SUMMARY REPORT
JULY 1982
ANNUAL MEETING SFWMD/FPL
GROUND WATER MONITORING PROGRAM
TURKEY POINT, FLORIDA
FLORIDA POWER & LIGHT COMPANY

JOB NO.: 04598-047-26
DATE: JULY 27, 1982

Dames & Moore
BOCA RATON, FLORIDA

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SUMMARY REPORT

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ANNUAL MEETING SFWMD/FPL

GROUND WATER MONITORING PROGRAM

TURKEY POINT, FLORIDA

FLORIDA POWER & LIGHT COMPANY

1.0 INTRODUCTION

This report, the third in the annual format discussed at our meeting in July 1979, presents the results of the Ground Water Monitoring and the Interceptor Ditch Programs required in compliance with the February 2, 1972 legal agreement between Florida Power & Light (FP&L), and the South Florida Water Management District (SFWMD). Specifically, this report addresses the data collected between July 1981 and June 1982 in relative perspective with historical data which are available from April 1972.

The annual report series was preceded by a series of seven semi-annual reports, issued alternately in January and July, beginning in July 1976. The semi-annual report series was preceded by 17 status reports which were issued quarterly (January, April, July and October).

In addition to the quarterly and more recent semi-annual reports, a summary report was submitted in March 1976 dealing with the G-Series wells used in the monitoring program. This summary report dealt with the initial four years of monitoring data.

The Ground Water Monitoring Program consists of periodic monitoring of the ground water level, temperature and conductivity in 24 wells. The

locations of these wells are shown on Figures 1 and 2. A description of the monitoring program, technique, logistics, and equipment is contained in Appendix E.

2.0 DATA REVIEW

RAINFALL

The rainfall for the past 12 month monitoring period exhibits a trend more in line with the historical wet season/dry season pattern typical to the site area prior to the 1979-1980 monitoring period and shows a marked improvement over the drought condition present during the 1980-1981 monitoring period (See Figure 3). The total precipitation recorded during the 1981-1982 monitoring period (57.27 inches at Structure 20 and 53.00 inches at Structure 20F) is more than twice that recorded during the 1980-1981 monitoring period (18.06 inches at Structure 20 and 27.90 inches at Structure 20F).

The peak rainfall for the wet season occurred in September 1981 (14.87 inches at Structure 20 and 12.26 inches at Structure 20F). It should be noted that these levels are the highest recorded during the entire history of the monitoring program. The preceding month of August 1981 also displayed levels of rainfall higher than those recorded during past monitoring periods (13.43 inches at Structure 20 and 12.02 inches at Structure 20F). The 1981-1982 monitoring period marked the return of the typical May/September wet season.

The dry season for the past 12 month monitoring period began in October 1981, October being the typical start of the dry season, with a marked reduction in levels of recorded rainfall (4.06 inches at Structure 20 and 3.25 inches at Structure 20F). January 1982 displayed the lowest levels of recorded rainfall for the current monitoring period with 0.20 inches being recorded at both stations. The average monthly, rainfall

recorded during the dry season months of October 1981 through March 1982 was 1.51 inches at Structure 20 and 1.80 inches at Structure 20F. The range of levels displayed at both stations during the past dry season period (3.27 inches at Structure 20F in November 1981 and 0.20 inches at both Structures 20 and 20F in January 1982) are typical of the reduced levels of rainfall recorded during recent dry season periods. The absence of an annually recurring historical rainfall pattern has become common in recent years and is taken into consideration when evaluating the system.

SURFACE WATER LEVELS

Surface water levels in the Levee 31 Borrow Canal and Canal 32 along pumping line C displayed increased seasonal fluctuation as well as the highest stage readings recorded in the history of the monitoring program during the past 12 month period (Figure 4). Both the increased fluctuation and the record high water levels can be directly attributed to the record levels of rainfall recorded during the wet season months of August and September 1981. There was also an increase in the maximum difference in water levels recorded in the the Levee 31 Borrow Canal during the 1981-1982 monitoring period over those recorded during the 1980-1981 monitoring period (2.02 feet and 1.47 feet, respectively).

Following the record high water levels recorded during August and September 1981, the observed water levels began a slow downward trend in October 1981, continuing until January 1982. The average head difference between the Levee 31 Borrow Canal and Canal 32 maintained during this period was 0.58 ft. The level of the Levee 31 Borrow Canal dropped below that of Canal 32 during the month of January 1982 until February 16, 1982

when the level rose 0.5 ft. in response to rainfall. The level of the Levee 31 Borrow Canal began a downward trend mid February and fell below the level of Canal 32 again near the end of March 1982. It should be noted that the lowest observed water level for the current monitoring period in the Levee 31 Borrow Canal occurred at this time (0.80 ft MSL). These low water levels correspond with the heaviest pumping of the Interceptor Ditch, from December 1981 through April 1982.

The water levels in both the Levee 31 Borrow Canal and Canal 32 began to trend upward in April 1982 in response to the onset of the wet season rainfall. This upward trend continued into the month of June 1982. The average head difference maintained during this period was 0.38 feet.

GROUND WATER LEVELS

The ground water levels recorded during the 1981-1982 monitoring period have generally exhibited a cessation of the downward trend which was typical of the 1980-1981 monitoring period and display a "leveling off" and, in some cases, a slight upward trend (Figure 4). These changes in the ground water level pattern can be attributed to the increase in rainfall for the 1981-1982 monitoring period over that for the 1980-1981 monitoring period.

The maximum ground water levels recorded during the past 12-month monitoring period occurred during the October 1981 monitoring period in response to the record high levels of rainfall recorded in August and September 1981.

The high range of ground water levels is represented by Wells G-14 and G-21 with ground water elevations of 3.15 ft MSL and 3.15 ft MSL,

respectively. These ground water levels are the highest recorded in these two wells during the history of the monitoring program. It should also be noted that in addition to wells G-14 and G-21, eight other wells also displayed record high ground water levels during the October 1981 monitoring period. These wells are ID-B, 3.07 ft MSL; ID-D, 3.01 ft MSL; L-1, 2.39 ft MSL; L-2, 2.82 ft MSL; L-3, 3.07 ft MSL; L-4, 2.14 ft MSL; L-5, 2.86 ft MSL, and; L-6, 2.78 ft MSL.

The low ground water levels recorded over the past 12-month monitoring period occurred, for the most part, in February 1982. These levels occurred in wells L-2, 0.30 ft MSL in April 1982 and L-3, 0.10 ft MSL in January 1982. It should be noted that well L-3 also displayed the maximum fluctuation in ground water levels over the past 12-month monitoring period, 2.97 feet. The minimum fluctuation was recorded in well G-6, 0.90 ft.

Historically, the maximum range throughout the system has been two feet. This range has been exceeded during the past 12-month monitoring period in the wells located adjacent to the Interceptor Ditch and the Levee 31 Borrow Canal.

GROUND WATER TEMPERATURES

The range of ground water temperatures for the 1981-1982 monitoring period is presented on Figures 5 through 12. This range is shown in relation to the historical envelope of temperatures for indicator wells L-2, L-3, L-5, G-6, G-14, G-27, G-28 and G-35. This envelope is composed of all historical data for two months considered to be a representative of wet season and dry season months, typically May and November.

The L-series indicator wells displayed temperatures slightly higher than the historical range in the depths above -25 ft MSL. For example, well L-2 displayed ground water temperatures 1.5°C above the envelope at -15 ft MSL. The temperatures at the shallower depths in the L-series wells reflect the temperatures in the L-31 Borrow Canal. The L-series displayed temperatures at the lower depths within the envelope with the exception of well L-5 which displayed temperatures 0.5°C above the envelope at depths below -20 ft MSL.

The ground water temperatures in the G-series wells were generally within the historical envelope with the following exceptions. At the depths above -10 ft MSL, temperatures ranged up to 1°C above the envelopes in wells G-6, G-27 and G-28. These excursions occurred in the three wells most influenced at these depths by the surrounding surface water during a period of record high rainfall. Wells G-14 and G-28 displayed temperatures below the envelope during the November 1981 monitoring period with the maximum deviation of 0.8°C occurring in well G-28 at -35 ft MSL.

Temperature time-history data (Appendix A) shows a "leveling off" of temperatures in the lower depths in the L-, X-, and ID-series wells and in some cases a slight upward trending is indicated. This is in contrast with the continued downward trend observed during the 1980-1981 monitoring period. Temperatures in the upper levels displayed seasonal patterns in line with those recorded in past years. The temperatures in the upper levels also show the effects of the record high rainfalls recorded in August and September 1981. Historical high temperatures were recorded in three wells during these months. The are ID-E, 28.5°C in August 1981; L-2, 28.0°C in September 1981 and G-35, 26.0°C in October 1981. Of these three

wells, L-2 displayed the most extreme departure from the envelope, 4.2°C at -9 ft MSL.

The ground water temperatures in those wells located adjacent to the system displayed low values during the months of December 1981 and January and March 1982. High temperatures were recorded in these wells in May and June 1982. The G-series wells do not appear to reflect the temperatures within the cooling canal system.

GROUND WATER CHLORINITIES

The range of the ground water chlorinities for the past 12-month monitoring period is presented on Figures 13 through 20. These figures show the chlorinity extremes for the period July 1981 through June 1982 as compared to the historical envelope of chlorinities for indicator wells L-2, L-3, L-5, G-6, G-14, G-27, G-28 and G-35. This envelope is composed of all historical data for two months considered to be a representative wet season and dry season month, typically May and November.

The L-series indicator wells displayed chlorinity values both below and above the envelope in August and December 1981. Well L-5 displayed the most radical departure from the envelope at depths below -20 ft MSL in June 1982 with a maximum variance of 2.5 ppt at -34 ft MSL. Well L-2 displayed an excursion above the envelope between -18 ft MSL and -35 ft MSL in August 1981. The maximum variance displayed was 2.9 ppt at -25 ft MSL. Well L-3 displayed levels of chlorinity below the envelope between the depths of -18 ft MSL and -25 ft MSL in December 1981. The maximum variance was 10.9 ppt at -23 ft MSL.

In the G-series wells located to the west of the cooling system, only well G-6 displayed any significant excursions above the envelope. These departures from the range occurred below -40 ft MSL and range in value from 6.4 ppt in November 1981 to 3.6 ppt in January 1982. No other significant excursions were detected in the G-series wells.

The chlorinity Time-History data (Appendix A) generally shows a cessation of the increase in chlorinities in the ID-, L-, and X-series wells as noted during the 1980-1981 monitoring period. This cessation is marked by a gradual downward trend towards the end of the 1981-1982 monitoring period. The chlorinities for the L-series were within the historical range as indicated by the Time-History records in Appendix A. The G-series wells were relatively constant and remained within the historical range.

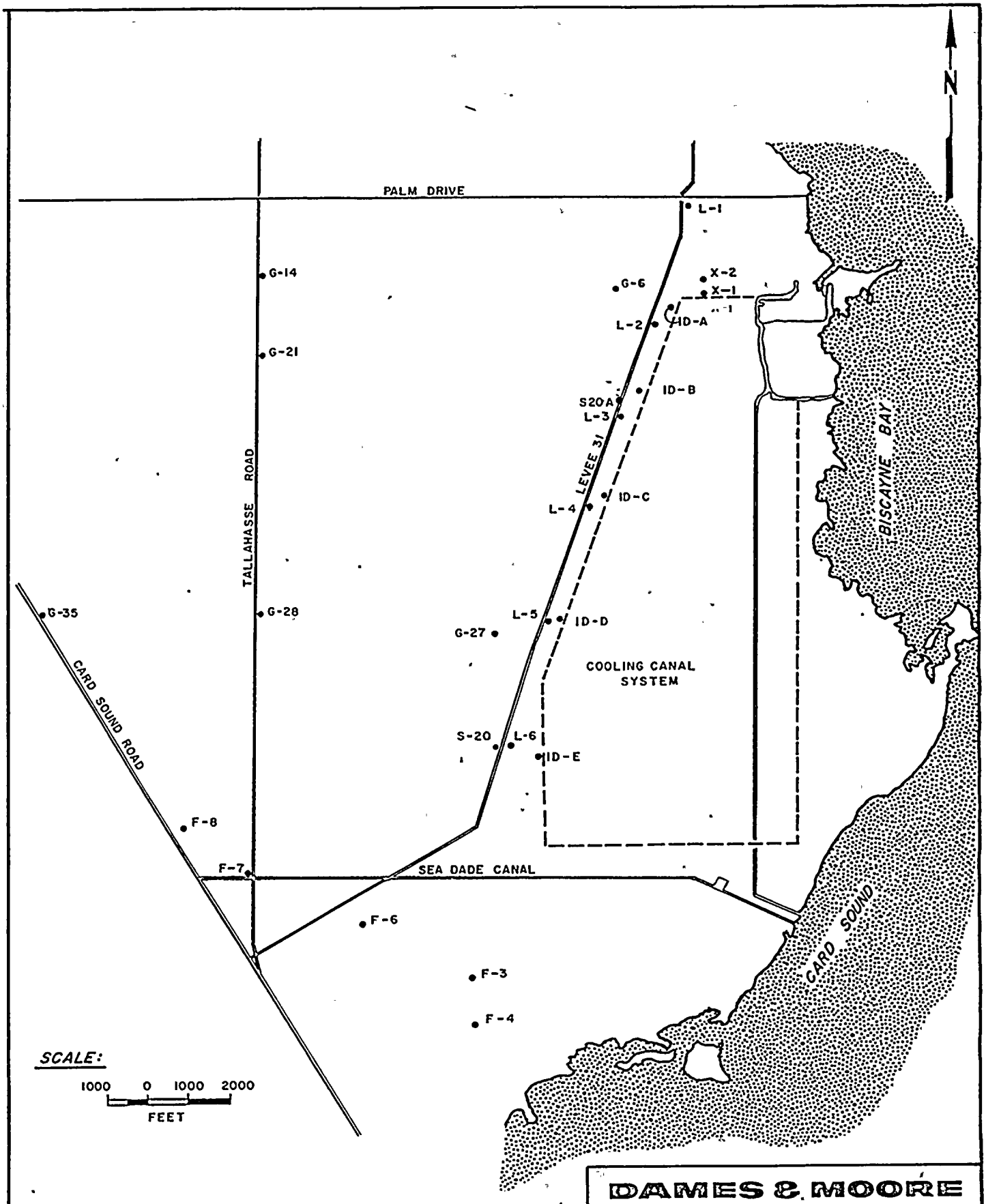
3.0 SUMMARY

During the past 12-month monitoring period, a return to the typical wet/dry season has been observed in the Turkey Point area. This return was marked by record high levels of recorded rainfall during the wet season months of August and September 1981.

Temperatures and chlorinities in the G-series wells, located west of the cooling canal system, displayed values generally within the historical ranges. No short or long-term trends were observed, indicating that the cooling canal system has not influenced the ground water to the west.

In the L-, X-, and ID-series wells temperatures and chlorinities appear to have "stabilized" in the lower levels during the 1981-1982 monitoring period. The upper levels reflect a seasonal fluctuation in line with historical patterns. Record high temperatures were recorded in the upper levels of wells ID-E, L-2 and G-35 in the latter part of 1981. These high temperatures coincide with the record levels of rainfall recorded in August and September 1981.

Ground water levels have risen during the past 12-month monitoring period and directly reflect a more typical historical wet/dry season pattern in the Turkey Point area than has been observed over the past few years. Record high ground water levels were recorded in all L-series wells during the October 1981 monitoring period. These levels directly reflect the increase in the level of the Levee-31 Borrow Canal in response to the heavy rains in August and September 1981.



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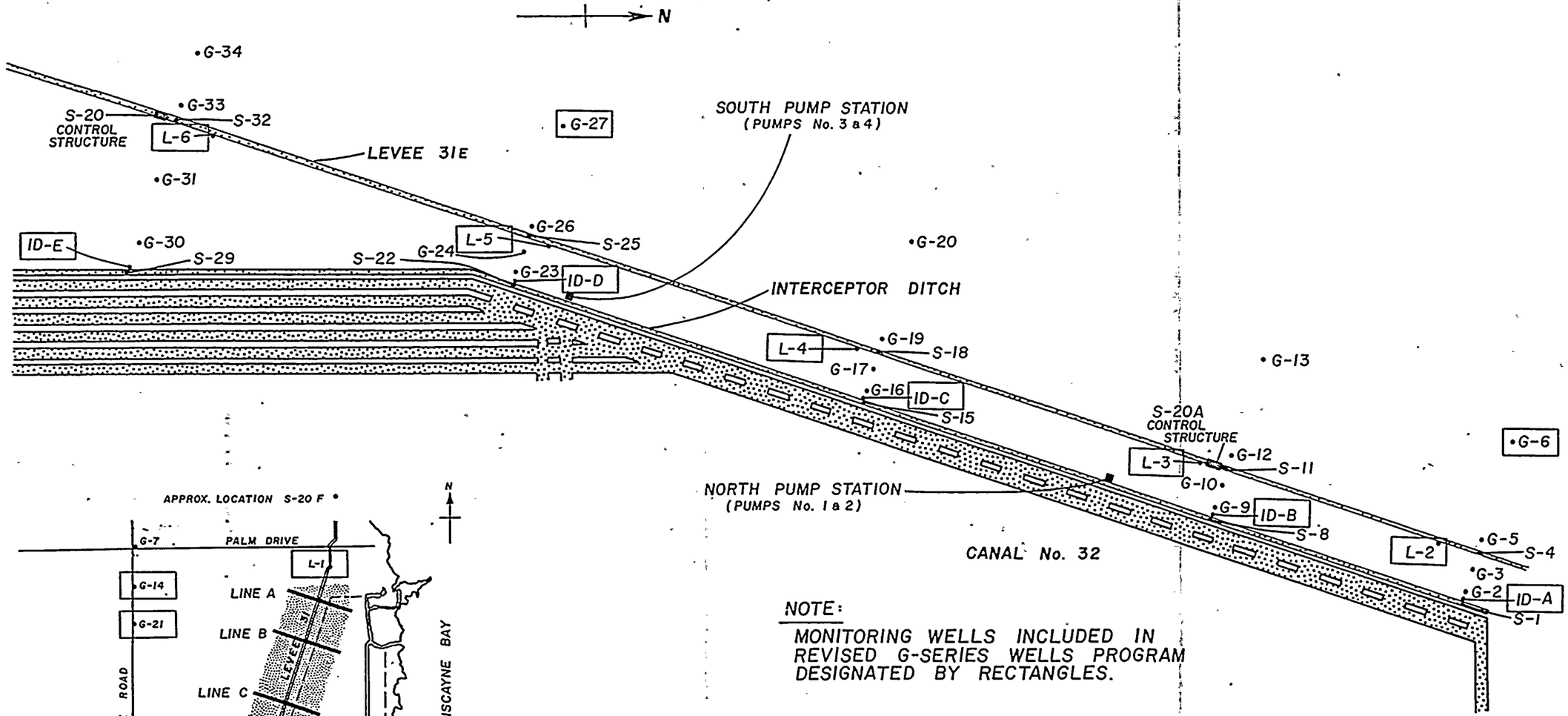
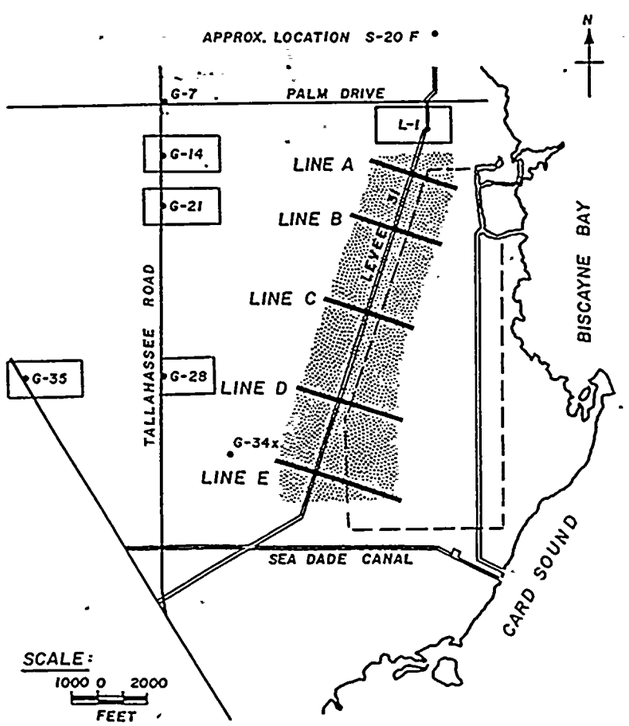
WELL LOCATIONS
CURRENT MONITORING PROGRAM

0459804726(7/80) FIGURE 1





NOTE:

MONITORING WELLS INCLUDED IN REVISED G-SERIES WELLS PROGRAM DESIGNATED BY RECTANGLES.

SCALE

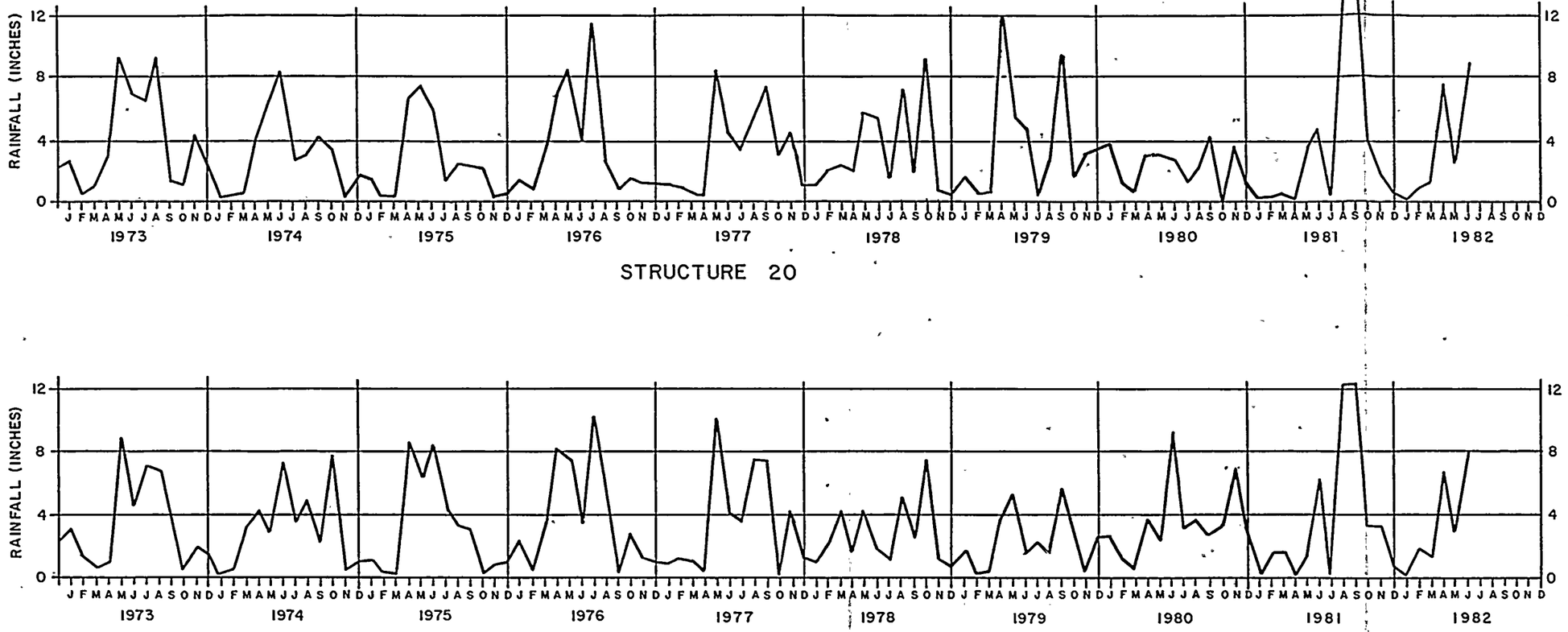
2000' 0 1000'

FEET

DAMES & MOORE

PLOT PLAN

0459804726(1/79) FIGURE 2



STRUCTURE 20

STRUCTURE 20F

SOURCE: SOUTH FLORIDA WATER MANAGEMENT DISTRICT

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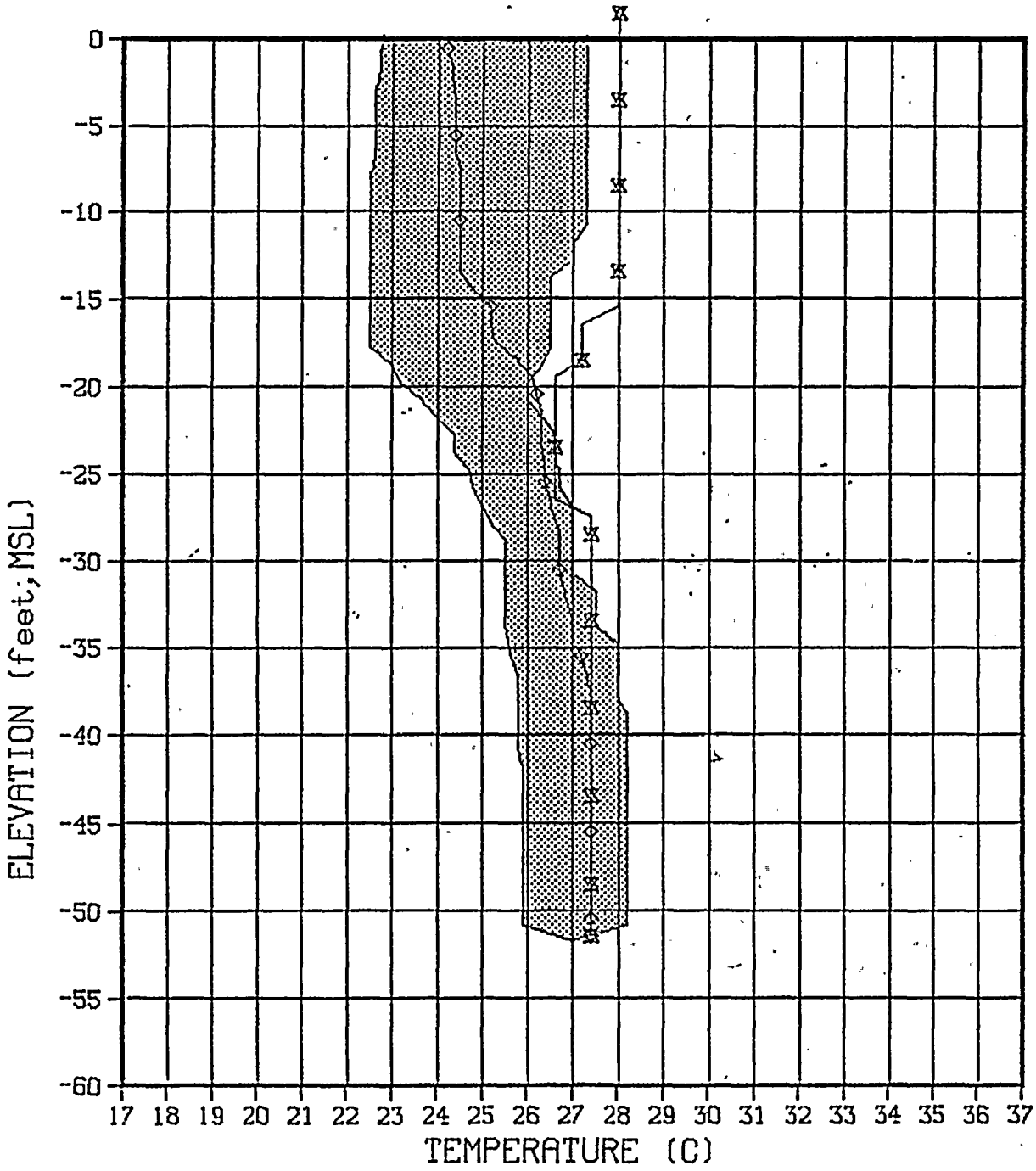
YEARLY RAINFALL
TURKEY POINT, FLORIDA

0459804726 (REV. 7/82) FIGURE 3.



