

**Final Report**  
**Foundation Stabilization Research Studies**

**House at 1183 Grenac Road**  
**Fairbanks, Alaska**

# Final Report

## Foundation Stabilization Research Studies

### House at 1183 Grenac Road, Fairbanks, Alaska

#### **Introduction**

The house at 1183 Grenac Road is a small three bedroom house with a two car attached garage. The house was supported on perimeter and interior footings about 2 feet below grade with an enclosed crawl space. The garage is on a concrete slab. The garage and crawl space were both heated.

AHFC took possession of the house and by 1991, it had sustained about 10 inches of differential settlement due to thawing permafrost and was basically uninhabitable. Because of the settlement, the house was deeded to the Permafrost Technology Foundation in 1991 for part of a study concerning house foundations on permafrost. The Permafrost Technology Foundation study included a subsurface investigation, installing temperature measuring devices and survey points, and measuring the temperature and settlement over a period of six years. A floor plan of the house is presented in Figure 1.

The Permafrost Technology Foundation opened the crawl space and supported the structure on several crib foundations in late 1991. A deck was constructed around the house to keep the sun, snow, and rain away from the foundations. The garage was left on its slab on grade foundation but the hot elements in the garage were either removed or insulated so that heat input to the garage was dramatically decreased.

This report is the final Permafrost Technology Foundation report on the foundation study on this house.

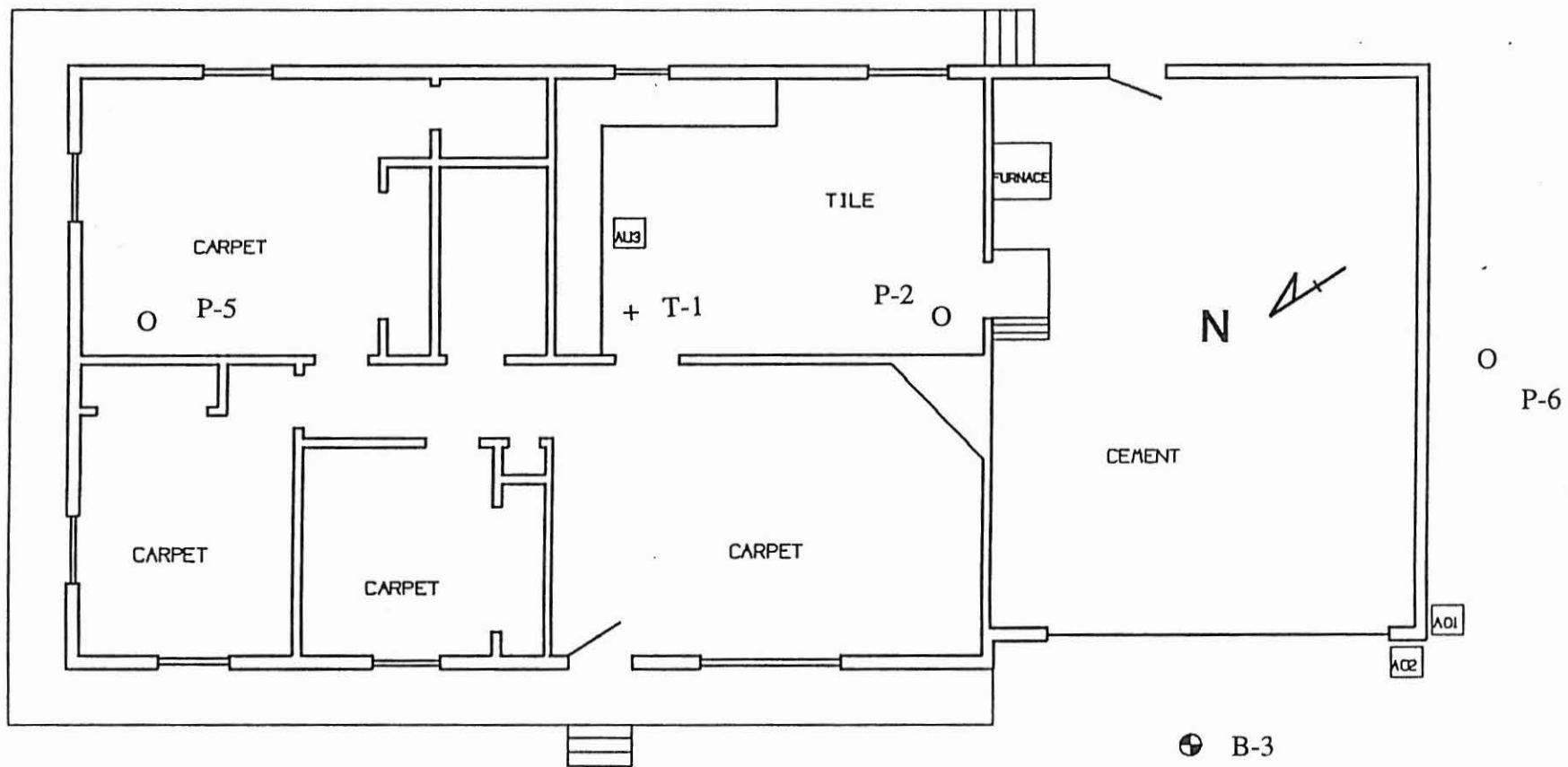
#### **Geotechnical Exploration**

The geotechnical explorations include two borings (B-3 and B-4), three probes (#2, #5 and #6), and one unlogged hole for a thermistor string (T-1). The number in the numbering system refers to the thermistor string number. The B, P, and T designate whether it was a boring, a probe or a thermistor string hole. The locations of all explorations are shown on Figure 1.

The borings were drilled with a hollow stem auger and included samples which were classified and taken to the laboratory for testing. The locations of the samples in the borings are shown on the Boring Logs, Figures A-1 and A-2 along with the soil classifications, water contents, and thermistor string locations. Samples of the soil were collected by driving a split spoon sampler out the bottom of a hollow stem auger using a 300-pound hammer and a 30-inch drop. The number of hammer blows required to drive the split spoon gives information on the competency of unfrozen soil. These samples are considered "disturbed samples." However, since they are retrieved essentially intact in



B-4



Legend:

- P = Probe
- ⊕ B = Boring
- + T = Thermistor Hole

FIGURE 1 - FLOOR PLAN OF HOUSE ON GRENAC ROAD SHOWING LOCATIONS OF SUBSURFACE EXPLORATIONS

their natural state they provide useful information about the soil. Below the top of the permafrost the soil was sampled with a dry core barrel. The core barrel was 5 feet long and about 3 inches in diameter and had diamond teeth set into the circumference at the tip. The core barrel was drilled into the ground and pulled back out. The sample as pushed out of the tube, classified and samples were taken back to the lab. A ¾ inch diameter PVC pipe was installed in each hole to house a thermistor string.

The probes consisted of driving a ¾ inch water pipe into the ground with a 40-pound hammer and counting the blows it took to drive each foot. The blow counts are shown on Figure A-3. The pipe in probe #6 was extracted and the hole advanced further with a solid stem auger. The pipe in each probe hole was extracted and ¾-inch PVC pipe was installed to house a thermistor string.

Boring B-1 encountered about 3 feet of sand and gravel fill under the driveway. The garage appears to be on about 3 feet of fill, which agrees with the findings in the boring. Silt, sandy silt, and clayey silt was found below the fill to the bottom of the boring at a depth of 55 feet. No water table was revealed and permafrost was found at a depth of 34 feet. The permafrost was generally friable which may indicate that it was marginally thaw stable.

Boring B-2 was in the backyard of the house and did not encounter the sand and gravel fill. Other than the fill, the soils encountered in the two borings were similar. Permafrost was found at a depth of 27.5 feet in the second boring. Adjusting for elevation at the top of the boring, the profiles in the two borings were very similar.

Probes 2 and 5 were under the house and reached refusal at a depth of about 27 feet. Probe 6 was at an elevation several feet higher than the others and was outside the house in an area covered with dry sand and gravel. It reached refusal at a depth of 35 feet.

Assuming the probes reached refusal at permafrost, the depth to permafrost was encountered at a fairly uniform elevation throughout the area.

## **Level Measurements**

### Background

Level measurements were taken to determine the relative elevation of the floor. The level measurements were made using a small precise telescopic level (sometime referred to as a "contractor's level") mounted on a tripod, and a surveyor's rod calibrated in millimeters. The millimeter rod was used instead of a standard surveyor's rod to give more precision to the measurements. Since the distance from the level to the rod was rarely over 15 feet, the rod could easily be read to the nearest millimeter (0.04 inch).

It should be noted, however, that when level measurements are this precise, perturbations can, and do, occur. These small changes are due to the placement of the rod from one measurement set to the next. Often the rod had to be placed behind furniture and it was

impossible to determine if it was sitting on the same spot under the same conditions as the previous measurement. If the location was slightly different or an electrical cord or something else happened to be under the rod, the readings would be different. Even the thickness of a few sheets of paper will show up at this precision. Many of the areas are carpeted, which makes it particularly difficult to get consistent readings.

There was also the possibility for a gross error in reading the rod. The level had the standard three cross hairs (center, upper, and lower) used for measuring distances in surveying. If the operator was careless or inexperienced (student labor was used for these measurements) a reading could be made using either the upper or lower cross hair instead of the center one. This would cause an error of tens of millimeters. These errors are readily identifiable when the data is plotted as a function of time. They have been included in the raw data, but have been eliminated in the analyses presented herein.

Level data was collected several times a year and accumulated for a period of almost six years. A letter on Figure B-1 designates each measurement location. The settlement data are presented in Table B-1. The data from different groups of letters were plotted together to show relevant comparisons such as along a wall or along the diagonal across the structure. These charts are shown on Figures B-2 through B-14. Table B-1 and Figures B-2 through B-14 show all the data collected.

All level data discussed thus far are referenced to Point A. The difference between curves representing two points is the relative difference in elevation of those two points but neither curve represents the true elevation or even relative changes in actual elevation.

Determining absolute elevations requires a stable surveyor's benchmark or other stable reference outside the structure. No such reference or benchmark was available at this location. Nevertheless, the relative elevations allow differential settlement to be observed. Relative differential movement between points in the structure is the most important information for this study.

During the analysis of the data, a number of points were determined to be grossly in error and were eliminated. From the remaining data it was determined that the accuracy of any given data point was on the order of 4 mm. Several individual measurements were made in succession to connect points within the house. The errors in individual measurements are accumulative hence, errors of up to 10 mm should be considered normal.

Figure 2 shows all of the relative elevation data on the house on one chart. From this data it is obvious that the house was about 220 mm out of level early in the study and that the initial releveling in the fall of 1991 reduced this spread to about 20 mm. The house continued to settle for about two years until it was about 50mm out of level in the summer of 1993 at which point it was relevelled and brought back to within about 20 mm of being level. The house continued to settle and was relevelled again in the spring of 1994. Since that time settlement has continued and in the spring of 1997 the house was about 60mm out of level. The spread in elevation at any given time is the actual

### Elevation of House on Grenac Relative to Point A

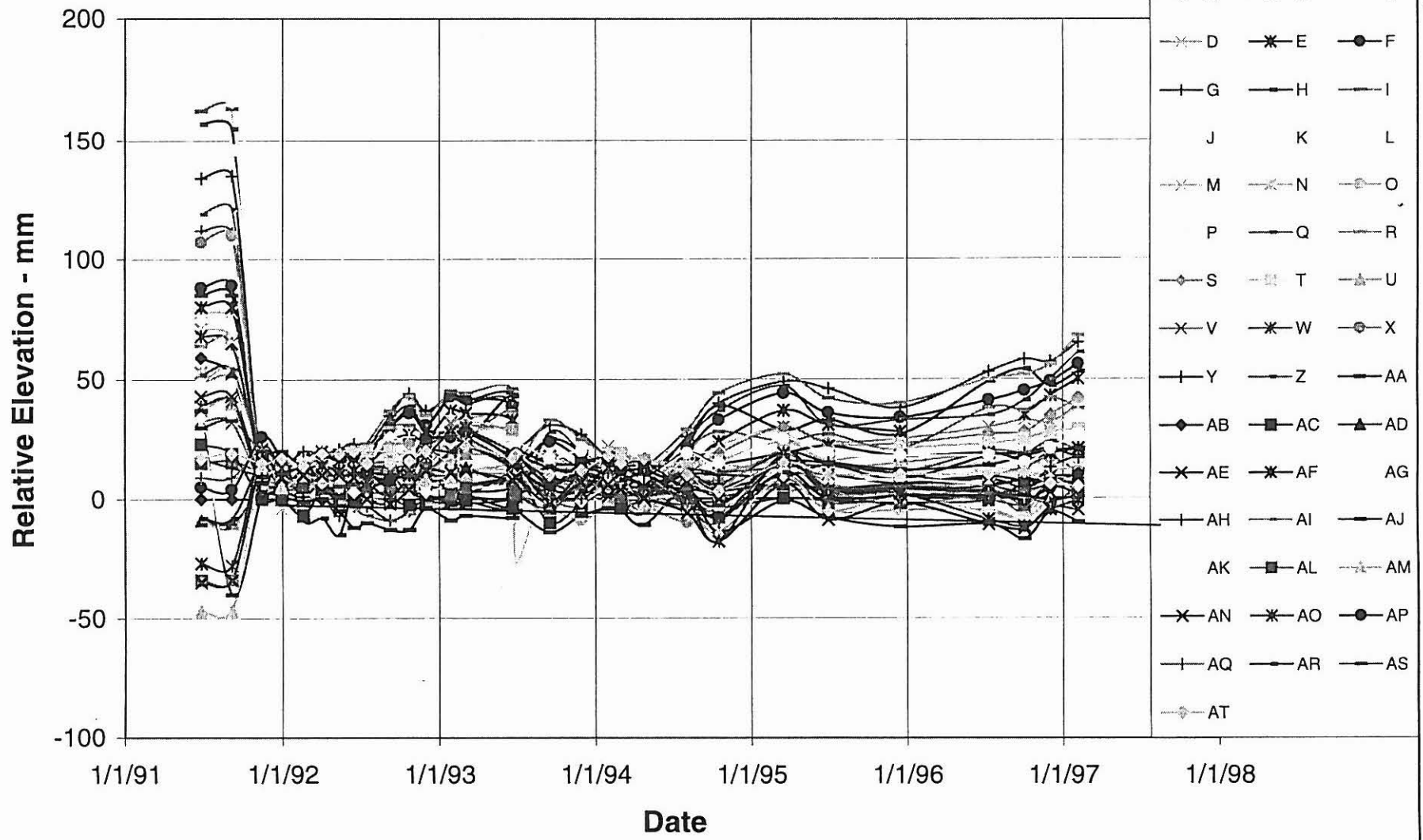


FIGURE 2

difference in elevation across the inside floor of the house. Since different flooring is used in different rooms, it is not the goal to have the entire interior floor perfectly level. In addition, some of the supporting beams under the house had taken a permanent set and it was not practical to make the house perfectly level.

Figure 3 shows all the relative elevation data from the house using Point AI and the date 9/15/93 as references. Point AI was chosen because it appears to be the most stable point in the house. September 1993 was chosen because it was the first data after the last releveling that was during the summer when all the frost effects should be out of the ground. The range of this data is shown in Figure 4. From this figure it appears that there is a slight trend, (on the order of 1mm per year), toward more differential movement with time. However there is an extreme amount of variability in the differential movement from time to time that does not appear to be related to seasons.

All of the relative elevation data from the garage is shown on Figure 5. It is obvious from the figure that the garage is about 200 mm out of level and that this does not seem to be changing rapidly. There does not seem to be a tendency toward major seasonal variations. There do appear to be fairly random changes in relative elevation which have no apparent explanation.

Figure 6 shows all the relative elevation data from the garage using Point GG and the date 6/27/91 as references. Point GG was chosen because it is always the highest in absolute elevation throughout the period of the measurements. June 1991 was chosen because it was the earliest data and it was during the summer when all the frost effects should be out of the ground. From the figure, it is obvious that there is a general trend toward settlement from point GG on the order of 3mm per year. There does appear to be at least 20mm of relatively random movement that does not have any apparent explanation.

The range of relative movement from Figure 6 is shown on Figure 7. This figure seems to show up to about 70mm of differential movement over the five year period. There appears to be a slight trend toward more differential movement with time but at the same time there is an extreme amount of variability in the differential movement from time to time.

#### Earthquakes and Other Dynamic Events

The presence of loose soils gives raise to the concern for settlement during a dynamic event such as an earthquake. During the period over which the level measurements were made, there were 15 earthquakes over a Richter Magnitude of 4.0. The two largest were a Magnitude 5.0 on November 1, 1992, and a Richter Magnitude 6.2 on October 6, 1995. The last one was the most significant, not only because it was the largest, but also because it was the shallowest at only 9 km below the surface. It was felt very strongly by residents of Fairbanks, however, reviewing the settlement data does not reveal any settlement that can be attributed to an earthquake. This suggests that significant settlement will not be caused by future earthquakes producing the same intensity. This

### Movement of House on Grenac Relative to Point AI and 9/15/93

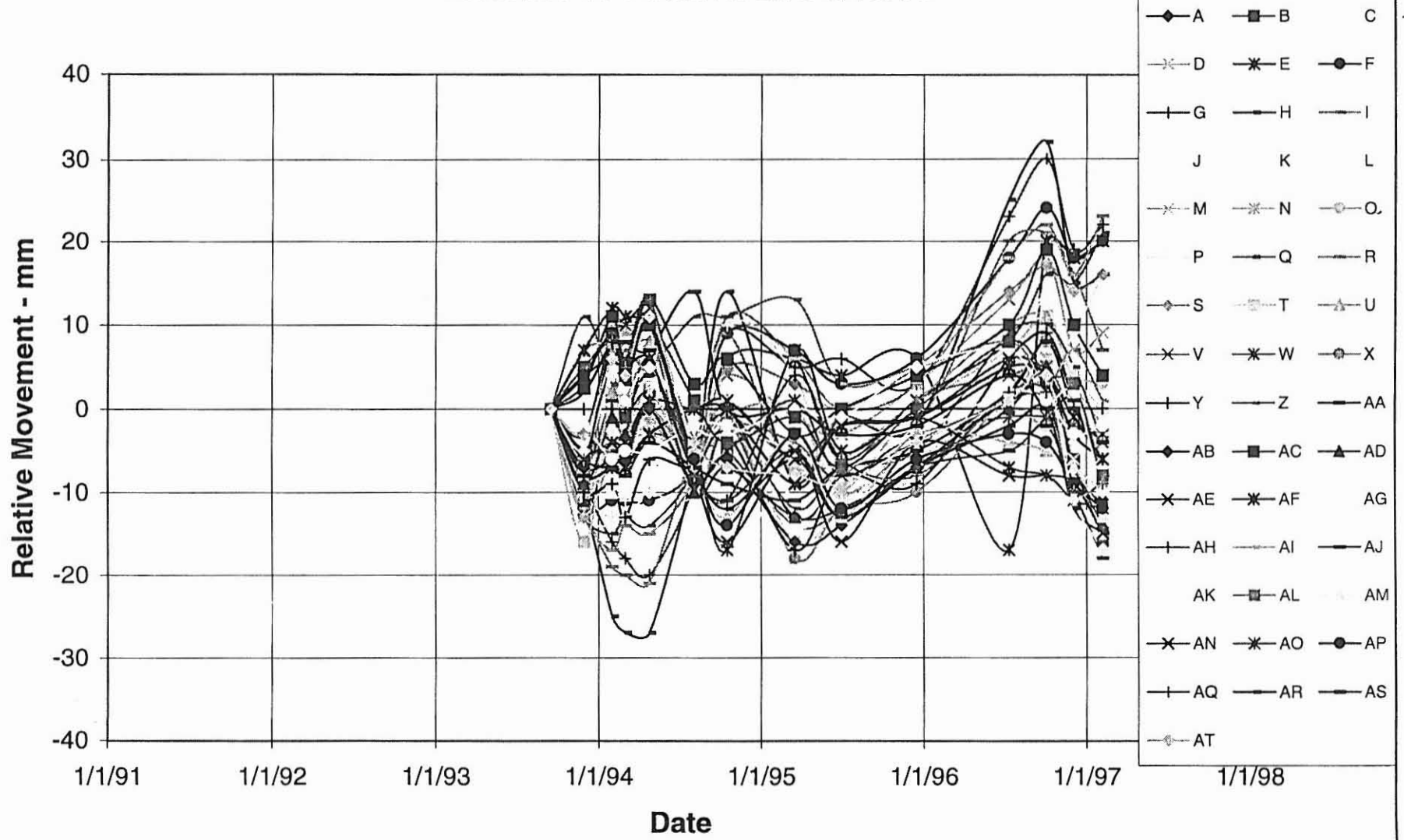


FIGURE 3



### Range of Movement Data for House on Grenac Relative to Point AI and 9/15/93

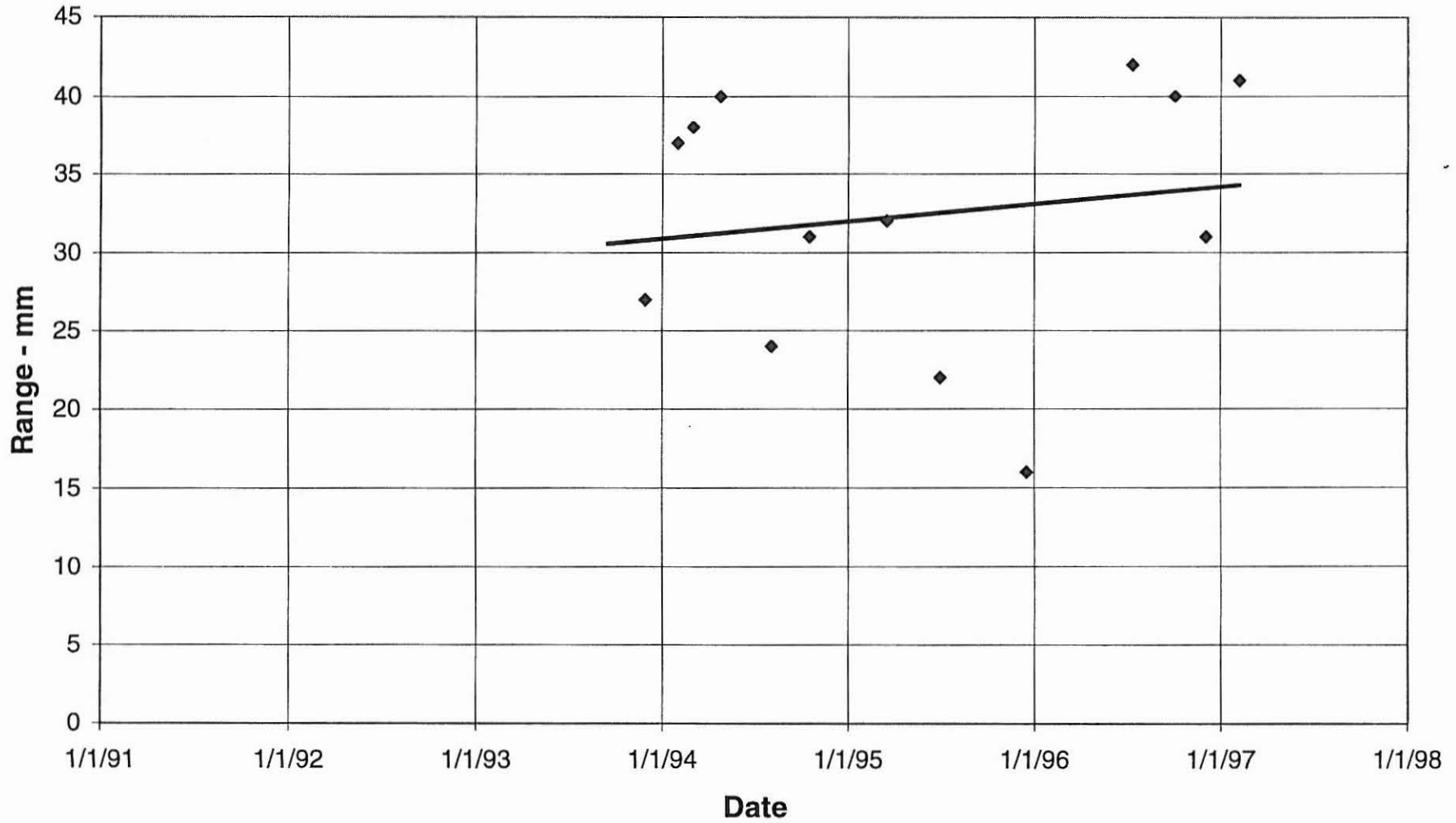


FIGURE 4

## Elevation of Garage at Grenac Relative to Point GG

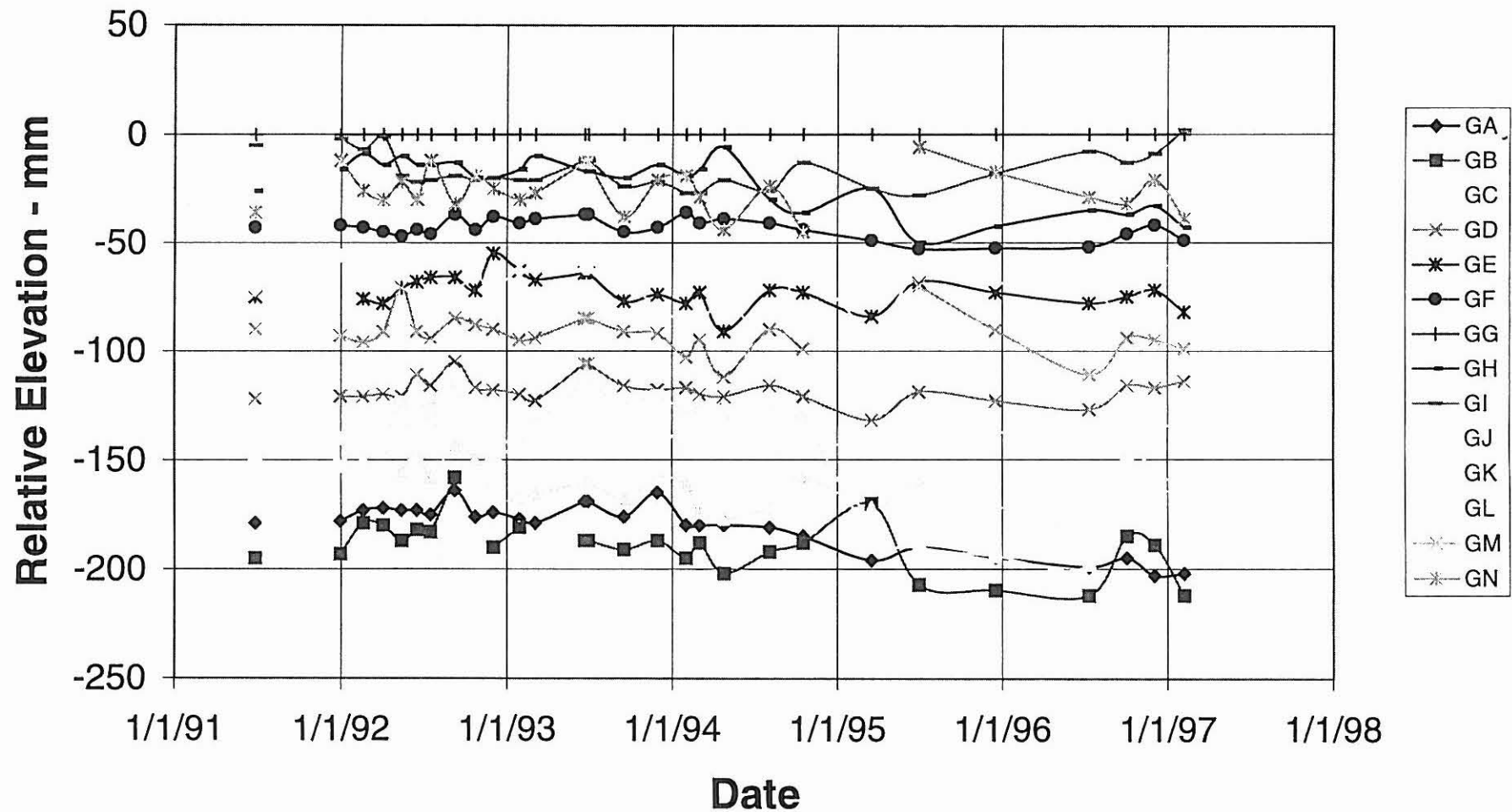


FIGURE 5

# Movement of Garage at Grenac Relative to Point GG and 6/27/91

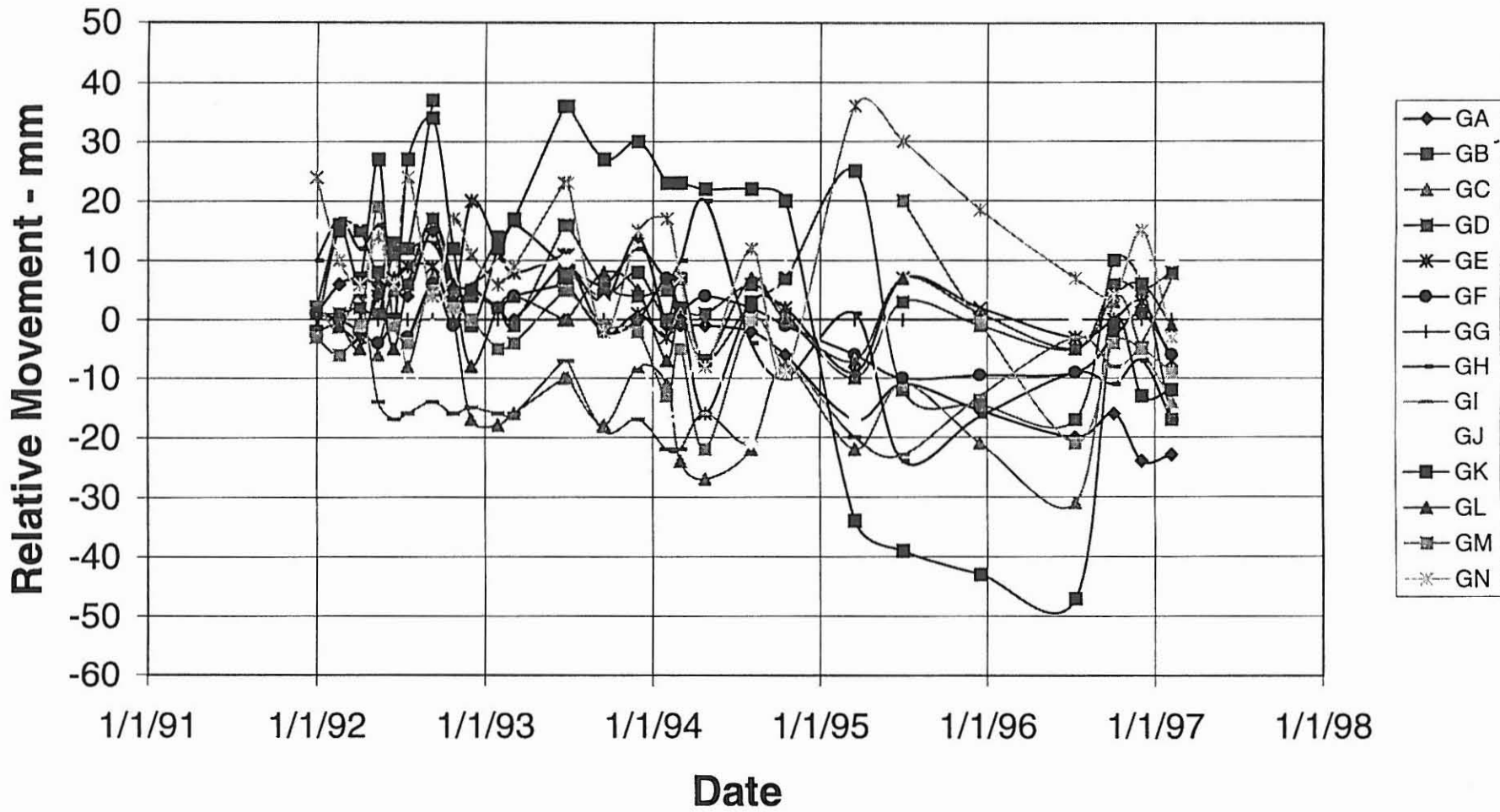


FIGURE 6

## Range of Relative Movement Data for Garage at Grenac Relative to Point GG

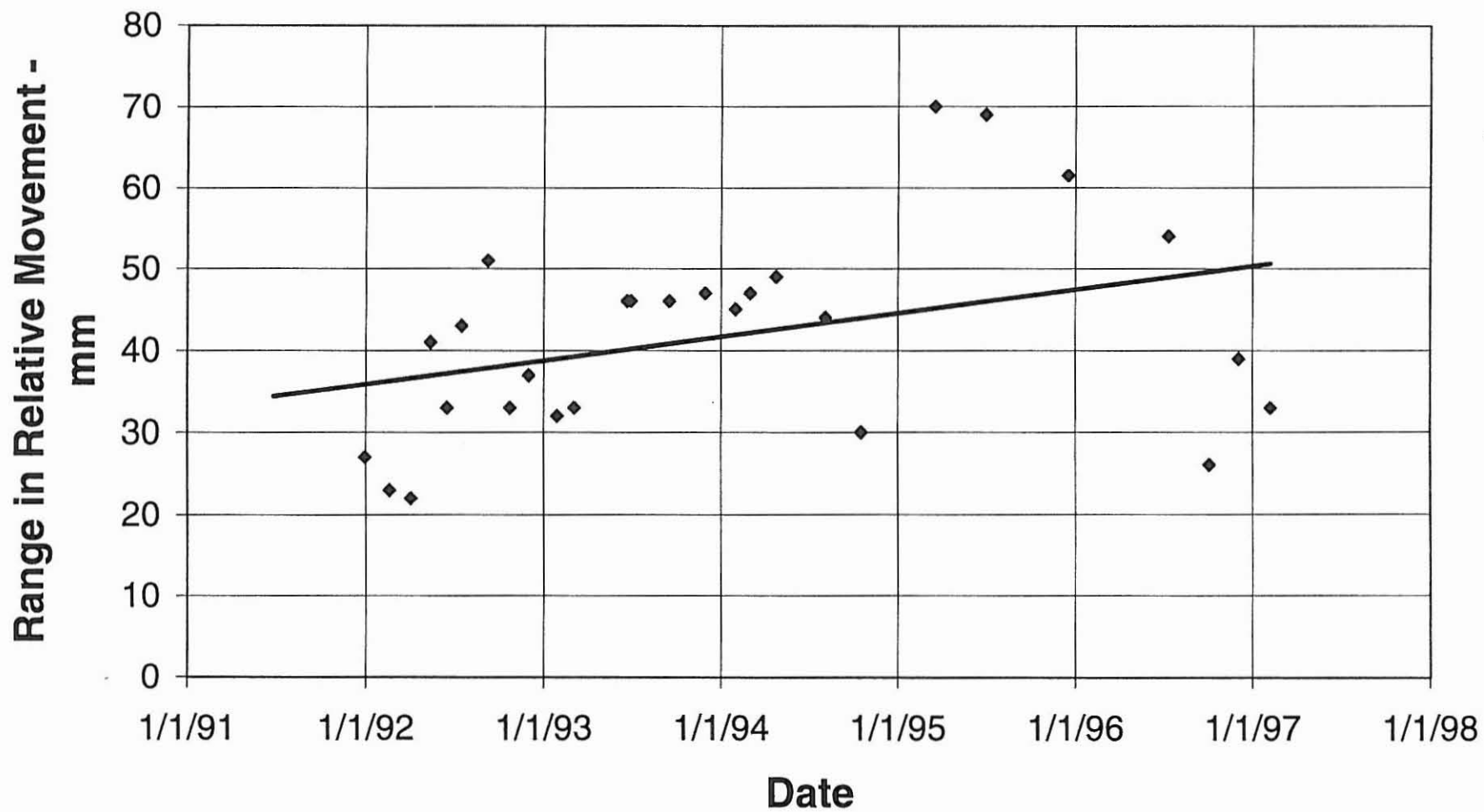


FIGURE 7

does not preclude the possibility of settlement during a more severe earthquake or other type of dynamic event. Even the same magnitude earthquake either closer or shallower may produce a higher intensity.

## Temperature Measurements

Temperature measurements were made with thermistors, which were read with a datalogger and converted, automatically to temperature. The locations of the thermistor strings are shown on Figure C-1. Thermistor strings with twelve thermistors were placed in the PVC Pipes installed for this purpose. The depths of the thermistors are shown on the data sheets, Table C-1.

The thermistor string was monitored periodically for five years. The raw data is shown in Table C-1. The temperature data was plotted with respect to time on charts to give a graphic indication of the trends over the duration of the study. These charts are shown on Figures C-2 through C-32. All data collected are shown on Table C-1 and on the figures.

Thermistors are capable of measuring temperature to the nearest one thousandth of a degree Centigrade. However, the nearest one tenth of a degree is probably satisfactory for everything except the location of the actual freezing front. Thermistors were used because they are more accurate and easier to read than thermocouples; however, they have the disadvantage of being more fragile, and they can drift a few thousands of a degree over time. To obtain the maximum accuracy, the strings must be calibrated in a reference bath both before and after their use. These thermistor strings were calibrated before placing them in the hole, but since they are buried after installation, it is impractical to remove them without destroying them. Therefore, the secondary calibration cannot be made. Since the calibration could not be completed, the temperatures cannot be relied upon to more than about a tenth of a degree Centigrade.

