COLLECTED: 04/04/1995 DATE RECEIVED: 06/14/1995
WELL DEPTH (Ft.): 315.0 TEMPERATURE REPORTED (F): ND
TREATMENT: NONE
COMMENTS: TURBIDITY DUE TO OXIDIZED IRON. ANALYSIS MAY NOT BE REPRESENTATIVEDUE TO TIME BETWEEN COLLECTION AND RECEIPT.

PARAMETER:	mg/L	PARAMETER:	mg/L
Iron (Total Fe):	1.64	Fluoride (F):	0.5
Manganese (Mn):	0.06	Chloride (Cl):	23.1
Calcium (Ca):	75.7	Sulfate (S04):	< 0.9
Magnesium (Mg):	36.1	Nitrate (N03-N):	< 0.02
Sodium (Na):	60.0		
Barium (Ba):	0.30		
Beryllium (Be):	< 0.003		
Boron (B):	0.24		
Chromium (Cr):	< 0.007		
Copper (Cu):	< 0.01		
Nickel (Ni):	< 0.031		
Zinc (Zn):	0.04		
Turbidity(Lab, NTU):	7.7	Alkalinity (CaC03):	451
Color (PCU):	8	Hardness (as CaC03):	337
pH (Lab):	7.9	Total Dissolved Minerals:	487
Odor:	NONE		

< = Below detection limit (i.e. <1.0 = less than 1.0 mg/L)
mg/L = milligrams per liter mg/L x 0.0584 = grains per gallon
uS/cm = microsiemens per centimeter
ND = Not determined/Information not available

IEPA Certified Environmental Laboratory, Number 100202

Analyst: Lauren F. Sievers
Assistant Chemist

Illinois State Geological Survey

Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820-6964
217/333-4747
FAX 217/244-7004

Illinois Department of
Energy and Natural Resources

March 24, 1995

Steve Wilson
ISWS
2204 Griffith Dr.
MC-674

Steve,

Enclosed is the GC analysis of the extracted gas from Site-25. It represents the gas extracted under a vacuum at a temperature which was ramped from rm temp to 60° C. We use this procedure to be sure we extract all the methane from the water. We can then accurately report how many cc of CH_4 there is per liter of water. The analysis, however, is therefore different than an analysis of the gas that would evolve from the water under normal atmospheric conditions. The gas that evolves at atmospheric pressure would be more enriched in methane and would have less CO_2 since the solubility of CO_2 is higher than CH_4. For example, another site we analyzed had 53% CH_4 and 32.5% CO_2 in the vacuum extracted gases and 74% CH_4 and 0.7% CO_2 in the gas evolved at atmospheric pressure. I thought I would relay this information to you so you would have a better understanding of the analysis you were receiving.

If you have any questions or comments please feel free to call me at 244-2396.

Best regards,

K. Hackley

Keith Hackley
ISGS, Isotope Geochemistry

"ILLINOIS STATE GEOLOGICAL SURVEY
615 EAST PEABODY DRIVE
CHAMPAIGN, IL 61820
217-244-2524

REPORT OF GAS ANALYSIS

LAB #: 5200 REQUEST #: 21725
SAMPLED: 3/02/95 ANALYZED: 3/03/95 REPORTED: 3/06/95
COUNTY: TAZEWELL
LOCATION: NE NE SE 17-24N-2W
WELL NAME: Site 25
GAS SAMPLE CONTAINER: Brass Cylinder #8
FORMATION: Banner Fm
PRODUCTING ZONE DEPTHS: Screen 302-307 ft deep, Surface Elev = 690 ft
GAS FLOW RATE: NA

RESULTS OF ANALYSIS
in volume percent, normalized

CARBON DIOXIDE (C02)	21.71
OXYGEN/ARGON (02 + Ar)	1.00
NITROGEN (N2)	15.17
METHANE (CH4)	62.11
ETHANE (C2H6)	ND
PROPANE (C3H8)	ND
ISO-BUTANE (I-C4H10)	ND
N-BUTANE (N-C4H10)	ND
ISO-PENTANE (I-C5H12)	ND
N-PENTANE (N-C5H12)	ND
HEXANES +	ND