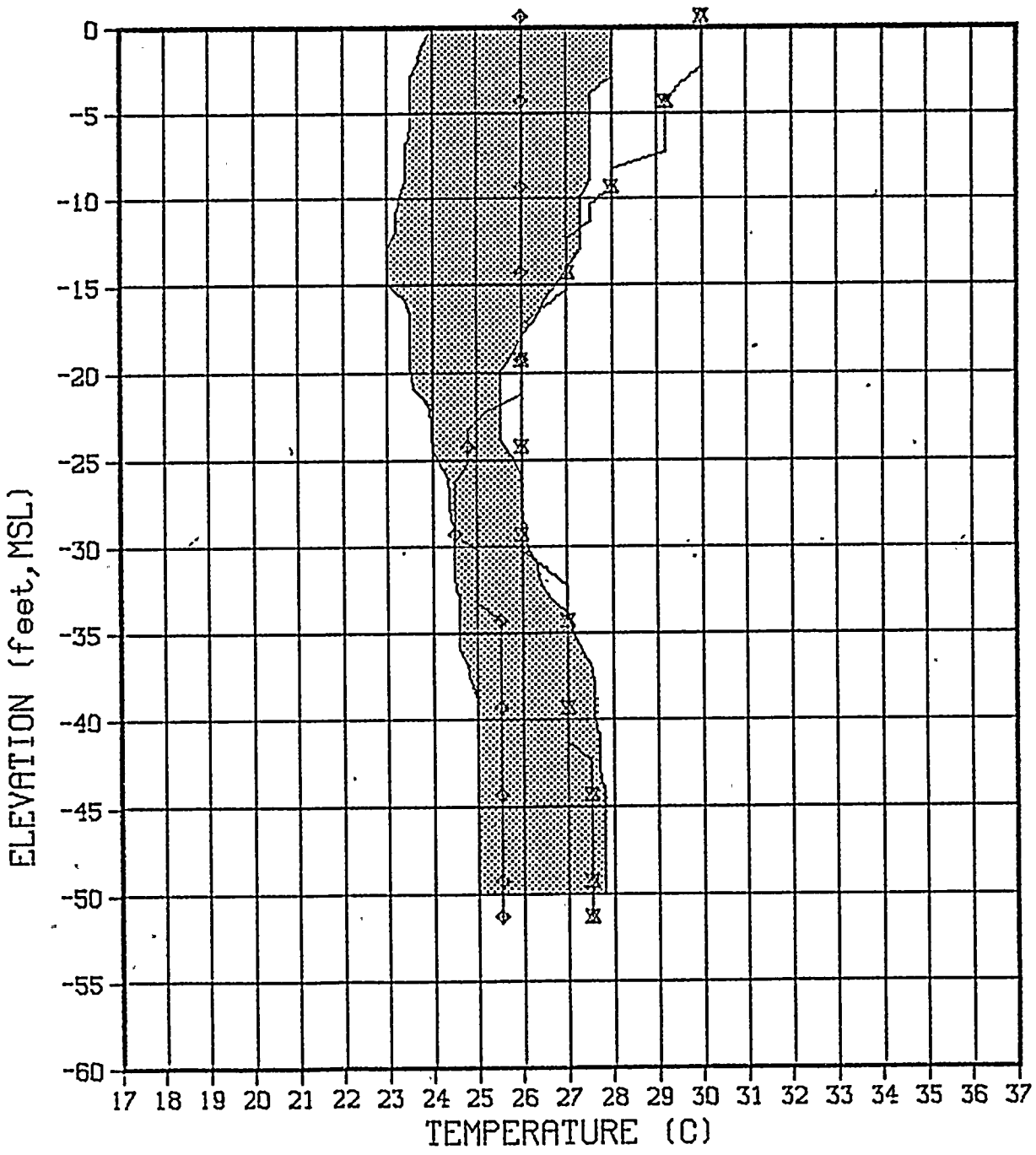
LEGEND

◇ JAN-82 ⧖ SEP-81

DAMES AND MOORE

EXTREMES OF TEMPERATURE
FOR JULY 81 - JUNE 82
WELL NUMBER L-2

0459804726 (7/82) FIGURE 5



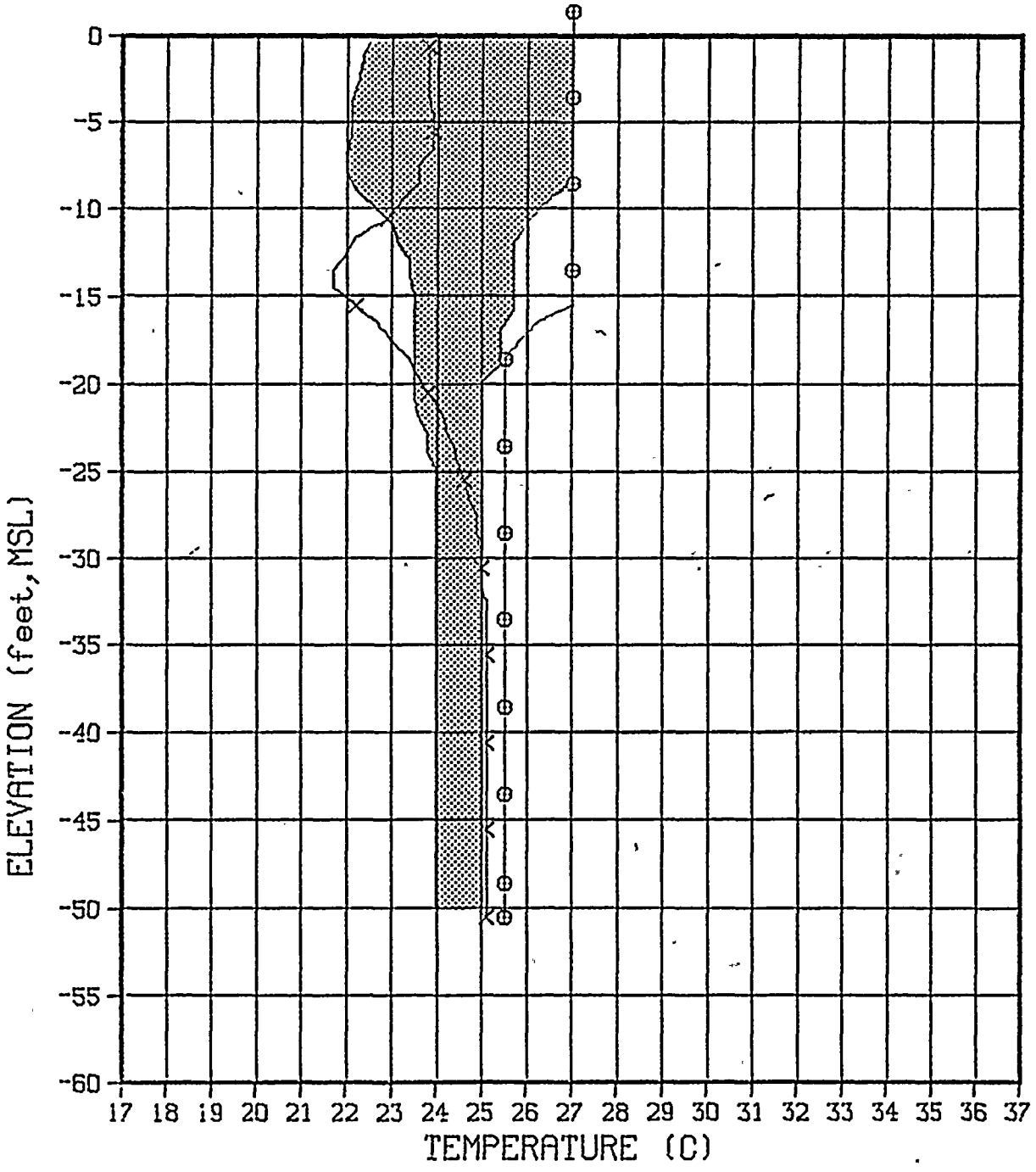
LEGEND

◆ NOV-81 ⧖ SEP-81

DAMES AND MOORE

EXTREMES OF TEMPERATURE
FOR JULY 81 - JUNE 82
WELL NUMBER L-3

0459804726 (7/82) FIGURE 6



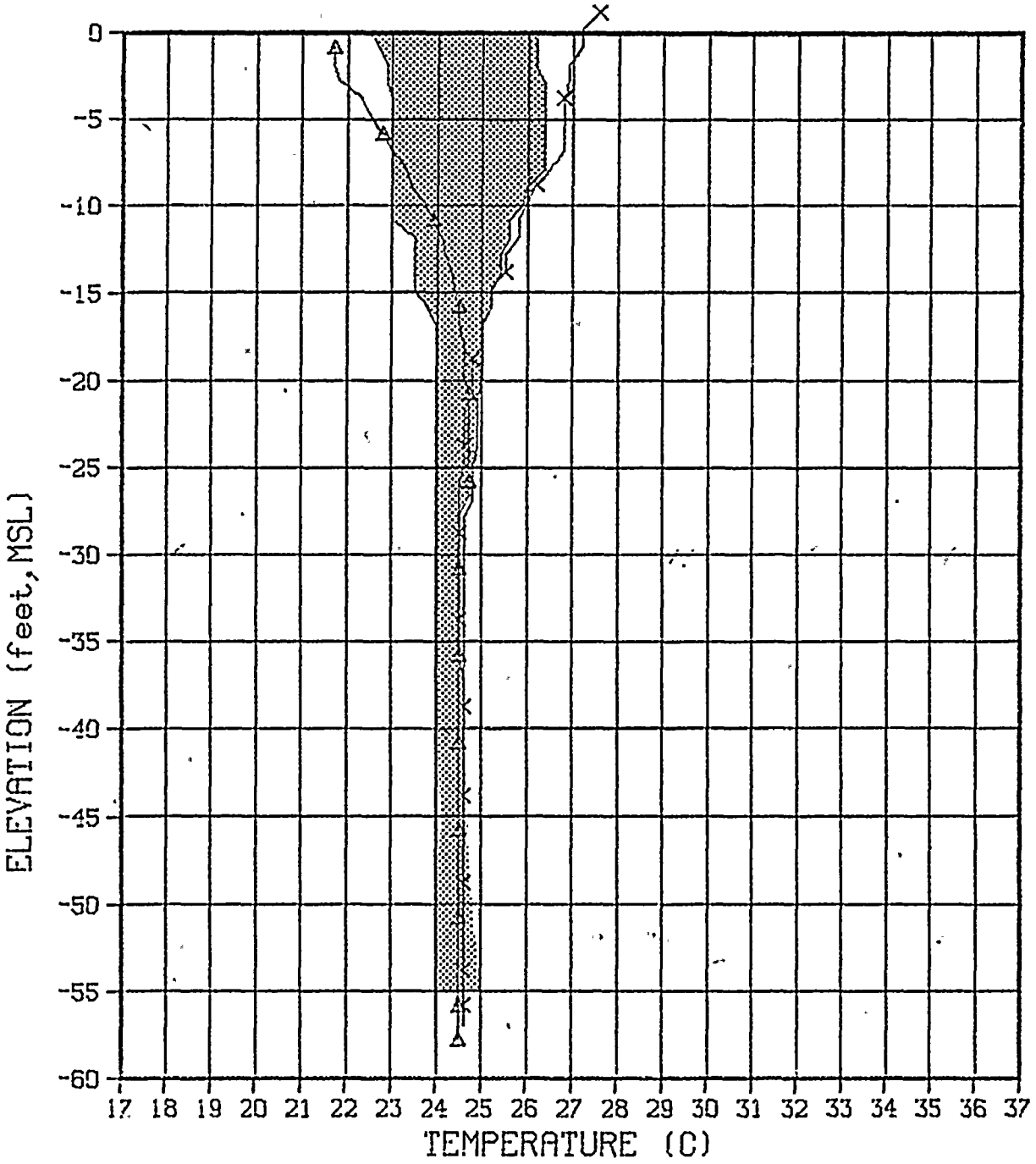
LEGEND

× FEB-82 ⊕ OCT-81

DAMES AND MOORE

EXTREMES OF TEMPERATURE
FOR JULY 81 - JUNE 82
WELL NUMBER L-5

0459804726 (7/82) FIGURE 7



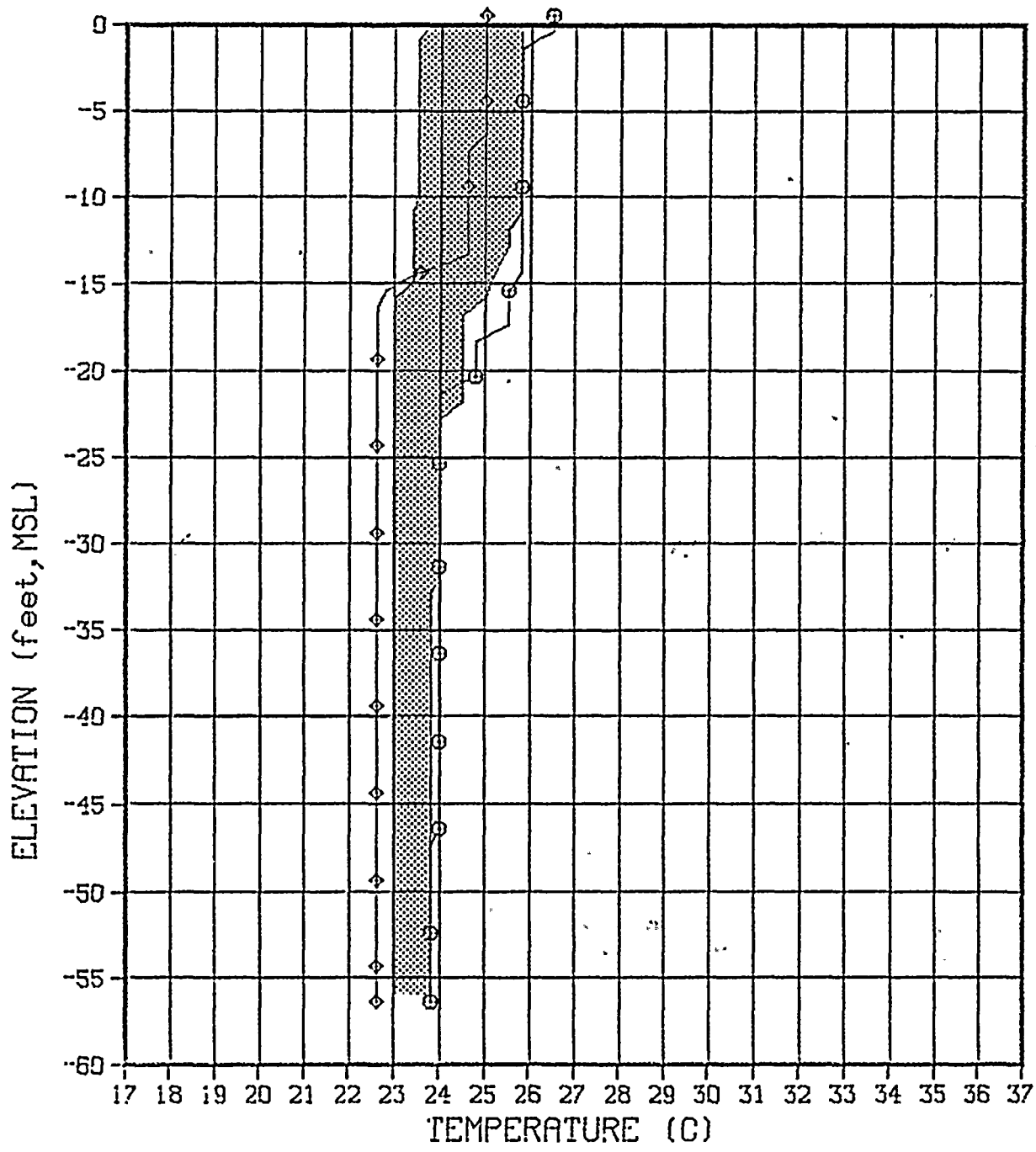
LEGEND

△ MAR-82 × NOV-81

DAMES AND MOORE

EXTREMES OF TEMPERATURE
FOR JULY 81 - JUNE 82
WELL NUMBER G-6

0459804726 (7/82) FIGURE 8



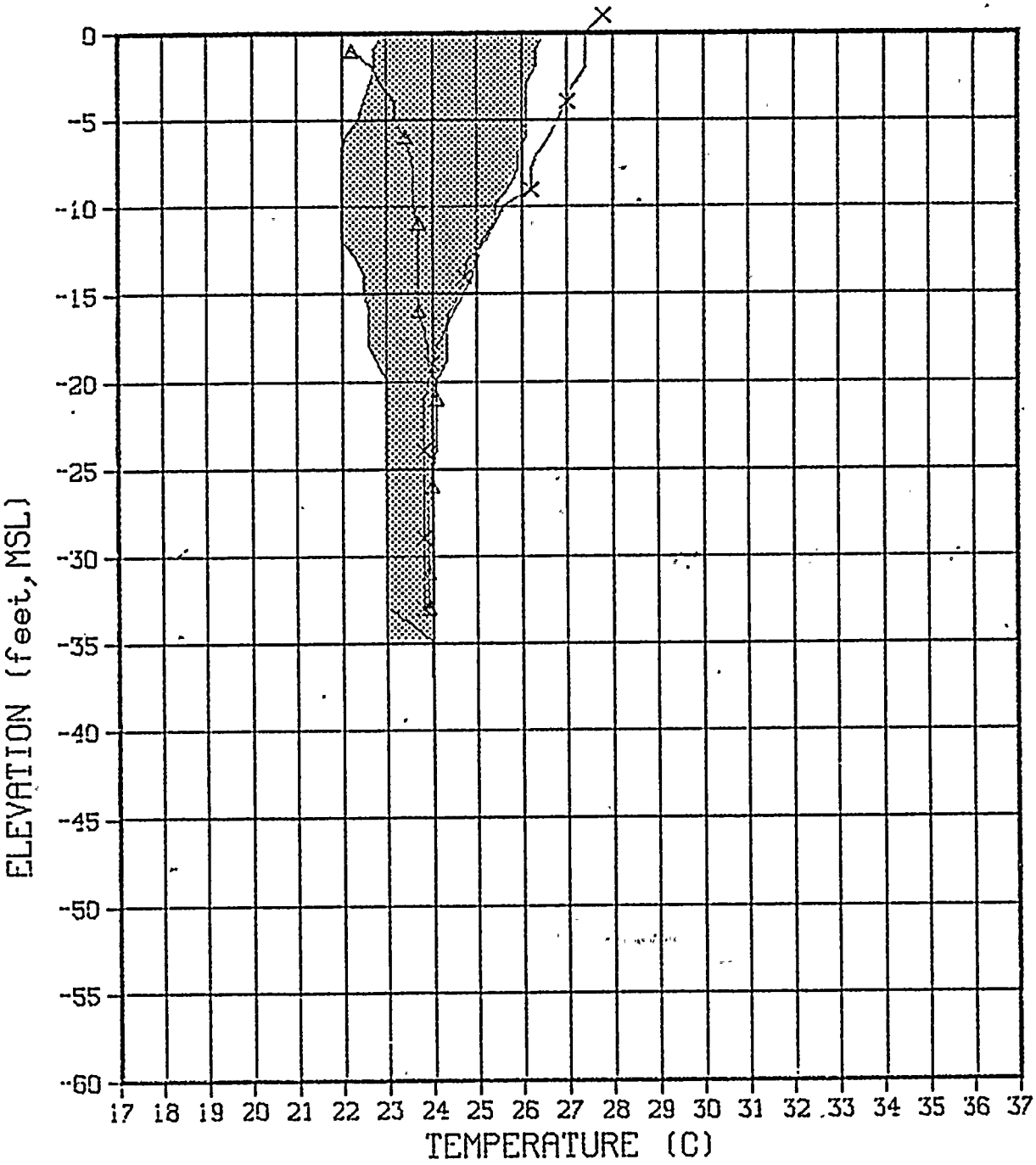
LEGEND

◈ NOV-81 ⊕ OCT-81

DAMES AND MOORE

EXTREMES OF TEMPERATURE
FOR JULY 81 - JUNE 82
WELL NUMBER G-14

0459804726 (7/82) FIGURE 9



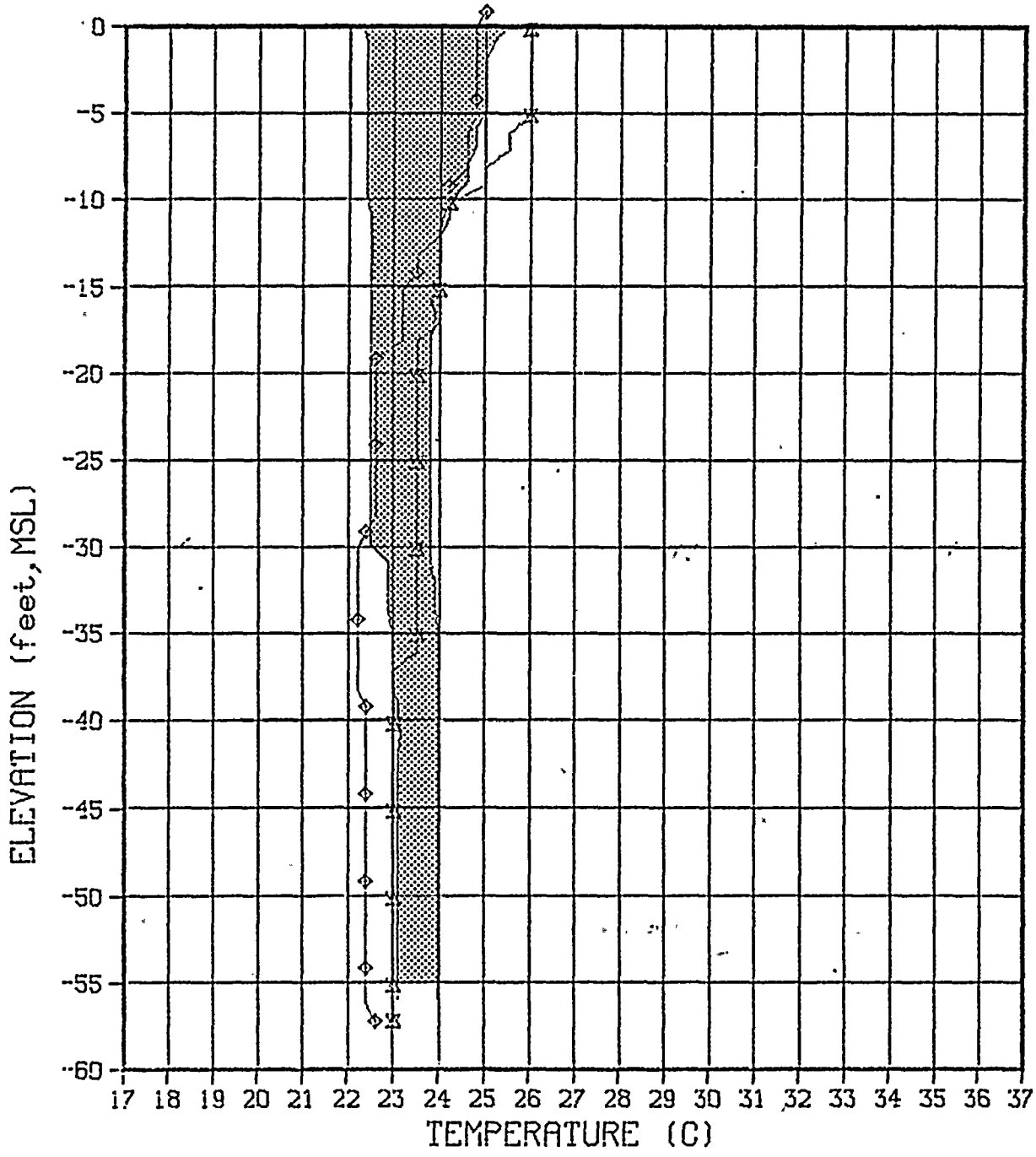
LEGEND

△ MAR-82 × NOV-81

DAMES AND MOORE

EXTREMES OF TEMPERATURE
FOR JULY 81 - JUNE 82
WELL NUMBER G-27

0459804726 (7/82) FIGURE 10



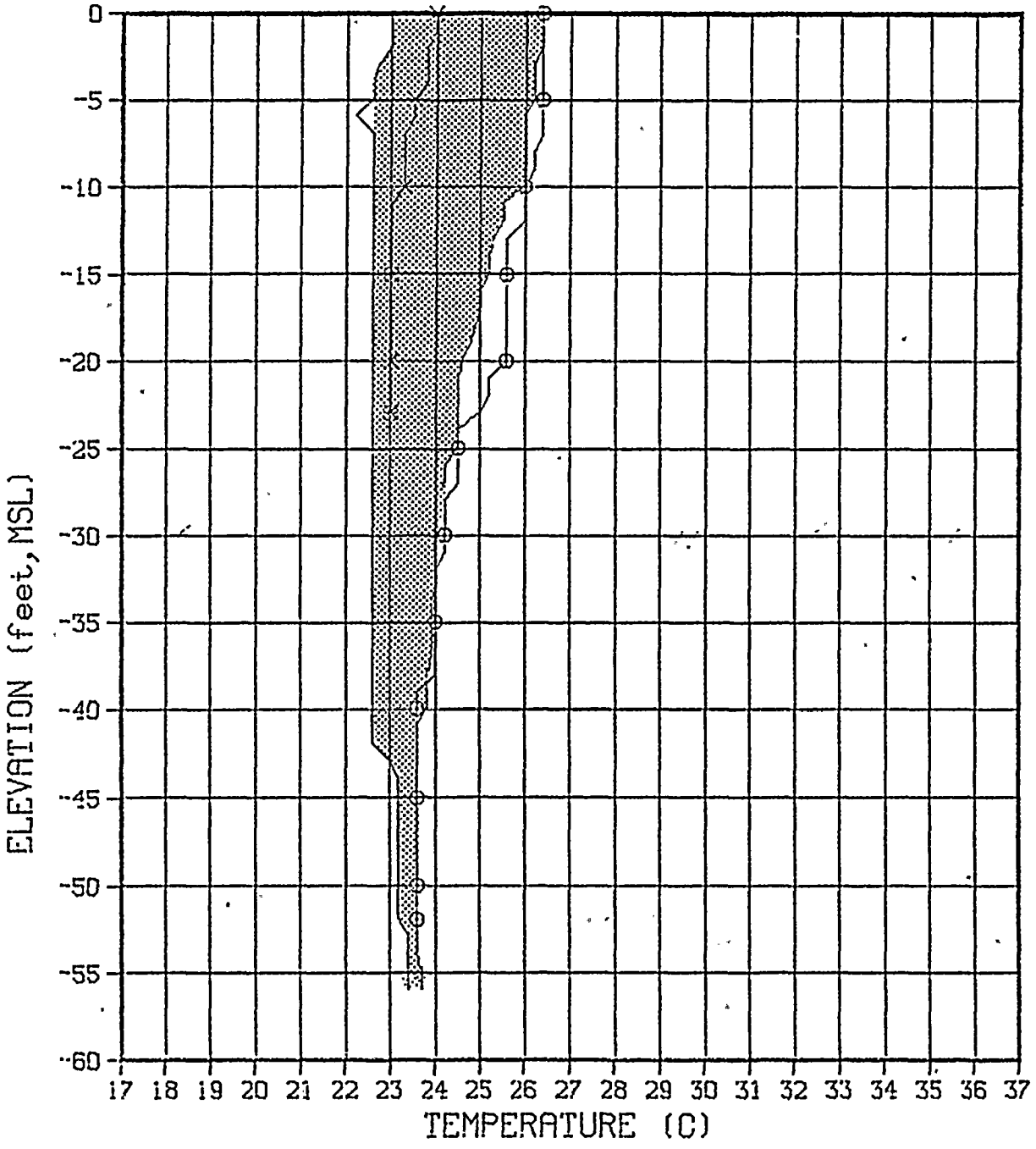
LEGEND

◇ NOV-81 ⧖ SEP-81

DAMES AND MOORE

EXTREMES OF TEMPERATURE
FOR JULY 81 - JUNE 82
WELL NUMBER G-28

0459804726 (7/82) FIGURE 11



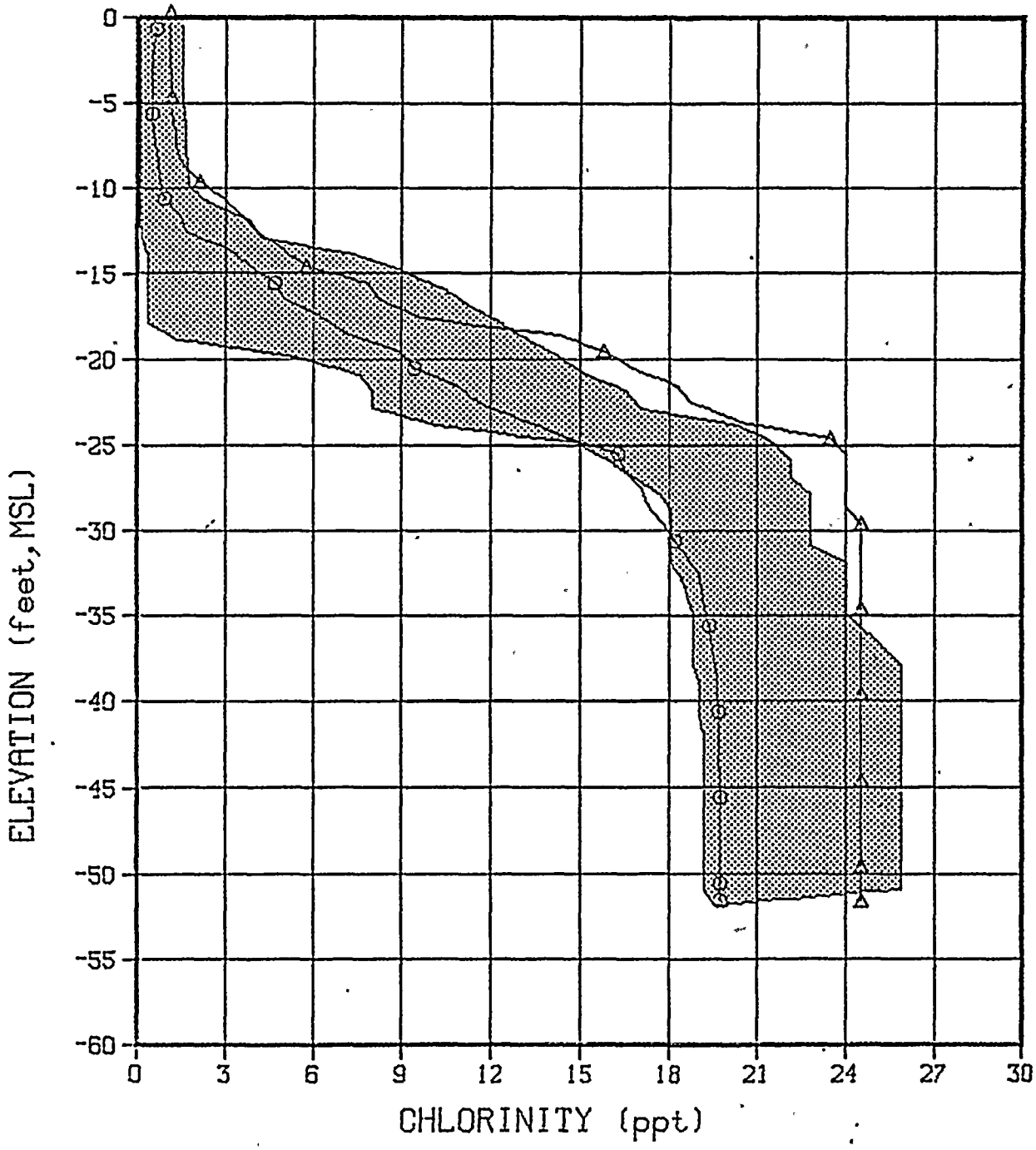
LEGEND

× MAY-82 ⊕ OCT-81

DAMES AND MOORE

EXTREMES OF TEMPERATURE
FOR JULY 81 - JUNE 82
WELL NUMBER G-35

0459804726 (7/82) FIGURE 12



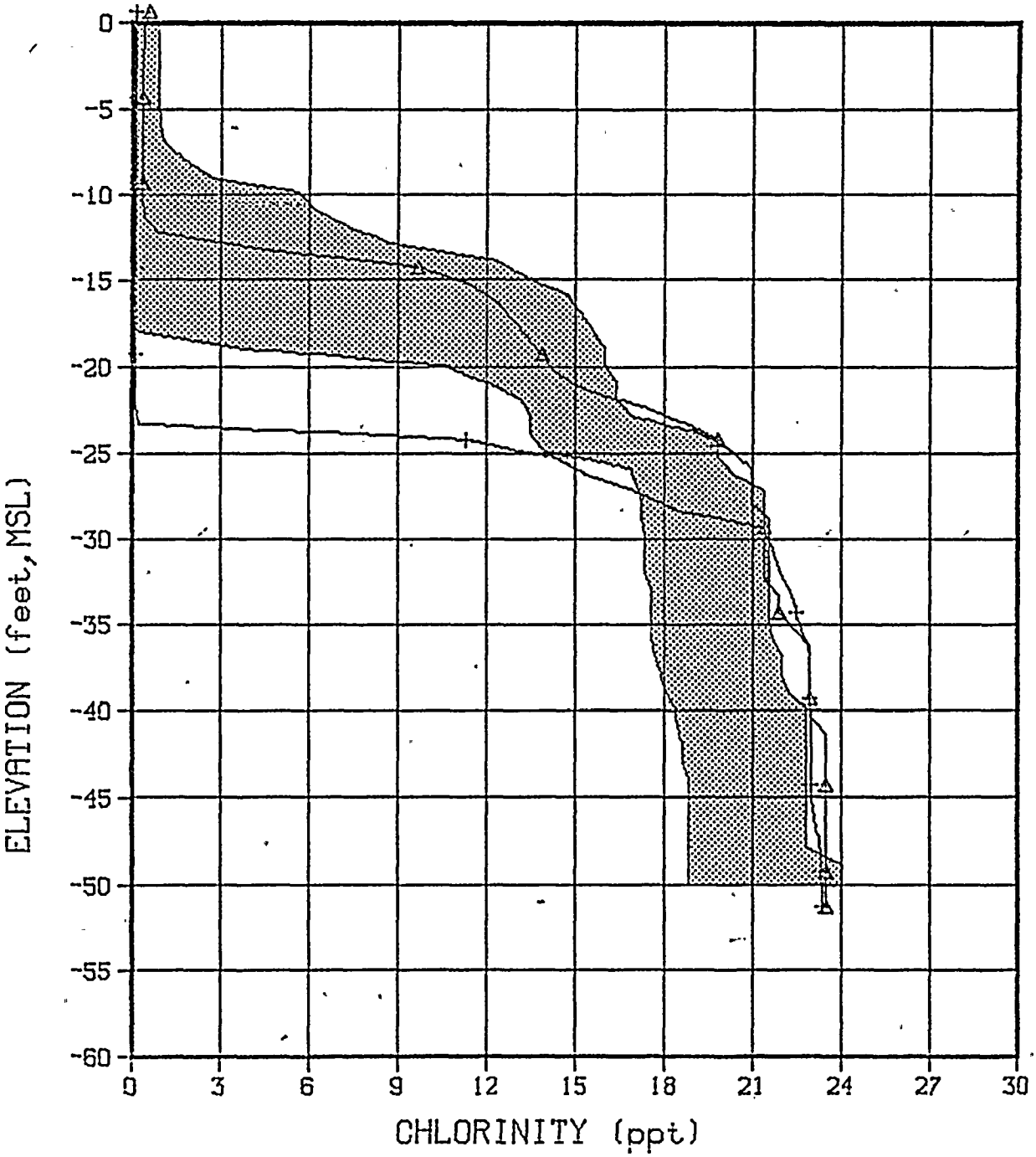
LEGEND

○ APR-82 △ AUG-81

DAMES AND MOORE

EXTREMES OF CHLORINITY
FOR JULY 81 - JUNE 82
WELL NUMBER L-2

0459804726 (7/82) FIGURE 13



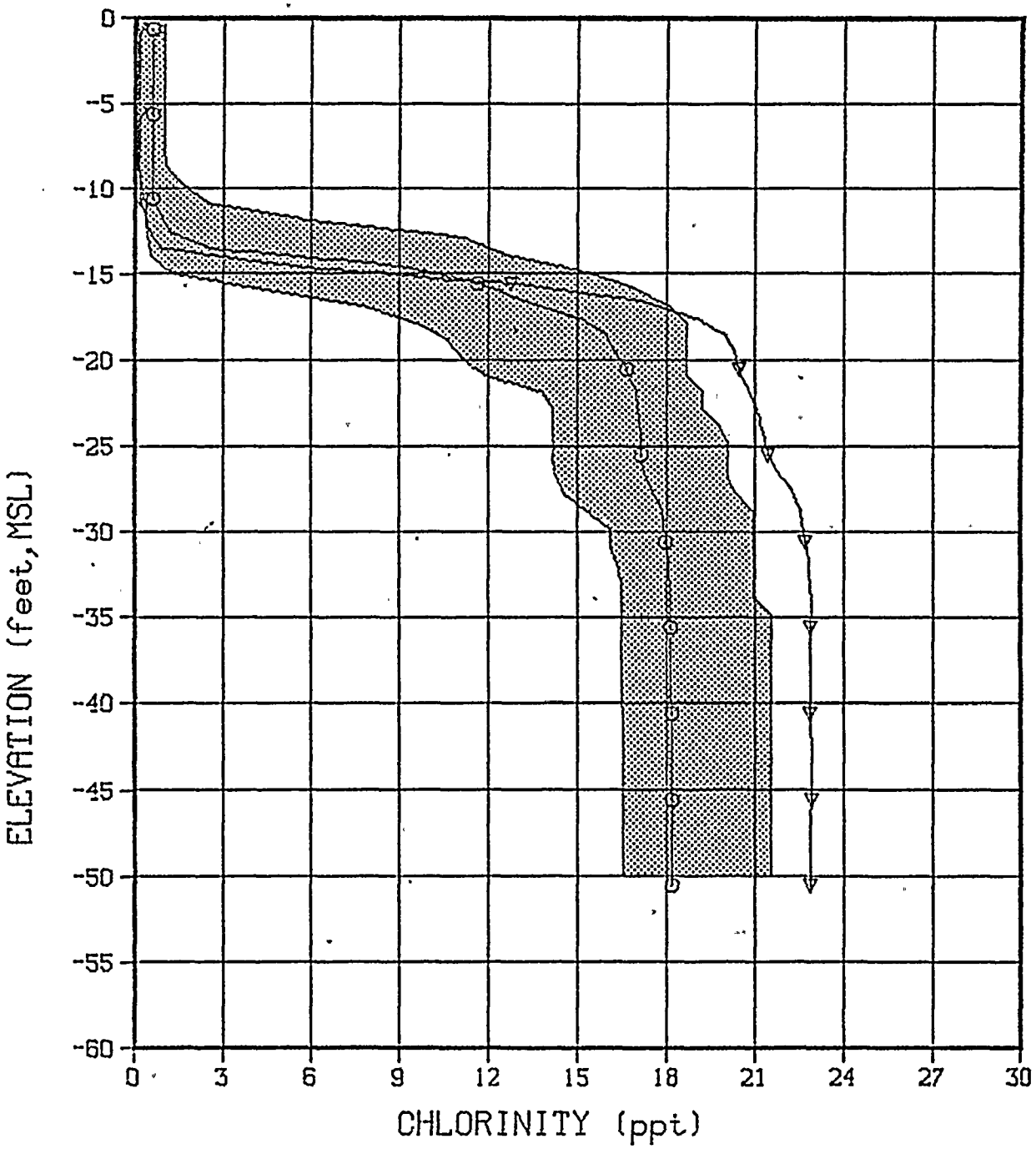
LEGEND

+ DEC-81 Δ AUG-81

DAMES AND MOORE

EXTREMES OF CHLORINITY
FOR JULY 81 - JUNE 82
WELL NUMBER L-3

0459804726 (7/82) FIGURE 14



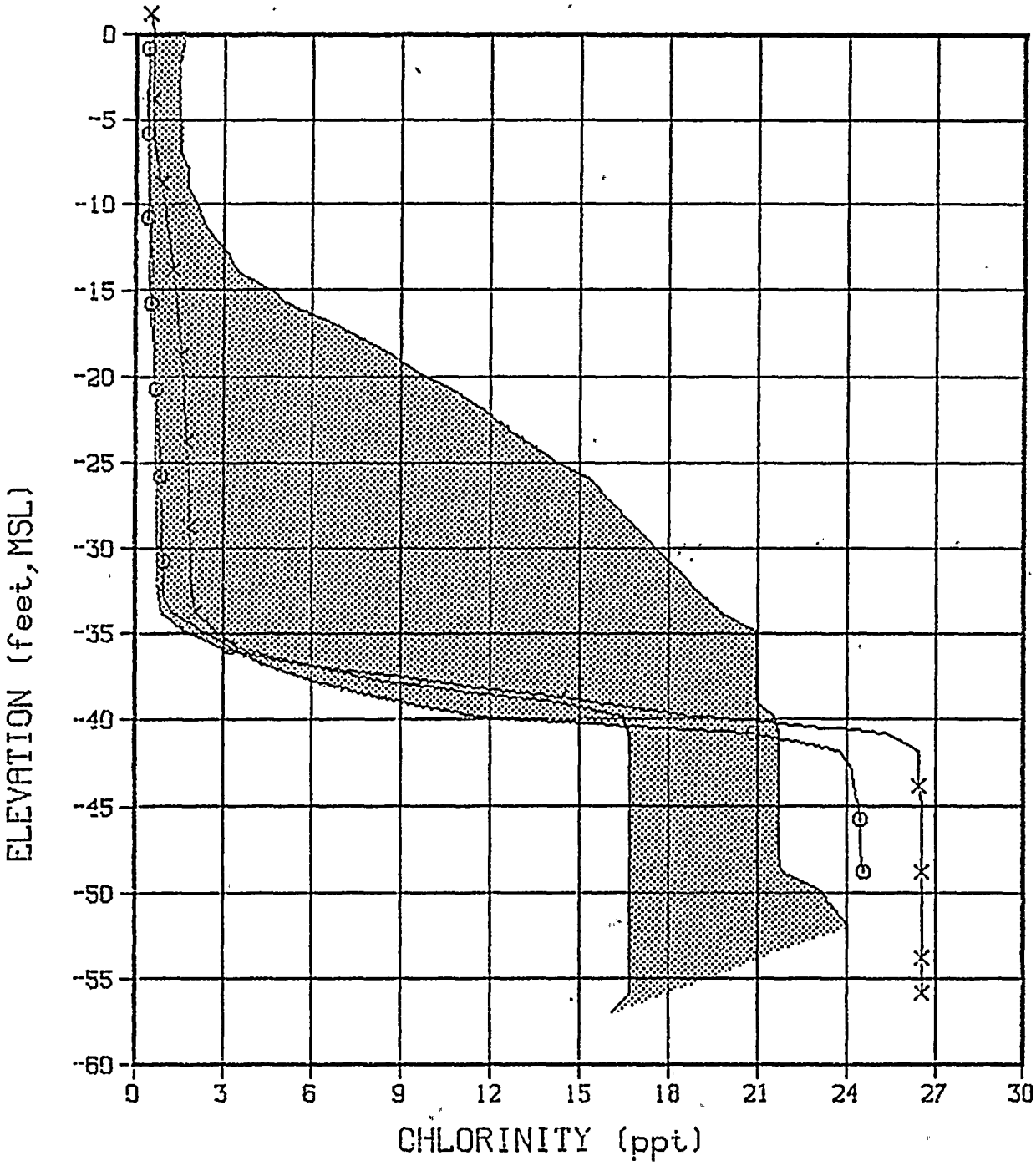
LEGEND