Selected portions of the temperatures from thermistor strings 1 through 7 are shown on Figures 8 through 14. Some data points fell outside the range of possibility and were eliminated. Only the deep temperatures are shown and the scales of the drawings are expanded to show only that data around freezing for strings 1 through 6. This allows the opportunity to study what is happening to the permafrost with time.

The data from the strings under the house (Strings 1, 2, and 5) show a dramatic decrease in temperature throughout 1992 due to removing the crawl space and putting the house on cribbing. These strings, also show a tendency for the deep ground temperatures to decrease and the permafrost to become shallower over the next three years. String 2 shows the permafrost raising 6.2 feet. String 2 does not extend to the top of the permafrost, however the deep ground temperature is definitely getting colder. String 5 clearly shows a depth of permafrost at about 19 feet in 1993 and shows the active layer reaching the top of the permafrost in 1996. Strings 3, 4, and 6 show a fairly stable environment. String 3 shows no change while String 4 shows a slight raising of the permafrost level and String 6 shows a slight lowering of the permafrost. The following table summarizes the information for Strings 1 through 6.

### Temperatures for String 1 at House on Grenac Road

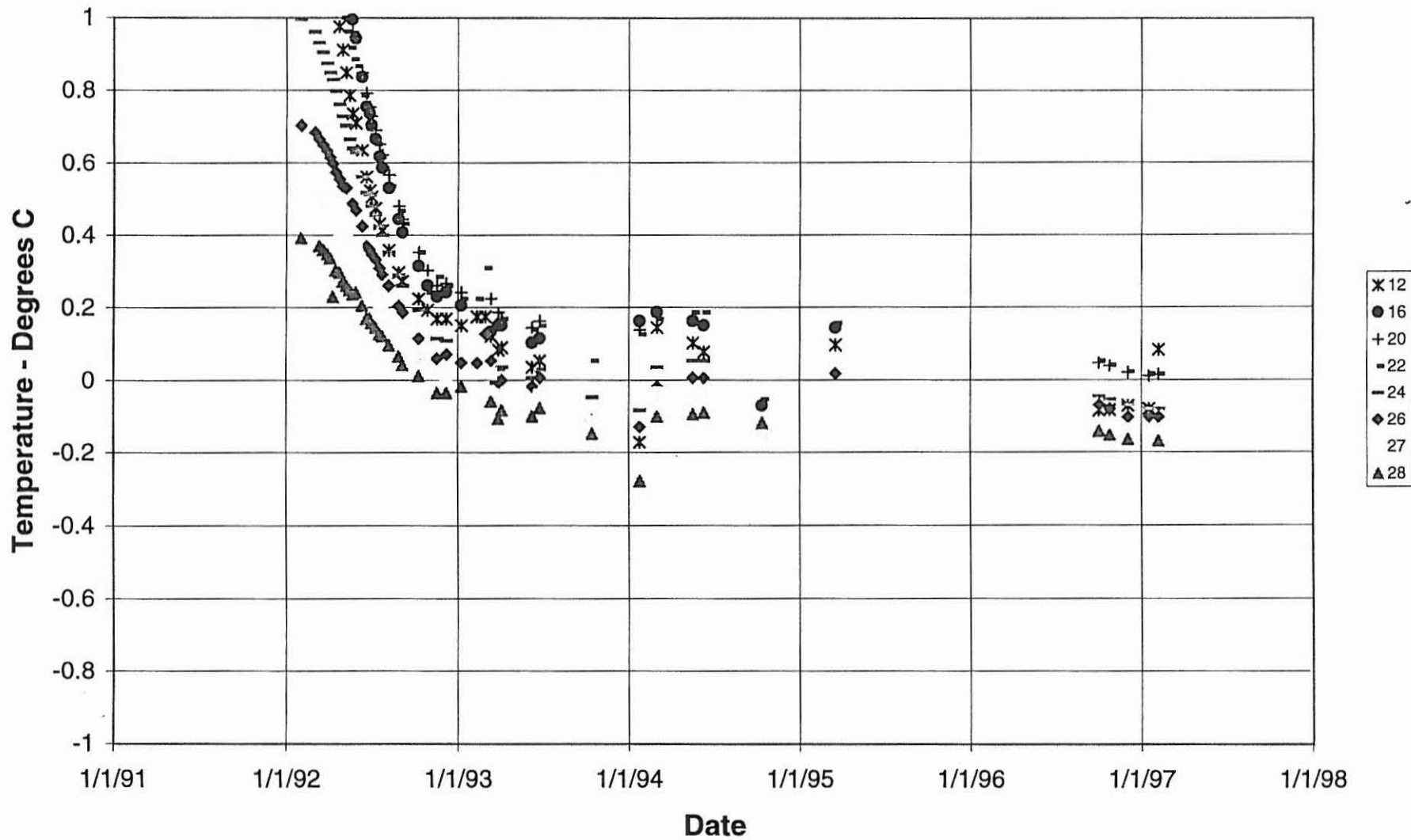


FIGURE 8

### Temperatures for String 2 at House on Grenac Road

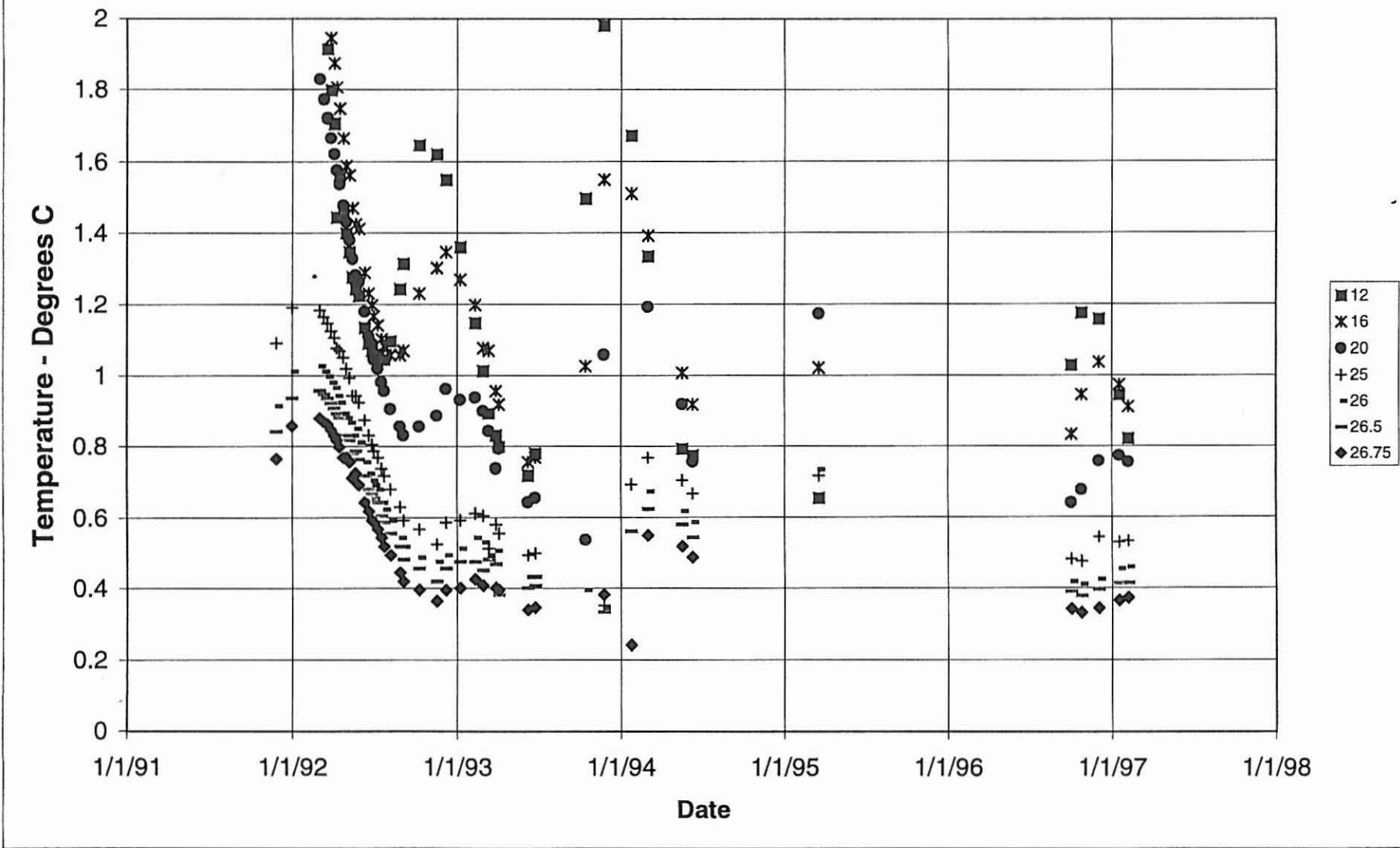


FIGURE 9

### Temperatures for String 3 at House on Grenac Road

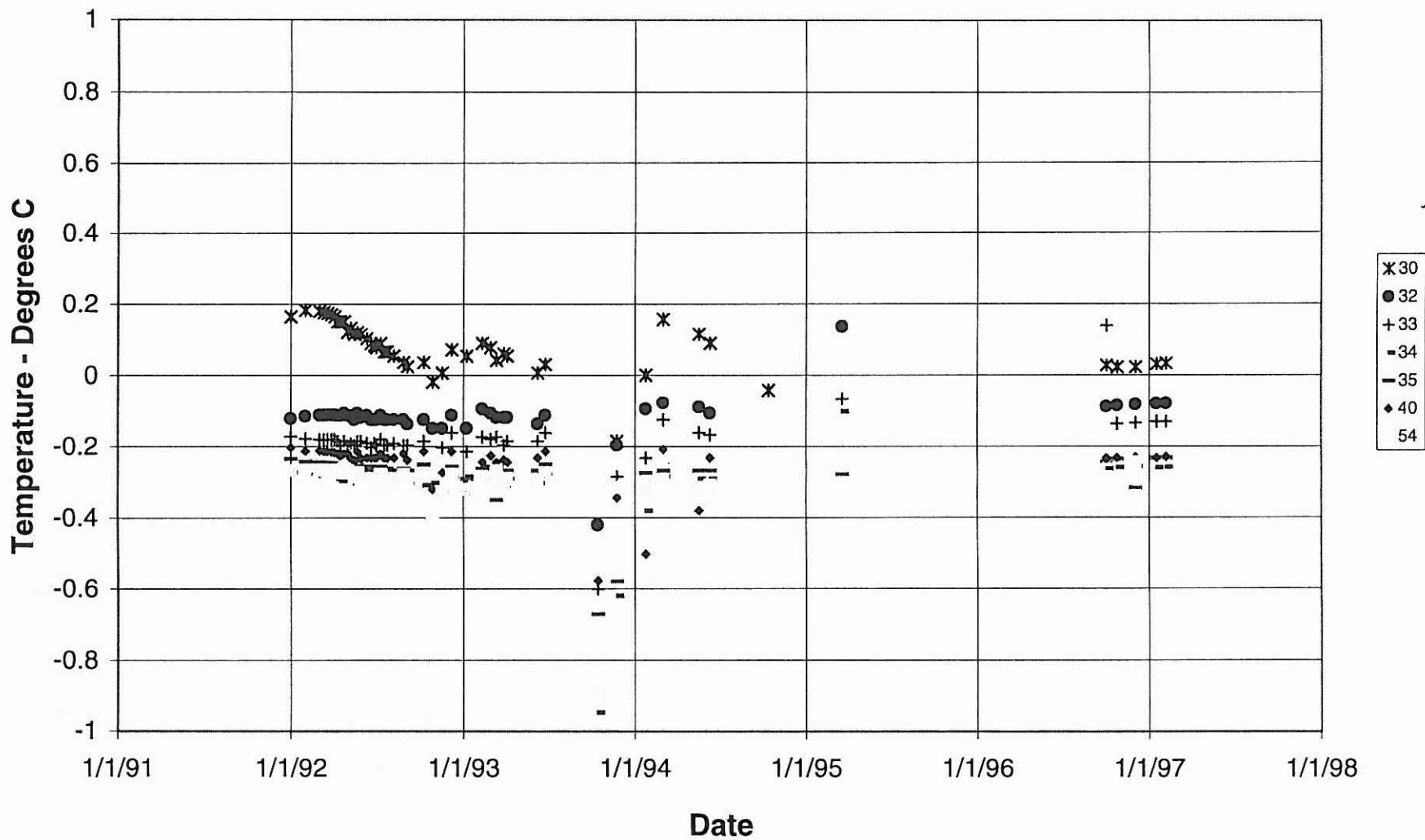


FIGURE 10



### Temperatures for String 4 at House on Grenac Road

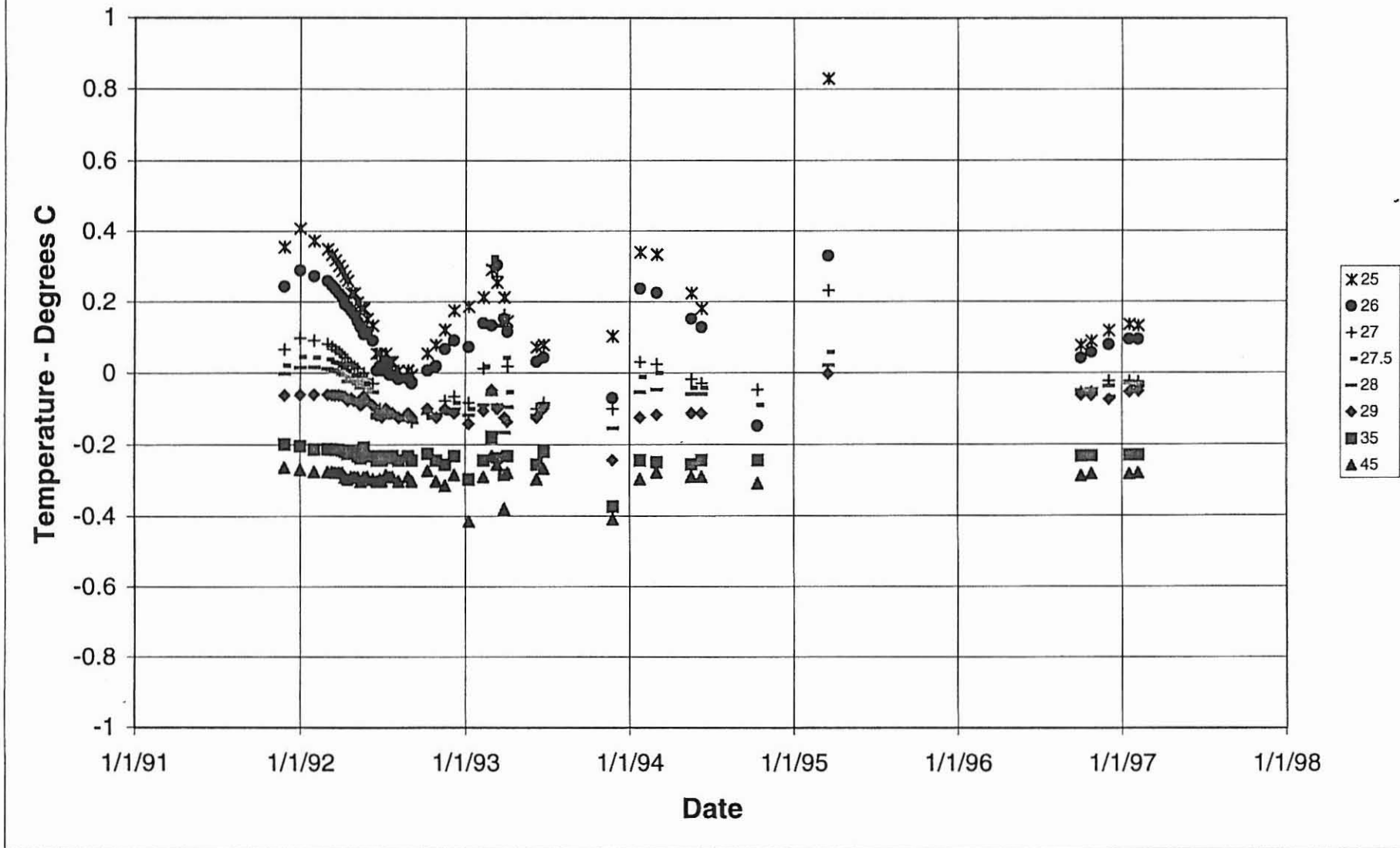


FIGURE 11

### Temperatures for String 5 at House on Grenac Road

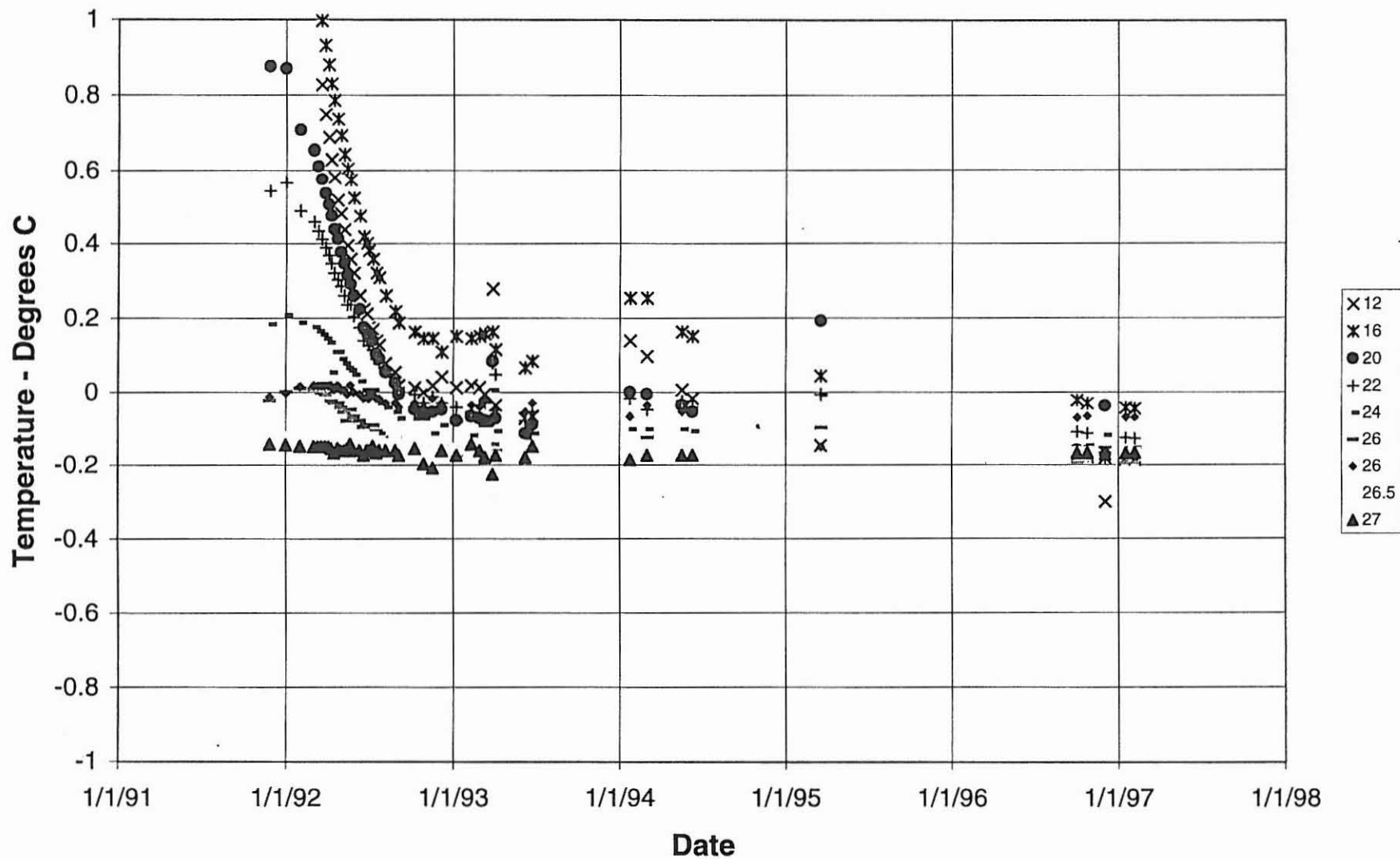


FIGURE 12

### Temperatures for String 6 at House on Grenac Road

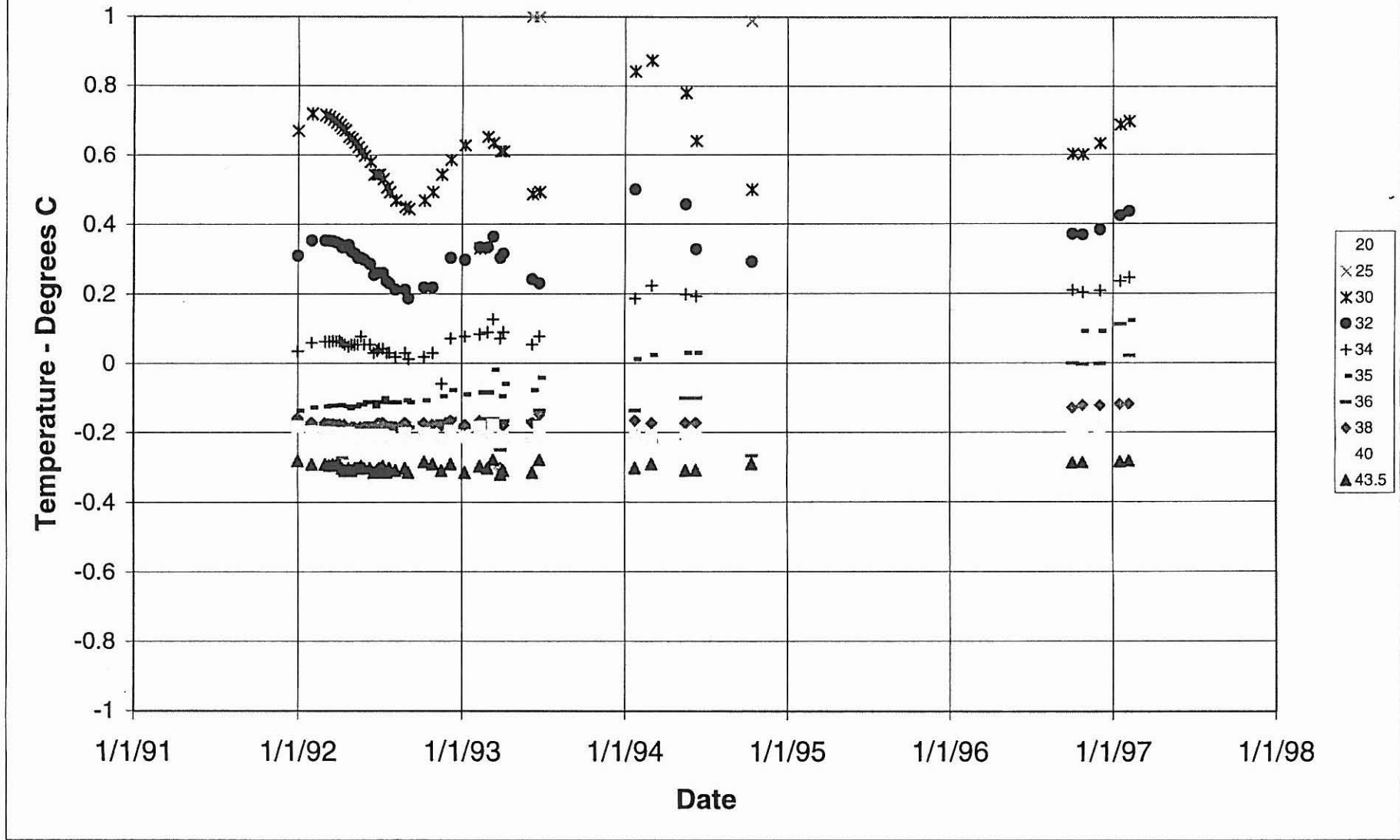


FIGURE 13

### Temperatures for String 7 at House on Grenac Road

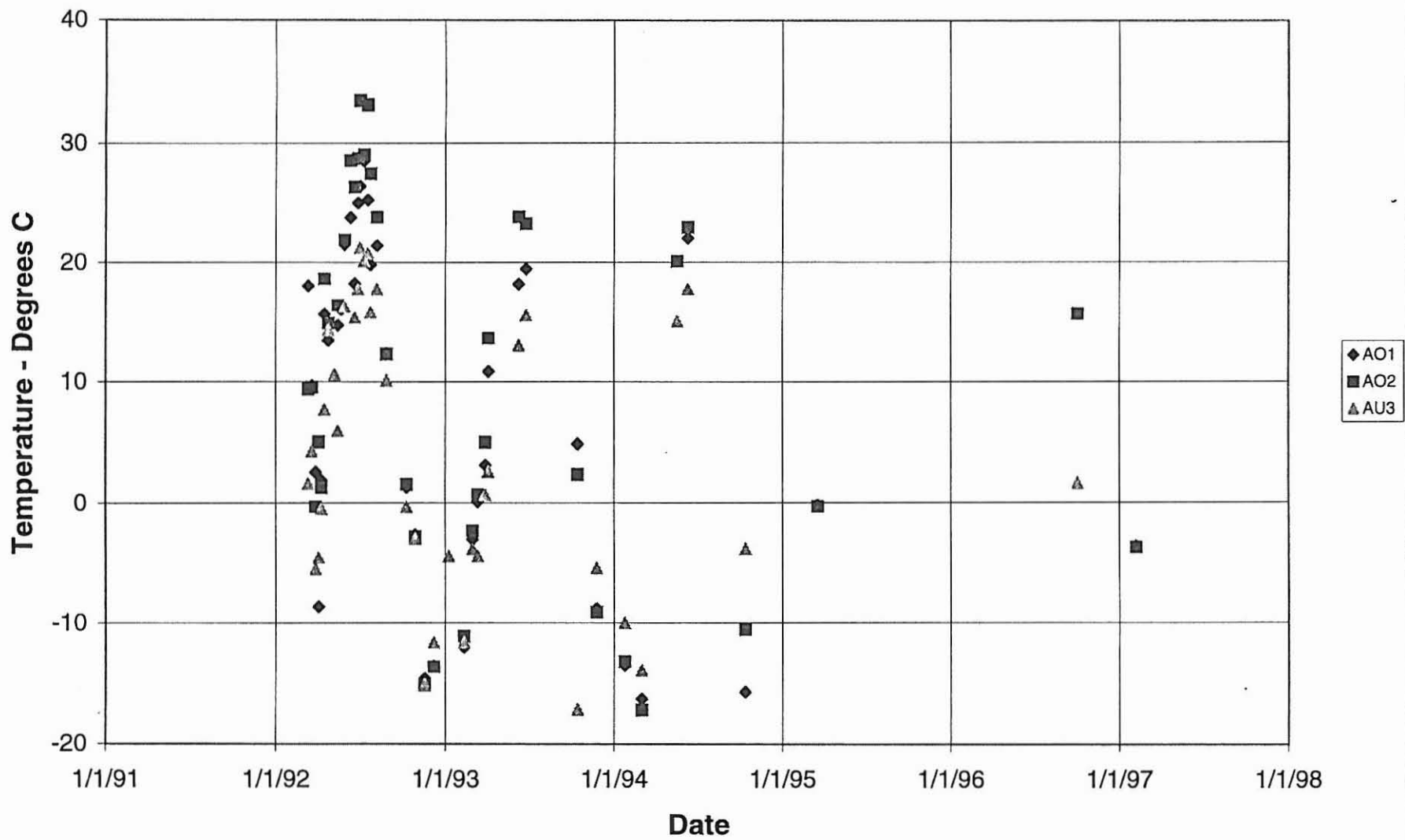


FIGURE 14

String #	Depth to Permafrost In Jan. 1993 ft.	Depth to Permafrost In Jan. 1997 ft.	Raise in Permafrost Elevation ft.
1	27.3	21.5	6.2
2	>26	>26	0.7?
3	30	30	0
4	23.7	23.3	0.4
5	19.0	6?	13
6	34.3	36	-1.7

String 7 shows that the winter temperatures under the house are very similar to those outside the house and that the summer temperatures are cooler under the house than outside.

## Results and Conclusions

The borings indicate that the driveway, the garage area, and probably the yard in front of the house have been filled with several feet of sand and gravel. The natural materials consist of silt varying in color from gray to black, and in texture from sandy silt to clayey silt. The water contents indicate that the silt is nearly saturated below about 10 feet although no actual water table was observed in the borings. It is likely that the phreatic surface was at a depth of about 10 feet during our borings but that the flow was so slow that no free water was observed in the borings. The permafrost did not have obvious excess ice except for a few thin ice lenses very deep in the profile. The frozen silt varied from friable to bonded.

The temperature measurements indicate that the remedial measures taken have stopped thawing of the permafrost under the house and have caused the permafrost to start rejuvenating. Since this site is underlain by high water content silt, frost heaving and subsequent thaw settlement in the active layer should be expected. The temperature measurements near the door of the garage indicate no change in the deep ground temperatures. The temperature measurements on the side of the garage, however indicate a continuing warming and subsequent thawing of the permafrost.

The settlement measurements in the house indicate a lot of variability, but the variation does not seem to be associated with seasons and there is only a very slight trend toward more total variability with time. The settlement measurements in the garage indicate a lot of variability. There does not seem to be a correlation with seasons but there is a definite tendency toward increased differential settlement over time.

The house is on cribbing which is easy to access and therefore the house would be easy to relevel if that were to become necessary. The settlement has slowed to the point where releveling should not be necessary very often, if at all.

The garage is a slab-on-grade, which is significantly out of level, and it is continuing to settle differentially. One option is to live with the problem. The continuing settlement seems to be at the rate of an inch or so every five years. With minimal maintenance on the intersection between the house and the garage and on the garage itself, it could be many years before remedial measures would be necessary. A second option would be to repair the garage by either grout jacking the whole garage or by leveling the exterior walls and pouring a new slab. After releveling the garage, the differential settlement should be expected to continue at about the same rate unless something else is done to stabilize the site. Raising the house was enough to reverse the settlement trend of the house, so keeping the garage cold and building a deck around the sides should stop the settlement.

The geosynthetic wall around the house was an experiment in the construction and performance of geosynthetic walls for this use. The experiment was to find how a geosynthetic wall would behave when filled with silt, and how the geosynthetic would behave under the ultraviolet light it receives in this environment.

The wall creeps inward with the freezing and thawing of the silt behind the fabric. This inward creep is not an indication of impending collapse, but it is detrimental to the deck and will require releveling the posts under the deck every year or two. This can be done by lifting the deck with a car jack, pulling the posts back into plumb and placing shims under them if necessary.

The ultraviolet light is deteriorating the fabric. The fabric has lost on the order of half its strength in the six years since the wall was constructed. If left unprotected, in a few years the wall will develop tears, probably as a result of some activity like kids climbing over it, and the wall will ultimately fail. The failure should be slow and leave plenty of time to do remedial measures without serious damage to the deck. The wall could be replaced with a number of different kinds of walls when that becomes necessary. Alternately, the wall could be protected from ultraviolet light and it should remain intact nearly indefinitely. Protection could be done using a covering such as certain paints, a spray-on asphalt, or a sacrificial layer of fabric. This protection will not stop the creep.

## Bibliography of References

Alkire, B.D., W.M. Haas and T.J. Kaderabek 1975. "Improving Low Temperature Compaction of Granular Soils," *Canadian Geotechnical Journal*, Vol. 12, No. 4, pp. 527-530.

ASHRAE 1989. *Handbook of Fundamentals*, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta GA.

Buska, J.S. and J.B. Johnson 1988. "Frost Heave Forces on H and Pipe Foundation Piles." *Proceedings of the Fifth International Permafrost Conference, Trondheim, Norway*, pp. 1039-1044.

Chamberlain, E.J. 1988. "A New Freezing Test for Determining Frost Susceptibility," *Proceedings of the Fifth International Permafrost Conference, Trondheim, Norway*, pp. 1045-1050.

Danyluk, L.S. 1986. *Stabilization of Fine-Grained Soil for Road and Airfield Construction*, AKDOT/PF Report AKARDÄ86-30.

Esch D.C. 1986. "Insulation Performance Beneath Roads and Airfields in Alaska," *Proceedings of the 4th Intl Cold Regions Specialty Conference*, Anchorage, AK. ASCE, 345 E. 47th. St. New York City, NY 10017-2398.

Esch D.C. 1988. "Embankment Case Histories on Permafrost," *Embankment Design and Construction in Cold Regions*. American Society of Civil Engineers, 345 East 47th St., New York, NY 10017-2398.

Farouki, O.T. 1985. "Ground Thermal Properties" *Thermal Design Considerations in Frozen Ground Engineering*, ASCE, pp. 186-203.

Forland K.S., T. Førland and S.K. Ratkje 1988, "Frost Heave," *Proceedings of the Fifth International Permafrost Conference, Trondheim, Norway*, pp. 344 -348.

Freitag D. and T. McFadden 1997. *Introduction to Cold Regions Engineering*. ASCE Press. American Society for Civil Engineers New York City, NY. ISBN 0-7844-0006-7

Hartman, C.W. and P.R. Johnson 1978, *Environmental Atlas of Alaska*, Univ. of Alaska Fairbanks, Fairbanks, AK.

Johnson, P.R. 1971. *Empirical Heat Transfer Rates of Small Long and Balch Thermal Piles and Thermal Convective Loops*, Institute of Arctic Environmental Engineering, University of Alaska Fairbanks. Report 7102. Johnston G.H., Editor 1981. *Permafrost Engineering Design and Construction*, John Wiley and Sons, New York.

- Kersten M.S. 1949. *Thermal Properties of Soils*. University of Minn., Engineering Experiment Station, Bull. 28.
- Kinney T.C. and K.A. Troost, 1984, "Thaw Strain of Laboratory Compacted Frozen Gravel," *Proceedings: 3rd International Specialty Conf. on Cold Regions Engineering*. Canadian Society for Civil Engineering, Edmonton, Alberta, Canada.
- Krzewinski T.G., T.A. Hammer and G.G. Booth 1988. "Foundation Considerations for Siting and Designing the Red Dog Mine Mill Facilities on Permafrost." *Proceedings of the Fifth International Permafrost Conference, Trondheim, Norway*. pp. 955-960.
- Linell, K.A. and C.W. Kaplar, 1966. "Description and Classification of Frozen Soils." Proc. International Conference on Permafrost (1963) Lafayette IN. U.S. National Academy of Sciences, Publ. 1287. pp. 481-487.
- Lovell C.W. 1983. "Frost Susceptibility of Soils" *Proceedings of the Fourth International Permafrost Conference, Fairbanks, Alaska*. pp. 735-739.
- Maksimjak R.V., S.S. Vyalov and A.A. Chapaev 1983. "Methods for Determining the Long-Term Strength of Frozen Soils," *Proceedings of the Fourth International Permafrost Conference, Fairbanks, Alaska*, pp. 783-786.
- McFadden, T. and F.L. Bennett 1991. *Construction in Cold Regions*. John Wiley and Sons Inc, New York City, NY. 615 Pgs. ISBN 0-471-52503-0.
- Nixon, J.F. 1986. "Pipeline Frost Heave Predictions Using a 2-D Thermal Model." in Andersland, O.B. and F.H. Sayles, eds., Research on Transportation Facilities in Cold Regions, Proceedings, American Society of Civil Engineers, Boston, October 27, 1986, pp. 67-82.
- Penner, E. and C.B. Crawford 1983. *Frost Action and Foundations*. National Research Council of Canada, Div. of Building Research. DBR No. 1090, Ottawa, Canada.
- Rice, E.F. 1982. *Building in the North*. University of Alaska Fairbanks, Fairbanks, AK.
- Rice, E.F. and K.E. Walker 1983. "Introduction to Cold Regions Engineering." U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH. Internal Report #808.
- Smith, D.W. Editor 1986. *Cold Climate Utilities Manual*. Canadian Society for Civil Engineering, 2050 Mansfield St. Montreal, Quebec, Canada, H3A 1Z2.



