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Impact of the 1993 Flood on Sedimentation and Sediment Quality in Backwater Lakes of Illinois

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Prepared for the
Illinois Environmental Protection Agency

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Illinois State Water Survey
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Champaign, Illinois

A Division of the Illinois Department of Natural Resources

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Illinois State Water Survey
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Introduction

The Great Mississippi Flood of 1993 has been recognized as one of the major natural disasters that has occurred in the central part of the country in recorded history. The flood affected a region that included nine states and three major rivers: the Mississippi, the Missouri, and the Illinois (figure 1). For a period of seven months, the state of Illinois felt a significant impact from the flooding along the Mississippi and Illinois Rivers. During this extended period of flooding, significant movement of sediment and pollutants occurred. As in many environmental disturbance cases, the analysis of the sediment affected by such a process tends to provide information that was not collected during the event and also provides a frame of reference for future data collection and analysis. This project was designed to characterize the conditions of selected backwater lakes in Illinois after the 1993 flood and to evaluate whether or not the flood affected the sediment deposition rate and pattern in the lakes. Another objective of the project was to evaluate if contaminants that entered the floodwaters have significantly altered the chemistry and toxicity of the sediment in the backwater lakes of the Mississippi and Illinois Rivers.

Backwater lakes along the Illinois and Mississippi Rivers are important ecological, recreational, and economic resources of the state that are under stress because of continuous sediment accumulation. The impact of a major flood such as the Great Flood of 1993 could be significant and thus needs to be documented and evaluated. It is therefore important that sedimentation surveys are conducted after the flood to record the condition of the lakes following a major hydrologic event and then to analyze the impact of such an event on the water and sediment quality.

Acknowledgments

The research project was funded by the Illinois Environmental Protection Agency (IEPA). Bill Ettinger, Division of Water Pollution Control, IEPA, was the project manager, and his cooperation and assistance are greatly appreciated. Nani G. Bhowmik, Hydrology Division

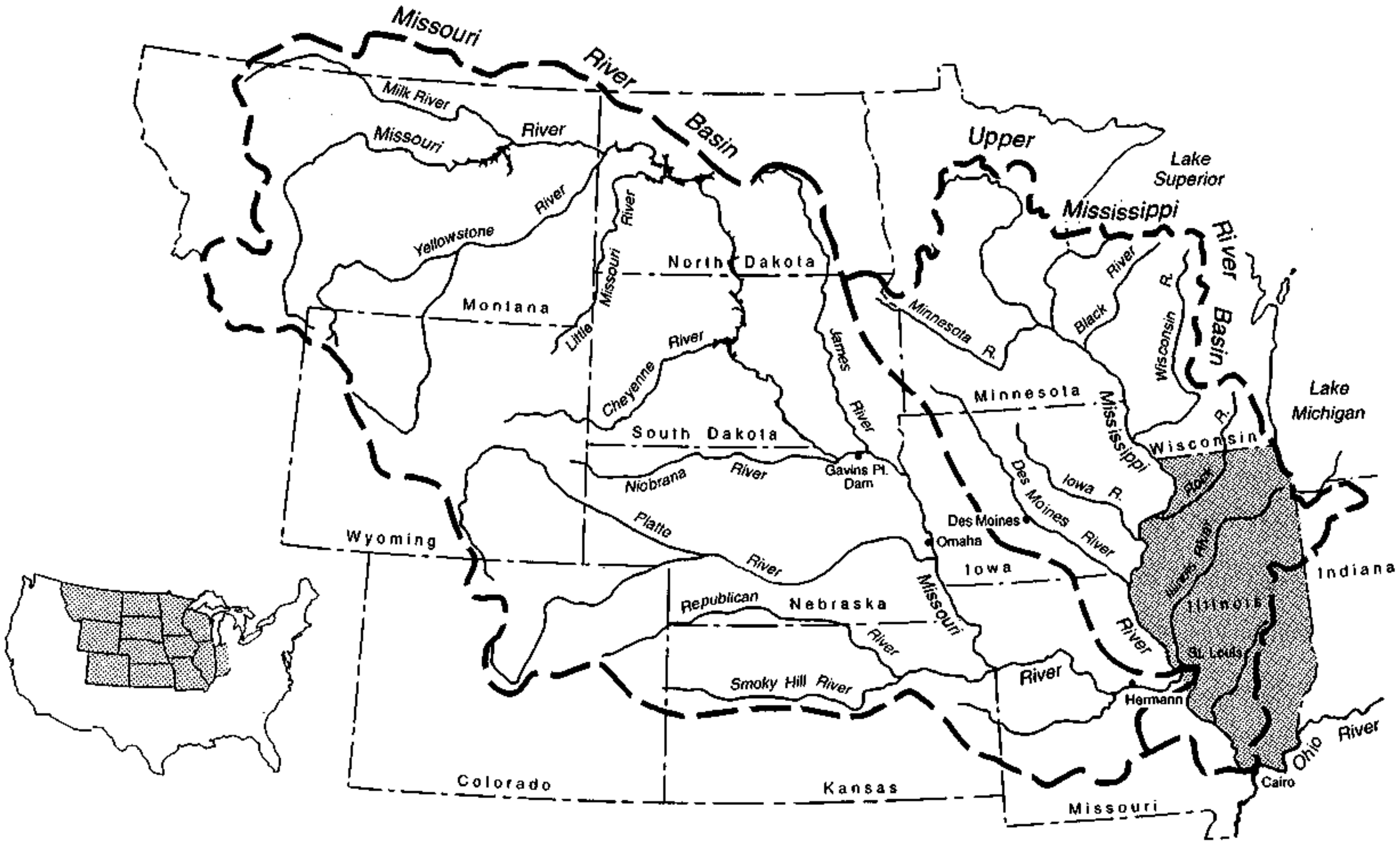

Figure 1. Area affected by the Great Mississippi Flood of 1993

Head, served as the Water Survey contact during the formulation and initiation of the project, and his enthusiastic guidance was instrumental in getting the project started.

A number of Water Survey staff participated in the data collection and analysis. Field data collection was conducted under the leadership of William C. Bogner and with the assistance of Nancy Johnson, Jim Slowikowski, and Tim Nathan. Kathy Brown also assisted on one of the field data collection trips. Chuck Theilling and his staff from the Illinois Natural History Survey assisted in field data collection in Swan Lake, Stump Lake, and Silver Lake. Their assistance and cooperation are greatly appreciated.

Most of the laboratory analyses were performed by the chemists in the Office of Analytical and Water Treatment Services at the Water Survey. Loretta M. Skowron, Office Director, and Daniel L. Webb assisted in the development of the protocol for field data collection, preservation, and delivery of water and sediment samples to the labs. Richard A. Cahill, Robert R. Frost, L. Ray Henderson, and John D. Steele, Illinois State Geological Survey (ISGS), performed the Cesium-137 and the inorganic chemistry analyses for sediment cores collected during this project and compared them to previous data. Their assistance and cooperation were invaluable.

Ken Nichols, Civil Engineering graduate research assistant, and David Preston, assisted in processing and plotting the data. Mark Vamer and George Krumins performed the Geographic Information Systems work related to processing location maps and bathymetry contour maps under the guidance of Kingsley Allan. Linda Hascall and Dave Cox prepared the figures for this report. Eva Kingston and Sarah Hibbeler edited the report, which was produced by Becky Howard.

The Great Flood of 1993

The Great Flood of 1993 was a major hydrologic event on a global scale and the worst natural disaster of the century in the United States. A rare combination of climatic and hydrologic conditions resulted in the worst flooding ever experienced in the Midwest. The major factors that contributed to this historic flood include:

- Record precipitation over a large area covering most of the Upper Mississippi and Missouri River basins from April to September 1993
- Ground already saturated from above normal precipitation in the fall and winter of 1992

Flood conditions were further aggravated by floodplains confined by levees and floodwalls along the Mississippi, Missouri, and Illinois Rivers. Factors that led to the flooding, the extent of damage caused by the flood, and the lessons learned from the flood have been documented in several reports by federal and state agencies (National Weather Service, 1994; Bhowmik, 1994; U.S. Army Corps of Engineers, 1994a, b, c, 1995; Scientific Assessment and Strategy Team, 1994; Interagency Floodplain Management Review Committee, 1994; U.S. General Accounting Office, 1995).

This report presents a brief discussion of the flood as background information to put the project objectives and the data collection period into perspective. Detailed information on the flood can be obtained from the references included at the end of this report.

Precipitation

The major cause of the Great Mississippi River Rood of 1993 was the unusual weather pattern that generated record precipitation through most of the Upper Mississippi River basin (UMRB) over a period of several months. Precipitation was above normal in the UMRB for each month from April to September of 1993. Figure 2 summarizes total precipitation for the six-month period over the whole region (Kunkel, 1994).

The severity of the precipitation in the region becomes obvious when the precipitation amounts over most of the area are compared to 535 millimeters (mm), normal precipitation for the whole river basin for the same six-month period. Most of the basin received above normal

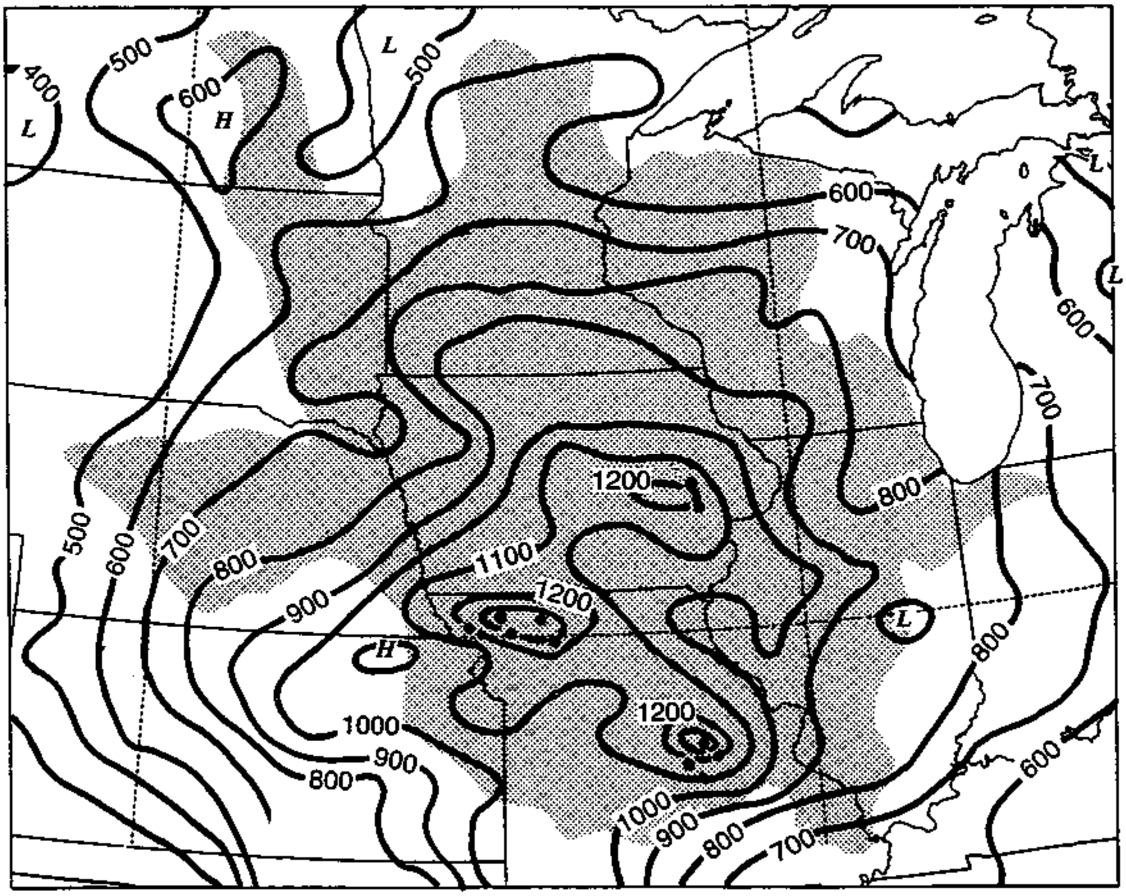

Figure 2. Spatial distribution of total precipitation in the Midwest for the period April 1 - September 30,1993 (Kunkel, 1994)

precipitation with some areas receiving more than twice the normal amount. The return period of the basin precipitation for the six-month period was estimated to be more than 200 years (Kunkel, 1994).

In addition to the excessive total precipitation over the basin for the worst six months, the pattern and variability of precipitation over a two-year period created conditions conducive to major flooding and disastrous consequences.

The monthly precipitation amounts and pattern over the two-year period that resulted in the Great Flood of 1993 in the UMRB are compared to the long-term averages and shown in figure 3. In general, it is obvious that precipitation was above normal from July 1992 to September 1993: 17.33 inches above normal for this 15-month period. The significance of the above normal precipitation in 1992 is in the resulting soil moisture conditions in the spring of 1993. Above normal precipitation in the second half of 1992 left most of the UMRB with high soil moisture conditions, increasing the probability of floods in the spring of 1993 even under normal precipitation conditions. Thus with precipitation in March and April slightly above normal (only by 0.41 inches), the Mississippi River was above flood stage in many places towards the end of April. With almost near normal precipitation for the most part of May, flood

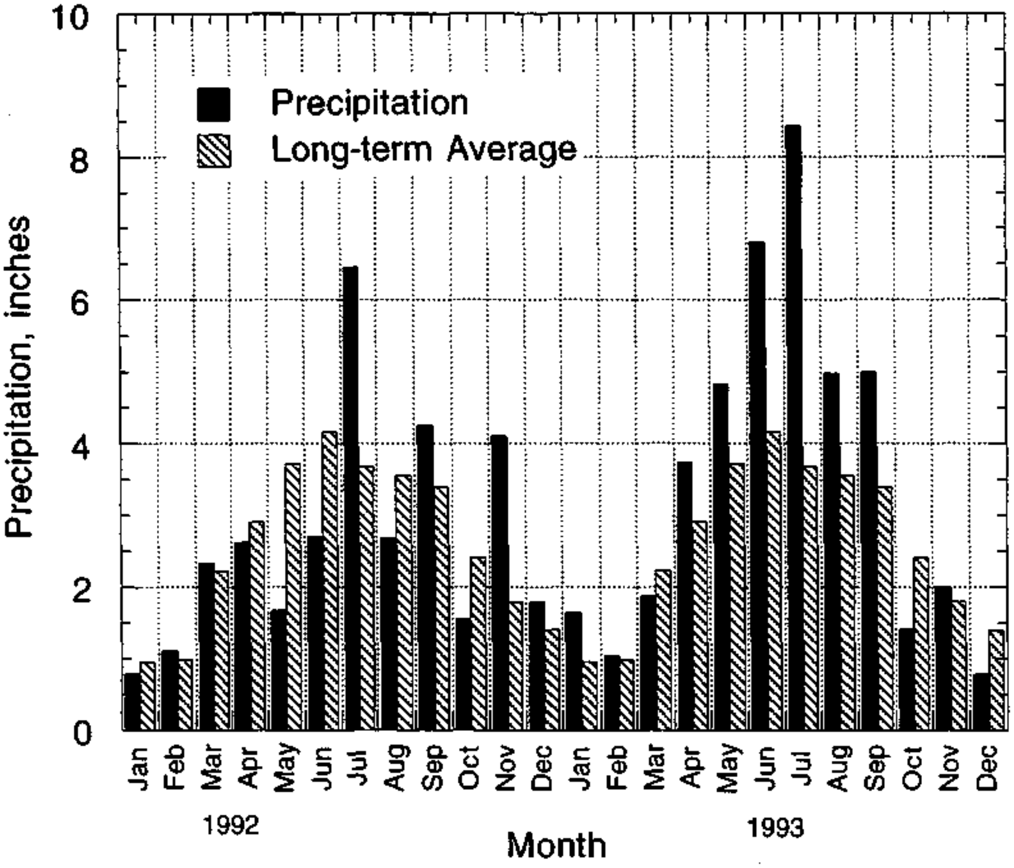

Figure 3. Monthly precipitation in 1992 and 1993 for the Upper Mississippi River basin

stages receded throughout the UMRB. Then starting in early June, precipitation was above normal till the end of September. For this four-month period, precipitation was more than 10 inches above normal. During the peak of the flood in July 1993, precipitation was 229 percent of normal.