o APR-82 ▽ JUNE-82

DAMES AND MOORE

EXTREMES OF CHLORINITY
FOR JULY 81 - JUNE 82
WELL NUMBER L-5

0459804726 (7/82) FIGURE 15



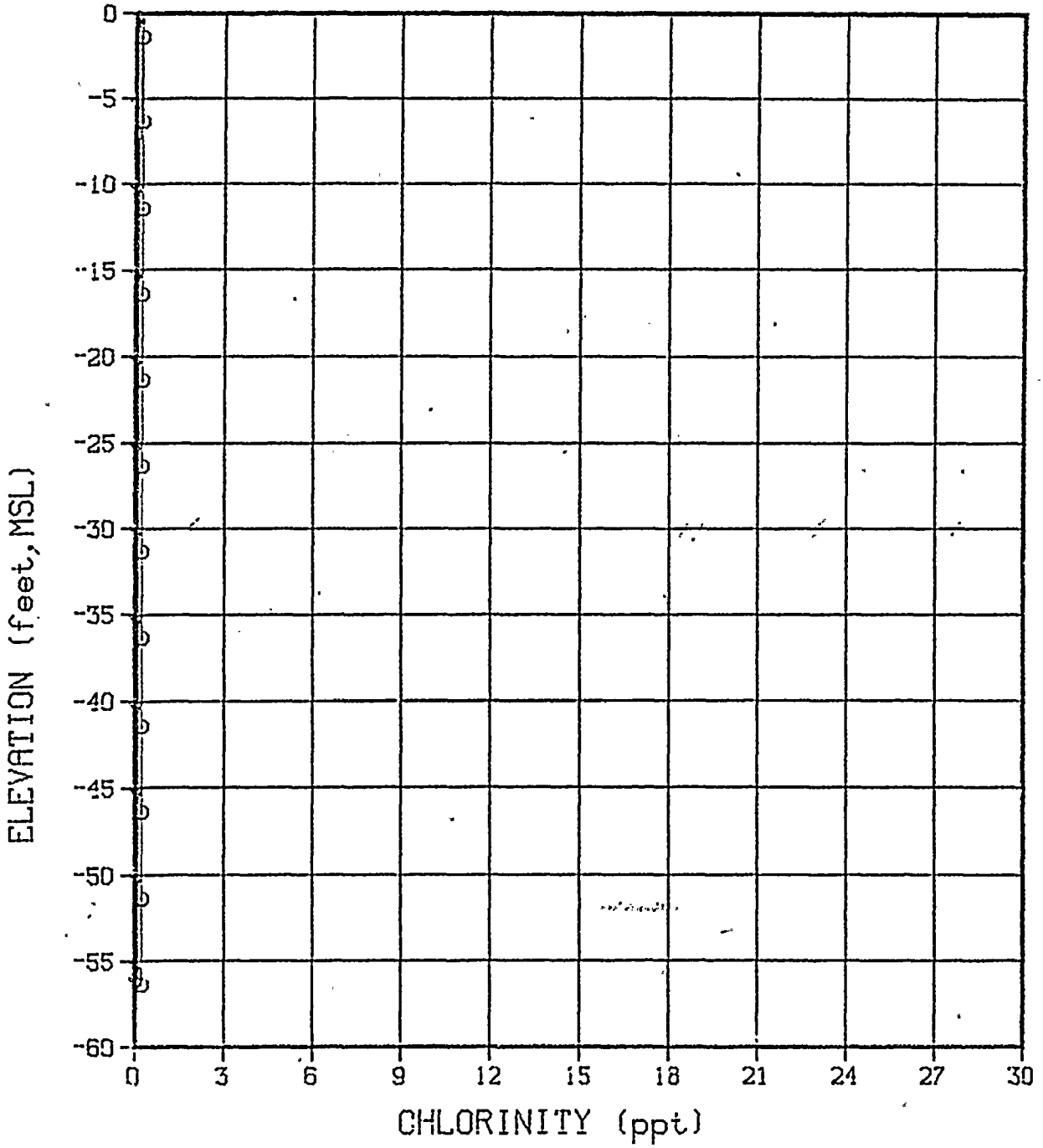
LEGEND

o JAN-82 × NOV-81

DAMES AND MOORE

EXTREMES OF CHLORINITY
FOR JULY 81 - JUNE 82
WELL NUMBER G-6

0459804726 (7/82) FIGURE 16



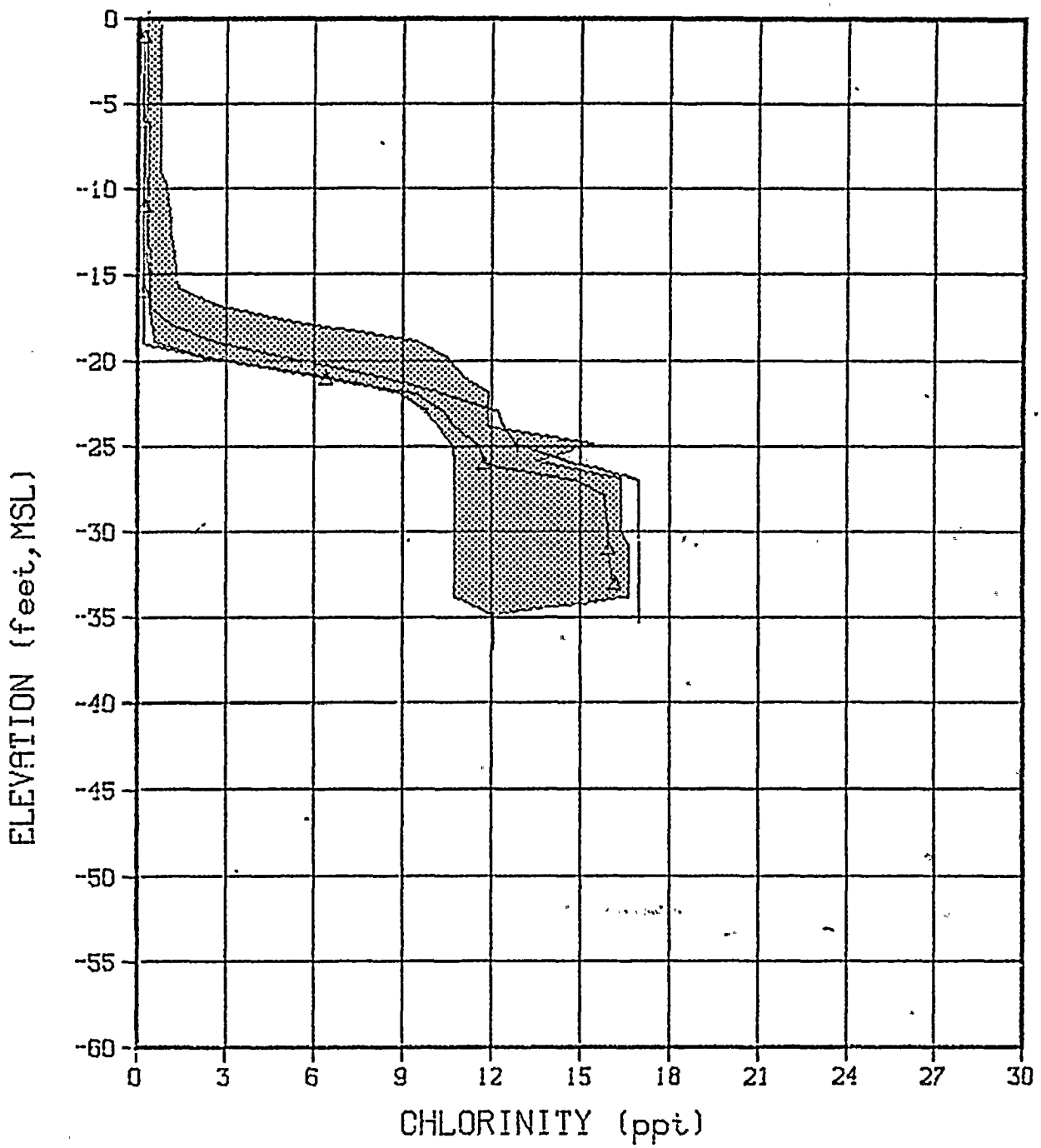
LEGEND

▽ JUNE-82 ○ APR-82

DAMES AND MOORE

EXTREMES OF CHLORINITY
FOR JULY 81 - JUNE 82
WELL NUMBER G-14

0459804726 (7/82) FIGURE 17



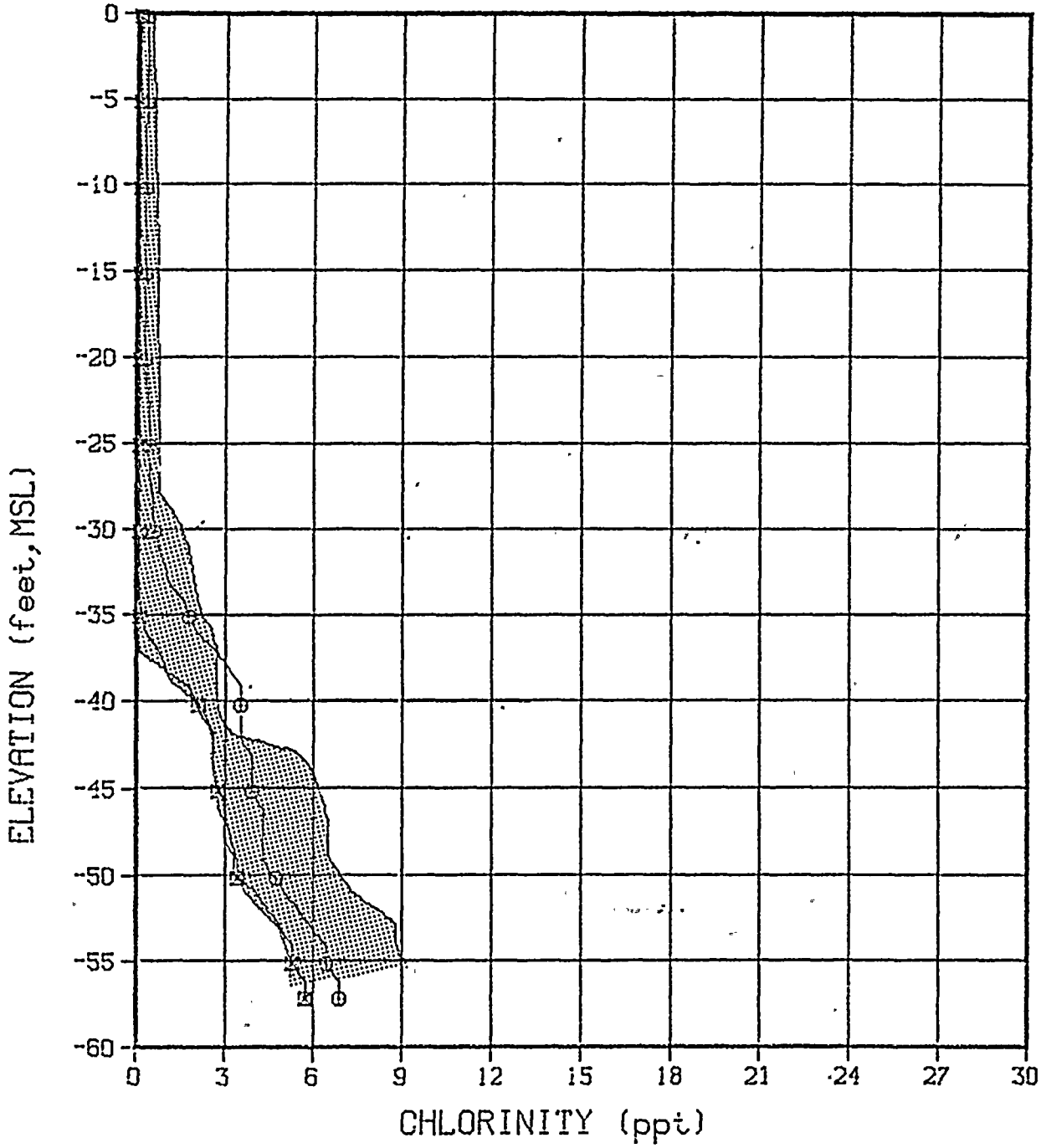
LEGEND

Δ MAR-82 + MAY-82

DAMES AND MOORE

EXTREMES OF CHLORINITY
FOR JULY 81 - JUNE 82
WELL NUMBER G-27

0459804726 (7/82) FIGURE 18



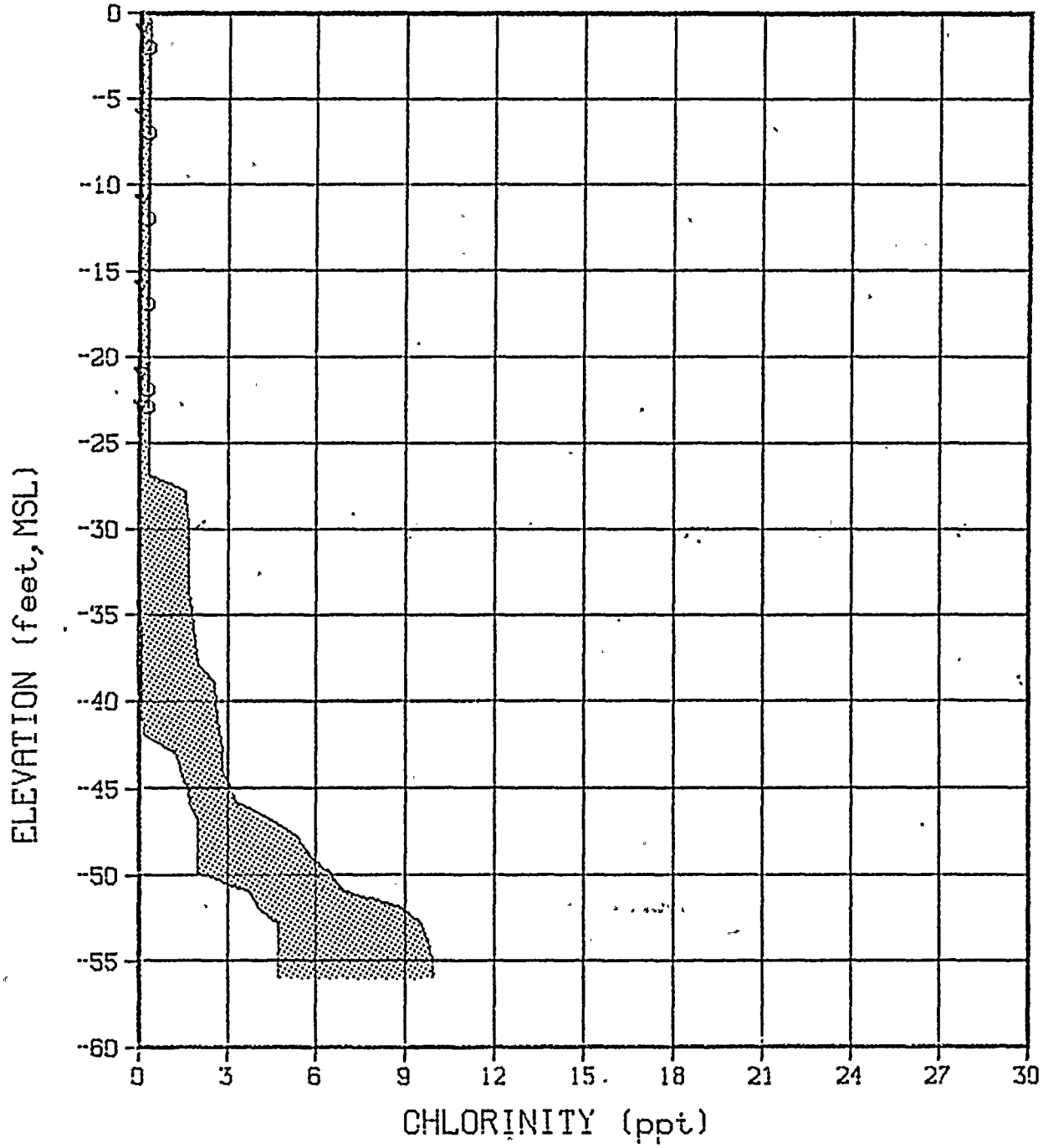
LEGEND

⊠ MAR-82 ⊕ OCT-81

DAMES AND MOORE

EXTREMES OF CHLORINITY
FOR JULY 81 - JUNE 82
WELL NUMBER C-28

0459804726 (7/82) FIGURE 19



LEGEND

▽ JUNE-82 ○ APR-82

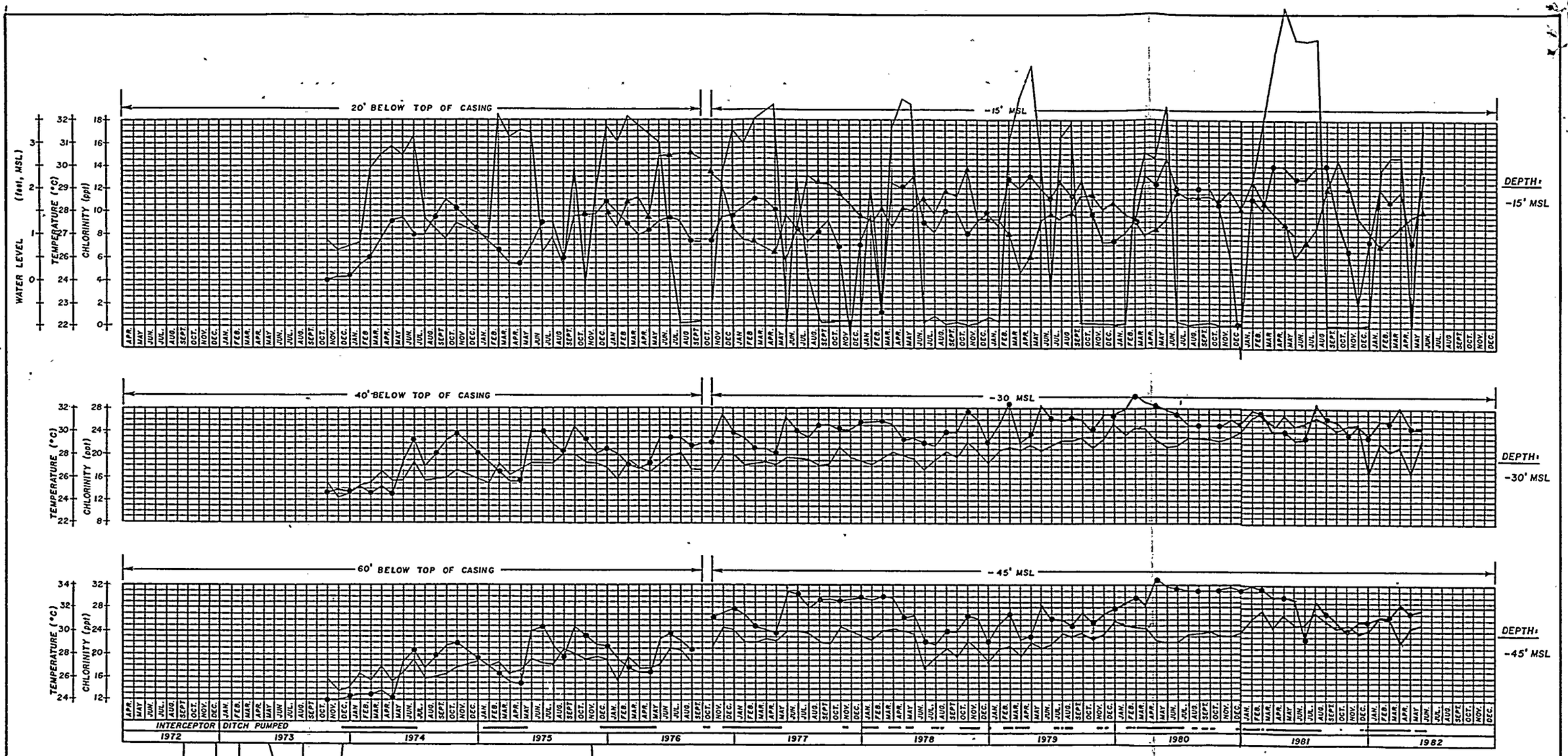
DAMES AND MOORE

EXTREMES OF CHLORINITY
FOR JULY 81 - JUNE 82
WELL NUMBER G-35

0459804726 (7/82) FIGURE 20

APPENDIX A

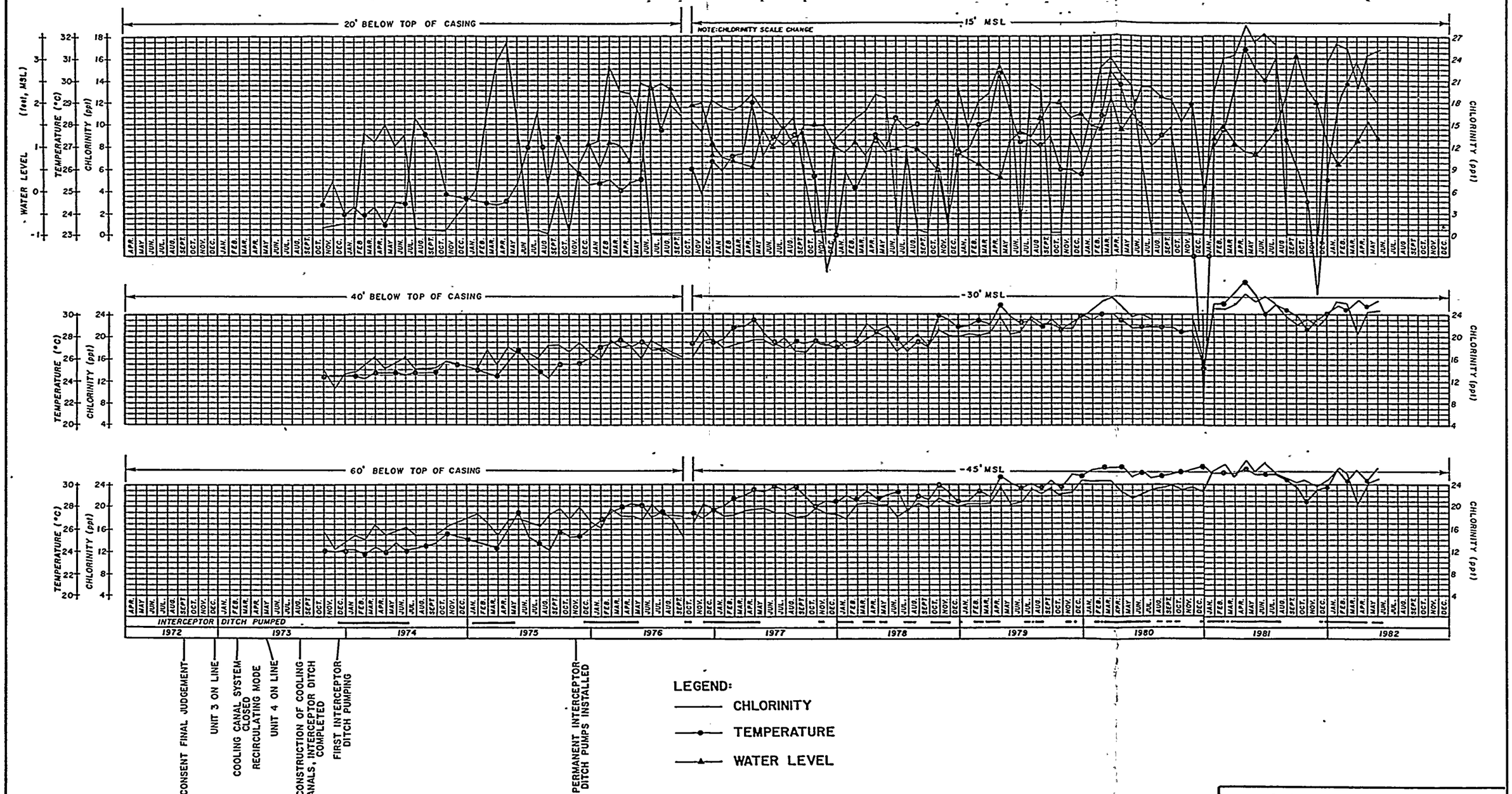
TIME-HISTORY DATA



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER ID-A

0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
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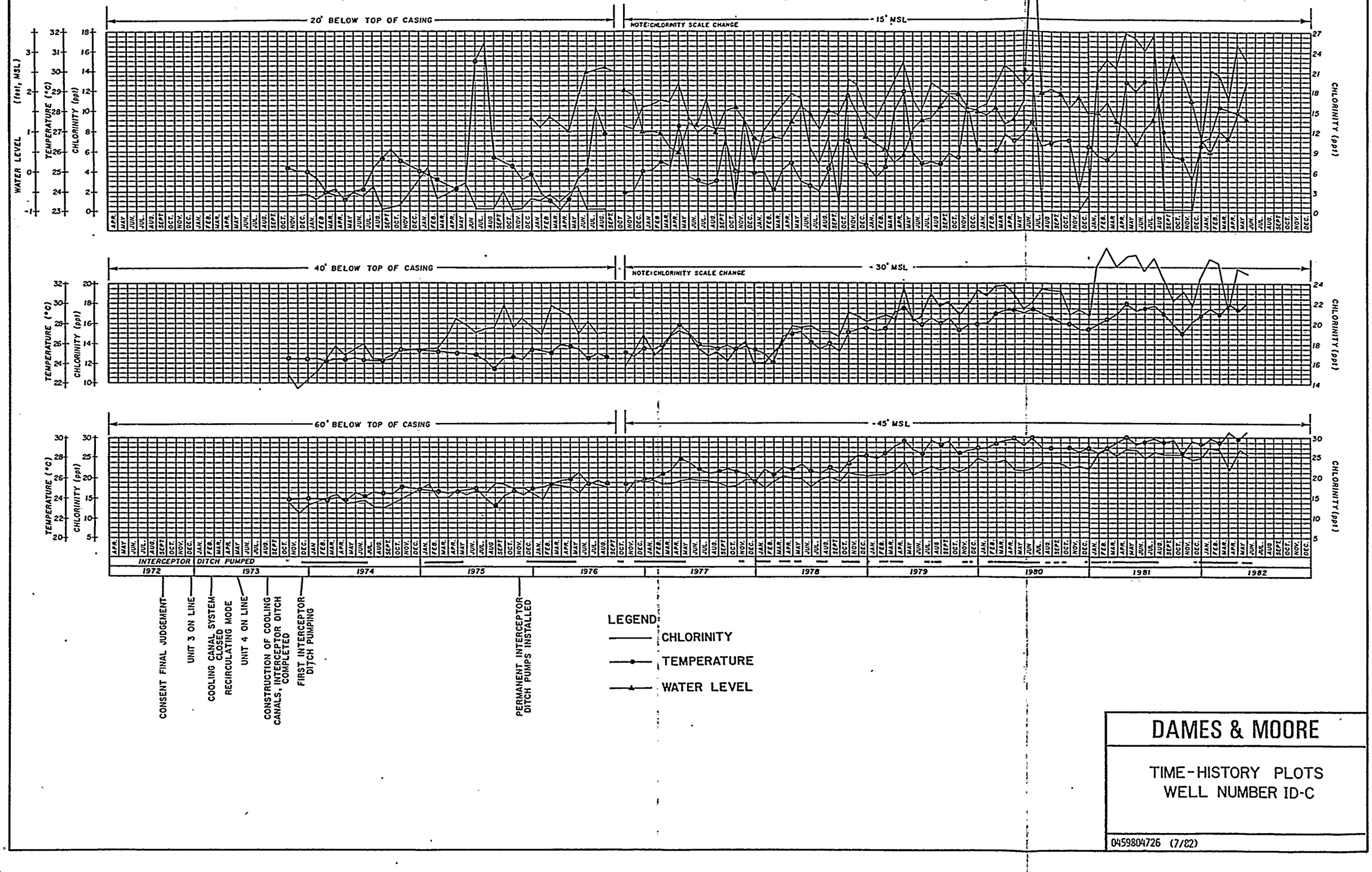

DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER ID-C

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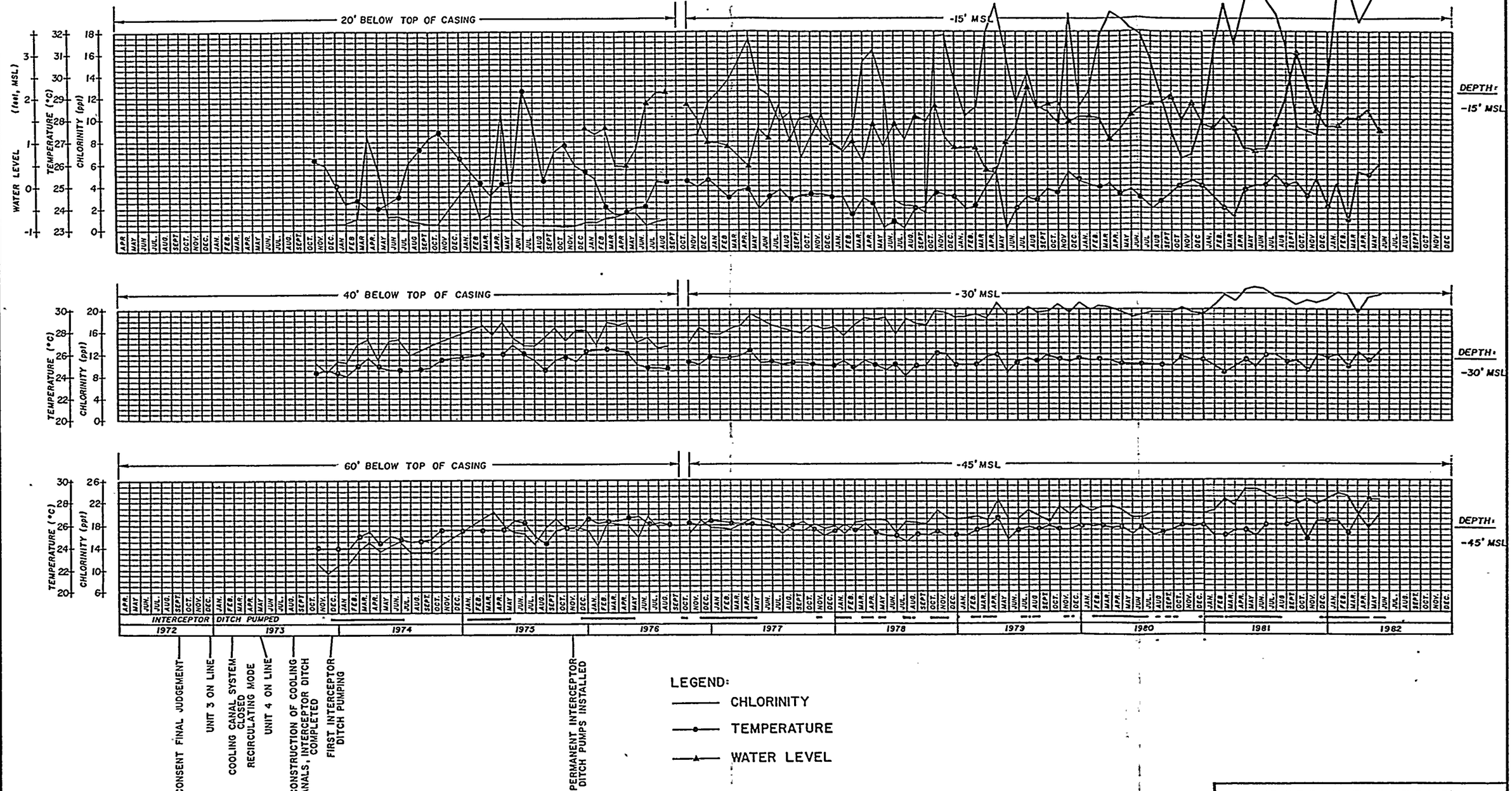

DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER ID-D

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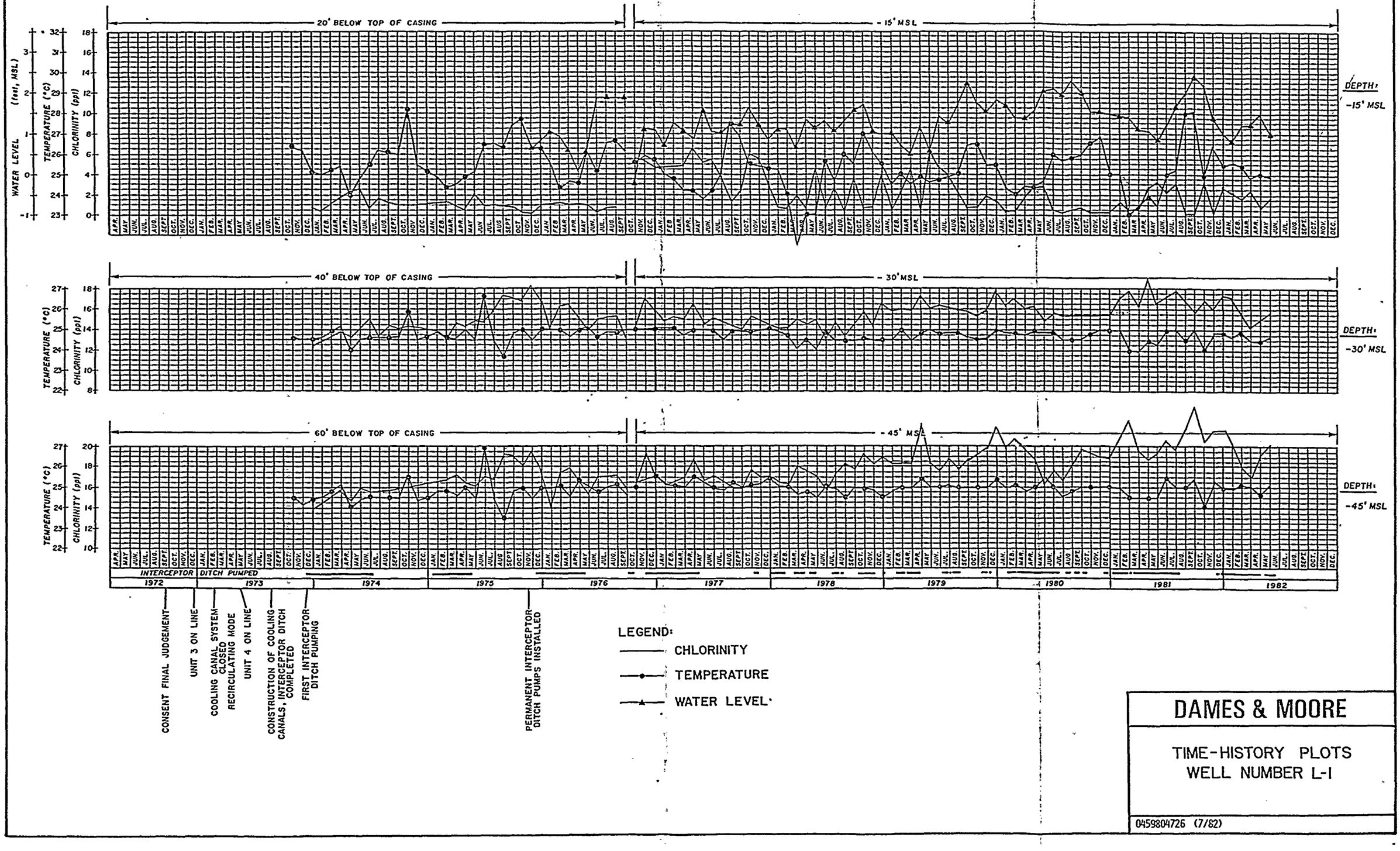
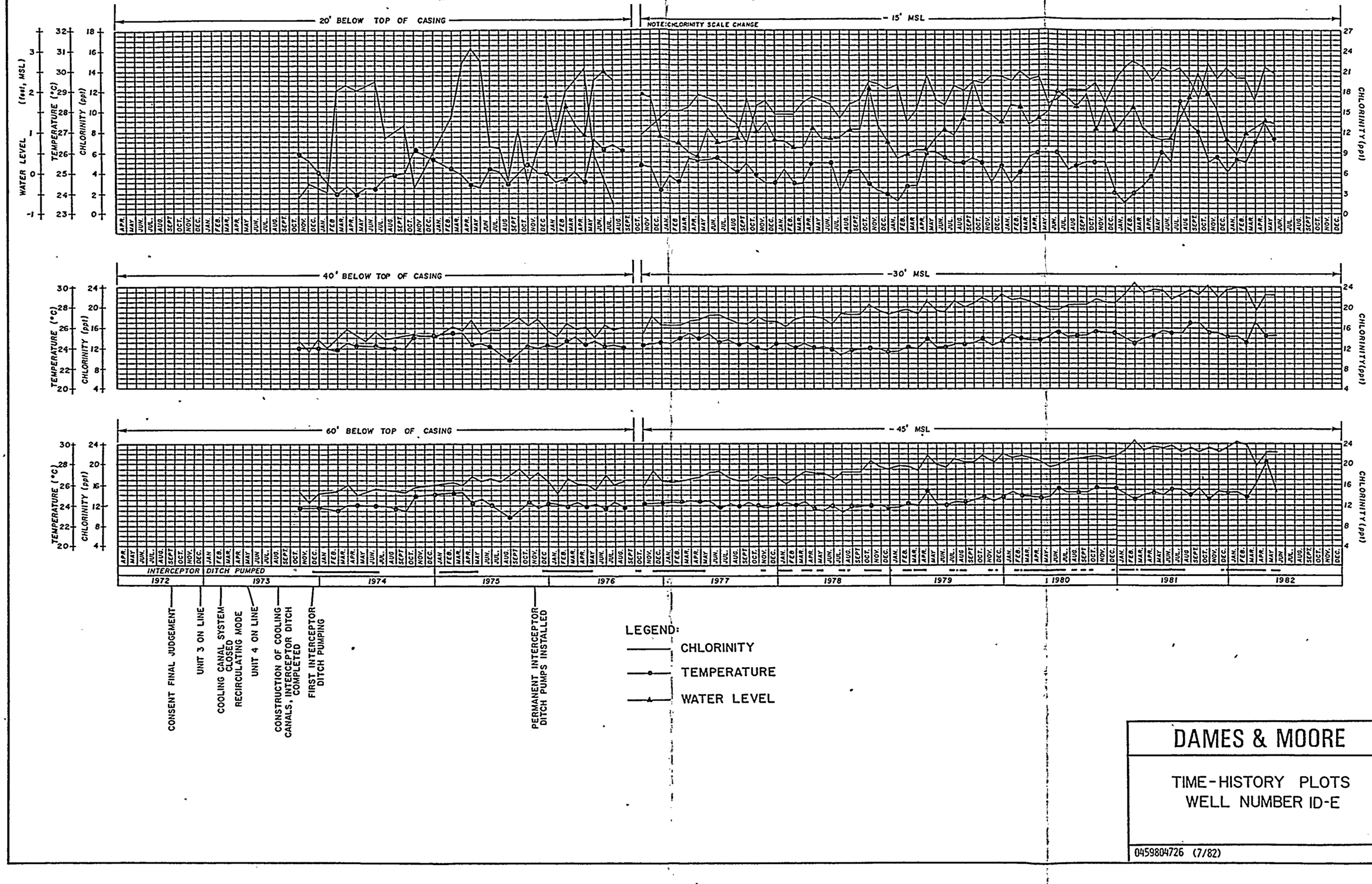


DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER L-1

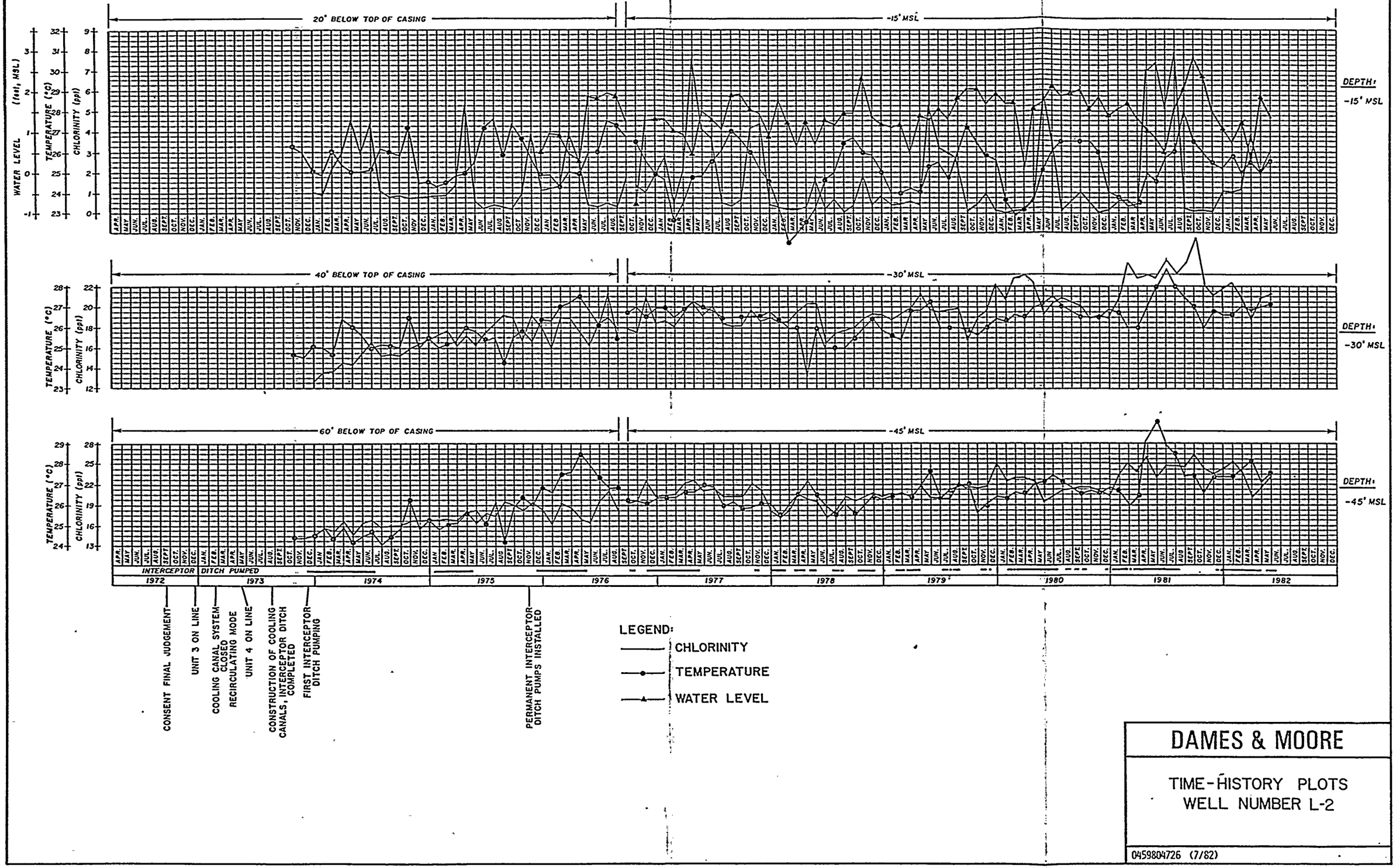
0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER ID-E

