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RCRA Facility Investigation
Phase IA Report
CIBA – GEIGY Facility
Cranston, Rhode Island

Volume 2 of 2

Submitted by:

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RCRA FACILITY INVESTIGATION
PHASE IA REPORT
CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND

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Appendix A

APPENDIX A

TERMS, ACRONYMS, AND ABBREVIATIONS

APPENDIX A
TERMS, ACRONYMS, AND ABBREVIATIONS

In order to improve the clarity of the RCRA Facility Investigation Phase IA Report, terms, acronyms, and abbreviations are explained below. Some terms, acronyms, and abbreviations are routinely used by the USEPA. Others are unique to this report.

Terms

- Environmental Characterization - characterization of the chemical constituents in environmental media.
- Environmental Media - includes any combination of soil, ground water, surface water, sediment, and air.
- Environmental Setting - includes climate, geography, geology, hydrogeology and hydrology.
- Physical Hydrologic Investigation of the Pawtuxet River - includes a literature review, bathymetric survey, water and suspended sediment discharge measurements, and a qualitative bed sediment evaluation.
- Subsurface Soil Sample - a soil sample retrieved from depths greater than 1 foot below ground surface.
- Surficial Soil Sample - a soil sample retrieved from 0.5 to 1 foot below ground surface.

Acronyms

- AAOI - Additional Area of Investigation.
- CMS - Corrective Measures Study.
- MPS - Media Protection Standards.
- ORTF - Over the River Tank Farm.
- PHERE - Public Health and Environmental Risk Evaluation. The PHERE is also referred to herein as the Risk Evaluation.

Acronyms - (continued)

- PRFI - Preliminary RCRA Facility Investigation. The PRFI is also referred to herein as the Preliminary Investigation.
- RCRA - Resource Conservation and Recovery Act.
- RFA - RCRA Facility Assessment. The RFA is also referred to herein as the Facility Assessment.
- RFI - RCRA Facility Investigation. The RFI is also referred to herein as the Facility Investigation.
- SWMU - Solid Waste Management Unit.

Abbreviations

- CIBA-GEIGY - The CIBA-GEIGY Corporation.
- Facility or the site - the CIBA-GEIGY facility in Cranston, Rhode Island.
- Facility Investigation Proposal - RCRA Facility Investigation Proposal.

Appendix B

APPENDIX B

DETAILED INTERPRETATION OF GEOPHYSICAL SURVEY RESULTS

APPENDIX B
DETAILED INTERPRETATION OF GEOPHYSICAL SURVEY RESULTS

The results from the geophysical surveys are described here in detail for the Production, Warwick, and Waste Water Treatment areas. The electrical resistivity survey was conducted along the same lines as the seismic refraction survey (except for lines 7 and 8 where resistivity was not performed).

All three areas were surveyed using ground-penetrating radar in July 1990. The soil conditions at the site were conducive to good radar penetration to a depth of ten feet almost everywhere. Two types of anomalies were mapped. First, those areas having anomalies suggestive of slab-like surfaces (such as foundations) were outlined in gray on the maps. Second, points along each traverse where pipe-like features appeared were marked with short lines, with the intention of connecting features that appeared to be continuous across traverses.

B.1 PRODUCTION AREA

B.1.1 Seismic Refraction Survey Results

The Production Area was surveyed using seismic refraction along lines 1, 8, and 11 as shown on Figure 2-1. Layer depths calculated along each line are shown in Figures 2-5 through 2-7. Seismic velocities computed for the three seismic refraction lines are presented in Appendix C.

Line 1

Line 1 extended from point 1-1 (near the entrance gate) southwest to point 1-6. The data for this line indicate that two layers exist to the look-down depth (Figure 2-5). The

first layer had apparent velocities ranging from 1171 to 2297 ft/sec, with an average velocity of 1752 ft/sec. These velocities indicate alluvium, most likely consisting of loose sands and/or gravels with interbedded clays. The boundary depth between layers 1 and 2 ranged from 44 feet (point 1-1) to 12 feet (point 1-4) to 14 feet (between points 1-5 and 1-6). The water table was not well defined.

The material encountered at expected water table levels (layer 2) was denser than wet sands. Velocities ranged from 4685 to 8426 ft/sec, with an average velocity of 5941 ft/sec. Layer 2 probably is a packed alluvium composed of dense silts, sands, clays, and/or gravels. Sands that may exist below these depths would have lower velocity; consequently, they would not be observed. Velocities that would strongly indicate unweathered bedrock were not encountered, possibly because bedrock was deeper than the survey could detect.

Line 8

Line 8 extended along the Pawtuxet River bulkhead from point 8-1 to point 8-5. The data indicate that two layers exist to the depth of the survey (Figure 2-6). The water table was not observed. The first layer had an average velocity of 2816 ft/sec, while the second layer had an average velocity of 8647 ft/sec. The boundary depth between layers 1 and 2 ranged from 30 feet (point 8-1) to 55 feet (near the center of the line) to 46 feet (point 8-5). The velocity of layer 1 indicates an alluvium -- probably unconsolidated interbedded sands, clays, and/or gravels; the velocity of layer 2 indicates highly-compacted silts, gravels, or till, or possibly a highly-weathered sandstone or shale.

Line 11

Line 11 was perpendicular to line 8 in order to avoid any possible refraction effects from the steel and concrete bulkhead; refraction off the bulkhead could have appeared as a false layer along line 8. Line 11 extended from point 11-1 (near the bulkhead) to point 11-4 (toward the northwest near Mill Street). The data indicate three layers (Figure 2-7).

Layer 1 had an average velocity of 1833 ft/sec; this velocity indicates a loosely packed alluvium, probably dry sands. The boundary depth between layers 1 and 2 ranged from 16 feet (point 11-1) to 8 feet (halfway between points 11-2 and 11-3) to 18 feet (point 11-4).

Layer 2 had an average velocity of 4280 ft/sec, indicating the top of the water table and a probable packed, wet alluvium (such as sand with interbedded gravels and clays). The thickness of layer 2 ranged from zero feet at point 11-1 (i.e., layer 2 pinches out) to 14 feet (point 11-2) to 55 feet (point 11-3) to a maximum of 64 feet (point 11-4). The apparent pinchout of layer 2 near the bulkhead may be an interference effect from the bulkhead.

Layer 3 had an average velocity of 11,995 ft/sec, indicating a dense till or weathered sandstone or shale bedrock. The depth to layer 3 ranged from 16 feet at point 11-1 (although this apparent depth may be an artifact of the bulkhead) to a maximum of 81 feet at point 11-4. The average depth to the top of layer 3 is about 60 feet.

B.1.2 Electrical Resistivity Survey Results

Two electrical resistivity lines were run in the Production Area. Sounding line 1 was run parallel to the Pawtuxet River in October 1989. Sounding line 11 was run roughly perpendicular to line 1 in July 1990 (Figure 2-1). Corrected resistivity values for the two resistivity soundings are presented in Appendix C.

Line 1

The results from sounding line 1 appear in Figure 2-8. Corrected resistivity values show the material to be dry sands to a depth of 4 feet. Between 4 and 24 feet the strata are very conductive, corresponding to clays or saturated, loose silty sands. From 24 to 48 feet, the material exhibits the resistivity of clayey silts and sands. A more resistive gravel or till may lie at 48 feet. Bedrock appears to lie at 60 feet. A more conductive layer is suggested

below 84 feet to the depth of the survey (96 feet); this may indicate a jointed, seamy, and/or weathered bedrock, or saturation with brackish water.

Line 11

The results from sounding line 11 appear in Figure 2-9. The electrical resistivity values observed here suggest moist to wet sands, fill, and gravel to a depth of about 12 feet. From 12 to about 20 feet, clays and/or clayey silts appear to exist. Below 20 feet, the material grades into a wet silty sand or gravel. The resistivity break at about 36 feet may reflect interbedded silty sands and clayey silts. The variable resistivities between about 45 and 60 feet may correspond to dense till or weathered bedrock.

B.1.3 Ground-Penetrating Radar Survey Results

Figure 2-10 presents the numerous near-surface pipe-like anomalies found in the Production Area. Very few linear features can be clearly delineated from the individual anomalies. A few areas have pipe-like anomalies that appear to be continuous across three or more GPR traverses -- these may be real pipes. The linear pipe-like features that appear do not correspond to the pipe locations shown on the utilities map of the area (refer to the RFI Proposal, Vol. 1 - Current Assessment Summary Report, Figures 2-3a and 2-3b). The anomalies that are not continuous across GPR traverses may be reflections of metallic building debris strewn over the area and intermixed with the fill.

The slab-like anomalies shown on Figure 2-10 appear to correspond reasonably well with the former building locations shown on the utilities map. There do not appear to be any significant structures below a depth of five feet; no obstructions to ground water flow were observed.

B.2 WARWICK AREA

B.2.1 Seismic Refraction Survey Results

Five seismic refraction lines were surveyed in the Warwick area -- lines 4, 5, 6, 7, and 10 as shown on Figure 2-1. Seismic velocities calculated for each layer for the five seismic refraction lines in the Warwick Area are presented in Appendix C. Figures 2-11 through 2-15 indicate the depths calculated for each refractive layer for the five seismic refraction lines.

Line 4

Line 4 extended from point 4-1 (near Vine Avenue) to point 4-5 (near the Pawtuxet River) as shown on Figure 2-1. The data indicate three layers as shown on Figure 2-11. Layer 1 is thin and has a hummocky boundary with layer 2. The thickness of layer 1 ranged from 13 feet (point 4-1) to 3 feet (point 4-5). The apparent velocity of layer 1 ranged from 1938 to 2896 ft/sec, with an average velocity of 2362 ft/sec; these velocities indicate a loosely-packed, dry alluvium of sands, clays, and/or gravels.

The top of layer 2 may be the water table. The thickness of layer 2 ranged from zero (i.e., a pinched-out layer) at point 4-1 to over 100 feet at point 4-5; its velocity ranged from 4322 to 5333 ft/sec, with an average velocity of 4875 ft/sec. These velocities indicate a packed alluvium of sands, clays, or gravels below the water table. The anomalous high elevation in layer 2 near geophones 6 and 7 may be attributable to near-surface demolition debris.

Layer 3 appears to dip precipitously toward the river, and ranged in depth from 13 feet (point 4-1) to 104 feet (point 4-5). This layer had velocities ranging from 10,725 to 12,252 ft/sec, with an average velocity of 11,523 ft/sec. These velocities indicate a till, or weathered sandstone/shale bedrock. The average depth to the top of layer 3 is about 60

feet. There were not enough data for layer 3 to compute an average velocity using the Hobson-Overton method (Hobson, 1970), so the estimate of the depth to the boundary between layers 2 and 3 has low confidence.

Line 5

Line 5 extended parallel to Vine Avenue from point 5-1 to point 5-5 as shown on Figure 2-1. The data indicate three layers as shown on Figure 2-12. The depth to the boundary between layers 1 and 2 ranged from 6 feet (point 5-1) to 13 feet (point 5-5). The velocity of layer 1 ranged from 2529 to 4046 ft/sec, with an average velocity of 2948 ft/sec. These velocities indicate a dry alluvium, probably sand.

The top of layer 2 appears to be the water table. Layer 2 had a velocity ranging from 4301 to 9302 ft/sec, with an average velocity of 5051 ft/sec. These velocities indicate a wet, packed alluvium of sands, clays, and/or gravels. Layer 2 thickness ranged from 42 feet (point 5-1) to 37 feet (between points 5-2 and 5-3) to 66 feet (point 5-5).

Layer 3 had an average velocity of 10,490 ft/sec, indicating a till or sandstone/shale bedrock. The depth to layer 3 ranged from 48 feet (point 5-1) to 45 feet (between points 5-2 and 5-3) to 78 feet (point 5-5). The average depth to the top of layer 3 is about 55 feet. There were not enough data for layer 3 to compute an average velocity using the Hobson-Overton method, so the estimates of the depth to the boundary between layers 2 and 3 have low confidence.

Line 6

Line 6 extended parallel to the Pawtuxet River from point 6-1 (near the bridge) to point 6-5 as shown on Figure 2-1. Both the water table and rock refractors were observed continuously along the seismic line. Three layers are indicated as shown on Figure 2-13. The velocity of layer 1 ranged from 2131 to 2388 ft/sec, with an average velocity of 2302

ft/sec. This velocity indicates an alluvium, probably a dry sand. Layer 1 extends fairly uniformly from one end of the line to the other, with a thickness of 6 feet at one end (point 6-1) and of 8 feet at the other end (point 6-5), but thinning to as little as 3 feet in some areas.

The water table may lie between layers 1 and 2. The velocity of layer 2 ranged from 4000 to 6154 ft/sec, with an average velocity of 5177 ft/sec. This velocity indicates a wet alluvium composed of sand with possible interbedded clays and gravels. The thickness of layer 2 ranged from 42 feet (point 6-1) to 79 feet (point 6-5).

Layer 3 had an average velocity of 13,206 ft/sec. This velocity indicates a dense till and/or sandstone or shale bedrock. The depth to layer 3 ranged from 48 feet (point 6-1) to 87 feet (point 6-5), with an average depth of about 60 feet.

Line 7

Line 7 extended parallel to the river through the paved section of the Warwick Area from point 7-1 to point 7-5 as shown on Figure 2-1. The data indicate three layers as shown on Figure 2-14. Layer 1 had an average velocity of 2454 ft/sec, indicating a fairly uniform alluvium consisting of dry sands. The depth to the boundary between layers 1 and 2 ranged from 4 feet (point 7-1) to 12 feet (near point 7-3) to 7 feet (point 7-5).

The water table may lie between layers 1 and 2. Layer 2 had an average velocity of 4846 ft/sec, indicating a wet alluvium consisting of interbedded sands, clays, and gravels. Layer 2 thins from 107 feet (point 7-1) to 39 feet (point 7-5).

Layer 3 had an average velocity of 11,206 ft/sec. This velocity indicates a till or weathered sandstone/shale bedrock. The depth to layer 3 ranged from 111 feet (point 7-1) to 46 feet (point 7-5), with an average depth of about 60 feet. There were not enough data

for layer 3 to compute an average velocity using the Hobson-Overton method, so the estimate of the depth to the boundary between layers 2 and 3 has low confidence.

Line 10

Line 10 extended along the Pawtuxet River in the woods (Figure 2-1) from point 10-1 to point 10-5. Three layers exist in this area as shown on Figure 2-15. Layer 1 had an average velocity of 931 ft/sec indicating dry alluvium, probably sand. Layer 1 is fairly thin and uniform, ranging from a depth of 7 feet (point 10-1) to 5 feet (near point 10-3) to 10 feet (point 10-5).

The water table may lie between layers 1 and 2. Layer 2 had an average velocity of 4796 ft/sec, indicating wet, packed alluvium, probably consisting of interbedded sands, clays, and gravels. Layer 2 appears to range from about 20 feet thick (near point 10-1), thinning to a minimum of 13 feet (between points 10-2 and 10-3), and then thickening gradually to 36 feet (near point 10-5).

Layer 3 had an average velocity of 12,867 ft/sec, indicating a dense till or weathered bedrock of sandstone or shale. The scatter of refracting points on this layer was excessive, possibly due to actual areal changes in bedrock elevation, but more likely due to difficulty in picking arrival times on the seismic refraction records. Depth to layer 3 appears to range from 27 feet (near point 10-1) to a minimum of 17 feet (between points 10-2 and 10-3) to a maximum of 46 feet (near point 10-5). The average depth to the top of layer 3 is about 30 feet. However, we regard these depths to layer 3 as having low confidence.

B.2.2 Electrical Resistivity Survey Results

Five resistivity lines were run in the Warwick area (Figure 2-1). Lines 4, 5, and 6a were run in October 1989; lines 6b and 10 were run in July 1990. Line 4 lies perpendicular to the Pawtuxet River near the eastern end of the area. Line 5 is parallel to Vine Avenue,

and lies near the southern end of line 4. Lines 6a and 6b run over the same line, parallel to the river in the western part of the Warwick area. Line 10 is parallel and adjacent to the river in the woods near the eastern end of the area. Corrected resistivity values for the 5 resistivity soundings are presented in Appendix C.

Line 4

The results from sounding line 4 appear in Figure 2-16. Corrected resistivity values suggest that dry sands lie to a depth of 7 to 8 feet. Wet sands continue to a depth of 18 feet; silty sands and clayey silts lie from 18 to 30 feet deep. More resistive materials (such as sands) continue between 30 to about 50 feet. Increasing resistivities between about 50 and 60 feet suggest till overlying bedrock. The more conductive materials below 60 feet may indicate seamy, jointed, and/or weathered bedrock, or bedrock saturated with brackish water.

Line 5

The results from sounding line 5 appear in Figure 2-17. Corrected resistivity values indicate that fill and/or granular materials (such as dry sand/gravel) exist to a depth of about 18 feet. Finer grained silty, clayey soils appear to reside between about 18 and 26 feet. Wet sands are suggested from 26 feet to 48 feet. The increased resistivity between about 48 and 60 feet may indicate till. The lower resistivity below 60 feet may indicate jointed, seamy, and/or weathered bedrock, or bedrock saturated with brackish water.

Line 6a

The results from sounding line 6a appear in Figure 2-18. It was impossible to derive corrected resistivity values for this sounding -- electrode contacts with the ground may have been poor, or the battery voltage may have been too low. This sounding was repeated in July 1990 as line 6b.

Line 6b

The results from sounding line 6b appear in Figure 2-19. This sounding suggests that dry sands grade into wet sands at a depth of about 5 feet, where the water table resides. Below 5 feet another resistive material (such as wet granular materials, perhaps denser sands or gravels) extends to a depth of about 13 to 14 feet. A finer-grained material, such as interbedded silts, clays, or silty, clayey fine sands, lies from 14 to 25 feet deep. Below 25 feet more resistive materials, such as sands or gravels, are observed. Till may exist between about 36 and 60 feet, as indicated by higher resistivities. Resistivities decrease substantially below about 60 feet, but the material type cannot be differentiated based on these data.

Line 10

The results from sounding line 10 appear in Figure 2-20. The surface at this location appears to consist of a dry fill or sand extending about 6 feet down to the water table. Below 6 feet, the material appears to consist of wet sands down to a depth of about 30 feet. Resistivities decrease between about 30 to 60 feet; this could be due to interbedded finer-grained materials, or re-worked, looser granular materials. The resistivities become more consistent below about 60 feet and may indicate bedrock.

B.2.3 Ground-Penetrating Radar Survey Results

Figure 2-21 presents the near-surface anomalies found in the Warwick Area. There are a few obvious foundation remnants and a very few alignments of pipe-like anomalies, but no apparent impediments to ground water flow. The pipe-like features that appear do not, in general, correspond to the utilities map of the area (refer to the RFI Proposal, Vol. 1 - Current Assessment Summary Report, Figures 2-3a and 2-3b). There do not appear to be any significant structures below a depth of five feet; no obstructions to ground water flow were observed.

B.3 WASTE WATER TREATMENT AREA

B.3.1 Seismic Refraction Survey Results

Three seismic refraction lines were surveyed in the Waste Water Treatment Area -- lines 2W, 3, and 9 as shown on Figure 2-1. Seismic velocities calculated for each layer of the three lines are presented in Appendix C. Depths calculated for each layer are presented in Figures 2-22 through 2-24.

Line 2W

Line 2W extended near the embankment on the north side of the area from point 2W-1 to point 2W-5 on the west, as shown on Figure 2-1. Three layers are evident on Figure 2-22. Layer 1 had an average velocity of 2022 ft/sec indicating a dry alluvium, probably sand. Layer 1 thickness ranged from 15 feet (point 2W-1) to a minimum thickness of 6 feet (near point 2W-3) to 10 feet (point 2W-5).

The water table appears to lie between layers 1 and 2. Layer 2 varies in apparent velocity from 4795 to 7619 ft/sec, with an average velocity of 5253 ft/sec, indicating a

composition of wet, packed alluvium -- probably interbedded sands, clays, and/or gravels. The thickness of layer 2 increased from 17 feet (point 2W-1) to 52 feet (point 2W-5).

Layer 3 had an average velocity of 10,525 ft/sec, indicating a packed till or possibly a highly-weathered sandstone or shale bedrock. The depth to layer 3 ranged from 33 feet (point 2W-1) to a minimum of 28 feet (near point 2W-2) to 62 feet (point 2W-5), with an average depth of about 45 to 50 feet.

Line 3

Line 3 extended parallel and close to the river as shown on Figure 2-1. Three layers were encountered as shown on Figure 2-23. Layer 1 had an average velocity of 1733 ft/sec, corresponding to a dry alluvium -- probably sand. This layer had a fairly uniform thickness, ranging from 14 feet (point 3-1) to a maximum thickness of 16 feet (between points 3-2 and 3-3) to 13 feet (point 3-5).

The water table appears to lie between layers 1 and 2. Layer 2 ranged in velocity from 3788 to 4693 ft/sec, with an average velocity of 4324 ft/sec, suggesting a wet, packed alluvium consisting of sands with interbedded clays and gravel. The thickness of layer 2 ranged from 13 feet (point 3-5) to a maximum thickness of 29 feet (near point 3-3) to 22 feet (point 3-1).

Layer 3 ranged in velocity from 8720 to 14,138 ft/sec, with an average velocity of 9190 ft/sec, indicating a till or weathered bedrock of sandstone or shale. The depth to layer 3 ranged from 26 feet (point 3-5) to 37 feet (point 3-1).

Line 9

Line 9 ran between and perpendicular to lines 2 and 3, from point 9-1 to point 9-5 as shown on Figure 2-1. Three layers were indicated as shown on Figure 2-24. Layer 1 had

an average velocity of 1533 ft/sec, indicating a dry sand or fill. Layer 1 ranged in thickness from 16 feet (near point 9-1) to a minimum of 4 feet (near point 9-3) to 8 feet (point 9-5).

The water table lies at or near the top of layer 2. Layer 2 had an average velocity of 4687 ft/sec, indicating a wet, packed alluvium of sands, clays, and gravels. The thickness of layer 2 ranged from 26 feet (point 9-1) to 45 feet (near point 9-3) to 31 feet (point 9-5).

Layer 3 had an average velocity of 11,285 ft/sec, indicating a consolidated till or possibly a weathered sandstone or shale bedrock. The depth to layer 3 averaged about 40 feet, with a minimum of 37 feet (between points 9-3 and 9-4) and maximum of 50 feet (between points 9-2 and 9-3).

B.3.2 Electrical Resistivity Survey Results

Three electrical resistivity lines were run in the Waste Water Treatment Area (Figure 2-1). Lines 2 and 3 were run in October 1989; line 9 was run in July 1990. Lines 2 and 3 parallel the Pawtuxet River on the north and south sides of the area, respectively. Line 9 was run perpendicular to lines 2 and 3. Corrected resistivity values for the three resistivity soundings are presented in Appendix C.

Line 2

The results from sounding line 2 appear in Figure 2-25. Corrected resistivity values suggest dry to wet sands to a depth of about 12 feet. The materials become finer-grained between about 12 to 30 feet, and may be clayey silts and/or silty clays. The higher resistivities between about 30 and 60 feet are likely denser, granular soils and may be suggestive of till. The lower resistivities below about 60 feet may be jointed, seamy, and/or decomposed (weathered) bedrock, transitioning into less weathered rock at about 84 feet. Alternatively, the lower resistivities between 60 to 84 feet may indicate bedrock saturated with brackish water.

Line 3

The results from sounding line 3 appear in Figure 2-26. The corrected resistivity values suggest granular materials to a depth of 15 feet, which may be saturated below about 7 feet. Clays and/or clayey silts appear to lie from 15 to 30 feet in depth. A dense resistive material such as till extends from 30 feet to about 48 feet. The resistivities below about 48 feet may indicate jointed, seamy, and/or weathered bedrock, transitioning into less weathered rock at about 84 feet in depth. Alternatively, the lower resistivities between 48 to 84 feet may indicate bedrock saturated with brackish water.

Line 9

The results from sounding line 9 appear in Figure 2-27. Corrected resistivity values suggest fill or sands that grade into wet sands at about 6 feet deep (where the water table appears). A possible interbedding of finer-grained silty, clayey materials exists from 6 to 8 feet, and a layer of more granular materials (such as sands and/or gravels) exists from about 8 to 18 feet. A clay or clayey silt appears to extend from about 18 feet to a depth of about 30 feet. The variable resistivities between about 30 and 60 feet may indicate increasingly dense materials such as till or silty, clayey till. A weathered, jointed bedrock may lie at about 60 feet deep. Alternatively, the resistivities below about 60 feet may indicate bedrock saturated with brackish water.

B.3.3 Ground-Penetrating Radar Survey Results

Figure 2-28 presents the near-surface anomalies found in the Waste Water Treatment Area. The most significant features present are the large slab-like anomalies obviously related to the tank foundations. These are only a few feet below the surface and probably will have no effect on ground water flow. The pipe-like features that appear do not, in general, correspond to the utilities map of the area (refer to the RFI Proposal, Vol. 1 - Current Assessment Summary Report, Figures 2-3a and 2-3b). There do not appear to be

any significant structures below a depth of five feet; no obstructions to ground water flow were observed.

B.4 GENERAL DISCUSSION OF GEOPHYSICAL RESULTS

This section discusses the results obtained from each geological survey.

B.4.1 Production Area

The results obtained from each of the geophysical methods are discussed here for the Production Area.

Seismic Refraction Survey Discussion

The seismic refraction lines run in the Production Area yielded inconsistent results near the bulkhead along the Pawtuxet River, as shown in lines 8 and 11 (Figures 2-6 and 2-7). The bulkhead probably acted as a false refractive or reflective layer, interfering with accurate imaging of the real soil and rock layering. This artifact is especially likely in the data from line 11, which suggest that the bedrock rises rapidly toward the surface near the bulkhead and that layer 2 pinches out; neither effect is apparent in the data from line 8 which runs parallel to the bulkhead. The till/weathered bedrock depth of 40 to 50 feet inferred from line 8 (Figure 2-6) is the more probable depth to this refracting layer near the river.

Farther away from the river, the data for lines 1 and 11 both indicated a thin top layer overlying a denser alluvium of sands, clays, gravels, and/or silts. The data from line 11 indicated a thick second layer underlain by bedrock or dense till at an average depth of about 60 feet, while the data from line 1 could not distinguish a third layer.

Electrical Resistivity Survey Discussion

The data from the two electrical resistivity soundings run in the Production Area (lines 1 and 11) are reasonably consistent in the sequence of sand and clay layers. The data from sounding 1 show a much thicker conductive layer than those from sounding 11. This thicker conductive layer could be interbedded, saturated, loose silty fine sands and silty clays/clayey silts. Both soundings 1 and 11 indicate increasing and variable resistivities below depths of 42 and 30 feet, respectively (Figures 2-8 and 2-9); that resistive layer could be a till, underlain by a less resistive weathered bedrock, or bedrock saturated with brackish water. The layers of alluvium (sand, clay, silt, and/or gravel) overlying bedrock in this area are very likely interfingering and discontinuous over the site.

Ground-Penetrating Radar Survey Discussion

The Production Area contained unknown amounts of rubble (from the destruction of twelve buildings and two tank farms) distributed over the site. Some foundation fragments are still present. The site appears to be littered with reinforcing steel, scraps of pipe, and pieces of metal, masonry, glass, and plastic. All this litter (on the surface and in the subsurface) created a large number of random ground-penetrating radar anomalies, as shown in Figure 2-10. The random anomalies from the rubble may have obscured the pipes and other utilities that were left in the ground. High soil conductivities, or the existence of interbedded conductive layers such as moist clay, can make interpretation difficult (if not impossible) and can cause significant anomalies to be obscured. From the results of the electrical resistivity survey, thick clays appear to exist under some parts of the Production Area. These clays may have partially obscured the former utilities. Alternatively, the utilities may have been disturbed or removed. No obvious impediments to ground water flow were observed in the upper ten feet of overburden imaged in the GPR survey. Future soil and rock sampling activities should not be impeded by debris if they are located in areas having no pipe- or slab-like anomalies.

B.4.2 Warwick Area

The results obtained from each of the geophysical methods are discussed here for the Warwick Area.

Seismic Refraction Survey Discussion

The data from seismic refraction line 6 (Figure 2-13) seem consistent with data from line 8 (on the opposite side of the river in the Production Area) (Figure 2-6). The data from both lines indicated a thick sequence of interbedded sands, clays and gravel/till. However, velocities indicative of bedrock were obtained only along line 6.

In the eastern part of the Warwick Area, lines 5, 7, and 10 are roughly parallel to one another and to the river. The data from these three lines seem relatively consistent (within the limits of the method). All three lines show three layers (Figures 2-12, 2-14, and 2-15). The first layer appears to thicken toward Vine Avenue, and this result is supported by the data from line 4 (Figure 2-11). The apparent increase in depth to rock in a westerly direction may be real, but it is more likely a spurious result caused by the interfingering of sands, silts, and clays having horizontally variable seismic velocities along each individual seismic line.

We have low confidence in the depth to layer 3 along line 10 (Figure 2-15). While running line 10, a large concrete effluent/storm-sewer pipe was observed on the south side of the river and may have caused artifacts in the data. It is also possible that the motion sensors along line 10 were not seated well enough in the peaty soil (at the surface in the woods), or that the blasts were not as well-coupled to the ground along this line. The average depth to layer 3 along line 4 is preferred (Figure 2-11).

Electrical Resistivity Survey Discussion

Although the data from electrical resistivity sounding 6a were not interpreted, they look similar to those from sounding 6b (see Figures 2-18 and 2-19). Sounding 6b looks similar to the interpretation for sounding 11 in the Production Area (Figure 2-7), the sounding closest to 6b. Both indicate a sequence of sands, clays, and gravels to the limits of the survey depths. The increasing resistivities between about 30 to 48 feet may indicate till. Jointed, weathered bedrock, or bedrock saturated with brackish water may lie at about 60 feet.

The data from lines 4, 5, and 10 (Figures 2-16, 2-17, and 2-20) indicate a thick sequence of sands and/or gravels. The clayey layer observed in sounding 5 (at 18 to 26 feet deep) apparently pinches out. The soils at these depths appear to be more sandy in lines 4 and 10. The data from sounding 4 indicate a resistive horizon at about 60 to 70 feet, with a more conductive layer beneath it. This resistive horizon may indicate till overlying jointed, weathered bedrock, or bedrock saturated with brackish water. A similar trend is observed in line 5 between about 50 to 65 feet deep, but is not as clearly developed in line 10.

Ground-Penetrating Radar Survey Discussion

No obvious impediments to ground water flow were observed in the upper ten feet of overburden in the Warwick Area. Future soil and rock sampling activities in this area should not be impeded if they are located in areas having no pipe- or slab-like anomalies (Figure 2-21).

B.4.3 Waste Water Treatment Area

The results obtained from each of the geophysical methods are discussed here for the Waste Water Treatment Area.

Seismic Refraction Survey Discussion

The data from the three seismic lines run in the Waste Water Treatment Area (2W, 3, and 9) seem consistent (within the limits of the method). The data from all three lines indicate three layers having reasonable areal changes in thickness (Figures 2-22, 2-23, and 2-24). The depths to layer 3 (interpreted as till/bedrock) along lines 2, 3, and 9 appear to agree reasonably well with each other.

Electrical Resistivity Survey Discussion

The data from electrical resistivity soundings 2, 3, and 9 (Figures 2-25, 2-26, and 2-27) indicate an interbedding of sands, silts, and clays with no consistent horizontal layering. The thicknesses of the sand, silt, and clay layers appear to vary widely across this area. The data from sounding 3 suggest the presence of a till between about 30 to 50 feet. The data from sounding 2 show a similar trend from about 36 to 60 feet. Line 9 shows variable and increasing resistivities below about 30 feet. This result could be caused by till. If the material below about 50 to 60 feet is bedrock, it is likely highly weathered, jointed, or saturated with brackish water.

Ground-Penetrating Radar Survey Discussion

No obvious impediments to ground water flow were observed in the upper ten feet of overburden in the Waste Water Treatment Area. Future soil and rock sampling activities in this area should not be impeded if they are located in areas having no pipe- or slab-like anomalies (Figure 2-28).

Appendix C

APPENDIX C

COMPUTER OUTPUT OF GEOPHYSICAL ANALYSES

SEISMIC

TABLES

CIBA GEIGY -- LINE 1

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer
1	-60.0	21.5	44.4	-22.9	
2	40.0	19.0	22.7	-3.7	
4	110.0	16.0	12.1	3.9	
5	207.0	16.0	13.2	2.8	
6	279.7	15.2	13.7	1.5	
geo					
1	.0	20.0	32.8	-12.8	
2	20.0	19.0	29.0	-10.0	
3	40.0	19.0	22.7	-3.7	
4	59.9	18.0	18.4	-.4	
5	79.7	15.0	14.1	.9	
6	99.7	16.0	12.5	3.5	
7	119.7	16.0	11.7	4.3	
8	139.7	16.0	12.7	3.3	
9	159.7	16.0	12.5	3.5	
10	179.7	16.0	13.7	2.3	
11	199.7	16.0	13.0	3.0	
12	219.7	16.0	13.5	2.5	

velocities used, spread 1

	layer 1	layer 2	layer
vertical	1752.		
horizontal		5941.	

CIBA GEIGY -- LINE 2W

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer 3 depth	layer 3 elev	layer
5	-30.0	16.0	9.7	6.3	62.3	-46.3	
4	80.0	15.0	7.9	7.1	54.4	-39.4	
3	180.0	15.0	7.2	7.8	41.8	-26.8	
2	280.0	15.0	11.7	3.3	30.2	-15.2	
1	340.0	14.5	15.2	-.7	32.5	-18.0	
geo							
1	.0	15.0	8.4	6.6	59.0	-44.0	
2	20.0	15.0	6.7	8.3	57.4	-42.4	
3	50.0	15.0	8.2	6.8	54.9	-39.9	
4	70.0	15.0	7.8	7.2	54.5	-39.5	
5	100.0	15.0	7.9	7.1	54.2	-39.2	
6	120.0	15.0	7.1	7.9	52.1	-37.1	
7	160.0	15.0	5.5	9.5	44.6	-29.6	
8	180.0	15.0	7.2	7.8	41.8	-26.8	
9	200.0	15.0	8.4	6.6	39.8	-24.8	
10	220.0	15.0	8.0	7.0	38.2	-23.2	
11	240.0	15.0	7.6	7.4	34.8	-19.8	
12	260.0	15.0	9.5	5.5	28.1	-13.1	
13	280.0	15.0	11.7	3.3	30.2	-15.2	
14	320.0	15.0	14.7	.3	34.5	-19.5	

velocities used, spread 1

	layer 1	layer 2	layer 3	layer
vertical	2022.	5253.		
horizontal		5253.	10525.	

CIBA GEIGY -- LINE 3

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer 3 depth	layer 3 elev	layer depth	layer elev
5	-50.0	14.2	13.4	.8	25.8	-11.6		
4	10.1	14.2	13.0	1.2	31.5	-17.3		
3	110.0	14.2	11.7	2.5	41.6	-27.4		
2	210.0	12.8	13.7	-.9	39.1	-26.3		
1	289.9	10.1	13.9	-3.8	36.6	-26.5		
geo								
1	.0	14.2	13.1	1.1	30.6	-16.4		
2	10.0	14.2	13.0	1.2	31.5	-17.3		
3	30.0	14.2	12.7	1.5	33.2	-19.0		
4	50.0	14.2	12.3	1.9	36.4	-22.2		
5	70.0	14.2	12.5	1.7	37.8	-23.6		
6	90.0	14.2	12.6	1.6	38.9	-24.7		
7	110.0	14.2	11.7	2.5	41.6	-27.4		
8	130.0	14.2	12.3	1.9	41.7	-27.5		
9	150.0	13.0	14.4	-1.4	39.4	-26.4		
10	170.0	13.0	16.2	-3.2	39.5	-26.5		
11	190.0	12.8	15.1	-2.3	38.8	-26.0		
12	210.0	12.8	13.7	-.9	39.1	-26.3		
13	240.0	12.8	14.9	-2.1	39.6	-26.8		

velocities used, spread 1

	layer 1	layer 2	layer 3	layer
vertical	1733.	4324.		
horizontal		4324.	9190.	

CIBA GEIGY -- LINE 4

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer 3 depth	layer 3 elev	layer
1	-100.0	14.0	12.6	1.4	12.6	1.4	
2	.0	14.0	8.1	5.9	30.8	-16.8	
3	80.0	12.0	5.8	6.2	59.3	-47.3	
4	180.0	12.0	3.6	8.4	85.4	-73.4	
5	239.9	12.0	2.7	9.3	103.5	-91.5	
geo							
1	.0	14.0	8.1	5.9	30.8	-16.8	
2	20.0	13.0	9.9	3.1	36.3	-23.3	
3	40.0	13.0	10.6	2.4	42.0	-29.0	
4	59.9	12.0	9.0	3.0	49.5	-37.5	
5	79.9	12.0	5.8	6.2	59.3	-47.3	
6	99.9	12.0	1.8	10.2	62.8	-50.8	
7	119.9	12.0	3.0	9.0	65.8	-53.8	
8	139.9	12.0	6.3	5.7	72.3	-60.3	
9	159.9	12.0	5.0	7.0	78.9	-66.9	
10	179.9	12.0	3.6	8.4	85.4	-73.4	
11	189.9	12.0	2.4	9.6	88.6	-76.6	

velocities used, spread 1

	layer 1	layer 2	layer 3	layer
vertical	2362.	4875.		
horizontal		4875.	11523.	

CIBA GEIGY -- LINE 5

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer 3 depth	layer 3 elev	layer
5	-50.0	13.7	12.6	1.1	78.3	-64.6	
4	10.0	13.8	10.9	2.9	69.4	-55.6	
3	110.0	14.2	9.2	5.0	51.1	-36.9	
2	190.0	13.8	9.3	4.5	50.5	-36.7	
1	290.0	13.0	6.0	7.0	48.0	-35.0	
geo							
1	.0	13.8	11.5	2.3	70.0	-56.2	
2	10.0	13.8	10.9	2.9	69.4	-55.6	
3	30.0	13.8	10.4	3.4	68.3	-54.5	
4	50.0	13.8	9.8	4.0	67.2	-53.4	
5	70.0	13.8	8.9	4.9	62.7	-48.9	
6	90.0	14.0	9.5	4.5	56.9	-42.9	
7	110.0	14.2	9.2	5.0	51.1	-36.9	
8	130.0	14.0	7.9	6.1	45.0	-31.0	
9	150.0	13.8	7.9	5.9	46.1	-32.3	
10	170.0	13.8	8.8	5.0	49.5	-35.7	
11	190.0	13.8	9.3	4.5	50.5	-36.7	
12	210.0	13.8	8.5	5.3	48.7	-34.9	
13	230.0	13.8	7.4	6.4	48.0	-34.2	
14	240.0	13.8	7.1	6.7	47.6	-33.8	

velocities used, spread 1

	layer 1	layer 2	layer 3	layer
vertical	2948.	5051.		
horizontal		5051.	10490.	

CIBA GEIGY -- LINE 6

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer 3 depth	layer 3 elev	layer
5	-50.0	13.7	7.5	6.2	86.8	-73.1	
4	10.0	13.7	6.2	7.5	77.8	-64.1	
3	110.0	13.8	5.9	7.9	62.8	-49.0	
2	190.0	13.8	3.0	10.8	54.4	-40.6	
1	290.0	13.8	6.4	7.4	48.3	-34.5	
geo							
1	.0	13.6	7.3	6.3	79.5	-65.9	
2	10.0	13.6	6.1	7.5	77.7	-64.1	
3	30.0	13.8	4.1	9.7	74.4	-60.6	
4	50.0	13.8	3.5	10.3	70.8	-57.0	
5	70.0	13.8	6.6	7.2	70.7	-56.9	
6	90.0	13.8	6.6	7.2	66.8	-53.0	
7	110.0	13.8	5.9	7.9	62.8	-49.0	
8	130.0	13.8	6.5	7.3	58.1	-44.3	
9	150.0	13.8	4.9	8.9	54.4	-40.6	
10	170.0	13.8	4.6	9.2	53.0	-39.2	
11	190.0	13.8	3.0	10.8	54.4	-40.6	
12	210.0	13.8	6.3	7.5	54.4	-40.6	
13	230.0	13.8	6.1	7.7	52.0	-38.2	
14	240.0	13.8	6.1	7.7	50.7	-36.9	

velocities used, spread 1

	layer 1	layer 2	layer 3	layer
vertical	2302.	5177.		
horizontal		5177.	13206.	

CIBA GEIGY -- LINE 7

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer 3 depth	layer 3 elev	layer
1	-60.0	14.2	3.9	10.3	111.4	-97.2	
2	40.0	14.2	10.0	4.2	82.1	-67.9	
3	120.0	14.1	12.6	1.5	64.0	-49.9	
4	220.0	14.1	9.9	4.2	54.7	-40.6	
5	280.0	11.9	7.3	4.6	46.1	-34.2	
geo							
1	.0	14.2	7.0	7.2	94.2	-80.0	
2	20.0	14.2	8.2	6.0	89.1	-74.9	
3	40.0	14.2	10.0	4.2	82.1	-67.9	
4	60.0	14.2	10.1	4.1	75.1	-60.9	
5	80.0	14.2	11.4	2.8	70.5	-56.3	
6	100.0	14.2	12.4	1.8	66.5	-52.3	
7	120.0	14.1	12.6	1.5	64.0	-49.9	
8	140.0	14.1	12.0	2.1	65.4	-51.3	
9	160.0	14.2	10.7	3.5	62.9	-48.7	
10	180.0	14.1	9.0	5.1	60.0	-45.9	
11	200.0	14.1	8.1	6.0	56.7	-42.6	
12	220.0	14.1	9.9	4.2	54.7	-40.6	
13	230.0	14.1	10.7	3.4	53.7	-39.6	

velocities used, spread 1

	layer 1	layer 2	layer 3	layer
vertical	2454.	4846.		
horizontal		4846.	11206.	

CIBA GEIGY -- PROFILE 8

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer
A	-89.8	20.5	30.0	-9.5	
B	-20.0	15.0	34.2	-19.2	
C	240.0	13.0	49.2	-36.2	
D	310.0	13.0	45.8	-32.8	
geo					
1	.0	15.0	36.9	-21.9	
2	20.0	15.0	38.7	-23.7	
3	40.0	15.0	40.2	-25.2	
4	60.0	14.5	42.7	-28.2	
5	80.0	14.0	46.1	-32.1	
6	100.0	13.5	49.3	-35.8	
7	120.0	13.0	51.7	-38.7	
8	140.0	13.0	53.7	-40.7	
9	160.0	13.0	54.4	-41.4	
10	180.0	13.0	50.2	-37.2	
11	200.0	13.0	45.9	-32.9	
12	220.0	13.0	50.2	-37.2	

velocities used, spread 1

	layer 1	layer 2	layer
vertical	2816.		
horizontal		8647.	

CIBA GEIGY PROFILE 9

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer 3 depth	layer 3 elev	layer
A	-79.9	14.0	16.3	-2.3	41.8	-27.8	
B	-19.9	14.5	13.3	1.2	44.9	-30.4	
C	110.0	11.5	4.4	7.1	46.4	-34.9	
D	240.0	13.0	8.9	4.1	41.8	-28.8	
E	280.0	11.8	8.3	3.5	38.7	-26.9	
geo							
1	.0	13.0	10.7	2.3	44.3	-31.3	
2	20.0	13.0	9.5	3.5	48.3	-35.3	
3	40.0	12.5	7.9	4.6	49.8	-37.3	
4	60.0	12.5	5.9	6.6	50.0	-37.5	
5	80.0	12.0	4.6	7.4	49.3	-37.3	
6	100.0	12.0	4.4	7.6	48.2	-36.2	
7	120.0	12.2	5.7	6.5	45.8	-33.6	
8	140.0	12.3	7.3	5.0	41.8	-29.5	
9	160.0	12.3	8.0	4.3	38.6	-26.3	
10	180.0	12.4	7.4	5.0	37.0	-24.6	
11	200.0	12.5	7.2	5.3	37.7	-25.2	
12	220.0	12.5	8.2	4.3	42.3	-29.8	

velocities used, spread 1

	layer 1	layer 2	layer 3	layer
vertical	1533.	4687.		
horizontal		4687.	11285.	

CIBA GEIGY -- PROFILE 10

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer 3 depth	layer 3 elev	layer
A	-100.0	10.0	6.9	3.1	26.8	-16.8	
B	-20.0	11.0	6.2	4.8	26.0	-15.0	
C	110.0	12.0	5.2	6.8	26.1	-14.1	
D	240.0	12.0	8.0	4.0	38.7	-26.7	
E	320.0	12.0	9.8	2.2	45.9	-33.9	
geo							
1	.0	11.0	5.8	5.2	25.6	-14.6	
2	20.0	11.0	5.4	5.6	22.1	-11.1	
3	40.0	11.3	4.8	6.5	19.9	-8.6	
4	60.0	11.5	4.5	7.0	17.0	-5.5	
5	80.0	11.8	4.6	7.2	20.3	-8.5	
6	100.0	12.0	5.0	7.0	25.6	-13.6	
7	120.0	12.0	5.4	6.6	26.6	-14.6	
8	140.0	12.0	5.8	6.2	25.8	-13.8	
9	160.0	12.0	6.7	5.3	26.0	-14.0	
10	180.0	12.0	6.6	5.4	28.1	-16.1	
11	200.0	12.0	7.3	4.7	29.0	-17.0	
12	220.0	12.0	7.6	4.4	36.9	-24.9	

velocities used, spread 1

	layer 1	layer 2	layer 3	layer
vertical	931.	4796.		
horizontal		4796.	12867.	

CIBA GEIGY -- PROFILE 11

spread A smoothed position of layers beneath shotpoints and geophones

sp	position	surf elev	layer 2 depth	layer 2 elev	layer 3 depth	layer 3 elev	layer
A	-85.0	13.0	16.2	-3.2	16.2	-3.2	
B	-20.0	15.0	11.9	3.1	26.4	-11.4	
C	124.9	18.0	11.0	7.0	66.1	-48.1	
D	262.9	19.0	18.3	.7	80.8	-61.8	
geo							
1	.0	15.0	9.9	5.1	34.2	-19.2	
2	10.0	15.0	9.1	5.9	42.1	-27.1	
3	20.0	15.0	8.3	6.7	46.0	-31.0	
4	29.9	16.0	8.1	7.9	50.9	-34.9	
5	39.9	16.0	6.7	9.3	53.5	-37.5	
6	49.9	16.5	6.8	9.7	55.9	-39.4	
7	59.9	16.5	6.7	9.8	57.7	-41.2	
8	69.9	17.0	7.3	9.7	60.0	-43.0	
9	79.9	17.0	8.0	9.0	61.9	-44.9	
10	89.9	17.5	9.2	8.3	62.9	-45.4	
11	99.9	17.5	9.6	7.9	62.9	-45.4	
12	109.9	18.0	10.3	7.7	64.6	-46.6	

velocities used, spread 1

	layer 1	layer 2	layer 3	layer
vertical	1833.	4280.		
horizontal		4280.	11995.	

RESISTIVITY

TABLES

Sounding Line 1

Station	A	L	MN	Rs	Factor	Rw	Ks	RHOs
1	2.000	3.000	1.600	167.500	1.306	218.797	16.415	2749.483
2	3.000	4.500	1.600	41.000	2.043	83.751	38.504	1578.670
3	4.000	6.000	2.000	18.210	2.188	39.834	54.978	1001.147
4	5.000	7.500	2.000	6.380	2.763	17.625	86.786	553.698
5	6.000	9.000	2.000	2.570	3.333	8.567	125.664	322.956
6	7.000	10.500	2.000	1.540	3.902	6.009	171.609	264.279
7	8.000	12.000	2.000	0.704	4.469	3.146	224.624	158.135
8	10.000	15.000	2.000	0.305	5.600	1.708	351.858	107.317
9	12.000	18.000	3.000	0.288	4.469	1.287	336.936	97.038
10	14.000	21.000	3.000	0.187	5.223	0.977	459.458	85.919
11	16.000	24.000	3.000	0.108	5.977	0.645	600.830	64.890
12	20.000	30.000	3.000	0.010	7.481	0.075	940.122	9.401
13	24.000	36.000	6.000	0.026	4.469	0.116	673.872	17.521
14	28.000	42.000	6.000	0.028	5.223	0.146	918.916	25.730
15	32.000	48.000	6.000	0.025	5.977	0.149	1201.659	30.041
16	40.000	60.000	10.000	0.018	4.469	0.080	1123.119	20.216
17	48.000	72.000	10.000	0.017	5.374	0.091	1620.748	27.553
18	56.000	84.000	10.000	0.014	6.278	0.088	2208.854	30.924
19	64.000	96.000	10.000	0.013	7.180	0.093	2887.438	37.537
20	80.000	120.000	10.000	0.008	8.984	0.072	4516.039	36.128
21	96.000	144.000	20.000	0.019	5.374	0.102	3241.495	61.588
22	112.000	168.000	20.000	0.015	6.278	0.094	4417.708	66.266
23	128.000	192.000	20.000	0.009	7.180	0.065	5774.876	51.974

Key to Resistivity Table Columns

A, L, MN - Electrode spacings (ft)

Rs - Apparent Schlumberger Resistance

Rw - Wenner resistance

RHOs - Corrected Schlumberger Resistivity

Sounding Line 2

Station	A	L	MN	Rs	Factor	Rw	Ks	RHOs
1	2.000	3.000	0.800	53.200	2.762	146.965	34.715	1846.817
2	3.000	4.500	1.000	25.100	3.333	83.667	62.832	1577.080
3	4.000	6.000	1.000	10.160	4.469	45.403	112.312	1141.089
4	5.000	7.500	1.000	5.210	5.600	29.176	175.929	916.591
5	6.000	9.000	1.000	2.770	6.729	18.640	253.684	702.704
6	7.000	10.500	1.000	1.690	7.857	13.279	345.575	584.022
7	8.000	12.000	1.000	1.226	8.984	11.015	451.604	553.666
8	10.000	15.000	1.000	0.525	11.238	5.900	706.073	370.688
9	12.000	18.000	3.000	0.937	4.469	4.187	336.936	315.709
10	14.000	21.000	3.000	0.618	5.223	3.228	459.458	283.945
11	16.000	24.000	3.000	0.385	5.977	2.301	600.830	231.319
12	20.000	30.000	3.000	0.205	7.481	1.534	940.122	192.725
13	24.000	36.000	6.000	0.246	4.469	1.099	673.872	165.772
14	28.000	42.000	6.000	0.102	5.223	0.533	918.916	93.729
15	32.000	48.000	6.000	0.220	5.977	1.315	1201.659	264.365
16	40.000	60.000	6.000	0.043	7.481	0.322	1880.243	80.850
17	48.000	72.000	10.000	0.097	5.374	0.521	1620.748	157.213
18	56.000	84.000	10.000	0.077	6.278	0.483	2208.854	170.082
19	64.000	96.000	10.000	0.031	7.180	0.223	2887.438	89.511
20	80.000	120.000	10.000	0.007	8.984	0.063	4516.039	31.612
21	96.000	144.000	20.000	0.017	5.374	0.091	3241.495	55.105
22	112.000	168.000	20.000	0.018	6.278	0.113	4417.708	79.519
23	128.000	192.000	20.000	0.013	7.180	0.093	5774.876	75.073

Sounding Line 3

Station	A	L	MN	Rs	Factor	Rw	Ks	RHOs
1	2.000	3.000	0.800	149.000	2.762	411.612	34.715	5172.475
2	3.000	4.500	1.000	126.700	3.333	422.333	62.832	7960.796
3	4.000	6.000	1.000	69.800	4.469	311.919	112.312	7839.373
4	5.000	7.500	1.000	44.200	5.600	247.520	175.929	7776.070
5	6.000	9.000	1.000	26.900	6.729	181.015	253.684	6824.089
6	7.000	10.500	1.000	15.980	7.857	125.557	345.575	5522.292
7	8.000	12.000	1.000	10.660	8.984	95.773	451.604	4814.098
8	10.000	15.000	1.000	5.130	11.238	57.648	706.073	3622.154
9	12.000	18.000	3.000	11.640	4.469	52.016	336.936	3921.933
10	14.000	21.000	3.000	7.070	5.223	36.928	459.458	3248.368
11	16.000	24.000	3.000	4.880	5.977	29.166	600.830	2932.048
12	20.000	30.000	3.000	0.721	7.481	5.394	940.122	677.828
13	24.000	36.000	6.000	0.547	4.469	2.444	673.872	368.608
14	28.000	42.000	6.000	0.353	5.223	1.844	918.916	324.377
15	32.000	48.000	6.000	0.295	5.977	1.763	1201.659	354.489
16	40.000	60.000	6.000	0.214	7.481	1.601	1880.243	402.372
17	48.000	72.000	10.000	0.226	5.374	1.215	1620.748	366.289
18	56.000	84.000	10.000	0.180	6.278	1.130	2208.854	397.594
19	64.000	96.000	10.000	0.108	7.180	0.775	2887.438	311.843
20	80.000	120.000	10.000	0.068	8.984	0.611	4516.039	307.091
21	96.000	144.000	20.000	0.100	5.374	0.537	3241.495	324.150
22	112.000	168.000	20.000	0.082	6.278	0.515	4417.708	362.252
23	128.000	192.000	20.000	0.068	7.180	0.488	5774.876	392.692
24	160.000	240.000	20.000	0.043	8.984	0.386	9032.079	388.379

Sounding Line 4

Station	A	L	MN	Rs	Factor	Rw	Ks	RHOs
1	2.000	3.000	0.800	48.400	2.762	133.705	34.715	1680.187
2	3.000	4.500	1.000	23.100	3.333	77.000	62.832	1451.416
3	4.000	6.000	1.000	10.030	4.469	44.822	112.312	1126.489
4	5.000	7.500	1.000	5.410	5.600	30.296	175.929	951.777
5	6.000	9.000	1.000	2.960	6.729	19.918	253.684	750.903
6	7.000	10.500	1.000	1.736	7.857	13.640	345.575	599.919
7	8.000	12.000	1.000	1.195	8.984	10.736	451.604	539.667
8	10.000	15.000	1.000	0.720	11.238	8.091	706.073	508.373
9	12.000	18.000	3.000	1.909	4.469	8.531	336.936	643.210
10	14.000	21.000	3.000	1.466	5.223	7.657	459.458	673.565
11	16.000	24.000	3.000	1.053	5.977	6.293	600.830	632.674
12	20.000	30.000	3.000	0.626	7.481	4.683	940.122	588.516
13	24.000	36.000	6.000	0.716	4.469	3.200	673.872	482.492
14	28.000	42.000	6.000	0.496	5.223	2.591	918.916	455.782
15	32.000	48.000	6.000	0.349	5.977	2.086	1201.659	419.379
16	40.000	60.000	10.000	0.379	4.469	1.694	1123.119	425.662
17	48.000	72.000	10.000	0.272	5.374	1.462	1620.748	440.843
18	56.000	84.000	10.000	0.224	6.278	1.406	2208.854	494.783
19	64.000	96.000	10.000	0.171	7.180	1.228	2887.438	493.752
20	80.000	120.000	10.000	0.180	8.984	1.617	4516.039	812.887
21	96.000	144.000	20.000	0.115	5.374	0.618	3241.495	372.772
22	112.000	168.000	20.000	0.082	6.278	0.515	4417.708	362.252
23	128.000	192.000	20.000	0.060	7.180	0.431	5774.876	346.493

Sounding Line 5

Station	A	L	MN	Rs	Factor	Rw	Ks	RHOs
1	2.000	3.000	0.800	84.200	2.762	232.603	34.715	2922.969
2	3.000	4.500	1.000	64.000	3.333	213.333	62.832	4021.239
3	4.000	6.000	1.000	44.100	4.469	197.072	112.312	4952.956
4	5.000	7.500	1.000	32.700	5.600	183.120	175.929	5752.884
5	6.000	9.000	1.000	26.800	6.729	180.342	253.684	6798.721
6	7.000	10.500	1.000	22.300	7.857	175.214	345.575	7706.327
7	8.000	12.000	1.000	18.090	8.984	162.527	451.604	8169.515
8	10.000	15.000	1.000	9.460	11.238	106.307	706.073	6679.450
9	12.000	18.000	3.000	17.610	4.469	78.695	336.936	5933.440
10	14.000	21.000	3.000	10.170	5.223	53.120	459.458	4672.687
11	16.000	24.000	3.000	6.250	5.977	37.354	600.830	3755.185
12	20.000	30.000	3.000	2.340	7.481	17.506	940.122	2199.885
13	24.000	36.000	6.000	1.963	4.469	8.772	673.872	1322.810
14	28.000	42.000	6.000	1.082	5.223	5.652	918.916	994.267
15	32.000	48.000	6.000	0.680	5.977	4.064	1201.659	817.128
16	40.000	60.000	10.000	0.565	4.469	2.525	1123.119	634.562
17	48.000	72.000	10.000	0.338	5.374	1.816	1620.748	547.813
18	56.000	84.000	10.000	0.226	6.278	1.419	2208.854	499.201
19	64.000	96.000	10.000	0.151	7.180	1.084	2887.438	436.003
20	80.000	120.000	10.000	0.104	8.984	0.934	4516.039	469.668
21	96.000	144.000	20.000	0.099	5.374	0.532	3241.495	320.908
22	112.000	168.000	20.000	0.067	6.278	0.421	4417.708	295.986

Sounding Line 6-A

Station	A	L	MN	Rs	Factor	Rw	Ks	RHOs
1	2.000	3.000	0.800	9.610	2.762	26.548	34.715	333.607
2	3.000	4.500	1.000	2.790	3.333	9.300	62.832	175.301
3	4.000	6.000	1.000	1.348	4.469	6.024	112.312	151.396
4	5.000	7.500	1.000	0.088	5.600	0.493	175.929	15.482
5	6.000	9.000	1.000	0.323	6.729	2.174	253.684	81.940
6	7.000	10.500	1.000	0.252	7.857	1.980	345.575	87.085
7	8.000	12.000	1.000	0.231	8.984	2.075	451.604	104.321
8	10.000	15.000	1.000	0.209	11.238	2.349	706.073	147.569
9	12.000	18.000	3.000	0.773	4.469	3.454	336.936	260.451
10	14.000	21.000	3.000	0.729	5.223	3.808	459.458	334.945
11	16.000	24.000	3.000	0.629	5.977	3.759	600.830	377.922
12	20.000	30.000	3.000	0.158	7.481	1.182	940.122	148.539
13	24.000	36.000	6.000	0.258	4.469	1.153	673.872	173.859
14	28.000	42.000	6.000	0.234	5.223	1.222	918.916	215.026
15	32.000	48.000	6.000	0.219	5.977	1.309	1201.659	263.163
16	40.000	60.000	6.000	0.189	7.481	1.414	1880.243	355.366
17	48.000	72.000	10.000	0.328	5.374	1.763	1620.748	531.605
18	56.000	84.000	10.000	0.357	6.278	2.241	2208.854	788.561
19	64.000	96.000	10.000	0.440	7.180	3.159	2887.438	1270.473
20	80.000	120.000	10.000	0.223	8.984	2.004	4516.039	1007.077
21	96.000	144.000	20.000	0.182	5.374	0.978	3241.495	589.952
22	112.000	168.000	20.000	0.094	6.278	0.590	4417.708	415.265
23	128.000	192.000	20.000	0.051	7.180	0.366	5774.876	294.519

Sounding CIBA 6-B

Station	A	L	MN	Rs	Factor	Rw	Ks	RHOs	RHOw
1	2.00	3.00	0.80	16.45	2.76	45.44	34.71	571.06	571.06
2	3.00	4.50	1.00	5.52	3.33	18.40	62.83	346.83	346.83
3	4.00	6.00	1.00	2.70	4.47	12.07	112.31	303.24	303.24
4	5.00	7.50	1.00	1.63	5.60	9.12	175.93	286.59	286.59
5	6.00	9.00	1.00	1.12	6.73	7.53	253.68	283.87	283.87
6	7.00	10.50	1.00	0.84	7.86	6.58	345.58	289.25	289.25
7	8.00	12.00	1.00	0.79	8.98	7.09	451.60	356.32	356.32
8	10.00	15.00	1.00	0.68	11.24	7.61	706.07	478.01	478.01
9	12.00	18.00	3.00	1.79	4.47	7.99	336.94	602.10	602.10
10	14.00	21.00	3.00	1.53	5.22	7.99	459.46	702.51	702.51
11	16.00	24.00	3.00	1.17	5.98	6.99	600.83	702.97	702.97
12	20.00	30.00	3.00	0.33	7.48	2.49	940.12	313.06	313.06
13	24.00	36.00	6.00	0.35	4.47	1.55	673.87	233.83	233.83
14	28.00	42.00	6.00	0.34	5.22	1.76	918.92	308.76	308.76
15	32.00	48.00	6.00	0.31	5.98	1.86	1201.66	373.72	373.72
16	40.00	60.00	6.00	0.28	7.48	2.08	1880.24	522.71	522.71
17	48.00	72.00	10.00	0.32	5.37	1.73	1620.75	520.26	520.26
18	56.00	84.00	10.00	0.33	6.28	2.07	2208.85	728.92	728.92
19	64.00	96.00	10.00	0.46	7.18	3.27	2887.44	1313.78	1313.78
20	80.00	120.00	10.00	0.18	8.98	1.58	4516.04	794.82	794.82
21	96.00	144.00	20.00	0.20	5.37	1.05	3241.50	635.33	635.33
22	112.00	168.00	20.00	0.07	6.28	0.43	4417.71	304.82	304.82
23	128.00	192.00	20.00	0.03	7.18	0.24	5774.88	196.35	196.35

Sounding CIBA 9

Station	A	L	MN	Rs	Factor	Rw	Ks	RHOs	RHOw
1	2.00	3.00	0.80	210.00	2.76	580.13	34.71	7290.07	7290.07
2	3.00	4.50	1.00	48.70	3.33	162.33	62.83	3059.91	3059.91
3	4.00	6.00	1.00	17.22	4.47	76.95	112.31	1934.01	1934.01
4	5.00	7.50	1.00	6.11	5.60	34.22	175.93	1074.93	1074.93
5	6.00	9.00	1.00	2.63	6.73	17.70	253.68	667.19	667.19
6	7.00	10.50	1.00	1.68	7.86	13.21	345.58	580.91	580.91
7	8.00	12.00	1.00	1.13	8.98	10.13	451.60	509.41	509.41
8	10.00	15.00	1.00	0.70	11.24	7.81	706.07	490.72	490.72
9	12.00	18.00	3.00	2.66	4.47	11.89	336.94	896.25	896.25
10	14.00	21.00	3.00	2.00	5.22	10.45	459.46	918.92	918.92
11	16.00	24.00	3.00	1.48	5.98	8.85	600.83	889.83	889.83
12	20.00	30.00	3.00	0.74	7.48	5.53	940.12	694.75	694.75
13	24.00	36.00	6.00	0.59	4.47	2.63	673.87	396.24	396.24
14	28.00	42.00	6.00	0.36	5.22	1.86	918.92	328.05	328.05
15	32.00	48.00	6.00	0.26	5.98	1.53	1201.66	307.62	307.62
16	40.00	60.00	6.00	0.15	7.48	1.14	1880.24	287.68	287.68
17	48.00	72.00	10.00	0.12	5.37	0.64	1620.75	192.87	192.87
18	56.00	84.00	10.00	0.10	6.28	0.62	2208.85	218.68	218.68
19	64.00	96.00	10.00	0.06	7.18	0.42	2887.44	170.36	170.36
20	80.00	120.00	10.00	0.07	8.98	0.61	4516.04	307.09	307.09
21	96.00	144.00	20.00	0.04	5.37	0.19	3241.50	116.69	116.69
22	112.00	168.00	20.00	0.02	6.28	0.11	4417.71	79.52	79.52
23	128.00	192.00	20.00	0.01	7.18	0.09	5774.88	69.30	69.30

Sounding CIBA 10

Station	A	L	MN	Rs	Factor	Rw	Ks	RHOs	RHOw
1	2.00	3.00	0.80	65.10	2.76	179.84	34.71	2259.92	2259.92
2	3.00	4.50	1.00	47.70	3.33	159.00	62.83	2997.08	2997.08
3	4.00	6.00	1.00	22.50	4.47	100.55	112.31	2527.02	2527.02
4	5.00	7.50	1.00	10.71	5.60	59.98	175.93	1884.20	1884.20
5	6.00	9.00	1.00	5.40	6.73	36.34	253.68	1369.89	1369.89
6	7.00	10.50	1.00	3.22	7.86	25.30	345.58	1112.75	1112.75
7	8.00	12.00	1.00	2.20	8.98	19.77	451.60	993.53	993.53
8	10.00	15.00	1.00	1.25	11.24	14.05	706.07	882.59	882.59
9	12.00	18.00	3.00	2.60	4.47	11.62	336.94	876.03	876.03
10	14.00	21.00	3.00	1.85	5.22	9.66	459.46	850.00	850.00
11	16.00	24.00	3.00	1.26	5.98	7.53	600.83	757.05	757.05
12	20.00	30.00	3.00	0.75	7.48	5.63	940.12	707.91	707.91
13	24.00	36.00	6.00	1.14	4.47	5.08	673.87	765.52	765.52
14	28.00	42.00	6.00	0.79	5.22	4.11	918.92	722.27	722.27
15	32.00	48.00	6.00	0.57	5.98	3.38	1201.66	678.94	678.94
16	40.00	60.00	6.00	0.34	7.48	2.57	1880.24	646.80	646.80
17	48.00	72.00	10.00	0.34	5.37	1.85	1620.75	557.54	557.54
18	56.00	84.00	10.00	0.23	6.28	1.46	2208.85	512.45	512.45
19	64.00	96.00	10.00	0.15	7.18	1.10	2887.44	441.78	441.78
20	80.00	120.00	10.00	0.08	8.98	0.68	4516.04	343.22	343.22
21	96.00	144.00	20.00	0.11	5.37	0.57	3241.50	343.60	343.60
22	112.00	168.00	20.00	0.07	6.28	0.44	4417.71	309.24	309.24
23	128.00	192.00	20.00	0.05	7.18	0.36	5774.88	288.74	288.74
24	160.00	240.00	20.00	0.03	8.98	0.26	9032.08	261.93	261.93

Sounding CIBA 1 1

Station	A	L	MN	Rs	Factor	Rw	Ks	RHOs	RHOw
1	2.00	3.00	0.80	13.10	2.76	36.19	34.71	454.76	454.76
2	3.00	4.50	1.00	12.12	3.33	40.40	62.83	761.52	761.52
3	4.00	6.00	1.00	4.06	4.47	18.14	112.31	455.99	455.99
4	5.00	7.50	1.00	2.66	5.60	14.90	175.93	467.97	467.97
5	6.00	9.00	1.00	1.68	6.73	11.31	253.68	426.19	426.19
6	7.00	10.50	1.00	1.28	7.86	10.06	345.58	442.34	442.34
7	8.00	12.00	1.00	0.95	8.98	8.54	451.60	429.02	429.02
8	10.00	15.00	1.00	0.58	11.24	6.52	706.07	409.52	409.52
9	12.00	18.00	3.00	1.48	4.47	6.61	336.94	498.67	498.67
10	14.00	21.00	3.00	1.07	5.22	5.59	459.46	491.62	491.62
11	16.00	24.00	3.00	0.69	5.98	4.15	600.83	416.98	416.98
12	20.00	30.00	3.00	0.15	7.48	1.15	940.12	144.78	144.78
13	24.00	36.00	6.00	0.20	4.47	0.87	673.87	131.40	131.40
14	28.00	42.00	6.00	0.18	5.22	0.96	918.92	168.16	168.16
15	32.00	48.00	6.00	0.10	5.98	0.59	1201.66	117.76	117.76
16	40.00	60.00	6.00	0.07	7.48	0.54	1880.24	135.38	135.38
17	48.00	72.00	10.00	0.11	5.37	0.59	1620.75	178.28	178.28
18	56.00	84.00	10.00	0.10	6.28	0.63	2208.85	220.89	220.89
19	64.00	96.00	10.00	0.09	7.18	0.65	2887.44	259.87	259.87
20	80.00	120.00	10.00	0.06	8.98	0.50	4516.04	252.90	252.90

Appendix D

APPENDIX D

BORING LOGS

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING RW-1 SHEET 1 OF 3

PROJECT AND LOCATION: Ciba Geigy Cranston, R.I.		ELEVATION AND DATUM:	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	FOREMAN: Larry Fredericks	DATE STARTED: 7/17/90	DATE FINISHED: 7/17/90
DRILLING EQUIPMENT: CME 75		COMPLETION DEPTH: 59.7	ROCK DEPTH: 59.5
SIZE AND TYPE OF BIT: CASING	SIZE AND TYPE CORE BARREL: NX	NO. SAMPLES: DIST 28	UNDIST 1 / CORE 0
		WATER LEVEL: FIRST 6 ft	COMPL / 24 HR
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: vertical
SAMPLER: 2 inch split spoon and Shelby tube			INSPECTOR: M. Craig
SAMPLER HAMMER	WEIGHT 140 lbs	DROP 30 inch (auto.)	

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	HNU/PID READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
Asphalt, concrete, brick (FILL)										0840 Begin drilling
SP- grayish tan loose m-f SAND, some gravel; tr silt, moist (FILL)		1–2	SS-1	1.5	4 6 7 5	0845				
S.A.A.		3–4	(b)SS-2(a)	1.2	4 4 5 3	0850				
SM - black med dense m-f SAND, some silt; tr. gravel, moist (FILL)		5–6	SS-3	0.8	3 5 6 9	0900	0.2	0.2	0910	0900 borehole headspace = background water level at 6.0ft.
S.A.A. with wood										
S.A.A.; wet		7–8	SS-4	0.8	12 9 9 8	0910	5.0	0.2	0915	
S.A.A.		9–10	SS-5	0.2	6 5 2 4	0921	1.0	0.2	0925	0920 borehole headspace and breathing zone = background
CL - dk gray firm silty CLAY with 0.25 inch f sand layer and sand in tip of spoon; wet		11–12	(b)SS-6(a)	1.3	5 4 3 3	0927	0.2	0.2	0930	
		13–14		0		1015				1015 Attempt Shelby tube at 13ft - no recovery
S.A.S; some f sand.		15–16	(b)SS-7(a)	1.3	3 7 5 4	1032	0.2	0.2	1035	
SP/SM - black med dense f-m SAND angular; some silt, wet		17–18	SS-8	2.0	5 8 10 12	1040				SS-8 for grain size analysis
S.A.A.; tr silt; color change to gray at 18ft		19	SS-9	1.6	8 8 9	1045				

WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING RW-1 **SHEET** 2 **OF** 3

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	HNU READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
S.A.A.; some silt; tr. gravel		21	SS-9	1.6	10 7	1045				
S.A.A.; tr silt, tr gravel; coarsens downward		22	SS-10	2.0	4 5 9	1055				
S.A.A.; fines downward		23	(6)SS-11(a)	2.0	3 4 4 9	1110	0.2	0.2	1115	
SP/SM gray loose silty f SAND; wet.		25								
S.A.A		26	SS-12	2.0	2 3 4 5	1205	0.2	0.2	1210	
S.A.A.; finer		27	SS-13	2.0	4 4 5 5	1215	0.2	0.2	1217	
S.A.A.		29	SS-14	2.0	3 3 3 3	1230				
S.A.A.		31	SS-15	2.0	3 5 7 7	1233				
S.A.A.		33	SS-16	0.8	2 2 2 4	1250	0.2	0.2	1255	
S.A.A.		35	SS-17	1.5	2 4 5 6	1304				
S.A.A.; fines downward		37	(6)SS-18(b)	2.0	4 5 6 4	1307				
SM/SC - gray firm sandy SILT; wet S.A.A.		39	SS-19	0.5	2 2 3 3	1345				
S.A.A.; fines downward		41	SS-20	1.0	3 5 6 6	1400				SS-20 for grain size analysis
ML - gray stiff sandy SILT; some clay; tr. gravel; wet		43								
ML/CL - gray very stiff clayey SILT; wet		44	SS-21	1.8	7 9 9 10	1425				

WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING RW-1 SHEET 3 OF 3

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	HNU READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
ML/CL		46	RW1-ST	1.9	X	1505				1505 Shelby tube inserted 1510 Shelby tube removed
S.A.A., tr. gravel		47								
SP/SM - gray hard gravelly SILT, with decomposed pyritic shale (TILL)		48	(6) SS-22	1.4	7 26 36 72	1550				
S.A.A., with decomposed shale and gray sandstone		49								
		50	SS-23	1.2	20 31 27 46	1610				
S.A.A.		51								
		52	SS-24	1.4	48 67 56 82	1620				
S.A.A.		53								
		54	SS-25	0.8	39 35 51 37	1642				
SP/SM - gray very dense silty SAND, some gravel, wet (TILL)		55								
		56	SS-26	0.9	45 48 69 53	1702	0.2	0.2	1704	
S.A.A.		57								
		58	SS-27	1.0	49 46 31 61	1710				
Decomposed white and gray sandstone		59	SS 28	0.7	40 100/2	17 40				
Bottom of boring 59.7 ft		60								1802 Tremie grout into borehole to seal.
		61								
		62								
		63								
		64								
		65								
		66								
		67								
		68								
		69								

WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING RW-1 SHEET 1 OF 1

PROJECT AND LOCATION	Ciba-Geigy Cranston, R.I.
ELEVATION AND DATUM	
PROJECT NO.	87X4660
DRILLING AGENCY	East Coast Drilling
FOREMAN	Larry Fredericks
DATE STARTED	8/8/90
DATE FINISHED	
DRILLING EQUIPMENT	CME 75
COMPLETION DEPTH	73
ROCK DEPTH	59.5
SIZE AND TYPE OF BIT	
SIZE AND TYPE CORE BARREL	5' NX Core
CASING	
CASING HAMMER / WEIGHT / DROP	
SAMPLER	
SAMPLER HAMMER / WEIGHT / DROP	
NO. SAMPLES	DIST / UNDIST / CORE
WATER LEVEL	FIRST / COMPL / 24 HR
BORING ANGLE AND DIRECTION	Vertical
INSPECTOR	PGN

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR RESIST BLOWS	m: POCKET PENETROMETER TSF	ROCK CORE RECOVERY %	CRACK SKETCH	CRACK CORD	RQD	CORE TIME FT	REMARKS
		70										
SANDSTONE, Medium Grained; Quartz, Biotite; moderately Hard; Moderately Strong; moderately to Deeply Weathered; moderate to Well Foliated; Poor to moderately Developed Schistose cleavage; Approximate 60° dip in cleavage; Numerous vertical and steeply dipping 1/10" quartz filled fractures; Subhedral quartz and green staining in fractures GRAY			RUN 1	2.2/3.0=73%				NR	CP CP CS CP	0.8/3.0=0.27		0 - Sample Taken 0.9'-1.25'
		73										

WOODWARD—CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING RW2 **SHEET** 1 **OF** 3

PROJECT AND LOCATION: CIBA-GEIGY CRANSTON RI		ELEVATION AND DATUM:	PROJECT NO.: 87X4650
DRILLING AGENCY: East Coast Drilling	FOREMAN: JIM	DATE STARTED: 7-17-90	DATE FINISHED: 7-18-90
DRILLING EQUIPMENT: CME-75		COMPLETION DEPTH: 50 lt	HOLE DEPTH: 52 lt
SIZE AND TYPE OF BIT: 4" HSA w/3 1/4" Roller Bit Plug	SIZE AND TYPE CORE BARREL: NX-5 foot long	NO. SAMPLES: DIST. 26	WIDTH: 1 / DEPTH: 20'
CASING: Outer 8 inch ID		WATER LEVEL: FIRST 5.57	COMPL. 6.74 / 24 HR
CASING HAMMER: WEIGHT:	DROP:	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: SPLIT SPOON		INSPECTOR: Kevin Murphy	
SAMPLER HAMMER: WEIGHT: 140	DROP: 30		

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR RESIST BL/6IN.	TIME	HNU/PID READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
FILL - Rock debris Roots Sand dry. moist		1	S1	2	(3) 3 7 7	8 43	.2	.2		
FILL - Sand f-grained Brown some debris. moist		2–3	S2	2	3 5 5 6	8 45	.2	.2		Particle size Sample taken
FILL - Very Loose black-gray clean SAND Wet		4–5	S3	2	3 4 3 3	9 05	.2	.2		Water table.
FILL - Very Loose Black Silty SAND Saturated		6–7	S4	2	1 3 3 7	9 27	.2	.2		
Very Loose Black Clayey SILT Saturated		8								
FILL - LOOSE Gray GRAVEL-SAND mixture grading into a SILT Saturated		9	S5	.5	5 15 3 7	9 24	.2	.2		
FILL? - Very Loose Black-gray Clayey SILT SATurated. w/gravel		10–11	S6	2	(2) 2 3 5	9 33	.2	.2		
Very Loose Black GRAVEL f-m SATurated		12								
GM - Very soft Gray SILT w/some gravel SATurated		13	S7	1	1 1 2 4	9 34	.2	.2		
CH - Soft-firm gray-green CLAY Wet		14–15	S8	2	(2) 3 5 8	9 53	.2	.2		
S.A.A.		16–17	S9	.5	3 5 7 7	9 57	.2	.2		
S.A.A. with 1-2 inch Silt lenses.		18–19	S10	2	1 1 1 2	10 18	.2	.2		

WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING RW 2 SHEET 2 OF 3

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	HNU READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
ML/CL - Black SILT Saturated.		21	S11	1		10:40	.2	.2		Shelby tube
OL - Soft Black Clayey SILT Saturated outside wet INSIDE		22								Bottom of spoon
		23	S12	2	1 3 4 5	11:21	.2	.2		Dense clay .3"
SAA.		24								
		25	S13	2	3 4 4 7	11:23	.2	.2		
SAA.		26								
		27	S14	2	1 3 3 4	11:29	.2	.2		
ML/CL - Soft Gray Clayey f SAND Saturated		28								
		29	S15	2	WR WR 4 4	11:45	.2	.2		grain size samples.
SAA.		30								
		31	S16	2	WR WR 2 3	11:55	.2	.2		
CL - Soft Black sandy-Silty CLAY Saturated		32								
		33	S17	2	3 3 3 6	12:05	.2	.2		
SAA.		34								
		35	S18	2	WH 1 2 2	12:45	.2	.2		
SAA. - layers of green silty CLAY		36								
		37	S19	2	WR 2 1 3	13:55	.2	.2		
SP/SM - Very Soft gray Sandy-SILT Saturated		38								
		39	S20	2	3 2 2 4	14:12	.2	.2		
SAA.		40								
		41	S21	1	10 20 30 14	14:22	.2	.2		
SAA.		42								
		43	S22	1.5	9 21 9 8	14:27	.2	.2		
		44								
			S23		33 14	15:21	.2	.2		

WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING RW-2 SHEET 3 OF 3

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	HNU READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
TILL - Pebbles gravel			S23	1	11 17	15[24]	.2	.2		
		46								
		47	S24	1	4 13 100 ~~45~~	15[25]	.2	.2		
		48								
Rock - Angular gray Bedrock Fragmented		49	S25	.5	~~45~~ 85 74 100	16[00]	.2	.2		
		50								7-18-90 EOD
		51								
		52								
		53								
		54								
		55								
		56								
		57								
		58								
		59								
		60								
		61								
		62								
		63								
		64								
		65								
		66								
		67								
		68								
		69								

WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING RW-2 **SHEET** 1 **OF** 2

PROJECT AND LOCATION	Ciba-Geigy Cranston, R.I.
ELEVATION AND DATUM	
PROJECT NO.	87X4660
DRILLING AGENCY	East Coast Drilling
FOREMAN	
DATE STARTED	8/7/90
DATE FINISHED	
DRILLING EQUIPMENT	CME-75
COMPLETION DEPTH	76
ROCK DEPTH	52
SIZE AND TYPE OF BIT	
SIZE AND TYPE CORE BARREL	NX-5foot long
NO. SAMPLES	DIST / UNDIST / CORE
WATER LEVEL	FIRST / COMPL / 24 HR
CASING	
CASING HAMMER	WEIGHT / DROP
SAMPLER	
SAMPLER HAMMER	WEIGHT / DROP
BORING ANGLE AND DIRECTION	Vertical
INSPECTOR	PGN

DESCRIPTION	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR RESIST BLS/6IN.	RECOVERY %	ROCK CORE CRACK SKETCH	CRACK COND	RQD	CORE TIME FT	REMARKS
SHALE, massive to sub horizontal cleavage; Laminated to very thin bedded w/ Alternating light and dark streaks; moderately Developed sub-horizontal cleavage, Dark Grey	56–59	Run 1	5.01		100%	13°, 10°, 10°, 10°	cg, cg, cg, cg, cg, cg, cg	3.1/5.0 = .62		unit becomes sandier and lighter in color
SHALE, sandy; moderately Hard, Moderately Strong	59–61					XXX	cg			Broken zone; 1&2 match
SANDSTONE, Very Fine Grained; Quartz; Hard; strong; massive, phyllitic coating on vertical fracture	61–66	Run 2	5.01		100%	15°, 10°	cg, cg, cg, cg	3.3/5.0 = .66		Phyllitic Swirls; Layering in Shale; 2&3 match; Cleavage
As Above Except Fine to medium Grained, phyllitic w/ ¼" Thin lamination										
As Above except mica mineralization on fractures; grain size coarsens w/ depth	66–71	Run 3	4.5 (Remainder in hole)		90%	0, NR	cg, cg, fe phyl	3.1/5 = .62		0-Sample Taken 69–69.4'; 3&4 match
As Above except some quartz pebbles; slightly streaked, some phyllite streaks	71–74	Run 4	5.0			60°, XXX	cp, cg, cg, cp	2.65/5.0 = 0.53		@ 3.5' in Run, soft piece of rock is embedded; broken & deeply weathered (Fe)

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LOG OF BORING Rw-2 SHEET 2 OF 2

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV., FT	SAMPLES: PENETR. RESIST BLS/6IN.	qu POCKET PENETROMETER TSF	ROCK CORE: RECOVERY %	ROCK CORE: CRACK: BEDDING	ROCK CORE: CRACK: CORE	ROCK CORE: RQD	ROCK CORE: CORE TIME FT	REMARKS
As above except no fractures from 74.8' to 76.0'												
		76										
End of coring at 76.0'												

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LOG OF BORING RW-3 **SHEET** 1 **OF** 3

PROJECT AND LOCATION: CIBA-Geigy – Cranston, RI		ELEVATION AND DATUM:	PROJECT NO.: 87x4660
DRILLING AGENCY: East Coast Drilling	FOREMAN: JIM	DATE STARTED: 7/18/90	DATE FINISHED: 7/20/90
DRILLING EQUIPMENT: CME-75 / DieDrick-D-50		COMPLETION DEPTH: 84	INDEX DEPTH: 68
SIZE AND TYPE OF BIT: 4 inch HSA w/3 1/4 bottom plug	SIZE AND TYPE CORE BARREL: NX - 5 foot long	NO. SAMPLES: DIST 29	WEIGHT 2 / DROP 7 - 5 foot
CASING: Outer 8 inch ID		WATER LEVEL: DATE 5.00	GROUND 6.5 / 24 HR. 2.85
CASING HAMMER: WEIGHT:	DROP:	BORING ANGLE AND DIRECTION: Vertical	
SAMPLER: Split Spoon		INSPECTOR: Kevin Murphy	
SAMPLER HAMMER: WEIGHT 140 lb	DROP 30 in		

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR. RESIST. BL/6IN.	TIME	HNU/PID READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
FILL - Loose Brown-Gray Silt w/ Organics, grass, Rock, debris; moist		1	S1	2	5 4 13 10	10:03	.2	.2		
		2								
OL - firm black SILT moist-wet		3	S2	.5	3 7 5 4	10:07	.2	.2		
SP/SM - very soft black sandy SILT to fine grained wet - Saturated ▼		4								
ML		5	S3	2	2 2 1 2	11:00	.2	.2		water table
S.A.A.		6								
		7	S4	2	WH WH 1 2	11:05	.2	.2		grain size Sample taken
PL - very soft Brown PEAT w/Roots organic moist - wet		8								
		9	S5	2	1 1 2 3	11:23	.2	.2		
SC - very loose clayey f-m SAND wet → Saturated		10								
S.A.A.		11	S6	2	3 2 3 4	11:35	.2	.2		
MH - Soft black SILT saturated		12								
SP/SM - soft gray f-c SAND w/traces of Silt saturated		13	S7	2	2 2 4 6	11:40	.2	.2		grain size Sample taken
		14								
S.A.A.		15	S8	2	2 2 4 3	12:09	.2	.2		
		16								
S.A.A.		17	S9	1	2 2 3 4	12:14	.2	.2		
		18								
S.A.A.		19	S10	2	5 5 3 4	12:30	.2	.2		

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LOG OF BORING RW-3 SHEET 2 OF 3

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BLOWS/6IN.	TIME	HNU READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
SC/SM to ML - Black Clayey SILT wet → saturated		21	S11	2		13:40	.2	.2		Shelby #1 full recovery
		22								
SAA. - color - grey green		23	S12	2	2 4 4 6	14:10	.2	.2		
SAA. Clay lenses grey green		24								
		25	S13	2	2 4 5 6	14:20	.2	.2		
SAA.		26								
		27	S14	2	6 10 8 8	14:30	.2	.2		
CL/ML Very Silty lenses (like varves)		28								
		29	S15	2		14:55	.2	.2		Shelby #2 full recovery
SAA.		30								
		31	S16	2	2 3 6 7	15:40	.2	.2		
SAA.		32								
		33	S17	2	3 3 5 4	15:45	.2	.2		
SAA.		34								
		35	S18	2	4 4 4 5	16:05	.2	.2		
		36								
CL - Soft → firm gray green Silty CLAY wet - saturated outside dry → moist inside		37	S19	2	3 4 5 6	16:05	.2	.2		
		38								
SAA.		39	S20	2	WH 2 3 3	16:32	.2	.2		
ML - Very Soft SILT Black Clayey Saturated - wet		40								
		41	S21	2	2 2 4 4	17:05	.2	.2		
SAA		42								
		43	S22	2	5 4 3 3	17:10	.2	.2		7/18/90 EOD 19:45
SAA.		44								

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LOG OF BORING RW 3 SHEET 3 OF 3

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	HNU READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
SAA, more Silt		46	S23	2	2 2 1 1	8:51	.2	.2		
SAA.		47	S24	2	2 3 3 3	8:59	.2	.2		
SAA.		48								
		49	S25	2	1 4 4 4	9:18	.2	.2		
ML - very Soft Black clayey SILT - saturated flowing		50								
		51	S26	0	WR WR WR WH	9:45	.2	.2		
SAA.		52								
		53	S27	2	WH 3 5 5	9:47	.2	.2		
SAA.		54								
GM - Loose Black clayey F-m GRAVEL w/pebbles wet - Saturated		55	S28	.5	1 5 4 5	10:30	.2	.2		
		56								
SAA.		57	S29	.5	5 5 7 8	10:40	.2	.2		augers Sand cored at 58 feet
SM. - very Loose gray -> Black silty f-SAND. saturated		58								
		59								Skipped over Sampler
		60								Augered to 60 feet
NO Recovery		61								
		62								
FLOWING SANDS		63								
		64								
		65								7/19/90 EOD 17:35
		66								
		67								
		68								
TOP OF ROCK		69								7/20/90 EOD 15:30

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LOG OF BORING RW-3 SHEET 1 OF

PROJECT AND LOCATION	Ciba-Geigy · Cranston, RI
ELEVATION AND DATUM	
PROJECT NO.	87X4660
DRILLING AGENCY	East Coast Drilling
FOREMAN	
DATE STARTED	8/8/90
DATE FINISHED	
DRILLING EQUIPMENT	CME-75/Diedrick D-50
COMPLETION DEPTH	84
ROCK DEPTH	68
SIZE AND TYPE OF BIT	
SIZE AND TYPE CORE BARREL	5' NX
NO. SAMPLES / DIST / UNDIST / CORE	
WATER LEVEL / FIRST / COMPL / 24 HR	
CASING	
CASING HAMMER / WEIGHT / DROP	
SAMPLER	
SAMPLER HAMMER / WEIGHT / DROP	
BORING ANGLE AND DIRECTION	Vertical
INSPECTOR	PGN

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES: TYPE NO. LOC	RECOV., FT	PENETR. RESIST. BLWS/6	or POCKET PENETROMETER TSF	ROCK CORE: RECOVERY %	CRACK: SKETCH	CRACK: COND	RQD	CORE TIME FT	REMARKS
Top of Core - 73.0'		73										Gap in Core
SANDSTONE, Medium Grained, Quartz; Hard; Strong; No observable Bedding; Sporadically distributed moderately developed schistose cleavage w/ ≈ 65°-70° dip, Fresh; light grey		74	Run 1	4.1			82 %	65°	cp, cp, cs, cg, cs, cg, cg	3.8/5.0 = .76		65° Dipping Fracture Along Schistose Plane, white mica & white Paste
		75										• Sample Taken .65'-1.0'
		76										
		77						NR				
End Core @ 78'		78										

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LOG OF BORING RW-4 **SHEET** 1 **OF** 2

PROJECT AND LOCATION: Ciba Geigy Cranston, R.I.		ELEVATION AND DATUM:	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	FOREMAN: Larry Fredericks	DATE STARTED: 7/18/90	DATE FINISHED: 7/19/90
DRILLING EQUIPMENT: CME 75		COMPLETION DEPTH: 33.5 ft	ROCK DEPTH: 28.0 ft
SIZE AND TYPE OF BIT:	SIZE AND TYPE CORE BARREL:	NO. SAMPLES: DIST 14	UNDIST 1 / CORE 1
CASING: 8 inch (temp)	NX	WATER LEVEL: FIRST 13.75ft	COMPL — / 24 HR —
CASING HAMMER: WEIGHT:	DROP:	BORING ANGLE AND DIRECTION: vertical	
SAMPLER: 2 inch split spoon and Shelby tube		INSPECTOR: M. Craig	
SAMPLER HAMMER: WEIGHT: 140 lbs.	DROP: 30 in. (auto)		

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	HNU/PID READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
Topsoil										1313 Begin drilling
SP-brown med dense m-f SAND; some gravel; tr silt; dry		1	(b)SS-1 (a)	1.3	4 6 8 4	1315	0.2	0.2	1317	
		2								
S.A.A.		3	SS-2	1.6	7 9 10 8	1320	0.2	0.2	1323	
SM - tan loose silty m-f SAND, tr gravel; dry		4								
		5	SS-3	1.4	4 5 5 6	1328				
		6								
SP/SM - tan loose silty f SAND; moist		7	(b)SS-4(a)	1.7	3 4 5 6	1333				
S.A.A.; tr gravel		8								
		9	SS-5	1.2	4 3 5 5	1350				SS-5 for grain size analysis
SM - tan loose silty f SAND; moist, with rust colored layer at bottom		10								
		11	SS-6	1.3	3 6 5 5	1410				
S.A.A. with rust layer at top.		12								
		13	SS-7	1.7	9 5 6 6	1412				
		14								
S.A.A.; wet		15	SS-8	1.4	2 3 2 3	1422				
		16								
SP/SM S.A.A.		17	SS-9	2.0	2 5 7 6	1425				SS-9 for grain size analysis
		18								
SM - grayish brown loose silty f SAND; wet; with thin rust colored layer		19	SS-10	1.8	2 3 3 3	1438	0.2	0.2	1545	

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LOG OF BORING RW-4 **SHEET** 2 **OF** 2

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	HNU READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
S.A.A.		21			2 2 4 3	1500				
SM - gray loose silty f SAND; some clay; tr. gravel; wet		22								
SM - mottled gray and tan loose silty f SAND; wet		23			3 3 2 2	1505				
ML/CL - gray soft clayey SILT; tr to some m sand; tr gravel; wet (TILL)		24								
		25				1530				Crushed end of Shelby on gravel.
SP/SM - gray m dense silty m SAND some gravel; wet (TILL)		26								
		27			39 14 12 55	1625	0.2	0.2	1626	
		28	SS 1H	0.4	50/4"	1640				
gray meta-sandstone		29								Attempt to auger can't advance past 28.5 ft
		30								Coring time:
		31	Run 1	4.5	RQD = 92	1750				2.5 min/ft
		32								2 min/ft
		33								2 min/ft
										2 min/ft
Bottom of boring 33.5 ft		34								See sheet attached for core log.
		35								
		36								
		37								
		38								
		39								
		40								
		41								
		42								
		43								
		44								

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LOG OF BORING RW-4 SHEET 1 OF 2

PROJECT AND LOCATION	Ciba-Geigy Cranston R.I.
ELEVATION AND DATUM	
PROJECT NO.	87X4660/1.03
DRILLING AGENCY	East Coast Drilling
FOREMAN	Larry Fredericks
DATE STARTED	8/8/90
DATE FINISHED	
DRILLING EQUIPMENT	CME-75
COMPLETION DEPTH	49 ft
ROCK DEPTH	28.5 ft
SIZE AND TYPE OF BIT	
SIZE AND TYPE CORE BARREL	NX
CASING	
NO. SAMPLES / DIST / UNDIST / CORE	
WATER LEVEL / FIRST / COMPL / 24 HR	
CASING HAMMER / WEIGHT / DROP	
BORING ANGLE AND DIRECTION	Vertical
SAMPLER	
INSPECTOR	PGN
SAMPLER HAMMER / WEIGHT / DROP	

DESCRIPTION	DEPTH, FT	SAMPLES: TYPE / NO. LOC	RECOV. FT	PENETR. RESIST. BLW/FT.	% POCKET PENETROMETER TSF	ROCK CORE: RECOVERY %	CRACK: BEDTCH	CRACK: COND	RQD	CORE TIME FT	REMARKS
Top of Core - 28.5'	28.5										
SANDSTONE, Medium Grained; Quartz, Some Shale and Quartz Pebbles at top of core; Some Round, some elongate, up to 1" long and locally much larger; Hard; Strong; Fresh; No distinct bedding; Poorly developed schistosity dipping at 65°; Pearly white Mica along Schistosity; light grey	29						65°	Cg			Crack Across 2" Quartzite clast
	30						40°	Cg Cg			Fe, mica along cleavage limonite (?) along cleavage
	31	Run 1	4.5			90%			3.5/5.0 = 0.70		
	32						XX				Broken Zone
	33						XX				
	34						NR				Drill String Sank
	35						45° XX	Cg CP			Broken Zone, Deeply weathered w/ 2" Quartz clast
Same As Above	36	Run 2	4.75			95%		Cg			
	37										
	38							Cg			
	39						NR				Run 2 Matches Run 3
Same As Above	40										
	41	Run 3	5.0			84%	70°	Cg CP			Deeply mineralized Fracture (Hematite/limonite ?), subhedral XLS dip 70°
	42							Cg Cg			
	43						70°				mineralized Fracture w/ euhedral Qtz, sm Hematite, limonite staining, parallel to Above Fracture
	44							Cg			
Same As Above	45	Run 4	4.75			95%		Cg Cg			All cg fractures exhibit Abundant white Mica on Surfaces
	46										
	47							Cg Cg			

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LOG OF BORING RW-4 SHEET 2 OF 2

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT	SAMPLES PENETR RESIST BLW/IN	w/ POCKET PENETROMETER TSF	ROCK CORE RECOVERY %	ROCK CORE CRACK SKETCH	ROCK CORE CRACK COND	ROCK CORE RQD	ROCK CORE CORE TIME FT	REMARKS
Same As Above		49	RW-4	4.75			95%	NR				
End Core @ 49.0'												

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LOG OF BORING P-19D **SHEET** 1 **OF** 2

PROJECT AND LOCATION: Ciba Geigy Cranston, R.I.		ELEVATION AND DATUM:	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	FOREMAN: Larry Fredericks	DATE STARTED: 7/19/90	DATE FINISHED: 7/19/90
DRILLING EQUIPMENT: CME 75		COMPLETION DEPTH: 28 ft	FINAL DEPTH: 28 ft
SIZE AND TYPE OF BIT:	SIZE AND TYPE CORE BARREL:	NO. SAMPLES: DIST 13	UNDIST 2 / DISP 0
CASING		WATER LEVEL: FIRST 3.8 ft	COMPL. — / 24 HR —
CASING HAMMER: WEIGHT:	DROP:	BORING ANGLE AND DIRECTION: vertical	
SAMPLER: 2 inch split spoon and Shelby tube		INSPECTOR: M. Craig	
SAMPLER HAMMER: WEIGHT: 140 lbs	DROP: 30 inch (auto.)		