Flood Heights and Discharges

To put the 1993 flood into historical perspective, a brief discussion of how the flood compares with other major floods in the Mississippi River is presented here. In hydrologic and hydraulic terminologies, different floods are compared on the basis of peak flood stages, peak discharges, and, occasionally, duration of flooding. The peak flood stage is the most popular and easily understood term because it refers to the highest flood elevation during the flood. Peak discharge is the most common scientific and engineering term used in ranking floods and refers to the highest flow rate during the flood. Flood duration refers to the period a river stage exceeded flood stage and is sometimes used in describing floods and in designing hydraulic structures but rarely in ranking floods.

It is important to discern the differences in these terms because sometimes the highest flood in terms of peak discharge may not be the highest flood in terms of peak stage. This was true for the 1993 flood at several locations along the Mississippi and Illinois Rivers.

Figure 4 compares historical peak discharges and stages for the Mississippi River at St. Louis, where the top ten historical floods in terms of stage are highlighted. The peak stages for the top ten floods and their corresponding peak discharges and rank are given in table 1. The 1993 flood ranks as the highest flood stage at St. Louis but as the second highest in terms of peak discharge. The peak flow estimated for the 1844 flood is higher than that measured during the 1993 flood. The 1973 flood is the second highest in terms of stage but only the seventh highest in terms of discharge. Similar kinds of observations can be made for the different floods listed in table 1. Several factors such as levees and navigation structures could have altered the stage-discharge relations at St. Louis over time (Knapp, 1994).

Table 1. Top Ten Peak Stages of the Mississippi River at St. Louis and Their Corresponding Peak Discharges and Rank

Peak stage (feet)	*Year*	*Rank in stage*	*Peak discharge (cfs)*	*Rank in discharge*
49.47	1993	1	1,030,000	2
43.23	1973	2	852,000	7
41.32	1844	3	1,300,000	1
40.28	1951	4	782,000	14
40.26	1947	5	783,000	13
39.27	1983	6	739,000	18
39.14	1944	7	844,000	9
39.13	1987	8	728,000	20
38.94	1943	8	840,000	10
38.0	1903	9	1,019,000	3

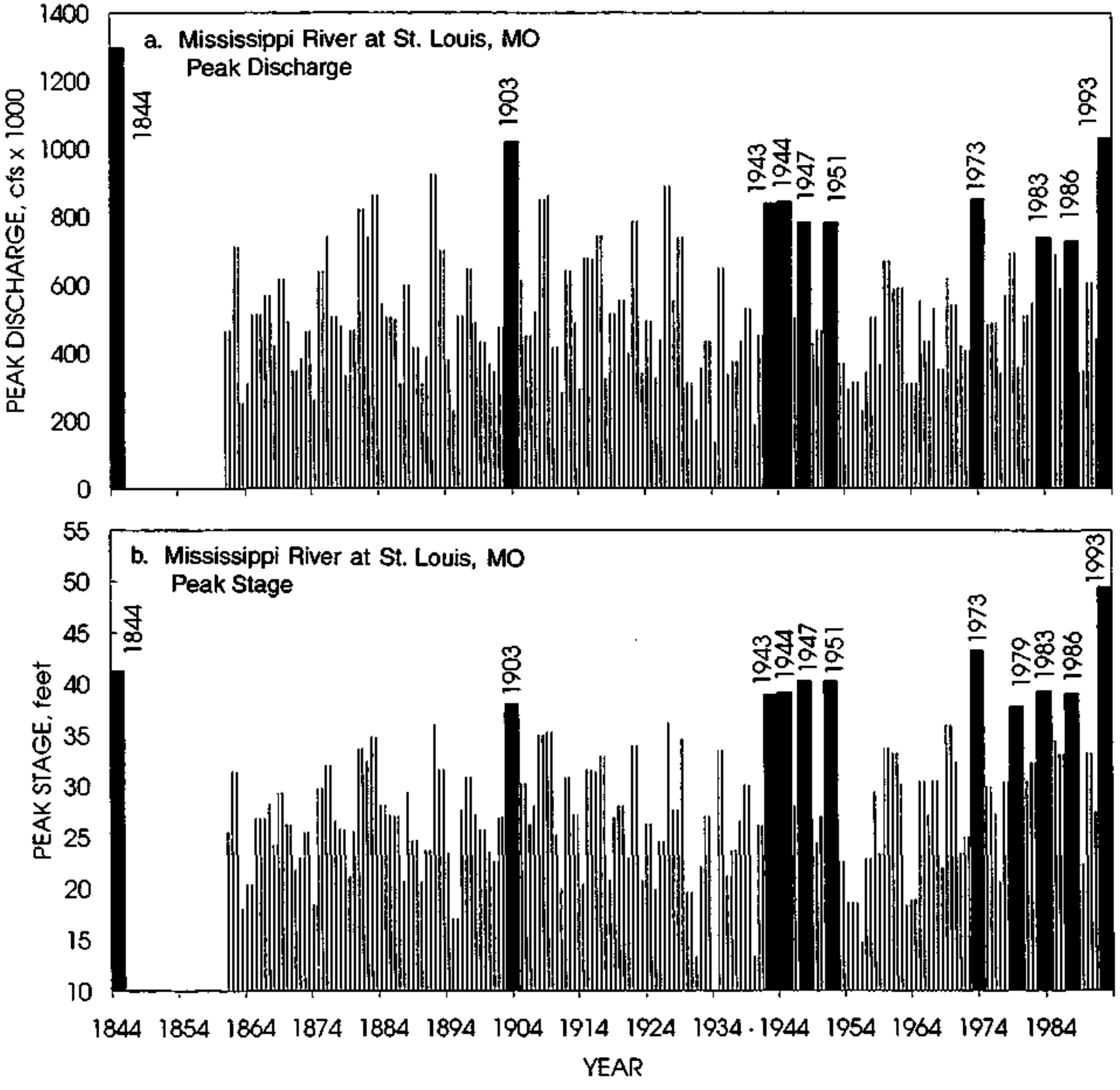

Figure 4. Historical peak discharges and stages for the Mississippi River at St. Louis

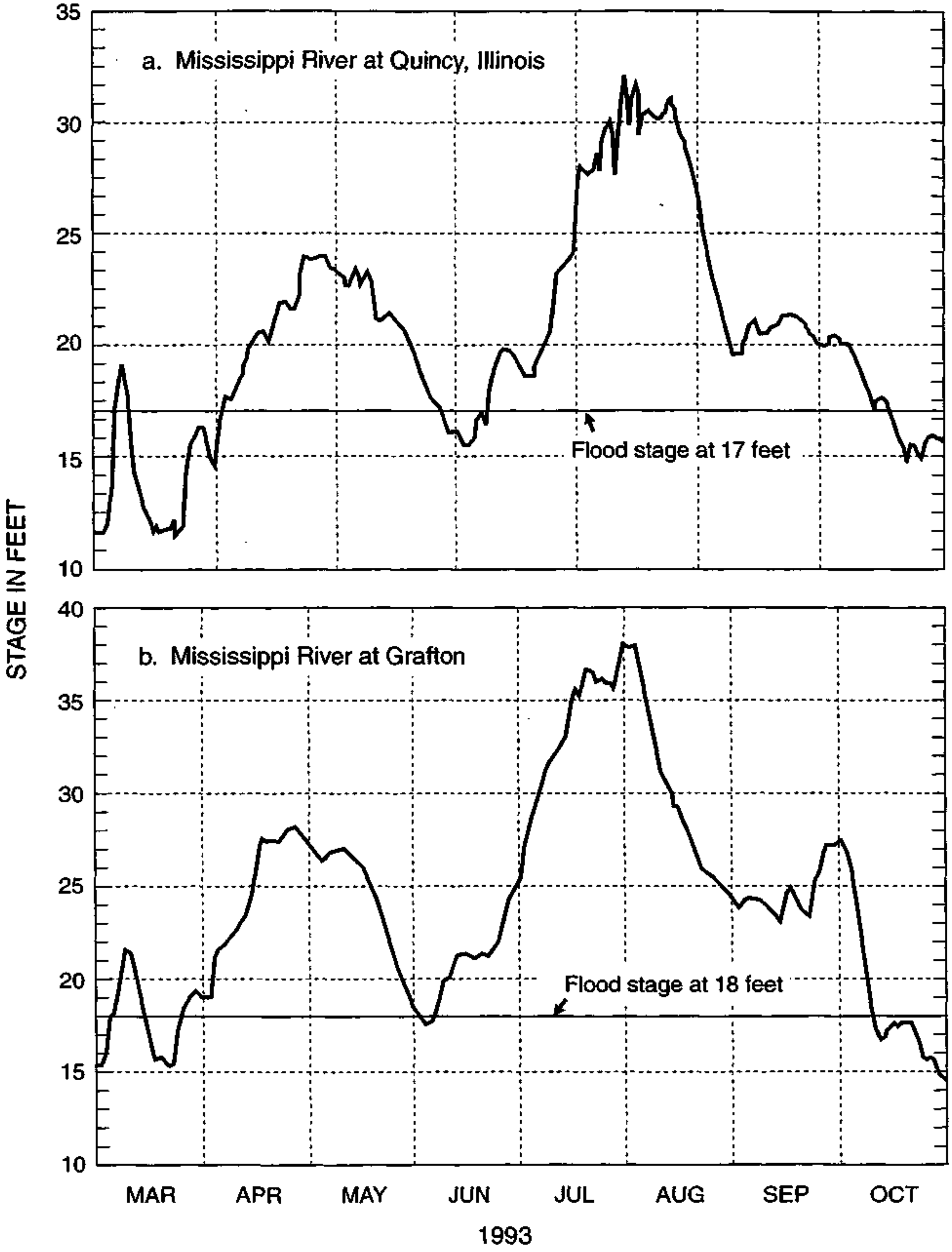

Figure 5. Mississippi River stages near Quincy and Grafton during the 1993 flood

For the purpose of relating flooding conditions along the Mississippi River to the study sites, the stages of the Mississippi River near Quincy and Grafton are shown in figure 5. Flooding for the Quincy area started in early March 1993 and lasted until mid-September 1993 with brief periods below flood stage in March, late May, and early June. Maximum flood stages more than 15 feet above flood stage were reached in July when a number of agricultural levees broke, dramatizing the force of the flood. Flooding had a direct impact on the Quincy area for a period of seven months. The Quincy Bay study site was flooded during this period and also felt the impact of levee breaks upstream of the bay.

Flooding severity varied along the Mississippi River. Flood records were broken for most parts of the Mississippi River from the Quad Cities to Chester, Illinois. Flooding along the main Mississippi River was not as serious downstream of Chester and upstream of the Quad Cities. Figure 6 compares the 1993 peak flood stages and previous record flood stages for the Mississippi River from Minneapolis to New Orleans. The Lower Mississippi River did not even exceed flood stage. The worst flooding occurred in the middle Mississippi River along the border between Dlinois, Iowa, and Missouri.

Study sites near Grafton, Illinois, experienced flooding conditions similar to those in the Quincy Bay area from March until early October. Flood stages peaked in late July and early August, and the peak flood stage was more than 20 feet above flood stage. Except for a few daysof conditions below flood stage, the Grafton area was continuously flooded for seven months. Such persistent and extreme flooding over a long period is what made the 1993 Mississippi River flood unique.

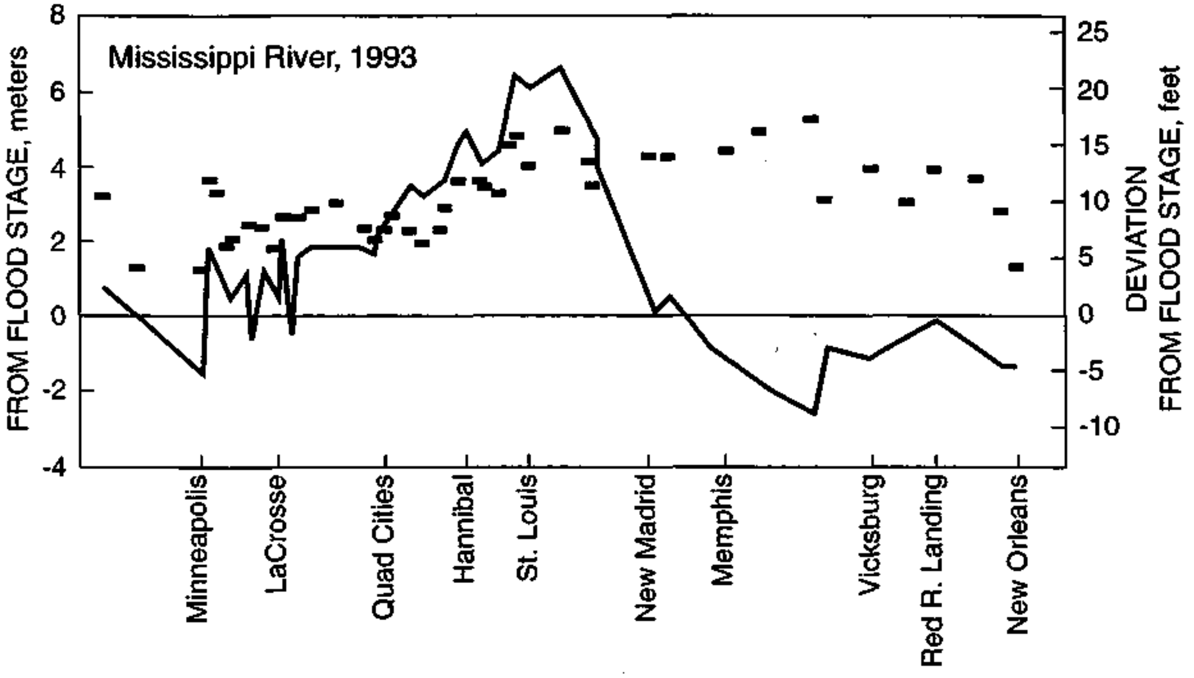

Figure 6. Comparison of 1993 flood peak stages with previous records along the Mississippi River

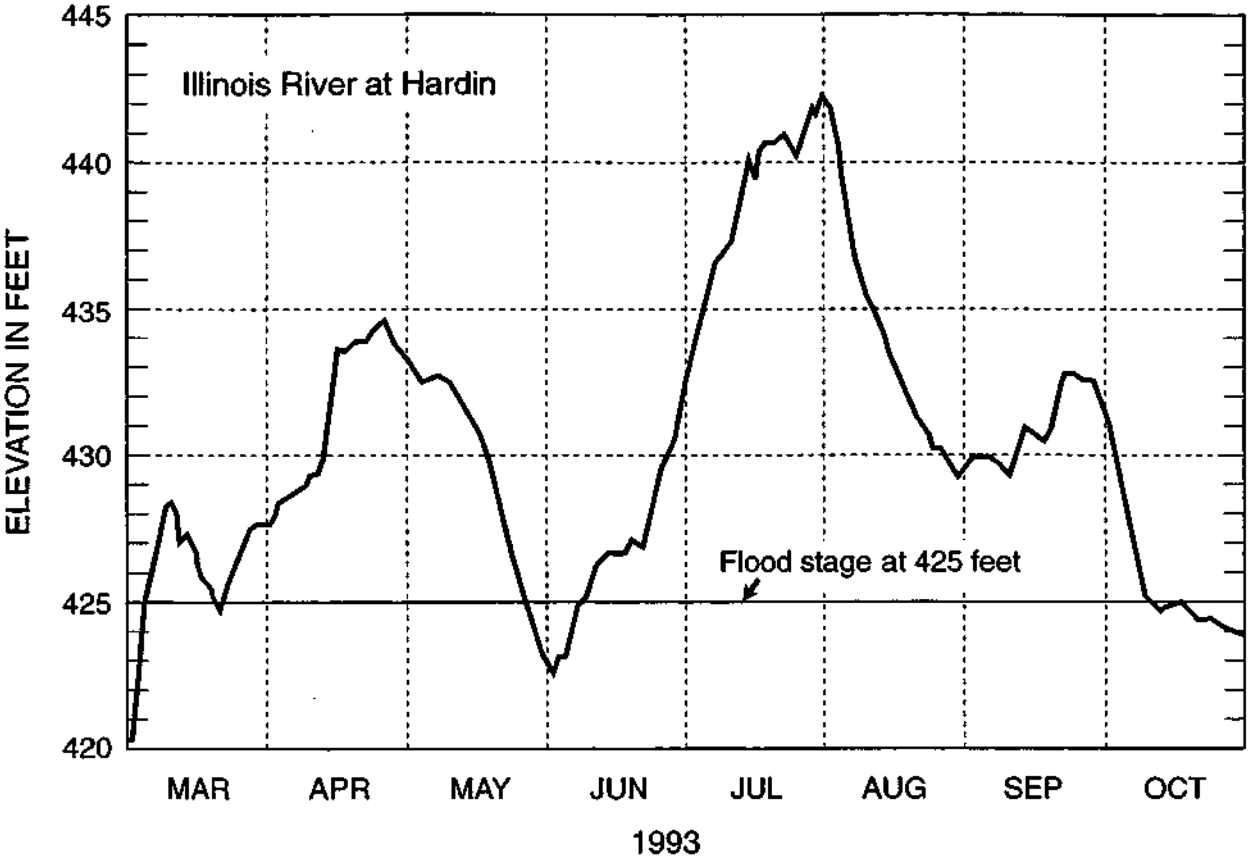

Figure 7. Illinois River stages at Hardin, IL, during the 1993 flood

Study sites on the Illinois River were also similarly affected by the Great Flood of 1993 in terms of stages and duration of flooding. Flood stages on the Lower Illinois River are greatly influenced and controlled by flood stages on the Mississippi River. Figure 7 shows the flood stages of the Illinois River at Hardin, Illinois (21 miles upstream from the junction of the Illinois River with the Mississippi River) during the 1993 flood. Like the Mississippi River, the Illinois River was above flood stage for more than seven months (early March until mid-October). The peak stage, more than 17 feet above flood stage, occurred at the end of July.