## Appendices

**Appendix A**  
**Bore Hole Logs**

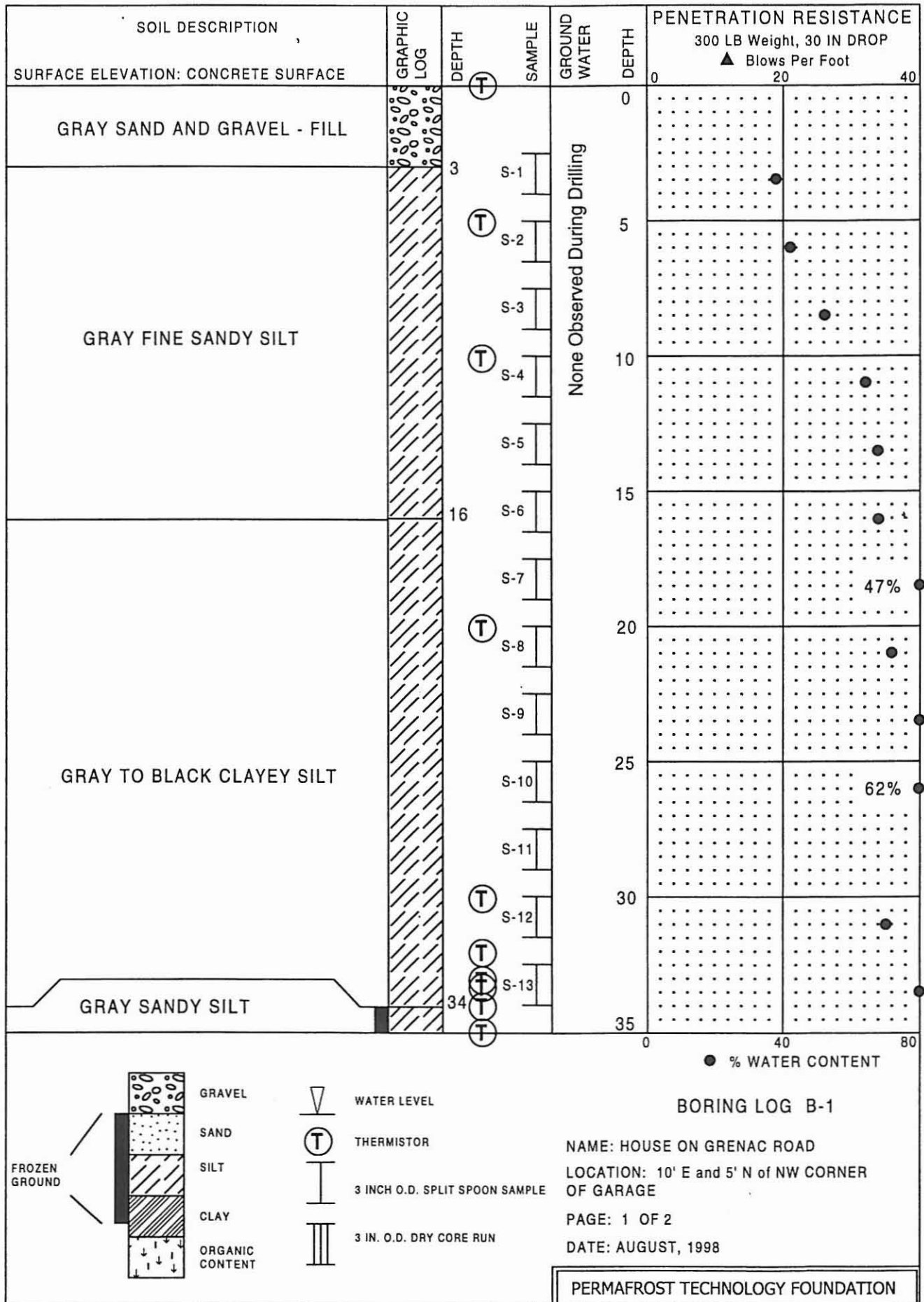


FIGURE A-1a



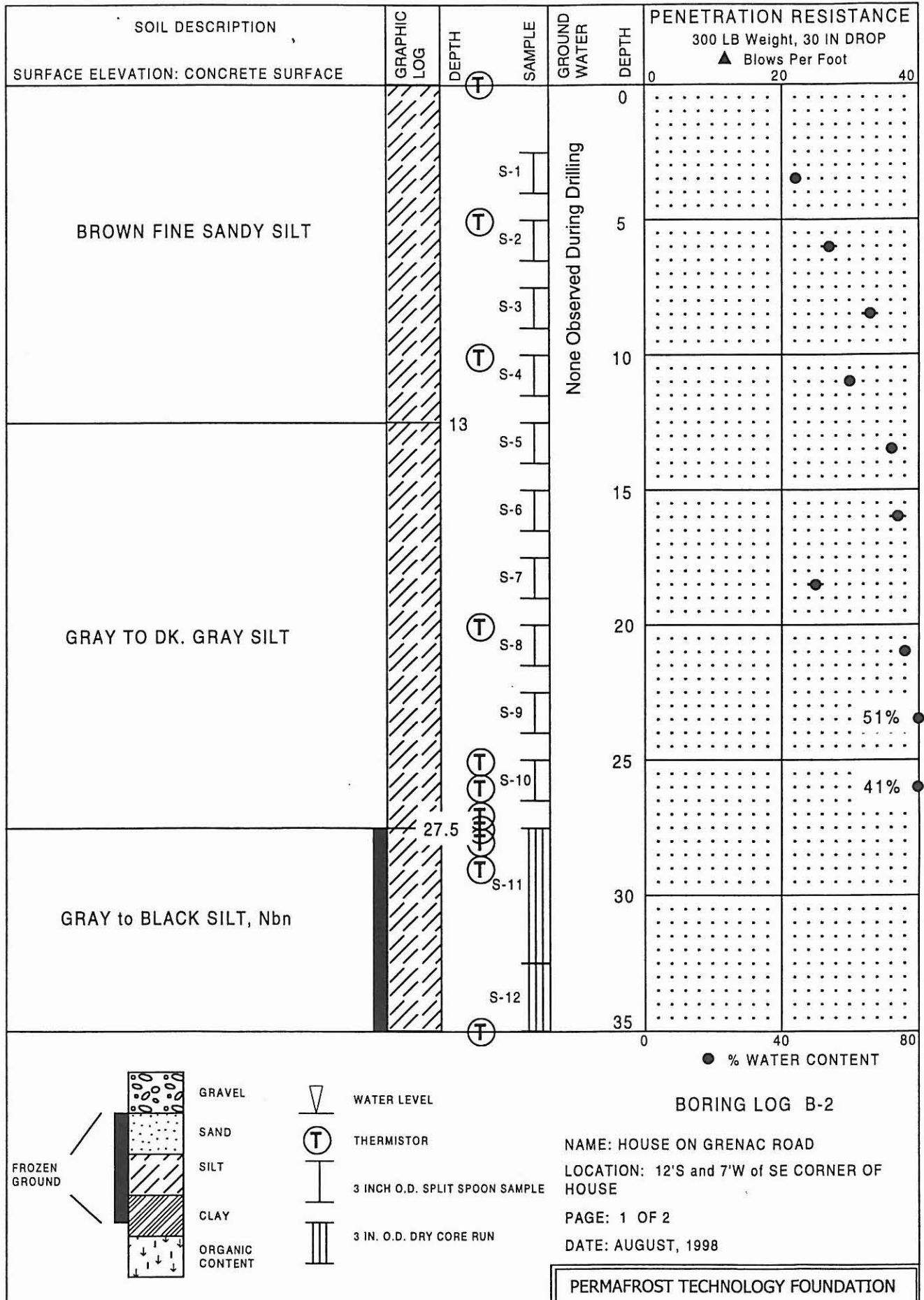


FIGURE A-2a

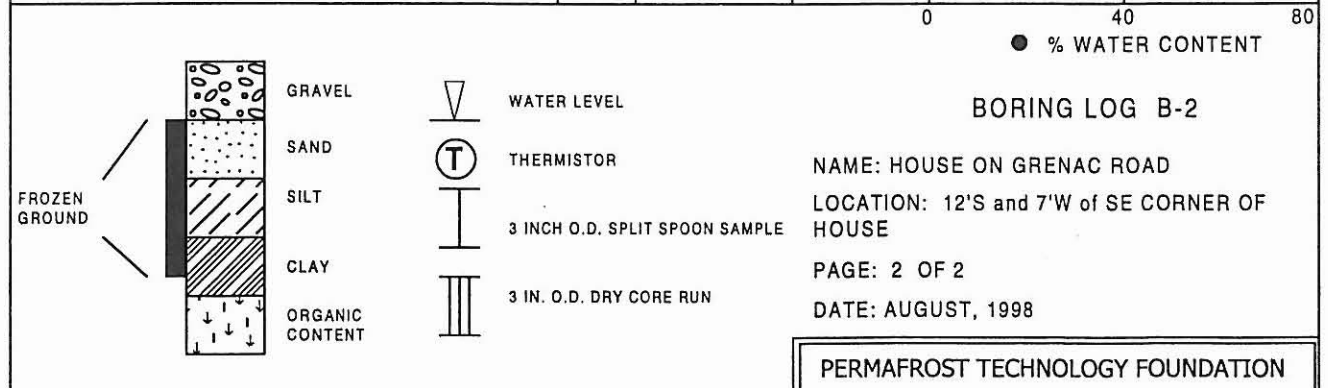
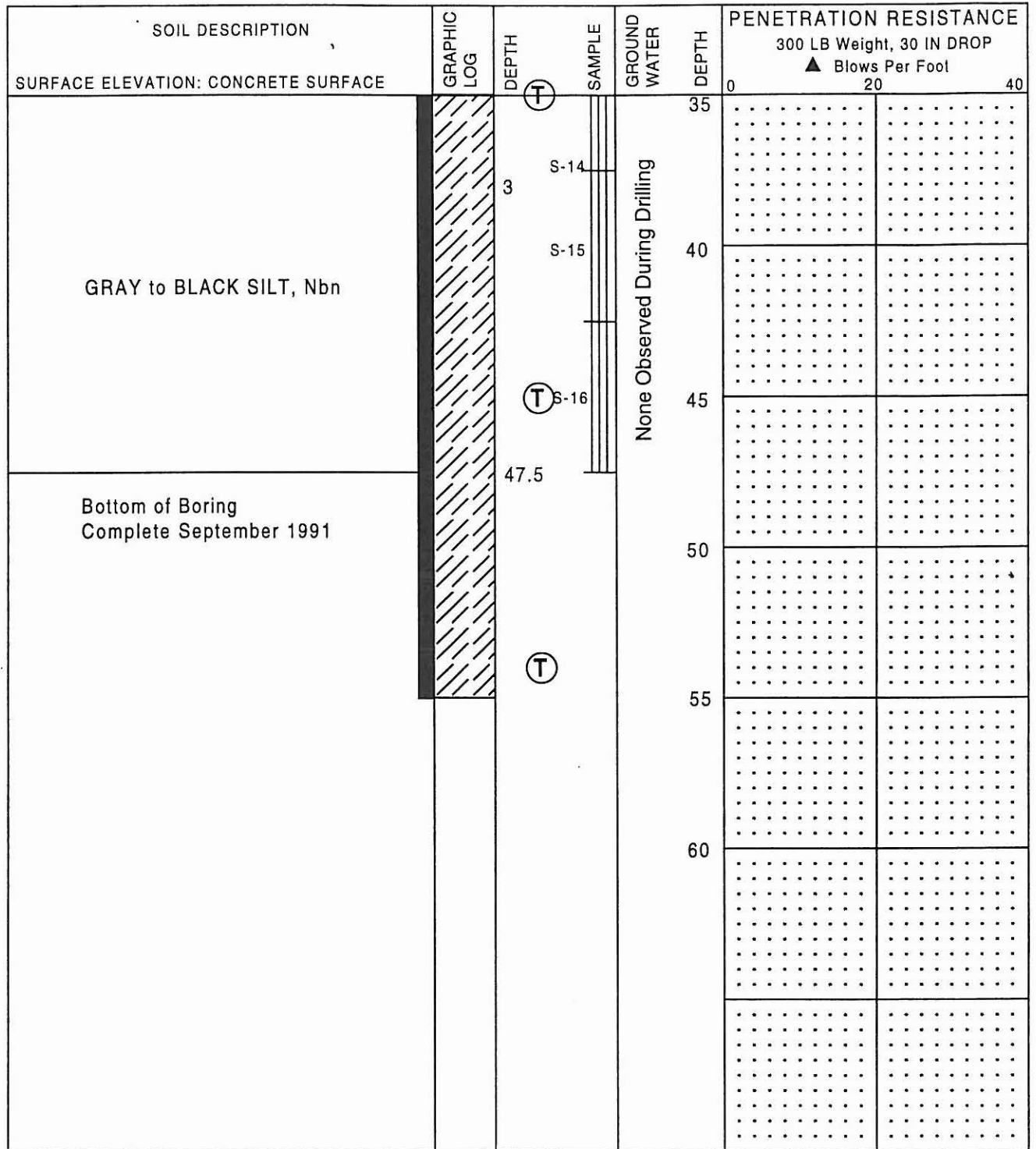


FIGURE A-2b

**Appendix B**  
**Level Measurements**





Settlement Measurements on House on Grenac

All measurements are relative to point A

House

	6/27/91	9/6/91	11/15/91	12/31/91	2/19/92	4/3/92	5/13/92	6/16/92	7/16/92	9/8/92	10/23/92	12/1/92
A	0	0	0	0	0	0	0	0	0	0	0	0
B	15	16	11	10	5	8	8	9	8	9	9	10
C	31	33	5	6	6	13	9	14	14	17	12	11
D	71	67	11	8			4	20	14	25	22	
E	68	65	13	8	2	6	2	10	13	24	27	25
F	88	89	13	9	3	7	2	13	19	30	36	31
G	112	111	13	12	-1	2	-7	10	20	35	44	37
H	157	155	7	20	-9	-8	-15	7	17	30	37	28
I	162	163	13	13	0	2	-5	11	20	30	31	27
J	167	166	16	7	5	9	7	16	20	26	23	24
K	145	146	9		3	7	7	11	14	18	19	15
L	108	109	5	1	5		8	13	11	17	8	14
M	78	78		-4	0	3	2	6	8	10	7	9
N	53	52	7	5	5	8	9	12	13	15	15	13
O	49	53	17	9	10	13	7	7	5	9	10	13
P	30	31	18	1	3	4	1	1	7	21	26	22
Q	52	54	18	5	6	8	1	10	16	33	39	31
R	64	66	21		10	10	5	15	23	37	43	35
S	48	50	10	3	8	10	5	13	13	22	23	19
T					13	17	12	19	20	20	18	21
U	37	40	4	1	7	15	8	15	15	16	14	12
V	33	32	6	7	7	13	11	10	6	9	8	11
W	39	41	15	12	17	20	16	17	14	11	12	18
X	107	110	2	0	-5	4	1	5	8	11	6	7
Y	134	135	9	4	1	7	2	7	13	13	9	8
Z	119	121	10	7	5	12	8	9	13	12	7	13
AA	85	85	7	6			7	4	11	4	3	5
AB	59	51	4	5						6	2	1
AC	23	19	0	0	-7	4	0	0	-1	0	-3	-1
AD	-9	-10	4	4	5	13	7	11	11	10	3	6
AE	43	43	4	4				2	1	-1	2	2
AF	80	80	13	12	17	5	6	8	5	8	10	8
AG	48	48	12	14	16	11	7	9	2	3	4	6
AH	17	13	10	10	13	5	-1	-3	-3	-9	-5	0
AI	-9	-12	5	6	11	1	-1	-4	-7	-9	-6	-2
AJ	37	-40	1	1	-1	0	-5	-12	-10	-13	-13	-4
AK	34	-34	18	17	12	7	5	3	1	-1	5	3
AL	-34	-34	15	4	6	9	7	8	3	3	4	13
AM	-47	-47	14	5	10	9	9	10	0	-2	3	8
AN	-35	-34	16	9	10	10	10	9	0	-2	4	12
AO	-27	-28	21	13	13	14	12	12	7	1	10	20
AP	5	4	26	17		19		18	11	8	16	25
AQ	9	9	21	14	20	19	21	23	13	13	15	22
AR	-8	-8	18		13	18	16	19	12	10	10	20
AS	30	33	20	20	14	19	19	19	15	15	10	24
AT	17	19	15	17	14	19	19	20	15	15	16	20

Garage

	6/27/91	9/6/91	11/15/91	12/31/91	2/19/92	4/3/92	5/13/92	6/16/92	7/16/92	9/8/92	10/23/92	12/1/92
GA	-666			-862	-867	-872	-875	-851	-829	-802	-801	-820
GB	-682			-877	-873	-880	-889	-860	-837	-796		-836
GC					-844		-858	-823	-812	-781	-775	-813
GD	-609			-805	-815	-820	-823	-789	-770	-743	-742	-764
GE					-770	-778	-773	-746	-720	-704	-697	-701
GF	-530			-726	-737	-745	-749	-722	-700	-675	-669	-684
GG	-487			-684	-694	-700	-702	-678	-654	-638	-625	-646
GH	-513			-700	-703	-714	-712	-692	-668	-651	-645	-666
GI	-492			-686	-701	-701	-721	-700	-675	-657	-646	-666
GJ	-559			-740	-751	-755	-755	-734	-738	-711	-691	-717
GK	-638			-837	-830	-844	-826	-829	-778	-755	-764	-798
GL	-625			-824	-833	-843	-835	-821	-786	-759	-757	-792
GM	-577			-777	-790	-791	-773	-769	-748	-723	-713	-736
GN	-523			-696	-720	-730	-724	-708	-666	-670	-644	-671

TABLE B-1

Settlement Measurements on House on Grenac  
 All measurements are relative to point A  
 House

	1/28/93	3/4/93	6/21/93	6/29/93	9/16/93	11/29/93	1/31/94	3/2/94	4/25/94	8/4/94	10/17/94	3/18/95
A	0	0	0	0	0	0	0	0	0	0	0	0
B	10	11	10	9	6	4	9	6	4	6	1	5
C	11	14	12	13	16	10	16	12	12	15	11	10
D	32	34	34	16	18	11	22	16	16	16	22	30
E	37	36	33	13	18	11	16	14	14	14	24	37
F	43	42	39	16	24	17	15	14	9	21	33	44
G	43	41	44	22	31	27	17	14	7	26	40	49
H	28	24	43	15	25	19	2	-1	-6	22	39	29
I	27	26	37	16	19	12	2	0	-6	19	28	24
J	23	24	27	16	18	10	6	6	4	17	20	20
K	13	14	16	10	13	8	6	4	1	13	14	12
L	10	10	9	4	5	3	-3	0	-3	5	8	4
M	9	12	12	8	8	0	5	5	1	7	7	5
N	11	12	14	12	15	10	12	12	9	15	15	10
O	25	26	11	3	-4	-9	-2	-2	-3	-10	-5	9
P	35	33	24	-26	11	6	0	1	-3	5	21	28
Q	42	40	40	-1	28	20	15	16	10	25	37	47
R	45	44	46	16	33	25	18	20	14	29	44	52
S	30	31	29	22	14	6	11	12	9	11	19	30
T	26	28	29	10	17	6	19	19	16	15	16	24
U	18	19	18	18	10	5	14	15	14	9	11	16
V	20	23	13	14	0	-3	9	9	6	-6	-2	9
W	28	30	16	10	1	-1	12	12	9	-3	-4	15
X	7	8	6	12	8	5	3	2	4	6	7	3
Y	7	6	8	8	13	8	6	1	3	10	10	9
Z	10	7	9	11	12	12	9	6	5	12	11	13
AA	4	3	5	17	13	10	8	6	5	10	4	15
AB	1	1	1	17	9	7	5	4	5	4	3	6
AC	-2	-1	-4	11	-10	-2	3	-4	-1	-3	-4	0
AD	10	13	4	2	6	2	7	4	8	0	-1	6
AE	-2	-2	0	6	3	3	1	0	0	7	4	10
AF	5	2	12	20	15	14	10	9	8	19	15	19
AG	7	5	7	23	17	20	13	13	8	19	15	25
AH	1	2	-3	17	6	11	8	7	2	10	6	19
AI	-4	-4	-5	3	-6	10	-1	2	-5	9	5	20
AJ	-9	-7	-8	-5	-14	-7	-4	-5	-11	4	-14	-1
AK	6	7	9	3	-1	-1	5	1	0	1	-4	12
AL	2	5	7	2	-4	6	6	1	2	1	-8	8
AM	9	10	11	13	-1	11	9	9	-2	-4	-14	9
AN	11	12	8	9	-2	7	6	4	0	-6	-18	6
AO	16	22	14	16	-1	11	13	11	5	-1	-18	19
AP	26	28	18	19	6	15	17	12	12	4	-8	16
AQ	27	26	15	15	1	0	11	7	10	-3	-10	18
AR	20	23	14	13	4	3	14	8	10	1	-8	11
AS	26	29	20	20	8	10	19	15	15	4	-3	16
AT	16	22	17	19	10	12	18	15	17	10	3	15

Garage

	1/28/93	3/4/93	6/21/93	6/29/93	9/16/93	11/29/93	1/31/94	3/2/94	4/25/94	8/4/94	10/17/94	3/18/95
GA	-844	-856	-805	-824	194	-806	-868	-873	-890	-806	-792	-838
GB	-848		-821	-842	179	-828	-883	-881	-912	-817	-795	-812
GC	-835	-843	-795	-815	202	-799	-849	-867	-887	-797	-765	-814
GD	-787	-800	-844	-761	254	-759	-805	-813	-831	-741	-728	-774
GE	-730	-744	-695	-719	293	-715	-766	-766	-801	-697	-680	-726
GF	-708	-716	-673	-692	325	-684	-724	-734	-749	-666	-651	-691
GG	-667	-677	-629	-655	370	-641	-688	-693	-710	-625	-607	-642
GH	-683	-687	-638	-672	350	-655	-707	-709	-716	-655	-643	-667
GI	-688	-698	-649	-667	346	-663	-715	-720	-731	-651	-620	-667
GJ	-730	-740	-702	-717	301	-720	-776	-782	-786	-718	-670	-731
GK	-806	-811	-750	-770	246	-762	-816	-821	-839	-754	-738	-827
GL	-803	-811	-777	-793	240	-774	-833	-830	-855	-756	-745	-787
GM	-762	-771	-751	-740	279	-733	-791	-788	-822	-715	-706	
GN	-697	-704	-713	-668	332	-662	-707	-722	-754	-649	-652	

TABLE B-1

Settlement Measurements on House on Grenac

All measurements are relative to point A

House	7/1/95	12/17/95	7/11/96	10/3/96	12/3/96	2/6/97
A	0	0	0	0	0	0
B	3	6	6	7	7	2
C	13	13	16	20	13	13
D	24	25	30	33	32	39
E	31	28		35	43	50
F	36	34	41	45	49	56
G	46	38	53	58	57	65
H	33	27	49	54	47	53
I	27	21	38	37	42	38
J	18	16	25	28	28	26
K	13	13	20	23	21	18
L	6	6	10	15	17	14
M	5	4	12	11	9	10
N	13	13	15	18	12	13
O	-5	-5	-5	-9	6	11
P	9	13	12	12	27	39
Q	31	33	35	41	50	61
R	42	40	50	52	56	68
S	23	23	27	28	35	42
T	16	21	23	25	28	29
U	13	15	19	18	20	20
V	1	5	3	2	6	8
W	2	2	-1	-3	6	10
X	5	2	9	13	17	11
Y	14	8	18	19	21	17
Z	14	11	20	19	24	20
AA	15	12	14	18	20	21
AB	4	6	9	7	7	10
AC	-1	-2	-1	6	7	6
AD	3	3	5	8	6	4
AE	10	6	8	4	9	9
AF	22	18	19	16	19	21
AG	19	18	18	15	21	27
AH	15	10	5	3	13	18
AI	6	3	1	-6	8	7
AJ	-8	-12	-11	-17	-6	-10
AK	7	8	5	-3	8	1
AL	-2	0	3	-3	6	0
AM	-5	0	-6	-9	-1	-2
AN	-9	-2	-11	-13	-4	-5
AO	3	2	-9	-12	-5	-1
AP	3	4	2	-1	4	6
AQ	4	-3	2	0	-2	4
AR	0	1	1	1	-1	1
AS	4	5	2	3	5	2
AT	10	10	10	11	6	5

Garage

	7/1/95	12/17/95	7/11/96	10/3/96	12/3/96	2/6/97
GA	-812	-761	-807	-785	-801	-808
GB	-829	-766	-820	-775	-787	-818
GC	-783	-771	-789	-737	-753	-770
GD	-741	-743	-735	-706	-715	-720
GE	-690	-703	-686	-665	-670	-688
GF	-675	-677	-660	-636	-640	-655
GG	-622	-730	-608	-590	-598	-606
GH	-672		-643	-627	-631	-649
GI	-650	-657	-616	-603	-607	-604
GJ	-687	-710	-680	-675	-660	-668
GK	-812	-812	-806	-742	-762	-769
GL	-753	-769	-751	-724	-730	-745
GM	-692	-727	-719	-684	-693	-705
GN	-628	-664	-637	-622	-619	-645