0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER L-2

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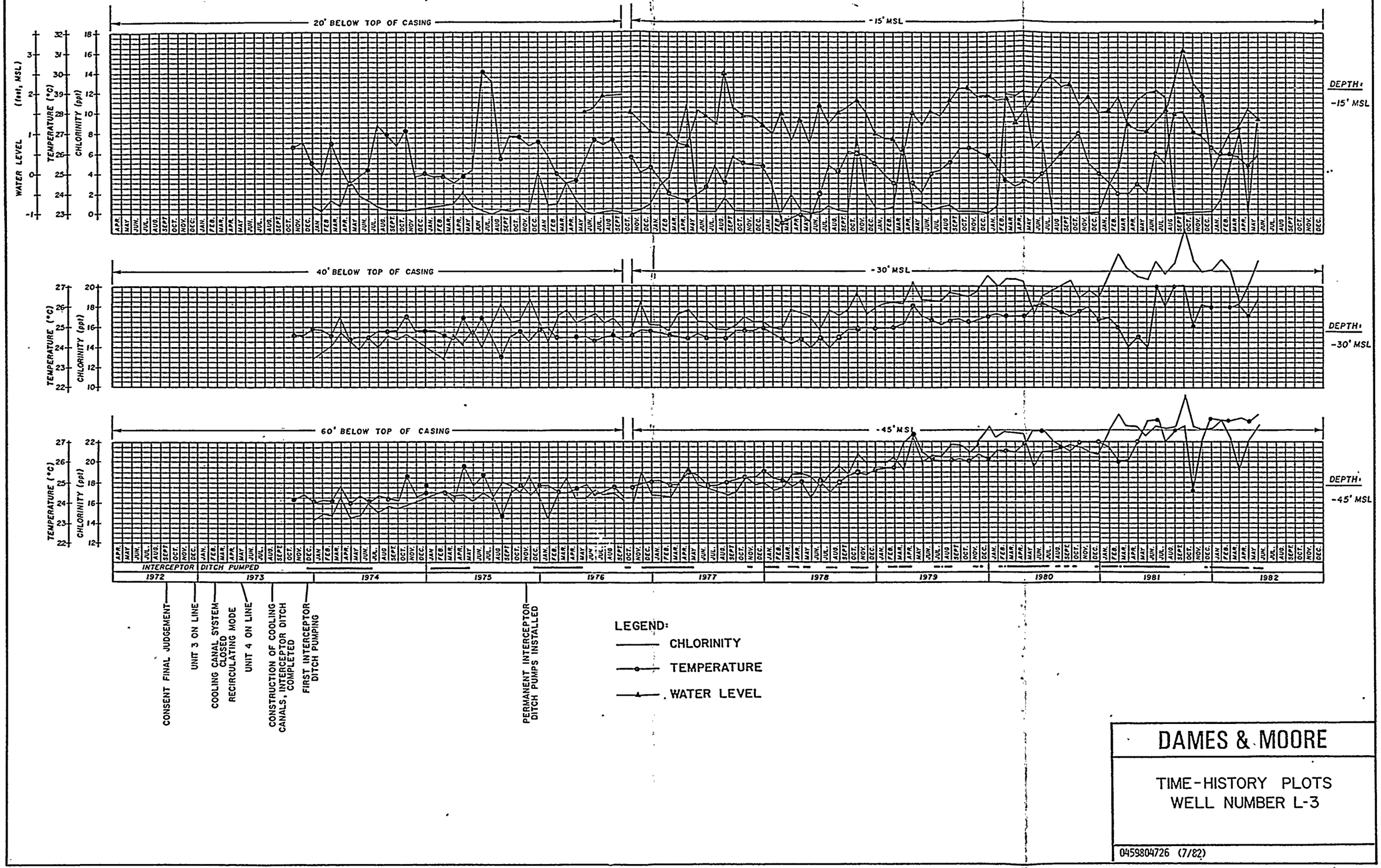

DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER L-3

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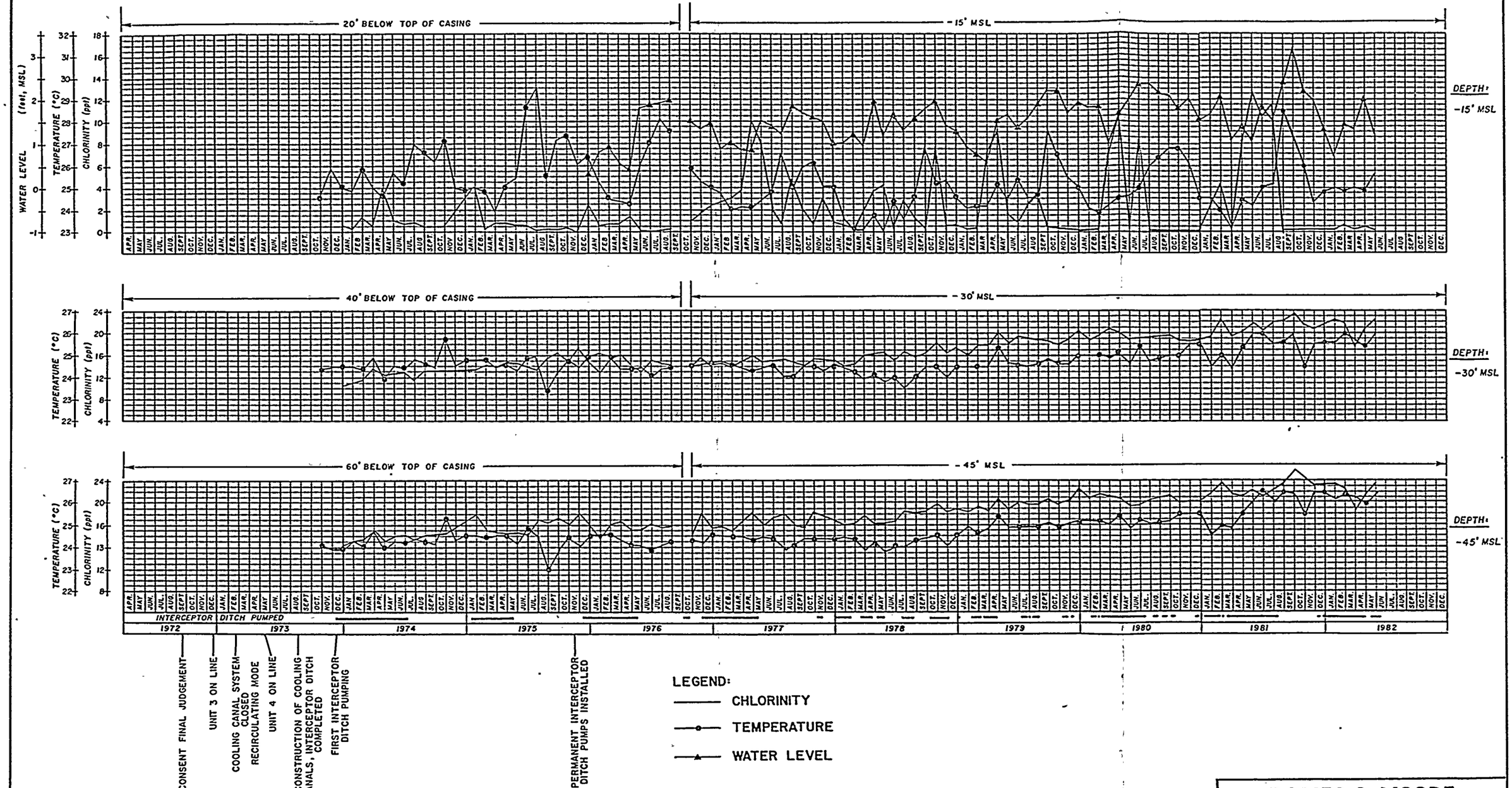
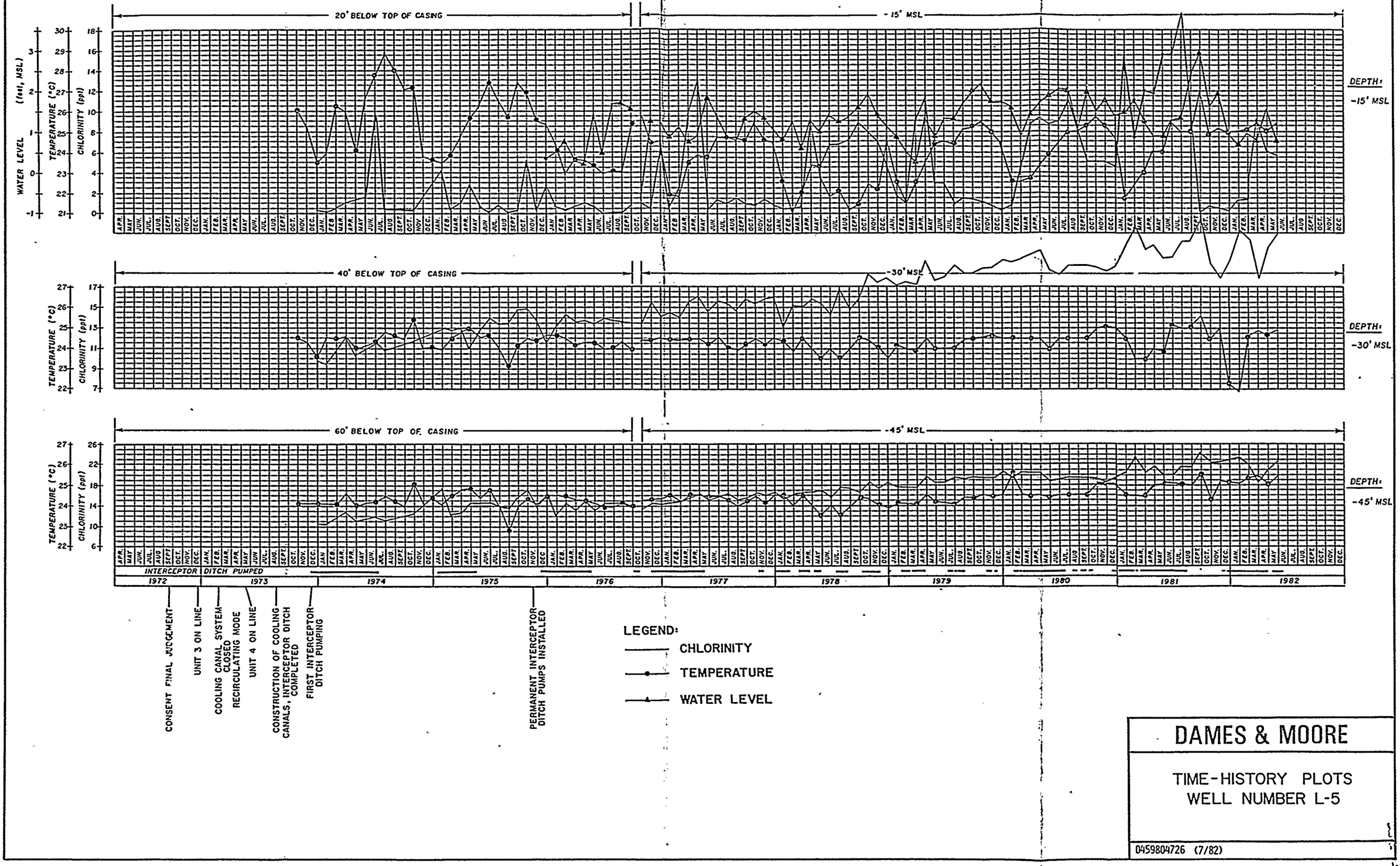


DAMES & MOORE

TIME-HISTORY PLOTS WELL NUMBER L-4

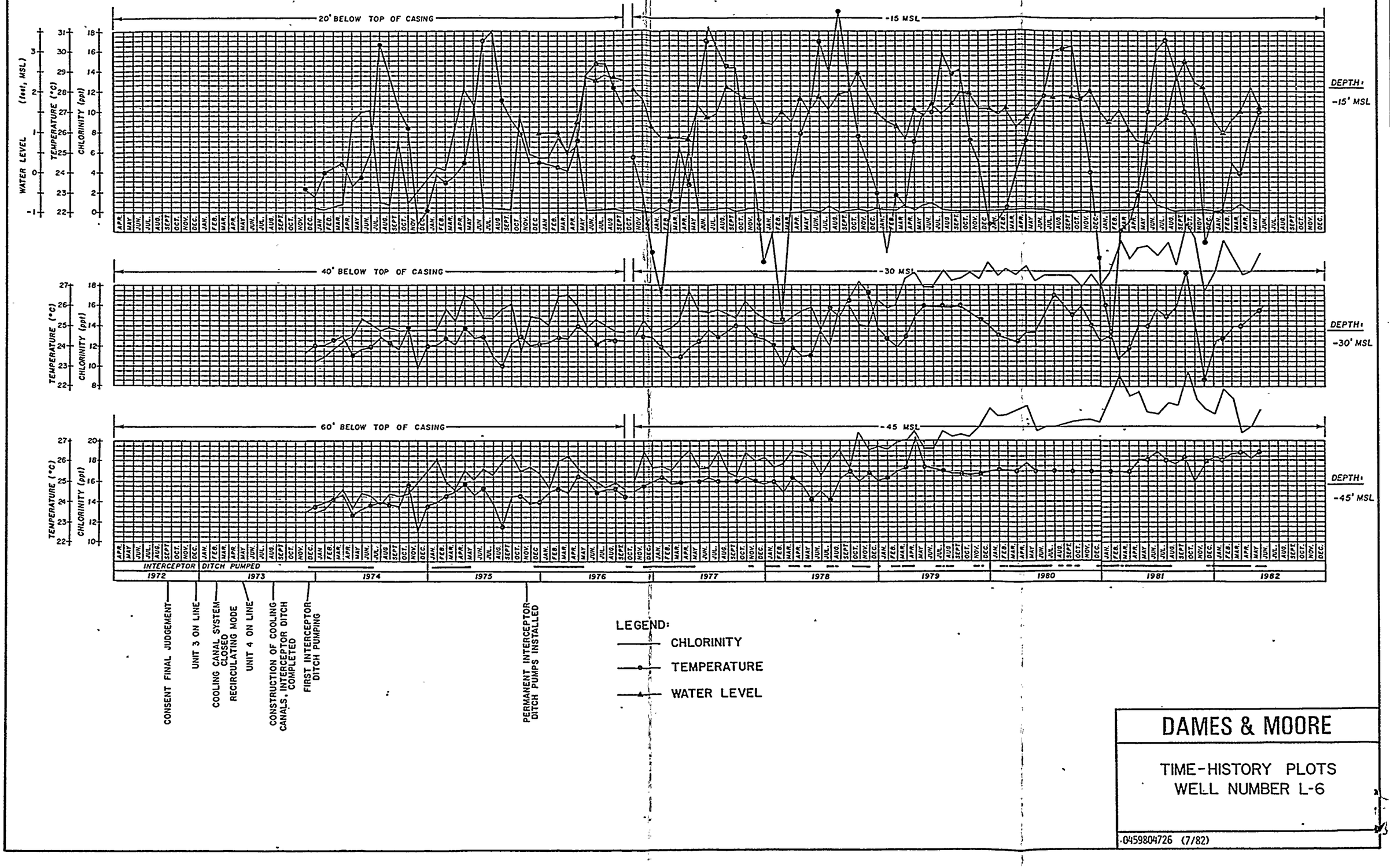
0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER L-5

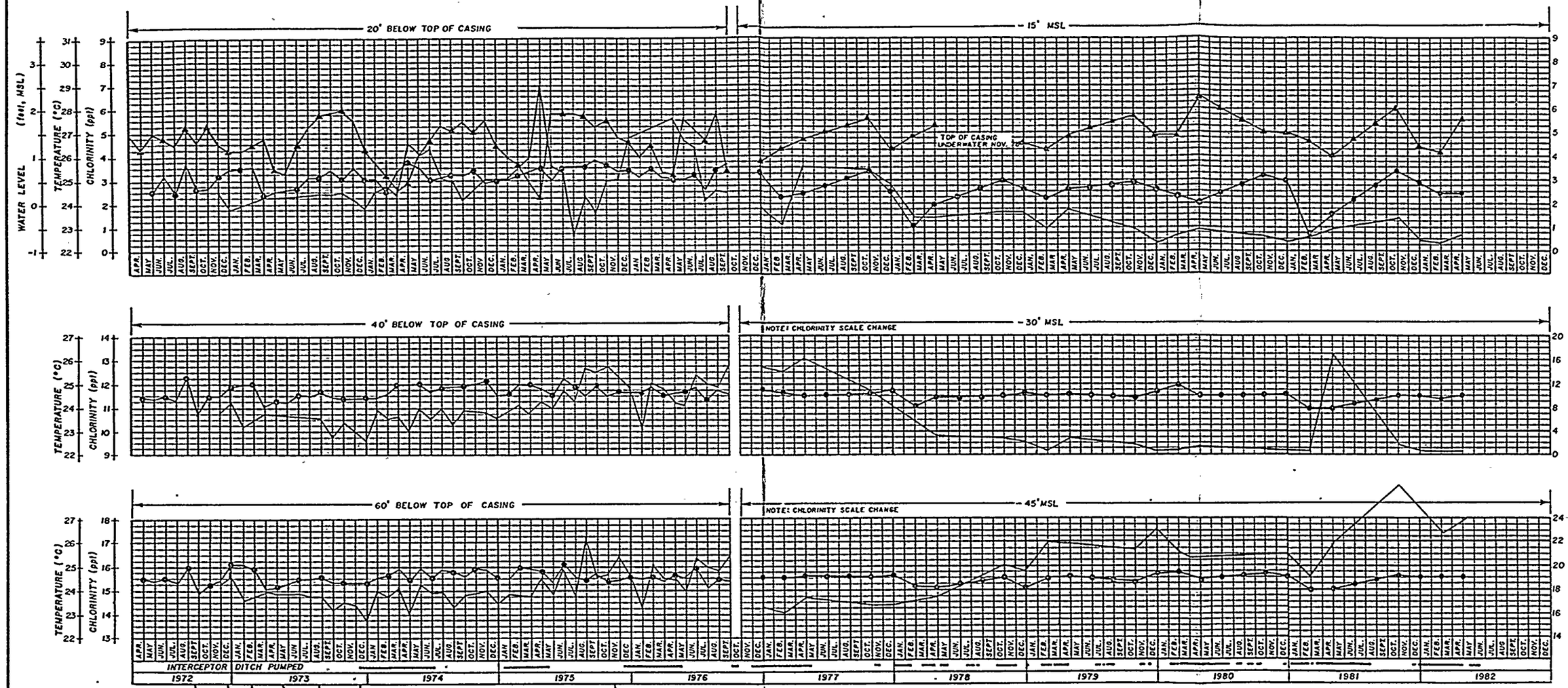
0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER L-6

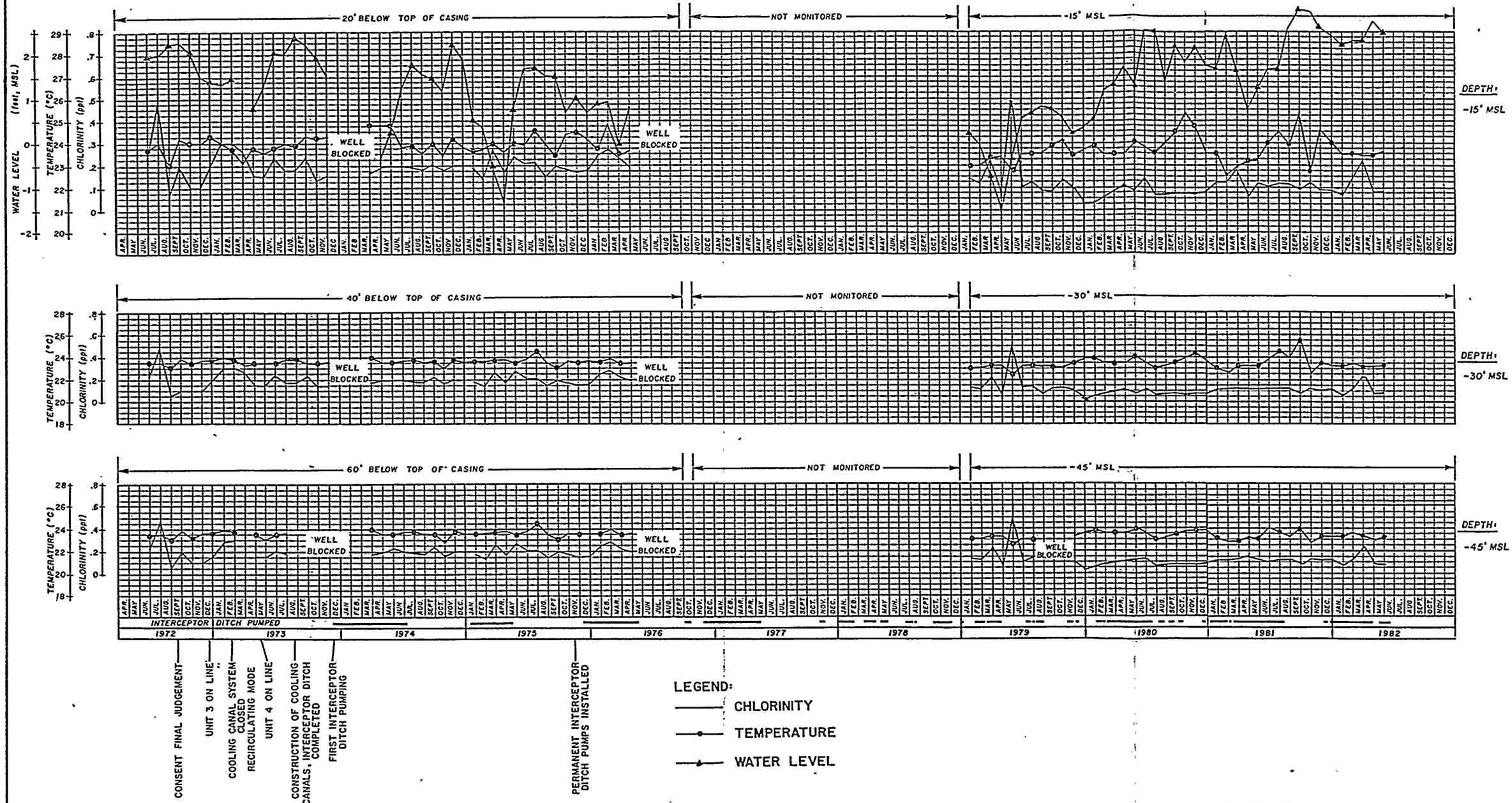
.04598O4726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER G-6

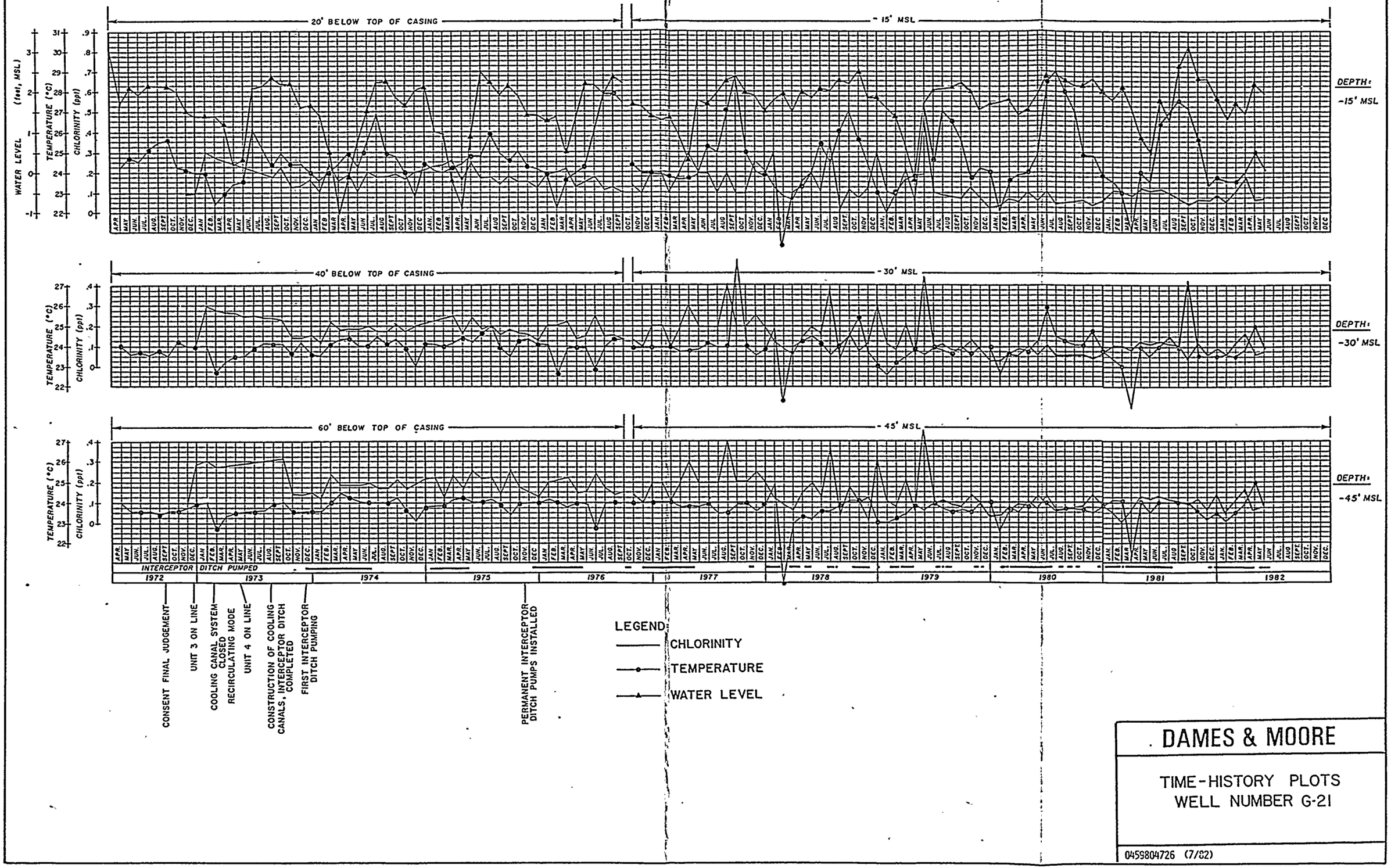
0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER G-14

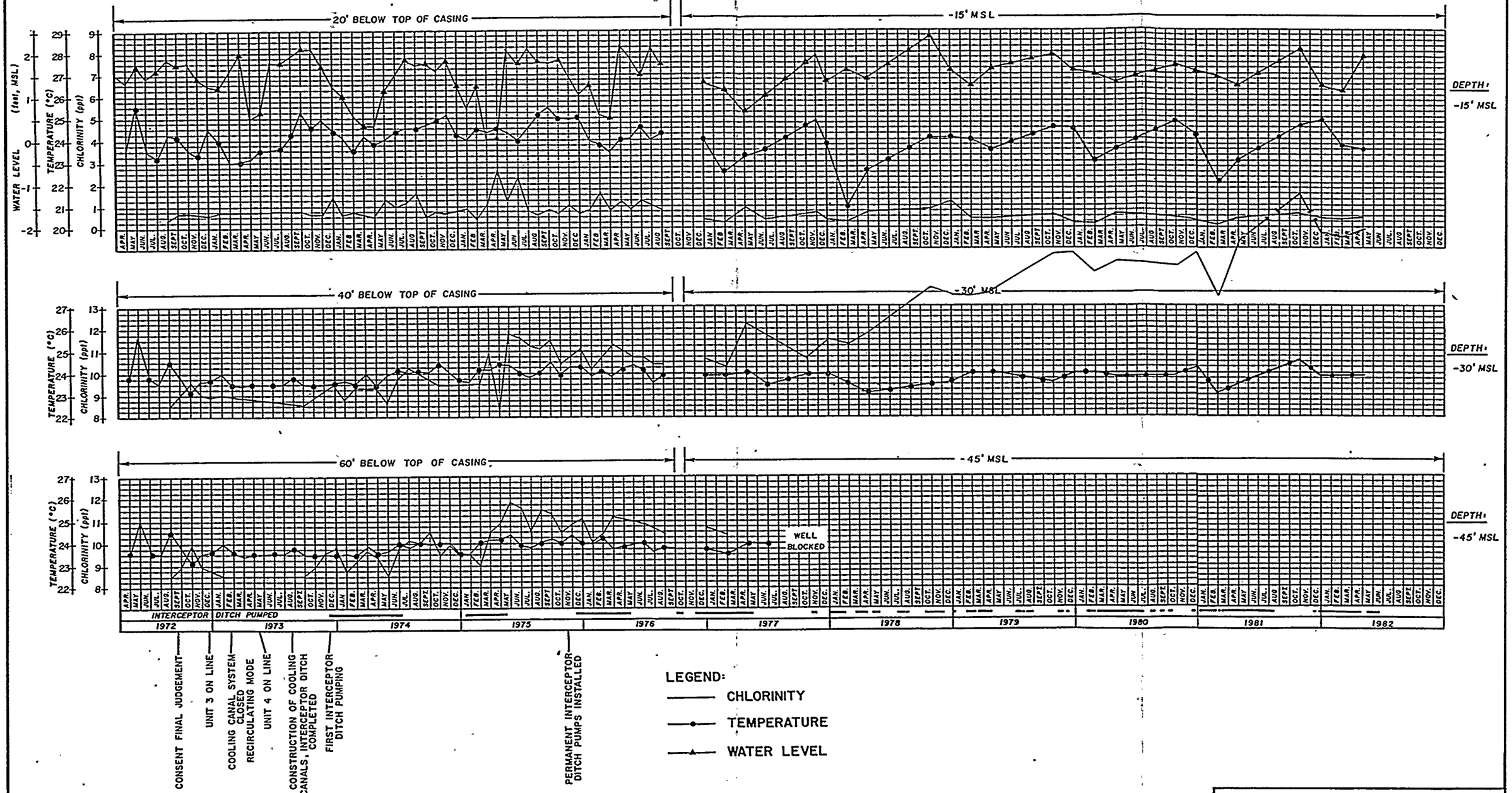
0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER G-21

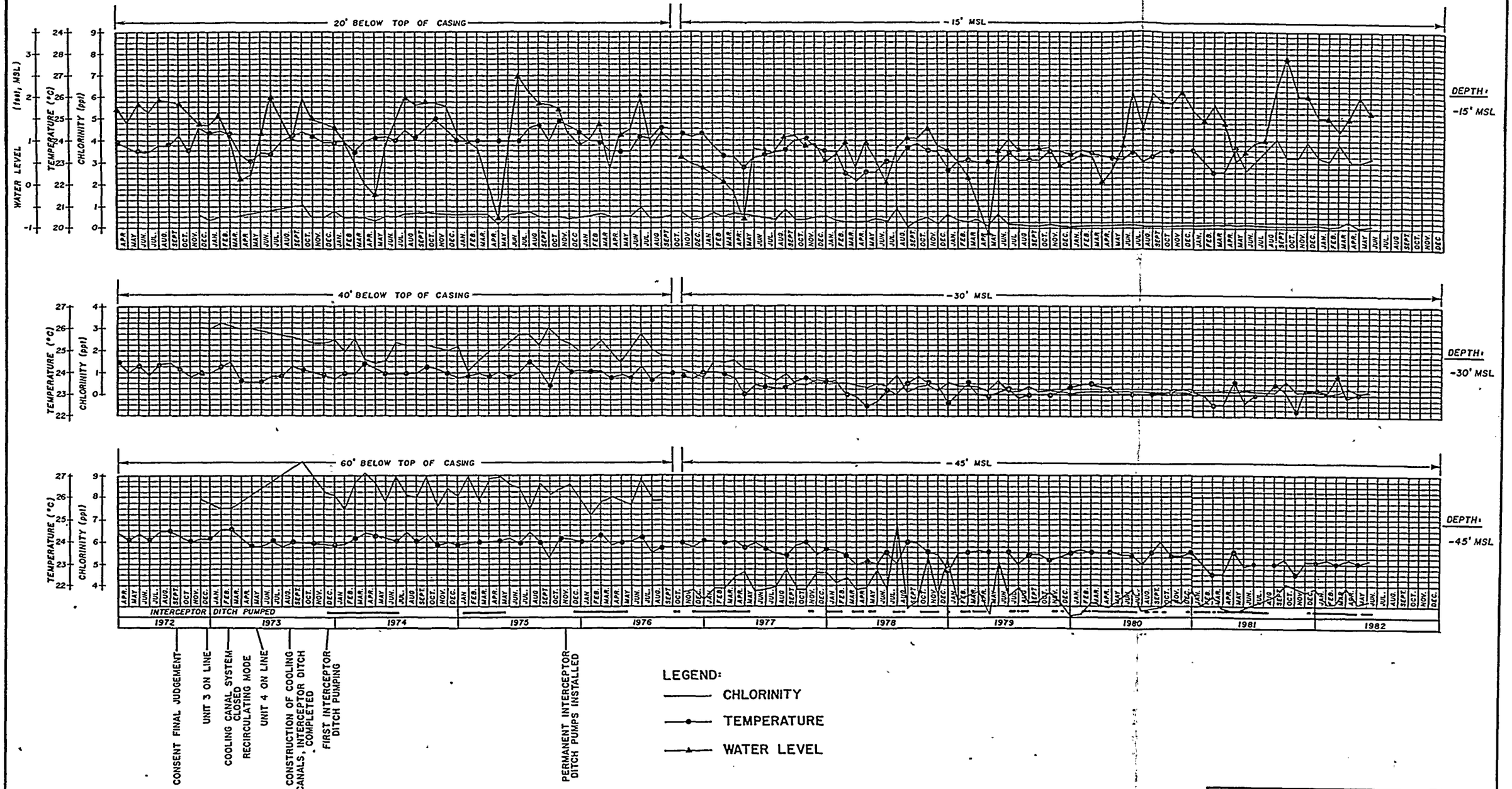
0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER G-27

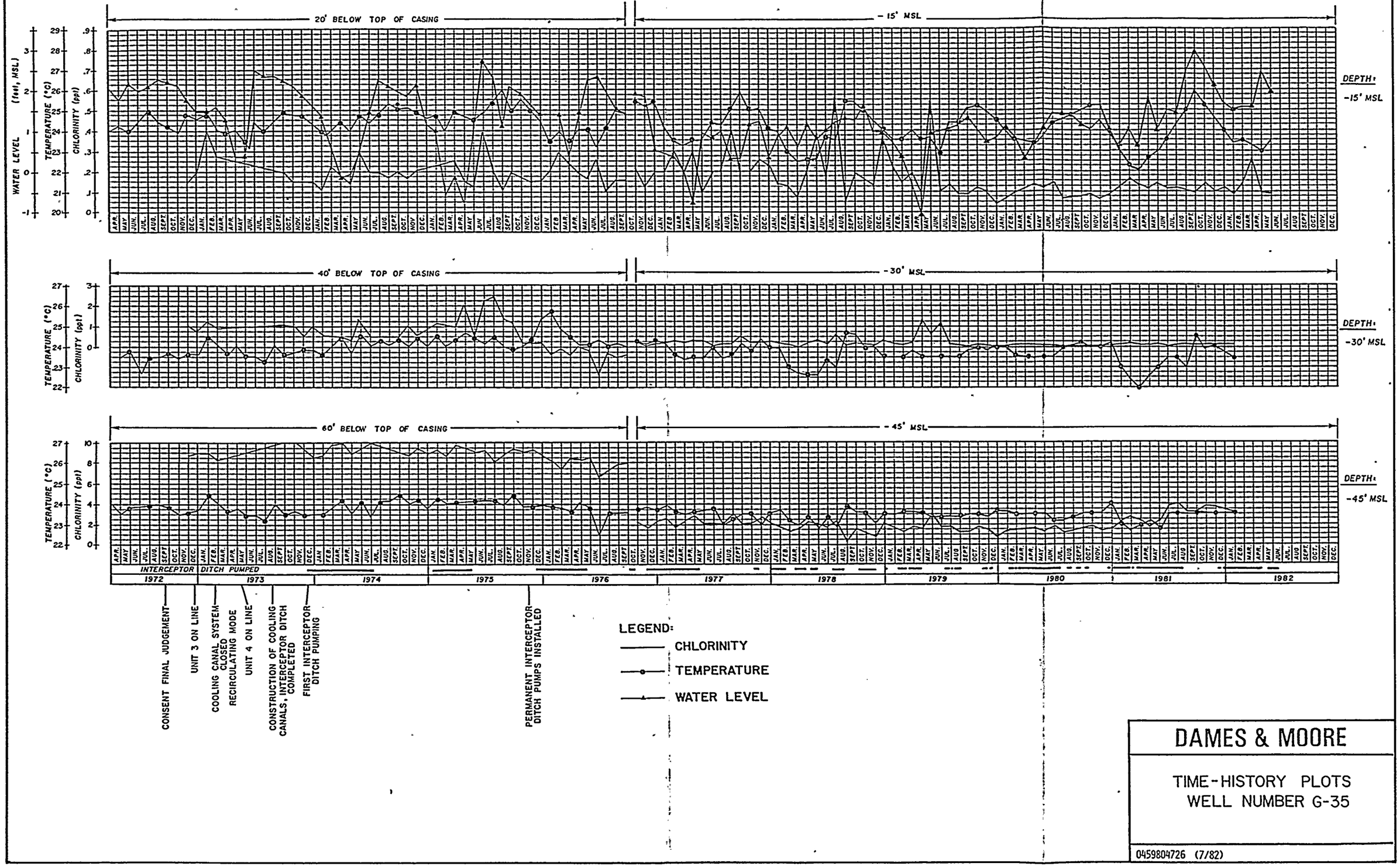
0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER G-28