Even though the Lower Illinois River flood stages and the duration of the flood are similar to those of the Mississippi River, the main difference between the two is the flow velocities experienced in the main channel on the floodplain. Because of backwater effects the flow velocities in the Illinois River are much less than those in the Mississippi River.

Backwater Lakes along the Illinois and Mississippi Rivers

Backwater lakes are important ecological, recreational, and economic resources of the state of Illinois and the nation. Most backwater lakes along the Mississippi and Lower Illinois

River were flooded by the Great Flood of 1993 for a period of seven months. How such an extreme event might have affected the physical, chemical, and biological characteristics of the backwater lakes is an important resource management issue that required investigation.

Backwater lakes are more numerous along the Illinois River than along the segment of the Mississippi River bordering Illinois. The major reason is the differences in the geomorphology of the rivers and the impact of the lock and dam systems. Backwater areas along the Mississippi River along the Illinois border were formed by the inundation of sloughs and depressions in the floodplain from higher low water levels created by the lock and dam system. The formation and nature of backwater lakes along the Illinois River is, however, much more complex and predates the lock and dam system. The Illinois River occupies only a small part of an ancient river valley that was formed by glacial action when the Illinois River valley was the drainage outlet for much of the UMRB. The ancient river that once occupied the valley carried much more flow than the present Illinois River. During the last stages of the Wisconsinan glacial period, drainage into the Illinois River valley was significantly reduced when drainage from the Upper Mississippi and Rock Rivers was diverted into the present-day Mississippi River valley. This left the Illinois River valley occupied by a smaller river with significantly reduced discharge. The smaller Illinois River could not transport the sediment delivered by tributary streams, resulting in the formation of alluvial fans and deltas near the mouths of the tributary streams. These fans and deltas created narrow constrictions that held back water in the deeper channels and depressions in the floodplain, forming some of the bigger bottomland lakes in the valley. Natural levees were also created along the riverbanks by continuous sediment deposition from overbank flows during floods isolating old channels, sloughs, depressions, and lakes from the main river. These natural processes over time created a number of backwater lakes along the Illinois River valley. Under normal flow conditions, most of these lakes are connected to the main river by narrow outlet channels (Demissie and Bhowmik, 1986; Division of Waterways, 1969).

The conditions of bottomland lakes along the Illinois River valley were significantly altered when the state of Illinois increased the diversion of water from Lake Michigan to the Illinois River through the Sanitary and Ship Canal starting in 1900. The increased diversion raised the low water level in the Lower Illinois River valley, resulting in larger bottomland lakes than before. Sloughs, marshes, ponds, wetlands, and small lakes were inundated by the higher low water to create bigger lakes. Completion of the 9-foot navigation waterway with a system of locks and dams along the Illinois River in the 1930s further increased the low water level, resulting in increased bottomland lake surface areas in the valley. At the same time, however, large portions of bottomland lakes, sloughs, ponds, and wetlands were leveed-off and drained for agricultural purposes (Bellrose et al., 1983). In 1975, there were an estimated 53 backwater lakes with surface area greater than 50 acres in the Illinois River valley. The total surface area of the backwater lakes was estimated to be 39,000 acres, occupying only 5.2 percent of the floodplain area (Lee and Stall, 1976).

Sedimentation has long been identified as the number one problem for bottomland lakes in the Illinois River (Lee and Stall, 1976, 1977; Bellrose et al., 1983; Illinois Division of Water

Resources, 1987; Demissie et al., 1992). It was estimated that on average the backwater lakes in the Illinois River valley had lost 72 percent of their water storage capacity due to sedimentation by 1990 (Demissie et al., 1992). Some lakes have completely filled with sediment. In addition to the loss of capacity, there is concern about the quality of sediment in the lakes and the potential impact on water quality. As the lakes become shallower, waves generated by wind and river traffic continuously resuspend the bottom sediment. If contaminants are stored in the sediment, they are also resuspended and become available to aquatic biota in the water column.

The main goal of this project was to assess the status of selected backwater lakes and to evaluate the impact of the Great Flood of 1993 in terms of sediment accumulation and quality of sediment.

Sedimentation Data Collection and Analysis

Data Collection Sites

After evaluating existing information on backwater lakes along the Illinois and Mississippi Rivers and the extent of the flood, four backwater lakes were selected as study sites for the project. Figure 8 shows the location of the lakes selected for this study. Swan Lake, Stump Lake, and Meredosia Lake are located on the Lower Illinois River and Quincy Bay is located on the Mississippi River. For comparison purposes, water and sediment samples were also collected from Silver Lake, a small backwater lake at the junction of the Mississippi and Illinois Rivers, but the lake was not studied in detail.

Swan Lake is located just upstream of the junction of the Illinois and Mississippi Rivers between river miles 5 and 9 and lies between the two rivers. It is part of the Mark Twain National Wildlife Refuge managed by the U.S. Fish and Wildlife Service. The lake was affected by the flooding in the Lower Illinois River and may have been directly connected to the Mississippi River during the height of the flood.

Stump Lake is also located just upstream of the junction of the Illinois and the Mississippi Rivers on the east side of the Illinois River (opposite Swan Lake). Two lakes in such close proximity were selected to evaluate the impact of potential direct overflow from the Mississippi River into the Swan Lake area.

Lake Meredosia is located further upstream on the Illinois River between river miles 72 and 78 in the upper end of the Alton Pool, which is controlled by Lock and Dam 26 on the Mississippi River. Floodwater elevations in the Alton Pool segment of the Illinois River are controlled by the flood elevations in the Mississippi River and the flow in the Illinois River. Lake Meredosia is thus representative of backwater lakes in the upper reaches that felt the impact of the Mississippi River flood along the Illinois River.

Quincy Bay is a backwater complex on the Mississippi River adjacent to the city of Quincy between river miles 327 and 330 on the east side of the Mississippi River. Sedimentation in the bay has been a major concern for Quincy area residents over the years. The Water Survey conducted a sedimentation survey of the lake in 1985 to develop potential remedial measures. During the 1993 flood, the Quincy Bay area was completely flooded, and there was also a significant impact due to the failure of agricultural levees upstream of the bay. Quincy Bay provided the best location on the Mississippi River along Illinois' borders to investigate the direct impact of the flood on backwater lakes.

Sedimentation Survey Procedures

Sedimentation survey procedures for the lakes varied according to local site conditions and the repeatability of historical data sets. In general, all depth or vertical control measurements

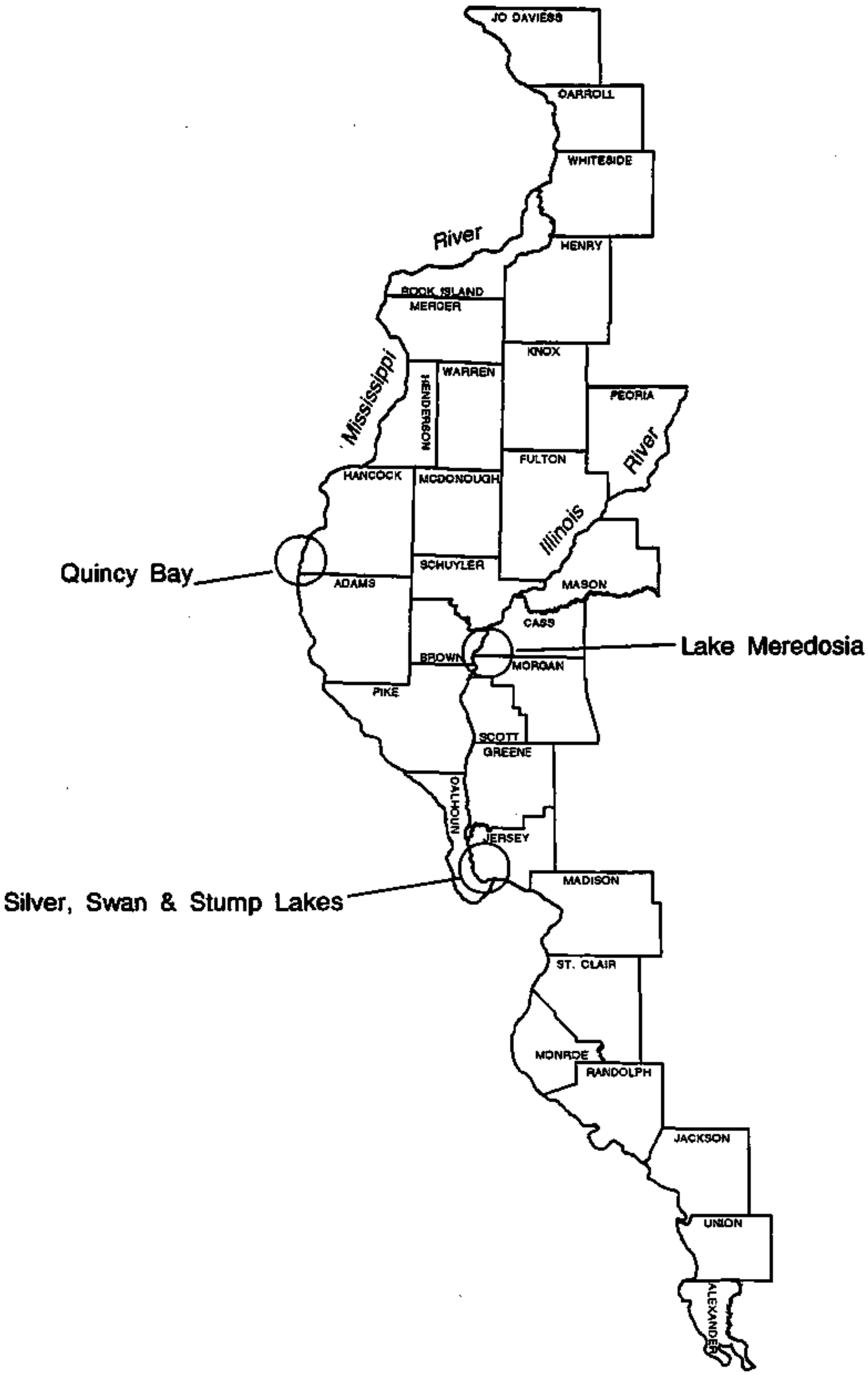

Figure 8. Location of backwater lakes selected for study along the Illinois and Mississippi Rivers

were made using a sounding pole. An electronic depth sounder was used in the Access Channel at Quincy Bay where high flow velocities and greater depths precluded the use of a sounding pole.

Methods used to maintain horizontal control for the surveys were more variable. The three basic techniques used for horizontal positioning were the standard lake sedimentation survey range cable method, two-dimensional electronic positioning using a microwave transponder system, and a range-azimuth location system integrating a single microwave transponder and a standard survey theodolite. The use of each method will be discussed in detail in the following discussion of each survey.

Quincy Bay

The 1994 depth survey of Quincy Bay was made to repeat as precisely as possible a previous survey conducted in 1985 (Adams et al., 1987) using standard lake sedimentation survey methodology, which includes the establishment of monumented sedimentation ranges (transects) that can be repetitively surveyed over a period of years to document the accumulation rate of sediments. Survey range lines are generally monumented by concrete posts, and the sedimentation rate is precisely determined based on the increase in bed elevation between successive surveys. In 1985, the survey included the measurement of sediment accumulation thickness by manually driving a sounding pole into the lake bottom to a point of refusal closely corresponding to the original water depth in an impounded reservoir. The significance of this measurement is not as well defined in the river backwater system but may be interpreted as a pre-development bed elevation.

The 1994 survey of Quincy Bay included the recovery of the range end monuments set in 1985 and a repetitive survey of the range lines (figure 9). Due to the poor intrasite visibility, no electronic positioning methods were used at Quincy Bay. Water depth was measured and adjusted to a normal pool elevation of 470 feet above national geodetic datum (the pool control elevation for Lock and Dam 21). Sediment penetration measurements were not made for the 1994 survey.

Lake Meredosia

Lake Meredosia was last surveyed in 1975 by Bems, Clancy, and Associates of Urbana under contract with the Water Survey. The 1975 survey (figure 10) included recovery and resurvey of a 1954 Illinois Division of Waterways horizontal control traverse around the lake. This traverse was the basis for establishing Illinois State plane coordinates for mapping the lake.

The 1994 survey of Lake Meredosia was made using a Racal Survey Microfix transponder system with two remote transponders. Operation of the system requires that a main processing unit in the survey boat communicate by microwave carrier pulses with a minimum of two remote units at known horizontal control points. The main processing unit interprets the