BTU/CU.FT. DRY @ 60½F & 14.7 PSIA:
TOTAL 629

SPECIFIC GRAVITY:
CALCULATED - 0.83

METHOD OF ANALYSIS: GAS CHROMATOGRAPHY ND = NOT DETECTED

ANALYSIS BY: CHAO-LI LIU

REMARKS:
Total Gas extracted from cylinder = 106.3 cc/L
Methane =66.0 cc/L

APPENDIX I WATER QUALITY DATA FOR PROJECT WELLS

Well	MTH-1	MTH-2	MTH-3	MTH-5	MTH-6	MTH-7	MTH-8
County	Tazewell	Tazewell	Tazewell	Tazewell	Tazewell	Tazewell	Tazewell
Depth	215	265	269	294	137	265	256
Date Sampled	09/09/94	08/18/94	08/18/94	09/01/94	09/09/94	07/18/94	07/18/94
Ca	99.8	70.4	85.2	65.4	81.5	79.7	70.7
Mg	43.5	36.8	37.5	31.8	37.4	41.0	38.6
Ba	0.051	0.225	0.28	0.235	0.062	0.241	0.243
Sr	0.105	0.602	0.276	0.481	0.117	0.586	0.375
Na	6.3	79.2	59.5	47.9	5.4	18.1	26.7
K	2.11	3.52	2.98	1.8	0.44	1.02	1.48
Li	0.00352	0.00857	0.006	0.00523	0.00882	0.00538	0.0092
Cl	20.5	50.1.	37.0	21.3	4.7	7.9	3.6
NO_3^-	15.70	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
SO_4^{2-}	56.5	0.9	1.6	<0.9	52.1	34.6	<0.9
F	<0.1	0.1	<0.1	0.2	<0.1	0.3	0.1
Alk	342.5	492.0	493.3	418.7	331.8	381.0	416.0
Fe	0.216	3.07	1.93	2.24	1.05	1.6	1.36
Mn	0.16	0.13	0.21	0.05	0.13	0.07	0.21
Cu	0.00339	<0.002	<0.002	< 0.002	<0.002	<0.002	<0.002
Pb	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Ni	<0.008	0.0087	<0.008	<0.008	0.01482	<0.008	0.00958
Zn	0.27465	0.0235	0.02908	0.02774	0.01951	0.02655	0.32678
Co	<0.004	< 0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Se	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
As	<0.003	0.0168	< 0.003	0.0122	0.0069	<0.003	0.0223
Al	0.314	1.885	0.025	0.044	0.014	<0.011	0.078
Ti	0.00942	0.07674	0.00153	0.00203	0.00117	<0.001	<0.001
Si	7.22	10.5	7.67	8.75	7.62	8.71	10.0
P	<0.15	0.29	<0.15	0.17	<0.15	0.2	<0.15
S	16.1	<0.11	<0.11	<0.11	15.9	11.7	<0.11
H_2S Odor				+		+	
NH_3	<0.1	4.5	1.0	3.3	0.4	2.6	2.0
NVOC	3.6	7.5	5.6	4.8	3.6	1.3	2.5
pH	7.06	7.76	7.45	7.58	7.31	7.79	7.66
Sp Cond	670	750	680	595	550	550	580
E	120	-103	-85	-106	-125	-244	-116

Notes: NO_3^- is nitrate nitrogen, mg N/L.
SO_4^{2-} is sulfate, mg SO_4/L.
Alk is alkalinity, mg $CaCO_3$/L.
+ in the H_2S column indicates hydrogen sulfide odor
NH_3 is ammonia nitrogen, mg N/L.
NVOC is nonvolatile organic carbon, mg C/L.
pH is in pH units.
Sp Cond is specific conductance, microsiemens/cm.
Eh is platinum electrode potential, mV vs standard hyd
All other concentration units are in mg/L.