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES: TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	MINI-PID READINGS (PPM): SAMPLE	AMBIENT AIR	TIME	REMARKS
SC/SM - dk. brown stiff sandy SILT, tr. gravel; dry		1	SS-1	2.0	6 10 6 3	1015	0.1	0.1	1017	1012 Begin drilling SS-1 and SS2(a) for grain size analysis
S.A.A.		2	(a) SS-2 (b)	2.0	2 2 2 3	1019				
ML - lt. brown soft SILT; some f sand; tr. clay; moist-wet.		3								Water at 3.8 ft
		4								
SP/SM - tan to lt. gray loose f SAND some silt; tr. gravel; wet		5	(a) SS-3 (b)	1.3	2 2 4 3	1025				
S.A.A.		6	SS-4	2.0	4 2 8 12	1030				SS-4 for grain size analysis.
ML - lt. brown firm SILT; tr. f sand, wet		7								
SP - rust to dk brown med. dense m-c SAND; some gravel; tr. silt; wet.		8	(a) SS-5 (b)	1.3	5 11 9 10	1042				
S.A.A., some grading		9								
		10	SS-6	1.4	3 5 6 7	1050	0.1	0.1	1056	SS-6 and SS7(a) for grain size analysis.
S.A.A.		11	(a) SS-7 (b)	1.5	9 5 5 4	1055	0.1	0.1	1059	
ML/CL - gray med. dense vf SAND; some silt; wet.		12								
		13	P19D-ST1 (b)	2.0	X	1230				Lunch break - 1100-1200 1230 insert Shelby tube 1245 remove Shelby
CL - gray stiff slightly plastic CLAY; wet		14								
		15	(a) SS-8 (b)	1.5	4 4 6 8	1302				
GC - gray loose clayey GRAVEL; some m-c sand, wet		16								
ML/CL - gray stiff slighty plastic CLAY; wet		17	(a) SS-9 (b)	1.1	5 6 7 5	1305				
		18								
		19								

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LOG OF BORING P19D

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	SAMPLES RECOV, FT	SAMPLES PENETR RESIST BL/BIN.	SAMPLES TIME	HNU READINGS (PPM) SAMPLE	HNU READINGS (PPM) AMBIENT AIR	HNU READINGS (PPM) TIME	REMARKS
ML/CL		21	P19D-ST2	2.0	X	1325				1325 Shelby tube inserted 1333 Shelby tube removed
		22								
S.A.A.		23	SS-10	0.8	3 4 3 2	1400				
		24								
S.A.A.		25	SS-11	1.3		1405				
		26								
S.A.A., trace f sand towards bottom of spoon		27	SS-12	2.0		1410				
dk gray siltstone; Bedrock?		28	SS-13	0	100/0.4ft	1422				Rock in tip of spoon. Attempt to auger; cannot advance EOB=28.1ft
		29								
		30								
		31								
		32								
		33								
		34								
		35								
		36								
		37								
		38								
		39								
		40								
		41								
		42								
		43								
		44								

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LOG OF BORING P21-D **SHEET** 1 **OF** 2

PROJECT AND LOCATION: Ciba Geigy Cranston, R.I.		ELEVATION AND DATUM:	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	FOREMAN: Larry Fredericks	DATE STARTED: 7/20/90	DATE FINISHED: 7/23/90
DRILLING EQUIPMENT: CME 75		COMPLETION DEPTH: 42 ft	FIRST DEPTH: Not encountered
SIZE AND TYPE OF BIT:	SIZE AND TYPE OF CORE BARREL:	NO. SAMPLES: DIST 18	UNDIST 2 / CORE 0
CASING		WATER LEVEL: FIRST 9.5	COMPL — / 24 HR —
CASING HAMMER / WEIGHT / DROP		DRILLING ANGLE AND DIRECTION: Vertical	
SAMPLER: 2 inch split spoon and Shelby tube		INSPECTOR: M. Craig	
SAMPLER HAMMER / WEIGHT: 140 lbs	DROP: 30 inch (auto)		

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES: TYPE NO. LOC	RECOV. FT	PENETR RESIST BL/6IN.	TIME	HNU/PID READINGS (PPM): SAMPLE	AMBIENT AIR	TIME	REMARKS
SP/SM - brown dense silty f SAND, some gravel; dry		1	SS-1	1.5	4 7 12 10	0925				0922 Begin drilling; SS-1 for grain size analysis
S.A.A.		2–3	SS-2	0.4	11 11 9 5	0927				
S.A.A., tr gravel; fines downward		4–5	SS-3	0.8	3 2 3 4	0935				
S.A.A.; moist		6–7	SS-4	0.2	2 2 2 2	0937				
SC/SM to ML - brown very soft sandy SILT, tr gravel, tr organic material; gray sand in tip of spoon; tip is wet.		8–9	SS-5	1.7	3 3 3 3	0950	0.2	0.2	0955	SS-5 for grain size analysis; water at 9.5 feet
SM - brown to tan very loose silty f SAND; tr gravel; wet		10–11	SS-6	1.2	3 3 8 8	1005				
S.A.A.		12								
GW - orange loose sandy GRAVEL; wet		13	(b) SS-7(a) (c)	1.2	2 5 5 6	1007				
ML/CL - tan soft slightly plastic CLAY; wet		14–15	SS-8	1.0	2 2 5 4	1015				
S.A.A.; gray with 0.2 ft tan at top.		16–17	P21D-ST1	2.0	X	1030				1030 Shelby tube inserted; 1040 Shelby tube removed
S.A.A.; 0.5 inch f sand interlayer		18–19	SS-9	1.4	2 3 3 (WR)	1210				

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LOG OF BORING P-21D **SHEET** 2 **OF** 2

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	HNU READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
ML/CL S.A.A. varved with f sand laminations		21	SS-10	1.6	2 4 5 7	1222	0.2	0.2	1230	
S.A.A.		22–23	SS-11	2.0	4 5 8 4	1225				
S.A.A.; little varving; tr gravel		24–25	SS-12	2.0	3 2 1 2	1239				
S.A.A.		26–27	(6) SS-13(a)	2.0	1 2 2 3	1245				
SC/SM - gray very soft slightly plastic silty CLAY; some f sand; interlayered silty and sandy clay; tr gravel.		28–29	SS-14	2.0	3 3 1 2	1255				
		30–31	P21D-ST2	1.0	X	1315				1315 Shelby tube inserted 1324 Shelby tube removed
SP/SM - gray loose silty f SAND coarsens downward to tr m sand.		32–33	SS-15	1.3	3 3 4 4	1350				SS-15 for grain size
S.A.A.; interlayered f and m sand		34–35	SS-16	1.3	8 4 3 6	1400				
SM - gray loose silty f-m SAND		36–37	(6) SS-17(a)	2.0	5 7 16 40	1415				
SP/SM - gray dense silty m-c SAND; some gravel (Till)		38–39	No sample							20 July 23 July Auger to 39 ft past an obstruction.
S.A.A.		40–41	SS-18	0.8	5 17 25 50	1035				
Bottom of boring 42.0 ft		42–43–44								

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LOG OF BORING P22D **SHEET** 1 **OF** 3

PROJECT AND LOCATION: Ciba Geigy Cranston R.I.		ELEVATION AND DATUM:	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	FOREMAN: L. Fredericks 7/23, P. 7/24	DATE STARTED: 7/23/90	DATE FINISHED: 7/24/90
DRILLING EQUIPMENT: CME 75 (7/23) Diedrich D50 (7/24)		COMPLETION DEPTH: 58.5 ft	ROCK DEPTH: 58.0
SIZE AND TYPE OF BIT:	SIZE AND TYPE CORE BARREL:	NO. SAMPLES: DIST 27	UNDIST 2 / CORE 0
CASING:		WATER LEVEL: FIRST 7.5 ft	COMPL. — / 24 HR —
CASING HAMMER: WEIGHT:	DROP:	BORING ANGLE AND DIRECTION: vertical	
SAMPLER: 2 inch split spoon and Shelby tube		INSPECTOR: M. Craig	
SAMPLER HAMMER: WEIGHT: 140 lbs	DROP: 30 inch		

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES: TYPE NO. LOC	RECOV. FT	PENETR RESIST BL/6IN.	TIME	HNU/PID READINGS (PPM): SAMPLE	AMBIENT AIR	TIME	REMARKS
Asphalt										1515 Begin drilling
SP/SM – interlayered dk brown soft sandy SILT; tr gravel and lt. brown silty SAND; dry (to 1.25 ft) (FILL)		1	(b) (c) SS-1 (a)	1.4	3 3 3 2	1519	0.1	0.1	1522	
SP/SM – tan loose silty f-m SAND; some gravel; dry (to 1.75 ft)		2								
SP/SM – brown loose silty f-c SAND; some gravel; dry (FILL)		3	SS-2	0.8	3 3 2 2	1537				
S.A.A.; trace coal (FILL)		4								
SP/SM – orangish tan med. dense m-c SAND; some gravel; tr silt; dry		5	(b) SS-3 (a)	1.3	1 5 20 11	1549				
		6								SS-3(b) and SS-4 for grain size
S.A.A. with 2 inch layer of brown silty m-c SAND; bottom 1 ft wet		7	SS-4	1.1	20 16 18 12	1555	0	0	1557	water at 7.5 ft.
		8								
SM/ML – tanish gray med. dense silty vf SAND; micaceous; wet		9	SS-5	1.5	5 5 7 7	1610	0	0	1612	SS-5 for grain size
S.A.A.; tan at bottom of spoon		10								
		11	SS-6	1.8	9 5 7 6	1612				
		12								
S.A.A. tan with 2 inch gravelly layer		13	SS-7	1.8	3 5 5 4	1620				
		14								
S.A.A. with 2 inch gravelly layer		15	SS-8	1.8	2 3 3 3	1631				
		16								
S.A.A. with 2 inch gravelly layer		17	SS-9	1.8	5 5 5 8	1635				
		18								
S.A.A. with gray silty clay in tip of spoon		19	SS-10	1.3	4 4 5	1651	0	0	1655	

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LOG OF BORING P22D **SHEET** 2 **OF** 3

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR RESIST BL/6IN.	TIME	HNU READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
SM/ML S.A.A. gray; siltier, tr clay										
CL - gray silty CLAY; laminated		21	(b) SS-11 (a)	1.5	5 5 5 6	1702				
ML - gray med dense vf SAND; tr clay; micaceous; wet		22								
ML/CL - gray stiff silty CLAY; laminated; wet		23	(b) SS-12 (a)	1.7	5 5 5 6	1710				
		24								
		25	P22D-ST1	2.0	X	1720				1720 Shelby tube inserted
		26								1730 Shelby tube removed
ML - tan very loose silty vf SAND with 2 inch gray silty clay layer; wet		27	(b) SS-13 (a)	2.0	3 1 2 5	1258				
		28								
CL - gray CLAY; wet										
ML - tan very loose silty vf SAND; with 2 inch gray silty clay layer; wet		29	(b) SS-14 (a)	2.0	3 1 1 5	1305				
CL - gray CLAY; wet		30								
ML - tan loose silty vf SAND; wet										
ML/CL - gray stiff CLAY; wet		31	(b) SS-15 (a)	1.7	7 5 4 5	1325				
		32								
S.A.A.; laminated; some silt.		33	SS-16	2.0	8 8 8 8	1330				
		34								
		35	P22D-ST2	2.0	X	1400				1400 Shelby tube inserted
		36								1407 Shelby tube removed
S.A.A.		37	SS-17	2.0	3 2 3 2	1450				
		38								
S.A.A.		39	SS-18	2.0	3 3 4 4	1455				
		40								
S.A.A.		41	SS-19	1.8	5 5 6 5	1515				
		42								
CL - gray stiff silty CLAY		43	SS-20	2.0	6 6 8 6	1520				
		44								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING P22D

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	HNU READINGS (PPM) SAMPLE	AMBIENT AIR	TIME	REMARKS
S.A.A.; few laminations		46	SS-21	1.4	R 2 2 5	1545				
ML - dk gray med. dense silty f SAND; wet		47	SS-22	1.6	1 9 6	1550				
ML - gray soft clayey SILT; wet		48								
ML/CL - gray very loose silty vf SAND; wet		49	SS-23	2.0	R R H 2	1620				SS-23 for grain size
S.A.A.		50								
		51	SS-24	2.0	R 4 5 8	1630				
S.A.A.		52								
		53	SS-25	1.2	R R H 2	1640				
S.A.A.		54								
		55	SS-26	1.4	R R 2 H	1705				
S.A.A. with dk gray shale in tip of spoon		56								
		57	(b)SS-27(a)	2.0	8 52 48 21	1715				
S.A.A.		58								
decomposed dk gray shale										
Bottom of boring 58.5 ft		59								
		60								
		61								
		62								
		63								
		64								
		65								
		66								
		67								
		68								
		69								

Appendix E

APPENDIX E

GEOTECHNICAL LABORATORY DATA

RADIAN CORPORATION

CIBA-GEIGY
CRANSTON, RI
GEOTECHNICAL ANALYSES RESULTS

Sample #	Dry Bulk Density (pcf)	Porosity (%)	Hydraulic Conductivity (cm/sec)
P19D-ST-1	98.3	34.3	5.0 E-6
P19D-ST-2	80.8	46.0	1.6 E-6
P21D-ST1	98.4	36.9	8.8 E-7
P21D-ST-2	87.2	41.8	4.0 E-4
RW-1-ST-1	96.2	35.7	2.0 E-5
RW-2-ST-1	88.8	40.7	1.3 E-5
RW-3-ST-1	110.2	26.4	2.3 E-4
RW-3-ST-2	91.5	38.9	1.7 E-6
RW-4-ST-1	107.0	31.4	8.5 E-7

NOTE: Particle Size Distribution results for these samples and the others delivered on 7/25/90 are on the attached pages.

RADIAN CORPORATION

CIBA-GEIGY
CRANSTON, RI
GEOTECHNICAL ANALYSIS RESULTS

		PARTICLE SIZE DISTRIBUTION Sieve Size						
		% Passing						
						Hydrometer		
Sample No.	Matrix	#10	#40	#100	#200	.02mm	.002mm	.001mm
RW-1 RS	Sediment	*	65	23	11			
RW-4 RS	Sediment	*	100	96	86	75	19	14
P22D-ST1	Soil	*	100	99	98	90	39	31
P22D-ST2	Soil	*	100	99	98	86	22	20
P22D SS-3B	Soil	70	25	9	5			
P22D SS-5	Soil	*	99	94	28	16	13	12
P22D SS-23	Soil	*	100	97	68	49	16	15

NOTE: * denotes sieve wasn't used in the analysis.

RADIAN CORPORATION

CIBA-GEIGY
CRANSTON, RI
GEOTECHNICAL ANALYSES RESULTS

PARTICLE SIZE DISTRIBUTION

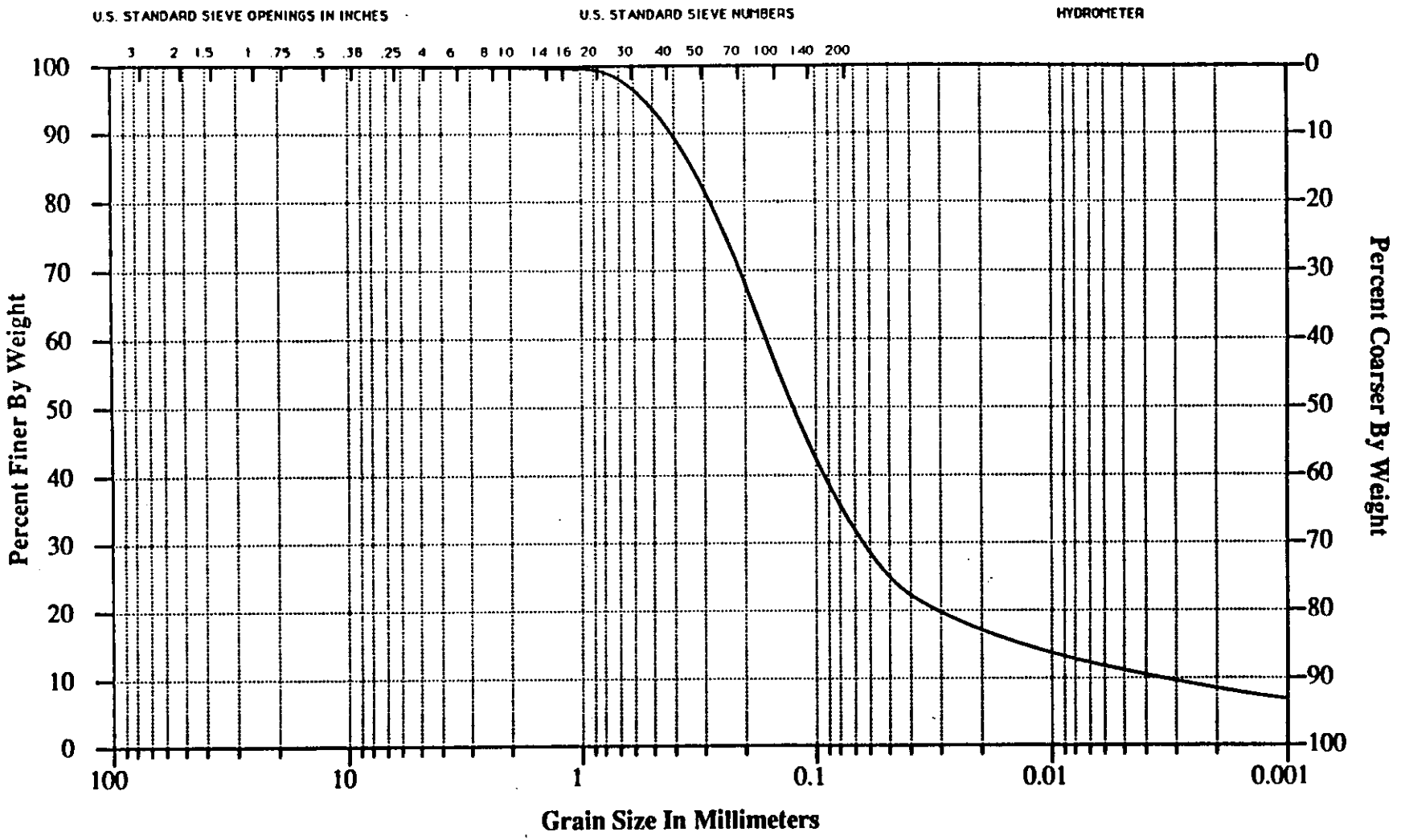
Sample No.	Sieve Size % Passing #4	#10	#40	#200	Hydrometer .02 mm	.002 mm	.001 mm
P-19D SS1-2	100	100	99	28	16	8	7
P19D-SS-4	88	86	40	5			
P19D-SS-6-7A	83	61	26	3			
P21DSS-1	79	64	38	9			
P21DSS-5	98	96	88	28	15	9	6
P21DSS-15	100	99	89	11			
P21DSS-18	82	62	27	14			
RW-1-SS-8	97	90	46	9			
RW1-SS-13-15	100	100	23	8			
RW-1-SS-20	99	98	97	42	17	8	7
RW-1-SS-24	71	59	41	21	15	13	11
RW2 SB-2	88	74	38	7			
RW-2 S-15	100	100	100	76	32	9	2
RW-2 S-22	100	100	90	18			
RW-3 S-4	100	99	97	30	17	8	6
RW-3 S-7	98	85	20	5			
RW-4-SS-5	100	99	85	18			
RW-4 SS-9	100	99	93	23	10	7	5

RADIAN CORPORATION

CIBA-GEIGY
CRANSTON, RI
GEOTECHNICAL ANALYSES RESULTS

PARTICLE SIZE DISTRIBUTION

Sample No.	Sieve Size % Passing #40	#100	#200	Hydrometer .02 mm	.002 mm	.001 mm
P19D-ST-1	100	100	99	80	25	19
P19D-ST-2	100	100	98	91	17	14
P21D-ST1	100	99	98	80	25	17
P21D-ST-2	99	29	10			
RW-1-ST-1	100	100	100	90	24	18
RW-2-ST-1	100	98	97	76	17	14
RW-3-ST-1	97	96	40	25	16	15
RW-3-ST-2	100	100	99	44	19	16
RW-4-ST-1	84	78	74	72	24	20



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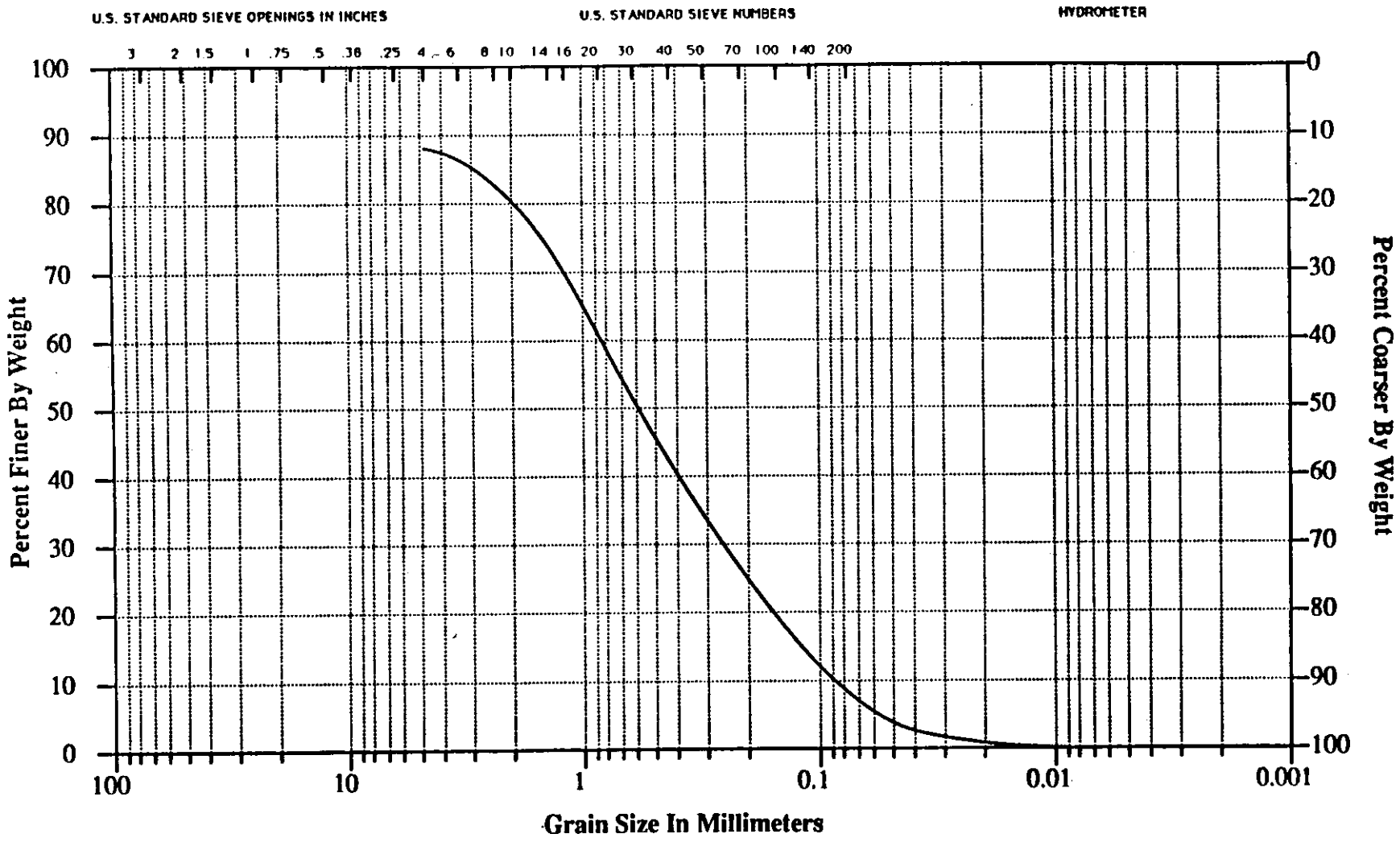
GRAIN SIZE CURVE
CIBA–GEIGY SITE: P–19D SS1–2
Cranston, Rhode Island



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GRAIN SIZE CURVE
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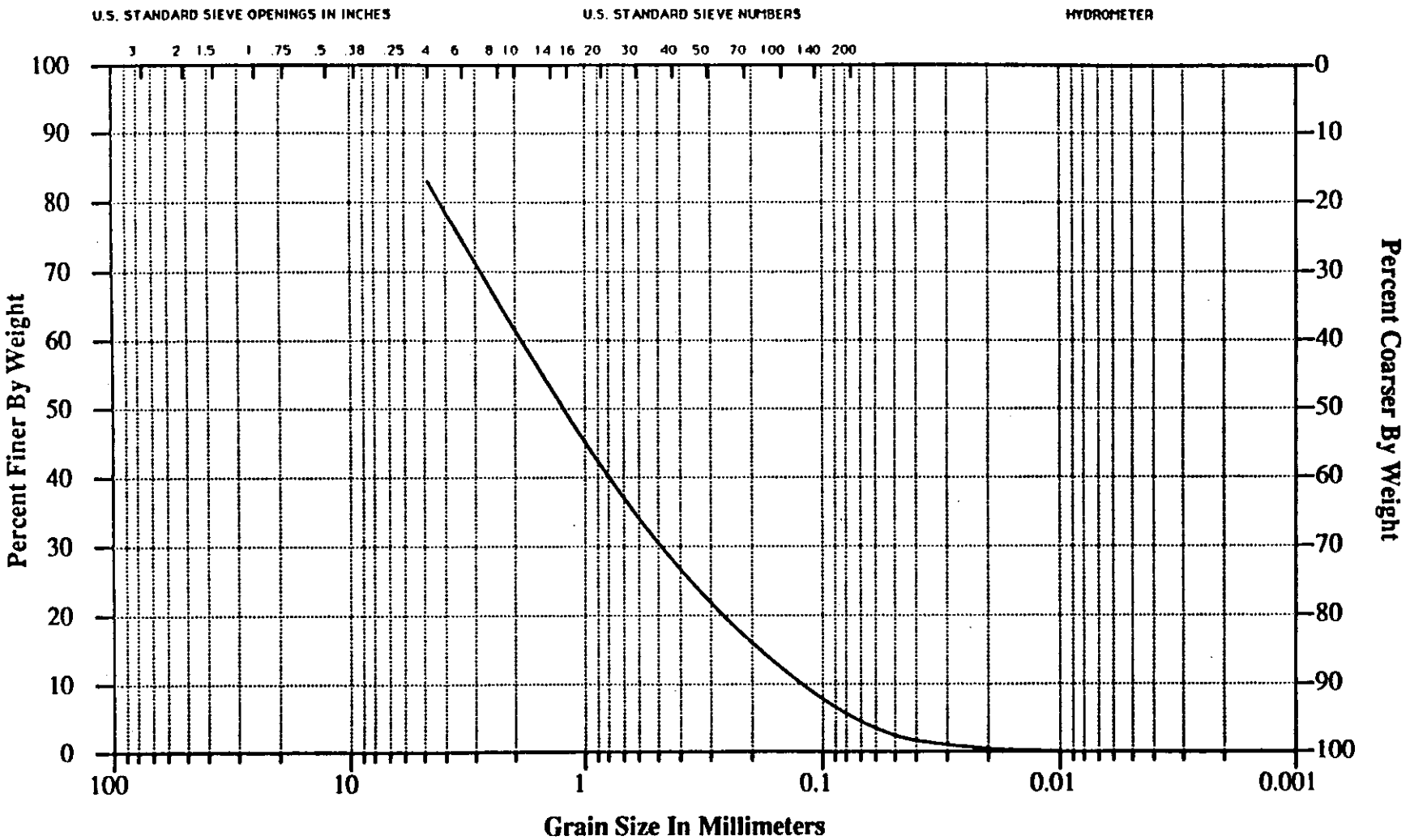
Cranston, Rhode Island



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GRAIN SIZE CURVE
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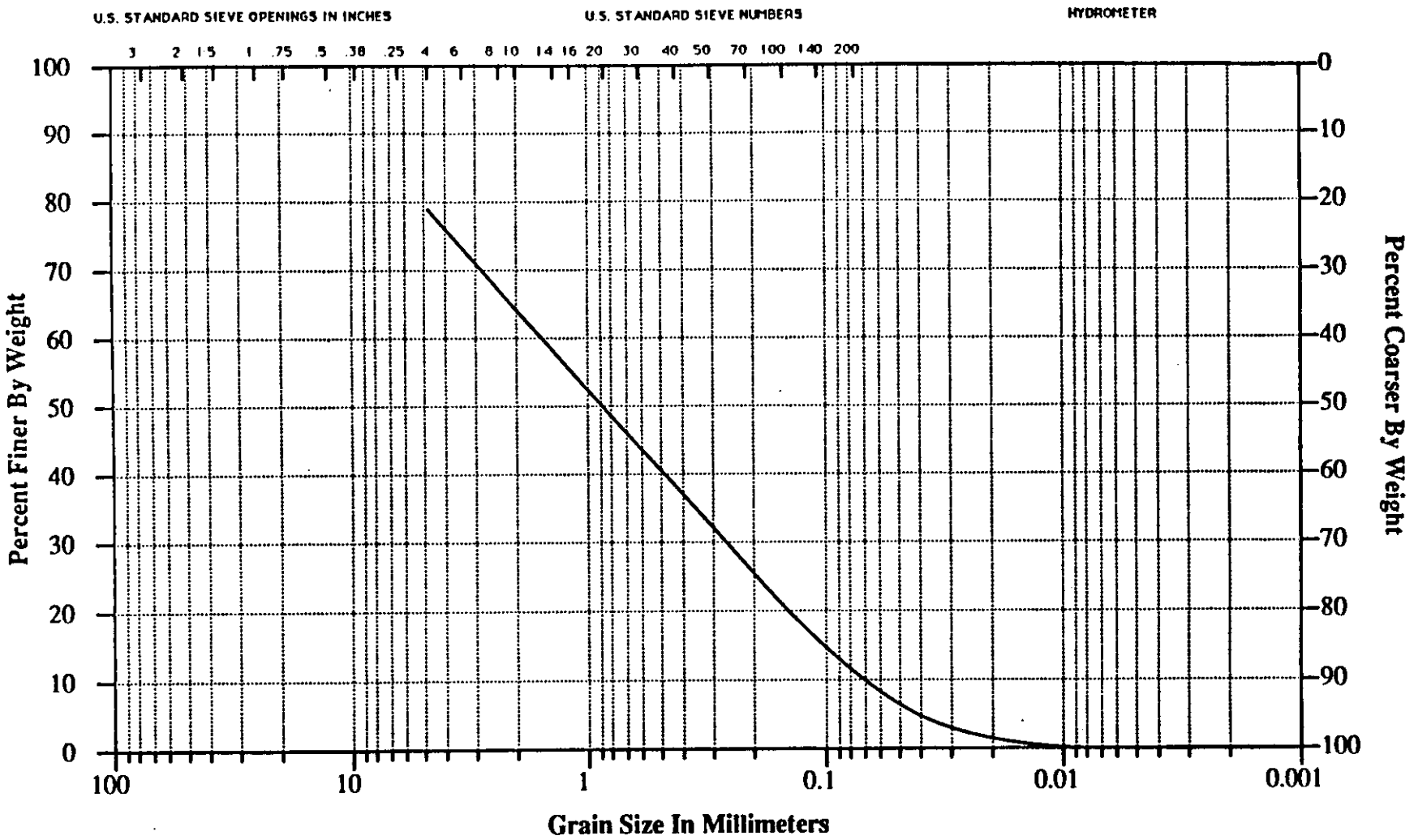
Cranston, Rhode Island



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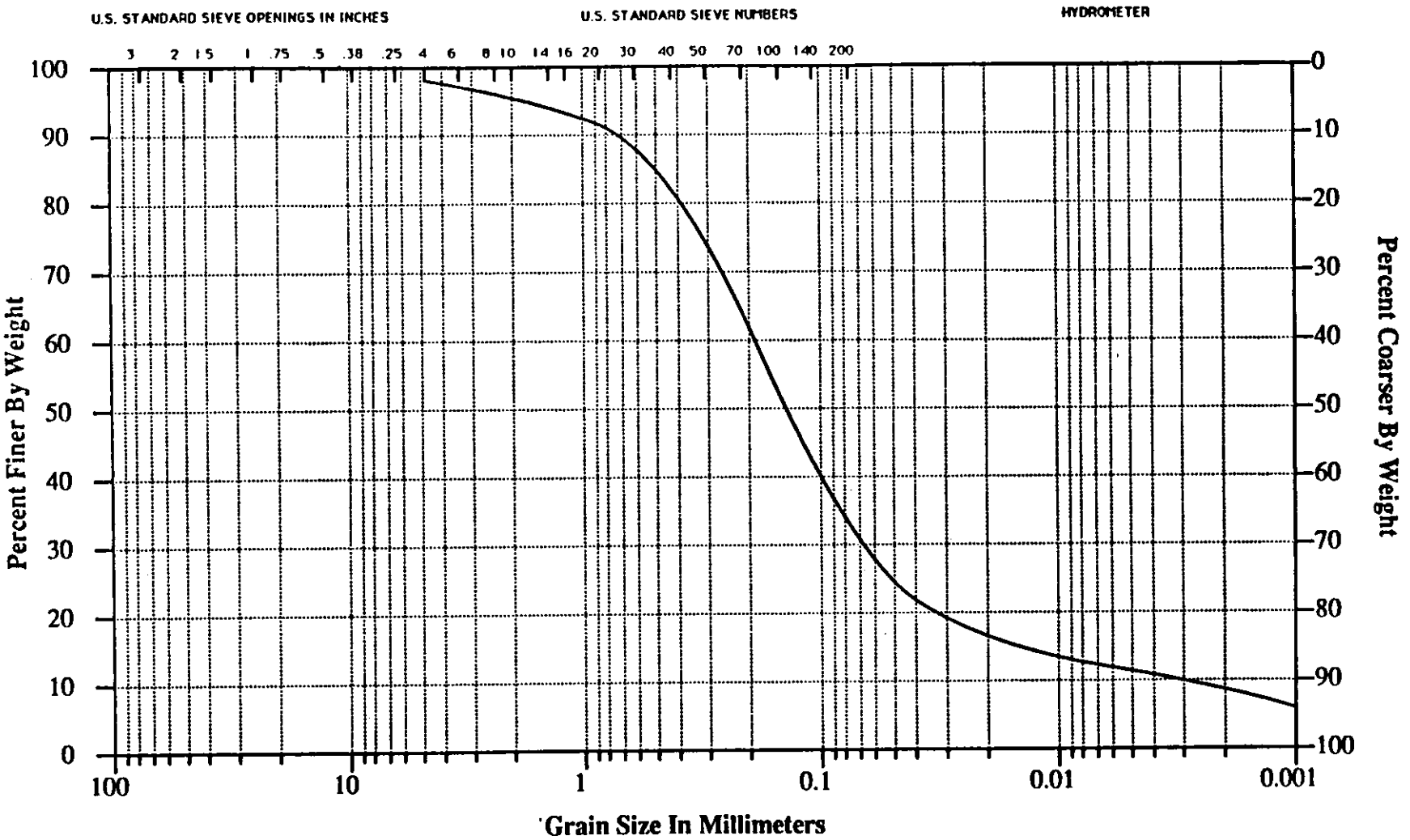
GRAIN SIZE CURVE
CIBA–GEIGY SITE: P21DSS–1
Cranston, Rhode Island



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GRAIN SIZE CURVE
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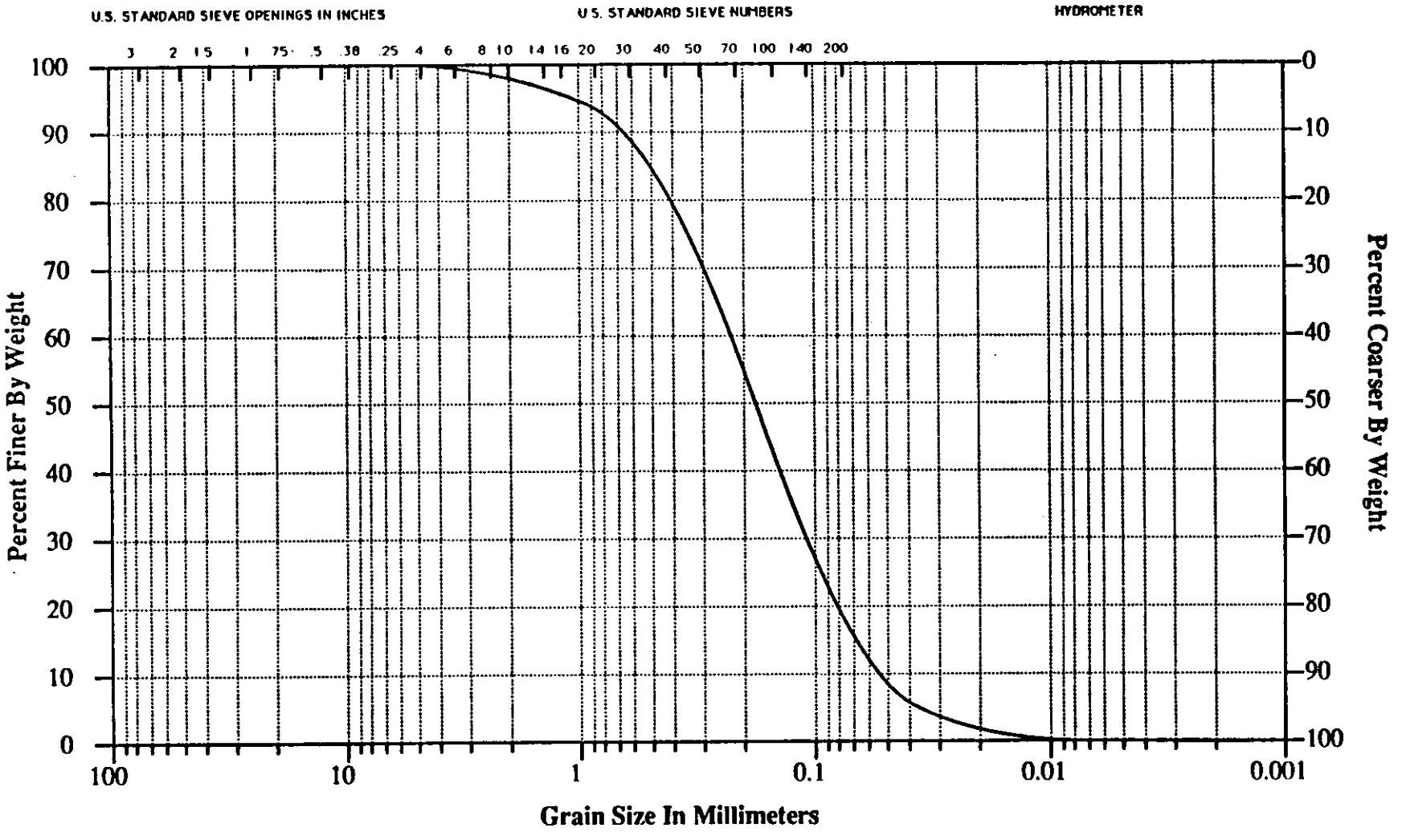
Cranston, Rhode Island



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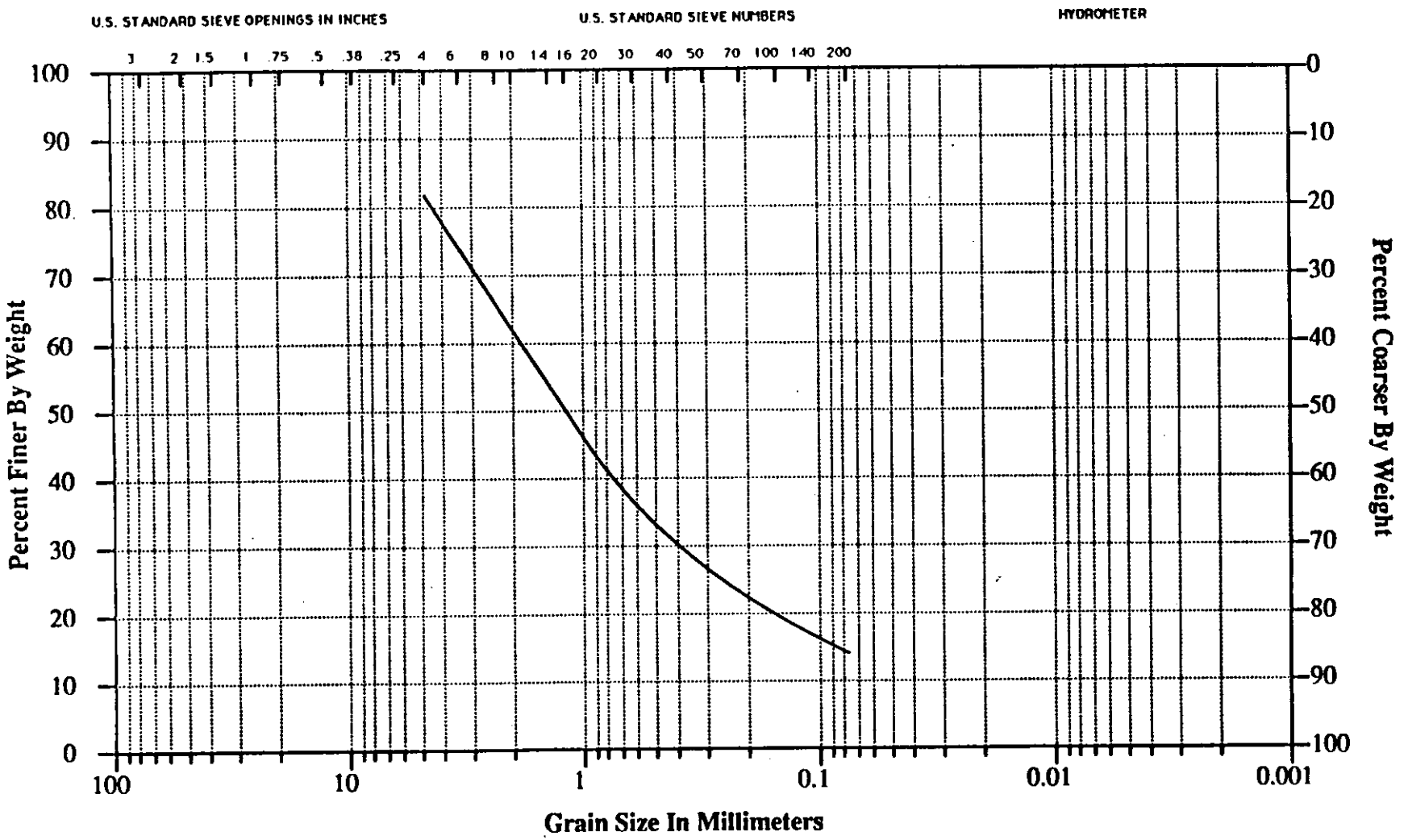
GRAIN SIZE CURVE
CIBA-GEIGY SITE: P21DSS-15
Cranston, Rhode Island



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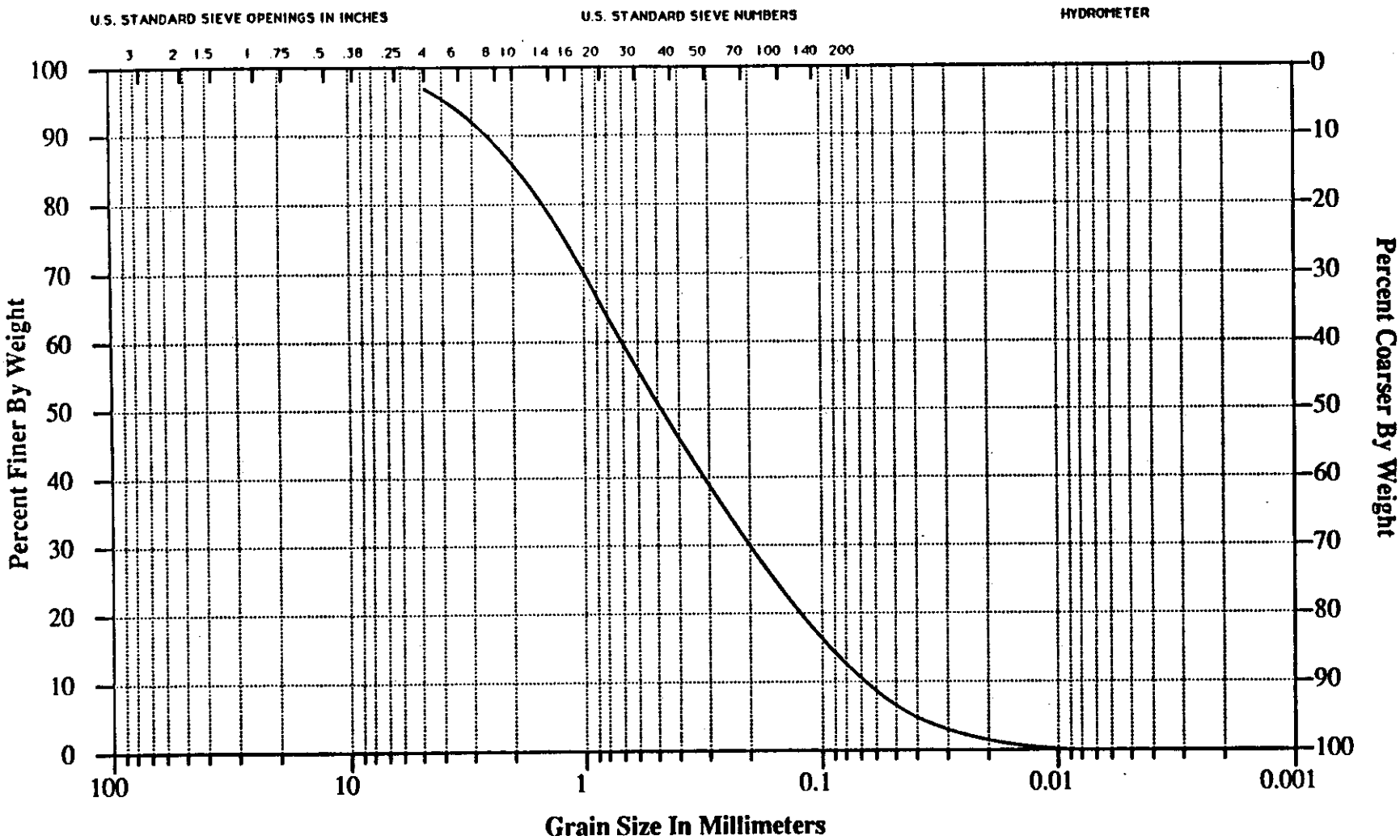
GRAIN SIZE CURVE
CIBA–GEIGY SITE: P21DSS–18
Cranston, Rhode Island



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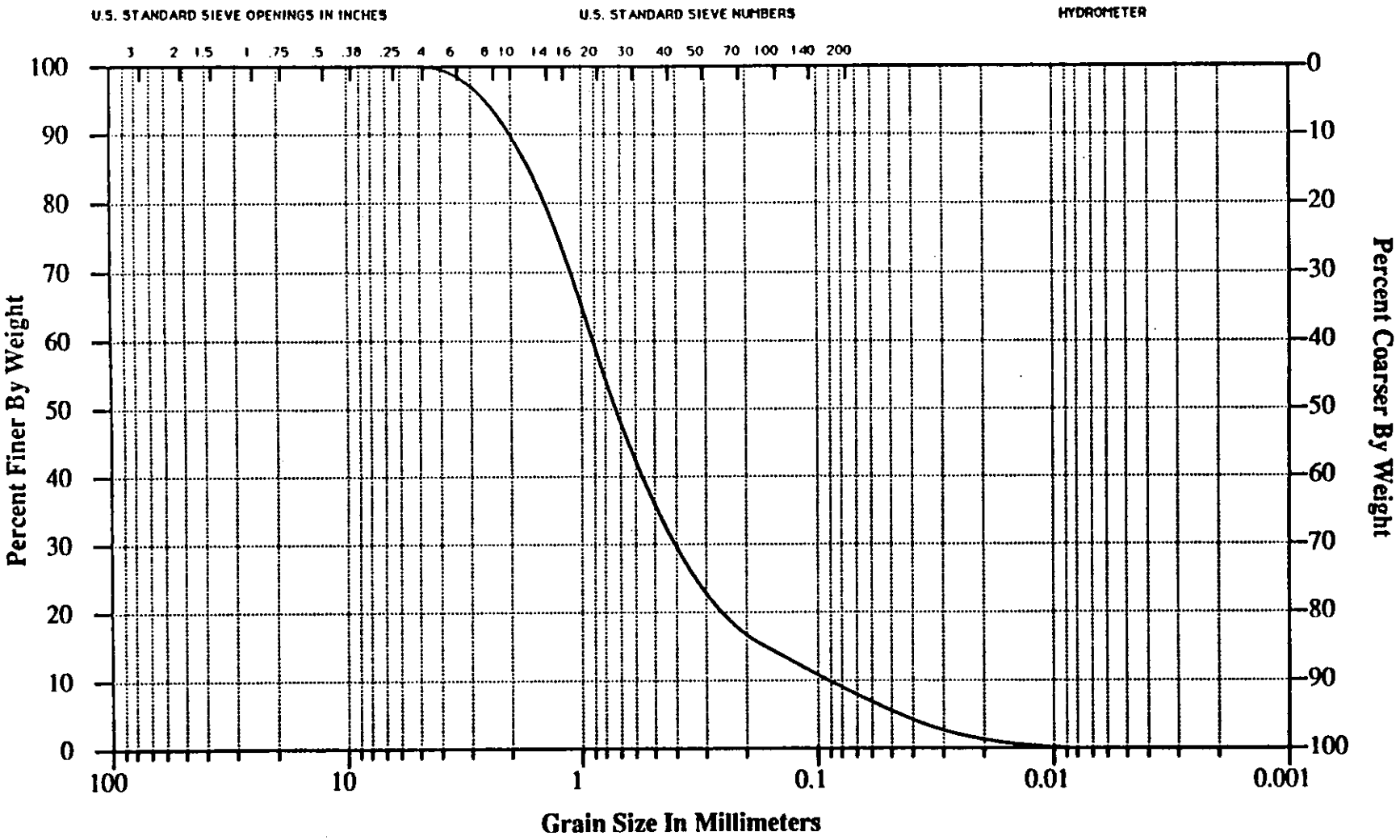
GRAIN SIZE CURVE
CIBA-GEIGY SITE: RW-1-SS-8
Cranston, Rhode Island



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GRAIN SIZE CURVE
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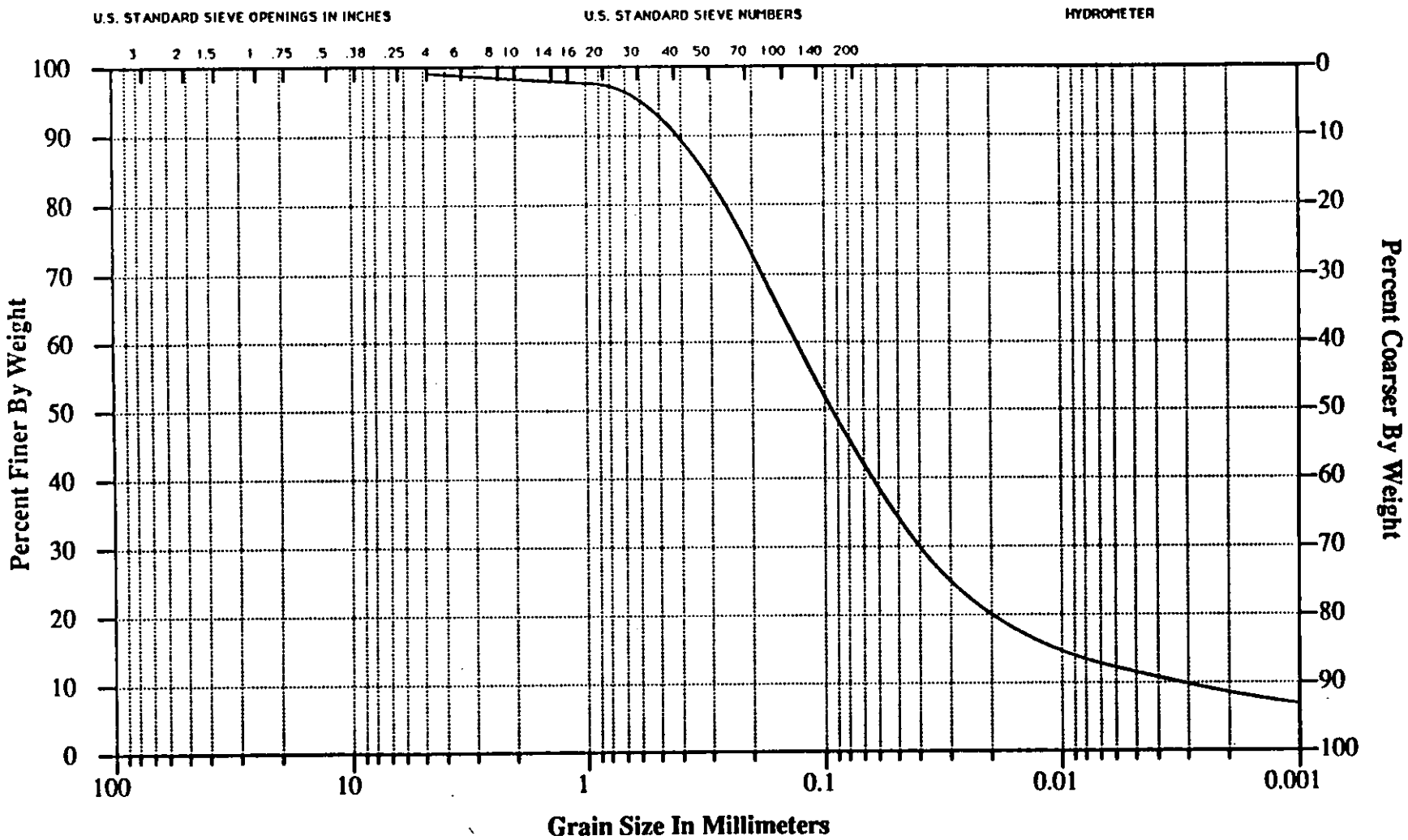
Cranston, Rhode Island



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GRAIN SIZE CURVE
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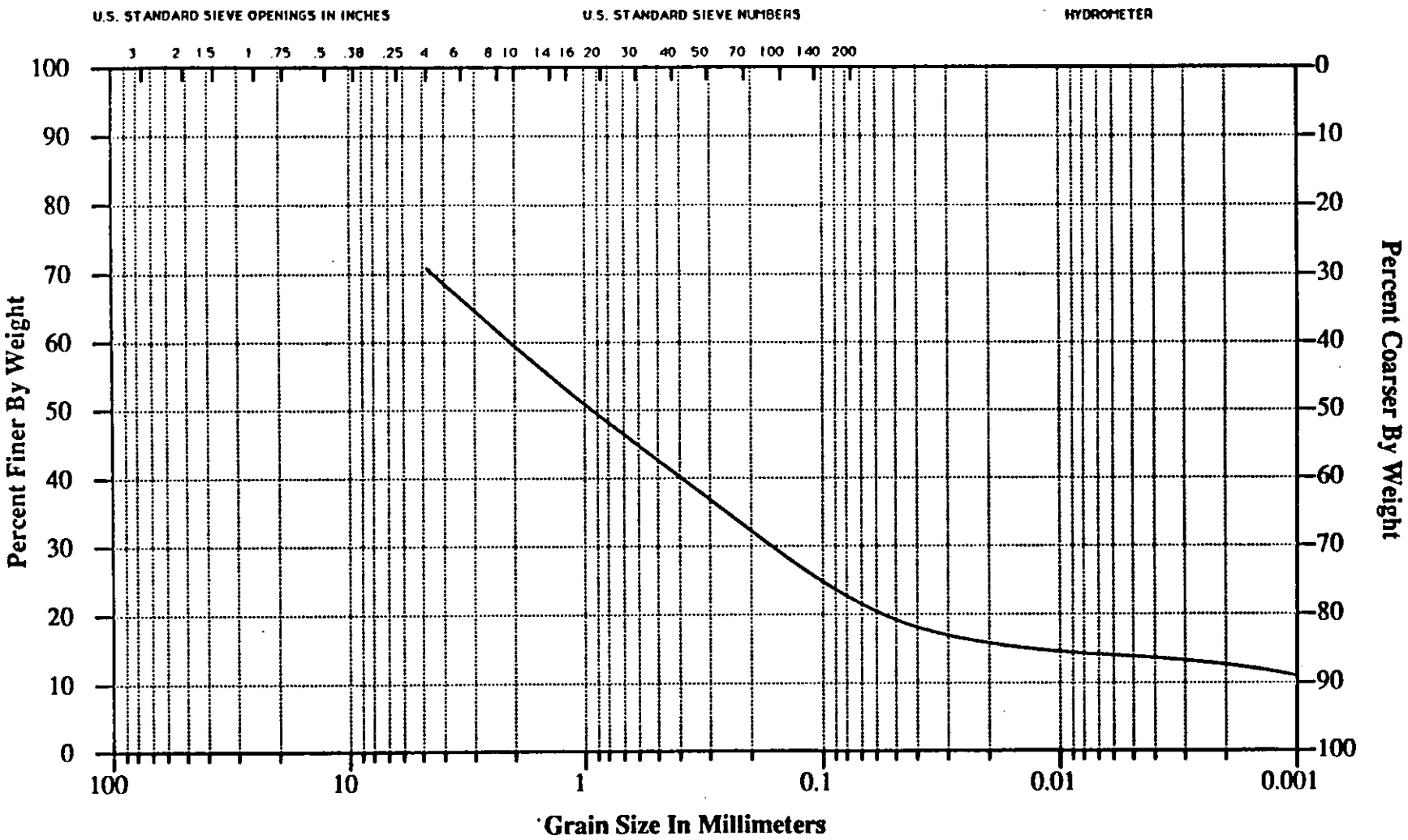
Cranston, Rhode Island



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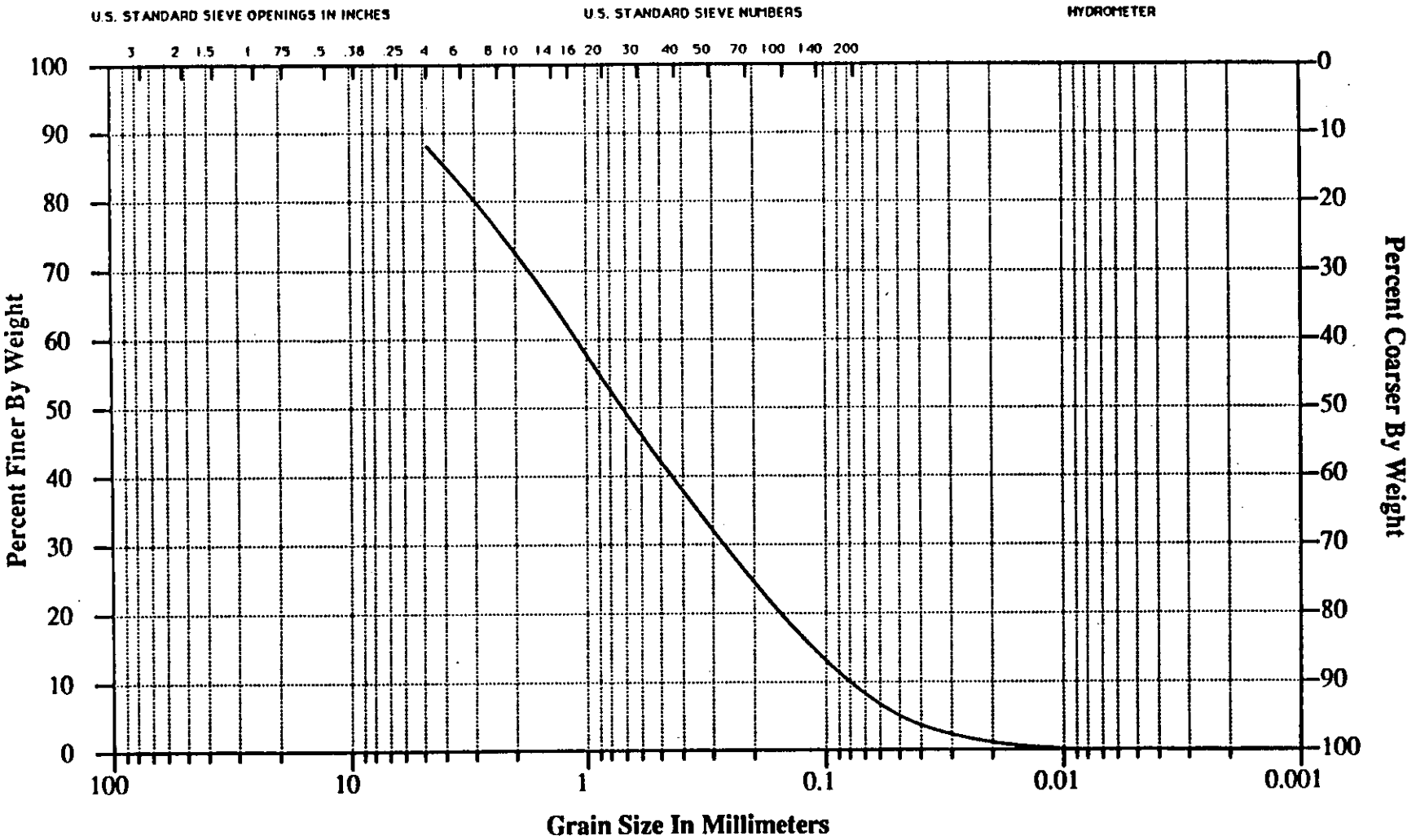
GRAIN SIZE CURVE
CIBA – GEIGY SITE: RW1 – SS – 24
Cranston, Rhode Island



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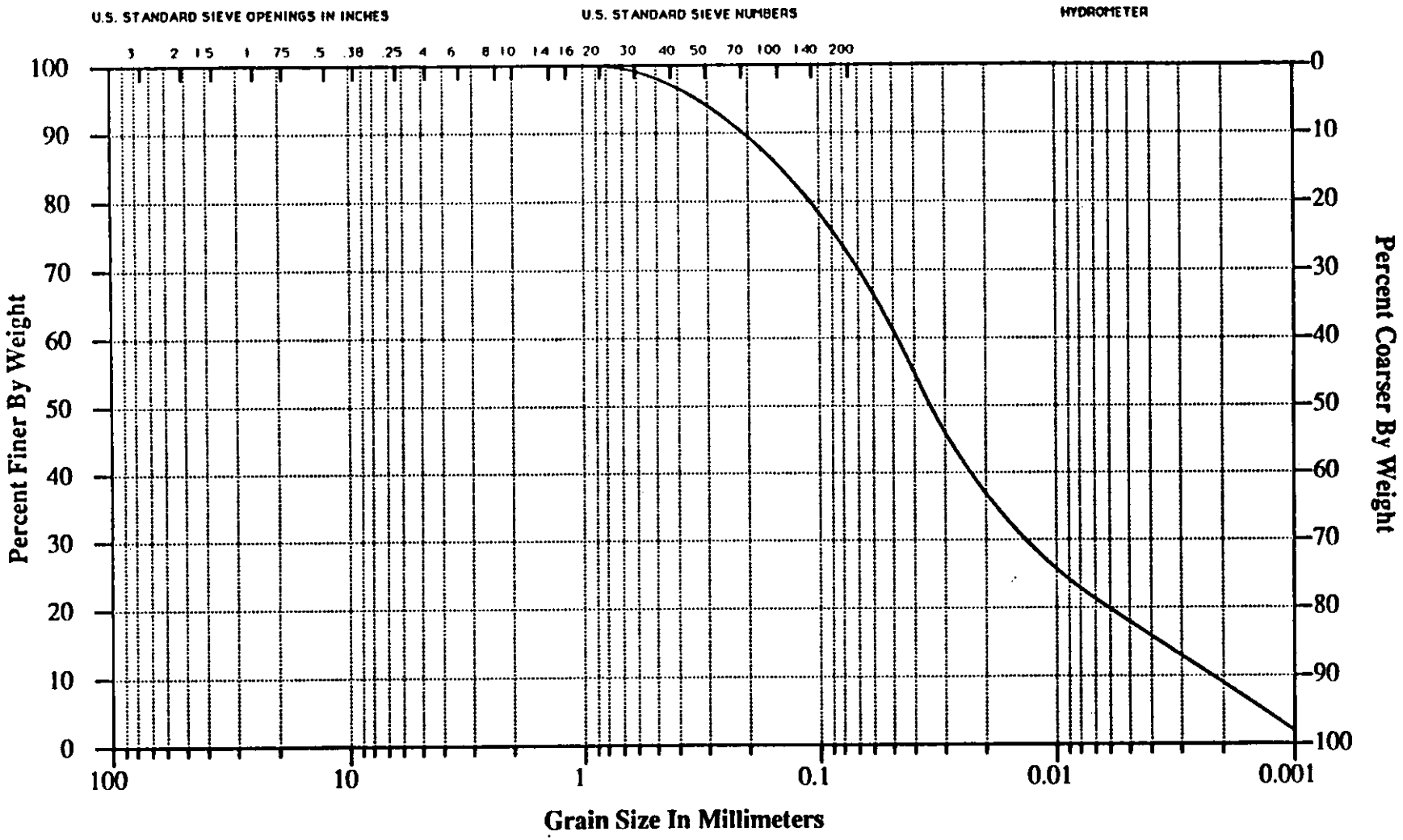
GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW2 SB–2
Cranston, Rhode Island



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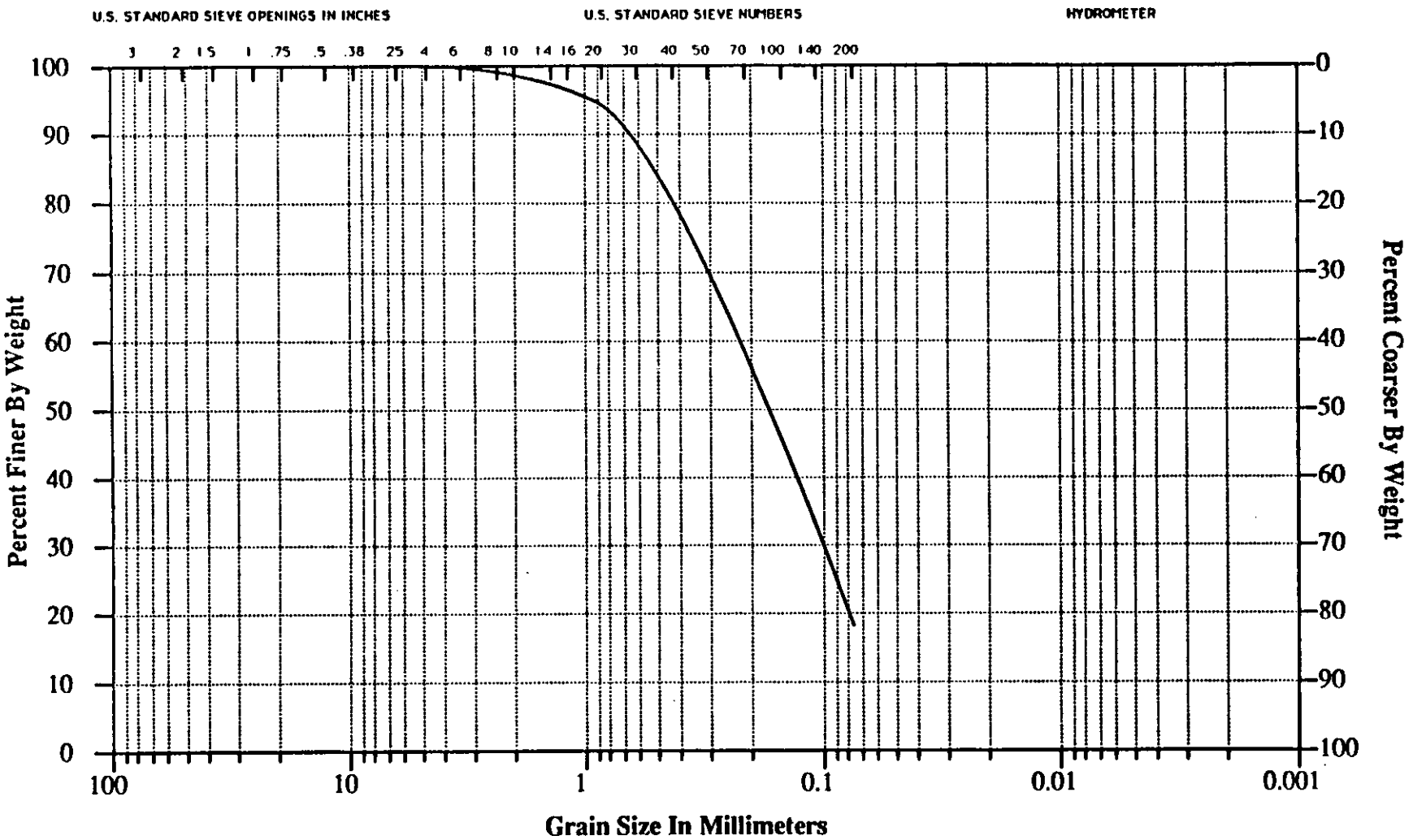
GRAIN SIZE CURVE
CIBA-GEIGY SITE: RW-2 S-15
Cranston, Rhode Island



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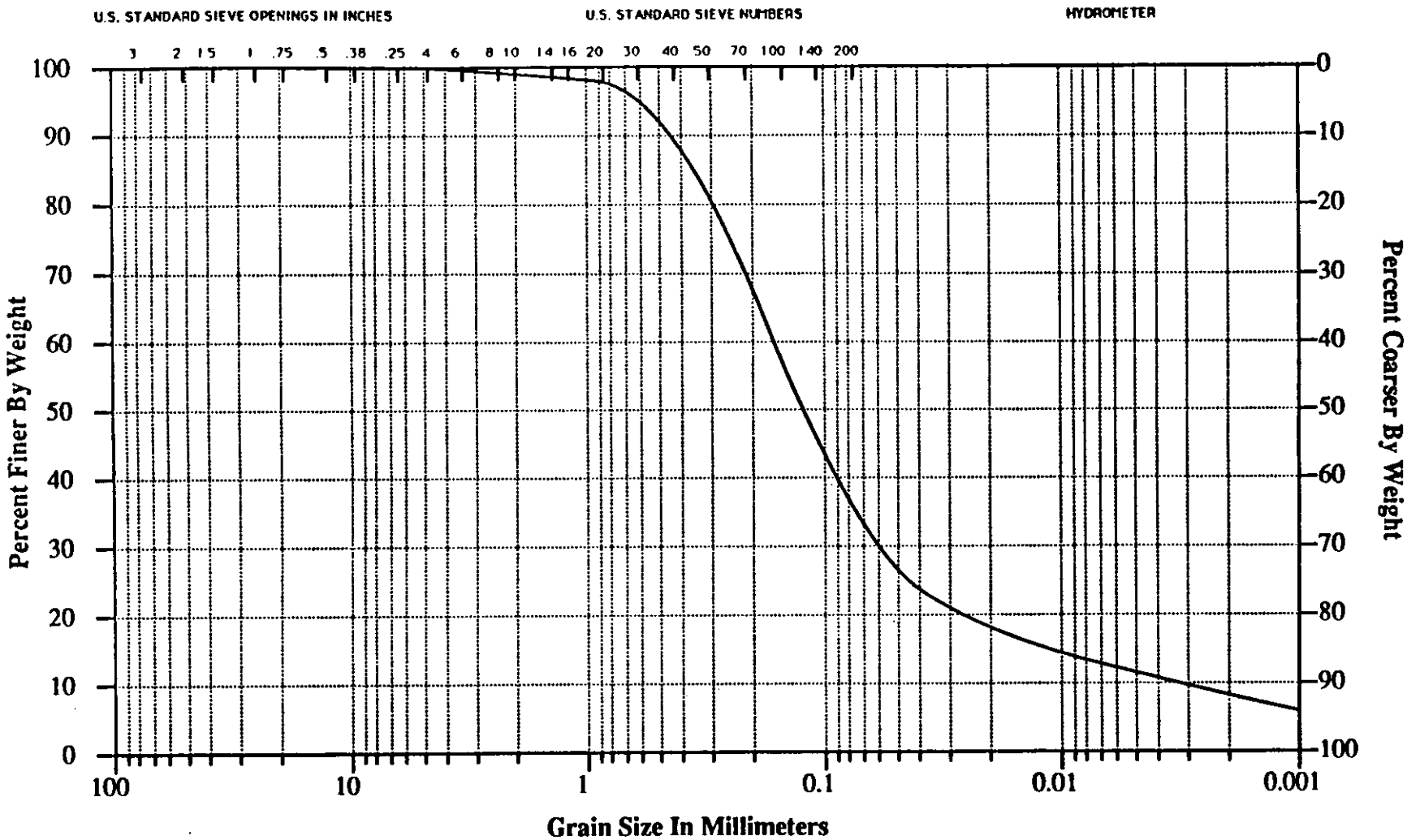
GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW–2 S–22
Cranston, Rhode Island



