Lead concentration variabilities of private water supplies located in Door County, Wisconsin. [DNR-044] 1988

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Original Project 44

Wisconsin Groundwater Management Practice Monitoring Project

No. ~~41~~ 44

GROUNDWATER
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Wisconsin Department of Natural Resources

DEPARTMENT OF NATURAL RESOURCES

Lead concentration variabilities of private water supplies located in Door County, Wisconsin

November, 1988

By:

Richard C. Stoll
Hydrogeologist

CONTENTS

Groundwater contamination exists in Door County because of its many land use practices and a susceptible hydrogeologic environment. This discussion dwells only on the lead contamination of drinking water supplies which appear to be the resultant of lead/arsenate pesticide use and handling practices in orchard areas. Although it is now over twenty years since widespread use of the pesticide, a large number of water supply wells show intermittent susceptibility to contamination by lead, an ingredient of the pesticide.

Groundwater sampling results from private wells indicate there is no assurance that a well does not have lead contamination susceptibility if only one sample has been collected from that well. For this reason, it is best to take more than one sample and to collect those samples when the ground is thawed and one to three days after a peak precipitation or runoff event.

Lead is the only ingredient of the pesticide that has been found in drinking water supplies to date. Arsenic has not been detected.

Background

The concern over lead contamination in Door County stems from the discovery of abandoned lead arsenate pesticide mixing facilities in the county. Lead arsenate was the dominant pesticide in Door County's fruit growing industry prior to 1960. Powdered lead arsenate was brought to mixing stations where it was dissolved in water and subsequently transported and applied on orchards. WDNR became aware of the facilities in 1984. Preliminary investigation indicated the following:

1. Soils around mixing sites can be heavily contaminated with lead and arsenic.

2. Groundwater near mixing sites can often be lead contaminated.

3. Arsenic does not appear to be entering the groundwater.

4. Lead concentrations in groundwater seem to increase shortly after some precipitation events.

The present study was implemented to answer some of the unknowns regarding this problem.

Problem Summary

To date, thirty-four lead pesticide mixing sites have been preliminarily studied and evaluated in Door County. More than two-thirds of these lie on the western half of upper Door County. The western half of Northern Door also has the most lead contaminated water supply wells. Within that area western Sevastopol Township currently has the most identified problem areas and wells. However, sample bias does exist since this area was also the most heavily sampled. Therefore, it is possible that other areas may be equally affected but yet unidentified.

Susceptible geology is the key factor to the lead problem in Door County. Where soil cover exists, it is predominantly thin and does very little to effectively filter pollutants. The majority of Door County's water is drawn from fractured Silurian bedrock that acts as the major aquifer. These same crevices that allow rapid aquifer recharge and substantial water supplies, act as conduits for the transfer of pollutants. The nature and placement of these crevices results in the following enigma: Interconnected crevices can expedite the transfer of pollutants over longer distances while less connected crevices will restrict their movement. These migrations also apply in the vertical sense (see Figure 1). The summation of this geological characterization would state that many times only one of two adjacent wells that draw from separate unconnected crevices may be contaminated. Due to this fact, a precise delineation of the extent of contamination is very difficult.

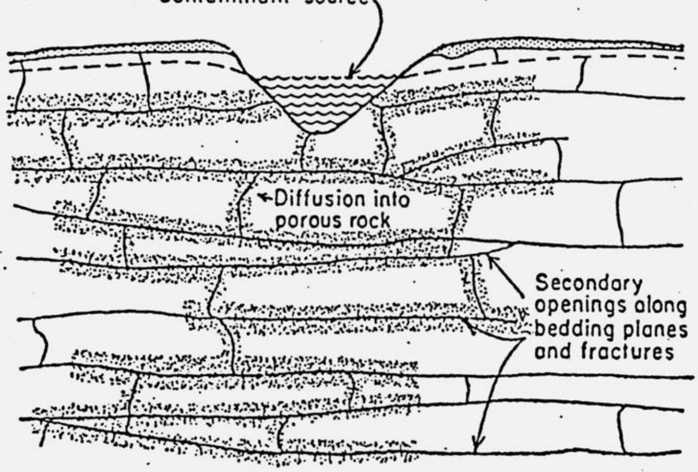
Recharge to the Silurian aquifer is rapid and lateral flow characteristics can vary widely. Interconnected conduit like fractures in the Silurian system can often conduct rapid transfer of pollutants to area wells. This authors thought is that surficial flushing during groundwater recharge (rain and snow melt events) is releasing and carrying residual contaminants attached to particulates (potentially soil) through the conduit-like network to some area wells. Some preliminary results of ongoing sampling indicates that filtered (.45 micron) water supply well samples tend not to contain lead while their unfiltered counterpart contains lead. This suggests that lead is being transported in some particulate state. Further, work to determine the reliability of various sediment filter sizes and methods is currently underway.

Conclusions

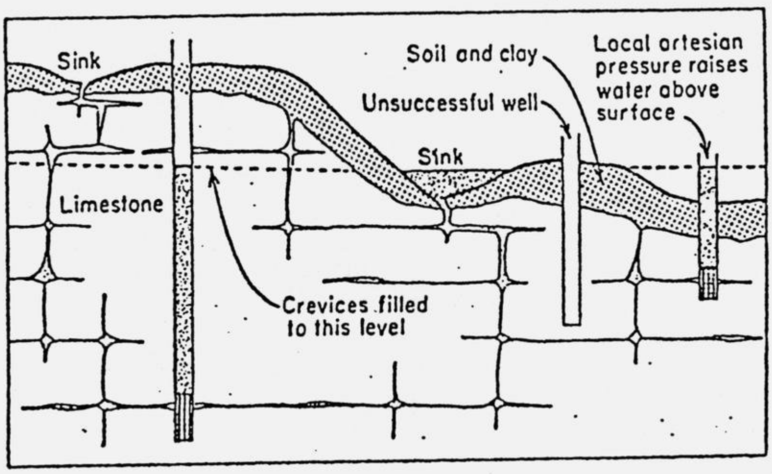
The lead contamination that does exist in a number of Door County private wells is not uniformly predictable. However, precipitation and runoff are two basic common factors that can help provide a prescription for general water quality testing practices. In descending order of importance, the months of March, April, November and May are probably the best to sample a well in, since these are the months when most percolation and runoff has typically occurred. Even though repeated samplings of private wells has not consistently revealed any single month as better than another for lead detections, the odds of hitting precipitation events are quite obviously best in one of the four months mentioned.

Sources

Lead is not easily leached to the groundwater (Residuals Management Technology Door County Lead Arsenate Report, May 1987, unpublished). It is quite likely that lead is entering the groundwater system with soils, in runoff that flows toward sink holes and other geologic weaknesses. Some further vertical movement in soils could also be occurring through macropores such as fissures, seams, worm tunnels or root holes that might function as natural conduits. Otherwise, much Door County runoff eventually meets groundwater through sink holes and bedrock fracture pathways (Door County Priority Watershed Plan, July 1986, unpublished). In karst groundwater, the flow velocity is such that solid particles can be transported further. However, heavy metals entering the system will likely precipitate out and unless conditions are optimum, the affects will only be local (White, William B. AWWA Journal, June 1987 pp. 133). Therefore, wells contaminated by lead are likely due to a nearby source. This is also supported by rapid changes of lead concentrations in the wells of this study.



Schematic representation of contaminant migration from a surface source through fractured porous limestone.



Schematic illustration of the occurrence of groundwater in carbonate rock in which secondary permeability occurs along enlarged fractures and bedding plane openings (after Walker, 1956; Davis and De Wiest, 1966).

Fig. 1

Since the presence of numerous sink holes, fractures and other entry ports to the subsurface suggests that much of the Door County runoff is actually delivered to the subsurface through geologic weaknesses (Door County Priority Watershed Plan, July '86, Page 1, Sect. IA, unpublished). The net effect would be to compound the percolation amounts during the peak months March, April, November and May. This also suggests lead concentration variabilities seen in the summer and fall months are not from percolation through the soil column but actually due to runoff from ground surface to nearby sink holes and fractures.

Sampling in March must be timed very carefully because much of the water entering the system is controlled by snow melt, which can often occur quite rapidly.

Mechanisms

Precipitation events were selected to be the primary focal point for discussion and interpretation based on these advantageous reasons:

1. It is an event that can be directly measured by nearly anybody and without complicated equipment.

2. It is the single natural factor in the study area most likely responsible for groundwater quality changes.

Shortcomings of using precipitation as a focal point for interpretation of groundwater quality information:

1. Precipitation may not have occurred at the same rate and degree throughout the entire study area. Therefore, several measuring stations would have been more desirable for precipitation information gathering.

2. Precipitation acts upon groundwater quality in an indirect way by carrying existing pollutants to it.

3. Many factors may impede or accelerate the response of a groundwater quality change due to a precipitation event. Just some of which are:

    a) Precipitation rate

    b) Precipitation duration

    c) Amount of precipitation necessary to initially mobilize soil particles into a flow of water directed toward the subsurface.

    d) Surface soil thickness

    e) Soil characteristics

f) Population of sinks, fractures and other geologic weaknesses

g) Degree of geologic weakness interconnections

h) Amount of contaminant contacted by precipitation

i) Ground surface topography

j) Presence of artificial or enhanced conduits such as man made trenches or poorly constructed wells.

No other single factor was found to eliminate these shortcomings yet offer a conveniently measurable event to focus upon. Therefore, precipitation was determined as the most advantageous focusing factor. As expected, it also exhibits many inconsistencies when compared directly to lead concentrations in private wells and their fluctuation periods. These inconsistencies are attributed to the same shortcomings listed above.

Because the project scope is more focused on gross groundwater quality changes and to provide easier data handling, the precipitation events were grouped into three day net precipitation quantities. The period of three days was selected because many lead samples were taken at this interval. These precipitation quantities were bar graphed and compared with the lead concentration graphs. They were viewed with respect to a single three day period and the three day period immediately following.

An attempt to view the data on a day by day basis was a massive undertaking which has not yet become fruitful. Aside from three day groupings, no other groups were tried.

There are, however, several common peak responses seen throughout the data when the precipitation graphs are overlaid upon the time versus concentration graphs. Since a pattern to the responses is not obvious, they are described in the following way:

<u>Asymmetry</u>

1. Lead concentration peaks occur without accompanying precipitation peaks.

2. Precipitation peaks occur without accompanying lead concentration peaks.

3. The magnitude of a lead peak does not appear directly tied to the magnitude of a precipitation peak.

   - However, a number of wells exhibiting upward lead concentration changes with precipation actually exhibited very minor lead peaks with some very high rainfall events. This may indicate that excess water is simply acting to dilute the lead concentration during some high rainfall events.

   - The magnitude of a lead peak is also very likely tied to the lead concentration present at the ground surface source.

4. Most wells did not exhibit consistently noticeable upward lead peaks on the same days, regardless of their proximity to one another.

Symmetry

1. Some wells did repeatedly exhibit upward lead peaks on some of the same days as one another and a three day precipitation peak.

2. Based on lead concentration increases, the peak periods when a well appeared most responsive to precipitation event generally occurred after 0.4 inches of rain fell in a three day period. However, there were some more intermitant minor fluctuations after less than 0.4 inches of precipitation fell also.

3. Nine (9) of 33 wells exhibited some noticeable degree of increasing lead contamination response to 0.4 or more inches of rainfall within a three day period. There were 30 different three day periods during 1987 which accumulated at least 0.4 inches of rainfall in each. The well (#44260) that best matched precipitation peaks did so 40% of the time rainfall achieved these levels in a three day period. The following indicates the frequency of increasing lead contamination response to precipitation by the nine wells.

Well #	# of Occurrences	% of Total (30)Occurrences
44260	12	40
09720	9	30
24350	7	23
45360	6	20
45140	6	20
26880	6	20
20060	5	17
03560	4	13
48990	2	6

These same wells also tend to show the greatest number of occurences and magnitude of lead concentration changes. This may suggest that other occurrences could exist at the more minute concentration levels but are not readily visible at the scale of these graphics (Fig. 2-9 are overlays of the lead concentration vs. time graphs and the precipitation bar graphs with the peak matches noted at the page top).

4. Many lead concentration peaks responding to rainfall showed a significant downside after the three day period, but did not necessarily drop to an undetectable level.

5. Wells that reacted to precipitation were not necessarily located near one another. Reaction to precipitation is more likely controlled by a wells degree of interconnection to the surface.

Lead concentrations vs. Time

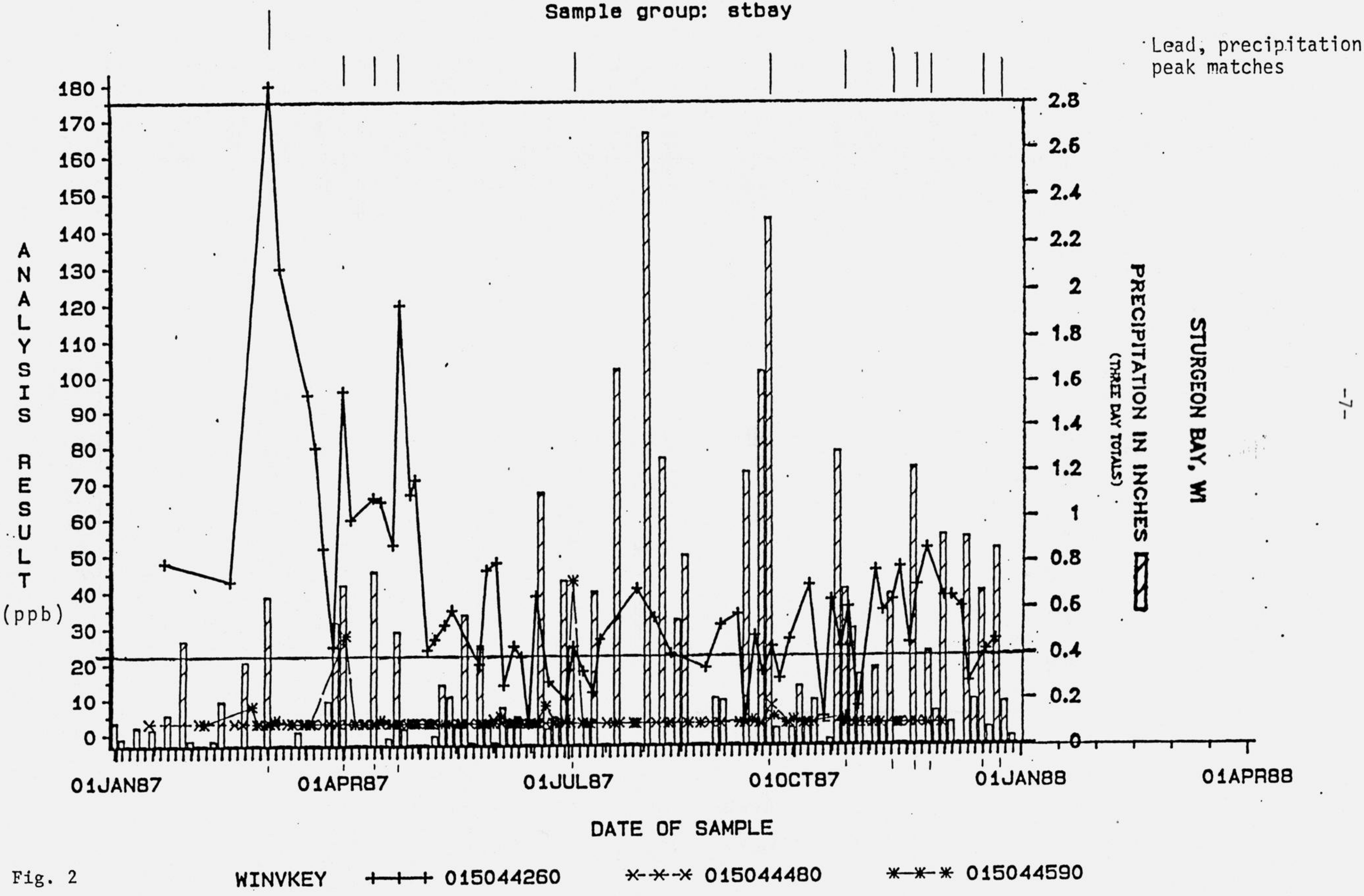
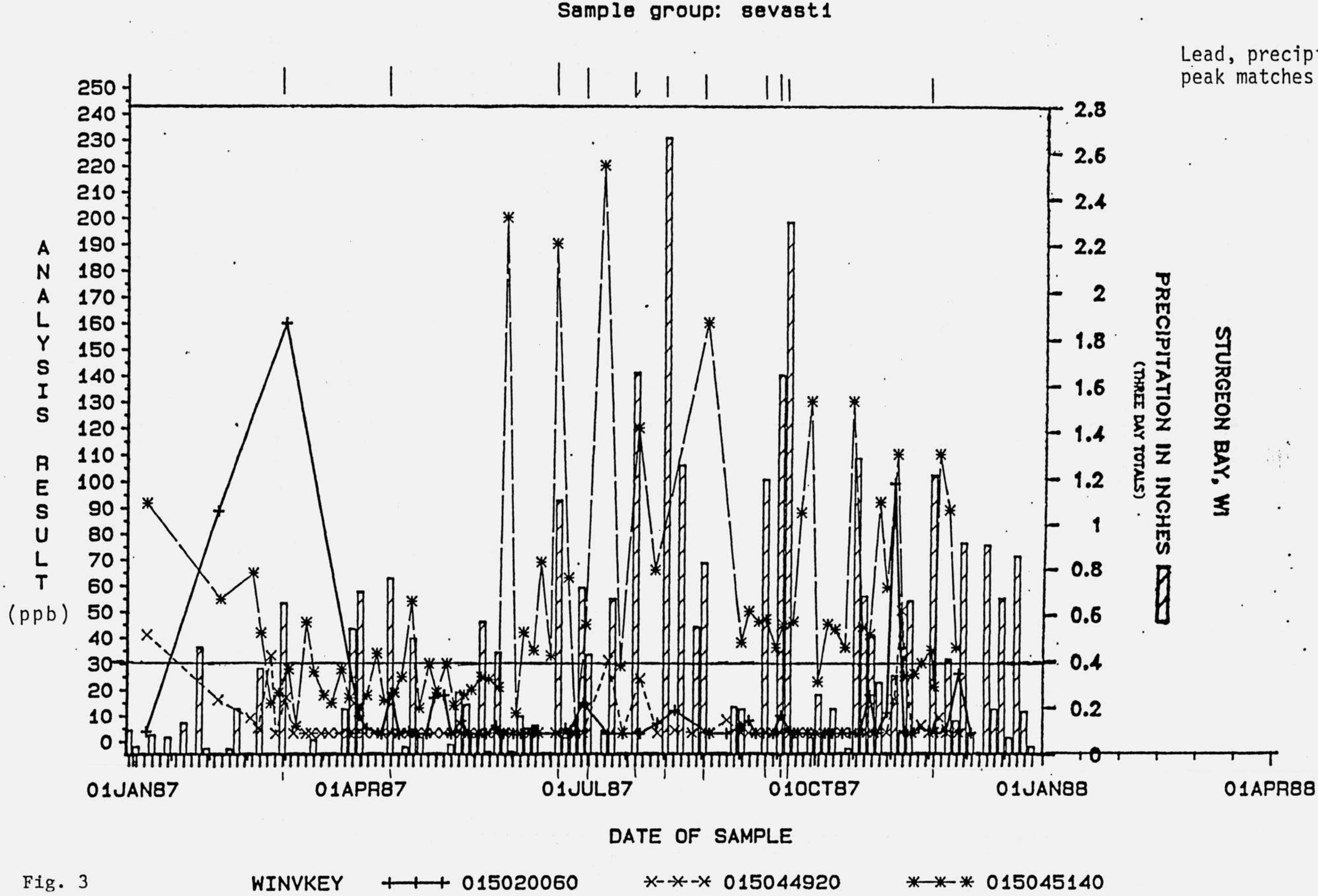


Fig. 2

Lead concentrations vs. Time



Lead, precipitation peak matches

Fig. 3

Lead, precipitation peak matches

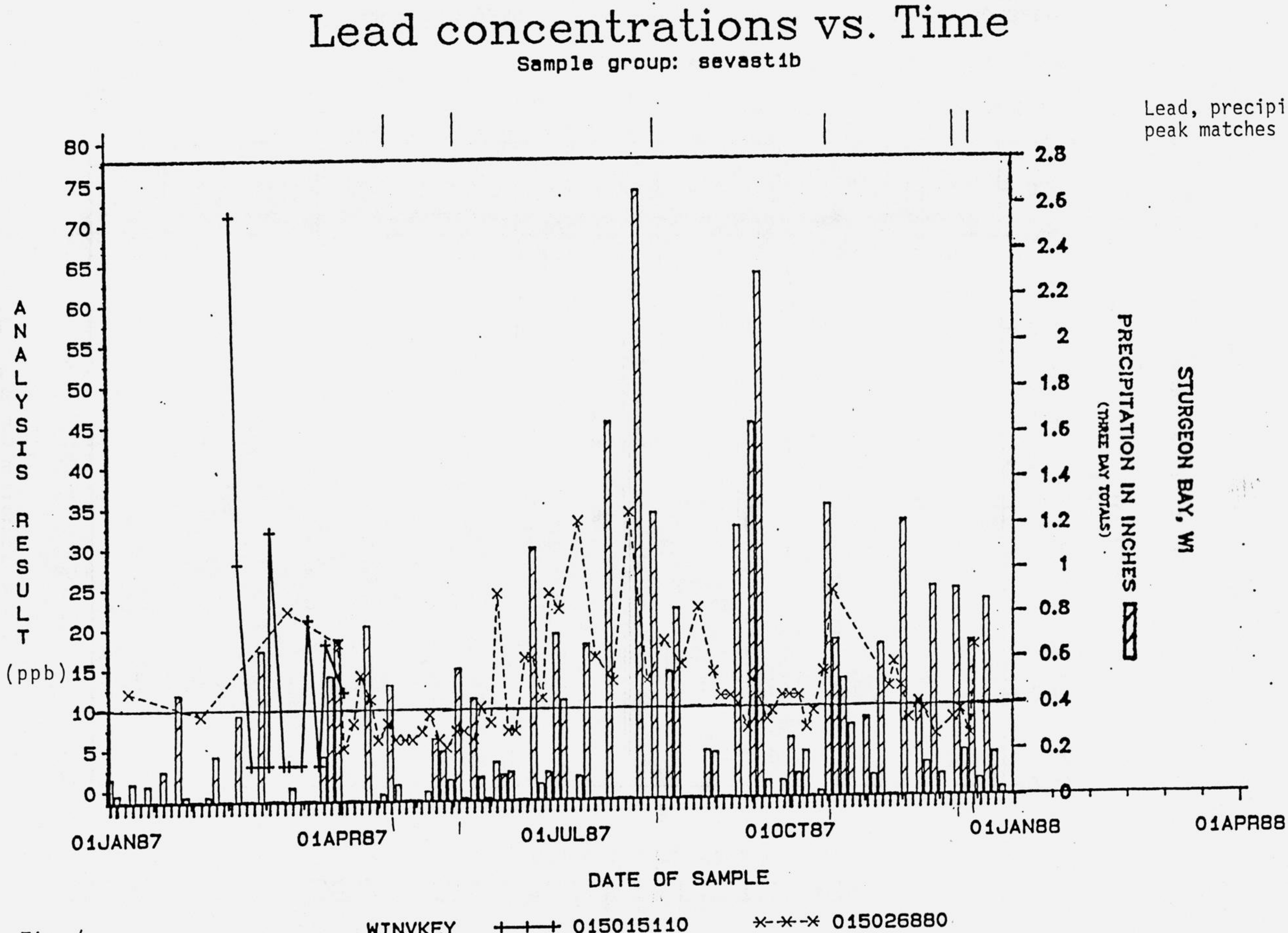


Fig. 4

Lead concentrations vs. Time

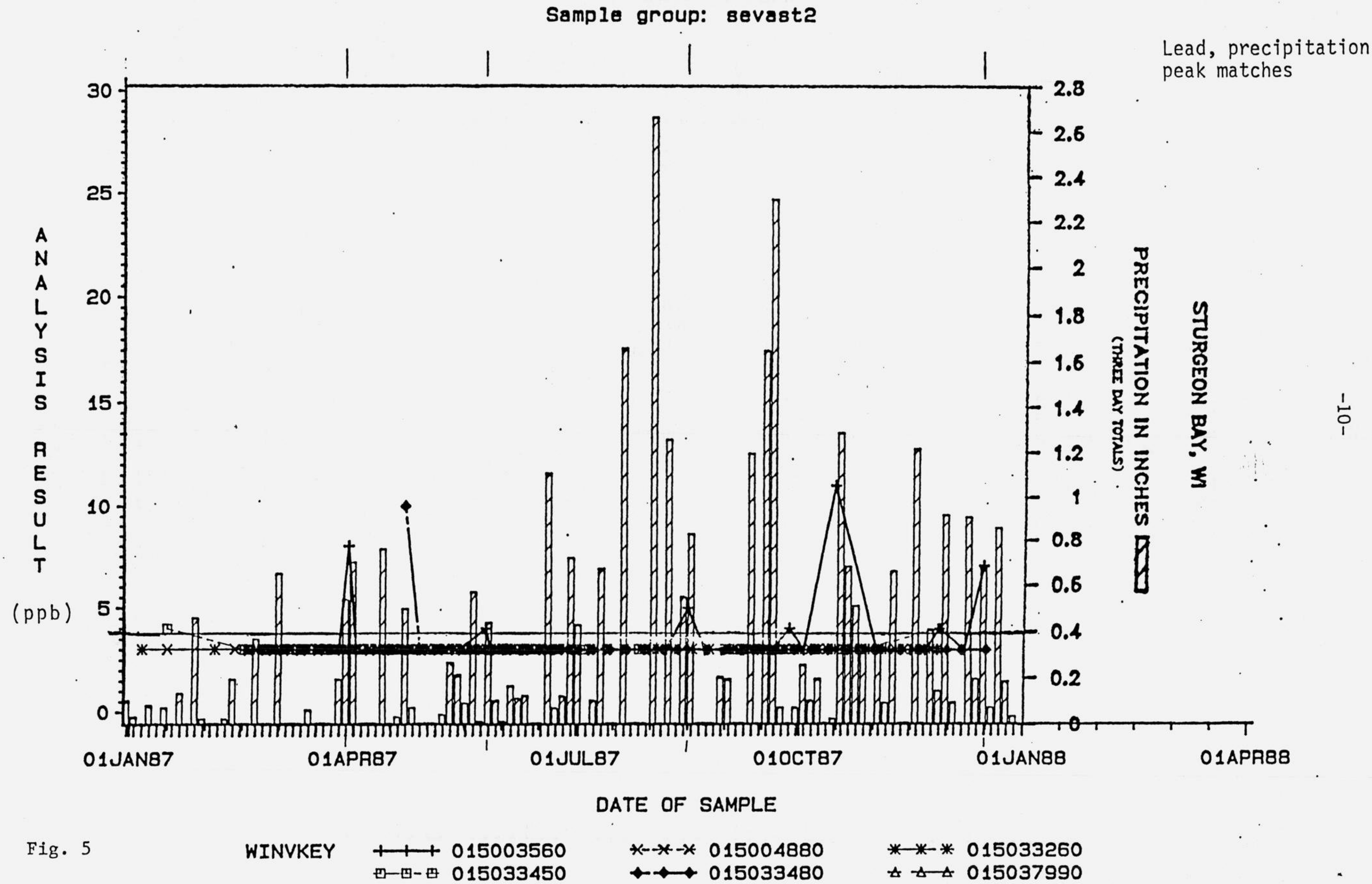


Fig. 5

Lead, precipitation peak matches

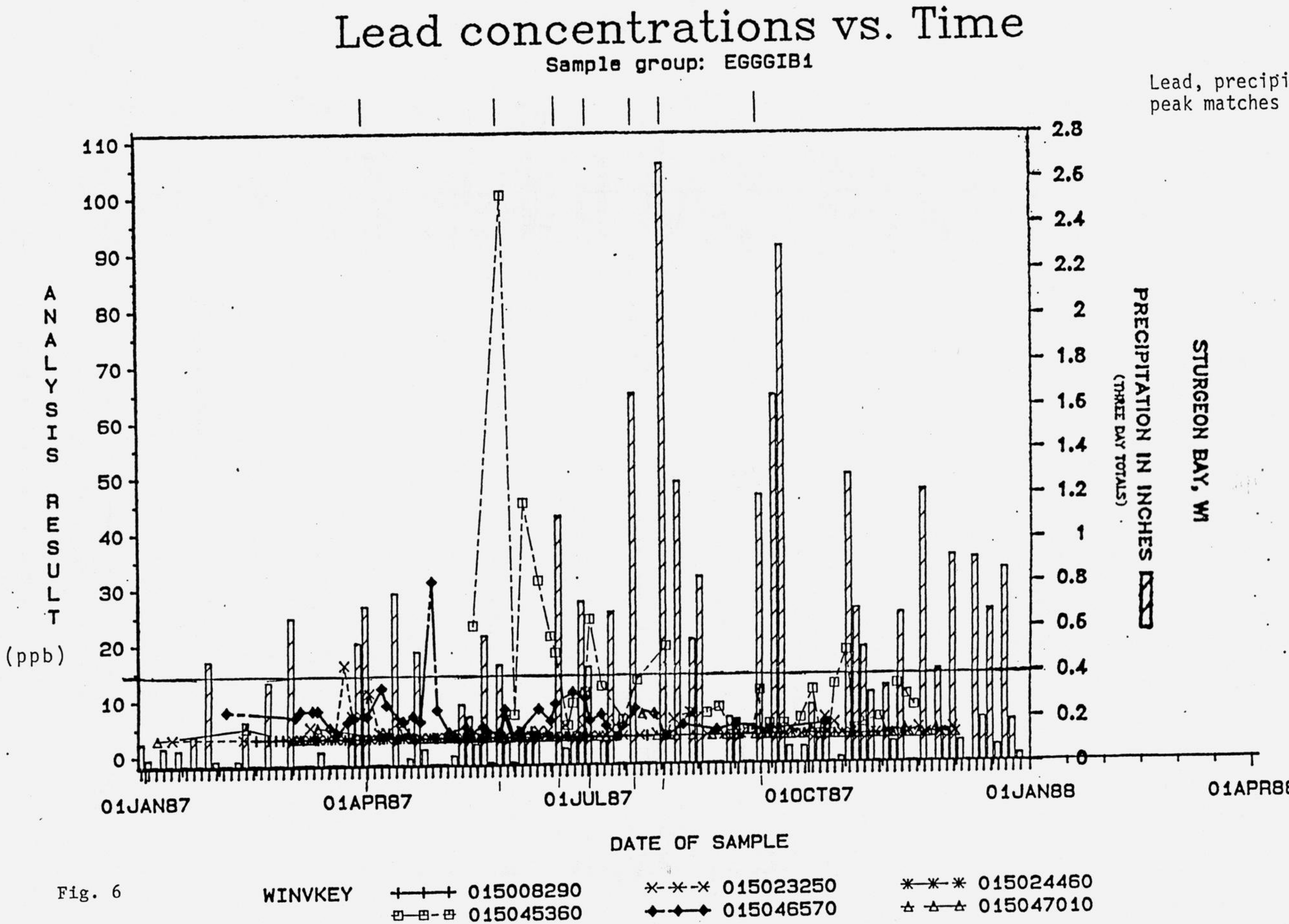


Fig. 6

Lead concentrations vs. Time

Lead, precipitation peak matches

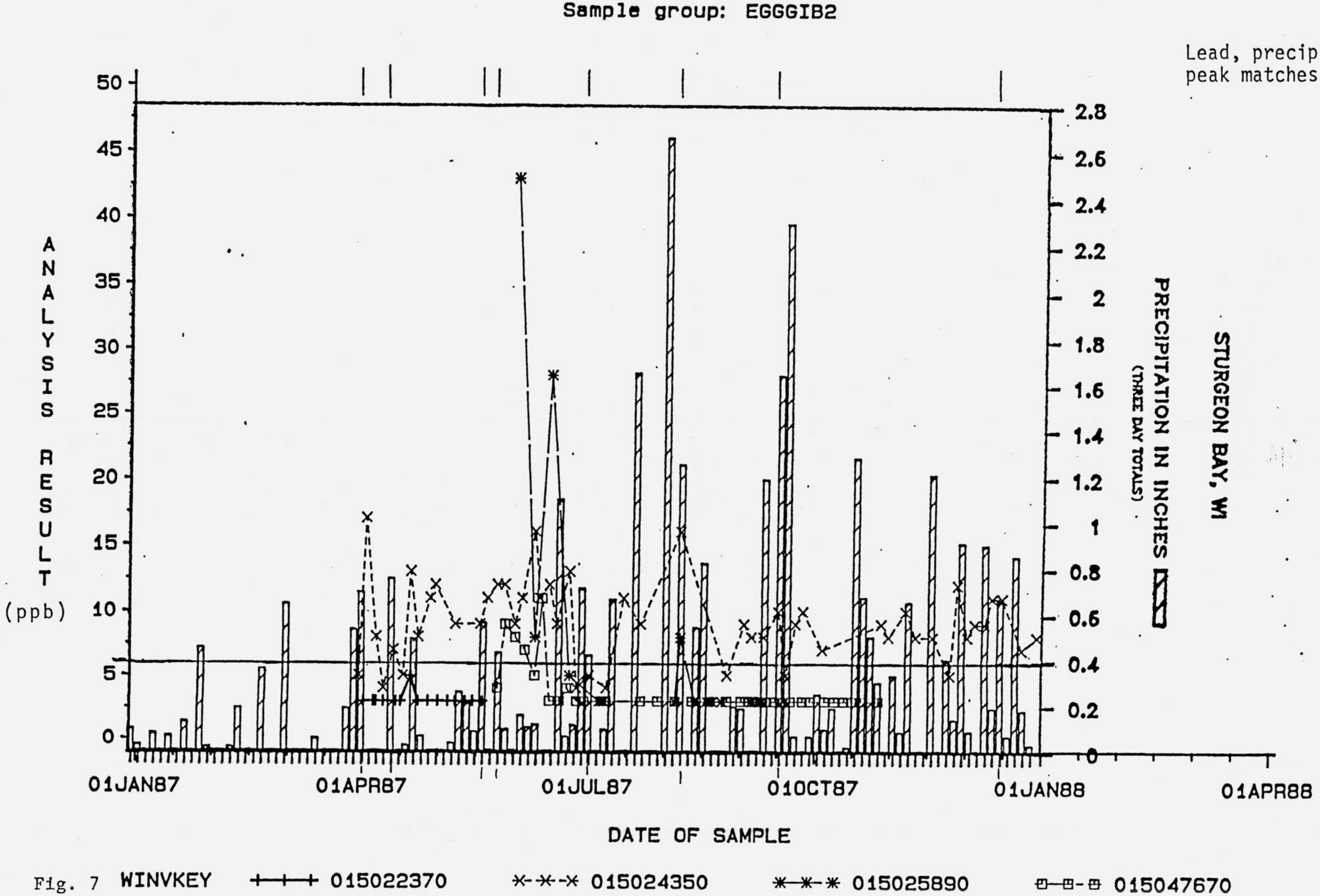
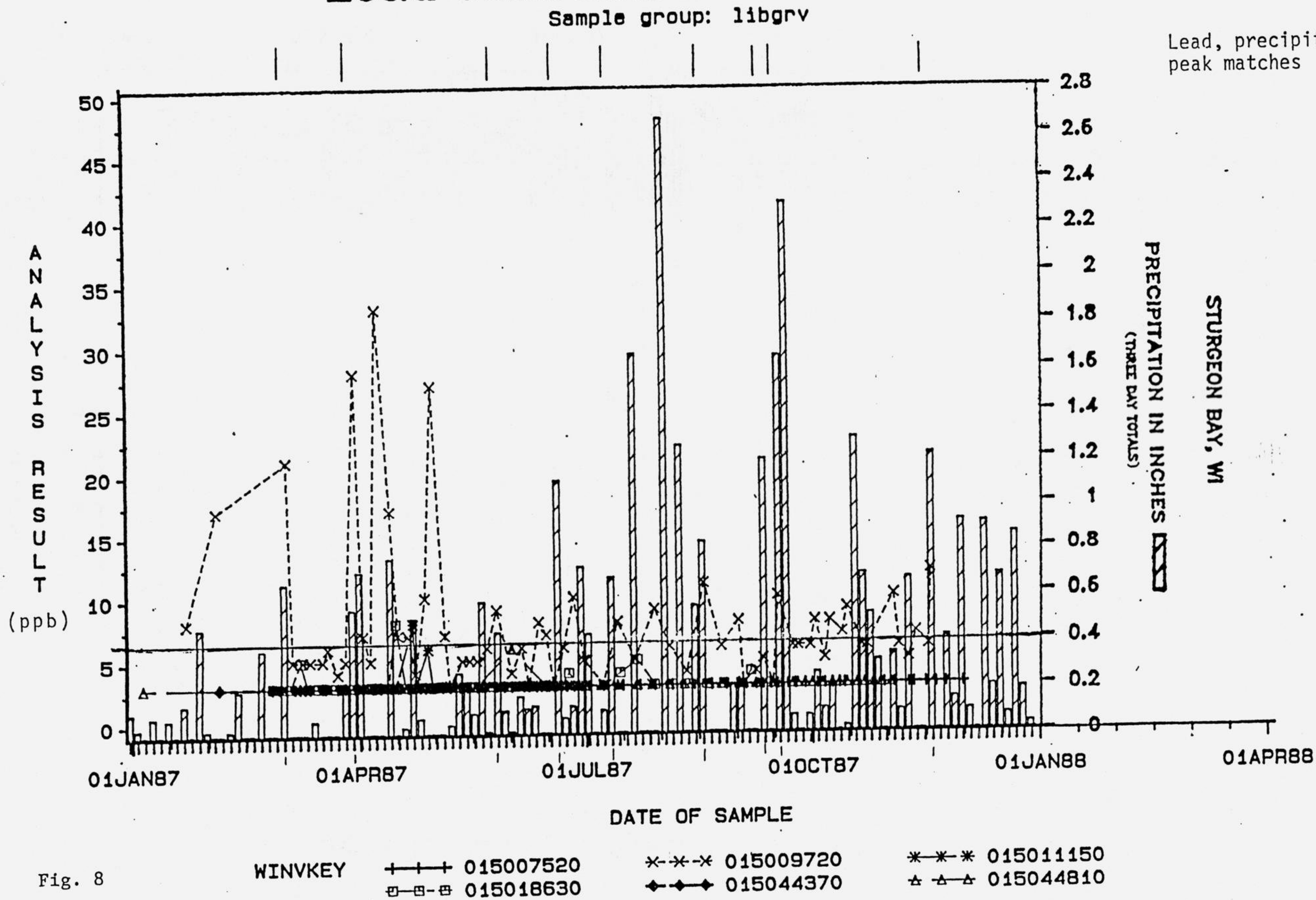


Fig. 7

Lead concentrations vs. Time



Lead, precipitation peak matches

Fig. 8

Lead concentrations vs. Time

Sample group: libgrvb

Lead, precipitation peak matches

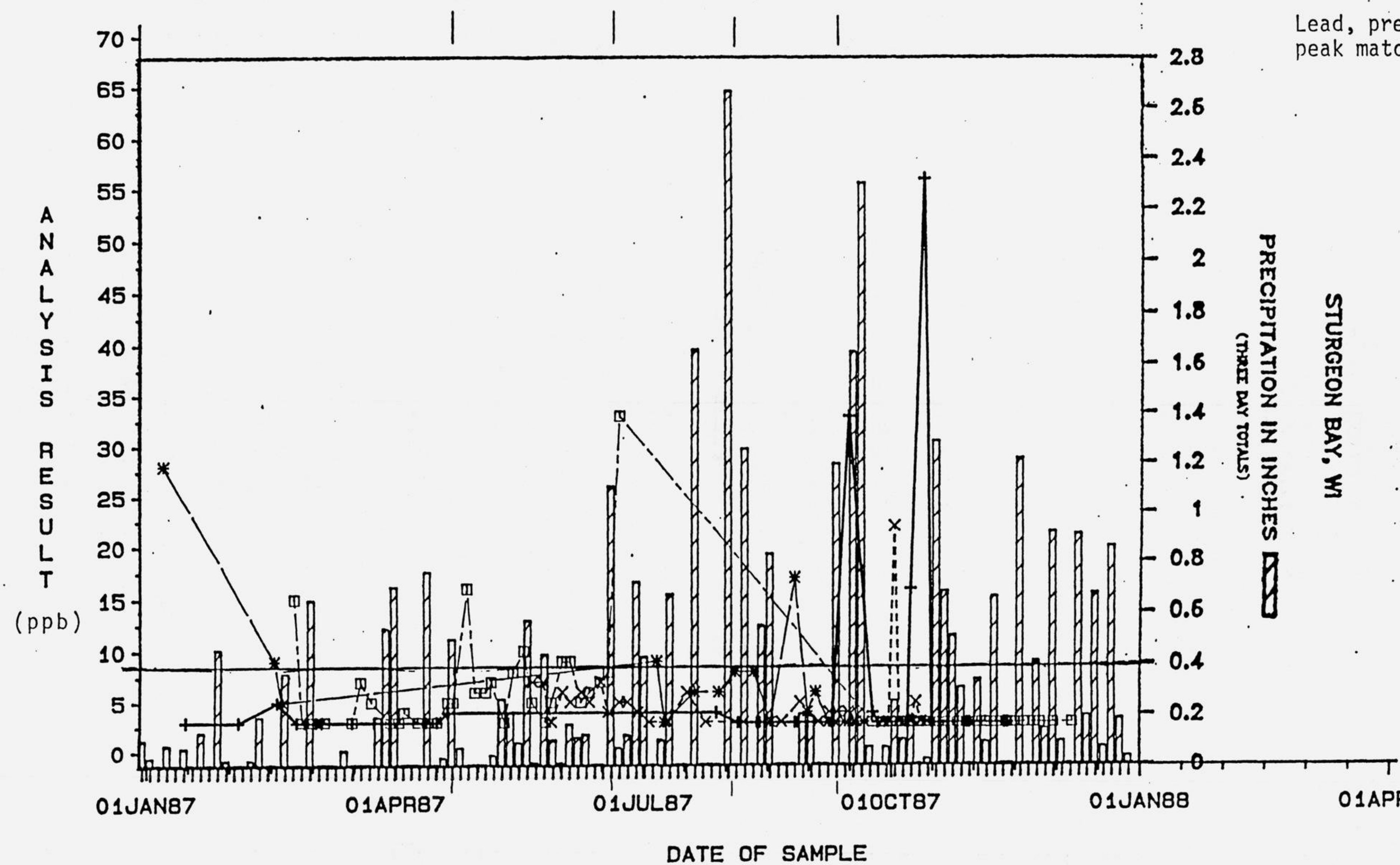


Fig. 9 WINVKEY +—+—+ 015007850 ×-×-× 015023030 ✱—✱—✱ 015029080 ⊡-⊡-⊡ 015048990

Timing and Frequency

It is difficult to time the sampling after the occurrence of a precipitation or runoff event. In addition, since lead concentrations in private wells have varied quite rapidly, it is necessary to sample a well more than once when determining its susceptibility to lead. Even the worst case well of 1987 (2400 ppb) failed to have a lead detection on at least one occasion. That well exceeded the 50 ppb health advisory standard 15 times in 1986-87. It was sampled 84 times. In fact, only one well always had a lead detection on every sample occasion. This same well was sampled 53 times but never exceeded 17 parts per billion lead. This is less than half the current health advisory level of 50 ppb.