Well	MTH-9	MTH-10A	MTH-10B	MTH-11A	MTH-11B	MTH-13	MTH-14	MTH-15
County	Tazewell	Tazewell	Tazewell	Tazewell	Tazewell	Tazewell	McLean	McLean
Depth	296	233	99	280	116	318	334	315
Date Sampled	06/22/94	07/13/94	07/13/94	06/22/94	06/22/94	05/18/94	09/13/94	09/13/94
Ca	71.1	72.1	67.0	67.3	70.2	79.2	82.3	56.1
Mg	41.7	35.4	37.2	34.5	34.5	34.4	41.8	30.2
Ba	0.137	0.236	0.069	0.198	0.17	0.22	0.179	0.367
Sr	0.675	0.467	0.201	0.436	0.498	0.283	0.532	0.567
Na	74.8	54.4	13.7	24.6	22.4	23.5	47.6	118.3
K	2.23	1.45	0.49	2.17	1.82	1.52	1.82	3.17
Li	0.00623	0.00567	0.00215	0.00816	0.00297	0.01215	0.00902	0.01114
Cl	10.2	11.6	2.5	4.8	5.8	3.0	41.8	89.4
NO_3^-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	22.00
SO_4^{2-}	4.2	<0.9	<0.9	1.2	4.5	<0.9	16.3	11.1
F	0.2	0.2	<0.1	0.1	0.1	0.2	0.1	0.1
Alk	500.3	447.8	364.8	389.8	415.0	409.5	458.7	496.8
Fe	0.24	1.84	1.41	1.71	1.92	3.82	3.67	0.436
Mn	0.18	0.15	0.04	0.09	0.05	0.09	0.21	0.11
Cu	<0.002	<0.002	<0.002	<0.002	0.0026	<0.002	<0.002	<0.002
Pb	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Ni	0.00916	<0.008	<0.008	<0.008	<0.008	<0.008	0.01034	<0.008
Zn	0.00933	0.05103	0.02744	0.08657	0.33334	0.00689	0.09015	0.51343
Co	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Se	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
As	0.0049	<0.003	0.0149	<0.003	0.0298	0.0034	0.0095	0.0040
Al	0.027	<0.011	<0.011	0.014	0.048	<0.011	0.626	0.112
Ti	0.00151	<0.001	0.00104	<0.001	<0.001	<0.001	0.0288	0.0017
Si	7.8	9.06	7.85	8.4	6.8	10.7	10.2	6.28
P	<0.15	0.2	<0.15	<0.15	<0.15	0.24	0.25	<0.15
S	1.47	<0.11	<0.11	0.23	1.56	<0.11	5.18	3.87
H_2S Odor		+	+	+				
NH_3	6.2	2.9	0.7	2.3	3.9	1.4	3.7	
NVOC	5.8	4.0		2.5	3.1	2.2	10.2	39.7
pH	7.7	7.63	7.69	7.74	7.61	7.4	7.49	7.87
Sp Cond	740	640	510	530	590	520	750	1100
E	-56	-124	-151	-138	-119	-170	-96	-103

Notes: NO_3^- is nitrate nitrogen, mg N/L.
SO_4^{2-} is sulfate, mg SO_4/L.
Alk is alkalinity, mg $CaCO_3$/L.
+ in the H_2S column indicates hydrogen sulfide odor
NH_3 is ammonia nitrogen, mg N/L.
NVOC is nonvolatile organic carbon, mg C/L.
pH is in pH units.
Sp Cond is specific conductance, microsiemens/cm.
Eh is platinum electrode potential, mV vs standard hyd
All other concentration units are in mg/L.