TABLE B-1

### GRENAC CHART 1 - DIAGONAL W-E

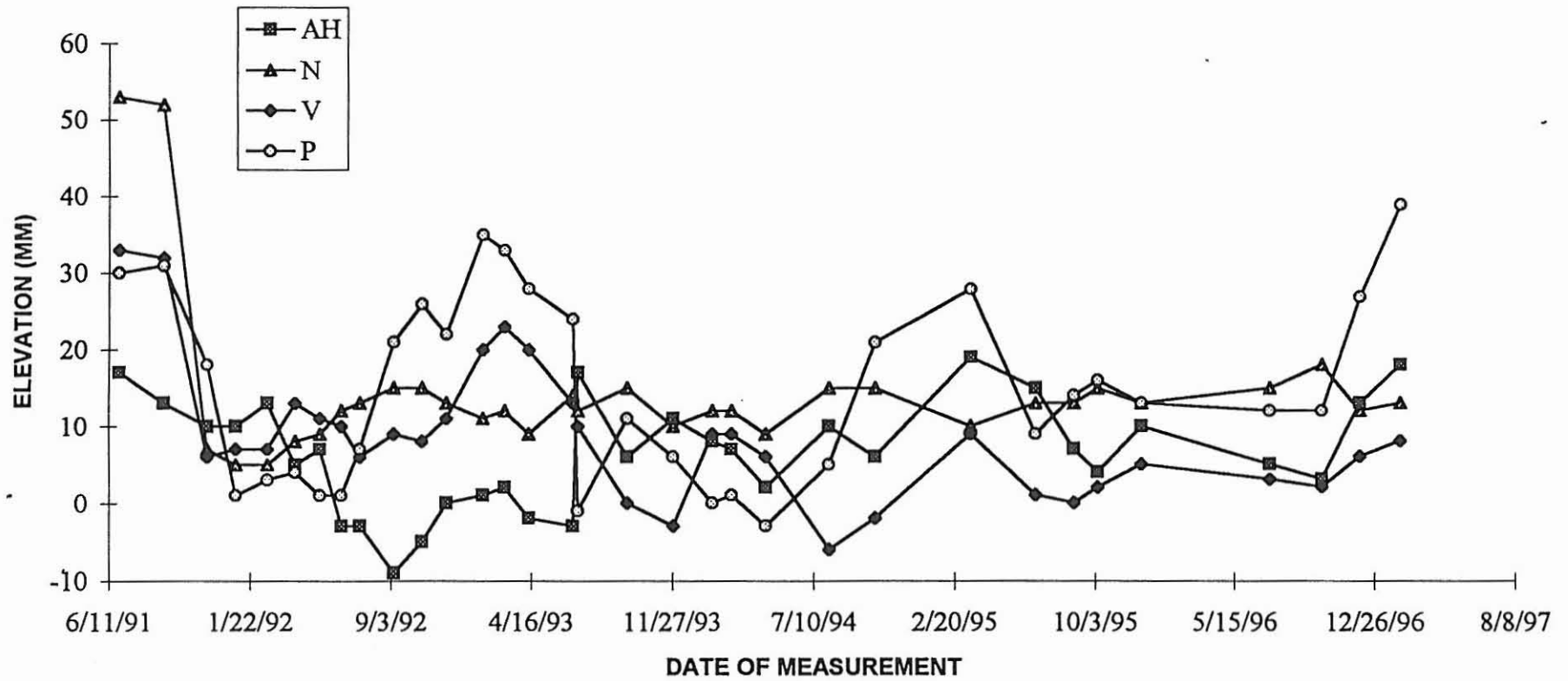


FIGURE B-2

### GRENAC CHART 2 - DIAGONAL N-S

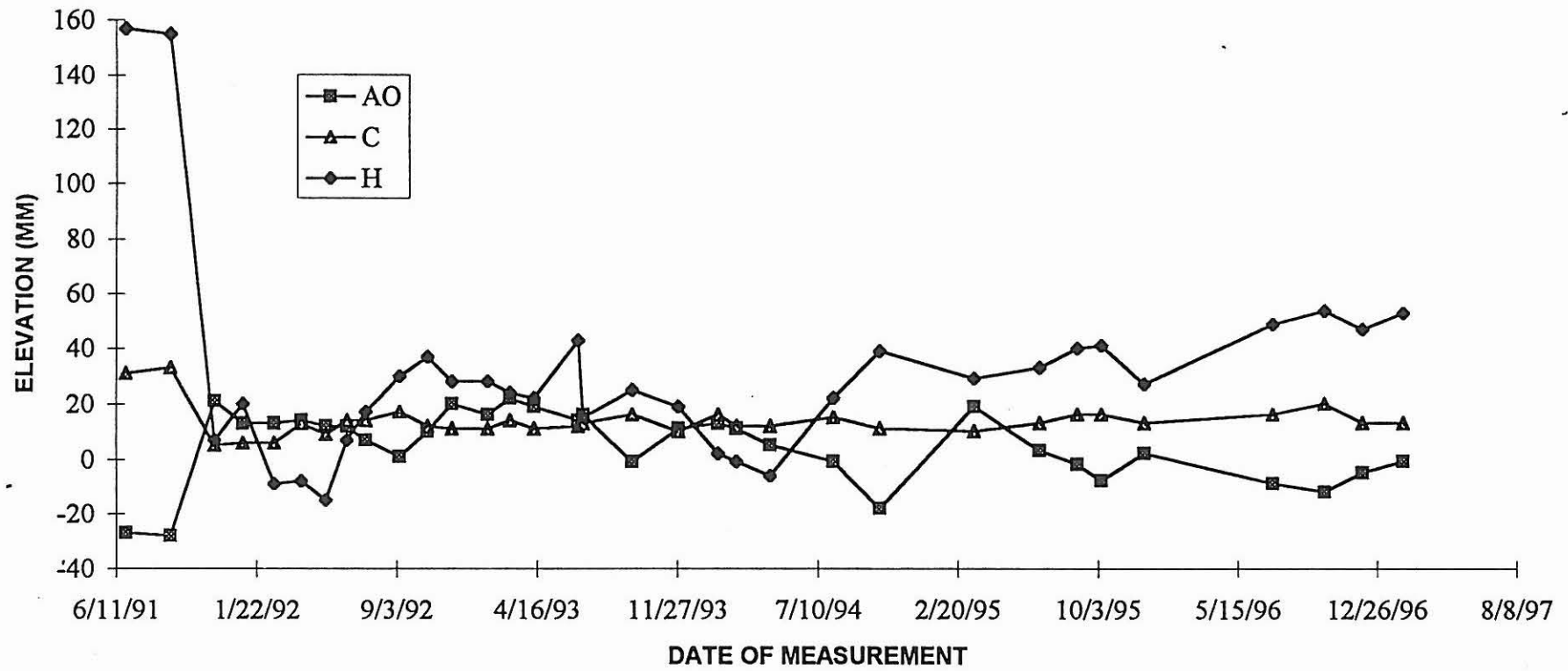


FIGURE B-3

### GRENAC CHART 3 - CENTER NW-SE

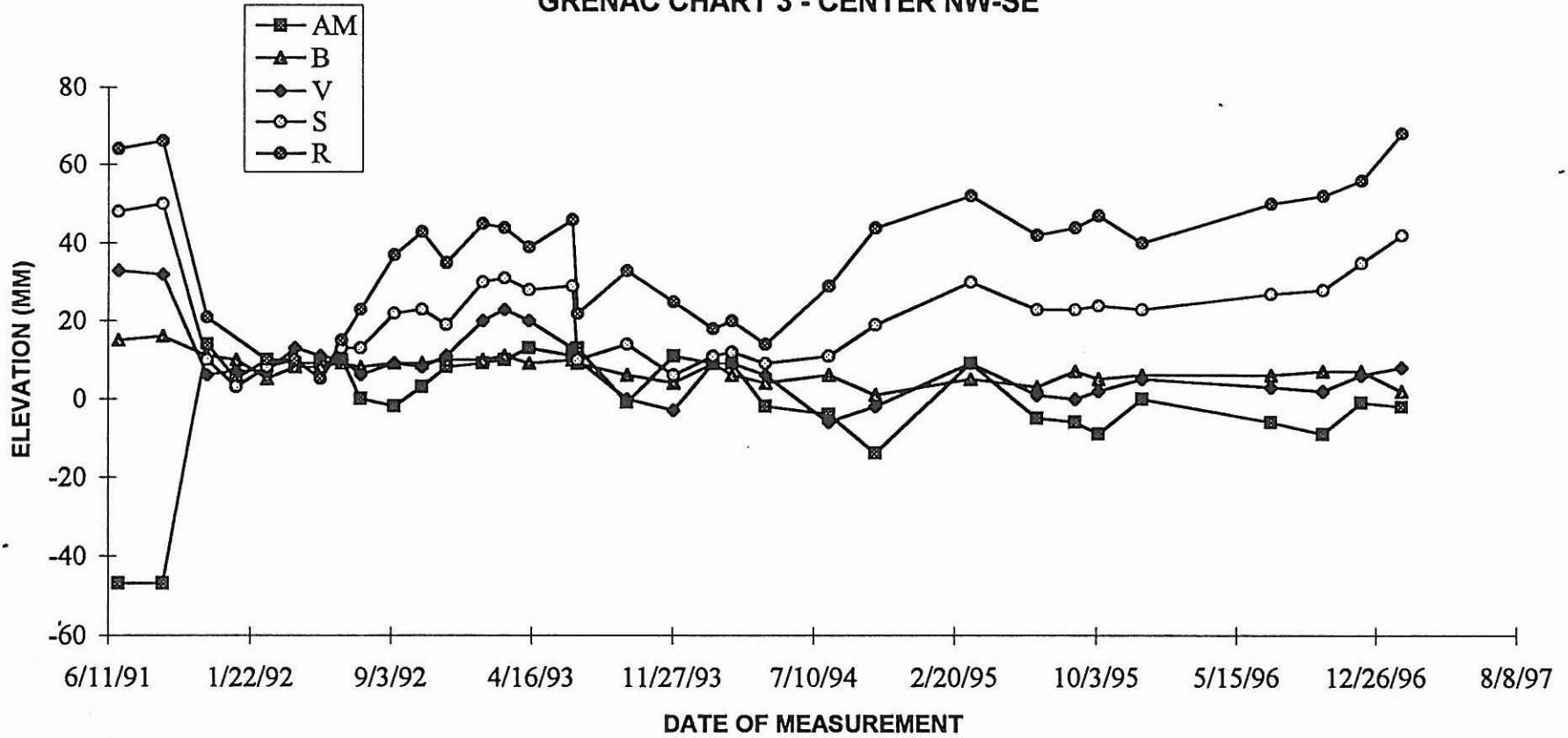


FIGURE B-4

### GRENAC CHART 4 - CENTER SW-NE

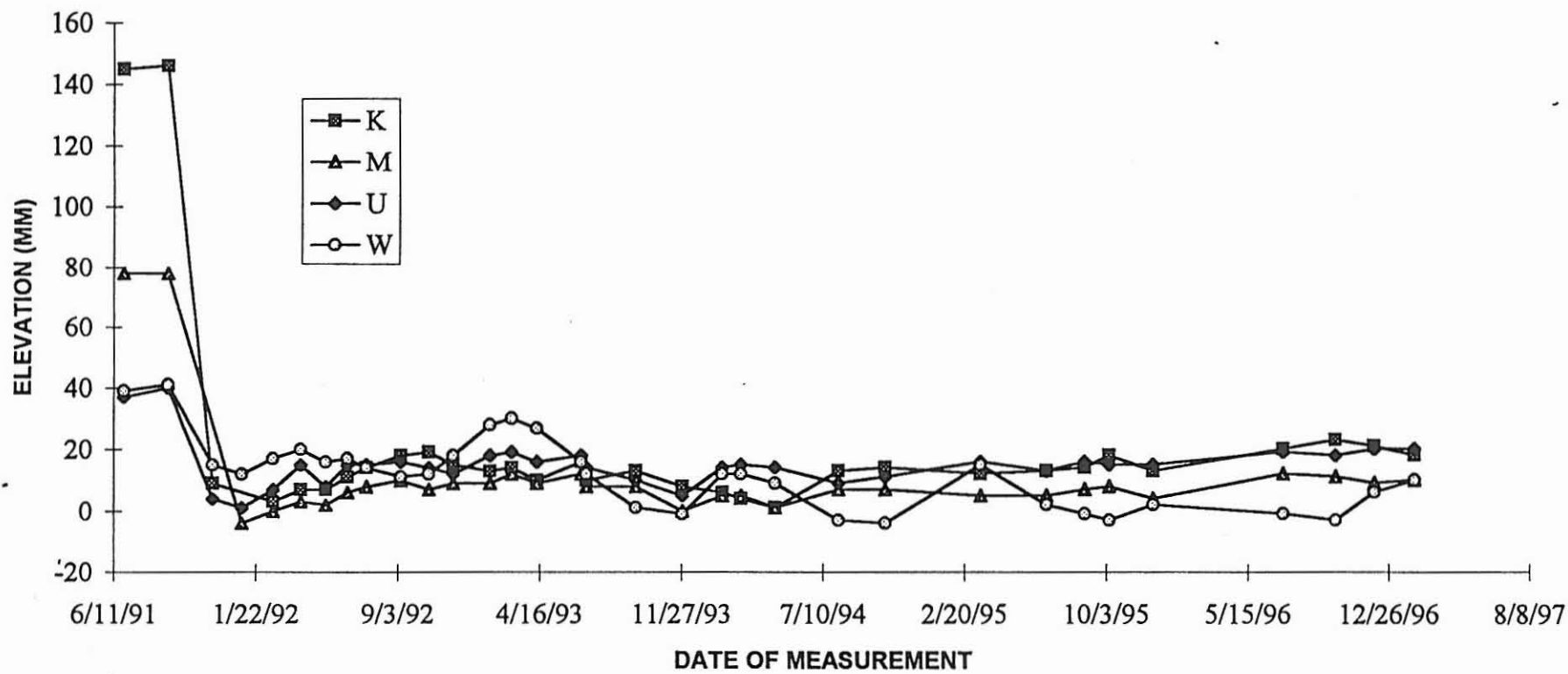


FIGURE B-5

### GRENAC CHART 5 - GARAGE NE WALL

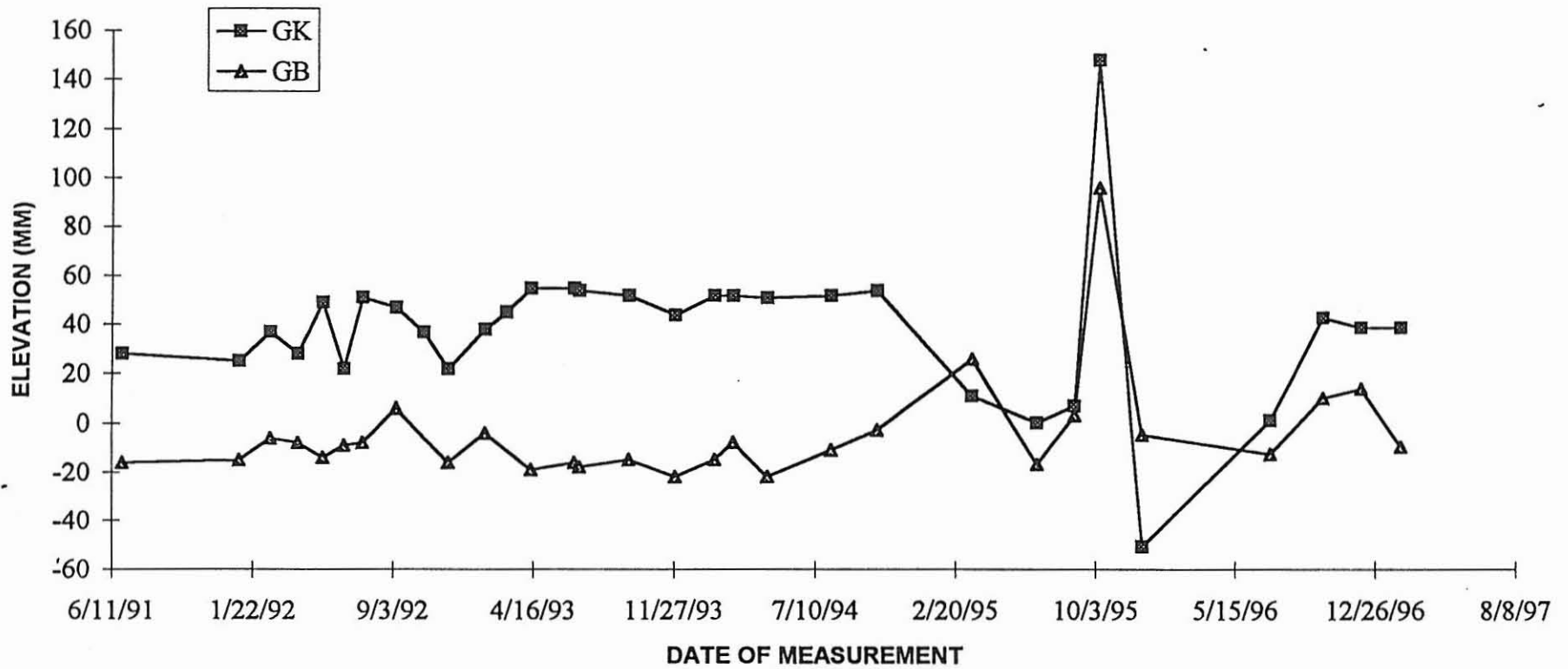


FIGURE B-6



### GRENAC CHART 6 - GARAGE SE WALL

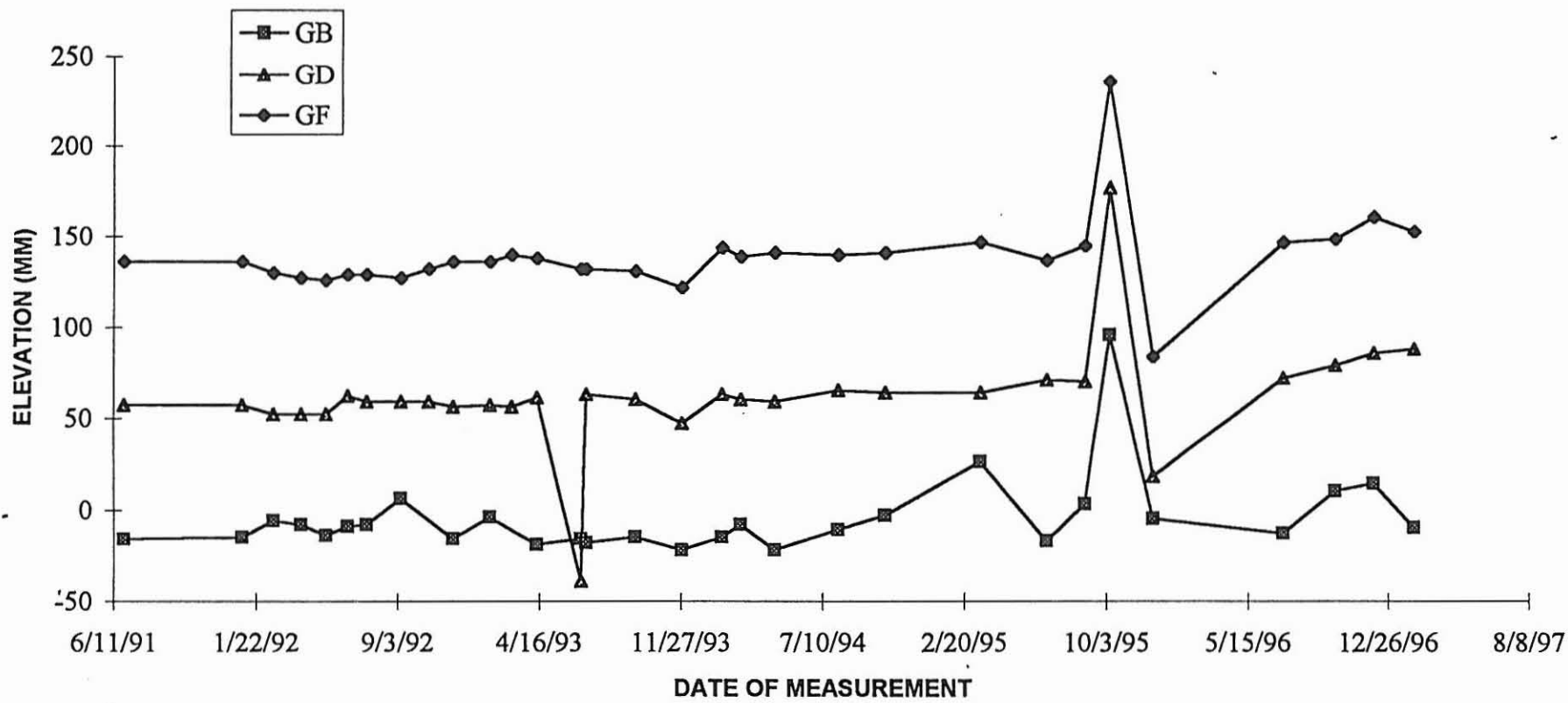


FIGURE B-7

### GRENAC CHART 7 - GARAGE DIAGONAL N-S

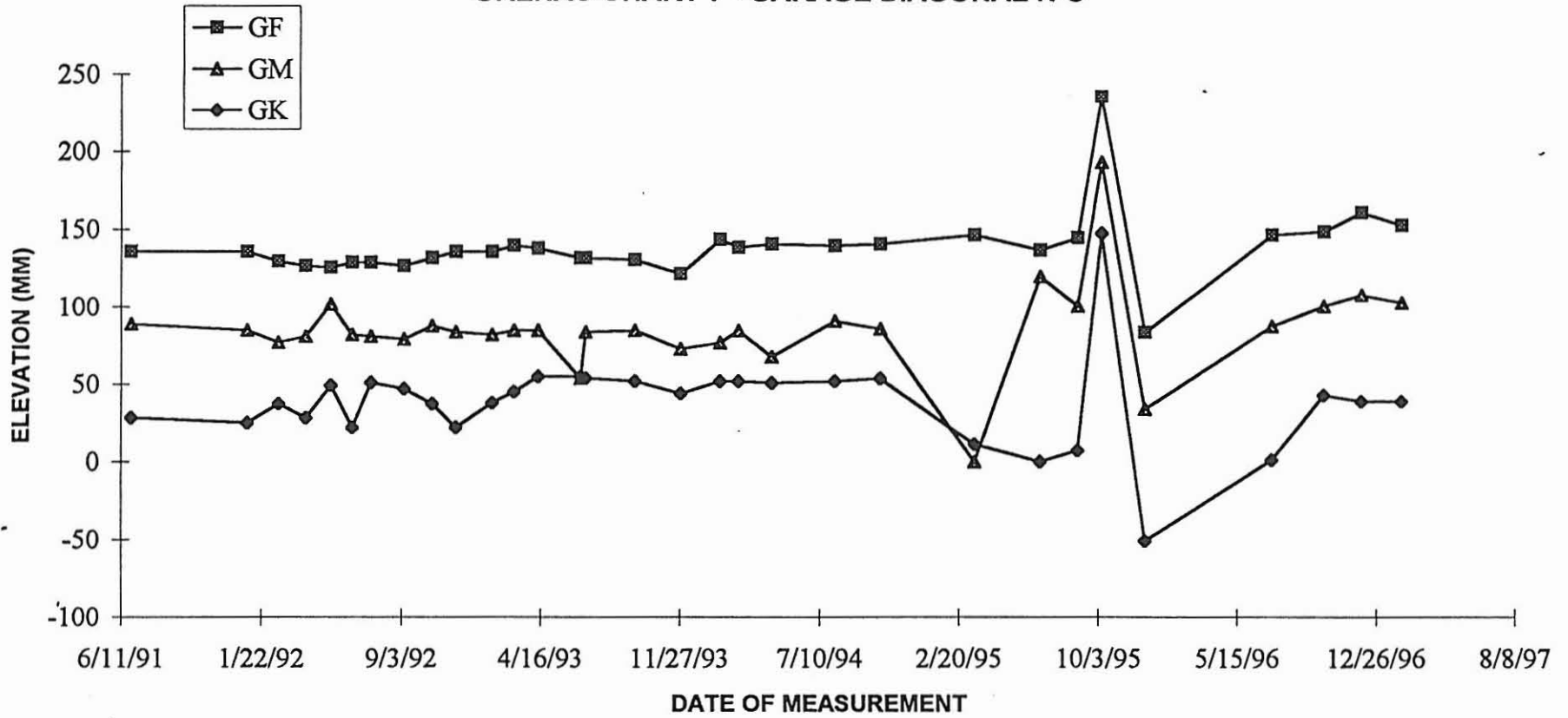


FIGURE B-8

### GRENAC CHART 8 - GARAGE DIAGONAL E-W

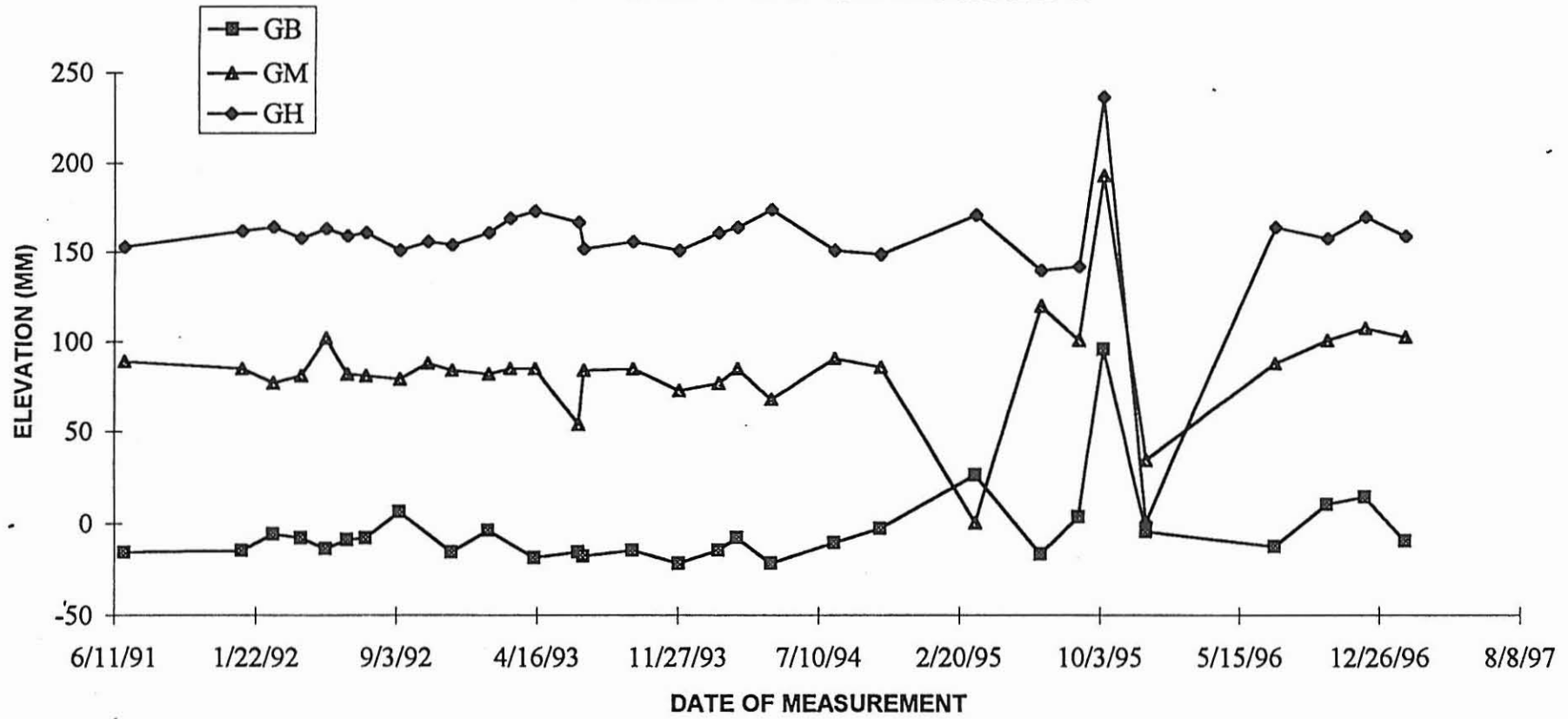


FIGURE B-9

### GRENAC CHART 9 - GARAGE CENTER NE-SW

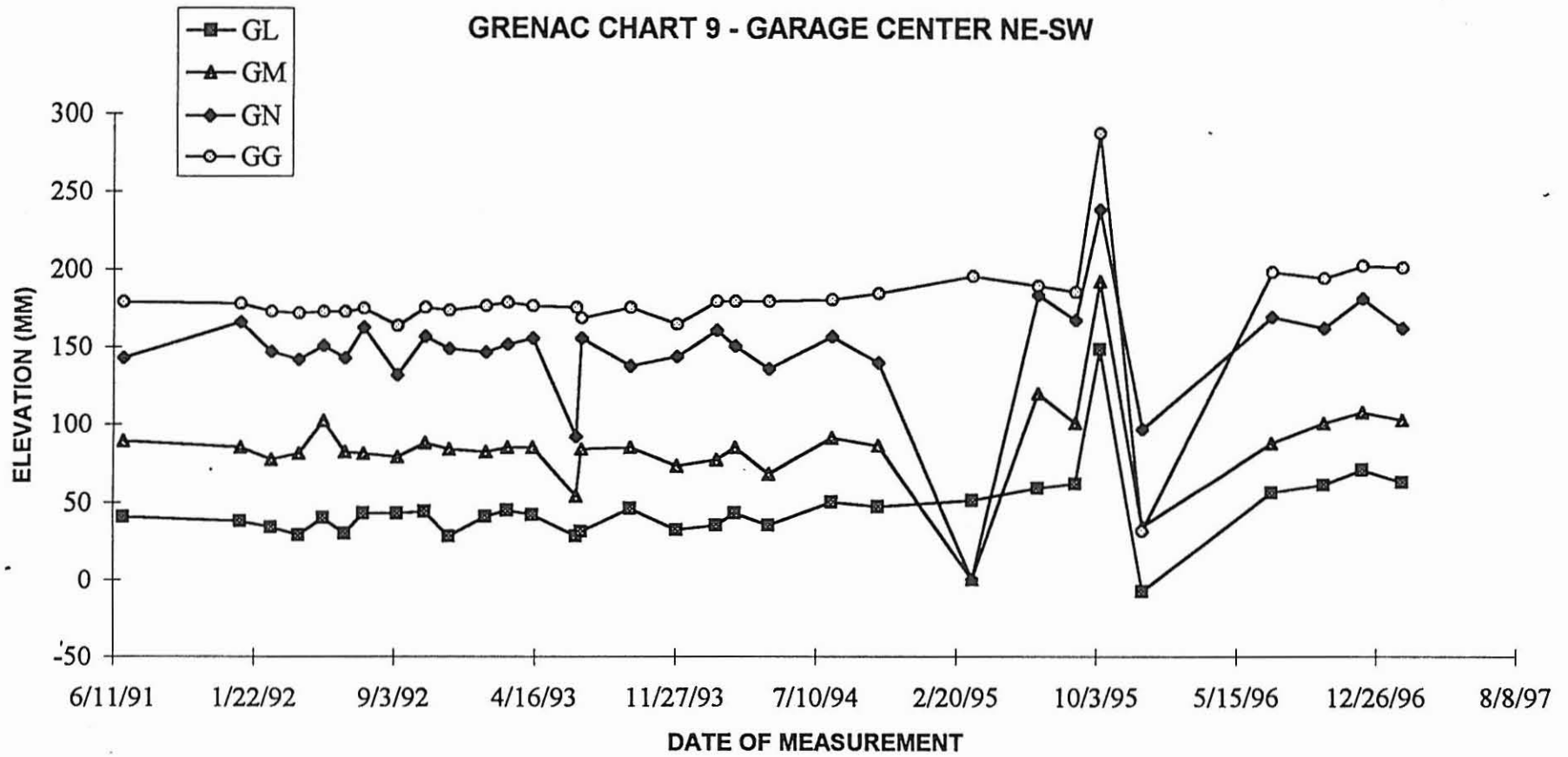


FIGURE B-10

### GRENAC CHART 10 - GARAGE CENTER SE-NW

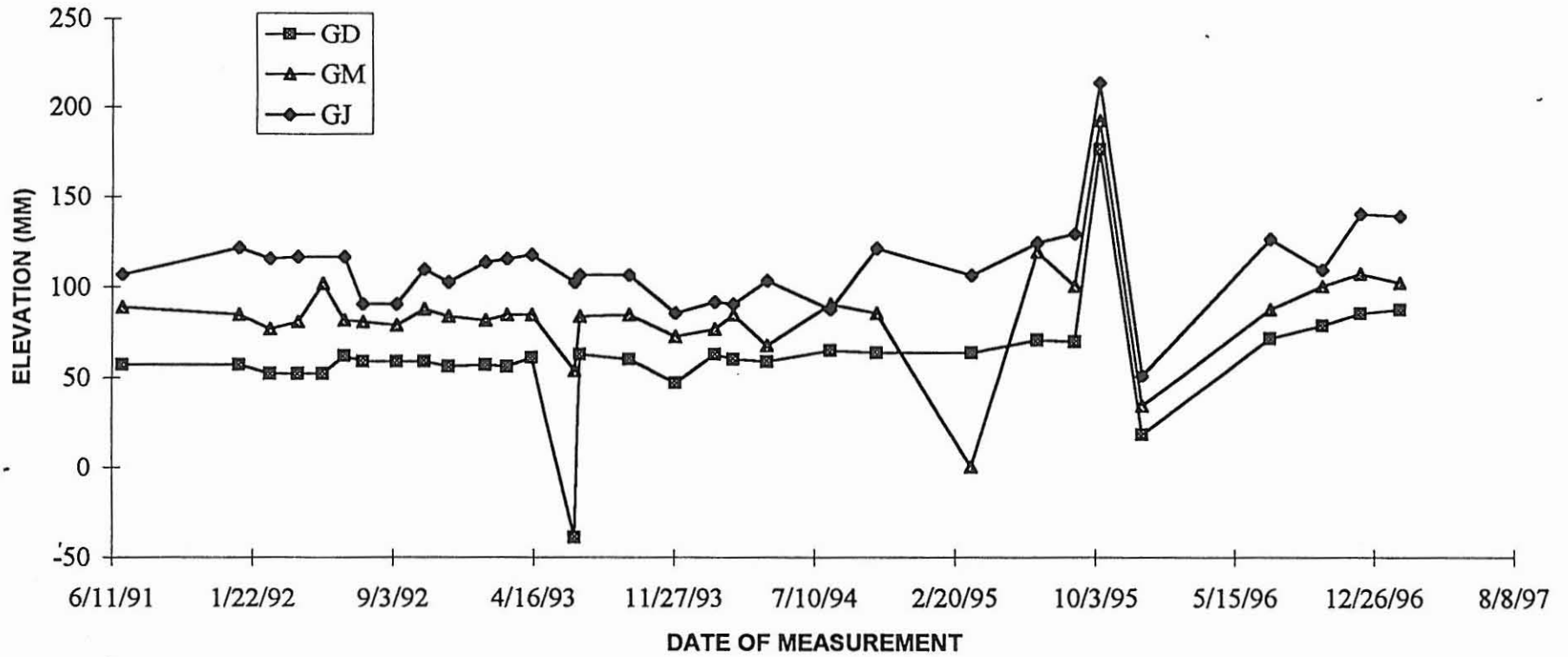


FIGURE B-11

### GRENAC BENCHMARK

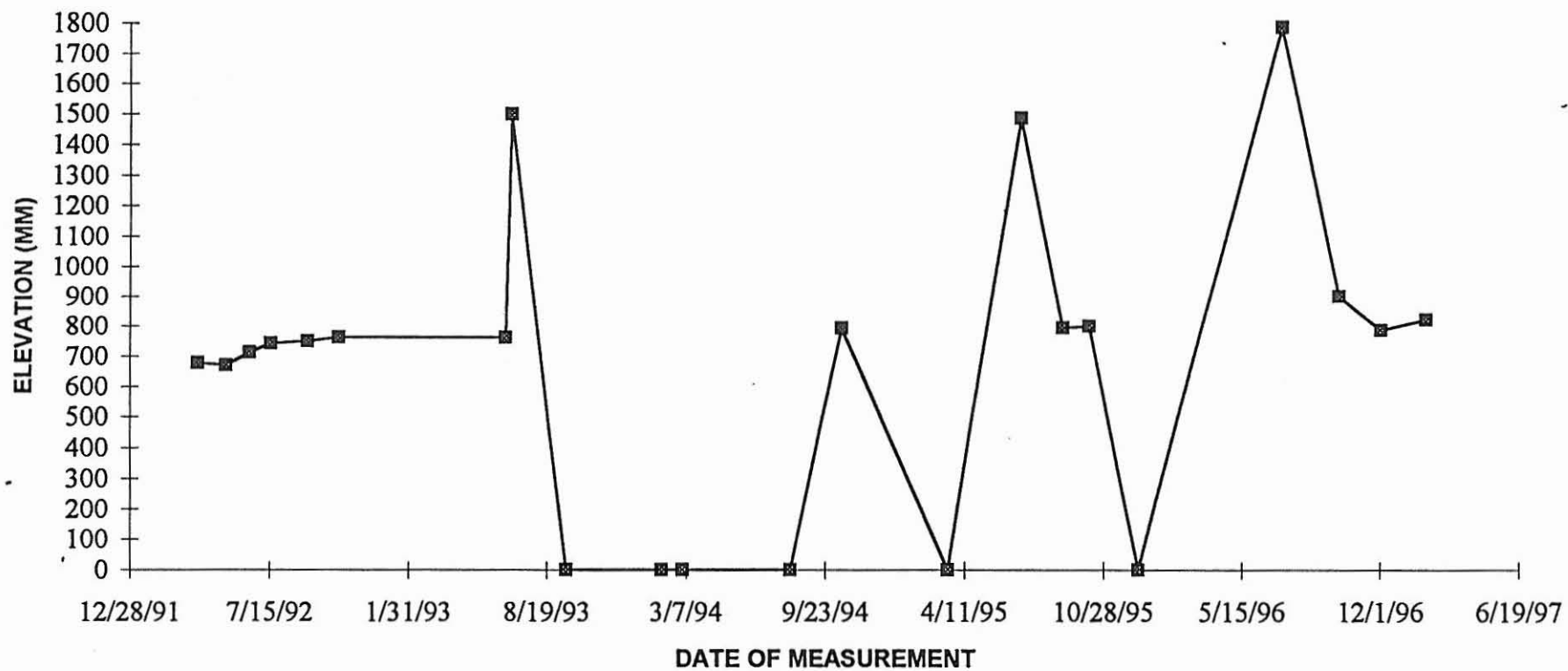


FIGURE B-12

### GRENAC NAIL #1

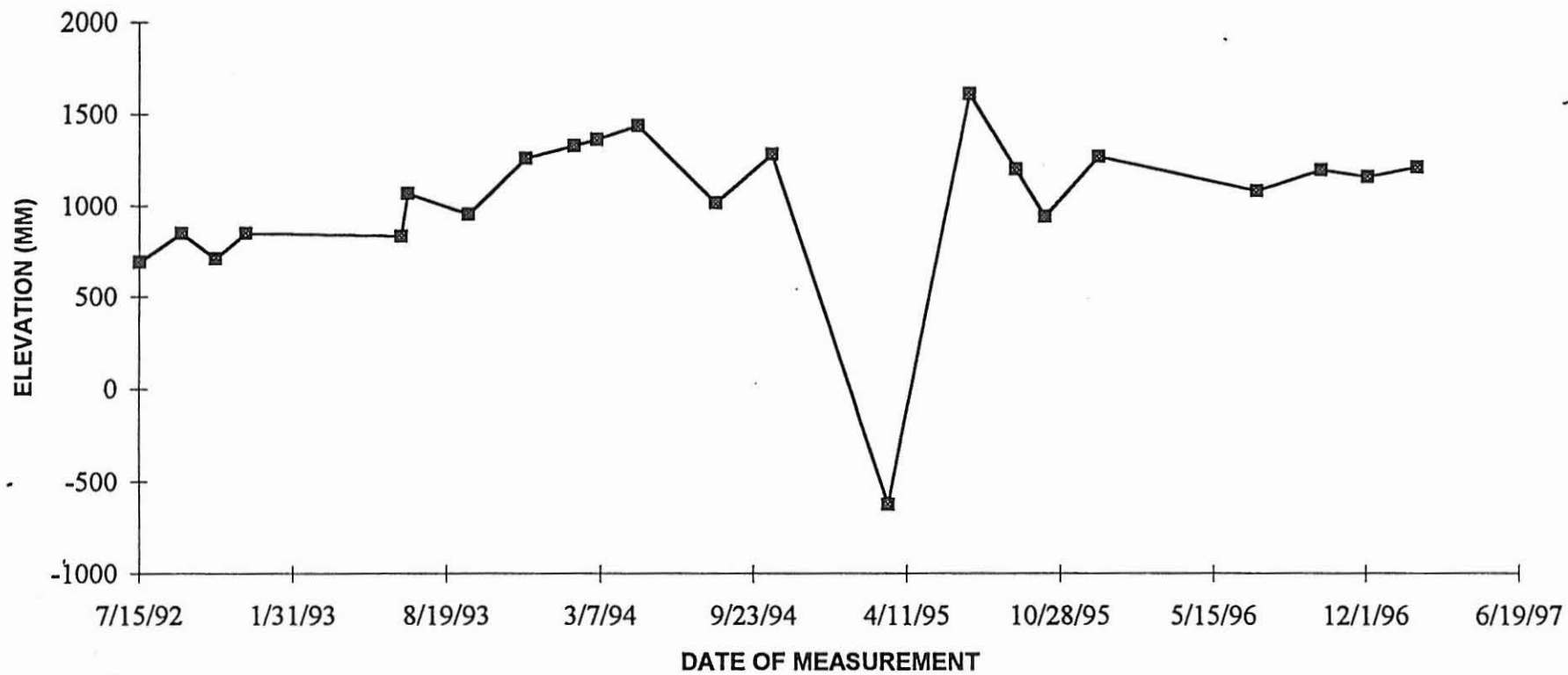


FIGURE B-13

### GRENAC NAIL #2

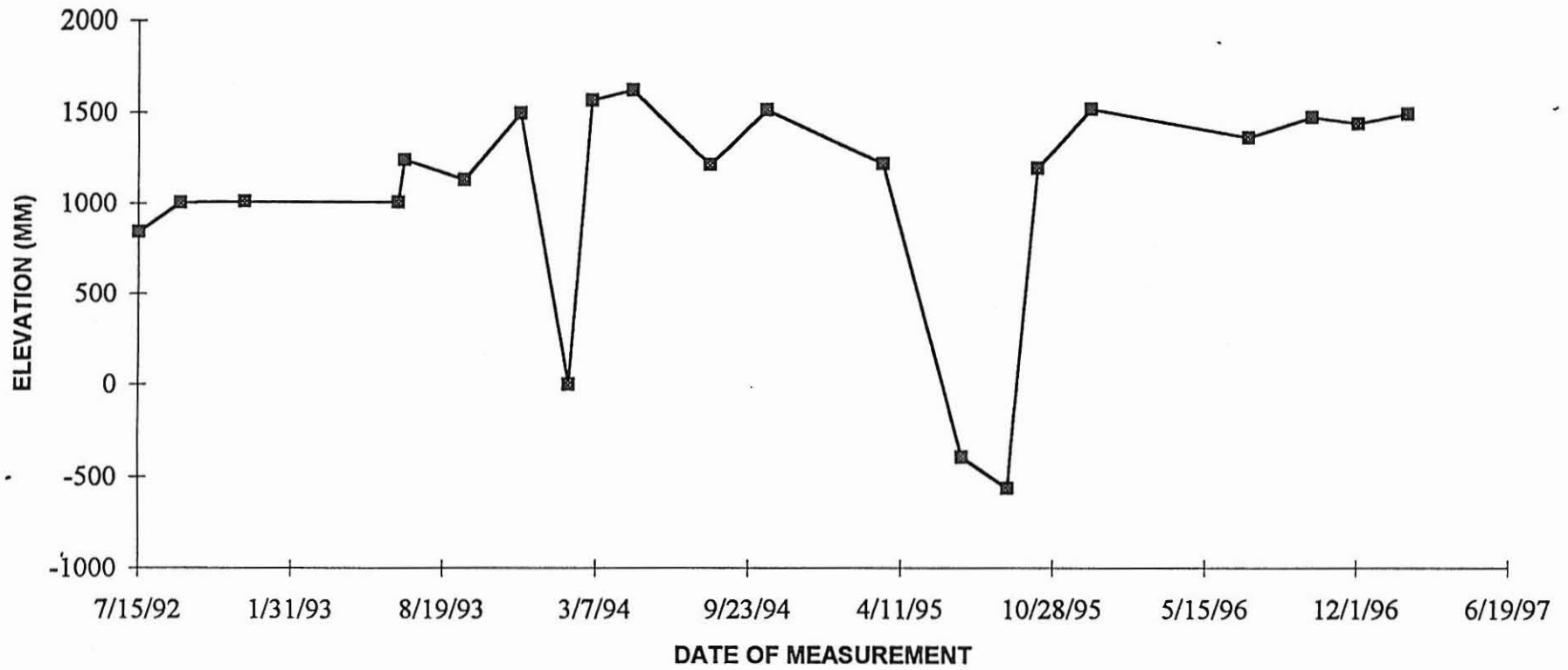
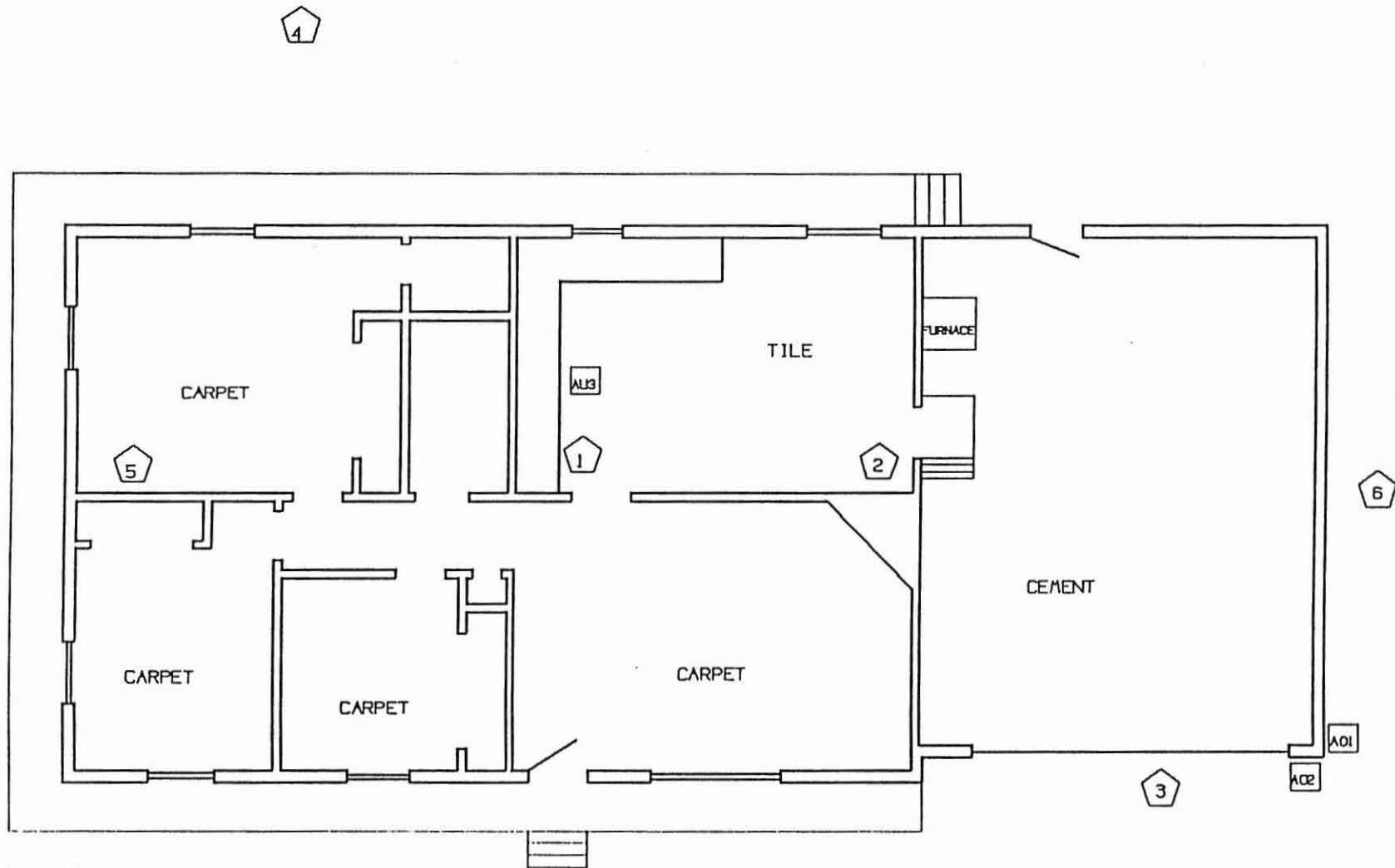


FIGURE B-14



**Appendix C**  
**Temperature Measurements**



Legend :

 Thermistor String

 Air Temperature

FIGURE C-1 - FLOOR PLAN OF HOUSE ON GRENAC ROAD  
SHOWING LOCATIONS OF THERMISTOR STRINGS

BM  
○ (Wellhead)

Thermistor Data for house at 1183 Grenac Rd.