Interpretation of what a lead detection means to the homeowner is difficult. Even so, when lead is detected, it does mean the well is susceptible, but does not mean the concentration is consistent or exempted from change with seasons or events.

Influences

Lead when detected did not have a consistent pattern. The occurrence or magnitude of lead concentrations many times did not appear to be tied directly to precipitation. Also, may wells did not react evenly or on the same day as one another. However, since some (nine of the 33 repeatedly sampled) wells do on occasion appear to react similarly on some of the same days and during precipitation peaks, it appears likely that site geology and source characteristics are playing an important controlling role.

Recommendations

1. Contact the Department of Health in Door County at the Sturgeon Bay Office with health related questions. To date, no health impacts have been recognized due to lead contamination in Door County. The Department of Health in Door County has been actively pursuing this issue.

   Even though most wells detecting lead only do so periodically, the Department of Health has expressed concern about any persons, particularly children, drinking water that might contain lead, even if it only intermittently exceeded the standard.

   The EPA is proposing to change the health standard from the current fifty parts per billion (50 ppb) to either five or ten parts per billion. This could mean that as many as 95 wells will have already met or exceeded the new standard at least once.

2. Contact the Door County Department of Soil and Water Conservation in Sturgeon Bay for additional information on local groundwater issues. Door County residents have been quite responsive to the issue of lead contamination in groundwater. They are actively seeking remedies to their groundwater problems and offer some excellent public awareness information to concerned citizens.

3. Homeowners and home buyers should sample their wells for lead several times to determine the susceptibility of their well. The expected times for the highest lead concentrations would be within three days after a rainfall that totals at least 0.4 inches. Based on precipitation totals and the post contamination patterns, the months of March, April, November and May should be the best sampling periods, in descending order of importance.

   A list of safe drinking water certified laboratories that can analyze these samples is attached or can be obtained from the Door County Soil and Water Conservation Department - Sturgeon Bay or the State of Wisconsin Department of Natural Resources (WDNR), Lake Michigan District Headquarters, Green Bay.

   Contact the WDNR for further information and assistance, if any water sample exceeds the health advisory for lead (currently 50 ppb).

4. Encourage government agencies (DILHR and WDNR - Water Supply Section 608-266-3415) and manufactures to carefully develop water treatment alternatives.

   There is currently no state approved method to treat the whole house water supply for lead. The few contaminated wells that have been drilled deeper have failed to produce an uncontaminated water supply.

5. Continue researching the reliability and effectiveness of filtering lead contamination from water samples, and the technique's possible use for some Door County water supplies.

6. Seek the advice of local well drillers, realtors, local government officials and landowners when considering land purchases, land use and well construction. They are already aware of many aspects of the lead contamination problem.

7. Encourage land use zoning where it is known that lead arsenate was heavily used or mixed for application.

   Discourage activities that would expose the soils, enhance water infiltration or residentially develop areas where humans, especially children, might come in contact with the soil.

8. Evaluate further the possible remediation of selected lead mixing sites. Determine sources, funding capabilities and practical/feasible solutions.

9. Investigate, through studies of past orchard areas, the possibilities of residual lead contaminants in soil to impact local groundwater.

Objectives

1. Determine the variability of lead concentrations in private wells that previously showed detections of lead.

2. Determine if fluctuations of lead concentrations in private wells can be matched with precipitation events.

3. Further determine if arsenic is a co-contaminant with lead.

4. Summarize and display all the lead groundwater data gathered, in a manner that allows for predictions of best sampling periods to identify worst case situations.

Methods

The following were elements of the project methodology. This methodology was intentionally tilted to give sample bias or preference toward sampling expected worst situation wells.

1. Sampling strategy

   a. Selected most sample sites upon the basis of a previous lead detection of at least 20 ppb.

   b. Selected some sample sites on the basis of nearby locations to a lead arsenate mixing site, even if a previous lead detection of at least 20 ppb had not occurred from the well.

   c. Considered well constructions after selectings sample locations. All available information was later researched and did not reveal any definite trends due to well construction. Lead packers are not noted or expected to have been used in any of the wells sampled.

   d. Collected all samples after flushing an unfiltered, unsoftened, cold water supply tap at least three to five minutes. Selected the same tap each sample time. This method eliminated the possible detection of lead from the plumbing.

   e. Conducted well sampling based upon the well owners approval and cooperation.

2. Sampling period

   a. The entire sampling period spanned six seasonal changes beginning in Spring of 1986 and ending in Fall of 1987.

      1) Sampled approximately 20 wells nearly every six weeks between Spring of 1986 and Winter of 1986. Obtained one hundred fifty-eight (158) water samples in total.

      2) Periodically sampled approximately 30 wells twice weekly between Spring of 1987 and Winter of 1987. Obtained one thousand six hundred sixty-two (1,662) water samples in total.

   b. Did not always sample all wells on the same dates as each other. This depended upon the individual well owners participation.

   c. Did not actively sample some wells for the entire study period. This participation also depended upon the individual well owner.

3. Sample collection

   a. The Wisconsin Department of Natural Resources provided all sample bottles to the homeowner or occupant.

   b. The homeowner or occupant collected and promptly mailed the sample to the State Laboratory of Hygiene in the mailer provided by the Department of Natural Resources.

4. Sample analyses

   a. Completed all sample preservation (nitric acid addition) and analysis at the Wisconsin State Laboratory of Hygiene.

   b. Analyzed arsenic from most samples taken between March and August 1987 which detected greater than 40 ppb lead. A total of 27 samples were analyzed and never detected arsenic during this period. To date there have been 154 samples taken from 77 wells and analyzed for arsenic, none of which detected it.

5. Data collection and management

   a. Assigned a nine digit identification number to each well. In this report, only the last four or five significant digits of that number are utilized when referring to an individual well.

b. Keyed all sample information into the Problem Assessment Monitoring File located in the Madison Central office (WDNR).

c. Notified all residents of their results through phone calls and/or mail.

6. Data management problems

   a. Encountered many problems when trying to recover the keyed data from the problem assessment monitoring file:

      1) miskeyed results;

      2) wrong F.I.D. numbers; and

      3) wrong dates.

   b. Rechecked all laboratory report slips and corrected the Problem Assessment Monitoring File.

   c. Double checked all laboratory report slips again to confirm that the proper corrections were made to the Problem Assessment Monitoring File. Since that file is still undergoing correction, some well data prior to 1986 may yet be missing.

Data presentation

The mass of data was compiled into five organizational structures for ease of interpretation and presentation. These groups include maps, time concentration plots, precipitation tracking, box plots and statistics.

A. Maps

Five separate sample groups were created on the basis of township designation:

1. Each township map contains its known lead arsenate mixing site locations. These sites are identified by an encircled single or double digit number that corresponds with the RMT Reports (Residual Management Technology Door County Lead Arsenate Report, May 1987, unpublished) site identification number.

2. Private wells sampled for lead are identified by the last four significant digits of the (WINKEY) nine digit identification number.

3. Five lead concentration groupings were selected and identified by a map symbol shape which represents the range of the highest lead concentration identified in that well since its monitoring inception.

4. Each map is located in the appendix and grouped with all the sample information for that Township area.

B. Time Concentration Plots

1. For data presentation purposes, eight sample groups were created, based upon the same five township boundaries. Plots can be found grouped in appendix by township boundaries. However, Egg Harbor, Sevastapol and Liberty Grove Townships were further subdivided to more clearly plot the lead data on time versus concentration graphics.

2. Two time versus concentration plots for each sample group exist:

   a) January 1, 1986 - January 1, 1987

   b) January 1, 1987 - April 1, 1988

C. Precipitation Tracking

1. Precipitation was tracked at the Door County Agricultural Station in Sevastopol Township and reported in daily amounts for the entire study period.

2. Daily precipitation totals were grouped as three day totals and presented in bar graphs for each of the years 1984, 1985, 1986, and 1987.

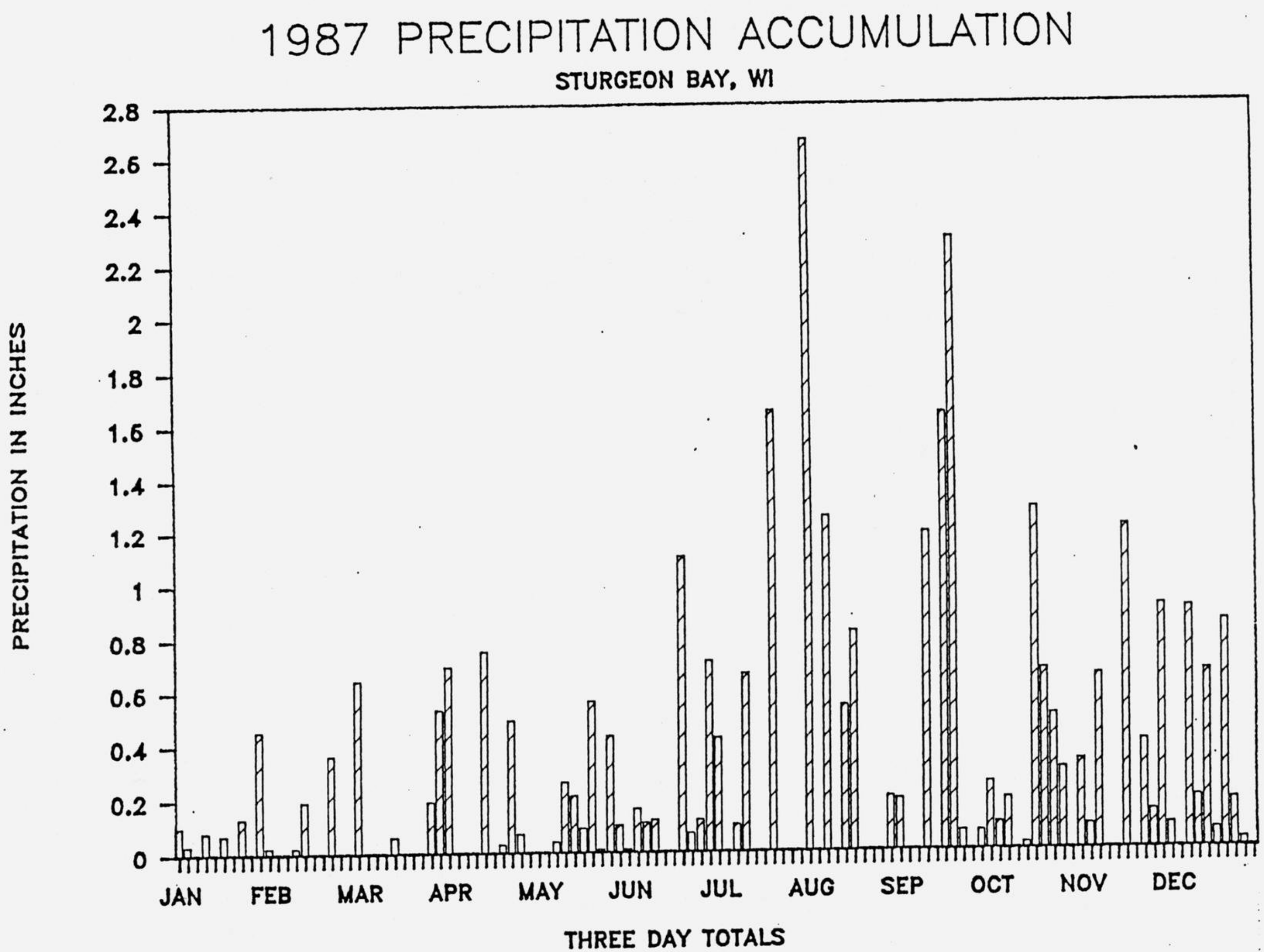
   a) For easy comparison of precipitation versus lead concentration, the horizontal scale on the precipitation graphs are identical to that on the time concentration plots for the same time periods.

   b) These three day groups roughly parallel the twice per week well water sampling interval of the 1987 year.

   c) The 1987 precipitation bar graph is included as figure 10.

3. Monthly precipitation amounts from 1984 - 1987 are also displayed in a bar graph format which show the deviations from the normal amounts (Fig. 10A).

4. The water balance calculation provided is based upon 1955 - 1980 temperature and precipitation information. This information appears below as provided by the RMT Report of May 1987 (Fig. 11A & 11B).



1987 PRECIPITATION ACCUMULATION
STURGEON BAY, WI
PRECIPITATION IN INCHES
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
THREE DAY TOTALS

Fig. 10

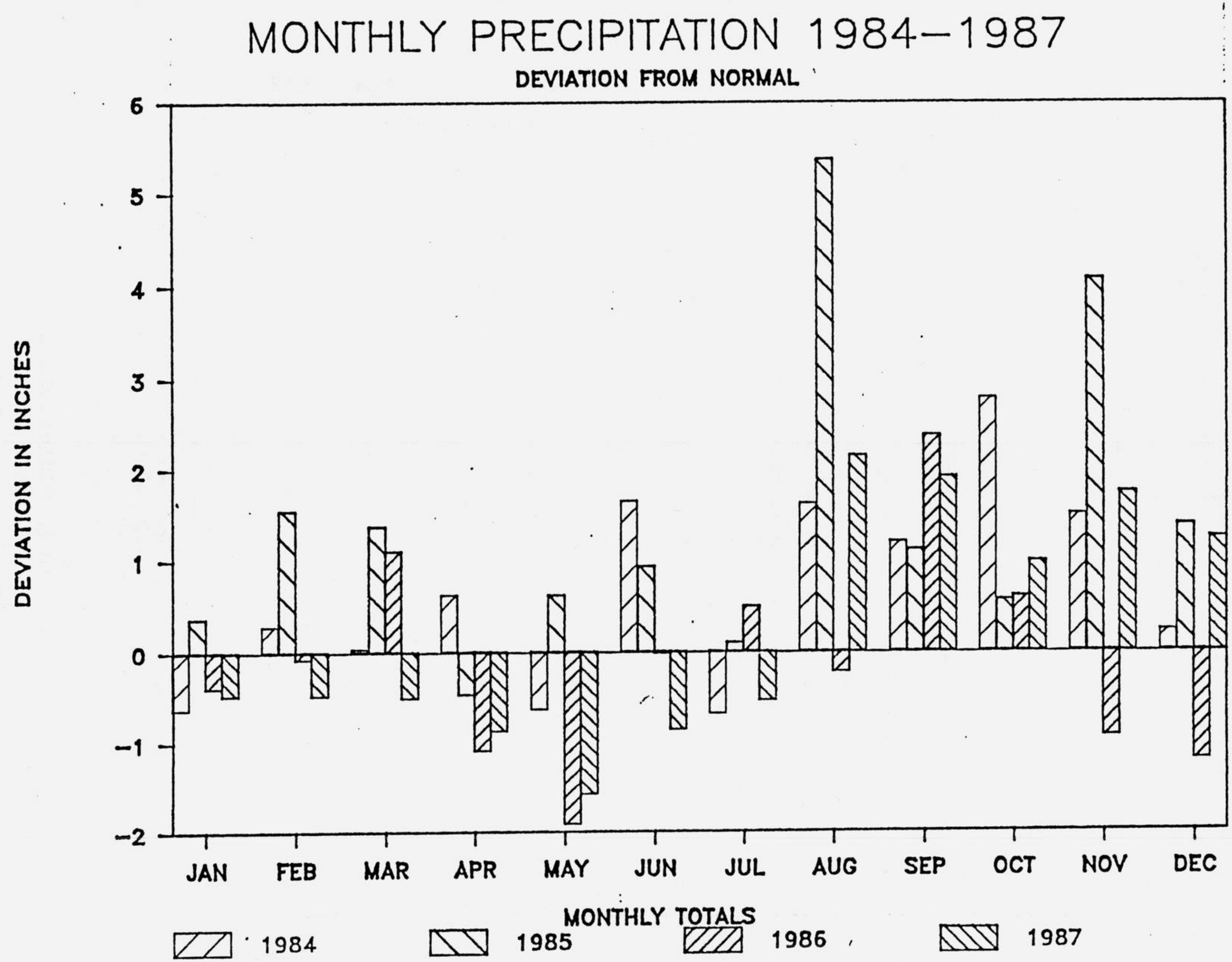

MONTHLY PRECIPITATION 1984–1987
DEVIATION FROM NORMAL
DEVIATION IN INCHES
6
5
4
3
2
1
0
–1
–2
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHLY TOTALS
1984
1985
1986
1987

Fig. 10A

STATE OF WISCONSIN

DEPARTMENT OF NATURAL RESOURCES
SOLID WASTE MANAGEMENT BUREAU

WATER BALANCE PROGRAM

FOR: DOOR COUNTY LEAD ARSENATE STUDY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
TEMPERATURE (F)	16.9	19.7	29.0	42.3	52.9	62.7	68.5	67.4	59.5	49.4	36.3	24.0	
MONTHLY I VALUES	0.00	0.00	0.00	1.23	3.58	6.41	8.33	7.95	5.43	2.71	0.33	0.00	35.97
UNADJUSTED POT. EVAPO-TRANSP.	0.00	0.00	0.00	0.03	0.07	0.11	0.13	0.12	0.09	0.06	0.01	0.00	
LATITUDE CORRECTION (r)	24.0	24.3	30.6	33.8	38.3	38.7	39.1	36.2	31.2	28.2	23.7	22.5	
POTENTIAL EVAPO-TRANSPIRATION	0.00	0.00	0.00	1.01	2.68	4.25	5.08	4.34	2.80	1.69	0.23	0.00	
PRECIPITATION	1.34	1.07	1.93	2.90	3.28	3.26	3.37	3.32	3.54	2.33	1.99	1.73	30.06
CUMULATIVE SNOW PACK (IN)	3.07	4.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.73	
CORRECTED EQUIV. PRECIP. (IN)	-0.00	0.00	6.07	2.90	3.28	3.26	3.37	3.32	3.54	2.33	1.99	0.00	
RUNOFF COEFFICIENT	0.10	0.10	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
MONTHLY RUNOFF (IN)	-0.00	0.00	1.21	0.29	0.33	0.33	0.34	0.33	0.35	0.23	0.20	0.00	
INFILTRATION (IN)	-0.00	0.00	4.86	2.61	2.95	2.93	3.03	2.99	3.19	2.10	1.79	0.00	
INFILTRATION MINUS PET (IN)	-0.00	0.00	4.86	1.60	0.27	-1.32	-2.05	-1.35	0.39	0.41	1.56	0.00	
ACCUMULATED WATER LOSS (IN)	-0.00	-0.00	0.00	0.00	0.00	-1.32	-3.36	-4.72	0.00	0.00	0.00	0.00	
SOIL MOISTURE STORAGE (IN)	2.16	2.16	2.16	2.16	2.16	1.11	0.39	0.20	0.59	0.99	2.16	2.16	
MONTHLY MOISTURE CHANGE (IN)	0.00	0.00	0.00	0:00	-0.00	-1.05	-0.72	-0.20	0.39	0.41	1.17	0.00	
ACTUAL EVAPO-TRANSP. (IN)	0.00	0.00	0.00	1.01	2.68	3.98	3.75	3.18	2.80	1.69	0.23	0.00	
NET PERCOLATION (IN)	-0.00	0.00	4.86	1.60	0.27	0.00	0.00	0.00	0.00	-0.00	0.39	0.00	7.12

NOTE: THE FOLLOWING CONDITIONS WERE USED IN COMPUTING THIS WATER BALANCE PER THORNTHWAITE & MATHER / EPA 1975 METHODS.

1 THE PROPOSED SITE HAS BEEN ESTIMATED TO BE AT 44.9 DEGREES NORTH LATITUDE.

2 THE FOLLOWING STATION; AT THE NOTED RELATIVE LOCATION WAS REFERENCED FOR ATMOSPHERIC DATA
1 STURGEON BAY EXP FARM WHICH IS 3.2 MILES SOUTH THE SITE LOCATION

3 THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) DATA FOR PRECIPITATION AND TEMPERATURE, FOR THE YEARS 1951 THROUGH 1980 FOR THE STATION NOTED IN ITEM 2; HAS BEEN REFERENCED IN THIS ANALYSIS.

4 UNADJUSTED POTENTIAL EVAPO-TRANSPIRATION VALUES HAVE BEEN CALCULATED USING THE EQUATION DEVELOPED BY THORNTHWAITE & MATHER AND NOT EPA/1975 TABLE 3 WHICH VARIES AS MUCH AS 0.01 FROM THE DEFINING EQUATION.

5 A SNOW PACK (IN EQUIVALENT INCHES OF RAINFALL) IS ACCUMULATED FOR EACH SUB 32 DEGREE FARENHEIT MONTH FROM OCTOBER THROUGH SEPTEMBER. THE TOTAL SNOW PACK IS THEN DISPERSED AS EQUIVALENT PRECIPITATION DURING A SPRING MELT EVENT, STARTING WHEN TEMPERATURES APPROACH 32 DEGREES.

6 THE CORRECTED EQUIVALENT PRECIPITATION IS THE SUM OF THE MONTHLY PRECIPITATION MINUS THE AMOUNT ADDED TO THE ACCUMULATED SNOW PACK PLUS THE ESTIMATED MONTHLY SNOW MELT.

7 RUNOFF COEFFICIENTS HAVE BEEN SELECTED PER CHOW, FENN, ET.AL. FOR THE TOPSOIL TYPE SPECIFIC TO THIS SITE FOR THE SURFACE SLOPE WHICH HAS BEEN ESTIMATED AS .02 FEET PER FOOT.

8 SELECTING AVAILABLE MOISTURE VALUES FROM THE RANGE OF VALUES RECORDED BY SCS, THE FOLLOWING FINAL COVER SYSTEM HAS BEEN ANALYZED: THE ROOT ZONE HAS BEEN ESTIMATED AT; 18 INCHES
THE FINAL COVER WAS SET AT; 60 INCHES OF SANDY LOAM WITH 12 % AVAILABLE MOISTURE

9 FOR MONTHS WHEN POTENTIAL EVAPO-TRANSPIRATION EXCEEDS INFILTRATION, THE MOISTURE STORAGE VALUES ARE COMPUTED BY THE EQUATION USED TO GENERATE EPA/1975 TABLES 11 THROUGH 22. THE VALUES DO NOT MATCH THE EQUATION VALUES AT ALL POINTS. THESE VARIATIONS DON'T AFFECT THE MONTHLY MOISTURE CHANGE VALUES BY MORE THAN 0.01.

10 ALL COMPUTED TABLE VALUES HAVE BEEN ROUNDED TO THE NEAREST 0.01 FOR PRINTING FORMAT. COMPUTER STORAGE ACCURACY OF THESE VALUES, RESULTS IN AN ANNUAL TOTAL PERCOLATION VALUE ACCURACY OF PLUS OR MINUS 0.05.

✓ Law
5/18/87

Fig. 11A

STATE OF WISCONSIN

DEPARTMENT OF NATURAL RESOURCES
SOLID WASTE MANAGEMENT BUREAU

WATER BALANCE PROGRAM

FOR: DOOR COUNTY LEAD ARSENATE STUDY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
TEMPERATURE (F)	16.9	19.7	29.0	42.3	52.9	62.7	68.5	67.4	59.5	49.4	36.3	24.0	
MONTHLY i VALUES	0.00	0.00	0.00	1.23	3.58	6.41	8.33	7.95	5.43	2.71	0.33	0.00	35.97
UNADJUSTED POT. EVAPO-TRANSP.	0.00	0.00	0.00	0.03	0.07	0.11	0.13	0.12	0.09	0.06	0.01	0.00	
LATITUDE CORRECTION (r)	24.0	24.3	30.6	33.8	38.3	38.7	39.1	36.2	31.2	28.2	23.7	22.5	
POTENTIAL EVAPO-TRANSPIRATION	0.00	0.00	0.00	1.01	2.68	4.25	5.08	4.34	2.80	1.69	0.23	0.00	
PRECIPITATION	1.34	1.07	1.93	2.90	3.28	3.26	3.37	3.32	3.54	2.33	1.99	1.73	30.06
CUMULATIVE SNOW PACK (IN)	3.07	4.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.73	
CORRECTED EQUIV. PRECIP. (IN)	-0.00	0.00	6.07	2.90	3.28	3.26	3.37	3.32	3.54	2.33	1.99	0.00	
RUNOFF COEFFICIENT	0.05	0.05	0.10	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
MONTHLY RUNOFF (IN)	-0.00	0.00	0.61	0.14	0.16	0.16	0.17	0.17	0.18	0.12	0.10	0.00	
INFILTRATION (IN)	-0.00	0.00	5.46	2.76	3.12	3.10	3.20	3.15	3.36	2.21	1.89	0.00	
INFILTRATION MINUS PET (IN)	-0.00	0.00	5.46	1.75	0.44	-1.15	-1.88	-1.19	0.56	0.52	1.66	0.00	
ACCUMULATED WATER LOSS (IN)	-0.00	-0.00	0.00	0.00	0.00	-1.15	-3.03	-4.22	0.00	0.00	0.00	0.00	
SOIL MOISTURE STORAGE (IN)	2.16	2.16	2.16	2.16	2.16	1.21	0.47	0.26	0.82	1.34	2.16	2.16	
MONTHLY MOISTURE CHANGE (IN)	0.00	0.00	0.00	0.00	-0.00	-0.95	-0.74	-0.21	0.56	0.52	0.82	0.00	
ACTUAL EVAPO-TRANSP. (IN)	0.00	0.00	0.00	1.01	2.68	4.05	3.94	3.36	2.80	1.69	0.23	0.00	
NET PERCOLATION (IN)	-0.00	0.00	5.46	1.75	0.44	0.00	0.00	0.00	0.00	0.00	0.84	0.00	8.49

NOTE: THE FOLLOWING CONDITIONS WERE USED IN COMPUTING THIS WATER BALANCE PER THORNTHWAITE & MATHER / EPA 1975 METHODS.

1 THE PROPOSED SITE HAS BEEN ESTIMATED TO BE AT 44.9 DEGREES NORTH LATITUDE.

2 THE FOLLOWING STATION; AT THE NOTED RELATIVE LOCATION WAS REFERENCED FOR ATMOSPHERIC DATA
1 STURGEON BAY EXP FARM WHICH IS 3.2 MILES SOUTH THE SITE LOCATION

3 THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) DATA FOR PRECIPITATION AND TEMPERATURE, FOR THE YEARS 1951 THROUGH 1980 FOR THE STATION NOTED IN ITEM 2; HAS BEEN REFERENCED IN THIS ANALYSIS.

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J Law
5/18/87

Fig. 11B

D. Box Plots

1. Box plots are included but may be difficult to interpret for many readers. The Appendix contains box plots for each well, They are grouped together according to the Township in which they exist.

2. The box plot is a pictorial way to view the data from several wells at once and how these wells relate to one another (Fig. 12).

3. The box plots are grouped and named the same as the time concentration plots.

4. Individual well identifications are done by the last 4-5 (same number as on maps) significant digits of the 9 digit well identification number. This well identification number is the same as the Winkey number on the time concentration plots.

5. The number of samples collected from each well is displayed beneath its respective box plot.

   a) Each box plot title ending in 6 only represents lead data from the time period between January 1, 1984 to December 31, 1986.

   b) Each box plot title ending in 8 only represents lead data from the time period between January 1, 1986, to April 1, 1988.

   c) Interpretations of these plots indicate that lead concentration changes that occur from year to year in an individual well do not necessarily make the same changes in the same months each year. This is as expected since many factors may effect how a well reacts to precipitation events. Also, the total number of samples taken in an individual well was largely different from one year to another.

Box plots display batches of data. Five values from a set of data are conventionally used: the extremes, the upper and lower hinges (quartiles), and the median. Such plots are becoming a widely used tool in exploratory data analysis and in preparing visual summaries for statisticians and nonstatisticians alike. Three variants of the basic display, devised by the authors, are described. The first visually incorporates a measure of group size: the second incorporates an indication of rough significance of differences between medians: the third combines the features of the first two. These techniques are displayed by examples.

KEY WORDS: Box Plots: Exploratory data analysis: Graphical techniques.

1. Introduction

Box plots display batches of data (Tukey 1970, 1977). Five values from a set of data are conventionally used: the extremes, the upper and lower hinges[1] (quartiles), and the median. The basic configuration of the display is shown in Figure A. The technique has been used with considerable success in a diverse range of projects (cf. Cleveland, Dunn, and Terpenning 1976; Cleveland, Graedel, and Kleiner 1977; Cohen, Gnanadesikan, and Landwehr 1977; Kettenring et al. 1976). Inevitably, certain weaknesses came to light in particular cases: most frequently these were the result of inappropriate interpretation of the results rather than problems with the technique itself. In almost all cases, inclusion of additional available information in the display would have prevented the misinterpretation.

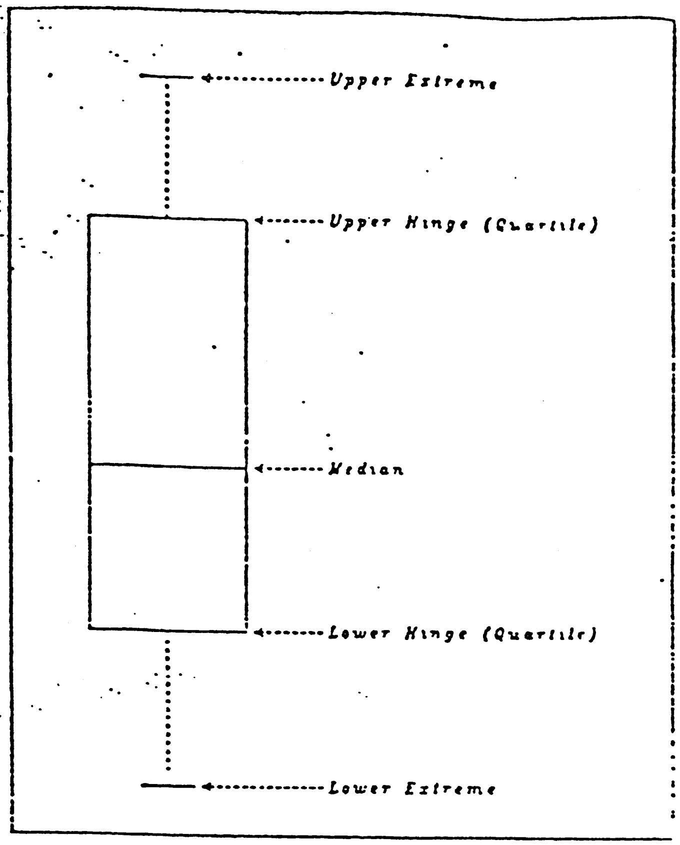


Figure A. Configuration of a Box Plot

From: <u>Variations of Box Plots</u>

by: McGill, Robert etal
The American Statistican, 2/78 vol 32 No.1 P. 12

*The level of confidence about the median is indicated by the sharpness of the waistline. A short sharp waistline indicates a high confidence in the value of the median. This usually occurs when many samples were taken.

A broad lenthy waistline indicates some possible doubt about the median value might exist. This would likely occur if too few samples were taken to establish a true median, especially if the sample results were very erratic or spread out.

Results

A. To date, 333 private water supply wells have been sampled for lead in Door County. One hundred nineteen of these wells detected lead on at least one occasion. Seventy-seven wells were also sampled for arsenic. Arsenic has not been detected in any water samples. The reasons for its absence are not yet known.

During 1986 and 1987, thirty-three worst case wells were sampled approximately twice weekly. Twelve of these exceeded the health advisory of 50 ppb at least once. Yet, only one well was above 50 ppb lead 25% of the time sampled. In addition, only two more wells were above 20 ppb lead 25% of the time sampled. However, concentration variations can occur rapidly to a well. Lead concentrations in several water supply wells in this study have changed by as much as 40 ppb within a three day period.

B. The monthly precipitation bar graphs indicate a general increase in precipitation over the study period (Fig. 10A).

C. The calculated water balance suggests the peak months for percolation of precipitation, in descending order are March, April November, and May. All others are equal at zero.

D. Also, in descending order, peak runoff periods are March, September, July, August, June, May, April, October, and November. All others are equal at zero.

E. Individual Well Statistics

1. These statistics were computed with the Statistical Analysis System (SAS) program Univariate procedure, and can be found in the appendix with other well information. They are identified by the same well identification number and grouped according to the township in which they exist.

2. The statistics computed are based upon the time period from January 1, 1984, through April 1, 1988.

   a) This longer time period was selected because it gave the most complete information for defining the magnitude of the problem at each well.

3. Additional bulk statistics are interpreted from the above and tabled below along with some general well information (Fig. 13 and 14).