Well.	MTH-15	MTH-17A	MTH-17B	MTH-18A	MTH-18B	MTH-19	MTH-20	MTH-21
County	McLean	Tazewell	Tazewell	Tazewell	Tazewell	McLean	McLean	McLean
Depth	315	239	80	317	160	312	311	325
Date Sampled	07/16/94	04/26/94	04/26/94	09/27/94	09/27/94	05/26/94	05/26/94	06/01/94
Ca	75.5	76.1	81.4	80.9	81.8	70.5	63.0	83.7
Mg	39.3	34.2	35.7	38.6	39.2	32.6	27.5	32.8
Ba	0.266	0.126	0.051	0.095	0.088	0.493	0.62	0.314
Sr	0.709	0.281	0.112	0.316	0.286	0.69	0.54	0.492
Na	98.9	14.3	6.3	10.8	10.2	94.6	102.9	45.5
K	2.43	1.25	0.35	1.51	2.17	1.67	1.97	1.16
Li	0.00758	0.00566	0.00288	0.00693	0.00866	0.00549	0.00619	0.00544
Cl	65.5	3.4	3.0	1.8	1.8	57.7	64.2	1.6
NO_3^-	19.3	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
SO_4^{2-}	1.7	<0.9	63.8	<0.9	1.1	<0.9	<0.9	<0.9
F	0.2	0.2	0.1	<0.1	0.1	0.4	0.4	0.2
Alk	527.0	368.3	300.7	427.0	412.5	470.8	447.8	485.3
Fe	1.52	3.52	1.16	2.66	3.02	2.1	1.9	1.72
Mn	0.17	0.056	0.117	0.04	0.06	0.04	0.03	0.09
Cu	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Pb	0.01471	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Ni	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Zn	0.01155	0.01364	0.01758	0.35499	0.11266	0.00428	0.00558	0.2545
Co	<0.004	<0.004	<0.004	<0.004	<0.004	0.00453	<0.004	<0.004
Se	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
As	0.0083	<0.003	<0.003	0.0732	0.0388	0.0176	0.0267	0.0046
Al	0.519	0.060	0.023	0.028	0.011	0.014	<0.011	0.025
Ti	0.01549	0.00326	0.00114	0.00162	0.00135	<0.001	<0.001	<0.001
Si	9.0	11.2	7.10	10.1	2.87	8.53.	7.48	8.97
P	<0.15	<0.15	<0.15	<0.15	<0.15	0.44	0.32	0.29
S	0.63	<0.11	19.4	0.25	0.33	0.13	0.15	0.42
H_2S Odor						+	+	
NH_3	23.6			5.0	3.6	3.3	3.5	5.7
NVOC	19.9	1.9	0.5	6.6	3.1	5.1	5.4	4.8
PH	7.53	7.07	7.07	7.15	6.95	7.44	7.51	7.39
Sp Cond	950	490	435	555	520	690	730	660
E	-105	-142	-141	-105	-89	-170	-170	-113

Notes: NO_3^- is nitrate nitrogen, mg N/L.
SO_4^{2-} is sulfate, mg SO_4/L.
Alk is alkalinity, mg $CaCO_3$/L.
+ in the H_2S column indicates hydrogen sulfide odor
NH_3 is ammonia nitrogen, mg N/L.
NVOC is nonvolatile organic carbon, mg C/L.
pH is in pH units.
Sp Cond is specific conductance, microsiemens/cm.
Eh is platinum electrode potential, mV vs standard hyd
All other concentration units are in mg/L.