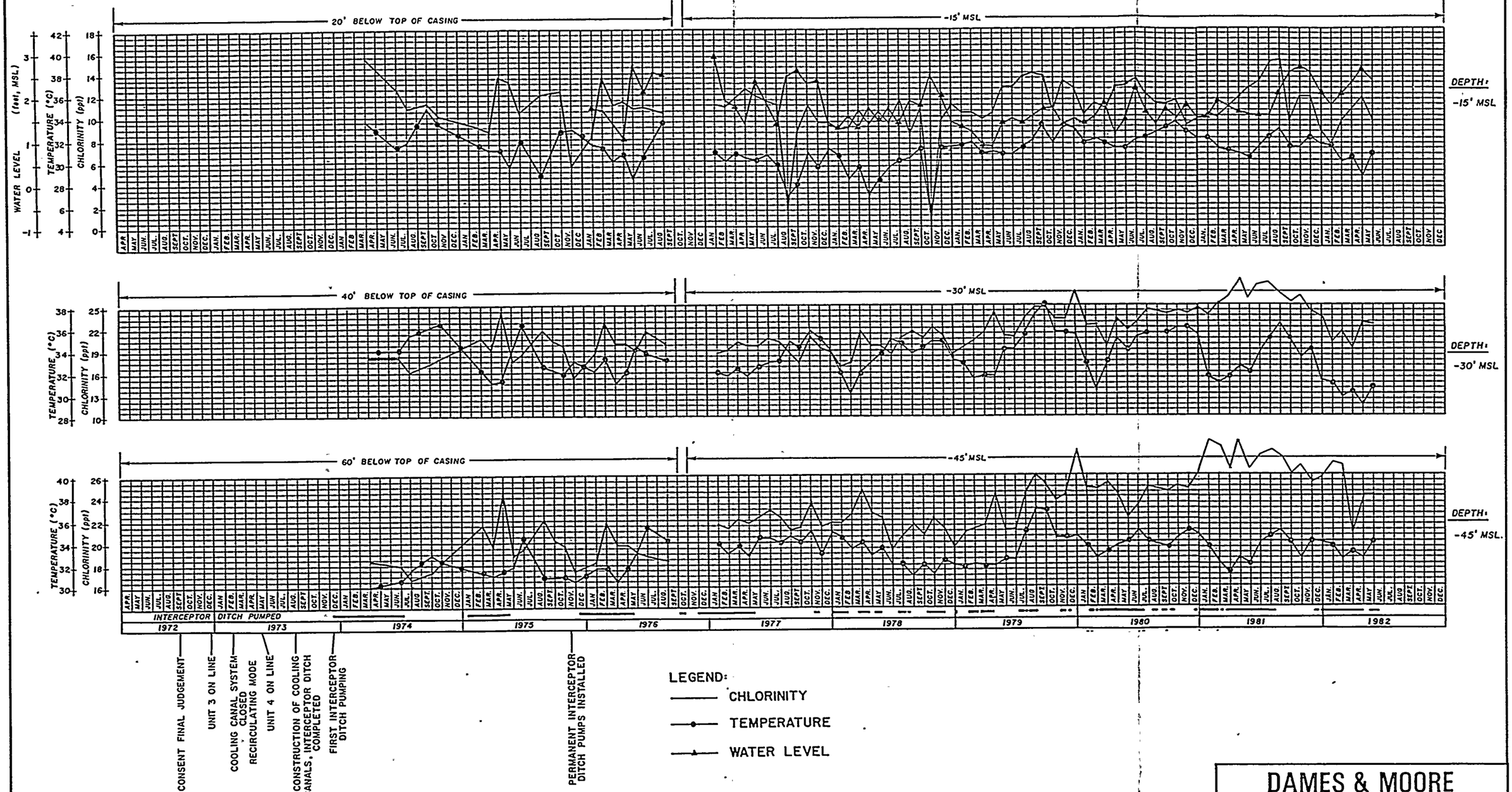
0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER G-35

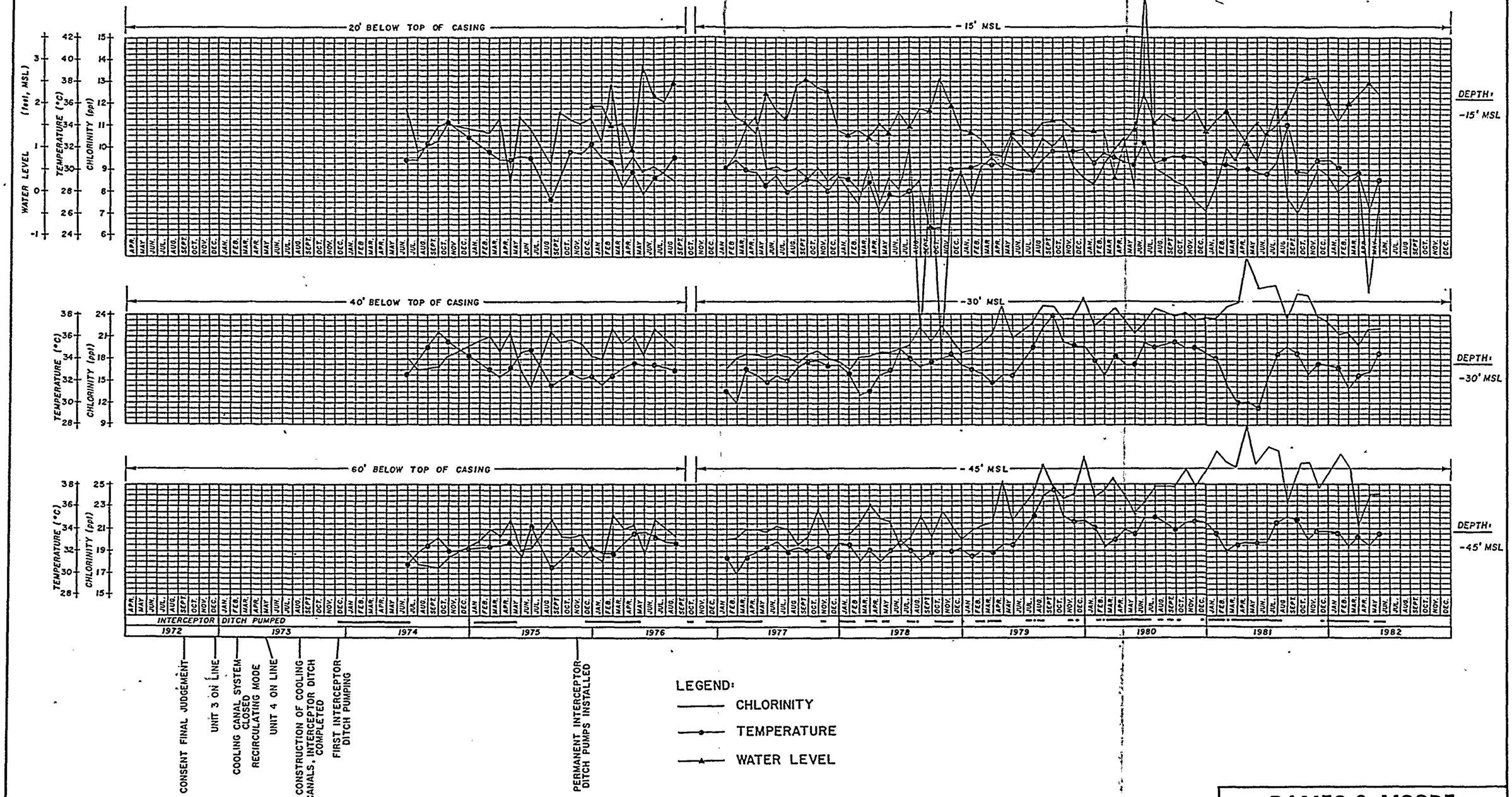
0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER X-1

0459804726 (7/82)



DAMES & MOORE

TIME-HISTORY PLOTS
WELL NUMBER X-2

0459804726 (7/82)

APPENDIX B

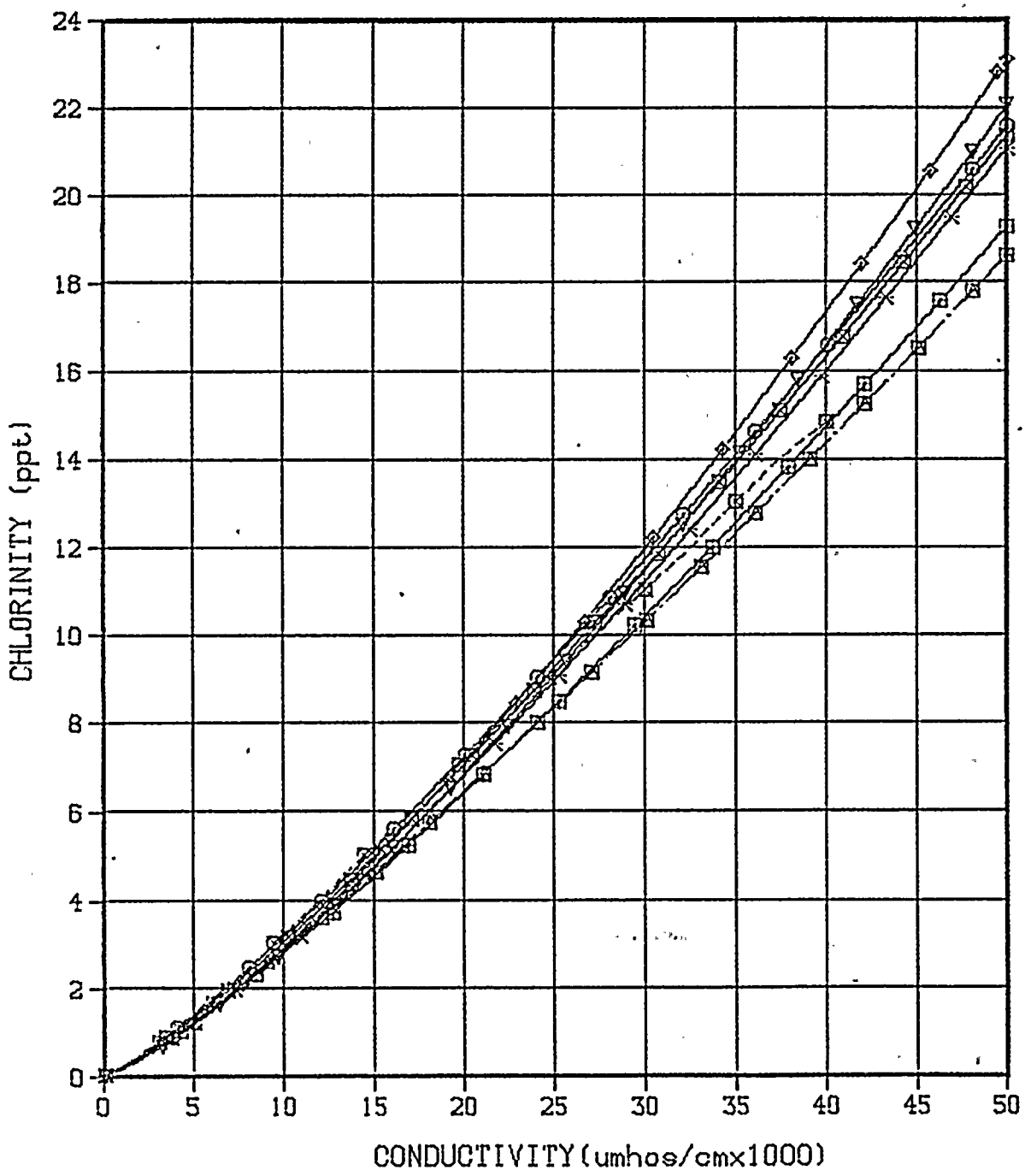
CONDUCTIVITY-CHLORINITY

CALIBRATIONS

APPENDIX B

CONDUCTIVITY-CHLORINITY CALIBRATIONS

The following figures present graphically the conductivity-chlorinity relationship for the ground water samples collected during the July 1981 - June 1982 monitoiring period as determined by Laboratory analyses. A discussion of the procedures for developing these relationships is presented in Appendix E.



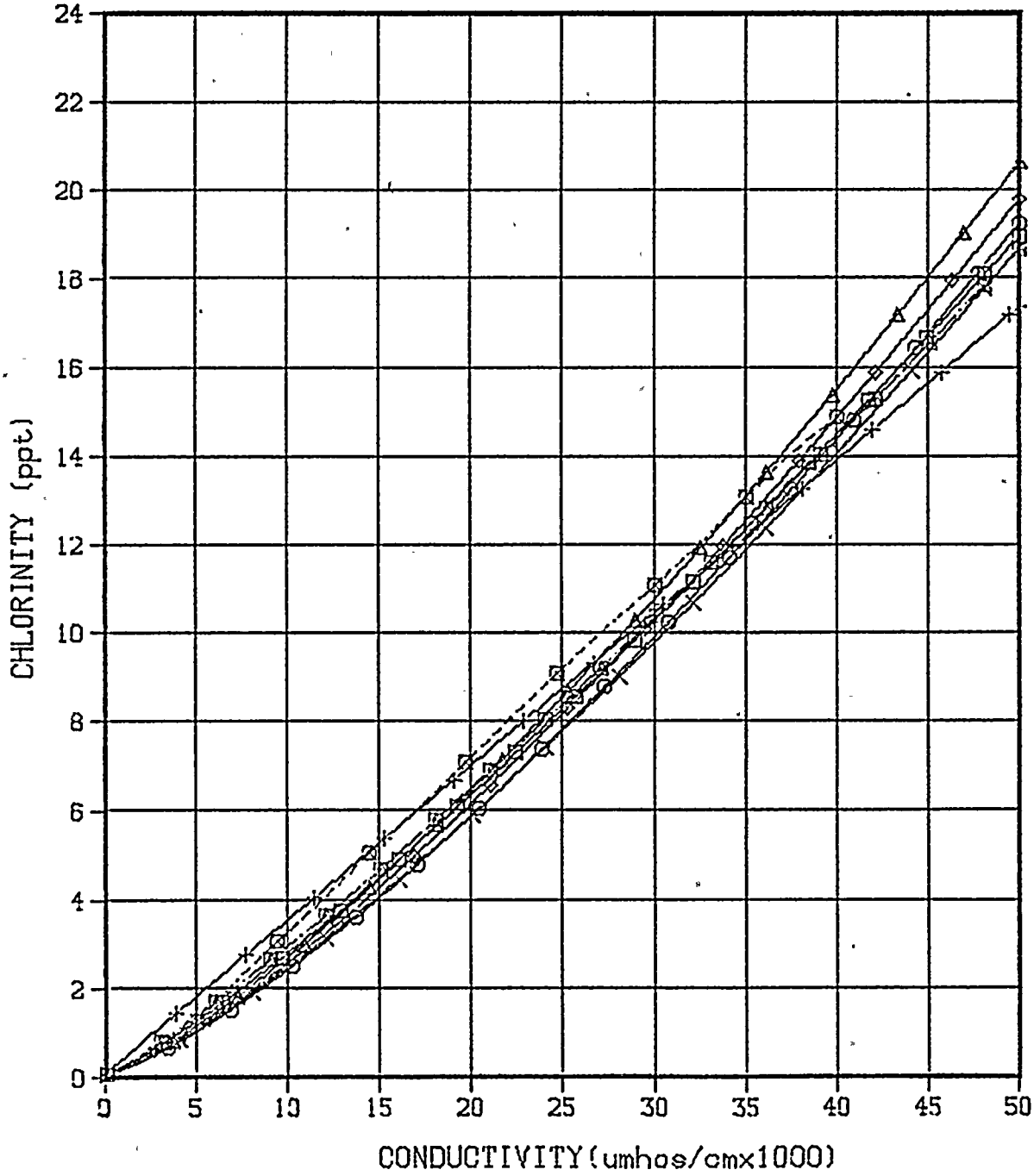
LEGEND

⊠ HISTORICAL	⊠ USGS
▽ JULY, 1981	◈ OCTOBER, 1981
⊠ AUGUST, 1981	⊕ NOVEMBER, 1981
✕ SEPTEMBER, 1981	⊞ DECEMBER, 1981

DAMES AND MOORE

CONDUCTIVITY-CHLORINITY RELATIONSHIPS G-SERIES WELLS

0459804726 (7/82)



LEGEND

⊠ HISTORICAL	⧈ USGS
□ JANUARY, 1982	+ APRIL, 1982
o FEBRUARY, 1982	× MAY, 1982
△ MARCH, 1982	◇ JUNE, 1982

DAMES AND MOORE

CONDUCTIVITY-CHLORINITY RELATIONSHIPS. G-SERIES WELLS

0459804726 (7/82)

APPENDIX C

INTERCEPTOR DITCH OPERATION

APPENDIX C

INTERCEPTOR DITCH OPERATION

The Interceptor Ditch Program consisted of construction of a ditch along the western edge of the cooling canal system and the installation of pumping facilities. The ditch and associated structures were established to control inland seepage of cooling canal water. This is accomplished by pumping water from the ditch during periods when a natural seaward ground water gradient does not exist. Operational procedures for the pumping stations and requirements for pumping are presented in the Ground Water Monitoring and Interceptor Ditch Operation Procedures Manual dated May 6, 1976.

Surface water elevations are monitored at staff gages located in the Levee 31E Borrow Canal, Cooling Canal 32, and the Interceptor Ditch. These staff gages are located at five positions in each of these canals relative to Lines A, B, C, D and E as shown on the inset, Figure 2. Water elevations are recorded twice a month during non-pumping periods (usually June through November) and once a week during potential pumping periods (December through May), except when the pumps are operating. When pumping occurs, water elevations are recorded at least twice a week.

Interceptor Ditch pumping for the wet season began July 1, 1981 as pumping continued uninterrupted from June 1981. Lines A, B and C were pumping at this time and continued until August 4 when Line C was shut down. Lines A and B continued pumping until August 18 when they too were shut down. The Interceptor Ditch was not pumped during September, October and November 1981 as a natural seaward gradient was present during these months.

Interceptor Ditch pumping for the dry season began December 14, 1981 with Lines A and B and continued until December 17. Pumping resumed on December 22 with Lines A and B. Line C began pumping on January 8, 1982 and Lines D and E on January 11. All lines continued pumping until February 18 when Lines C, D and E were shut down. Lines A and B continued pumping through the end of February 1982. Lines C, D and E resumed pumping on March 1, 1982 and all lines continued pumping until March 31 when Lines D and E were shut down. Lines A, B and C were pumped during the entire month of April 1982 and were joined briefly by Lines D and E on April 12 and 13, and again from April 20 to 28. No pumping was required between May 1 and May 18, 1982. All lines began pumping on May 19 and continued until June 8 when Lines D and E were shut down. Lines A, B and C were shut down on June 9, 1982.

This concludes the Interceptor Ditch pumping program for the July 1981 - June 1982 monitoring period.

APPENDIX D

VARIATIONS FROM HISTORICAL ENVELOPE CURVES

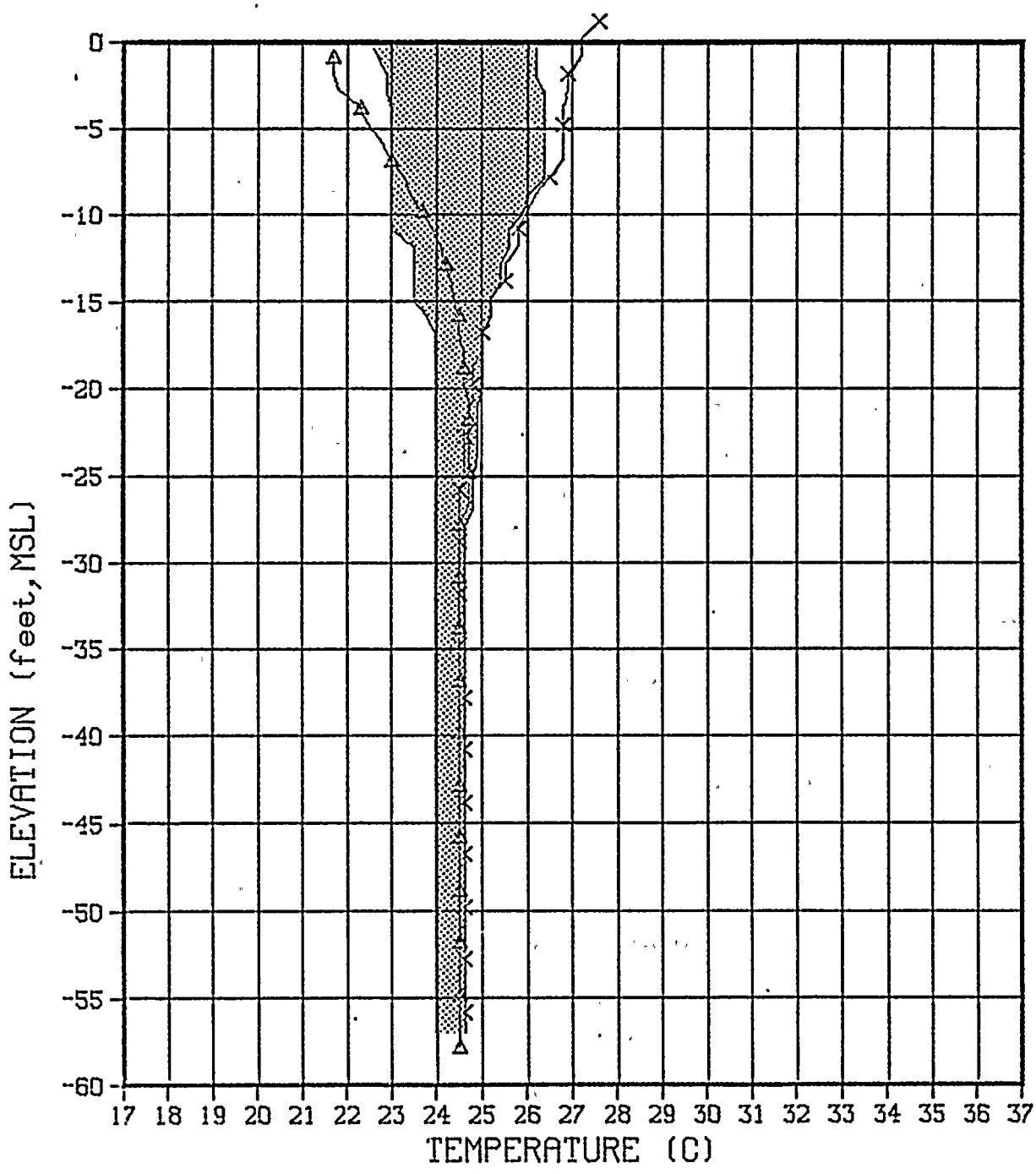
APPENDIX D

VARIATIONS FROM HISTORICAL ENVELOPE CURVES

Historical envelope curves have been prepared which show the historical ranges of temperature and chlorinity profiles. The historical base for envelope curves is from November 1976 through June 1981.

This appendix contains plots of the historical envelope curves for each well having excursions from that envelope during the July 1981 through June 1982 monitoring period. The shaded area on each plot is the historical envelope while temperature and chlorinity excursions are shown as profile lines.

The excursions presented in the following figures are similar to those for indicator wells presented in Section 2.0 of the report. The reader is referred to Sections 2.0 and 3.0 for a summary of the results of the July 1981 - June 1982 monitoring program.



LEGEND

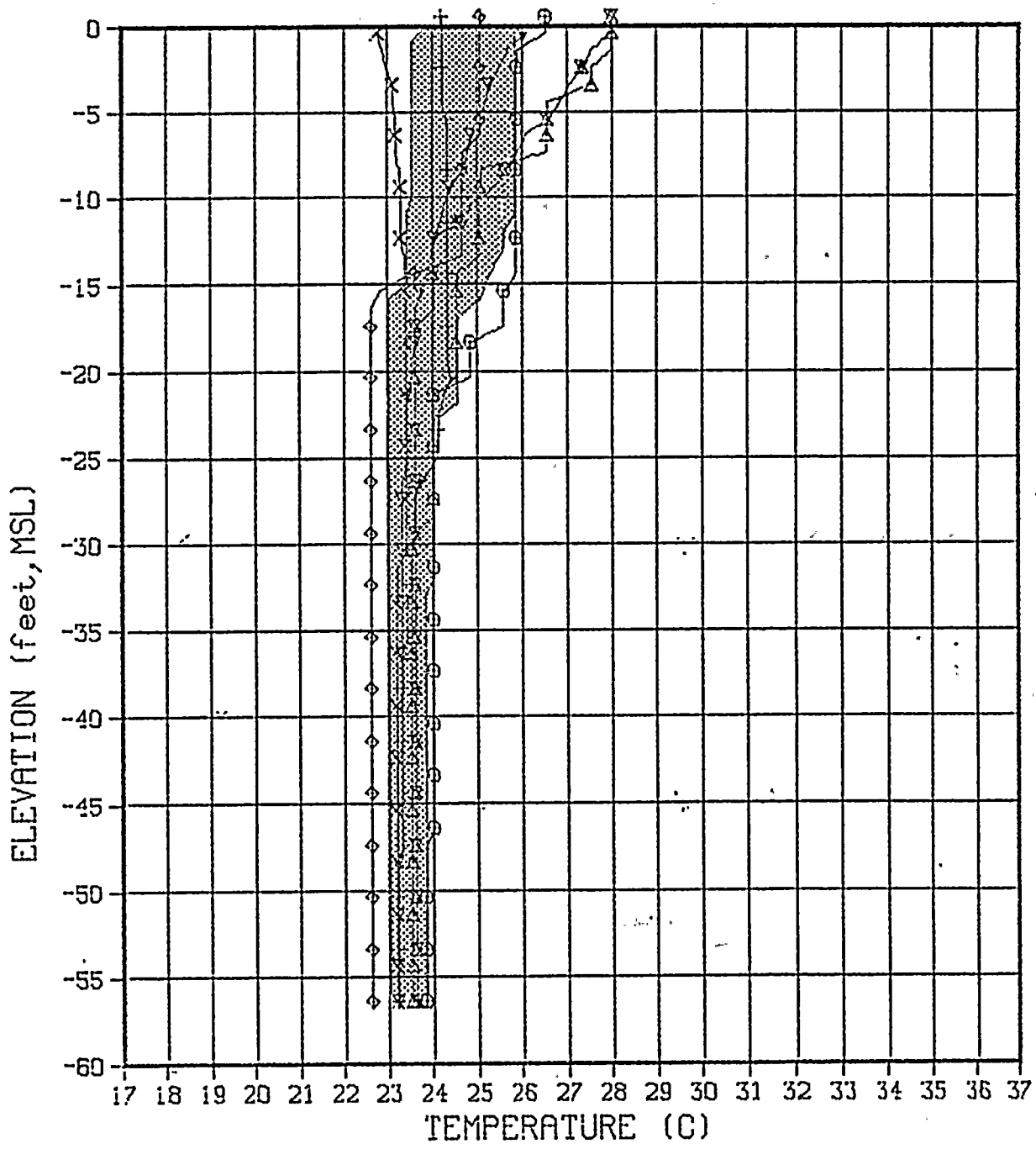
△ MAR-82 × NOV-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER G-6

0459804726 (7/82)



LEGEND

△ AUG-81 + DEC-81 × FEB-82 ▽ JUNE-82

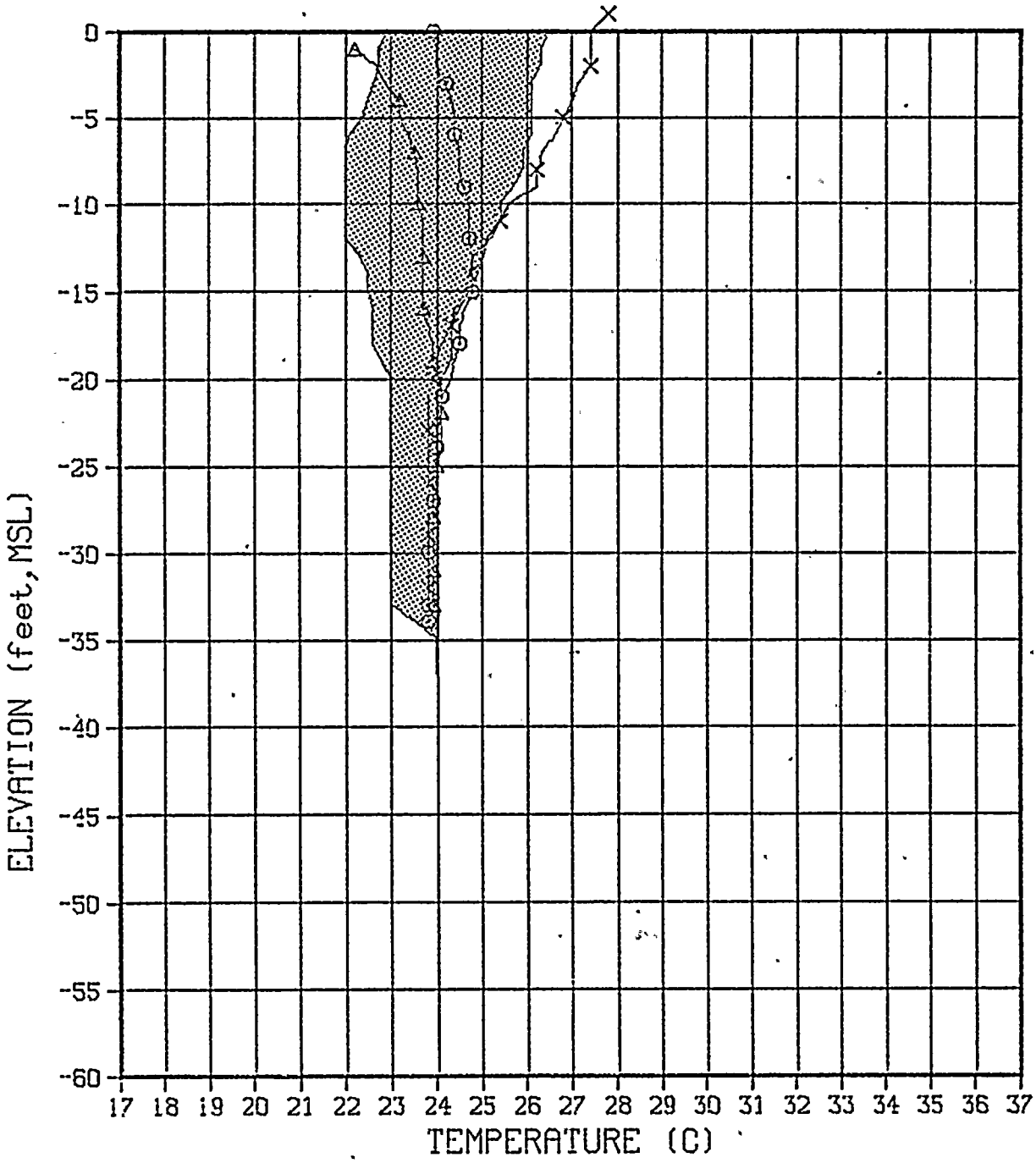
◇ NOV-81 ⊕ OCT-81 ⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER G-14

0459804726 (7/82)



LEGEND

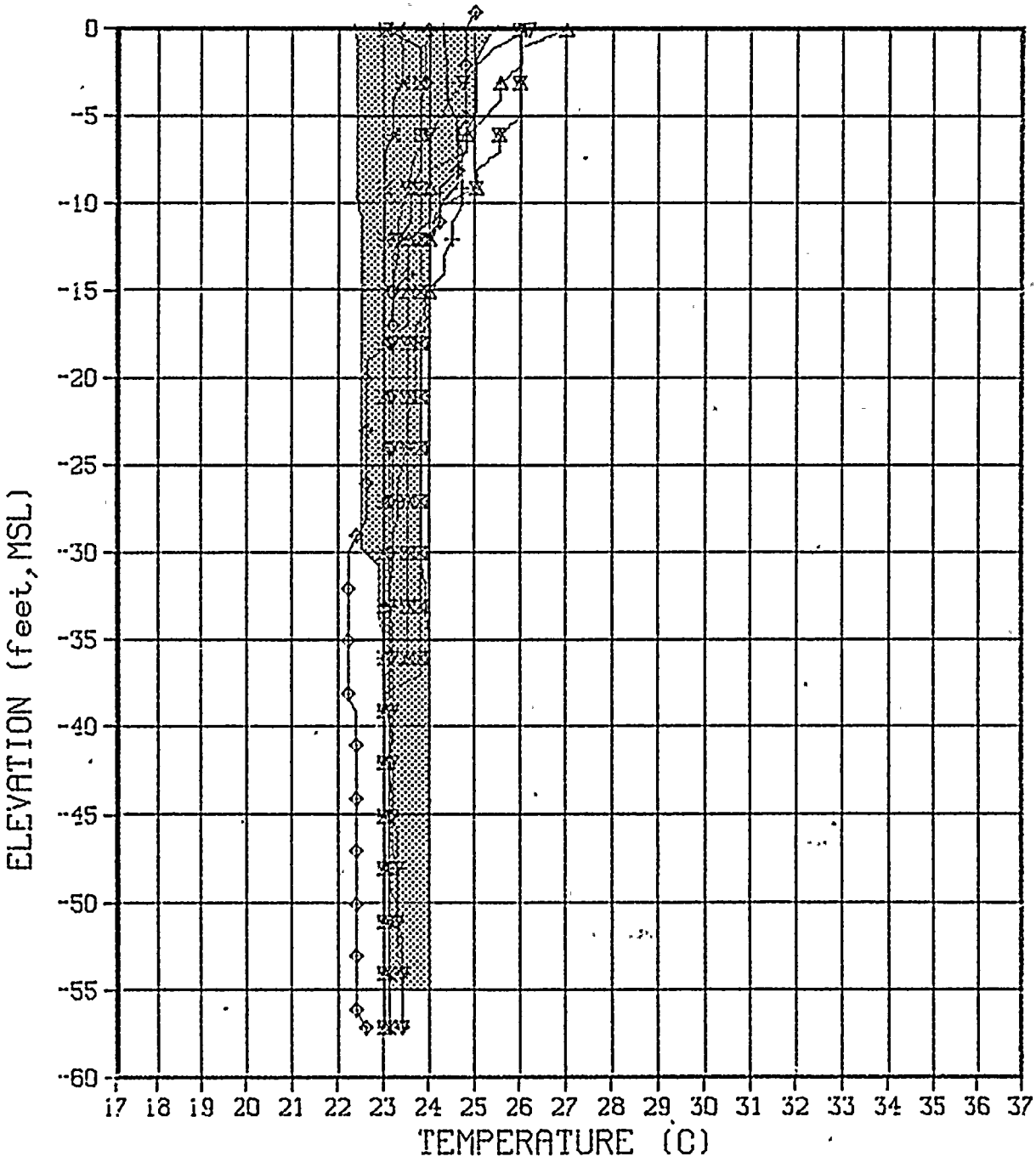
○ JAN-82 △ MAR-82 × NOV-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER G-27

0459804726 (7/82)



LEGEND

△ AUG-81 + DEC-81 ◇ JAN-82 ▽ JUNE-82

⊠ MAR-82 ✕ MAY-82 ◈ NOV-81 ⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER G-28

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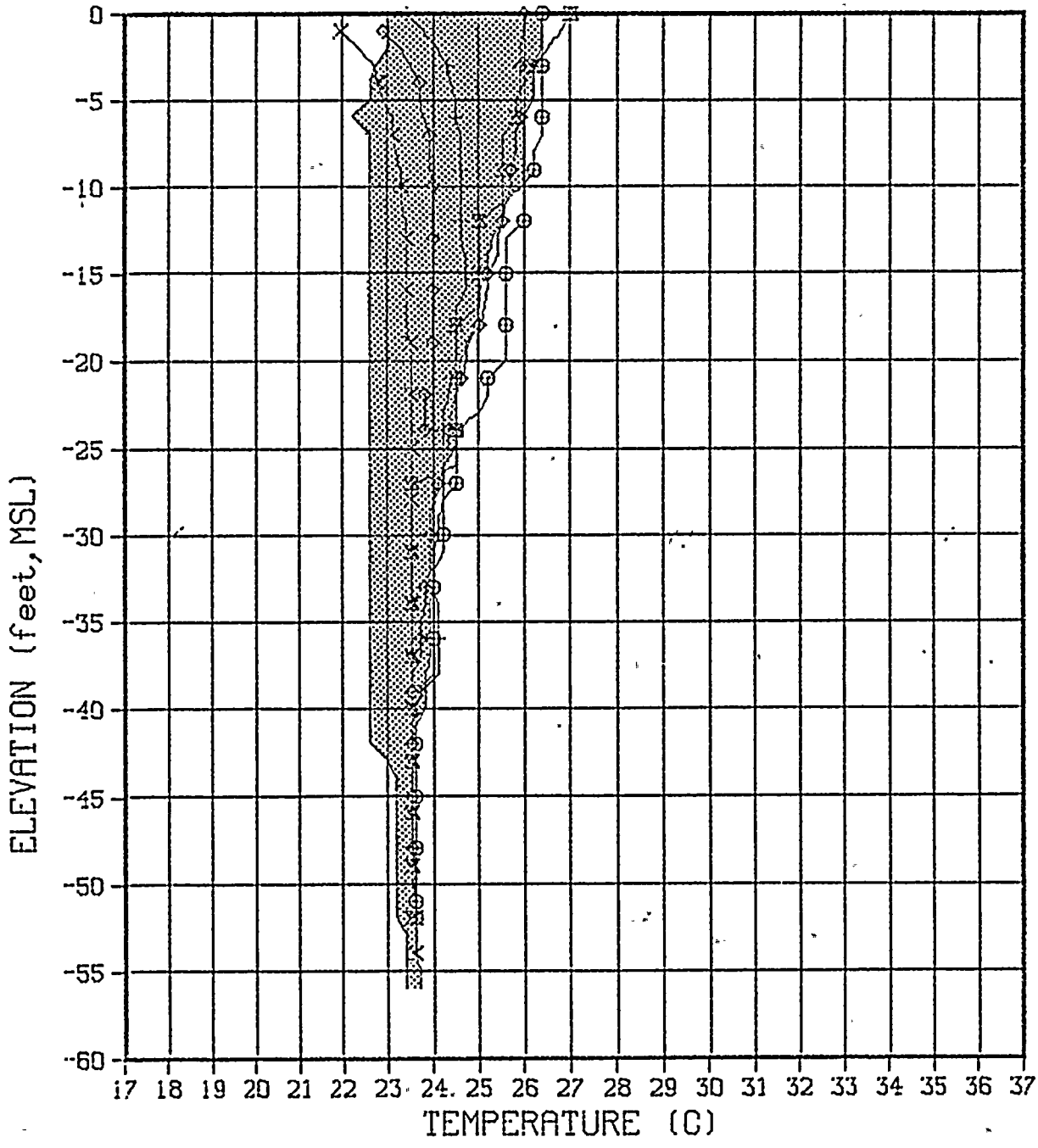