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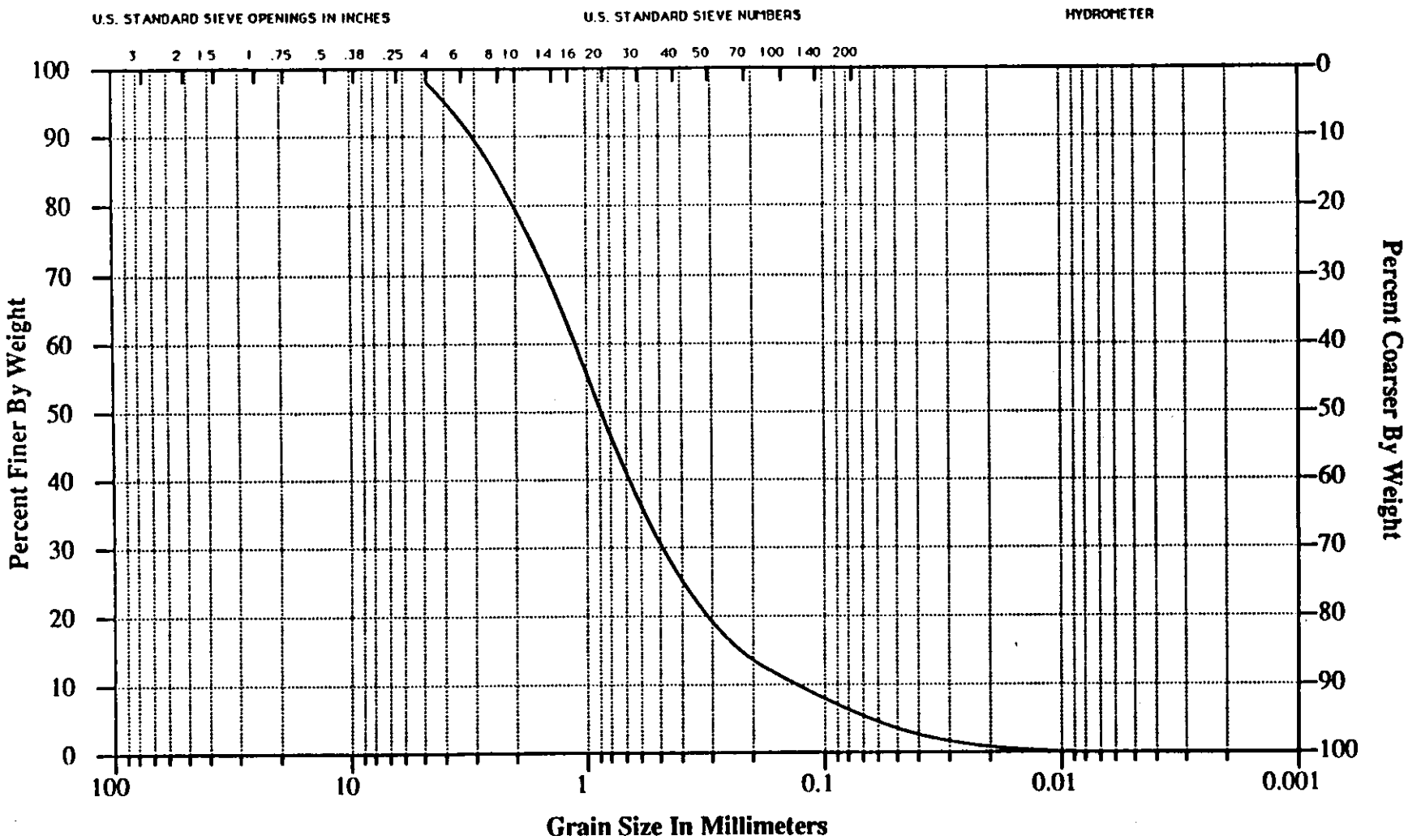
GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW–3 S–4
Cranston, Rhode Island



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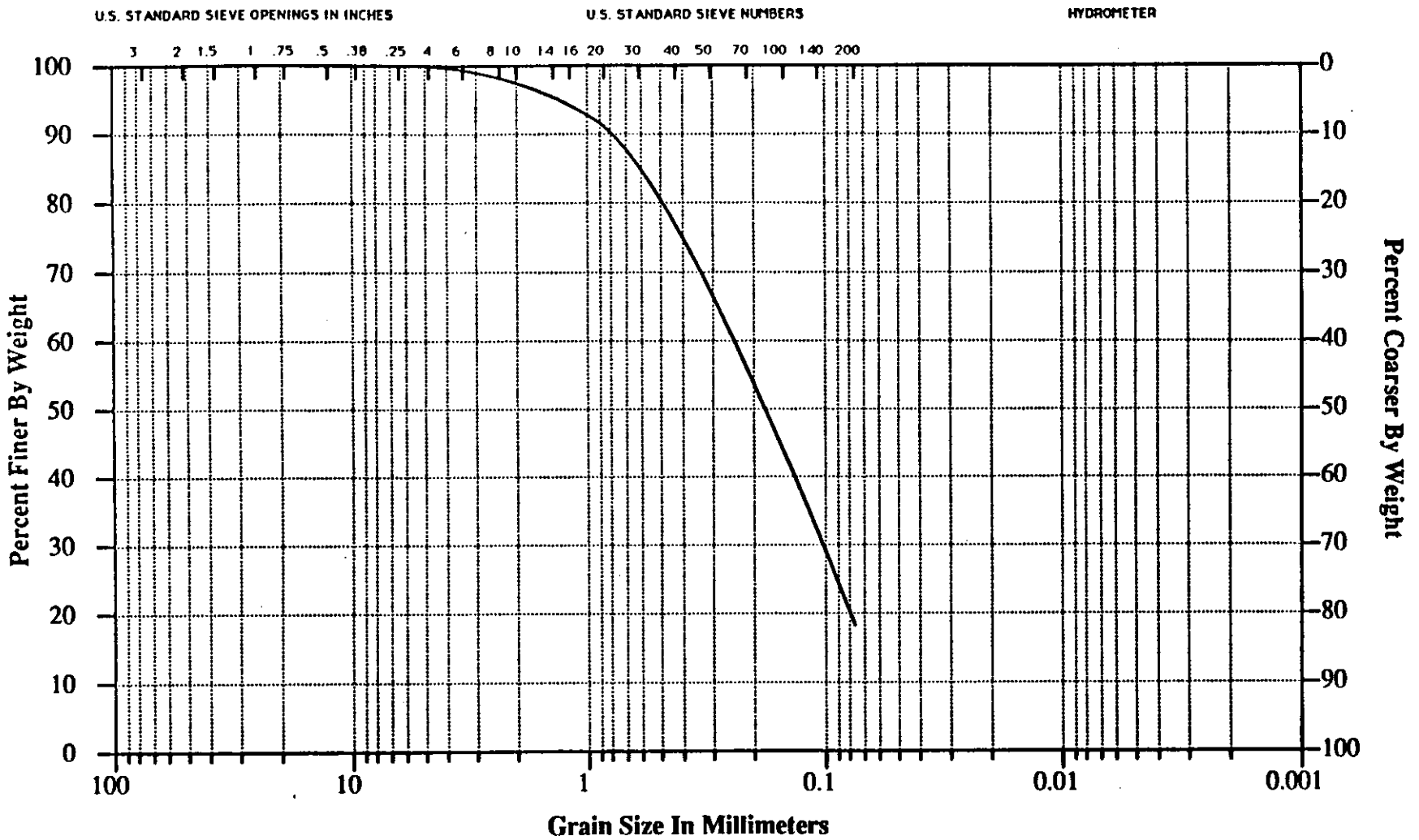
GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW–3 S–7
Cranston, Rhode Island



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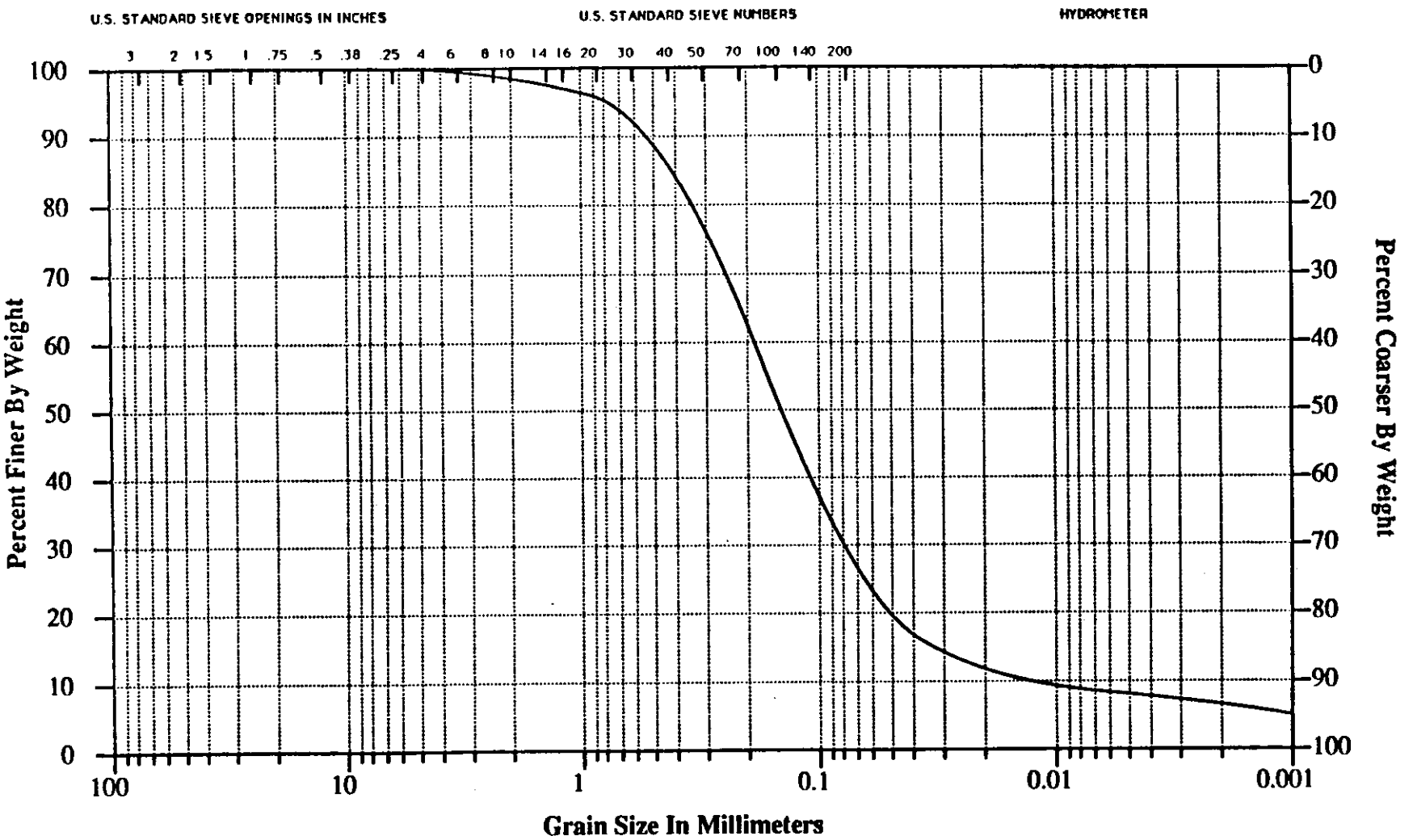
GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW–4 S–5
Cranston, Rhode Island



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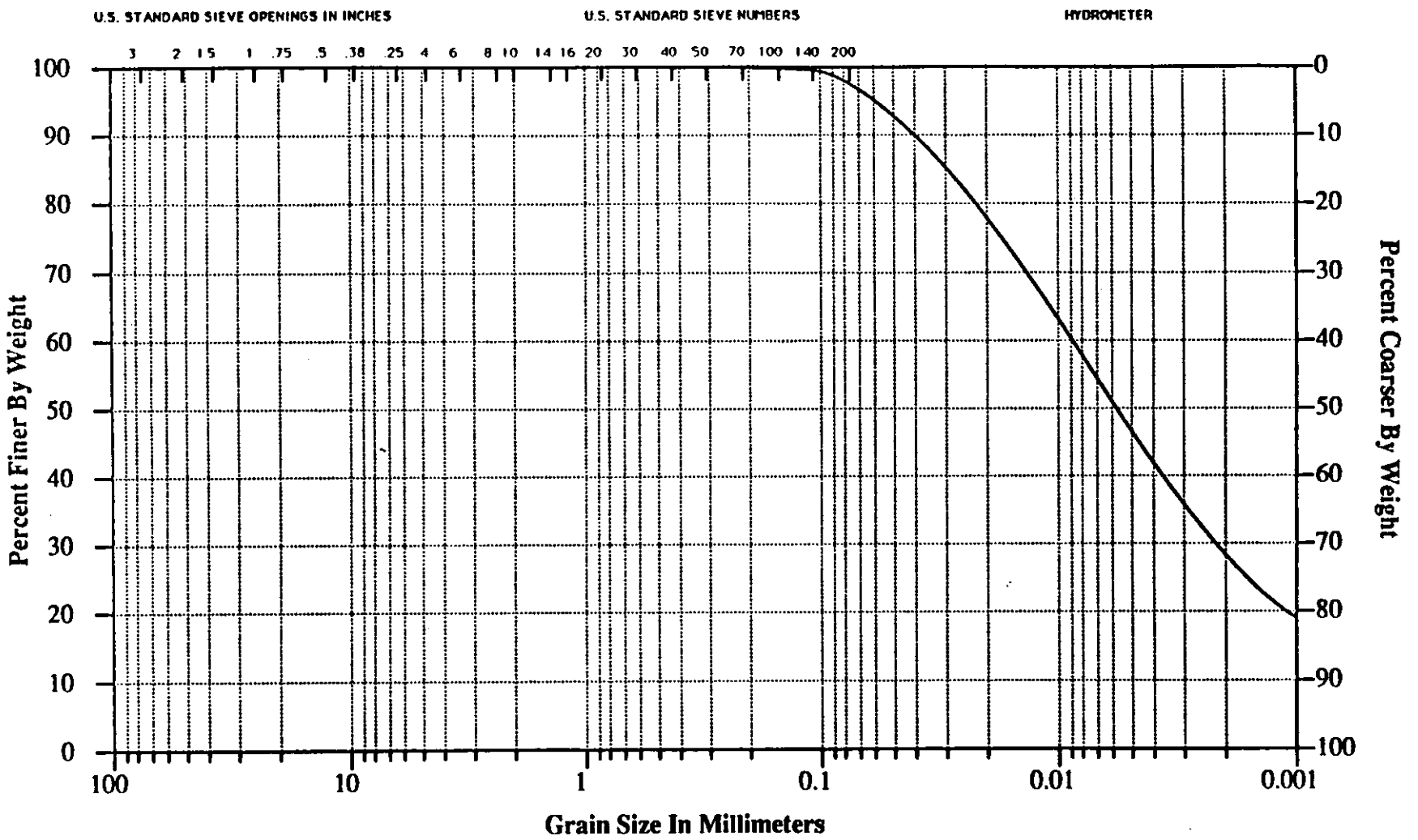
GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW–4 S–9
Cranston, Rhode Island



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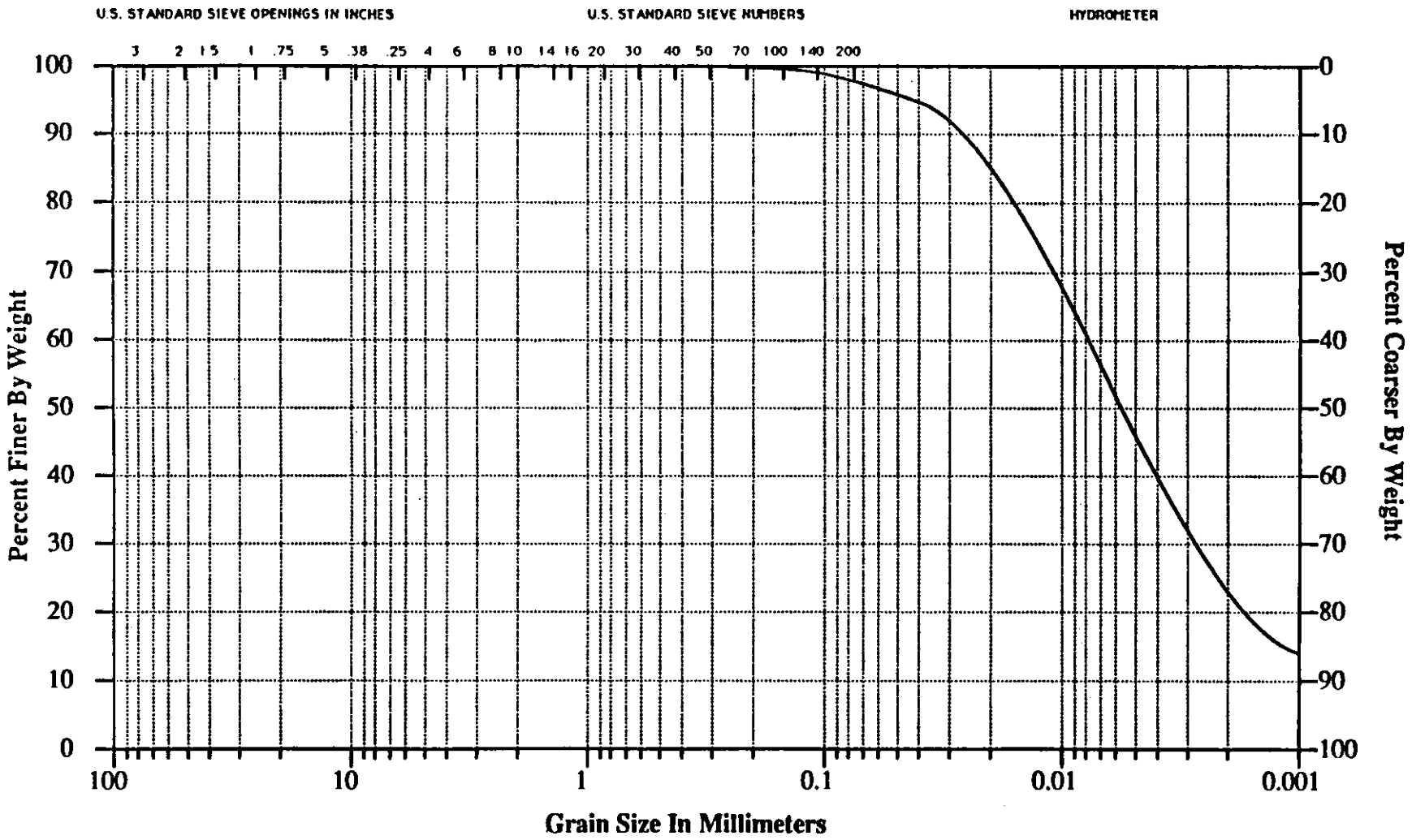
GRAIN SIZE CURVE
CIBA–GEIGY SITE: P19D–ST–1
Cranston, Rhode Island



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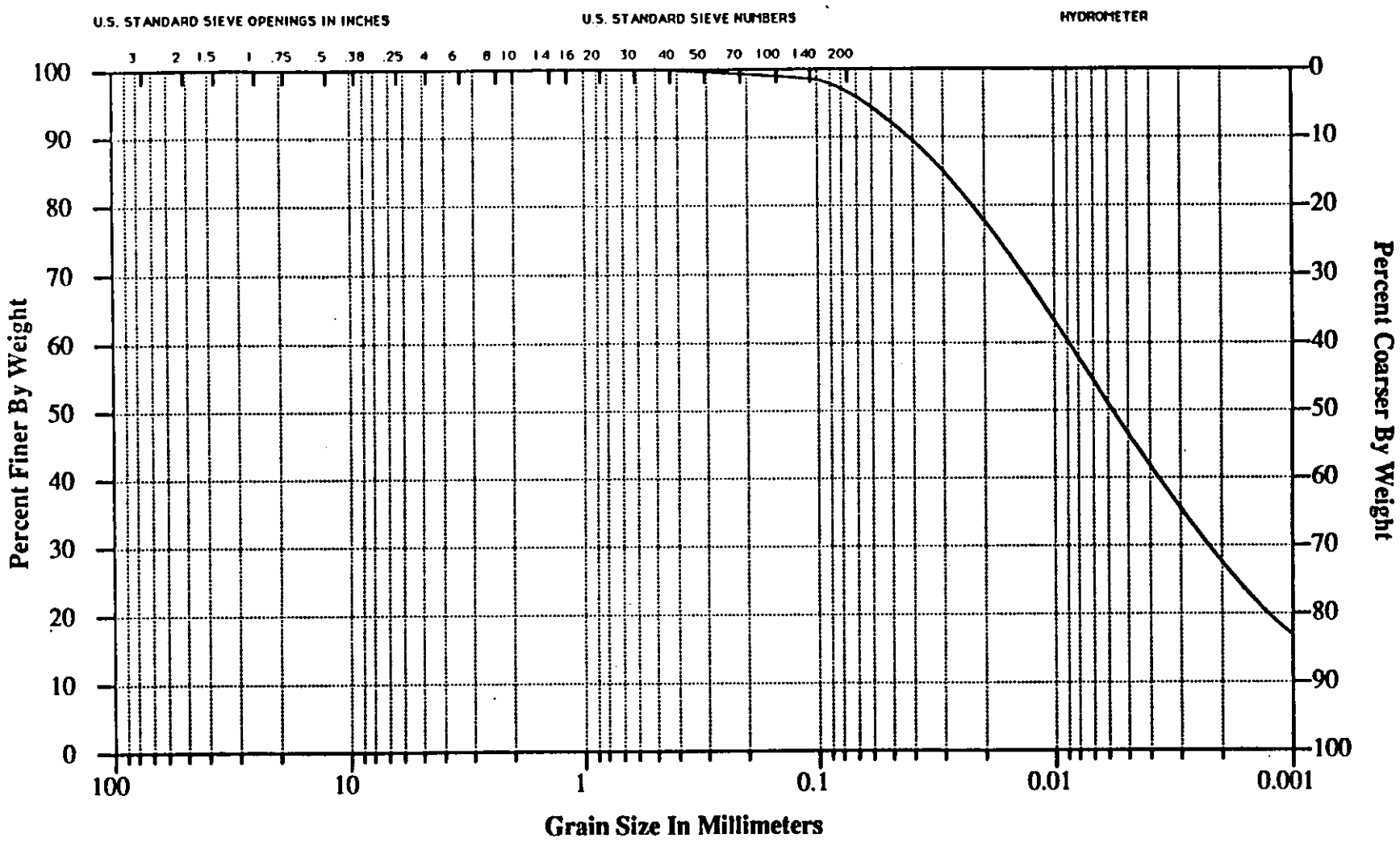
GRAIN SIZE CURVE
CIBA–GEIGY SITE: P19D–ST–2
Cranston, Rhode Island



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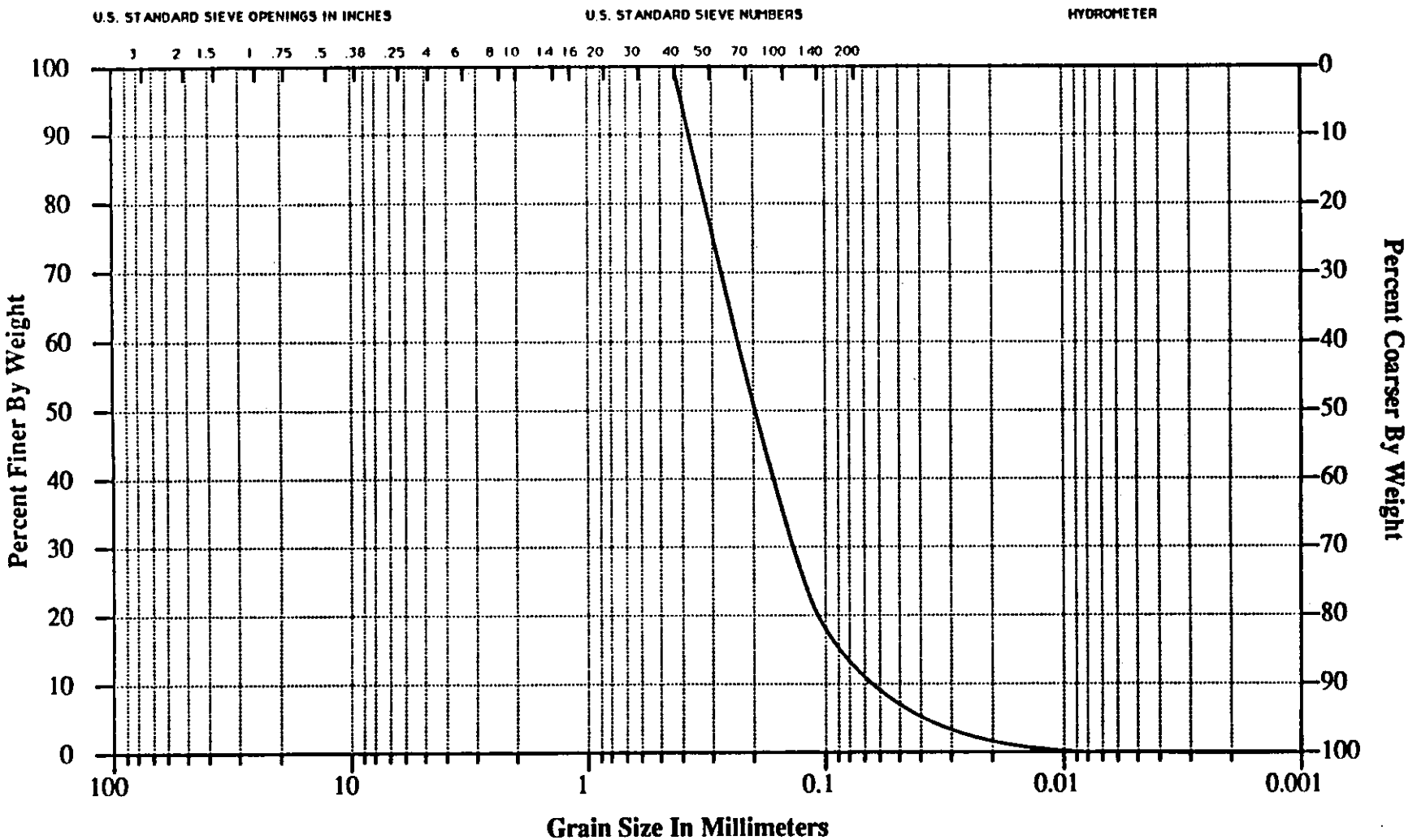
GRAIN SIZE CURVE
CIBA–GEIGY SITE: P21D–ST1
Cranston, Rhode Island



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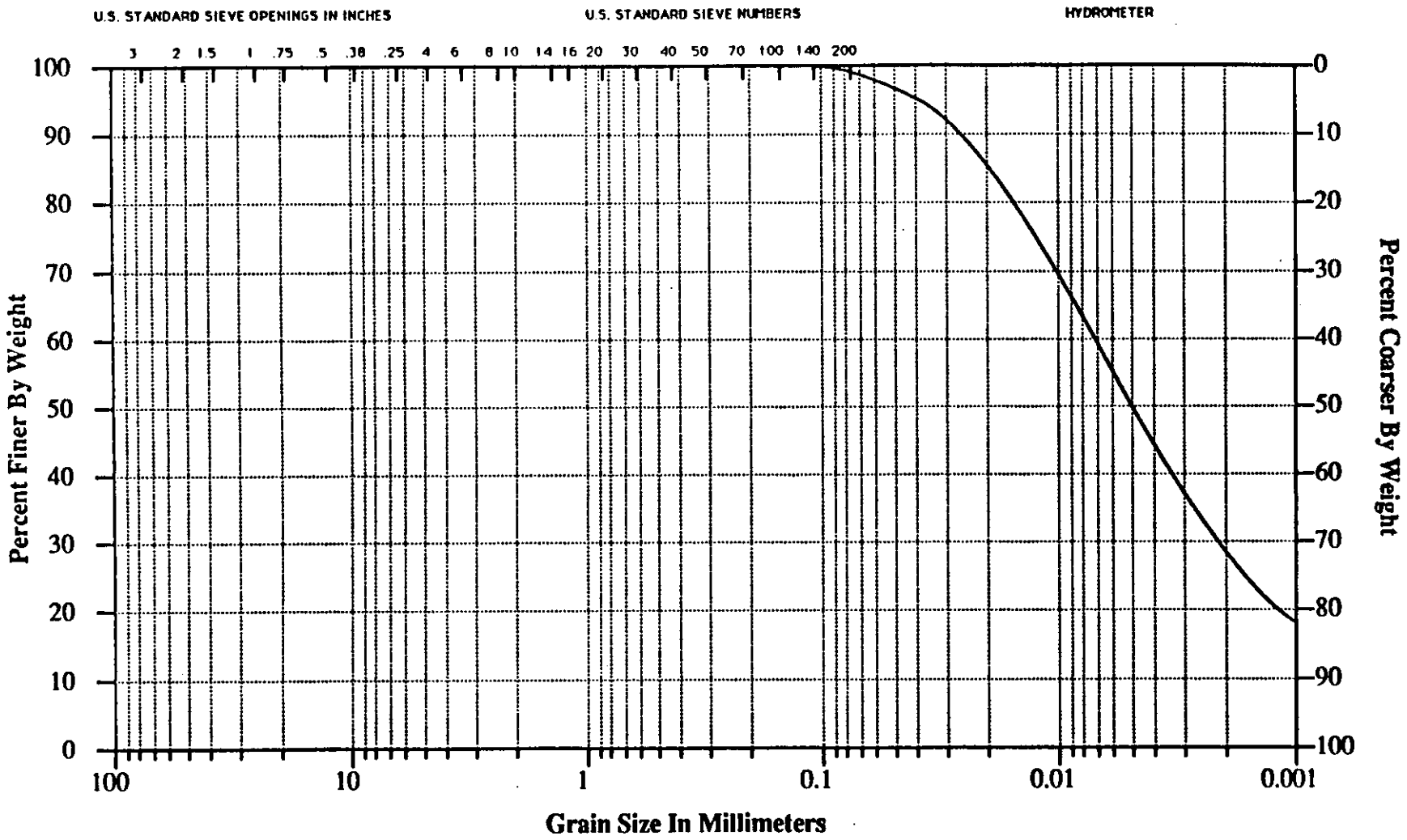
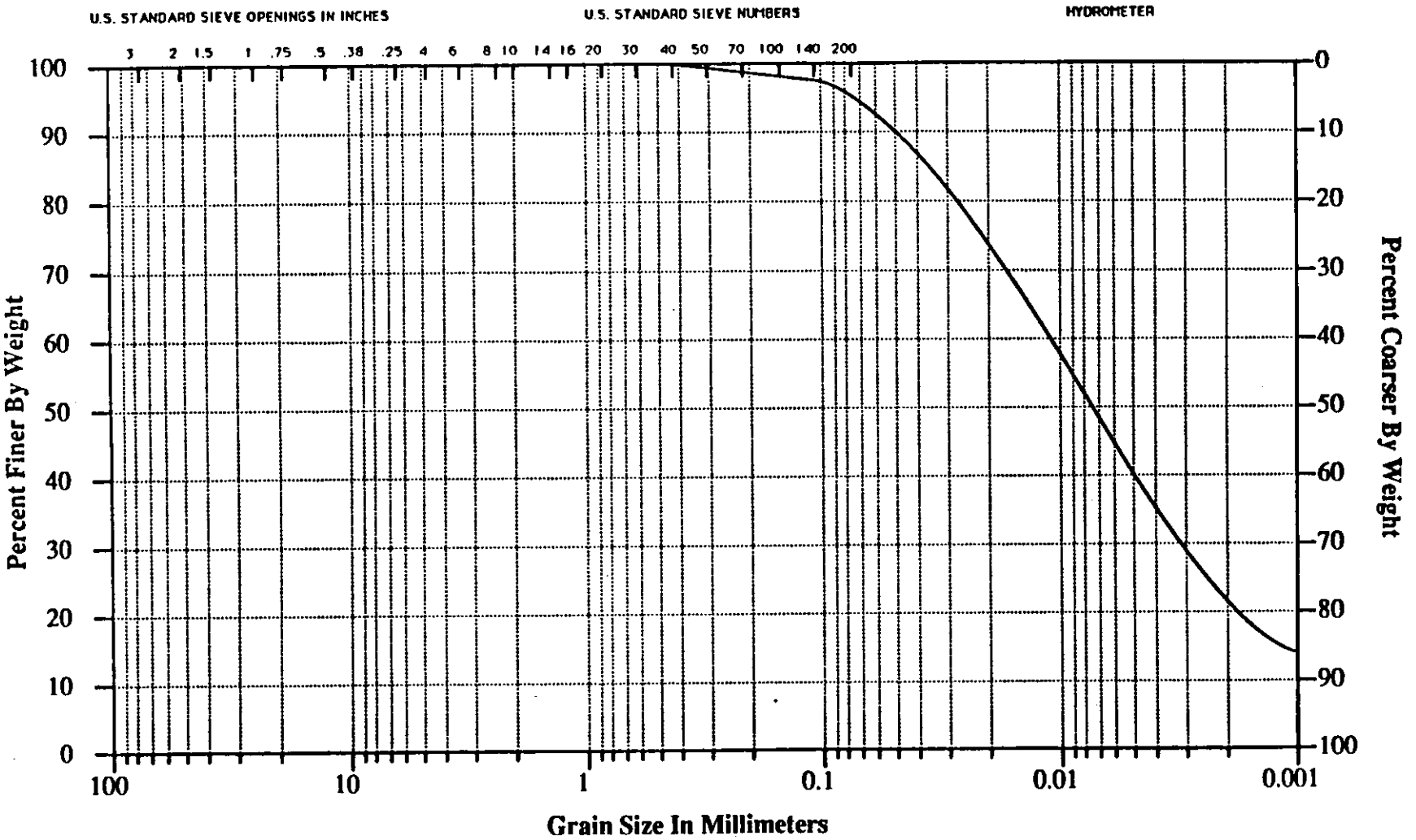
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: P21D–ST–2
Cranston, Rhode Island



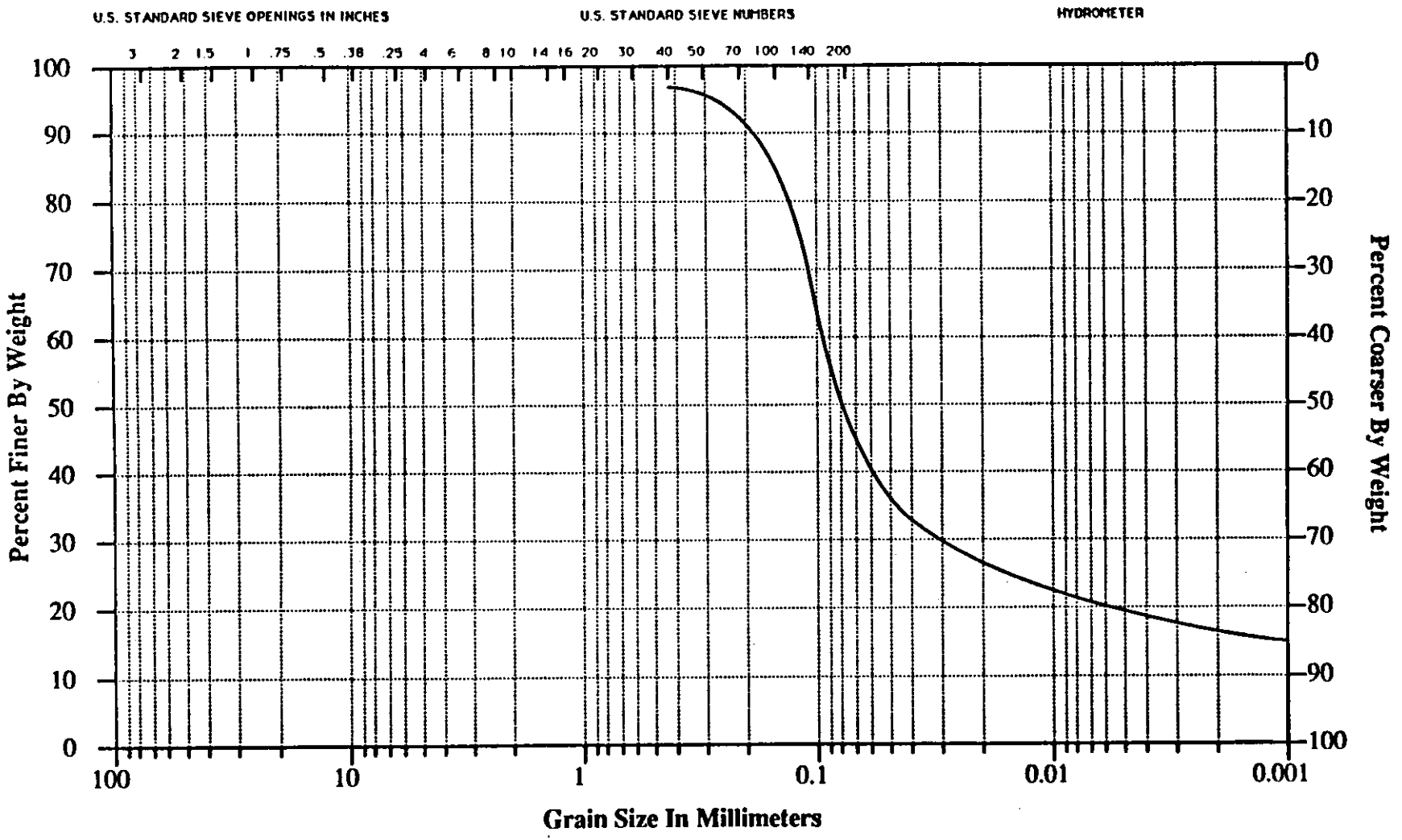
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW–1–ST–1
Cranston, Rhode Island



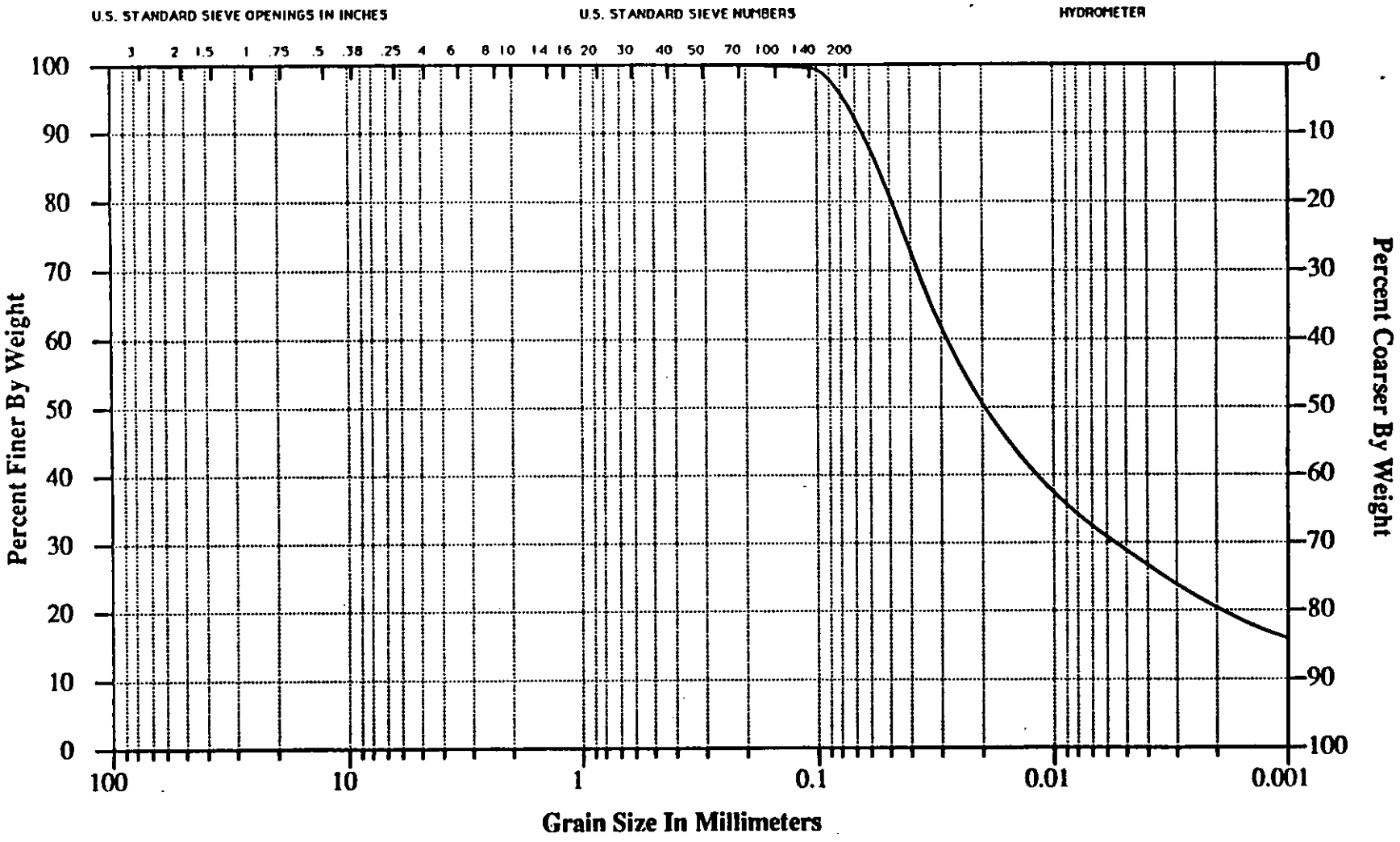
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW–2–ST–1
Cranston, Rhode Island



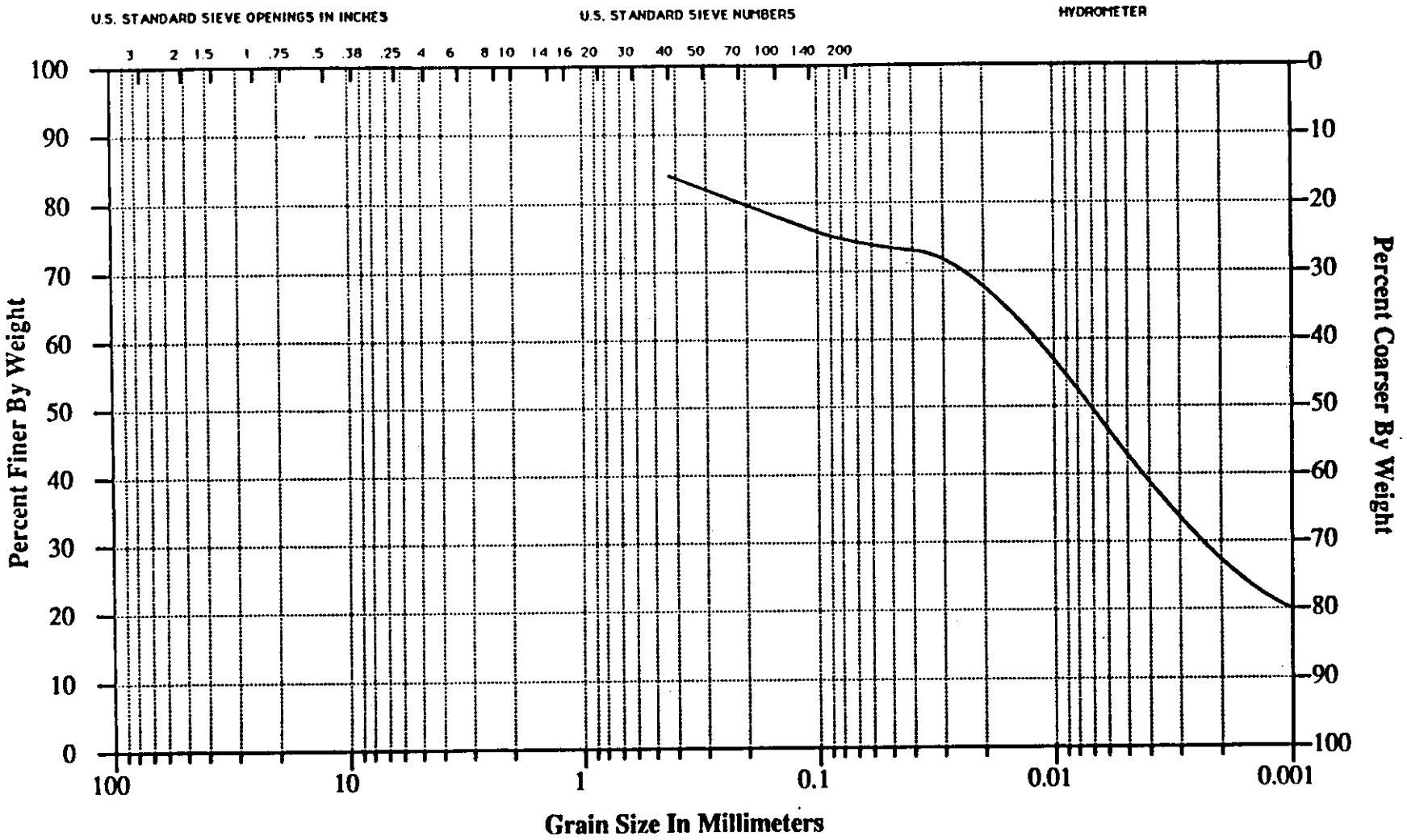
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW–3–ST–1
Cranston, Rhode Island



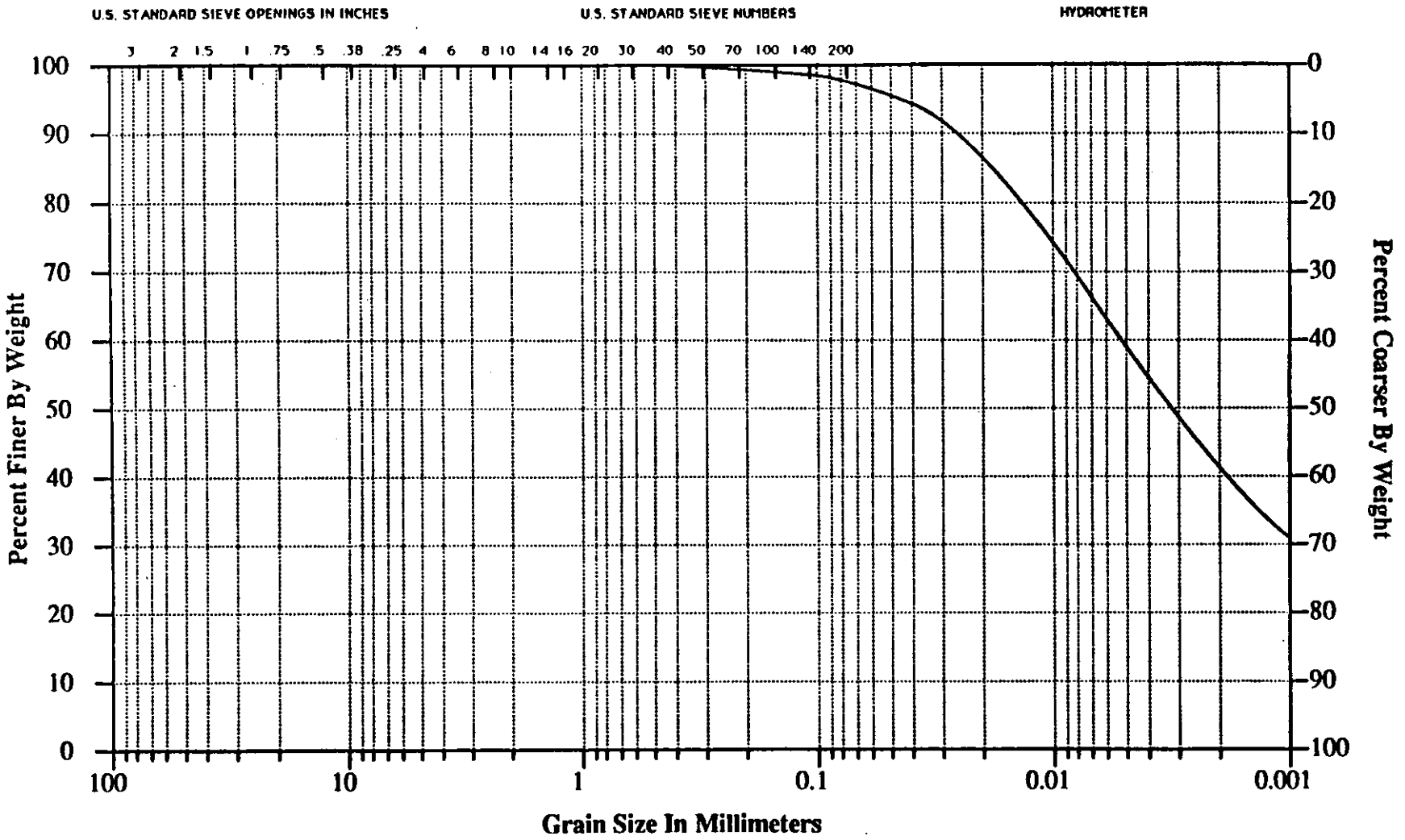
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW–3–ST–2
Cranston, Rhode Island



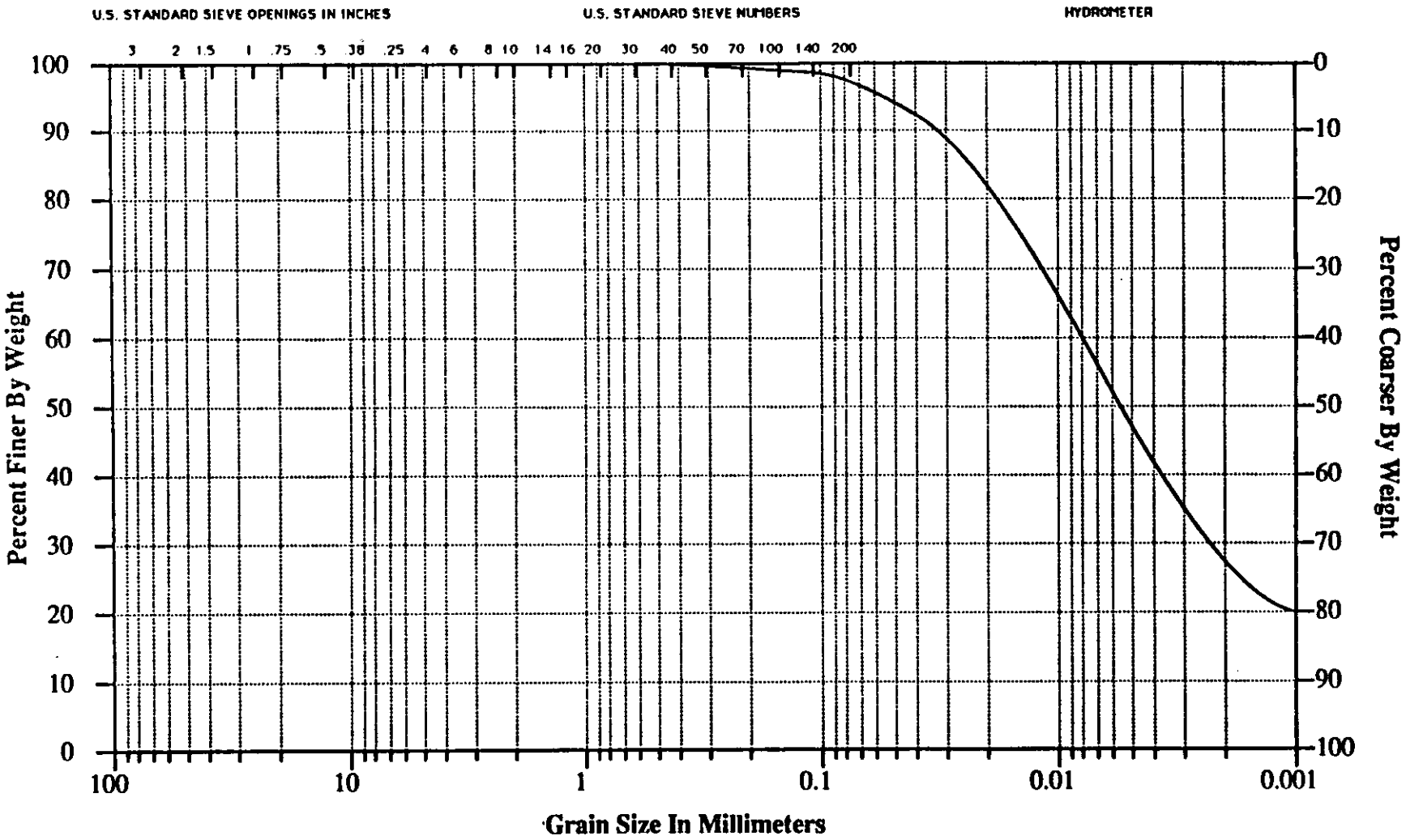
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA – GEIGY SITE: RW – 4 – ST – 1
Cranston, Rhode Island



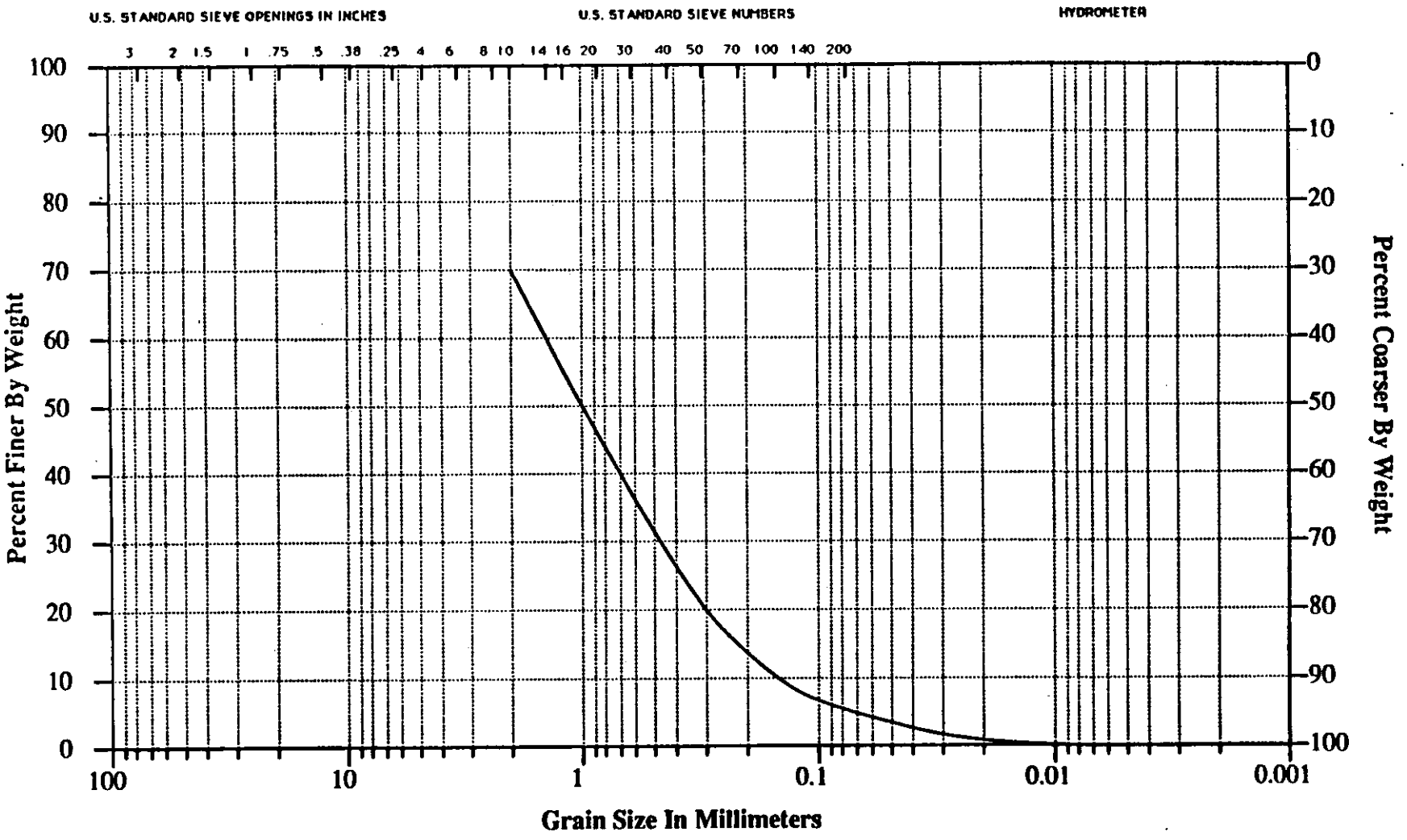
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: P22D–ST1
Cranston, Rhode Island



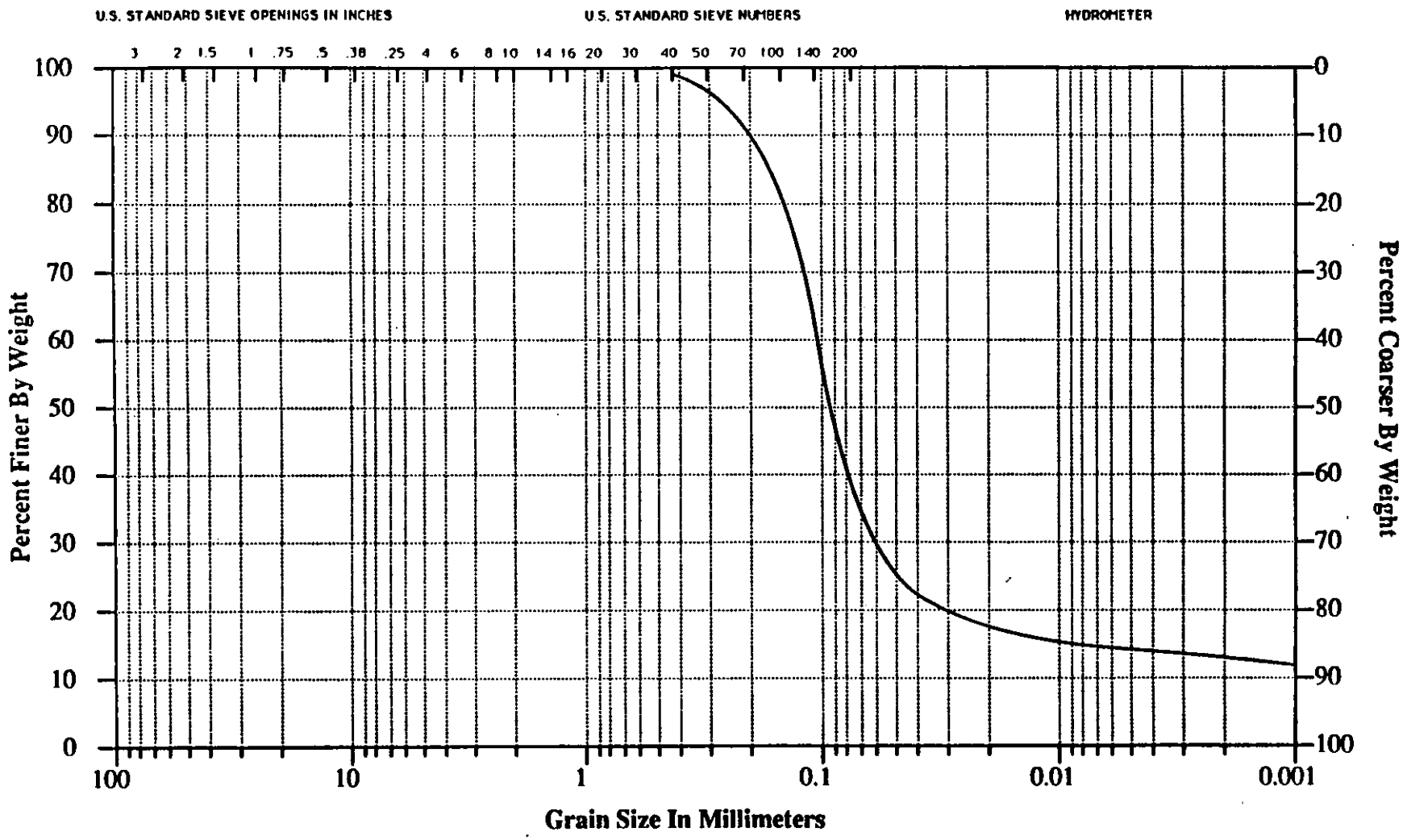
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: P22D–ST2
Cranston, Rhode Island



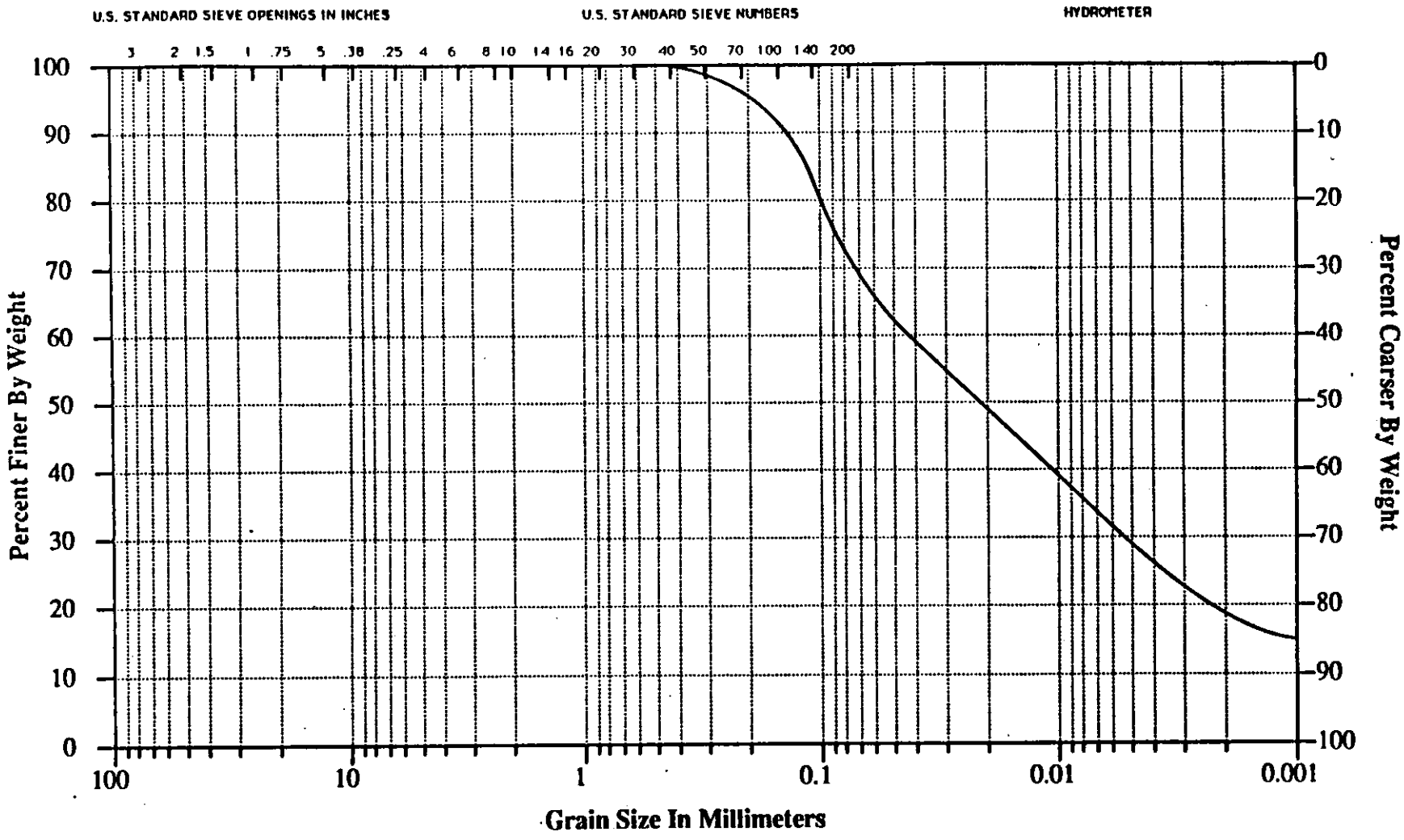
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: P22D SS–3B
Cranston, Rhode Island



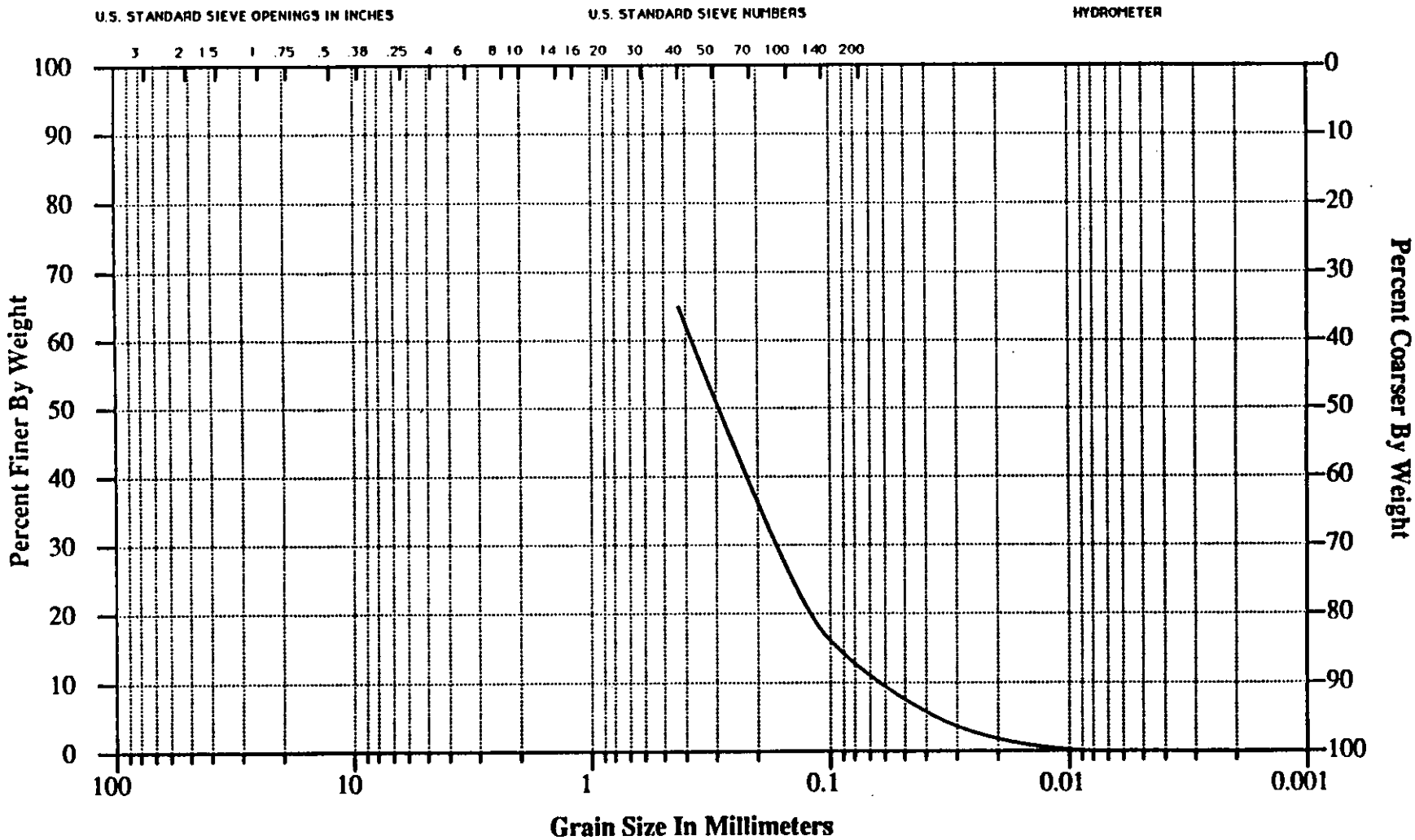
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: P22D SS–5
Cranston, Rhode Island



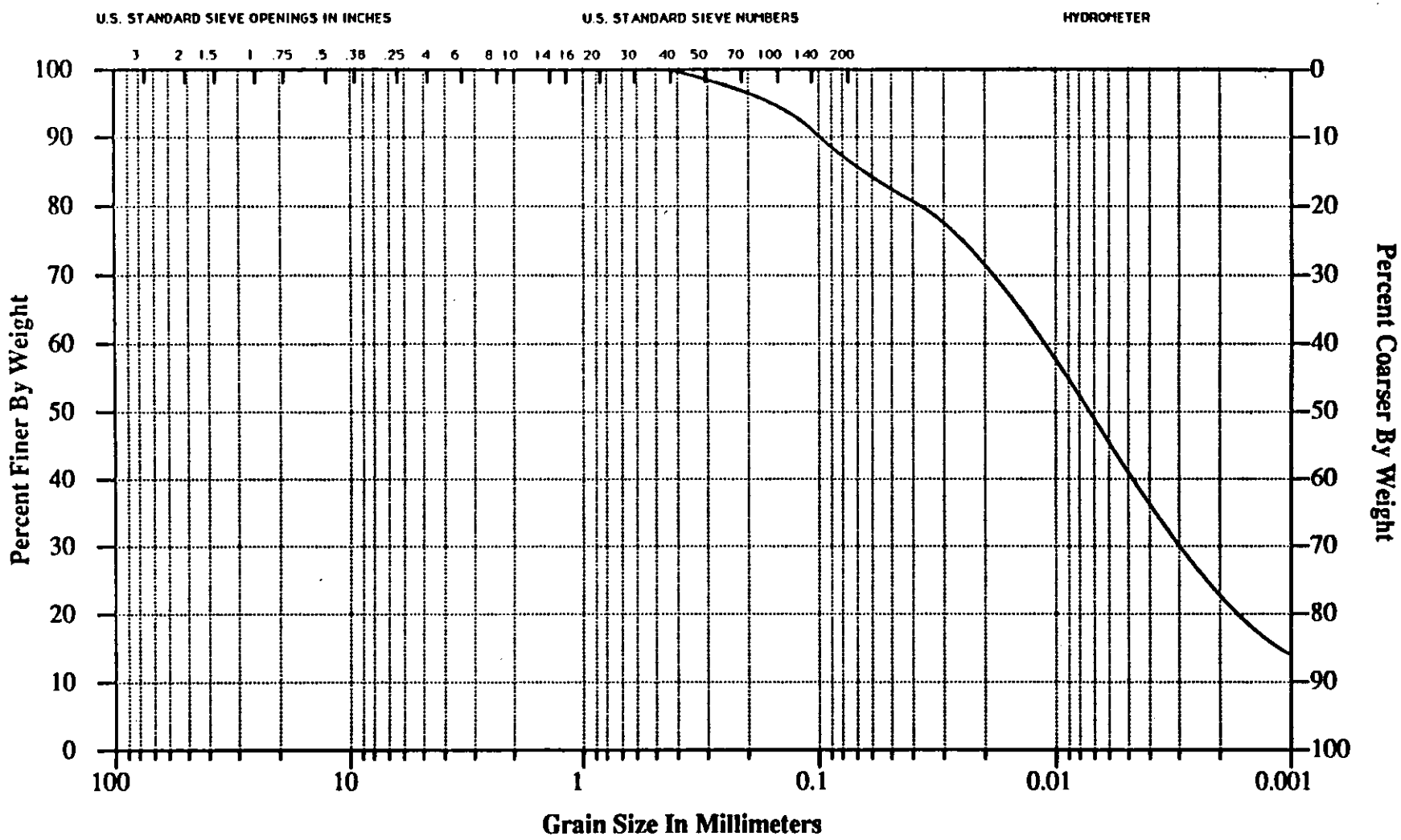
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: P22D SS–2
Cranston, Rhode Island



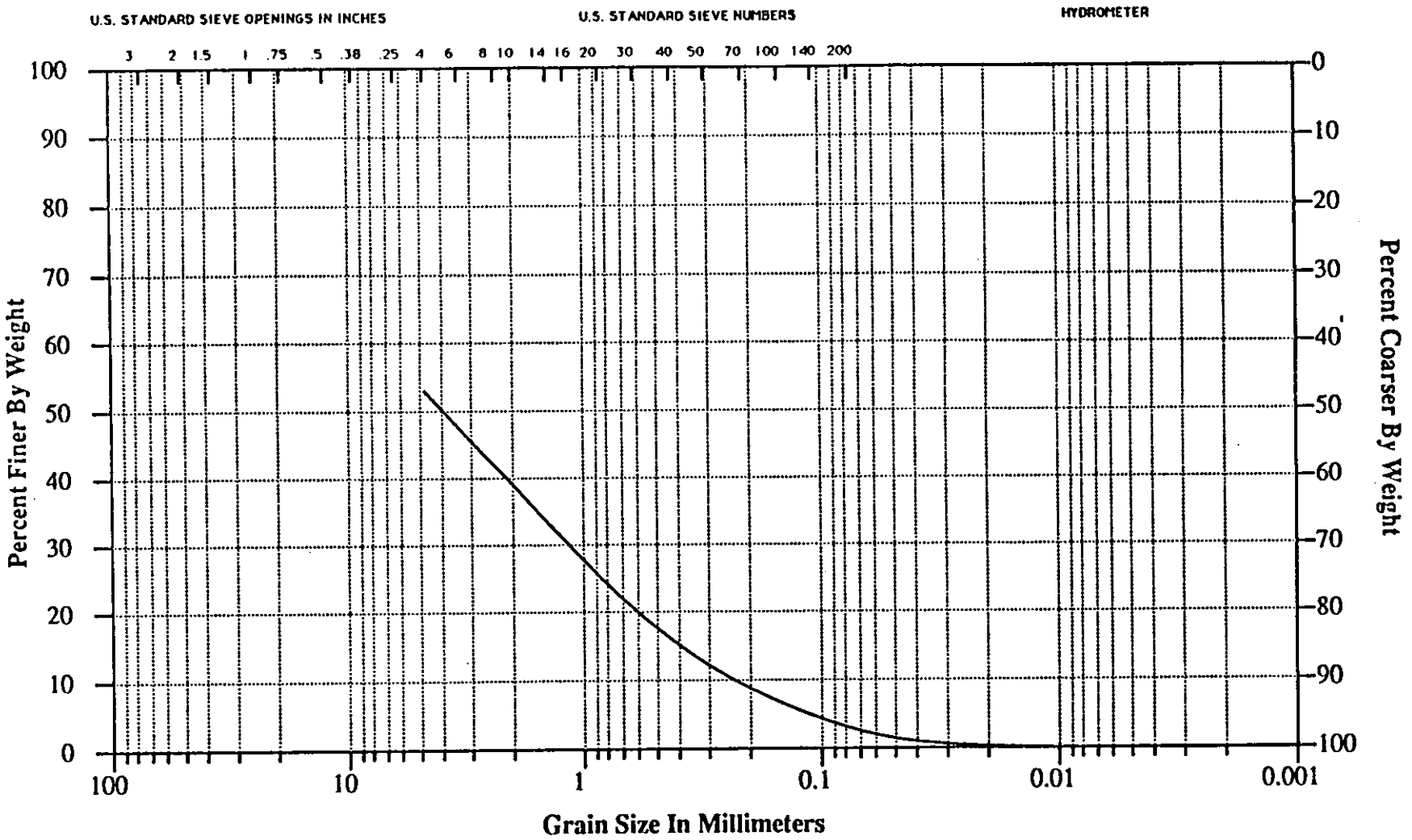
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: RW–1 RS
Cranston, Rhode Island



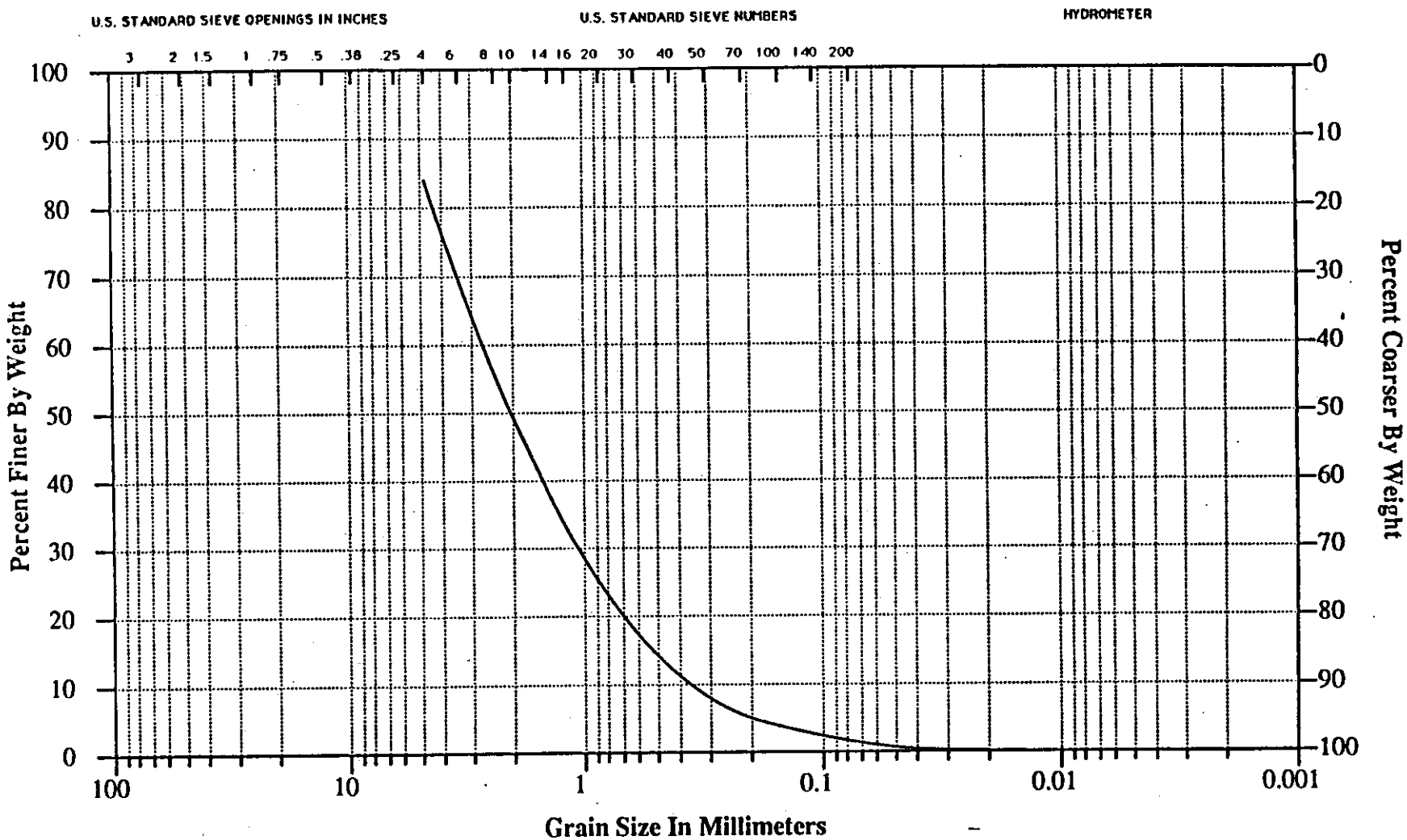
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA – GEIGY SITE: RW – 4 RS
Cranston, Rhode Island



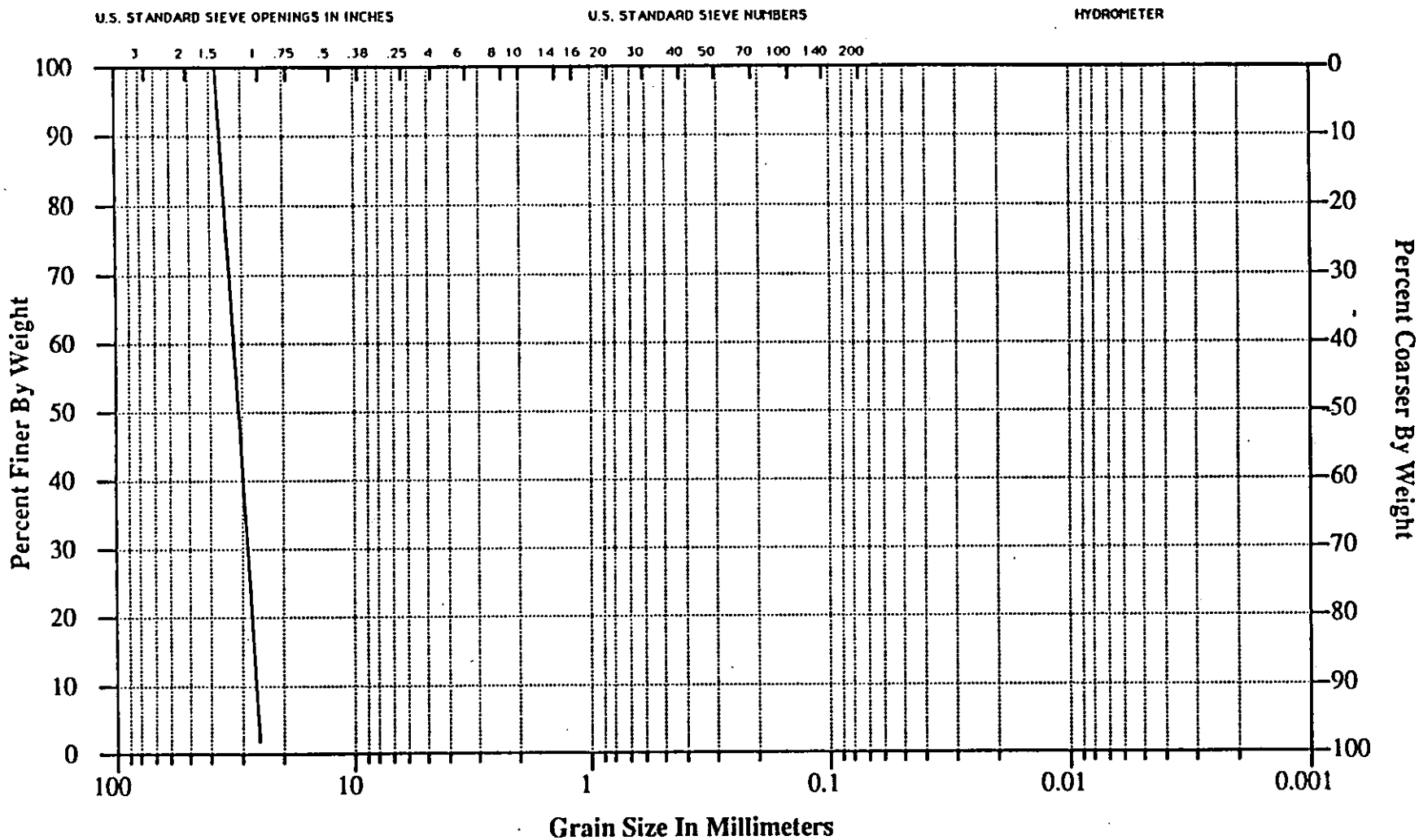
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA – GEIGY SITE: SD – FO1R
Cranston, Rhode Island



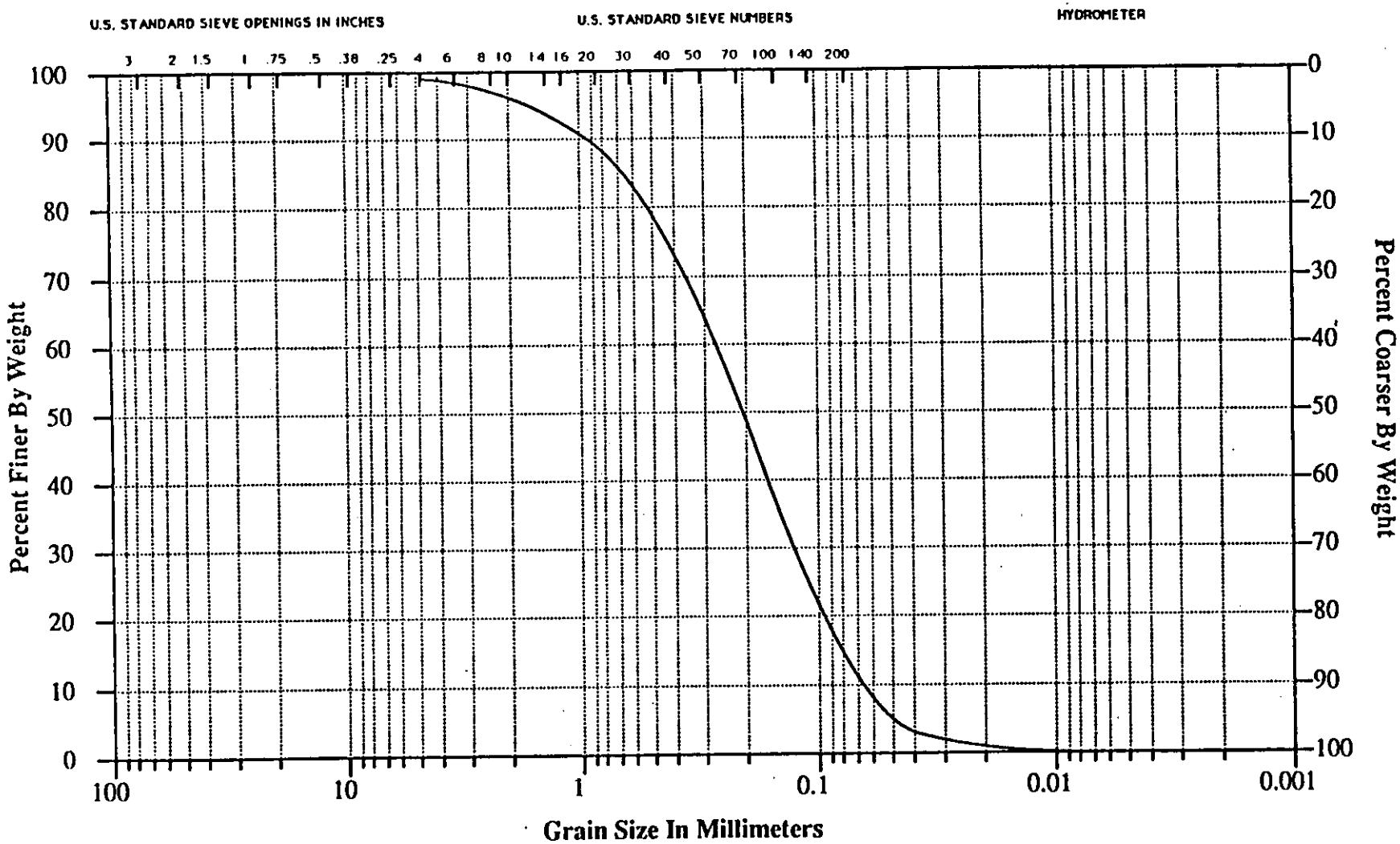
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA – GEIGY SITE: SD – F10R
Cranston, Rhode Island