TOWNSHIP	Well FID	Casing Depth (feet)	Total Depth (feet)	# Samples	# Detects	% of Samples W/Detects	*Median	*Low	*High	*Q_3	*Q_3-Q_1	*95% Value	# Samples > 50ppb	# Samples > 20ppb	Skewness	Variance	Kurtosis	# Lead Sites W/in 2 miles	# Lead Sites W/in 1 mile	# Lead Sites W/in ½ mile
Sevastopol	33450	194	294	44	6	14	3	3	25	3	0	4	1	1	6.59242	10.9979	43.6202	5	4	1
Sturgeon Bay	44590			65	13	20	3	3	43	3	0	8	0	2	5.77335	34.0346	34.6699	1	0	0
Sturgeon Bay	44260	173	241	69	68	99	35	3	180	48	24	96	16	54				1	1	0
															**2.40504	891.723	7.34094			
Sturgeon Bay	44480	173	254	72	3	4	3	3	8	3	0	3	0	0				1	0	0
Sevastopol	26880	135	197	80	78	98	11	3	34	16	8	29	0	14	1.23408	49.9176	1.12619	5	2	1
Sevastopol	37990			26	2	8	3	3	3	3	0	3	0	0	-------	--0-----	-------	5	2	1
Sevastopol	03560			83	58	70	3	3	140	4	1	13.6	3	3	5.91242	335.703	37.509	5	4	2
Sevastopol	44920	251	317	84	22	26	3	3	150	4.75	1.75	42.5	2	8	5.2358	390.913	32.6459	0	0	0
Sevastopol	20060	170	234	73	34	47	3	3	160	6	3	58.2	3	5	4.79825	568.25	24.9966	2	0	0
Sevastopol	04880	170	320	26	5	19	3	3	10	3	0	8.6	0	0	3.71153	2.26	14.8355	8	1	1
Sevastopol	33260		128	83	0	0	3	3	3	3	0	3	0	0	-------	--0----	-------	10	3	0
Sevastopol	33480	170	232	44	3	7	3	3	21	3	0	10	0	1	4.85869	9.27273	25.4269	12	4	2
Sevastopol	45140	251	301	84	83	99	41.5	3	2,400	86.25	62	250	29	67	8.43605	68847.7	74.7794	10	4	1
Sevastopol	15110	250	325	22	12	55	5.5	3	120	22	19	112.65	2	6	2.89349	779.022	8.9884	8	4	1
Egg Harbor	22370			16	2	13	3	3	5	3	0	5	0	0	3.02973	0.295833	9.09343	1	1	0
Egg Harbor	47670			33	7	21	3	3	11	3	0	9.6	0	0	2.59819	3.90341	6.10757	1	0	0
Egg Harbor	08290	155	206	42	8	19	3	3	42	3	0	7	0	1	6.2755	36.4994	40.0869	1	0	0
Egg Harbor	45360			47	40	85	7	3	100	13	9	55.8	2	7	3.56396	298.65	14.85	4	3	1
Egg Harbor	47010	90	120	70	9	13	3	3	7	3	0	5	0	0	4.00154	0.481159	16.8259	3	0	0
Gibraltar	25890			19	7	37	3	3	210	8	5	210	1	4	3.92995	2272.02	16.1937	3	2	1
Egg Harbor	24350			53	53	100	9	4	17	11	3	16	0	0	0.427236	8.91001	0.382262	3	1	1
Egg Harbor	24460			42	4	10	3	3	20	3	0	10.25	0	0	4.94703	8.40418	26.0317	4	2	1
Egg Harbor	46570	186	320	52	49	94	6.5	3	370	8	3	86.65	2	4	5.64892	3146.33	33.2162	1	0	0
Gibraltar	23250	192	261	83	40	48	3	3	16	4	1	7.8	0	0	3.47168	4.79254	14.1279	3	2	2
Liberty Grove	44810	154	181	41	2	5	3	3	6	3	0	4.8	0	0	4.63338	0.309756	21.302	0	0	0
Liberty Grove	18630			49	10	20	3	3	13	3	0	6.5	0	0	4.90209	2.62925	26.4638	1	0	0
Liberty Grove	11150			31	6	19	3	3	15	3	0	10.8	0	0	4.28396	5.50323	19.5587	3	3	3
Liberty Grove	07520	270		62	2	3	3	3	10	3	0	3	0	0	7.87401	0.790323	62	3	3	2
Liberty Grove	07850	173	244	45	18	40	3	3	160	6	3	49.1	2	4	5.3609	619.719	31.3818.	3	3	1
Liberty Grove	09720	153	303	67	64	96	6	3	33	8	3	24.6	0	4	2.80809	32.986	8.40839	4	3	3
Liberty Grove	48990	20	192	56	27	48	3	3	33	6	3	15.15	0	1	3.88316	23.7789	18.9936	3	3	1
Liberty Grove	44370			38	1	3	3	3	3	3	0	3	0	0	-------	-0-------	--------	1	1	1
Liberty Grove	23030		187	46	36	78	4	3	77	7	4	26.55	1	3	5.10792	135.273	29.4142	1	1	0
Liberty Grove	29080			24	17	71	7	3	78	14.5	14.5	65.5	1	3	3.52752	247.245	14.3601	3	3	1

**One set of statistics represents both wells as a group
*All values of 3ppb actually represent less than 3 ppb since this was the minimum laboratory detection limit.

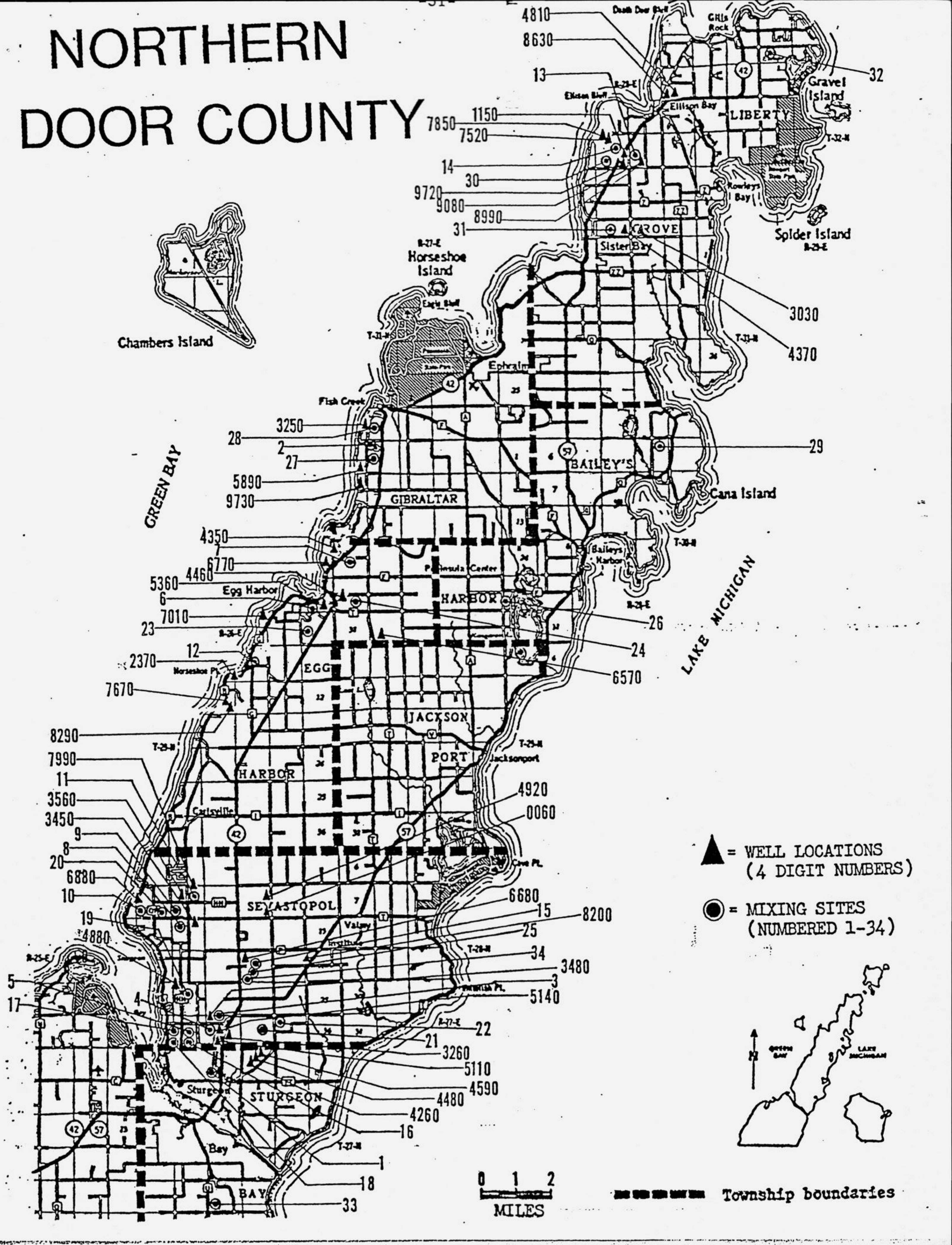
Fig. 13

TOWNSHIP	# Lead Sites	# Wells >50 ppb	# Wells >20 ppb	Highest Lead Level	# Wells Sampled	# Wells W/Detects	# Samples	# Samples W/Detects	# Samples >50ppb	# Samples >20ppb	# Medians >3ppb	# 95% ≤50ppb
Sturgeon Bay	2	1	2	180	3	3	206	84	1	2	1	3
Sevastopol	17	5	8	2,400	10	9	605	297	39	104	3	7
Egg Harbor	5	2	3	370	8	8	355	172	2	3	3	6
Gibraltar	3	1	1	210	2	2	102	47	1	1	0	1
Liberty Grove	5	3	5	160	10	10	459	183	3	5	3	9
TOTALS:	32	12	19		33	32	1,727	783	46	115	10	26

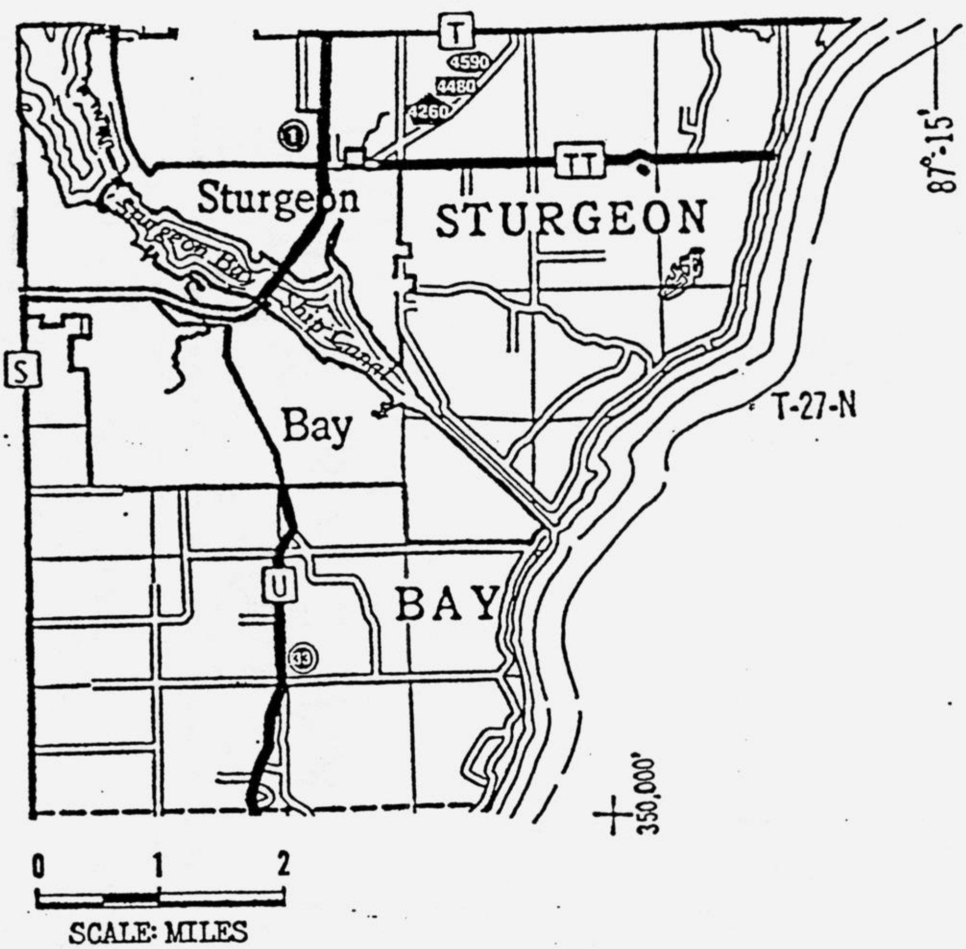
Fig. 14

APPENDIX

NORTHERN DOOR COUNTY



STURGEON BAY TOWNSHIP



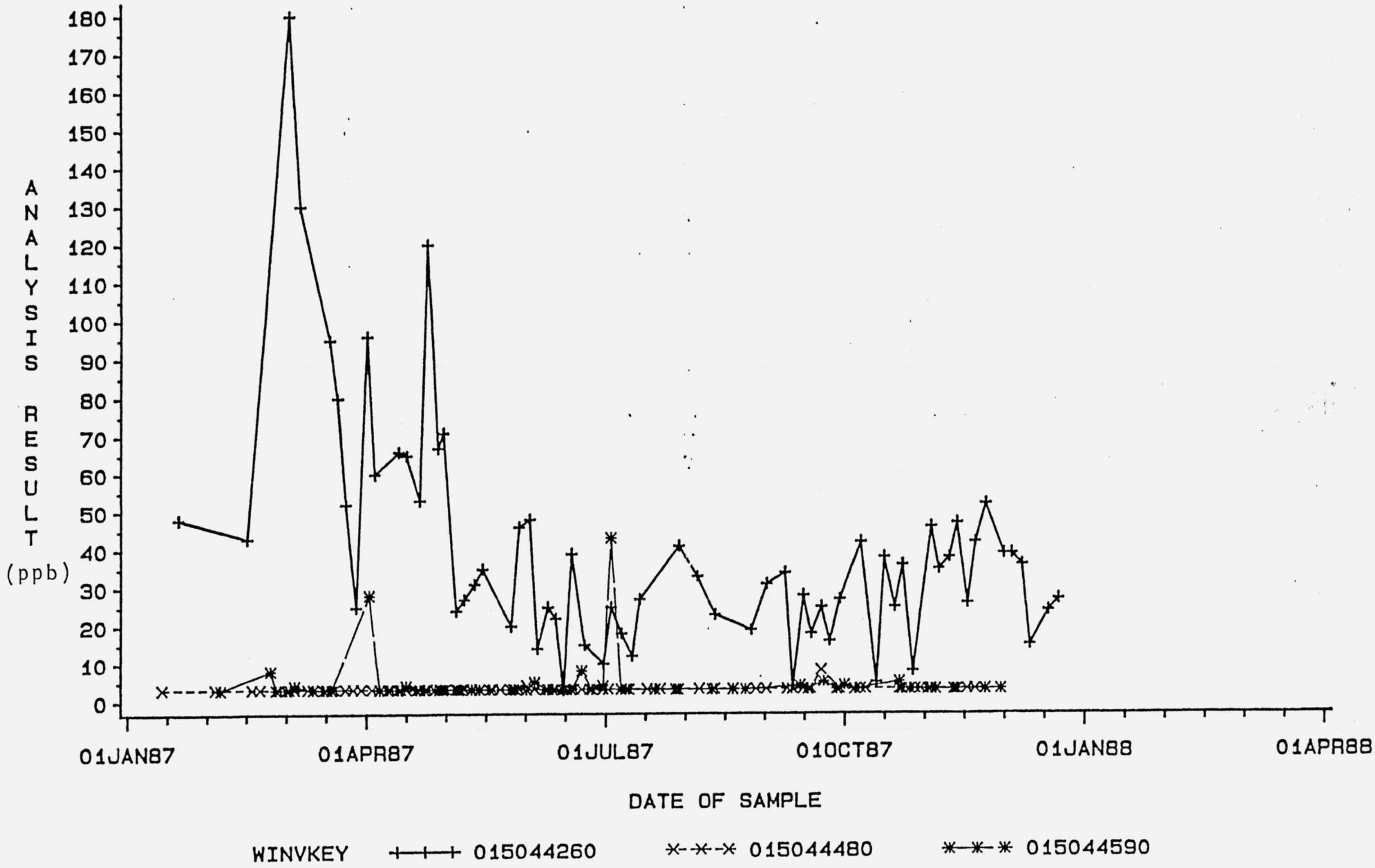
KEY

(00) = Mixing Sites
0000 = < 3 ppb
0000 = 3 - 19 ppb
0000 = 20 - 49 ppb
0000 = 50 - 100 ppb
0000 = > 100 ppb

(ppb = parts per billion)

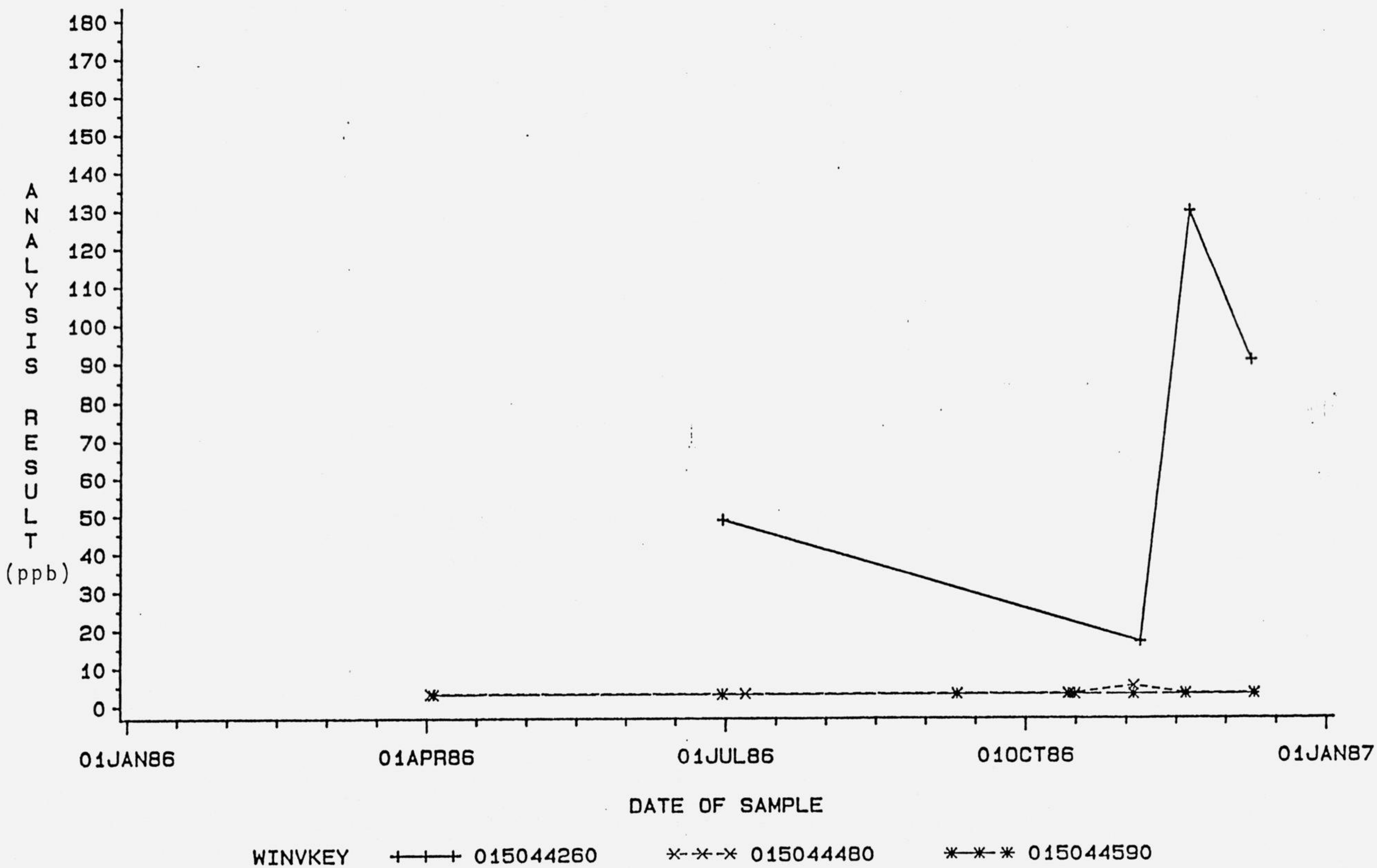
Lead concentrations vs. Time

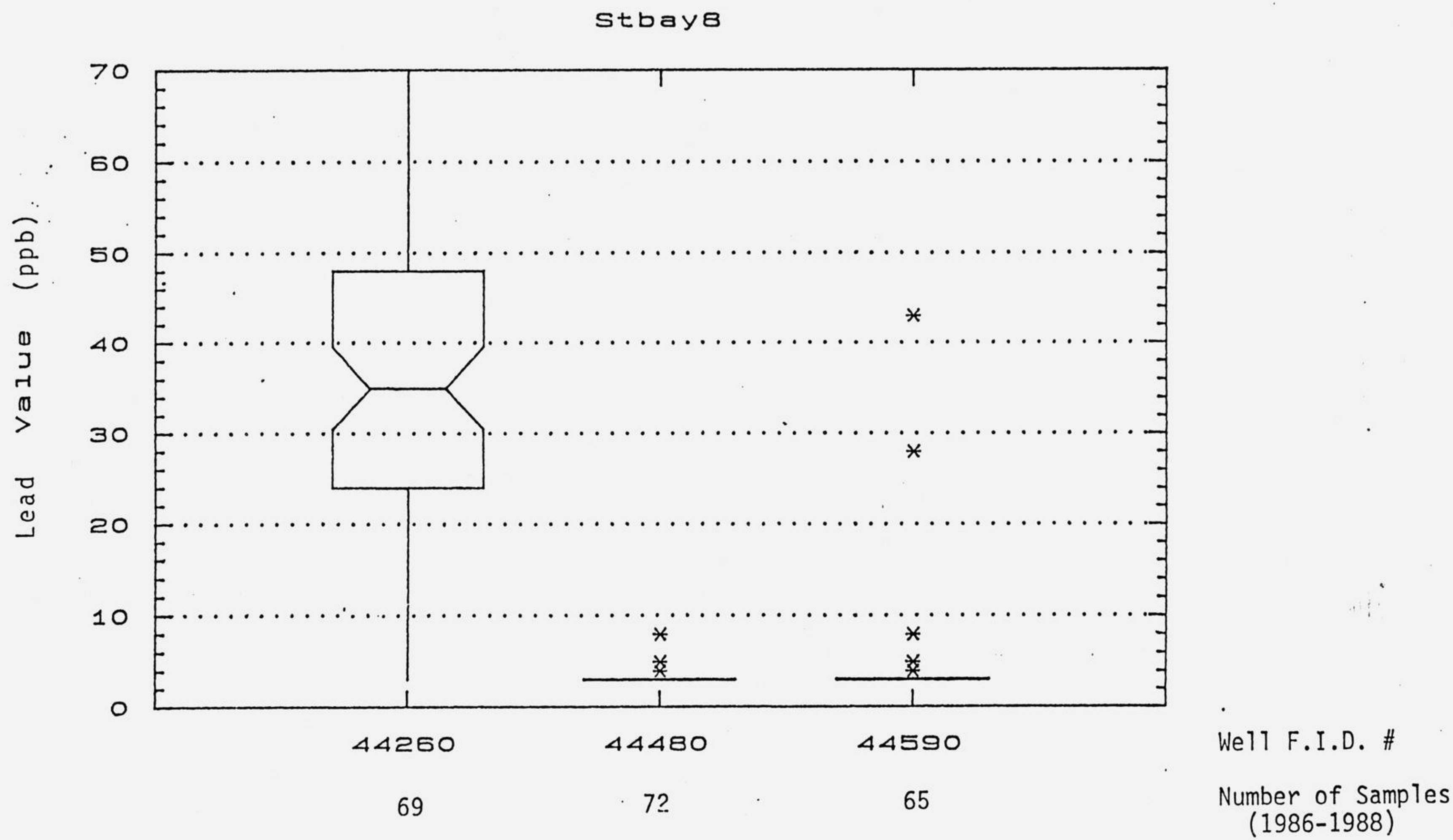
Sample group: stbay



Lead concentrations vs. Time

Sample group: stbay




Stbay8
Lead Value (ppb)
70
60
50
40
30
20
10
0
44260
44480
44590
69
72
65
Well F.I.D. #
Number of Samples
(1986-1988)

TRSQQ=2726E03NESW

UNIVARIATE

Well F.I.D. # 44590

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	65	SUM WGTS	65
MEAN	4.32308	SUM	281
STD DEV	5.83392	VARIANCE	34.0346
SKEWNESS	5.77335	KURTOSIS	34.6699
USS	3393	CSS	2178.22
CV	134.948	STD MEAN	0.723609
T:MEAN=0	5.97433	PROB>|T|	0.0001
SGN RANK	1072.5	PROB>|S|	0.0001
NUM ¬= 0	65		

QUANTILES(DEF=4)

100% MAX	43	99%	43
75% Q3	3	95%	8
50% MED	3	90%	5
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	40		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504459)	5	(01504459)
3	(01504459)	8	(01504459)
3	(01504459)	8	(01504459)
3	(01504459)	28	(01504459)
3	(01504459)	43	(01504459)

TRSQQ=2726E03SWNE

UNIVARIATE

Well F.I.D. # 44260

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	141	SUM WGTS	141
MEAN	22.1418	SUM	3122
STD DEV	29.8617	VARIANCE	891.723
SKEWNESS	2.40504	KURTOSIS	7.34094
USS	193968	CSS	124841
CV	134.866	STD MEAN	2.51481
T:MEAN=0	8.80458	PROB>|T|	0.0001
SGN RANK	5005.5	PROB>|S|	0.0001
NUM ¬= 0	141		

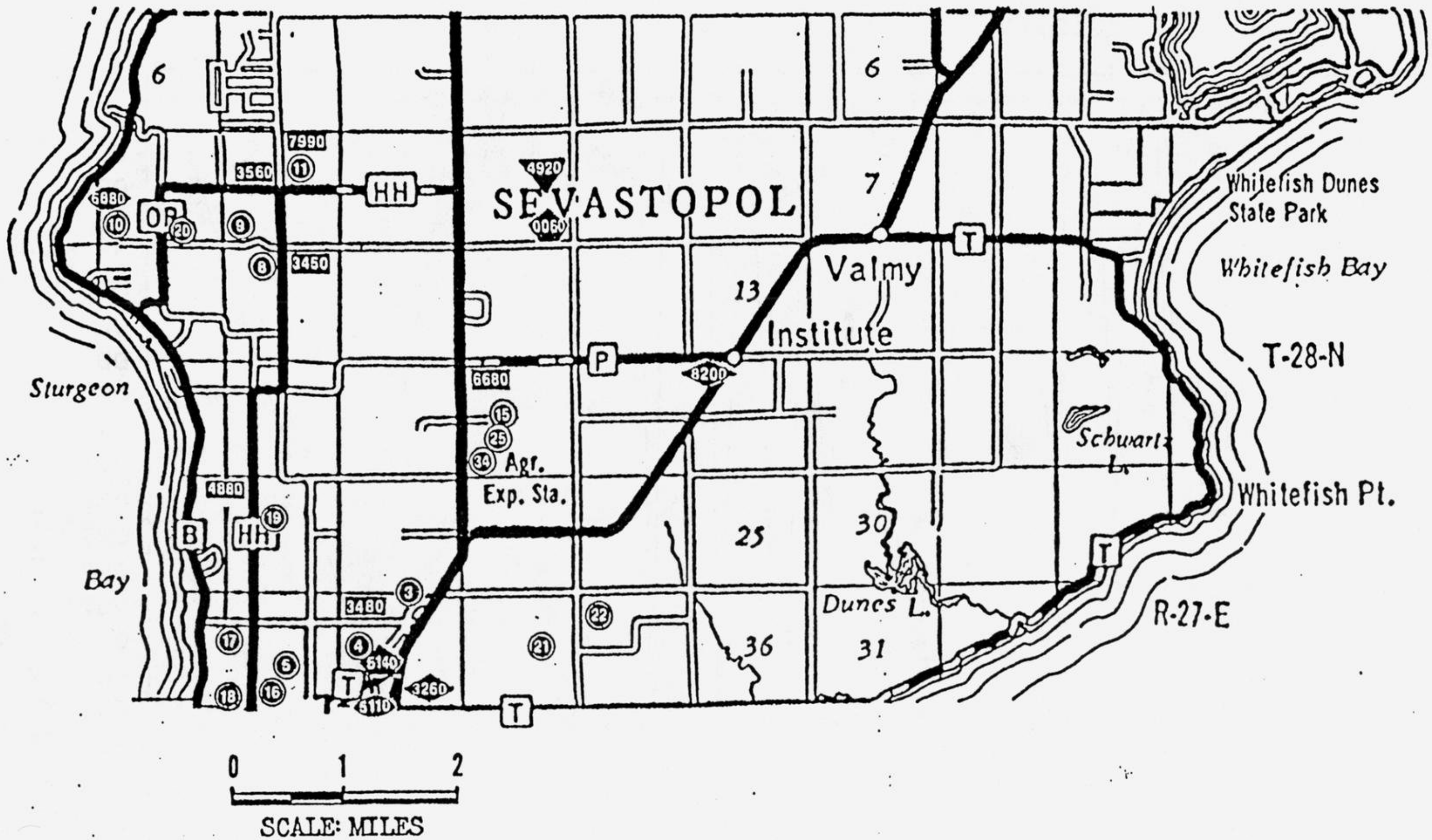
QUANTILES(DEF=4)

100% MAX	180	99%	159
75% Q3	34.5	95%	89.9
50% MED	4	90%	52.8
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	177		
Q3-Q1	31.5		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504448)	96	(01504426)
3	(01504448)	120	(01504426)
3	(01504448)	130	(01504426)
3	(01504448)	130	(01504426)
3	(01504448)	180	(01504426)

SEVASTOPOL TOWNSHIP



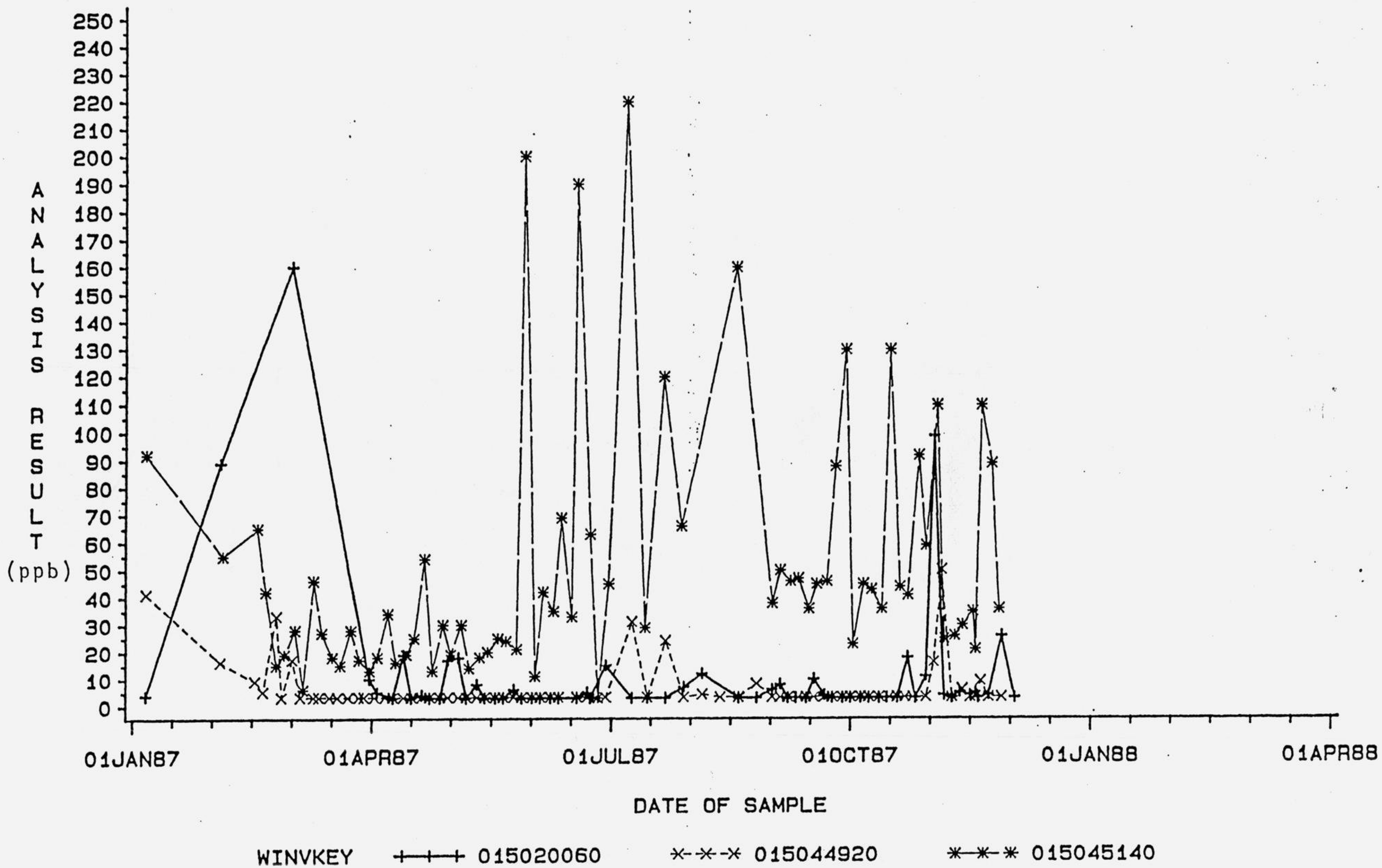
KEY

(00) = Mixing Sites
0000 = < 3 ppb
0000 = 3 - 19 ppb
0000 = 20 - 49 ppb
0000 = 50 - 100 ppb
0000 = > 100 ppb

(ppb = parts per billion)