LEGEND

+ DEC-81 × FEB-82 ◇ JAN-82 ◈ NOV-81

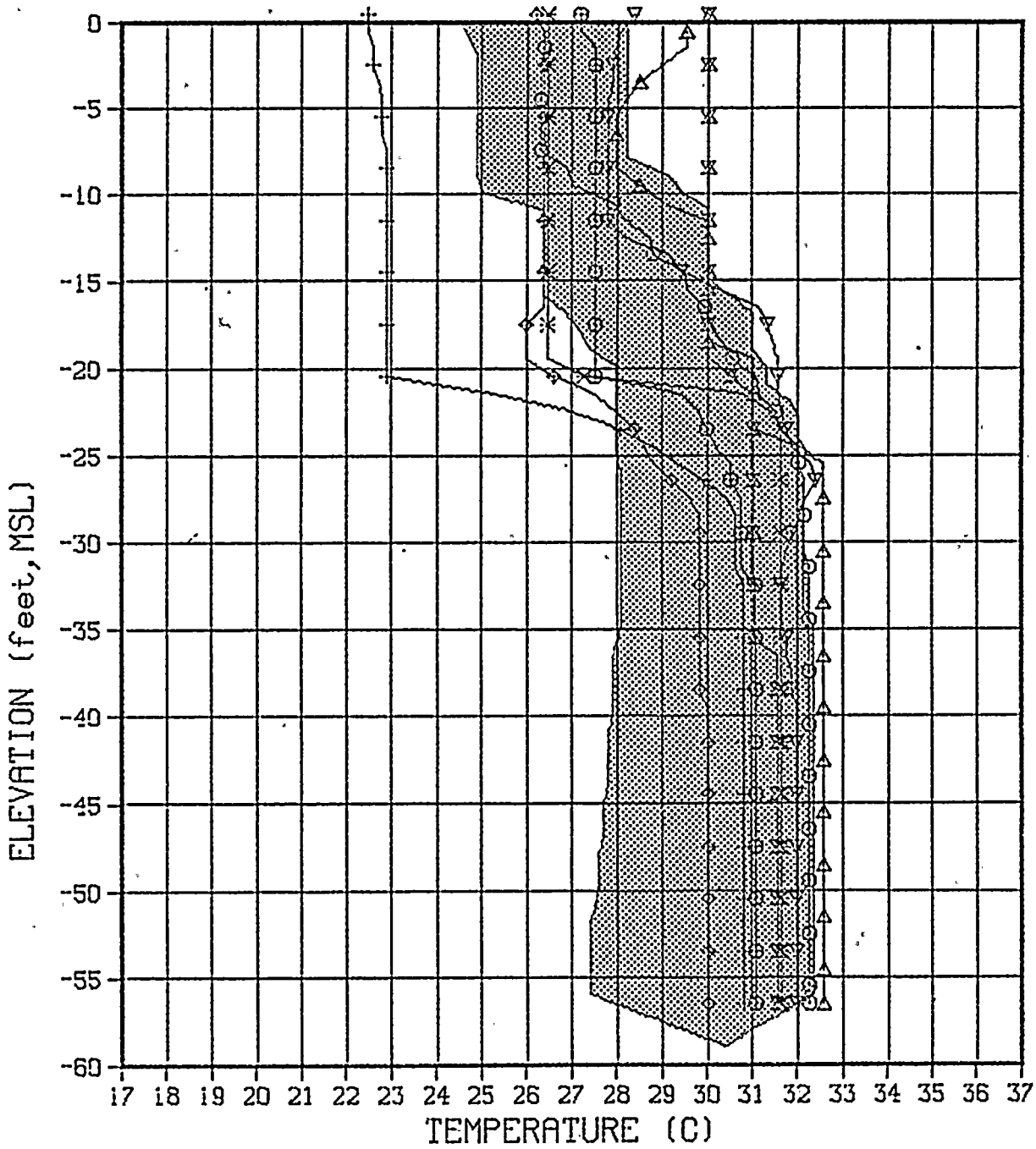
⊕ OCT-81 ⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER G-35

0459804726 (7/82)



LEGEND

○ APR-82 △ AUG-81 + DEC-81 ▽ JUNE-82

✕ MAY-82 ◇ NOV-81 ⊕ OCT-81 ⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER ID-A

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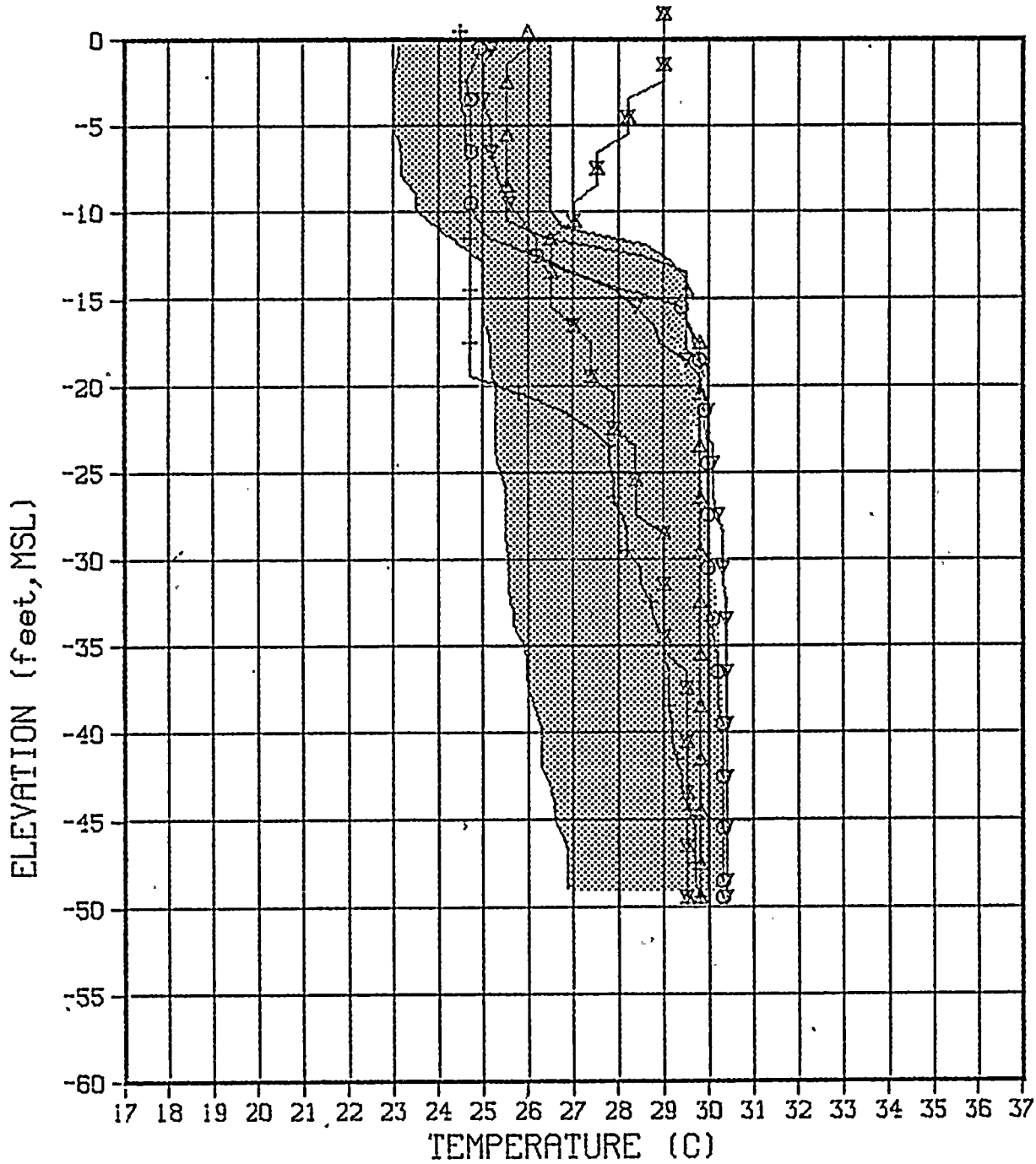

LEGEND

○ APR-82 △ AUG-81 + DEC-81 ▽ JUNE-82

⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER ID-C

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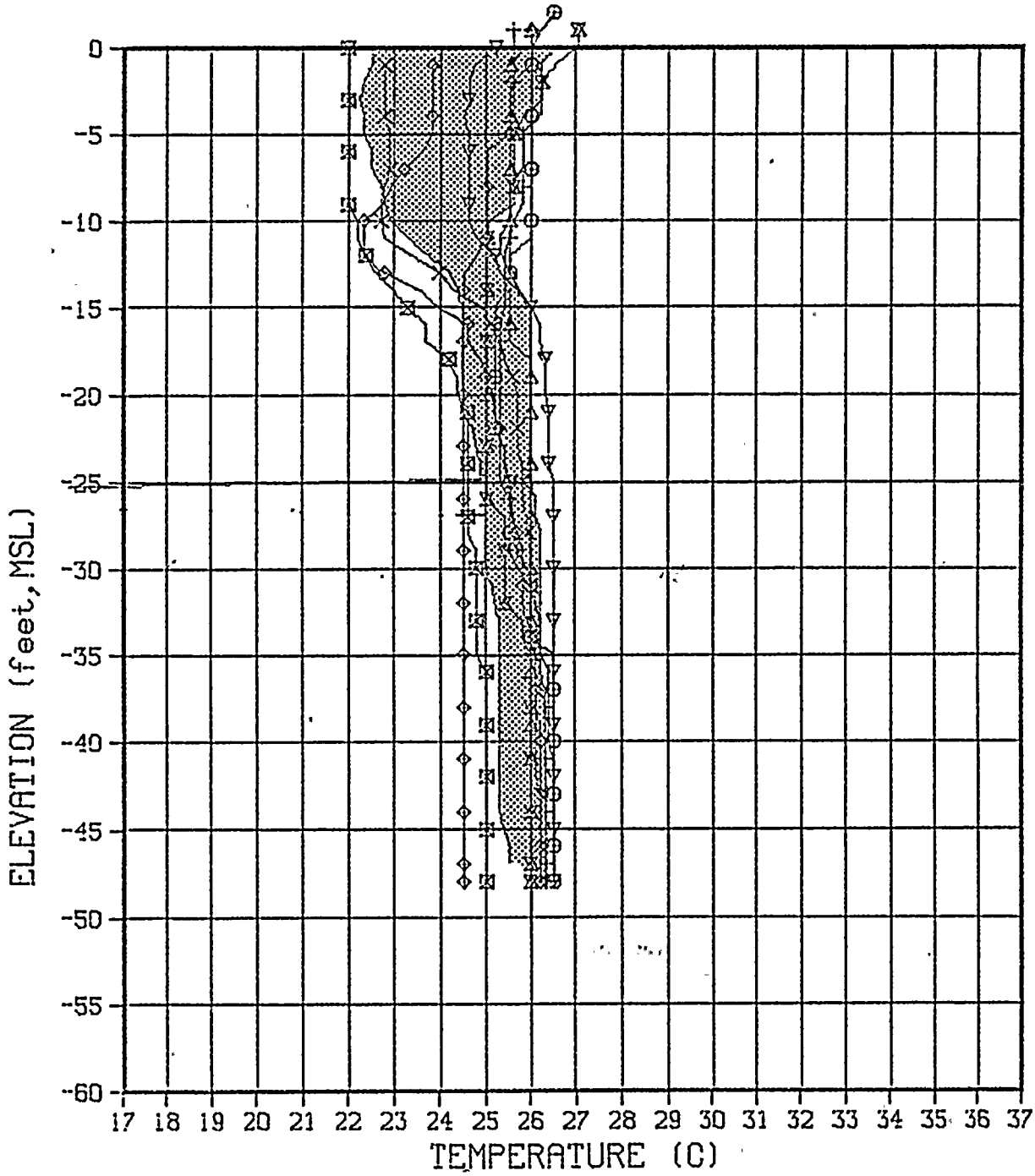


LEGEND

△ AUG-81 + DEC-81 × FEB-82 ◇ JAN-82

▽ JUNE-82 ⊠ MAR-82 ◈ NOV-81 ⊙ OCT-81

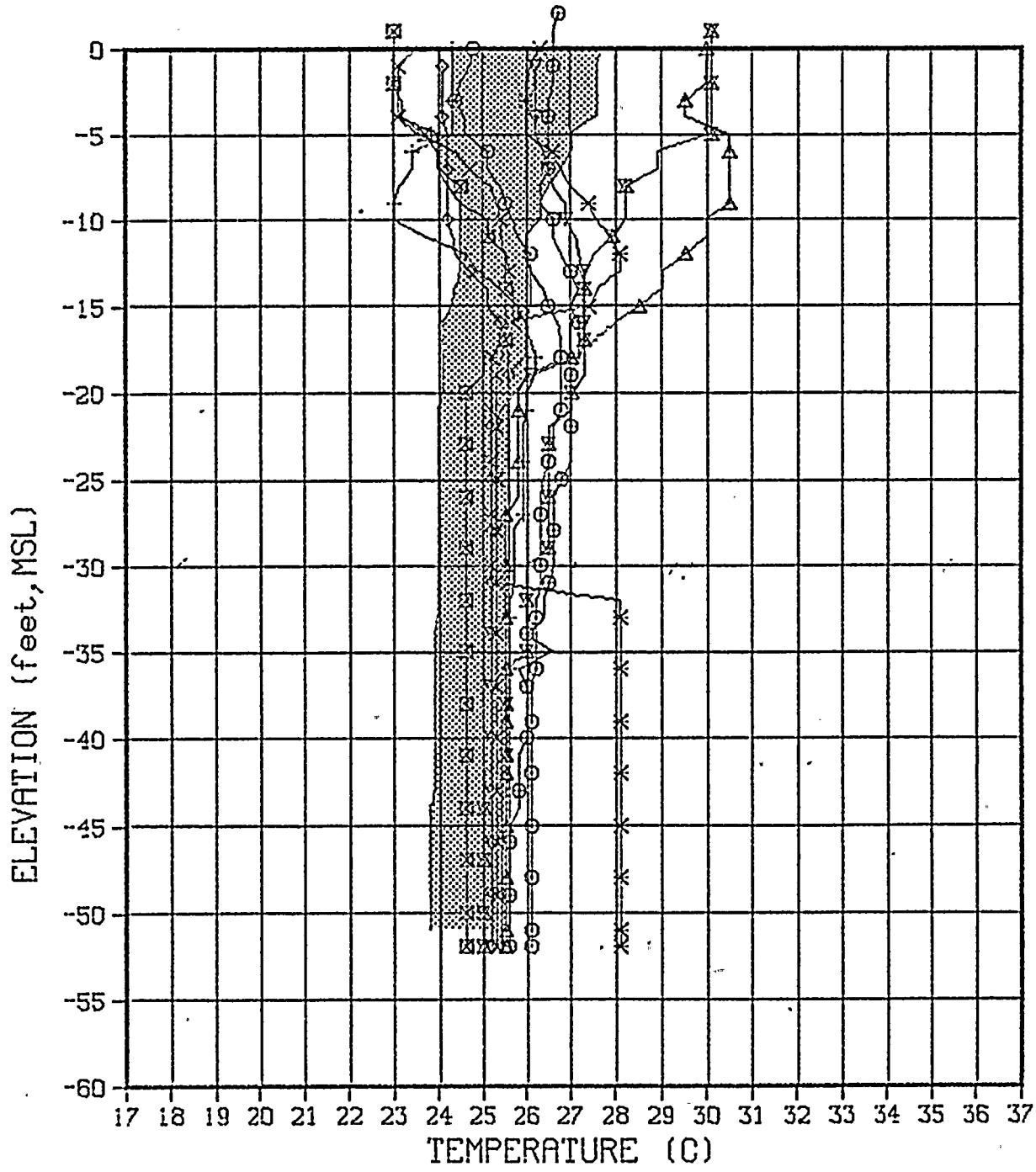
⧓ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER ID-D

0459804726 (7/82)



LEGEND

○ APR-82 △ AUG-81 + DEC-81 × FEB-82

◇ JAN-82 ▽ JUNE-82 ⊠ MAR-82 ✳ MAY-82

⊕ OCT-81 ⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER ID-E

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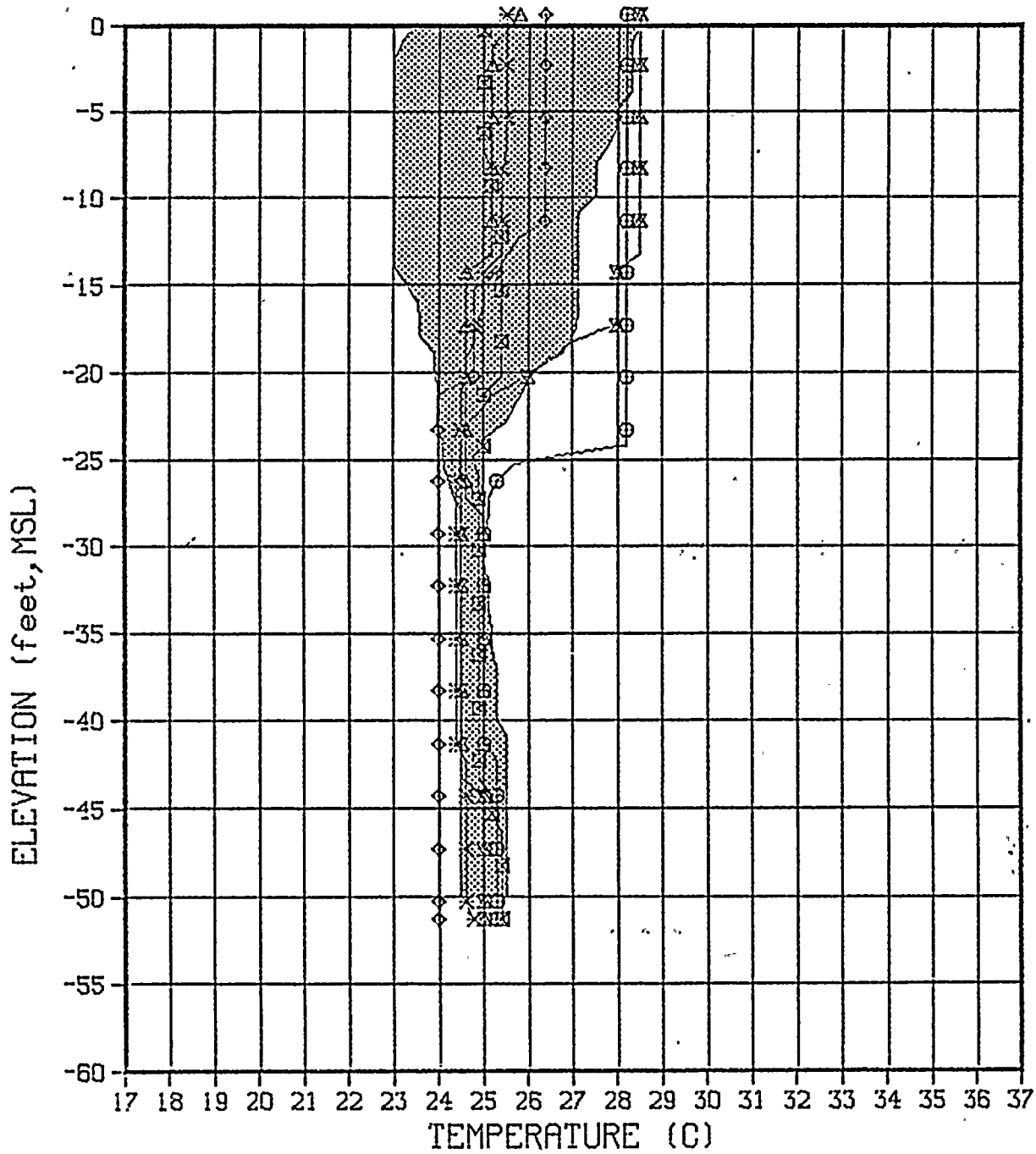


LEGEND

△ AUG-81 ⊠ MAR-82 ✕ MAY-82 ◇ NOV-81

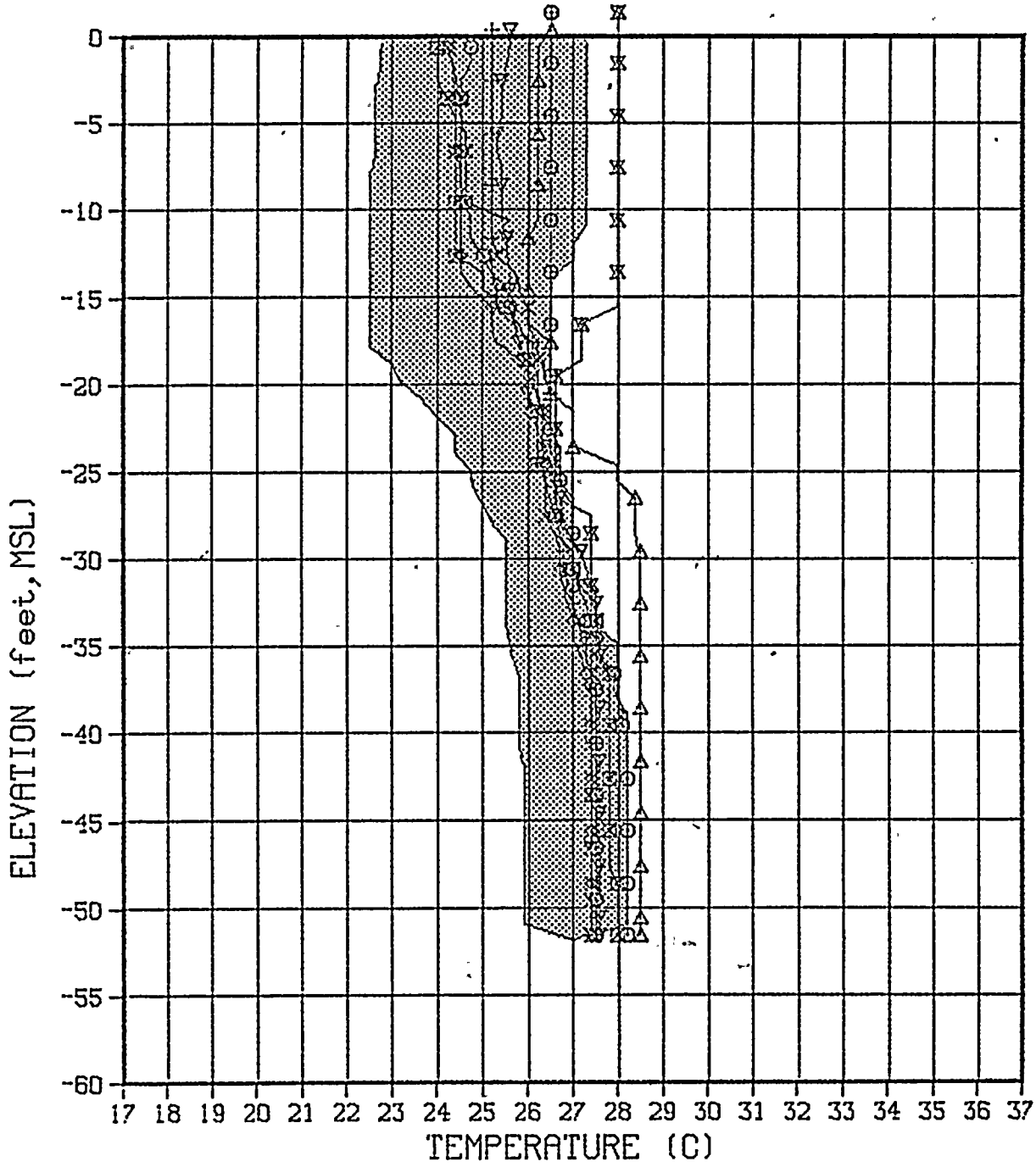
⊕ OCT-81 ⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER L-1

0459804726 (7/82)



LEGEND

○ APR-82 △ AUG-81 + DEC-81 × FEB-82

◇ JAN-82 ▽ JUNE-82 ⊠ MAR-82 ⊕ OCT-81

⊠ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER L-2

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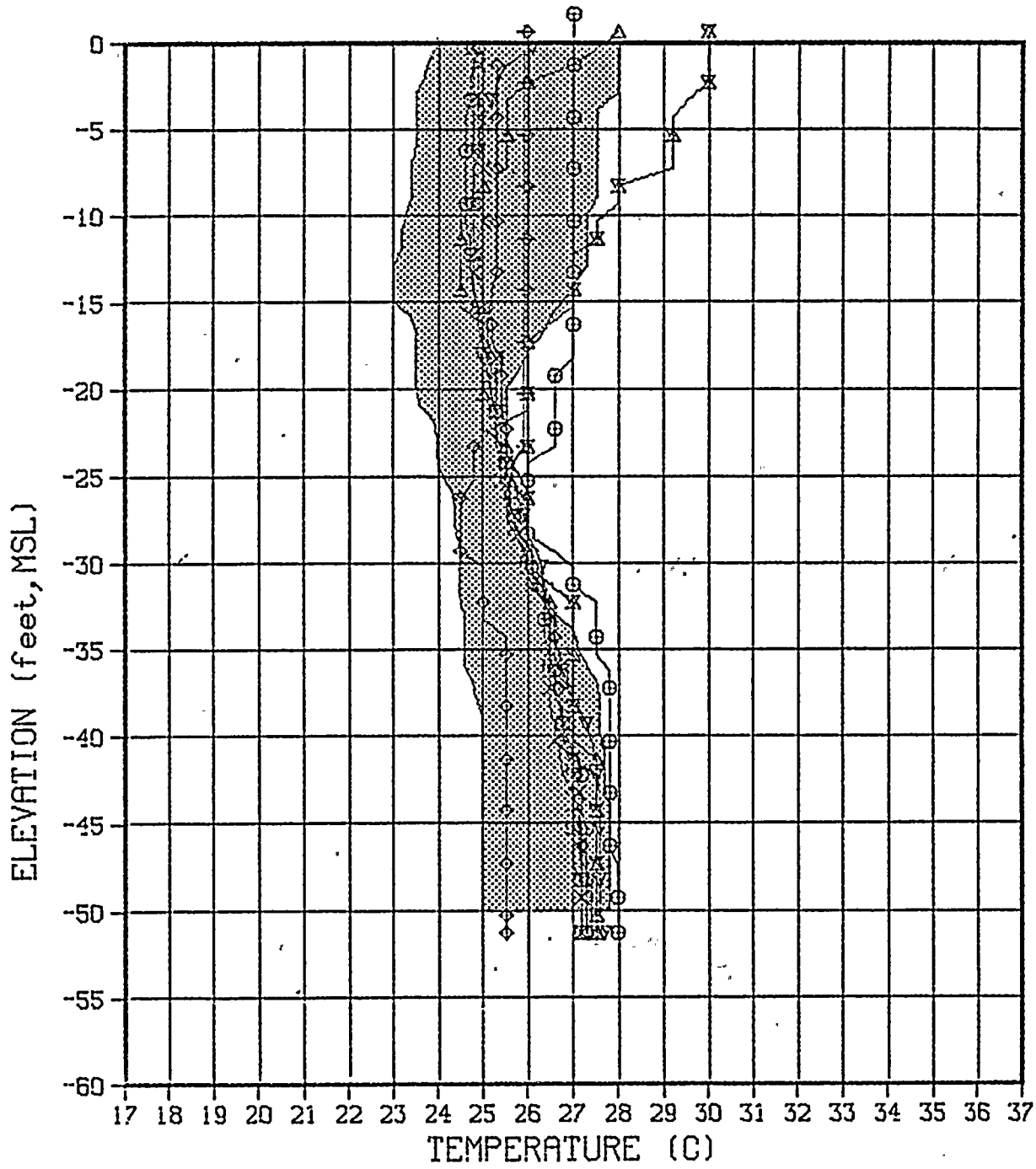

LEGEND

○ APR-82 △ AUG-81 + DEC-81 × FEB-82

◇ JAN-82 ▽ JUNE-82 ⊠ MAR-82 ◈ NOV-81

⊕ OCT-81 ⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER L-3

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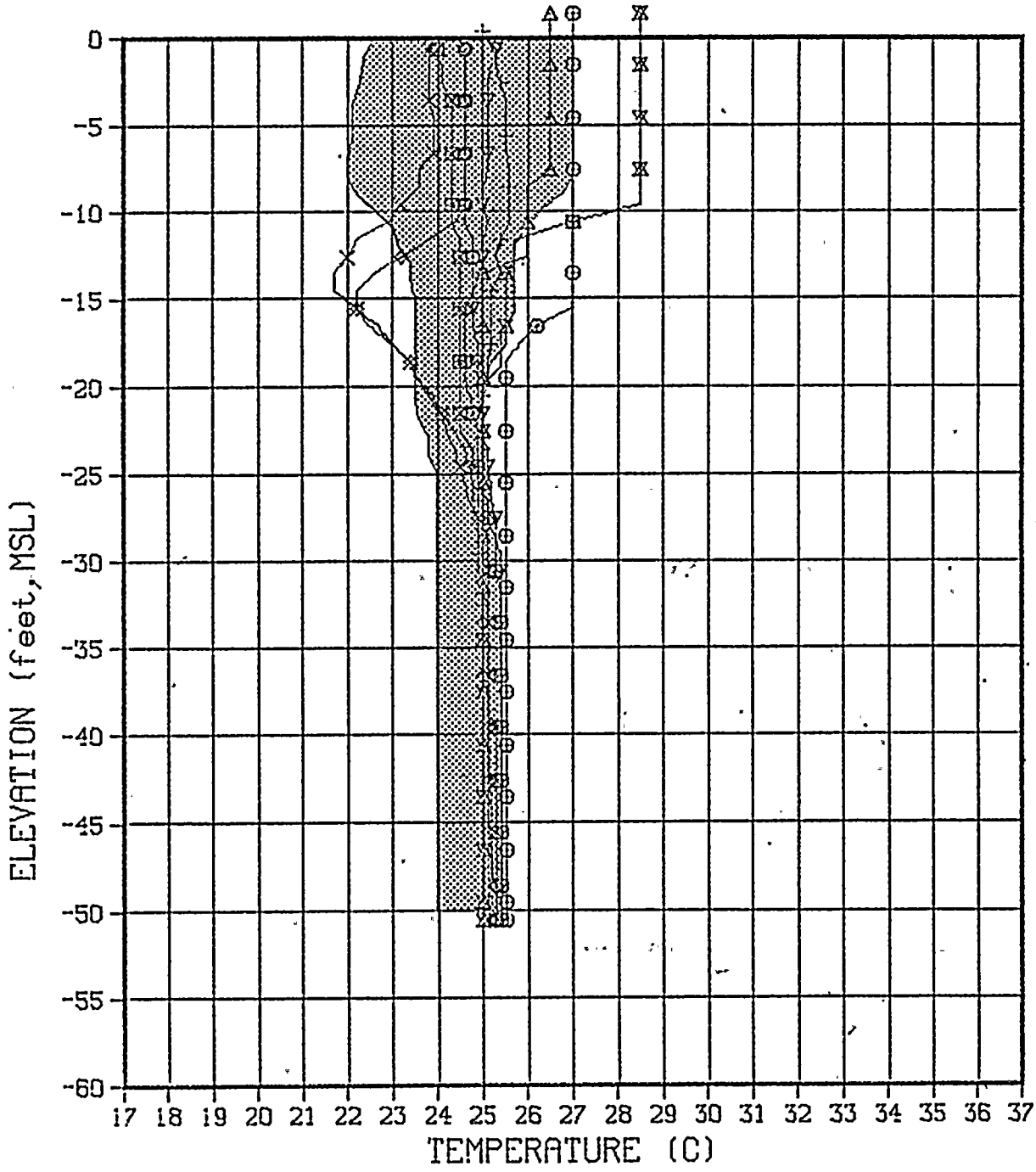


LEGEND

○ APR-82 △ AUG-81 + DEC-81 × FEB-82

◇ JAN-82 ▽ JUNE-82 ⊠ MAR-82 ⊕ OCT-81

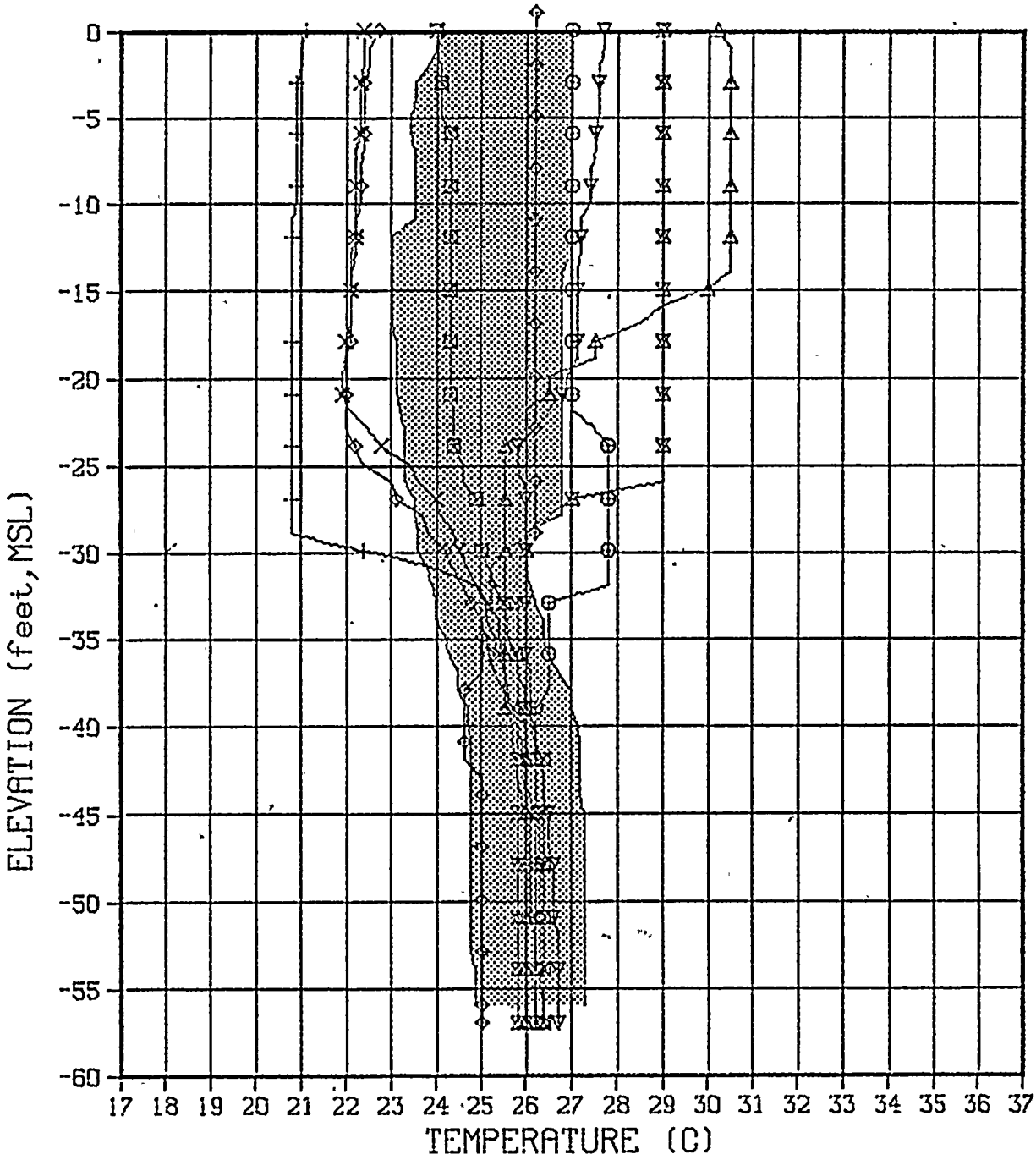
⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER L-5

0459804726 (7/82)