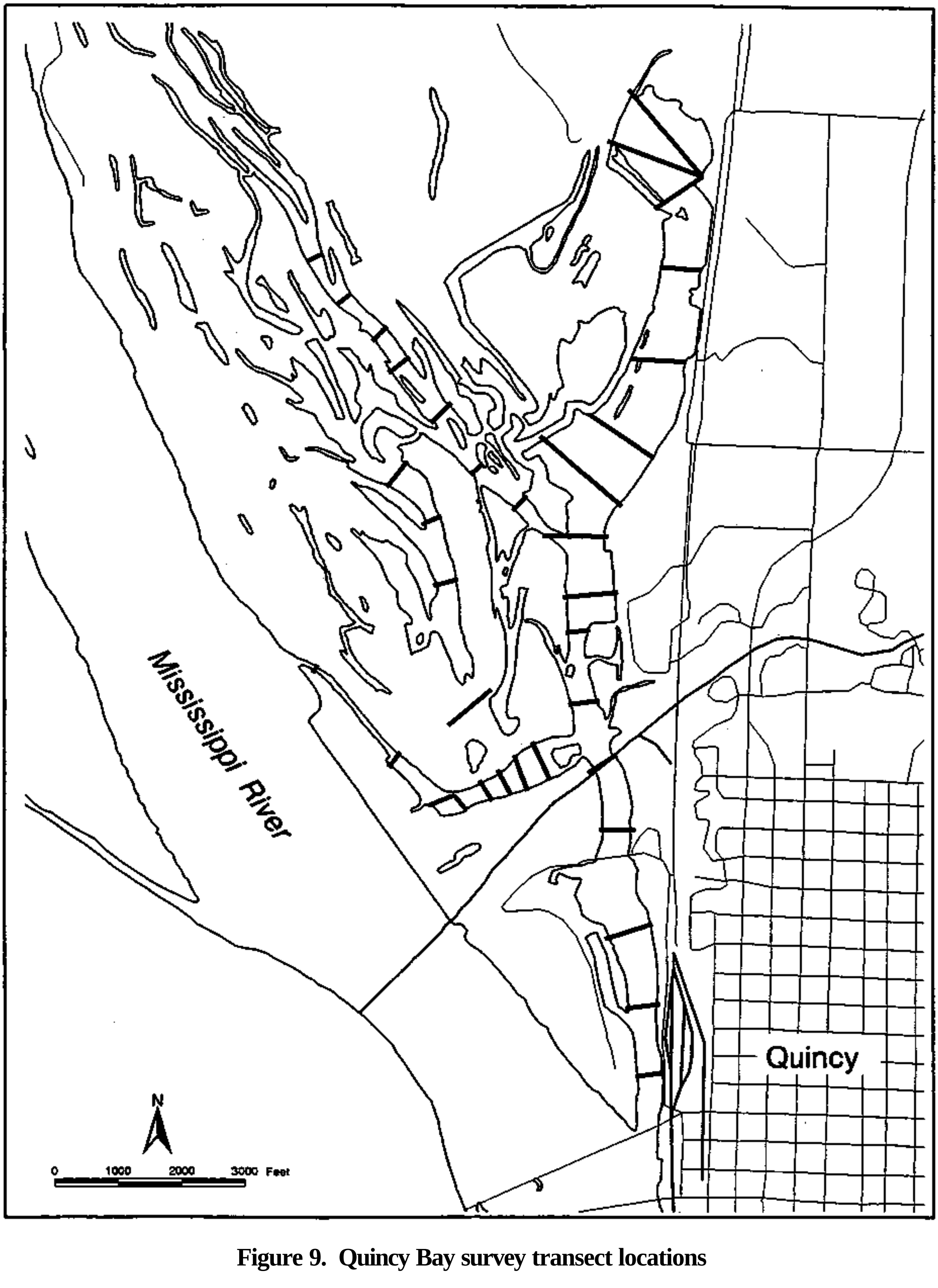

Figure 9. Quincy Bay survey transect locations

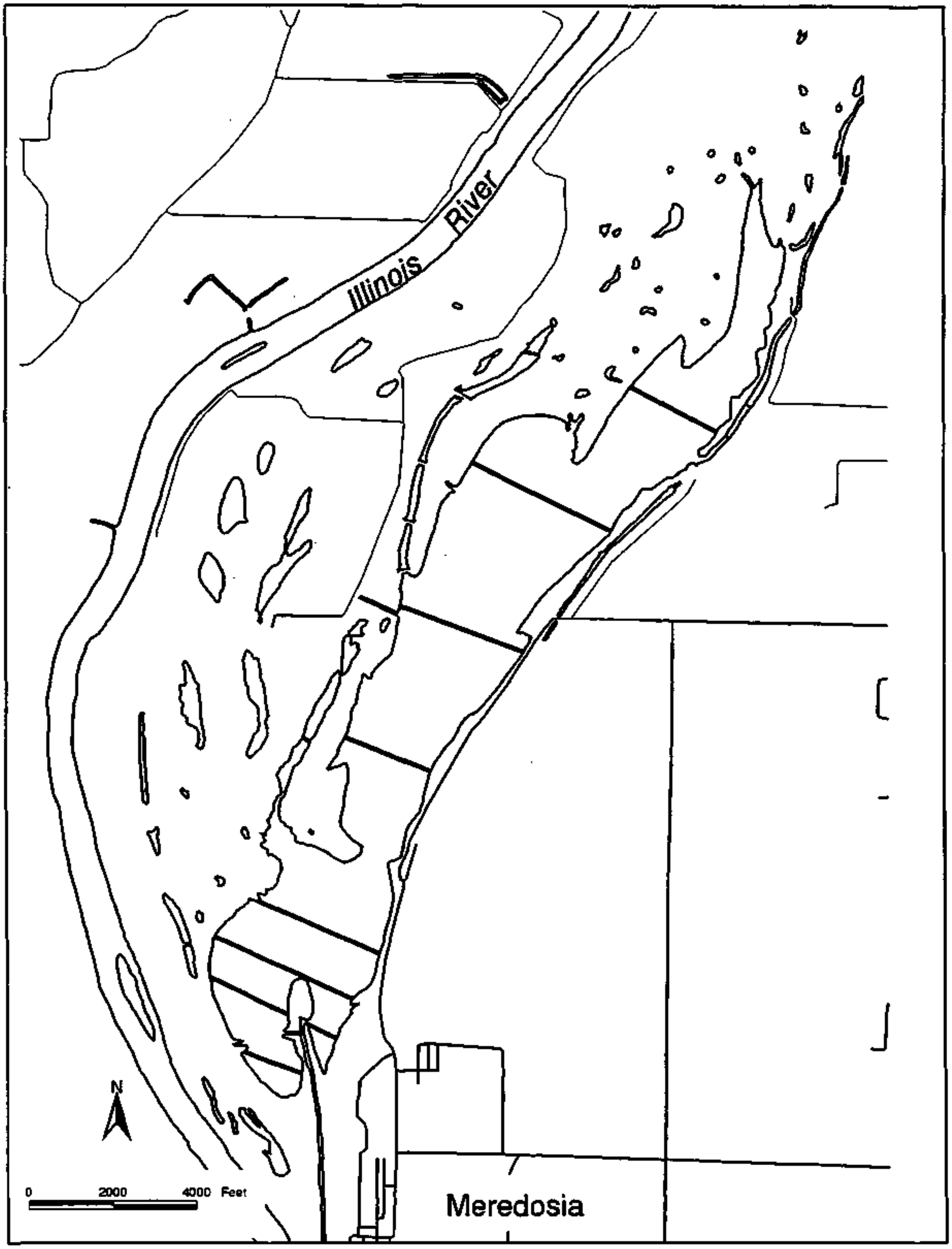

Figure 10. Lake Meredosia survey transect locations

carrier pulses to determine simultaneous distances to the two remote units and geometrically converts these distances and the horizontal control positions of the remote units to coordinate positions for the survey boat.

Horizontal control monumentation established in 1975 by Berns, Clancy, and Associates was recovered in 1994 and used as the basis for locating control points for the remote microwave transponder sites. Survey lines from the 1975 survey were resurveyed for 1994 water depth by keying the end-point coordinates of the lines into the navigation program of the positioning system and following a guidance screen to maintain an on-line position.

In addition to the repetition survey of the 1975 survey lines, supplemental lines were surveyed using the existing horizontal control to develop a denser coverage of the lake. All horizontal position information including distances to the remote transponders and the field-calculated horizontal position for the survey boat were downloaded directly to a laptop computer at each depth measurement point.

Depth measurements were made with a marked one-inch diameter sounding pole. Water depths were noted by hand along with a fixed identification number from the positioning system. Lake-level information was collected daily to adjust water depths to a common pool level of 424 feet above datum.

Swan Lake

The survey of Swan Lake took advantage of a system of horizontal control monumentation that was established along the shores of the southern portion of the lake in 1988 by Metropolitan Engineering Company (MECO) of Collinsville, Illinois. MECO had monumented eight control points with established horizontal control for use in developing depth contours for the lake. The horizontal control system from this survey was used to extend temporary control marks to all portions of Swan Lake as well as the Fuller Lake State Fish and Waterfowl Management Area. Upon further review, it was determined that the vertical precision of the 1988 MECO survey was not consistent with the precision of the present study.

The horizontal control system established by MECO in 1988 was recovered and used to establish additional temporary control points along the northern periphery of the lake and into the Fuller Lake area. The original and temporary control points were used as sites for the remote transponders of the Racal positioning system. Two boats were used in the survey, each with an independent positioning system. Between two and four remote transponders were in operation for each survey transect. Transects (figure 11) were run on 200-meter grid spacing, providing full coverage of the accessible portions of the lake. Transects were oriented in a north-south direction in the southern section of the lake and were reoriented to east-west lines in the northern portion of Swan Lake and in Fuller Lake. All positioning data including all measured distances to remote transponders and field-calculated position coordinates were downloaded directly to a laptop computer at each depth measurement point.

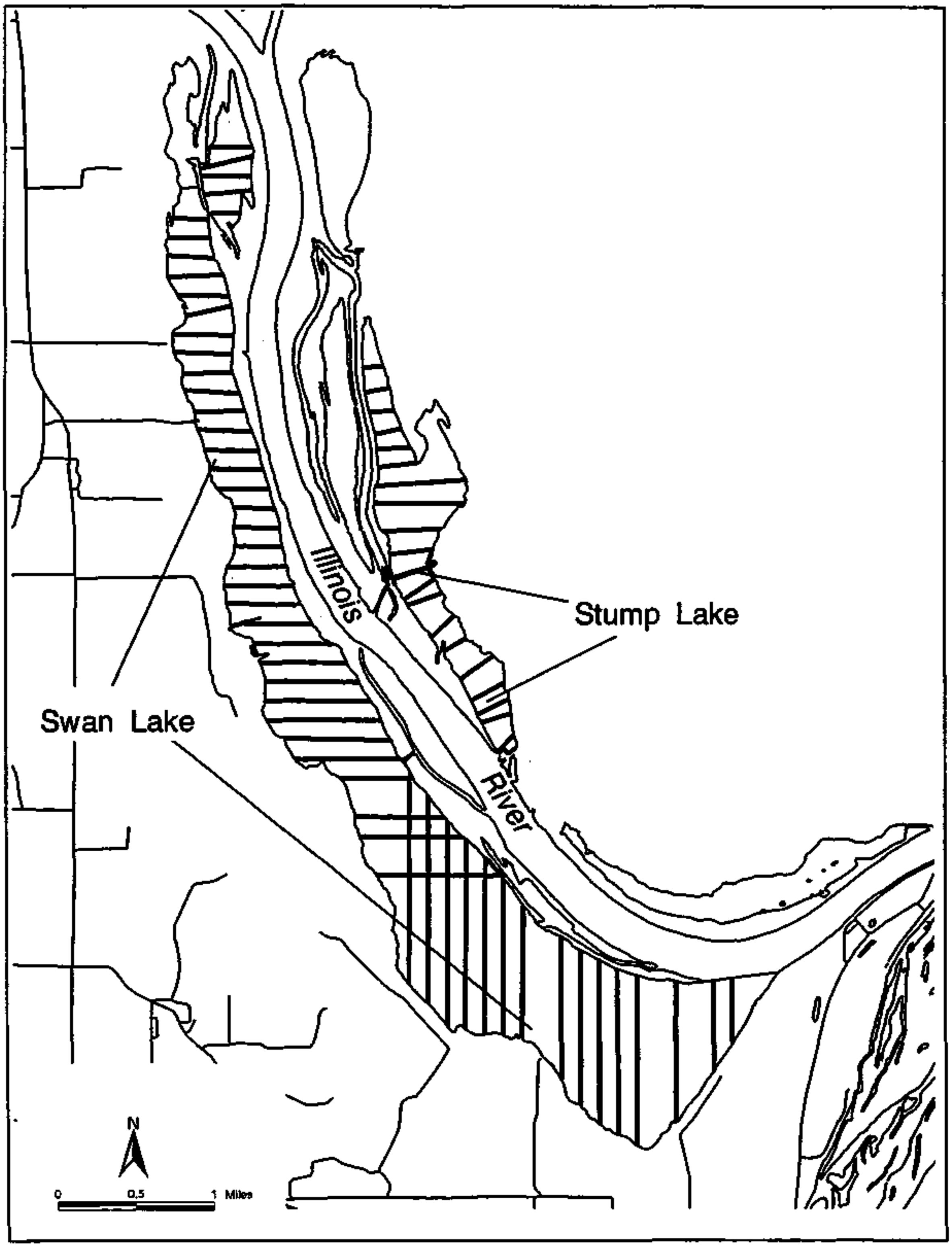

Figure 11. Swan Lake and Stump Lake survey transect locations

Depth measurements were made using sounding poles marked at 0.1-foot intervals. Depth measurements were noted by hand along with a fixed identification number from the positioning system. Lake-level information was collected daily to adjust all depth data to a common pool level of 419 feet.

Stump Lake

No previous survey information was available for Stump Lake. In order to establish horizontal control in the area of the lake, a differential global positioning system (DGPS) was used to transfer horizontal control from the MECO system at Swan Lake to two points on Stump Lake. These two points were a primary survey base station located on the causeway separating the two pools of Stump Lake and an azimuth reference mark located in the northeastern corner of the Pere Marquette Marina parking lot.

The long, narrow configuration of Stump Lake and the extensive area of flooded ground around the periphery of the lake limited accessibility for establishing transponder sites. The alternative survey method used for these conditions was a range-azimuth type survey. The primary survey station on the lake causeway was occupied with the main processing unit for the Microfix positioning system and a surveyor's theodolite. During the survey simultaneous measurements were made for a grid azimuth and the distance to a remote transponder in the survey boat and the water depth.

Nineteen cross-sectional transects were surveyed in Stump Lake (figure 11): ten in the northern basin and nine in the southern basin. Depth measurements were made with sounding poles marked in 0.1-foot increments. Lake level on the date of survey was 420.6 feet above datum. Depth measurements were used to calculate lakebed elevations based on this water surface elevation.

Sedimentation Data Analysis

Quincy Bay

The cross-sectional plots for all cross sections surveyed in Quincy Bay and the data are provided in appendix A. These plots are loosely grouped into similar areas as follows:

- The access channel (AC)
- Willow Slough (WS)
- Lower main bay (LMB): Cross sections 1-4 in the main bay
- Middle main bay (MMB): Cross sections 6-8 in the main bay
- Upper main bay (UMB): Cross sections 9-16 in the main bay
- Upper Broad Lake (UBL).

Examples of the cross-sectional plots for Quincy Bay are shown in figure 12. All of the plots indicate limited sedimentation activity over the 10-year period from 1985 to 1994. The precision of the depth measurements for both the 1985 and 1994 surveys was 0.1 foot, revealing that a threshold indicating measurable sedimentation would be a change in depth of more than 0.2 foot. Table 2 lists the 1985 and 1994 average depths for each transect, the total average loss of depth for each transect, and the average annual loss of depth.

The access channel (AC) sections were the most active bed erosion areas of the system in 1985 with water depths of more than 20 feet in a channel that was constructed with a design depth of 6 feet. This section was still extremely active in 1994. Flow velocities and sediment inflow through the AC continue to be the most significant source of change in the bay system. The lower Broad Lake area that was dredged to a depth of approximately 20 feet in 1959 to obtain construction fill for the Burlington Northern Railroad causeway has been completely filled by materials scoured from the AC area. The area has been reformed by natural processes as an extension of the AC and is now separated from the remains of Broad Lake by lateral bar deposits. As a result of the continued changes due to the AC, the area that was originally termed lower Broad Lake in the 1985 study is now completely integrated into the AC.

Transect plots for the AC and the average depth analysis (table 2) indicate that the area continues to be very dynamic in terms of sedimentation and scour. As stated above, the lateral sand bar has completely cut off upper Broad Lake, but the transect plots for this area show a consistent area of scour within the flow areas: It should be expected that this area will continue to change based on short-term changes in flow conditions. Long periods of low to medium annual flood events on the Mississippi River may result in large reductions in depth particularly in the original AC that may subsequently be completely scoured out in a single major flood event.

The 1993 Mississippi River flood had the greatest impact on the Willow Slough and Triangle Lake areas. Impacts in these areas were the result of flows through the breached levee system in the Indian Graves Drainage and Levee District. The Triangle Lake area has always been severely affected by discharges from the Indian Graves Drainage and Levee District. The pump station for the district has discharged directly into Triangle Lake and with Frazier Creek has been the source of the sediment deposited in the lake. In 1994 the western lobe of Triangle Lake was completely filled with exposed sediment, and a shallow channel had formed to pass the drainage district outflows. The formation of this channel in Triangle Lake and the large sand deposits in the Willow Slough area are probably attributable to the floodwater outwash from Indian Graves.

The transects (appendix A) and the average depth analyses (table 2) for the Willow Slough area indicate general scour conditions through its full length with the exception of the section that was dredged for levee repair borrow material in transect 5. Scour through the Slough is the result of discharges through the breached levee district. During the 1994 survey, numerous areas of sand deposition were observed in the upper end of Willow Slough and in the area between the Slough and the Levee District. These areas of deposition are also a result of the levee failure, which cannot be adequately documented within the scope of this project.