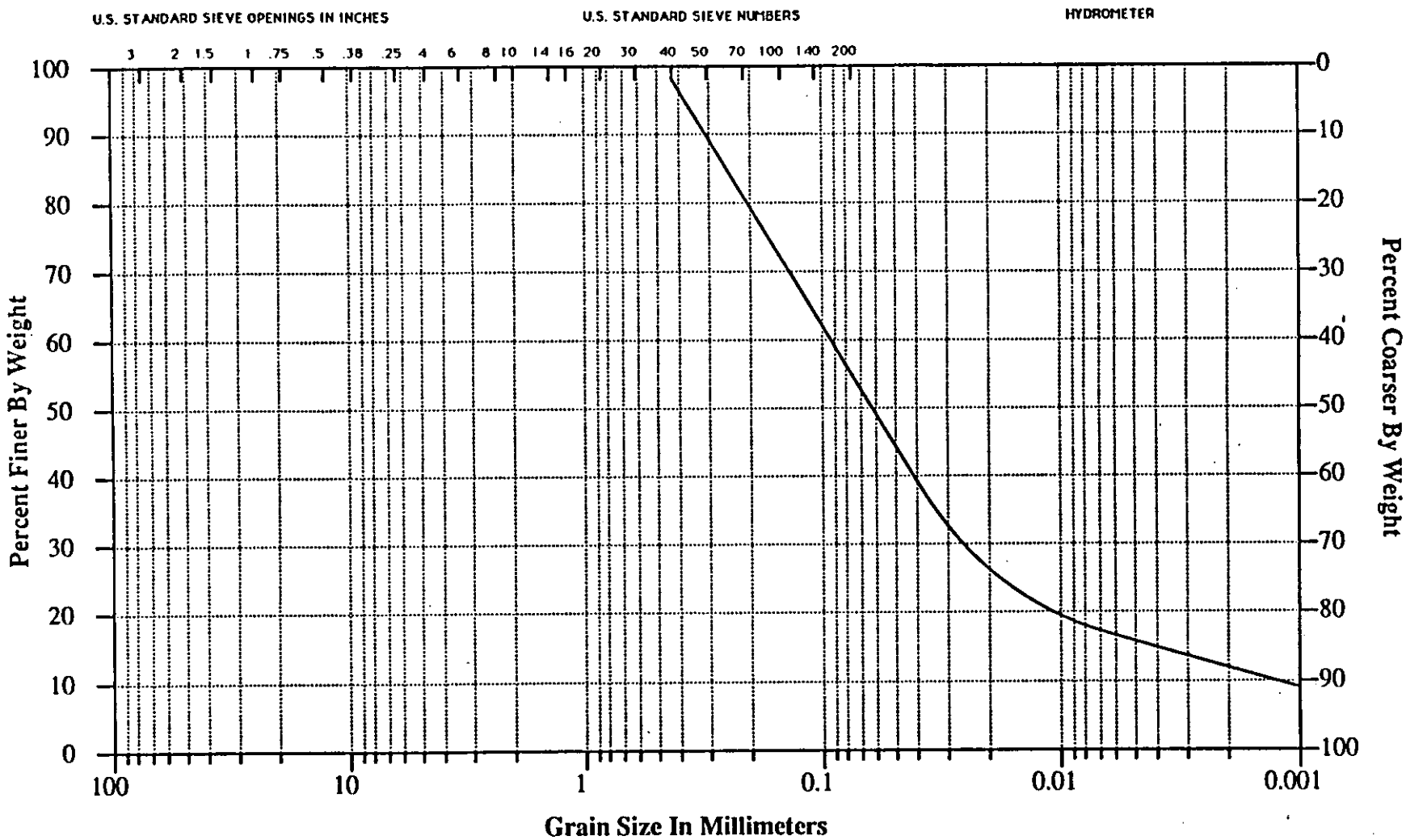
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA – GEIGY SITE: SD – FO7R
Cranston, Rhode Island



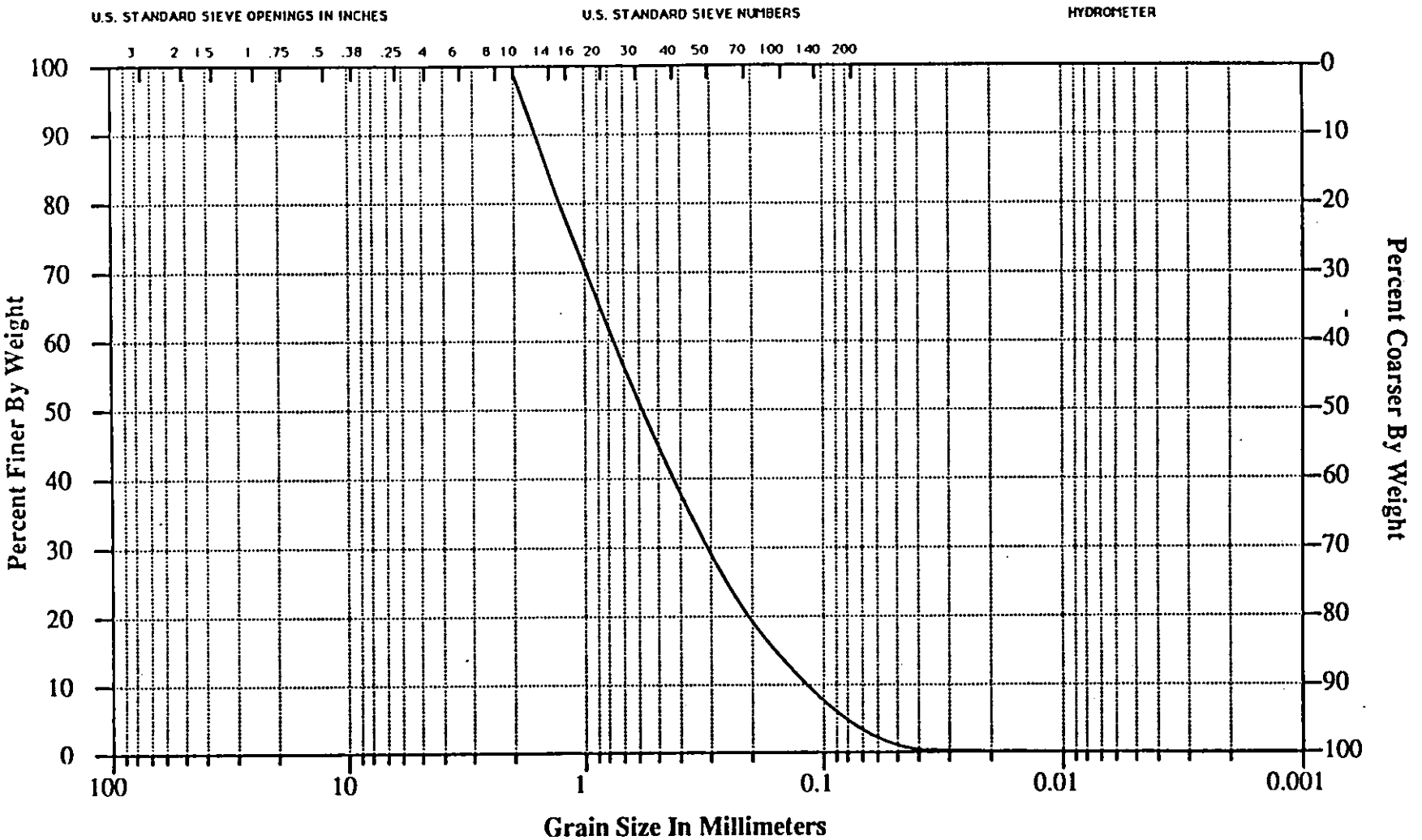
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA–GEIGY SITE: SD–FO2R
Cranston, Rhode Island



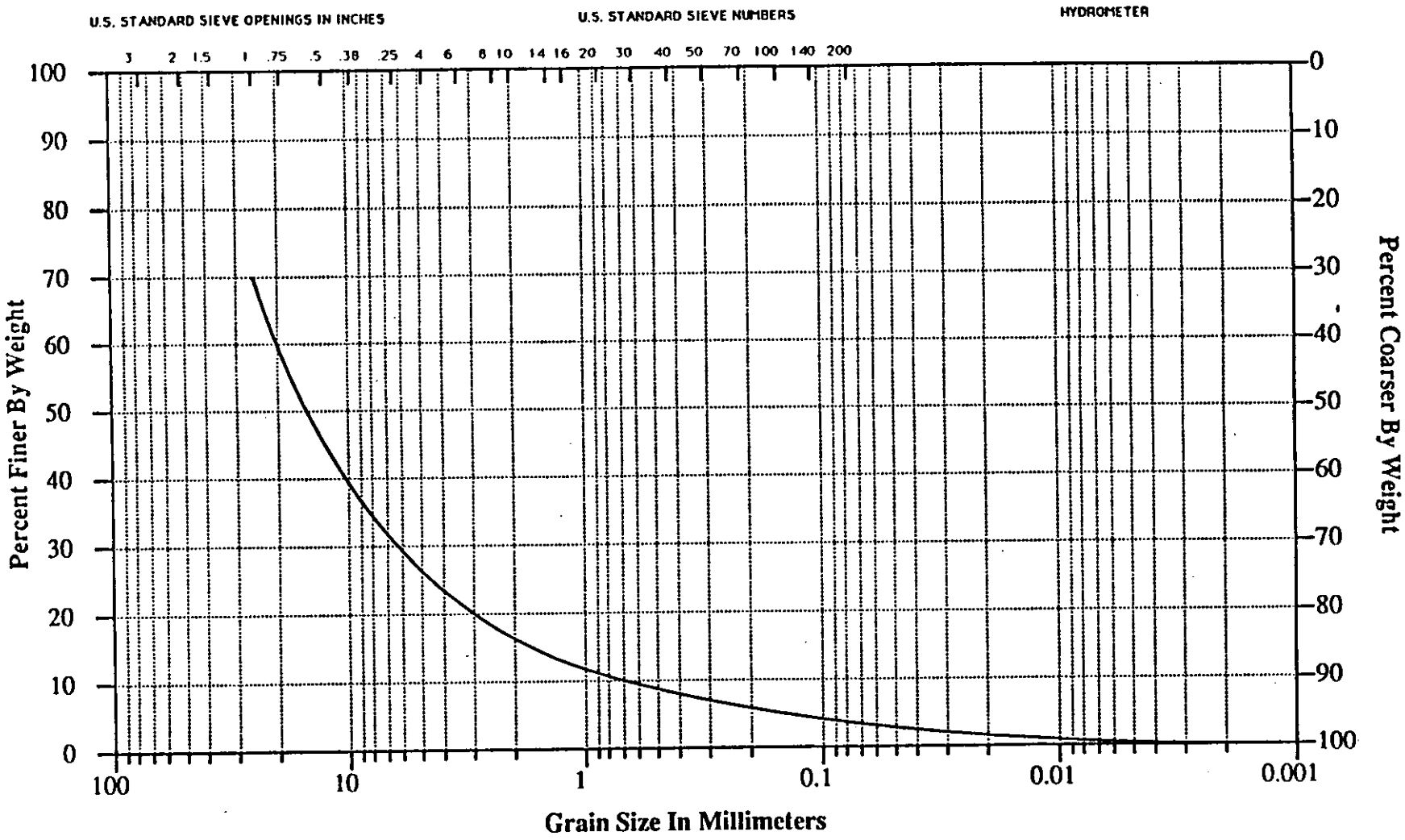
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA – GEIGY SITE: SD – FO3R
Cranston, Rhode Island



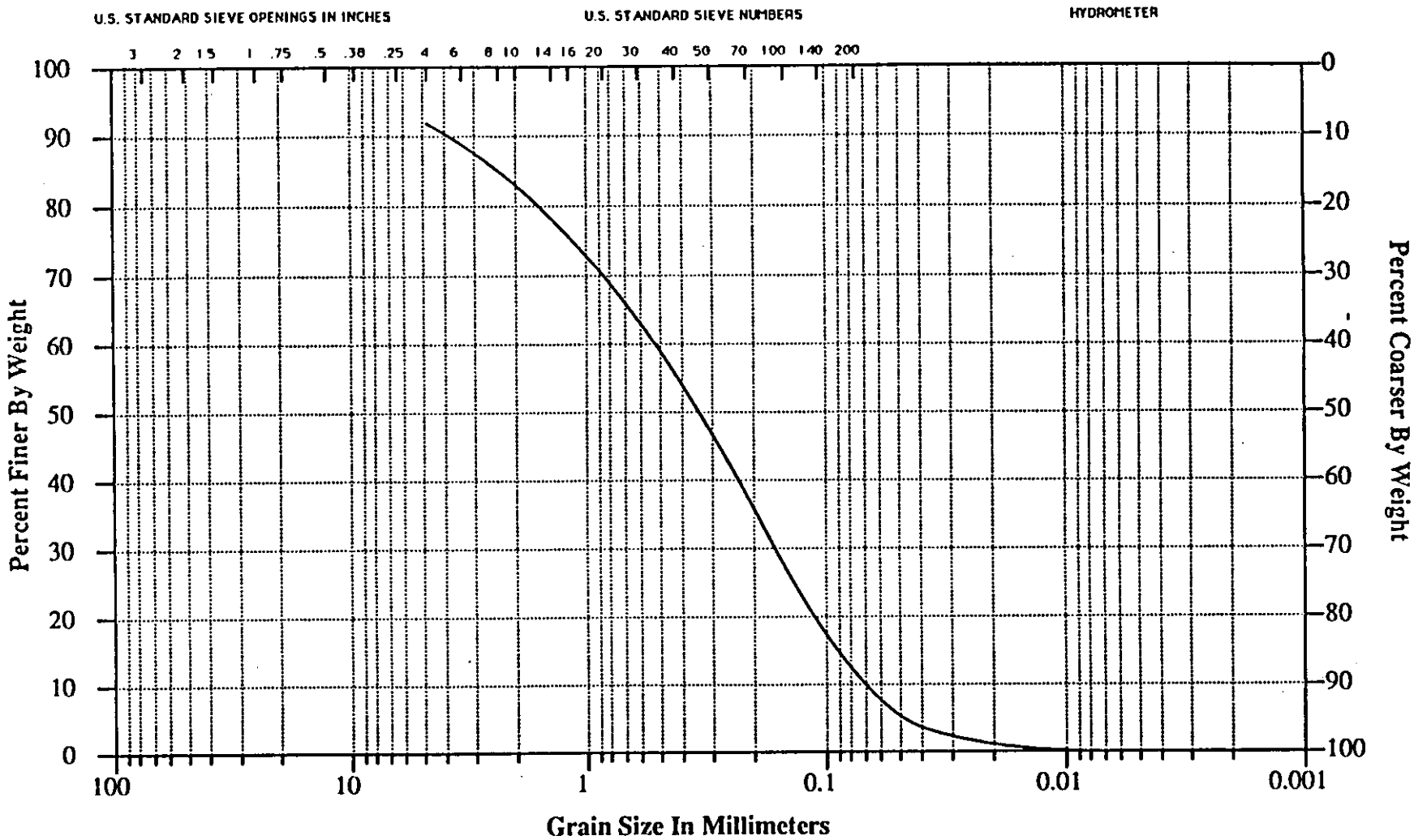
KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA – GEIGY SITE: SD – FO5L
Cranston, Rhode Island



KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA – GEIGY SITE: SD – FO6L
Cranston, Rhode Island



KWBA
Environmental Science and Engineering

GRAIN SIZE CURVE
CIBA – GEIGY SITE: SD – FO1A – R
Cranston, Rhode Island

RADIAN CORPORATION
8501 Mo-Pac Blvd.
P.O. Box 201088
Austin, TX 78720-1088

Chain of Custody Record

PROJECT 87X4660 Phase Ia (Geotech SOIL CHAR TYPE Shelby Tubes)

SITE CIBA-GEIGY CRANSTON R.I.

COLLECTOR MARION CRAIB - KEVIN MURPHY

Analyses: (A) POROSITY (B) BULK DENSITY (C) HYD. CONDUCTIVITY (D) PARTICLE SIZE DIST.

SAMPLE I.D.	MATRIX TYPE	DATE/TIME	Analyses	REMARKS
RW-2-ST-1	soil/Shelby	7-17-90		—
RW-1-ST-1	soil/Shelby	7-17-90	Analyze each sample for parameters	—
RW-3-ST-~~1~~2 (JL) 7-20	soil/Shelby	7-18-90	(A)-(D). Group similar areas	—
RW-4-ST-1	soil/Shelby	7-18-90	(RW-2) when presenting	—
RW-3-ST-1	soil/Shelby	7-18-90	geotechnical parameter results	—
P19D-ST-2	soil/Shelby	7-19-90	in the lab report.	—
P19D-ST-1	soil/Shelby	7-19-90	Present all QA/QC and	—
P21D-ST1	soil/Shelby	7-20-90	raw data into worksheet in	
P21D-ST-2	soil/Shelby	7-20-90	each test method w/ results	

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:
J LORENZO	7-23-90	11:45 AM			7-24-90	0900	Jake Tundsey
Jake Tundsey	7-24-90	1500					

RECEIVED FOR LABORATORY BY:	DATE	TIME	REMARKS
Phil Cadarette (KWBEA)	7-25-90	1130	

10-88-25948

RADIAN CORPORATION
8501 Mo-Pac Blvd.
P.O. Box 201088
Austin, TX 78720-1088

Chain of Custody Record

PROJECT: 87X4660 Phase Ia (SOIL CHAR. GEOTECH ANALYSIS ONLY)
SITE: CIBA-GEIGY CRANSTON RI
COLLECTOR: MARION CRAIG - KEVIN MURPHY

Analyses: PARTICLE SIZE DISTRIBUTION

SAMPLE I.D.	Matrix TYPE	DATE/TIME	PARTICLE SIZE DISTRIBUTION	REMARKS
P19D-SS-6-7A	soil	7-19-90 TIME: N/A	1 liter jar	–
RW-4-SS-5	soil	7-19-90 TIME: N/A		–
*SS-8-RW-1	soil	7-17-90 TIME: N/A		–
RW-1-SS-20	soil	7-17-90 TIME: N/A	(1 liter jar)	–
*SS-24-RW-1	soil	7-17-90 TIME: N/A	Present all QA/QC + raw data w/ lab results	–
RW-2 S-15	soil	7-19-90 TIME: N/A	*Note: When presenting analytical	–
RW-1-SS-13-15	soil	7-19-90 TIME: N/A	results please group similar locations	–
RW-2 SB-2	soil	7-19-90 TIME: N/A	together (i.e., RW-1 PSD results all grouped on data sheet)	–
P19D-SS-4	soil	7-19-90 TIME: N/A	1 liter jar	–

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:
J LORENZO	7-23-90	11:45 AM			7-24-90	0900	Jane Lundsey
Jane Lundsey	7-24-90	1500					

RECEIVED FOR LABORATORY BY:	DATE	TIME	REMARKS
Phil Cadwell (KWS&A)	7-25-90	1130	

10-86-25946

RADIAN CORPORATION
8501 Mo-Pac Blvd.
P.O. Box 201088
Austin, TX 78720-1088

Chain of Custody Record

PROJECT: 87X 4660 Phase Ia (Soil lab & geotech analysis only) TYPE:

SITE: CIBA GEIGY CRANSTON, RI

COLLECTOR: Marion Craig - Kevin Murphy

Analyses: PARTICLE SIZE DISTRIBUTION

SAMPLE I.D.	MATRIX TYPE	DATE/TIME		REMARKS
RW-3 S-7	soil	7-19-90 TIME: N/A	1 liter jar	—
RW-2 S-22	soil	7-19-90 TIME: N/A		—
RW-3 S-4	soil	7-19-90 TIME: N/A		—
RW-4 SS-9	soil	7-19-90 TIME: N/A		—
P-19D SS1-[redacted]2	soil	7-19-90 TIME: N/A	1 liter jar	—
P21D SS-5	soil	7-20-90 TIME: N/A	Present all QA/QC + raw data w/ lab results	
P21D SS-15	soil	7-20-90 TIME: N/A	*Note: When presenting analytical	
P21D SS-1	soil	7-20-90 TIME: N/A	results please group similar locations	
P21D SS-18	soil	7-23-90 TIME: N/A	together (i.e. RW-1 PSD results all grouped together)	

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:
J Lorenzo	7-23-90	11:45 AM			7-24-90	0900	Jane Lundry
Jane Lundry	7-24-90	1500					

RECEIVED FOR LABORATORY BY:	DATE	TIME	REMARKS
Phil Cadwell (KWB&A)	25 July '90	1130	

10-86-25948

Appendix F

APPENDIX F

WELL CONSTRUCTION REPORTS

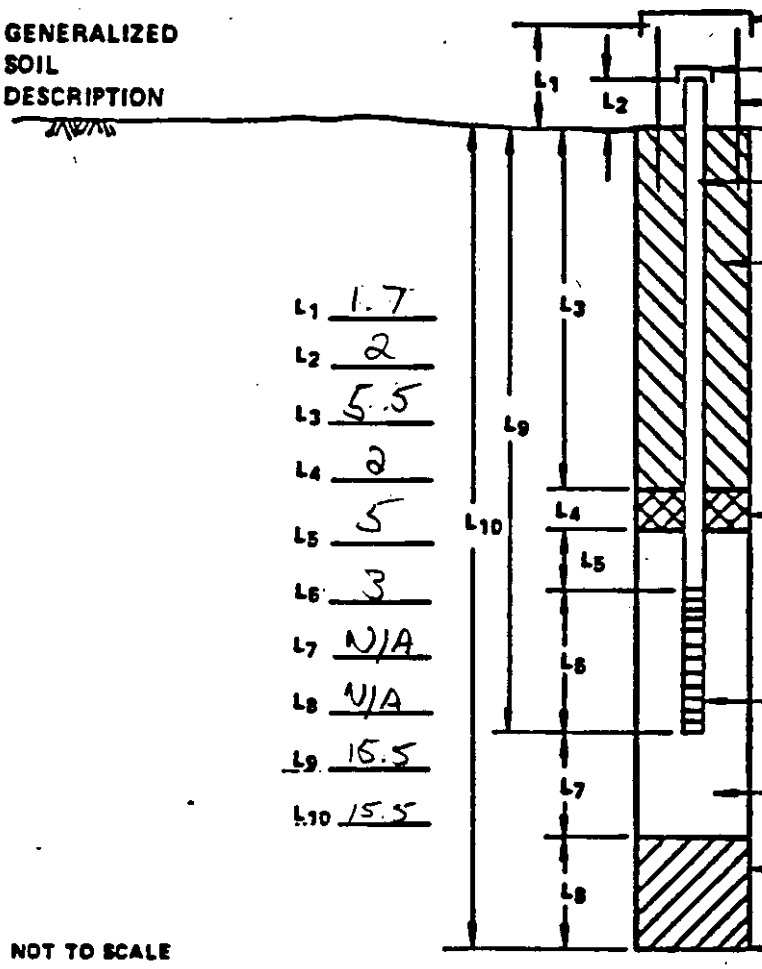
WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

CONSTRUCTION OF MONITORING WELL NO. P15S

PROJECT AND LOCATION: CIBA - GEIGY	GROUND ELEV. AND DATUM: 13.95	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	TOP OF RISER ELEV.: 15.69	DATE FINISHED: 7-24-90
METHOD OF DRILLING: 4" HSA ID	TOP OF PROTECTIVE CASING ELEV.: 15.69	INSPECTOR: Kevin Murphy
DIA. OF BOREHOLE: 6.5	GROUND WATER ELEV.: 6.82	CHECKED BY: CT
DEPTH OF BOREHOLE: 15.5		

GENERALIZED SOIL DESCRIPTION



L1	1.7
L2	2
L3	5.5
L4	2
L5	5
L6	3
L7	N/A
L8	N/A
L9	15.5
L10	15.5

STEEL COVER AND LOCK

VENTED CAP

STEEL PROTECTIVE CASING

DIA. OF RISER PIPE: 1¼"

TYPE OF PIPE: Galvanized Steel

TYPE OF ANNULAR SEAL: Cement - Bentonite

TYPE OF SEAL: Bentonite pellets

TYPE AND DIA. OF SCREEN: Stainless steel 1¼" 7.5 slot

TYPE OF FILTER PACK: Washed Sand

TYPE OF BOTTOM SEAL: N/A

BOTTOM OF BOREHOLE: 15.5

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Augered down to 8 foot then pushed well point the rest of the way. Soil cuttings were used for soil description. A 2 foot bentonite seal was installed (7.5-5.5'). A cement - bentonite annular seal was put in to ground surface. A protective casing finished off the installation

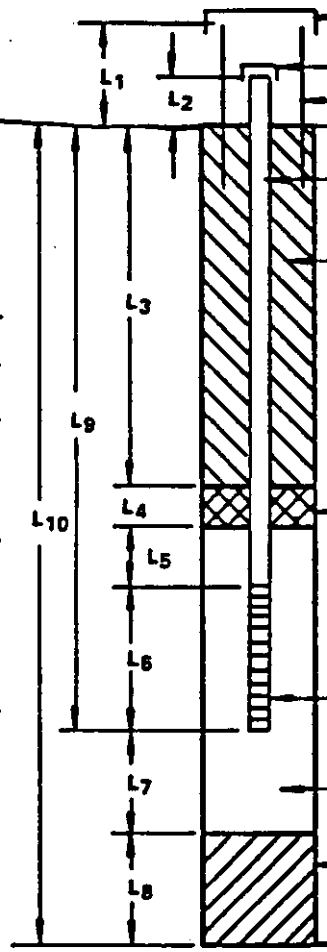
WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

CONSTRUCTION OF MONITORING WELL NO. P16S

PROJECT AND LOCATION: CIBA GEIGY CRANSTON, RI	GROUND ELEV. AND DATUM: 14.26	PROJECT NO.: 87X4660
DRILLING AGENCY: EAST COAST Drilling	TOP OF RISER ELEV.: 16.29	DATE FINISHED: 7/24/90
METHOD OF DRILLING: 4" HSA ID	TOP OF PROTECTIVE CASING ELEV.: 16.65	INSPECTOR: Kevin Murphy
DIA. OF BOREHOLE: 6.5	GROUND WATER ELEV.: 7.19	CHECKED BY: CT
DEPTH OF BOREHOLE: 15.5		

GENERALIZED SOIL DESCRIPTION



STEEL COVER AND LOCK

VENTED CAP

STEEL PROTECTIVE CASING

DIA. OF RISER PIPE: 1 1/4"

TYPE OF PIPE: GALVANIZED STEEL

TYPE OF ANNULAR SEAL: Cement - Bentonite

TYPE OF SEAL: BENTONITE PELLETS

TYPE AND DIA. OF SCREEN: STAINLESS STEEL 1 1/4" 7.5 SLOT

TYPE OF FILTER PACK: NATURAL SAND PACK

TYPE OF BOTTOM SEAL: N/A

BOTTOM OF BOREHOLE: 15.5

L1	2.4
L2	2.0
L3	5.5
L4	2
L5	5
L6	3
L7	N/A
L8	N/A
L9	15.5
L10	15.5

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Augered to 8 feet then pushed the well point the rest of the way. Soil descriptions were taken from the cuttings. A 2 foot bentonite seal was put in (7.5-5.5), then a annular seal of cement-bentonite was put in up to the ground surface. A stick up protective casing finished off the installation.

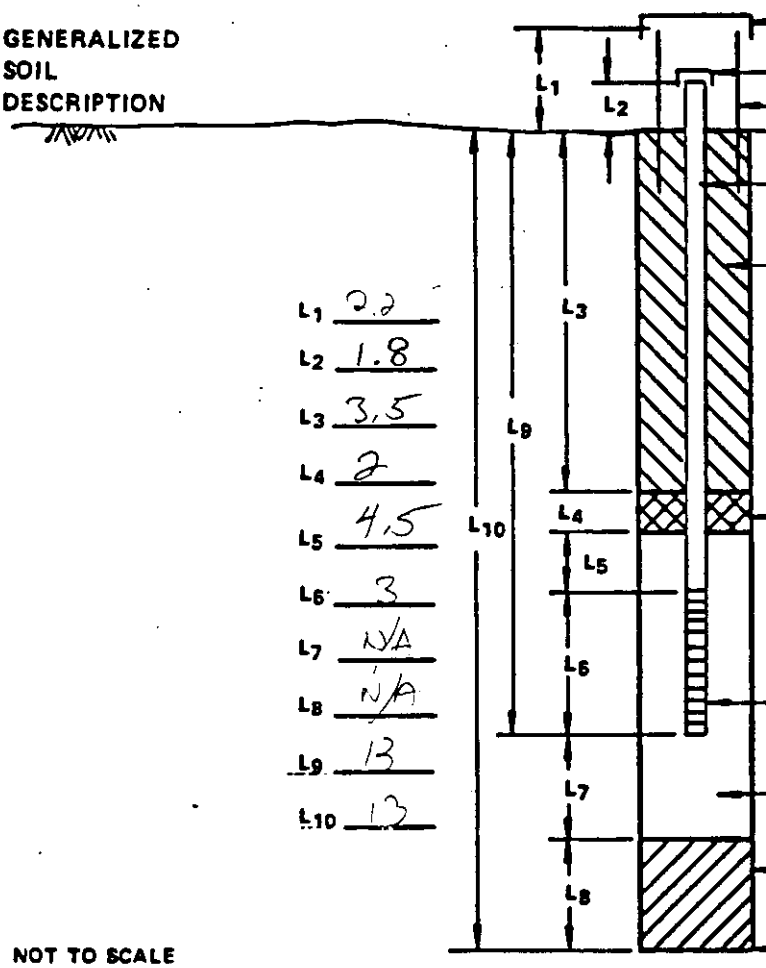
WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

CONSTRUCTION OF MONITORING WELL NO. P175

PROJECT AND LOCATION: CIBA GEIGY CRANSTON, RI	GROUND ELEV. AND DATUM: 15.28	PROJECT NO.: 87X4660
DRILLING AGENCY: EAST COAST DRILLING	TOP OF RISER ELEV.: 17.07	DATE FINISHED: 7/24/90
METHOD OF DRILLING: 4" HSA ID	TOP OF PROTECTIVE CASING ELEV.: 17.52	INSPECTOR: Kevin Murphy
DIA. OF BOREHOLE: 6.5	GROUND WATER ELEV.: 9.71	CHECKED BY: CT
DEPTH OF BOREHOLE: 13		

GENERALIZED SOIL DESCRIPTION



L1 2.2
L2 1.8
L3 3.5
L4 2
L5 4.5
L6 3
L7 N/A
L8 N/A
L9 13
L10 13

STEEL COVER AND LOCK

VENTED CAP

STEEL PROTECTIVE CASING

DIA. OF RISER PIPE 1 1/4"

TYPE OF PIPE GALVANIZED STEEL

TYPE OF ANNULAR SEAL Cement - Bentonite

TYPE OF SEAL Bentonite Pellets

TYPE AND DIA. OF SCREEN 1 1/4" Stainless Steel 7.5 feet

TYPE OF FILTER PACK Natural Sand Pack

TYPE OF BOTTOM SEAL N/A

BOTTOM OF BOREHOLE 13

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS Augered down to 7 feet then pushed well point the rest of the way to 13 feet. The soil descriptions were taken from the soil cuttings. A 2 foot bentonite seal was used (5.5-3.5) then a cement-bentonite annular seal was put in up to the ground surface. A steel protective casing was installed which finished well installation.

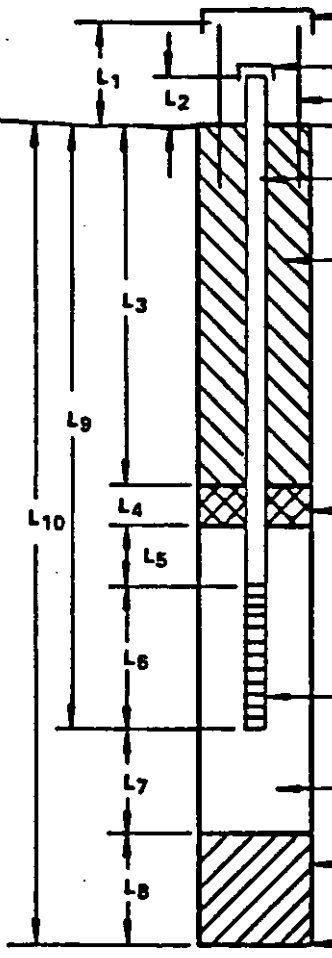
WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

CONSTRUCTION OF MONITORING WELL NO. P 18D

PROJECT AND LOCATION: CIBA GEIGY CRANSTON, R.I.	GROUND ELEV. AND DATUM: 11.41	PROJECT NO.: 87X4660
DRILLING AGENCY: EAST COAST Drilling	TOP OF RISER ELEV.: 13.27	DATE FINISHED: 7/30/90
METHOD OF DRILLING: 4" HSA IB	TOP OF PROTECTIVE CASING ELEV.: 13.61	INSPECTOR: KEVIN MURPHY
DIA. OF BOREHOLE: 6.5	GROUND WATER ELEV.: 2.37	CHECKED BY: CT
DEPTH OF BOREHOLE: 66		

GENERALIZED SOIL DESCRIPTION



STEEL COVER AND LOCK

VENTED CAP

STEEL PROTECTIVE CASING

DIA. OF RISER PIPE: 1 1/4"

TYPE OF PIPE: Galvanized Steel

TYPE OF ANNULAR SEAL: Cement - Bentonite

TYPE OF SEAL: Bentonite Pellets

TYPE AND DIA. OF SCREEN: Stainless Steel 7.5 slot. 1 1/4"

TYPE OF FILTER PACK: Natural filter Pack

TYPE OF BOTTOM SEAL: N/A

BOTTOM OF BOREHOLE: 66

L1	2.2
L2	1.9
L3	60
L4	2
L5	1
L6	3
L7	N/A
L8	N/A
L9	66
L10	66

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Warwick area. Augered down to 57 feet then pushed the rest of the way down. Soil description taken from cuttings and compared to RW3. A 2 foot bentonite seal was put in (62-60) then from 60 feet up a cement-bentonite annular seal was put in to ground surface. A stickup protective casing finished well installation.

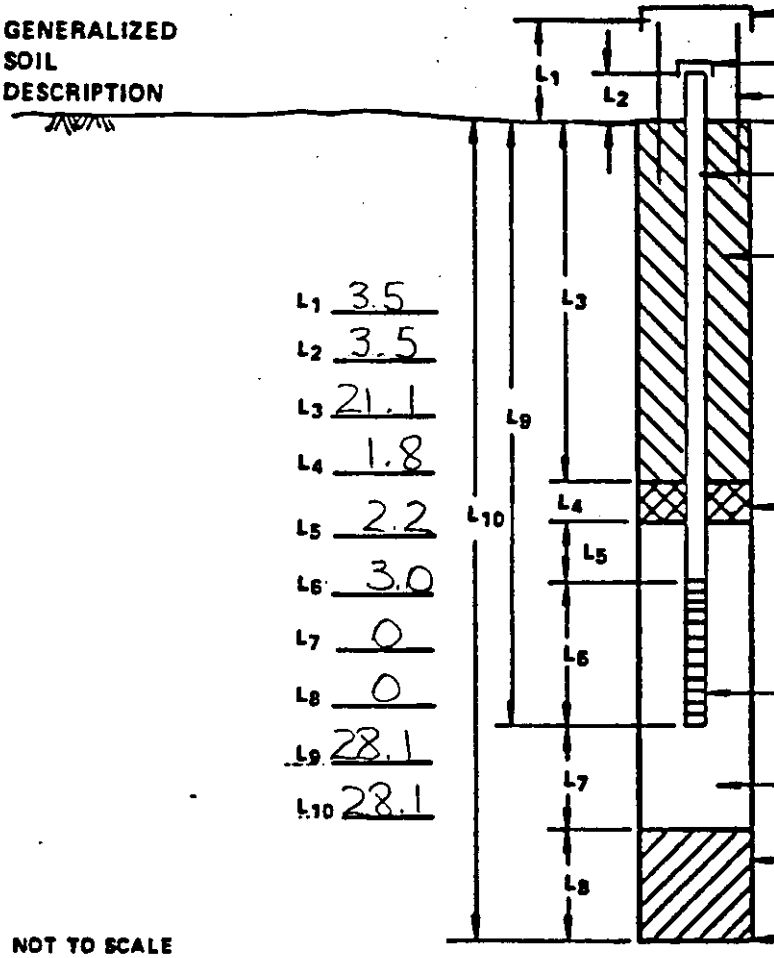
WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

CONSTRUCTION OF MONITORING WELL NO. P19D

PROJECT AND LOCATION: Ciba Geigy Cranston, R.I.	GROUND ELEV. AND DATUM: 13.70	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	TOP OF RISER ELEV.: 17.21	DATE FINISHED: 7/19/90
METHOD OF DRILLING: Rotary	TOP OF PROTECTIVE CASING ELEV.: 17.22	INSPECTOR: M. Craig
DIA. OF BOREHOLE: 6.25 in.	GROUND WATER ELEV.: 13.14	CHECKED BY: CT
DEPTH OF BOREHOLE: 28.1 ft		

GENERALIZED SOIL DESCRIPTION



L_1	3.5
L_2	3.5
L_3	21.1
L_4	1.8
L_5	2.2
L_6	3.0
L_7	0
L_8	0
L_9	28.1
L_{10}	28.1

STEEL COVER AND LOCK

VENTED CAP

STEEL PROTECTIVE CASING

DIA. OF RISER PIPE: 1.25 in

TYPE OF PIPE: Steel

TYPE OF ANNULAR SEAL: Cement/bentonite grout

TYPE OF SEAL: Bentonite Pellets

TYPE AND DIA. OF SCREEN: Stainless Steel 7.5 slot 1.25 in.

TYPE OF FILTER PACK: 00 sand

TYPE OF BOTTOM SEAL: None

BOTTOM OF BOREHOLE: 28.1

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Augered to 28.1 ft. Used 50 gallons of grout containing 3 bags cement and 1/3 bucket powdered bentonite. Grout was tremied into place from 21 feet to the surface. A 1.8 foot bentonite seal was placed at depth of 21 to 23 feet.

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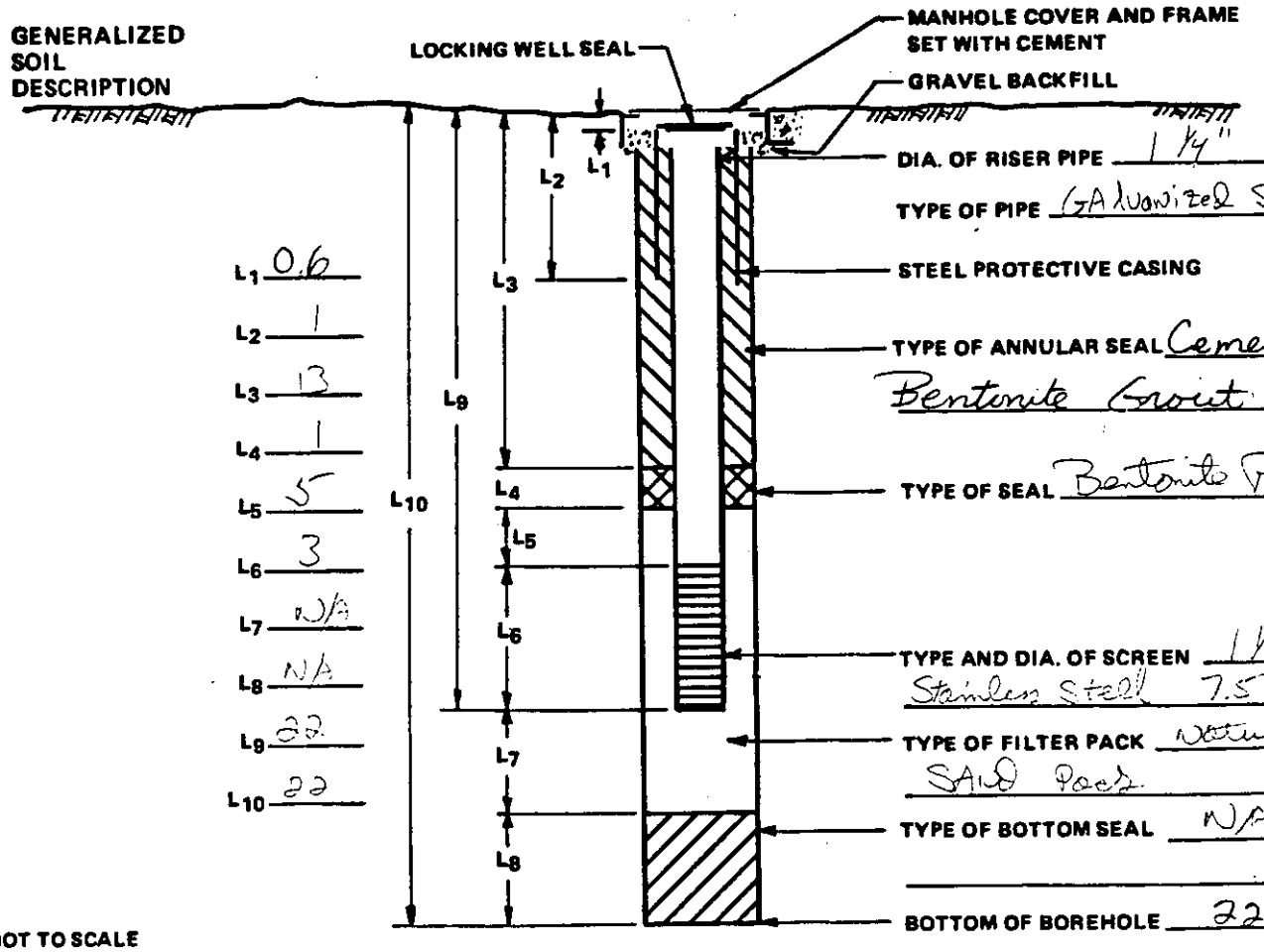
CONSTRUCTION OF FLUSHMOUNT MONITORING WELL NO. P20S

PROJECT AND LOCATION: CIBA-Geigy - CRANSTON RI	GROUND ELEV. AND DATUM: 24.60	PROJECT NO.: 87x4660
DRILLING AGENCY: EAST Coast Drilling	TOP OF RISER ELEV.: 24.02	DATE FINISHED: 7/27/90
METHOD OF DRILLING: 4" HSA ID	TOP OF PROTECTIVE CASING ELEV.: 24.60	INSPECTOR: Kevin Murphy
DIA. OF BOREHOLE: 6.5	GROUND WATER ELEV.: 10.50	CHECKED BY: CT
DEPTH OF BOREHOLE: 22		

GENERALIZED SOIL DESCRIPTION



L_1 0.6
L_2 1
L_3 13
L_4 1
L_5 5
L_6 3
L_7 N/A
L_8 N/A
L_9 22
L_{10} 22

DIA. OF RISER PIPE: 1 1/4"

TYPE OF PIPE: GA lvanized Steel

STEEL PROTECTIVE CASING

TYPE OF ANNULAR SEAL: Cement-Bentonite Grout

TYPE OF SEAL: Bentonite Pellets

TYPE AND DIA. OF SCREEN: 1 1/4" Stainless Steel 7.5 slot

TYPE OF FILTER PACK: Natural SAND Pack

TYPE OF BOTTOM SEAL: N/A

BOTTOM OF BOREHOLE: 22

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Piezometer installed in the Residental area was augered down to 15 feet then pushed down the rest of the distance. Grouting cement was fortified with Bentonite powder, the screen is a 3 foot long stainless steel screen with 7.5 slotting. The Sand pack around this is the natural Sand in place.

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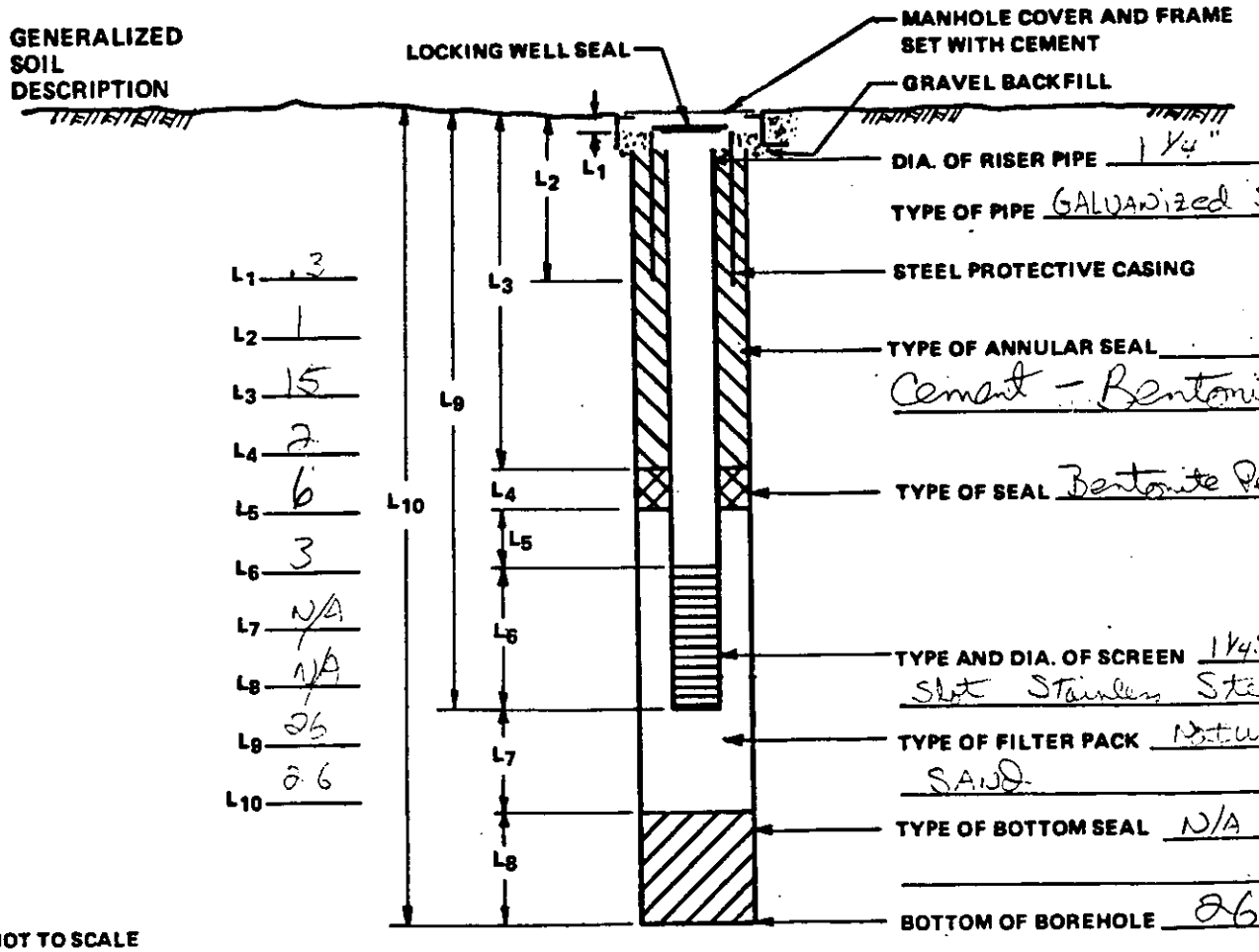
CONSTRUCTION OF FLUSHMOUNT MONITORING WELL NO. P20D

PROJECT AND LOCATION: CIBA - GEIGY CRANSTON RI	GROUND ELEV. AND DATUM: 24.61	PROJECT NO.: 87X4660
DRILLING AGENCY: EAST Coast Drilling	TOP OF RISER ELEV.: 24.30	DATE FINISHED: 7/27/90
METHOD OF DRILLING: 4" HSA ID	TOP OF PROTECTIVE CASING ELEV.: 24.61	INSPECTOR: Kevin Murphy
DIA. OF BOREHOLE: 6.5	GROUND WATER ELEV.: 10.26	CHECKED BY: CT
DEPTH OF BOREHOLE: 26		

GENERALIZED SOIL DESCRIPTION



L1 .3
L2 1
L3 15
L4 2
L5 6
L6 3
L7 N/A
L8 N/A
L9 26
L10 8.6

DIA. OF RISER PIPE 1 1/4"

TYPE OF PIPE GALVANIZED STEEL

STEEL PROTECTIVE CASING

TYPE OF ANNULAR SEAL Cement - Bentonite

TYPE OF SEAL Bentonite Pellets

TYPE AND DIA. OF SCREEN 1 1/4" 7.5 Slot Stainless Steel

TYPE OF FILTER PACK Natural SAND

TYPE OF BOTTOM SEAL N/A

BOTTOM OF BOREHOLE 26

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Augered down 17 feet then pushed the well point the rest of the way. Soil description were taken from the cuttings. A 2 foot bentonite seal was put in (18-16) then a cement-bentonite annular seal was put in upto ground level. The installation was completed with the installation of a flush mounted protective casing.

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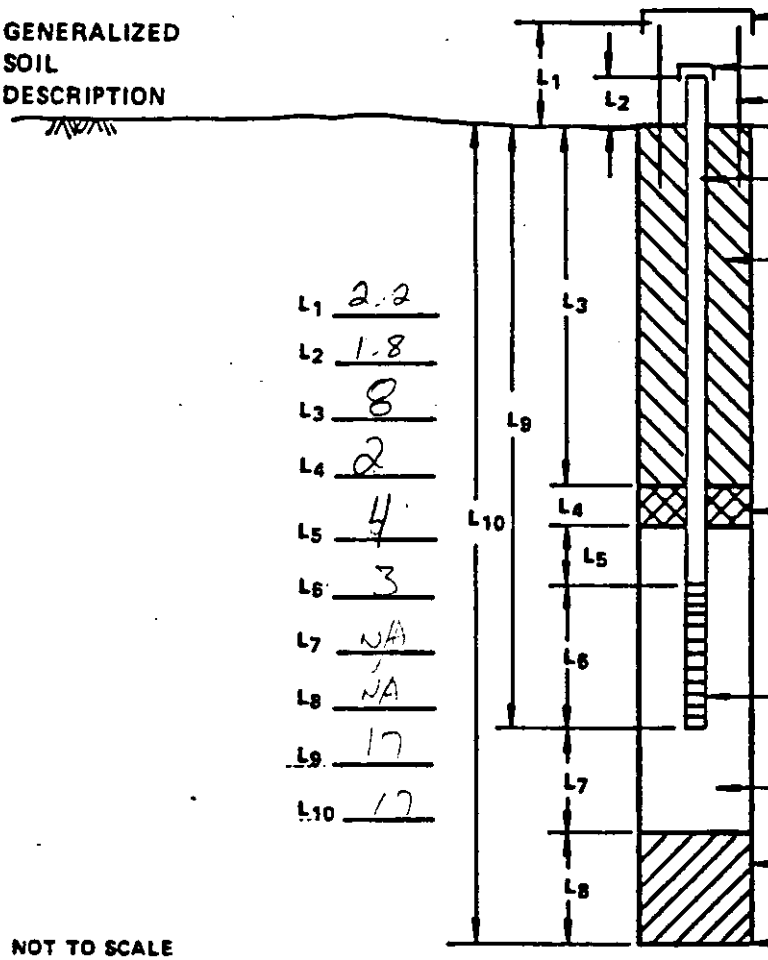
CONSTRUCTION OF MONITORING WELL NO. D215

PROJECT AND LOCATION: CIBA-GEIGY CRANSTON, RI	GROUND ELEV. AND DATUM: 15.19	PROJECT NO.: 87X4550
DRILLING AGENCY: EAST COAST DRILLING	TOP OF RISER ELEV.: 16.96	DATE FINISHED: 7/24/90
METHOD OF DRILLING: 4" HSA ID	TOP OF PROTECTIVE CASING ELEV.: 17.35	INSPECTOR: K. M.
DIA. OF BOREHOLE: 6.5	GROUND WATER ELEV.: 6.98	CHECKED BY: LT
DEPTH OF BOREHOLE: 17		

GENERALIZED SOIL DESCRIPTION



L1 2.2
L2 1.8
L3 8
L4 2
L5 4
L6 3
L7 NA
L8 NA
L9 17
L10 17

STEEL COVER AND LOCK

VENTED CAP

STEEL PROTECTIVE CASING

DIA. OF RISER PIPE 1¼"

TYPE OF PIPE Galvanized Steel

TYPE OF ANNULAR SEAL Cement-Bentonite

TYPE OF SEAL Bentonite Pellets

TYPE AND DIA. OF SCREEN 1¼" Stainless Steel 7.5 Slot

TYPE OF FILTER PACK Natural Sand

TYPE OF BOTTOM SEAL NA

BOTTOM OF BOREHOLE 17

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS Augered down to 15 feet then pushed well point the rest of the way. Auger cuttings were used for soil description. A 2 foot bentonite seal was installed from 9-7 feet with a cement-bentonite annular seal from 7 feet to the ground surface. A stick up protective casing completed the well installation.

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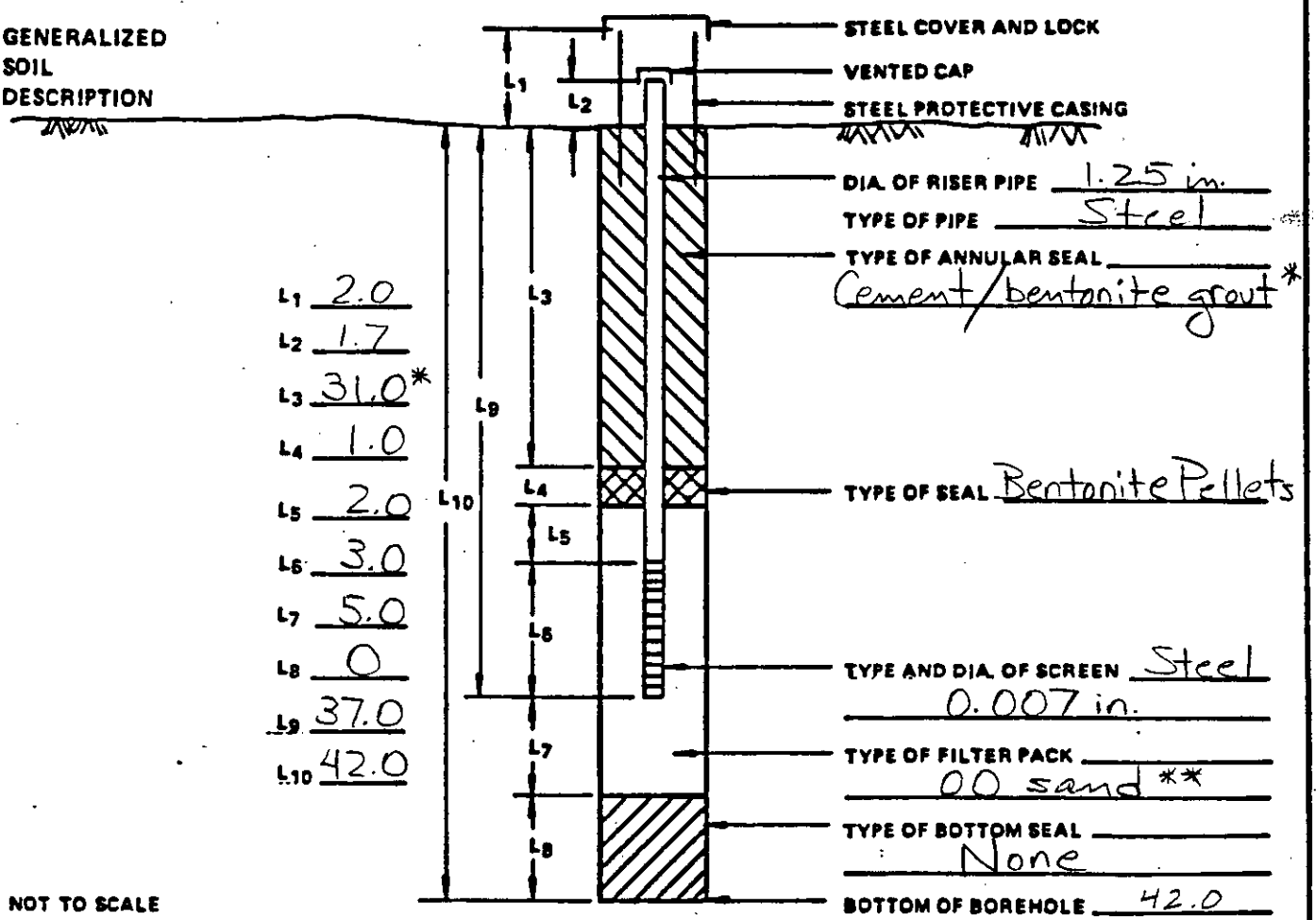
CONSTRUCTION OF MONITORING WELL NO. P21D

PROJECT AND LOCATION: Ciba Geigy Cranston, R.I.	GROUND ELEV. AND DATUM: 14.04	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	TOP OF RISER ELEV.: 15.75	DATE FINISHED: 7/23/90
METHOD OF DRILLING: Rotary	TOP OF PROTECTIVE CASING ELEV.: 16.11	INSPECTOR: M. Craig
DIA. OF BOREHOLE: 6.25 in.	GROUND WATER ELEV.: 10.28	CHECKED BY: CT
DEPTH OF BOREHOLE: 42.0 ft		

GENERALIZED SOIL DESCRIPTION



NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Borehole was augered to 40 ft. Split spoon sample was collected from 40 to 42 ft to confirm presence of till. Grout consisted of 3 bags cement and 1/3 bucket powdered bentonite in 50 gallons, was tremied in.
* borehole caved in on pellets from -31 to -23 ft
** running sand filled the bottom of the borehole to -36 ft.

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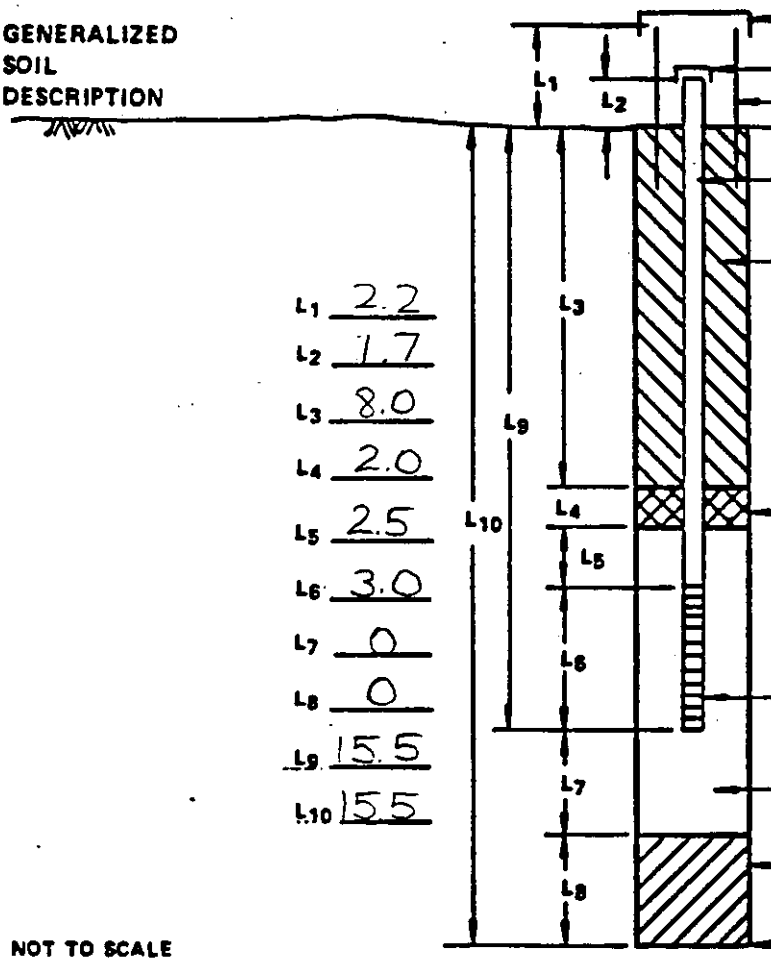
CONSTRUCTION OF MONITORING WELL NO. P22S

PROJECT AND LOCATION: Ciba Geigy Cranston, R.I.	GROUND ELEV. AND DATUM: 15.19	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	TOP OF RISER ELEV.: 16.96	DATE FINISHED: 7/25/90
METHOD OF DRILLING: Rotary	TOP OF PROTECTIVE CASING ELEV.: 17.35	INSPECTOR: M. Craig
DIA. OF BOREHOLE: 6.25 in.	GROUND WATER ELEV.: 9.52	CHECKED BY: CT
DEPTH OF BOREHOLE: 12.5 ft		

GENERALIZED SOIL DESCRIPTION



STEEL COVER AND LOCK

VENTED CAP

STEEL PROTECTIVE CASING

DIA. OF RISER PIPE 1.25 in.

TYPE OF PIPE Steel

TYPE OF ANNULAR SEAL Cement/bentonite grout

TYPE OF SEAL Bentonite Pellets

TYPE AND DIA. OF SCREEN Stainless Steel 0.007 in. slot 1.25 in.

TYPE OF FILTER PACK 00 sand

TYPE OF BOTTOM SEAL None

BOTTOM OF BOREHOLE 15.5

L_1	2.2
L_2	1.7
L_3	8.0
L_4	2.0
L_5	2.5
L_6	3.0
L_7	0
L_8	0
L_9	15.5
L_{10}	15.5

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Augered to -12.5 ft then drove piezometer to -15.5 ft. Native sand rose inside of augers to -11.5 ft before sand pack was added to -10.0 ft. Fifty gallons of grout mixed (3 bags cement, 1/3 bucket bentonite). Twenty five gallons used to grout P22S, remainder used to top off P22D. Grout was tremied in place.

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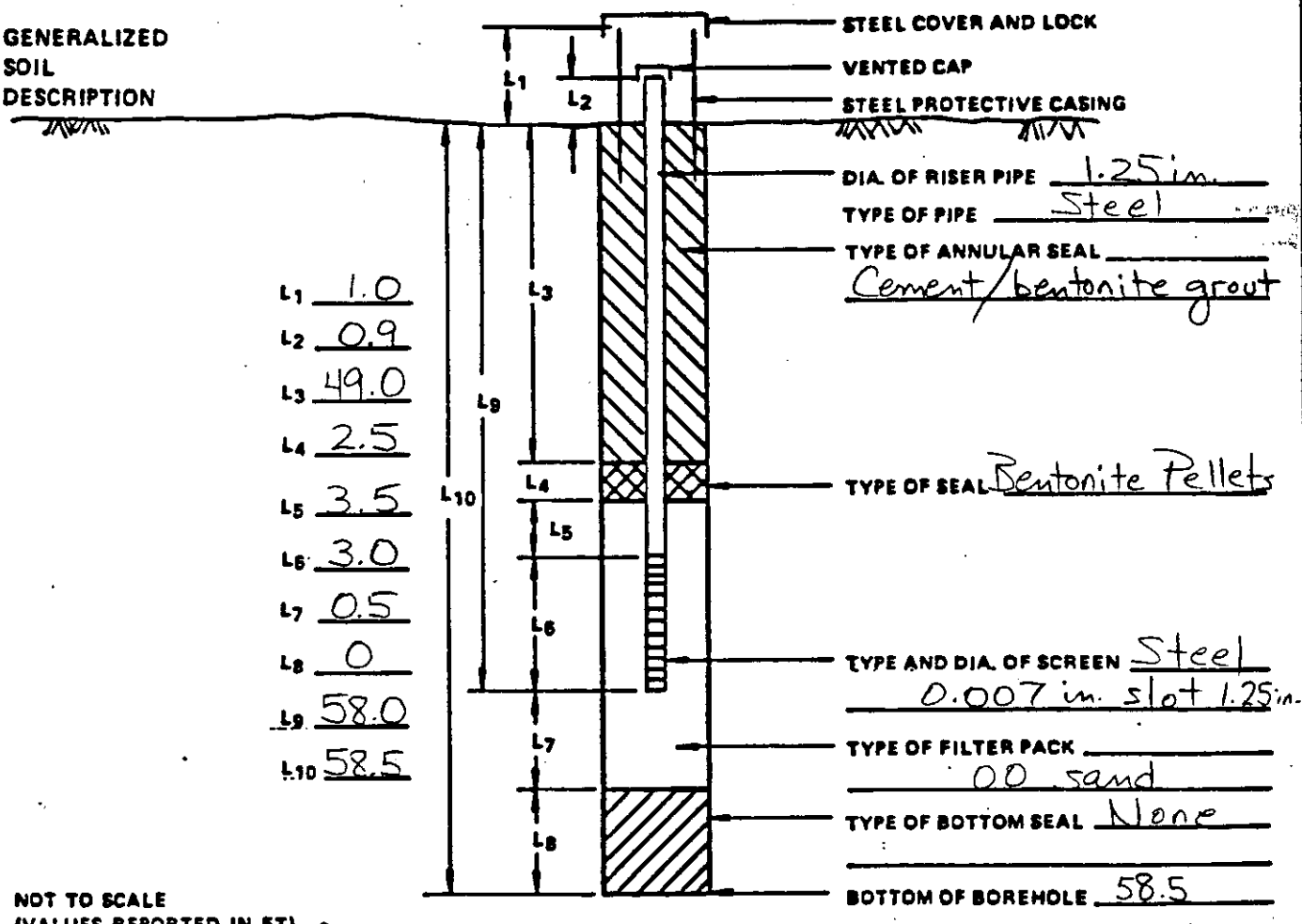
CONSTRUCTION OF MONITORING WELL NO. P22D

PROJECT AND LOCATION: Ciba Geigy Cranston, R.I.	GROUND ELEV. AND DATUM: 16.60	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	TOP OF RISER ELEV.: 17.57	DATE FINISHED: 7/25/90
METHOD OF DRILLING: Rotary	TOP OF PROTECTIVE CASING ELEV.: 17.60	INSPECTOR: M. Craig
DIA. OF BOREHOLE: 6.25 in.	GROUND WATER ELEV.: 11.45	CHECKED BY: CT
DEPTH OF BOREHOLE: 58.5 ft		

GENERALIZED SOIL DESCRIPTION



L_1	1.0
L_2	0.9
L_3	49.0
L_4	2.5
L_5	3.5
L_6	3.0
L_7	0.5
L_8	0
L_9	58.0
L_{10}	58.5

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Augered to 58 feet. Fifty gallons of grout contained 3 bags cement and 1/3 bucket powdered bentonite. Grout was tremied into place to a depth of 49 feet

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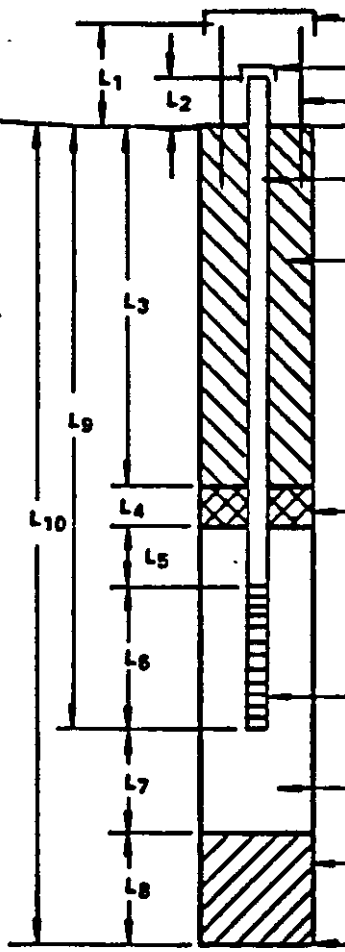
CONSTRUCTION OF MONITORING WELL NO. RW 1

PROJECT AND LOCATION: CIBA - GEIGY CRANSTON, RI	GROUND ELEV. AND DATUM: 14.94	PROJECT NO.: 87X4660
DRILLING AGENCY: EAST COAST DRILLING	TOP OF RISER ELEV.: 16.52	DATE FINISHED: 8-7-90
METHOD OF DRILLING: AIR Rotary	TOP OF PROTECTIVE CASING ELEV.: 17.50	INSPECTOR: Kevin Murphy
DIA. OF BOREHOLE: 7 7/8	GROUND WATER ELEV.: 9.08	CHECKED BY: CT
DEPTH OF BOREHOLE: 93		

GENERALIZED SOIL DESCRIPTION



STEEL COVER AND LOCK

VENTED CAP

STEEL PROTECTIVE CASING

DIA. OF RISER PIPE: 4 inch ID

TYPE OF PIPE: Stainless Steel

TYPE OF ANNULAR SEAL: Cement - Bentonite Mixture

TYPE OF SEAL: Bentonite Slurry

TYPE AND DIA. OF SCREEN: 10 slot 4 inch Stainless Steel w/2ft sump

TYPE OF FILTER PACK: #2 morie sand

TYPE OF BOTTOM SEAL: N/A

BOTTOM OF BOREHOLE: 93

L1	2.6
L2	1.6
L3	76
L4	2
L5	3
L6	12
L7	N/A
L8	N/A
L9	93
L10	93

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Drilled 7 7/8 borehole using air rotary method to a depth of 68 feet. Driller advanced 8 inch steel casing into competent bedrock (at 68 feet). Flowing sands were encountered in fractured bedrock at about 71 feet. A second 6 inch casing was installed past the fracture zone to a depth of 80 feet. Borehole was reamed out to a depth of 92 feet with a 5 7/8" bit. Installation of

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CONSTRUCTION OF MONITORING WELL NO. RW1

REMARKS Monitoring well included: blank tail piece (92-90), 10 slot screen (90-80), and riser pipe (80-70). well installation included a filter pack of #2 morie sand (92-80), secondary filter sand "00" (80-78), bentonite seals (78-77) and a cement-bentonite annular seal from 77 to ground surface. A stick up protective casing completed installation.

Development started with a water level of 43.71 feet. Pumping rate ranged from 7 gpm at the start to around 5 gpm after pumping had begun. Temperature stabilized at around 17 degrees centigrad with a specific conductivity of 113.5 uMHOS with turbidity of 15-24. The well was pumped dry 3 times and was allowed to recharge to 50% each time. Recovery was at a rate of 10 feet per 20 minutes. Development was with dedicated hose and a submersible pump.

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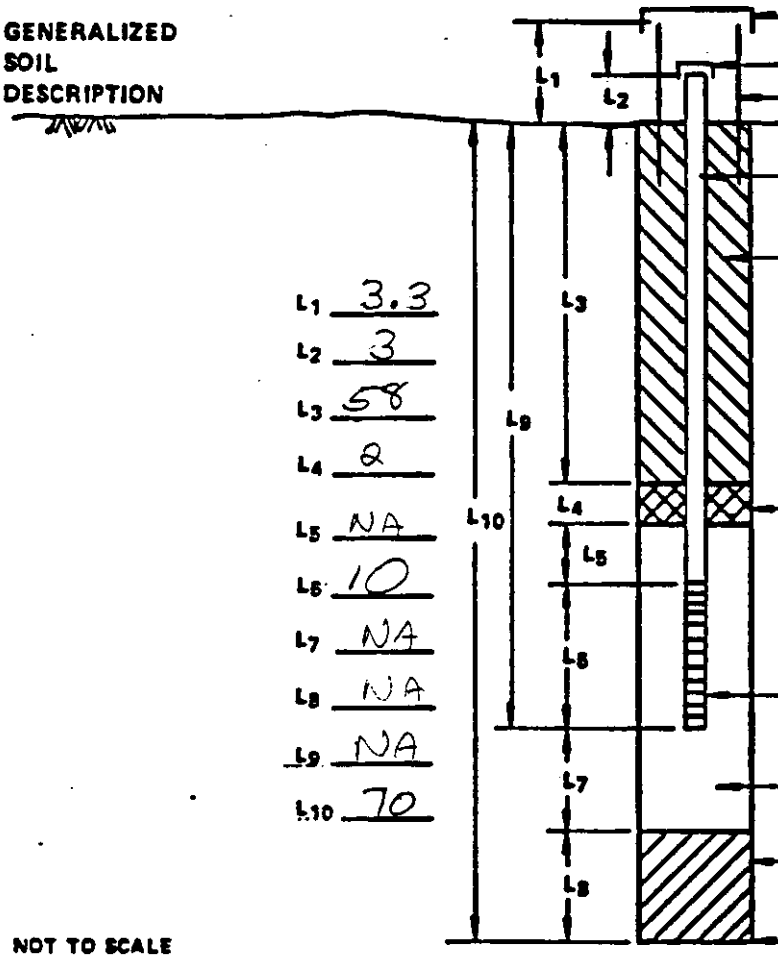
CONSTRUCTION OF MONITORING WELL NO. RW-2

PROJECT AND LOCATION: CIBA-GEIGY CRANSTON, RI	GROUND ELEV. AND DATUM: 14.87	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	TOP OF RISER ELEV.: 17.89	DATE FINISHED: 8/1/90
METHOD OF DRILLING: Air Rotary	TOP OF PROTECTIVE CASING ELEV.: 18.21	INSPECTOR: Kevin Murphy
DIA. OF BOREHOLE: 7 7/8	GROUND WATER ELEV.: 11.62	CHECKED BY: JDA
DEPTH OF BOREHOLE: 70		

GENERALIZED SOIL DESCRIPTION



L1 3.3
L2 3
L3 58
L4 2
L5 NA
L6 10
L7 NA
L8 NA
L9 NA
L10 70

STEEL COVER AND LOCK

VENTED CAP

STEEL PROTECTIVE CASING

DIA. OF RISER PIPE 4 inch ID

TYPE OF PIPE Stainless Steel

TYPE OF ANNULAR SEAL Cement-Bentonite mix

TYPE OF SEAL Bentonite Pellets

TYPE AND DIA. OF SCREEN N/A

TYPE OF FILTER PACK N/A

TYPE OF BOTTOM SEAL N/A

BOTTOM OF BOREHOLE 70

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS Drilled 8 inch hole using Air rotary method to 60 feet then installed a 8 inch casing into bedrock. Inside the 8 inch casing a 4 inch stainless steel riser pipe was installed. A two (2) foot Bentonite seal was installed; then a cement-bentonite mixture was placed in the annulus up to ground surface. A 3 7/8 bit was used to punch down the next 10 feet

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CONSTRUCTION OF MONITORING WELL NO. RW2

REMARKS for the open bedrock well. To finish the installation a protective casing was placed on top, then cemented into place.

Well development started at 11:26 on 3 August 1990. The turbidity meter was still inoperative, because the meter would not hold a charge. Specific conductivity and temperature settled at 190 µMHOS and 18.5°C. The water cleared substantially and pumping was terminated after 20 min 11:46 The well recovered to 7 feet after 14 minutes. The total drawdown was 18 feet.

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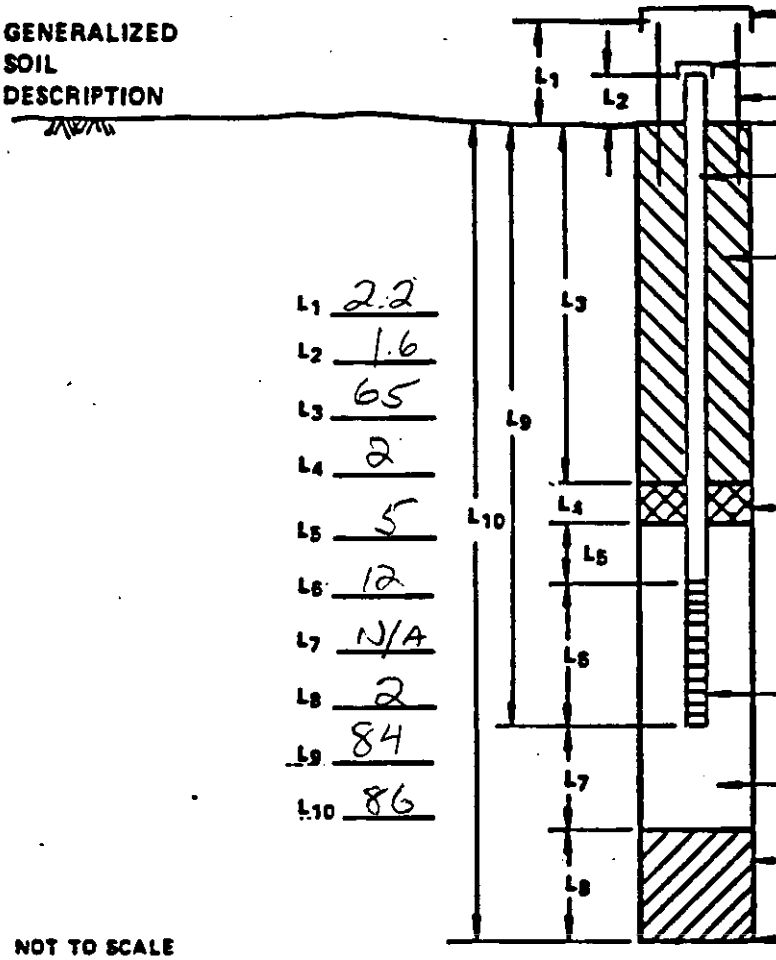
CONSTRUCTION OF MONITORING WELL NO. RW3

PROJECT AND LOCATION: CIBA-GEIGY CRANSTON, RI	GROUND ELEV. AND DATUM: 11.87	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	TOP OF RISER ELEV.: 13.49	DATE FINISHED: 8-1-90
METHOD OF DRILLING: Air Rotary	TOP OF PROTECTIVE CASING ELEV.: 14.03	INSPECTOR: Kevin Muffley
DIA. OF BOREHOLE: 7 7/8 inch	GROUND WATER ELEV.: 10.63	CHECKED BY:
DEPTH OF BOREHOLE: 84		

GENERALIZED SOIL DESCRIPTION



STEEL COVER AND LOCK

VENTED CAP

STEEL PROTECTIVE CASING

DIA. OF RISER PIPE: 4 inch ID

TYPE OF PIPE: Stainless Steel

TYPE OF ANNULAR SEAL: Cement - Bentonite mixture

TYPE OF SEAL: Bentonite Pellets

TYPE AND DIA. OF SCREEN: 10 slot 4 inch Stainless Steel w/ 1/2 foot sump

TYPE OF FILTER PACK: #2 Morie SAND

TYPE OF BOTTOM SEAL: Bentonite (2 foot of Pellets)

BOTTOM OF BOREHOLE: 86 feet

L1	2.2
L2	1.6
L3	65
L4	2
L5	5
L6	12
L7	N/A
L8	2
L9	84
L10	86

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Drilled using Air Rotary method to 68 feet then advanced steel casing into competent bedrock. During coring a super hard substance was encountered about 77 feet. Air rotary drilled to 86 feet. A 2 foot bentonite seal was put on the bottom of the hole (86-84 feet); sump (84-82 feet); 10 slot screen (82-72 feet); and riser from (72-1 foot above ground surface).

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CONSTRUCTION OF MONITORING WELL NO. RW3

REMARKS Well installation included a filter pack of #2 morie sand (84-67 feet), with a (1 foot) "00" sand layer encompasing the top foot; a bentonite layer of 2 feet (67-65 feet) and a bentonite-cement annular seal to ground surface. A stick-up protective casing completed the installation

Development of well was started on 8-6-90 water level before Development was 2.85 the following in the Development data

Time	Temp °C	Specific conductivity	
16:05	15.5	115	
16:10	16.0	112	
16:15	19.0	116	well went dry 16:20
17:00	19.0	116	
17:05	20.0	115	
17:10	19.0	116	well went dry 17:11
17:45	22.0	120	
17:50	19.0	117	
17:55	19.0	116	well went dry 1758

Recovery was approximately 20 feet per half hour Well was developed using a submersible pump and dedicated poly tubing. Well was allowed to recovery to 50% recovery each time it went dry

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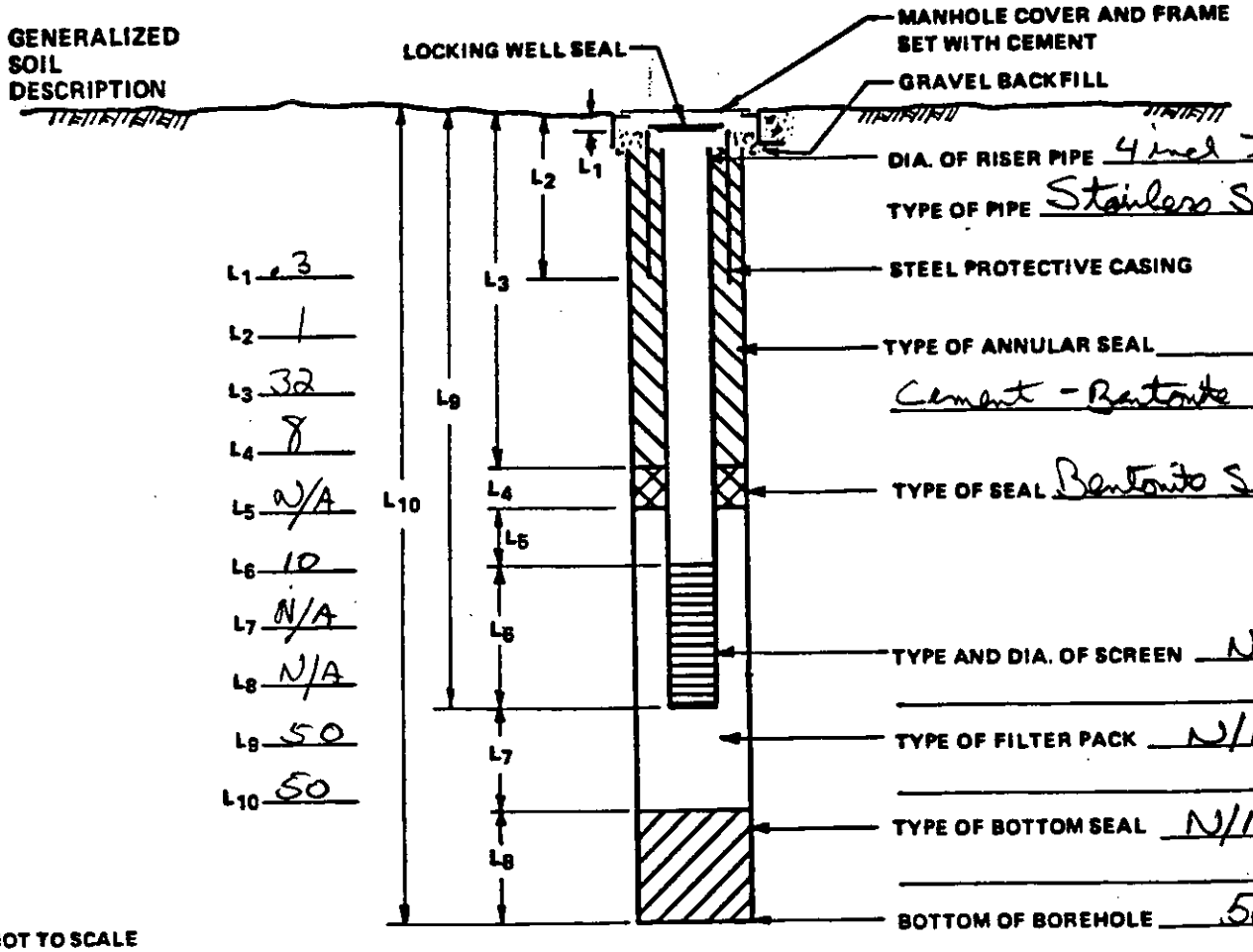
CONSTRUCTION OF FLUSHMOUNT MONITORING WELL NO. RW4

PROJECT AND LOCATION: CIBA-GEIGY, Canton RI	GROUND ELEV. AND DATUM: 24.08	PROJECT NO.: 87X4660
DRILLING AGENCY: East Coast Drilling	TOP OF RISER ELEV.: 23.79	DATE FINISHED: 8/2/90
METHOD OF DRILLING: Air Rotary	TOP OF PROTECTIVE CASING ELEV.: 24.08	INSPECTOR: Kevin Murphy
DIA. OF BOREHOLE: 7 7/8	GROUND WATER ELEV.: 10.29	CHECKED BY:
DEPTH OF BOREHOLE: 50		

GENERALIZED SOIL DESCRIPTION



L1 .3
L2 1
L3 32
L4 8
L5 N/A
L6 10
L7 N/A
L8 N/A
L9 50
L10 50

DIA. OF RISER PIPE: 4 inch ID

TYPE OF PIPE: Stainless Steel

STEEL PROTECTIVE CASING

TYPE OF ANNULAR SEAL: Cement - Bentonite mix

TYPE OF SEAL: Bentonite Slurry

TYPE AND DIA. OF SCREEN: N/A

TYPE OF FILTER PACK: N/A

TYPE OF BOTTOM SEAL: N/A

BOTTOM OF BOREHOLE: 50

NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: Drilled 8 inch hole using Air rotary method to 40 feet. Then a 8 inch casing was set in competent bedrock. Flowing sands were encountered at 32-37 feet, to avoid this the casing was put at 40 feet. Riser was put in to within (.3) of the ground surface, installation was (8) feet (40-32) of bentonite slurry followed by 32 feet of cement -

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CONSTRUCTION OF MONITORING WELL NO. RW 4

REMARKS Bentonite mixture. The next day the hole was reamed an additional 10 feet, to 50 feet. A flush mount protective casing finished off the installation.

Development of RW4 was on 3 August, 1990. after a 10 gpm start the rate fell to 7 gpm after 15 minutes. Specific conductivity stabilized at 195 µM HOS and the Temperature stabilized at 19.5 °C also the water level stabilized at 40.5 feet. The water was very turbid at the start and cleared only slightly after a half hour. After one hour the well development was stopped and the well recovered in 26 minutes

Appendix G

APPENDIX G

SLUG TEST DATA

APPENDIX G
SLUG TEST DATA

G.1 SLUG TEST OVERVIEW

Cooper, et. al (1967), Bouwer and Rice (1976), Black (1978), Kipp (1985), and Pandit and Miner (1986) have described slug test data reduction techniques. In general, Cooper's technique is designed for a confined aquifer response. Bouwer and Rice's technique, supplemented by Black's, is designed for an unconfined aquifer response; Kipp's technique is designed for a confined aquifer response with inertial effects.