LEGEND

△ AUG-81 + DEC-81 × FEB-82 ◇ JAN-82

▽ JUNE-82 ⊠ MAR-82 ✦ NOV-81 ⊕ OCT-81

⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER L-6

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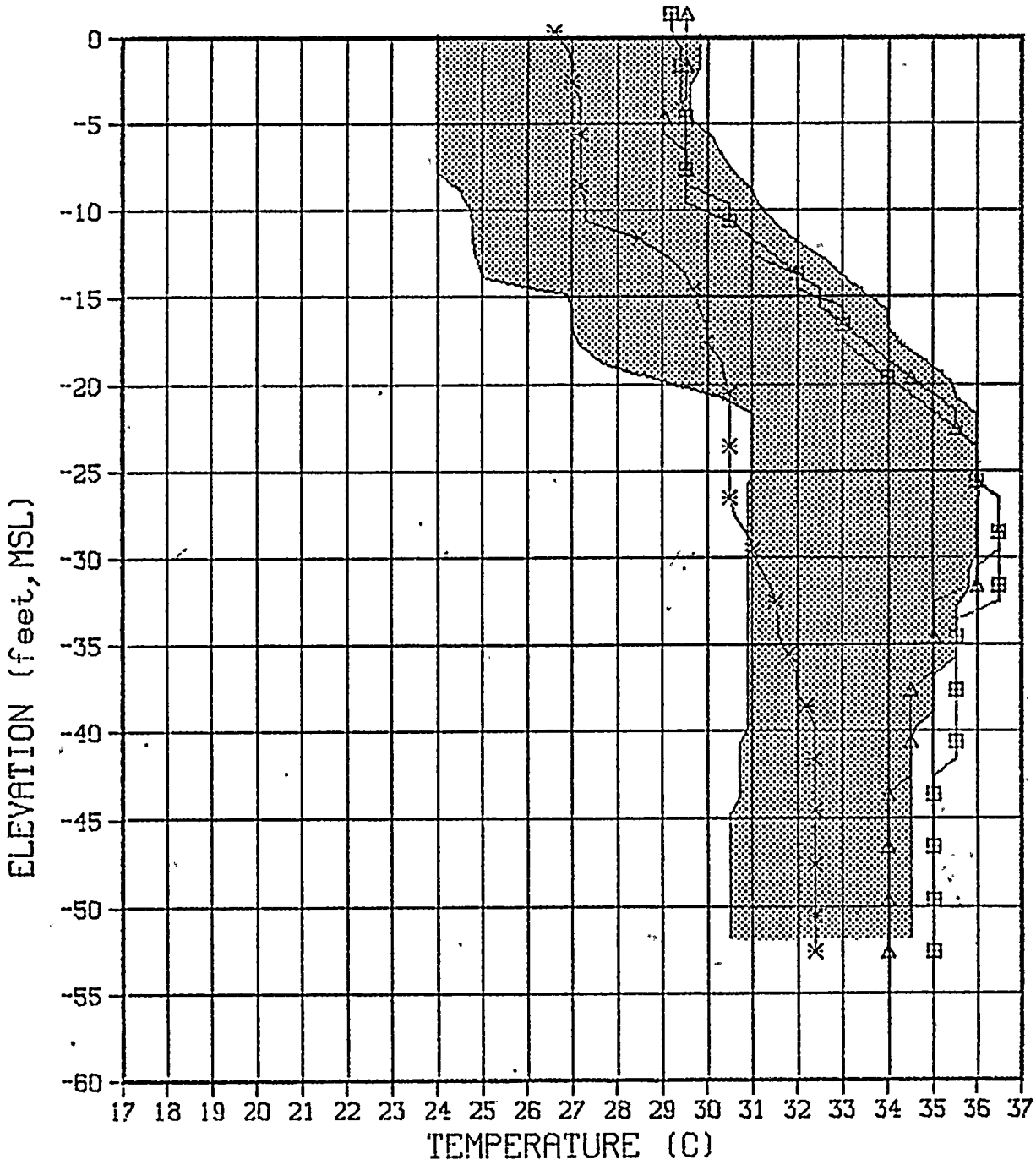


LEGEND

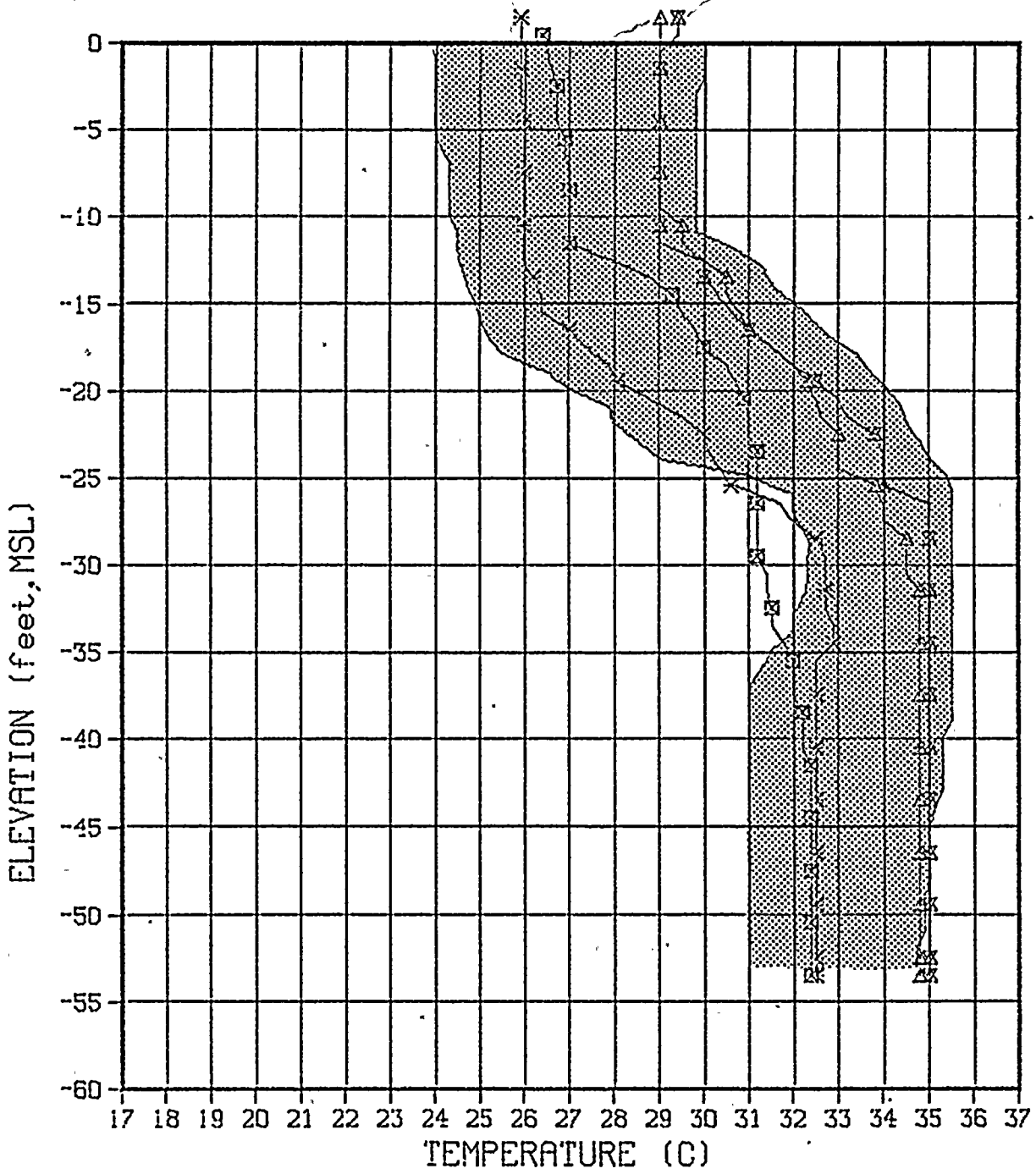
△ AUG-81 ✕ MAR-82 ⊞ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER X-1

0459804726 (7/82)



LEGEND

△ AUG-81 ⊠ MAR-82 ✕ MAY-82 ⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM TEMPERATURE ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER X-2

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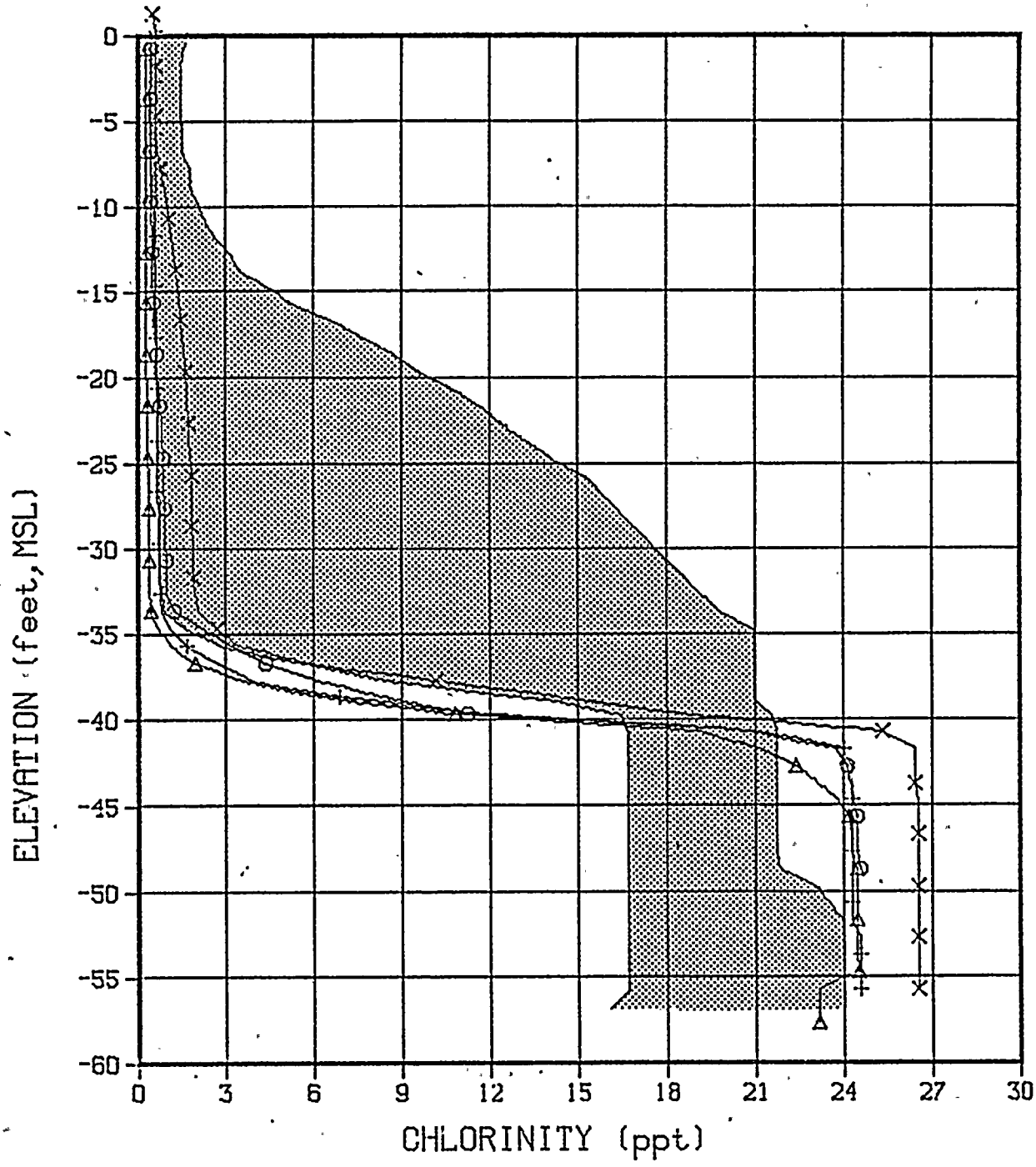


LEGEND

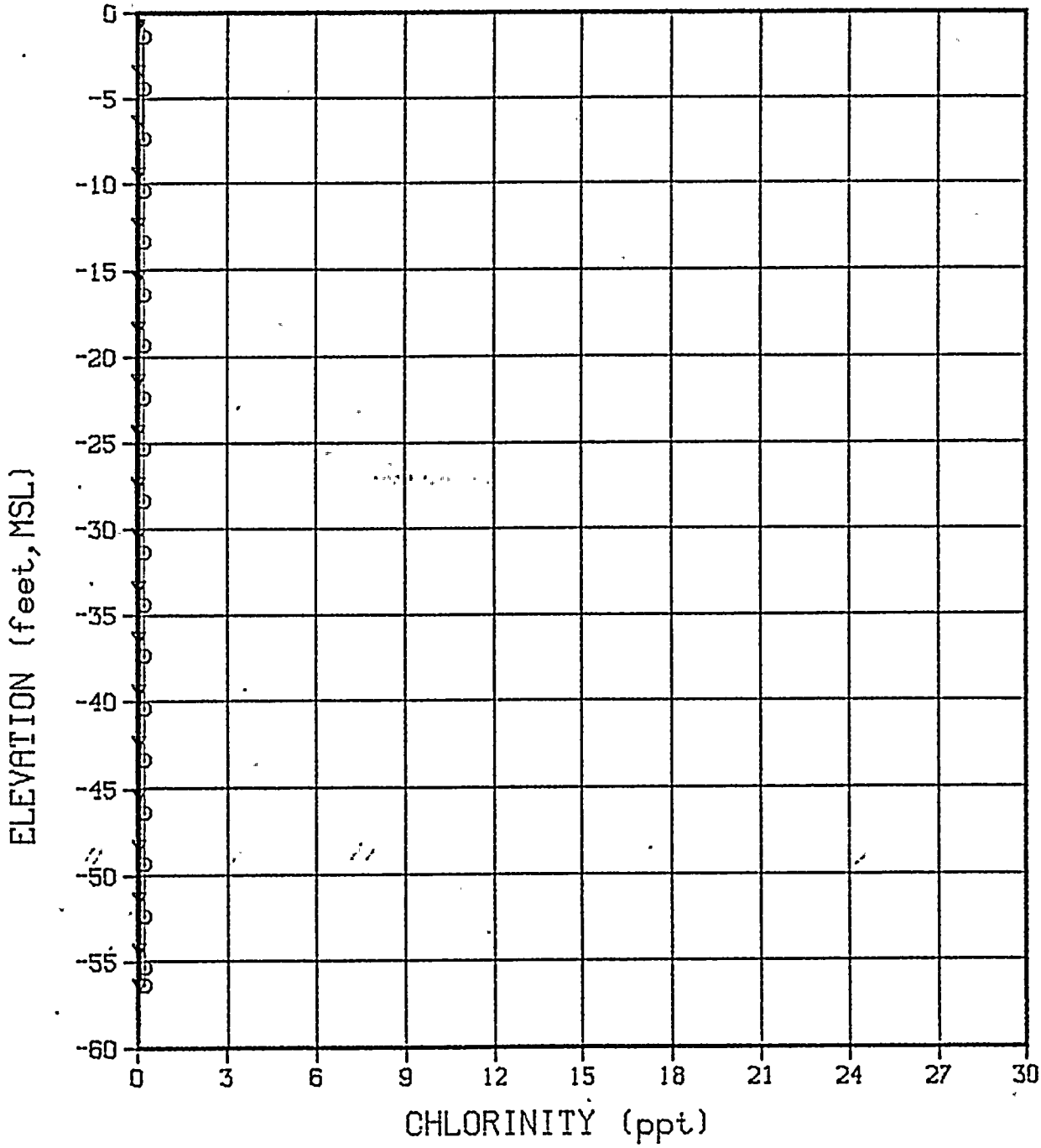
○ JAN-82 △ MAR-82 + MAY-82 × NOV-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER G-6

0459804726 (7/82)



LEGEND

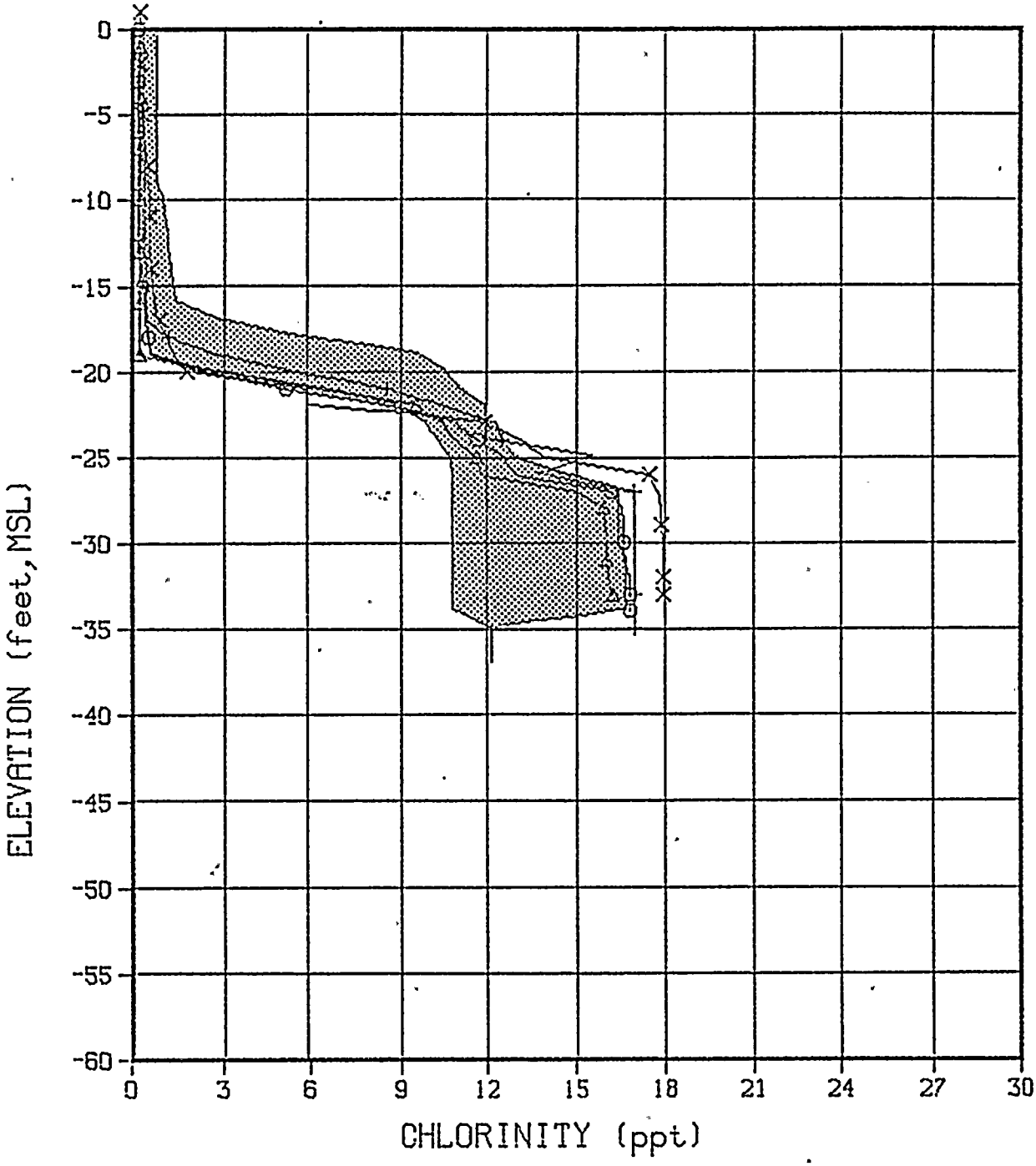
○APR-82 ▽JUNE-82

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER G-14

0459804726 (7/82)



LEGEND

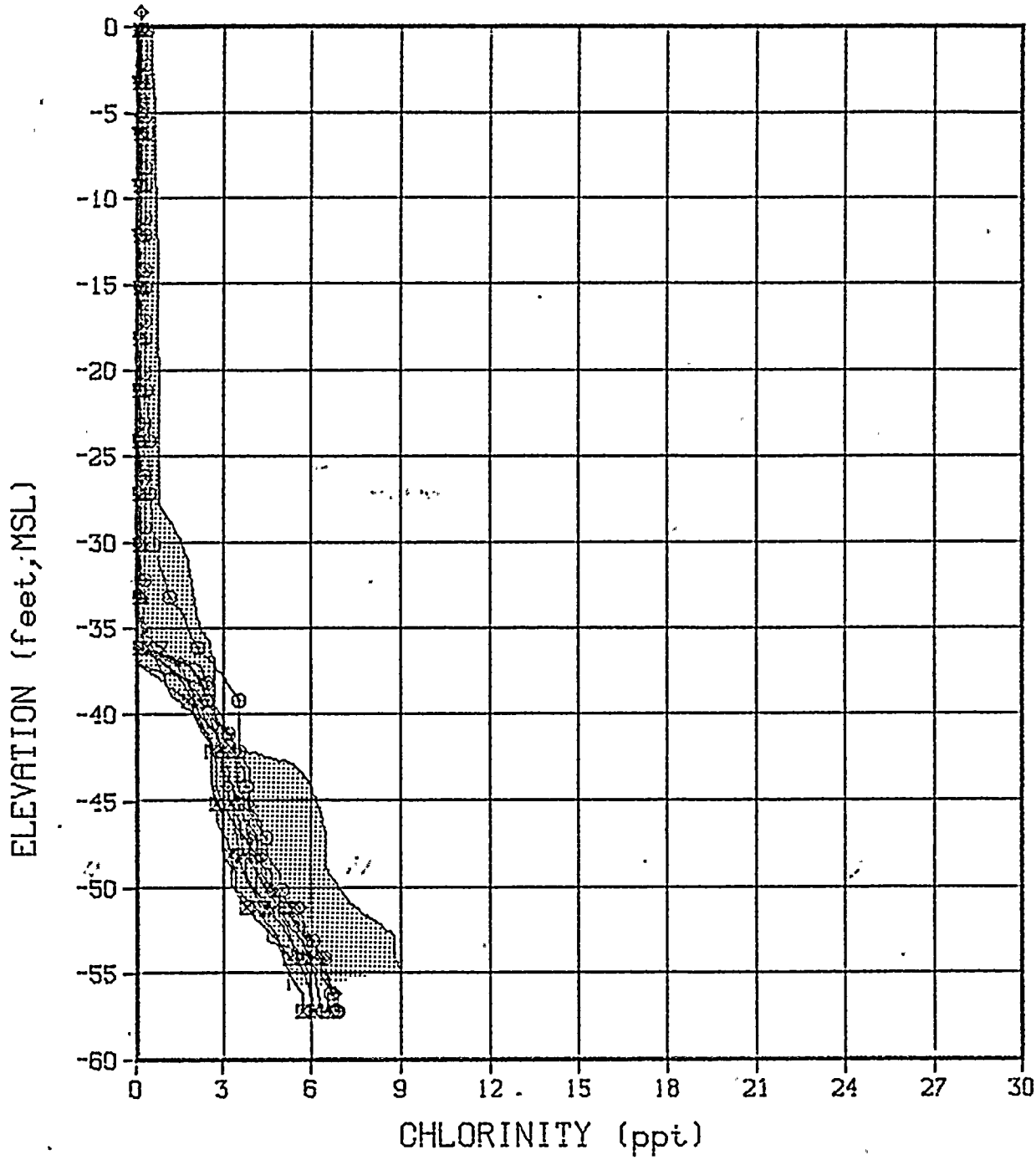
○ JAN-82 △ MAR-82 + MAY-82 × NOV-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER G-27

0459804726 (7/82)



LEGEND

○APR-82 △AUG-81 +DEC-81 ◇JAN-82

▽JUNE-82 ⊠MAR-82 ×MAY-82 ◈NOV-81

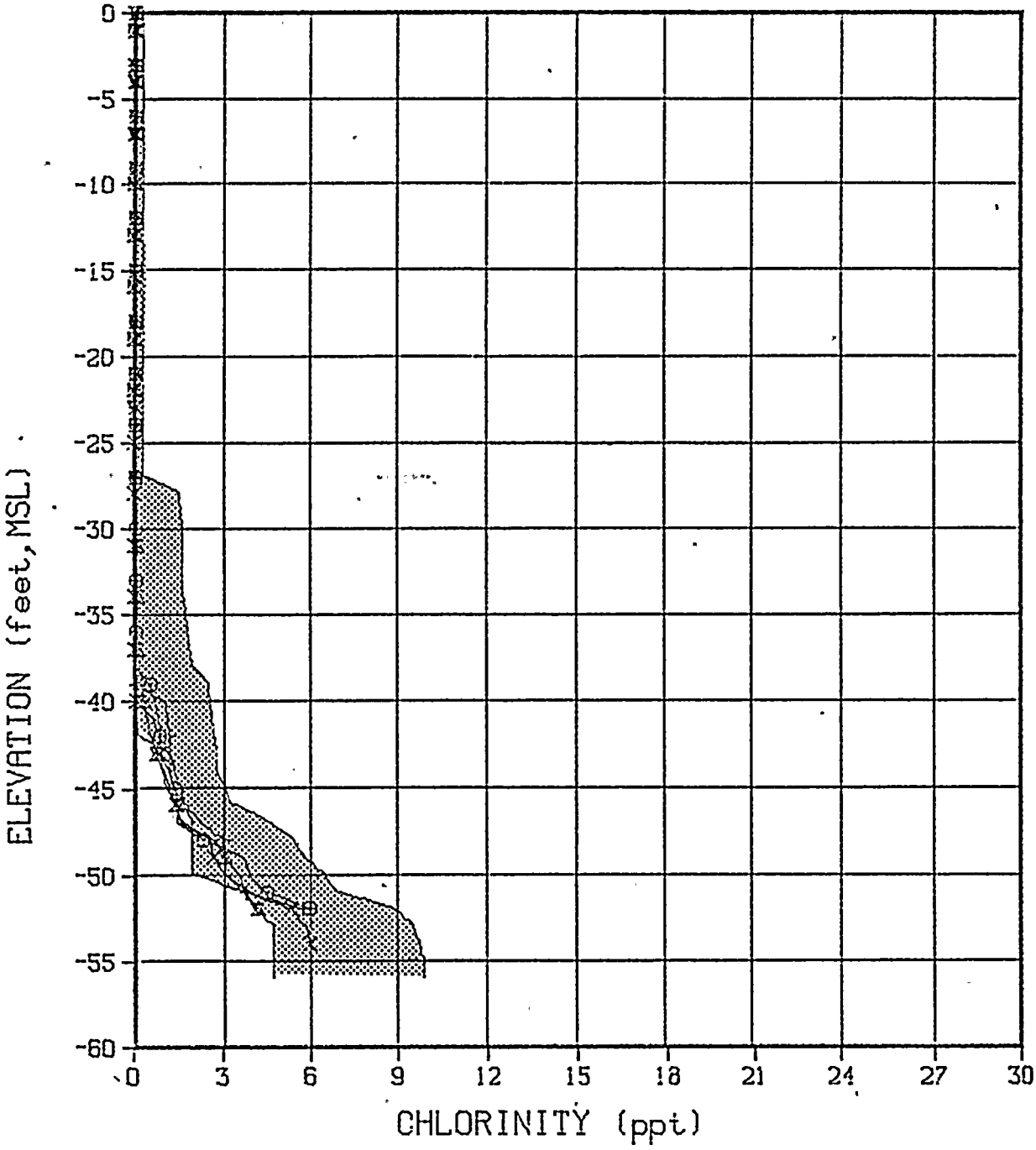
⊕OCT-81 ⧆SEP-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER G-28

0459804726 (7/82)



LEGEND

+DEC-81 ×FEB-82 ▽JUNE-8 ⊠MAR-82

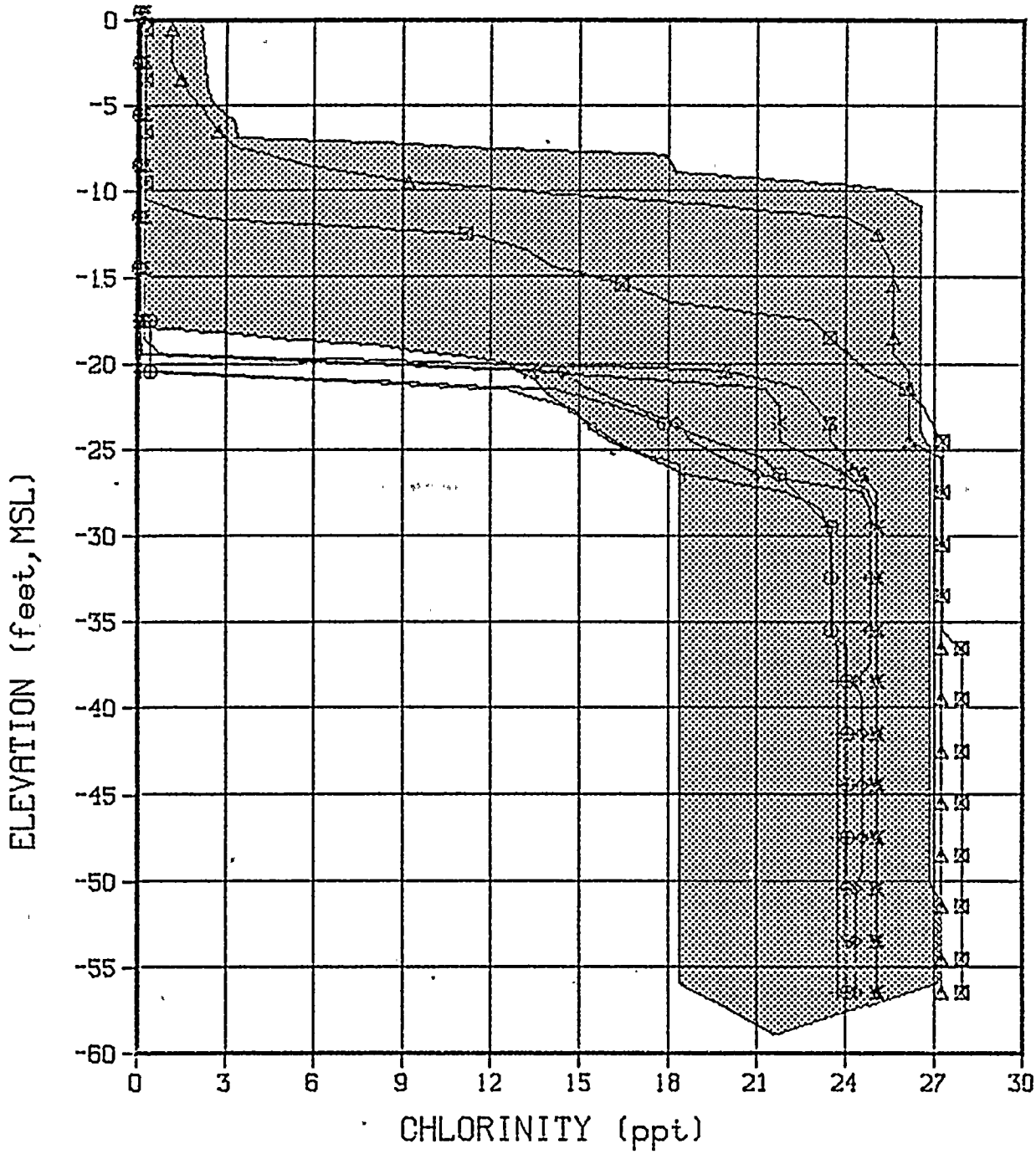
×MAY-82 ⊕OCT-81 ⧖SEP-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER G-35

0459804726 (7/82)



LEGEND

△AUG-81 +DEC-81 ⊠MAR-82 ×MAY-82

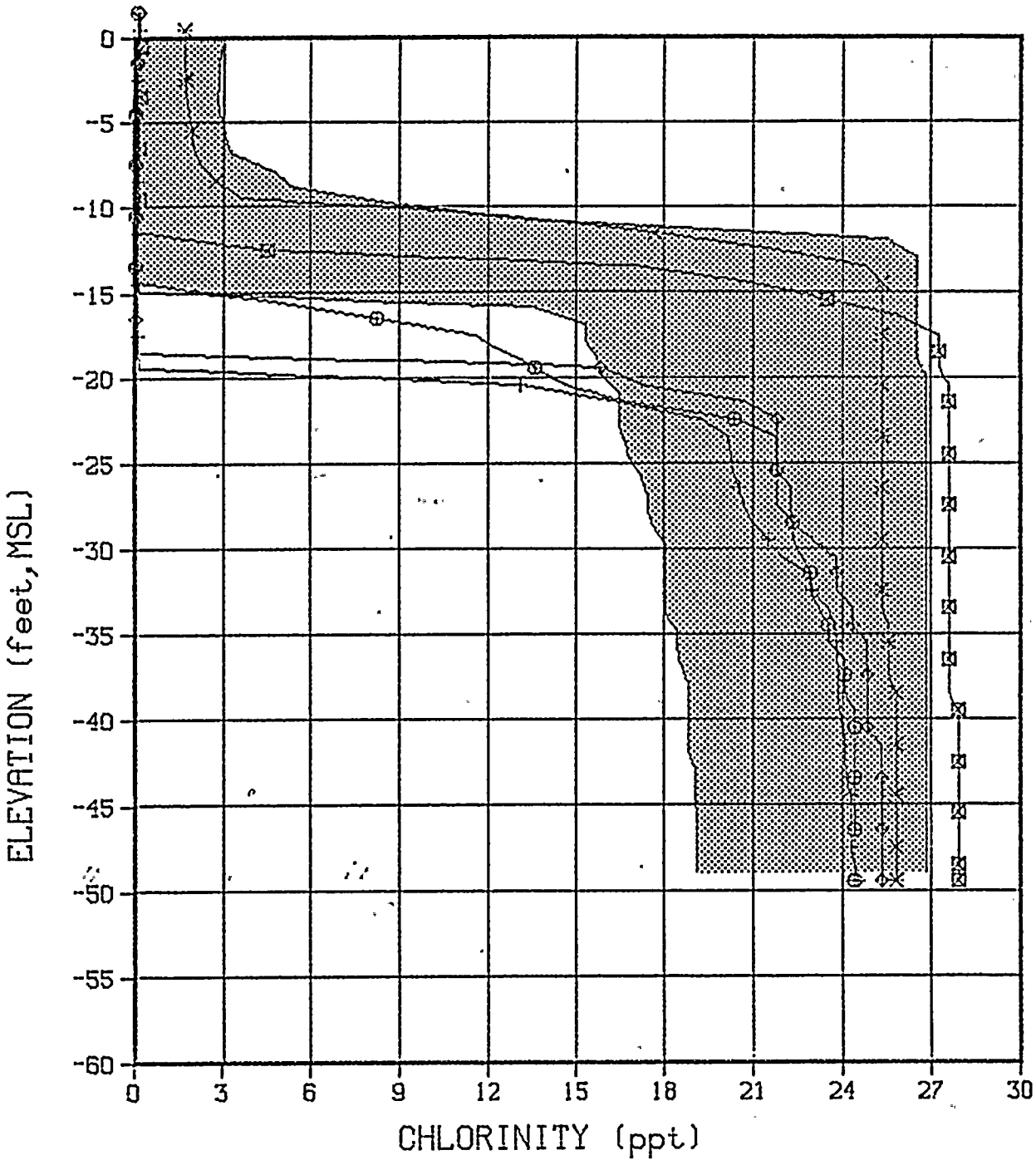
◈NOV-81 ⊕OCT-81 ⧖SEP-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER ID-A

0459804726 (7/82)



LEGEND

+DEC-81 ⊠MAR-82 ×MAY-82 ◈NOV-81

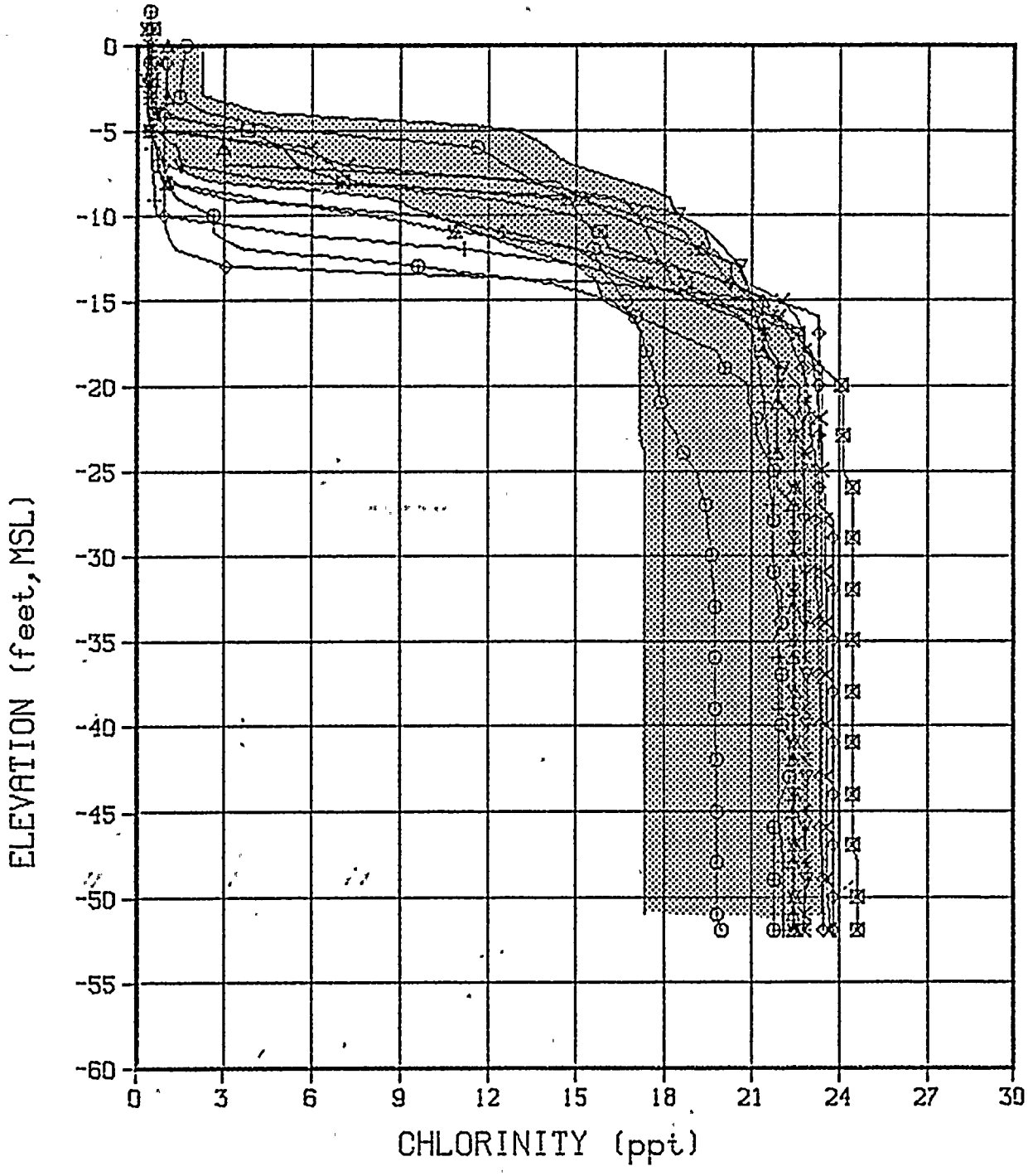
⊕OCT-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER ID-C