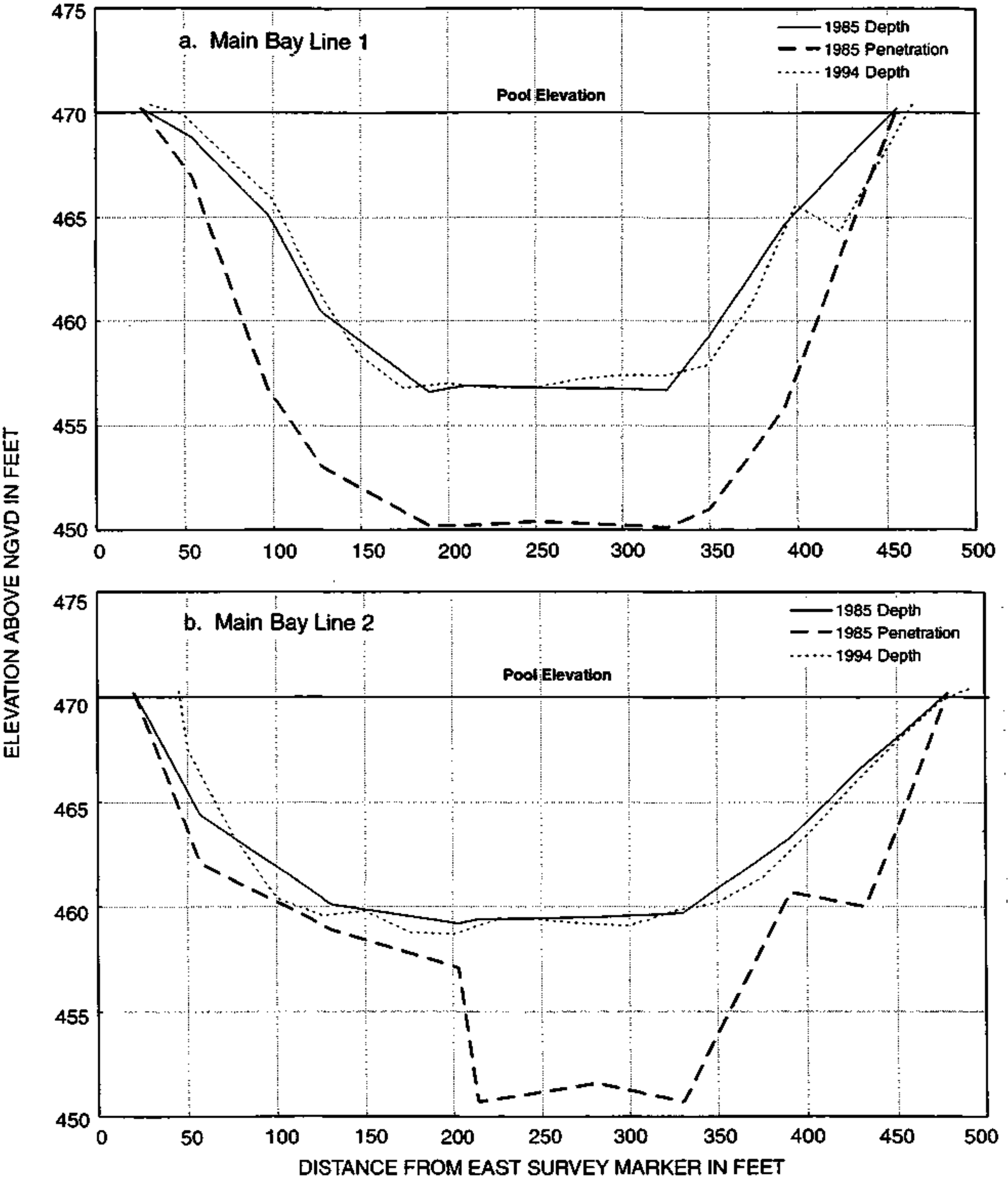

Figure 12. Quincy Bay cross-sectional transect plots

Table 2. Quincy Bay Depth Analysis by Transect

Transect	*1985 depth (feet)*	*1994 depth (feet)*	*Loss 1985 to 1994 (feet)*	*Average annual loss 1985 to 1994 (feet per year)*
LMB1	8.56	8.59	>0.2	
LMB2	7.75	8.18	-0.43	-0.05
LMB3	4.33	4.20	>0.2	
LMB4	6.46	7.36	-0.90	-0.10
MMB6	1.35	2.88	-1.53	-0.17
MMB7	3.05	2.95	>0.2	
MMB8	2.02	1.63	0.40	0.04
UMB-9	1.39	1.45	>0.2	
UMB10	1.53	1.46	>0.2	
UMB11	2.73	2.44	0.29	0.03
UMB12	3.37	2.77	0.60	0.07
UMB13	2.37	2.05	0.32	0.04
UMB14	1.82	1.60	0.22	0.02
UMB15	2.69	2.63	>0.2	
UMB16	2.37	2.42	>0.2	
AC1	2.84	5.38	-2.54	-0.28
AC2	2.96	5.02	-2.06	-0.23
AC3	3.66	6.97	-3.31	-0.37
AC4	6.07	8.56	-2.49	-0.28
AC5	7.52	8.34	-0.82	-0.09
AC6	6.23	7.59	-1.35	-0.15
AC7	15.80	18.30	-2.50	-0.28
AC8	16.44	23.16	-6.72	-0.75
WS-1	1.29	1.63	-0.34	-0.04
WS-2	1.29	1.36	>0.2	
WS-3	1.40	1.90	-0.51	-0.06
WS-4	2.00	2.36	-0.36	-0.04
WS-5	13.46	11.56	1.90	0.21
WS-6	3.91	4.18	-0.27	-0.03
WS-7	1.92	2.22	-0.30	-0.03
	0.09		>0.2	
TL-2	0.47	0.55	>0.2	
BL3	0.95	1.29	-0.34	-0.04
BL4	1.51	1.86	-0.35	-0.04
BL5	1.11	1.21	<0.2	

Transects in the area of the lower main bay (LMB) lie along Quincy's waterfront park and are generally exposed to significant flow velocities as a result of flow through from the AC. Transects plots (figure 12) and average depth analysis (table 2) indicate little or no new sedimentation and some scour activity. The patterns of deposition and sedimentation in LMB are reasonable for an area of the bay subject to persistent flow and that carries high flows during flooding events. This area will probably continue to be subjected to alternating deposition and scour conditions similar to the AC area. There is a potential for the continued growth of the AC influence into the LMB.

Transect plots (appendix A) and average depth analyses (table 2) in the middle main bay area (MMB) show some loss of depth due to new sedimentation on transects MMB 7 and 8 but a clear indication of scour on MMB 6, which is consistent with the transitional nature of this portion of the bay. The area is consistently in a sluggish backwater condition under normal pool conditions, and some sedimentation is expected. However, the south end of the area in the vicinity of MMB 6 is likely to be subject to strong eddying effects during high flow events in the AC and LMB. Scour by an eddy current on LMB 6 is also consistent with the formation of a 25-foot-deep scour hole at the entry of the AC to the main bay.

Transects in the upper main bay (UMB) are in a perennial backwater condition. There is no situation under which flow velocities in this area could ever be expected to be significant. Transect plots (appendix A) and average depth analyses (table 2) indicate sedimentation has occurred in this area in moderate amounts. Sedimentation impacts have been highest on the southern transects with a tendency to decrease towards the north. This pattern of sedimentation during the period 1985 to 1994 is indicative of source of inflow from the south end, probably the Mississippi inflows through the AC. Frazier Creek, the major local source of sediment input to UMB, has been rerouted into Triangle Lake and is no longer a significant factor in sedimentation of UMB.

Transects in what remains of the Broad Lake portion of the bay system indicate an increase in depth since 1985. Transect plots (appendix A) and average depth analyses (table 2) indicate that bed erosion on these transects may have occurred due to high flows through the area resulting from the Indian Graves levee break. This observation should be treated cautiously due to the severe alterations of the hydraulic conditions in the lower Broad Lake area. These alterations may have resulted in a different relationship between the Mississippi River stages and the water level in Broad Lake. Since river stages were used to adjust measured depths to a common datum during both surveys, this effect might produce an apparent increase in depth.

The Water Survey's Geographic Information Systems (GIS) Group processed transect data from the 1994 survey of Quincy Bay to develop the depth contour mapping presented in figure 13. This contour analysis was used to calculate the overall volume of the lake below an elevation of 470 feet National Geodetic Vertical Datum of 1929 (NGVD) for 1994. Results based on this analysis are presented in table 3.

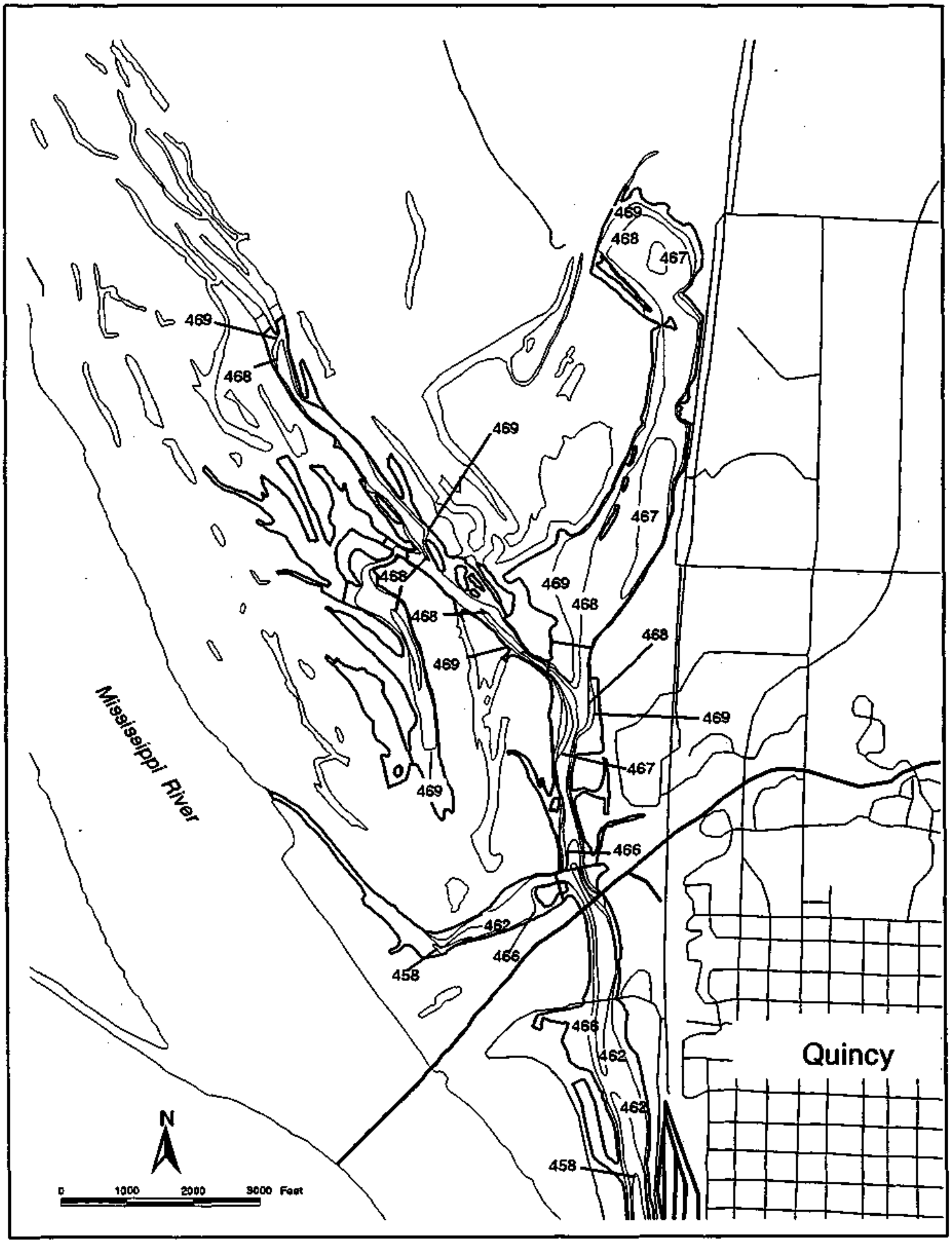

Figure 13. Hydrographic map of Quincy Bay

Table 3. Quincy Bay Hydrographic Data

Parameter	*Willow Slough*	*Lower main bay*	*Middle main bay*	*Upper main bay*	*Broad Lake*
Lake volume (acre-feet)	71	435	82	326	41
Lake area (acres)	53	88	47	166	46
Average depth (feet)	1.3	4.9	1.7	2.0	0.9

Lake Meredosia

Historically, the sedimentation problem at Lake Meredosia has been associated with Illinois River backflows up the outlet channel on the rising limb of a flood hydrograph. In this situation, rising stages on the river are not sufficient to overflow the separating wetlands between the river and lake but can enter through the outflow channel. This mechanism has been responsible for the continued growth of the delta at the south end of the lake.

Under conditions of high river stages (over approximately 15 feet on the Meredosia gage) flows are initiated over the separating wetlands and flows through the lake are from north to south. Because of the diffused flow through the wetlands area, the sedimentation patterns resulting from this process are not as distinct as those resulting from the more direct channelized inflow at the south end of the lake.

Cross-sectional plots and average depth analysis (table 4) of the Lake Meredosia transects show these mechanisms to some degree. The cross-sectional plots and data are provided in appendix A. Selected cross-sectional plots are shown in figure 14. Sediment deposition has been highest at the south end of the lake and decreased to the north. Very little sedimentation has occurred at the midpoint of the lake (transect 5). Continuing to the north end of the lake, sediment deposition appears to increase to transect 9.

Table 4. Lake Meredosia Depth Analysis by Transects

Transect	*Depth 1975 (feet)*	*Depth 1994 (feet)*	*Loss 1975 to 1994 (feet)*	*Average annual loss 1975 to 1994*	
				(feet per year)	*(cm per year)*
2	1.48	1.01	0.47	0.025	0.75
3	1.71	1.40	0.31	0.016	0.50
4	3.31	2.06	1.25	0.066	2.01
5	3.67	3.59	0.08	0.004	0.13
6	3.64	3.24	0.40	0.021	0.64
7	3.24	2.83	0.41	0.022	0.66
8	2.49	2.18	0.31	0.016	0.50
9	2.23	1.60	0.63	0.033	1.01

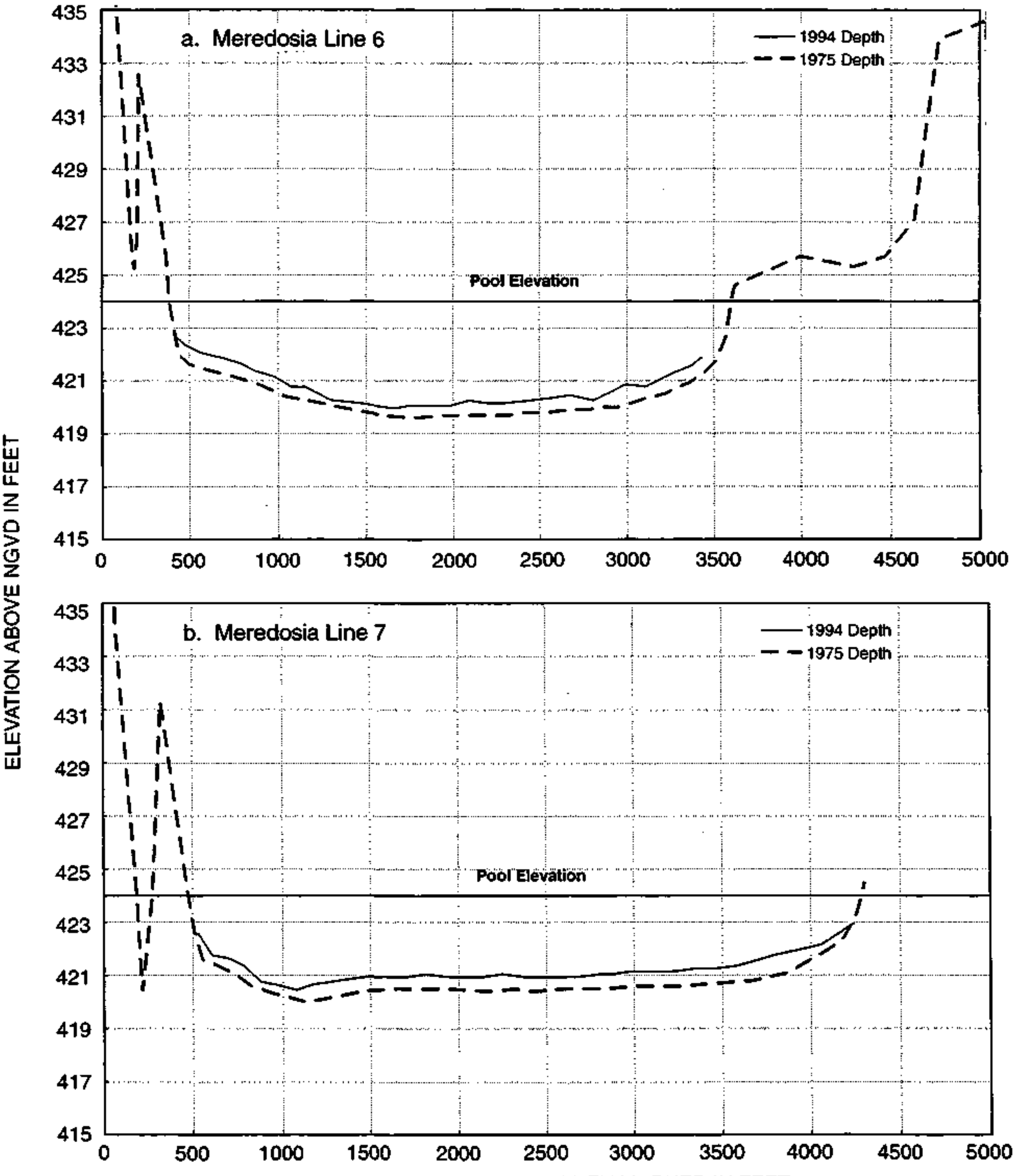

Figure 14. Lake Meredosia cross-sectional transect plots

Table 5. Lake Meredosia Hydrographic Data

Parameter	*1975*	*1994*
Lake volume (acre-feet)	3710	3110
Lake area (acres)	1380	1380
Average depth (feet)	2.7	2.2
Average sediment accumulation (feet)	-	0.5
Average annual depth loss (feet)	-	0.026

In terms of the overall sedimentation of the lake, the impact of the southern inflow of sediment-laden water into the lake is more limited in scale due to the flow pattern in the lake. Water entering the lake through the outlet displaces the "old" lake water into the northern sections of the lake, but the "new" high sediment water never reaches the northern lake area because it drains out of the lake system through its original entry point. The northern inflow of water affects the whole lake because of its flow-through nature. Water entering at the north end passes through the full length of the lake and exits through the outlet channel.