String 1

Date	11/27/91	1/1/92	2/1/92	3/2/92	3/11/92	3/19/92	3/27/92	4/3/92	4/9/92	4/15/92	4/23/92	4/30/92
0					-3.622	-0.394	-3.92	-7.694	-1.724	-0.595	1.496	0.181
2			-4.98	-4.618	-4.65	-2.44	-1.418	-1.79	-1.956	-2.504	-1.121	-0.723
4			-0.569	-1.182	-1.784	-1.103	-0.788	-0.743	-0.968	-0.991	-0.763	-0.595
8			1.211	0.979	0.83	0.712	0.612	0.544	0.499	0.444	0.382	0.346
12			1.892	1.682	1.537	1.416	1.299	1.209	1.16	1.058	0.975	0.912
16			1.968	1.817	1.709	1.614	1.52	1.444	1.412	1.302	1.224	1.153
20			1.629	1.546	1.483	1.426	1.366	1.317	1.321	1.224	1.166	1.115
22			1.381	1.326	1.282	1.242	1.197	1.161	1.141	1.09	1.039	1
24			0.996	0.961	0.932	0.905	0.875	0.849	0.83	0.798	0.761	0.729
26			0.704	0.686	0.668	0.652	0.633	0.616	0.598	0.574	0.555	0.536
27			0.536	0.522	0.509	0.497	0.482	0.468	0.187	0.438	0.413	0.401
28			0.392	-0.381	0.369	0.359	0.347	0.336	0.23	0.303	0.297	0.272

String 2

Date	11/27/91	1/1/92	2/1/92	3/2/92	3/11/92	3/19/92	3/27/92	4/3/92	4/9/92	4/15/92	4/23/92	4/30/92
0	-7.365	-7.944			-2.556	-0.498	-2.699	-6.143	-1.356	-0.338	0.956	0.139
4	2.542	1.191	1.795	-0.165	-0.39	-0.317	-0.281	-0.269	-0.303	-0.327	-0.297	-0.279
8	4.068	2.929	3.505	1.629	1.472	1.338	1.218	1.138	1.077	1.026	0.981	0.937
12	3.916	3.2	3.984	2.166	2.031	1.914	1.798	1.707	1.444	1.562	1.464	1.399
16	3.136	2.863	3.973	2.214	2.118	2.033	1.945	1.874	1.806	1.747	1.667	1.588
20	2.097	2.106	3.544	1.829	1.772	1.72	1.667	1.621	1.575	1.536	1.477	1.431
22	1.72	1.794	3.355	1.657	1.617	1.582	1.544	1.51	1.483	1.444	1.412	1.366
24	1.193	1.291	2.944	1.251	1.228	1.204	1.178	1.155	1.134	1.102	1.07	1.045
25	1.091	1.191	2.927	1.183	1.164	1.146	1.125	1.106	1.077	1.07	1.051	1.019
26	0.915	1.012	2.714	1.027	1.012	0.998	0.981	0.966	0.943	0.924	0.893	0.88
26.5	0.841	0.936	2.647	0.958	0.947	0.936	0.922	0.908	0.893	0.88	0.83	0.83
26.75	0.763	0.857	2.57	0.879	0.869	0.862	0.846	0.83	0.817	0.798	0.767	0.767

String 3

Date	11/27/91	1/1/92	2/1/92	3/2/92	3/11/92	3/19/92	3/27/92	4/3/92	4/9/92	4/15/92	4/23/92	4/30/92
0		-7.211		-10.456	-6.399	-3.85	-0.231	-5.636	-2.793	-3.591	-0.155	
5		0.945	-0.055	-0.398	-0.651	-0.408	-0.305	-0.239	-0.291	-0.327	-0.232	-0.179
10		2.48	1.634	1.443	1.318	1.215	1.121	1.054	1	0.943	0.899	0.867
20		2.037	1.783	1.706	1.647	1.596	1.541	1.495	1.457	1.399	1.36	1.314
30		0.165	0.183	0.18	0.176	0.174	0.17	0.165	0.151	0.151	0.151	0.121
32		-0.122	-0.115	-0.112	-0.112	-0.111	-0.111	-0.111	-0.113	-0.113	-0.107	-0.113
33		-0.171	-0.178	-0.18	-0.181	-0.18	-0.18	-0.181	-0.185	-0.197	-0.185	-0.197
33.5		-0.12	-0.125	-0.126	-0.125	-0.125	-0.125	-0.126	-0.125	-0.131	-0.113	-0.137
34		-0.273	-0.279	-0.281	-0.282	-0.282	-0.282	-0.283	-0.291	-0.297	-0.297	-0.291
35		-0.234	-0.242	-0.244	-0.245	-0.245	-0.246	-0.248	-0.256	-0.25	-0.256	-0.256
40		-0.204	-0.213	-0.213	-0.214	-0.214	-0.216	-0.217	-0.22	-0.226	-0.22	-0.22
54		-0.267	-0.266	-0.266	-0.266	-0.269	-0.266	-0.266	-0.268	-0.274	-0.262	-0.268

String 4

Date	11/27/91	1/1/92	2/1/92	3/2/92	3/11/92	3/19/92	3/27/92	4/3/92	4/9/92	4/15/92	4/23/92	4/30/92
0	-5.502	-3.501	-2.889	-2.632	-2.243	-1.68	-0.816	-1.359	-1.333	-2.374	-0.054	0.084
5	1.368	0.658	0.202	0.134	0.077	0.078	0.059	0.045	0.024	0.006	0	0.006
10	2.584	1.74	1.053	0.928	0.844	0.779	0.719	0.668	0.629	0.58	0.53	0.512
20	1.143	1.131	0.92	0.856	0.808	0.767	0.726	0.692	0.654	0.617	0.592	0.549
25	0.355	0.408	0.372	0.349	0.333	0.318	0.302	0.287	0.272	0.26	0.224	0.224
26	0.243	0.288	0.272	0.258	0.246	0.235	0.222	0.213	0.193	0.187	0.175	0.163
27	0.066	0.098	0.092	0.082	0.074	0.066	0.059	0.052	0.042	0.03	0.024	0.018
27.5	0.021	0.045	0.043	0.038	0.03	0.027	0.021	0.016	0.006	-0.006	-0.006	-0.012
28	-0.002	0.015	0.016	0.012	0.009	0.005	0.003	-0.002	-0.006	-0.024	-0.018	-0.018
29	-0.063	-0.062	-0.061	-0.062	-0.063	-0.063	-0.063	-0.064	-0.066	-0.078	-0.072	-0.078
35	-0.199	-0.204	-0.213	-0.212	-0.213	-0.214	-0.214	-0.216	-0.22	-0.226	-0.22	-0.226
45	-0.264	-0.27	-0.276	-0.277	-0.277	-0.278	-0.278	-0.279	-0.291	-0.297	-0.291	-0.291

Thermistor Data for house at 1183 Grenac Rd.

String 5

Date	11/27/91	1/1/92	2/1/92	3/2/92	3/11/92	3/19/92	3/27/92	4/3/92	4/9/92	4/15/92	4/23/92	4/30/92
0	-7.202	-8.306			-4.831	-3.098	-2.307	-5.119	-3.126	-3.838	-0.82	-0.619
4	1.487	0.461	-0.467	-0.906	-1.366	-0.864	-0.642	-0.578	-0.723	-0.803	-0.595	-0.479
8	2.52	1.568	0.722	0.571	0.473	0.395	0.327	0.28	0.236	0.199	0.175	0.139
12	2.397	1.845	1.156	1.009	-0.91	0.827	0.748	0.687	0.629	0.58	0.518	0.481
16	1.84	1.65	1.241	1.136	1.061	0.997	0.932	0.88	0.83	0.786	0.736	0.692
20	0.876	0.87	0.707	0.653	0.611	0.575	0.536	0.506	0.475	0.438	0.413	0.376
22	0.543	0.566	0.489	0.459	0.434	0.412	0.389	0.368	0.346	0.321	0.303	0.285
24	0.184	0.208	0.188	0.176	0.165	0.156	0.145	0.135	0.054	0.109	0.109	0.09
26	-0.023	0.001	0.011	0.009	0.003	-0.002	-0.007	-0.12	-0.024	-0.03	-0.03	-0.042
26	-0.012	-0.003	0.015	0.018	0.018	0.018	0.018	0.017	0.018	0.006	0.018	0.006
26.5	-0.124	-0.124	-0.122	-0.121	-0.121	-0.121	-0.119	-0.119	-0.125	-0.125	-0.131	-0.125
27	-0.143	-0.145	-0.149	-0.15	-0.15	-0.15	-0.15	-0.15	-0.155	-0.167	-0.155	-0.161

String 6

Date	11/27/91	1/1/92	2/1/92	3/2/92	3/11/92	3/19/92	3/27/92	4/3/92	4/9/92	4/15/92	4/23/92	4/30/92
0		-6.86	-8.259	-7.408	-2.391	-1.464	-0.137	-3.784	-0.814	-0.113	11.875	5.172
10		3.066	2.258	2.066	1.933	1.816	1.768	1.749	1.747	1.753	1.707	1.72
20		2.722	2.39	2.299	2.23	2.168	2.103	2.049	2	1.947	1.893	1.846
25		1.665	1.616	1.579	1.55	1.523	1.493	1.465	1.444	1.399	1.379	1.353
30		0.672	0.72	0.716	0.711	0.704	0.696	0.688	0.679	0.673	0.654	0.648
32		0.309	0.353	0.353	0.352	0.351	0.347	0.343	0.333	0.333	0.34	0.321
34		0.035	0.06	0.063	0.063	0.064	0.064	0.064	0.06	0.054	0.048	0.054
35		-0.137	-0.128	-0.125	-0.123	-0.123	-0.122	-0.121	-17.09	-0.125	-0.131	-0.125
36		-0.169	-0.175	-0.175	-0.175	-0.176	-0.176	-0.176	-0.274	-0.191	-0.179	-0.185
38		-0.159	-0.172	-0.174	-0.175	-0.176	-0.178	-0.178	-0.185	-0.179	-0.197	-0.185
40		-0.183	-0.198	-0.2	-0.201	-0.203	-0.203	-0.204	-0.203	-0.203	-0.203	-0.214
43.5		-0.282	-0.292	-0.292	-0.295	-0.292	-0.294	-0.294	-0.303	-0.309	-0.303	-0.309

String 7

Date	11/27/91	1/1/92	2/1/92	3/2/92	3/11/92	3/19/92	3/27/92	4/3/92	4/9/92	4/15/92	4/23/92	4/30/92
AO1					17.998	9.677	2.513	-8.651	1.846	15.617	13.394	
AO2					9.376	9.534	-0.297	5.028	1.289	18.605	14.869	
AU3					1.599	4.262	-5.481	-4.525	-0.485	7.703	14.255	

Thermistor Data for house at 1183 Grenac Rd.

String 1

Date	5/7/92	5/14/92	5/21/92	5/28/92	6/10/92	6/19/92	6/26/92	6/30/92	7/9/92	7/17/92	7/23/92	8/6/92
0	1.76	0.88	4.611	7.611	8.847	8.729	10.004	11.283	13.17	12.801	11.44	13.071
2	-0.792	-0.532	-0.409	-0.297	-0.208	-0.143	-0.066	0.054	0.309	0.867	1.327	2.443
4	-0.676	-0.473	-0.426	-0.38	-0.338	-0.333	-0.303	-0.303	-0.279	-0.279	-0.274	-0.244
8	0.303	0.266	0.23	0.236	0.181	0.145	0.133	0.121	0.115	0.09	0.078	0.054
12	0.849	0.786	0.736	0.711	0.636	0.561	0.524	0.506	0.475	0.432	0.413	0.358
16	1.096	1.032	0.994	0.943	0.836	0.754	0.736	0.704	0.667	0.617	0.586	0.53
20	1.07	1.007	0.962	0.943	0.849	0.792	0.754	0.729	0.692	0.654	0.623	0.567
22	0.962	0.918	0.886	0.867	0.786	0.729	0.704	0.679	0.654	0.617	0.586	0.536
24	0.704	0.667	0.642	0.629	0.561	0.518	0.512	0.481	0.456	0.425	0.401	0.352
26	0.53	0.352	0.487	0.468	0.425	0.37	0.358	0.346	0.333	0.309	0.291	0.26
27	0.389	0.358	0.352	0.358	0.309	0.278	0.266	0.26	0.242	0.212	0.199	0.175
28	0.26	0.248	0.236	0.242	0.205	0.169	0.169	0.157	0.145	0.127	0.121	0.097

String 2

Date	5/7/92	5/14/92	5/21/92	5/28/92	6/10/92	6/19/92	6/26/92	6/30/92	7/9/92	7/17/92	7/23/92	8/6/92
0	1.179	1.166	2.918	5.868	7.041	7.247	8.162	9.723	10.708	10.905	10.225	11.737
4	-0.338	-0.25	-0.22	-0.203	-0.185	-0.179	-0.161	-0.137	-0.107	-0.03	0.193	1.641
8	0.905	0.849	0.836	0.836	0.805	0.798	0.817	0.842	0.893	0.943	1.007	1.224
12	1.347	1.276	1.243	1.224	1.134	1.09	1.07	1.058	1.058	1.045	1.045	1.096
16	1.562	1.47	1.425	1.412	1.289	1.231	1.198	1.166	1.141	1.102	1.083	1.058
20	1.379	1.327	1.282	1.263	1.179	1.109	1.09	1.045	1.019	0.981	0.956	0.905
22	1.321	1.276	1.25	1.224	1.141	1.096	1.07	1.045	1.019	0.975	0.95	0.905
24	1.019	0.975	0.956	0.924	0.874	0.836	0.811	0.792	0.767	0.729	0.711	0.667
25	0.994	0.943	0.943	0.924	0.874	0.83	0.805	0.786	0.767	0.736	0.717	0.679
26	0.867	0.83	0.849	0.811	0.754	0.723	0.704	0.692	0.679	0.642	0.623	0.592
26.5	0.817	0.779	0.786	0.761	0.717	0.679	0.667	0.654	0.642	0.605	0.586	0.555
26.75	0.754	0.711	0.723	0.692	0.642	0.617	0.592	0.586	0.567	0.543	0.518	0.493

String 3

Date	5/7/92	5/14/92	5/21/92	5/28/92	6/10/92	6/19/92	6/26/92	6/30/92	7/9/92	7/17/92	7/23/92	8/6/92
0	3.983	1.973	6.437	15.873	13.47	13.12	15.198	17.283	20.765	16.706	17.656	17.719
5	-0.131	-0.125	6.454	-0.084	-0.054	-0.006	0.456	1.786	3.878	5.366	6.257	7.759
10	0.855	0.817	0.836	0.817	0.817	0.861	0.956	1.058	1.276	1.575	1.76	2.395
20	1.263	1.211	1.186	1.147	1.077	1.032	1.007	0.981	0.975	0.943	0.931	0.905
30	0.133	0.115	0.121	0.115	0.103	0.09	0.084	0.078	0.09	0.066	0.066	0.054
32	-0.113	-0.125	-0.107	-0.119	-0.113	-0.125	-0.125	-0.125	-0.113	-0.125	-0.125	-0.125
33	-0.191	-0.197	-0.185	-0.185	-0.191	-0.203	-0.191	-0.197	-0.179	-0.197	-0.197	-0.191
33.5	-0.131	-0.137	-0.113	-0.131	-0.125	-0.137	-0.137	-0.137	-0.125	-0.137	-0.131	-0.137
34	-0.291	-0.303	-0.279	-0.291	-0.291	-0.297	-0.291	-0.291	-0.285	-0.297	-0.291	-0.291
35	-0.262	-0.268	-0.244	-0.256	-0.256	-0.268	-0.268	-0.268	-0.256	-0.268	-0.262	-0.268
40	-0.232	-0.238	-0.214	-0.232	-0.232	-0.232	-0.232	-0.232	-0.22	-0.232	-0.232	-0.232
54	-0.274	-0.285	-0.274	-0.297	-0.291	-0.297	-0.291	-0.291	-0.279	-0.297	-0.291	-0.291

String 4

Date	5/7/92	5/14/92	5/21/92	5/28/92	6/10/92	6/19/92	6/26/92	6/30/92	7/9/92	7/17/92	7/23/92	8/6/92
0	1.78	0.297	7.861	17.283	26.515	9.775	12.038	12.948	14.268	14.721	14.775	15.773
5	-0.006	-0.018	0.006	-0.018	0.127	0.042	0.199	0.742	1.987	3.153	3.916	5.237
10	0.481	0.419	0.407	0.309	0.611	0.389	0.358	0.358	0.475	0.667	0.886	1.431
20	0.518	0.481	0.462	0.419	0.37	0.297	0.285	0.26	0.26	0.236	0.224	0.199
25	0.199	0.181	0.181	0.151	0.133	0.054	0.054	0.042	0.054	0.03	0.03	0.006
26	0.145	0.127	0.109	0.115	0.09	0.006	0.018	0.006	0.018	-0.006	-0.006	-0.018
27	0.012	-0.012	0	-0.018	-0.03	-0.113	-0.101	-0.113	-0.101	-0.113	-0.113	-0.125
27.5	-0.018	-0.03	-0.03	-0.042	-0.054	-0.119	-0.113	-0.125	-0.113	-0.125	-0.119	-0.131
28	-0.03	-0.042	-0.018	-0.042	-0.054	-0.125	-0.113	-0.125	-0.113	-0.125	-0.113	-0.125
29	-0.084	-0.09	-0.066	-0.078	-0.09	-0.119	-0.113	-0.125	-0.101	-0.113	-0.113	-0.125
35	-0.232	-0.238	-0.208	-0.232	-0.232	-0.244	-0.232	-0.244	-0.232	-0.238	-0.232	-0.244
45	-0.291	-0.303	-0.291	-0.291	-0.297	-0.303	-0.297	-0.303	-0.285	-0.291	-0.291	-0.303

Thermistor Data for house at 1183 Grenac Rd.

String 5

Date	5/7/92	5/14/92	5/21/92	5/28/92	6/10/92	6/19/92	6/26/92	6/30/92	7/9/92	7/17/92	7/23/92	8/6/92
0	-0.705	-0.333	0.475	3.067	5.124	5.677	6.197	7.676	8.632	8.887	8.535	9.672
4	-0.409	-0.385	-0.35	-0.338	-0.303	-0.303	-0.279	-0.274	-0.25	-0.256	-0.244	-0.22
8	0.115	0.078	0.072	0.042	0.018	-0.018	-0.018	-0.03	-0.03	-0.054	-0.054	-0.078
12	0.438	0.395	0.358	0.321	0.26	0.224	0.212	0.175	0.169	0.139	0.127	0.078
16	0.642	0.605	0.574	0.524	0.475	0.419	0.401	0.382	0.358	0.321	0.309	0.26
20	0.346	0.315	0.291	0.26	0.224	0.175	0.163	0.151	0.139	0.103	0.09	0.054
22	0.26	0.236	0.236	0.205	0.175	0.139	0.139	0.127	0.115	0.09	0.078	0.054
24	0.078	0.066	0.06	0.048	0.03	0.006	0.006	0	0.006	-0.024	-0.03	-0.042
26	-0.054	-0.078	-0.048	-0.066	-0.078	-0.095	-0.09	-0.09	-0.09	-0.107	-0.113	-0.125
26	0.006	-0.006	0.018	0	-0.006	-0.018	-0.012	-0.018	-0.006	-0.018	-0.018	-0.03
26.5	-0.179	-0.137	-0.119	-0.125	-0.131	-0.149	-0.137	-0.137	-0.125	-0.143	-0.137	-0.143
27	-0.161	-0.155	-0.143	-0.161	-0.161	-0.173	-0.161	-0.161	-0.149	-0.167	-0.161	-0.161

String 6

Date	5/7/92	5/14/92	5/21/92	5/28/92	6/10/92	6/19/92	6/26/92	6/30/92	7/9/92	7/17/92	7/23/92	8/6/92
0	10.894	11.327	16.292	27.419	16.796	14.829	17.829	18.688	19.516	18.988	18.572	18.523
10	1.8	1.893	1.987	2.041	2.491	2.939	3.443	3.826	4.302	4.775	5.14	5.969
20	1.8	1.747	1.727	1.687	1.628	1.588	1.575	1.575	1.582	1.582	1.601	1.68
25	1.321	1.282	1.263	1.231	1.186	1.134	1.121	1.102	1.096	1.058	1.051	1.032
30	0.636	0.623	0.611	0.598	0.58	0.543	0.543	0.543	0.53	0.506	0.493	0.468
32	0.315	0.303	0.303	0.297	0.285	0.254	0.26	0.26	0.26	0.236	0.23	0.212
34	0.054	0.054	0.078	0.054	0.054	0.03	0.036	0.042	0.042	0.03	0.03	0.018
35	-0.125	-0.119	-0.119	-0.113	-0.113	-0.125	-0.113	-0.113	-0.101	-0.113	-0.113	-0.113
36	-0.197	-0.185	-0.179	-0.185	-0.173	-0.197	-0.185	-0.173	-0.173	-0.185	-0.173	-0.185
38	-0.185	-0.191	-0.185	-0.185	-0.185	-0.197	-0.191	-0.173	-0.173	-0.185	-0.185	-0.185
40	-0.214	-0.208	-0.208	-0.208	-0.208	-0.226	-0.214	-0.208	-0.208	-0.22	-0.214	-0.22
43.5	-0.303	-0.303	-0.297	-0.303	-0.303	-0.315	-0.309	-0.303	-0.297	-0.315	-0.303	-0.309

String 7

Date	5/7/92	5/14/92	5/21/92	5/28/92	6/10/92	6/19/92	6/26/92	6/30/92	7/9/92	7/17/92	7/23/92	8/6/92
AO1		14.667	16.002	21.497	23.72	18.181	24.955	26.343	28.473	25.206	19.795	21.402
AO2		16.351		21.863	28.5	26.295	28.691	33.364	29.022	33.024	27.419	23.763
AU3	10.6	5.91		16.248		15.337	17.719	21.193	20.095	20.728	15.773	17.719

Thermistor Data for house at 1183 Grenac Rd.

String 1

Date	8/27/92	9/4/92	10/9/92	10/28/92	11/17/92	12/7/92	1/8/93	2/10/93	2/28/93	3/12/93	3/28/93	4/4/93
0	8.295	7.75	-0.315	-2.311	-11.295	-8.693	-3.355	-11.224	-4.316	-4.84	-2.126	-0.214
2	2.742	2.395	0	-0.042	-0.101	-0.179				-2.716	-2.327	-1.461
4	-0.179	-0.149	-0.161	-0.161	-0.173	-0.149				-1.554	-1.333	-1.143
8	0.036	0.018	-0.036	-0.024	-0.054	-0.012				-0.072	-0.078	-0.084
12	0.297	0.272	0.224	0.193	0.169	0.169	0.151	0.175	0.175	0.121	0.084	0.09
16	0.444	0.407	0.315	0.26	0.23	0.242	0.205			0.133	0.151	0.151
20	0.481	0.444	0.352	0.303	0.26	0.266	0.242			0.224	0.187	0.169
22	0.468	0.432	0.352	0.242	0.285	0.26	0.224	0.224	0.309	-0.006	0.151	0.169
24	0.291	0.26	0.193	-0.338	0.115	0.109				0.024	0.03	0.036
26	0.205	0.187	0.115	-0.374	0.06	0.072	0.048	0.048	0.127	0.054	-0.006	0
27	0.133	0.115	0.06	-0.208	0.018	0.012				0.018	-0.054	-0.084
28	0.066	0.042	0.012	-0.161	-0.036	-0.036	-0.018			-0.06	-0.107	-0.084

String 2

Date	8/27/92	9/4/92	10/9/92	10/28/92	11/17/92	12/7/92	1/8/93	2/10/93	2/28/93	3/12/93	3/28/93	4/4/93
0	8.458	7.157	0.26	-1.317	-7.859	-6.277	-2.53	-8.897	-3.191	-3.473	-1.587	-0.078
4	3.153	3.457	2.081	1.641	1.198	0.943	0.401	-0.054	-0.161	-0.173	-0.25	-0.244
8	1.713	1.866	2.135	1.661	1.753	1.562	1.231	0.874	0.711	0.605	0.549	0.555
12	1.243	1.314	1.647	1.276	1.621	1.549	1.36	1.147	1.013	0.893	0.83	0.798
16	1.058	1.07	1.231	0.692	1.302	1.347	1.269	1.198	1.077	1.07	0.956	0.918
20	0.855	0.83	0.855	0.754	0.886	0.962	0.931	0.937	0.899	0.842	0.736	0.792
22	0.842	0.817	0.798	0.555	0.83	0.88	0.886	0.905	0.855	0.811	0.617	0.792
24	0.617	0.58	0.555	0.53	0.555	0.586	0.598	0.598	0.611	0.592	0.567	0.567
25	0.629	0.592	0.567	0.536	0.524	0.586	0.592	0.611	0.605	0.512	0.58	0.555
26	0.543	0.518	0.487	0.26	0.475	0.493	0.512	0.543	0.53	0.493	0.506	-0.09
26.5	0.518	0.481	0.456	0.163	0.419	0.456	0.475	0.475	0.45	0.481	0.468	0.382
26.75	0.444	0.419	0.395	0.181	0.364	0.395	0.401	0.425	0.407	-0.432	0.401	0.395

String 3

Date	8/27/92	9/4/92	10/9/92	10/28/92	11/17/92	12/7/92	1/8/93	2/10/93	2/28/93	3/12/93	3/28/93	4/4/93
0	12.061	7.936	-0.155	-2.062	-10.815	-10.206	-5.029	-12.71	-4.967	-5.092	-3.37	-0.167
5	8.133	7.964	3.626	2.388	1.457	0.969	0.236	-0.584	-0.432	-0.572	-0.438	0.362
10	3.37	3.633	3.655	3.082	2.491	2.02	1.399	0.994	0.798	0.592	0.598	0.574
20	0.931	0.943	1.153	1.237	1.334	1.353	1.282	1.147	1.083	0.88	0.943	0.905
30	0.036	0.024	0.036	-0.018	0.006	0.072	0.054	0.09	0.078	0.042	0.06	0.054
32	-0.125	-0.137	-0.125	-0.149	-0.149	-0.113	-0.149	-0.095	-0.107	-0.119	-0.119	-0.119
33	-0.197	-0.197	-0.185	-0.421	-0.203	-0.161	-0.214	-0.173	-0.179	-0.173	-0.197	-0.185
33.5	-0.131	0.137	-0.125	-0.315	-0.161	-0.125	-0.256	-0.143	-0.125	-0.119	-0.131	-0.125
34	-0.291	-0.303	-0.309	-0.303	-0.327	-0.285	-0.285	-0.291	-0.285	-0.256	-0.309	-0.291
35	-0.262	-0.268	-0.25	-0.872	-0.327	-0.256	-0.291	-0.262	-0.256	-0.35	-0.285	-0.268
40	-0.22	-0.238	-0.214	-0.321	-0.274	-0.214	-0.309	-0.244	-0.226	-0.244	-0.238	-0.244
54	-0.279	-0.291	-0.279	-0.409	-0.327	-0.279	-0.321	-0.285	-0.291	-0.268	-0.297	-0.291

String 4

Date	8/27/92	9/4/92	10/9/92	10/28/92	11/17/92	12/7/92	1/8/93	2/10/93	2/28/93	3/12/93	3/28/93	4/4/93
0	11.898	9.427	0.654	0.291	-0.03	-0.066	-0.161	-0.238	-0.024	-0.279	-0.238	-0.208
5	6.028	6.078	3.604	2.429	1.72	1.289	0.798	0.574	0.53	0.389	0.327	0.321
10	2.251	2.477	2.868	2.271	2.074	1.747	1.314	1.109	1.282	0.918	0.717	0.792
20	0.236	0.254	0.493	0.543	0.648	0.729	0.686	0.654	0.698	0.598	0.536	0.499
25	0.006	-0.006	0.054	0.078	0.121	0.175	0.187	0.212	0.291	0.254	0.212	0.145
26	-0.018	-0.03	0.006	0.018	0.066	0.09	0.072	0.139	0.133	0.303	0.151	0.115
27	-0.125	-0.137	-0.113	-0.315	-0.078	-0.066	-0.084	0.012	0.303	0.272	0.163	0.018
27.5	-0.125	-0.137	-0.125	-0.119	-0.113	-0.084	-0.101	0.018	0.327	0.133	0.042	-0.054
28	-0.119	-0.131	-0.113	-0.665	-0.107	-0.101	-0.119	-0.09	-0.06	-0.09	-0.167	-0.095
29	-0.113	-0.125	-0.101	-0.125	-0.101	-0.113	-0.143	-0.107	-0.048	-0.101	-0.125	-0.137
35	-0.232	-0.244	-0.226	-0.244	-0.256	-0.232	-0.297	-0.244	-0.179	-0.238	-0.285	-0.232
45	-0.291	-0.303	-0.274	-0.303	-0.315	-0.285	-0.415	-0.291	-0.232	-0.256	-0.38	-0.279

Thermistor Data for house at 1183 Grenac Rd.

String 5

Date	8/27/92	9/4/92	10/9/92	10/28/92	11/17/92	12/7/92	1/8/93	2/10/93	2/28/93	3/12/93	3/28/93	4/4/93
0	6.697	4.494	-0.291	-1.233	-6.833	-5.962	-3.355	-9.221	-3.828	-4.005	-1.772	-1.076
4	-0.173	2.014	-0.167	-0.155	-0.173	-0.137	-0.161	-1.488	-1.07	-1.127	-0.35	-0.809
8	-0.09	-0.113	-0.084	-0.09	-0.101	-0.066	-0.09	-0.113	-0.095	-0.131	0.364	-0.137
12	0.054	0.018	0.012	0	0.018	0.042	0.012	0.018	0.012	-0.006	0.278	-0.036
16	0.218	0.187	0.163	0.145	0.145	0.109	0.151	0.145	0.151	0.157	0.163	0.115
20	0.024	-0.006	-0.048	-0.06	-0.054	-0.048	-0.078	-0.066	-0.072	-0.078	0.084	-0.072
22	0.03	0.012	-0.006	-0.03	-0.012	-0.03	-0.042	-0.054	-0.036	-0.03	0.078	0.048
24	-0.054	-0.072	-0.072	-0.072	-0.113	-0.09	-0.078	-0.119	-0.09	-0.09	0.006	-0.107
26	-0.125	-0.137	-0.137	-0.161	-0.155	-0.149	-0.173	-0.137	-0.167	-0.185	-0.143	-0.161
26	-0.03	-0.042	-0.03	-0.042	-0.018	-0.03	-0.072	-0.036	-0.042	-0.024	-0.084	-0.048
26.5	-0.137	-0.149	-0.149	-0.149	-0.143	-0.149	-0.155	-0.149	-0.155	-0.155	-0.297	-0.179
27	-0.161	-0.173	-0.155	-0.197	-0.208	-0.161	-0.173	-0.143	-0.161	-0.179	-0.226	-0.173

String 6

Date	8/27/92	9/4/92	10/9/92	10/28/92	11/17/92	12/7/92	1/8/93	2/10/93	2/28/93	3/12/93	3/28/93	4/4/93
0	13.344	10.492	0.886	-0.619	-6.248	-6.393	-3.683	-6.218	-2.041	-1.729	-0.479	-0.036
10	6.882	6.997	6.385	5.092	4.572	3.759	2.749	1.96	1.68	1.582	1.608	1.634
20	1.886	1.973	2.436	2.56	2.658	2.644	2.457	2.203	2.034	1.933	1.516	1.727
25	1.039	1.058	1.218	1.308	1.425	1.483	1.496	1.464	1.405	1.34	1.16	1.237
30	0.45	0.444	0.468	0.493	0.543	0.586	0.629	0.331	0.654	0.636	0.611	0.611
32	0.212	0.187	0.218	0.218	-0.26	0.303	0.297	0.333	0.333	0.364	0.303	0.315
34	0.03	0.012	0.018	0.03	-0.06	0.072	0.078	0.084	0.09	0.127	0.072	0.09
35	-0.107	-0.113	-0.107	-0.279	-0.095	-0.078	-0.09	-0.084	-0.084	-0.018	-0.095	-0.06
36	-0.173	-0.185	-0.173	-0.173	-0.167	-0.161	-0.185	-0.173	-0.161	-0.161	-0.25	-0.167
38	-0.173	-0.185	-0.173	-0.179	-0.179	-0.167	-0.179	-0.167	-0.173	-0.179	-0.303	-0.179
40	-0.203	-0.22	-0.203	-0.208	-0.22	-0.197	-0.214	-0.185	-0.208	-0.179	-0.333	-0.214
43.5	-0.303	-0.315	-0.285	-0.291	-0.309	-0.291	-0.315	-0.297	-0.303	-0.279	-0.321	-0.309

String 7

Date	8/27/92	9/4/92	10/9/92	10/28/92	11/17/92	12/7/92	1/8/93	2/10/93	2/28/93	3/12/93	3/28/93	4/4/93
AO1	12.344		1.295	-2.613	-14.64	-13.598		-12.031	-3.021	0.09	3.103	10.839
AO2	12.285		1.529	-2.782	-15.144	-13.667		-11.094	-2.295	0.704	4.988	13.609
AU3	10.077		-0.315	-2.975	-15.103	-11.636	-4.418	-11.624	-3.823	-4.4	0.661	2.567



Thermistor Data for house at 1183 Grenac Rd.

String 1

Date	6/8/93	6/24/93	10/14/93	11/24/93	1/24/94	3/2/94	5/18/94	6/10/94	10/13/94	3/19/95	10/2/96	10/25/96
0	7.565	10.828	3.29	-5.928	-9.12	-12.95	4.822	9.983	-4.658			
2	-0.125	0.145	0.224	-0.072	-2.358	-5.48	-4.222	-0.203	-2.206	-7.153	0.555	-0.107
4	-0.385	-0.327	0.06	-0.262	-0.167	-1.244	-0.578	-0.444	-0.268	-4.015	-0.15	-0.168
8	-0.113	-0.09	-0.161	-0.244	-0.107	-0.113	-0.113	-0.119	-5.428	-0.146	-0.291	-0.276
12	0.036	0.054	-4.89	-0.208	-0.173	0.145	0.103	0.078	-5.519	0.097	-0.085	-0.084
16	0.103	0.115	-0.113	-0.374	0.163	0.187	0.163	0.151	-0.072	0.144		
20	0.145	0.163	-0.262	-0.107	0.139			-26.228	-2.608		0.047	0.039
22	0.139	0.151	0.054	-0.232	0.127	0.169	0.187	0.187	-0.054	0.157	0.053	0.041
24	0.006	0.03	-0.048	-0.191	-0.084	0.036	0.054	0.054	-0.877		-0.046	-0.055
26	-0.018	0.006	-0.502	-0.149	-0.131	-0.018	0.006	0.006	-0.671	0.019	-0.07	-0.081
27	-0.066	-0.042	-0.113	-0.25	-0.285	-0.036	-0.048	-0.042	-0.143		-0.146	-0.154
28	-0.101	-0.078	-0.149	-0.137	-0.279	-0.101	-0.095	-0.09	-0.119		-0.142	-0.153

String 2

Date	6/8/93	6/24/93	10/14/93	11/24/93	1/24/94	3/2/94	5/18/94	6/10/94	10/13/94	3/19/95	10/2/96	10/25/96
0	6.54	8.593	3.938	-2.628	-6.873	-10.117	4.862	7.465	-1.461	-0.094		-6.539
4	-0.125	0.054	-12.175	1.987	0.407	0.012	-0.22	-0.173	2.484		1.824	1.15
8	-0.642	0.817	-0.385	2.299	1.425	1.007	0.53	0.561	1.893	-0.54	1.334	1.39
12	0.717	0.779	1.496	1.98	1.674	1.334	0.792	0.773	-10.047	0.653	1.028	1.175
16	0.754	0.767	1.026	1.549	1.51	1.392	1.007	0.918	-5.327	1.022	0.833	0.946
20	0.642	0.654	0.536	1.058	0.248	1.192	0.918	0.754	0.444	1.173	0.639	0.676
22	0.673	0.673	-0.877	0.905	0.555	1.09	0.931	0.861	-2.762	1.022	0.648	0.661
24	0.468	0.468	-3.434	0.586	0.654	0.792	0.692	0.654	-1.333	0.995	0.452	0.452
25	0.493	0.499	-2.664	0.352	0.692	0.767	0.704	0.667	-0.197	0.716	0.481	0.475
26	0.432	0.432	0.395	0.346	-1.576	0.673	0.617	0.586	-0.578	0.733	0.418	0.411
26.5	0.401	0.407	-0.397	0.333	0.561	0.623	0.58	0.543	0.054		0.39	0.378
26.75	0.34	0.346	-6.046	0.382	0.242	0.549	0.518	0.487	-2.869		0.341	0.331

String 3

Date	6/8/93	6/24/93	10/14/93	11/24/93	1/24/94	3/2/94	5/18/94	6/10/94	10/13/94	3/19/95	10/2/96	10/25/96
0	12.595	14.242	3.766	-5.693	-9.837	-13.93	10.861	17.16	-4.867	0.543		
5	-0.03	1.634	5.028	2.095	0.084	-1.036	-0.185	-0.125	3.752		2.857	1.095
10	0.667	0.918	-0.479	2.868	1.773	1.186	0.543	0.53	3.399		1.4	1.331
20	0.679	0.673	1.007	1.399	1.608	1.444	0.994	0.88	0.224	-1.488	0.61	0.658
30	0.006	0.03	-4.344	-0.185	0	0.157	0.115	0.09	-0.042	-1.493	0.027	0.023
32	-0.137	-0.113	-0.421	-0.197	-0.095	-0.078	-0.09	-0.107	-16.309	0.136	-0.088	-0.085
33	-0.185	-0.161	-0.601	-0.285	-0.232	-0.125	-0.161	-0.167	-10.479	-0.067	0.14	-0.136
33.5	-0.125	-0.113	-4.18	-0.303	-0.125	-0.072	-0.125	-0.125	-0.438	-0.136		-0.094
34	-0.303	-0.279	-0.946	-0.619	-0.38	-0.285	-0.291	-0.291	-1.729	-0.101	-0.262	-0.258
35	-0.268	-0.25	-0.671	-0.579	-0.274	-0.268	-0.268	-0.268	-0.537	-0.278	-0.242	-0.235
40	-0.232	-0.214	-0.578	-0.344	-0.502	-0.208	-0.38	-0.232	-4.809		-0.233	-0.232
54	-0.297	-0.274	-0.894	-0.315	-0.309	-0.297	-0.315	-0.309	-1.505		-0.305	-0.307

String 4

Date	6/8/93	6/24/93	10/14/93	11/24/93	1/24/94	3/2/94	5/18/94	6/10/94	10/13/94	3/19/95	10/2/96	10/25/96
0	11.645	13.89	3.626	0.236	-0.385	-0.854	7.068	12.309	-20.949	-0.298		-0.614
5	2.457	4.066	4.751	2.196	1.166	0.742	0.352	2.074	4.409	0.62	3.251	1.777
10	0.698	1.147	3.435	2.868	1.8	1.327	0.717	0.792	3.648	0.615	1.736	1.634
20	0.321	0.321	-0.797	0.817	1.083	0.962	0.605	0.53	0.817	1.134	0.303	0.37
25	0.072	0.078	-0.923	0.103	0.34	0.333	0.224	0.181	-13.334	0.83	0.077	0.088
26	0.03	0.042	-0.191	-0.072	0.236	0.224	0.151	0.127	-0.149	0.329	0.04	0.056
27	-0.101	-0.084	-1.702	-0.101	0.03	0.024	-0.018	-0.03	-0.048	0.232	-0.055	-0.055
27.5	-0.113	-0.09	-1.615	-0.409	-0.012	0	-0.042	-0.042	-0.09	0.058		-0.061
28	-0.119	-0.09	-1.4	-0.155	-0.054	-0.048	-0.06	-0.06	-0.648	0.021	-0.05	-0.048
29	-0.125	-0.101	-3.201	-0.244	-0.125	-0.119	-0.113	-0.113	-1.95	-0.003	-0.063	-0.064
35	-0.256	-0.22	-0.262	-0.374	-0.244	-0.25	-0.256	-0.244	-0.244		-0.233	-0.232
45	-0.297	-0.268	-6.479	-0.409	-0.297	-0.279	-0.291	-0.291	-0.309		-0.289	-0.283

TABLE C-1

Thermistor Data for house at 1183 Grenac Rd.