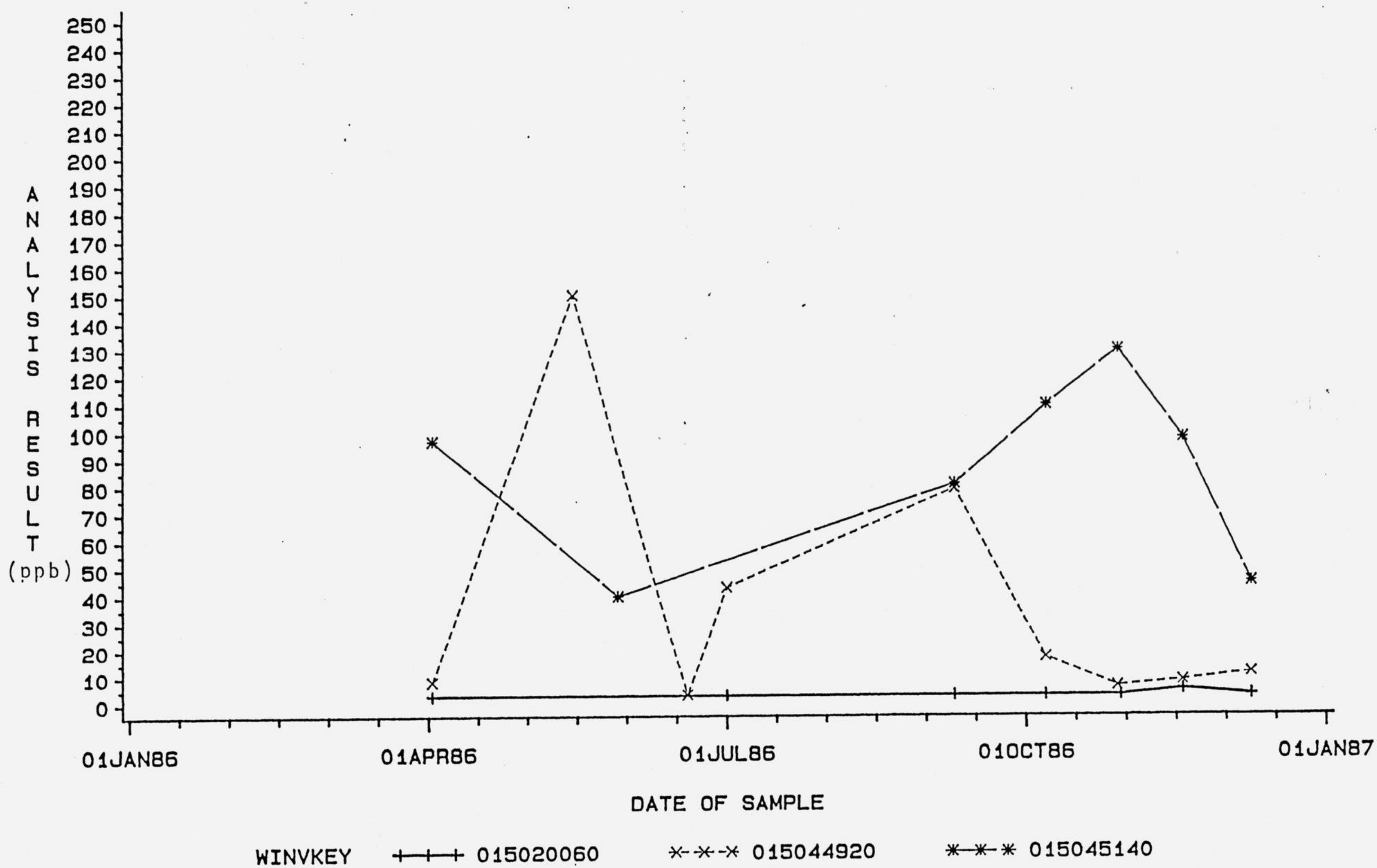
Lead concentrations vs. Time

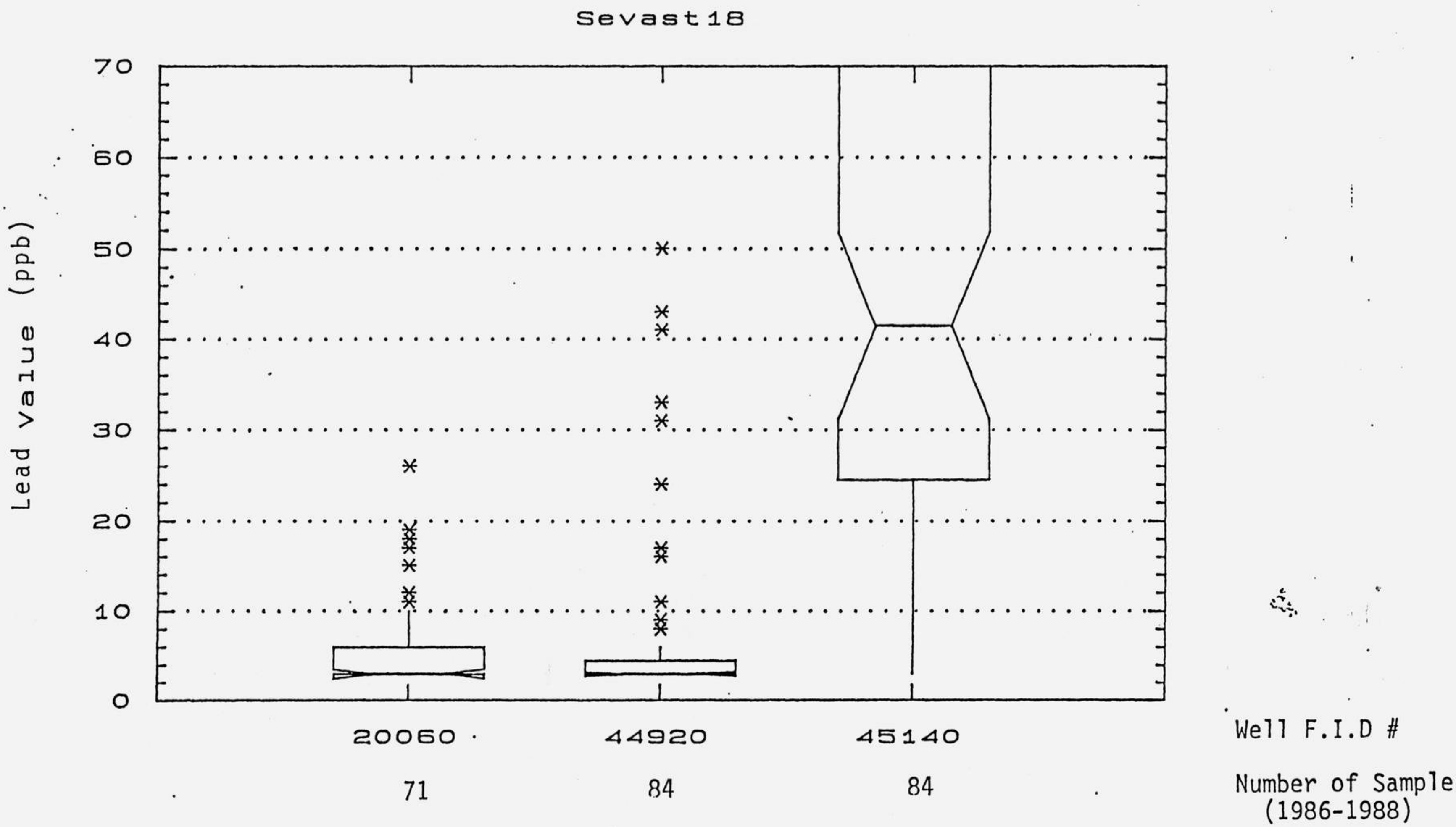
Sample group: sevast1

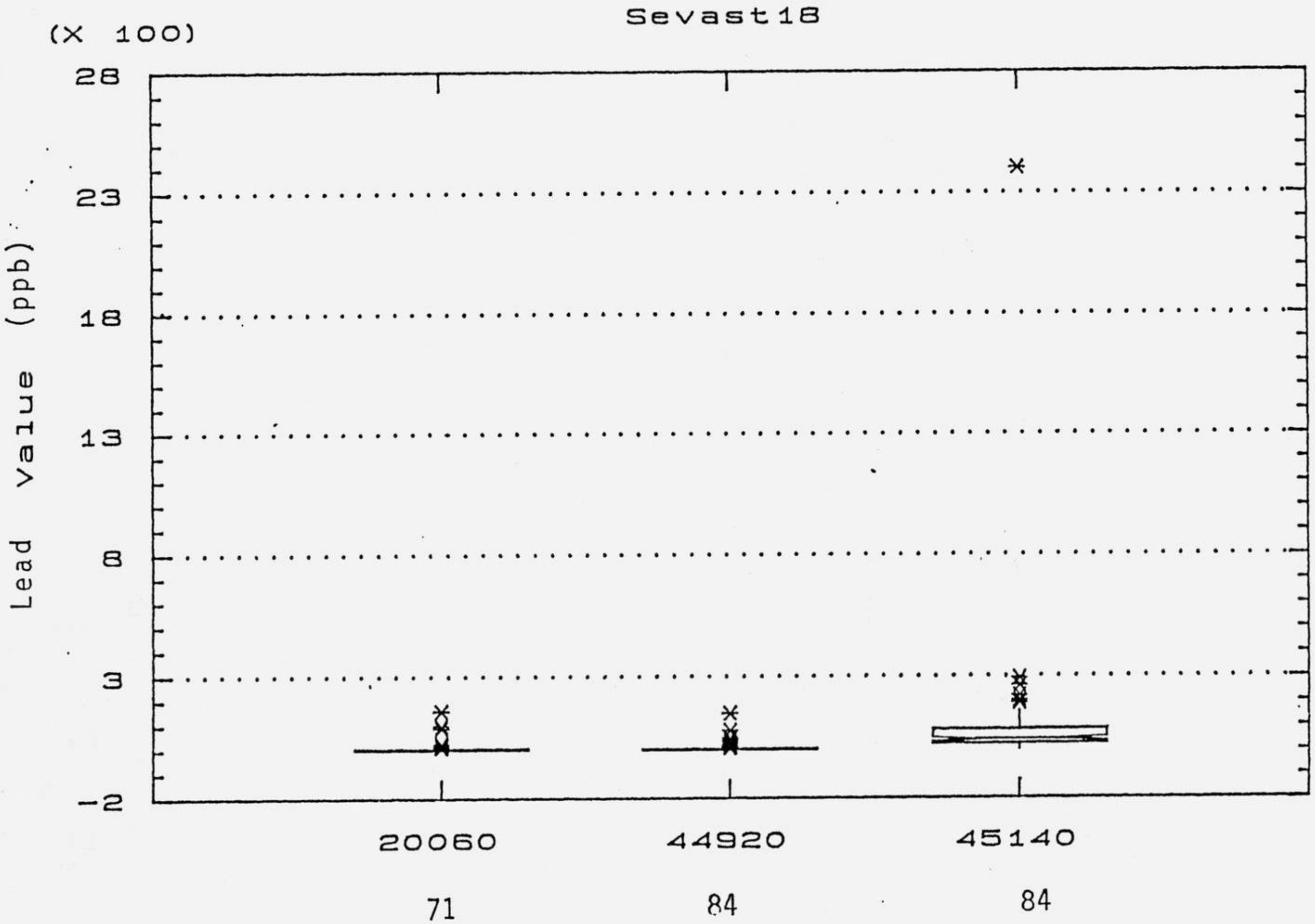


Lead concentrations vs. Time

Sample group: sevast1



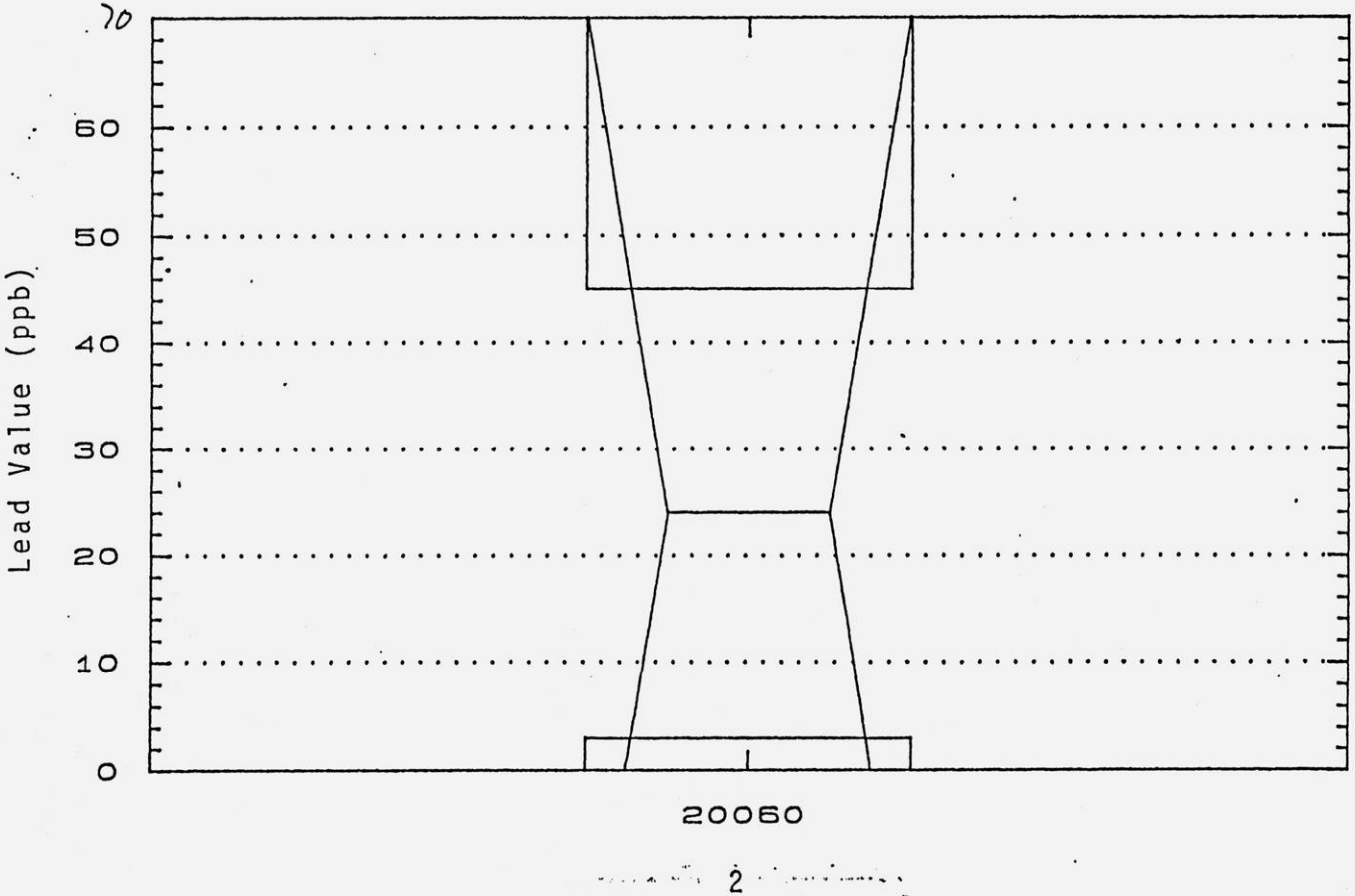

Sevast18
Lead Value (ppb)
0
10
20
30
40
50
60
70
20060
44920
45140
71
84
84
Well F.I.D #
Number of Samples
(1986-1988)



Well F.I.D. #

Number of Samples (1986-1988)

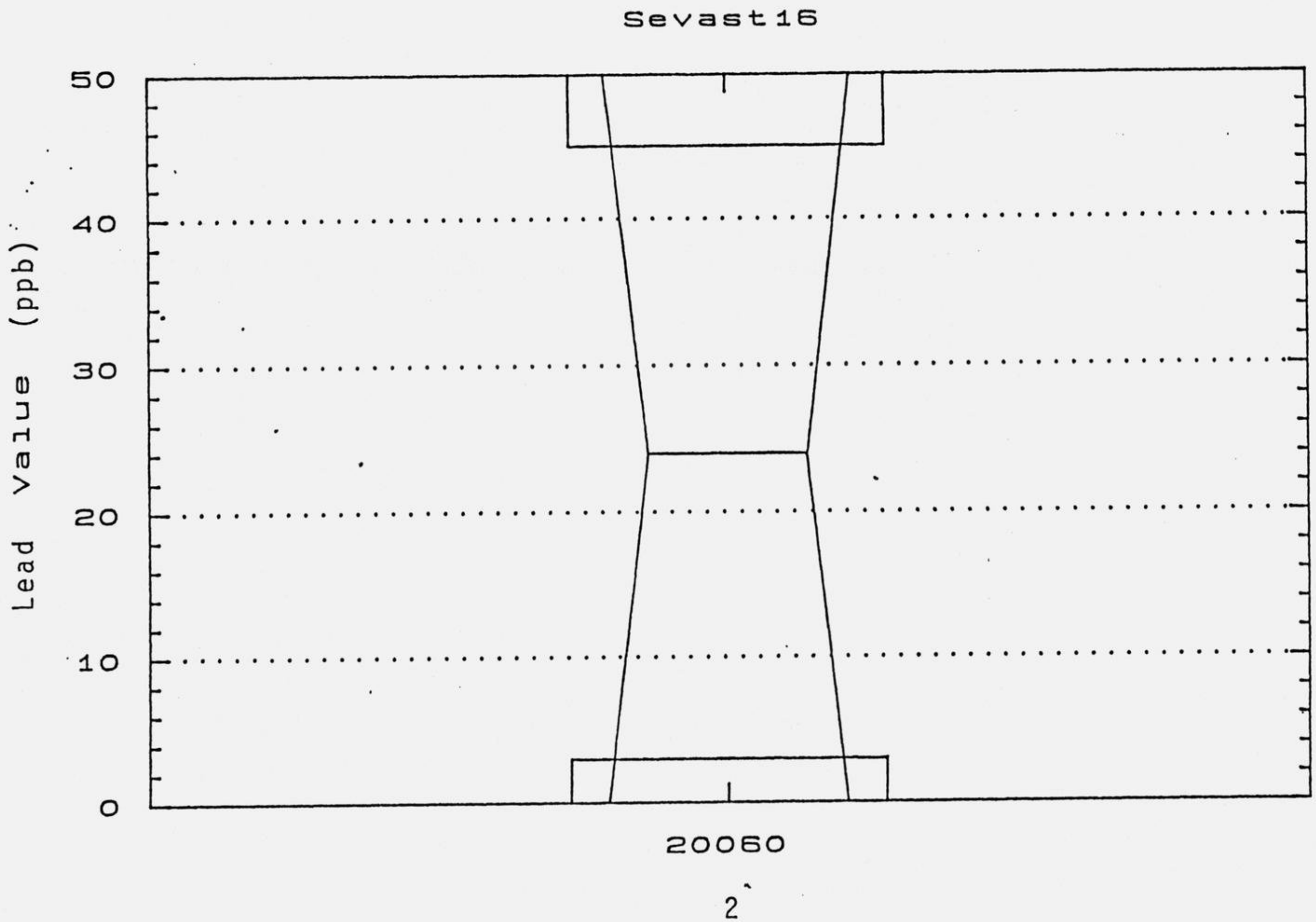
Sevast 16



Well F.I.D. #

Number of Samples

(1984-1986)

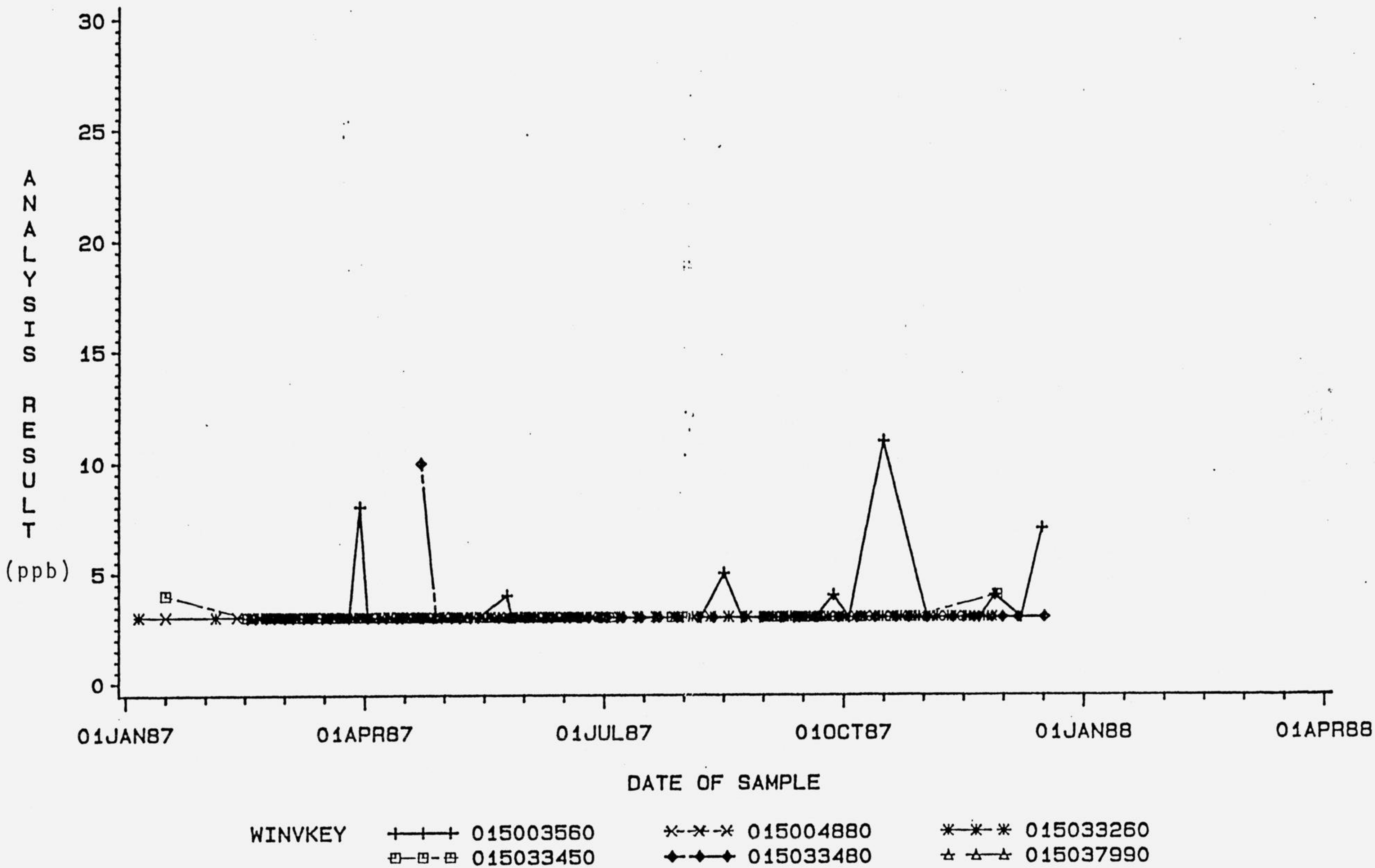


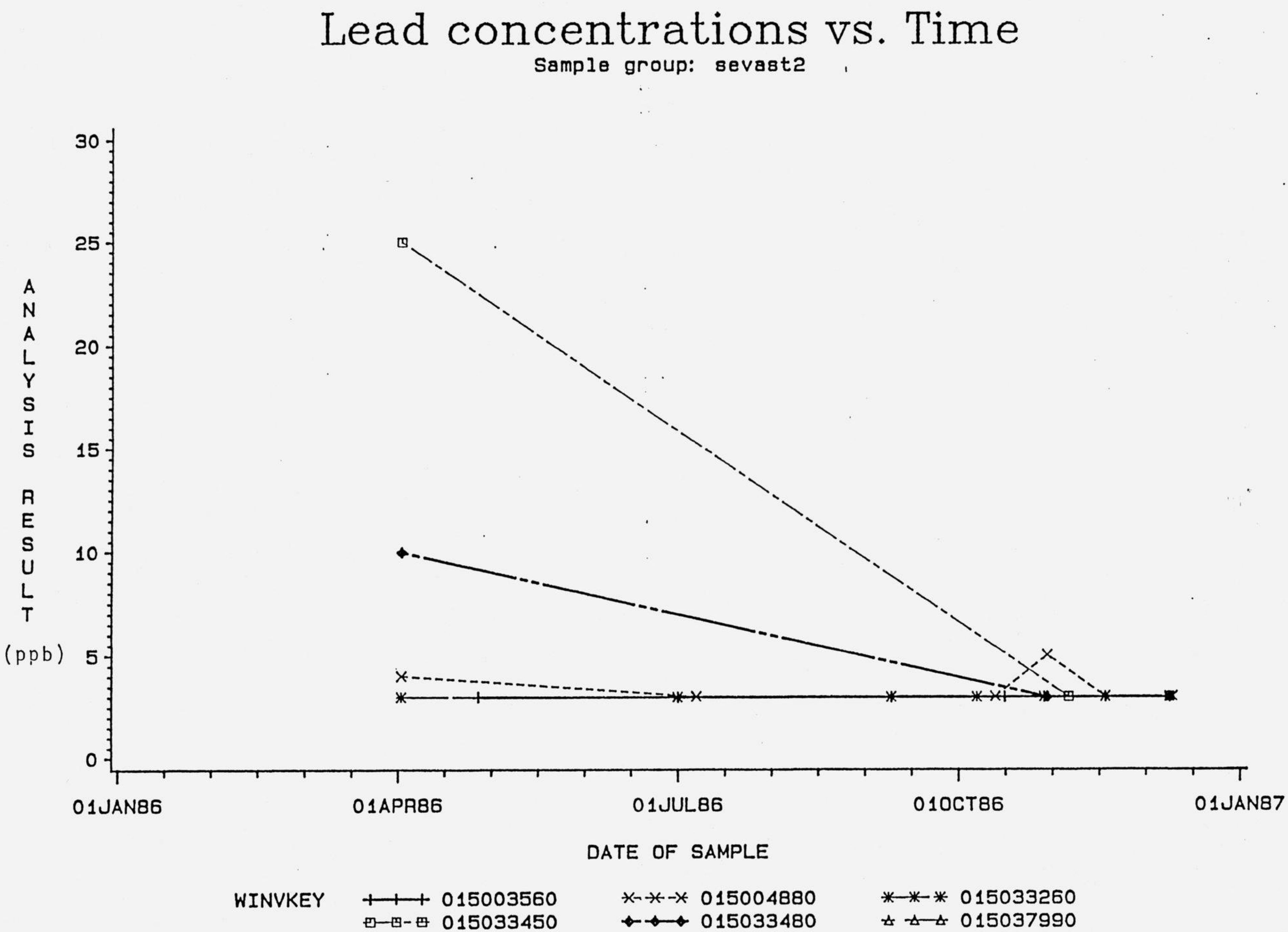
Well F.I.D #

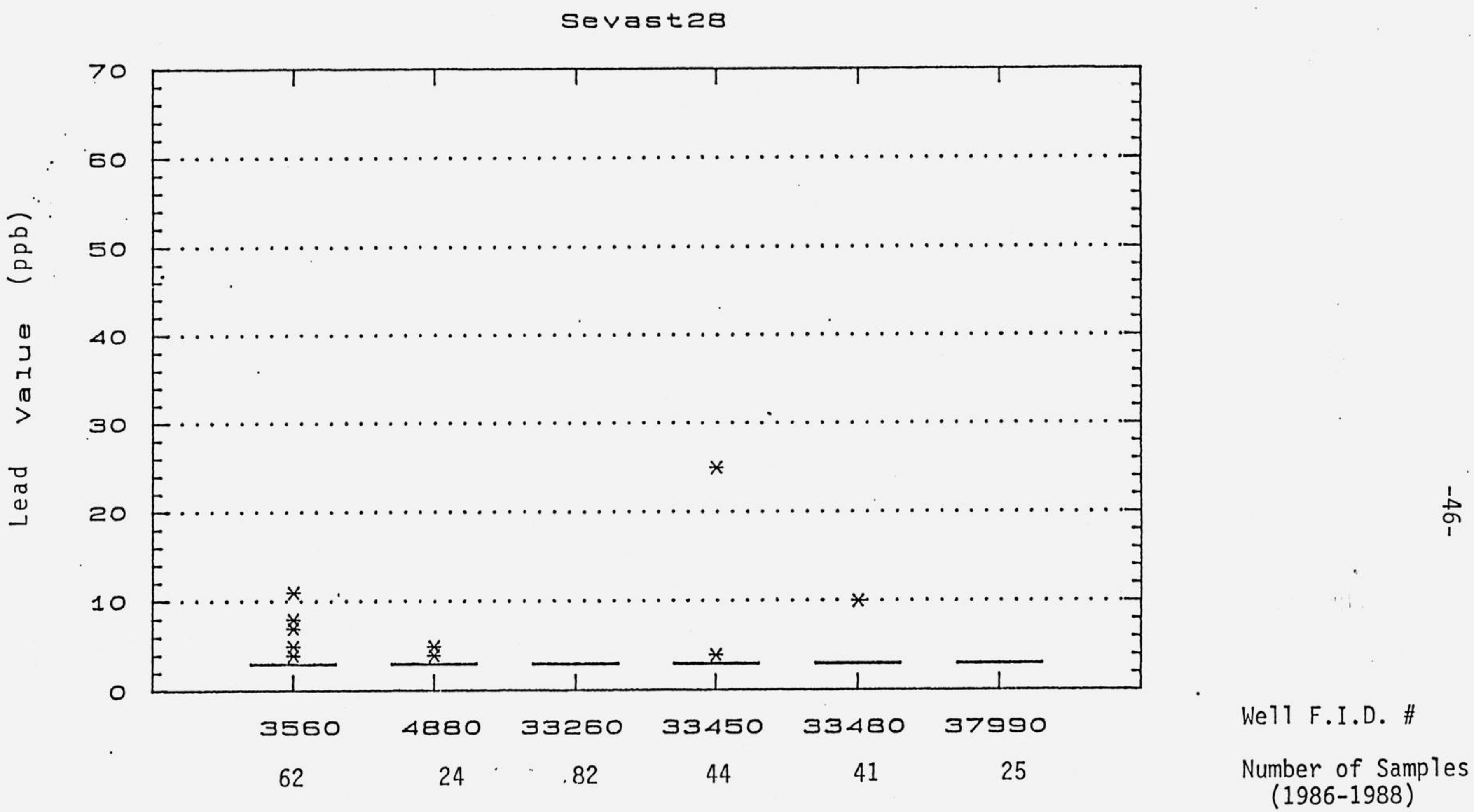
Number of Samples
(1984-1986)

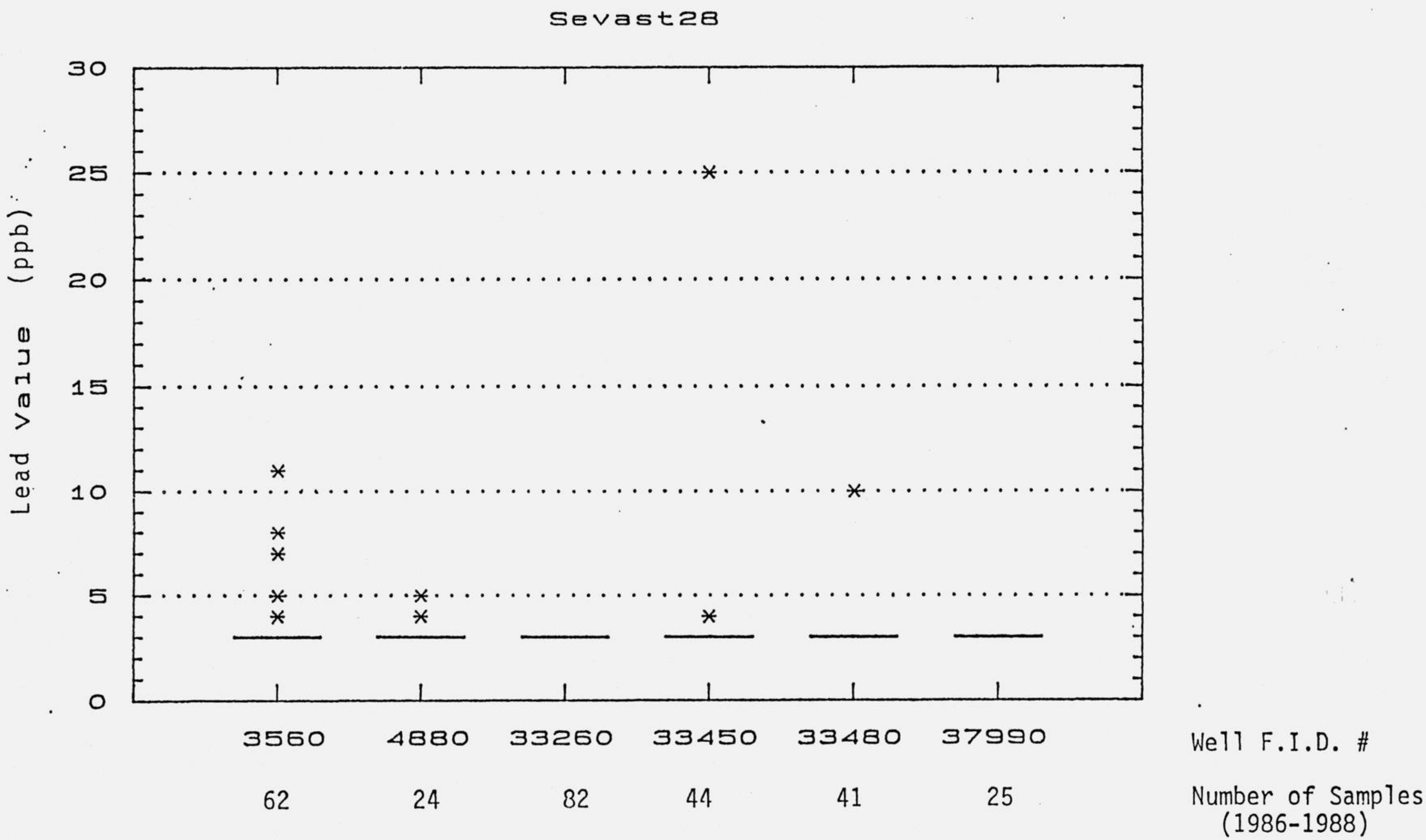
Lead concentrations vs. Time

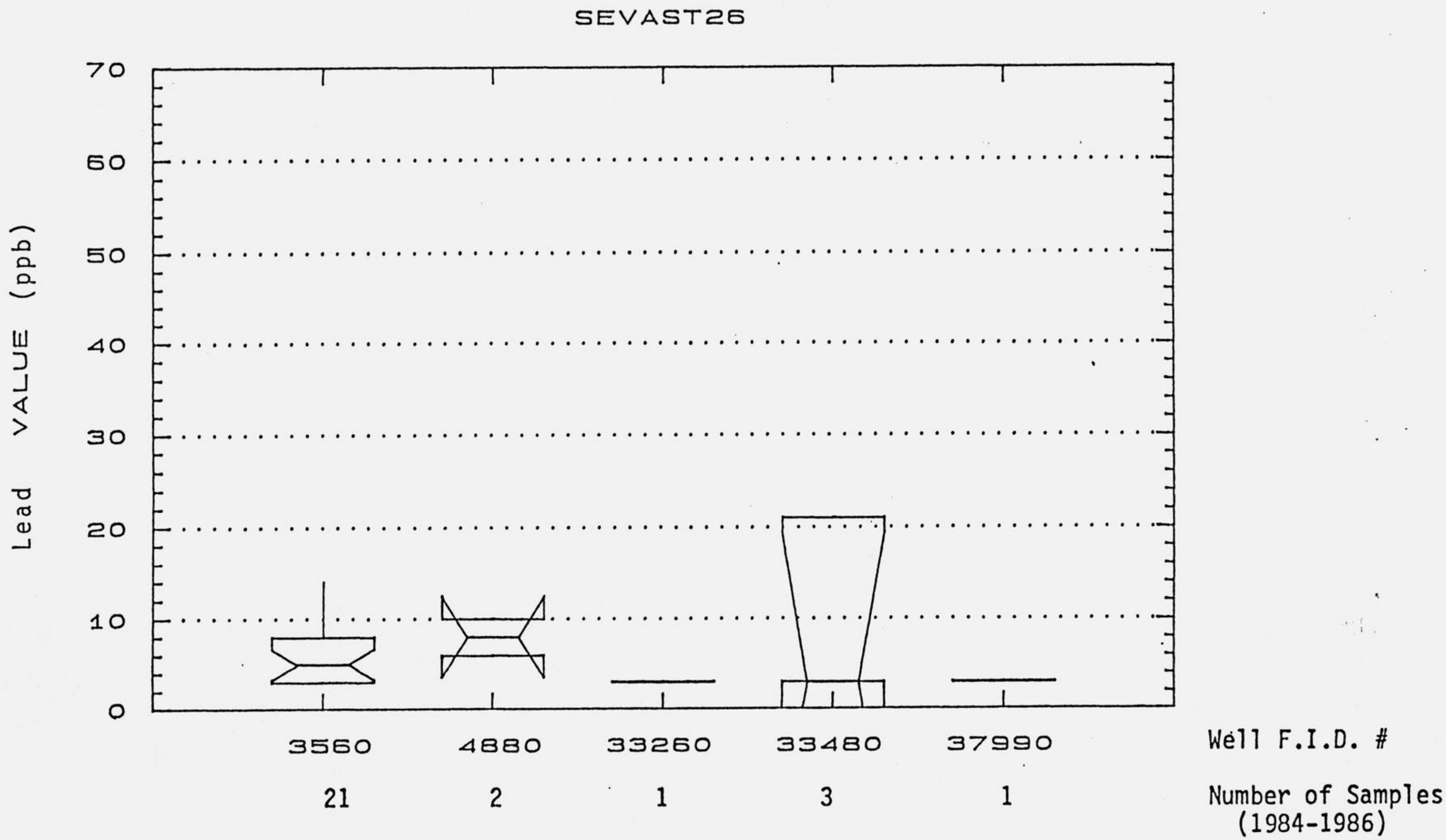
Sample group: sevast2

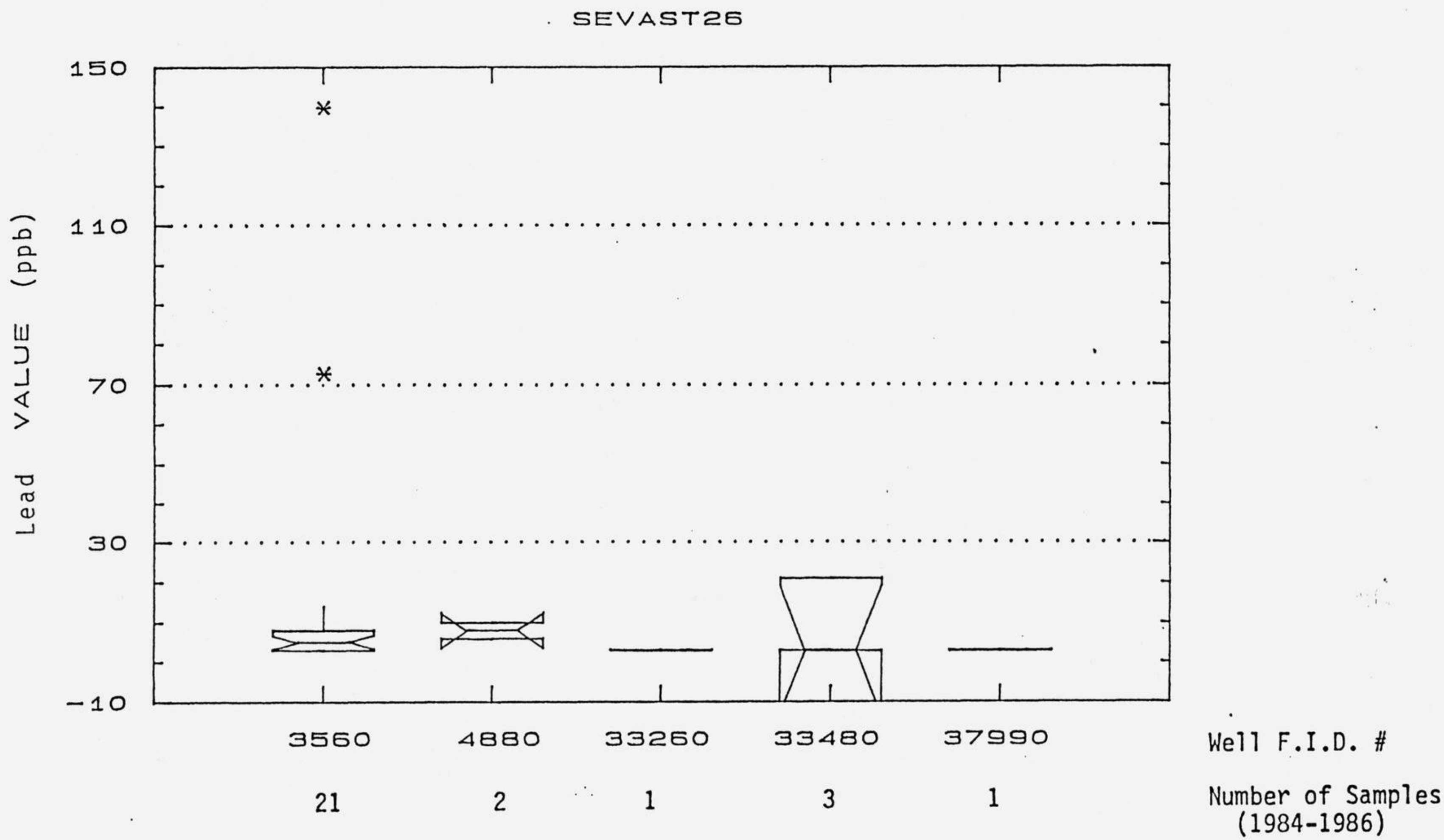


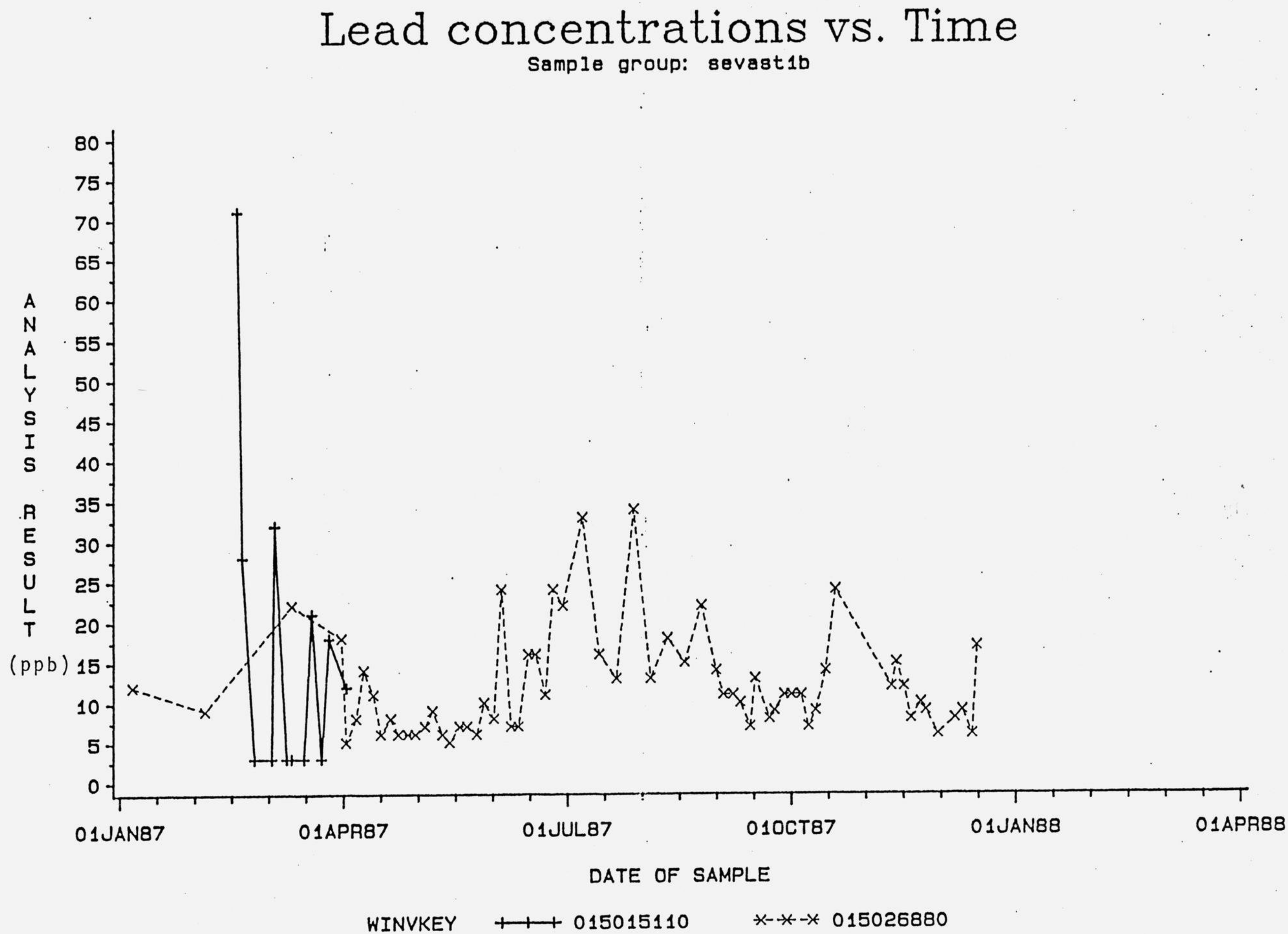

Lead concentrations vs. Time
Sample group: sevast2
ANALYSIS RESULT (ppb)
30
25
20
15
10
5
0
01JAN86
01APR86
01JUL86
01OCT86
01JAN87
DATE OF SAMPLE
WINVKEY
015003560
015004880
015033260
015033450
015033480
015037990