Kipp's technique requires reliable initial (early) measurements. Since our initial measurements were not completely reliable, we did not use Kipp's technique.

Spiked data -- measurements of instantaneous head change (H_o) being greater than predicted -- often result from surging a well in a low permeability formation during insertion of the slug. Pandit and Miner offer guidelines for handling spiked data recorded at the beginning of the test; their methods were used to correct for error in our initial measurements.

Since both the Cooper technique and the Bouwer technique predict similar aquifer responses, Black (1978) recommends using both techniques for any slug test. Black recognizes the underlying conceptual differences of the two methods, but states:

> "In view of their similarity it is most useful to construct both type curves on the same diagram... in order to see which gives the best fit to the results obtained regardless of any preconception about the aquifer conditions... It is very seldom that the result from a properly conducted slug test can not be obtained. If not, then either the conditions do not satisfy closely enough those involved in the analytical assumptions

or some more practical deviation such as water running slowly down to the water level has occurred."

G.2 HEAD VERSUS TIME PLOTS

Slug tests measure head as a function of time. Linear regression was used on the head versus time plots to estimate H_o -- the maximum water level displacement caused by insertion or removal of a slug. Typically, the initial measurements will exceed the predicted maximum displacement values for two reasons: 1) the formation is so tight that the well casing is surged, or 2) the transducer is too close to the area where the slug is inserted and the pressure exerted by introducing the slug exceeds the transducer's maximum pressure rating. In our slug tests, both conditions were observed. In addition, because of the small well diameters (1.25 inches), the transducer itself was moved during insertion and removal of the slug. This transducer movement produced an additional offset in the head data.

H_o can be estimated using linear regression; a "theoretical" value for H_o can be calculated by dividing the volume of the slug by the volume of one foot of casing (assuming no surge or loss to the aquifer). When estimating H_o using linear regression, the line can be fit in two ways. The first method uses a maximum number of recovery points where the y-intercept must be less than the initial head value (non surge). The second method uses a minimum number of data points to maximize the estimated H_o value (under the condition that estimated H_o will not exceed the theoretical value for H_o). Bouwer and Rice (1976) discuss using linear regression for determining H_o.

For both linear regression methods, the time scale is corrected so that the start time (t_o) produces monotonic data (Pandit and Miner, 1986). This correction is made by subtracting the time interval during which a water level surge or pressure-induced transducer error has occurred. In our slug tests the data logger usually was activated after the slug was inserted; therefore, adjustments in the time axis also were required and were made following the guidelines presented by Pandit and Miner (1986).

Calculating a theoretical value for H_o assumes both that the system is confined and that the aquifer is responding to the slug the instant the slug enters the water column (whether or not the water column is oscillating in the riser). Finally, note that slug tests may not be valid when permeabilities are greater than 10^{-2} cm/sec for two reasons. First, the test duration may be too short -- water levels may return to static levels before a sufficient number of readings can be made. Second, data error may be greater due to well losses into the permeable material.

G.3 SLUG TEST DATA

Results of the slug tests were summarized in Table 4-3. All data reductions were performed initially using SLUGT, a proprietary computer program (Woodward-Clyde Consultants, unpublished). SLUGT generates head versus time plots, allows on-screen manual curve matching for the Cooper technique, and produces a statistical analysis of the curve fits. Curve matching using the Black curve also was performed (not using SLUGT). All of the input parameters and resulting curves have been included in this appendix review. Also included are the type curves by Black (1978) for the Bouwer and Rice technique, as well as the type curves for the Cooper technique.

G.4 REFERENCES

Black, J.H. (1978), "The Use of the Slug Test in Groundwater Investigations", Water Services, March.

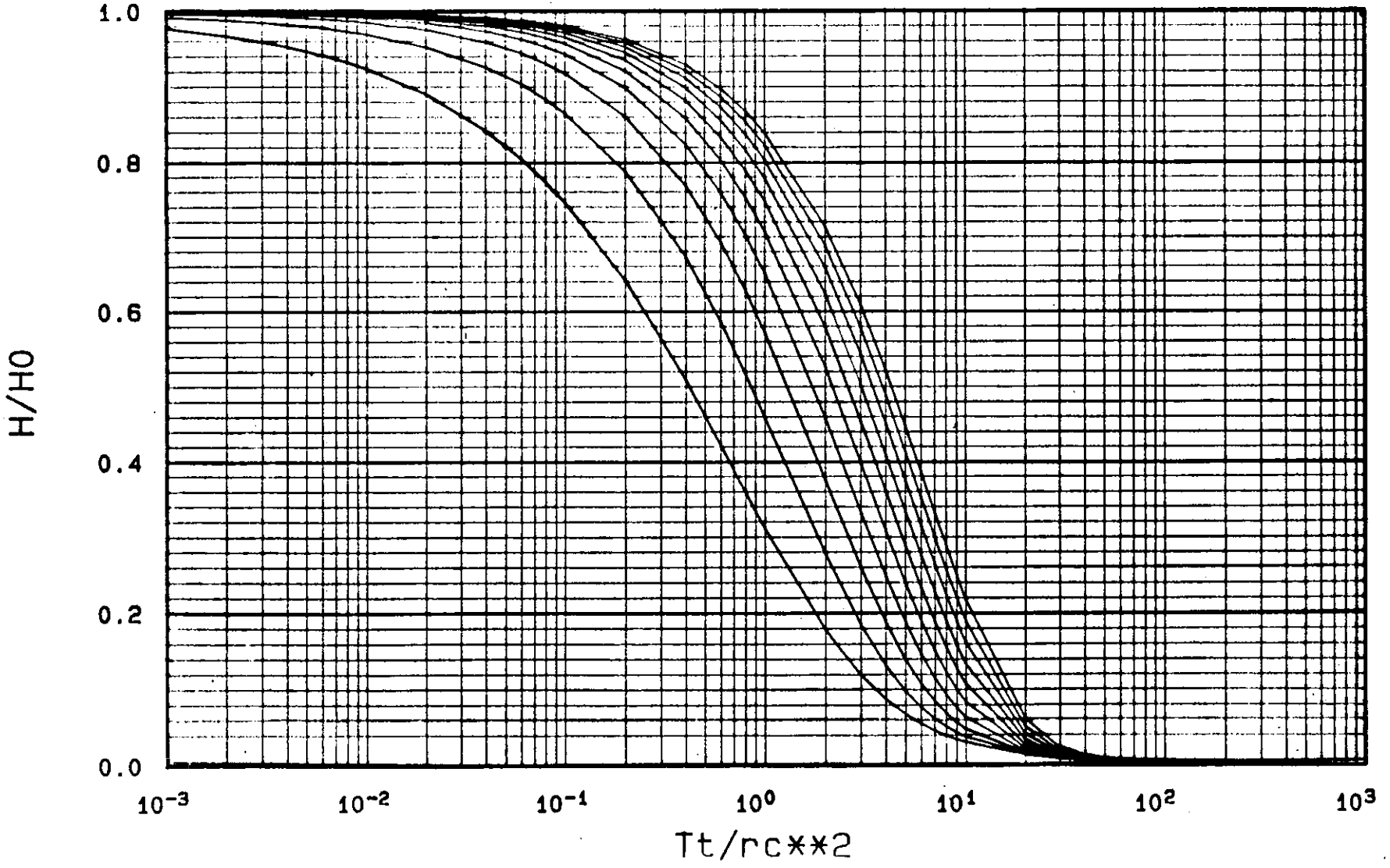
Bouwer, H. and R.C. Rice (1976), "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely/Partially Penetrating Wells", Water Resources Research, V. 12, No. 3.

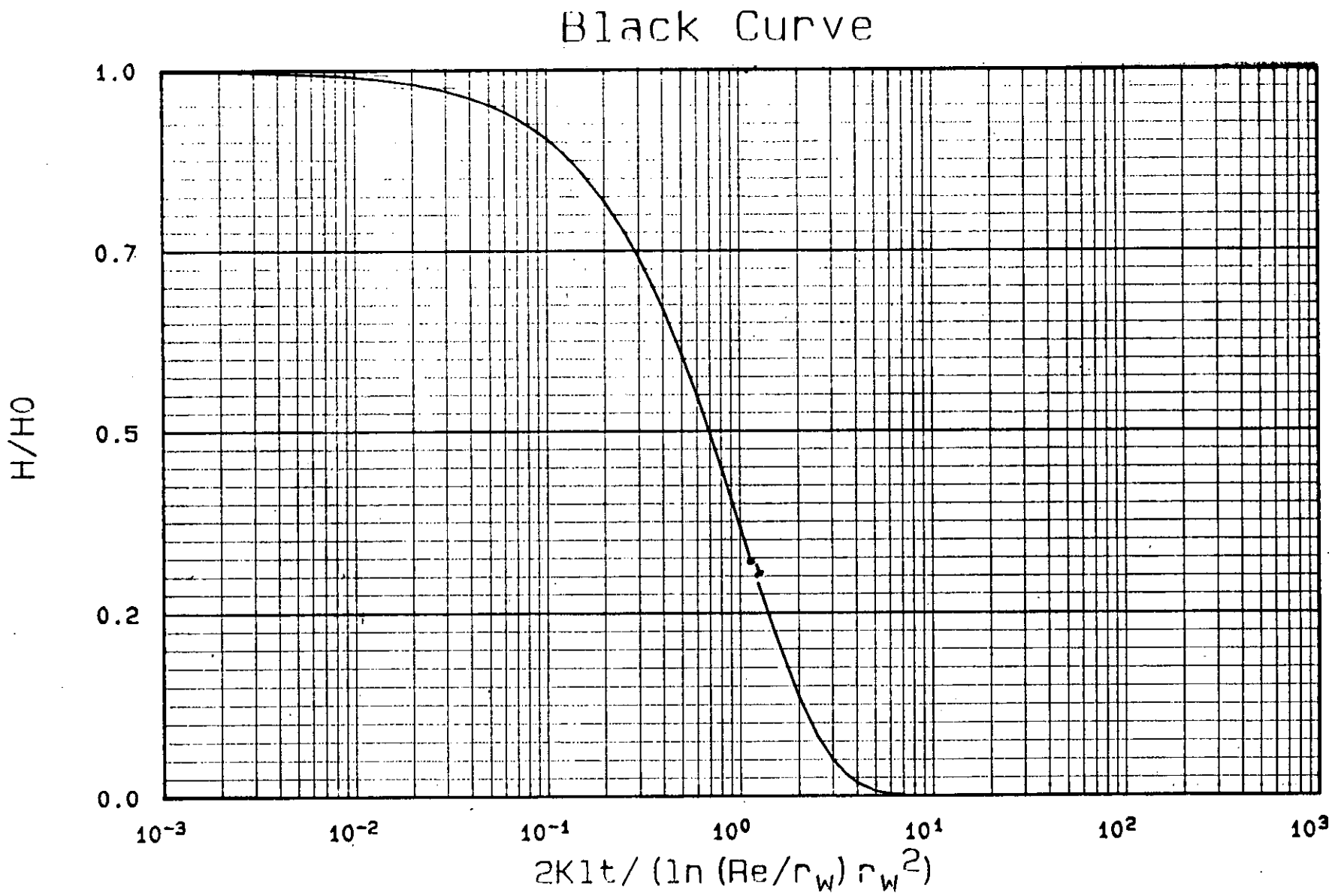
Cooper, H.H., Jr., J.D. Bredehoeft and I.S. Papadopulos (1967), "Response of a Finite-Diameter Well to an Instantaneous Charge of Water", Water Resources Research, Vol. 3, p. 263-269.

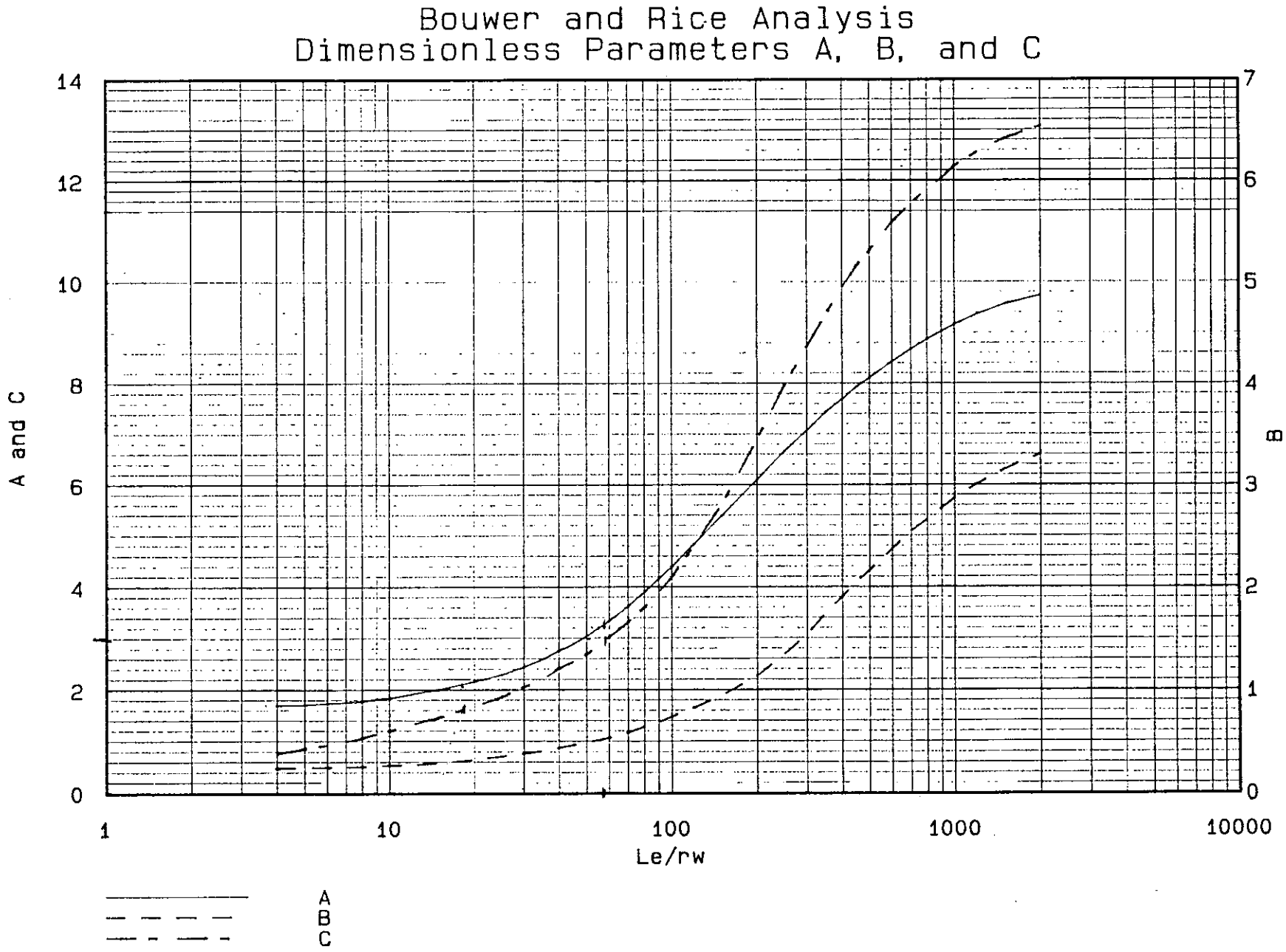
Kipp, K.L. (1985), "Type Curve Analysis of Inertial Effects in the Response of a Well to a Slug Test", Water Resources Research, V. 21, No. 9.

Pandit, N.S. and R.F. Miner (1986), "Interpretation of Slug Test Data", Groundwater, Volume 24, No. 6.

Slug Test Analysis
Type Curves For Instantaneous Charge




Black Curve
1.0
0.7
0.5
0.2
0.0
H/H0
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
$2Klt/(\ln(Re/r_w)r_w^2)$


Bouwer and Rice Analysis
Dimensionless Parameters A, B, and C
A and C
B
Le/rw
0
2
4
6
8
10
12
14
0
1
2
3
4
5
6
7
1
10
100
1000
10000
A
B
C

PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/21/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: P15S (FALLING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 1.25 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 8.70 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 8.70 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 14

TIME (SECOND)	HEAD (FEET)
0.20	1.310
1.20	1.090
2.20	0.880
3.20	0.710
4.20	0.580
5.20	0.470
6.20	0.370
7.20	0.290
8.20	0.230
9.20	0.180
10.20	0.140
11.20	0.100
12.20	0.050
13.20	0.020

H0 CALCULATED BASED ON FIRST 10 DATA POINTS

COMPUTED VALUE FOR H0 (FEET) 1.4268

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 1.43 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.379E-03	1.585E-04	1.572E-04	4.121E-03	2.875640	9.34	0.00
1.000E-02	1.000E-02	1.925E-03	2.213E-04	5.367E-04	4.360E-03	1.985739	6.24	3.10
1.000E-03	1.000E-03	2.474E-03	2.844E-04	9.339E-04	4.600E-03	1.481710	4.66	1.58
1.000E-04	1.000E-04	3.041E-03	3.496E-04	1.328E-03	4.901E-03	1.174709	3.90	0.76
1.000E-05	1.000E-05	3.604E-03	4.143E-04	1.713E-03	5.281E-03	0.990009	3.61	0.29
1.000E-06	1.000E-06	4.170E-03	4.793E-04	2.092E-03	5.761E-03	0.879780	3.57	0.04
1.000E-07	1.000E-07	4.742E-03	5.450E-04	2.465E-03	6.227E-03	0.793300	3.52	0.05
1.000E-08	1.000E-08	5.252E-03	6.037E-04	2.783E-03	6.526E-03	0.712801	3.40	0.12
1.000E-09	1.000E-09	5.827E-03	6.697E-04	3.150E-03	6.953E-03	0.652794	3.30	0.10
1.000E-10	1.000E-10	6.464E-03	7.430E-04	3.564E-03	7.487E-03	0.606878	3.21	0.10

MANUAL CURVE MATCH RESULTS:

NO ACCEPTABLE MATCH, UNCONFINED CONDITIONS IMPLIED

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 3.76E-04 FT/SECOND = 1.15E-02 CM/SECOND

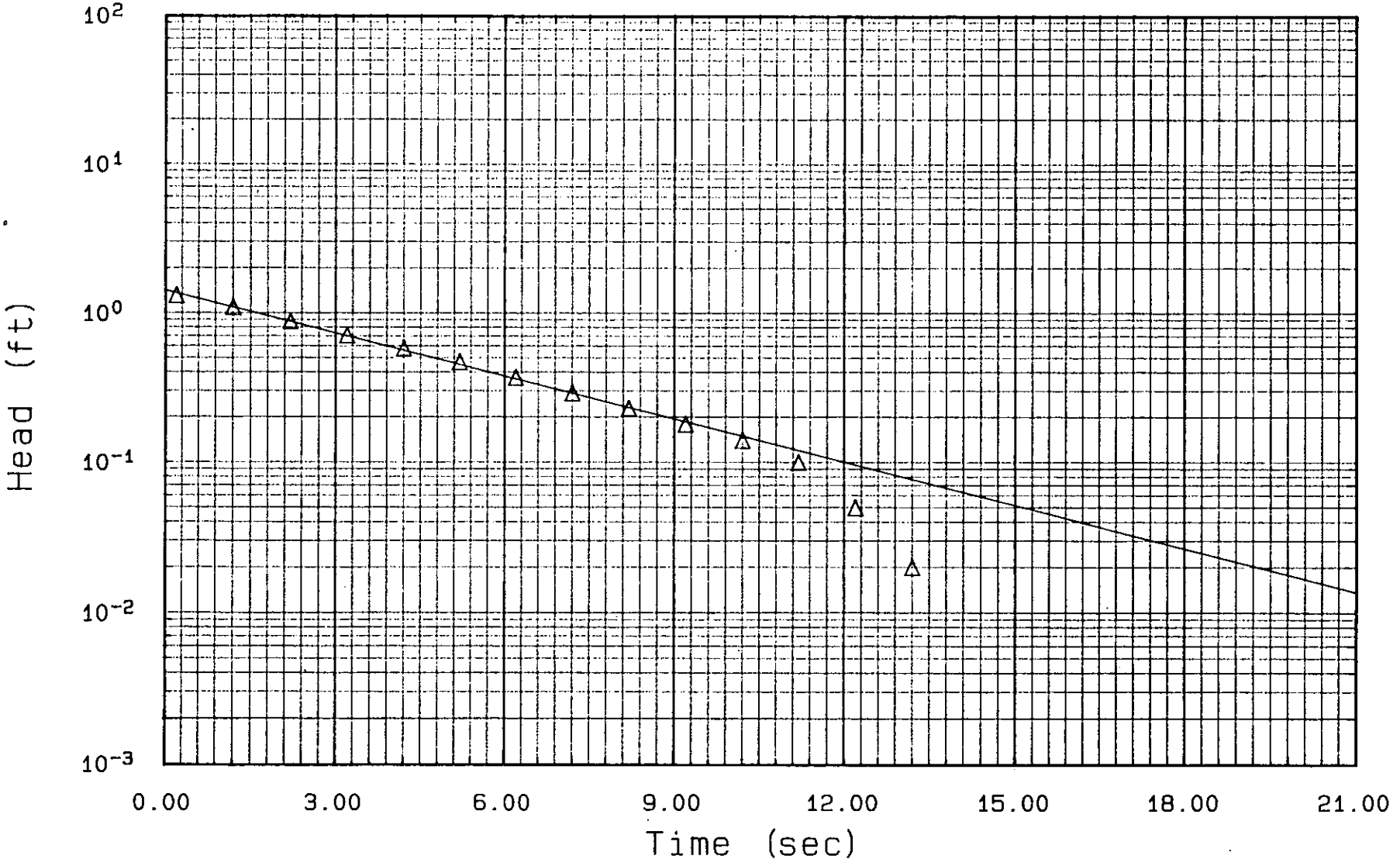
TRANSMISSIVITY = 3.27E-03 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

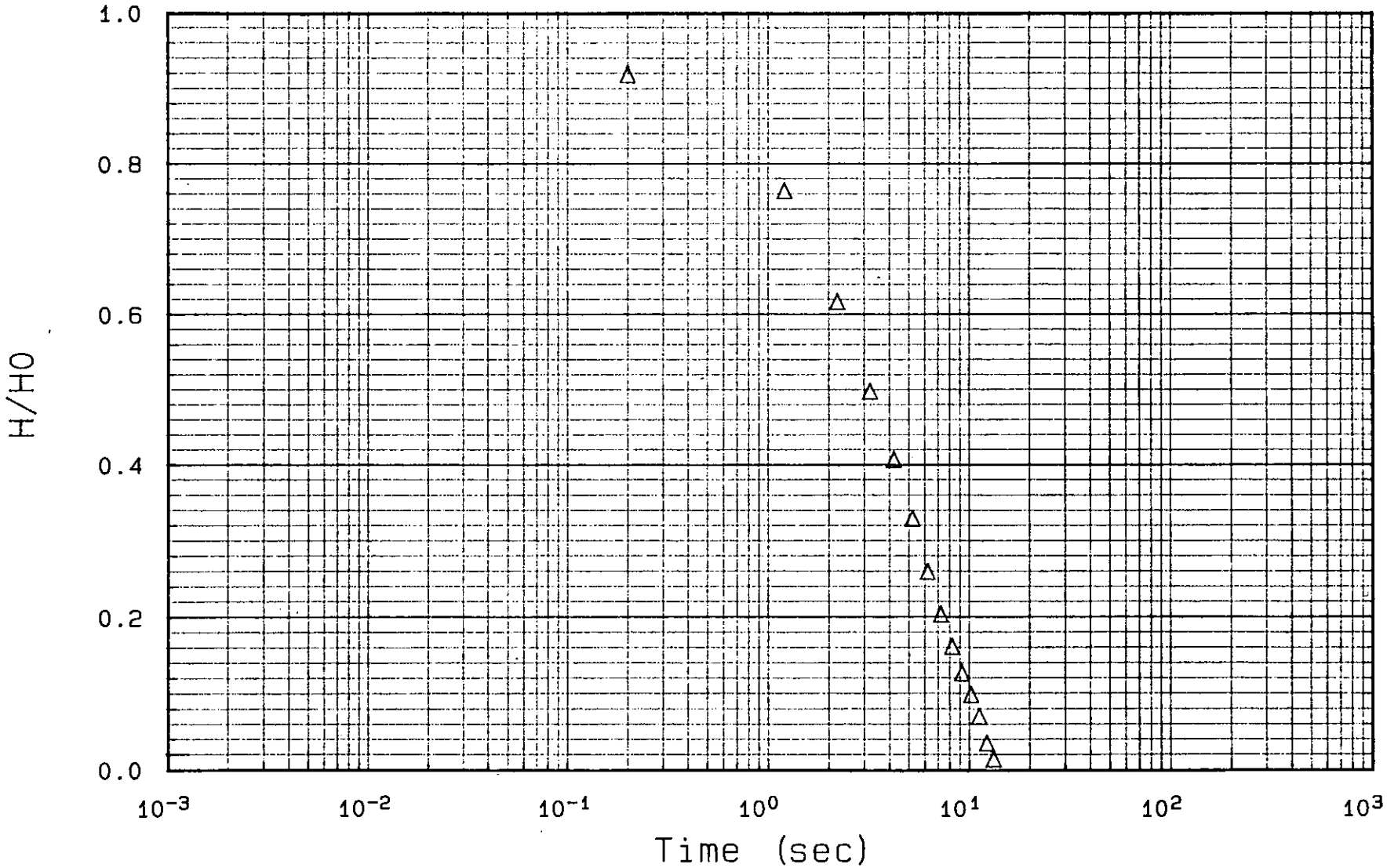
PERMEABILITY = 3.76E-04 FT/SECOND = 1.15E-02 CM/SECOND

TRANSMISSIVITY = 3.27E-03 FT**2/SECOND

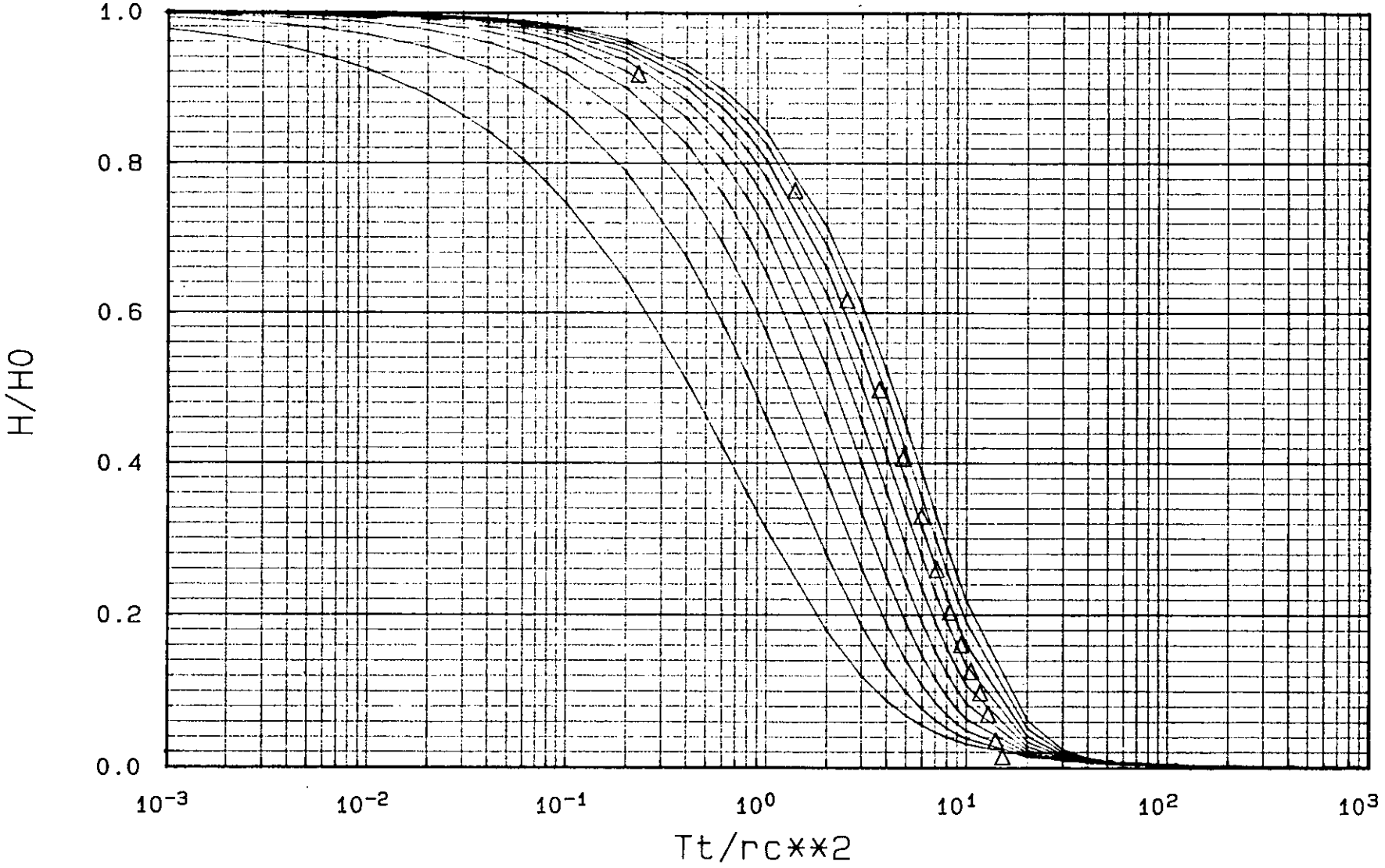
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P15S (FALLING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P15S (FALLING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P15S (FALLING) Date 8/21/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/21/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: P15SA (RISING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 1.25 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 8.70 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 8.70 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 20

TIME (SECOND)	HEAD (FEET)
0.20	2.160
1.20	1.740
2.20	1.340
3.20	1.060
4.20	0.870
5.20	0.700
6.20	0.560
7.20	0.450
8.20	0.370
9.20	0.310
10.20	0.260
11.20	0.220
12.20	0.180
13.20	0.160
14.20	0.140
15.20	0.120
16.20	0.110
17.20	0.100
18.20	0.100
23.20	0.080

HO CALCULATED BASED ON FIRST 11 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 2.1664

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 2.17 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.856E-03	2.134E-04	1.759E-06	1.106E-03	0.594954	9.18	0.00
1.000E-02	1.000E-02	2.661E-03	3.059E-04	5.059E-06	1.365E-03	0.510923	10.11	-0.93
1.000E-03	1.000E-03	3.435E-03	3.948E-04	1.300E-05	1.636E-03	0.472470	10.85	-0.74
1.000E-04	1.000E-04	4.063E-03	4.670E-04	3.514E-05	1.906E-03	0.460524	11.57	-0.73
1.000E-05	1.000E-05	4.646E-03	5.340E-04	6.184E-05	2.219E-03	0.464423	11.95	-0.38
1.000E-06	1.000E-06	5.329E-03	6.126E-04	8.862E-05	2.497E-03	0.451969	11.91	0.04
1.000E-07	1.000E-07	6.159E-03	7.079E-04	1.142E-04	2.848E-03	0.443925	11.71	0.20
1.000E-08	1.000E-08	7.033E-03	8.083E-04	1.390E-04	3.197E-03	0.434875	11.66	0.06
1.000E-09	1.000E-09	7.865E-03	9.041E-04	1.646E-04	3.541E-03	0.429286	11.71	-0.06
1.000E-10	1.000E-10	8.631E-03	9.920E-04	1.894E-04	3.842E-03	0.423195	11.79	-0.08

MANUAL CURVE MATCH RESULTS:

NO ACCEPTABLE MATCH, UNCONFINED CONDITIONS IMPLIED

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 3.63E-04 FT/SECOND = 1.11E-02 CM/SECOND

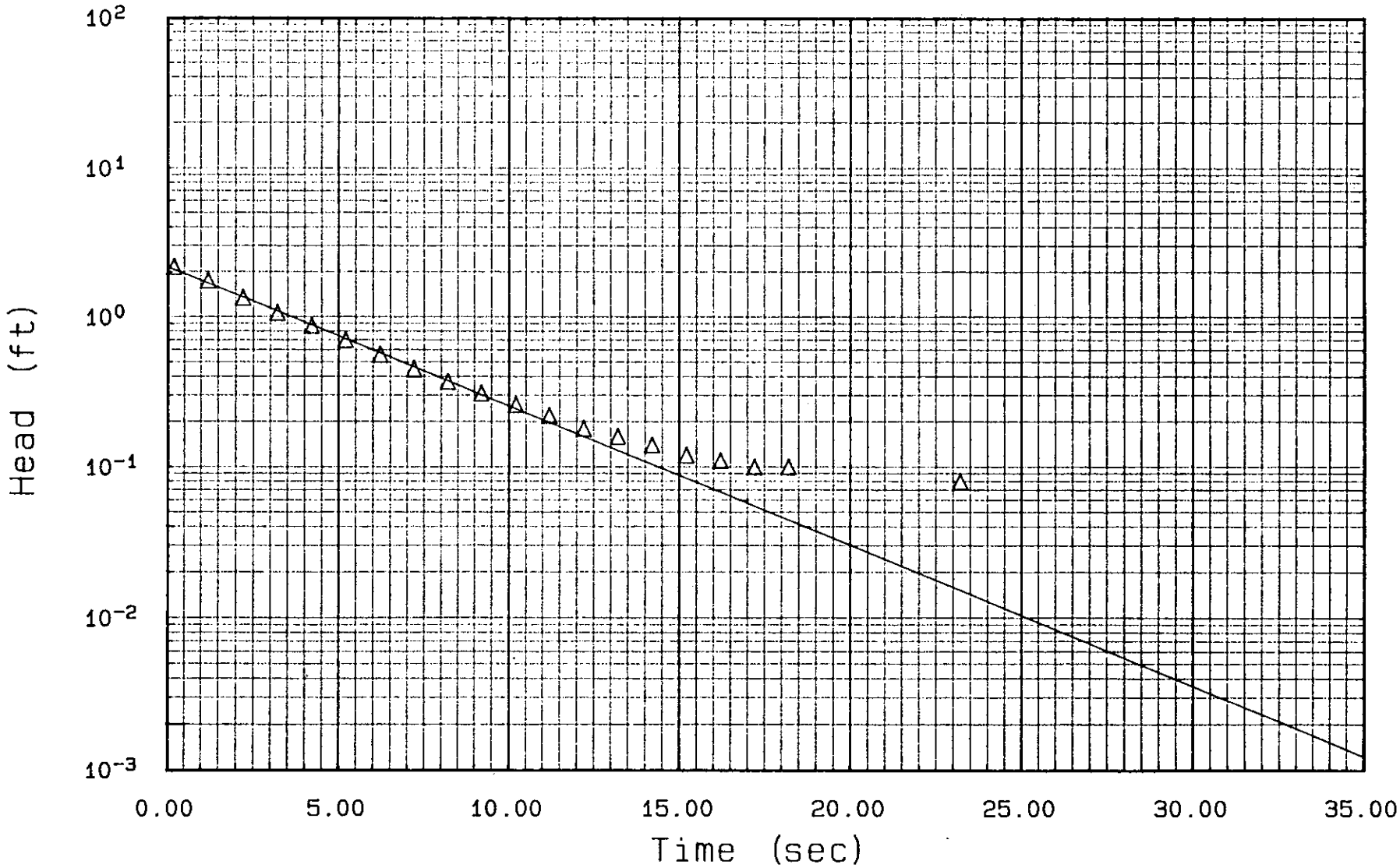
TRANSMISSIVITY = 3.16E-03 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

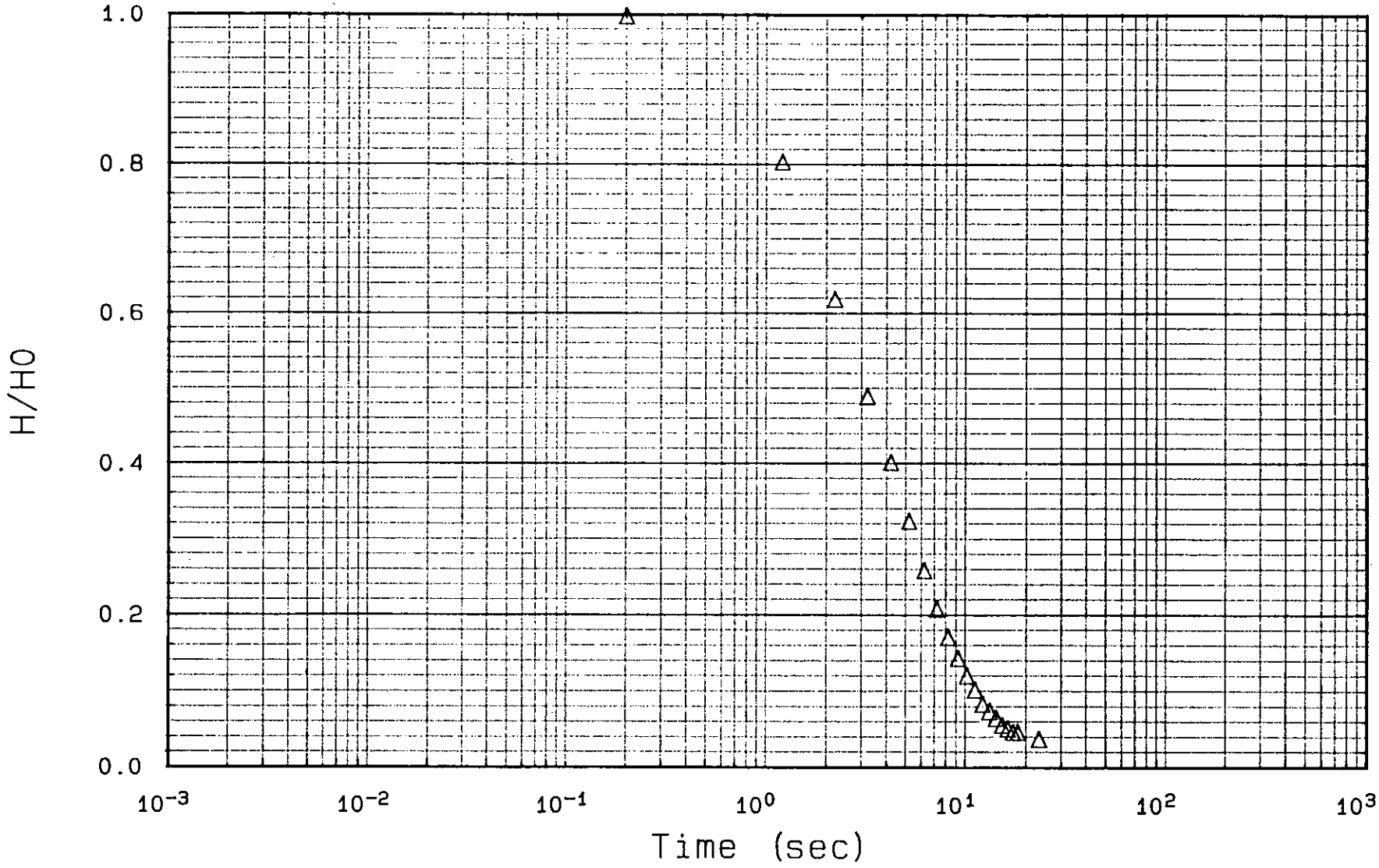
PERMEABILITY = 3.63E-04 FT/SECOND = 1.11E-02 CM/SECOND

TRANSMISSIVITY = 3.16E-03 FT**2/SECOND

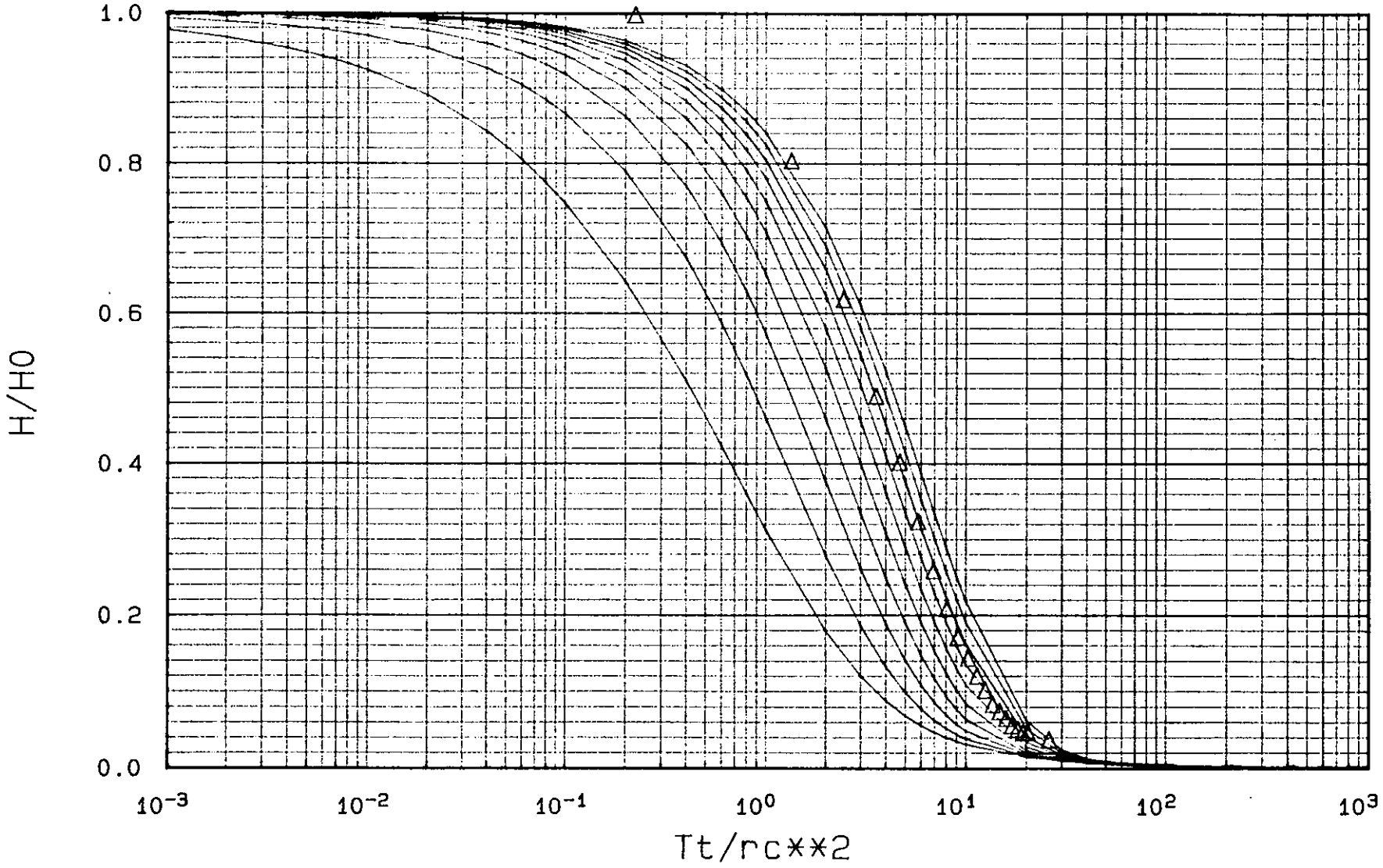
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P15SA (RISING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P15SA (RISING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P15SA (RISING) Date 8/21/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/21/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: P16S (FALLING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 1.25 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 8.60 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 8.60 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 11

TIME (SECOND)	HEAD (FEET)
0.50	1.051
1.00	0.918
1.50	0.795
2.00	0.684
2.50	0.589
3.00	0.507
3.50	0.434
4.50	0.305
5.50	0.207
6.50	0.150
7.50	0.061

HO CALCULATED BASED ON FIRST 10 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 1.3015

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 1.30 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.017E-03	1.182E-04	3.179E-04	2.503E-03	2.148891	3.77	0.00
1.000E-02	1.000E-02	1.695E-03	1.970E-04	9.212E-04	3.095E-03	1.282693	2.17	1.60
1.000E-03	1.000E-03	2.393E-03	2.782E-04	1.543E-03	3.620E-03	0.868329	1.42	0.75
1.000E-04	1.000E-04	3.000E-03	3.488E-04	2.126E-03	3.386E-03	0.420118	0.64	0.78
1.000E-05	1.000E-05	3.641E-03	4.233E-04	2.685E-03	3.561E-03	0.240754	0.54	0.10
1.000E-06	1.000E-06	4.347E-03	5.054E-04	3.239E-03	4.402E-03	0.267685	0.58	-0.04
1.000E-07	1.000E-07	5.023E-03	5.841E-04	3.785E-03	5.527E-03	0.346715	0.75	-0.17
1.000E-08	1.000E-08	5.695E-03	6.623E-04	4.143E-03	6.627E-03	0.436069	0.92	-0.17
1.000E-09	1.000E-09	6.291E-03	7.316E-04	4.648E-03	7.067E-03	0.384460	0.90	0.02
1.000E-10	1.000E-10	6.910E-03	8.034E-04	5.339E-03	7.286E-03	0.281764	0.82	0.08

MANUAL CURVE MATCH RESULTS:

NO ACCEPTABLE MATCH, UNCONFINED CONDITIONS IMPLIED

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 5.56E-04 FT/SECOND = 1.69E-02 CM/SECOND

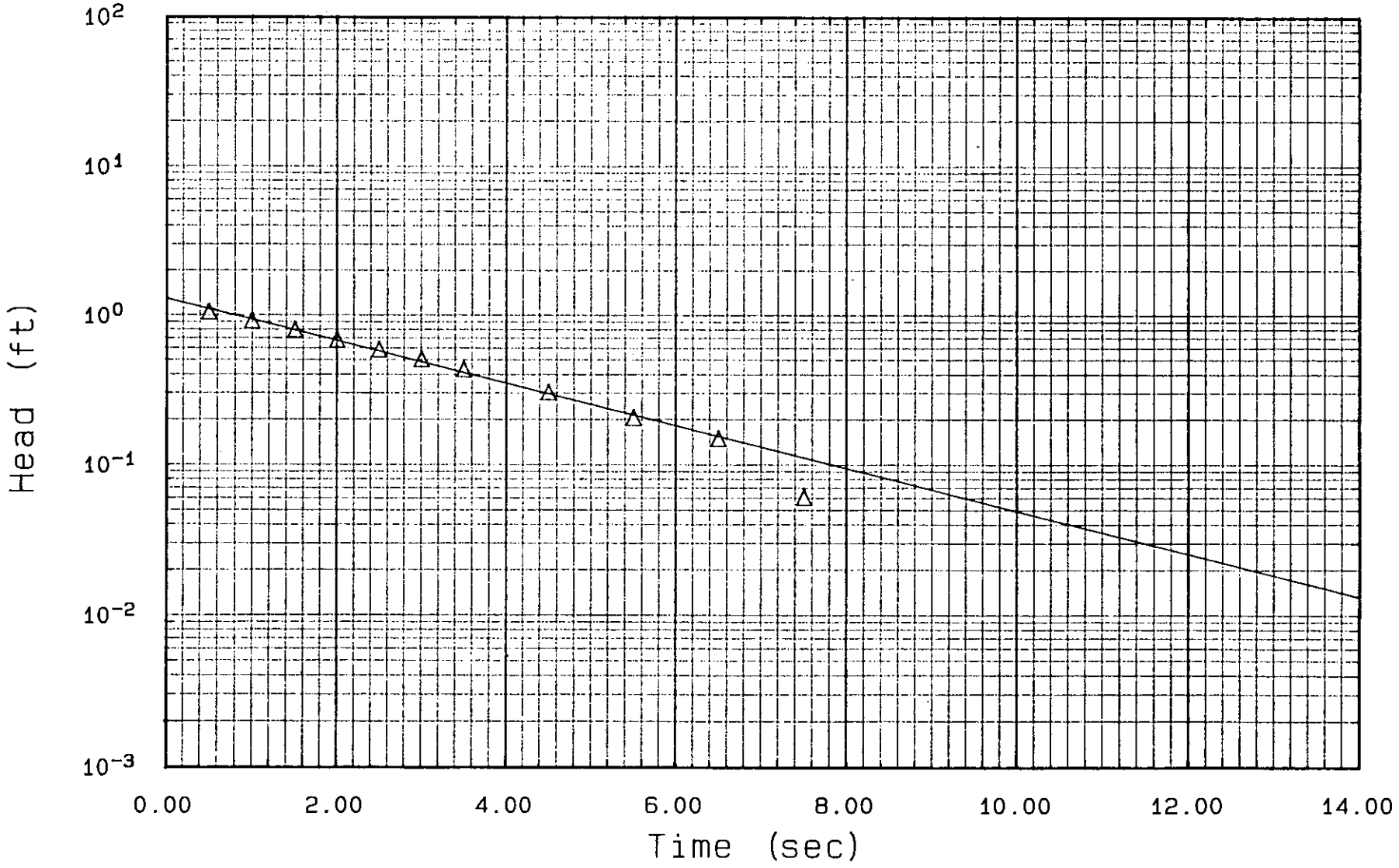
TRANSMISSIVITY = 4.78E-03 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

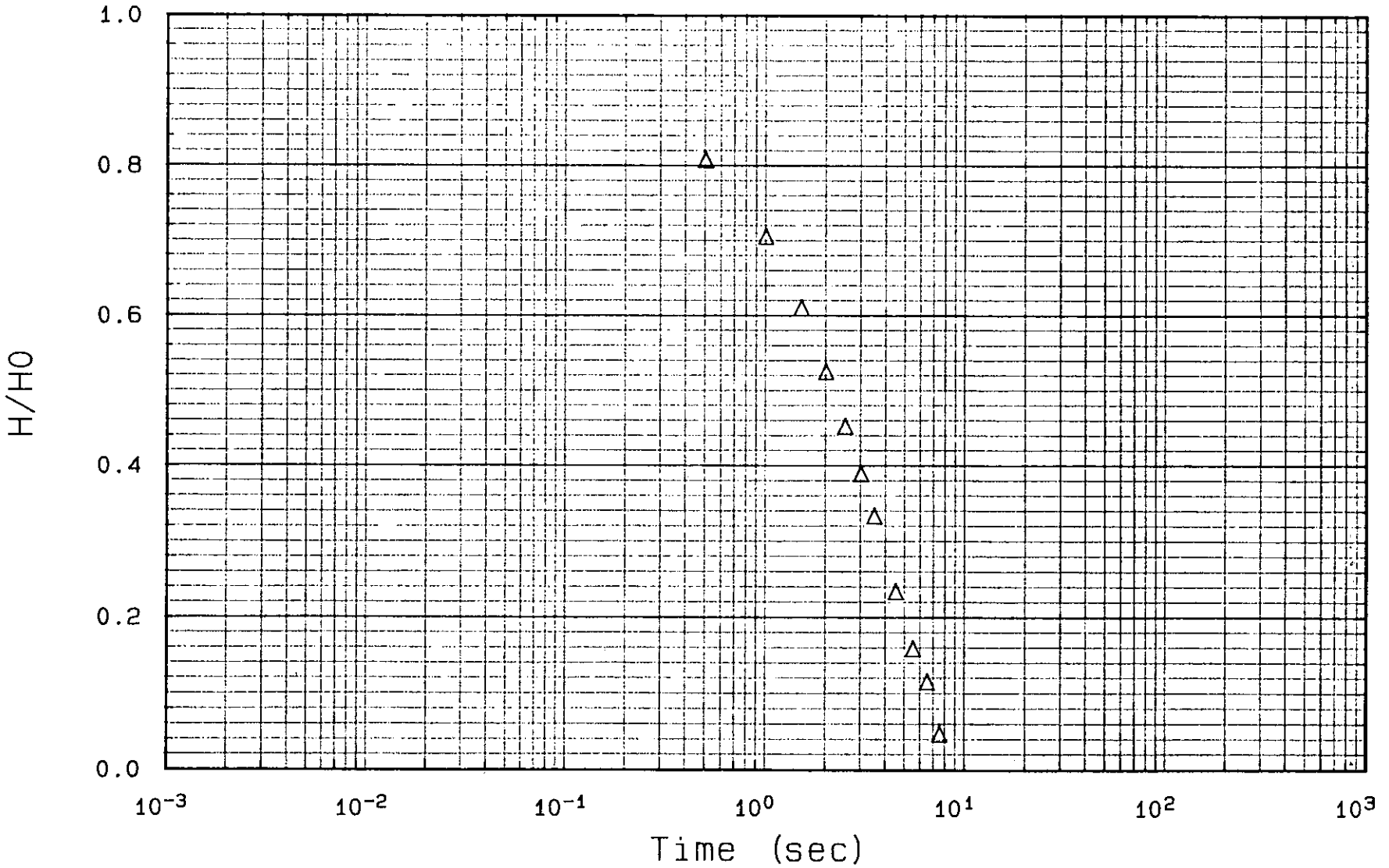
PERMEABILITY = 5.56E-04 FT/SECOND = 1.69E-02 CM/SECOND

TRANSMISSIVITY = 4.78E-03 FT**2/SECOND

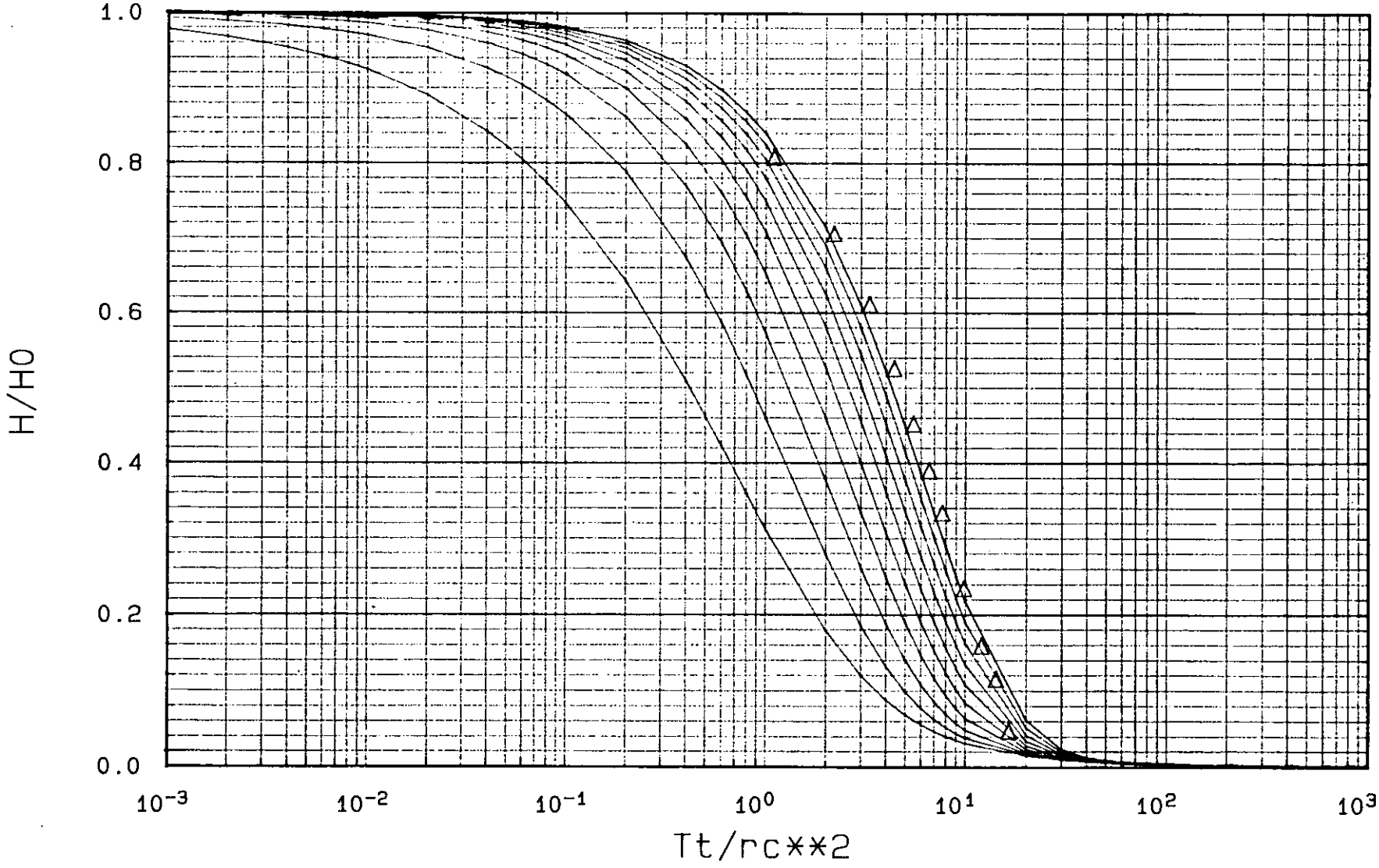
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P16S (FALLING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P16S (FALLING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P16S (FALLING) Date 8/21/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

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PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/21/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: P16SA (RISING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 1.25 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 8.60 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 8.60 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 25

TIME (SECOND)	HEAD (FEET)
0.50	2.020
1.00	1.812
1.50	1.562
2.00	1.360
2.50	1.198
3.00	1.028
3.50	1.337
4.00	0.990
4.50	0.775
5.50	0.591
6.50	0.474
7.50	0.373
8.50	0.297
9.50	0.241
10.50	0.184
11.50	0.117
12.50	0.092
13.50	0.070
14.50	0.054
15.50	0.041
16.50	0.032
17.50	0.026
18.50	0.019
19.50	0.016
24.50	0.003

HO CALCULATED BASED ON FIRST 20 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 2.4946

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 2.49 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	8.043E-03	9.352E-04	2.703E-04	2.224E-02	2.731473	19.73	0.00
1.000E-02	1.000E-02	9.256E-03	1.076E-03	5.700E-04	2.221E-02	2.337680	17.40	2.33
1.000E-03	1.000E-03	1.048E-02	1.219E-03	8.874E-04	2.246E-02	2.058353	16.05	1.35
1.000E-04	1.000E-04	1.164E-02	1.353E-03	1.213E-03	2.244E-02	1.824388	15.07	0.97
1.000E-05	1.000E-05	1.285E-02	1.495E-03	1.503E-03	2.242E-02	1.627212	14.35	0.72
1.000E-06	1.000E-06	1.409E-02	1.639E-03	1.805E-03	2.240E-02	1.461452	13.86	0.50
1.000E-07	1.000E-07	1.530E-02	1.780E-03	2.097E-03	2.236E-02	1.324206	13.54	0.32
1.000E-08	1.000E-08	1.653E-02	1.922E-03	2.390E-03	2.200E-02	1.186285	13.26	0.28
1.000E-09	1.000E-09	1.788E-02	2.079E-03	2.668E-03	2.237E-02	1.101563	13.17	0.09
1.000E-10	1.000E-10	1.922E-02	2.235E-03	2.969E-03	2.231E-02	1.006106	13.09	0.09

MANUAL CURVE MATCH RESULTS:

NO ACCEPTABLE MATCH, UNCONFINED CONDITIONS IMPLIED

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 4.41E-04 FT/SECOND = 1.34E-02 CM/SECOND

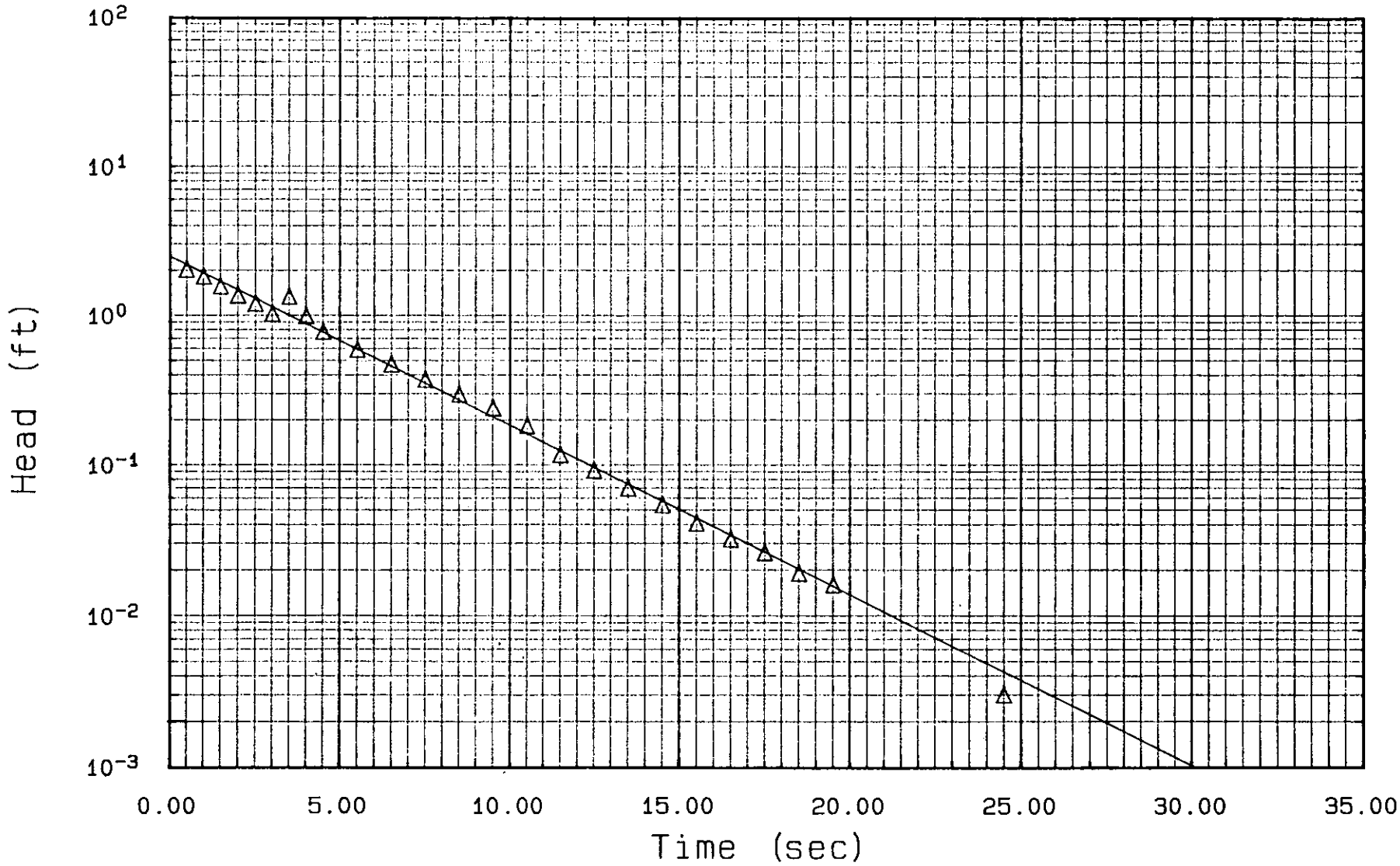
TRANSMISSIVITY = 3.79E-03 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

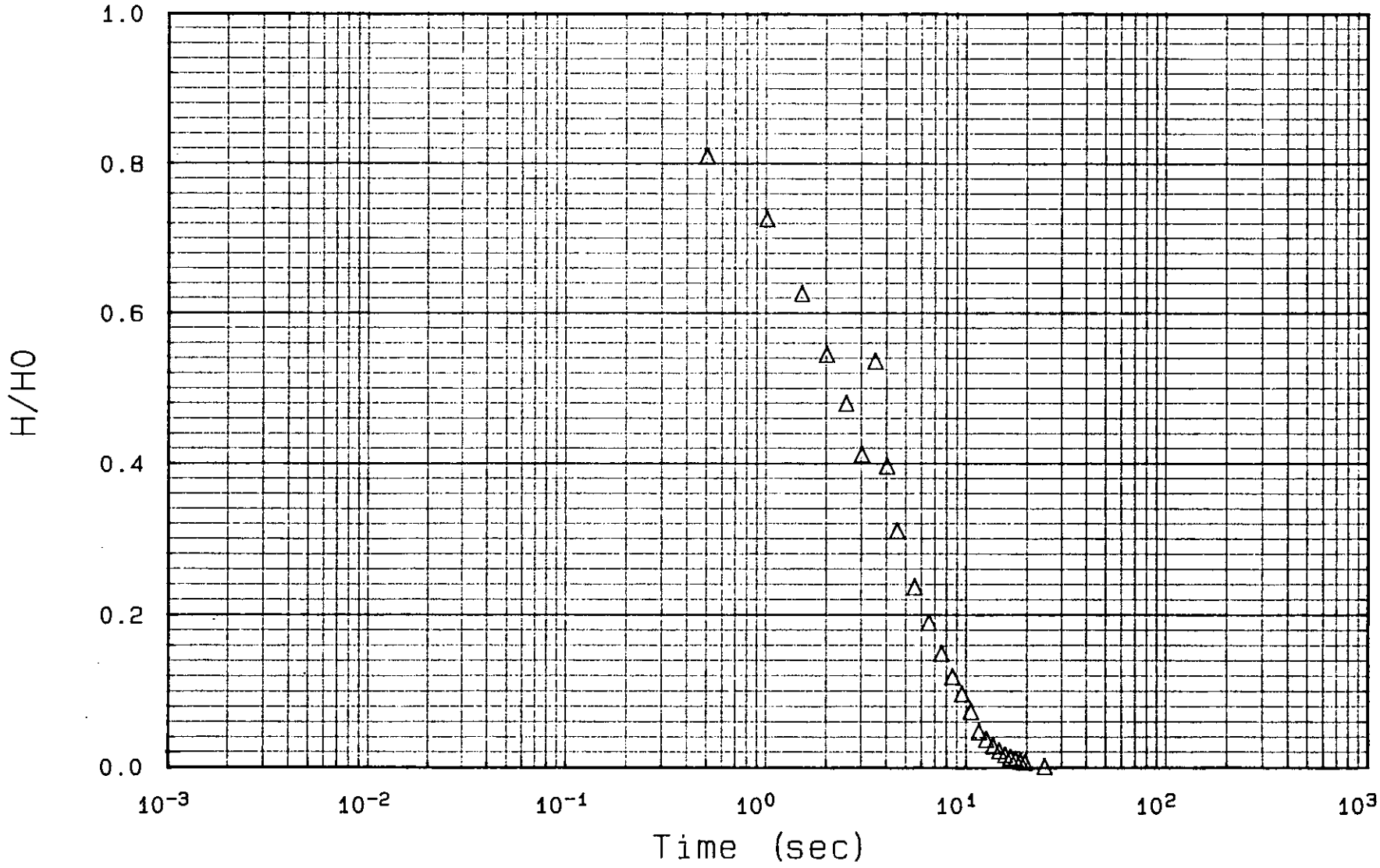
PERMEABILITY = 4.41E-04 FT/SECOND = 1.34E-02 CM/SECOND

TRANSMISSIVITY = 3.79E-03 FT**2/SECOND

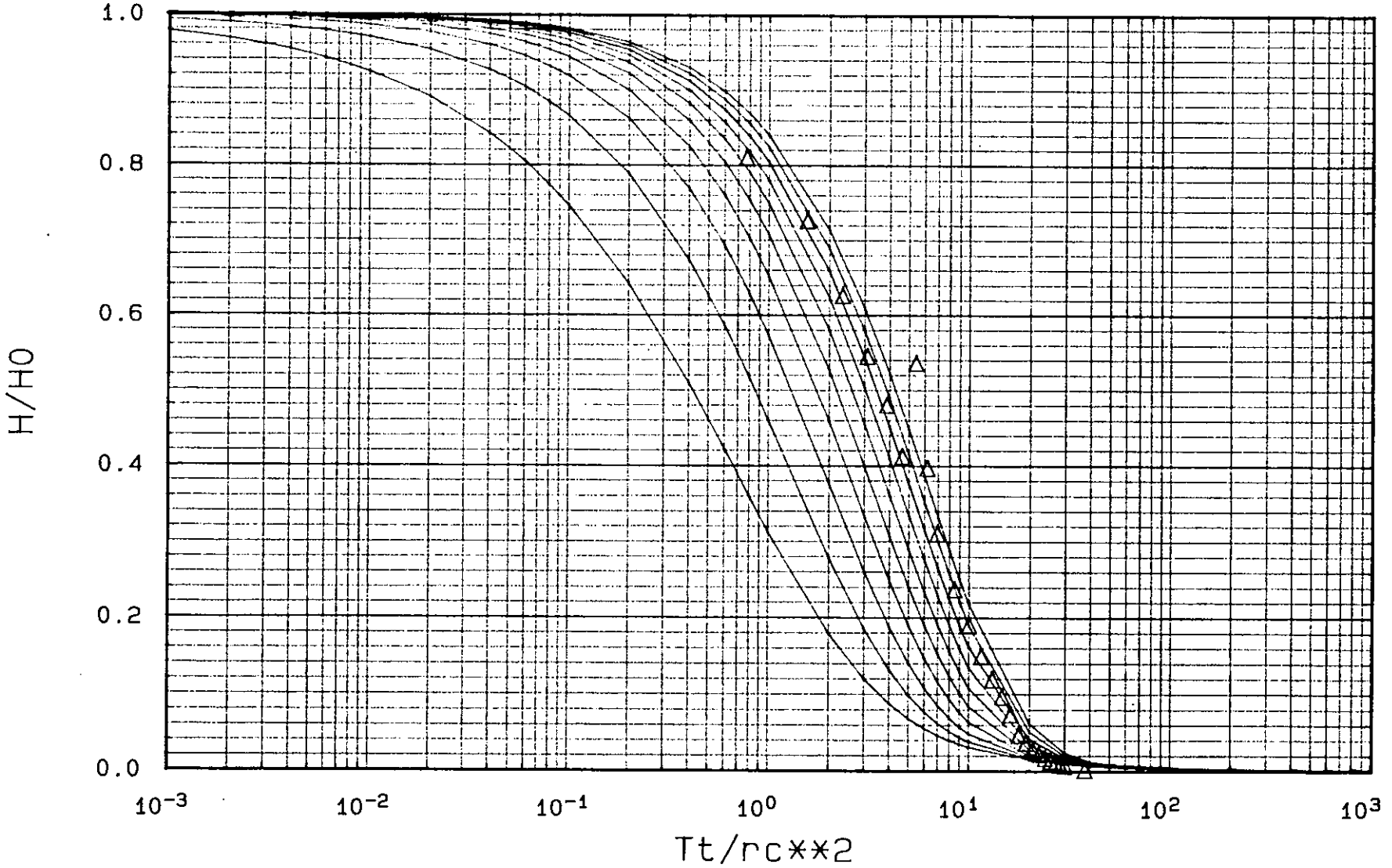
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P16SA (RISING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P16SA (RISING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P16SA (RISING) Date 8/21/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/21/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: P17S (FALLING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 1.25 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 7.80 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 7.80 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 51

TIME (SECOND)	HEAD (FEET)
1.00	0.940
2.00	0.930
3.00	0.920
4.00	0.910
5.00	0.900
6.00	0.890
7.00	0.880
12.01	0.840
17.00	0.800
22.00	0.770
27.01	0.730
32.00	0.710
37.00	0.680
42.01	0.650
47.00	0.630
52.00	0.610
57.01	0.590
62.00	0.570
67.00	0.550
72.00	0.540
77.00	0.520
82.00	0.500
87.01	0.490
92.00	0.480
97.00	0.460

102.01	0.450
107.00	0.440
137.00	0.390
167.00	0.340
197.00	0.310
227.00	0.270
257.00	0.250
287.00	0.230
317.00	0.210
347.00	0.190
377.00	0.180
407.00	0.170
437.00	0.160
467.00	0.140
497.00	0.130
527.00	0.120
557.00	0.110
587.00	0.110
707.00	0.090
827.00	0.070
947.00	0.050
1067.00	0.040
1187.00	0.040
1307.00	0.030
1427.00	0.030
1547.00	0.020

HO CALCULATED BASED ON FIRST 14 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 0.9410

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 0.94 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	6.846E-05	8.777E-06	1.272E-07	2.253E-05	0.327240	934.11	0.00
1.000E-02	1.000E-02	1.242E-04	1.592E-05	3.658E-07	2.501E-05	0.198396	1043.15	-109.03
1.000E-03	1.000E-03	1.868E-04	2.394E-05	9.397E-07	3.926E-05	0.205201	1096.28	-53.13
1.000E-04	1.000E-04	2.496E-04	3.200E-05	1.987E-06	5.516E-05	0.213059	1123.96	-27.68
1.000E-05	1.000E-05	3.124E-04	4.005E-05	3.603E-06	7.132E-05	0.216799	1136.40	-12.44
1.000E-06	1.000E-06	3.752E-04	4.810E-05	5.570E-06	8.719E-05	0.217564	1141.76	-5.36
1.000E-07	1.000E-07	4.368E-04	5.600E-05	7.460E-06	1.029E-04	0.218445	1144.72	-2.96
1.000E-08	1.000E-08	4.964E-04	6.365E-05	9.312E-06	1.184E-04	0.219689	1148.38	-3.67
1.000E-09	1.000E-09	5.563E-04	7.132E-05	1.121E-05	1.338E-04	0.220350	1151.16	-2.77
1.000E-10	1.000E-10	6.166E-04	7.906E-05	1.279E-05	1.491E-04	0.221127	1152.50	-1.34

MANUAL CURVE MATCH RESULTS:

NO ACCEPTABLE MATCH, UNCONFINED CONDITIONS IMPLIED

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.50E-05 FT/SECOND = 4.56E-04 CM/SECOND

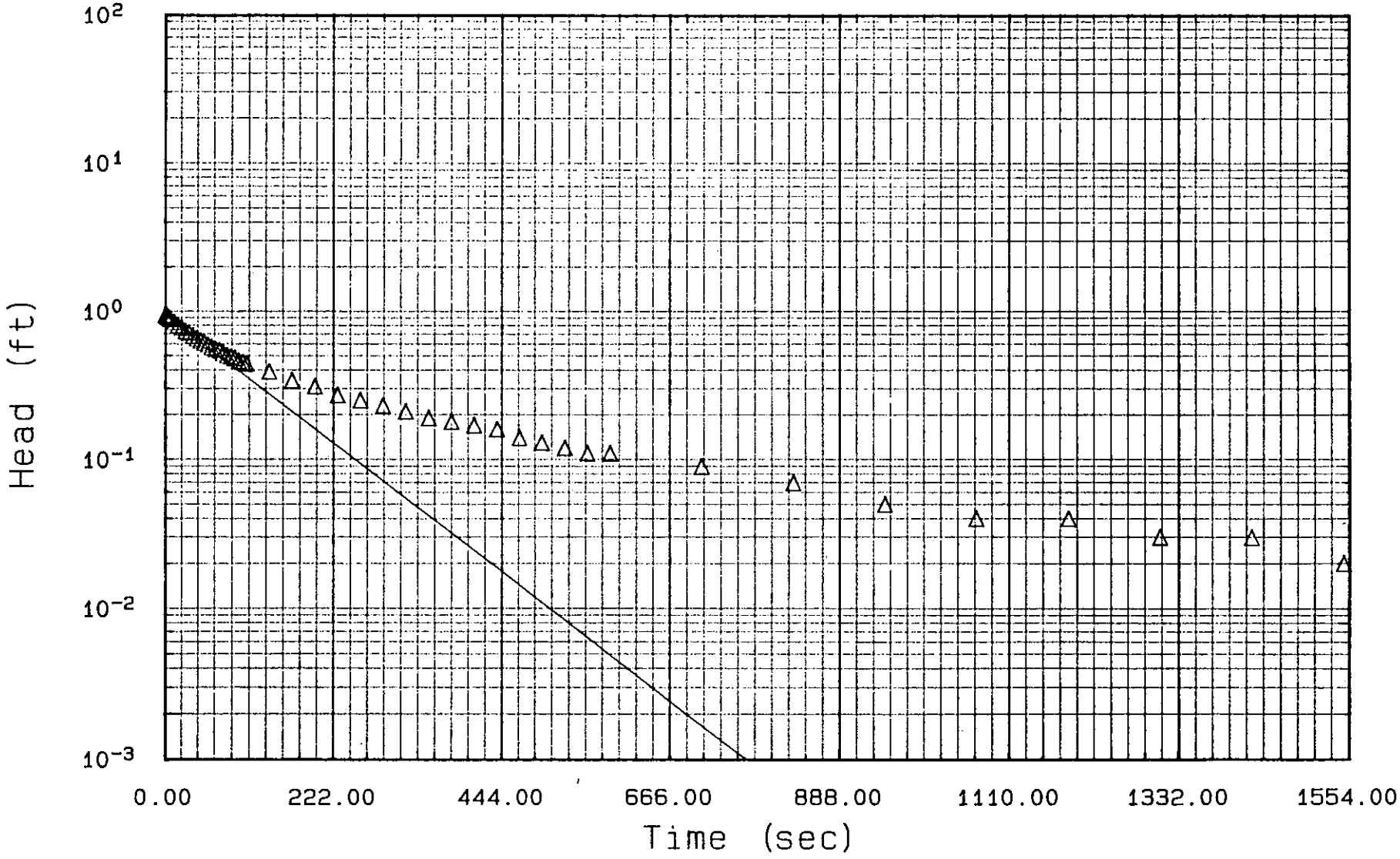
TRANSMISSIVITY = 1.17E-04 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

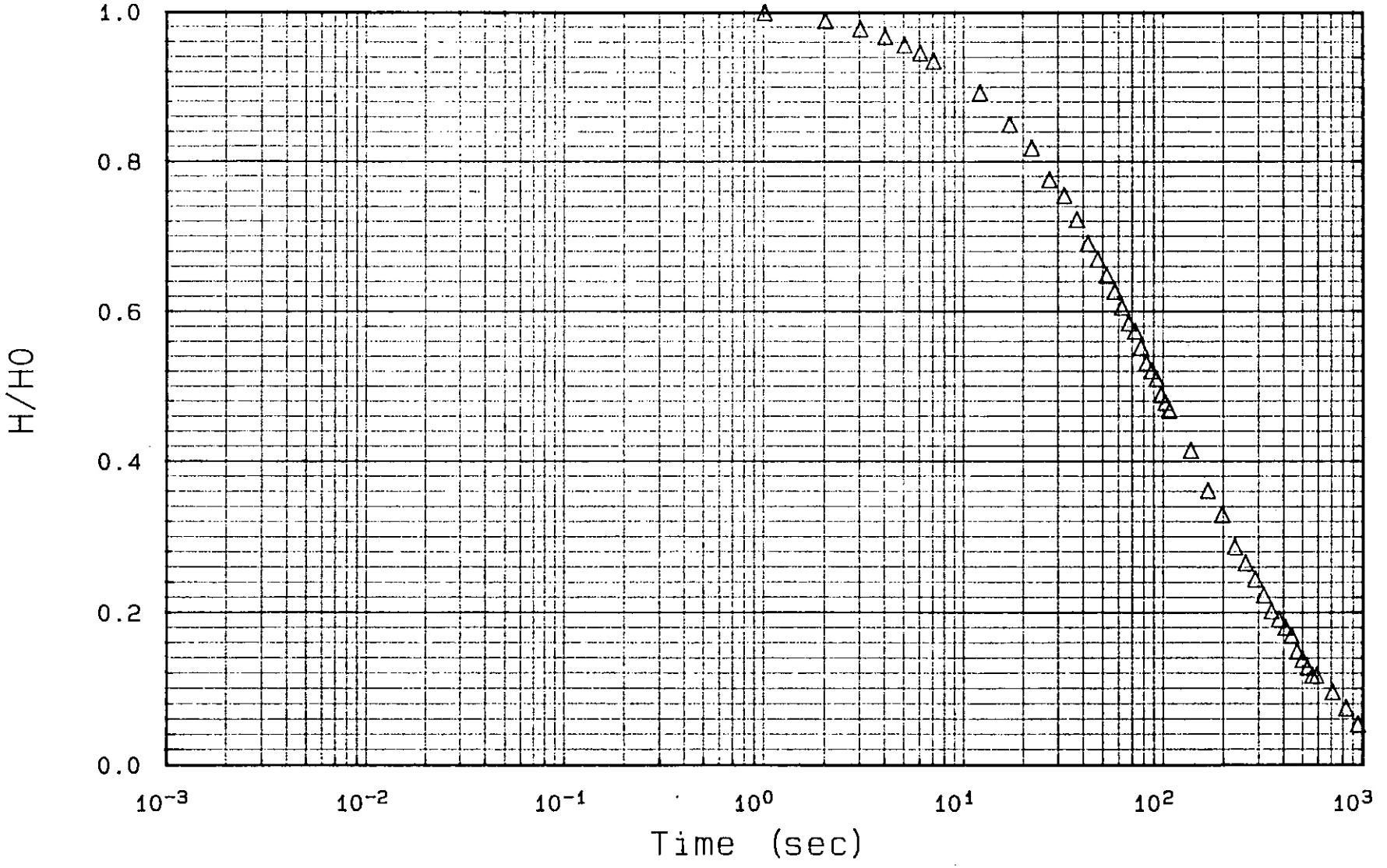
PERMEABILITY = 1.50E-05 FT/SECOND = 4.56E-04 CM/SECOND

TRANSMISSIVITY = 1.17E-04 FT**2/SECOND

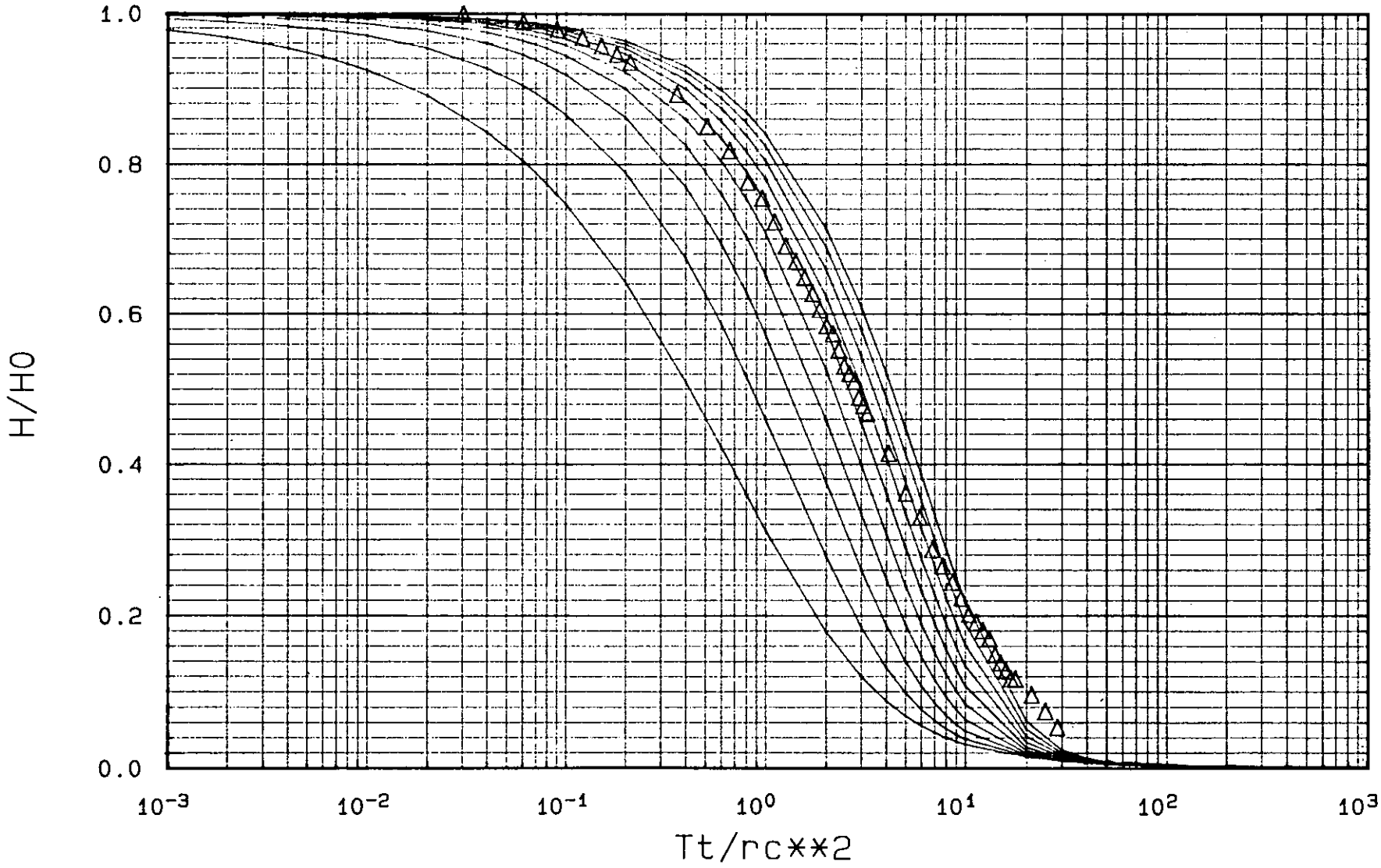
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P17S (FALLING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P17S (FALLING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P17S (FALLING) Date 8/21/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/22/90

FIELD INVESTIGATOR: C. TRIONE

WELL NO.: P19D (FALLING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 6.50 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 0.25
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 26.80 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.50 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 55

TIME (SECOND)	HEAD (FEET)
1.00	2.440
2.00	2.430
3.00	2.420
4.00	2.410
5.00	2.400
6.00	2.400
7.00	2.390
8.00	2.380
9.00	2.370
10.00	2.360
11.00	2.350
12.00	2.350
13.00	2.340
18.01	2.300
23.00	2.270
28.00	2.240
33.01	2.200
38.00	2.180
43.00	2.150
48.01	2.120
53.00	2.090
58.00	2.070
63.01	2.040
68.00	2.020
73.00	1.990