String 5												
Date	6/8/93	6/24/93	10/14/93	11/24/93	1/24/94	3/2/94	5/18/94	6/10/94	10/13/94	3/19/95	10/2/96	10/25/96
0	5.35	6.802	1.926	-2.965	-7.136	-10.982	2.84	6.299	-8.271	-0.279		-11.918
4	-0.338	-0.285	-2.1	-0.155	-0.333	-1.053	-0.467	-0.374	-0.268		-0.155	-0.165
8	-0.173	-0.149	-2.363	-0.22	-0.107	-0.084	-0.149	-0.167	-7.761	-3.285	-0.316	-0.308
12	-0.072	-0.066	-2.747	0.09	0.139	0.097	0.006	-0.018	-3.156	-0.147	-0.174	-0.178
16	0.066	0.084	-3.296	0.078	0.254	0.254	0.163	0.151	-3.429	0.044	-0.023	-0.031
20	-0.113	-0.09	-3.799	-0.256	0	-0.006	-0.036	-0.054	-0.095	0.192	-0.159	-0.163
22	-0.078	-0.054	-0.368	-3.707	-0.018	-0.048	-0.024	-0.042	-3.473	-0.007	-0.109	-0.113
24	-0.125	-0.113	-0.462	-0.368	-0.101	-0.101	-0.101	-0.107	-0.137	-0.007		-0.147
26	-0.173	-0.149	-0.832	-0.374	-0.155	-0.125	-0.161	-0.155	-0.22	-0.097	-0.191	-0.188
26	-0.054	-0.03	-0.262	-0.561	-0.066	-0.036	-0.054	-0.054	-1.183	-0.15	-0.07	-0.066
26.5	-0.173	-0.149	-12.058	-0.368	-0.161	-0.167	-0.173	-0.167	-0.167		-0.166	-0.166
27	-0.179	-0.149	-0.238	-0.185	-0.185	-0.173	-0.173	-0.173	-0.185		-0.166	-0.166
String 6												
Date	6/8/93	6/24/93	10/14/93	11/24/93	1/24/94	3/2/94	5/18/94	6/10/94	10/13/94	3/19/95	10/2/96	10/25/96
0	14.748	16.234	5.835	-2.986	-7.097	-10.398	10.752	14.856		-0.153		-8.729
10	2.868	3.916	5.132	5.423	2.415	1.973	1.353	1.933	6.402		5.298	4.736
20	1.431	1.483	-0.119	3.039	2.939	2.547	1.813	1.661	1.575	1.64	1.885	2.081
25	1	1	-0.456	1.667	1.88	1.793	1.431	1.045	0.988	1.638	1.139	1.2
30	0.487	0.493	-11.937	0.648	0.842	0.874	0.779	0.642	0.499	1.64	0.602	0.601
32	0.242	0.23	-1.543	0.115	0.499	-0.601	0.456	0.327	0.291	0.867	0.37	0.368
34	0.054	0.078	-1.516	-0.327	0.187	0.224	0.199	0.193	-11.218	0.642	0.21	0.204
35	-0.078	-0.042	-0.543	-17.643	0.012	0.024	0.03	0.03	-0.63	0.266		0.092
36	-0.167	-0.137	-5.177	-1.35	-0.137	-0.226	-0.101	-0.101	-0.268	0.265	0	-0.003
38	-0.173	-0.149	-1.826	-0.179	-0.167	-0.173	-0.173	-0.173	-9.45	0.097	-0.13	-0.122
40	-0.22	-0.185	-0.297	-21.45	-0.208	-0.214	-0.208	-0.208			-0.186	-0.184
43.5	-0.315	-0.279	-10.55	-0.321	-0.303	-0.291	-0.309	-0.309	-0.291		-0.288	-0.287
String 7												
Date	6/8/93	6/24/93	10/14/93	11/24/93	1/24/94	3/2/94	5/18/94	6/10/94	10/13/94	3/19/95	10/2/96	10/25/96
AO1	18.149	19.447	4.869	-8.819	-13.544	-16.309	20.06	22	-15.748	-0.194		
AO2	23.784	23.213	2.34	-9.102	-13.209	-17.216	20.077	22.924	-10.537	-0.292	15.645	
AU3	12.997	15.532	-17.171	-5.419	-10.008	-13.938	15.019	17.734	-3.823		1.609	

TABLE C-1

Thermistor Data for house at 1183 Grenac Rd.

String 1

Date	12/3/96	1/17/97	2/6/97
0			-6.176
2	-2.397	-9.35	-8.244
4	-0.175	-5.786	-5.822
8	-0.257	-0.598	-1.598
12	-0.072	-0.08	0.084
16			
20	0.021	0.011	0.015
22	0.023	0.017	0.016
24	-0.069	-0.08	-0.081
26	-0.103	-0.103	-0.103
27	-0.169	-0.182	-0.179
28	-0.165		-0.169

String 2

Date	12/3/96	1/17/97	2/6/97
0	-10.224	-7.618	-4.422
4	0.519	-0.309	-0.957
8	1.116	0.718	0.531
12	1.157	0.945	0.821
16	1.037	0.974	0.912
20	0.756	0.772	0.753
22	0.721	0.748	0.739
24	0.507	0.517	0.519
25	0.544	0.529	0.533
26	0.424	0.454	0.459
26.5	0.396	0.413	0.414
26.75	0.343	0.365	0.373

String 3

Date	12/3/96	1/17/97	2/6/97
0		-11.542	-7.014
5	0.047	-1.782	-2.095
10	0.895	0.522	0.402
20	0.702	0.654	0.626
30	0.023	0.031	0.033
32	-0.082	-0.08	-0.079
33	-0.134	-0.13	-0.13
33.5	-0.112	-0.093	-0.091
34	-0.256	-0.259	-0.257
35	-0.316	-0.232	-0.231
40	-0.229	-0.233	-0.23
54	-0.244		-0.3

String 4

Date	12/3/96	1/17/97	2/6/97
0	-0.9	-1.541	-1.604
5	0.712	0.358	0.263
10	1.116	0.706	0.59
20	0.373	0.412	0.378
25	0.118	0.136	0.132
26	0.078	0.093	0.093
27	-0.024	-0.024	-0.025
27.5	-0.07	-0.036	-0.038
28	-0.038	-0.031	-0.03
29	-0.076	-0.054	-0.052
35		-0.23	-0.23
45		-0.284	-0.281

Thermistor Data for house at 1183 Grenac Rd.

String 5

Date	12/3/96	1/17/97	2/6/97
0	-0.283	-11.399	-5.958
4		-5.402	-5.302
8	-0.162	-0.55	-1.238
12	-0.3	-0.186	-0.186
16	-0.18	-0.044	-0.046
20	-0.038	-0.175	-0.174
22	-0.173	-0.126	-0.128
24	-0.118	-0.155	-0.154
26	-0.154	-0.195	-0.194
26	-0.163	-0.069	-0.068
26.5	-0.092	-0.169	-0.168
27	-0.171	-0.168	-0.166

String 6

Date	12/3/96	1/17/97	2/6/97
0	-7.683	-7.832	-5.364
10	3.196	1.951	1.611
20	2.236	2.058	1.914
25	1.324	1.37	1.34
30	0.634	0.689	0.699
32	0.382	0.423	0.435
34	0.209	0.236	0.246
35	0.092	0.112	0.123
36	-0.002	0.112	0.021
38	-0.123	-0.119	-0.118
40	-0.185	-0.182	-0.181
43.5		-0.285	-0.283