Sevast28
Lead Value (ppb)
70
60
50
40
30
20
10
0
3560
4880
33260
33450
33480
37990
62
24
82
44
41
25
Well F.I.D. #
Number of Samples
(1986-1988)


Sevast28
Lead Value (ppb)
30
25
20
15
10
5
0
3560
4880
33260
33450
33480
37990
Well F.I.D. #
62
24
82
44
41
25
Number of Samples
(1986-1988)

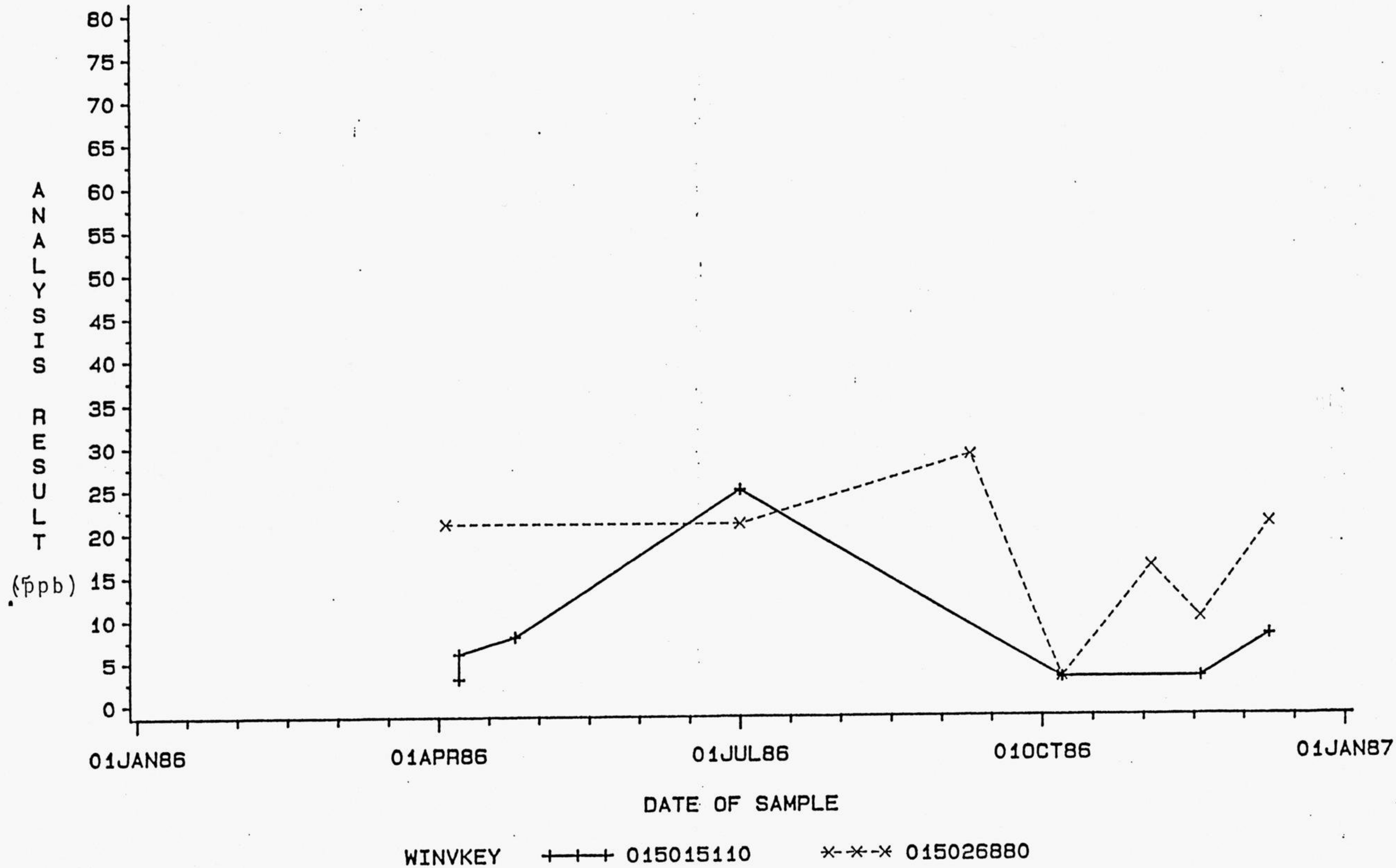

SEVAST26
Lead VALUE (ppb)
70
60
50
40
30
20
10
0
3560
4880
33260
33480
37990
Well F.I.D. #
21
2
1
3
1
Number of Samples
(1984-1986)

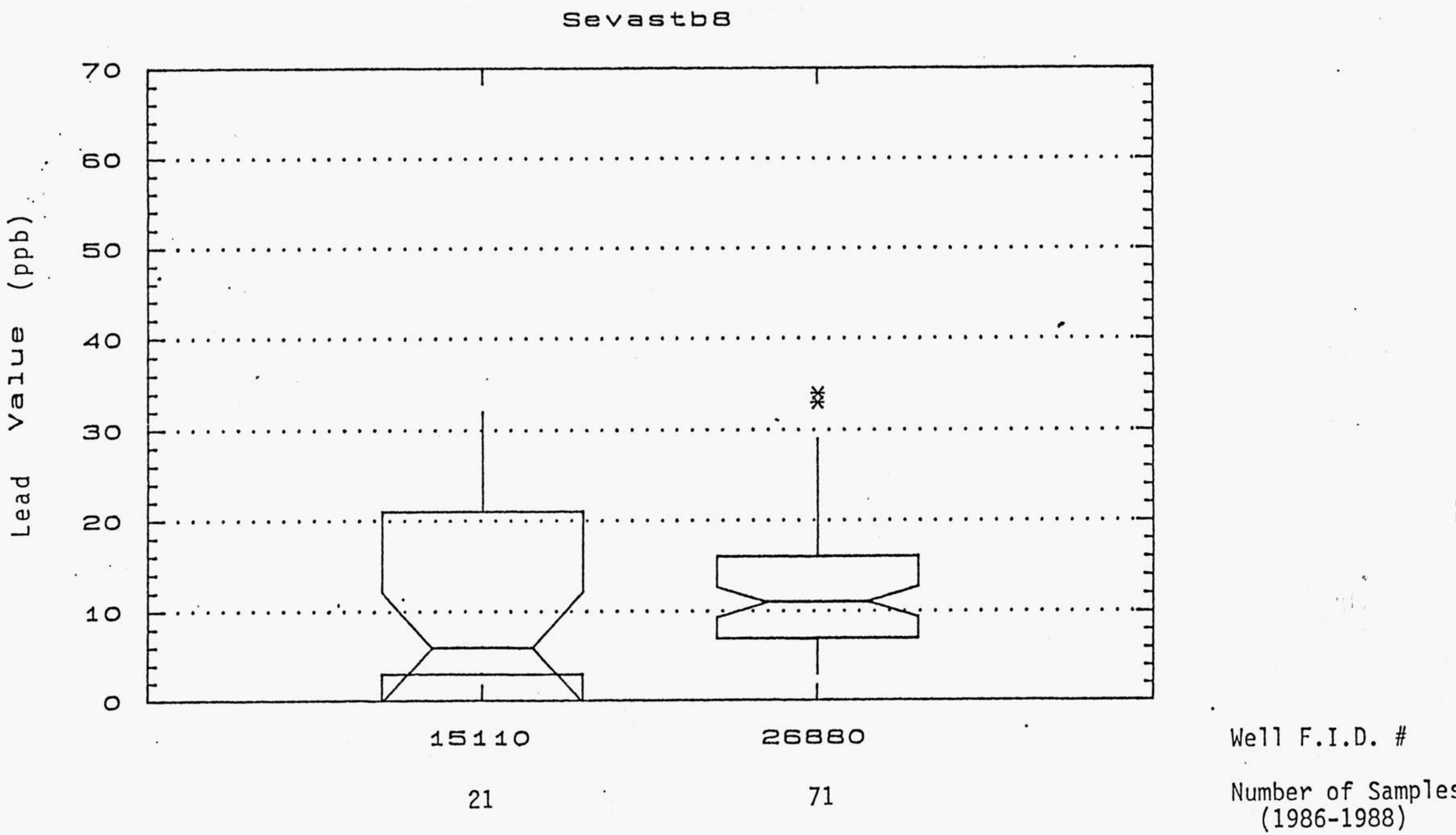

SEVAST26
Lead VALUE (ppb)
150
110
70
30
-10
3560
4880
33260
33480
37990
Well F.I.D. #
21
2
1
3
1
Number of Samples
(1984-1986)


Lead concentrations vs. Time
Sample group: sevast1b
ANALYSIS RESULT (ppb)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
01JAN87
01APR87
01JUL87
01OCT87
01JAN88
01APR88
DATE OF SAMPLE
WINVKEY
015015110
015026880

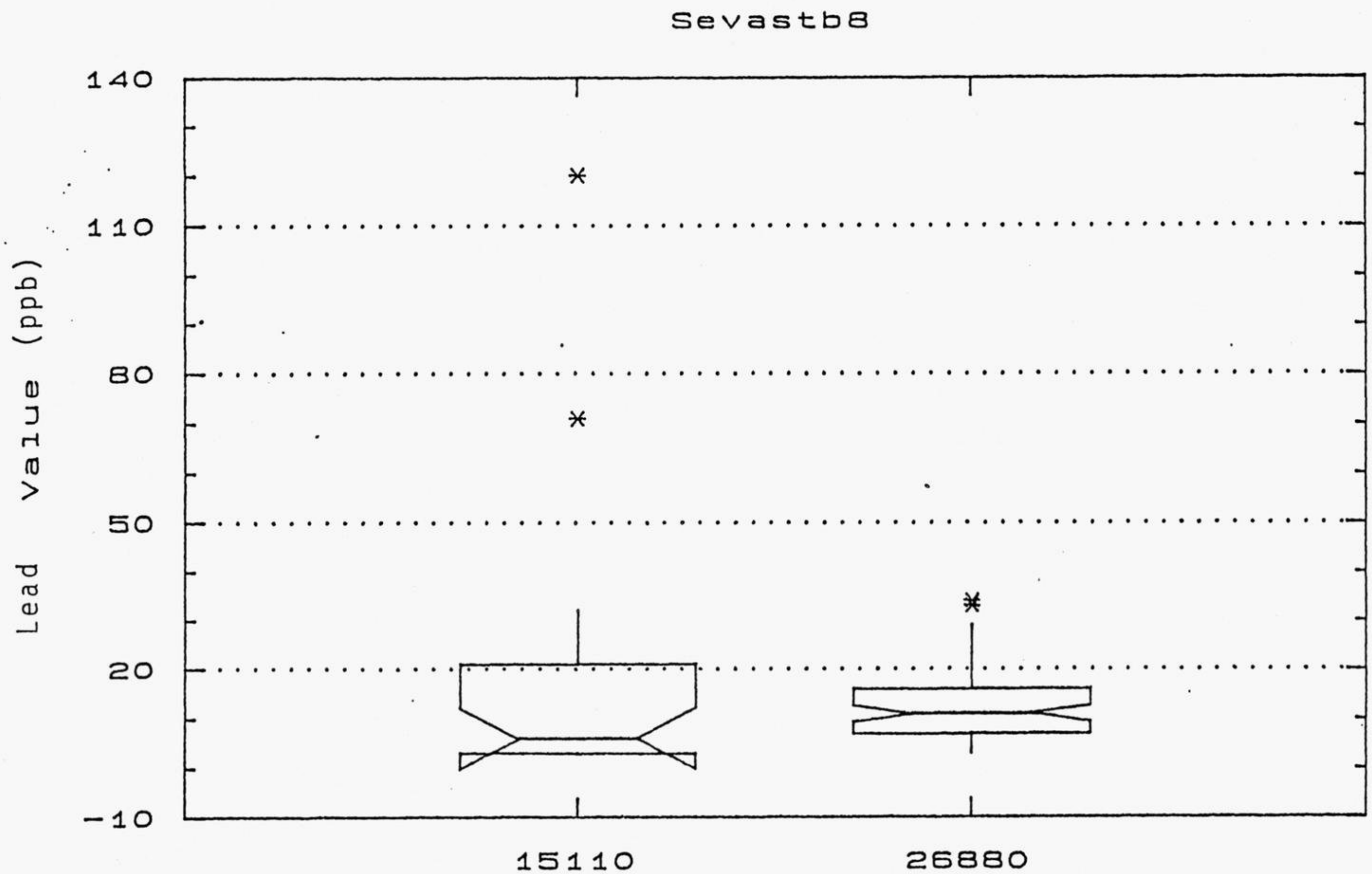
Lead concentrations vs. Time

Sample group: sevast1b



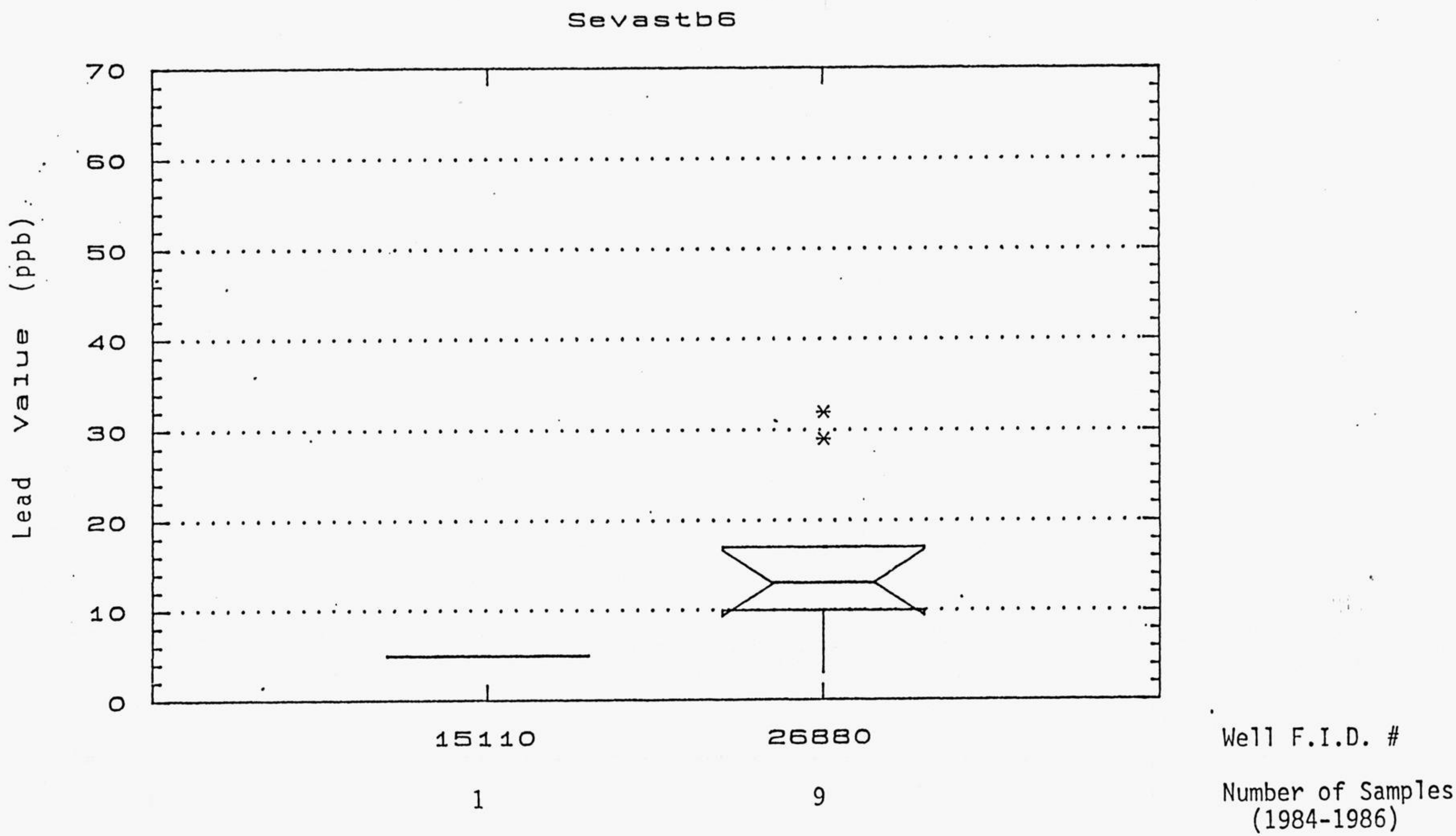


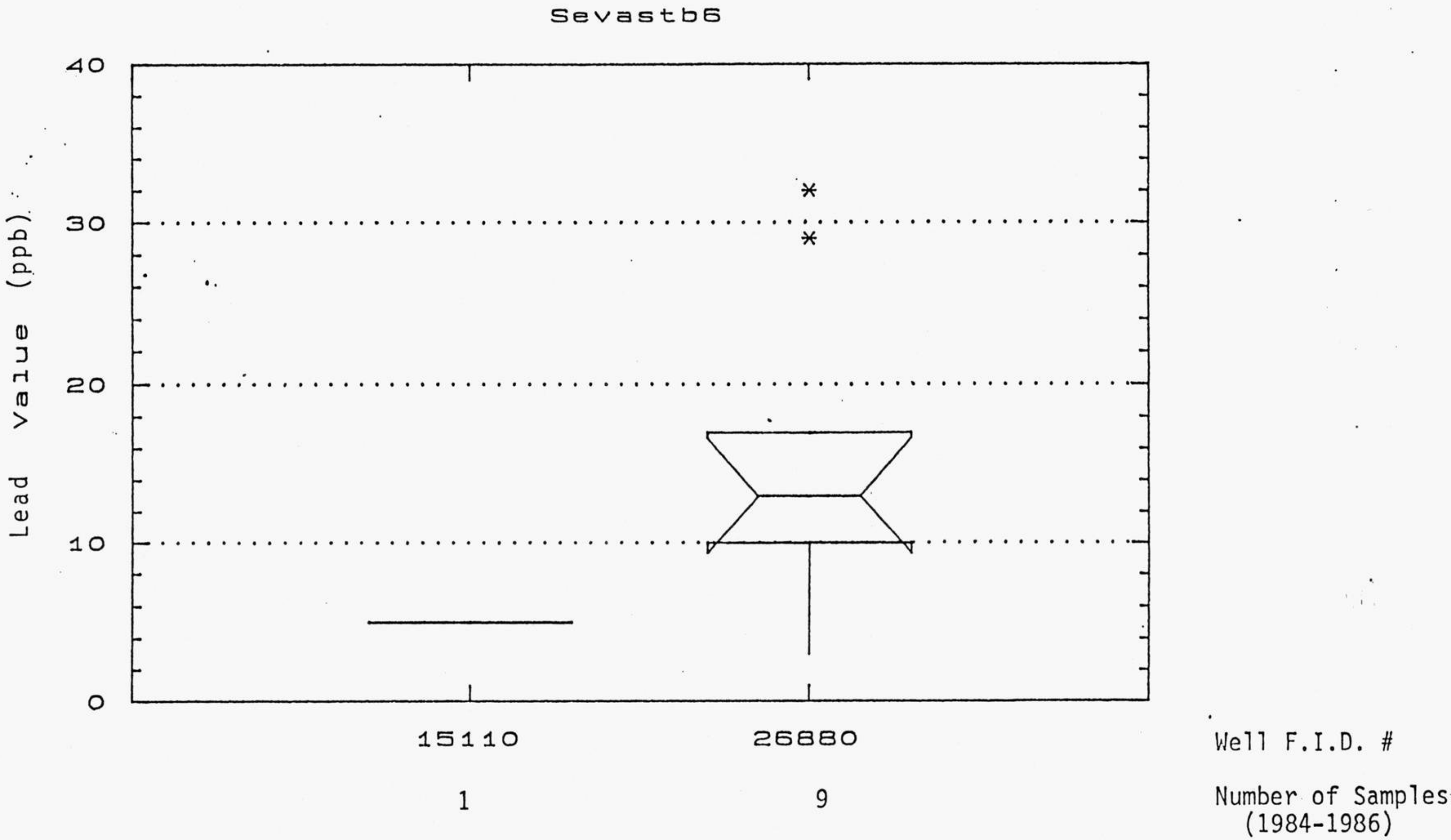
Sevastb8
Lead Value (ppb)
0
10
20
30
40
50
60
70
15110
26880
21
71
Well F.I.D. #
Number of Samples
(1986-1988)



Well F.I.D. #

21	71	Number of Samples (1986-1988)


Sevastb6
Lead Value (ppb)
70
60
50
40
30
20
10
0
15110
26880
1
9
Well F.I.D. #
Number of Samples
(1984-1986)



Sevastb6
Lead Value (ppb)
40
30
20
10
0
15110
26880
1
9
Well F.I.D. #
Number of Samples
(1984-1986)

TRSQQ=2825E12SENE

UNIVARIATE

Well F.I.D. # 26880

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	80	SUM WGTS	80
MEAN	12.8625	SUM	1029
STD DEV	7.06524	VARIANCE	49.9176
SKEWNESS	1.23408	KURTOSIS	1.12619
USS	17179	CSS	3943.49
CV	54.929	STD MEAN	0.789917
T:MEAN=0	16.2833	PROB>|T|	0.0001
SGN RANK	1620	PROB>|S|	0.0001
NUM ¬= 0	80		

QUANTILES(DEF=4)

100% MAX	34	99%	34
75% Q3	16	95%	29
50% MED	11	90%	23.8
25% Q1	8	10%	6
0% MIN	3	5%	5.05
		1%	3
RANGE	31		
Q3-Q1	8		
MODE	6		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01502688)	29	(01502688)
3	(01502688)	29	(01502688)
5	(01502688)	32	(01502688)
5	(01502688)	33	(01502688)
6	(01502688)	34	(01502688)

TRSQQ=2826E08NENW

UNIVARIATE

Well F.I.D. # 37990

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	26	SUM WGTS	26
MEAN	3	SUM	78
STD DEV	0	VARIANCE	0
SKEWNESS	.	KURTOSIS	.
USS	234	CSS	0
CV	0	STD MEAN	0
T:MEAN=0	.	PROB>|T|	.
SGN RANK	175.5	PROB>|S|	0.0001
NUM ¬= 0	26		

QUANTILES(DEF=4)

100% MAX	3	99%	3
75% Q3	3	95%	3
50% MED	3	90%	3
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	0		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01503799)	3	(01503799)
3	(01503799)	3	(01503799)
3	(01503799)	3	(01503799)
3	(01503799)	3	(01503799)
3	(01503799)	3	(01503799)

TRSQQ=2826E08NWSW

UNIVARIATE

Well F.I.D. # 03560

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	83	SUM WGTS	83
MEAN	7.16867	SUM	595
STD DEV	18.3222	VARIANCE	335.703
SKEWNESS	5.91242	KURTOSIS	37.509
USS	31793	CSS	27527.6
CV	255.587	STD MEAN	2.01112
T:MEAN=0	3.56451	PROB>|T|	.000611293
SGN RANK	1743	PROB>|S|	0.0001
NUM ¬= 0	83		

QUANTILES(DEF=4)

100% MAX	140	99%	140
75% Q3	4	95%	13.6
50% MED	3	90%	7.6
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	137		
Q3-Q1	1		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01500356)	12	(01500356)
3	(01500356)	14	(01500356)
3	(01500356)	73	(01500356)
3	(01500356)	73	(01500356)
3	(01500356)	140	(01500356)

TRSQQ=2826E10SENE

UNIVARIATE

Well F.I.D. # 44920

VARIABLE=TESTVAL   ANALYSIS RESULT

MOMENTS

N	84	SUM WGTS	84
MEAN	9.25	SUM	777
STD DEV	19.7715	VARIANCE	390.913
SKEWNESS	5.2358	KURTOSIS	32.6459
USS	39633	CSS	32445.7
CV	213.746	STD MEAN	2.15725
T:MEAN=0	4.28787	PROB>|T|	0.0001
SGN RANK	1785	PROB>|S|	0.0001
NUM ¬= 0	84		

QUANTILES(DEF=4)

100% MAX	150	99%	150
75% Q3	4.75	95%	42.5
50% MED	3	90%	20.5
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	147		
Q3-Q1	1.75		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504492)	41	(01504492)
3	(01504492)	43	(01504492)
3	(01504492)	50	(01504492)
3	(01504492)	79	(01504492)
3	(01504492)	150	(01504492)

TRSQQ=2826E11SENE

UNIVARIATE

Well F.I.D. # 20060

VARIABLE=TESTVAL   ANALYSIS RESULT

MOMENTS

N	73	SUM WGTS	73
MEAN	10.4384	SUM	762
STD DEV	23.838	VARIANCE	568.25
SKEWNESS	4.79825	KURTOSIS	24.9966
USS	48868	CSS	40914
CV	228.369	STD MEAN	2.79003
T:MEAN=0	3.74131	PROB>|T|	.000365085
SGN RANK	1350.5	PROB>|S|	0.0001
NUM ¬= 0	73		

QUANTILES(DEF=4)

100% MAX	160	99%	160
75% Q3	6	95%	58.2
50% MED	3	90%	18
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	157		
Q3-Q1	3		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01502006)	26	(01502006)
3	(01502006)	45	(01502006)
3	(01502006)	89	(01502006)
3	(01502006)	99	(01502006)
3	(01502006)	160	(01502006)

TRSQQ=2826E20NESW

UNIVARIATE

Well F.I.D. # 04880

VARIABLE=TESTVAL   ANALYSIS RESULT

MOMENTS

N	26	SUM WGTS	26
MEAN	3.5	SUM	91
STD DEV	1.50333	VARIANCE	2.26
SKEWNESS	3.71153	KURTOSIS	14.8355
USS	375	CSS	56.5
CV	42.9523	STD MEAN	0.294827
T:MEAN=0	11.8714	PROB>|T|	0.0001
SGN RANK	175.5	PROB>|S|	0.0001
NUM ¬= 0	26		

QUANTILES(DEF=4)

100% MAX	10	99%	10
75% Q3	3	95%	8.6
50% MED	3	90%	5.3
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	7		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01500488)	3	(01500488)
3	(01500488)	4	(01500488)
3	(01500488)	5	(01500488)
3	(01500488)	6	(01500488)
3	(01500488)	10	(01500488)

TRSQQ=2826E33NESW

UNIVARIATE

Well F.I.D. # 33260

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	83	SUM WGTS	83
MEAN	3	SUM	249
STD DEV	0	VARIANCE	0
SKEWNESS	.	KURTOSIS	.
USS	747	CSS	0
CV	0	STD MEAN	0
T:MEAN=0	.	PROB>|T|	.
SGN RANK	1743	PROB>|S|	0.0001
NUM ¬= 0	83		

QUANTILES(DEF=4)

100% MAX	3	99%	3
75% Q3	3	95%	3
50% MED	3	90%	3
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	0		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01503326)	3	(01503326)
3	(01503326)	3	(01503326)
3	(01503326)	3	(01503326)
3	(01503326)	3	(01503326)
3	(01503326)	3	(01503326)

TRSQQ=2826E33NWNW

UNIVARIATE

Well F.I.D. # 33480

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	44	SUM WGTS	44
MEAN	3.72727	SUM	164
STD DEV	3.04512	VARIANCE	9.27273
SKEWNESS	4.85869	KURTOSIS	25.4269
USS	1010	CSS	398.727
CV	81.6982	STD MEAN	0.459068
T:MEAN=0	8.11921	PROB>|T|	0.0001
SGN RANK	495	PROB>|S|	0.0001
NUM ¬= 0	44		

QUANTILES(DEF=4)

100% MAX	21	99%	21
75% Q3	3	95%	10
50% MED	3	90%	3
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	18		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01503348)	3	(01503348)
3	(01503348)	3	(01503348)
3	(01503348)	10	(01503348)
3	(01503348)	10	(01503348)
3	(01503348)	21	(01503348)

TRSQQ=2826E33SWNE

UNIVARIATE

Well F.I.D. # 45140

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	84	SUM WGTS	84
MEAN	89.4524	SUM	7514
STD DEV	262.388	VARIANCE	68847.7
SKEWNESS	8.43605	KURTOSIS	74.7794
USS	6386504	CSS	5714359
CV	293.328	STD MEAN	28.6289
T:MEAN=0	3.12455	PROB>|T|	0.0024534
SGN RANK	1785	PROB>|S|	0.0001
NUM ¬= 0	84		

QUANTILES(DEF=4)

100% MAX	2400	99%	2400
75% Q3	86.25	95%	250
50% MED	41.5	90%	145
25% Q1	24.25	10%	15.5
0% MIN	3	5%	13
		1%	3
RANGE	2397		
Q3-Q1	62		
MODE	45		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504514)	220	(01504514)
6	(01504514)	260	(01504514)
11	(01504514)	290	(01504514)
13	(01504514)	290	(01504514)
13	(01504514)	2400	(01504514)

TRSQQ=2826E33SWSW

UNIVARIATE

Well F.I.D. # 15110

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	22	SUM WGTS	22
MEAN	17.4545	SUM	384
STD DEV	27.911	VARIANCE	779.022
SKEWNESS	2.89349	KURTOSIS	8.98884
USS	23062	CSS	16359.5
CV	159.907	STD MEAN	5.95064
T:MEAN=0	2.93322	PROB>|T|	0.00795248
SGN RANK	126.5	PROB>|S|	0.0001
NUM ¬= 0	22		

QUANTILES(DEF=4)

100% MAX	120	99%	120
75% Q3	22	95%	112.65
50% MED	5.5	90%	59.3
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	117		
Q3-Q1	19		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01501511)	25	(01501511)
3	(01501511)	28	(01501511)
3	(01501511)	32	(01501511)
3	(01501511)	71	(01501511)
3	(01501511)	120	(01501511)

TRSQQ= 2826E17NENE

UNIVARIATE

Well F.I.D.# 33450

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	44	SUM WGTS	44
MEAN	3.54545	SUM	156
STD DEV	3.31631	VARIANCE	10.9979
SKEWNESS	6.59242	KURTOSIS	43.6202
USS	1026	CSS	472.909
CV	93.5368	STD MEAN	0.499952
T:MEAN=0	7.09159	PROB>|T|	0.0001
SGN RANK	495	PROB>|S|	0.0001
NUM ¬= 0	44		

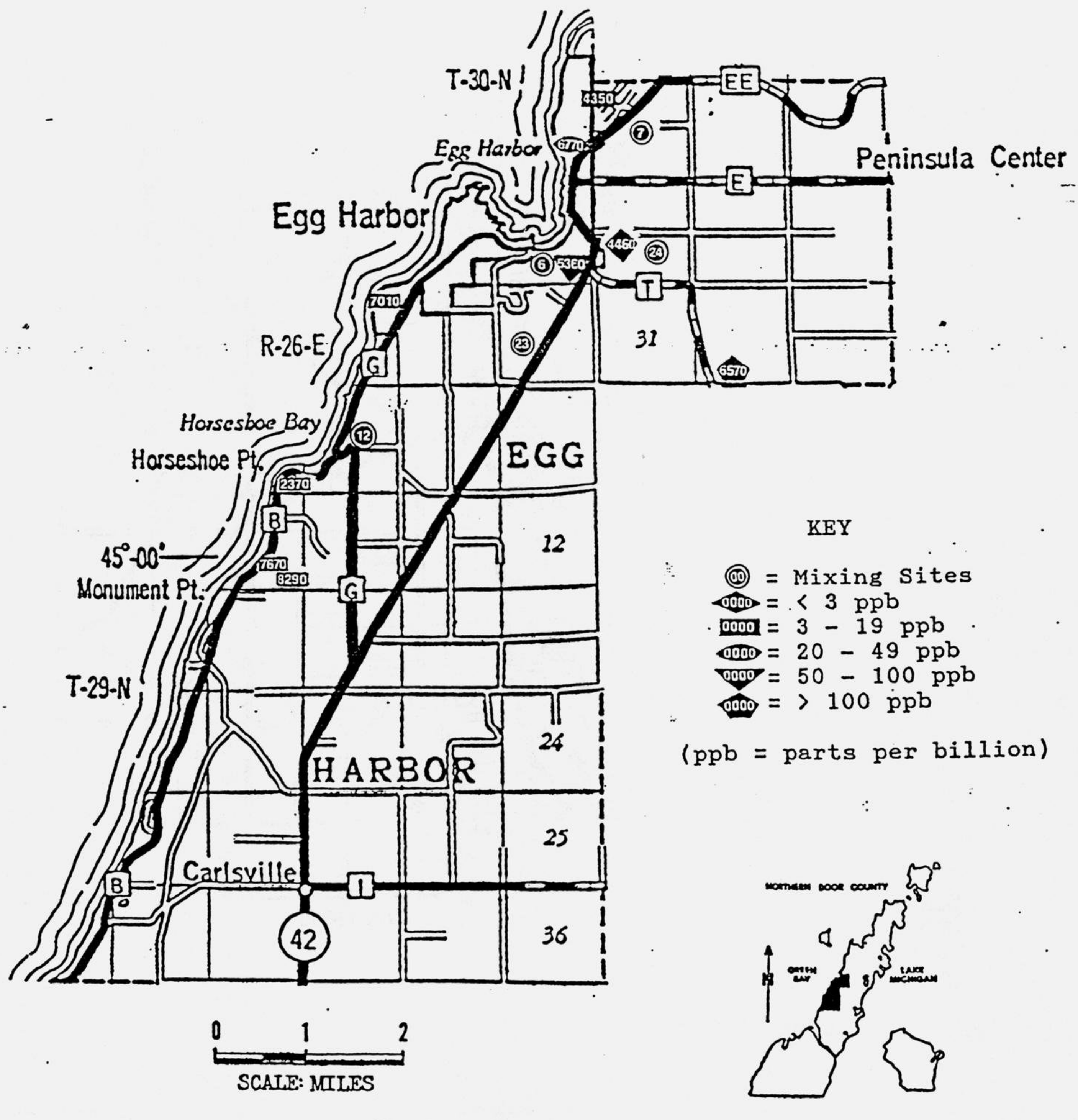
QUANTILES(DEF=4)

100% MAX	25	99%	25
75% Q3	3	95%	4
50% MED	3	90%	3
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	22		
Q3-Q1	0		
MODE	3		

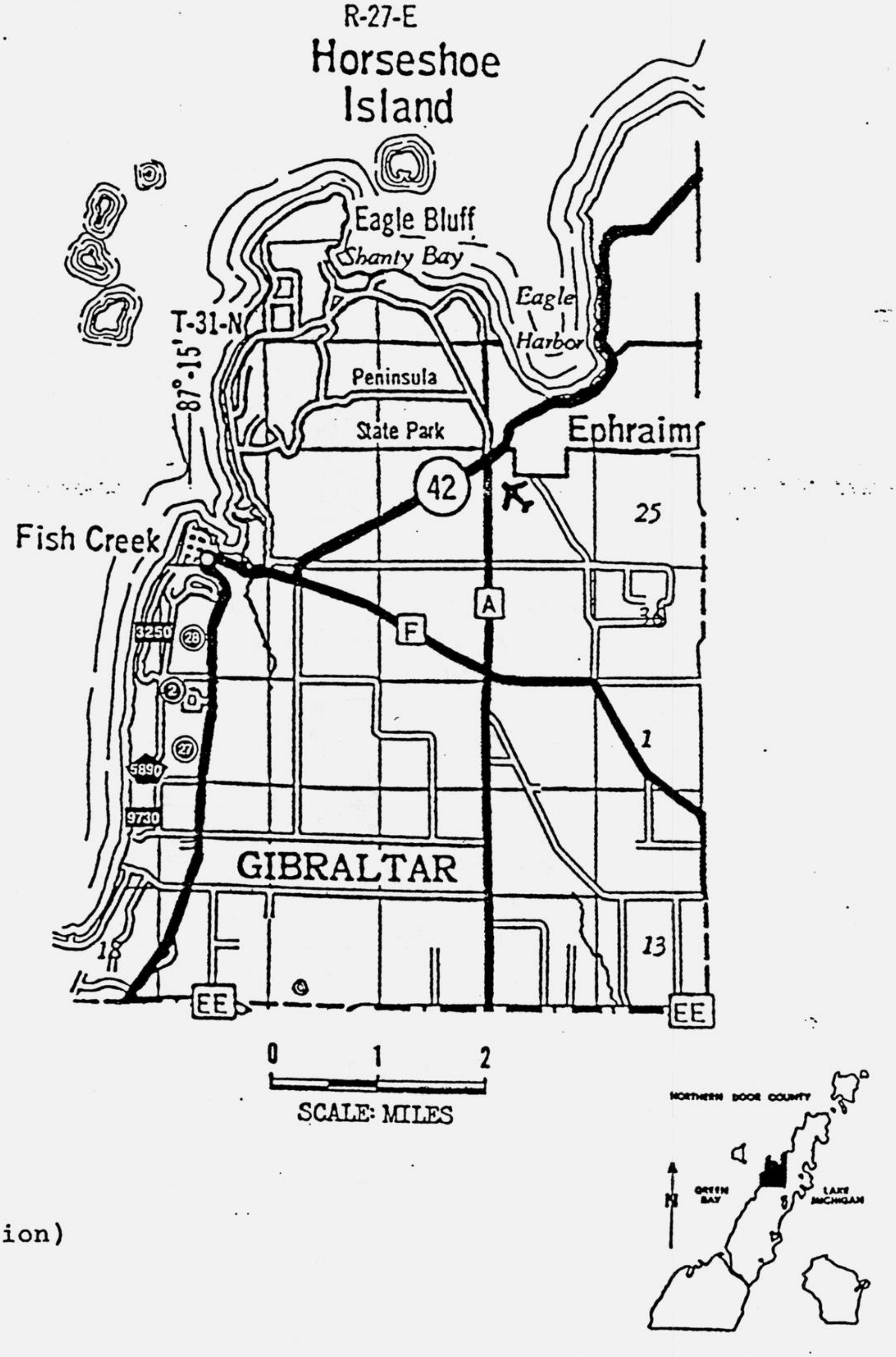
EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01503345)	3	(01503345)
3	(01503345)	3	(01503345)
3	(01503345)	4	(01503345)
3	(01503345)	4	(01503345)
3	(01503345)	25	(01503345)