78.00	1.970
83.00	1.950
88.00	1.920
93.01	1.900
98.00	1.880
103.00	1.860
108.01	1.840
113.00	1.820
143.00	1.710
173.00	1.600
203.00	1.500
233.00	1.410
263.00	1.330
293.00	1.250
323.00	1.170
353.00	1.100
383.00	1.030
413.00	0.970
443.00	0.910
473.00	0.850
503.00	0.790
533.00	0.740
563.00	0.690
593.00	0.650
713.00	0.490
833.00	0.360
953.00	0.260
1073.00	0.180
1193.00	0.120
1313.00	0.050

HO CALCULATED BASED ON FIRST 17 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 2.4414

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 2.44 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	6.650E-06	6.333E-07	6.800E-08	2.752E-05	4.128056	853.85	0.00
1.000E-02	1.000E-02	1.323E-05	1.260E-06	1.956E-07	3.062E-05	2.299957	360.13	493.73
1.000E-03	1.000E-03	2.176E-05	2.073E-06	5.025E-07	3.429E-05	1.552760	207.57	152.55
1.000E-04	1.000E-04	3.067E-05	2.921E-06	1.063E-06	3.911E-05	1.240637	203.09	4.48
1.000E-05	1.000E-05	3.934E-05	3.747E-06	1.808E-06	4.151E-05	1.009251	224.55	-21.46
1.000E-06	1.000E-06	4.793E-05	4.565E-06	2.666E-06	4.346E-05	0.851195	242.68	-18.13
1.000E-07	1.000E-07	5.657E-05	5.387E-06	3.733E-06	4.788E-05	0.780357	252.71	-10.04
1.000E-08	1.000E-08	6.530E-05	6.219E-06	4.698E-06	5.387E-05	0.753002	255.63	-2.92
1.000E-09	1.000E-09	7.401E-05	7.048E-06	5.637E-06	6.029E-05	0.738418	257.83	-2.20
1.000E-10	1.000E-10	8.243E-05	7.850E-06	6.641E-06	6.324E-05	0.686708	264.18	-6.35

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0158

TRANSMISSIVITY = 4.2762E-05 FEET**2/SECOND
STORATIVITY = 1.0000E-10

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 4.02E-06 FT/SECOND = 1.23E-04 CM/SECOND

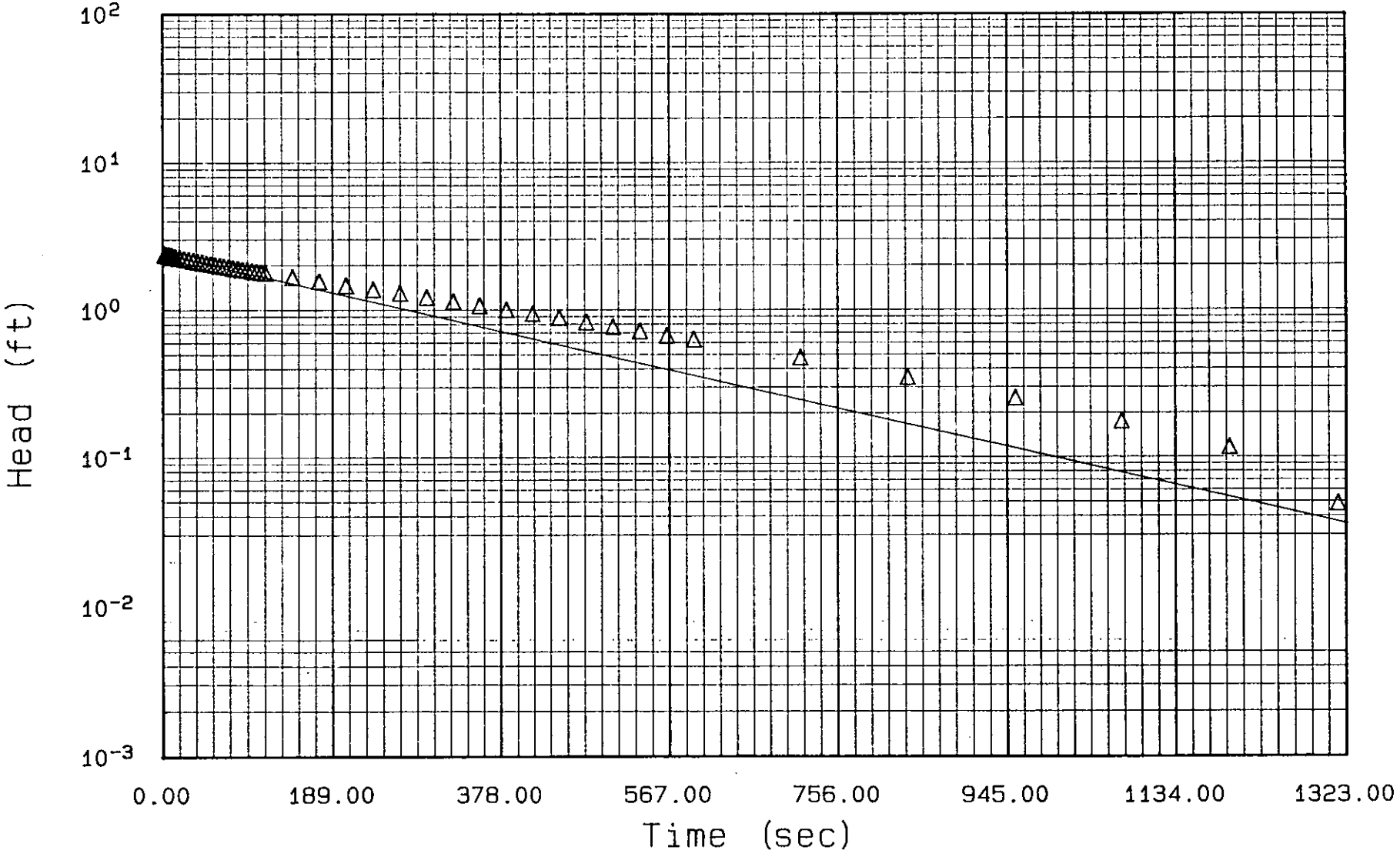
TRANSMISSIVITY = 4.22E-05 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

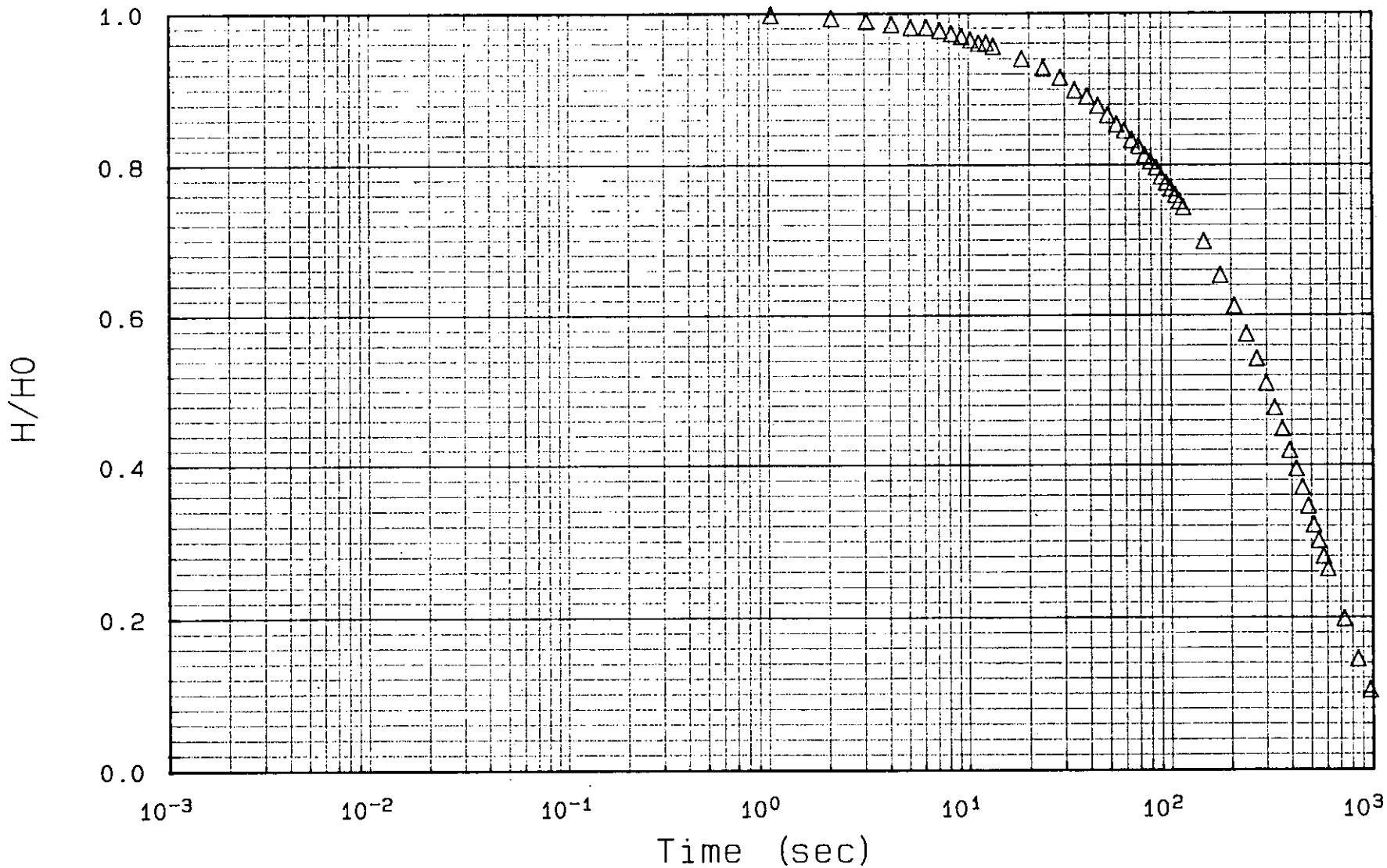
PERMEABILITY = 6.32E-06 FT/SECOND = 1.93E-04 CM/SECOND

TRANSMISSIVITY = 6.63E-05 FT**2/SECOND

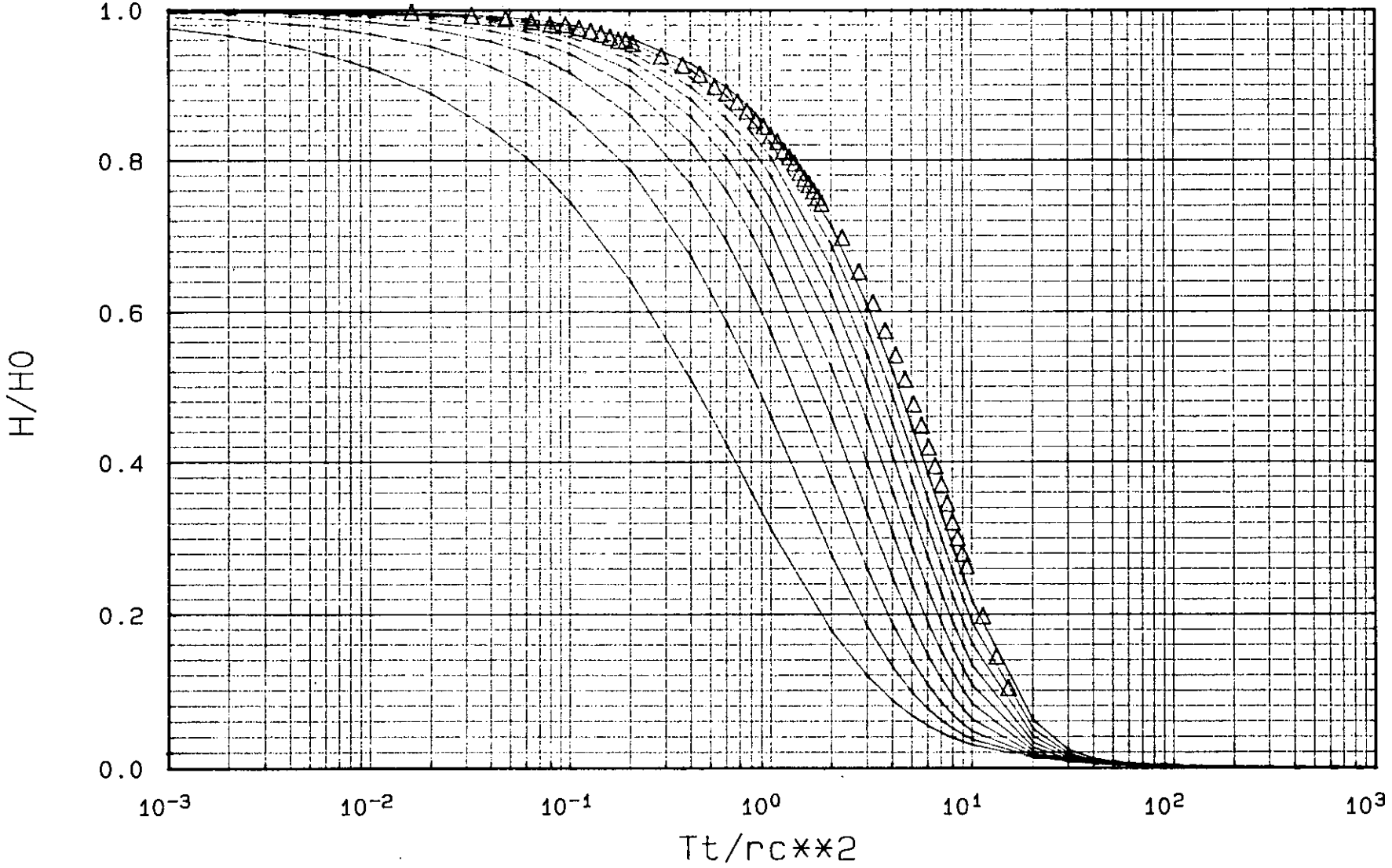
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P19D (FALLING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P19D (FALLING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P19D (FALLING) Date 8/22/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05

CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI

DATE OF SLUG TEST: 8/22/90

FIELD INVESTIGATOR: C. TRIONE

WELL NO.: P19DA (RISING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 6.50 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 0.25
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 26.80 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.50 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 62

TIME (SECOND)	HEAD (FEET)
1.00	3.110
2.00	3.090
3.00	3.070
4.00	3.050
6.00	3.040
7.00	3.060
8.00	3.100
9.00	3.030
10.00	2.970
11.00	2.920
12.00	2.920
17.00	2.880
22.00	2.840
27.00	2.810
32.00	2.780
37.00	2.740
42.00	2.710
47.00	2.680
52.00	2.660
57.00	2.630
62.00	2.600
67.00	2.570
72.00	2.550
77.00	2.530
82.00	2.500

87.00	2.480
92.00	2.460
97.00	2.440
102.00	2.430
107.00	2.410
112.00	2.390
142.00	2.270
172.00	2.150
202.00	2.050
232.00	1.960
262.00	1.870
292.00	1.790
322.00	1.710
352.00	1.640
382.00	1.570
412.00	1.510
442.00	1.460
472.00	1.400
502.00	1.340
532.00	1.290
562.00	1.240
592.00	1.200
712.00	1.030
832.00	0.900
952.00	0.800
1072.00	0.710
1192.00	0.650
1312.00	0.590
1432.00	0.560
1552.00	0.520
1672.00	0.490
1792.00	0.470
1912.00	0.450
2032.00	0.430
2152.00	0.410
2392.00	0.390
2632.00	0.370

HO CALCULATED BASED ON FIRST 15 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 3.1103

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 3.11 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	5.623E-06	5.356E-07	1.266E-08	3.849E-06	0.682298	520.91	0.00
1.000E-02	1.000E-02	1.301E-05	1.239E-06	1.434E-08	7.386E-06	0.566828	792.02	-271.12
1.000E-03	1.000E-03	2.255E-05	2.148E-06	9.357E-08	1.690E-05	0.745139	913.54	-121.52
1.000E-04	1.000E-04	3.258E-05	3.103E-06	1.979E-07	2.711E-05	0.826016	968.85	-55.31
1.000E-05	1.000E-05	4.247E-05	4.045E-06	3.366E-07	3.712E-05	0.866009	997.50	-28.65
1.000E-06	1.000E-06	5.223E-05	4.974E-06	4.964E-07	4.693E-05	0.889154	1014.80	-17.30
1.000E-07	1.000E-07	6.174E-05	5.880E-06	6.656E-07	5.659E-05	0.905826	1031.16	-16.36
1.000E-08	1.000E-08	7.093E-05	6.755E-06	8.135E-07	6.613E-05	0.920855	1053.31	-22.15
1.000E-09	1.000E-09	8.005E-05	7.624E-06	1.010E-06	7.560E-05	0.931846	1066.62	-13.30
1.000E-10	1.000E-10	8.925E-05	8.500E-06	1.172E-06	8.499E-05	0.939184	1070.54	-3.93

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0023

TRANSMISSIVITY = 6.2954E-06 FEET**2/SECOND
STORATIVITY = 1.0000E-02

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 4.90E-06 FT/SECOND = 1.49E-04 CM/SECOND

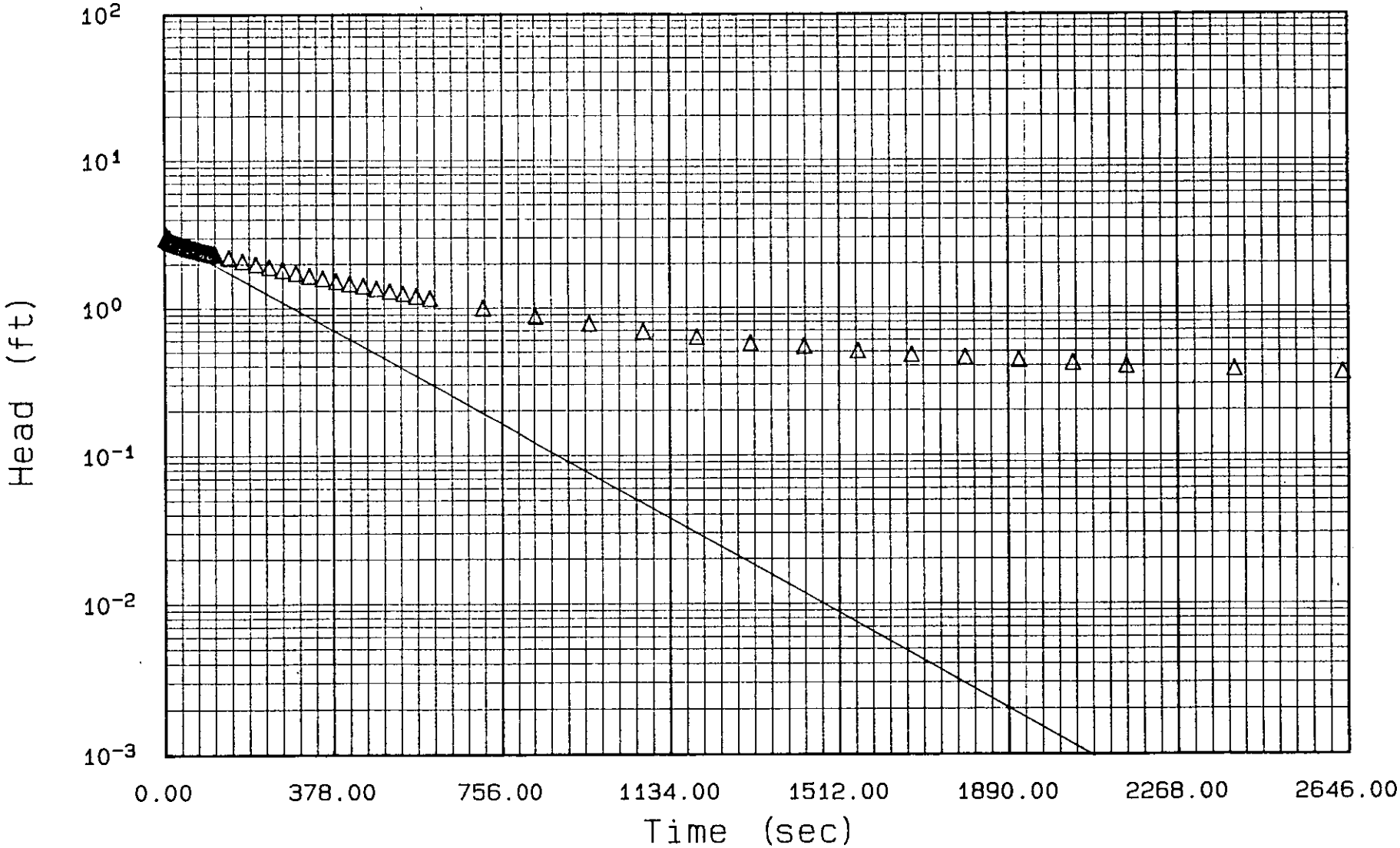
TRANSMISSIVITY = 5.15E-05 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

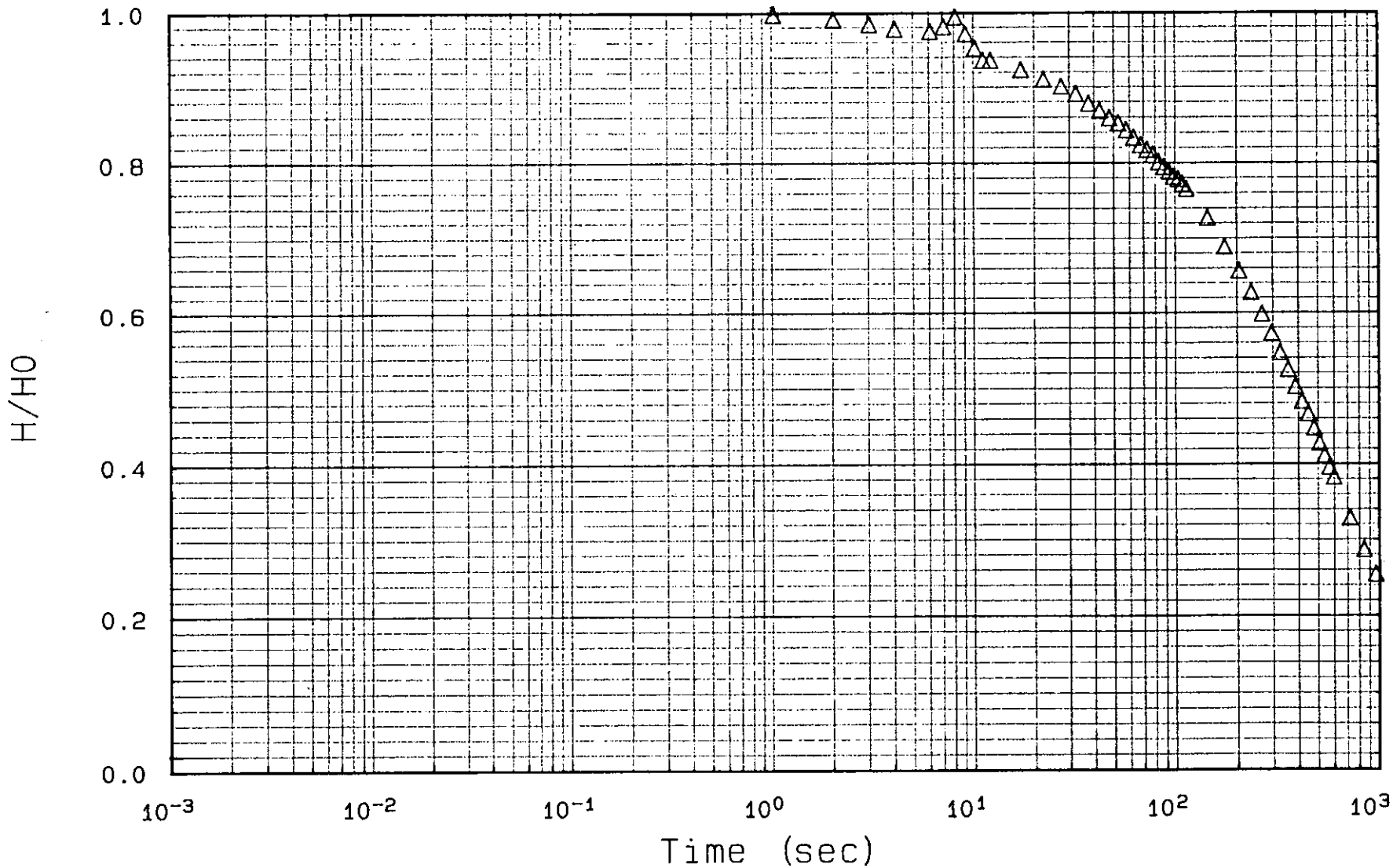
PERMEABILITY = 7.70E-06 FT/SECOND = 2.35E-04 CM/SECOND

TRANSMISSIVITY = 8.09E-05 FT**2/SECOND

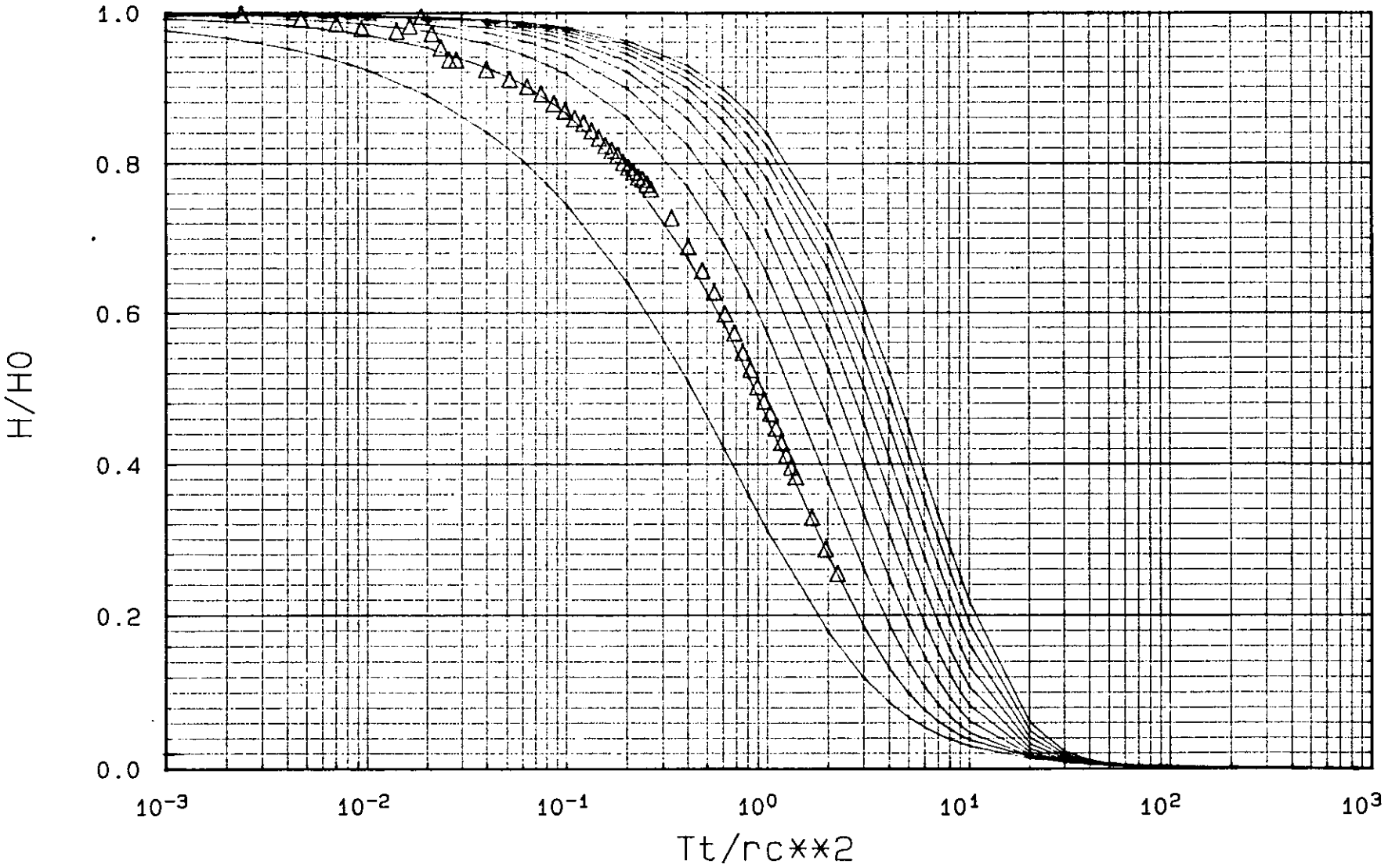
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P19DA (RISING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P19DA (RISING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P19DA (RISING) Date 8/22/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/22/90

FIELD INVESTIGATOR: C. TRIONE

WELL NO.: P20S (FALLING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 1.25 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 8.10 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 8.10 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 60

TIME (SECOND)	HEAD (FEET)
1.00	2.580
2.00	2.570
3.00	2.550
4.00	2.530
5.00	2.510
6.00	2.490
7.00	2.480
8.00	2.520
9.00	2.450
10.00	2.430
11.00	2.420
12.00	2.400
13.00	2.390
14.00	2.370
15.00	2.360
16.00	2.340
17.00	2.330
18.00	2.310
23.00	2.250
28.00	2.190
33.00	2.130
38.00	2.070
43.00	2.010
48.00	1.960
53.00	1.910

58.00	1.860
63.00	1.810
68.00	1.760
73.00	1.720
78.00	1.680
83.00	1.630
88.00	1.590
93.00	1.560
98.00	1.520
103.00	1.480
108.00	1.440
113.00	1.410
118.00	1.380
148.00	1.200
178.00	1.050
208.00	0.920
238.00	0.810
268.00	0.710
298.00	0.630
328.00	0.560
358.00	0.500
388.00	0.440
418.00	0.390
448.00	0.350
478.00	0.320
508.00	0.290
538.00	0.260
568.00	0.240
598.00	0.220
718.00	0.160
838.00	0.070
958.00	0.050
1078.00	0.030
1198.00	0.020
1318.00	0.010

HO CALCULATED BASED ON FIRST 30 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 2.5770

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 2.58 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	7.879E-05	9.727E-06	*********	1.383E-04	1.757141	610.89	0.00
1.000E-02	1.000E-02	1.220E-04	1.507E-05	*********	1.416E-04	1.163316	588.12	22.78
1.000E-03	1.000E-03	1.735E-04	2.142E-05	*********	1.441E-04	0.836258	643.83	-55.72
1.000E-04	1.000E-04	2.266E-04	2.797E-05	*********	1.467E-04	0.656905	689.50	-45.66
1.000E-05	1.000E-05	2.779E-04	3.431E-05	*********	1.495E-04	0.550932	723.59	-34.09
1.000E-06	1.000E-06	3.273E-04	4.041E-05	*********	1.523E-04	0.481641	748.02	-24.44
1.000E-07	1.000E-07	3.747E-04	4.626E-05	*********	1.550E-04	0.432922	766.64	-18.61
1.000E-08	1.000E-08	4.238E-04	5.232E-05	*********	1.579E-04	0.393201	778.66	-12.02
1.000E-09	1.000E-09	4.748E-04	5.861E-05	*********	1.608E-04	0.361645	786.95	-8.29
1.000E-10	1.000E-10	5.263E-04	6.497E-05	*********	1.640E-04	0.335518	794.11	-7.16

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0301

TRANSMISSIVITY = 8.1715E-05 FEET**2/SECOND
STORATIVITY = 1.0000E-09

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 9.45E-06 FT/SECOND = 2.88E-04 CM/SECOND

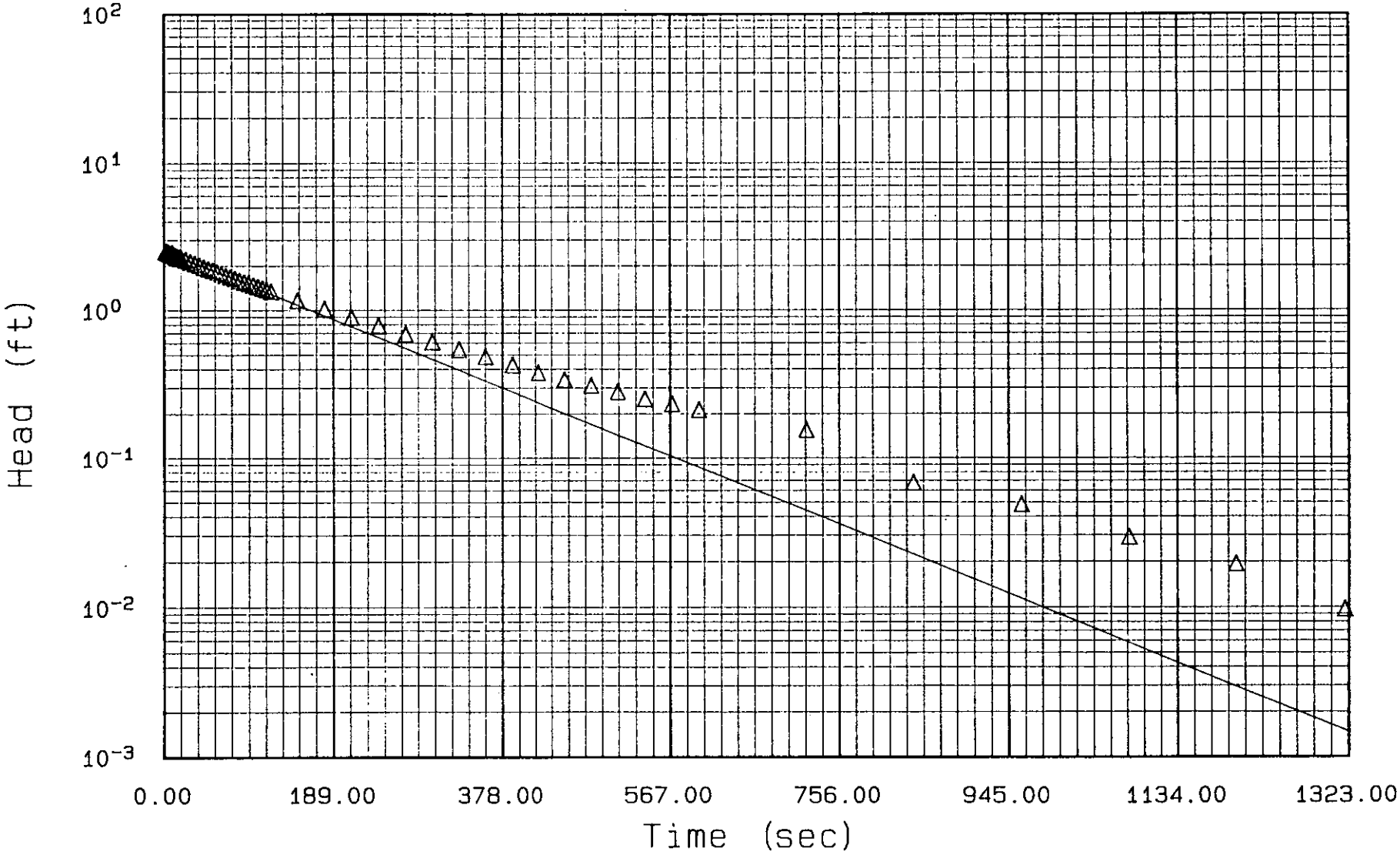
TRANSMISSIVITY = 7.66E-05 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

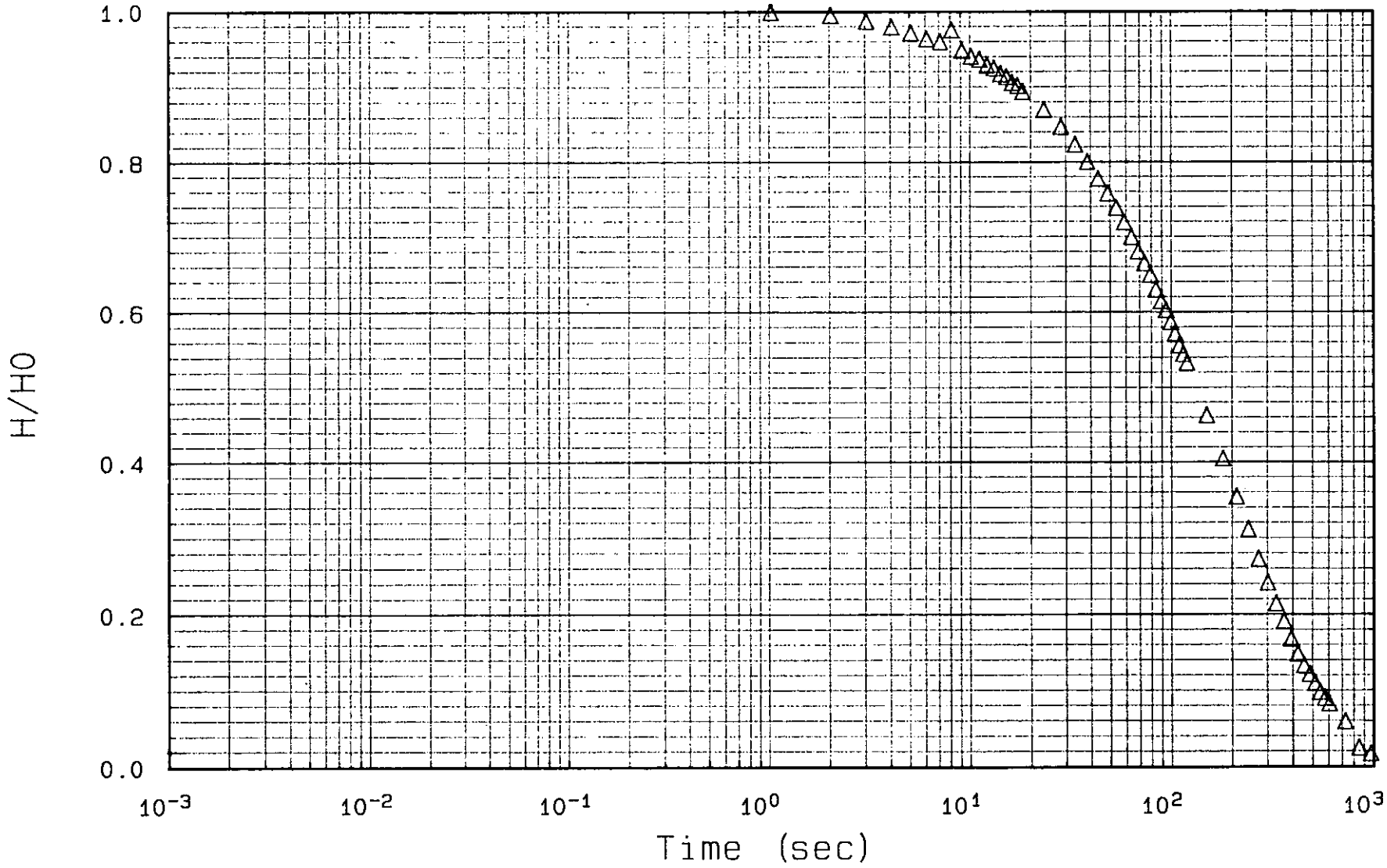
PERMEABILITY = 9.45E-06 FT/SECOND = 2.88E-04 CM/SECOND

TRANSMISSIVITY = 7.66E-05 FT**2/SECOND

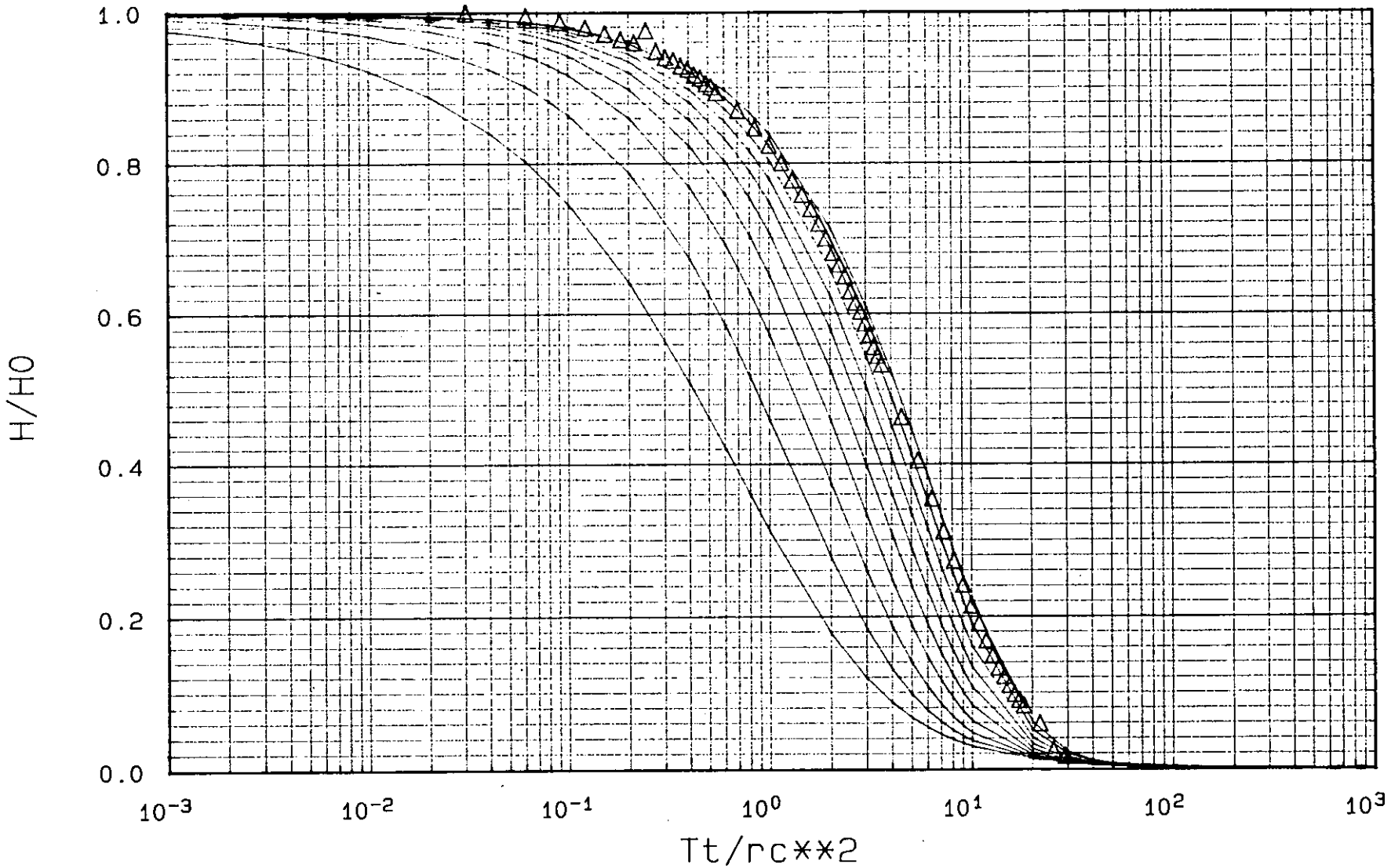
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20S (FALLING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20S (FALLING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20S (FALLING) Date 8/22/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/22/90

FIELD INVESTIGATOR: C. TRIONE

WELL NO.: P20SA (RISING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 1.25 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 8.10 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 8.10 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 58

TIME (SECOND)	HEAD (FEET)
0.20	3.040
1.40	3.010
2.40	2.990
3.40	2.960
4.40	2.930
5.40	2.920
6.40	2.900
7.40	2.870
8.40	2.860
9.40	2.840
10.40	2.830
11.40	2.810
12.40	2.790
13.40	2.780
14.40	2.760
15.40	2.740
16.40	2.720
17.40	2.710
18.40	2.690
23.41	2.610
28.40	2.530
33.40	2.450
38.41	2.380
43.40	2.300
48.40	2.230

53.41	2.170
58.40	2.110
63.40	2.050
68.41	1.990
73.40	1.930
78.40	1.870
83.40	1.810
88.40	1.750
93.40	1.700
98.41	1.650
103.40	1.600
108.40	1.560
113.41	1.510
118.40	1.470
148.40	1.220
178.40	1.010
208.40	0.850
238.40	0.710
268.40	0.590
298.40	0.500
328.40	0.420
358.40	0.360
388.40	0.300
418.40	0.260
448.40	0.220
478.40	0.190
508.40	0.160
538.40	0.140
568.40	0.120
598.40	0.100
718.40	0.050
838.40	0.020
958.40	0.010

HO CALCULATED BASED ON FIRST 16 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 3.0302

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 3.03 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.512E-04	1.867E-05	*********	2.224E-04	1.483414	566.72	0.00
1.000E-02	1.000E-02	2.235E-04	2.760E-05	*********	2.271E-04	1.039623	575.08	-8.36
1.000E-03	1.000E-03	3.073E-04	3.794E-05	*********	2.304E-04	0.794326	614.78	-39.69
1.000E-04	1.000E-04	3.896E-04	4.810E-05	*********	2.339E-04	0.674940	647.73	-32.95
1.000E-05	1.000E-05	4.698E-04	5.800E-05	*********	2.377E-04	0.611030	669.93	-22.20
1.000E-06	1.000E-06	5.512E-04	6.805E-05	*********	2.416E-04	0.570397	684.03	-14.09
1.000E-07	1.000E-07	6.354E-04	7.845E-05	*********	2.453E-04	0.539622	693.47	-9.44
1.000E-08	1.000E-08	7.191E-04	8.878E-05	*********	2.487E-04	0.511752	701.69	-8.22
1.000E-09	1.000E-09	8.007E-04	9.885E-05	*********	2.528E-04	0.500675	708.77	-7.08
1.000E-10	1.000E-10	8.838E-04	1.091E-04	*********	2.572E-04	0.485409	714.23	-5.46

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0395

TRANSMISSIVITY = 1.0703E-04 FEET**2/SECOND
STORATIVITY = 1.0000E-10

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.12E-05 FT/SECOND = 3.40E-04 CM/SECOND

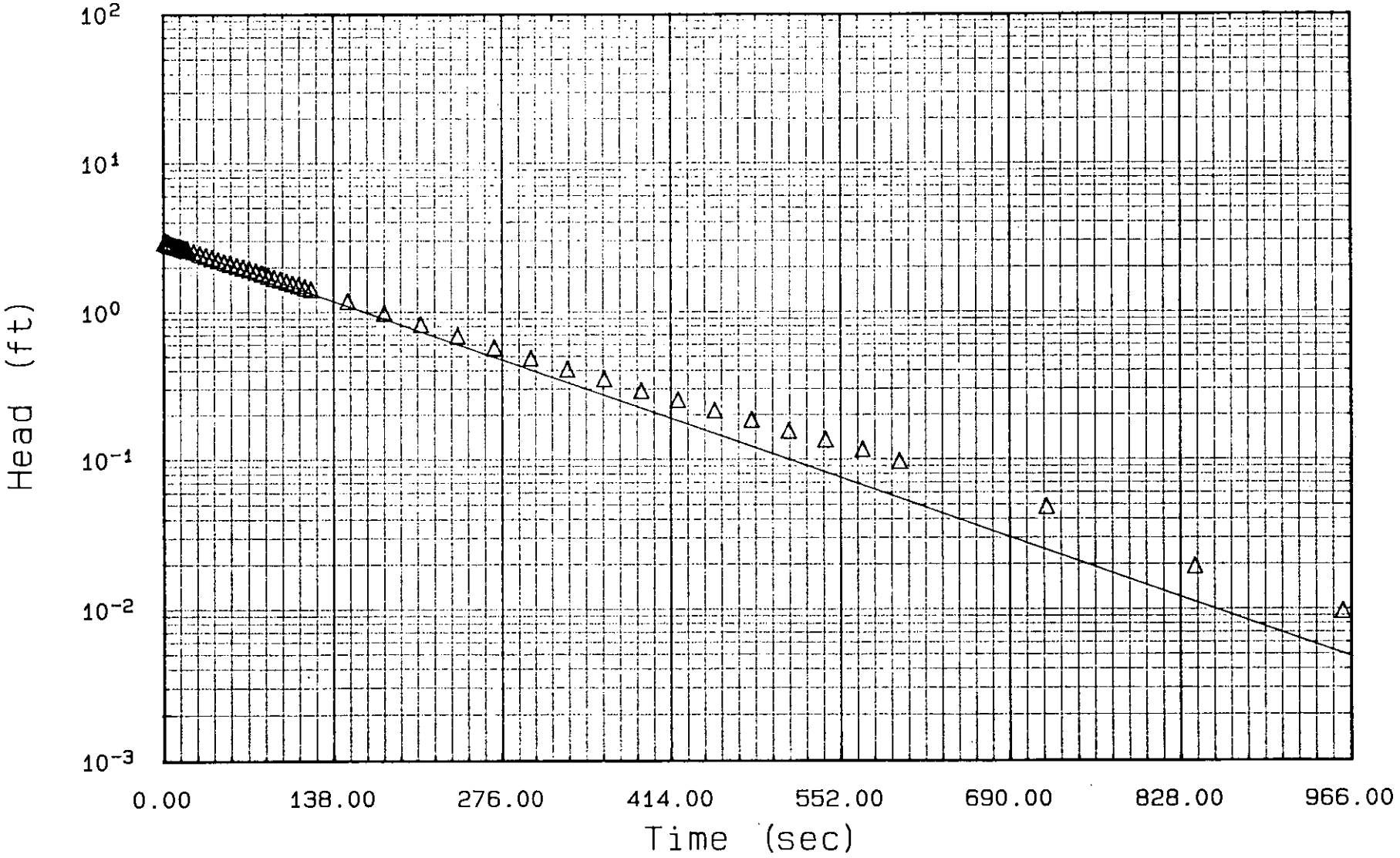
TRANSMISSIVITY = 9.04E-05 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

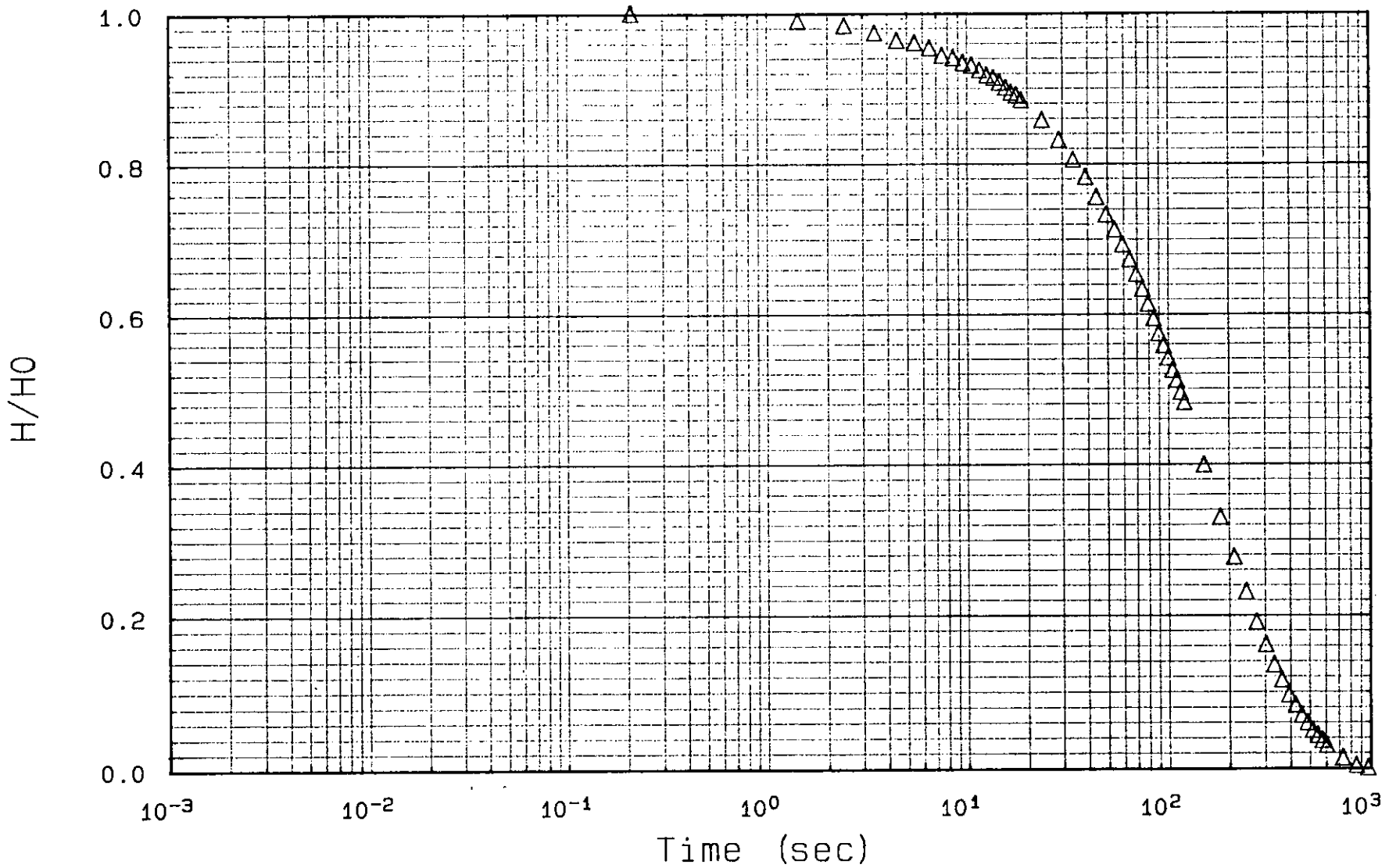
PERMEABILITY = 1.12E-05 FT/SECOND = 3.40E-04 CM/SECOND

TRANSMISSIVITY = 9.04E-05 FT**2/SECOND

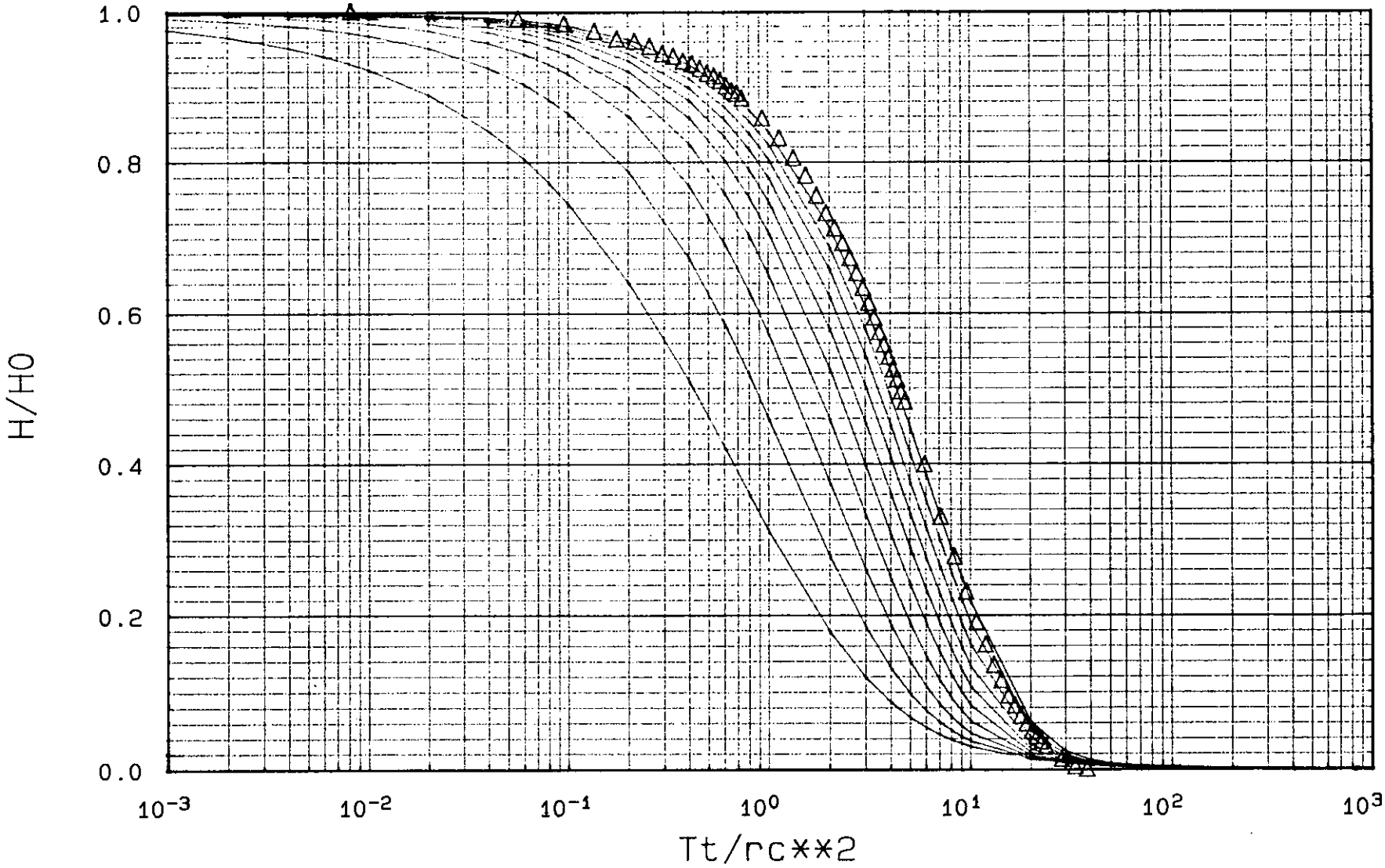
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20SA (RISING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20SA (RISING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20SA (RISING) Date 8/22/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/22/90

FIELD INVESTIGATOR: C. TRIONE

WELL NO.: P20SR (FALLING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 1.25 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 8.10 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 8.10 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 58

TIME (SECOND)	HEAD (FEET)
1.00	2.570
2.00	2.550
3.00	2.530
4.00	2.510
5.00	2.490
6.00	2.480
7.00	2.520
8.00	2.450
9.00	2.430
10.00	2.420
11.00	2.400
12.00	2.390
13.00	2.370
14.00	2.360
15.00	2.340
16.00	2.330
17.00	2.310
22.00	2.250
27.00	2.190
32.00	2.130
37.00	2.070
42.00	2.010
47.00	1.960
52.00	1.910
57.00	1.860

62.00	1.810
67.00	1.760
72.00	1.720
77.00	1.680
82.00	1.630
87.00	1.590
92.00	1.560
97.00	1.520
102.00	1.480
107.00	1.440
112.00	1.410
117.00	1.380
147.00	1.200
177.00	1.050
207.00	0.920
237.00	0.810
267.00	0.710
297.00	0.630
327.00	0.560
357.00	0.500
387.00	0.440
417.00	0.390
447.00	0.350
477.00	0.320
507.00	0.290
537.00	0.260
567.00	0.240
597.00	0.220
717.00	0.160
837.00	0.070
957.00	0.050
1077.00	0.030
1197.00	0.020

HO CALCULATED BASED ON FIRST 25 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 2.5669

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 2.57 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	6.388E-05	7.887E-06	*********	7.804E-05	1.223843	473.95	0.00
1.000E-02	1.000E-02	1.068E-04	1.318E-05	*********	8.164E-05	0.768528	546.67	-72.72
1.000E-03	1.000E-03	1.582E-04	1.953E-05	*********	8.480E-05	0.542795	616.71	-70.04
1.000E-04	1.000E-04	2.114E-04	2.610E-05	*********	8.809E-05	0.427256	657.05	-40.34
1.000E-05	1.000E-05	2.628E-04	3.245E-05	*********	9.157E-05	0.362880	684.15	-27.10
1.000E-06	1.000E-06	3.123E-04	3.855E-05	*********	9.499E-05	0.322145	702.56	-18.41
1.000E-07	1.000E-07	3.597E-04	4.441E-05	*********	9.869E-05	0.295249	716.37	-13.81
1.000E-08	1.000E-08	4.088E-04	5.047E-05	*********	1.028E-04	0.273985	723.82	-7.46
1.000E-09	1.000E-09	4.598E-04	5.677E-05	*********	1.074E-04	0.258358	727.87	-4.05
1.000E-10	1.000E-10	5.113E-04	6.313E-05	*********	1.126E-04	0.246054	731.51	-3.64

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0243

TRANSMISSIVITY = 6.5850E-05 FEET**2/SECOND
STORATIVITY = 1.0000E-07

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 9.70E-06 FT/SECOND = 2.96E-04 CM/SECOND

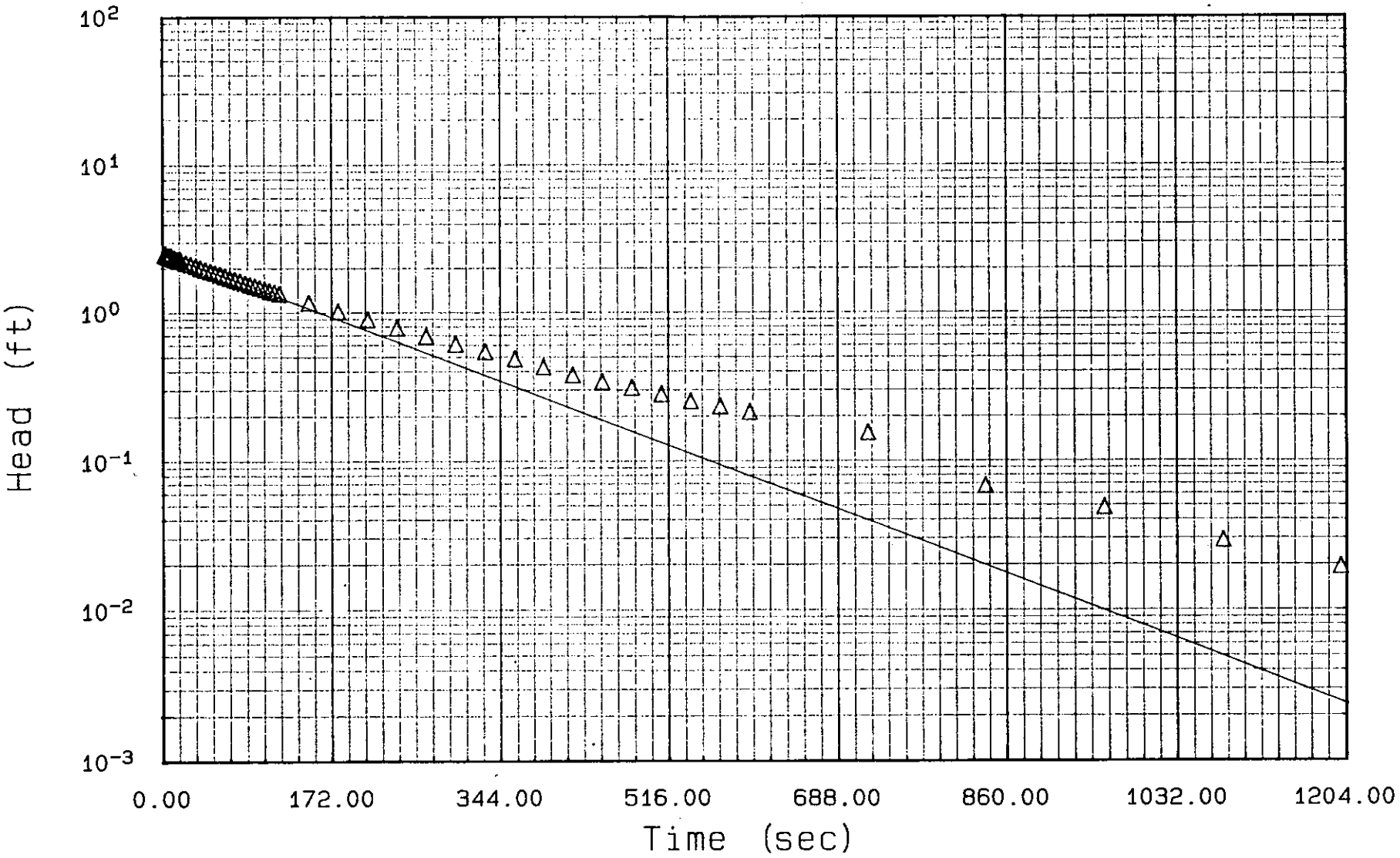
TRANSMISSIVITY = 7.86E-05 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

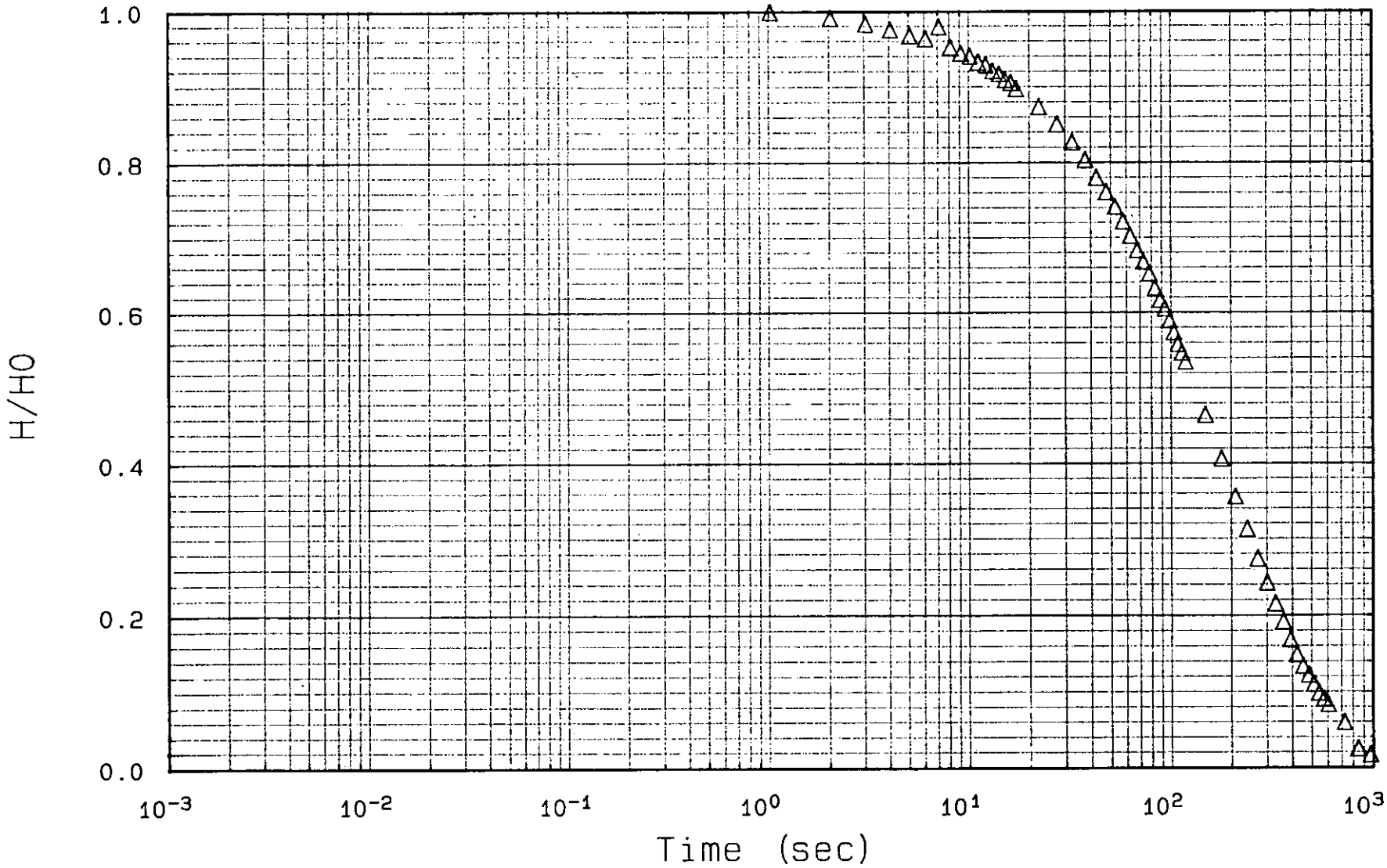
PERMEABILITY = 9.70E-06 FT/SECOND = 2.96E-04 CM/SECOND

TRANSMISSIVITY = 7.86E-05 FT**2/SECOND

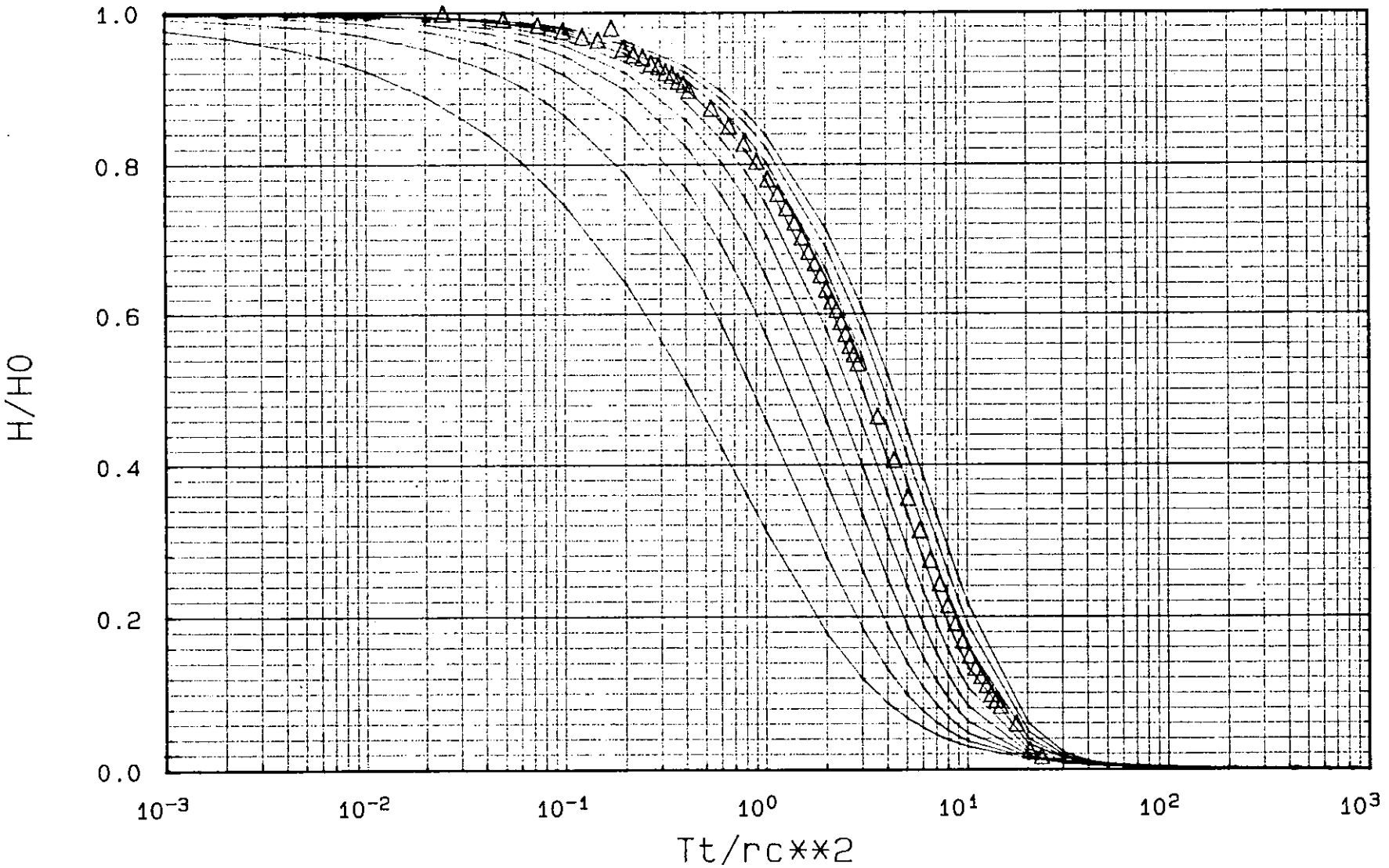
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20SR (FALLING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20SR (FALLING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20SR (FALLING) Date 8/22/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05

CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI

DATE OF SLUG TEST: 8/22/90

FIELD INVESTIGATOR: C. TRIONE

WELL NO.: P20D (FALLING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 6.00 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 0.25
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 11.80 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 11.80 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 33

TIME (SECOND)	HEAD (FEET)
30.00	0.760
60.00	0.750
90.00	0.740
120.00	0.730
150.00	0.710
180.00	0.700
210.00	0.690
240.00	0.680
270.00	0.660
300.00	0.650
330.00	0.630
360.00	0.620
390.00	0.610
420.00	0.600
450.00	0.590
570.00	0.540
690.00	0.500
810.00	0.470
930.00	0.430
1050.00	0.400
1170.00	0.370
1290.00	0.340
1410.00	0.310
1530.00	0.290
1650.00	0.270

1770.00	0.240
1890.00	0.220
2010.00	0.200
2130.00	0.180
2250.00	0.160
2370.00	0.150
2490.00	0.130
2610.00	0.120

HO CALCULATED BASED ON FIRST 30 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 0.7969

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 0.80 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	2.774E-06	2.351E-07	2.661E-07	2.457E-06	0.789761	799.89	0.00
1.000E-02	1.000E-02	5.729E-06	4.855E-07	1.101E-06	3.711E-06	0.455489	1005.57	-205.68
1.000E-03	1.000E-03	9.137E-06	7.743E-07	2.342E-06	4.925E-06	0.282740	1133.98	-128.41
1.000E-04	1.000E-04	1.257E-05	1.065E-06	3.611E-06	7.094E-06	0.277165	1199.52	-65.54
1.000E-05	1.000E-05	1.593E-05	1.350E-06	4.754E-06	9.856E-06	0.320216	1236.15	-36.63
1.000E-06	1.000E-06	1.925E-05	1.631E-06	5.874E-06	1.255E-05	0.346703	1259.06	-22.92
1.000E-07	1.000E-07	2.253E-05	1.909E-06	6.979E-06	1.522E-05	0.365860	1274.87	-15.80
1.000E-08	1.000E-08	2.574E-05	2.181E-06	8.073E-06	1.785E-05	0.379819	1289.67	-14.81
1.000E-09	1.000E-09	2.881E-05	2.442E-06	9.159E-06	2.045E-05	0.391970	1310.31	-20.64
1.000E-10	1.000E-10	3.186E-05	2.700E-06	1.024E-05	2.303E-05	0.401537	1326.03	-15.72

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0015

TRANSMISSIVITY = 4.1999E-06 FEET**2/SECOND
STORATIVITY = 1.0000E-04

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 7.74E-07 FT/SECOND = 2.36E-05 CM/SECOND

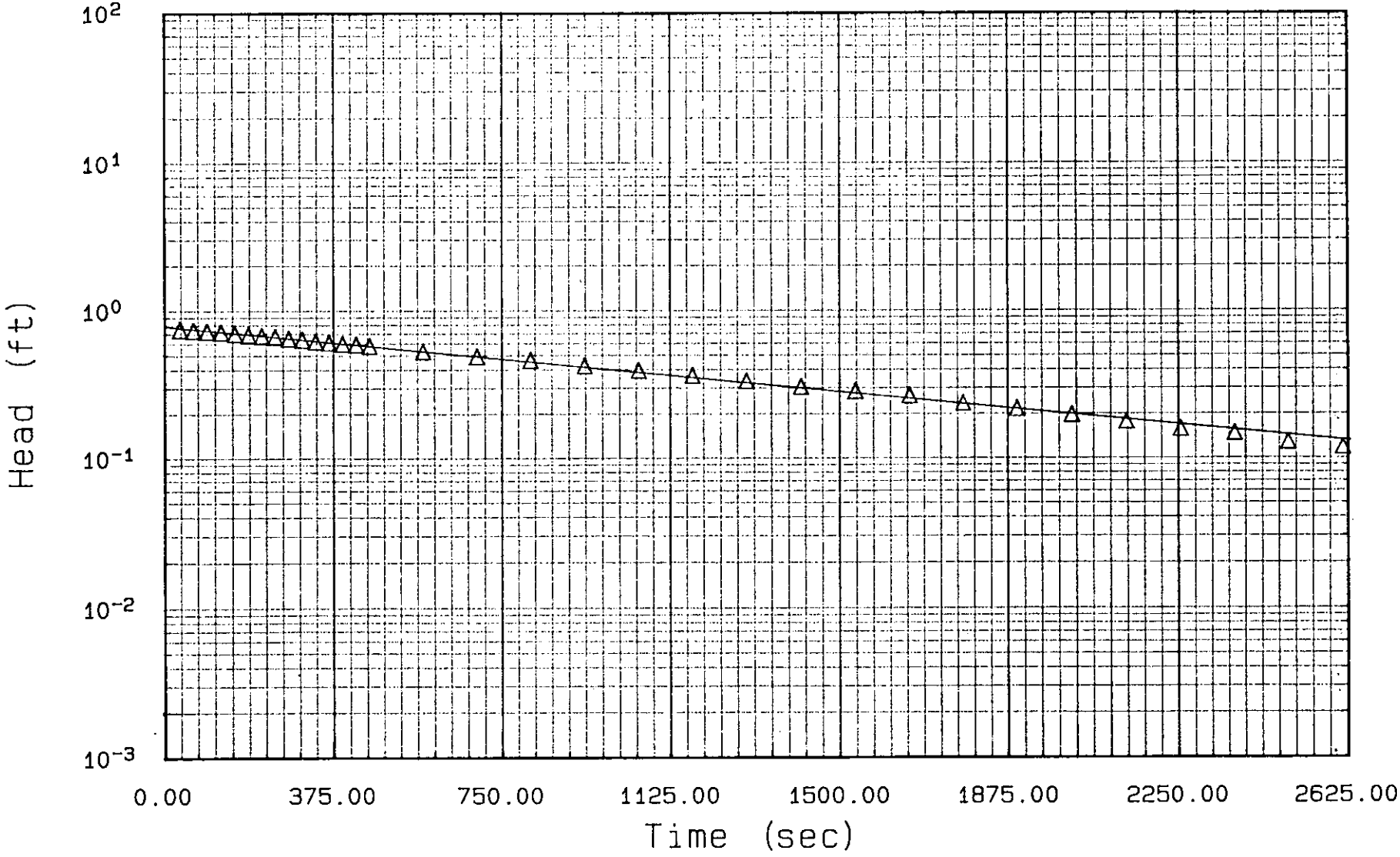
TRANSMISSIVITY = 9.13E-06 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

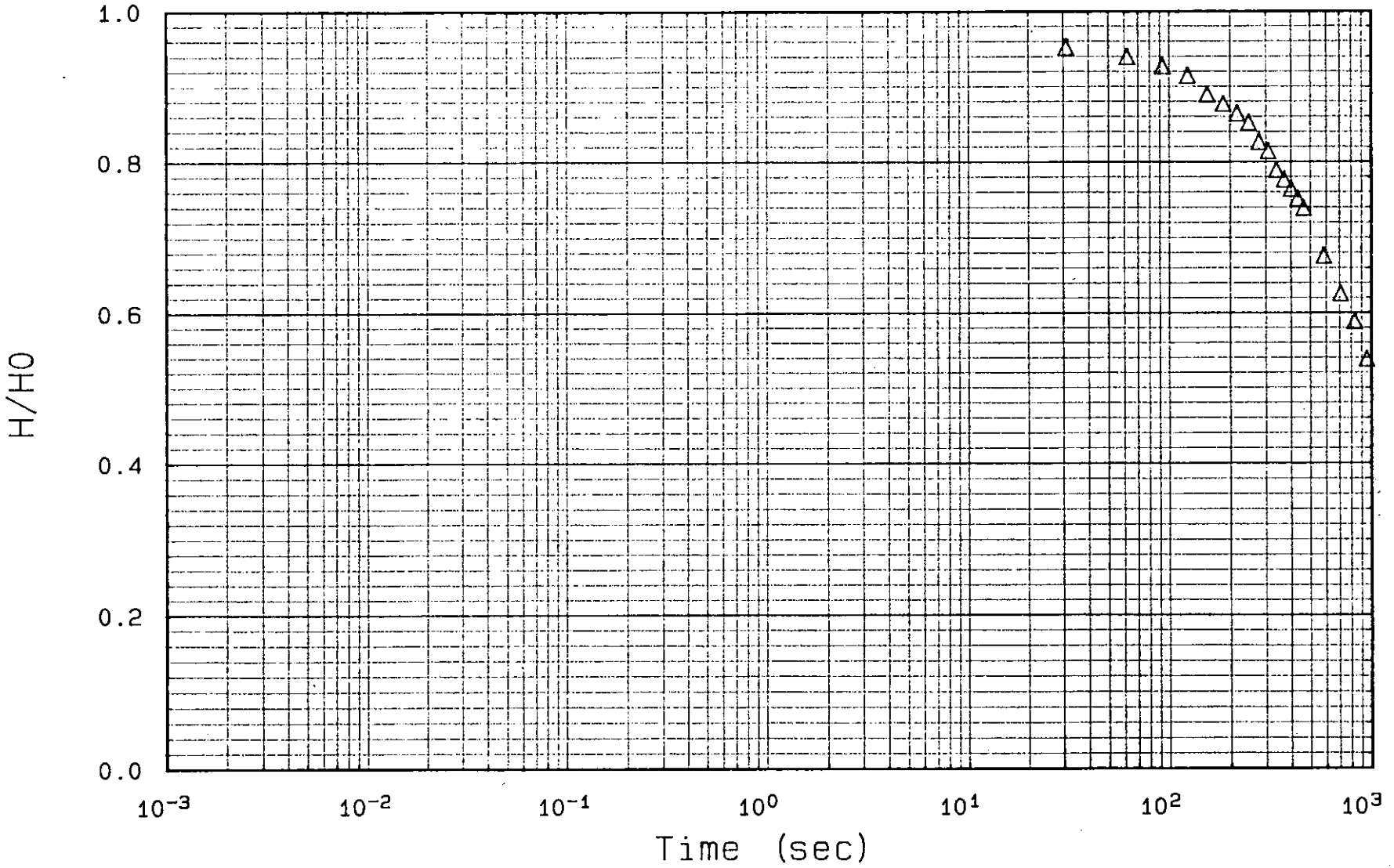
PERMEABILITY = 1.21E-06 FT/SECOND = 3.70E-05 CM/SECOND

TRANSMISSIVITY = 1.43E-05 FT**2/SECOND

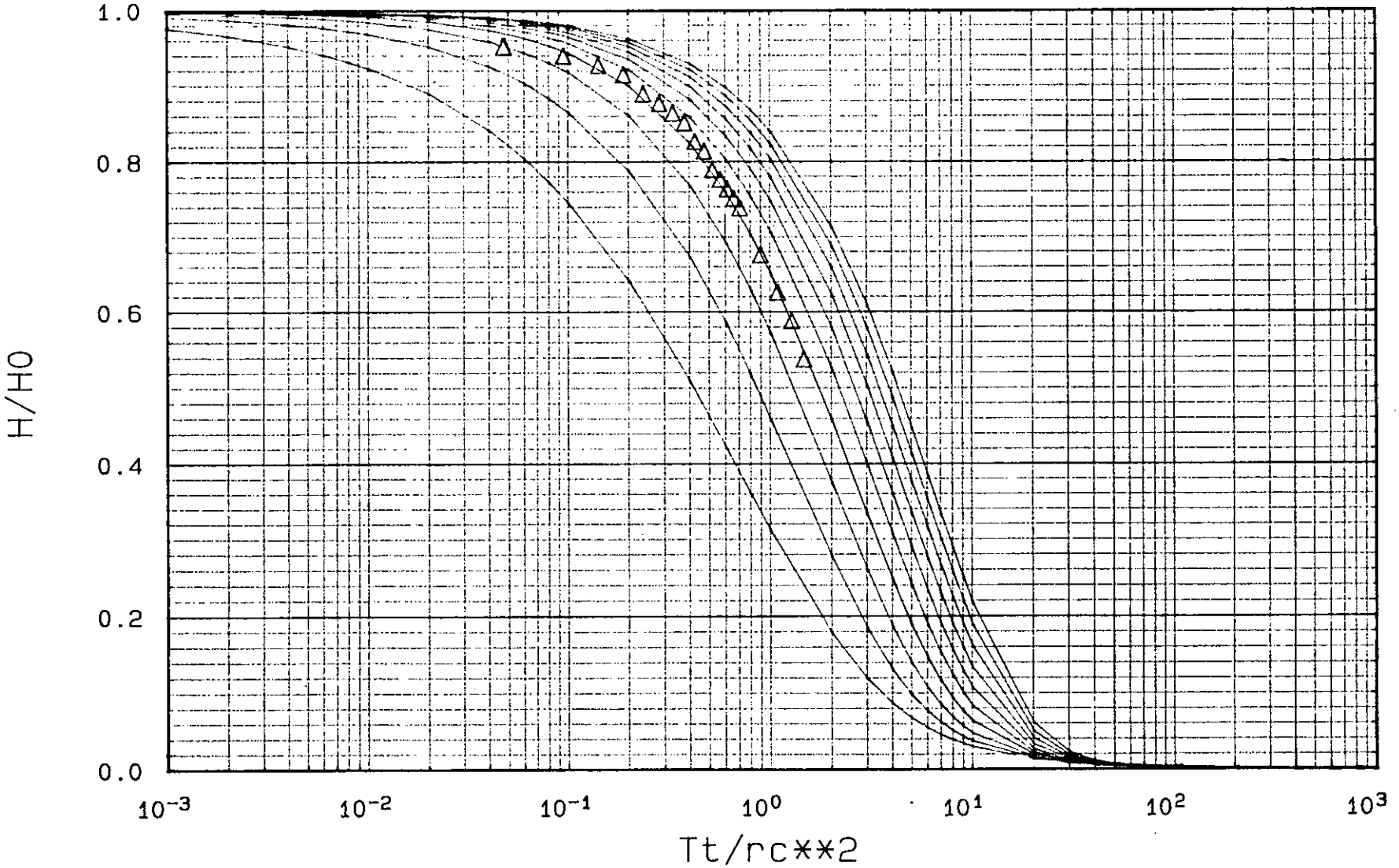
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20D (FALLING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20D (FALLING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20D (FALLING) Date 8/22/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05

CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI

DATE OF SLUG TEST: 8/22/90

FIELD INVESTIGATOR: C. TRIONE

WELL NO.: P20DA (RISING)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 6.50 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 0.25
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 11.80 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 11.80 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 38

TIME (SECOND)	HEAD (FEET)
30.00	1.340
60.00	1.300
90.00	1.260
120.00	1.220
150.00	1.190
180.00	1.160
210.00	1.130
240.00	1.110
270.00	1.080
300.00	1.050
330.00	1.030
360.00	1.000
390.00	0.980
420.00	0.950
450.00	0.930
480.00	0.900
600.00	0.810
720.00	0.730
840.00	0.670
960.00	0.600
1080.00	0.540
1200.00	0.480
1320.00	0.440
1440.00	0.400
1560.00	0.360

1680.00	0.320
1800.00	0.290
1920.00	0.260
2040.00	0.230
2160.00	0.200
2280.00	0.170
2400.00	0.150
2520.00	0.120
2640.00	0.100
2760.00	0.080
2880.00	0.060
3000.00	0.030
3120.00	0.020

HO CALCULATED BASED ON FIRST 29 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 1.3641

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 1.36 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	8.532E-06	7.231E-07	6.911E-08	1.665E-05	1.942874	1757.12	0.00
1.000E-02	1.000E-02	1.315E-05	1.114E-06	3.613E-07	1.790E-05	1.334009	1578.76	178.36
1.000E-03	1.000E-03	1.813E-05	1.537E-06	1.173E-06	1.881E-05	0.972967	1617.19	-38.43
1.000E-04	1.000E-04	2.302E-05	1.950E-06	2.214E-06	1.998E-05	0.772050	1689.26	-72.08
1.000E-05	1.000E-05	2.771E-05	2.348E-06	3.267E-06	2.151E-05	0.658252	1753.45	-64.19
1.000E-06	1.000E-06	3.229E-05	2.736E-06	4.294E-06	2.351E-05	0.595003	1798.90	-45.44
1.000E-07	1.000E-07	3.716E-05	3.149E-06	5.304E-06	2.585E-05	0.552971	1818.09	-19.19
1.000E-08	1.000E-08	4.216E-05	3.573E-06	6.297E-06	2.707E-05	0.492752	1824.62	-6.53
1.000E-09	1.000E-09	4.713E-05	3.994E-06	7.282E-06	2.872E-05	0.454821	1832.30	-7.68
1.000E-10	1.000E-10	5.212E-05	4.417E-06	8.265E-06	3.089E-05	0.434106	1837.81	-5.52

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0037

TRANSMISSIVITY = 9.9596E-06 FEET**2/SECOND
STORATIVITY = 1.0000E-07

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 9.52E-07 FT/SECOND = 2.90E-05 CM/SECOND

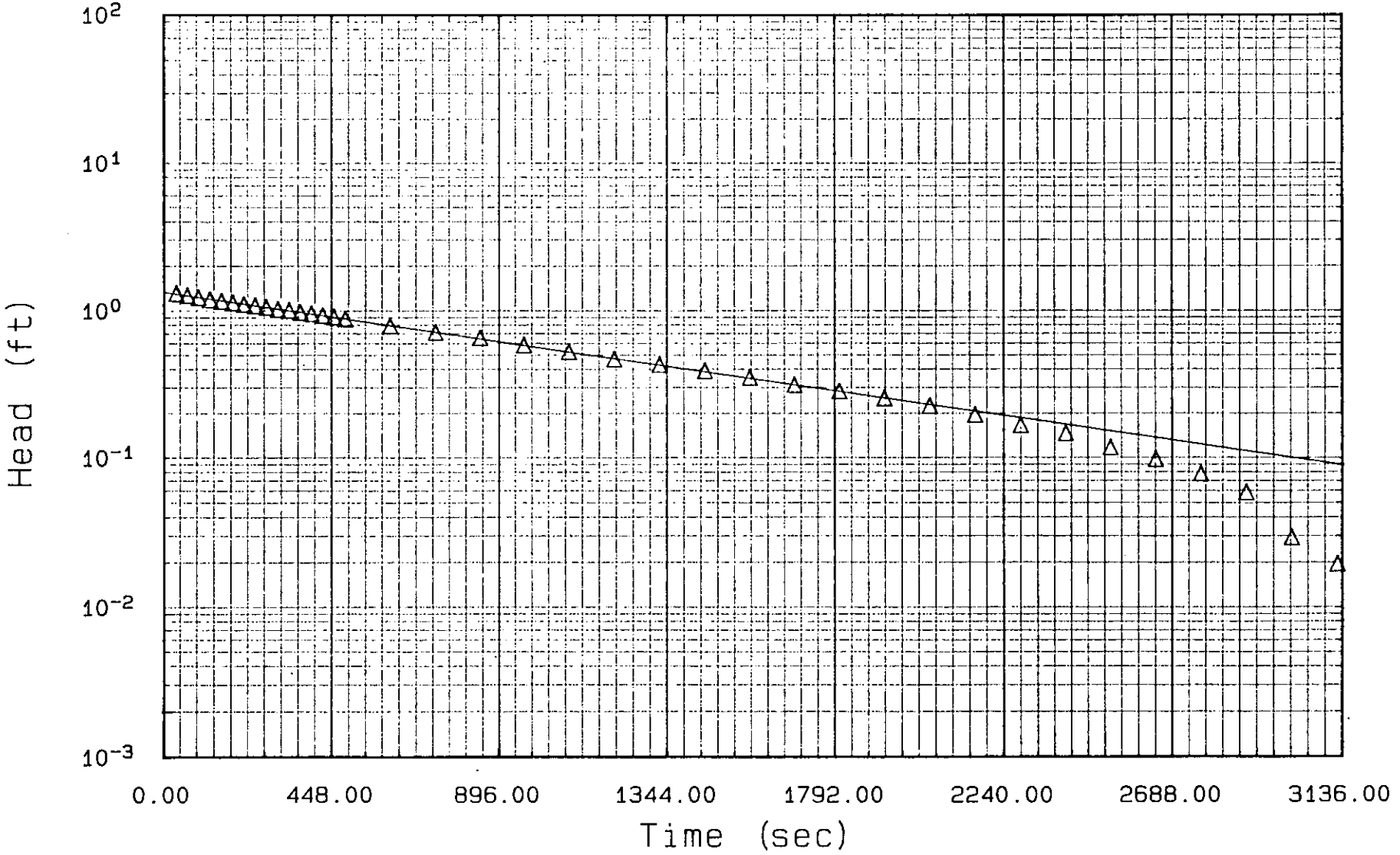
TRANSMISSIVITY = 1.12E-05 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

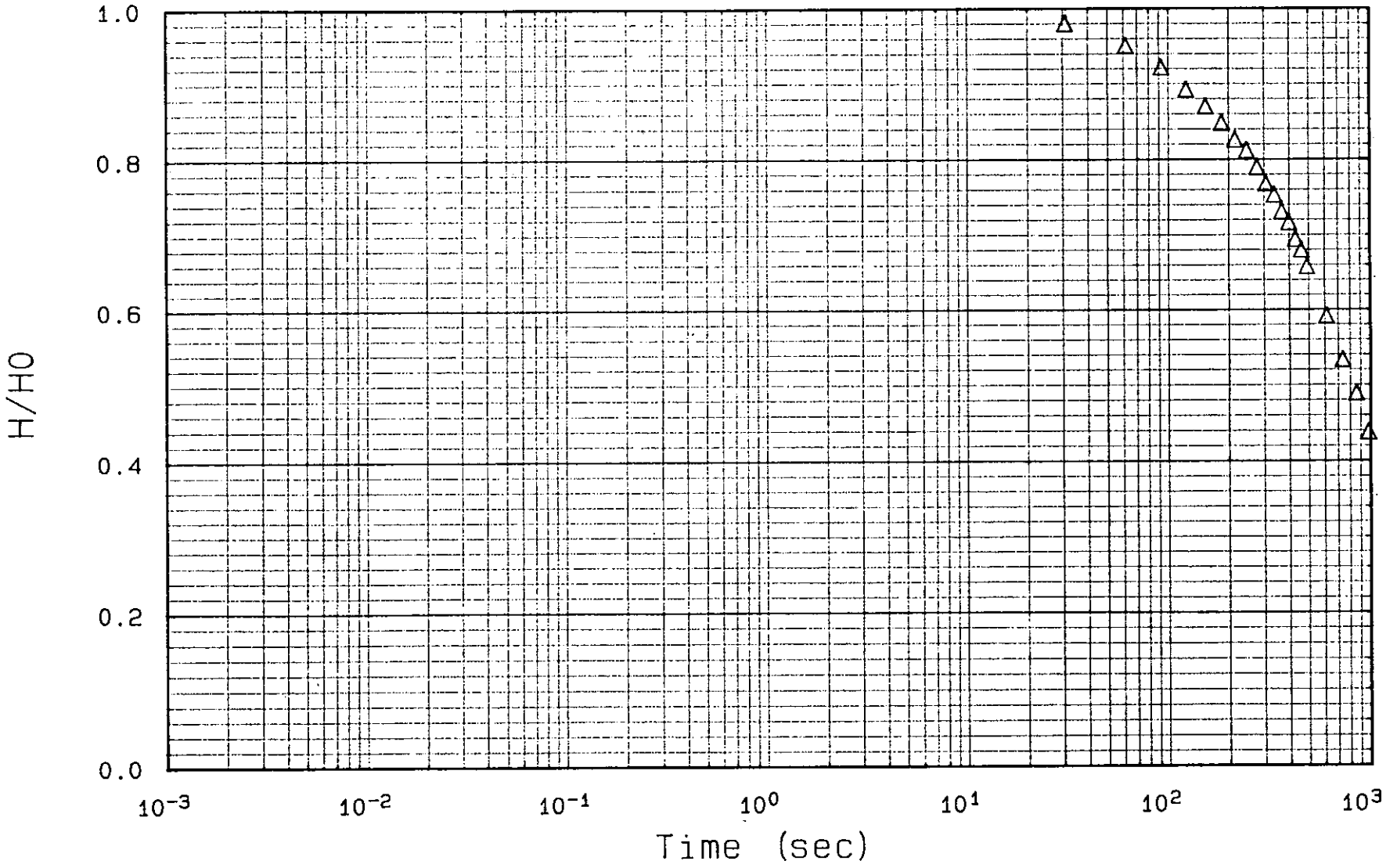
PERMEABILITY = 1.53E-06 FT/SECOND = 4.68E-05 CM/SECOND

TRANSMISSIVITY = 1.81E-05 FT**2/SECOND

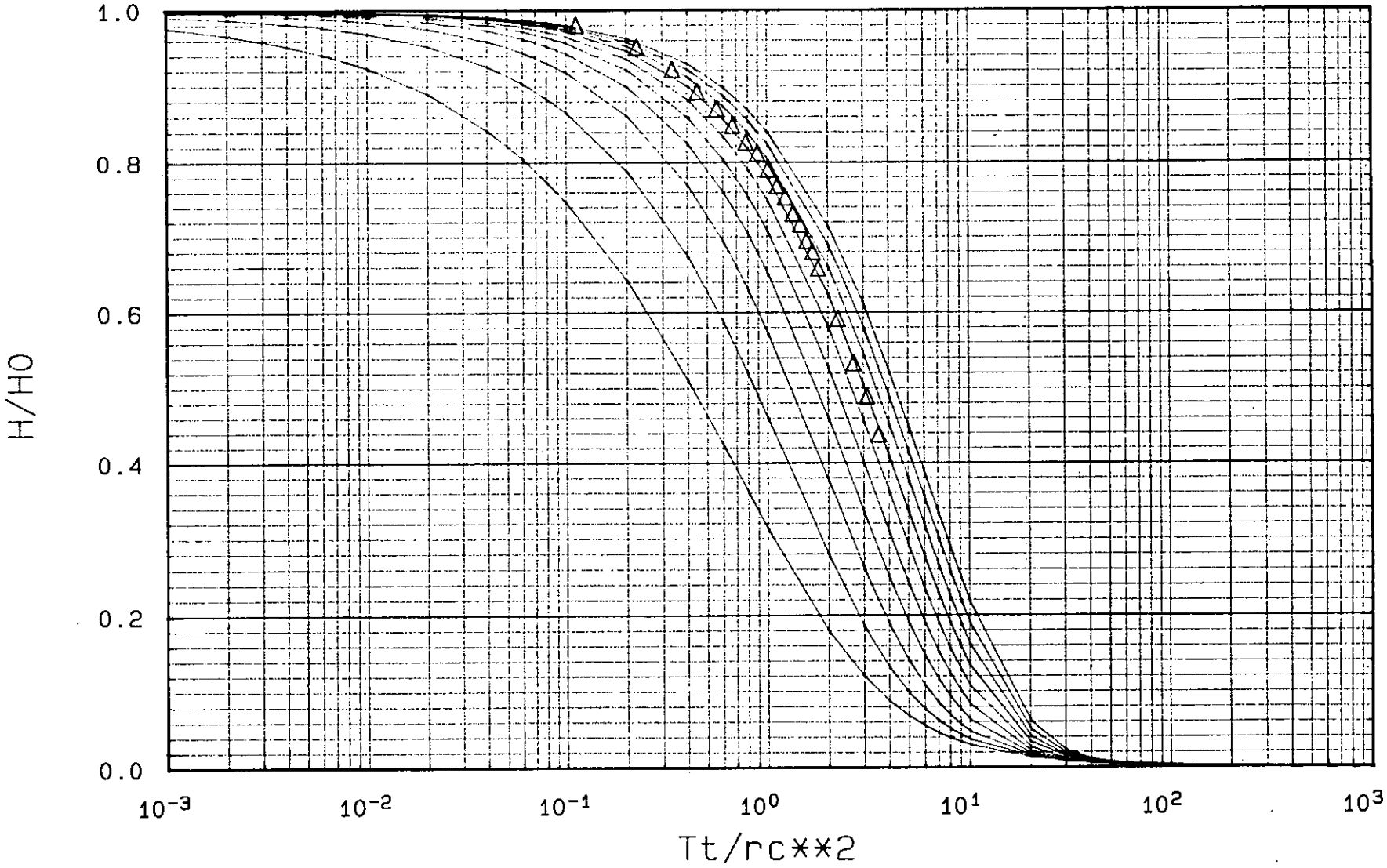
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20DA (RISING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20DA (RISING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P20DA (RISING) Date 8/22/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05

CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI

DATE OF SLUG TEST: 8/21/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: P-21S (F)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 1.25 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 7.39 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 7.39 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 67

TIME (SECOND)	HEAD (FEET)
1.00	0.392
2.00	0.389
6.00	0.386
17.00	0.382
27.00	0.379
37.00	0.376
42.00	0.373
52.00	0.370
57.00	0.367
67.00	0.363
77.00	0.360
87.00	0.357
97.00	0.354
102.00	0.351
112.00	0.348
142.00	0.341
172.00	0.335
202.00	0.326
232.00	0.322
262.00	0.316
292.00	0.310
322.00	0.307
352.00	0.300
412.00	0.291
502.00	0.284

532.00	0.291
592.00	0.284
652.00	0.275
712.00	0.262
772.00	0.250
832.00	0.234
952.00	0.224
1012.00	0.221
1072.00	0.212
1132.00	0.193
1192.00	0.180
1252.00	0.171
1312.00	0.161
1372.00	0.152
1432.00	0.136
1492.00	0.133
1552.00	0.126
1612.00	0.123
1672.00	0.117
1732.00	0.117
1792.00	0.114
1852.00	0.107
1912.00	0.101
1972.00	0.101
2032.00	0.098
2092.00	0.088
2152.00	0.082
2212.00	0.076
2272.00	0.076
2332.00	0.073
2392.00	0.063
2452.00	0.051
2512.00	0.047
2572.00	0.038
2632.00	0.032
2692.00	0.025
2752.00	0.028
2812.00	0.025
2872.00	0.022
2932.00	0.019
3052.00	0.016
3112.00	0.006

HO SPECIFIED BY USER

SPECIFIED VALUE FOR HO (FEET) 0.3950

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 0.40 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.627E-05	2.202E-06	2.989E-07	1.605E-05	0.968457	3600.07	0.00
1.000E-02	1.000E-02	2.790E-05	3.775E-06	1.435E-06	1.759E-05	0.578984	3769.10	-169.03
1.000E-03	1.000E-03	4.311E-05	5.833E-06	2.423E-06	1.842E-05	0.371070	3926.90	-157.81
1.000E-04	1.000E-04	5.932E-05	8.027E-06	3.399E-06	2.762E-05	0.408302	4030.87	-103.97
1.000E-05	1.000E-05	7.467E-05	1.010E-05	4.354E-06	4.118E-05	0.493133	4102.29	-71.42
1.000E-06	1.000E-06	9.048E-05	1.224E-05	5.290E-06	5.447E-05	0.543506	4137.58	-35.29
1.000E-07	1.000E-07	1.071E-04	1.449E-05	6.216E-06	6.747E-05	0.571928	4150.15	-12.57
1.000E-08	1.000E-08	1.238E-04	1.676E-05	7.136E-06	8.026E-05	0.590506	4156.62	-6.47
1.000E-09	1.000E-09	1.402E-04	1.898E-05	8.052E-06	9.293E-05	0.605215	4164.67	-8.06
1.000E-10	1.000E-10	1.563E-04	2.115E-05	8.963E-06	1.056E-04	0.618463	4171.84	-7.17

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0007

TRANSMISSIVITY = 1.9204E-06 FEET**2/SECOND
STORATIVITY = 1.0000E-01

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

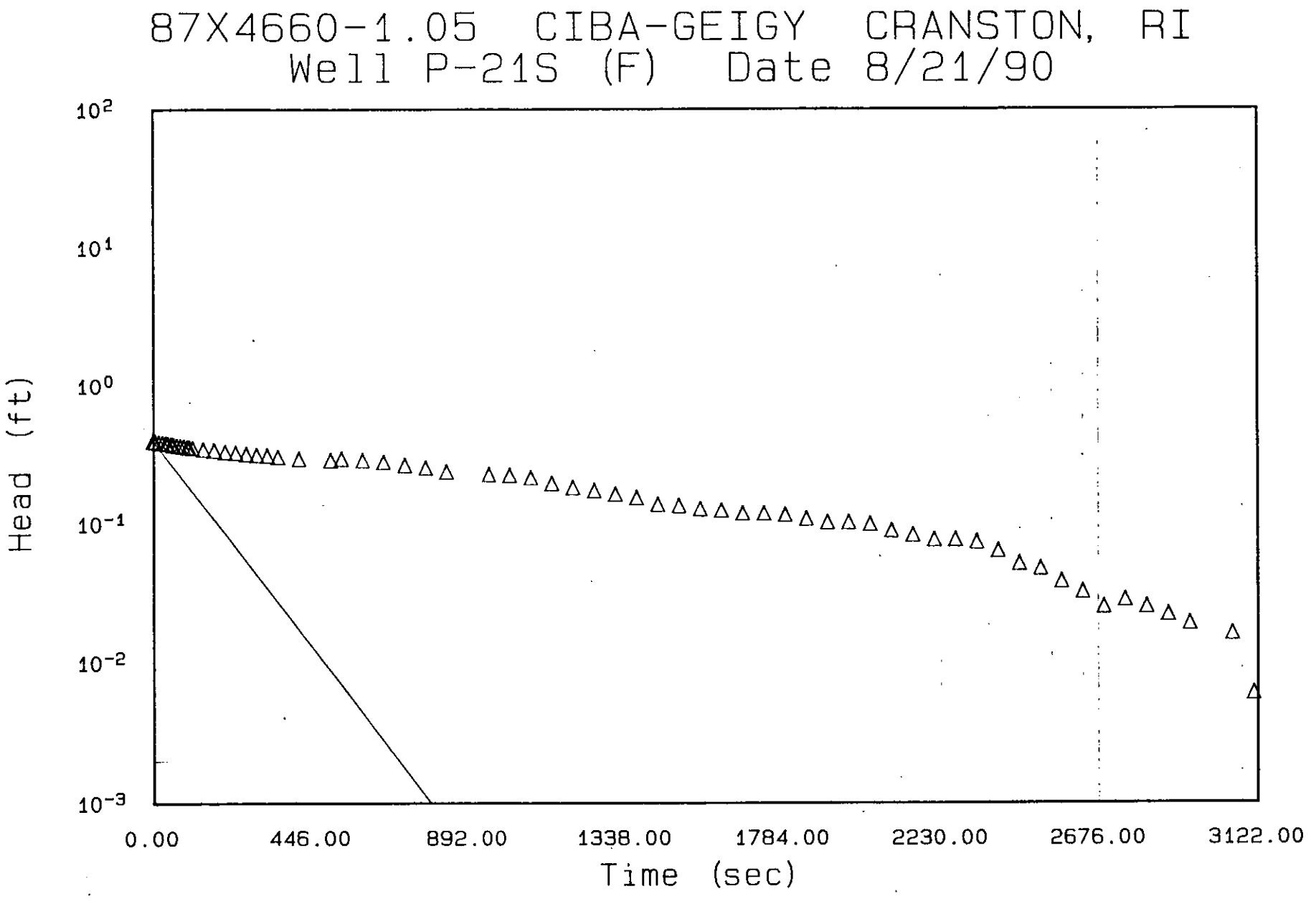
PERMEABILITY = 1.26E-05 FT/SECOND = 3.84E-04 CM/SECOND

TRANSMISSIVITY = 9.31E-05 FT**2/SECOND

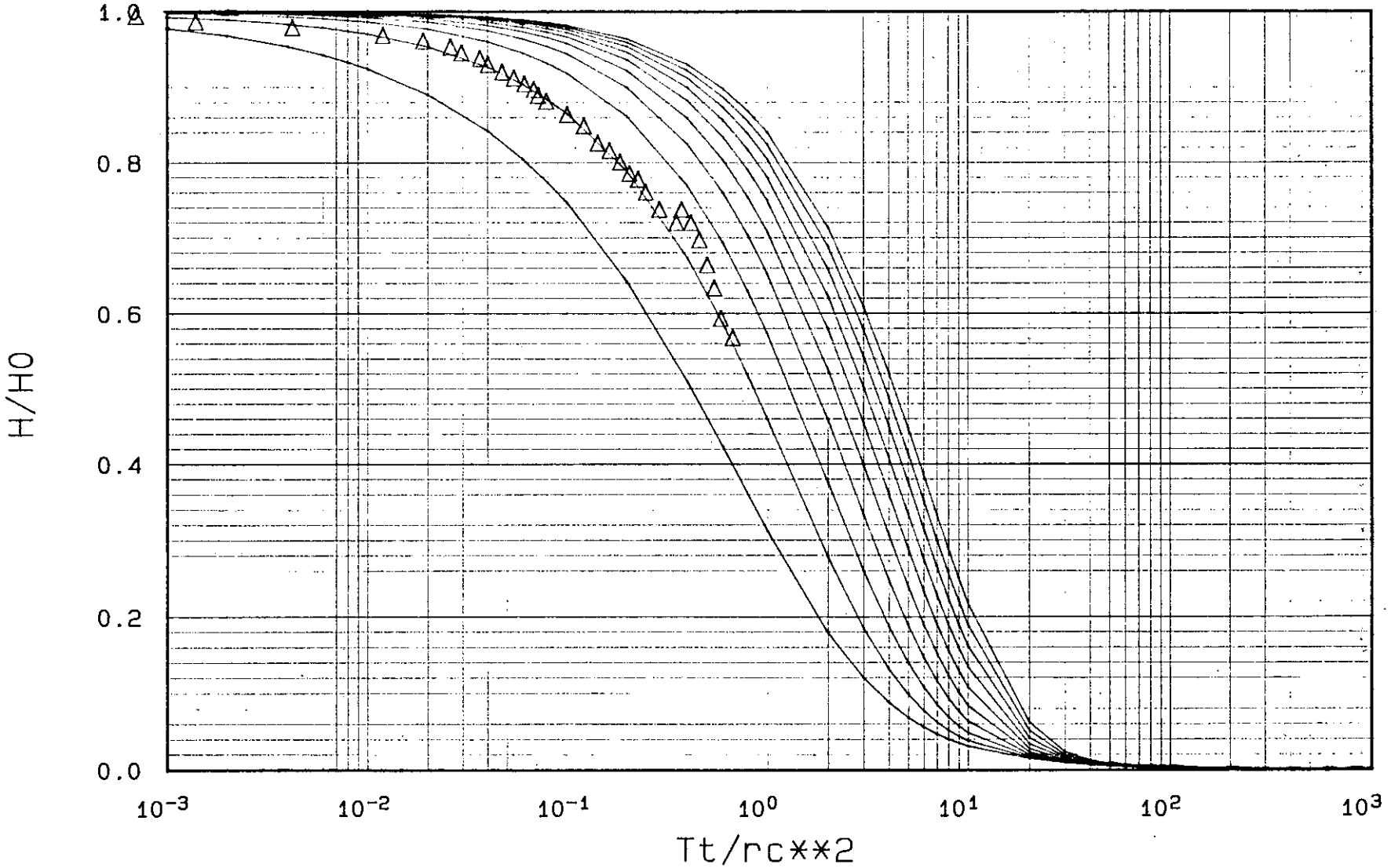
COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.26E-05 FT/SECOND = 3.84E-04 CM/SECOND

TRANSMISSIVITY = 9.31E-05 FT**2/SECOND


87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P-21S (F) Date 8/21/90
Head (ft)
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
0.00
446.00
892.00
1338.00
1784.00
2230.00
2676.00
3122.00
Time (sec)

87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P-21S (F) Date 8/21/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/21/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: P-21S r2 (R)

INPUT DATA ARE:

INNER CASING DIAMETER = 1.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 1.25 INCHES
DIAMETER OF DRILLED HOLE = 1.25 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 9.39 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 9.39 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 78

TIME (SECOND)	HEAD (FEET)
1.00	0.312
2.00	0.303
3.00	0.300
4.00	0.297
7.00	0.293
10.00	0.290
14.00	0.287
24.00	0.284
39.00	0.281
44.00	0.281
49.00	0.278
69.00	0.275
84.00	0.271
104.00	0.268
144.00	0.262
174.00	0.252
204.00	0.246
294.00	0.240
384.00	0.237
414.00	0.233
444.00	0.230
474.00	0.227
504.00	0.224
534.00	0.224
594.00	0.218

774.00	0.214
834.00	0.208
894.00	0.205
954.00	0.199
1014.00	0.192
1074.00	0.189
1134.00	0.186
1194.00	0.183
1254.00	0.180
1314.00	0.173
1374.00	0.170
1434.00	0.167
1494.00	0.164
1554.00	0.158
1614.00	0.154
1674.00	0.148
1734.00	0.145
1794.00	0.135
1854.00	0.126
1914.00	0.123
1974.00	0.123
2034.00	0.120
2094.00	0.116
2154.00	0.113
2214.00	0.107
2274.00	0.101
2334.00	0.101
2394.00	0.094
2454.00	0.094
2514.00	0.091
2574.00	0.085
2634.00	0.079
2694.00	0.079
2754.00	0.075
2814.00	0.072
2874.00	0.069
2934.00	0.066
2994.00	0.060
3054.00	0.056
3174.00	0.053
3354.00	0.050
3594.00	0.047
3654.00	0.044
3714.00	0.037
3894.00	0.034
3954.00	0.031
4074.00	0.028
4134.00	0.025
4194.00	0.022
4254.00	0.018
4314.00	0.015
4434.00	0.012
4494.00	0.009

HO CALCULATED BASED ON FIRST 25 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 0.2900

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 0.29 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	6.918E-06	7.368E-07	*********	5.969E-06	2.153813	4601.69	0.00
1.000E-02	1.000E-02	1.016E-05	1.082E-06	*********	6.409E-06	3.159958	4599.63	2.06
1.000E-03	1.000E-03	1.019E-05	1.085E-06	*********	6.643E-06	7.128362	4094.96	504.67
1.000E-04	1.000E-04	4.641E-06	4.942E-07	*********	7.402E-06	31.674002	1742.48	2352.49
1.000E-05	1.000E-05	*********	*********	*********	8.940E-06	*********	13256.70	-11514.22
1.000E-06	1.000E-06	*********	*********	*********	1.086E-05	*********	8721.79	4534.91
1.000E-07	1.000E-07	*********	*********	*********	1.180E-05	*********	7889.37	832.42
1.000E-08	1.000E-08	*********	*********	*********	1.222E-05	*********	7648.77	240.60
1.000E-09	1.000E-09	*********	*********	*********	1.346E-05	*********	7400.92	247.86
1.000E-10	1.000E-10	*********	*********	*********	1.522E-05	*********	7314.93	85.99

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0004

TRANSMISSIVITY = 1.1501E-06 FEET**2/SECOND
STORATIVITY = 1.0000E-02

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 9.11E-07 FT/SECOND = 2.78E-05 CM/SECOND

TRANSMISSIVITY = 8.56E-06 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 9.11E-07 FT/SECOND = 2.78E-05 CM/SECOND

TRANSMISSIVITY = 8.56E-06 FT**2/SECOND

PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05

CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI

DATE OF SLUG TEST: 8/21/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: P21D (FALLING)

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 6.50 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 0.25
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 33.70 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 5.00 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 54

TIME (SECOND)	HEAD (FEET)
1.00	2.730
2.00	2.720
3.00	2.700
4.00	2.690
5.00	2.670
6.00	2.660
7.00	2.650
8.00	2.640
9.00	2.620
10.00	2.610
11.00	2.600
12.00	2.580
13.00	2.570
18.01	2.500
23.00	2.440
28.00	2.380
33.01	2.330
38.00	2.270
43.00	2.220
48.01	2.170
53.00	2.120
58.00	2.070
63.01	2.030
68.00	1.980
73.00	1.940

78.00	1.900
83.00	1.860
88.00	1.820
93.01	1.780
98.00	1.740
103.00	1.710
108.01	1.670
113.00	1.640
143.00	1.450
173.00	1.280
203.00	1.130
233.00	0.990
263.00	0.880
293.00	0.780
323.00	0.690
353.00	0.600
383.00	0.530
413.00	0.460
443.00	0.410
473.00	0.360
503.00	0.310
533.00	0.270
563.00	0.240
593.00	0.210
713.00	0.120
833.00	0.070
953.00	0.040
1073.00	0.020
1193.00	0.020

HO CALCULATED BASED ON FIRST 33 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 2.7260

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 2.73 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.732E-04	3.464E-05	*********	9.447E-04	5.463802	1197.57	0.00
1.000E-02	1.000E-02	2.643E-04	5.286E-05	*********	9.866E-04	3.751819	722.46	475.11
1.000E-03	1.000E-03	3.712E-04	7.425E-05	*********	1.023E-03	2.790608	454.34	268.12
1.000E-04	1.000E-04	4.804E-04	9.609E-05	*********	1.058E-03	2.258835	308.48	145.86
1.000E-05	1.000E-05	5.900E-04	1.180E-04	*********	1.095E-03	1.934469	222.78	85.70
1.000E-06	1.000E-06	6.939E-04	1.388E-04	*********	1.134E-03	1.733185	174.81	47.97
1.000E-07	1.000E-07	7.960E-04	1.592E-04	*********	1.177E-03	1.593837	147.16	27.65
1.000E-08	1.000E-08	9.009E-04	1.802E-04	*********	1.224E-03	1.483675	126.91	20.26
1.000E-09	1.000E-09	1.007E-03	2.013E-04	*********	1.277E-03	1.406683	114.62	12.28
1.000E-10	1.000E-10	1.116E-03	2.232E-04	*********	1.329E-03	1.335414	105.68	8.94

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0301

TRANSMISSIVITY = 8.3677E-04 FEET**2/SECOND
STORATIVITY = 1.0000E-10

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 6.16E-05 FT/SECOND = 1.88E-03 CM/SECOND

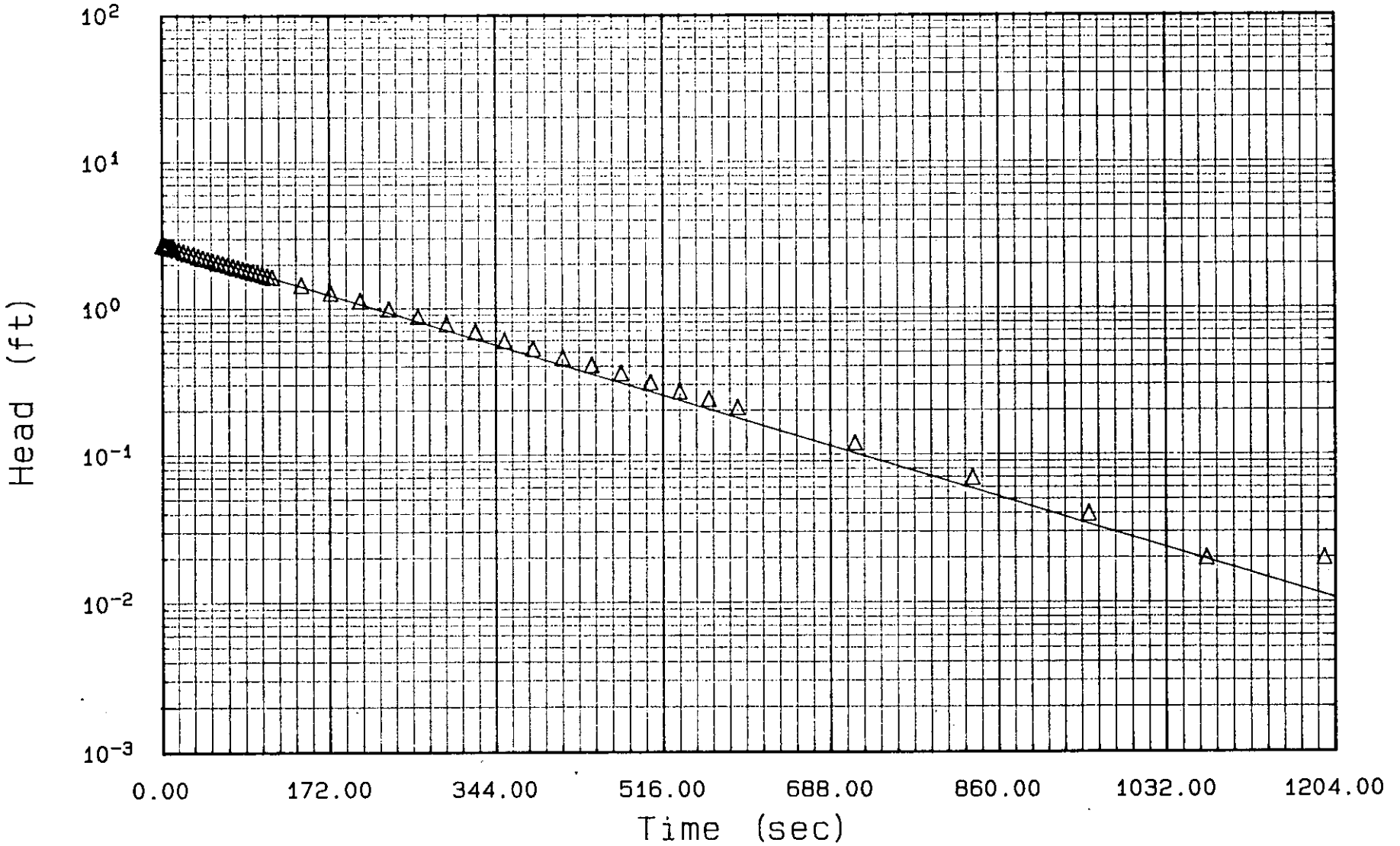
TRANSMISSIVITY = 3.08E-04 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

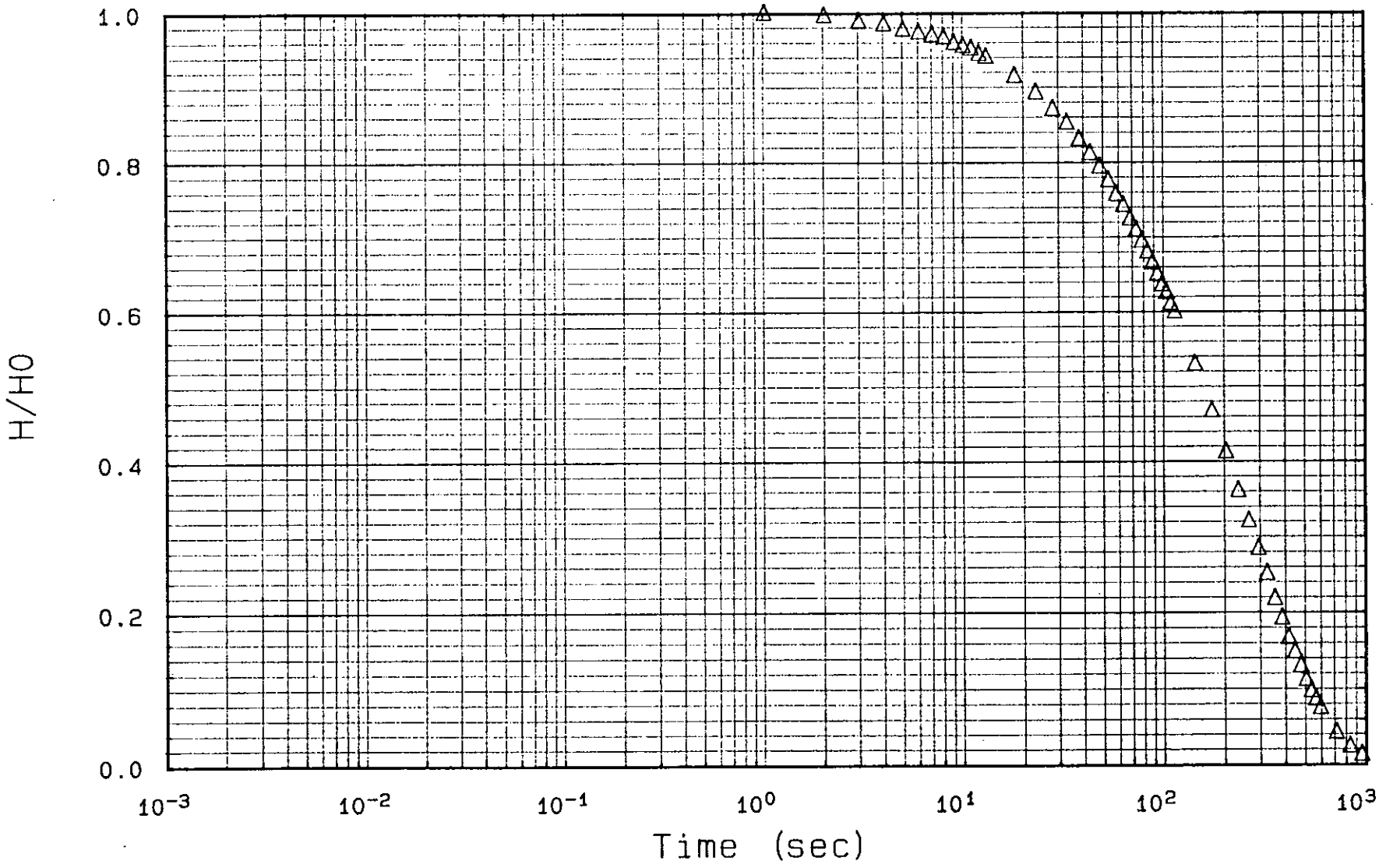
PERMEABILITY = 7.23E-05 FT/SECOND = 2.20E-03 CM/SECOND

TRANSMISSIVITY = 3.61E-04 FT**2/SECOND

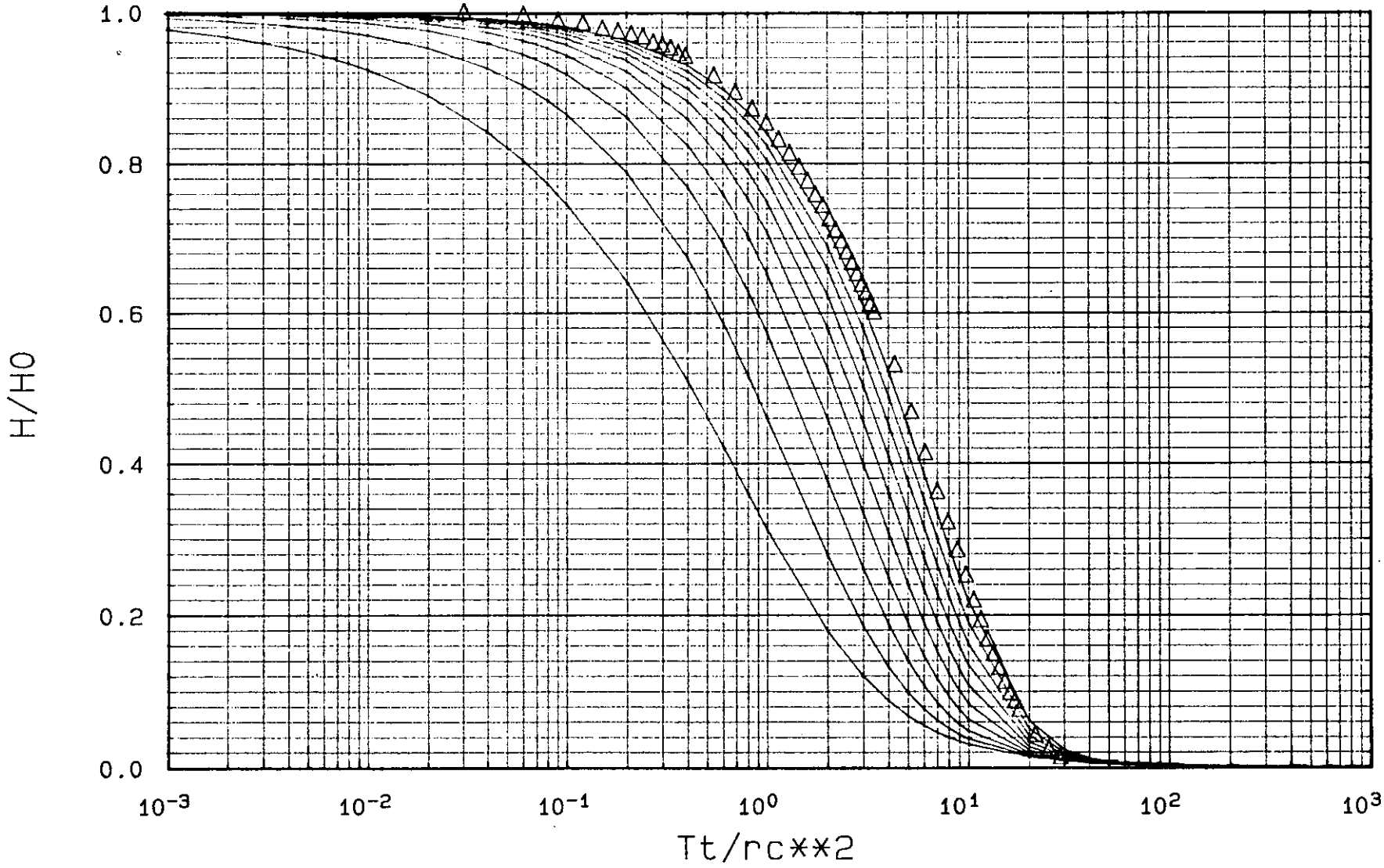
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P21D (FALLING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P21D (FALLING) Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P21D (FALLING) Date 8/21/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05

CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI

DATE OF SLUG TEST: 8/21/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: P-21DA (R) r2

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 6.50 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 0.25
EFFECTIVE AQUIFER THICKNESS USED 3.00

LENGTH OF SCREEN OR INTAKE PORTION = 3.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 33.70 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 5.00 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 42

TIME (SECOND)	HEAD (FEET)
1.00	2.690
2.00	2.590
3.00	2.500
4.00	2.440
5.00	2.380
6.00	2.320
7.00	2.250
8.00	2.180
9.00	2.040
10.00	2.080
11.00	2.030
12.00	1.980
13.00	1.930
14.00	1.890
15.00	1.850
16.00	1.800
17.00	1.770
22.00	1.530
27.00	1.360
32.00	1.210
37.00	1.080
42.00	0.960
47.00	0.850
52.00	0.760
57.00	0.670

62.00	0.600
67.00	0.530
72.00	0.480
77.00	0.420
82.00	0.380
87.00	0.340
92.00	0.300
97.00	0.280
102.00	0.250
107.00	0.230
112.00	0.210
117.00	0.190
147.00	0.120
177.00	0.090
207.00	0.080
237.00	0.070
357.00	0.060

HO CALCULATED BASED ON FIRST 20 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 2.6924

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 2.69 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	7.690E-04	1.538E-04	1.078E-06	1.454E-03	1.889771	58.03	0.00
1.000E-02	1.000E-02	1.234E-03	2.467E-04	3.100E-06	1.677E-03	1.356816	20.61	37.42
1.000E-03	1.000E-03	1.731E-03	3.461E-04	7.964E-06	1.888E-03	1.086458	21.96	-1.36
1.000E-04	1.000E-04	2.230E-03	4.459E-04	1.684E-05	2.233E-03	0.993895	29.09	-7.12
1.000E-05	1.000E-05	2.729E-03	5.457E-04	2.889E-05	2.567E-03	0.930269	32.50	-3.41
1.000E-06	1.000E-06	3.186E-03	6.371E-04	4.579E-05	2.961E-03	0.914997	37.52	-5.02
1.000E-07	1.000E-07	3.632E-03	7.264E-04	6.213E-05	3.477E-03	0.940110	40.78	-3.26
1.000E-08	1.000E-08	4.100E-03	8.201E-04	7.770E-05	3.997E-03	0.955899	41.94	-1.16
1.000E-09	1.000E-09	4.602E-03	9.203E-04	9.351E-05	4.515E-03	0.960906	41.79	0.15
1.000E-10	1.000E-10	5.126E-03	1.025E-03	1.082E-04	5.031E-03	0.960312	42.01	-0.22

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.1562

TRANSMISSIVITY = 4.3396E-03 FEET**2/SECOND
STORATIVITY = 1.0000E-10

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 3.40E-04 FT/SECOND = 1.03E-02 CM/SECOND

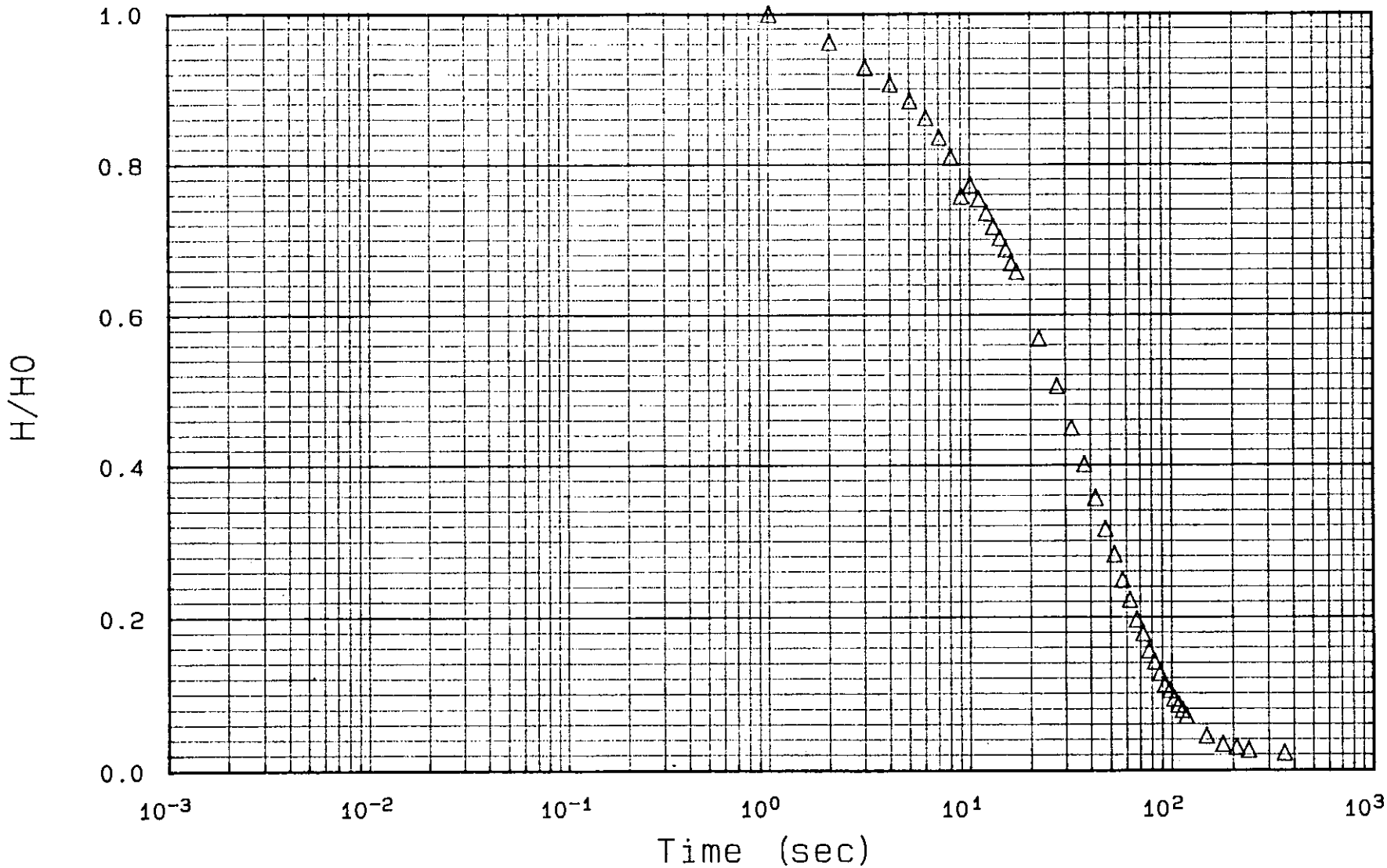
TRANSMISSIVITY = 1.70E-03 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

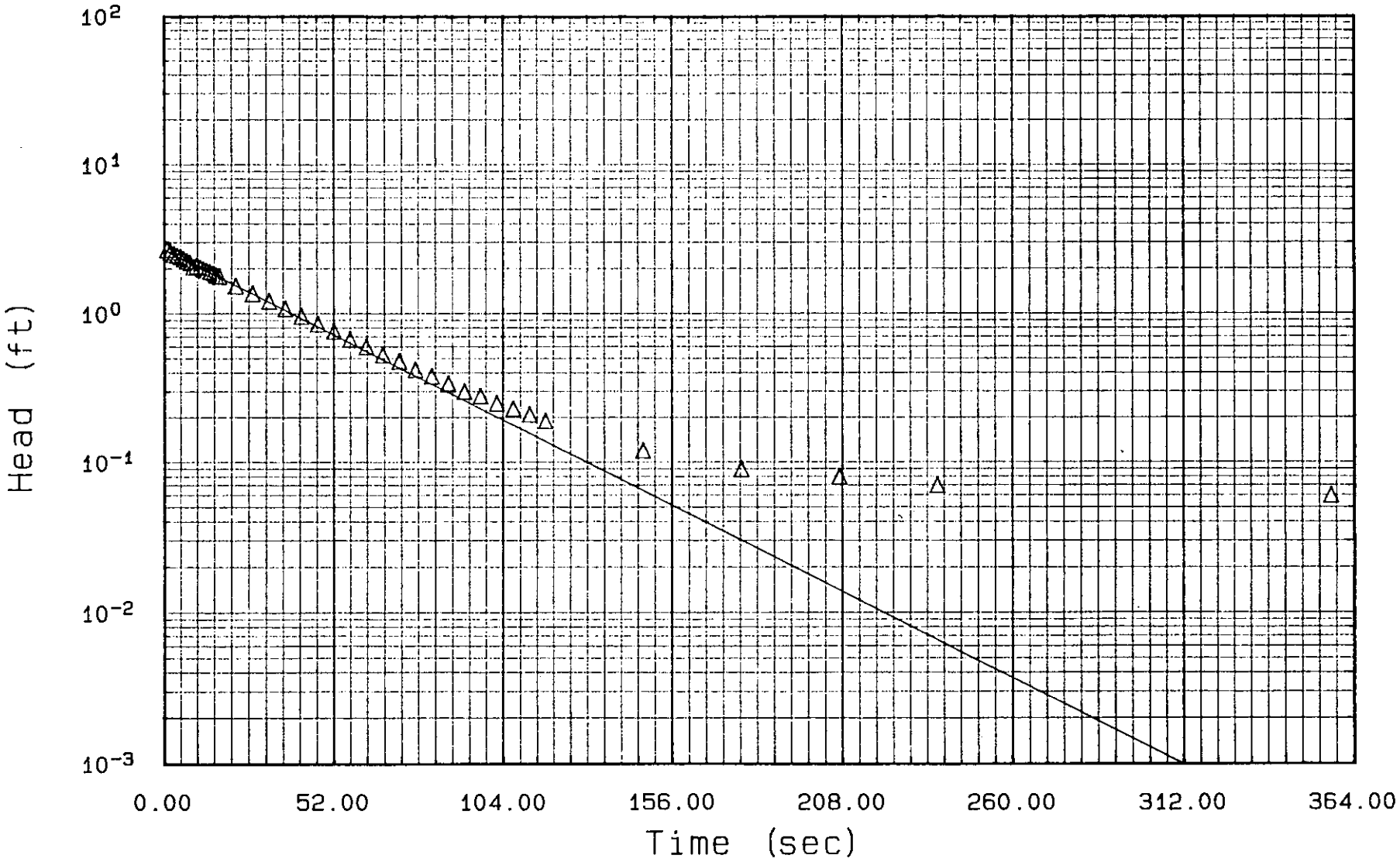
PERMEABILITY = 3.98E-04 FT/SECOND = 1.21E-02 CM/SECOND

TRANSMISSIVITY = 1.99E-03 FT**2/SECOND

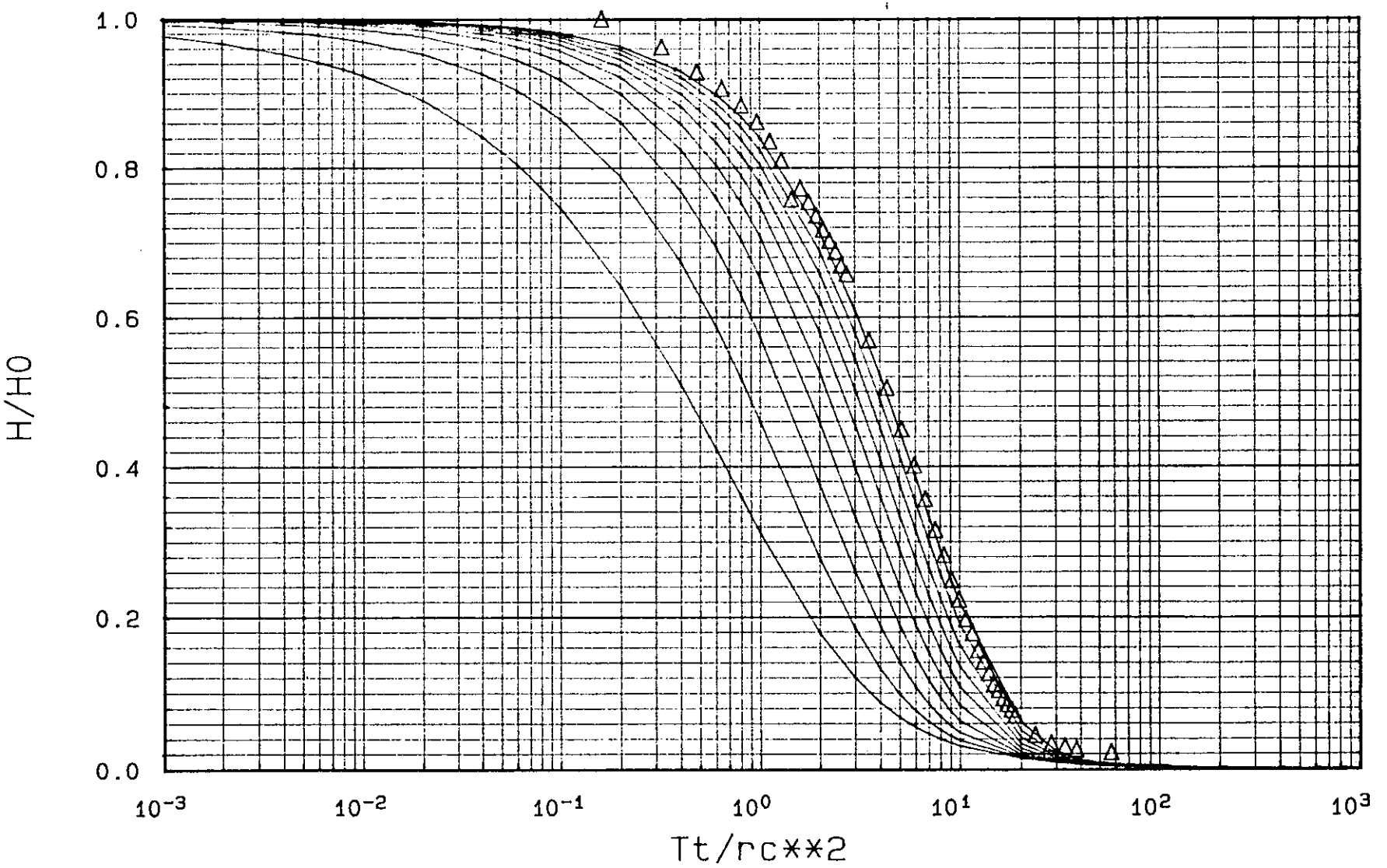
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P-21DA (R) r2 Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P-21DA (R) r2 Date 8/21/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well P-21DA (R) r2 Date 8/21/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/22/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: RW1 (FALLING)

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 7.88 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 0.25
EFFECTIVE AQUIFER THICKNESS USED 12.00

LENGTH OF SCREEN OR INTAKE PORTION = 12.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 85.56 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 19.00 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 100

TIME (SECOND)	HEAD (FEET)
0.50	2.452
1.00	2.436
2.00	2.414
4.00	2.411
8.00	2.408
11.00	2.405
14.00	2.402
16.00	2.398
21.00	2.392
26.00	2.383
31.00	2.379
36.00	2.373
41.00	2.367
46.00	2.360
51.00	2.354
56.00	2.348
61.00	2.341
66.00	2.335
71.00	2.329
76.00	2.323
81.00	2.316
86.00	2.310
91.00	2.304
96.00	2.297
101.00	2.294

106.00	2.288
111.00	2.278
116.00	2.275
146.00	2.237
176.00	2.202
206.00	2.171
236.00	2.136
266.00	2.098
296.00	2.070
326.00	2.035
356.00	2.006
386.00	1.978
416.00	1.953
446.00	1.927
476.00	1.902
506.00	1.880
536.00	1.852
566.00	1.826
596.00	1.804
656.00	1.747
716.00	1.693
776.00	1.643
836.00	1.592
896.00	1.548
956.00	1.507
1016.00	1.450
1076.00	1.403
1136.00	1.352
1196.00	1.301
1256.00	1.267
1316.00	1.235
1376.00	1.188
1436.00	1.147
1496.00	1.105
1556.00	1.074
1616.00	1.039
1676.00	1.004
1736.00	0.979
1796.00	0.944
1856.00	0.909
1916.00	0.881
1976.00	0.849
2036.00	0.815
2096.00	0.774
2156.00	0.739
2216.00	0.720
2276.00	0.695
2336.00	0.672
2396.00	0.650
2456.00	0.616
2516.00	0.584
2576.00	0.565
2636.00	0.536
2696.00	0.505
2756.00	0.476
2816.00	0.457
2876.00	0.432
2936.00	0.404
2996.00	0.372
3056.00	0.350

3116.00	0.318
3176.00	0.290
3236.00	0.271
3296.00	0.246
3356.00	0.236
3416.00	0.227
3476.00	0.198
3536.00	0.173
3596.00	0.151
3656.00	0.130
3716.00	0.101
3776.00	0.076
3836.00	0.054
3896.00	0.038
3956.00	0.016

HO CALCULATED BASED ON FIRST 15 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 2.4267

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 2.43 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.736E-05	9.136E-07	*********	2.842E-04	17.805115	7517.78	0.00
1.000E-02	1.000E-02	2.584E-05	1.360E-06	*********	2.949E-04	14.178981	5139.40	2378.38
1.000E-03	1.000E-03	3.537E-05	1.861E-06	*********	3.042E-04	13.789283	3742.06	1397.34
1.000E-04	1.000E-04	4.443E-05	2.338E-06	*********	3.133E-04	15.789805	2986.87	755.19
1.000E-05	1.000E-05	5.244E-05	2.760E-06	*********	3.237E-04	18.766836	2582.21	404.66
1.000E-06	1.000E-06	5.959E-05	3.136E-06	*********	3.344E-04	21.951414	2331.87	250.34
1.000E-07	1.000E-07	6.658E-05	3.504E-06	*********	3.460E-04	24.806068	2177.09	154.78
1.000E-08	1.000E-08	7.436E-05	3.914E-06	*********	3.580E-04	26.272675	2029.32	147.77
1.000E-09	1.000E-09	8.098E-05	4.262E-06	*********	3.706E-04	29.041304	1956.93	72.39
1.000E-10	1.000E-10	8.863E-05	4.665E-06	*********	3.839E-04	30.260366	1878.65	78.28

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0015

TRANSMISSIVITY = 4.0748E-05 FEET**2/SECOND
STORATIVITY = 1.0000E-05

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 2.79E-06 FT/SECOND = 8.50E-05 CM/SECOND

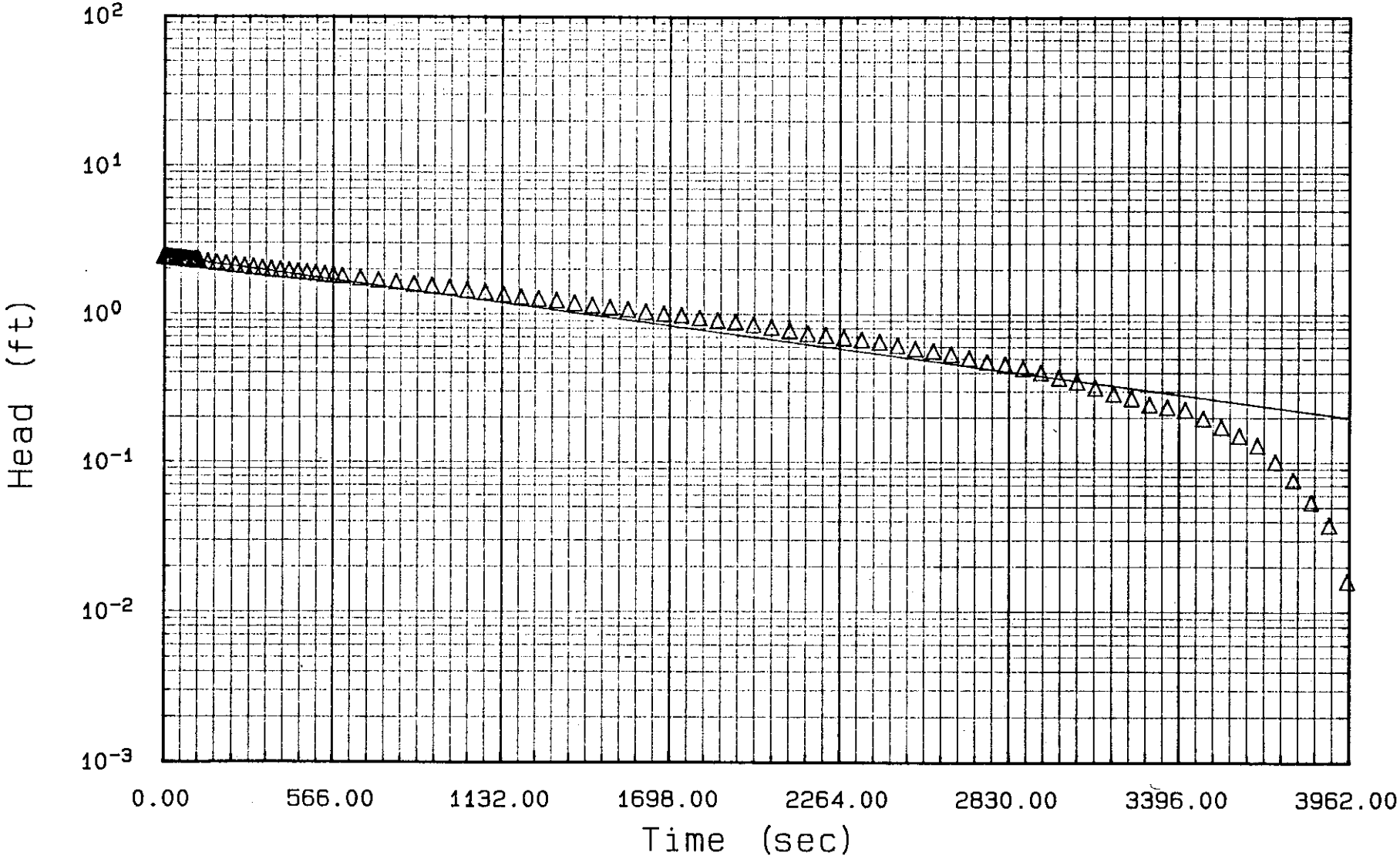
TRANSMISSIVITY = 5.30E-05 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

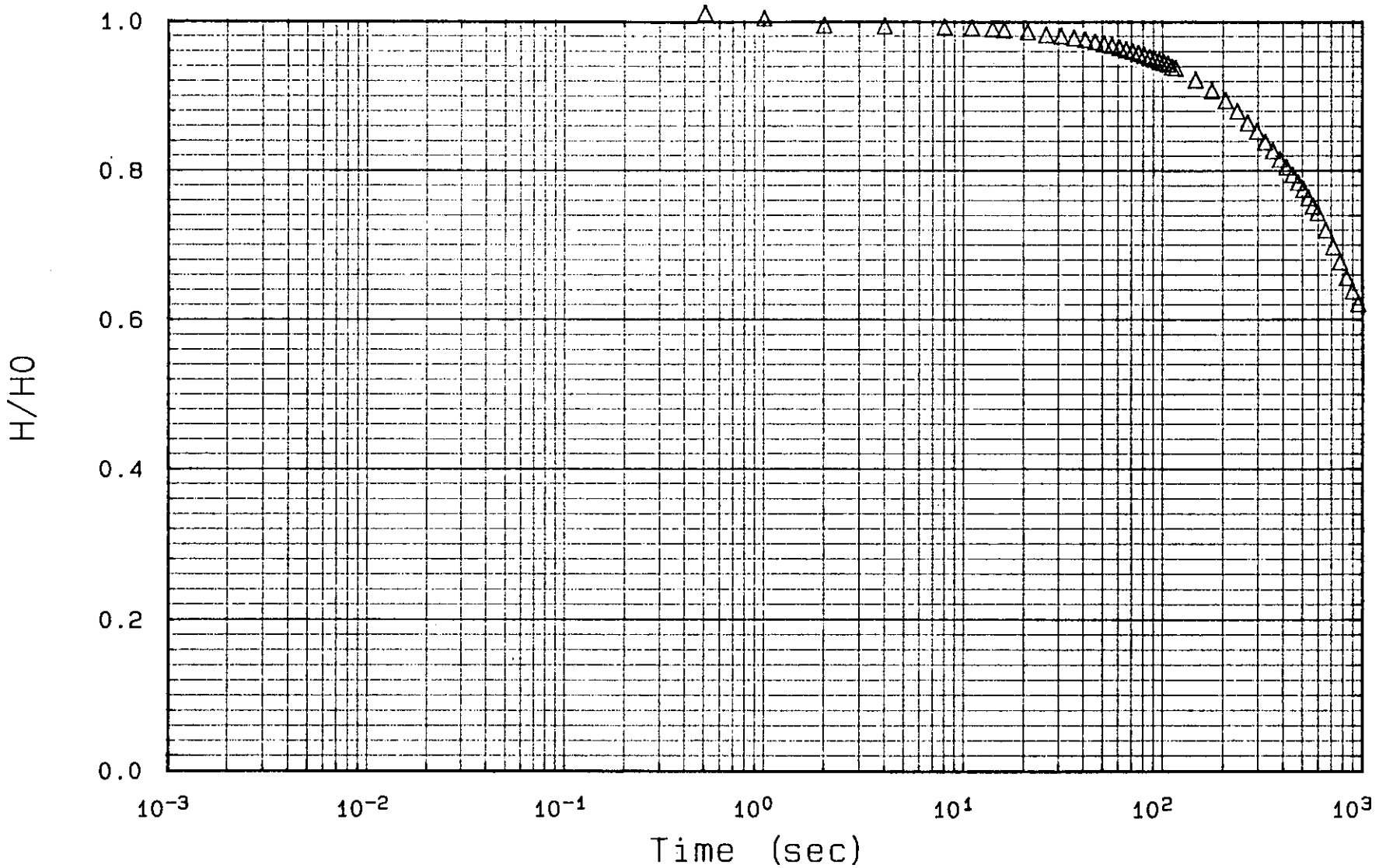
PERMEABILITY = 3.27E-06 FT/SECOND = 9.95E-05 CM/SECOND

TRANSMISSIVITY = 6.21E-05 FT**2/SECOND

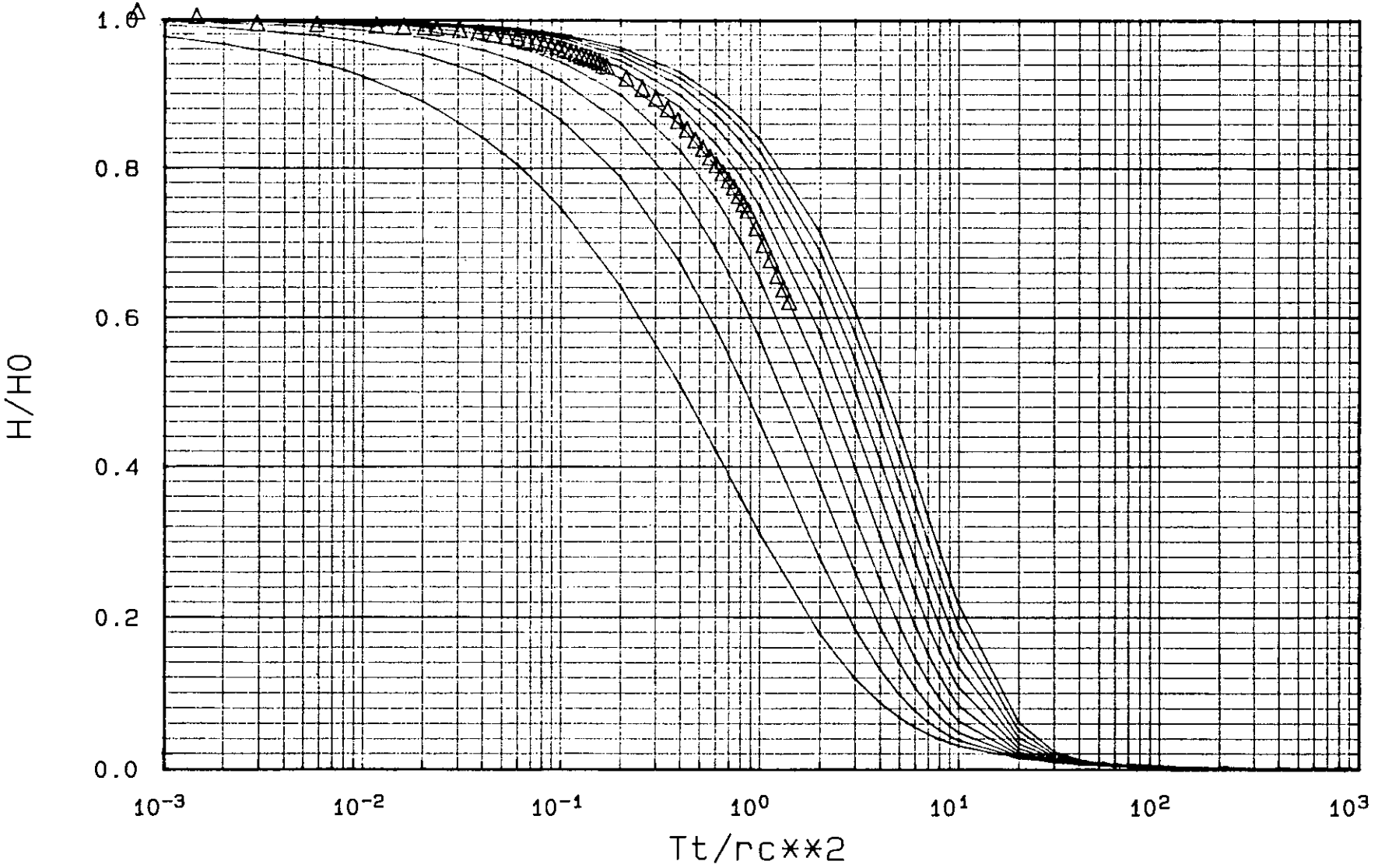
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW1 (FALLING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW1 (FALLING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW1 (FALLING) Date 8/22/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/22/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: RW1A (RISING)

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 7.88 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 0.25
EFFECTIVE AQUIFER THICKNESS USED 12.00

LENGTH OF SCREEN OR INTAKE PORTION = 12.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 85.56 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 19.00 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 102

TIME (SECOND)	HEAD (FEET)
1.00	1.618
3.00	1.615
4.00	1.612
6.00	1.609
8.00	1.606
9.00	1.603
15.00	1.590
20.00	1.584
25.00	1.574
30.00	1.568
35.00	1.561
40.00	1.552
45.00	1.546
50.00	1.539
55.00	1.530
60.00	1.524
65.00	1.517
70.00	1.511
75.00	1.505
80.00	1.498
85.00	1.492
90.00	1.486
95.00	1.476
100.00	1.473
105.00	1.467

110.00	1.460
140.00	1.419
170.00	1.384
200.00	1.353
230.00	1.324
260.00	1.293
290.00	1.264
320.00	1.230
350.00	1.198
380.00	1.169
410.00	1.138
440.00	1.109
470.00	1.090
500.00	1.068
530.00	1.040
560.00	1.018
590.00	0.992
650.00	0.948
710.00	0.913
770.00	0.863
830.00	0.828
890.00	0.796
950.00	0.762
1010.00	0.730
1070.00	0.695
1130.00	0.670
1190.00	0.635
1250.00	0.613
1310.00	0.585
1370.00	0.572
1430.00	0.550
1490.00	0.528
1550.00	0.493
1610.00	0.477
1670.00	0.446
1730.00	0.430
1790.00	0.427
1850.00	0.420
1910.00	0.408
1970.00	0.379
2030.00	0.357
2090.00	0.344
2150.00	0.319
2210.00	0.303
2270.00	0.291
2330.00	0.288
2390.00	0.281
2450.00	0.265
2510.00	0.256
2570.00	0.243
2630.00	0.243
2690.00	0.234
2750.00	0.215
2810.00	0.218
2870.00	0.205
2930.00	0.202
2990.00	0.190
3050.00	0.174
3110.00	0.164
3170.00	0.161

3230.00	0.155
3290.00	0.142
3350.00	0.133
3410.00	0.133
3470.00	0.136
3530.00	0.129
3590.00	0.133
3650.00	0.129
3710.00	0.126
3770.00	0.110
3830.00	0.098
3890.00	0.085
3950.00	0.073
4010.00	0.060
4070.00	0.041
4130.00	0.025
4190.00	0.012

HO CALCULATED BASED ON FIRST 26 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 1.6152

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 1.62 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	2.408E-05	1.267E-06	*********	2.390E-04	10.013218	4673.85	0.00
1.000E-02	1.000E-02	3.779E-05	1.989E-06	*********	2.497E-04	6.767868	2909.82	1764.03
1.000E-03	1.000E-03	5.330E-05	2.805E-06	*********	2.590E-04	5.150430	1949.78	960.03
1.000E-04	1.000E-04	6.906E-05	3.635E-06	*********	2.682E-04	4.359238	1437.21	512.58
1.000E-05	1.000E-05	8.443E-05	4.444E-06	*********	2.777E-04	3.949374	1162.40	274.81
1.000E-06	1.000E-06	9.838E-05	5.178E-06	*********	2.877E-04	3.760615	1034.99	127.41
1.000E-07	1.000E-07	1.129E-04	5.944E-06	*********	2.986E-04	3.620839	936.63	98.36
1.000E-08	1.000E-08	1.282E-04	6.746E-06	*********	3.108E-04	3.476827	836.68	99.95
1.000E-09	1.000E-09	1.437E-04	7.564E-06	*********	3.242E-04	3.420695	750.17	86.51
1.000E-10	1.000E-10	1.597E-04	8.405E-06	*********	3.380E-04	3.332405	684.43	65.74

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0025

TRANSMISSIVITY = 6.9900E-05 FEET**2/SECOND
STORATIVITY = 1.0000E-05

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 4.16E-06 FT/SECOND = 1.27E-04 CM/SECOND

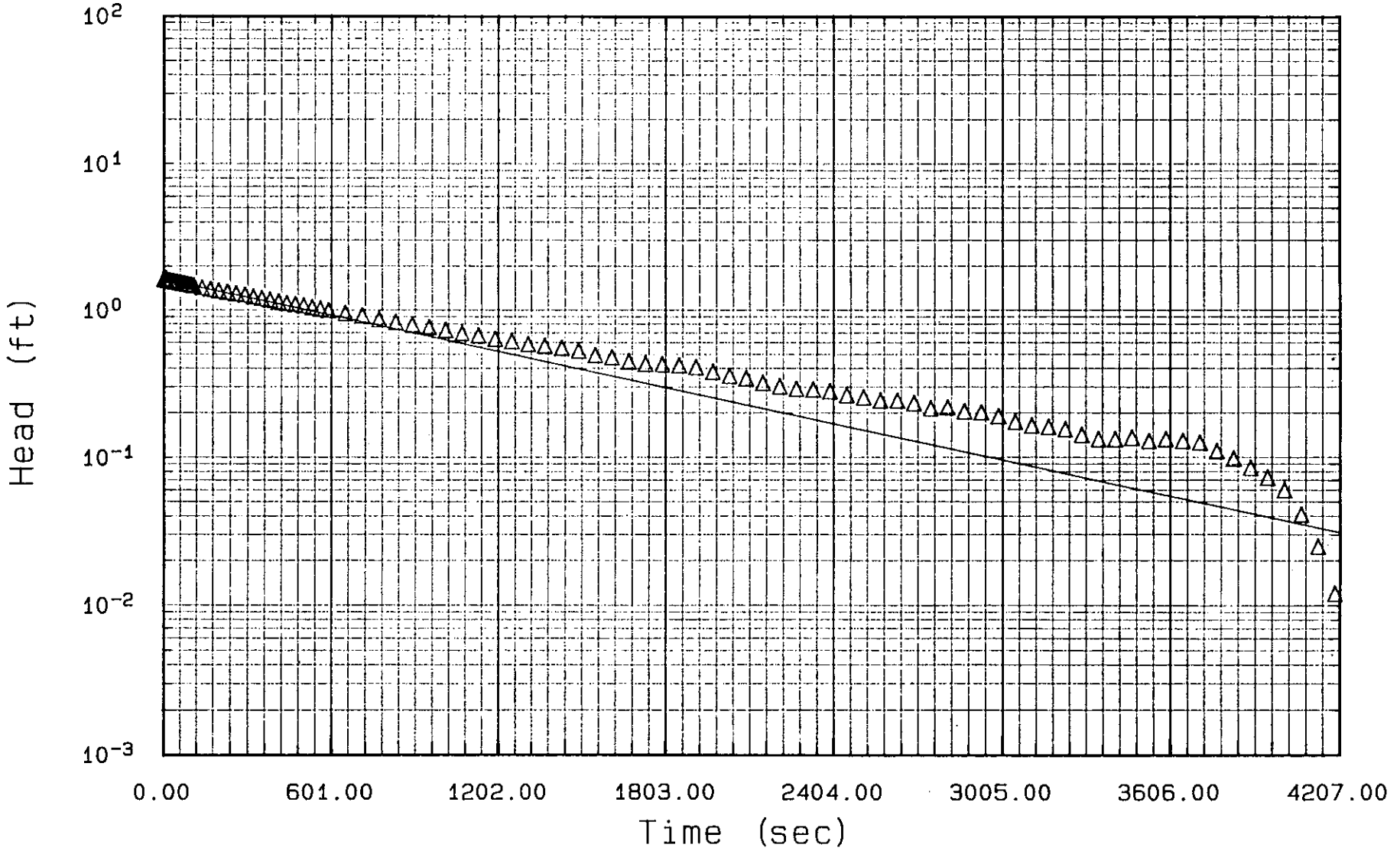
TRANSMISSIVITY = 7.90E-05 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

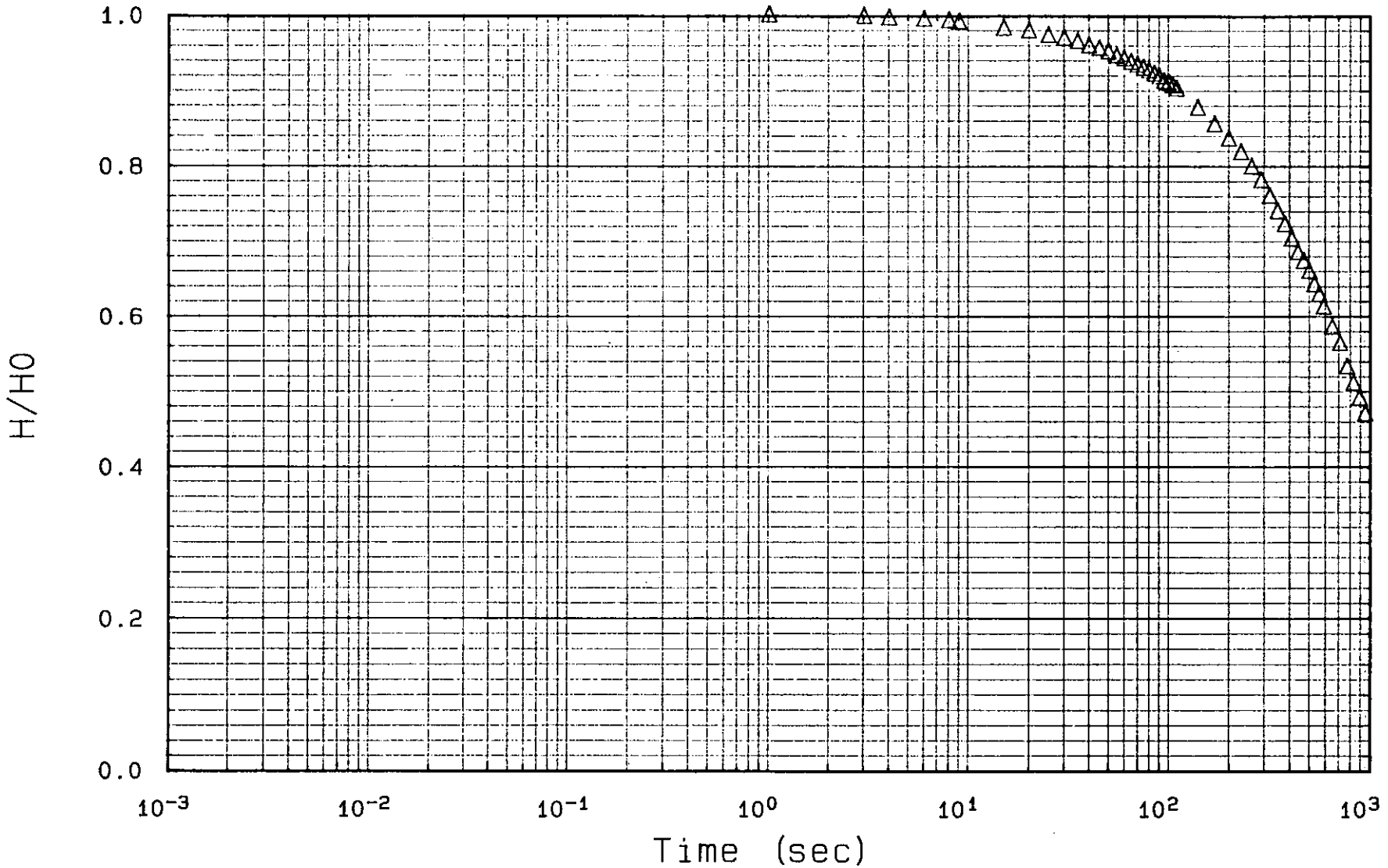
PERMEABILITY = 4.87E-06 FT/SECOND = 1.48E-04 CM/SECOND