String 7

Date	12/3/96	1/17/97	2/6/97
AO1			-3.597
AO2			-3.686
AU3			

### GRENAC AIR TEMPERATURES

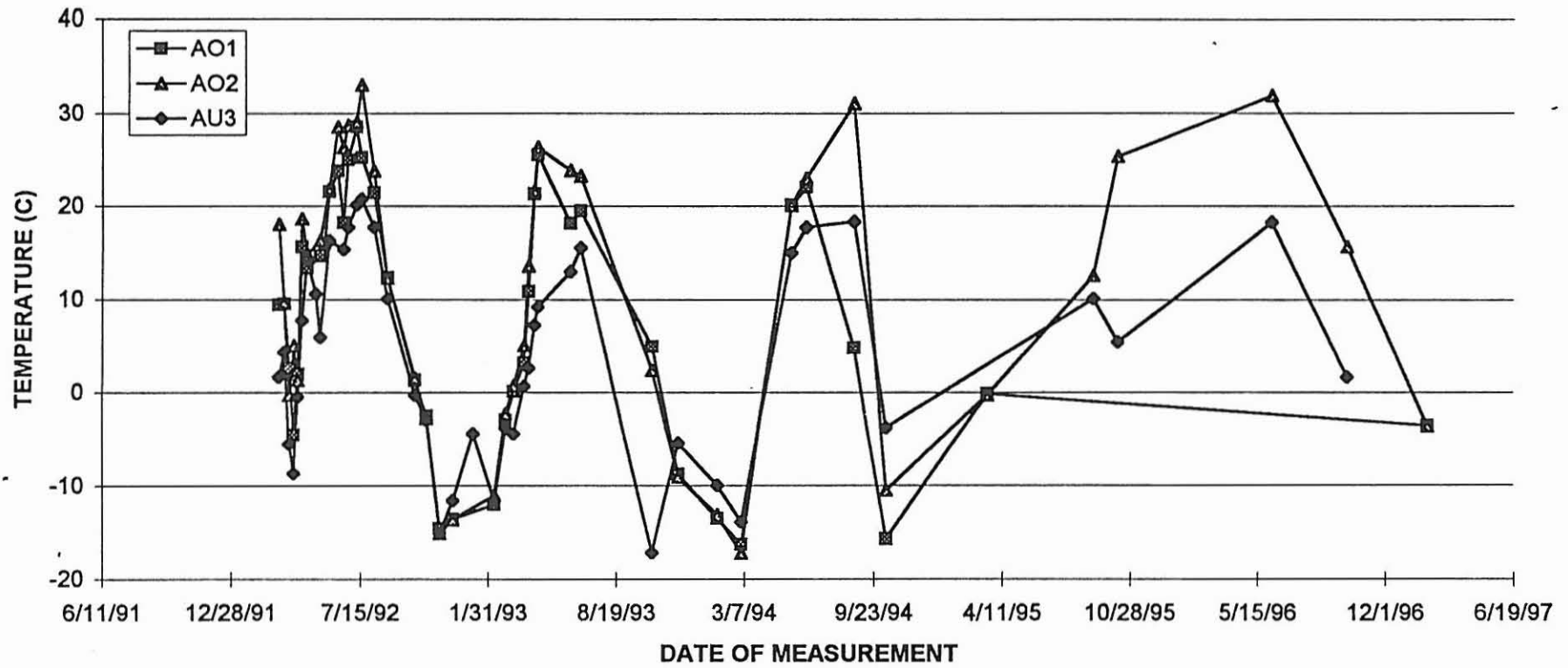


FIGURE C-2

### GRENAC STRING #1S

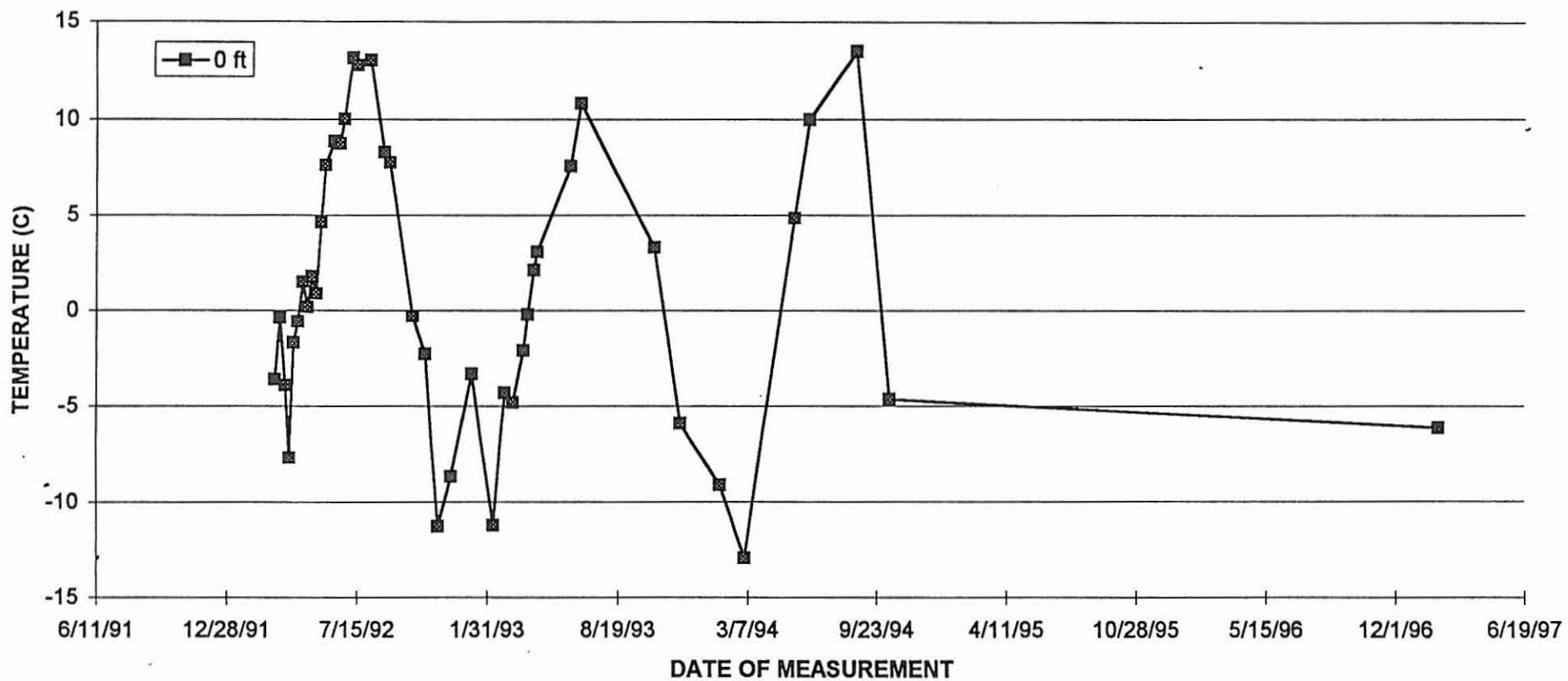


FIGURE C-3

### GRENAC CHART #1A

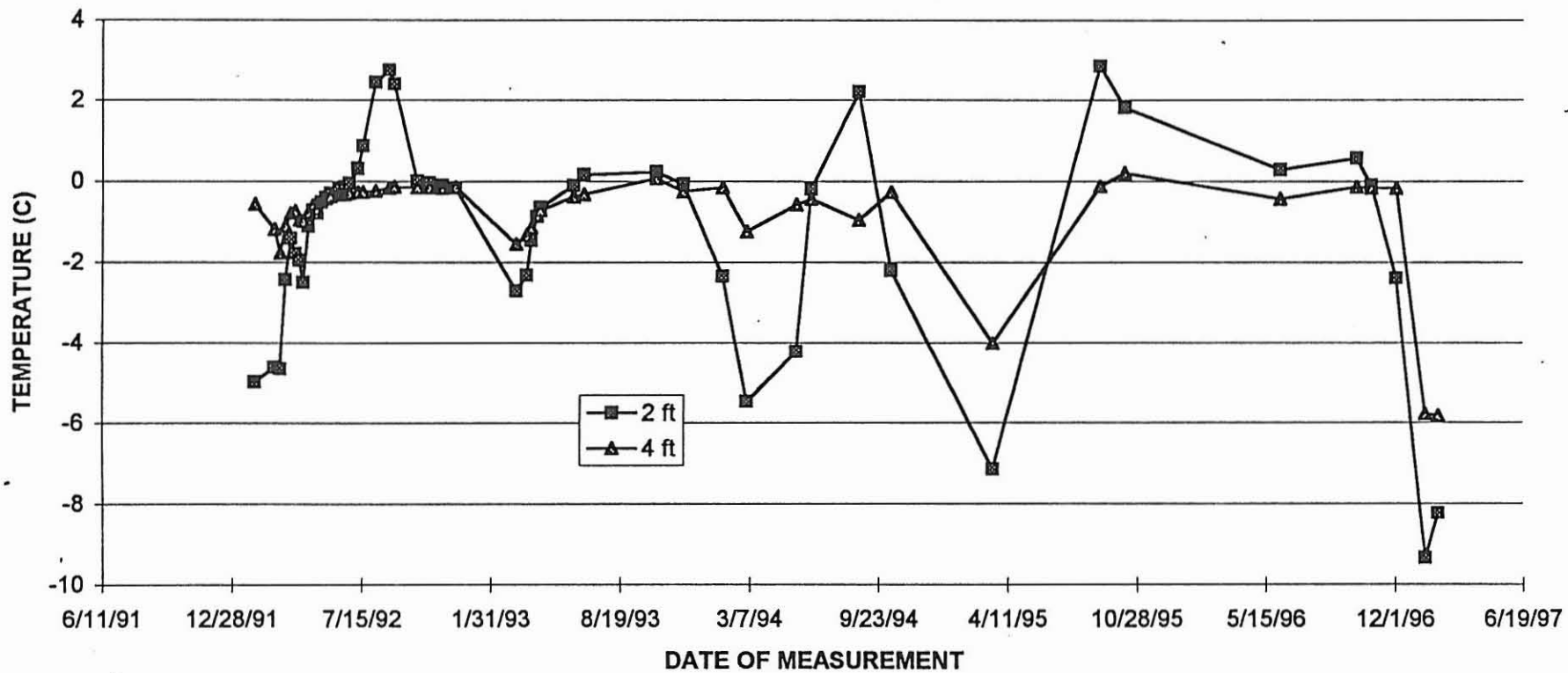


FIGURE C-4

### GRENAC CHART #1B

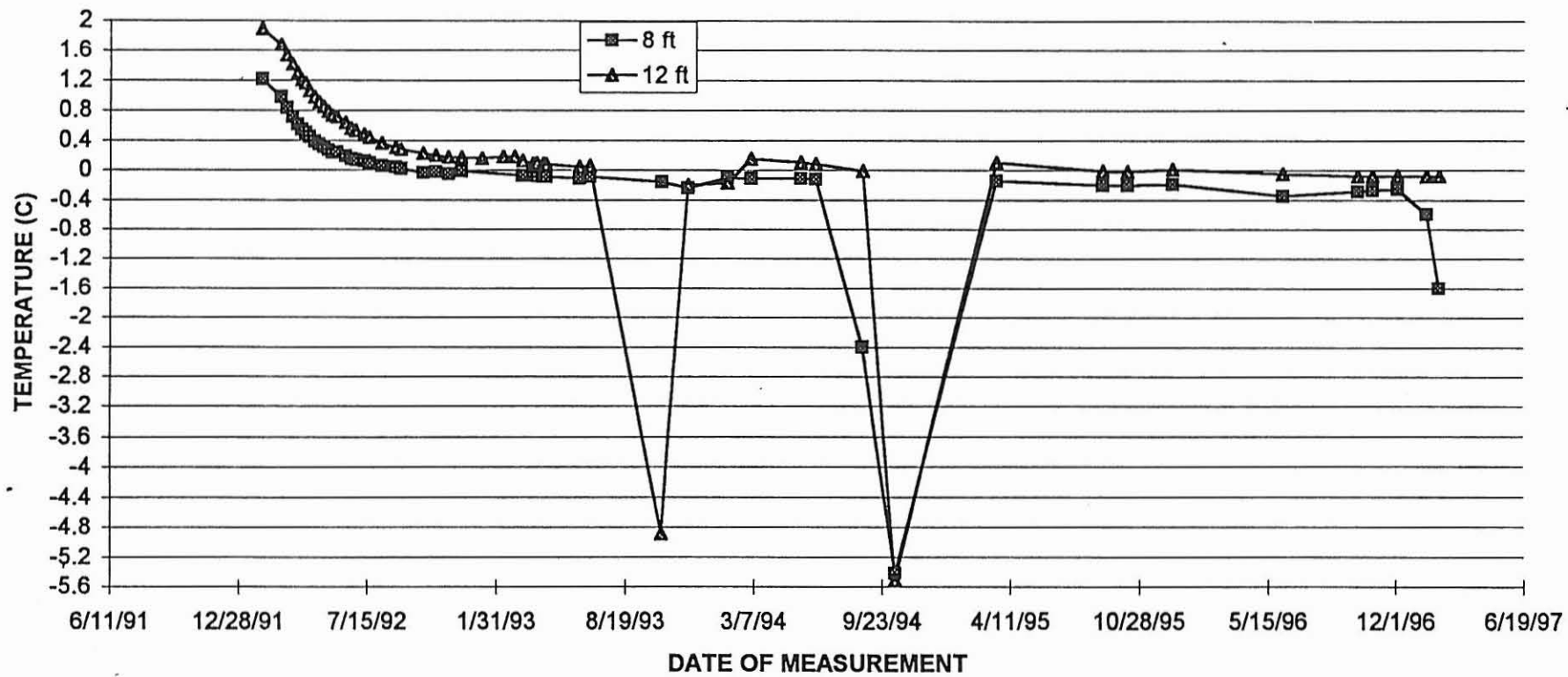


FIGURE C-5



GRENAC CHART #1C

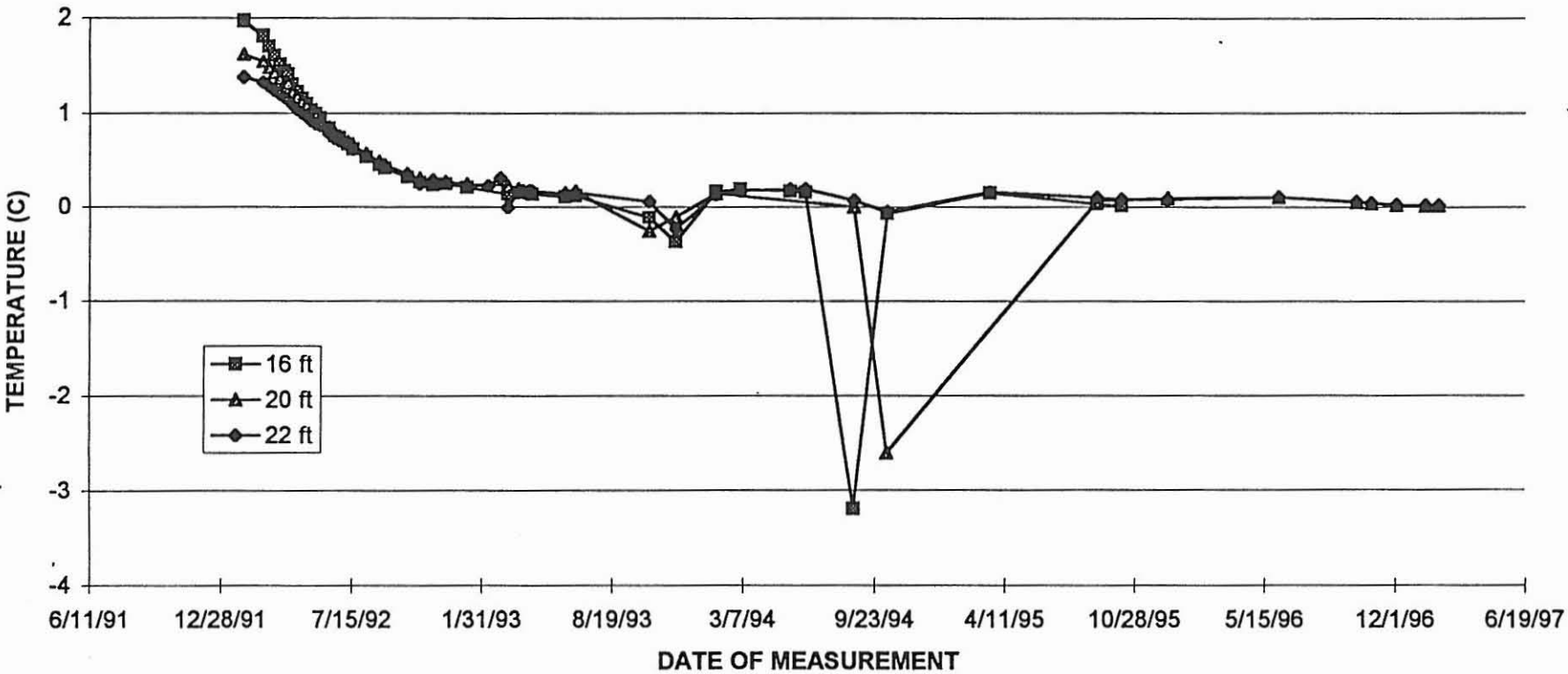


FIGURE C-6

### GRENAC CHART #1D

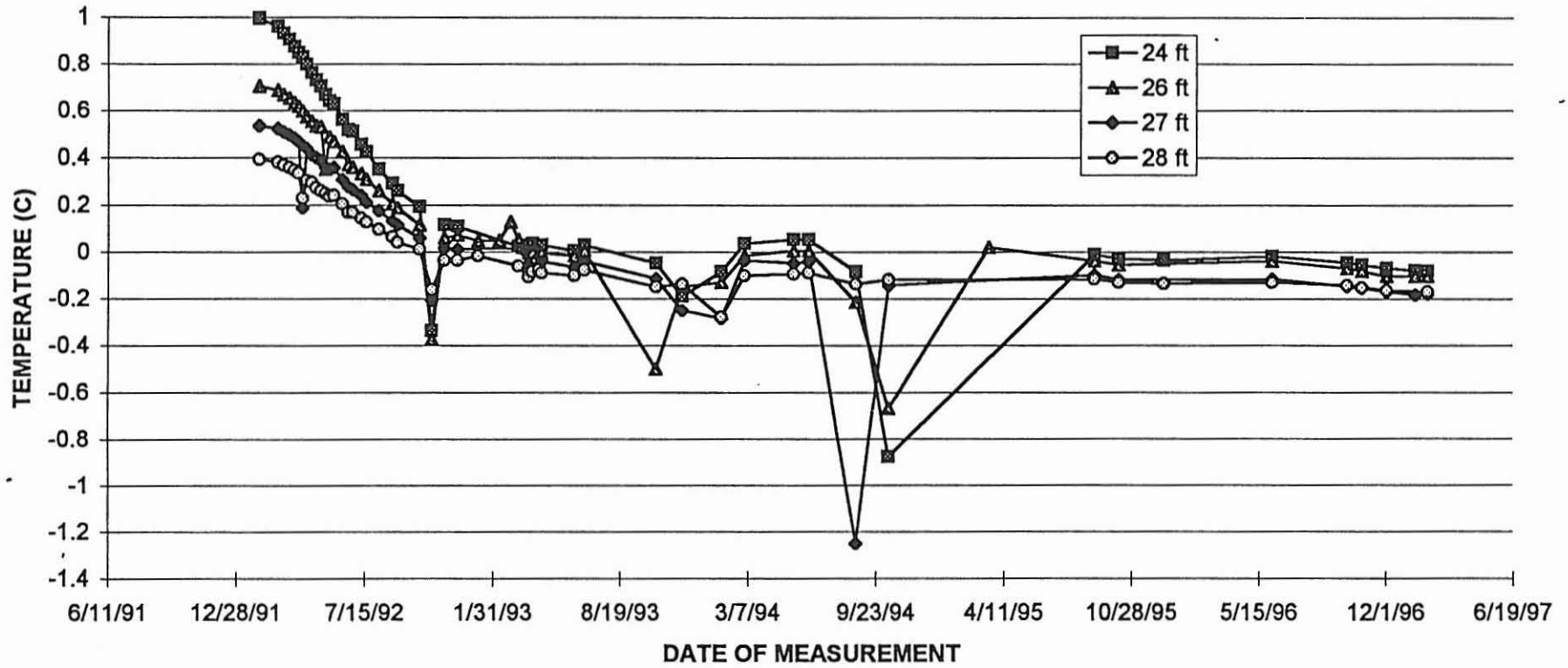


FIGURE C-7

### GRENAC CHART #2S

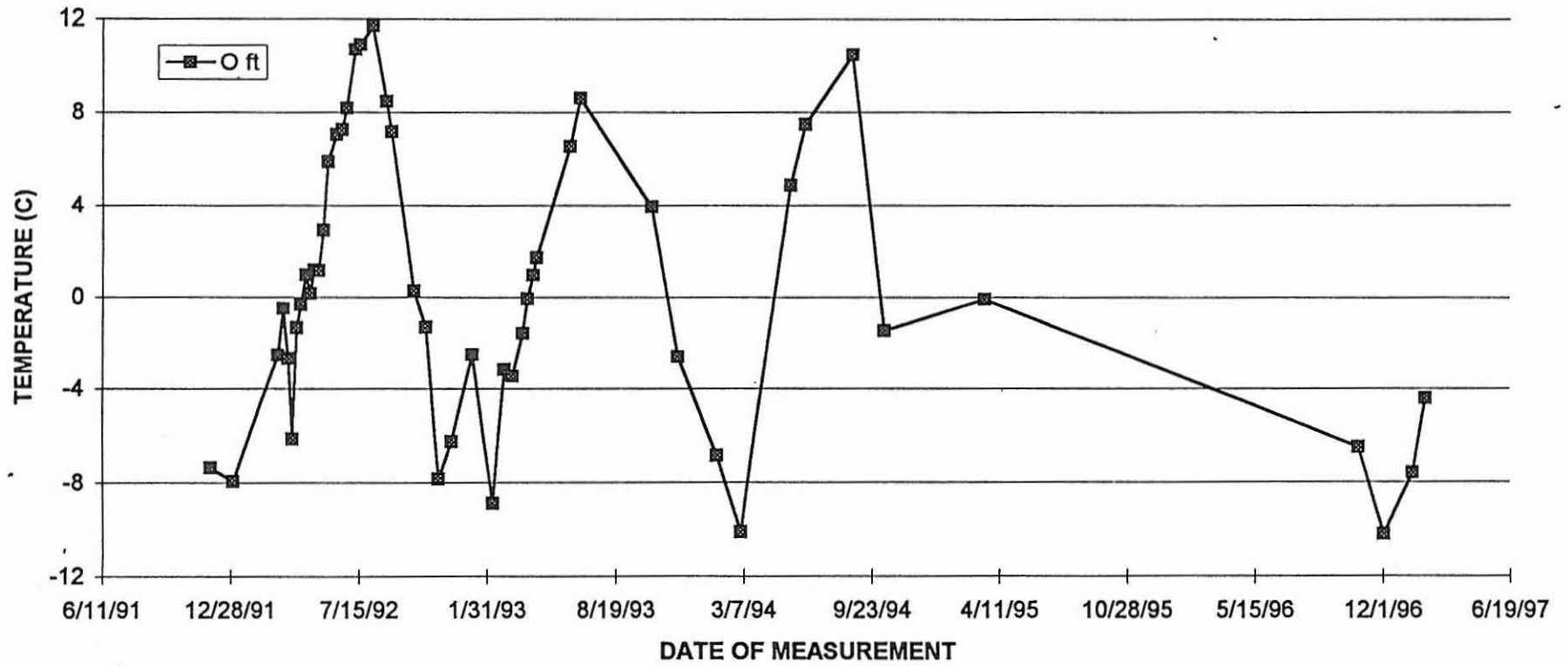


FIGURE C-8

GRENAC CHART #2A

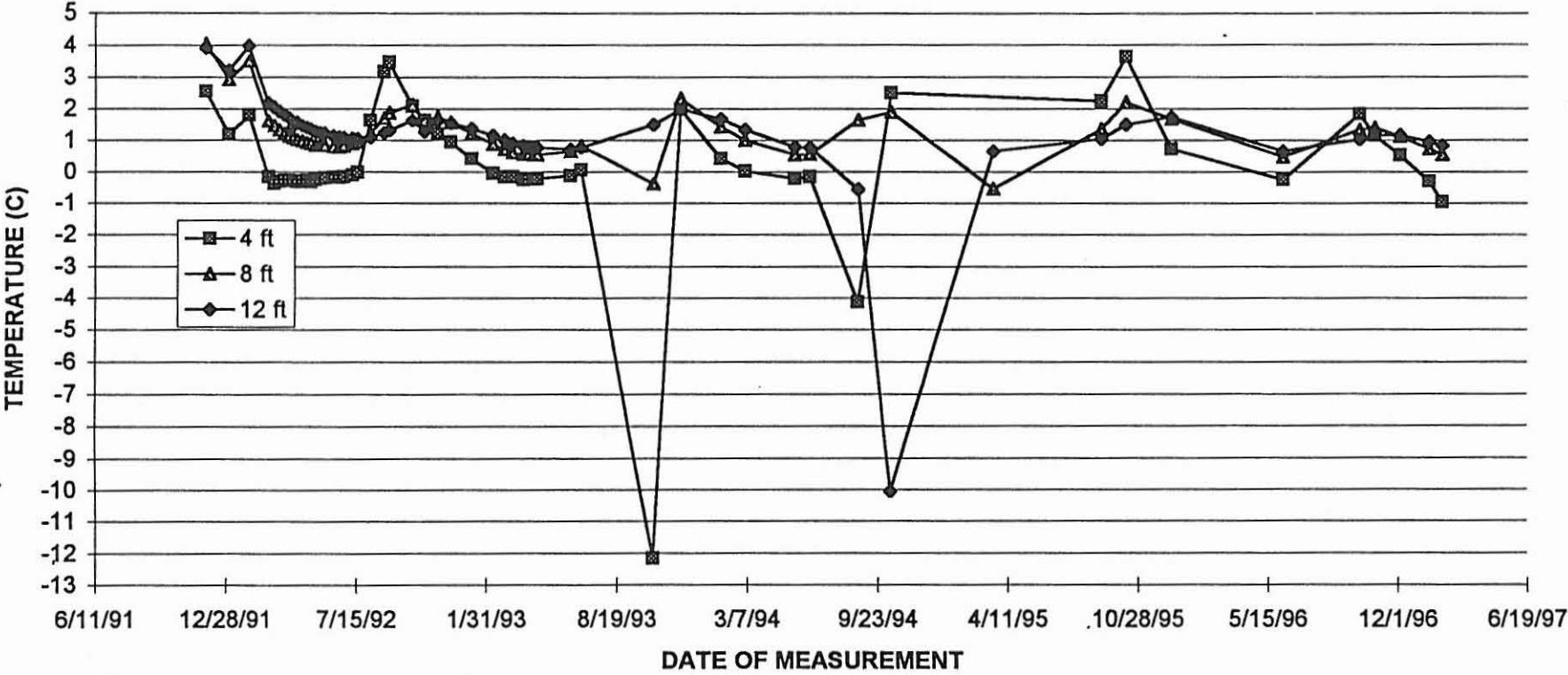


FIGURE C-9

### GRENAC CHART #2B

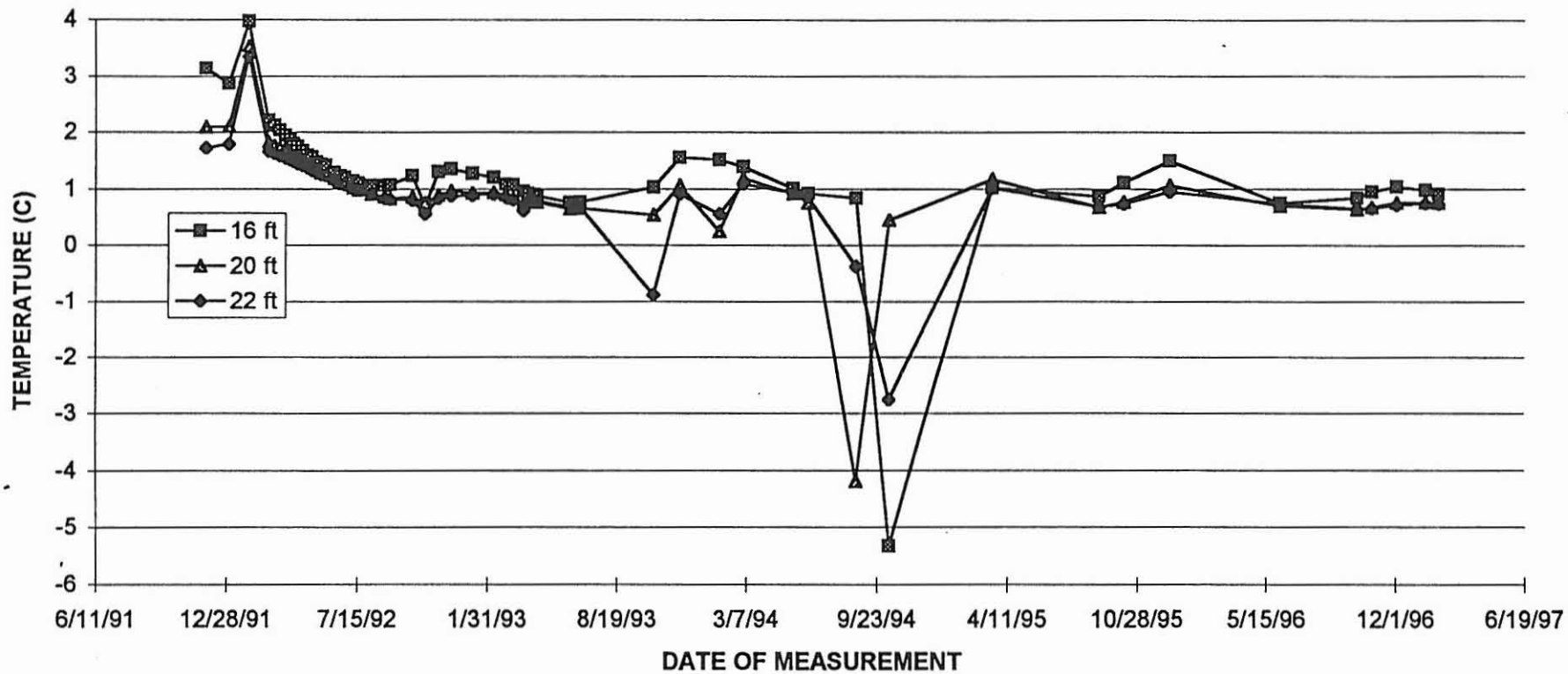


FIGURE C-10

GRENAC CHART #2C

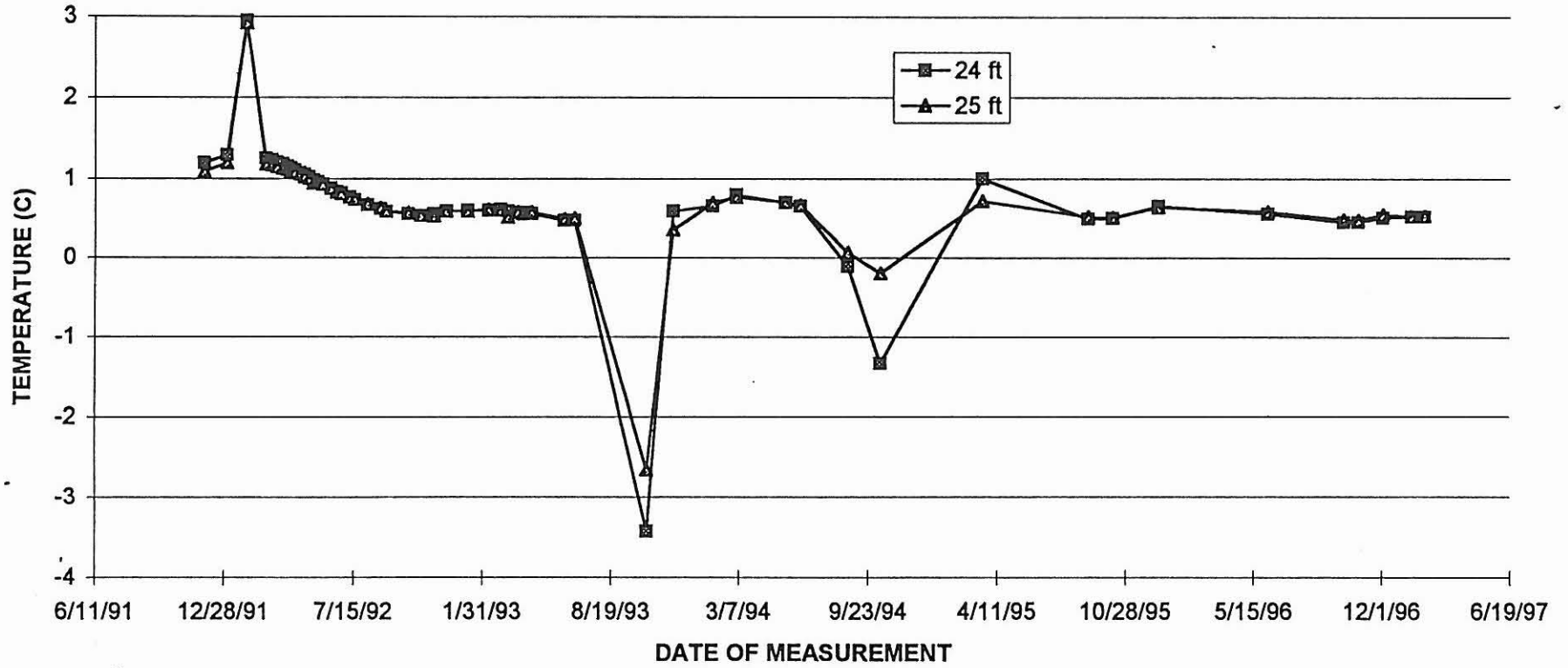


FIGURE C-11

GRENAC CHART #2D

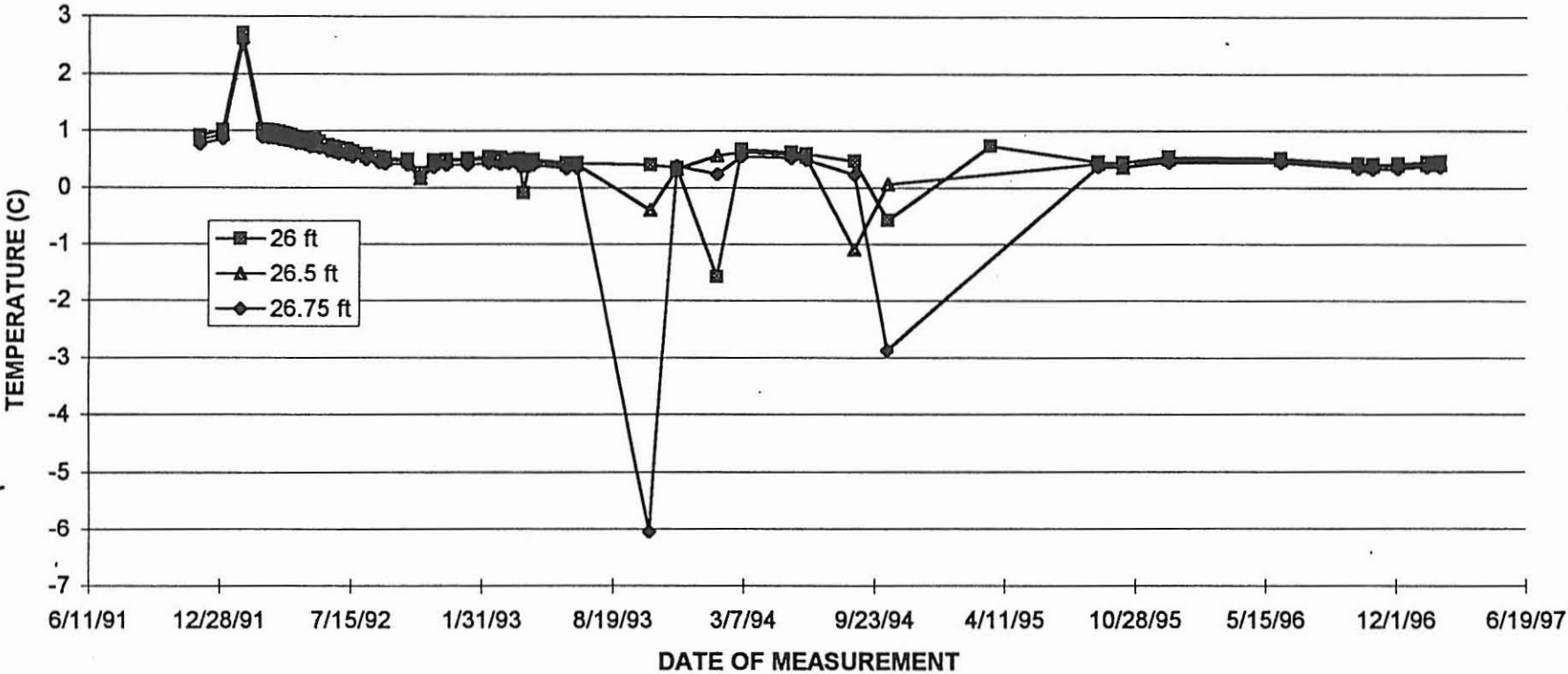


FIGURE C-12

### GRENAC CHART #3S

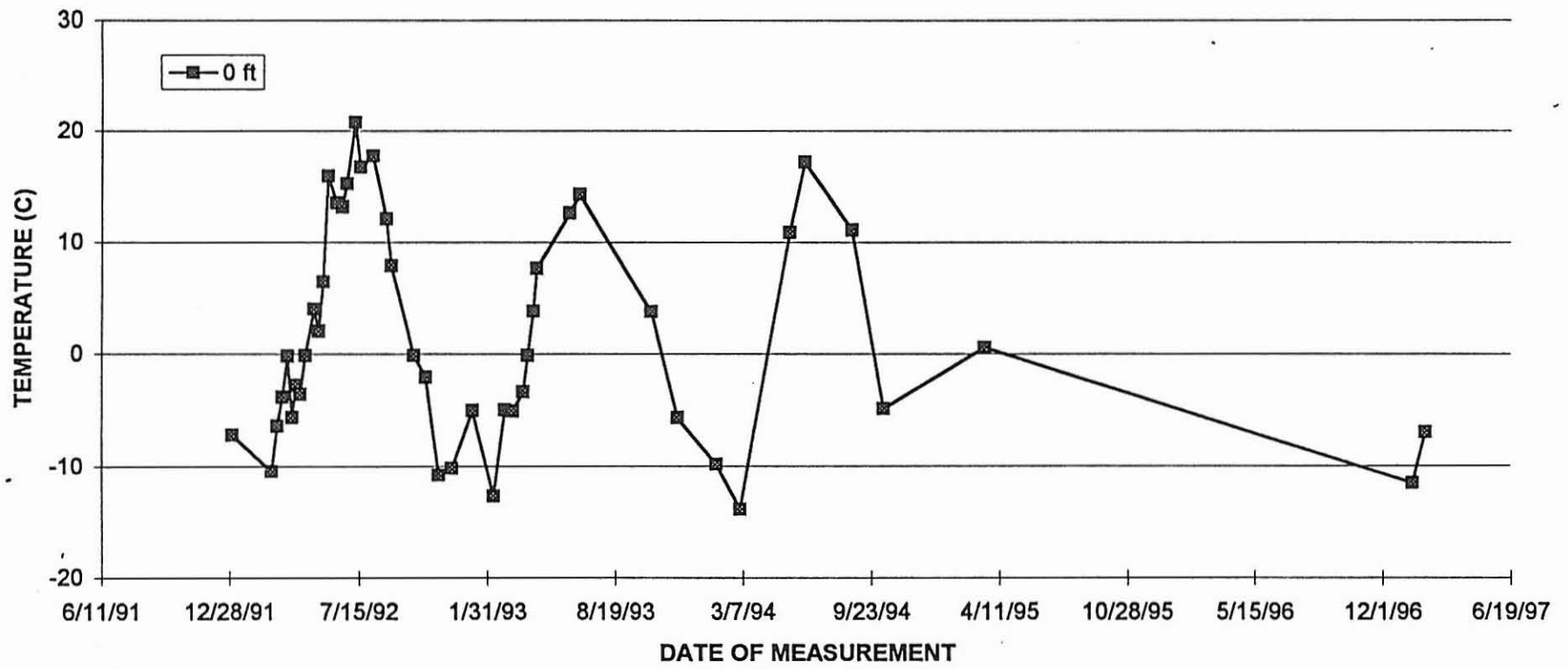


FIGURE C-13



### GRENAC CHART #3A

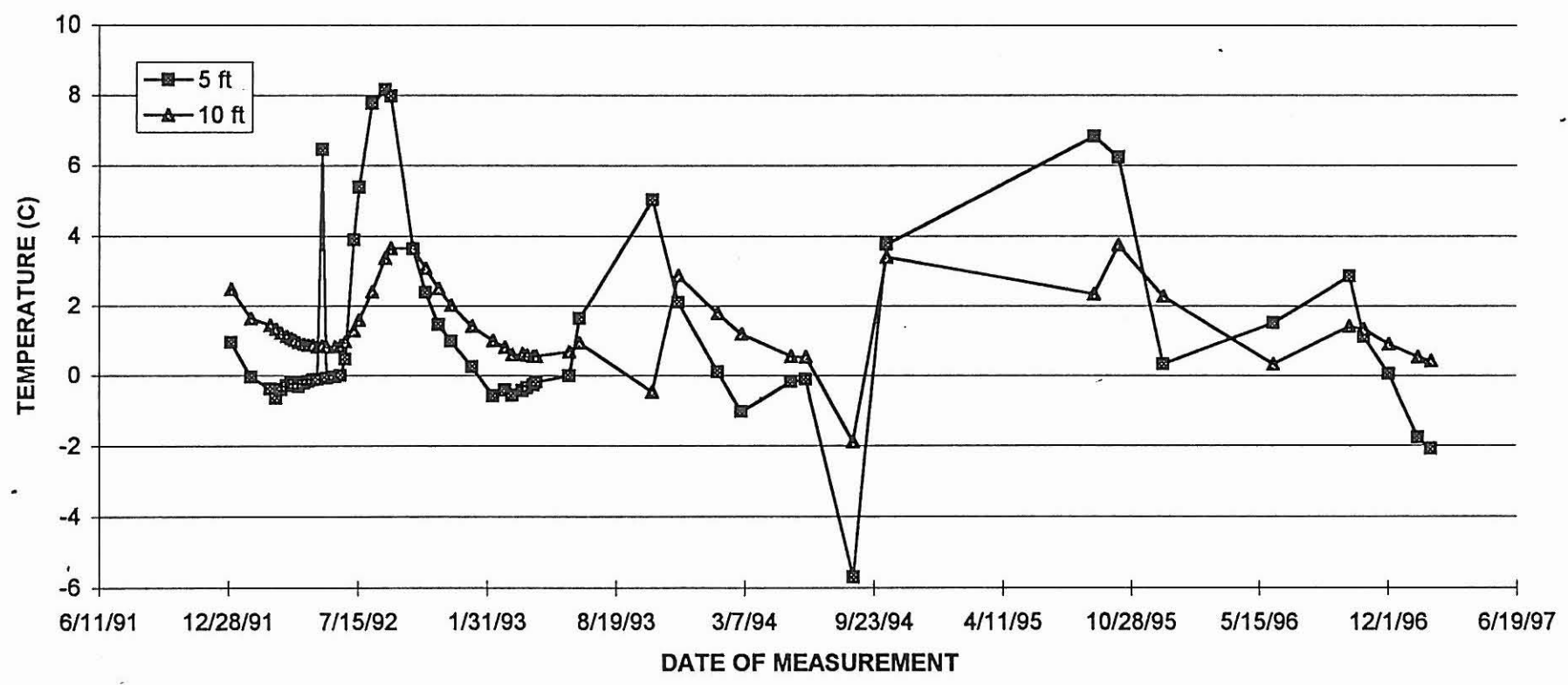


FIGURE C-14

### GRENAC CHART #3B

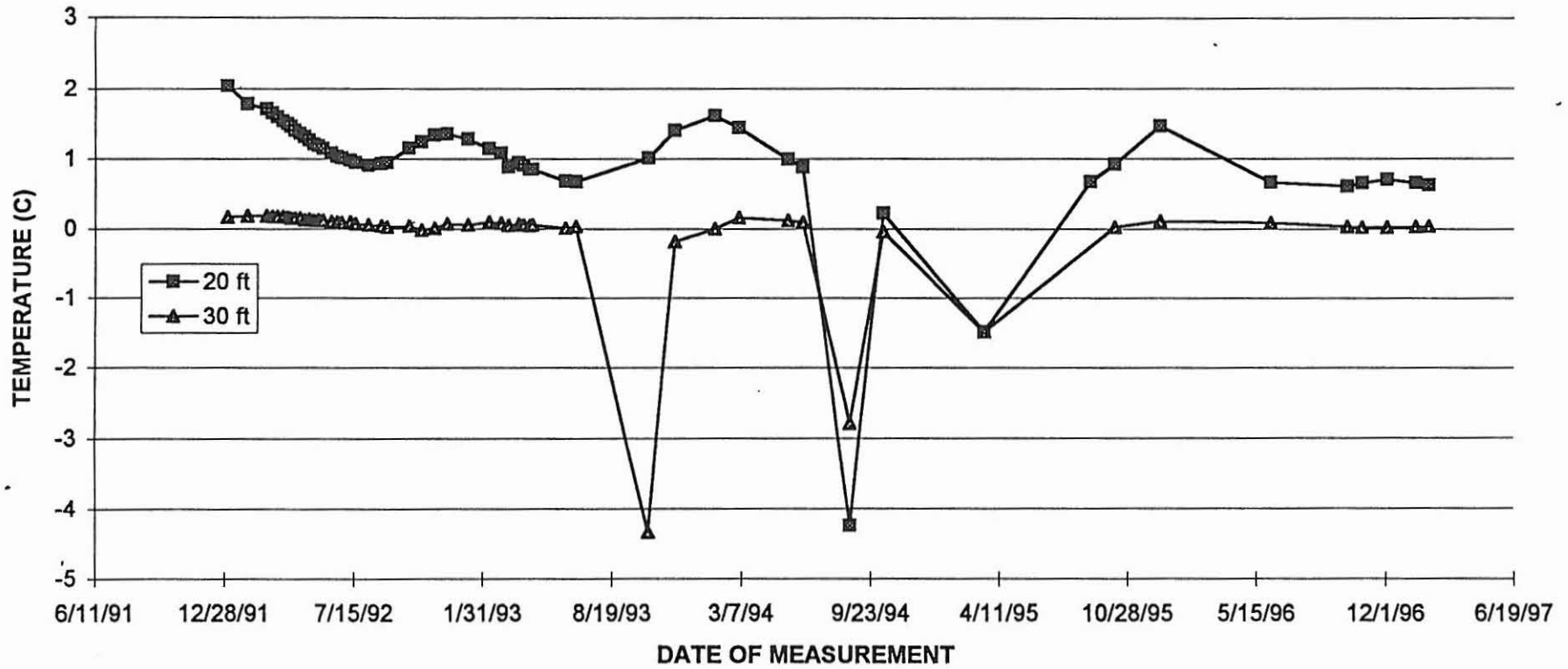


FIGURE C-15

### GRENAC CHART #3C

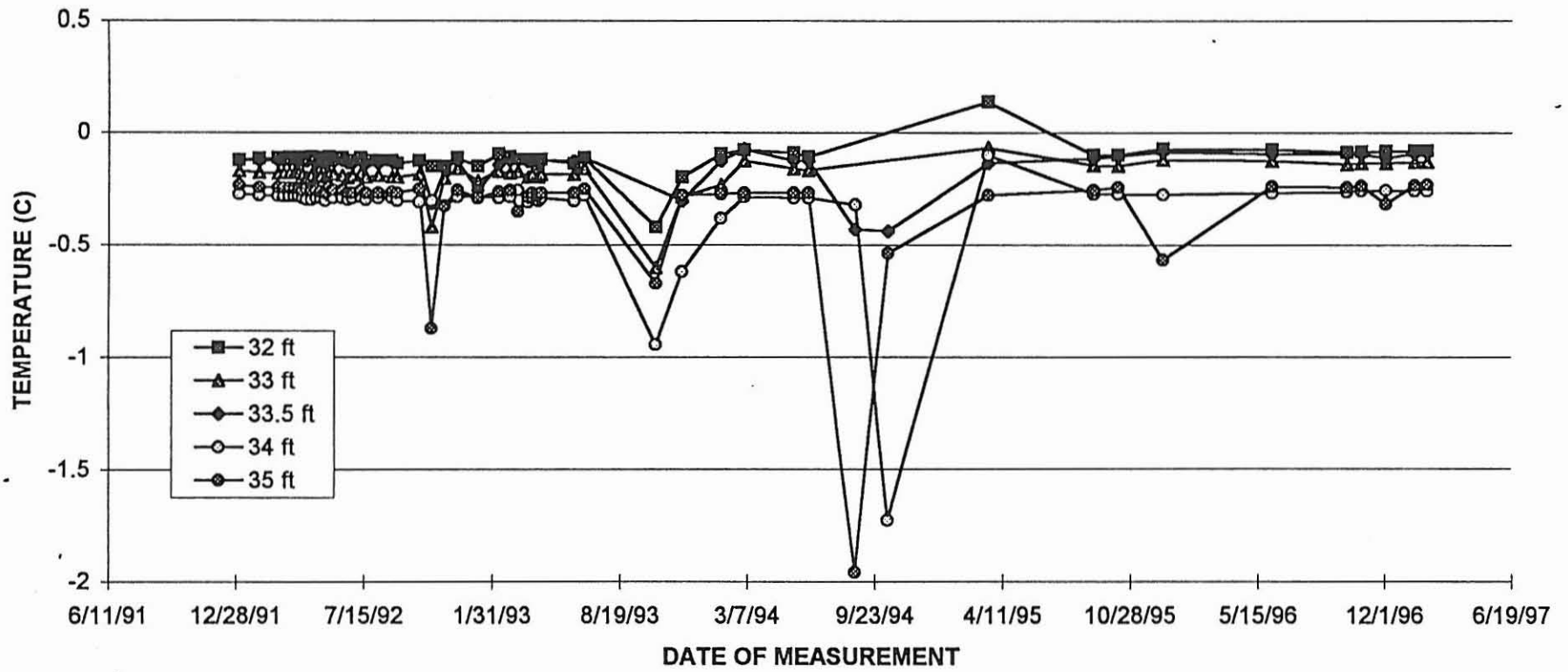


FIGURE C-16