EGG HARBOR TOWNSHIP



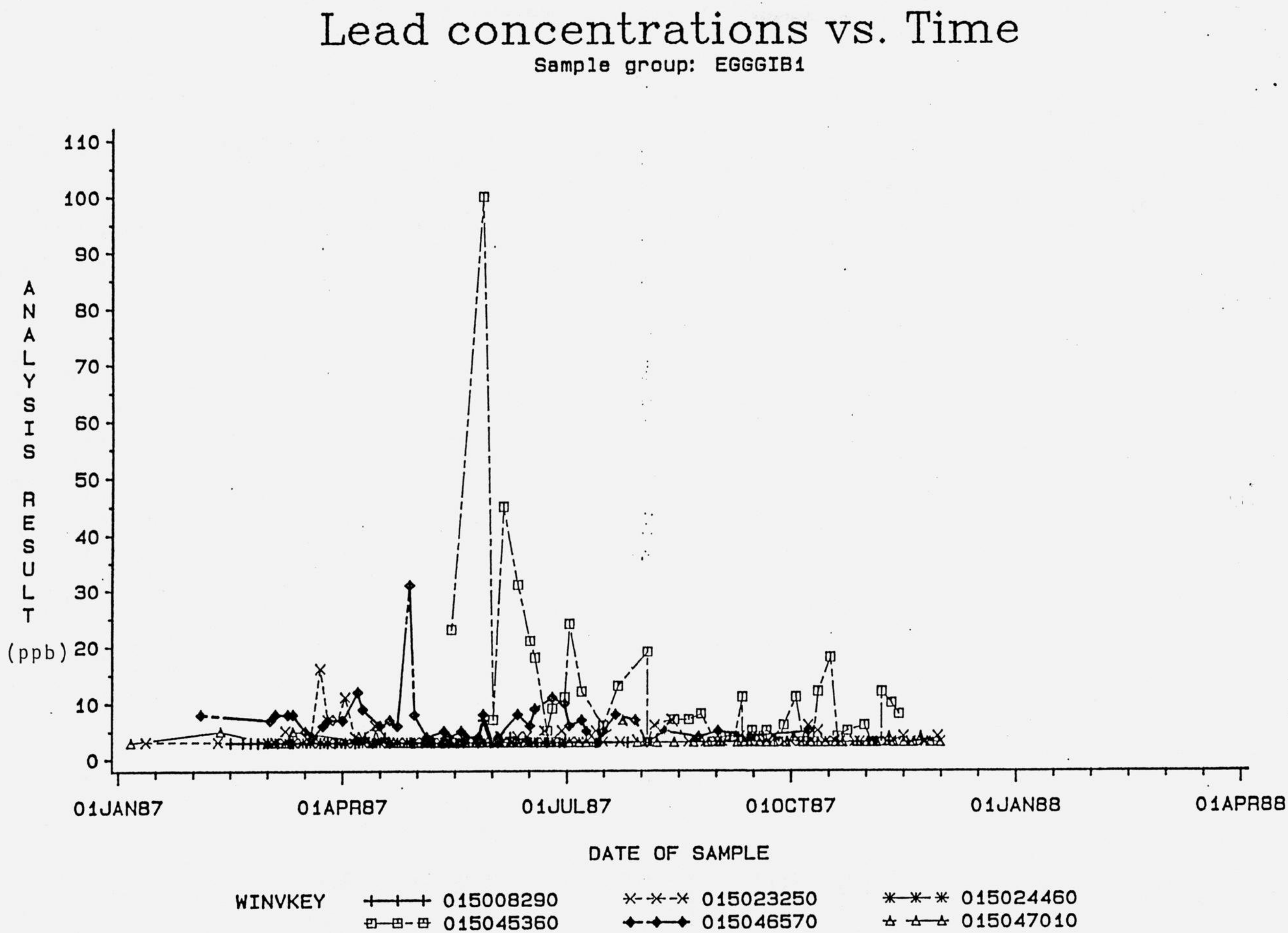
GIBRALTAR TOWNSHIP



KEY

- (00) = Mixing Sites
- 0000 = < 3 ppb
- 0000 = 3 - 19 ppb
- 0000 = 20 - 49 ppb
- 0000 = 50 - 100 ppb
- 0000 = > 100 ppb

(ppb = parts per billion)

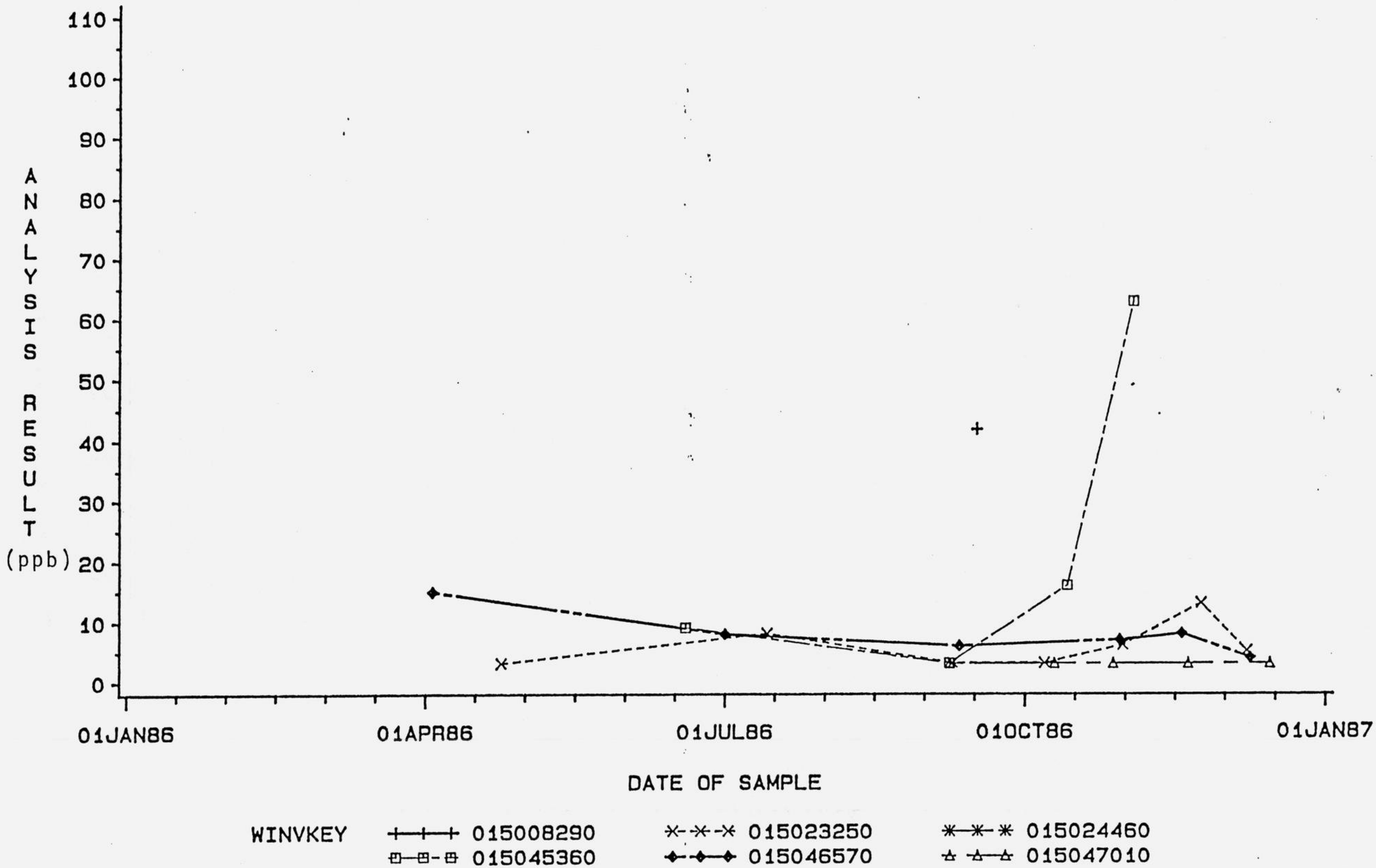


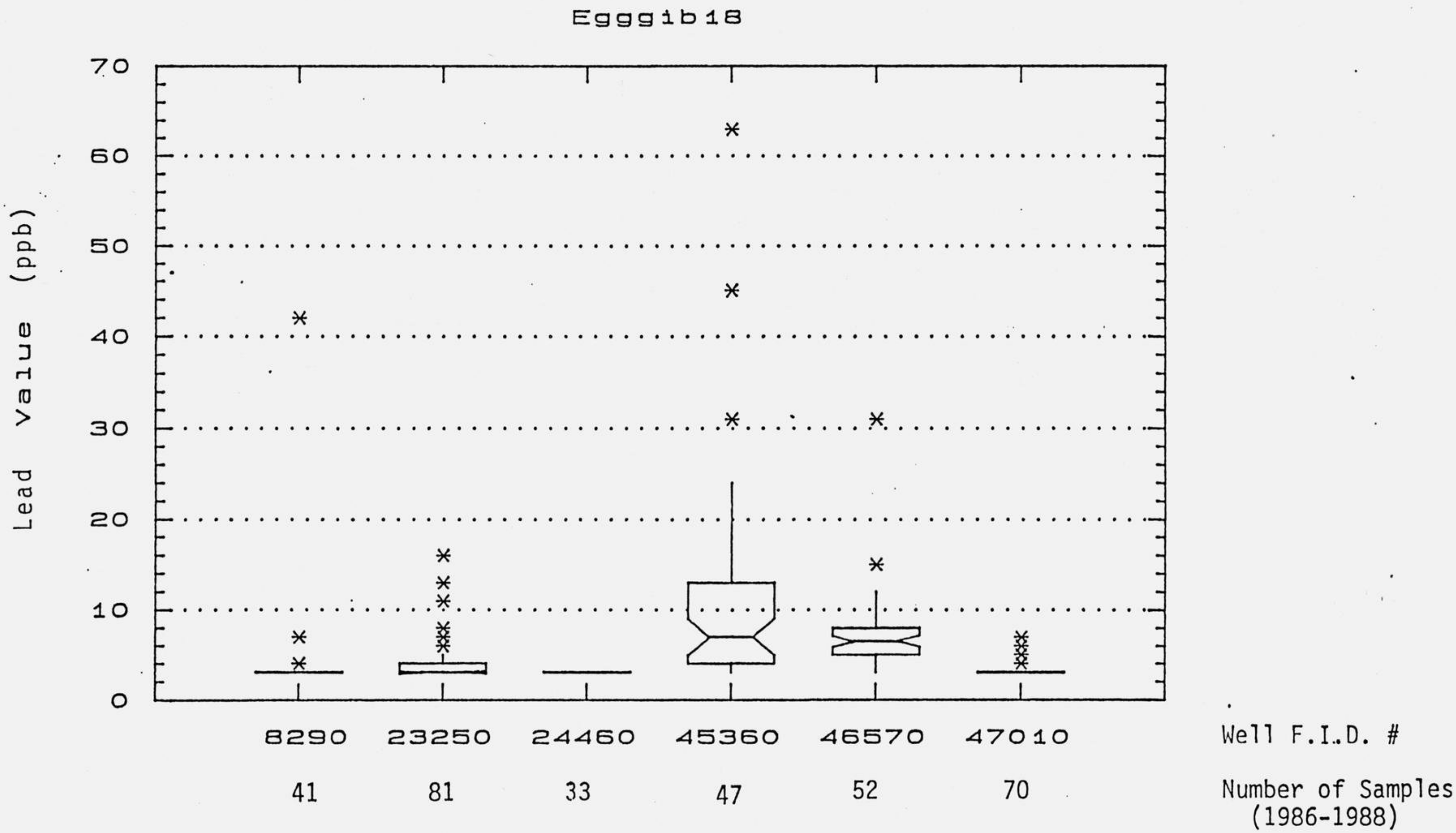
Lead concentrations vs. Time
Sample group: EGGGIB1
ANALYSIS RESULT (ppb)
0
10
20
30
40
50
60
70
80
90
100
110
01JAN87
01APR87
01JUL87
01OCT87
01JAN88
01APR88
DATE OF SAMPLE
WINVKEY
015008290
015023250
015024460
015045360
015046570
015047010

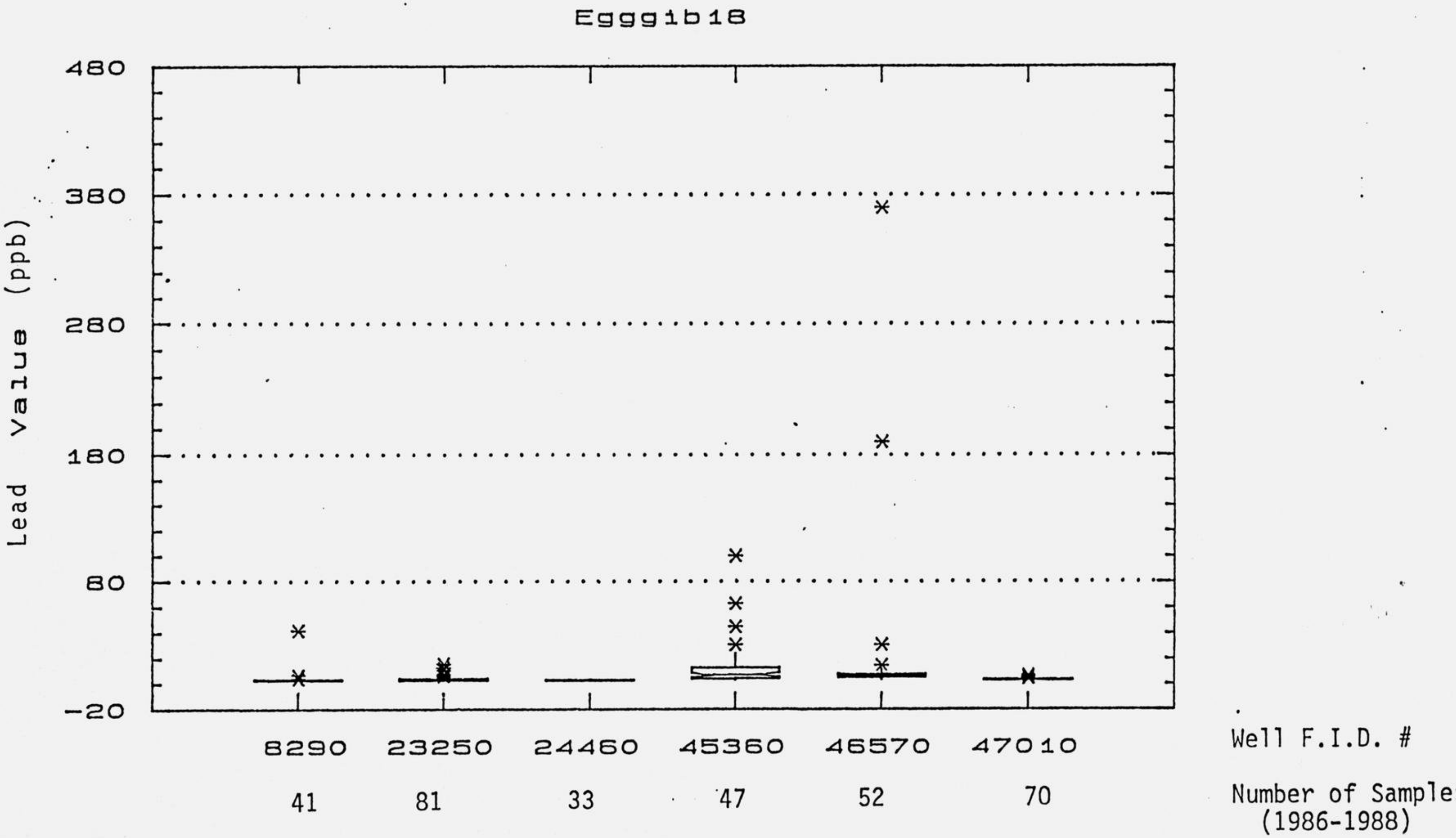
-62-

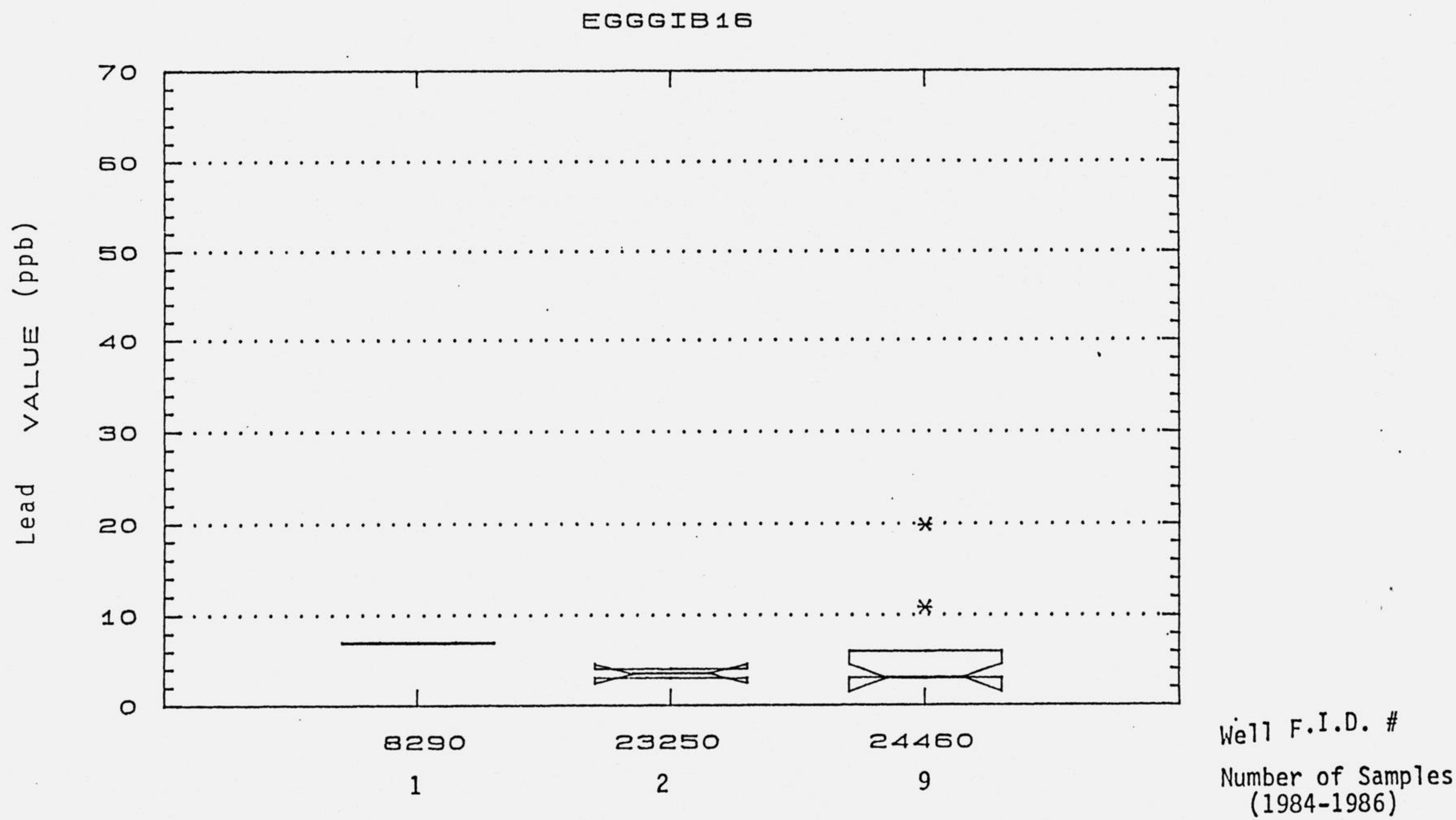
Lead concentrations vs. Time

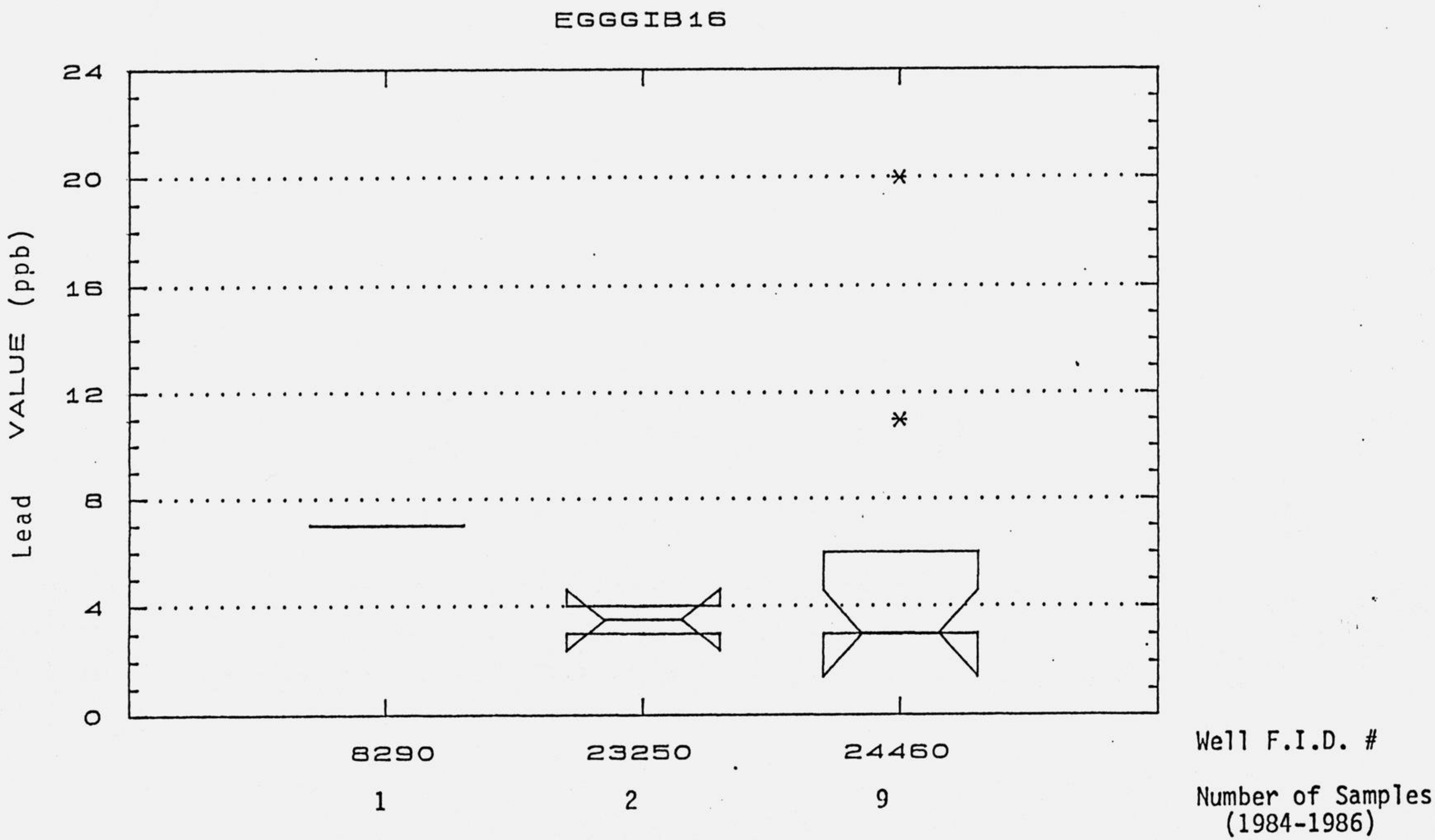
Sample group: EGGGIB1




Egggib18
70
60
50
40
30
20
10
0
Lead Value (ppb)
8290
23250
24460
45360
46570
47010
Well F.I.D. #
41
81
33
47
52
70
Number of Samples
(1986-1988)


Egggib18
Lead Value (ppb)
480
380
280
180
80
-20
8290
23250
24460
45360
46570
47010
Well F.I.D. #
41
81
33
47
52
70
Number of Samples (1986-1988)

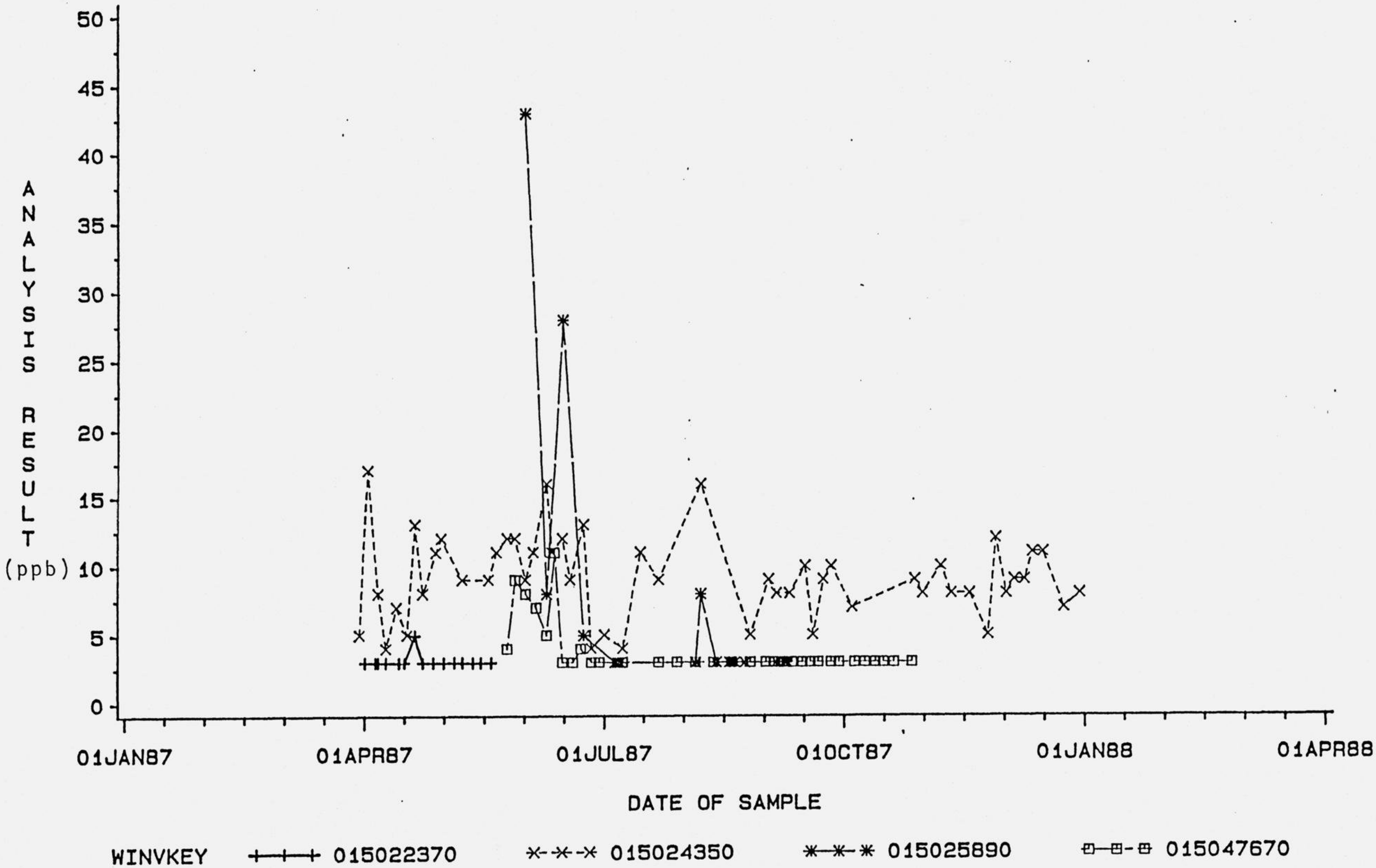

EGGGIB16
Lead VALUE (ppb)
0
10
20
30
40
50
60
70
8290
23250
24460
1
2
9
Well F.I.D. #
Number of Samples
(1984-1986)

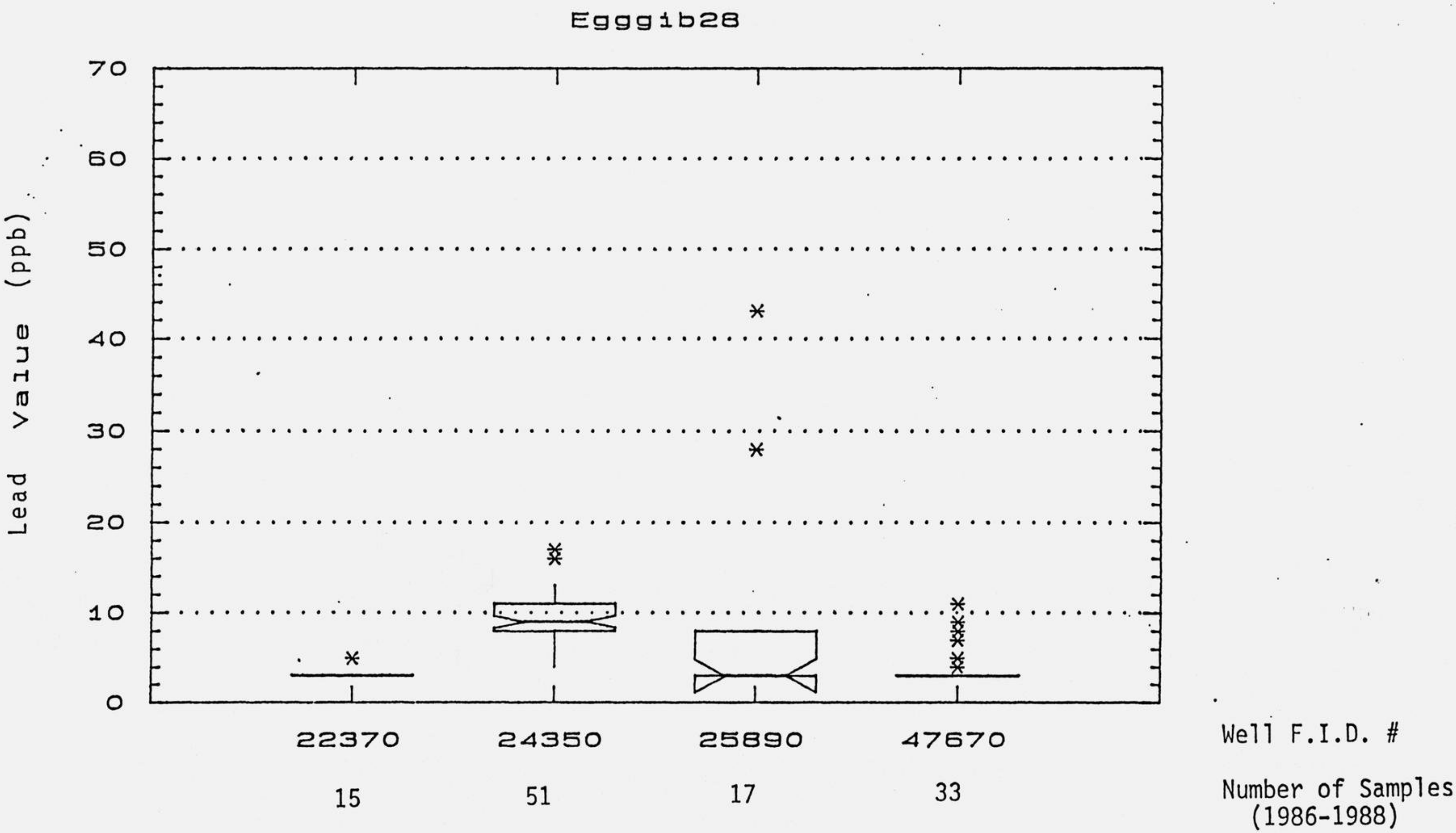


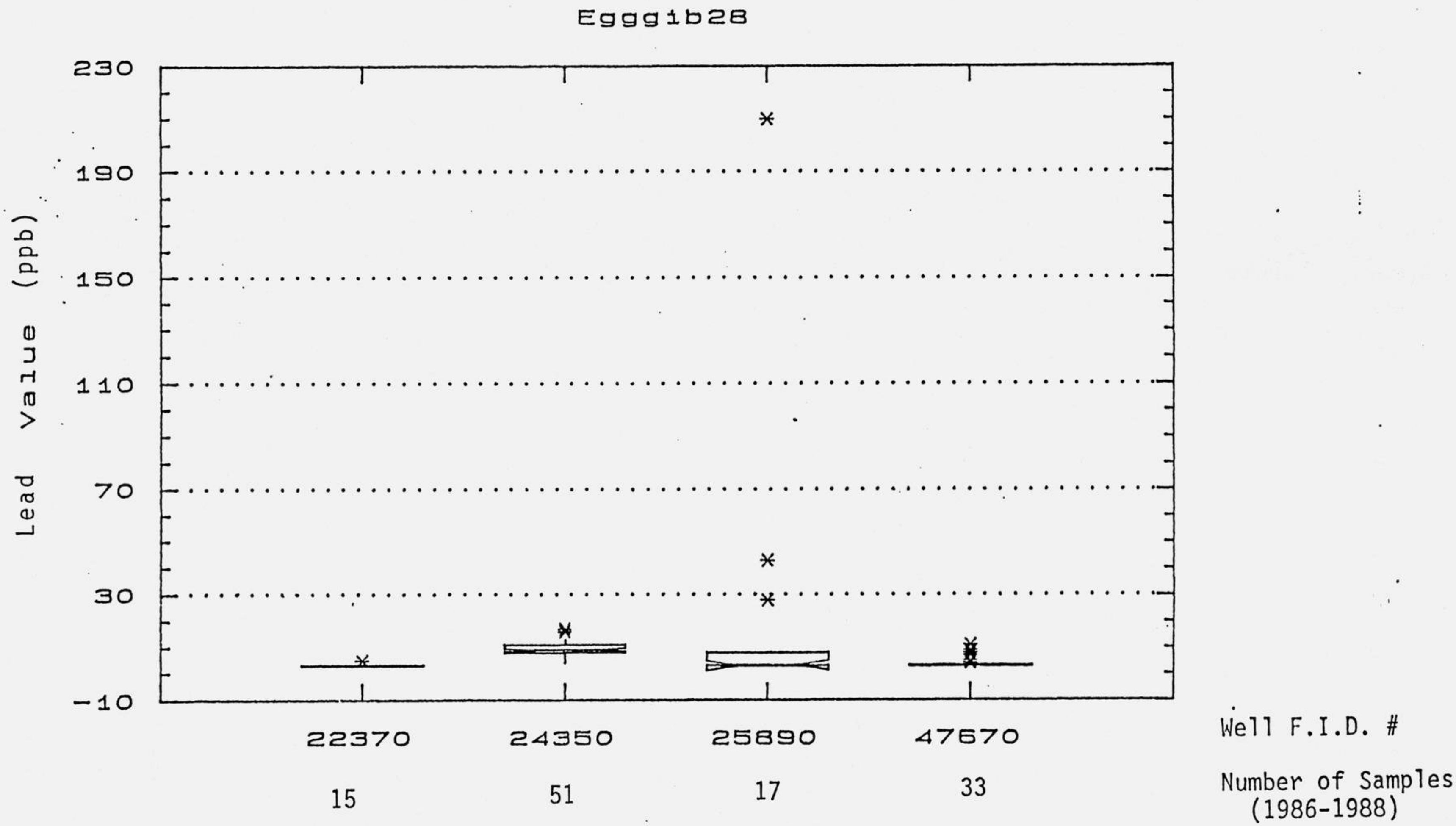
EGGGIB16
Lead VALUE (ppb)
24
20
16
12
8
4
0
8290
23250
24460
Well F.I.D. #
1
2
9
Number of Samples (1984-1986)