TRANSMISSIVITY = 9.25E-05 FT**2/SECOND

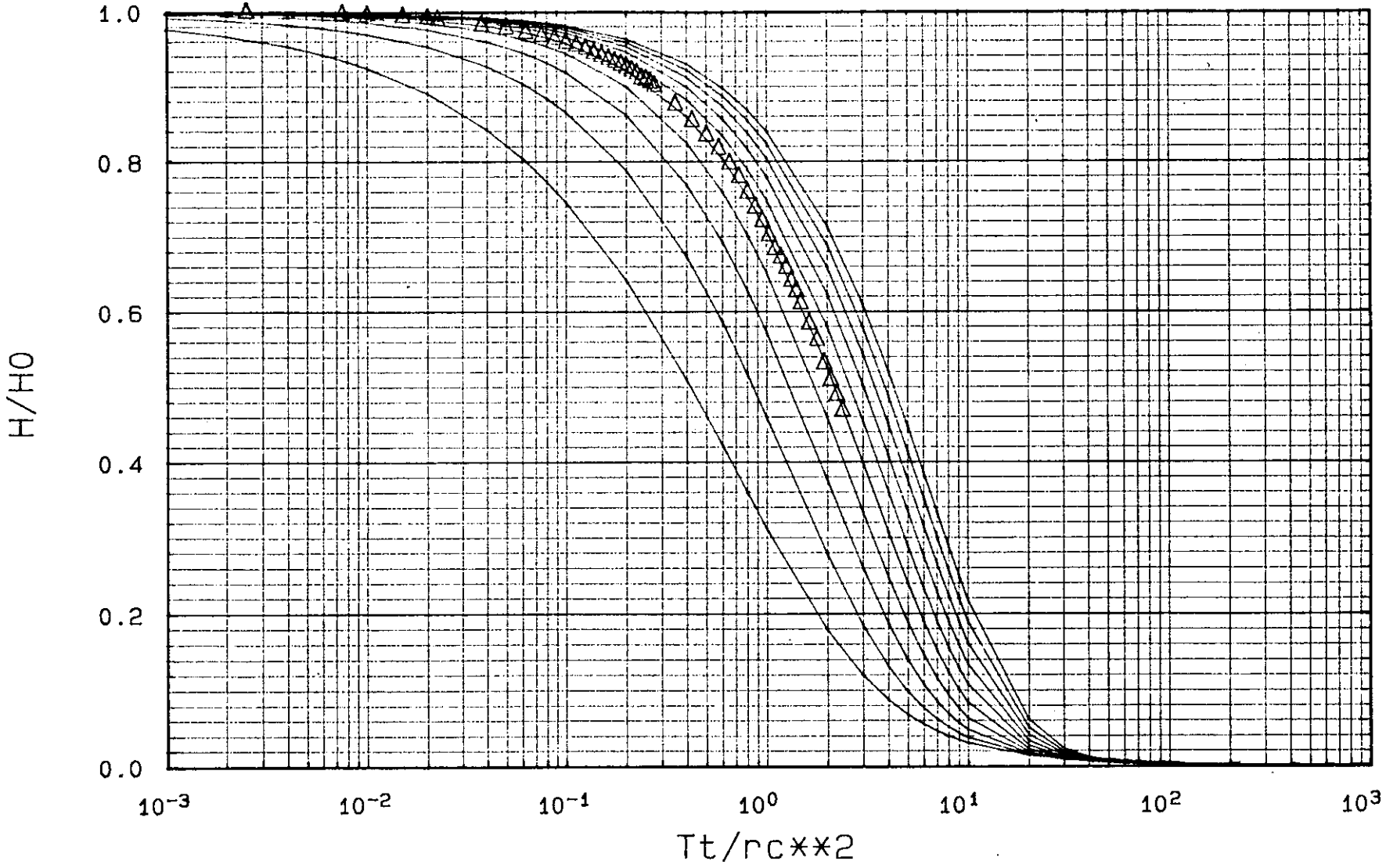
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW1A (RISING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW1A (RISING) Date 8/22/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW1A (RISING) Date 8/22/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/20/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: rw-3 (F) r2

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 7.88 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 0.25
EFFECTIVE AQUIFER THICKNESS USED 12.00

LENGTH OF SCREEN OR INTAKE PORTION = 12.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 82.25 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 16.00 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 69

TIME (MINUTE)	HEAD (FEET)
0.12	2.380
0.17	2.370
0.19	2.360
1.16	2.350
1.41	2.340
6.99	2.330
7.49	2.320
9.99	2.310
17.99	2.290
21.99	2.280
25.99	2.270
27.99	2.260
29.99	2.240
31.99	2.230
33.99	2.220
35.99	2.210
37.99	2.200
39.99	2.190
41.99	2.170
43.99	2.170
45.99	2.160
47.99	2.150
49.99	2.130
51.99	2.110
55.99	2.100

59.99	2.080
61.99	2.070
63.99	2.060
65.99	2.050
67.99	2.040
69.99	2.030
71.99	2.010
73.99	2.010
75.99	1.990
77.99	1.990
79.99	1.970
81.99	1.960
83.99	1.960
85.99	1.940
87.99	1.930
89.99	1.920
91.99	1.900
93.99	1.910
95.99	1.880
109.99	1.830
119.99	1.790
129.99	1.740
139.99	1.690
149.99	1.650
159.99	1.610
169.99	1.570
179.99	1.530
189.99	1.490
199.99	1.450
209.99	1.410
219.99	1.380
229.99	1.350
239.99	1.320
249.99	1.280
259.99	1.240
269.99	1.220
279.99	1.190
289.99	1.160
299.99	1.140
309.99	1.110
319.99	1.080
329.99	1.050
339.99	1.030
349.99	1.010

HO CALCULATED BASED ON FIRST 65 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 2.4025

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = 2.40 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/MINUTE AND PERMEABILITY UNITS ARE IN FT/MINUTE

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	2.113E-05	1.321E-06	5.765E-06	1.118E-04	5.015436	131.37	0.00
1.000E-02	1.000E-02	6.348E-05	3.967E-06	2.722E-05	5.846E-04	8.780032	47.23	84.13
1.000E-03	1.000E-03	1.433E-04	8.954E-06	6.387E-05	1.897E-03	12.794218	20.20	27.03
1.000E-04	1.000E-04	2.392E-04	1.495E-05	1.036E-04	3.580E-03	14.531126	40.26	-20.06
1.000E-05	1.000E-05	3.358E-04	2.099E-05	1.426E-04	5.284E-03	15.310495	50.35	-10.09
1.000E-06	1.000E-06	4.305E-04	2.690E-05	1.808E-04	6.944E-03	15.710497	55.85	-5.50
1.000E-07	1.000E-07	5.235E-04	3.272E-05	2.185E-04	8.577E-03	15.967549	59.26	-3.41
1.000E-08	1.000E-08	6.152E-04	3.845E-05	2.557E-04	1.018E-02	16.138935	61.57	-2.30
1.000E-09	1.000E-09	7.063E-04	4.414E-05	2.925E-04	1.178E-02	16.258532	63.26	-1.70
1.000E-10	1.000E-10	7.965E-04	4.978E-05	3.291E-04	1.337E-02	16.367529	64.52	-1.26

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0149

TRANSMISSIVITY = 4.1487E-04 FEET**2/MINUTE
STORATIVITY = 1.0000E-10

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.10E-05 FT/MINUTE = 3.35E-04 CM/MINUTE

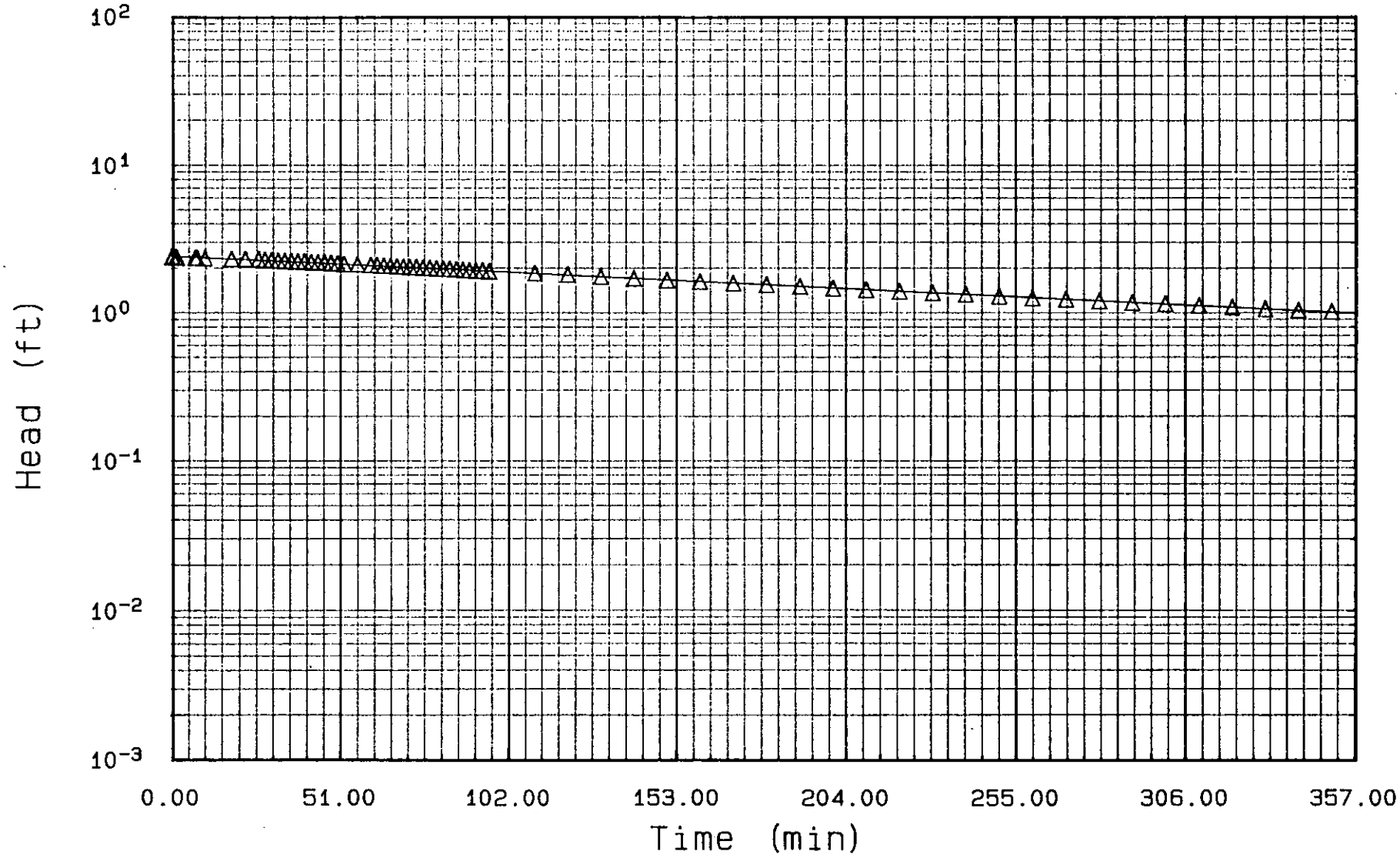
TRANSMISSIVITY = 1.76E-04 FT**2/MINUTE

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

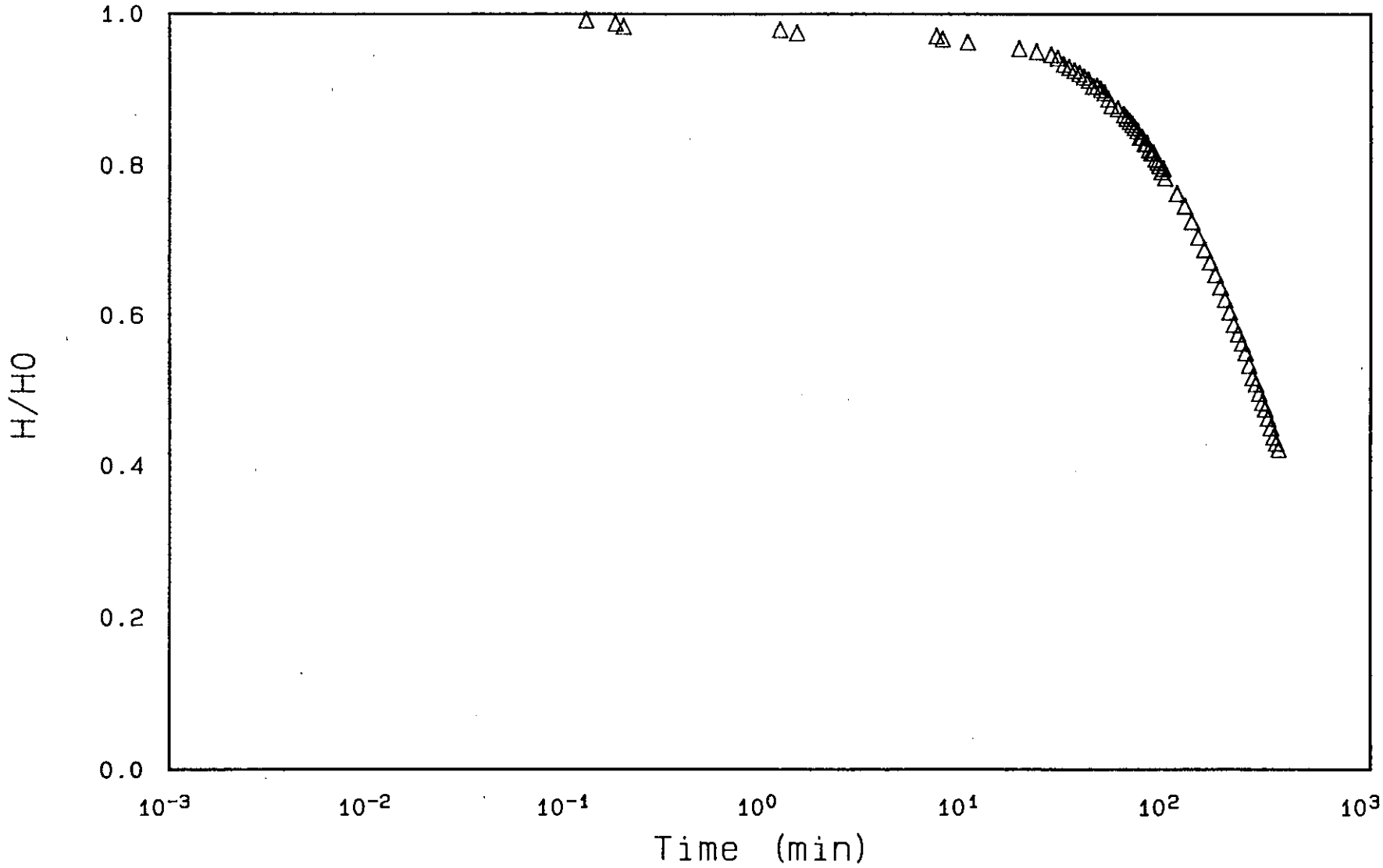
PERMEABILITY = 1.29E-05 FT/MINUTE = 3.93E-04 CM/MINUTE

TRANSMISSIVITY = 2.06E-04 FT**2/MINUTE

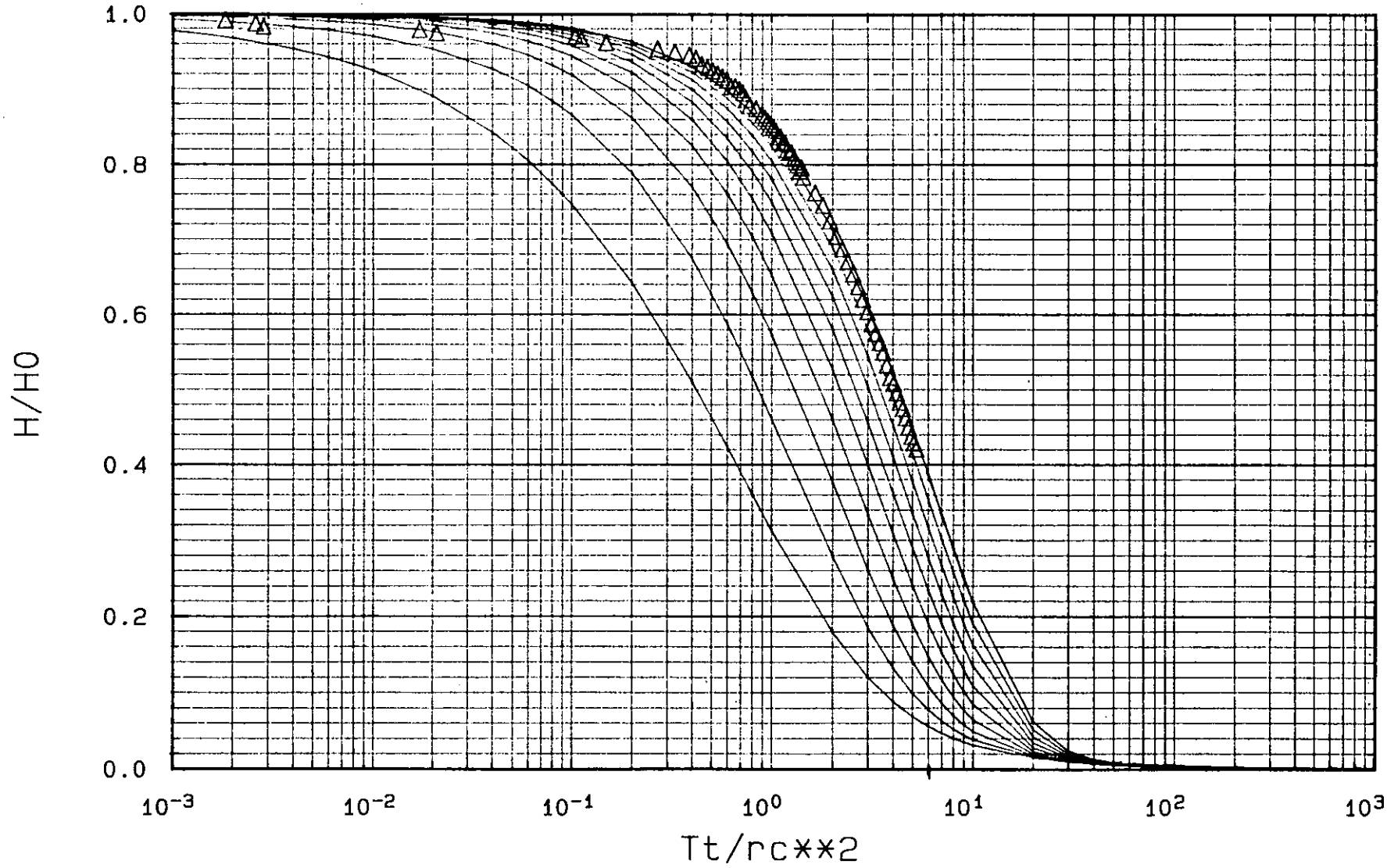
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well rw-3 (F) r2 Date 8/20/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well rw-3 (F) r2 Date 8/20/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well rw-3 (F) r2 Date 8/20/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/20/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: RW-3 (R)

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 7.88 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 0.25
EFFECTIVE AQUIFER THICKNESS USED 12.00

LENGTH OF SCREEN OR INTAKE PORTION = 12.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 82.25 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 16.00 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 37

TIME (MINUTE)	HEAD (FEET)
0.02	1.600
2.43	1.590
2.93	1.580
3.93	1.560
5.93	1.550
8.93	1.540
11.93	1.520
15.93	1.510
17.93	1.500
21.93	1.490
23.93	1.480
25.93	1.470
27.93	1.460
31.93	1.450
33.93	1.440
37.93	1.430
39.93	1.420
41.93	1.410
45.93	1.400
49.93	1.390
51.93	1.380
53.93	1.370
57.93	1.360
59.93	1.350
63.93	1.340

65.93	1.340
67.93	1.330
69.93	1.320
73.93	1.310
75.93	1.300
77.93	1.300
79.93	1.290
83.93	1.280
87.93	1.270
89.93	1.260
93.93	1.250
97.93	1.240

HO CALCULATED BASED ON FIRST 10 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 1.5908

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 1.59 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/MINUTE AND PERMEABILITY UNITS ARE IN FT/MINUTE

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	9.380E-07	5.863E-08	*********	2.152E-05	*********	690.42	0.00
1.000E-02	1.000E-02	6.299E-06	3.937E-07	*********	6.055E-05	*********	293.51	396.91
1.000E-03	1.000E-03	4.687E-06	2.929E-07	*********	1.070E-04	*********	780.08	-486.56
1.000E-04	1.000E-04	*********	*********	*********	1.928E-04	*********	414.81	365.27
1.000E-05	1.000E-05	*********	*********	*********	2.829E-04	*********	187.46	227.35
1.000E-06	1.000E-06	*********	*********	*********	3.704E-04	*********	135.51	51.95
1.000E-07	1.000E-07	*********	*********	*********	4.567E-04	*********	114.13	21.38
1.000E-08	1.000E-08	*********	*********	*********	5.417E-04	*********	106.66	7.47
1.000E-09	1.000E-09	*********	*********	*********	6.258E-04	*********	96.32	10.34
1.000E-10	1.000E-10	*********	*********	*********	7.094E-04	*********	92.73	3.59

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0037

TRANSMISSIVITY = 1.0199E-04 FEET**2/MINUTE
STORATIVITY = 1.0000E-03

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.44E-05 FT/MINUTE = 4.40E-04 CM/MINUTE

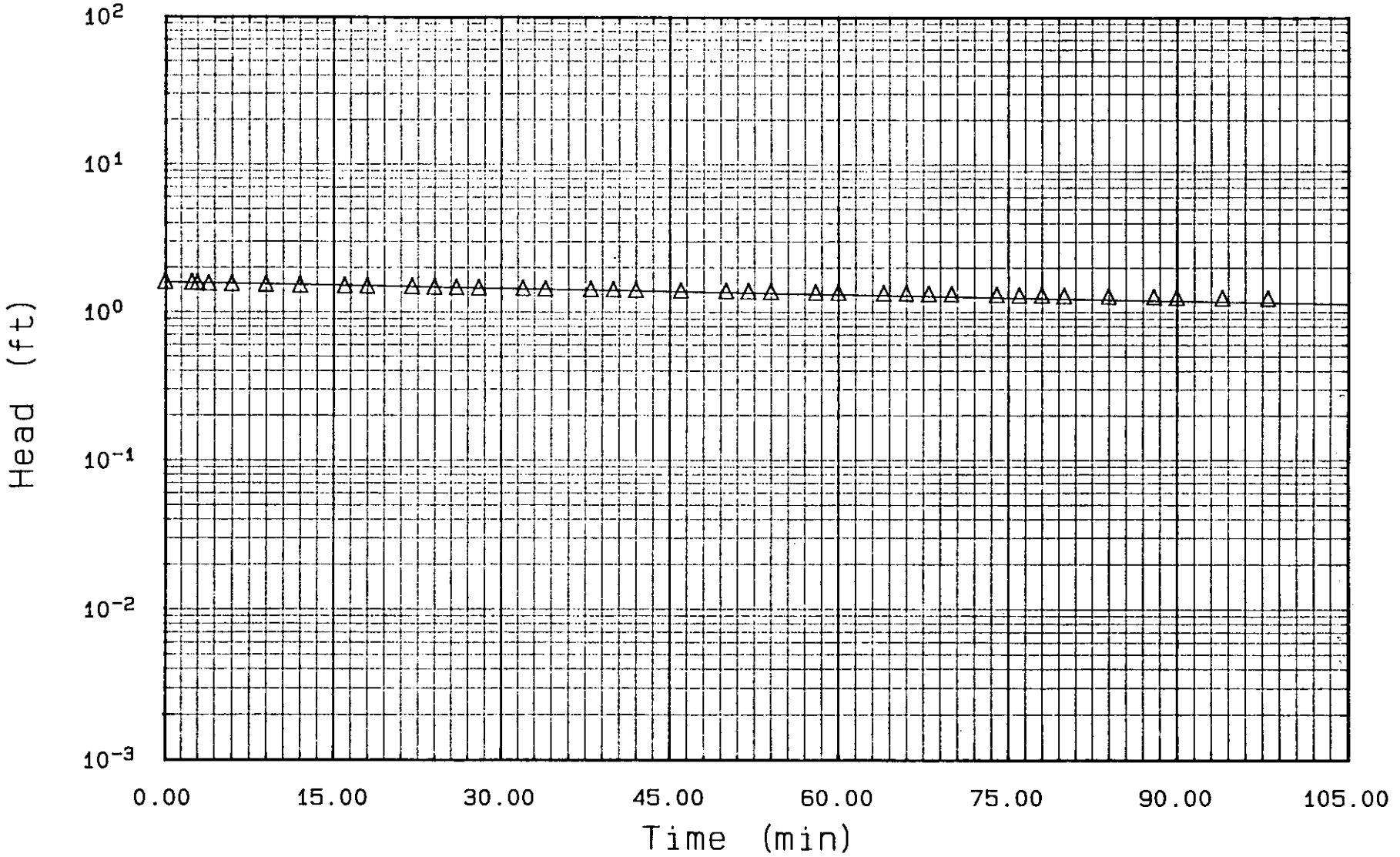
TRANSMISSIVITY = 2.31E-04 FT**2/MINUTE

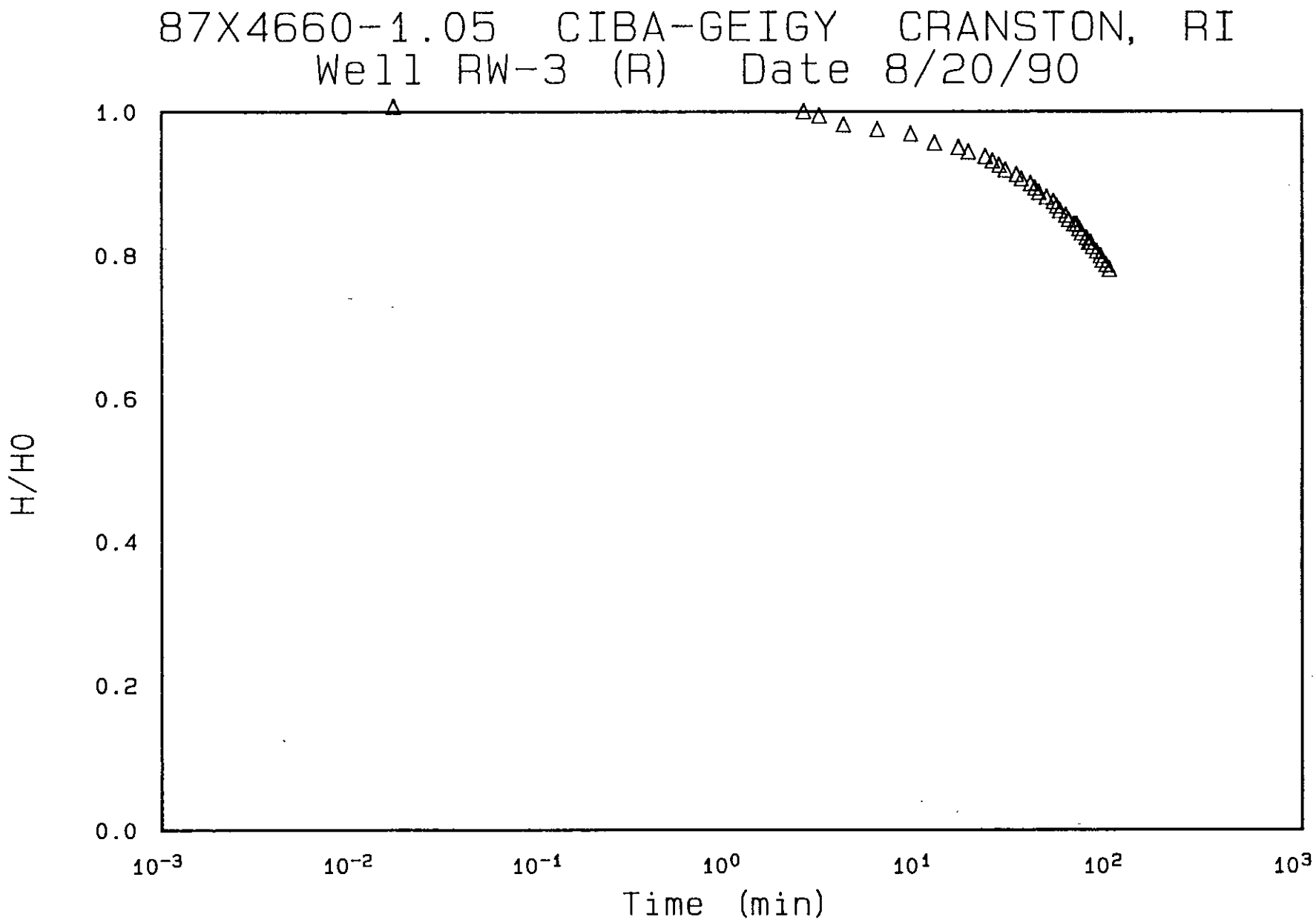
COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.69E-05 FT/MINUTE = 5.15E-04 CM/MINUTE

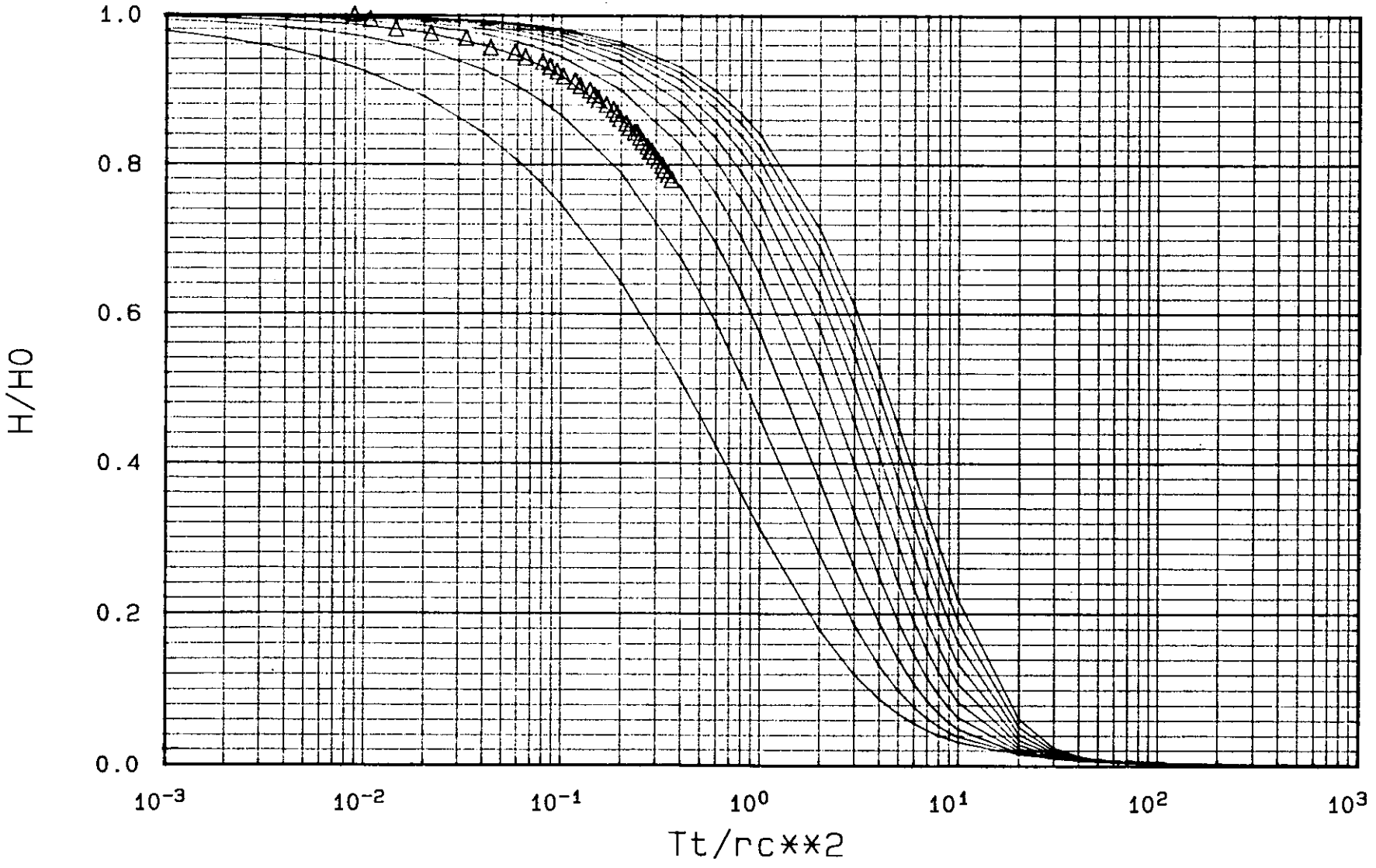
TRANSMISSIVITY = 2.70E-04 FT**2/MINUTE

87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW-3 (R) Date 8/20/90




87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW-3 (R) Date 8/20/90
1.0
0.8
0.6
0.4
0.2
0.0
H/HO
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Time (min)

87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW-3 (R) Date 8/20/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/20/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: RW4 (FALLING)

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 3.88 INCHES
DIAMETER OF DRILLED HOLE = 3.88 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 12.00

LENGTH OF SCREEN OR INTAKE PORTION = 12.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 34.40 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 21.00 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 44

TIME (SECOND)	HEAD (FEET)
1.00	1.899
3.00	1.804
4.00	1.791
5.00	1.728
6.00	1.731
7.00	1.709
8.00	1.671
13.00	1.570
18.00	1.469
23.00	1.380
28.00	1.289
33.00	1.209
38.00	1.137
43.00	1.032
48.00	1.001
53.00	0.947
58.00	0.890
63.00	0.843
68.00	0.792
73.00	0.748
78.00	0.707
83.00	0.666
88.00	0.631
93.00	0.596
98.00	0.565

103.00	0.536
108.00	0.511
138.00	0.365
168.00	0.274
198.00	0.207
228.00	0.163
258.00	0.122
288.00	0.097
318.00	0.081
348.00	0.062
378.00	0.056
408.00	0.047
438.00	0.035
468.00	0.025
498.00	0.019
528.00	0.016
558.00	0.009
588.00	0.012
648.00	0.003

HO CALCULATED BASED ON FIRST 8 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 1.8982

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 1.90 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.063E-01	7.749E-04	3.690E-05	*********	6.483E-03	8.366513	865.05	0.00
1.000E-02	1.063E-02	9.910E-04	4.719E-05	*********	6.555E-03	6.615869	653.22	211.83
1.000E-03	1.063E-03	1.223E-03	5.825E-05	*********	6.598E-03	5.396291	506.68	146.54
1.000E-04	1.063E-04	1.454E-03	6.925E-05	*********	6.676E-03	4.595548	411.47	95.21
1.000E-05	1.063E-05	1.684E-03	8.021E-05	*********	6.746E-03	4.012502	343.05	68.42
1.000E-06	1.063E-06	1.919E-03	9.137E-05	*********	6.740E-03	3.522901	286.75	56.30
1.000E-07	1.063E-07	2.153E-03	1.025E-04	*********	6.814E-03	3.176808	247.49	39.26
1.000E-08	1.063E-08	2.392E-03	1.139E-04	*********	6.890E-03	2.894192	216.24	31.26
1.000E-09	1.063E-09	2.634E-03	1.254E-04	*********	6.938E-03	2.649215	189.73	26.51
1.000E-10	1.063E-10	2.875E-03	1.369E-04	*********	7.009E-03	2.453851	169.31	20.42

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0734

TRANSMISSIVITY = 2.0386E-03 FEET**2/SECOND
STORATIVITY = 1.0000E-09

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 7.02E-05 FT/SECOND = 2.14E-03 CM/SECOND

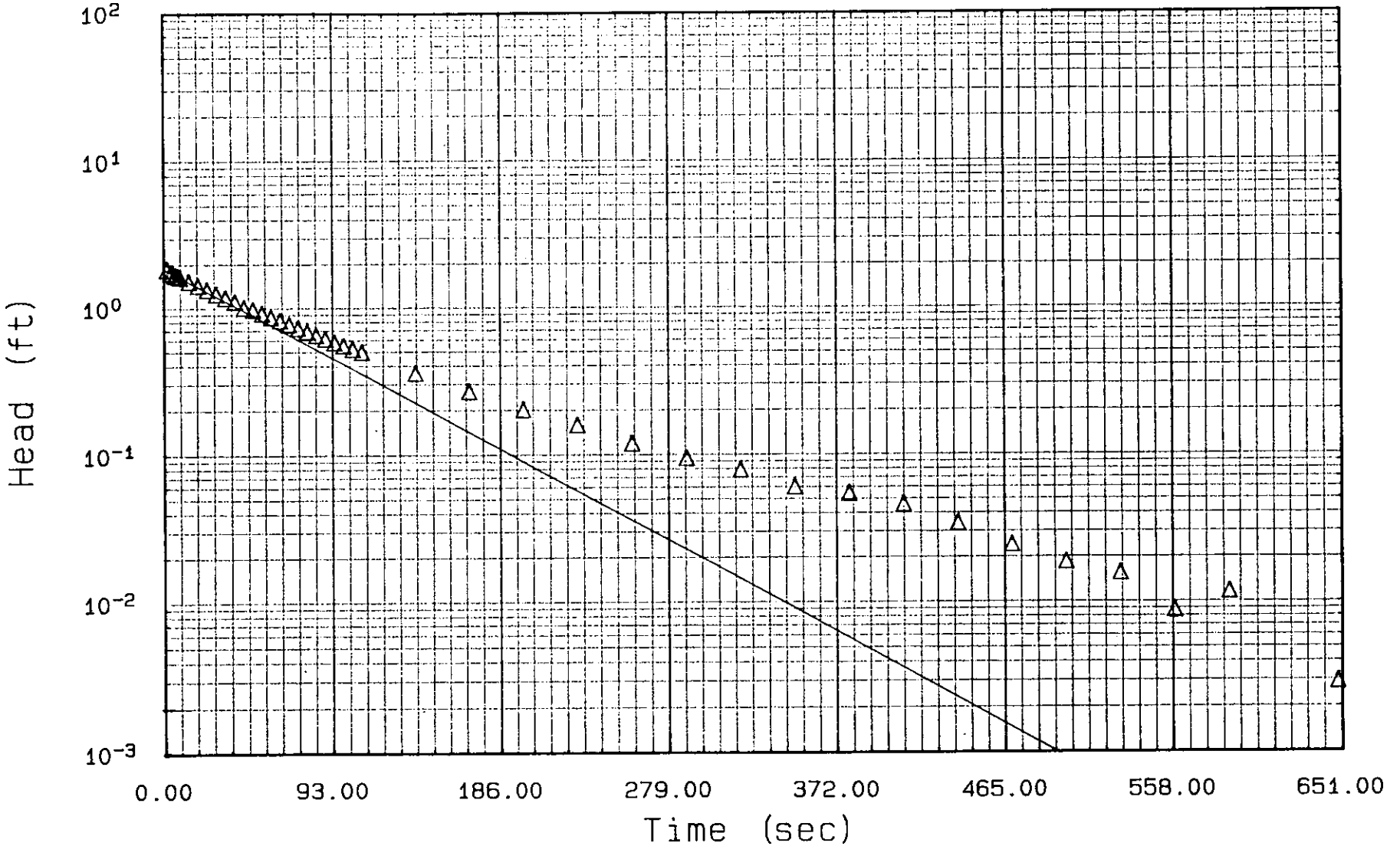
TRANSMISSIVITY = 1.47E-03 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

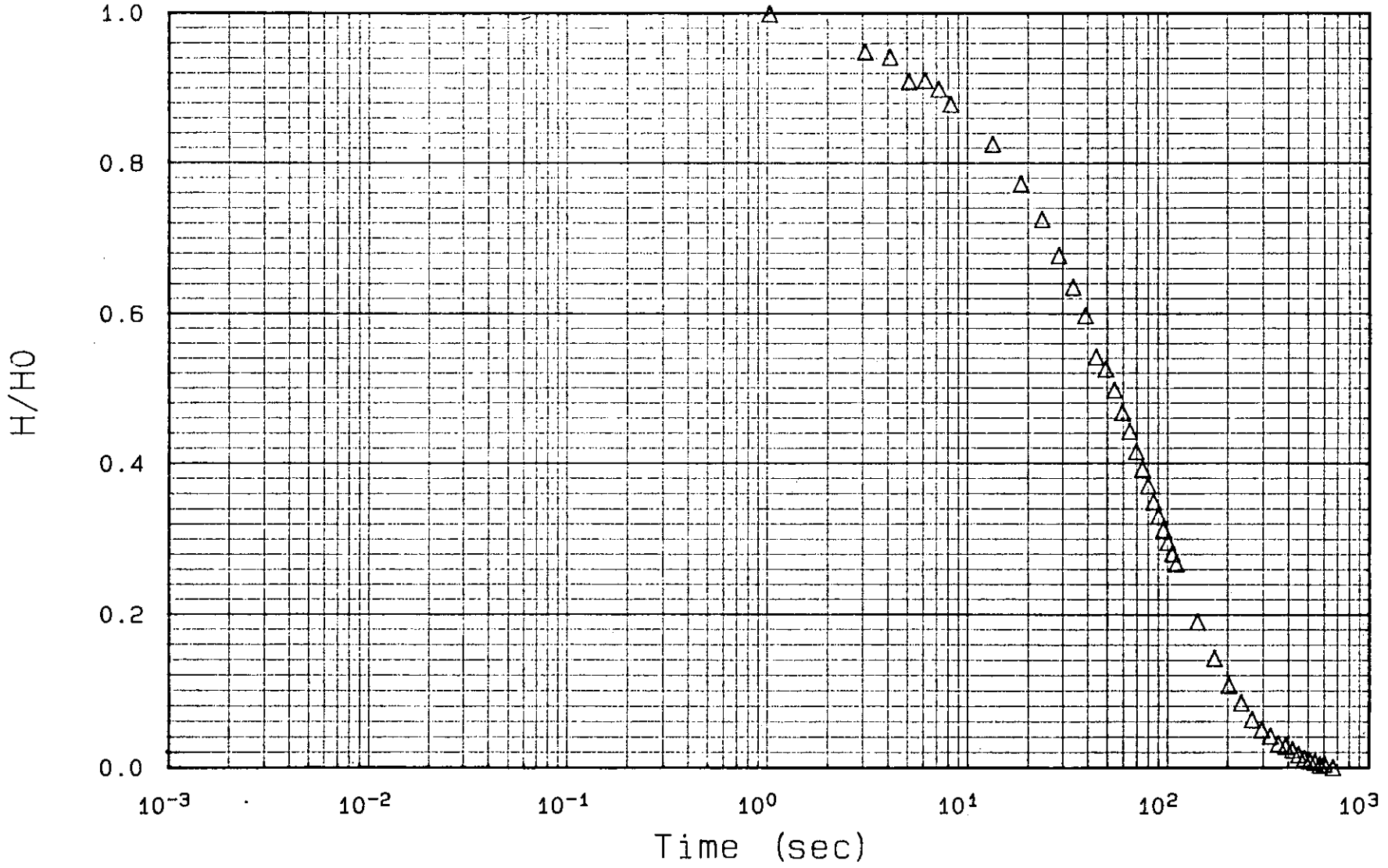
PERMEABILITY = 7.02E-05 FT/SECOND = 2.14E-03 CM/SECOND

TRANSMISSIVITY = 1.47E-03 FT**2/SECOND

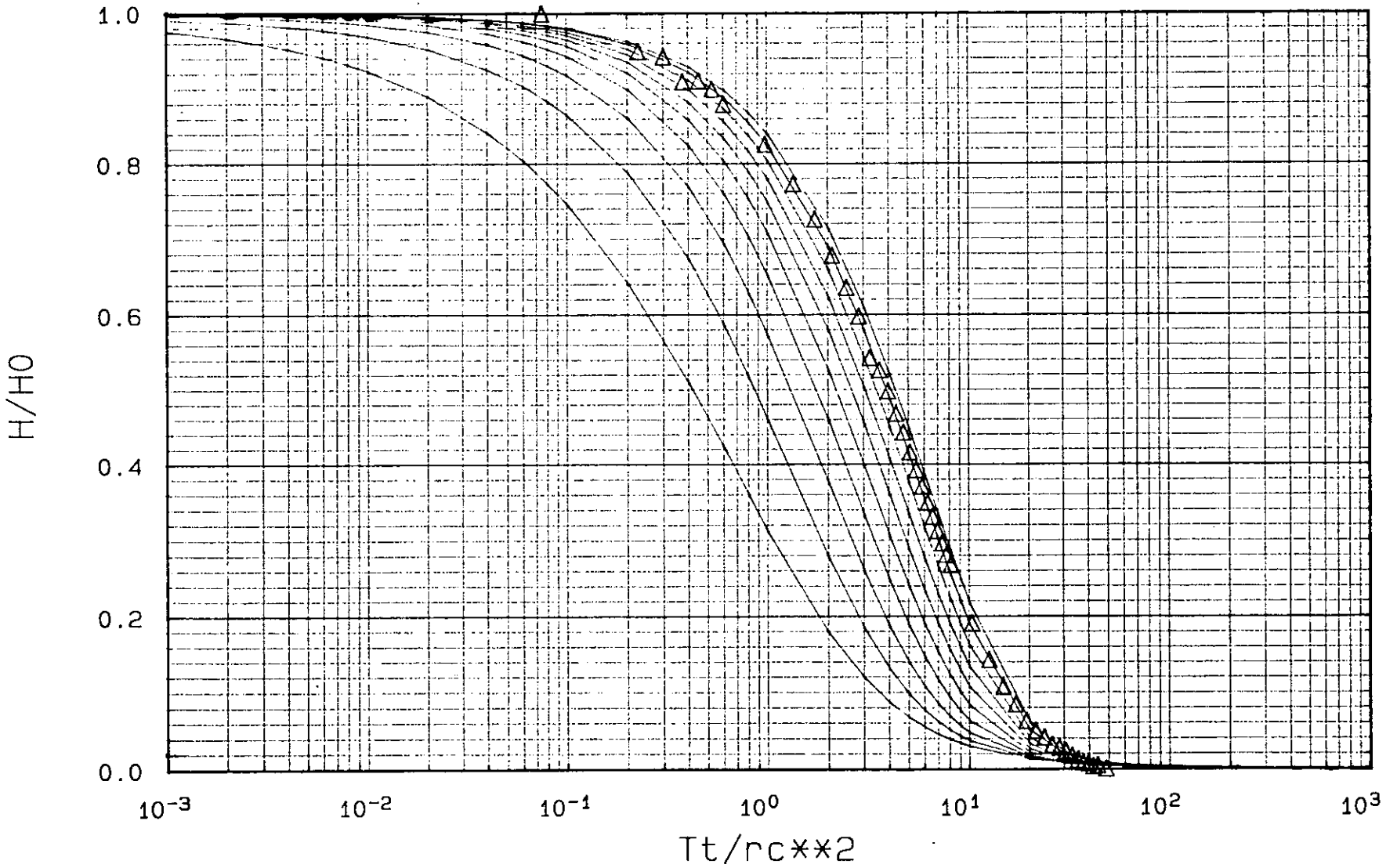
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW4 (FALLING) Date 8/20/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW4 (FALLING) Date 8/20/90



87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW4 (FALLING) Date 8/20/90



PROGRAM SLUGT, VERSION 7,FEB. 1988

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:
(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER)
(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS)

PROJECT NO.: 87X4660-1.05 CLIENT: CIBA-GEIGY

SITE LOCATION: CRANSTON, RI DATE OF SLUG TEST: 8/20/90

FIELD INVESTIGATOR: CHUCK TRIONE

WELL NO.: RW4A (RISING)

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 3.88 INCHES
DIAMETER OF DRILLED HOLE = 3.88 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
EFFECTIVE AQUIFER THICKNESS USED 12.00

LENGTH OF SCREEN OR INTAKE PORTION = 12.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 34.40 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 21.00 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 40

TIME (SECOND)	HEAD (FEET)
1.00	1.837
2.00	1.805
3.00	1.774
8.00	1.609
13.00	1.477
18.00	1.410
23.00	1.325
28.00	1.249
33.00	1.179
38.00	1.157
43.00	1.097
48.00	1.047
53.00	0.987
58.00	0.936
63.00	0.885
68.00	0.841
73.00	0.800
78.00	0.762
83.00	0.718
88.00	0.680
93.00	0.645
98.00	0.617
103.00	0.582
133.00	0.421
163.00	0.313

193.00	0.245
223.00	0.194
253.00	0.153
283.00	0.128
313.00	0.109
343.00	0.093
373.00	0.083
403.00	0.077
433.00	0.071
463.00	0.065
493.00	0.061
553.00	0.055
583.00	0.052
643.00	0.049
703.00	0.042

HO CALCULATED BASED ON FIRST 8 DATA POINTS

COMPUTED VALUE FOR HO (FEET) 1.8378

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 1.84 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/SECOND AND PERMEABILITY UNITS ARE IN FT/SECOND

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.063E-01	3.532E-04	1.682E-05	5.507E-07	5.321E-04	1.504692	125.02	0.00
1.000E-02	1.063E-02	5.410E-04	2.576E-05	1.584E-06	6.559E-04	1.209423	35.28	89.74
1.000E-03	1.063E-03	7.340E-04	3.495E-05	4.070E-06	7.847E-04	1.063484	55.71	-20.43
1.000E-04	1.063E-04	9.216E-04	4.389E-05	8.607E-06	9.876E-04	1.062338	81.38	-25.67
1.000E-05	1.063E-05	1.116E-03	5.317E-05	1.464E-05	1.284E-03	1.137060	89.68	-8.30
1.000E-06	1.063E-06	1.322E-03	6.294E-05	2.159E-05	1.575E-03	1.175319	94.32	-4.64
1.000E-07	1.063E-07	1.529E-03	7.280E-05	2.917E-05	1.862E-03	1.199070	103.41	-9.09
1.000E-08	1.063E-08	1.732E-03	8.248E-05	3.688E-05	2.147E-03	1.218229	109.80	-6.39
1.000E-09	1.063E-09	1.936E-03	9.219E-05	4.489E-05	2.429E-03	1.231652	111.52	-1.72
1.000E-10	1.063E-10	2.146E-03	1.022E-04	5.294E-05	2.710E-03	1.238455	111.03	0.49

MANUAL CURVE MATCH RESULTS:

MATCH POINT AT Tt/rc**2 = 1.0, TIME = 0.0477

TRANSMISSIVITY = 1.3238E-03 FEET**2/SECOND
STORATIVITY = 1.0000E-06

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 6.63E-05 FT/SECOND = 2.02E-03 CM/SECOND

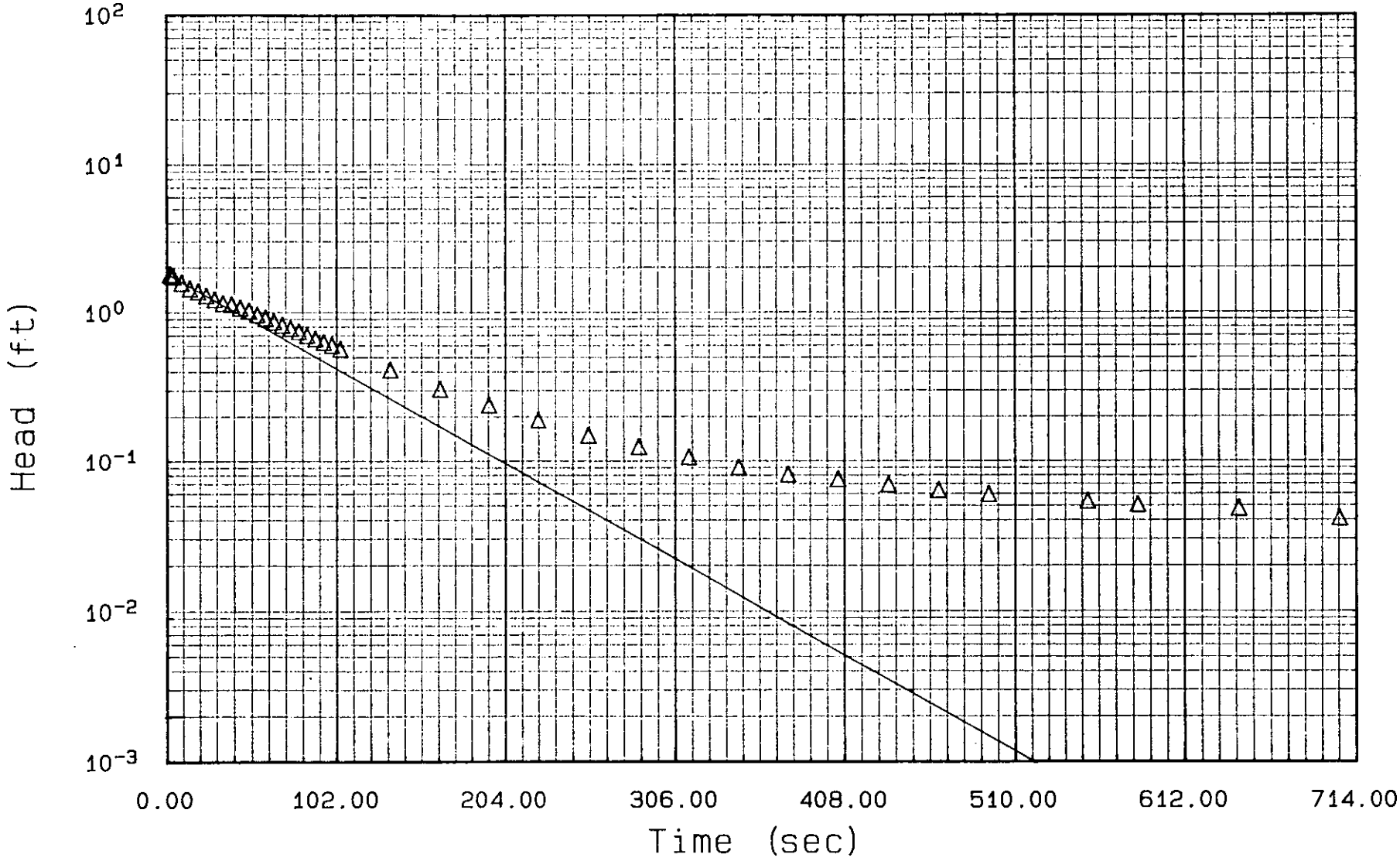
TRANSMISSIVITY = 1.39E-03 FT**2/SECOND

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

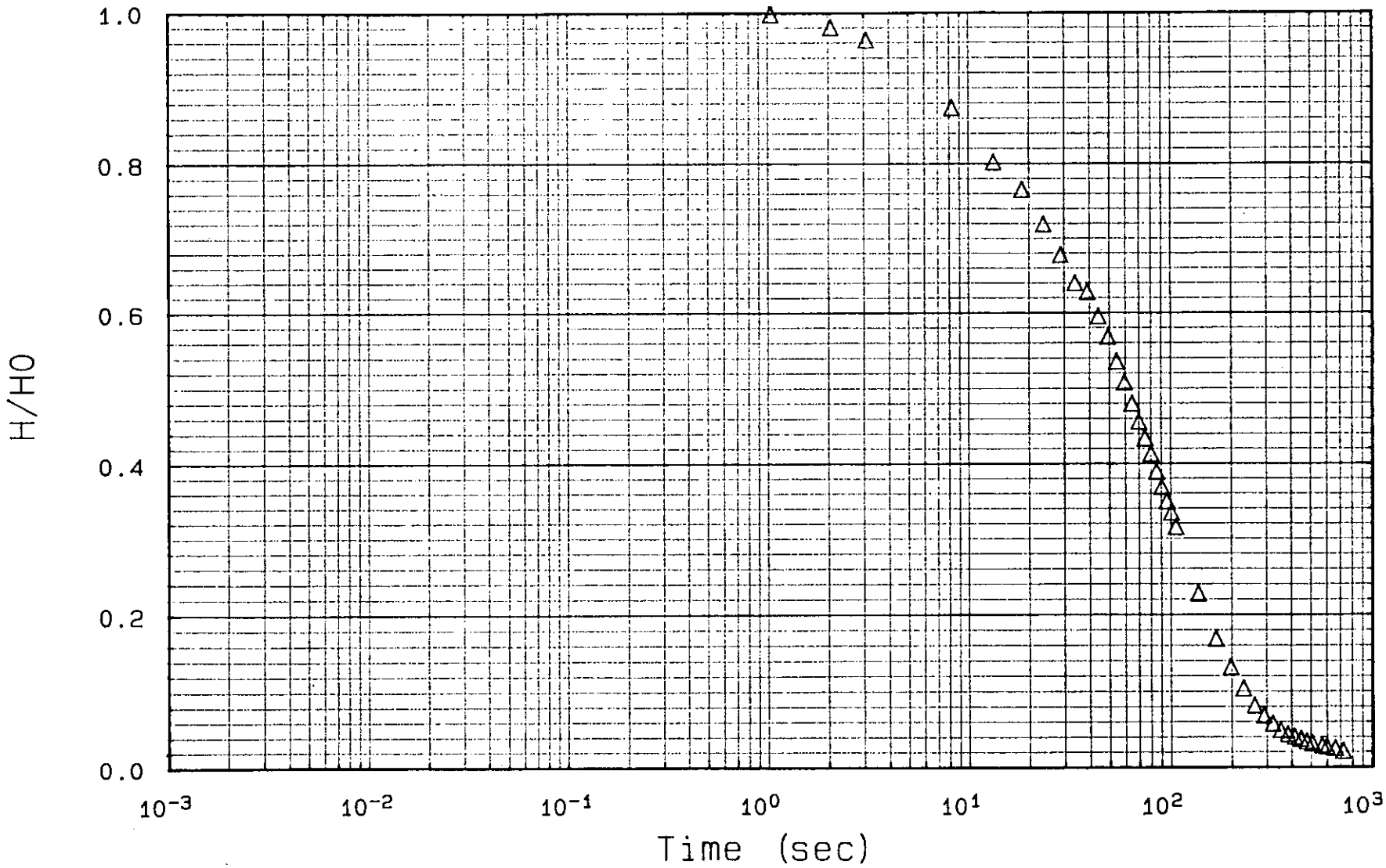
PERMEABILITY = 6.63E-05 FT/SECOND = 2.02E-03 CM/SECOND

TRANSMISSIVITY = 1.39E-03 FT**2/SECOND

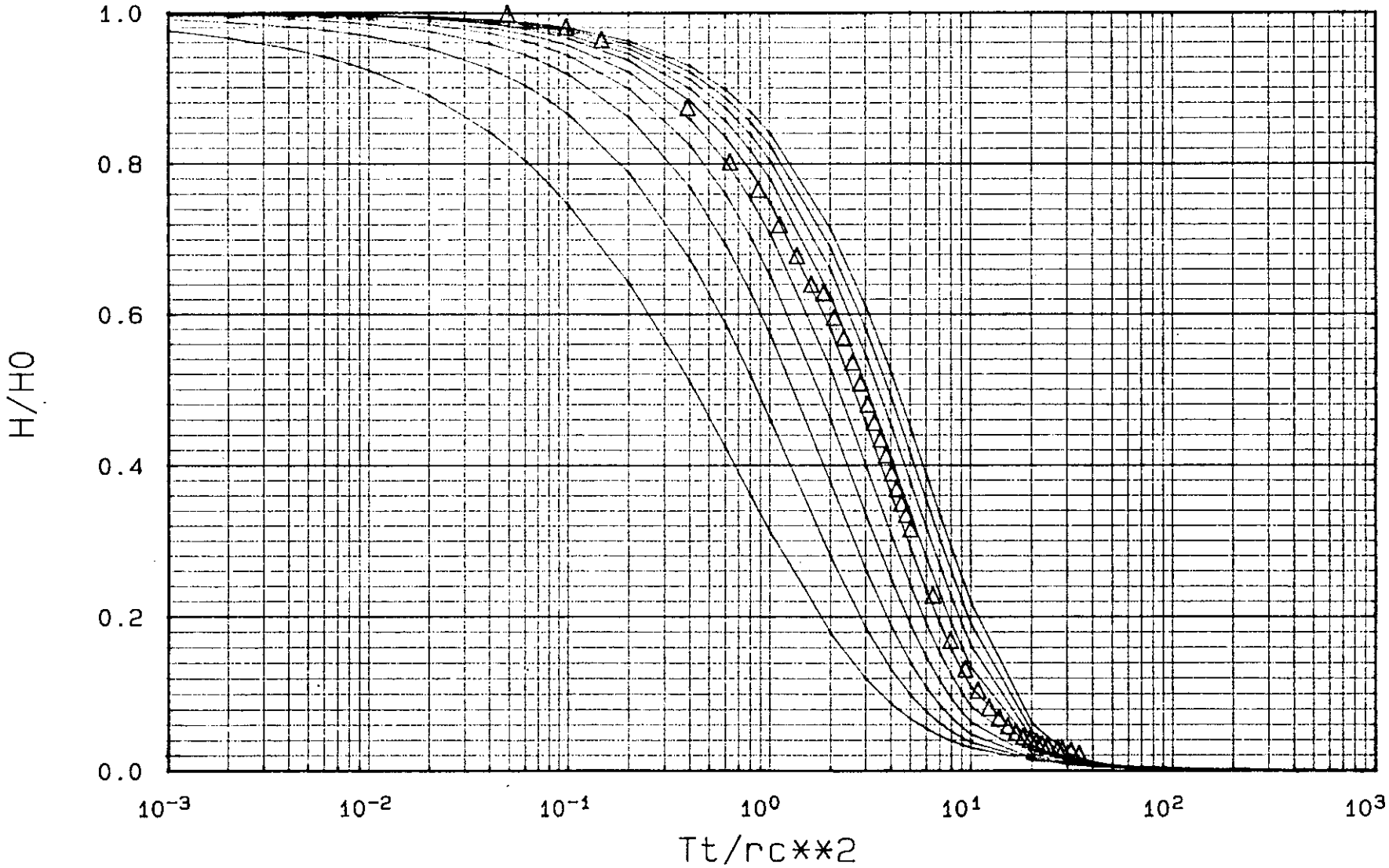
87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW4A (RISING) Date 8/20/90

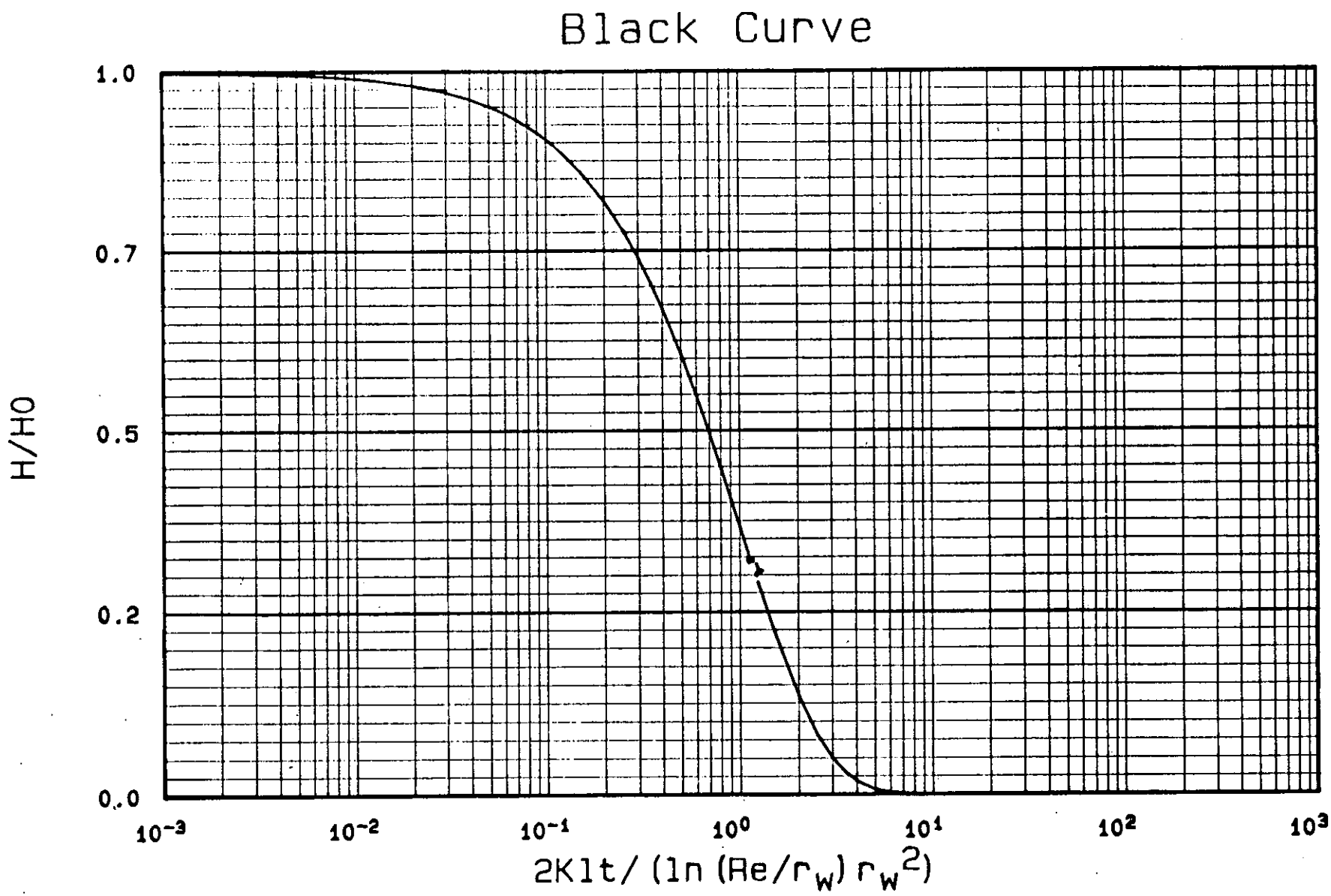


87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW4A (RISING) Date 8/20/90

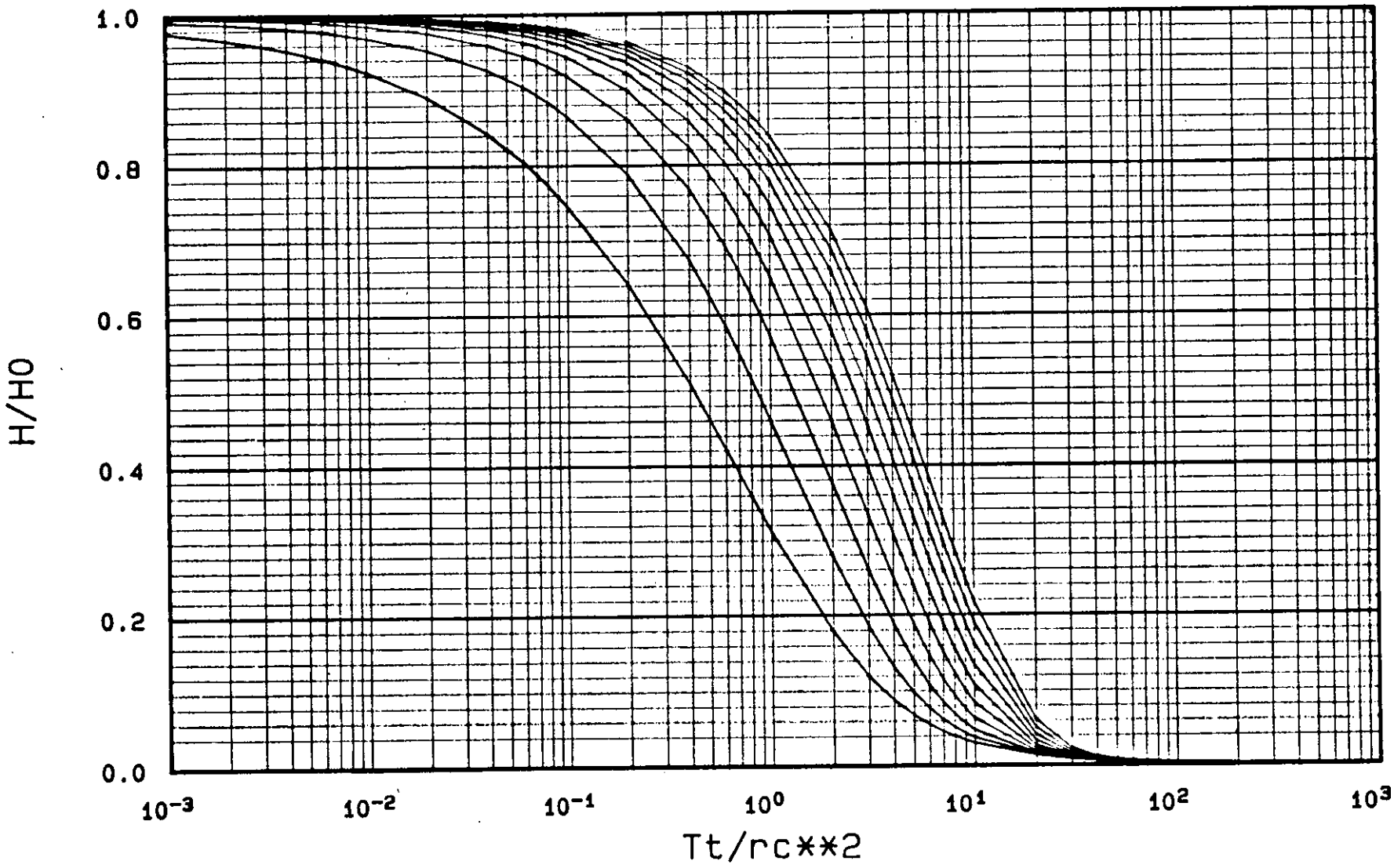


87X4660-1.05 CIBA-GEIGY CRANSTON, RI
Well RW4A (RISING) Date 8/20/90




Black Curve
1.0
0.7
0.5
0.2
0.0
H/HO
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
$2Klt/(\ln(Re/r_w)r_w^2)$

Slug Test Analysis
Type Curves For Instantaneous Charge



Appendix H

APPENDIX H

HEADSPACE ANALYSIS

APPENDIX H

HEADSPACE ANALYSIS

H.1 OVERVIEW

In Phase IA, soil from continuous sample borings was field-screened for volatile organic compounds (VOCs) in accordance with the procedures described in the RFI Quality Assurance Plan (Volume 2). Samples were analyzed from seven borings located in four areas. The results of the headspace analysis are presented in Table H-1. The boring locations in Table H-1 correspond to the following areas:

Boring Location	Area
RW-1	Production Area
RW-2, P-19D	Waste Water Treatment Area
RW-3, P-21D, P-22D	Warwick Area
RW-4	Residential Area (between the Production and Waste Water Treatment areas)

The results of the headspace analysis are presented here for each area.

H.2 PRODUCTION AREA

Soil samples from boring RW-1 were screened with an HNu photoionizing detector (an instrument not sensitive to methane). VOC concentrations ranging from 0.4 to 600 parts per million (ppm) were detected. Seven samples, taken from depths of 2.5 to 12.5 feet, had concentrations exceeding 50 ppm. The results of the headspace analysis indicate that VOCs are present in soils along the bulkhead. These results will be confirmed in Phase IB, when soils (surficial and subsurface) from the Production Area will be characterized chemically.

H.3 WASTE WATER TREATMENT AREA

Soil samples from two borings in the Waste Water Treatment Area were field-screened in Phase IA. Samples from boring RW-2 were analyzed with an HNu; samples from boring P-19D were measured with an OVA. VOC concentrations ranged from 0.1 to 9 ppm for soil samples of both borings; most of the measurements were below 1 ppm. The results of the headspace analysis indicate that soil from downgradient borings in the Waste Water Treatment Area were not contaminated with VOCs.

H.4 WARWICK AREA

Soil samples from three borings (RW-3, P-21D, and P-22D) in the Warwick Area were field-screened in Phase IA. Samples from boring RW-3 were analyzed initially with an OVA at 2-second intervals only. To evaluate the potential for methane interference, selected samples were re-analyzed with an OVA and an HNu at 2-, 20-, and 60-second intervals. Samples exhibiting a gradual decrease in concentrations suggested that a non-methane organic contaminant was present. Soil samples that exhibited high initial VOC concentrations also exhibited a gradual drop in concentration during the re-analysis. These field screening results will be confirmed in Phase IB when soils from SWMU-5 (near RW-3) will be field-screened and characterized chemically.

Soil samples from boring P-21D also were analyzed with an OVA in Phase IA. Soil samples taken from depths of 3 to 13 feet had VOC concentrations ranging from 9 to 850 ppm. Only a gradual decrease in concentrations was observed in the measurements taken at 20- and 60-second intervals. Boring P-20D is not located near known or suspected past facility releases. However, based on the results of the headspace analysis, soil near this boring will be investigated further in Phase IB.

Soil samples from boring P-22D were analyzed with an OVA in Phase IA. For most samples, VOC concentrations were below 1 ppm; only one sample had a concentration

exceeding 5 ppm. Sample SS-27B, taken from a depth of 57 feet, had a concentration of 20 ppm.

H.5 RESIDENTIAL AREA (BETWEEN THE PRODUCTION AND WASTE WATER TREATMENT AREAS)

Soil samples from boring RW-4 were analyzed using both HNu and OVA. VOC concentrations ranged from 0.1 to 3 ppm. The results of the headspace analyses indicate that VOCs were not present in soil samples collected from the residential area.

TABLE H-1
CIBA-GEIGY FACILITY, CRANSTON, RHODE ISLAND
FIELD SCREENING RESULTS OF SOIL SAMPLES

WCC Field Sample I.D.	Instrument Type	VOC: ppm (2 sec)	VOC: ppm (20 sec)	VOC: ppm (60 sec)
Production Area				
RW-1 SS-1	HNU	0.7	--	--
RW-1 SS-2A	HNU	125	--	--
RW-1 SS-2B	HNU	600	--	--
RW-1 SS-3	HNU	140	--	--
RW-1 SS-4	HNU	400	--	--
RW-1 SS-5	HNU	200	--	--
RW-1 SS-6A	HNU	250	--	--
RW-1 SS-6B	HNU	52	--	--
RW-1 SS-7A	HNU	7	--	--
RW-1 SS-7B	HNU	9	--	--
RW-1 SS-8	HNU	20	--	--
RW-1 SS-9	HNU	6	--	--
RW-1 SS-10	HNU	12	--	--
RW-1 SS-11A	HNU	40	--	--
RW-1 SS-11B	HNU	5	--	--
RW-1 SS-12	HNU	16	--	--
RW-1 SS-13	HNU	16	--	--
RW-1 SS-14	HNU	6	--	--
RW-1 SS-15	HNU	2	--	--
RW-1 SS-16	HNU	0.4	--	--
RW-1 SS-17	HNU	0.6	--	--
RW-1 SS-18A	HNU	2	--	--
RW-1 SS-18B	HNU	0.4	--	--
RW-1 SS-19	HNU	1	--	--
RW-1 SS-20	HNU	0.6	--	--
RW-1 SS-21A	HNU	0.4	--	--
RW-1 SS-21B	HNU	1	--	--
RW-1 SS-22A	HNU	1	--	--
RW-1 SS-22B	HNU	1	--	--
RW-1 SS-23	HNU	1	--	--
RW-1 SS-24	HNU	1	--	--
RW-1 SS-25	HNU	1	--	--
RW-1 SS-26	HNU	1	--	--
RW-1 SS-27	HNU	1	--	--
RW-1 SS-28	HNU	0.6	--	--

Done by JL
Checked by MH

TABLE H-1 (continued)
CIBA-GEIGY FACILITY, CRANSTON, RHODE ISLAND
FIELD SCREENING RESULTS OF SOIL SAMPLES

WCC Field Sample I.D.	Instrument Type	VOC: ppm (2 sec)	VOC: ppm (20 sec)	VOC: ppm (60 sec)
Waste Water Treatment Area				
RW-2 S-1	HNU	0.8	--	--
RW-2 S-3	HNU	0.6	--	--
RW-2 S-4	HNU	5.0	--	--
RW-2 S-5	HNU	6.0	--	--
RW-2 S-6	HNU	0.6	--	--
RW-2 S-8	HNU	1.2	--	--
RW-2 S-9	HNU	0.4	--	--
RW-2 S-10	HNU	0.4	--	--
RW-2 S-12	HNU	0.4	--	--
RW-2 S-13	HNU	0.4	--	--
RW-2 S-14	HNU	0.4	--	--
RW-2 S-16	HNU	0.2	--	--
RW-2 S-17	HNU	0.4	--	--
RW-2 S-18	HNU	0.2	--	--
RW-2 S-19	HNU	0.4	--	--
RW-2 S-20	HNU	0.4	--	--
RW-2 S-21	HNU	0.5	--	--
RW-2 S-23	HNU	0.4	--	--
RW-2 S-24	HNU	0.2	--	--
RW-2 S-25	HNU	0.4	--	--
Waste Water Treatment Area				
P19-D SS-1	OVA	0.1	0.1	0.1
P19-D SS-2A	OVA	1	0.5	0.5
P19-D SS-2B	OVA	9	3	2
P19-D SS-3A	OVA	0.1	0.1	0.1
P19-D SS-3B	OVA	9	3	1
P19-D SS-4	OVA	0.5	0.3	0.1
P19-D SS-5B	OVA	1.5	1.0	0.5
P19D SS-6-7-A	OVA	2	0.1	0.5
P19-D SS-7B	OVA	1.0	1.0	0.5
P19D SS-8A	OVA	0.3	0.1	0.1
P19D SS-8B	OVA	0.5	0.1	0.1
P19D SS-9A	OVA	0.3	0.3	0.1
P19D SS-9B	OVA	0.5	0.2	0.1
P19D SS-10	OVA	0.5	0.3	0.1
P19D SS-11	OVA	0.5	0.5	0.1
P19D SS-12	OVA	0.8	0.3	0.1

Done by JL
Checked by MH

TABLE H-1 (continued)
CIBA-GEIGY FACILITY, CRANSTON, RHODE ISLAND
FIELD SCREENING RESULTS OF SOIL SAMPLES

WCC Field Sample I.D.	Instrument Type	VOC: ppm (2 sec)	VOC: ppm (20 sec)	VOC: ppm (60 sec)
Warwick Area				
RW-3 S-1	OVA	300	--	--
RW-3 S-2	OVA	450	--	--
RW-3 S-3	OVA	450	--	--
RW-3 S-5	OVA	380	--	--
RW-3 S-6	OVA	400	--	--
RW-3 S-8	OVA	20	--	--
RW-3 S-9	HNU	0.1	0.1	0.1
RW-3 S-10	HNU	0.1	0.1	0.1
RW-3 S-12	HNU	0.1	0.1	0.1
RW-3 S-13	HNU	0.1	0.1	0.1
RW-3 S-14	HNU	0.1	0.1	0.1
RW-3 S-16	HNU	0.1	0.1	0.1
RW-3 S-17	HNU	0.1	0.1	0.1
RW-3 S-18	HNU	0.1	0.1	0.1
RW-3 S-19	HNU	0.1	0.1	0.1
RW-3 S-20	HNU	0.1	0.1	0.1
RW-3 S-21	HNU	0.1	0.1	0.1
RW-3 S-22	HNU	0.1	0.1	0.1
RW-3 S-1*	OVA	40	10	1-2
RW-3 S-2*	OVA	45	15	5-5
RW-3 S-3*	OVA	100	30	3-5
RW-3 S-5*	OVA	75	1.5	1.5
RW-3 S-5A*	OVA	1.2	0.5	0.2
RW-3 S-6*	OVA	8.5	5.5	1.5
RW-3 S-8*	OVA	1.5	0.1	0.1
RW-3 S-23	OVA	0.1	0.1	0.1
RW-3 SS-23 matrix duplicates	OVA	0.1	0.1	0.1
RW-3 S-24	OVA	0.1	0.1	0.1
RW-3 S-25	OVA	0.1	0.1	0.1
RW-3 S-26	OVA	0.1	0.1	0.1
RW-3 SS-26 matrix duplicates	OVA	0.1	0.1	0.1
RW-3 S-27	OVA	0.1	0.1	0.1
RW-3 S-28	OVA	0.5	0.5	0.1
RW-3 S-29	OVA	1.0	0.5	0.5
Warwick Area				
P21D SS-2	OVA	0.1	0.1	0.1
P21D SS-3	OVA	100	100	75
P21D SS-4	OVA	40	35	30
P21D SS-5	OVA	850	825	800
P21D SS-6	OVA	9	5	25

Done by JL
Checked by MH

TABLE H-1 (continued)
CIBA-GEIGY FACILITY, CRANSTON, RHODE ISLAND
FIELD SCREENING RESULTS OF SOIL SAMPLES

WCC Field Sample I.D.	Instrument Type	VOC: ppm (2 sec)	VOC: ppm (20 sec)	VOC: ppm (60 sec)
P21D SS-7A	OVA	600	200	100
P21D SS-7B	OVA	2.0	1.0	1.0
P21D SS-7C	OVA	2.0	1.5	0.5
P21D SS-8	OVA	2.5	1.0	0.5
P21D SS-9	OVA	1.5	0.5	0.1
P21D SS-10	OVA	1.0	0.5	0.2
P21D SS-11	OVA	1.5	0.5	0.5
P21D SS-12	OVA	0.8	0.5	0.2
P21D SS-13A	OVA	1.0	0.5	0.5
P21D SS-13B	OVA	0.2	0.1	0.1
P21D SS-14	OVA	1.0	0.5	0.2
P21D SS-16	OVA	0.5	0.2	0.1
P21D SS-17A	OVA	2.0	1.5	1.0
P21D SS-17B	OVA	1.0	0.8	0.8
P22D SS-1A	OVA	0.3	0.1	0.1
P22D SS-1B	OVA	0.1	0.1	0.1
P22D SS-1C	OVA	0.1	0.1	0.1
P22D SS-2	OVA	0.5	0.3	0.3
P22D SS-3A	OVA	0.1	0.1	0.1
P22D SS-3B	OVA	1.5	0.1	0.1
P22D SS-4	OVA	2.5	1.8	1.0
P22D SS-5	OVA	1.2	1.2	0.5
P22D SS-6	OVA	1.0	0.5	0.5
P22D SS-7	OVA	0.5	0.2	0.1
P22D SS-8	OVA	4.0	2.0	1.0
P22D SS-9	OVA	3.5	2.0	1.0
P22D SS-10	OVA	3.8	2.0	1.0
P22D SS-11A	OVA	4.0	2.0	1.0
P22D SS-11B	OVA	1.0	0.5	0.2
P22D SS-11C	OVA	0.1	0.1	0.1
P22D SS-12A	OVA	0.8	0.2	0.1
P22D SS-12B	OVA	0.1	0.1	0.1
P22S SS-13A	OVA	1.0	0.5	0.5
P22D SS-13B	OVA	1.0	0.3	0.1
P22D SS-14A	OVA	0.5	0.3	0.3
P22D SS-14B	OVA	0.1	0.1	0.1
P22D SS-15A	OVA	1.3	0.8	0.8
P22D SS-15B	OVA	0.2	0.1	0.1
P22D SS-16	OVA	0.3	0.1	0.1
P22D SS-17	OVA	0.1	0.1	0.1
P22D SS-18	OVA	0.1	0.1	0.1
P22D SS-19	OVA	0.1	0.1	0.1
P22S SS-20	OVA	0.1	0.1	0.1
P22D SS-21	OVA	0.1	0.1	0.1
P22D SS-22A	OVA	0.1	0.1	0.1
P22D SS-22B	OVA	0.1	0.1	0.1

Done by JL
Checked by MH

TABLE H-1 (continued)
CIBA-GEIGY FACILITY, CRANSTON, RHODE ISLAND
FIELD SCREENING RESULTS OF SOIL SAMPLES

WCC Field Sample I.D.	Instrument Type	VOC: ppm (2 sec)	VOC: ppm (20 sec)	VOC: ppm (60 sec)
P22D SS-23	OVA	0.1	0.1	0.1
P22D SS-24	OVA	0.1	0.1	0.1
P22D SS-25	OVA	1.0	0.8	0.2
P22D SS-26	OVA	0.8	0.2	0.1
P22D SS-27A	OVA	0.1	0.1	0.1
P22D SS-27B	OVA	20.0	5.0	2.5
Residential Area				
RW-4 SS-1	OVA	0.1	--	--
RW-4 SS-1A	HNU	1	1	0.1
RW-4 SS-1B	HNU	0.1	0.1	0.1
RW-4 SS-2	HNU	1	1	0.1
RW-4 SS-4	OVA	0.1	--	--
RW-4 SS-4A	OVA	0.1	--	--
RW-4 SS-4B	OVA	0.1	--	--
RW-4 SS-5	OVA	0.1	--	--
RW-4 SS-6	HNU	3	--	--
RW-4 SS-7	HNU	1	--	--
RW-4 SS-8	HNU	2	--	--
RW-4 SS-9	HNU	1	--	--
RW-4 S-11A	HNU	0.5	1.5	0.1
RW-4 S-11B	HNU	0.5	1.5	0.5
RW-4 SS-12	HNU	3	--	--
RW-4 S-12A	HNU	1	0.5	0.1
RW-4 S-12B	HNU	0.1	0.1	0.1
RW-4 S-13	HNU	0.5	0.1	0.1
RW-4 S-14	HNU	0.5	0.1	0.1

Notes:

1. Instrument Types:

   HNu - vapor sample analyzed with an HNu Systems PI 101 Portable Photoionizer (10.2 ev probe).
   OVA - vapor sample analyzed with a Century Systems (Foxboro) Organic Vapor Analyzer (Model 128).

2. VOC - Volatile organic compound concentration in parts per million (ppm)
   --- No reading taken.

3. After discovering that methane was the predominant indicator in many of the samples, VOC readings were taken at 2-, 20-, and 60-second intervals at the start of day 2. A sharp drop in the concentration measurement over time indicated that a very light contaminant, such as methane (e.g., high vapor pressure) was present in the headspace volume. Thus, a gradual drop in concentration possibly indicated a nonmethane organic contaminant. To confirm, the HNu (e.g., a photoionization detector that is non-sensitive to methane) was used to screen samples exhibiting a slow VOC drop and/or a high (greater than 50 ppm) VOC reading. Positive readings with the HNu confirmed the contaminant(s) as non-methane.

Done by JL
Checked by MH