The Water Survey's GIS Group processed transect data from the 1975 and 1994 surveys of Lake Meredosia to develop the depth contour mapping presented in figure 15. This contour analysis was used to calculate the overall volume of the lake below an elevation of 424 feet NGVD for both 1975 and 1994. Some results based on this analysis are presented in table 5.

Swan Lake

The 1994 cross-sectional transect plots and the data for 15 of the 44 transects surveyed in Swan Lake are provided in appendix A. Depth plots have been added for several of these transects for comparison with a 1904 survey by the Corps of Engineers as shown in figure 16 (Woermann, 1904). The 1904 survey represents conditions in the area prior to inundation by the construction of the Alton lock and dam. These representative cross sections show that as much as 5 feet of sediment has accumulated on the lake bottom since 1904.

Wetlands vegetation has become established in accumulated sediment and exposed soils along much of the shoreline. During the recovery of the horizontal control monumentation from the 1988 MECO survey, monuments described in 1988 as exposed by 6 inches were either flush with the soil surface or buried, indicating that these exposed sediments continue to accumulate during high water periods.

The Water Survey's GIS Group processed transect data from the 1994 survey of Swan Lake to develop the depth contour mapping presented in figure 17. This contour analysis was used to calculate the overall volume of the lake below an elevation of 419 feet NGVD for 1994. Some results based on this analysis are presented in table 6.

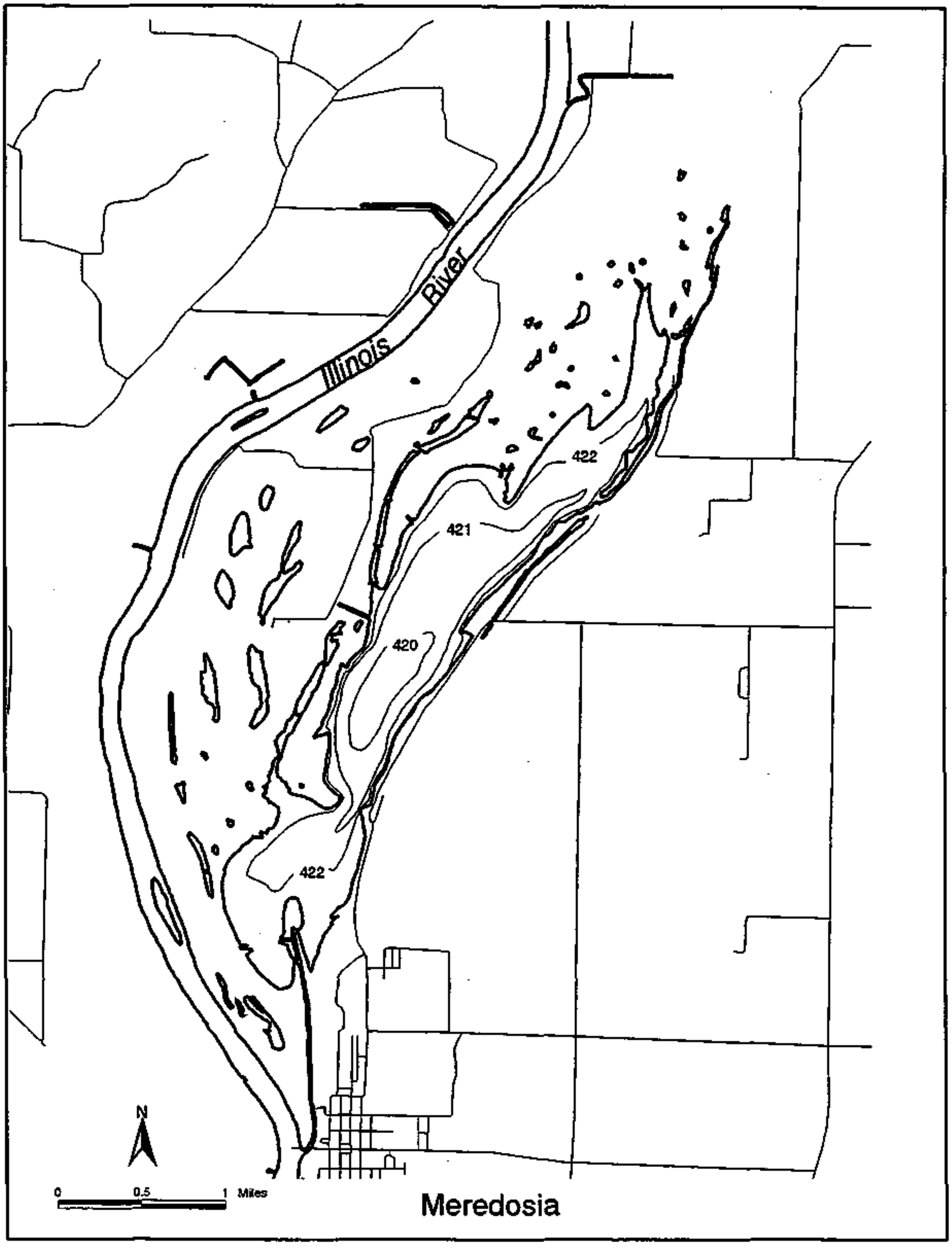

Figure 15. Hydrographic map of Lake Meredosia, 1994

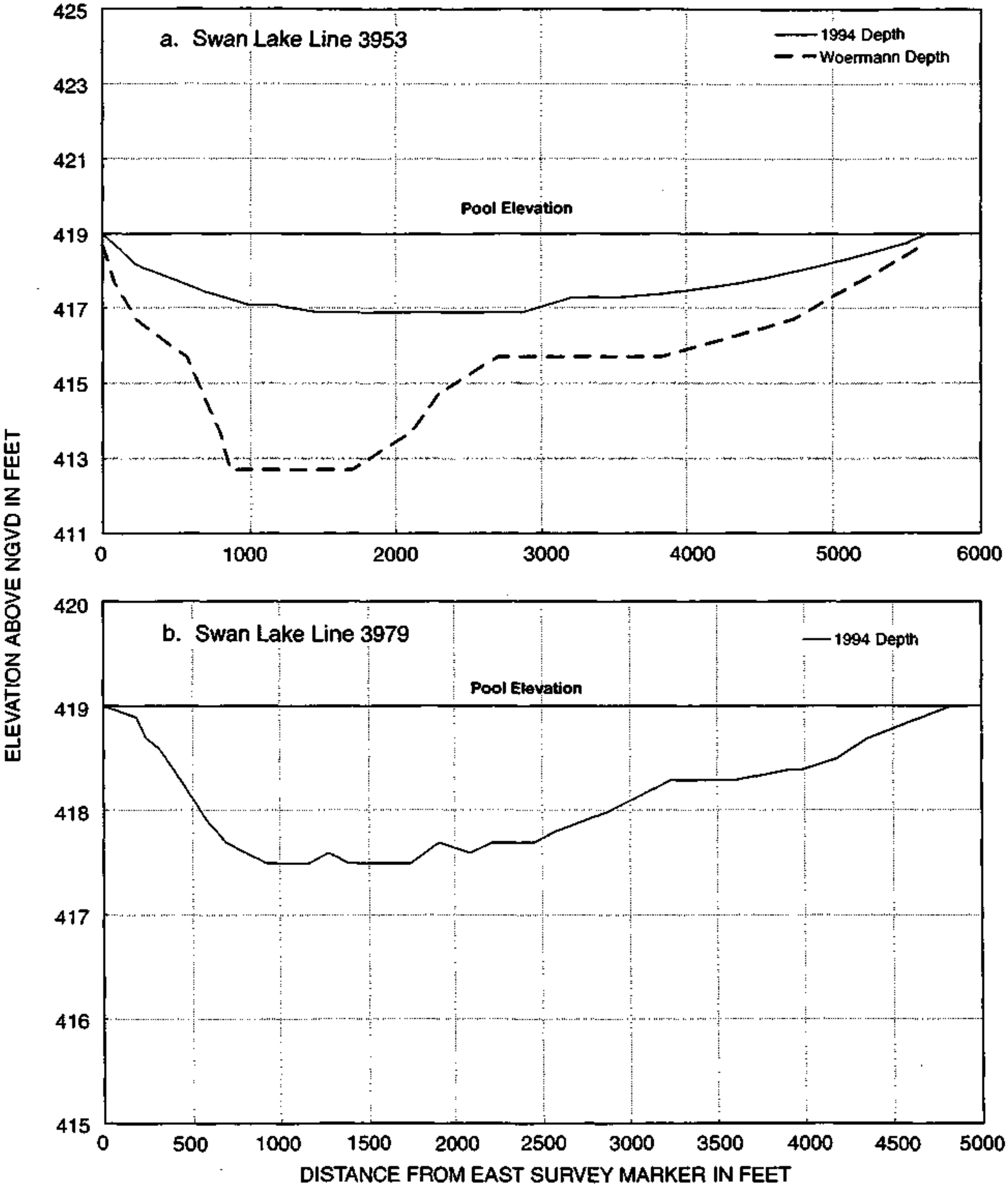

Figure 16. Swan Lake cross-sectional transect plots

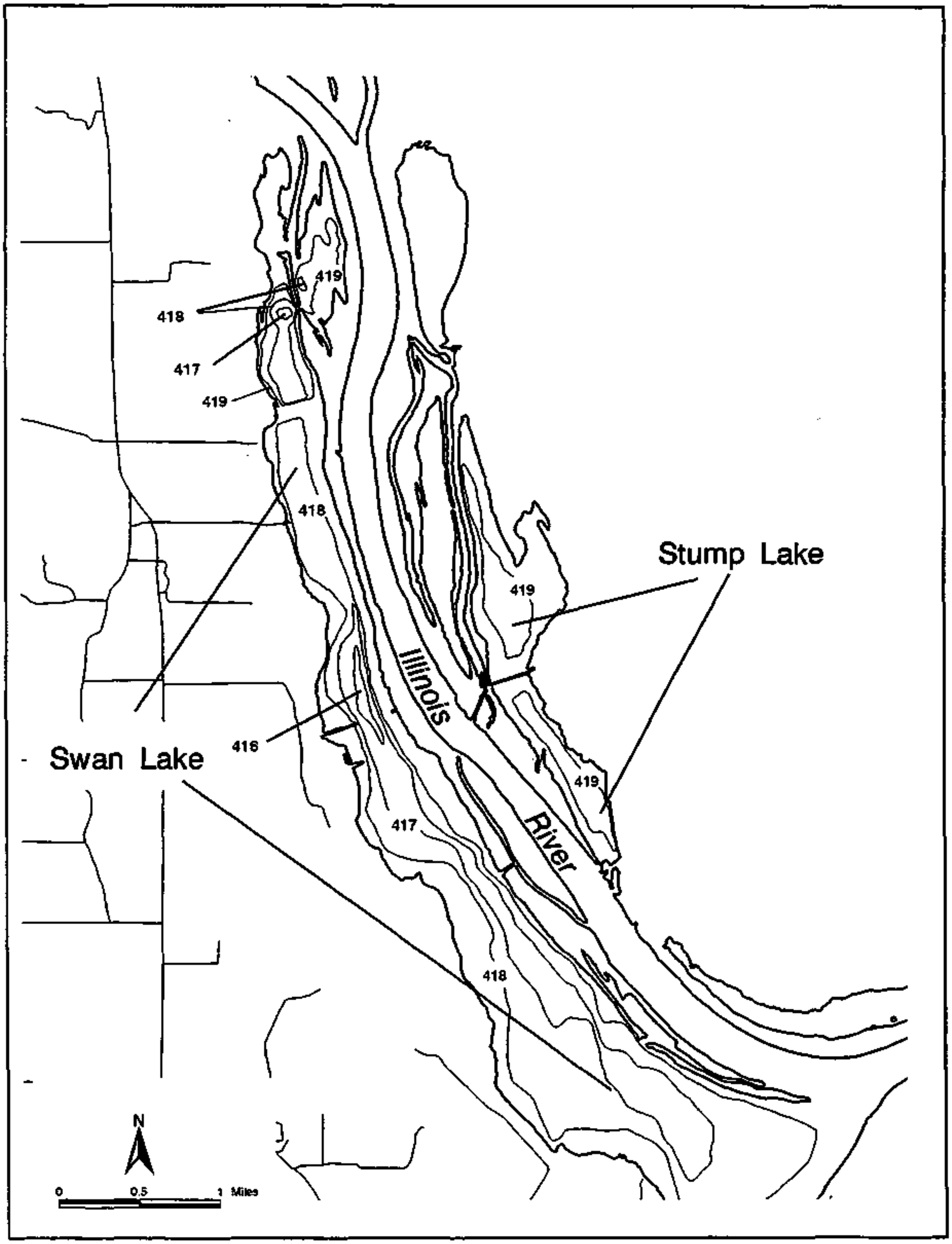

Figure 17. Hydrographic map of Swan Lake and Stump Lake

Table 6. Swan Lake Hydrographic Data

Parameter	*1994*
Lake volume (acre-feet)	2994
Lake area (acres)	2421
Average depth (feet)	1.2

Stump Lake

The cross-sectional transect plots and the data for 10 of the 19 transects surveyed in Stump Lake are provided in appendix A. Selected cross-sectional plots are shown in figure 18. Depth plots for two of these transects have been added for comparison with a 1904 survey by the Corps of Engineers (Woermann, 1904). The 1904 survey represents conditions in the area prior to inundation by the construction of the Alton lock and dam. These representative cross sections show that in general less than 2 feet of sediment has accumulated on the lake bottom since 1904. The end points of the 1904 cross sections do not appear to match well with the 1994 survey lines. This may be a result of dike, road, and other construction activities particularly along the western shore.

The Water Survey's GIS Group processed transect data from the 1994 survey of Stump Lake to develop the depth contour mapping presented in figure 17. This contour analysis was used to calculate the overall volume of the lake below an elevation of 420.5 feet NGVD for 1994. Some results based on this analysis are presented in table 7.

Physical Characteristics of Sediments

Samples of the accumulated sediments were collected and analyzed for unit weight and particle size distributions. These characteristics are indicative of the general depositional environment in the lakes. For example, sediments with fine particle sizes and low unit weights are generally indicative of low flow velocities, permanent flooding, and often a high organic content. In contrast, sediments with coarse particle sizes and high unit weights are indicative of high flow areas where bed transport processes are more significant than suspended sediment processes. Between these two extremes, sedimentation conditions vary with changes in ambient or extreme flow conditions.