Well	MTH-22A	MTH-22B	MTH-24A	MTH-24B	MTH-25	SWS-2A	SWS-3A	SWS-3B
County	Logan	Logan	Tazewell	Tazewell	Tazewell	Tazewell	Tazewell	Tazewell
Depth	311	160	333	122	344	286	262	60
Date Sampled	05/18/94	05/18/94	09/20/94	09/20/94	09/09/94	07/13/94	09/20/94	05/26/94
Ca	77.2	82.9	67.9	69.9	75.2	72.8	69.1	94.4
Mg	36.0	40.4	32.9	33.5	36.5	34.3	32.6	43.5
Ba	0.129	0.172	0.144	0.144	0.299	0.49	0.149	0.133
Sr	0.312	0.346	0.585	0.61	0.537	0.596	0.368	0.195
Na	15.3	18.9	17.4	17.7	67.1	88.2	14.7	6.9
K	1.4	2.65	1.74	1.32	2.28	2.23	1.22	<0.24
Li	0.00658	0.01013	0.00701	0.00305	0.01164	0.0071	0.00591	0.00231
Cl	3.1	2.2	1.1	1,1	31.5	12.9	2.6	4.8
NO_3^-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
SO_4^{2-}	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	51.1
F	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2
Alk	391.0	449.8	393.3	385.5	481.3	506.2	366.5	397.7
Fe	1.97	2.97	4.57	4.49	2.23	2.55	4.27	6.93
Mn	0.23	0.037	0.04	0.06	0.23	0.07	0.20	0.26
Cu	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Pb	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Ni	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Zn	0.00845	0.00787	0.07684	0.03865	0.02029	0.10139	0.04025	0.00742
Co	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Se	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03
As	0.0033	0.0109	0.0960	0.0817	<0.003	0.0097	0.0273	0.0445
Al	0.013	0.012	0.017	0.015	0.067	0.029	0.273	0.114
Ti	<0.001	0.00179	0.00104	<0.001	0.00303	<0.001	0.01001	0.00477
Si	10.8	12.6	8.46	8.68	9.14	9.05	10.5	7.89
P	0.17	<0.15	0.25	0.24	0.18	0.21	<0.15	0.24
S	<0.11	<0.11	<0.11	<0.11	0.15	0.12	<0.11	16.5
H_2S Odor	+		+			+		+
NH_3	3.3	5.9	2.8		4.2	4.0		0.5
NVOC	1.9	3.1	7.1	7.0	9.7	5.1	4.7	1.1
pH	7.19	7.08	7.39	7.53	7.54	7.58	7.38	7.22
Sp Cond	470	525	515	505	720	775	510	520
E	-173	-122	-124	-141	-164	-136	-140	-161

Notes: NO_3^- is nitrate nitrogen, mg N/L.
SO_4^{2-} is sulfate, mg SO_4/L.
Alk is alkalinity, mg $CaCO_3$/L.
+ in the H_2S column indicates hydrogen sulfide odor
NH_3 is ammonia nitrogen, mg N/L.
NVOC is nonvolatile organic carbon, mg C'/L.
pH is in pH units.
Sp Cond is specific conductance, microsiemens/cm.
Eh is platinum electrode potential, mV vs standard hyd
All other concentration units are in mg/L.

Well	SWS-5	SWS-6	SWS-7	SWS-A	SWS-B	sws-c
County	Tazewell	Tazewell	Tazewell	McLean	McLean	McLean
Depth	256	287	353	330	315	315
Date Sampled	07/16/94	03/06/94	07/16/94	12/02/93	06/01/94	06/01/94
Ca	69.1	83.6	80.7	76.6	73.9	88.5
Mg	34.6	42.3	38.2	40.1	37.5	40.6
Ba	0.274	0.132	0.239	0.236	0.344	0.406
Sr	0.332	0.275	0.408	0.507	0.752	0.604
Na	28	23	39.3	103.1	117.5	135.3
K	1.77	2.25	1.84	4.15	2.55	1.75
Li	0.00861	0.00971	0.00784	0.01407	0.00573	0.01332
Cl	6.9	3.0	18.4	30.6	73.8	59.3
NO_3^-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
SO_4^{2-}	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
F	0.1	0.2	0.1	0.4	0.3	0.2
Alk	407.3		464.7	509.3	552.5	662.5
Fe	2.89	3.44	4.1	11.1	3.93	3.28
Mn	0.11	0.038	0.10	0.53	0.08	0.06
Cu	<0.002	0.00331	<0.002	0.01306	<0.002	<0.002
Pb	<0.014	<0.014	0.01495	0.02262	<0.014	<0.014
Ni	<0.008	<0.008	0.01126	0.02742	<0.008	0.00893
Zn	0.00901	0.01706	0.13866	0.10262	0.00899	0.06513
Co	<0.004	<0.004	<0.004	0.00668	<0.004	<0.004
Se	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
As	<0.003	0.0067	<0.003	0.0037	0.0063	0.0193
Al	0.106	0.262	1.333	6.402	0.184	0.069
Ti	0.00295	0.00893	0.04789	0.2706	0.00647	0.00203
Si	9.4	13.0	13.2	24.8	9.26	9.62
P	<0.15	<0.15	<0.15	0.16	0.3	0.39
S	<0.11	<0.11	0.11	0.38	0.26	0.29
H_2S Odor	+				+	+
NH_3	1.4	2.1	2.2	1.6	8.1	10.5
NVOC	1.9	13.6	3.2		6.8	9.2
pH	7.74	7.09	7.55	7.19	7.42	7.18
Sp Cond	590	600	670	730	875	950
E	-168		-125		-159	-131