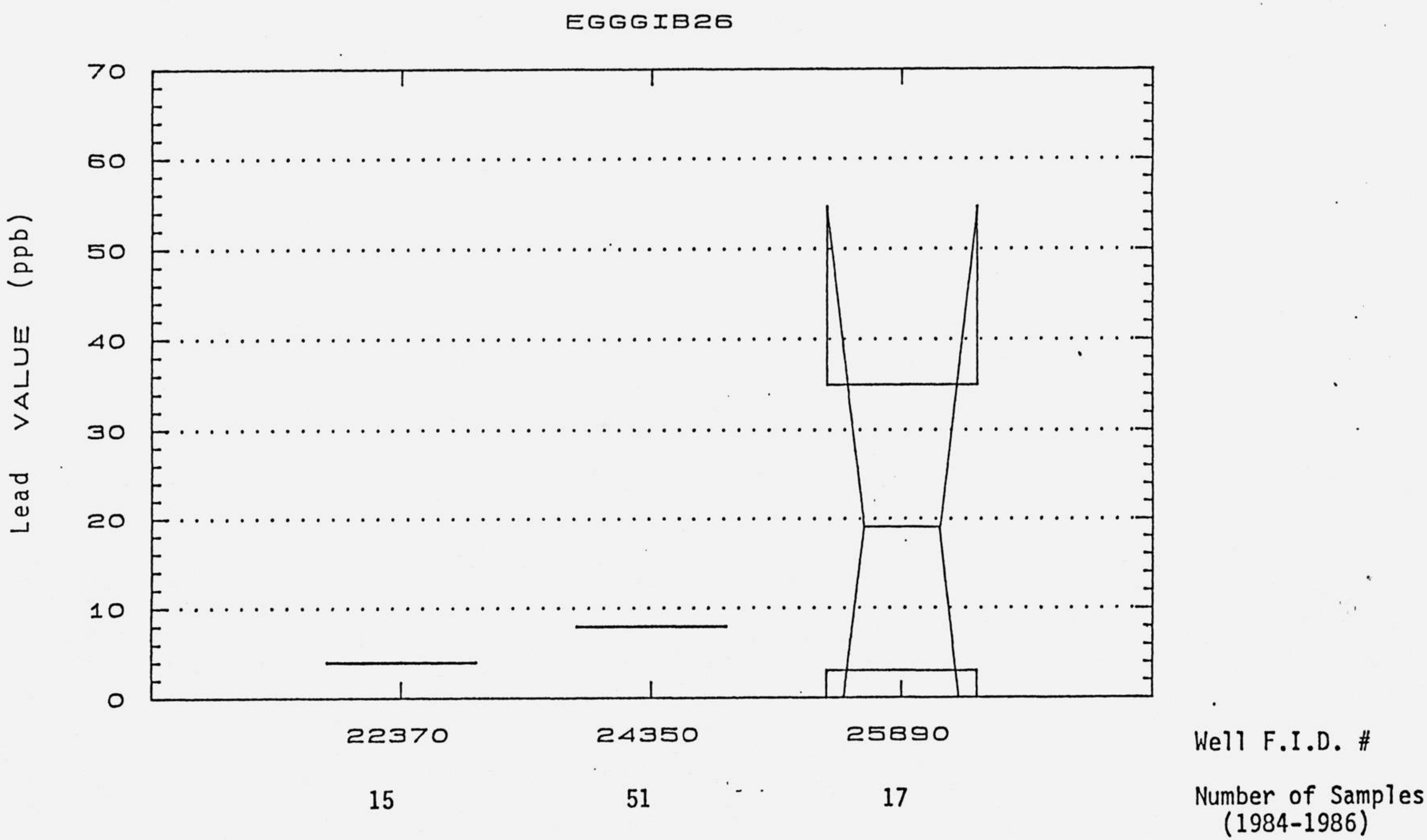
Lead concentrations vs. Time

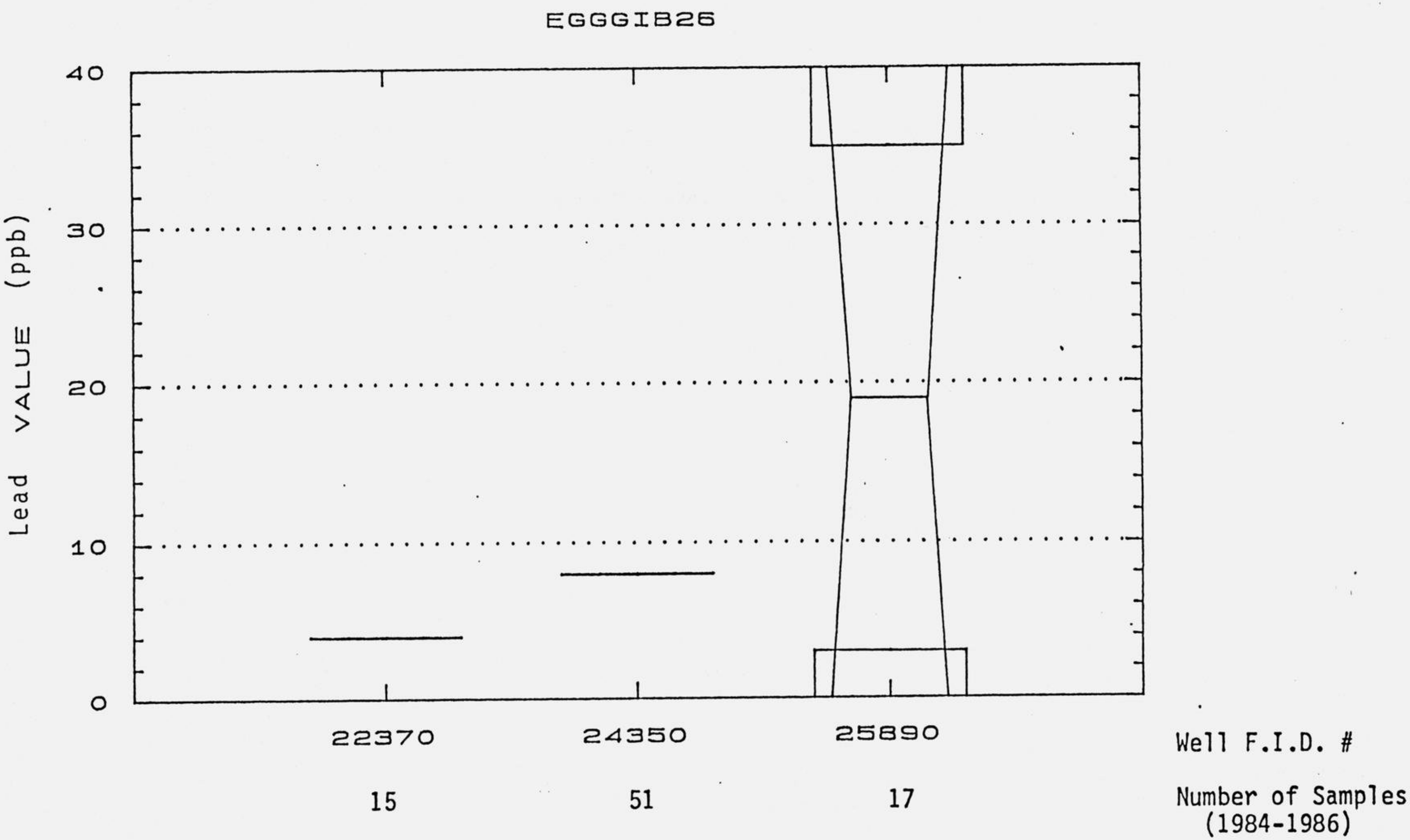
Sample group: EGGGIB2




Egggib28
Lead Value (ppb)
70
60
50
40
30
20
10
0
22370
24350
25890
47670
Well F.I.D. #
15
51
17
33
Number of Samples
(1986-1988)


Egggib28
Lead Value (ppb)
230
190
150
110
70
30
-10
22370
24350
25890
47670
Well F.I.D. #
15
51
17
33
Number of Samples
(1986-1988)


EGGGIB26
Lead VALUE (ppb)
0
10
20
30
40
50
60
70
22370
24350
25890
Well F.I.D. #
15
51
17
Number of Samples
(1984-1986)


EGGGIB26
Lead VALUE (ppb)
40
30
20
10
0
22370
24350
25890
Well F.I.D. #
15
51
17
Number of Samples
(1984-1986)

TRSQQ=2926E10SWNW

UNIVARIATE

Well F.I.D. # 08290

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	42	SUM WGTS	42
MEAN	4.19048	SUM	176
STD DEV	6.04147	VARIANCE	36.4994
SKEWNESS	6.2755	KURTOSIS	40.0869
USS	2234	CSS	1496.48
CV	144.172	STD MEAN	0.93222
T:MEAN=0	4.49516	PROB>|T|	0.0001
SGN RANK	451.5	PROB>|S|	0.0001
NUM ¬= 0	42		

QUANTILES(DEF=4)

100% MAX	42	99%	42
75% Q3	3	95%	7
50% MED	3	90%	4
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	39		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01500829)	4	(01500829)
3	(01500829)	4	(01500829)
3	(01500829)	7	(01500829)
3	(01500829)	7	(01500829)
3	(01500829)	42	(01500829)

TRSQQ=3026E25SWSE

UNIVARIATE

Well F.I.D. # 45360

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	47	SUM WGTS	47
MEAN	12.9574	SUM	609
STD DEV	17.2815	VARIANCE	298.65
SKEWNESS	3.56396	KURTOSIS	14.85
USS	21629	CSS	13737.9
CV	133.371	STD MEAN	2.52077
T:MEAN=0	5.14028	PROB>|T|	0.0001
SGN RANK	564	PROB>|S|	0.0001
NUM ¬= 0	47		

QUANTILES(DEF=4)

100% MAX	100	99%	100
75% Q3	13	95%	55.8
50% MED	7	90%	25.4
25% Q1	4	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	97		
Q3-Q1	9		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504536)	24	(01504536)
3	(01504536)	31	(01504536)
3	(01504536)	45	(01504536)
3	(01504536)	63	(01504536)
3	(01504536)	100	(01504536)

TRSQQ=3026E26SWSE

UNIVARIATE

Well F.I.D. # 47010

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	70	SUM WGTS	70
MEAN	3.2	SUM	224
STD DEV	0.693657	VARIANCE	0.481159
SKEWNESS	4.00154	KURTOSIS	16.8259
USS	750	CSS	33.2
CV	21.6768	STD MEAN	0.0829078
T:MEAN=0	38.5971	PROB>|T|	0.0001
SGN RANK	1242.5	PROB>|S|	0.0001
NUM ¬= 0	70		

QUANTILES(DEF=4)

100% MAX	7	99%	7
75% Q3	3	95%	5
50% MED	3	90%	3.9
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	4		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504701)	4	(01504701)
3	(01504701)	5	(01504701)
3	(01504701)	5	(01504701)
3	(01504701)	6	(01504701)
3	(01504701)	7	(01504701)

TRSQQ=3027E07NENE

UNIVARIATE

Well F.I.D. # 25890

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	19	SUM WGTS	19
MEAN	19.6316	SUM	373
STD DEV	47.6657	VARIANCE	2272.02
SKEWNESS	3.92995	KURTOSIS	16.1937
USS	48219	CSS	40896.4
CV	242.801	STD MEAN	10.9353
T:MEAN=0	1.79525	PROB>|T|	0.0894226
SGN RANK	95	PROB>|S|	0.0001
NUM ¬= 0	19		

QUANTILES(DEF=4)

100% MAX	210	99%	210
75% Q3	8	95%	210
50% MED	3	90%	43
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	207		
Q3-Q1	5		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01502589)	8	(01502589)
3	(01502589)	28	(01502589)
3	(01502589)	35	(01502589)
3	(01502589)	43	(01502589)
3	(01502589)	210	(01502589)

TRSQQ=3027E19NWNE

UNIVARIATE

Well F.I.D. # 24350

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	53	SUM WGTS	53
MEAN	9.11321	SUM	483
STD DEV	2.98496	VARIANCE	8.91001
SKEWNESS	0.427236	KURTOSIS	0.382262
USS	4865	CSS	463.321
CV	32.7543	STD MEAN	0.410016
T:MEAN=0	22.2264	PROB>|T|	0.0001
SGN RANK	715.5	PROB>|S|	0.0001
NUM ¬= 0	53		

QUANTILES(DEF=4)

100% MAX	17	99%	17
75% Q3	11	95%	16
50% MED	9	90%	12.6
25% Q1	8	10%	5
0% MIN	4	5%	4
		1%	4
RANGE	13		
Q3-Q1	3		
MODE	8		

EXTREMES

LOWEST	ID	HIGHEST	ID
4	(01502435)	13	(01502435)
4	(01502435)	13	(01502435)
4	(01502435)	16	(01502435)
5	(01502435)	16	(01502435)
5	(01502435)	17	(01502435)

TRSQQ=3027E30SWNE

UNIVARIATE

Well F.I.D. # 24460

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	42	SUM WGTS	42
MEAN	3.71429	SUM	156
STD DEV	2.899	VARIANCE	8.40418
SKEWNESS	4.94703	KURTOSIS	26.0317
USS	924	CSS	344.571
CV	78.0499	STD MEAN	0.447325
T:MEAN=0	8.30333	PROB>|T|	0.0001
SGN RANK	451.5	PROB>|S|	0.0001
NUM ¬= 0	42		

QUANTILES(DEF=4)

100% MAX	20	99%	20
75% Q3	3	95%	10.25
50% MED	3	90%	4.4
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	17		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01502446)	3	(01502446)
3	(01502446)	5	(01502446)
3	(01502446)	6	(01502446)
3	(01502446)	11	(01502446)
3	(01502446)	20	(01502446)

TRSQQ=3027E32SWSE

UNIVARIATE

Well F.I.D. # 46570

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	52	SUM WGTS	52
MEAN	17.4423	SUM	907
STD DEV	56.0922	VARIANCE	3146.33
SKEWNESS	5.64892	KURTOSIS	33.2162
USS	176283	CSS	160463
CV	321.587	STD MEAN	7.77858
T:MEAN=0	2.24235	PROB>|T|	0.0293146
SGN RANK	689	PROB>|S|	0.0001
NUM ¬= 0	52		

QUANTILES(DEF=4)

100% MAX	370	99%	370
75% Q3	8	95%	86.65
50% MED	6.5	90%	11.7
25% Q1	5	10%	4
0% MIN	3	5%	3
		1%	3
RANGE	367		
Q3-Q1	3		
MODE	8		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504657)	12	(01504657)
3	(01504657)	15	(01504657)
3	(01504657)	31	(01504657)
4	(01504657)	190	(01504657)
4	(01504657)	370	(01504657)

TRSQQ=3127E31SENE

UNIVARIATE

Well F.I.D. # 23250

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	83	SUM WGTS	83
MEAN	4.01205	SUM	333
STD DEV	2.18919	VARIANCE	4.79254
SKEWNESS	3.47168	KURTOSIS	14.1279
USS	1729	CSS	392.988
CV	54.5653	STD MEAN	0.240294
T:MEAN=0	16.6964	PROB>|T|	0.0001
SGN RANK	1743	PROB>|S|	0.0001
NUM ¬= 0	83		

QUANTILES(DEF=4)

100% MAX	16	99%	16
75% Q3	4	95%	7.8
50% MED	3	90%	6
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	13		
Q3-Q1	1		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01502325)	7	(01502325)
3	(01502325)	8	(01502325)
3	(01502325)	11	(01502325)
3	(01502325)	13	(01502325)
3	(01502325)	16	(01502325)

TRSQQ=2926E03SWSW

UNIVARIATE

Well F.I.D. # 22370

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	16	SUM WGTS	16
MEAN	3.1875	SUM	51
STD DEV	0.543906	VARIANCE	0.295833
SKEWNESS	3.02973	KURTOSIS	9.09343
USS	167	CSS	4.4375
CV	17.0637	STD MEAN	0.135976
T:MEAN=0	23.4416	PROB>|T|	0.0001
SGN RANK	68	PROB>|S|	.000150386
NUM ¬= 0	16		

QUANTILES(DEF=4)

100% MAX	5	99%	5
75% Q3	3	95%	5
50% MED	3	90%	4.3
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	2		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01502237)	3	(01502237)
3	(01502237)	3	(01502237)
3	(01502237)	3	(01502237)
3	(01502237)	4	(01502237)
3	(01502237)	5	(01502237)

TRSQQ=2926E09NESW

UNIVARIATE

Well F.I.D. # 47670

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	33	SUM WGTS	33
MEAN	3.81818	SUM	126
STD DEV	1.9757	VARIANCE	3.90341
SKEWNESS	2.59819	KURTOSIS	6.10757
USS	606	CSS	124.909
CV	51.7446	STD MEAN	0.343926
T:MEAN=0	11.1018	PROB>|T|	0.0001
SGN RANK	280.5	PROB>|S|	0.0001
NUM ¬= 0	33		

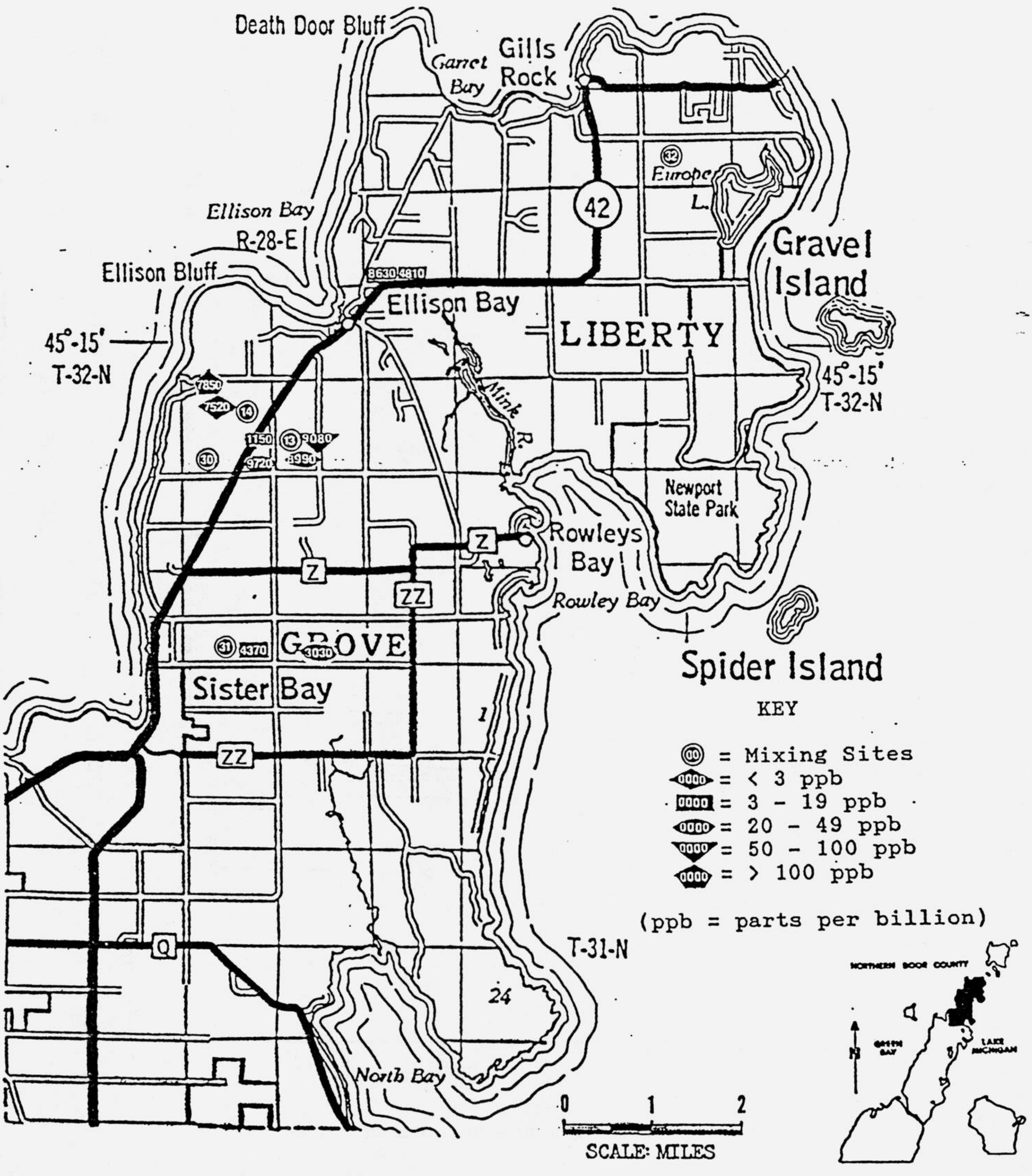
QUANTILES(DEF=4)

100% MAX	11	99%	11
75% Q3	3	95%	9.6
50% MED	3	90%	7.6
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	8		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504767)	5	(01504767)
3	(01504767)	7	(01504767)
3	(01504767)	8	(01504767)
3	(01504767)	9	(01504767)
3	(01504767)	11	(01504767)

LIBERTY GROVE TOWNSHIP



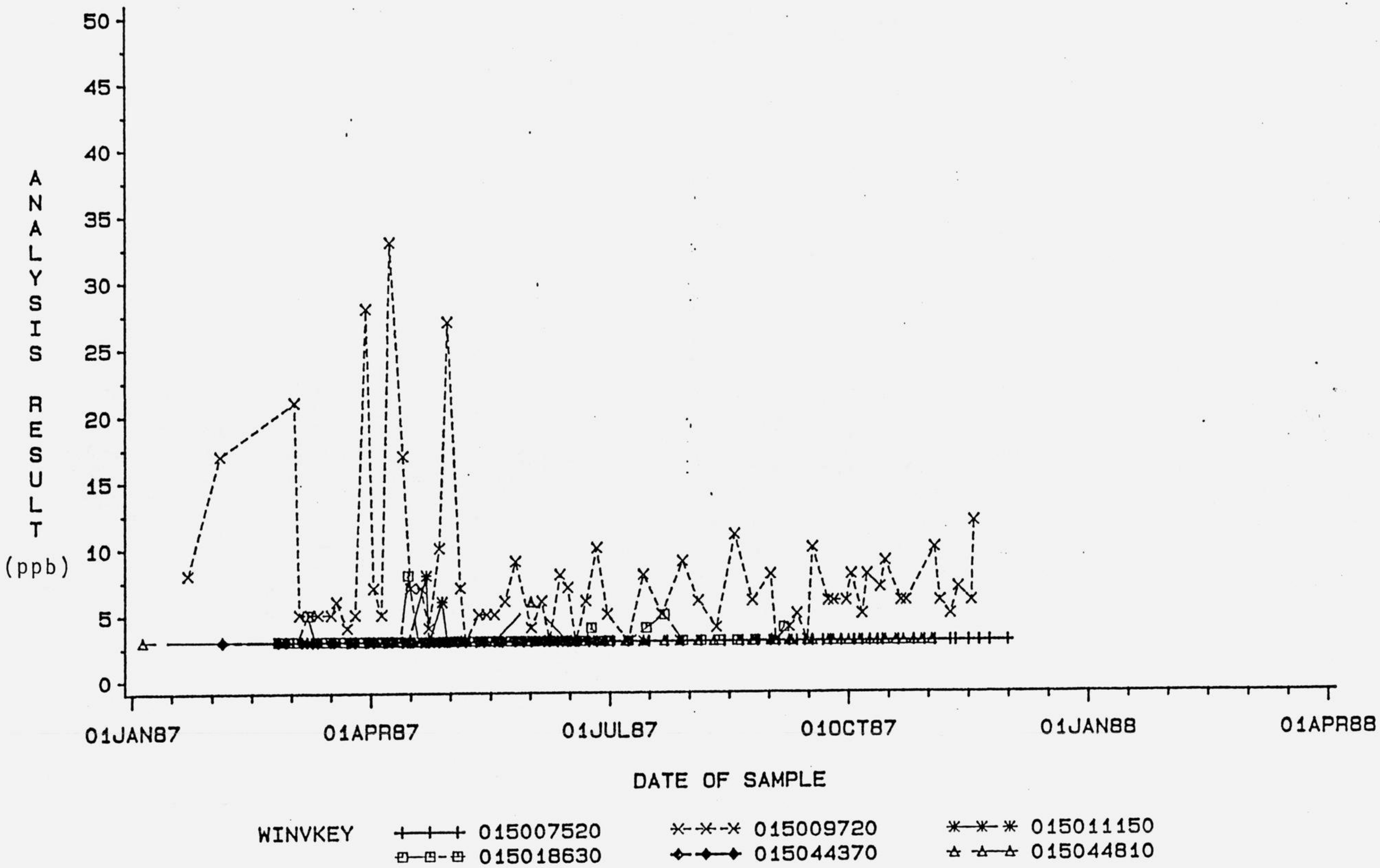
KEY

- (00) = Mixing Sites
- 0000 = < 3 ppb
- 0000 = 3 - 19 ppb
- 0000 = 20 - 49 ppb
- 0000 = 50 - 100 ppb
- 0000 = > 100 ppb

(ppb = parts per billion)

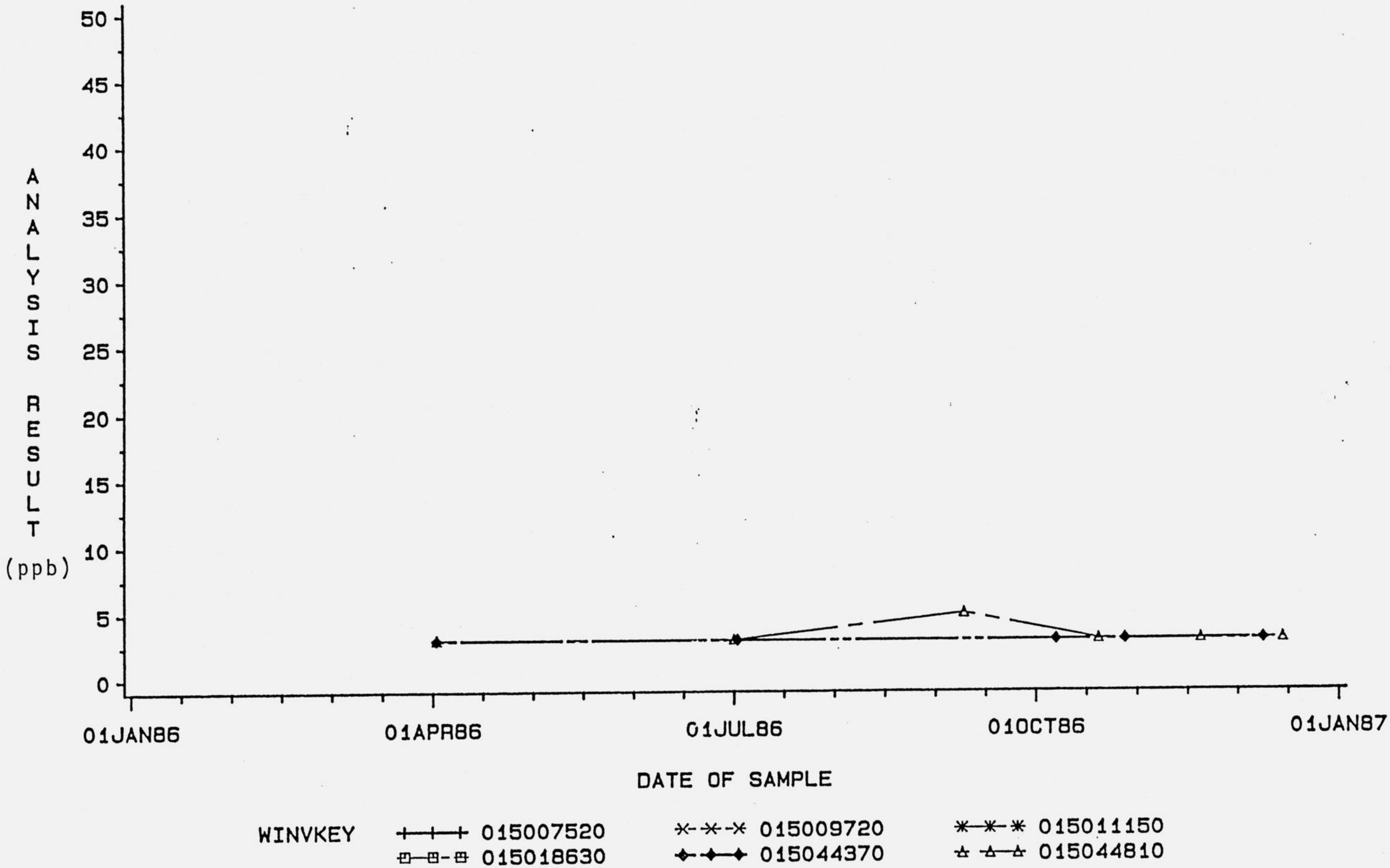
Lead concentrations vs. Time

Sample group: libgrv

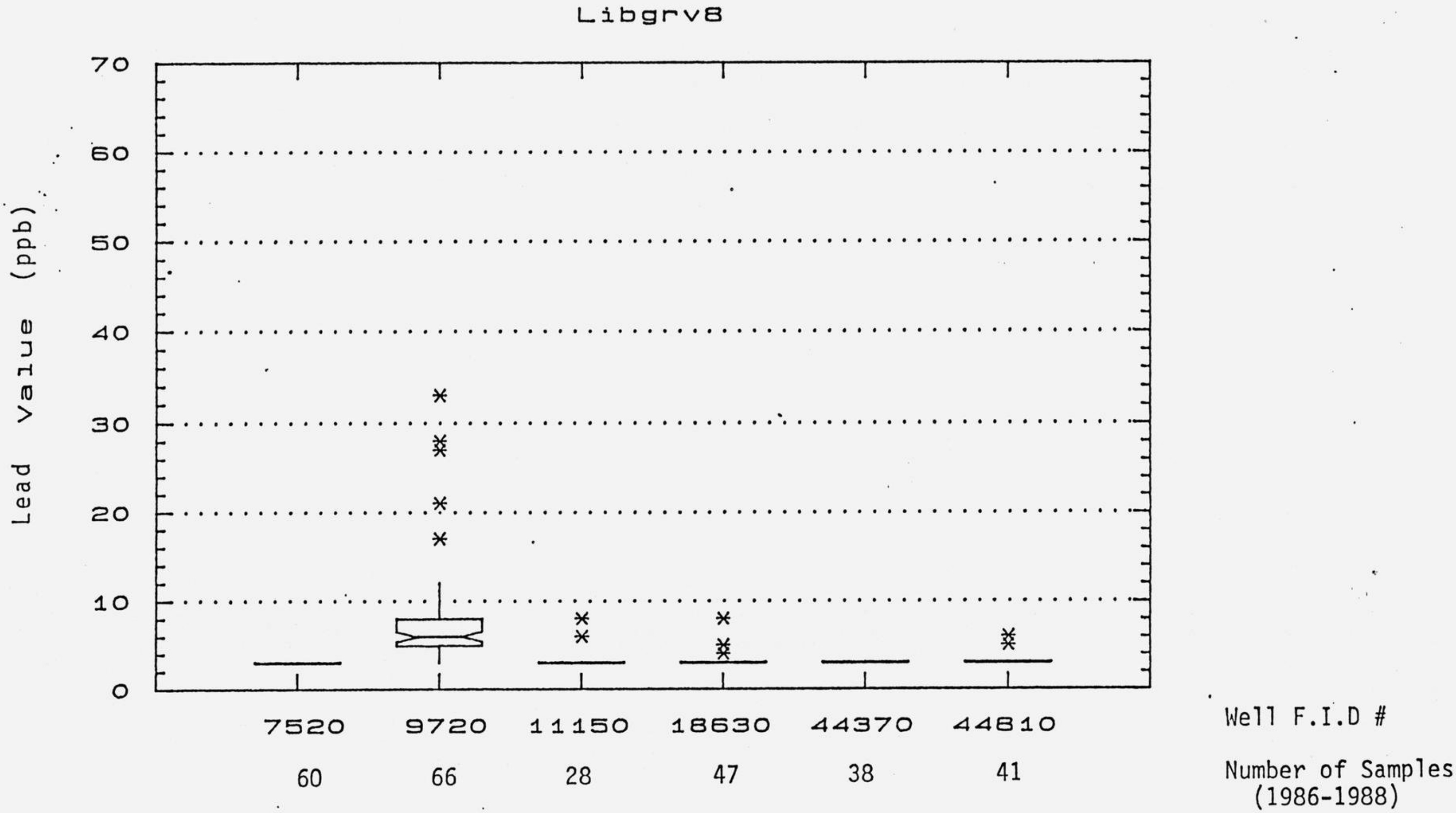


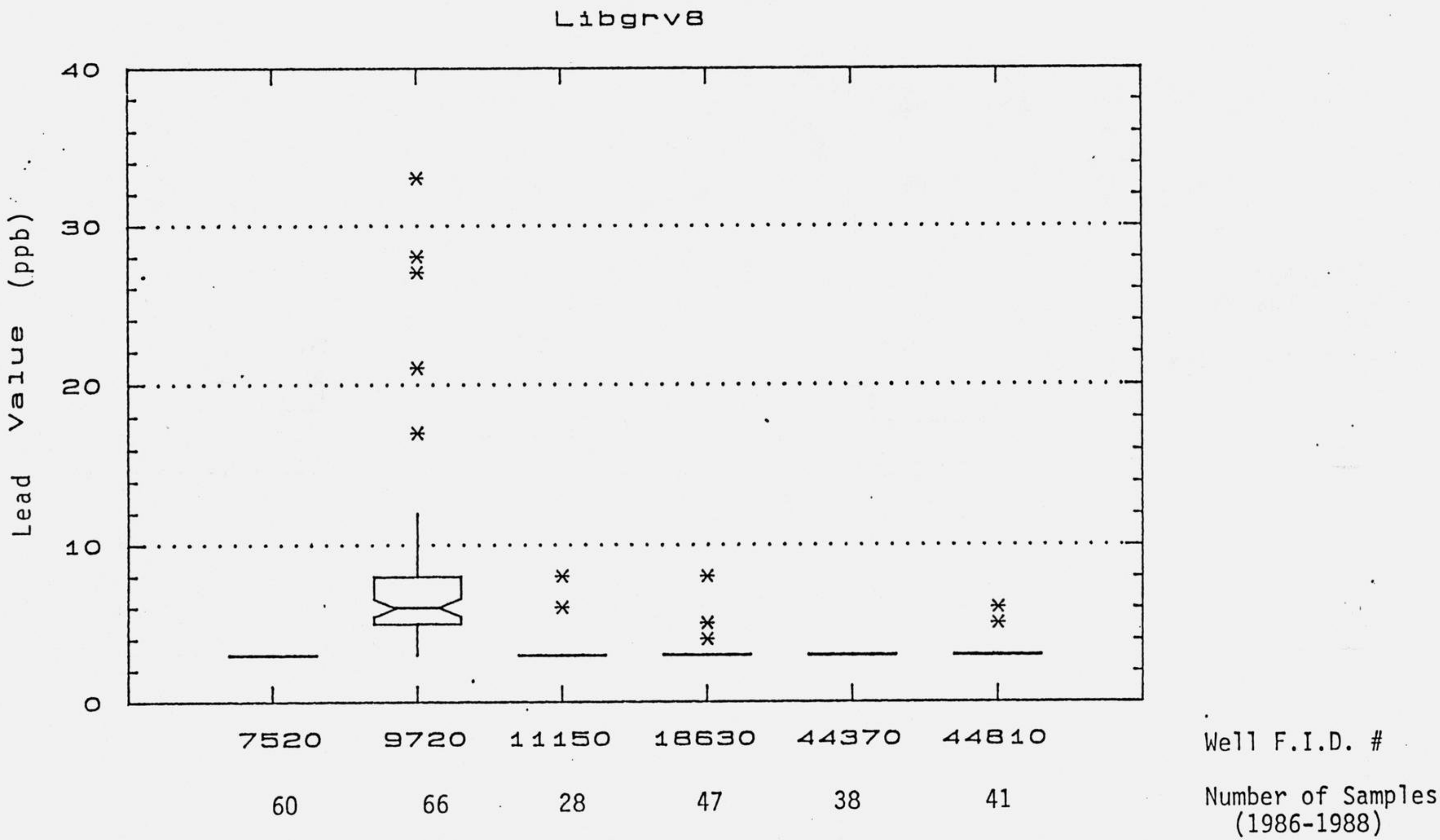
Lead concentrations vs. Time

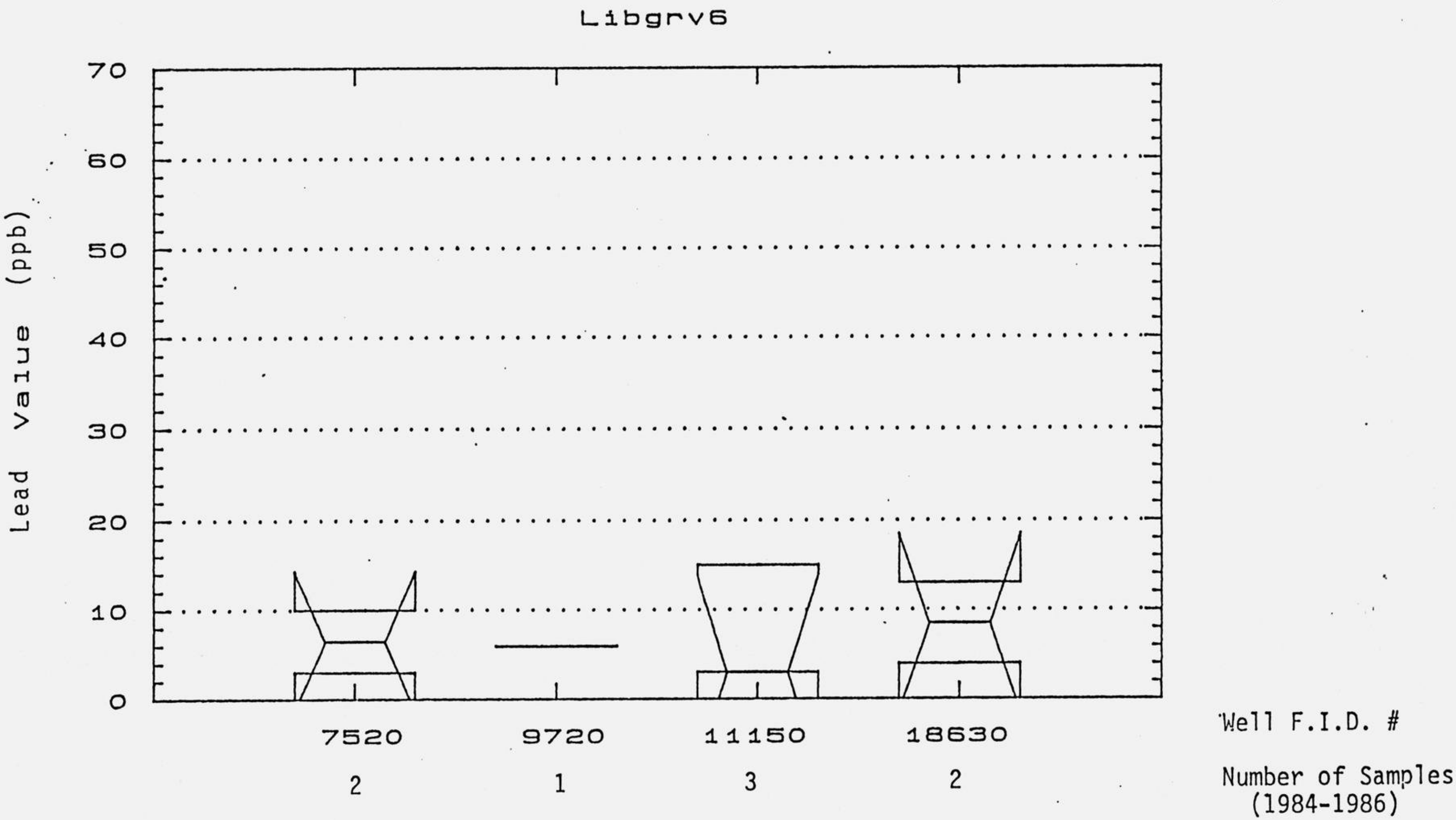
Sample group: libgrv

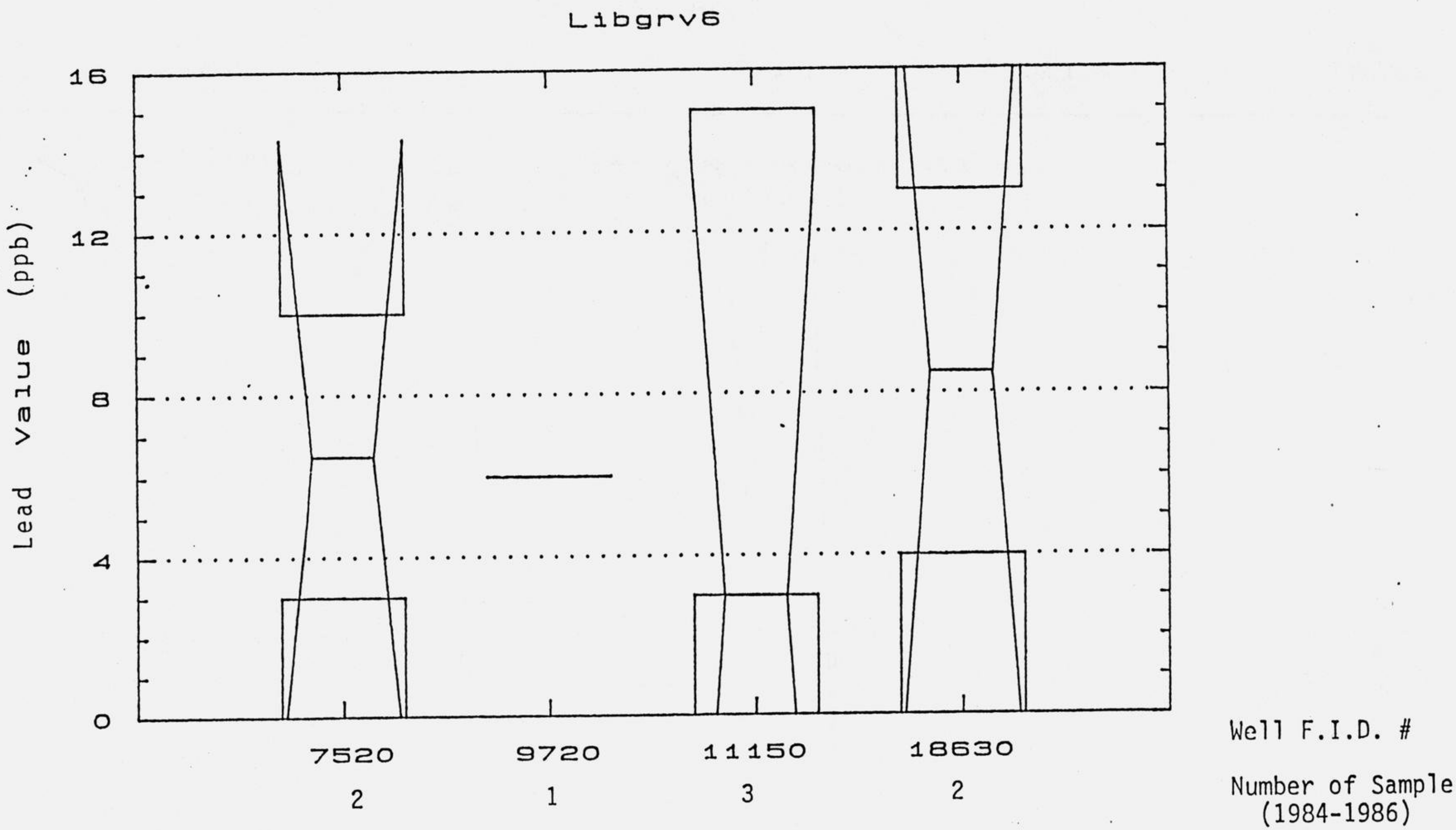


-79-


Libgrv8
Lead Value (ppb)
70
60
50
40
30
20
10
0
7520
9720
11150
18630
44370
44810
60
66
28
47
38
41
Well F.I.D #
Number of Samples
(1986-1988)