0459804726 (7/82)



LEGEND

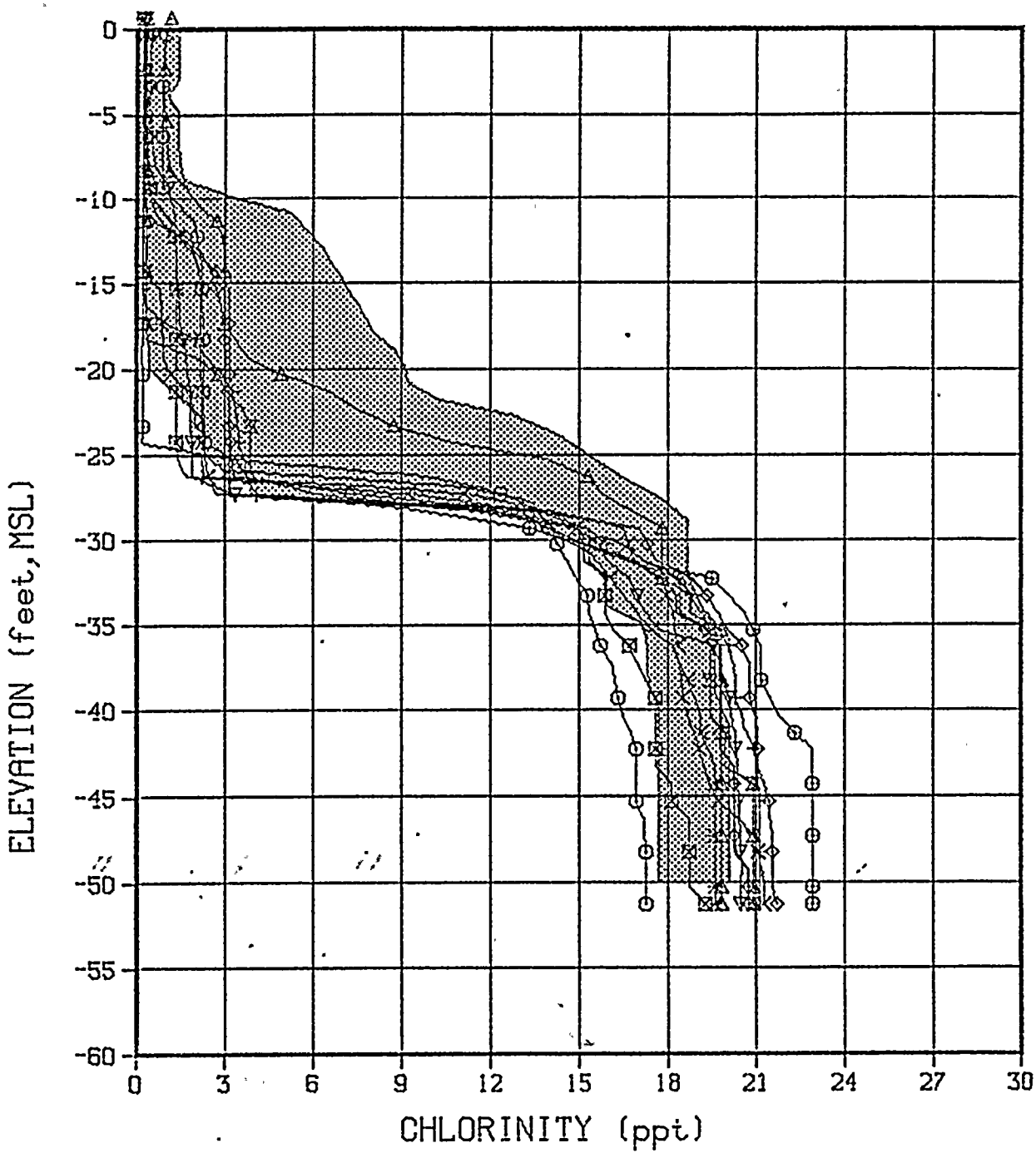
○APR-82	△AUG-81	+DEC-81	×FEB-82
◇JAN-82	▽JUNE-82	⊠MAR-82	✳MAY-82
◈NOV-81	⊕OCT-81	⧆SEP-81	

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER ID-E

0459804726 (7/82)



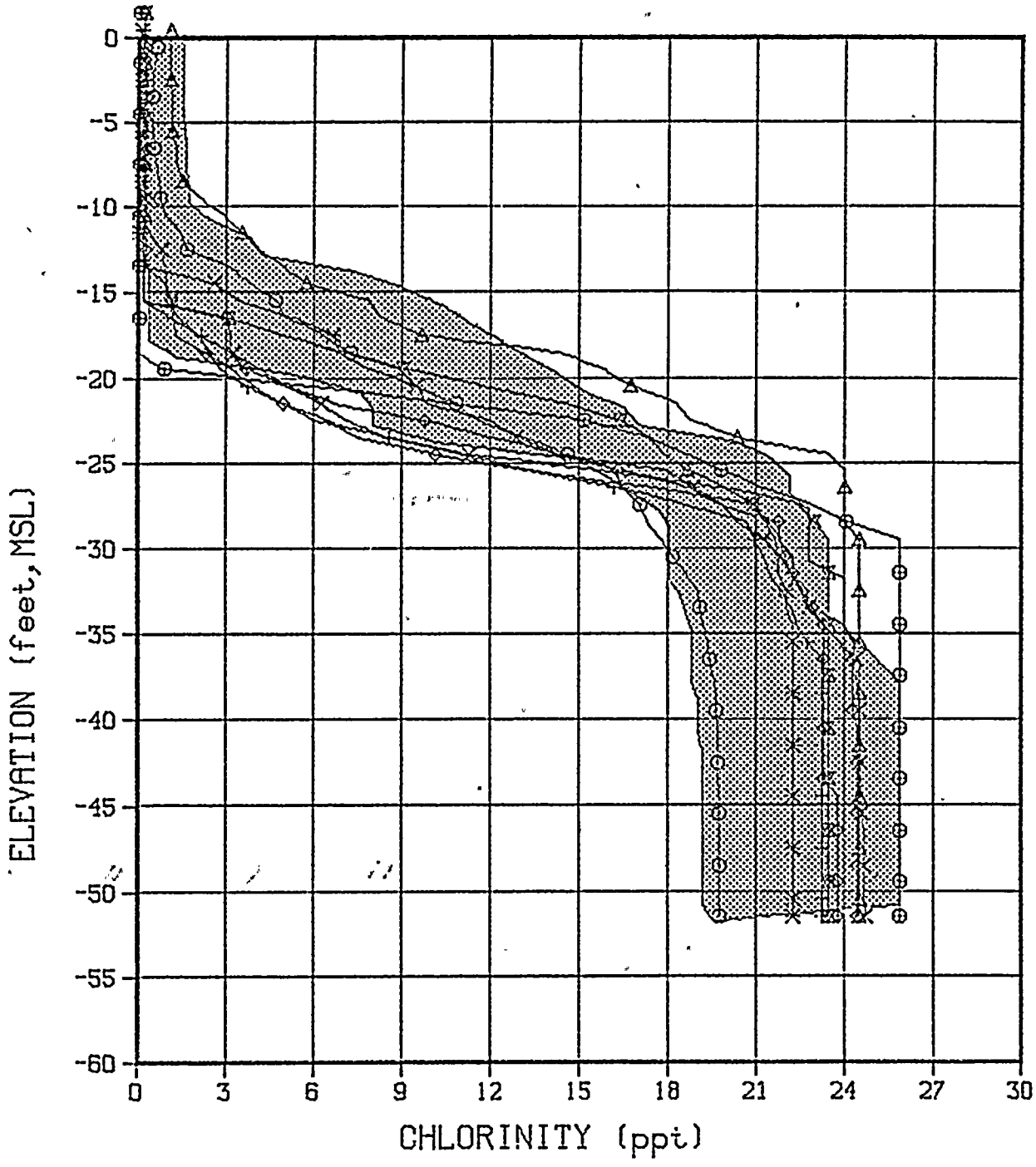
LEGEND

○APR-82	△AUG-81	+DEC-81	×FEB-82
◇JAN-82	▽JUNE-82	⊠MAR-82	✳MAY-82
◈NOV-81	⊕OCT-81	⧖SEP-81	

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82
WELL NUMBER L-1

0459804726 (7/82)



LEGEND

○APR-82 △AUG-81 +DEC-81 ×FEB-82

◇JAN-82 ✳MAY-82 ◈NOV-81 ⊕OCT-81

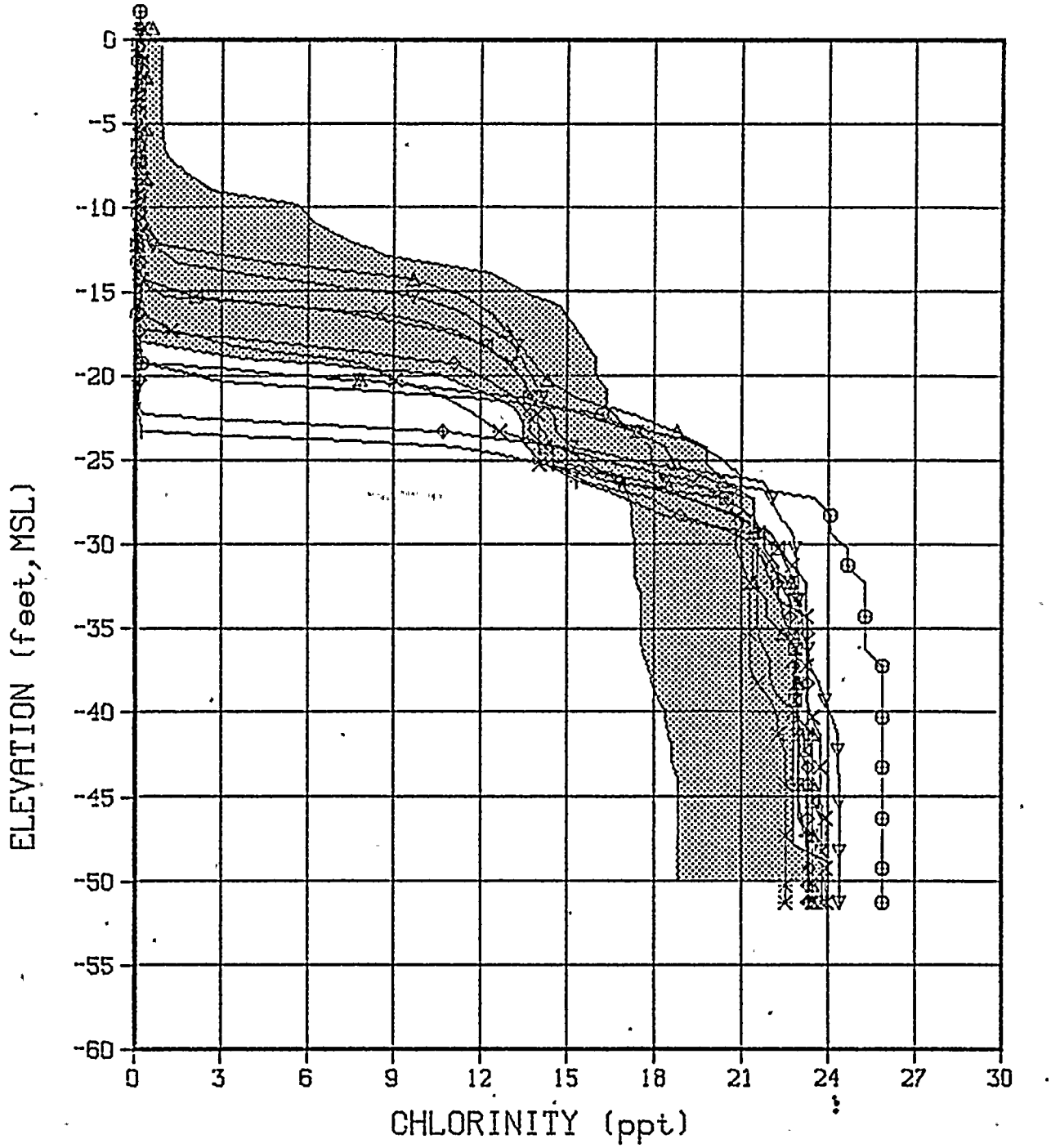
⧖SEP-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER L-2

0459804726 (7/82)



LEGEND

△AUG-81 +DEC-81 ×FEB-82 ◇JAN-82

▽JUNE-82 ⊠MAR-82 ✳MAY-82 ◈NOV-81

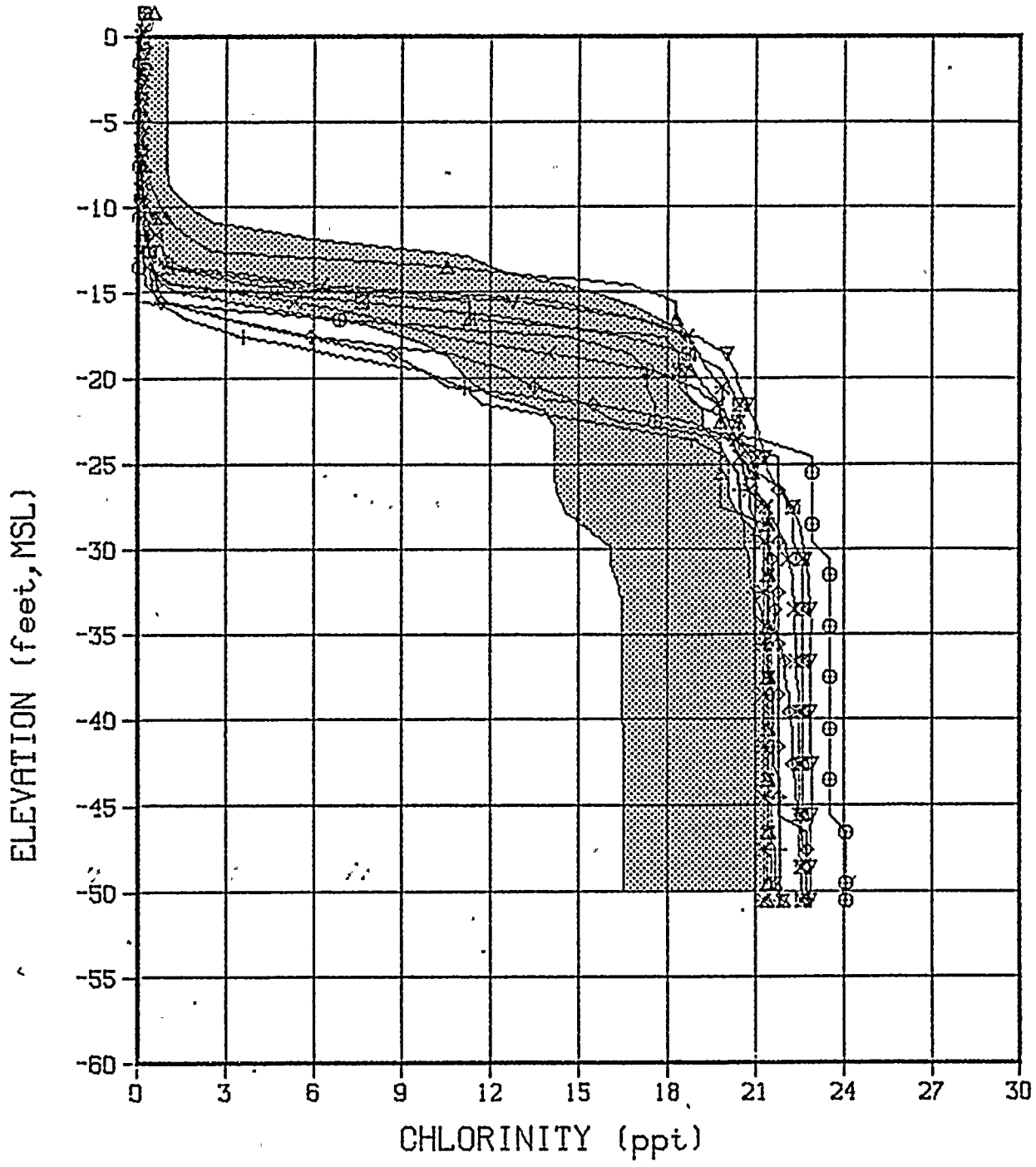
⊕OCT-81 ⧖SEP-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER L-3

0459804726 (7/82)



LEGEND

△ AUG-81 + DEC-81 × FEB-82 ◇ JAN-82

▽ JUNE-82 ⊠ MAR-82 ✳ MAY-82 ◈ NOV-81

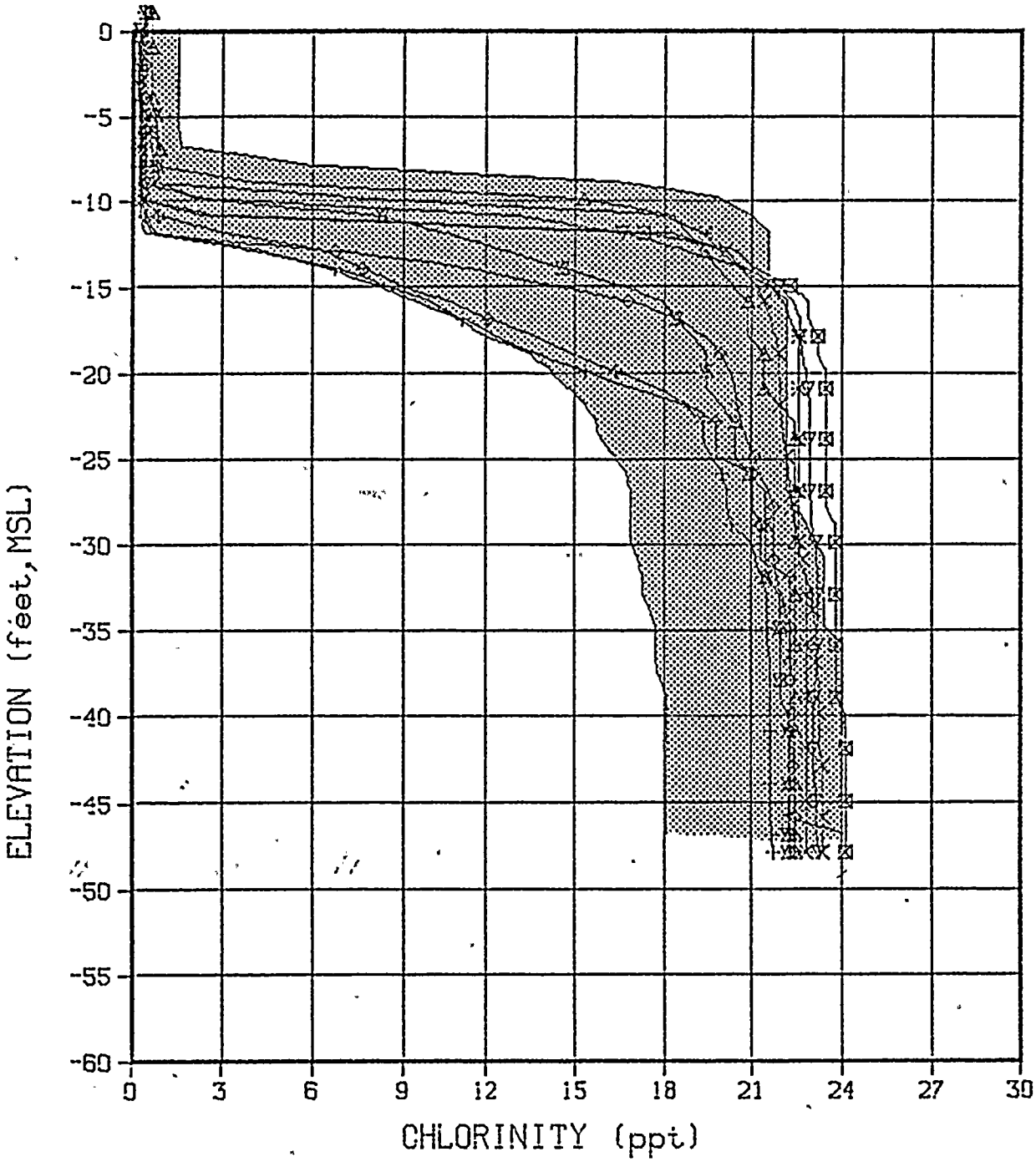
⊕ OCT-81 ⧖ SEP-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER L-5

0459804726 (7/82)



LEGEND

△AUG-81 +DEC-81 ×FEB-82 ◇JAN-82

▽JUNE-82 ⊠MAR-82 ×MAY-82 ◈NOV-81

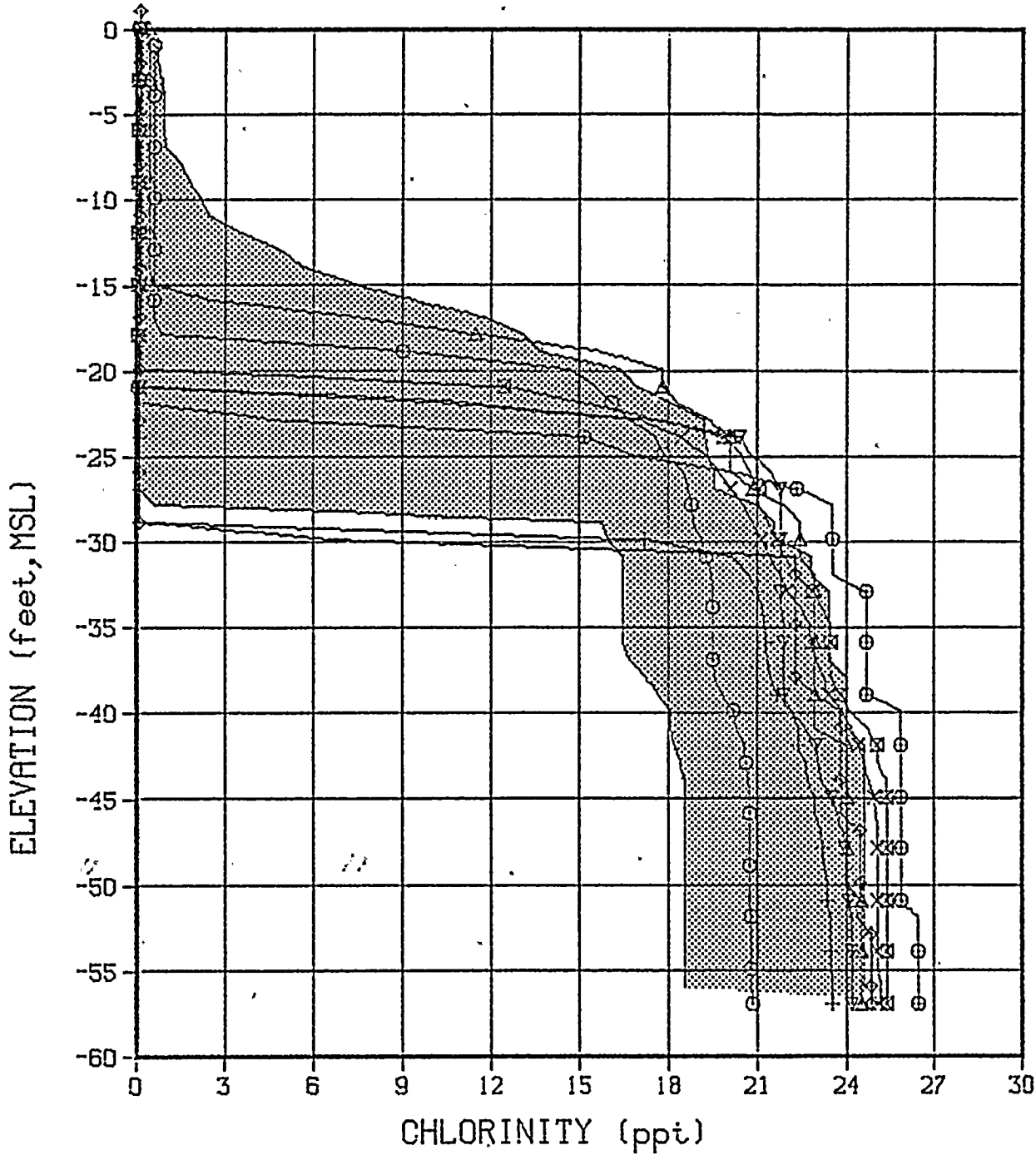
⊠SEP-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER ID-D

0459804726 (7/82)



LEGEND

○APR-82 △AUG-81 +DEC-81 ×FEB-82

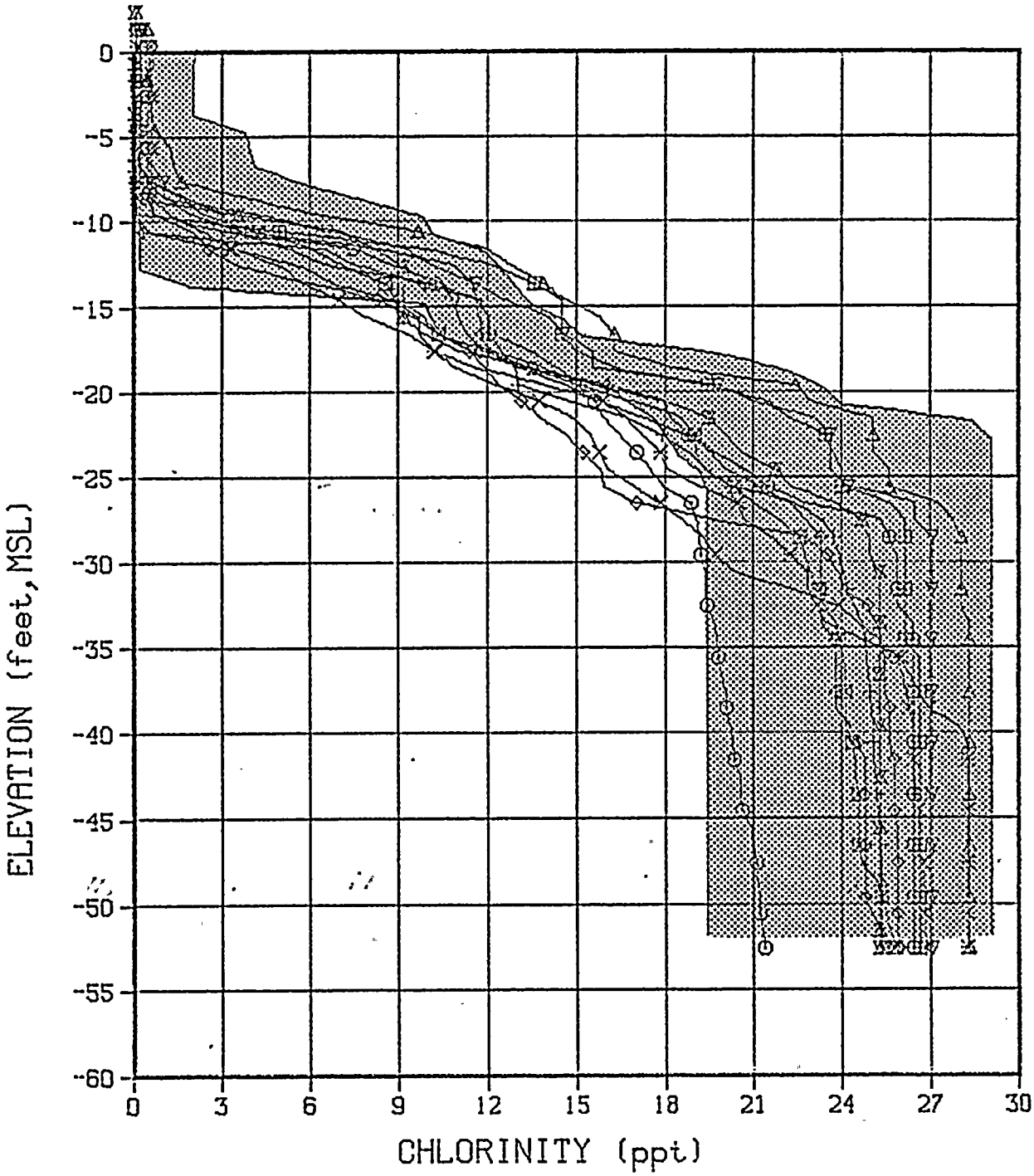
▽JUNE-82 ⊠MAR-82 ◇NOV-81 ⊕OCT-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER L-6

0459804726 (7/82)



LEGEND

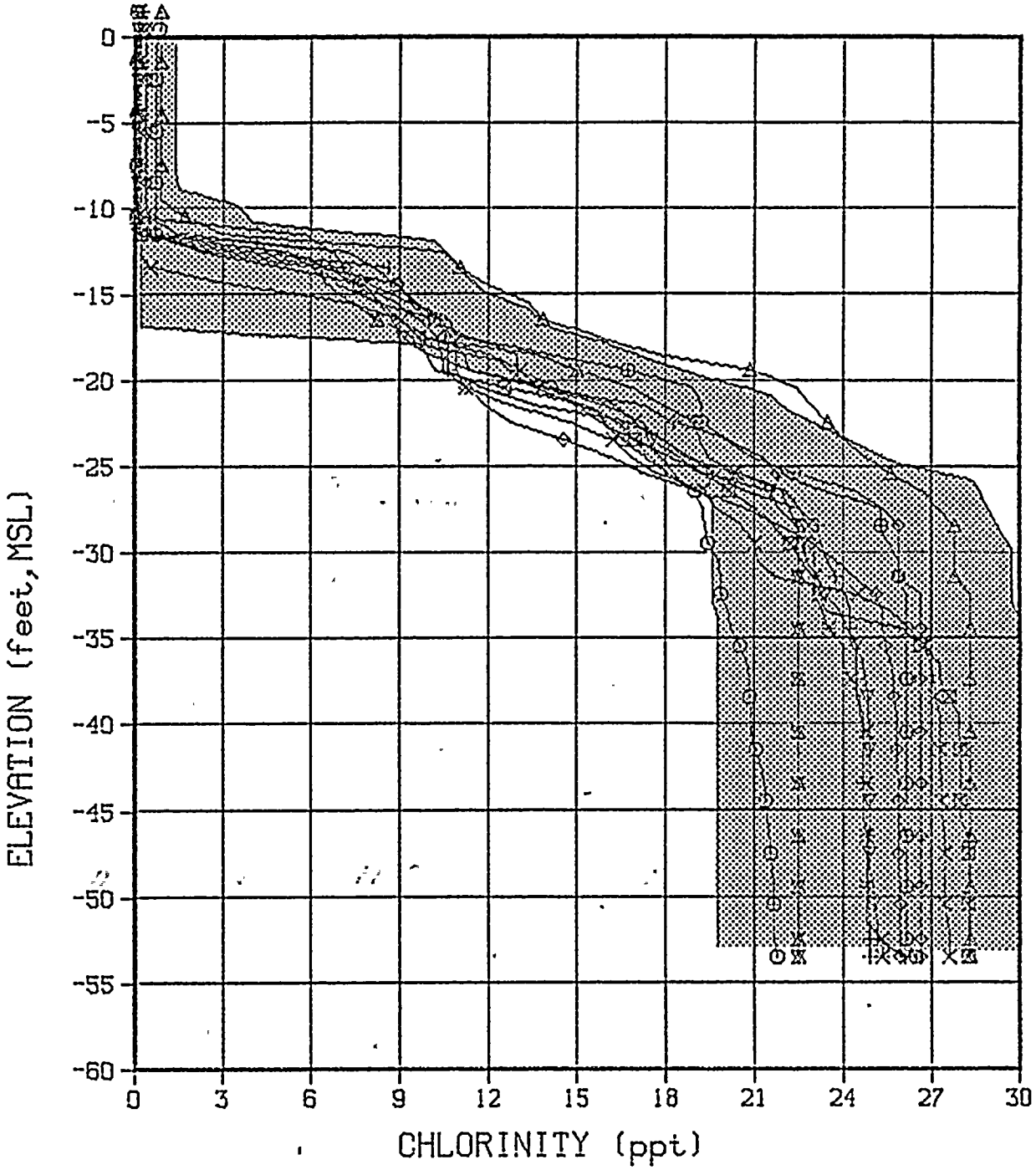
○ APR-82	△ AUG-81	+ DEC-81	× FEB-82
◇ JAN-82	▽ JUL-81	⊠ JUNE-82	✳ MAR-82
⊕ MAY-82	⊛ NOV-81	⊠ OCT-81	⊞ SEP-81

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER X-1

0459804726 (7/82)



LEGEND

○ APR-82	△ AUG-81	+ DEC-81	× FEB-82
◇ JAN-82	▽ JUNE-82	⊠ MAR-82	✳ MAY-82
◈ NOV-81	⊕ OCT-81	⧆ SEP-81	

DAMES AND MOORE

EXCURSIONS FROM CHLORINITY ENVELOPE FOR JUL 81 - JUN 82

WELL NUMBER X-2

0459804726 (7/82)

APPENDIX E

MONITORING PROGRAMS

APPENDIX E

MONITORING PROGRAMS

G-SERIES WELLS

The G-Series Wells Monitoring Program was initiated in April 1972 in compliance with the February 2, 1972 legal agreement between FP&L and the South Florida Water Management District (SFWMD). This monitoring program consisted of two separate but related projects:

1. The Ground Water Quality Monitoring Program and,
2. The Interceptor Ditch Program.

The original ground water monitoring program entailed 38 monitoring wells installed at 23 separate locations west of the cooling canal system and designated as the G-Series wells. Two piezometers, one 50 feet and one 20 feet deep, were installed at 15 of the 23 locations. The 20 feet deep piezometer was located approximately 10 feet north of the 50 feet piezometer.

Surface water and ground water elevations, ground water temperature and conductivity were measured in each of these wells near the beginning of each month. For the 15 pairs of piezometers, ground water temperature and conductivity were measured at the bottom of the casing; in the composite wells, these parameters were measured at depths of 20, 40, and 60 feet below the top of the well casing. In addition, water samples were obtained to verify and to correlate the water conductivity data by titration for chlorinity. A regression analysis of these data established the monthly relationship between conductivity and chlorinity, this relationship then being used to convert conductivity to chlorinity.

A revised ground water monitoring program was implemented in November 1976 following ratification of the third supplemental agreement between FP&L and SFWMD in September 1976. The revised program consisted of monitoring the ID-Series wells, the L-Series wells and wells G-7, G-21, G-28 and G-35 near the beginning of each month. As of January 1979, well G-14 was substituted for well G-7 because of damage to the well by local farmers. The L-wells and ID-wells are described in a following section. Additionally, wells G-6 and G-27 are monitored at the beginning of January, March, May, and November. Monitoring consists of measuring surface water and ground water elevation and ground water conductivity and temperature. Temperature and conductivity are measured at one-foot intervals for the entire well depth. One water sample is obtained from each well for analysis of the chlorinity.

L-, ID , X WELLS

FP&L installed 13 additional wells to aid in the determination of the effects of the cooling canal system on the ground water. Six wells were installed along Levee 31E Borrow Canal (L-wells), five along the Interceptor Ditch (ID-wells), and two north of the Feeder Canal (X-wells). These wells are composite wells extending to a depth of approximately 70 feet.

A flexible monitoring schedule was maintained for these wells. These wells were normally monitored at about two-week frequencies (near the beginning of the month when the G-Series wells were monitored and near the middle of the month). Temperature and conductivity measurements were initially made in these wells at five-feet intervals from the ground water

surface to the bottom of the casing. However, since December 1975, temperature and conductivity measurements have been made at one-foot intervals.

As mentioned previously, the ID- and L-wells are now incorporated in the G-Series Wells Monitoring Program. These wells are monitored once a month. Similarly, the X-wells are monitored once a month.

MONITORING EQUIPMENT

The in-situ conductivity and temperature measurements are obtained with a Hydrolab series 4000 digital conductivity-temperature meter. Calibration of the field conductivity meters is done in the laboratory with saline solutions of known conductivity at the beginning and end of each day of measurements.

Water samples are obtained with a Masterflex sampling pump.

The reader is referred to the March 31, 1976 G-Series Wells Summary Report for more detailed descriptions of monitoring equipment and calibration.

New equipment was acquired during the period July 1981 through June 1982. This equipment consists of the aforementioned Hydrolab series 4000 digital conductivity-temperature meter. This equipment replaces the Hydrolab model TC-2 unit used during past monitoring periods.

LABORATORY ANALYSES

The water samples collected during the monthly monitoring programs are titrated to determine chlorinity. The chlorinity was determined by

titrating the water samples with mercuric nitrate, using a potassium chromate solution as the end point indicator. These titrations are performed at Florida Power & Light's laboratories at Turkey Point.

The chlorinity, once it is determined, is used to develop a relationship between conductivity and chlorinity content. Conductivity-chlorinity relationships are determined for each series of wells each month. The conductivity-chlorinity relationships developed for this monitoring period are shown in Appendix B.

The conductivity-chlorinity relationships are used to convert the appropriate monthly conductivity data to equivalent values of chlorinity.

The methodology used to determine the conductivity-chlorinity relationships is discussed in greater detail in the G-well summary report.

MONITORING PROGRAM LOGISTICS

Field data collection efforts have been conducted from the FP&L field laboratories at Turkey Point. All monitoring equipment is stored at these facilities. Instrument calibration and most instrument maintenance have also been handled at these facilities.

Transportation to the monitoring wells is dependent on well location. Some of the wells are located in swampy areas and are accessible only by helicopter. Since discontinuance of the E-Well Monitoring Program, a helicopter will be required on-site only during the months of January, March, May and November for the revised ground water monitoring programs. During the remaining months all the required wells can be reached by automobile.