Notes: NO_3^- is nitrate nitrogen, mg N/L.
SO_4^{2-} is sulfate, mg SO_4/L.
Alk is alkalinity, mg $CaCO_3$/L.
+ in the H_2S column indicates hydrogen sulfide odor
NH_3 is ammonia nitrogen, mg N/L.
NVOC is nonvolatile organic carbon, mg C/L.
pH is in pH units.
Sp Cond is specific conductance, microsiemens/cm.
Eh is platinum electrode potential, mV vs standard hyd
All other concentration units are in mg/L.

APPENDIX J GROUNDWATER WITHDRAWALS
Total Groundwater Withdrawals (mgd) by County, Municipality, Category, and Year for the Study Area

	1988	1989	1990	1991	1992	1993
McLean County						
Danvers	0.085	0.090	0.075	0.095	0.085	0.084
McLean	0.116	0.102	0.097	0.102	0.102	0.093
Normal	2.417	2.137	2.268	2.103	1.991	1.826
Stanford	0.058	0.053	0.060	0.059	0.063	0.059
Total Municipal	2.731	2.383	2.450	2.360	2.243	2.062
Rural-Residential	0.145	0.140	0.147	0.147	0.140	0.140
Industrial	0.000	0.000	0.000	0.000	0.000	0.000
Livestock	0.117	0.108	0.097	0.093	0.090	0.097
Irrigation	0.200	0.200	0.200	0.200	0.200	0.200
Total	3.076	2.831	2.894	2.800	2.673	2.499
Water Source						
Glasford Fm.	—	—	—	—	—	—
Banner Fm.	3.076	2.831	2.894	2.800	2.673	2.499
Logan County						
Atlanta	0.132	0.126	0.123	0.128	0.134	0.136
Emden	0.081	0.079	0.073	0.073	0.074	0.074
Total Municipal	0.213	0.205	0.195	0.201	0.208	0.210
Rural-Residential	0.199	0.199	0.199	0.199	0.199	0.199
Industrial	0.000	0.000	0.000	0.000	0.000	0.000
Livestock	0.038	0.033	0.033	0.033	0.032	0.030
Irrigation	0.000	0.000	0.000	0.000	0.000	0.000
Total	0.450	0.437	0.428	0.433	0.439	0.439
Water Source						
Glasford Fm.	0.132	0.126	0.123	0.128	0.134	0.136
Banner Fm.	0.318	0.311	0.305	0.305	0.305	0.303
Tazewell County						
Armington	0.027	0.026	0.025	0.027	0.025	0.025
Delavan	0.174	0.154	0.151	0.181	0.175	0.179
Hopedale	0.073	0.068	0.088	0.080	0.075	0.075
Mackinaw	0.149	0.149	0.165	0.165	0.158	0.164
Minier	0.105	0.099	0.094	0.104	0.100	0.097
Total Municipal	0.528	0.496	0.523	0.537	0.533	0.540
Rural-Residential	1.113	1.097	1.104	1.077	1.079	1.096
Industrial	—	—	—	—	—	0.001
Livestock	0.357	0.355	0.373	0.373	0.345	0.336
Irrigation	0.000	0.000	0.000	0.000	0.000	0.000
Total	1.998	1.948	2.000	1.987	1.957	1.973
Water source						
Glasford Fm.	0.176	0.170	0.186	0.187	0.026	0.023
Banner Fm.	1.822	1.778	1.814	1.800	1.931	1.950