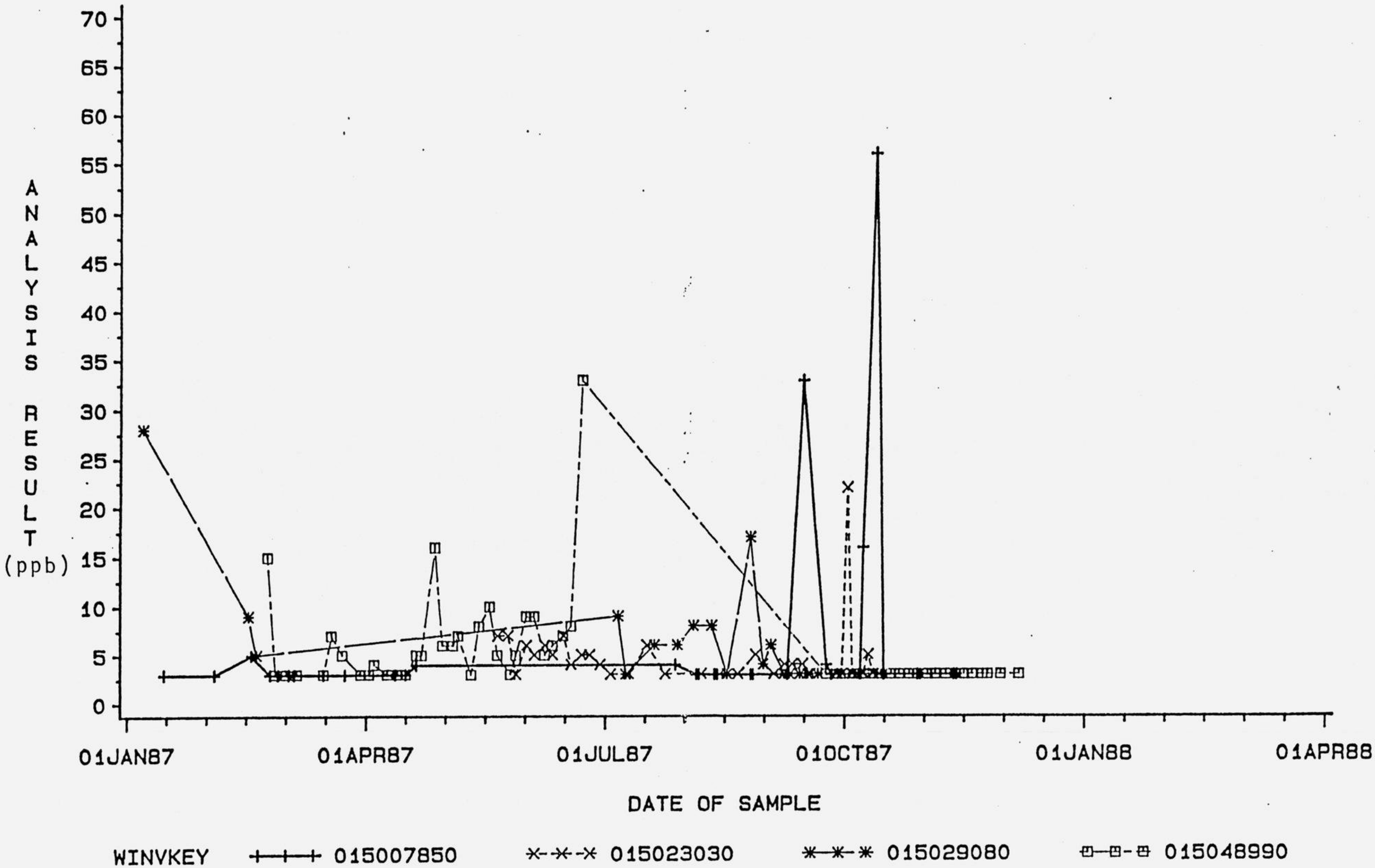

Libgrv8
Lead Value (ppb)
40
30
20
10
0
7520
9720
11150
18630
44370
44810
60
66
28
47
38
41
Well F.I.D. #
Number of Samples
(1986-1988)


Libgrv6
Lead Value (ppb)
70
60
50
40
30
20
10
0
7520
9720
11150
18630
2
1
3
2
Well F.I.D. #
Number of Samples (1984-1986)


Libgrv6
Lead Value (ppb)
16
12
8
4
0
7520
9720
11150
18630
2
1
3
2
Well F.I.D. #
Number of Samples
(1984-1986)

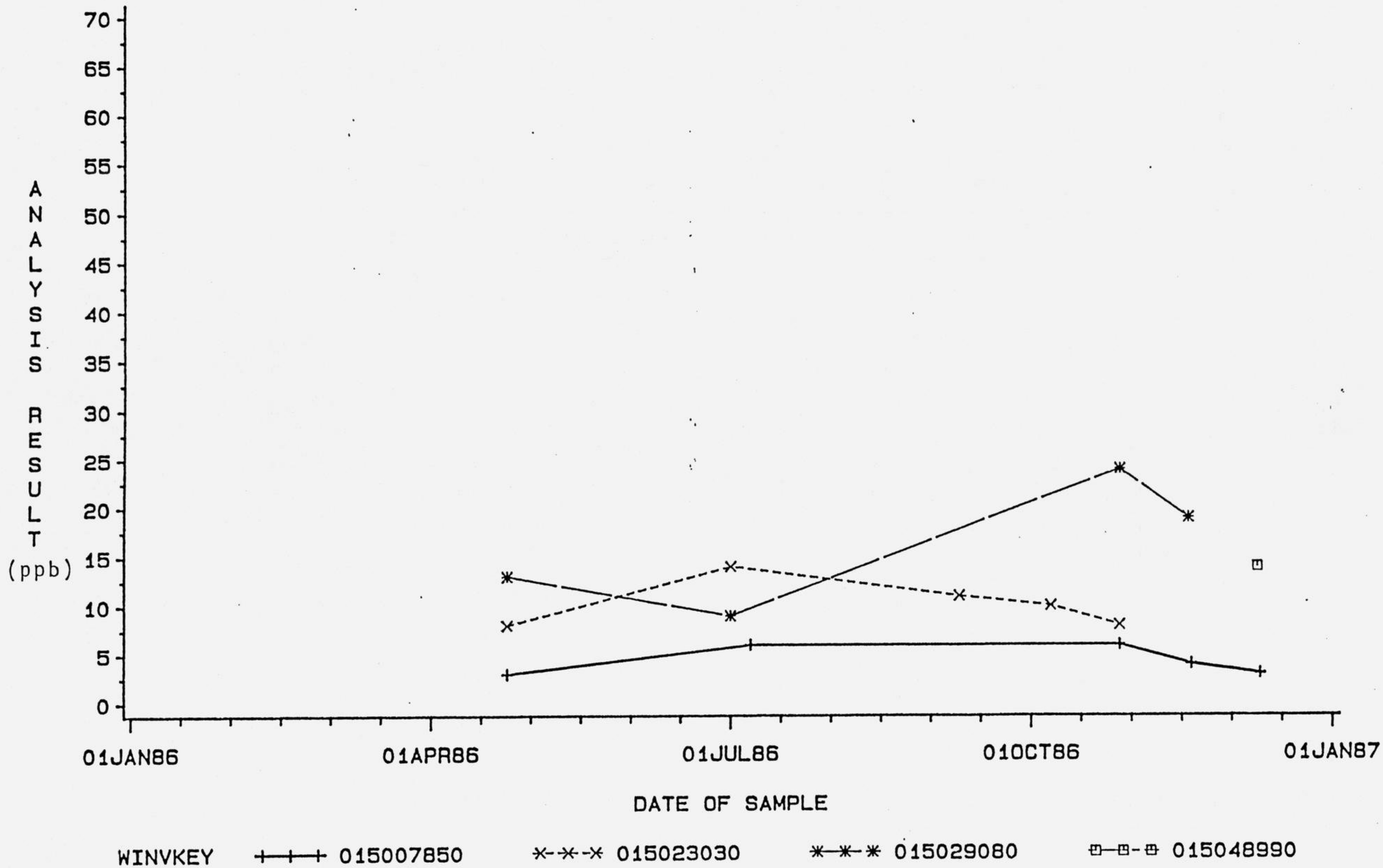
Lead concentrations vs. Time

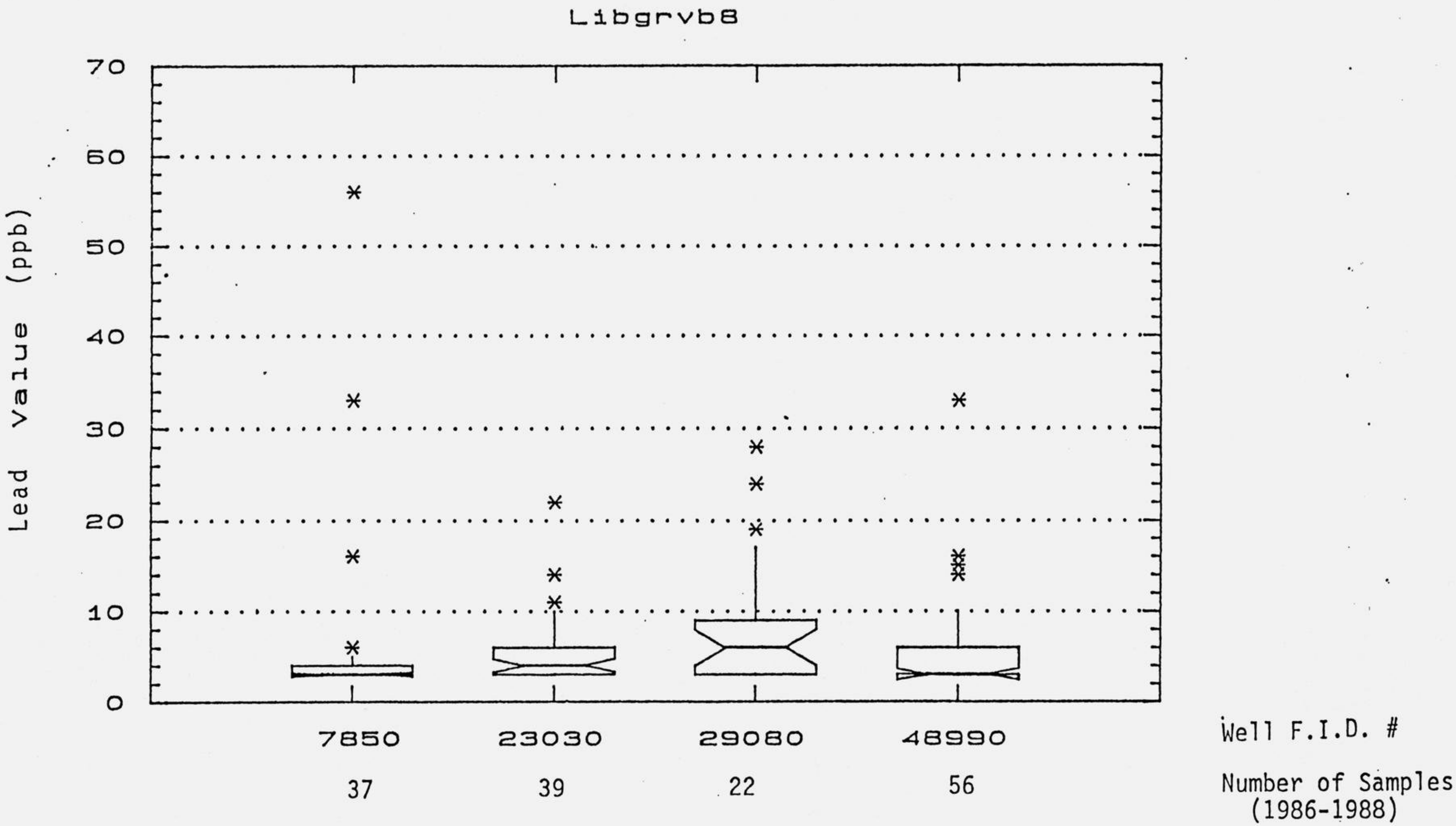
Sample group: libgrvb

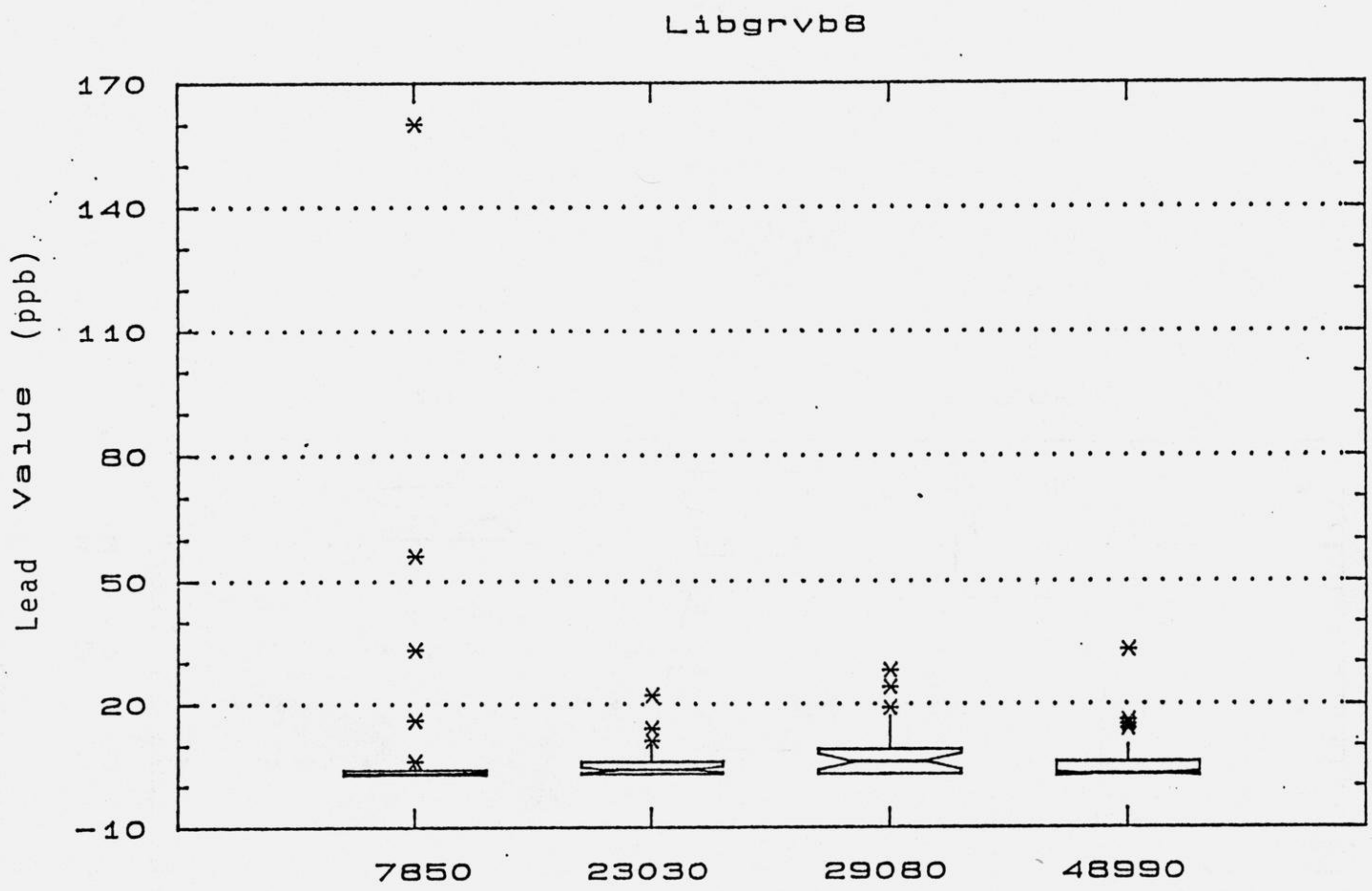


Lead concentrations vs. Time

Sample group: libgrvb

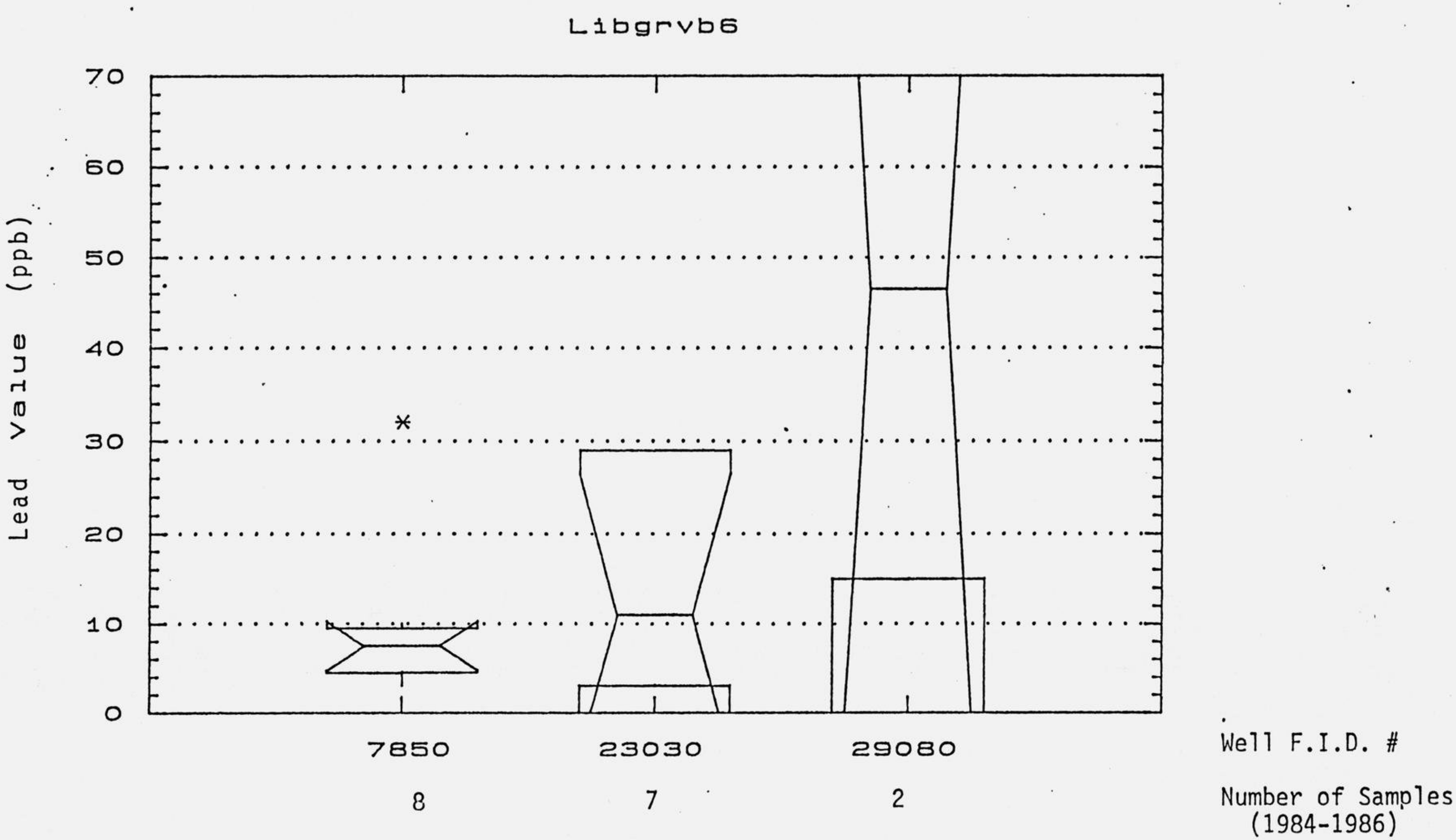


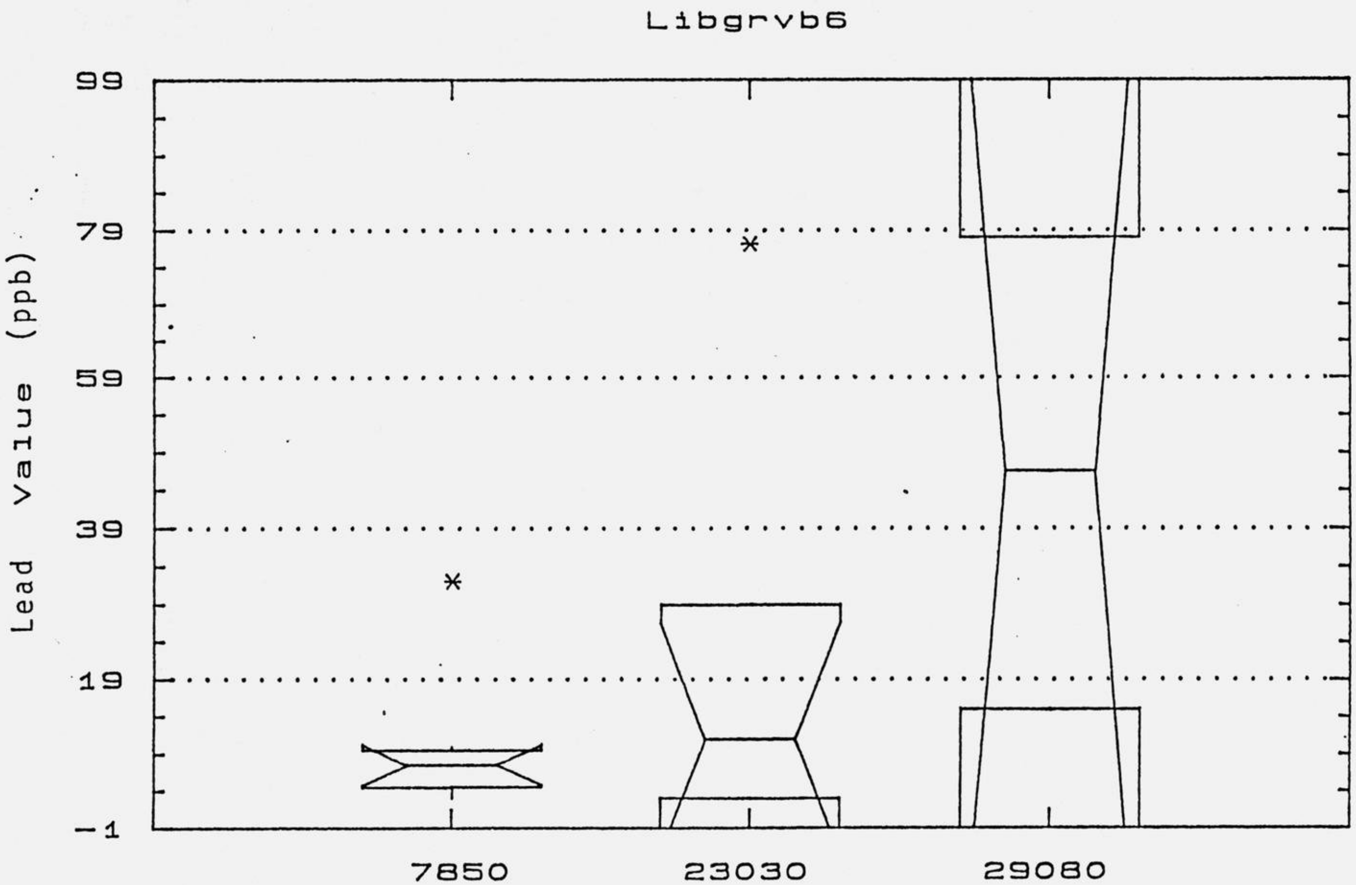

Libgrvb8
Lead Value (ppb)
0
10
20
30
40
50
60
70
7850
23030
29080
48990
37
39
22
56
Well F.I.D. #
Number of Samples
(1986-1988)



Well F.I.D. #

37	39	22	56	Number of Samples (1986-1988)


Libgrvb6
Lead Value (ppb)
70
60
50
40
30
20
10
0
7850
23030
29080
Well F.I.D. #
8
7
2
Number of Samples
(1984-1986)



Well F.I.D. #

8 7 2

Number of Samples (1984-1986)

TRSQQ=3228E'1SWSW

UNIVARIATE

Well F.I.D. # 18630

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	49	SUM WGTS	49
MEAN	3.46939	SUM	170
STD DEV	1.6215	VARIANCE	2.62925
SKEWNESS	4.90209	KURTOSIS	26.4638
USS	716	CSS	126.204
CV	46.7373	STD MEAN	0.231642
T:MEAN=0	14.9773	PROB>|T|	0.0001
SGN RANK	612.5	PROB>|S|	0.0001
NUM ¬= 0	49		

QUANTILES(DEF=4)

100% MAX	13	99%	13
75% Q3	3	95%	6.5
50% MED	3	90%	4
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	10		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01501863)	4	(01501863)
3	(01501863)	5	(01501863)
3	(01501863)	5	(01501863)
3	(01501863)	8	(01501863)
3	(01501863)	13	(01501863)

TRSQQ=3228E21NESE

UNIVARIATE

Well F.I.D. # 11150

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	31	SUM WGTS	31
MEAN	3.64516	SUM	113
STD DEV	2.3459	VARIANCE	5.50323
SKEWNESS	4.28396	KURTOSIS	19.5587
USS	577	CSS	165.097
CV	64.3564	STD MEAN	0.421335
T:MEAN=0	8.65145	PROB>|T|	0.0001
SGN RANK	248	PROB>|S|	0.0001
NUM ¬= 0	31		

QUANTILES(DEF=4)

100% MAX	15	99%	15
75% Q3	3	95%	10.8
50% MED	3	90%	5.4
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	12		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01501115)	3	(01501115)
3	(01501115)	3	(01501115)
3	(01501115)	6	(01501115)
3	(01501115)	8	(01501115)
3	(01501115)	15	(01501115)

TRSQQ=3228E21NWNE

UNIVARIATE

Well· F.I.D. # 07520

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	62	SUM WGTS	62
MEAN	3.1129	SUM	193
STD DEV	0.889001	VARIANCE	0.790323
SKEWNESS	7.87401	KURTOSIS	62
USS	649	CSS	48.2097
CV	28.5586	STD MEAN	0.112903
T:MEAN=0	27.5714	PROB>|T|	0.0001
SGN RANK	976.5	PROB>|S|	0.0001
NUM ¬= 0	62		

QUANTILES(DEF=4)

100% MAX	10	99%	10
75% Q3	3	95%	3
50% MED	3	90%	3
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	7		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01500752)	3	(01500752)
3	(01500752)	3	(01500752)
3	(01500752)	3	(01500752)
3	(01500752)	3	(01500752)
3	(01500752)	10	(01500752)

TRSQQ=3228E21NWNW

UNIVARIATE

Well F.I.D. # 07850

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS / QUANTILES(DEF=4)

MOMENTS				QUANTILES(DEF=4)			
N	45	SUM WGTS	45	100% MAX	160	99%	160
MEAN	10.0889	SUM	454	75% Q3	6	95%	49.1
STD DEV	24.8942	VARIANCE	619.719	50% MED	3	90%	22.4
SKEWNESS	5.3609	KURTOSIS	31.3818	25% Q1	3	10%	3
USS	31848	CSS	27267.6	0% MIN	3	5%	3
CV	246.748	STD MEAN	3.711			1%	3
T:MEAN=0	2.71864	PROB>|T|	0.00934411	RANGE	157		
SGN RANK	517.5	PROB>|S|	0.0001	Q3-Q1	3		
NUM ¬= 0	45			MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01500785)	16	(01500785)
3	(01500785)	32	(01500785)
3	(01500785)	33	(01500785)
3	(01500785)	56	(01500785)
3	(01500785)	160	(01500785)

TRSQQ=3228E21SESW

UNIVARIATE

Well F.I.D. # 09720

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS				QUANTILES(DEF=4)			
N	67	SUM WGTS	67	100% MAX	33	99%	33
MEAN	7.79104	SUM	522	75% Q3	8	95%	24.6
STD DEV	5.74334	VARIANCE	32.986	50% MED	6	90%	13
SKEWNESS	2.80809	KURTOSIS	8.40839	25% Q1	5	10%	3.8
USS	6244	CSS	2177.07	0% MIN	3	5%	3
CV	73.7172	STD MEAN	0.701661			1%	3
T:MEAN=0	11.1037	PROB>|T|	0.0001	RANGE	30		
SGN RANK	1139	PROB>|S|	0.0001	Q3-Q1	3		
NUM ¬= 0	67			MODE	5		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01500972)	17	(01500972)
3	(01500972)	21	(01500972)
3	(01500972)	27	(01500972)
3	(01500972)	28	(01500972)
3	(01500972)	33	(01500972)

TRSQQ=3228E22SWSE

UNIVARIATE

Well F.I.D. # 48990

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS				QUANTILES(DEF=4)			
N	56	SUM WGTS	56	100% MAX	33	99%	33
MEAN	5.30357	SUM	297	75% Q3	6	95%	15.15
STD DEV	4.87636	VARIANCE	23.7789	50% MED	3	90%	9.3
SKEWNESS	3.88316	KURTOSIS	18.9936	25% Q1	3	10%	3
USS	2883	CSS	1307.84	0% MIN	3	5%	3
CV	91.9449	STD MEAN	0.651631			1%	3
T:MEAN=0	8.13892	PROB>|T|	0.0001	RANGE	30		
SGN RANK	798	PROB>|S|	0.0001	Q3-Q1	3		
NUM ¬= 0	56			MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504899)	10	(01504899)
3	(01504899)	14	(01504899)
3	(01504899)	15	(01504899)
3	(01504899)	16	(01504899)
3	(01504899)	33	(01504899)

TRSQQ=3228E33SESW

UNIVARIATE

Well F.I.D. # 44370

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	38	SUM WGTS	38
MEAN	3	SUM	114
STD DEV	0	VARIANCE	0
SKEWNESS	.	KURTOSIS	.
USS	342	CSS	0
CV	0	STD MEAN	0
T:MEAN=0	.	PROB>|T|	.
SGN RANK	370.5	PROB>|S|	0.0001
NUM ¬= 0	38		

QUANTILES(DEF=4)

100% MAX	3	99%	3
75% Q3	3	95%	3
50% MED	3	90%	3
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	0		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504437)	3	(01504437)
3	(01504437)	3	(01504437)
3	(01504437)	3	(01504437)
3	(01504437)	3	(01504437)
3	(01504437)	3	(01504437)

TRSQQ=3228E34SWSW

UNIVARIATE

Well F.I.D. # 23030

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	46	SUM WGTS	46
MEAN	7.56522	SUM	348
STD DEV	11.6307	VARIANCE	135.273
SKEWNESS	5.10792	KURTOSIS	29.4142
USS	8720	CSS	6087.3
CV	153.739	STD MEAN	1.71485
T:MEAN=0	4.41158	PROB>|T|	0.0001
SGN RANK	540.5	PROB>|S|	0.0001
NUM ¬= 0	46		

QUANTILES(DEF=4)

100% MAX	77	99%	77
75% Q3	7	95%	26.55
50% MED	4	90%	12.6
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	74		
Q3-Q1	4		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01502303)	12	(01502303)
3	(01502303)	14	(01502303)
3	(01502303)	22	(01502303)
3	(01502303)	29	(01502303)
3	(01502303)	77	(01502303)

TRSQQ=3828E22SWSE

UNIVARIATE

Well F.I.D. # 29080

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	24	SUM WGTS	24
MEAN	11.875	SUM	285
STD DEV	15.724	VARIANCE	247.245
SKEWNESS	3.52752	KURTOSIS	14.3601
USS	9071	CSS	5686.62
CV	132.413	STD MEAN	3.20965
T:MEAN=0	3.69978	PROB>|T|	0.00119742
SGN RANK	150	PROB>|S|	0.0001
NUM ¬= 0	24		

QUANTILES(DEF=4)

100% MAX	78	99%	78
75% Q3	14.5	95%	65.5
50% MED	7	90%	26
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	75		
Q3-Q1	11.5		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01502908)	17	(01502908)
3	(01502908)	19	(01502908)
3	(01502908)	24	(01502908)
3	(01502908)	28	(01502908)
3	(01502908)	78	(01502908)

TRSQQ=3228E11SWSE

UNIVARIATE

Well F.I.D. # 44810

VARIABLE=TESTVAL ANALYSIS RESULT

MOMENTS

N	41	SUM WGTS	41
MEAN	3.12195	SUM	128
STD DEV	0.556557	VARIANCE	0.309756
SKEWNESS	4.63338	KURTOSIS	21.302
USS	412	CSS	12.3902
CV	17.8272	STD MEAN	0.0869197
T:MEAN=0	35.9177	PROB>|T|	0.0001
SGN RANK	430.5	PROB>|S|	0.0001
NUM ¬= 0	41		

QUANTILES(DEF=4)

100% MAX	6	99%	6
75% Q3	3	95%	4.8
50% MED	3	90%	3
25% Q1	3	10%	3
0% MIN	3	5%	3
		1%	3
RANGE	3		
Q3-Q1	0		
MODE	3		

EXTREMES

LOWEST	ID	HIGHEST	ID
3	(01504481)	3	(01504481)
3	(01504481)	3	(01504481)
3	(01504481)	3	(01504481)
3	(01504481)	5	(01504481)
3	(01504481)	6	(01504481)

* 50 ppb = current Health Advisory Level for lead in drinking water
* 5 ppb = proposed federal Maximum Contaminant Level in drinking water

Well F.I.D.#	- Unique Facility Identification number which specifically identifies a well.
# Samples	- The number of samples analyzed on which calculations are based.
# Detects	- The number of samples with lead concentration levels above the detection limit of 3 ppb.
% of Samples w/Detects	- Percent of samples with detectable lead concentrations.
Mean	- The average concentration in all the samples from a well.
Median	- The "middle value"; such that half the samples had lead concentrations above this and half below.
Q_3	- The "seventy-fifth percentile"; the lead concentration level with 75% of the values below and 25% above this number.
Q_1	- The "twenty-fifth percentile"; the lead concentration level with 25% of the values below and 75% above this number.
$Q_3 - Q_1$	- "Interquartile range"; a common measure of spread, calculated by the differences between the 75% and 25% quartiles.
95% Value	- The "ninety-fifth percentile"; the lead concentration level with 95% of the values below and 5% above this number.
Skewness	- A measure of whether the bulk of the samples fell among the high values or the low values. A higher skewness value indicates there were a few samples with lead values much higher than the normal from that well.
Variance	- A measure of dispersion; the extent to which each sample value differed from one another. The higher the variance, the greater the dispersion of lead values.
Kurtosis	- A measure of the peakedness or flatness of the frequency distribution graph; the concentration of the values near the mean.

Wisconsin laboratories certified for lead analysis in drinking water under the Safe Drinking Water Act, as of March 28, 1988.

Results Reported	Lab Name	One Sample **	Two Samples ** - Plumbing check - Only if 1st draw and after 5 minutes - Must be submitted at same time
Within about 2-3 weeks	Davy Laboratories P.O. Box 2076 La Crosse, WI 54601 608-782-3130	19.00	30.00
Within about 2-3 weeks	Enviroscan 303 W. Military Road Rothschild, WI 54474 715-359-7226	35.00	35.00
Within about 2-3 weeks	Northern Lake Service, Inc. 400 North Lake Avenue Crandon, WI 54520 715-478-2777	18.00	35.00
Within about 2-3 weeks	RMT, Inc. 1406 East Washington Avenue Madison, WI 53703 608-255-2134	28.00	?
Within about 6 weeks	WI State Lab of Hygiene 465 Henry Mall Madison, WI 53706 800-362-3020	16.00	32.00

* You must tell laboratory that you are most interested in sampling for lead from the aquifer not the plumbing.

** All prices as of June 30, 1988.