### GRENAC CHART #3D

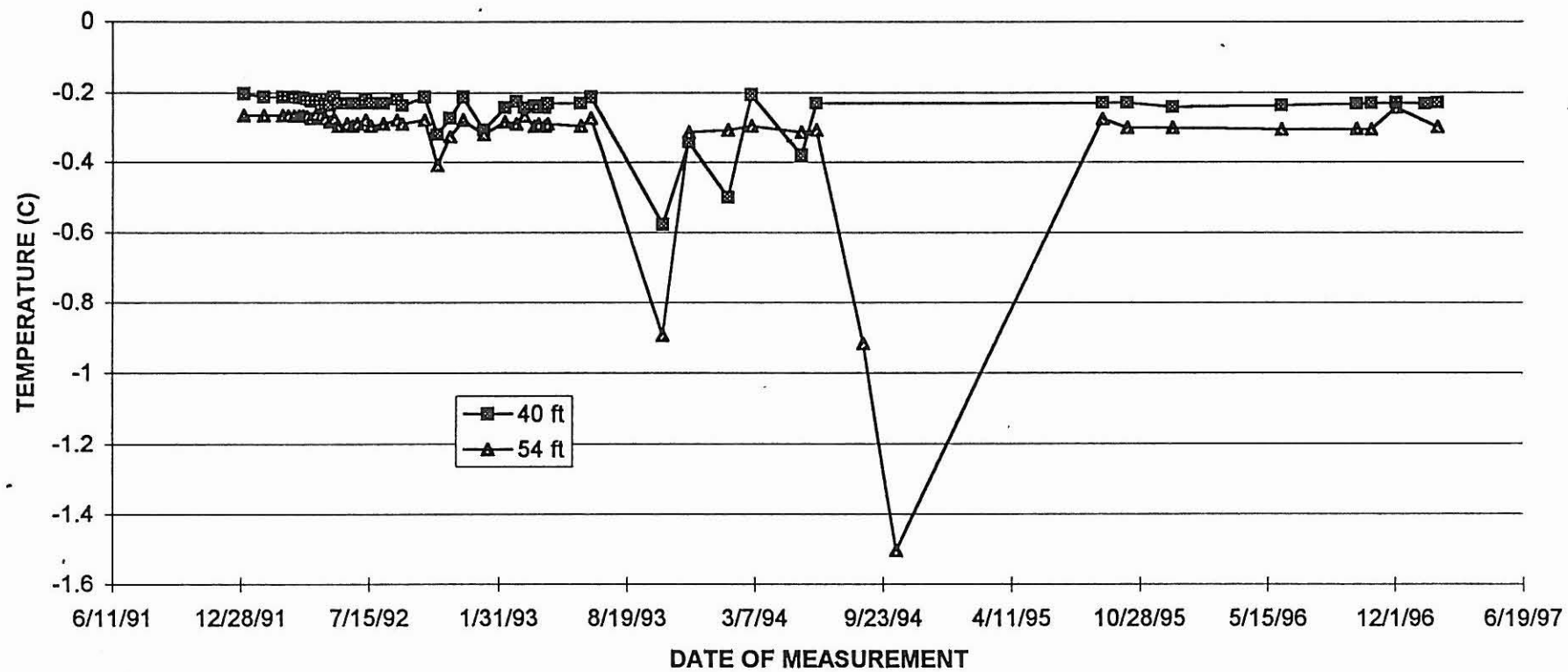


FIGURE C-17

GRENAC CHART #4S

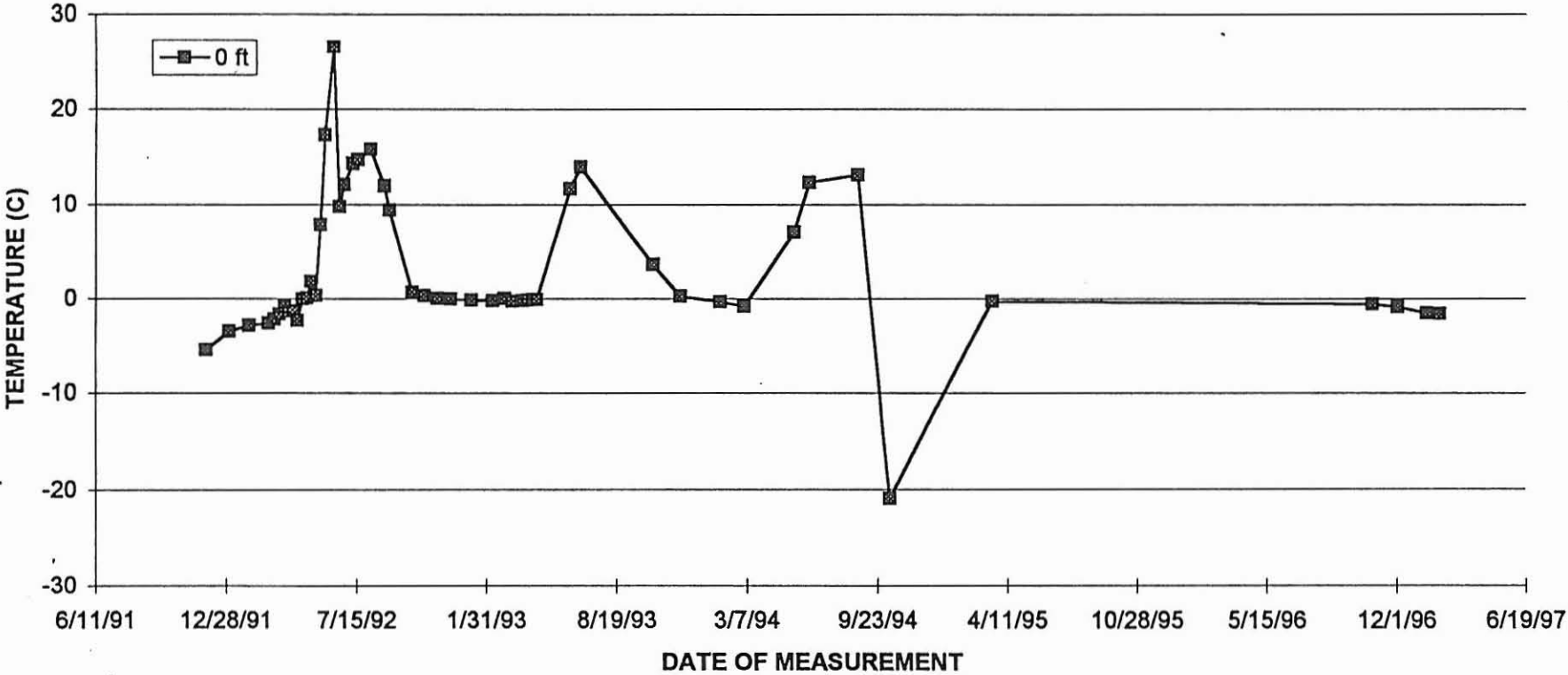


FIGURE C-18

### GRENAC CHART #4A

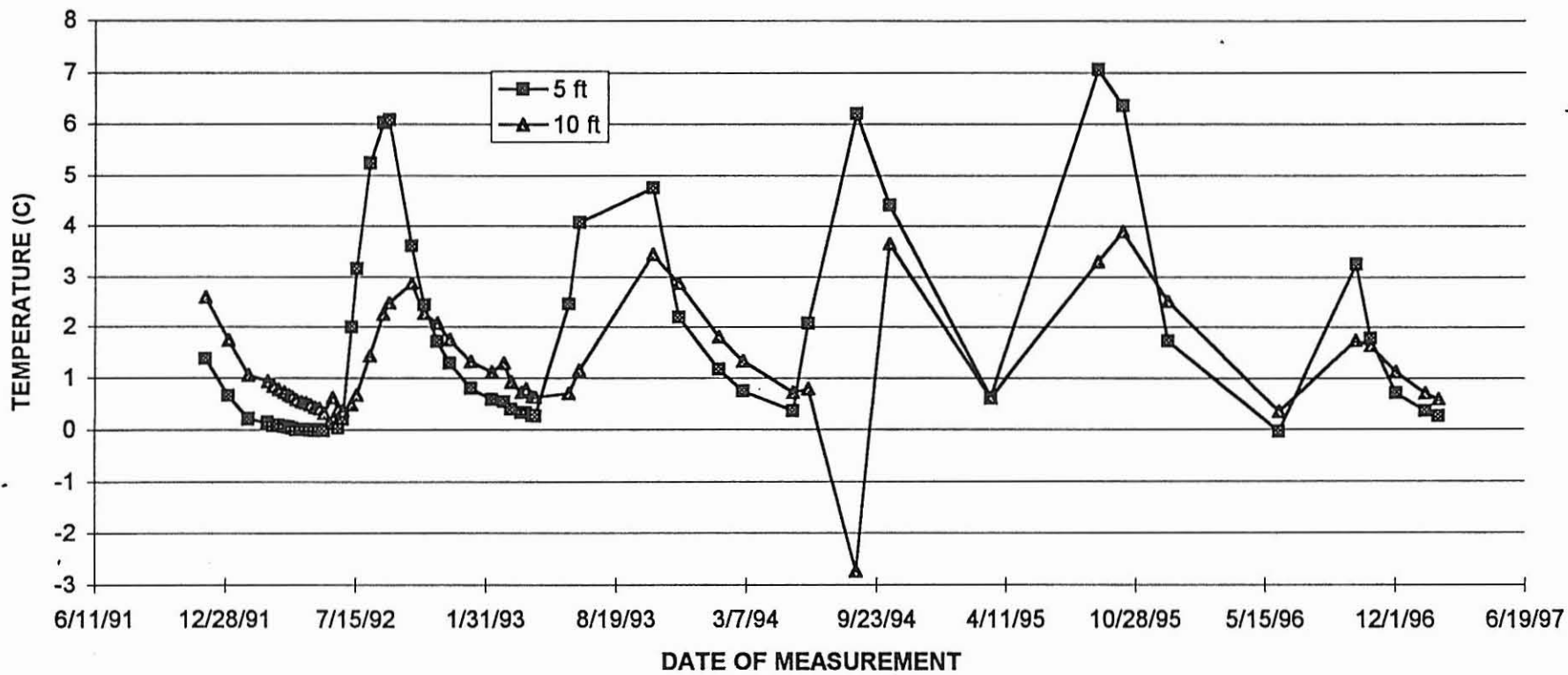


FIGURE C-19

### GRENAC CHART #4B

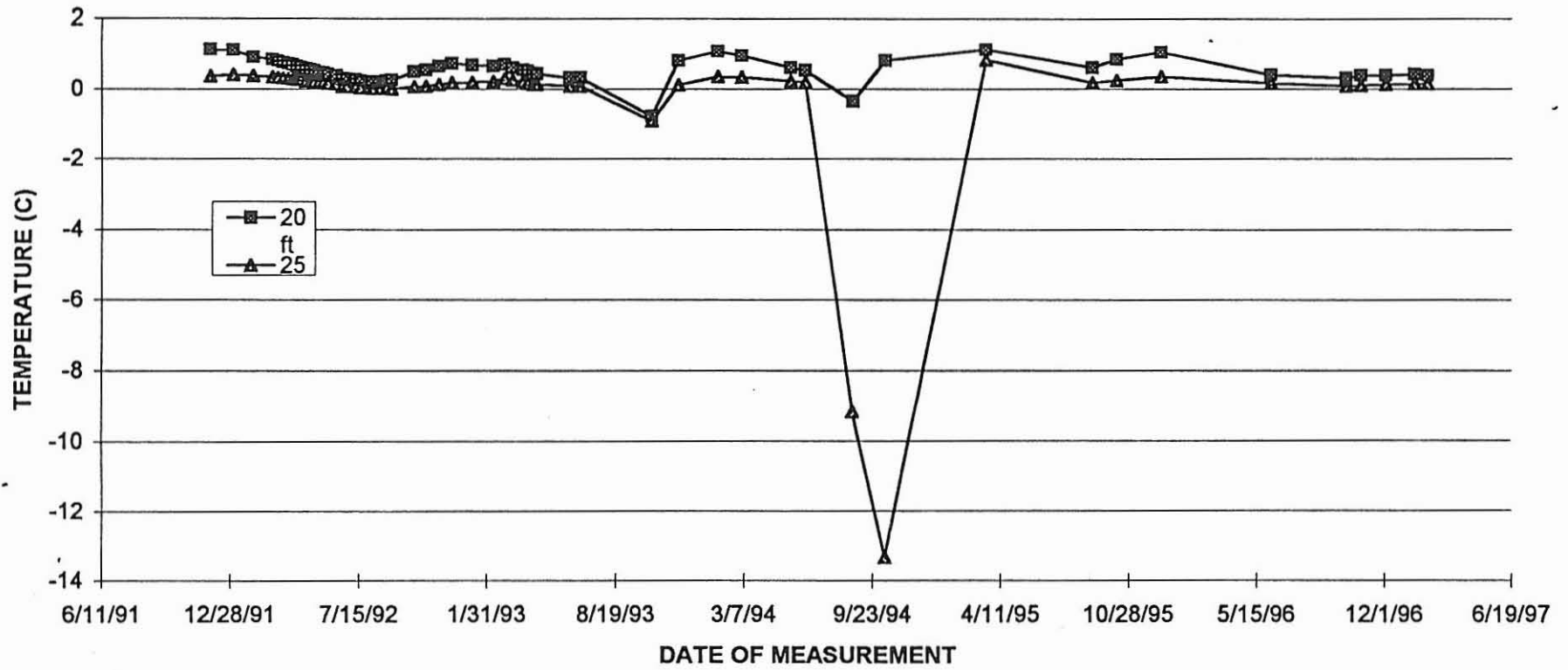


FIGURE C-20

### GRENAC CHART #4C

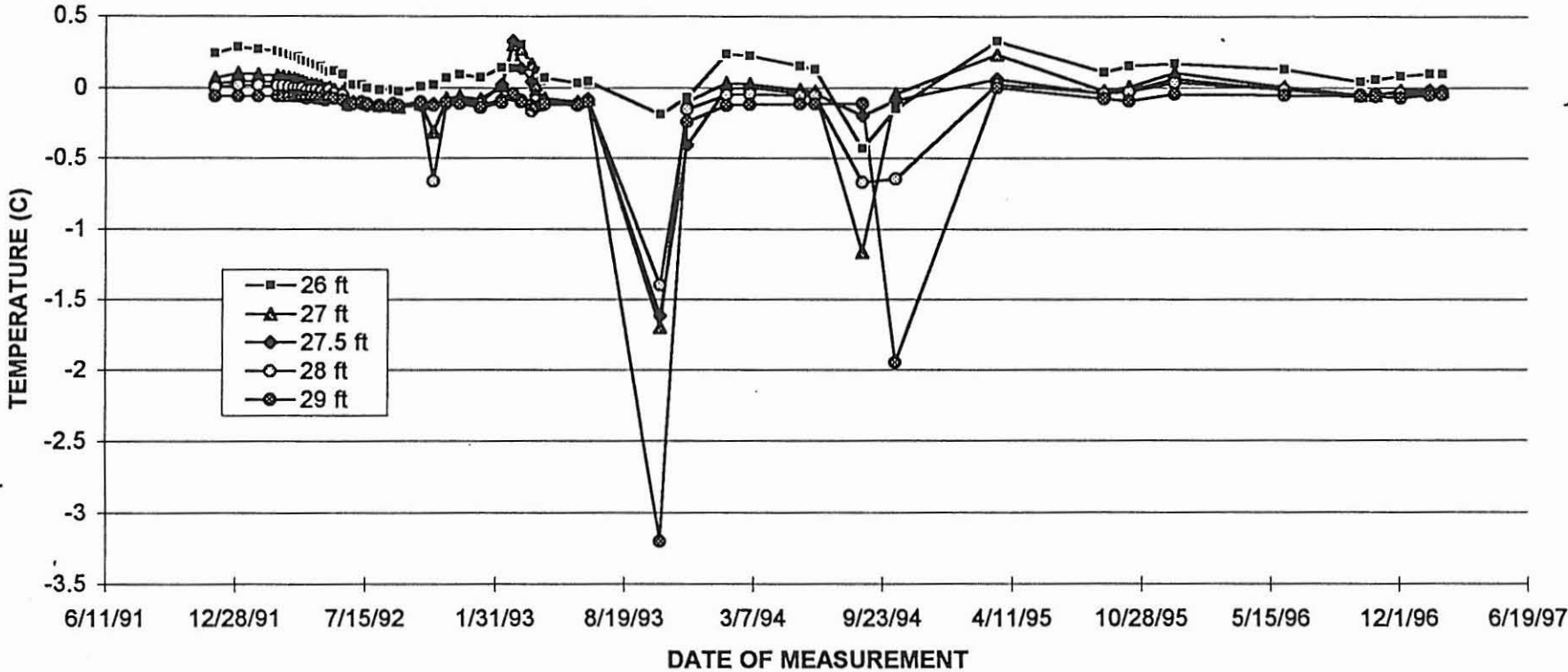


FIGURE C-21



### GRENAC CHART #4D

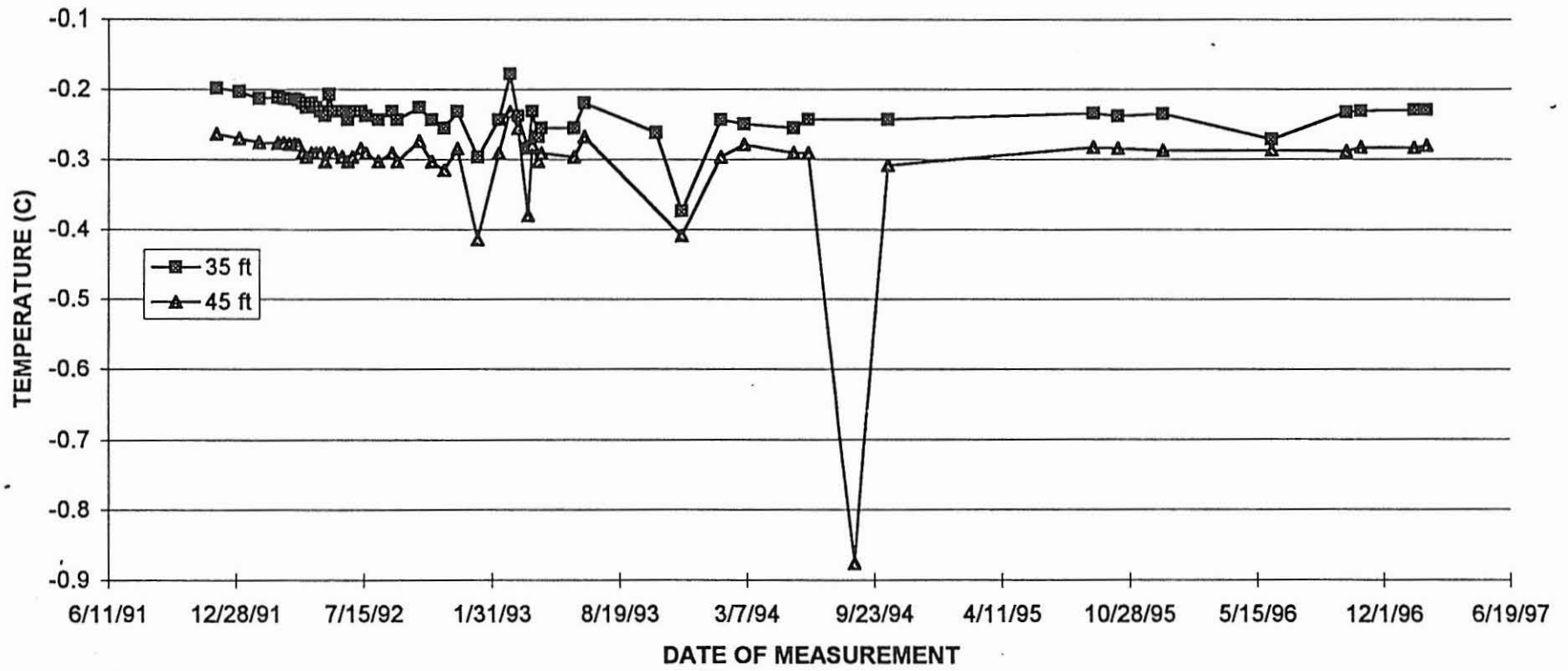


FIGURE C-22

### GRENAC CHART #5S

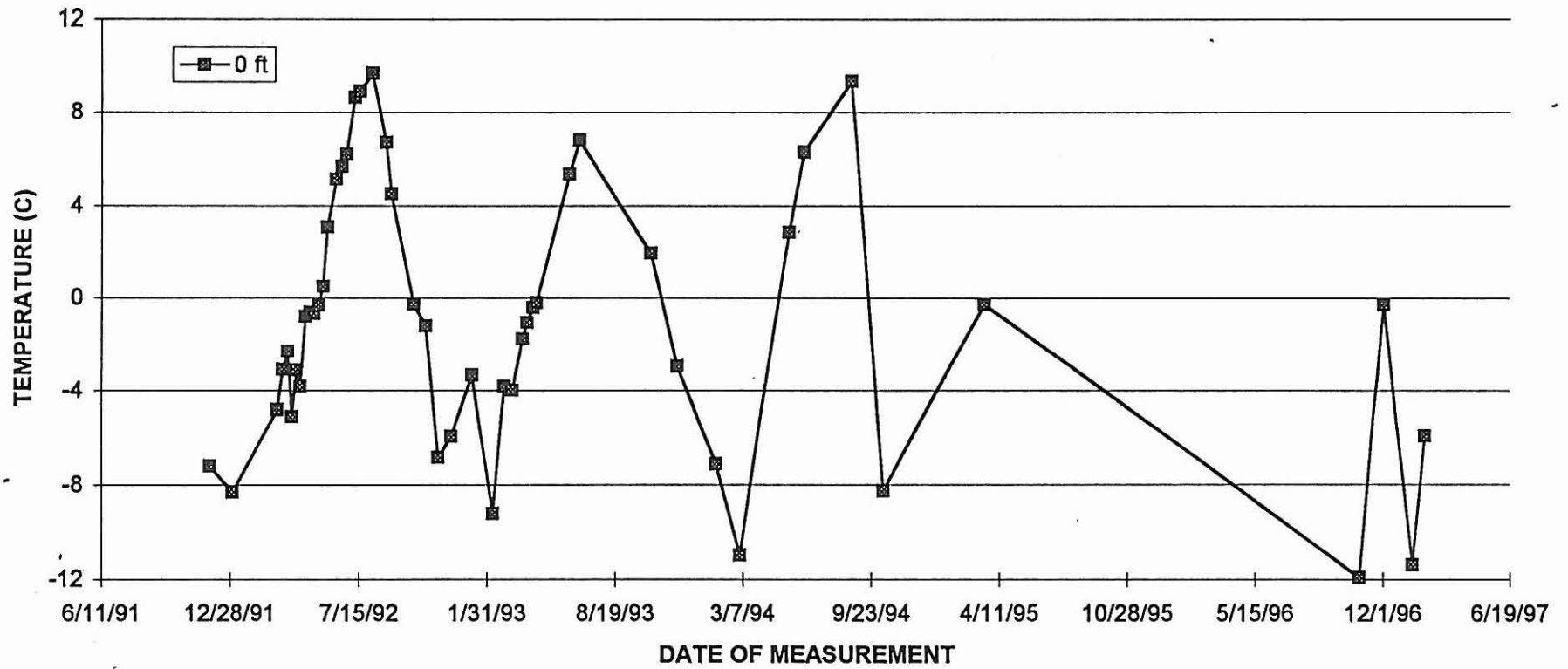


FIGURE C-23

GRENAC CHART #5A

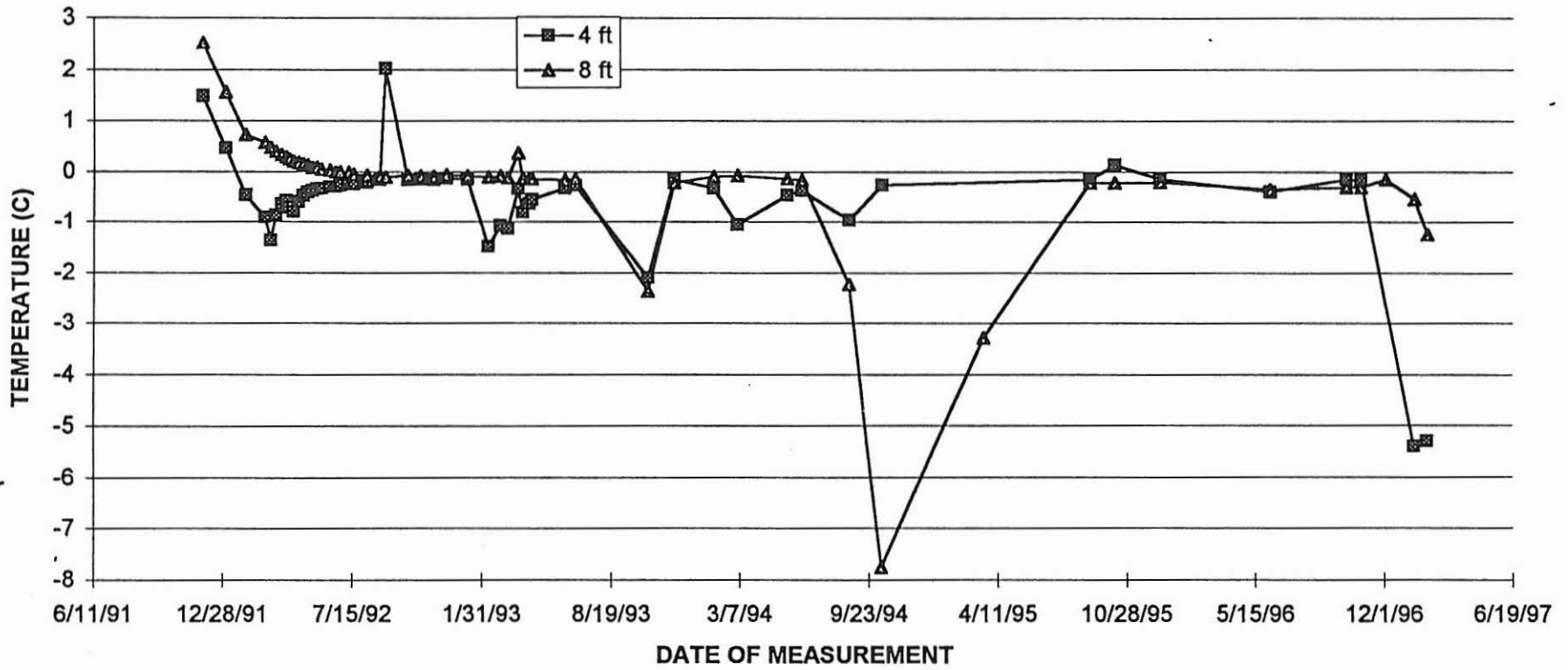


FIGURE C-24

GRENAC CHART #5B

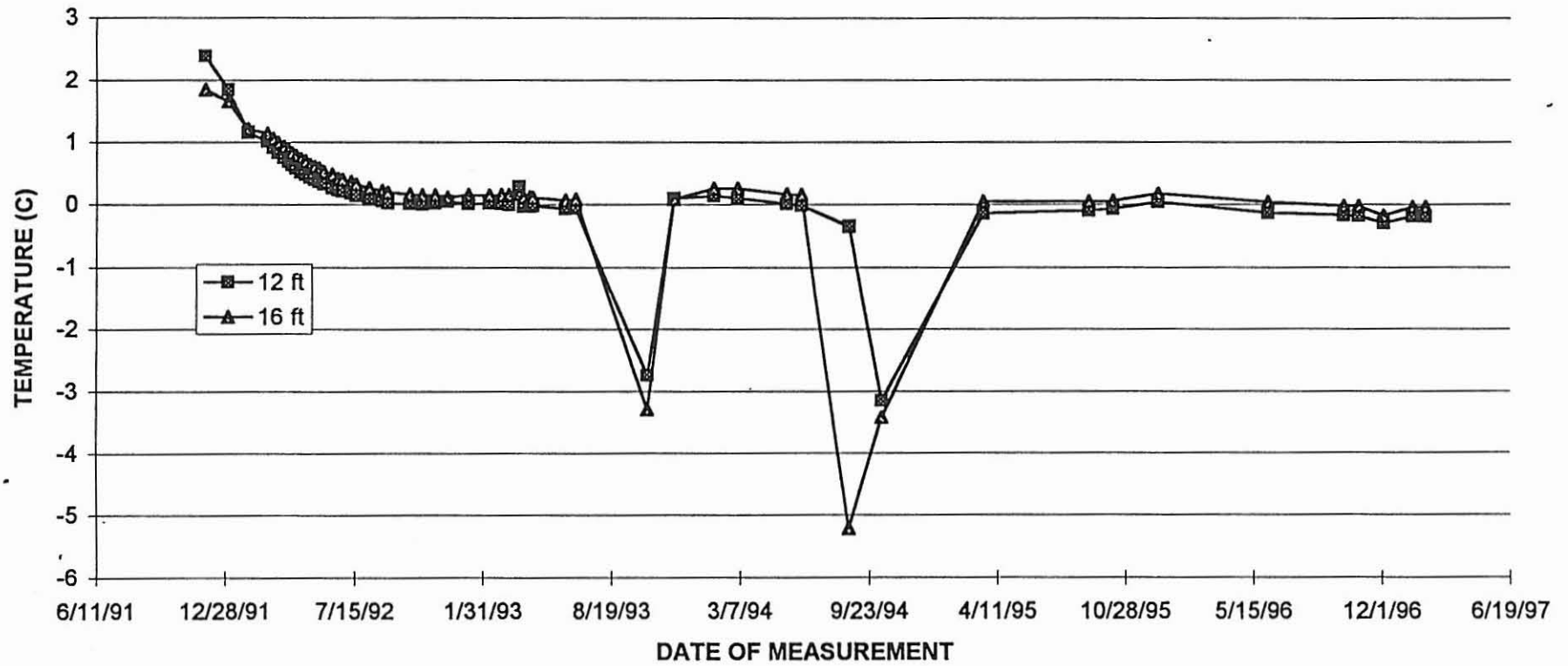


FIGURE C-25

### GRENAC CHART #5C

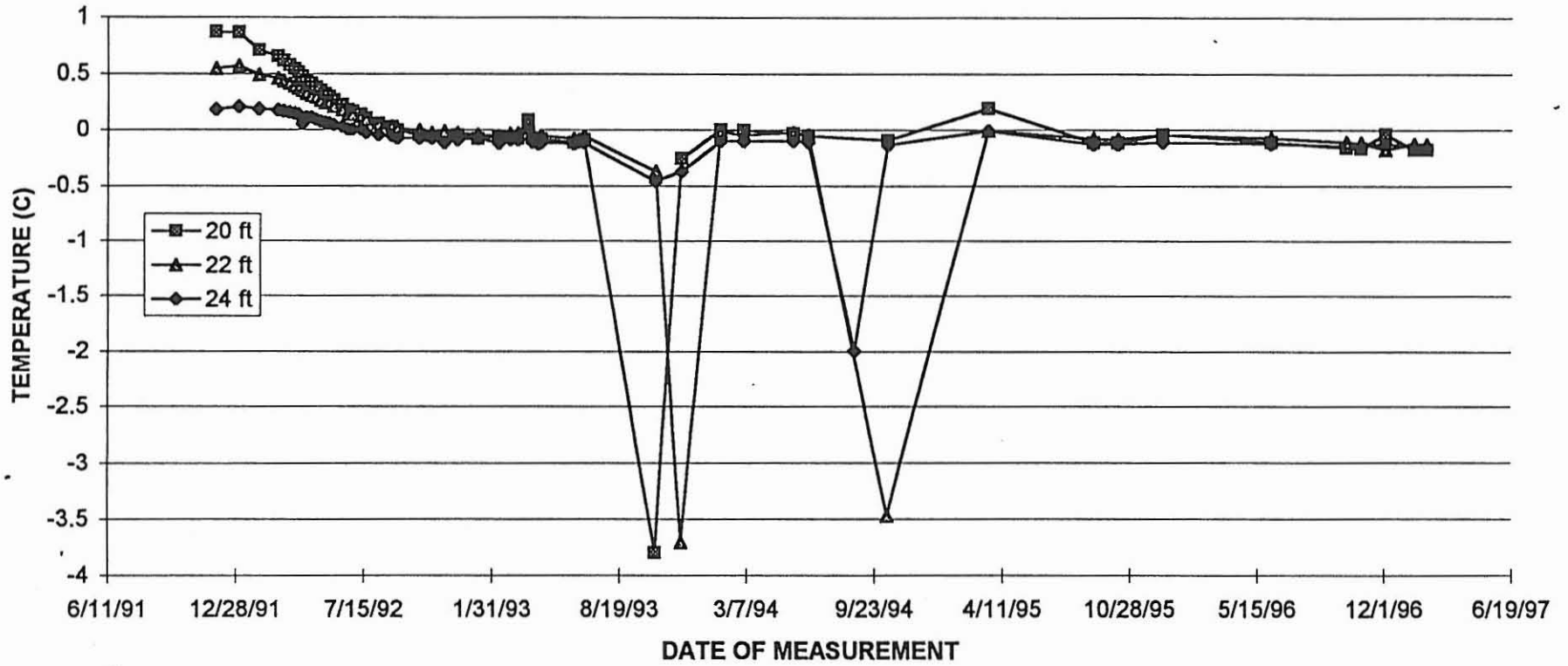


FIGURE C-26

### GRENAC CHART #5D

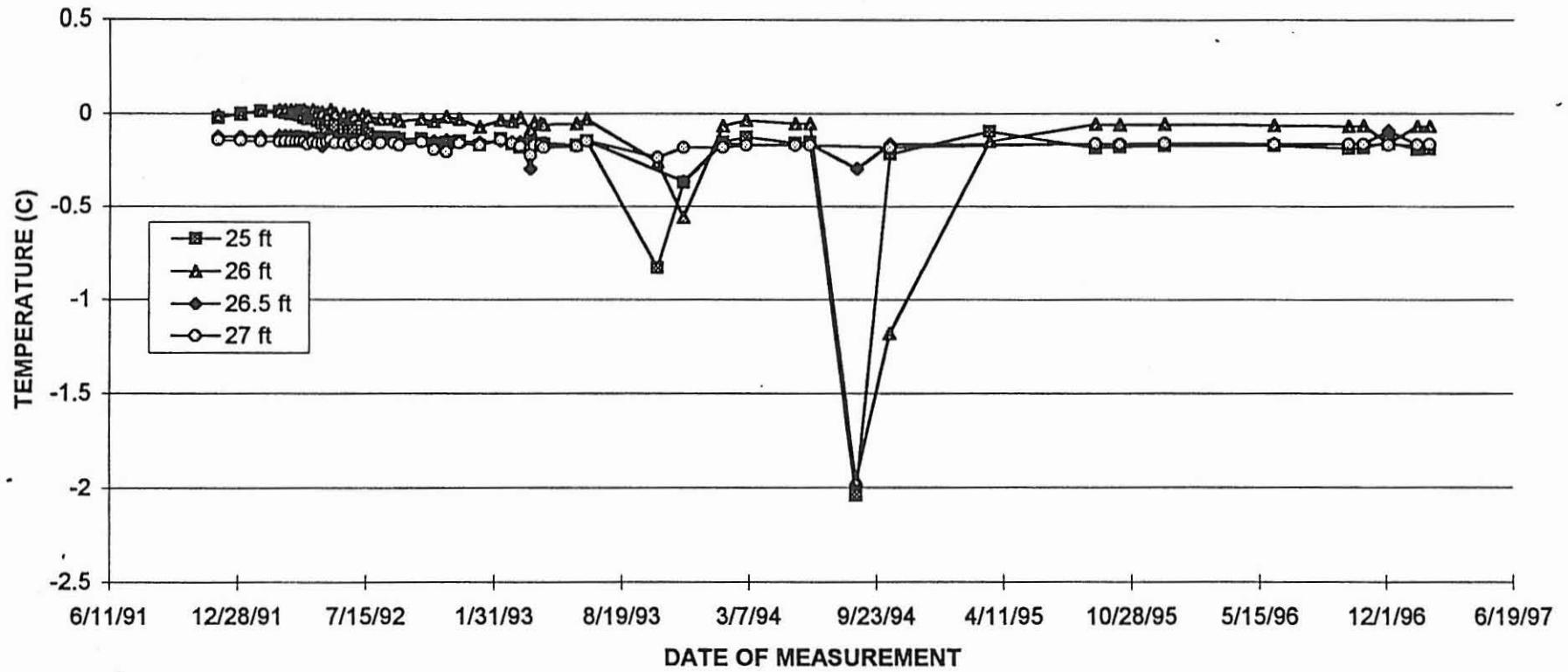


FIGURE C-27

GRENAC CHART #6S

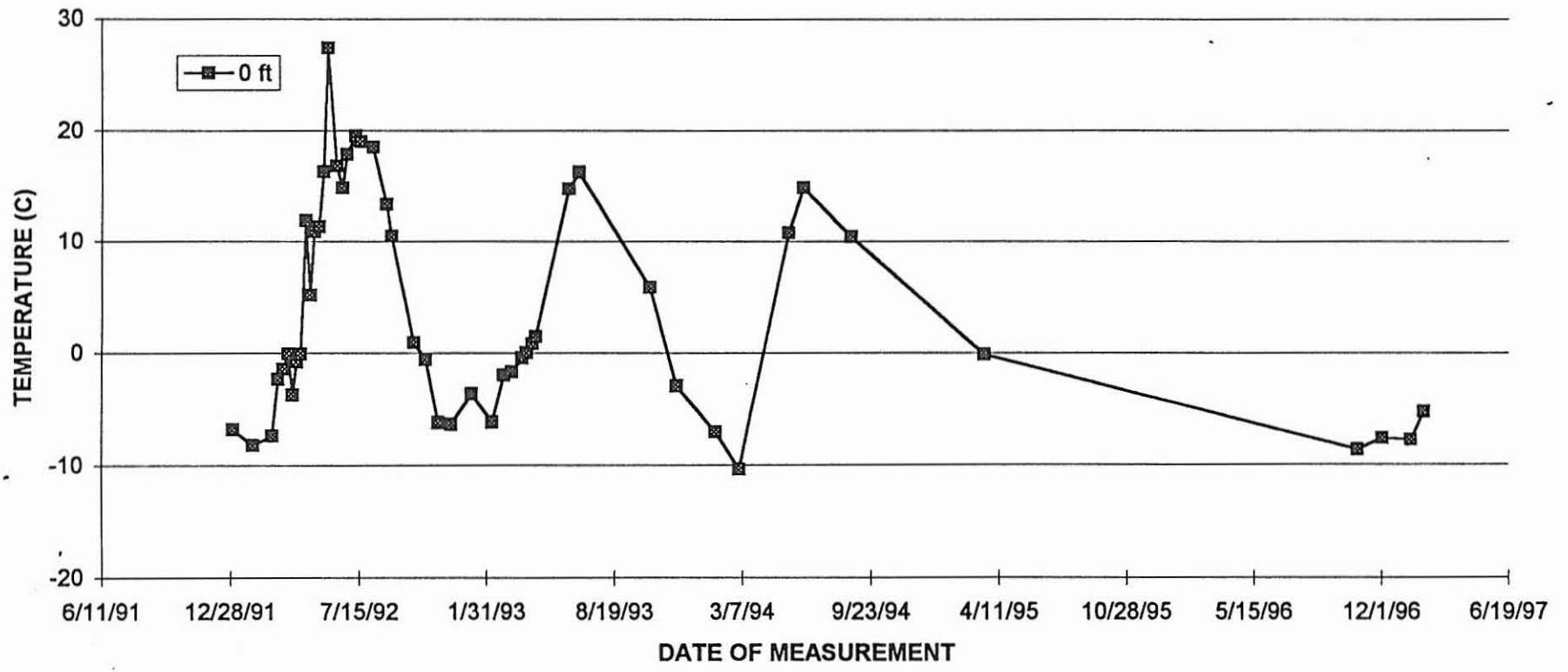


FIGURE C-28

GRENAC CHART #6A

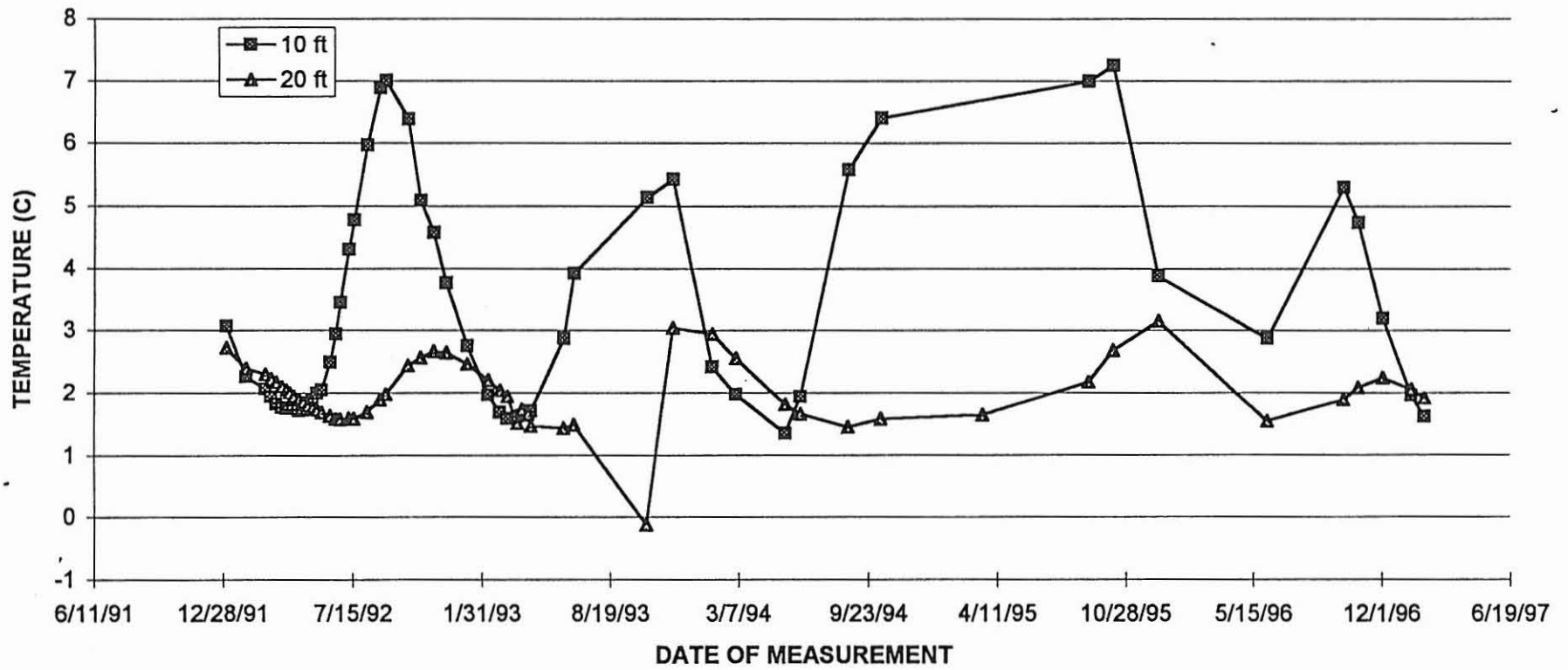


FIGURE C-29



GRENAC CHART #6B

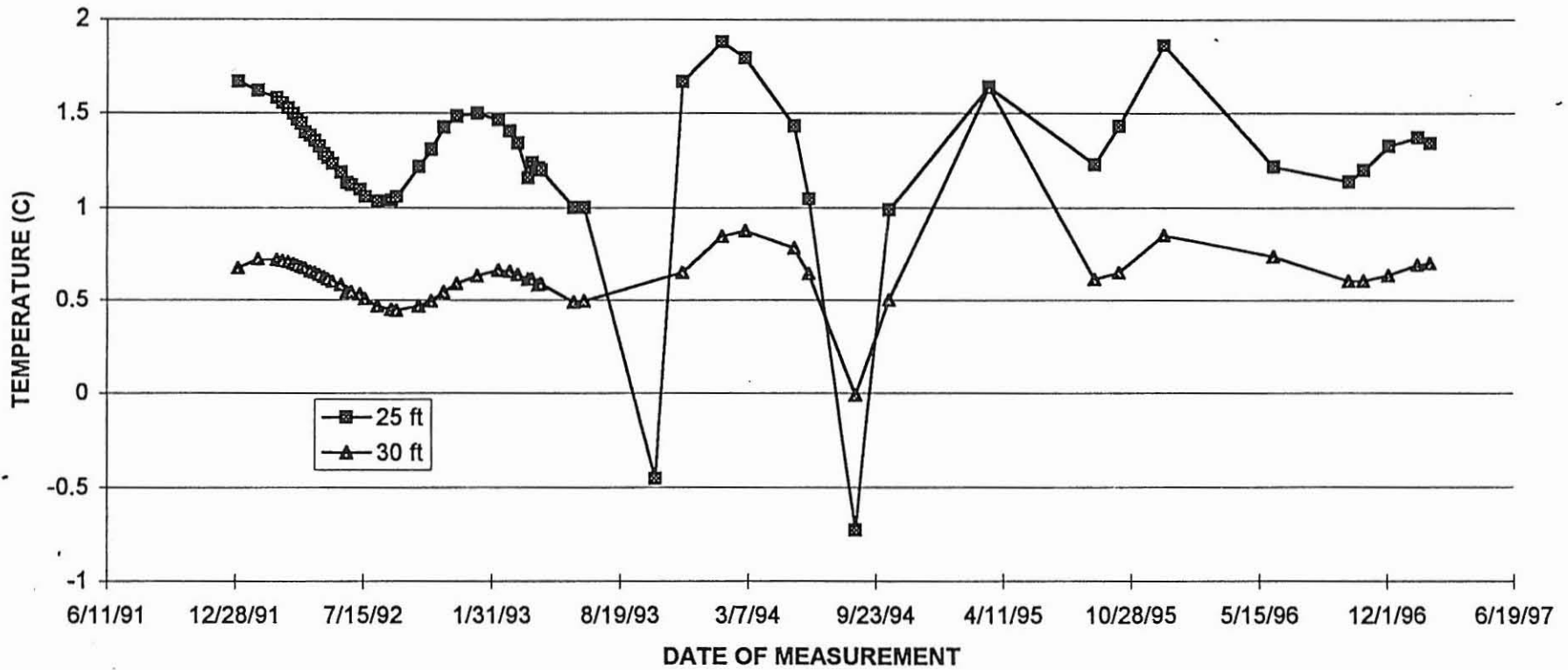


FIGURE C-30

### GRENAC CHART #6C

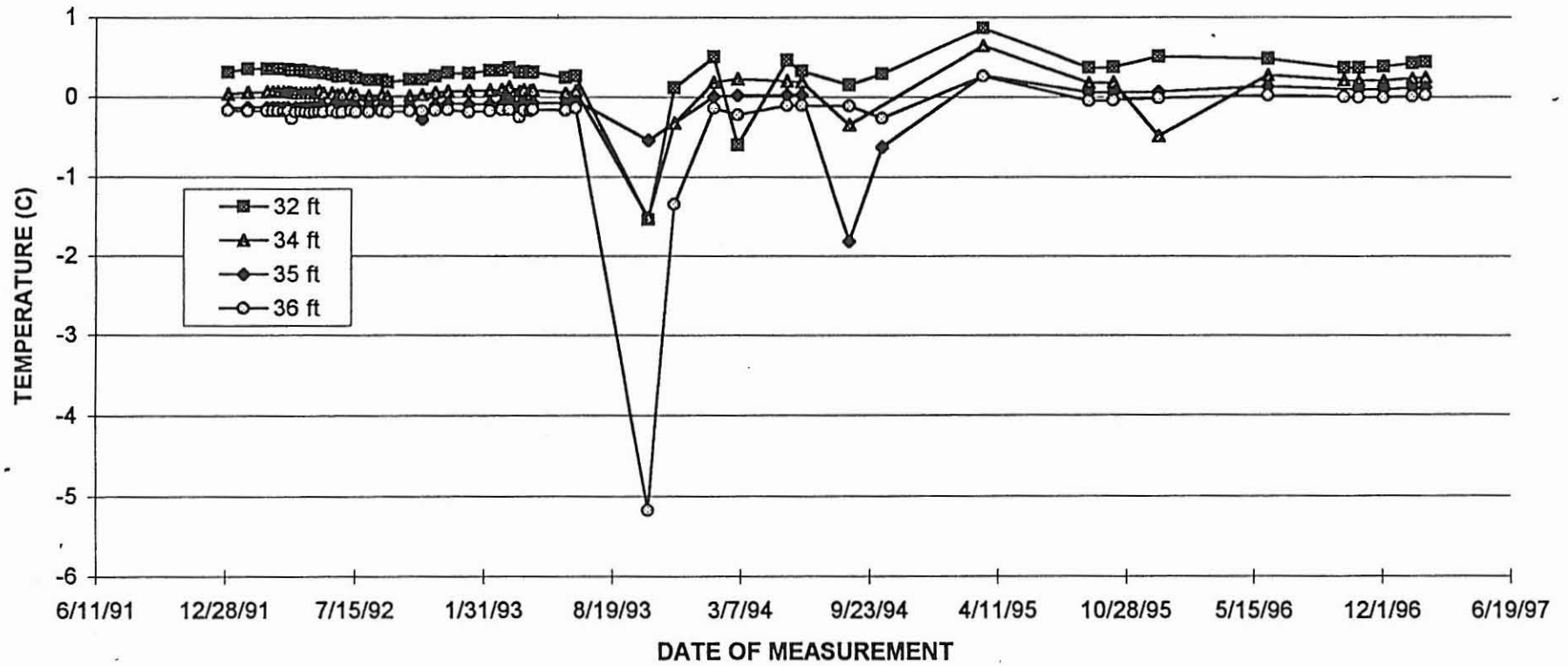


FIGURE C-31

### GRENAC CHART #6D

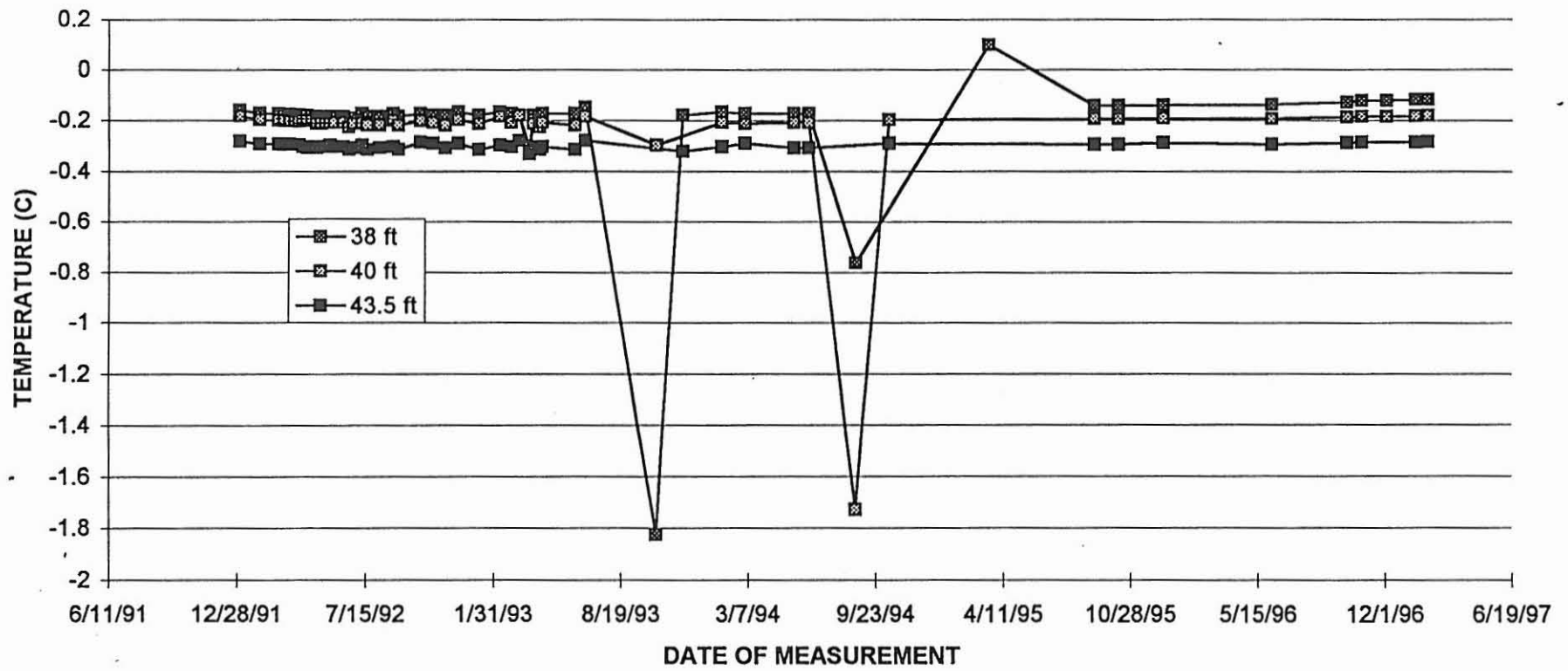


FIGURE C-32