Table 7. Stump Lake Hydrographic Data

Parameter	*North Pool*	*South Pool*
Lake volume (acre-feet)	323	207
Lake area (acres)	325	183
Average depth (feet)	1.0	1.1

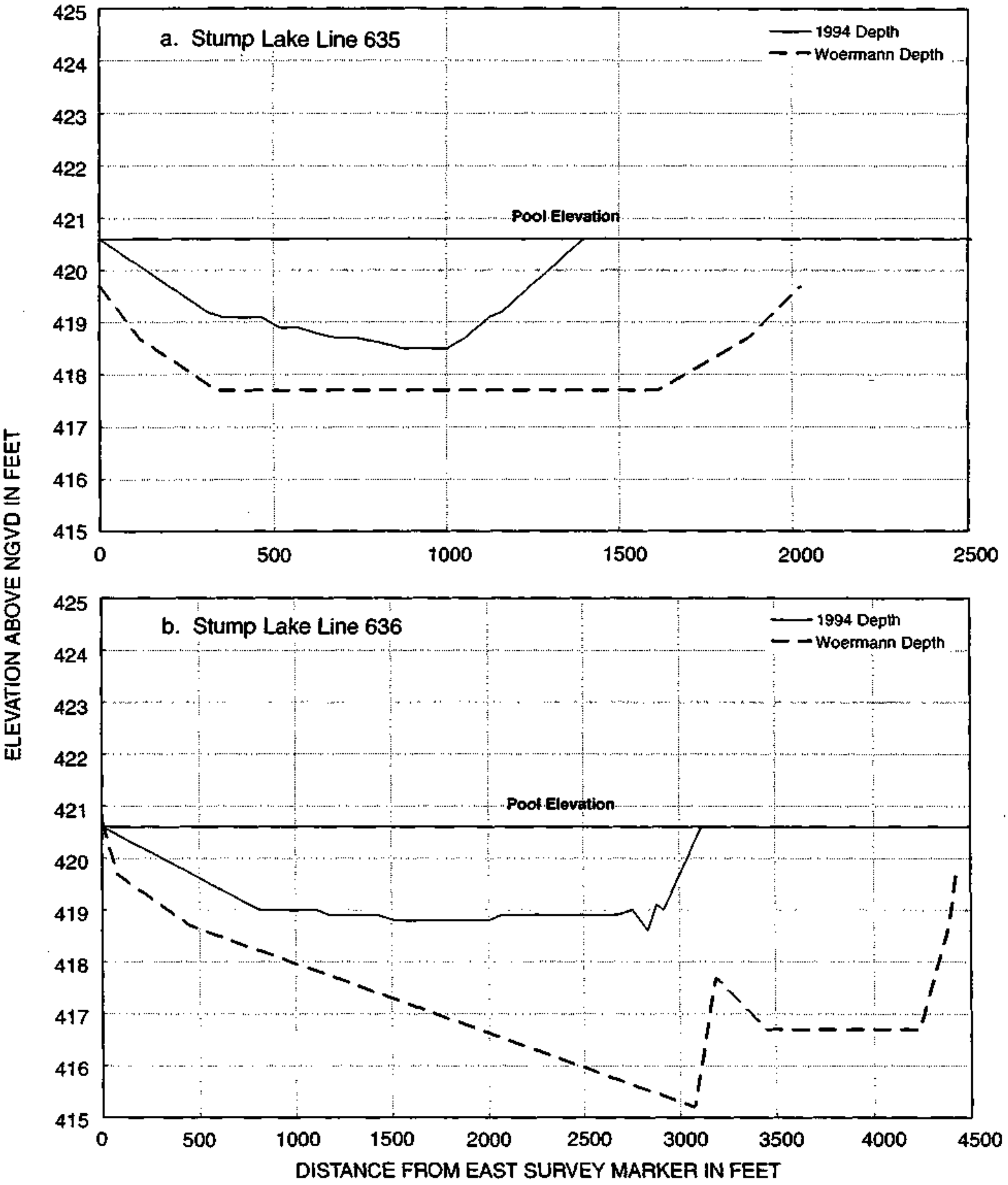

Figure 18. Stump Lake cross-sectional transect plots

Quincy Bay

Observations concerning the wide variety of flow environments in Quincy Bay in the previous transect cross section analysis are well supported by the range of sediment characteristics found in the bay complex. Sediment particle sizes found in the Quincy Bay sediments range from very coarse sand and fine gravel to fine clay materials too fine to be fractionated by available laboratory analyses. Particle size distributions and unit weights for the Quincy Bay sediments are presented in appendix B.

Sediment conditions in the AC (appendix B) indicate medium to coarse sand. Unit weights between 80 and 95 pounds per cubic foot suggest a loosely compacted condition. These results support the conclusion drawn in the earlier discussion of the cross-sectional analysis that scour and deposition are very active in this area.

Analyses for sediment samples collected in the LMB area are presented in appendix B. With the exception of sample PS 53, all samples indicate sediments composed primarily of silt and clay materials with the sand fraction ranging from 0 percent to 30 percent. Unit weights for these samples range from 45 to 65 pounds per cubic foot. PS 53 was collected in transect 3 and shows a striking similarity to the samples collected in the AC. Based on these sample analyses and the transect cross-sectional data presented earlier, very little change has been occurring in the LMB. However, the continued reconfiguration of the lower Broad Lake/AC area and the similar physical characterization of PS 53 and the AC bed materials support a concern that a similar channel reconfiguration could occur in the LMB area.

Willow Slough bed material is characterized in figure B3. The particle size and unit weight data indicate a loose high organic clay material. The slough area has generally been subject to little or no flow. During the flood of 1993, the breaching of the South Indian Graves levee passed a large flow of water through the Slough, which is a probable cause of the slightly increased depths between 1985 and 1994. PS 12, a particle size sample collected from the northern transect in the Slough showed a significant fine sand fraction. Even with the high flow velocities that must have occurred during the 1993 flood, almost no sand size materials transited past the dredged hole at transect 5 in the Slough.

The bed characterizations for upper Broad Lake and the middle and upper main bay areas (appendix B) are all typical of limited flow backwater conditions. Particle size distributions show no sand fraction and significant clay fractions. The low unit weight ranges are indicative of high organic content.

Lake Meredosia

Bed material particle size distribution plots presented in appendix B indicate the spatial and vertical homogeneity of the Lake Meredosia sediments. The most significant spatial variation is a higher silt fraction in samples collected south of the narrows and directly subject to Illinois River backflows.

This spatial distinction between the sediment particle sizes found in the southern lobe of the lake and the northern lobe is clearly defined in the figures shown in appendix B, a plot of all analyzed surficial sediment samples. The vertical homogeneity of the size distributions can also be seen in the figures. All of the size distributions from individual core sections show no vertical variations for samples in the southern lobe (transect 3), the north end of the lake (transect 8), or the middle reaches of the lake (transects 5 and 6). These findings further support the earlier cross-sectional analyses concerning the impacts of backflows from the south end of the lake and through-flows from the north end of the lake.

Swan Lake

Bed material particle size distribution plots presented in appendix B indicate the spatial and vertical homogeneity of the Swan Lake sediments. Combined plots of the particle size distributions indicate minor spatial variations going away from the Illinois River and based on sediment layering.

Sediments near the Illinois River main channel are slightly coarser than samples located farther landward. This finding would correspond well to typical geomorphic models of natural levee formation adjacent to stream channels.

Most of the vertical sample sets show a coarser surface layer than the base sediments. The slightly coarser surface layer might be related to an influx of sediments during the flood of 1993.

Stump Lake

Bed material particle size distribution plots presented in appendix B indicate the spatial and vertical homogeneity of the Stump Lake sediments. The most significant spatial variation is a higher silt fraction in samples collected south of the narrows and directly subject to Illinois River backflows.

Sedimentation Rates Determined by ^{137}Cs Technique

Background of the ^{137}Cs Technique

The long radioactive half-life (30.174 years) and the distinct pattern of Cesium-137 (^{137}Cs) introduction into the environment make it a very useful tracer of recent atmospheric, hydrologic, and sedimentological processes. ^{137}Cs was produced by the atmospheric testing of nuclear weapons and began to be deposited in significant quantities in 1952. About 90 percent of the total flux of Cs in the Northern Hemisphere was deposited between 1954 and 1963, prior to the signing of the Limited Nuclear Test Ban Treaty of 1963. Despite sporadic inputs in recent years, the amount of Cs in the atmosphere has decreased since 1966 to near zero (Ritchie and McHenry, 1990).

The effectiveness of ^{137}Cs in the study of sedimentation processes in aquatic environments has been critically reviewed by Crickmore et al. (1990), Ritchie and McHenry (1990), and Santschi and Honeyman (1989). The application of Cs to measure accumulation patterns in small watersheds has been demonstrated by Brown et al. (1981), Lance et al. (1986), and McHenry et al. (1973), and in a wetland area by Kadlec and Robbins (1984). The technique has been successfully used in Illinois to study sedimentation processes in lakes associated with the Illinois and Mississippi Rivers (Cahill and Steele, 1986; Cahill and Autrey, 1987), and to study deposition processes in Lake Michigan (Robbins and Edgington, 1975; Edgington and Robbins, 1976; Christensen and Goetz, 1987).

The key assumption made when using ^{137}Cs to measure depositional processes is that following deposition, there is no significant movement of Cs as a result of chemical, physical, or biological processes. The critical evaluations of Ritchie and McHenry (1990) and Santschi and Honeyman (1989) indicate that Cs is strongly adsorbed on clay materials and would not migrate under normal conditions. A number of studies have measured Cs contamination from nuclear facilities to track contamination in streams (Cerling et al., 1990; Sobocinski et al., 1990). These studies found that ^{137}Cs adsorption on sediments was essentially irreversible and that the Cs was immobile.

^{137}Cs Procedure

Each sediment sample was weighed "as received" and then dried at 110°C overnight and reweighed. The percent weight loss at 110°C was calculated and used to calculate mass accumulation rates.

The ^{137}Cs activity was determined by counting the gamma activity of 10 grams (g) of dried sediment with a 15 percent efficient Ge(Li) detector for a minimum of 24 hours. The 662 kiloelectron-volt (keV) photon activity in sediment samples was compared to the activity of the National Bureau of Standards Environment Radioactivity Standard (NBS 4350B). The average percent relative error to the accepted value was 11 percent for ten measurements. The relative standard deviation of the counting statistics was typically less than ± 20 percent. The Cs measurements were checked by analysis of duplicate samples and other reference samples. The lowest specific activity that could be detected in a 10-g sample by using a 24-hour counting time on a 15 percent efficient Ge(Li) detector was approximately 0.005 Becquere/gram (Bq/g). Becquere represents one disintegration per second.

Depending on operating conditions, however, the limit of detection was variable. The use of a longer counting period and a higher efficiency improves the limit of detection. In some cases, counts as long as three days were used. Cs was considered to have been detected if the results for a sediment interval met the following criteria: (1) the peak-to-background ratio was greater than 1; (2) the error associated with fitting the peak by the computer software was less than 30 percent; and (3) the sediment interval was counted for a minimum of 24 hours.

A plot of the ^{137}Cs activity versus depth in the core can be used to select the position in the sedimentation record when the fallout from the testing of nuclear weapons in the atmosphere began to be deposited in significant quantities, 1952, or the peak time of fallout from nuclear testing, 1963. Sedimentation rates can be calculated with either year as a marker. All of the sedimentation rates obtained in this study were calculated based on the assumption of a constant rate of sedimentation over the time interval of interest (31 or 42 years). The extent of the agreement between the two rates (based on the onset of and peak activity in atmospheric fallout) can be used to assess the uniformity of the sedimentation rates in an area.

The determination of the exact location of the 1952 horizon is often difficult. There were much smaller amounts of ^{137}Cs deposited in 1954 than in the peak years of atmospheric testing in 1961-1963. More man one half-life has now passed since 1954, and this would reduce the amount of ^{137}Cs present by more than 50 percent due to radioactive decay.

Results

The results of the ^{137}Cs determined sedimentation rates are summarized in table 8. Included in the results are the length of the core analyzed, the number of samples for which ^{137}Cs was measured, the depth to the peak activity observed in the core, the depth to the "nondetectable" activity observed in the core, and the 31- and 42-year average sedimentation rates. The data are also plotted in figures 19-22.

There was no observable sediment layer in the cores that could be attributed to the flood of 1993. In general the sediment was very uniform in texture and appearance. The uppermost intervals counted (0 to 5 cm) in all the sediment cores contained measurable amounts of Cs. The flood deposits probably would include reworked or eroded soil upstream that would have retained the Cs signature. The exception may be Quincy Bay Core 1, which contained the low Cs levels.

The sedimentation rates obtained for the six cores appear to be reasonable. Sedimentation rates obtained by sediment surveys for Swan Lake ranged from 0.5 to 0.8 centimeters per year or cm/y (Bellrose et al., 1983; Lee, 1984), while a rate of 1.2 cm/y was obtained using Cs (Cahill and Steele, 1986). The results obtained in this study are consistent with the previous Cs results. Sedimentation rates obtained by sediment surveys for Meredosia Lake ranged from 1.3 to 1.1 cm/y (Bellrose et al., 1983; Lee, 1984). These results are similar to the 1.1 cm/y obtained using the Cs procedure.

There were no available sedimentation rate estimates available for the other four cores. The rates obtained for Silver Lake and Stump Lake are similar to results for adjacent Swan Lake. The two Quincy Bay cores have similar sedimentation rates, although the core collected near the Mississippi River had a slightly higher long-term sedimentation rate.

Table 8. Summary of ^{137}Cs Results from 1994 Sampling of Lakes Associated with the Illinois and Mississippi Rivers

Lake	*Length of core (cm)*	*n*	*Depth to peak (cm)*	*31-year rate (cm/y)*	*Depth to no activity (cm)*	*42-year average rate (cm/y)*
Meredosia Lake	65	13	33	1.1	48	1.0
Swan Lake	55	13	43	1.4	52	1.2
Silver Lake	57	14	48	1.6	*	>1.4
Stump Lake	56	11	28	0.9	43	1.0
Quincy Bay-1	65	12	48	1.6	58	1.4
Quincy Bay-2	64	11	40	1.3	53	1.3

Note:

* Core was of insufficient length to reach depth with "no" activity

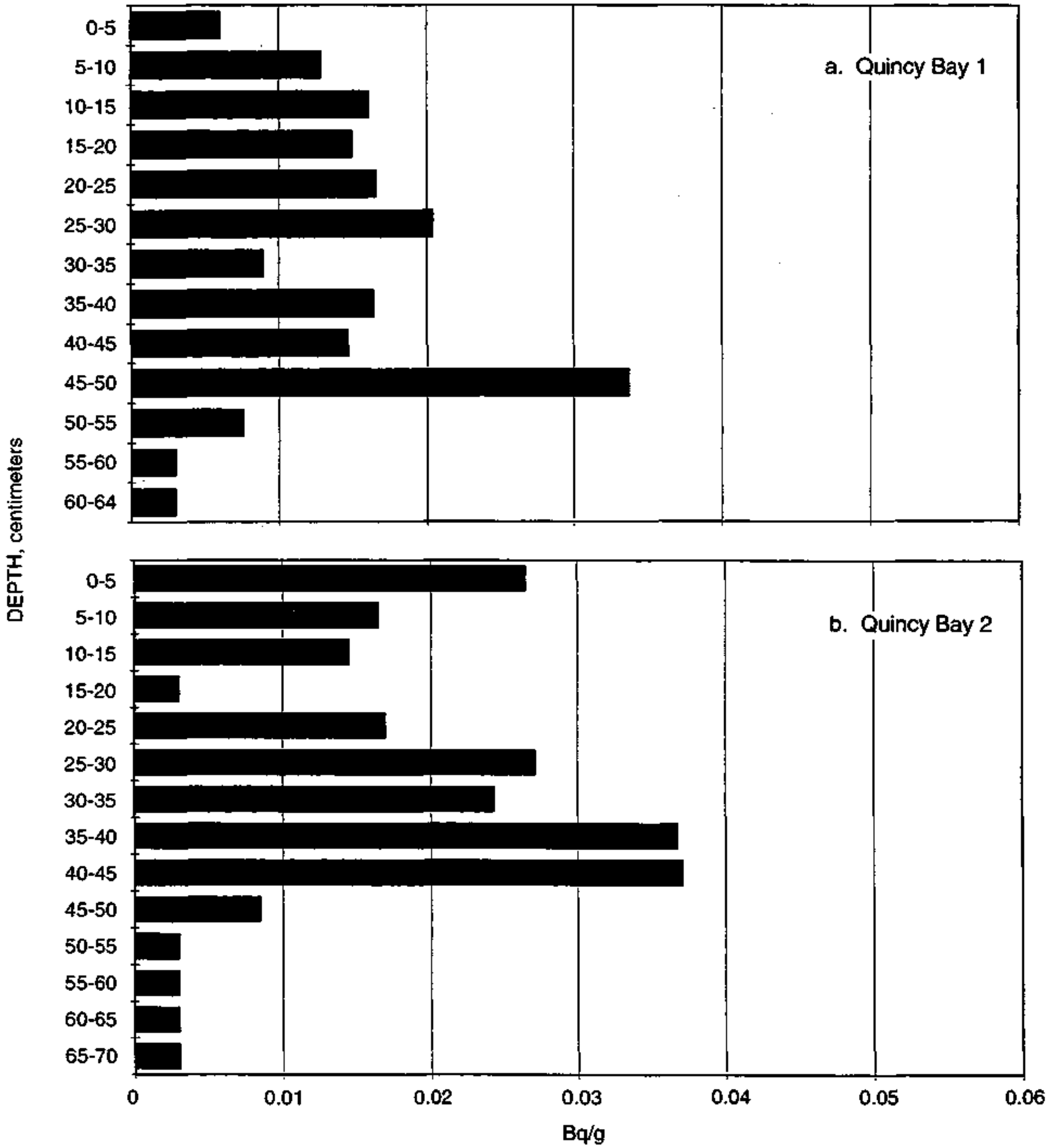

Figure 19. Cesium-137 profiles for sediment cores from Quincy Bay

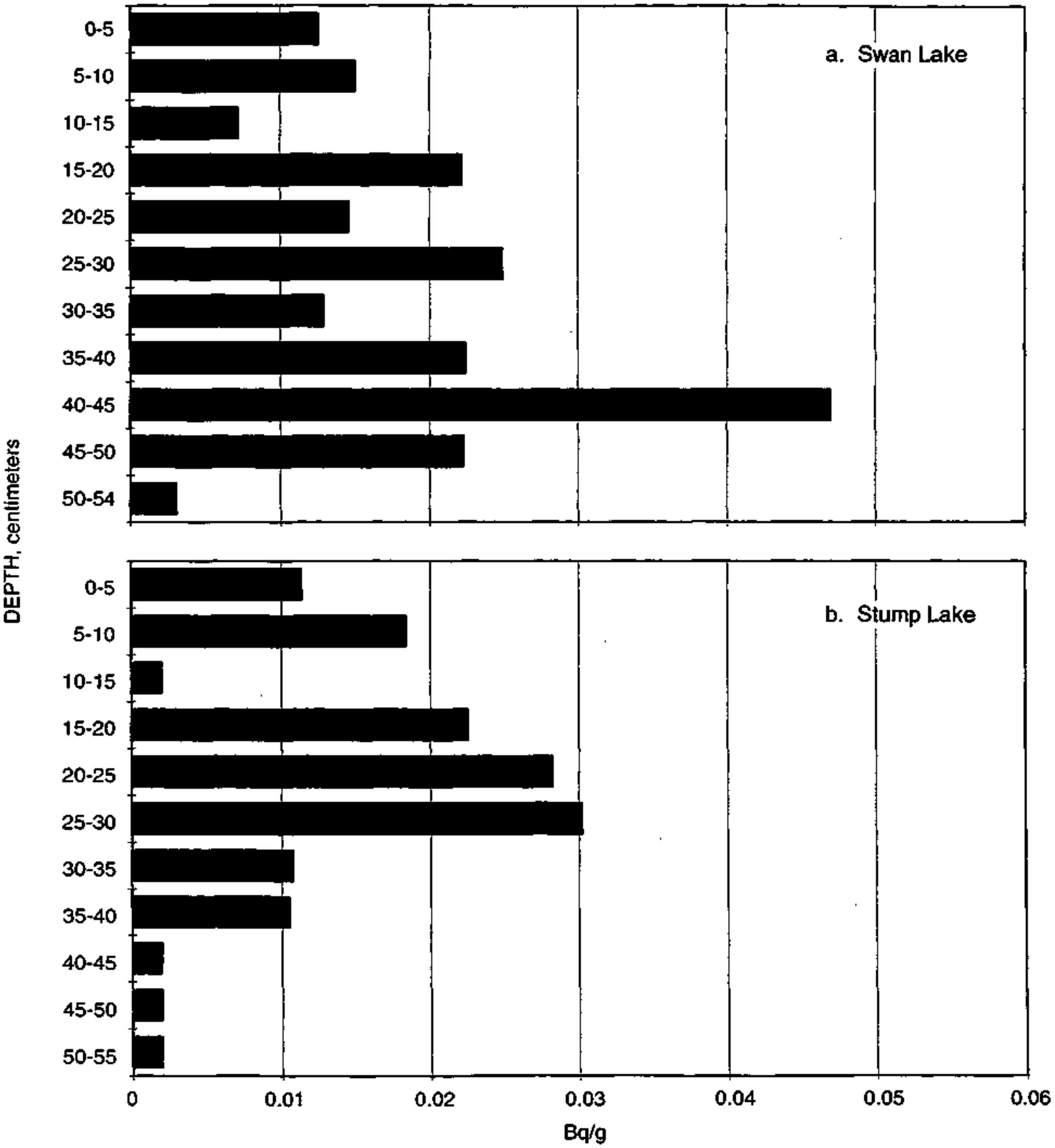

Figure 20. Cesium-137 profiles for sediment cores from Swan Lake and Stump Lake

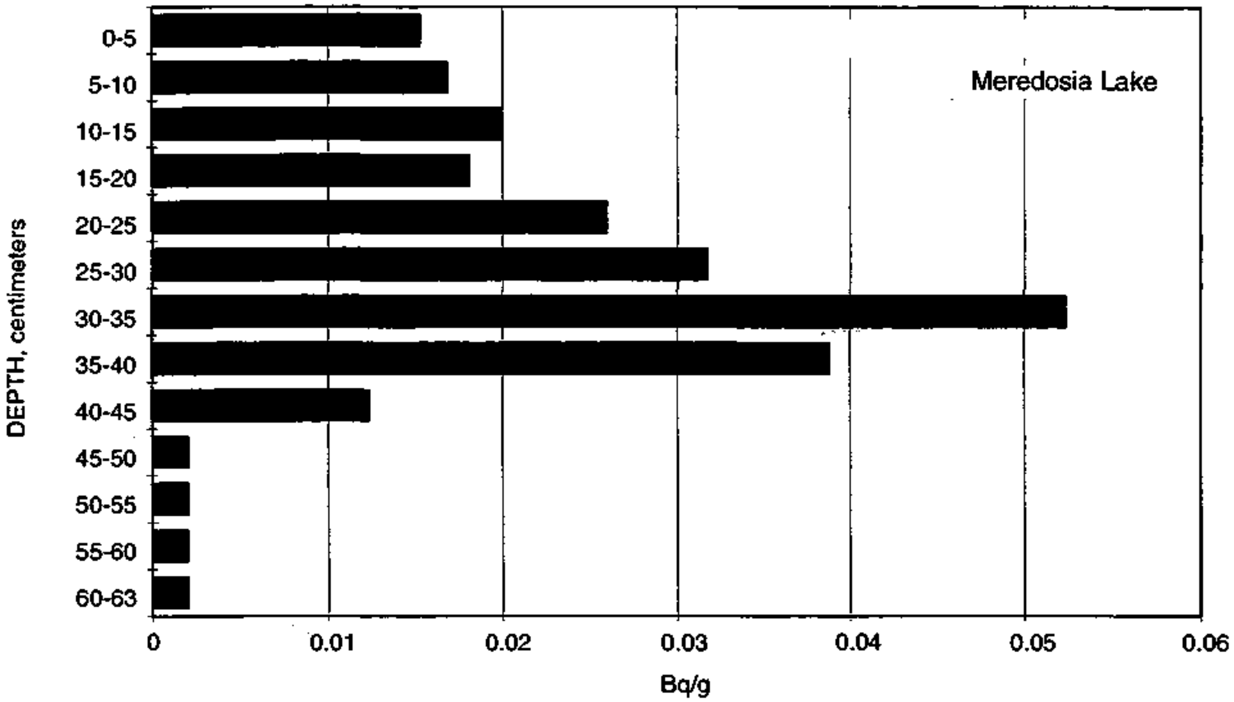

Figure 21. Cesium-137 profiles for sediment cores from Lake Meredosia

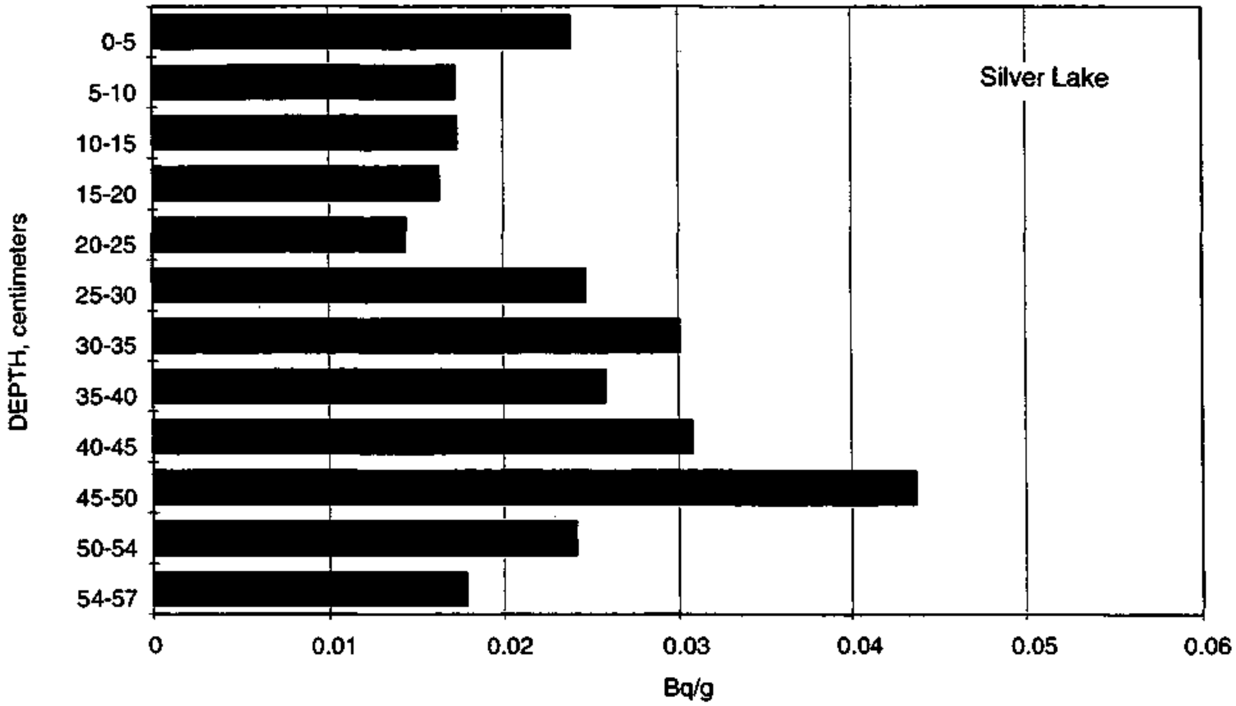

Figure 22. Cesium-137 profile for a sediment core from Silver Lake

Sediment Quality

One of the major tasks of this project was to collect sediment samples from selected backwater lakes to analyze the chemical composition of the sediment samples to evaluate the impact of the 1993 flood on sediment quality. Sediment and water samples were collected from five lakes at 17 sites and analyzed for inorganic and organic chemicals. This section of the report presents the description of the data collection sites, discussion of the data collection and analysis procedures, and the results.

Data Collection Sites

Sediment and water samples were collected at 17 locations in five lakes: Lake Meredosia, Quincy Bay, Silver Lake, Swan Lake, and Stump Lake. Four of the lakes are the same lakes discussed in the preceding section on sedimentation. The fifth lake, Silver Lake, located at the junction of the Mississippi and Illinois Rivers, was sampled to investigate conditions at the junction of the two rivers and for comparison with the Illinois and Mississippi River sites.

Four of the sampling sites were in Lake Meredosia, five in Quincy Bay, one in Silver Lake, four in Swan Lake, and three in Stump Lake. Exact locations of the sampling stations are shown in figures 23-25. Table 9 lists the date of data collection, location and site, and type of sample analysis to be performed. A description of the sampling sites and the field conditions during sampling are provided in appendix C.

Data Collection Procedures

A data collection protocol was established at the start of the project to make sure that all samples were collected in a consistent manner following standard data collection procedures. After reviewing the IEPA's Quality Assurance and Field Methods Manual (QAFMM), the following protocol was prepared to supplement existing protocols documented in the QAFMM. Established protocols for sample collection in the QAFMM are referenced without further discussion. Sampling protocols for water and surficial sediments for nutrient, metals, and organics analysis are well defined by the QAFMM and were followed for this project.

Sample collection for this project included aqueous nutrients, metals, and organics; sediment nutrients, metals and organics; and both aqueous and sediment samples for toxicity testing. Additional samples were collected to date sediment layers using Cs decay analysis.

Sediment core samples were collected using a 2-inch-diameter by 20-inch long lined core sampler instead of the site extruded piston core sampler to move sample sectioning to a more controlled setting. Samples for metals and organics were collected in CAB (plastic) liners, and samples for organic analysis were collected in stainless steel liners. Each liner received an acetone, de-ionized (DI) water, and native water rinse prior to sampling. Samples were stored in the tubes for no more than 24 hours before extrusion and selection.

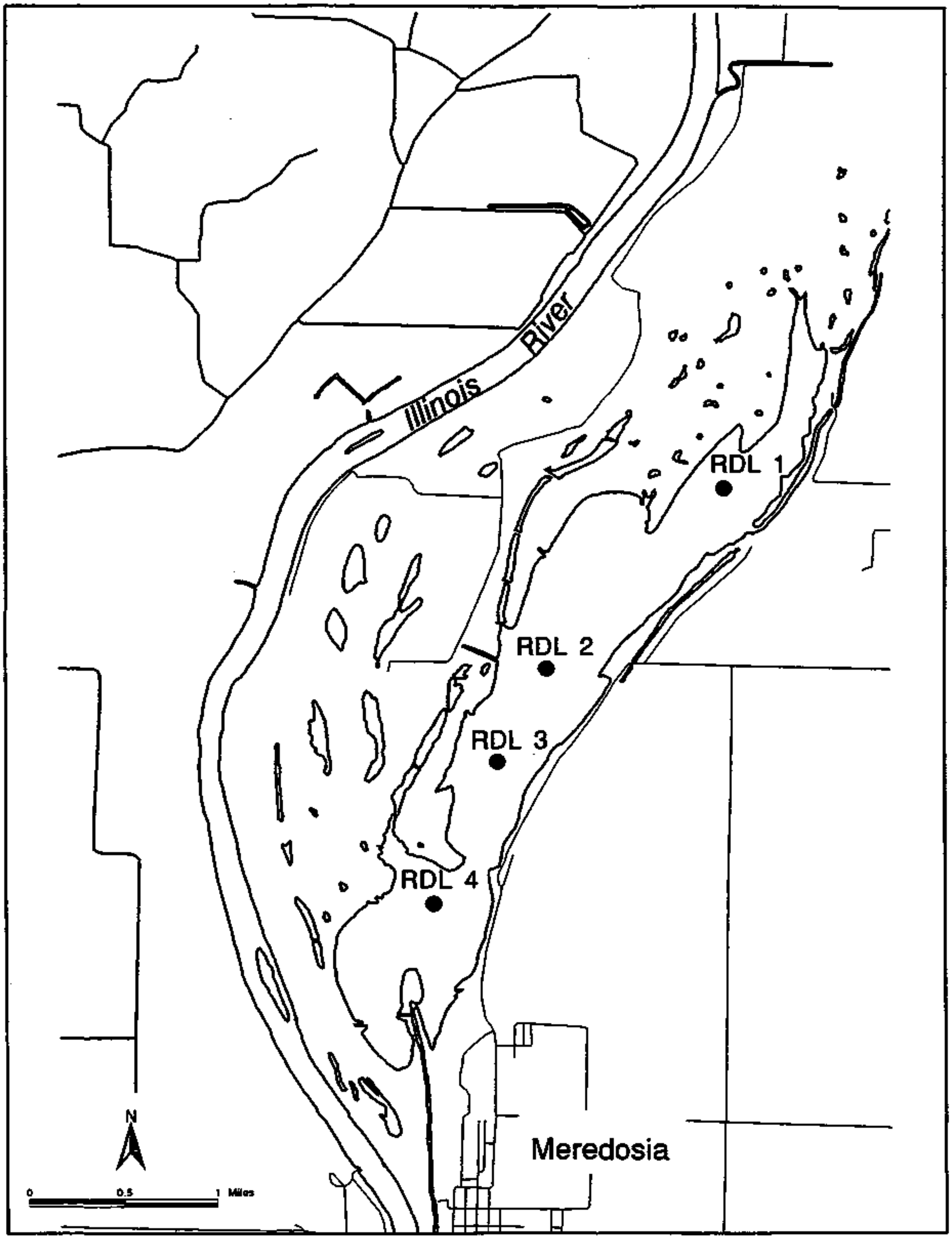

Figure 23. Sampling locations in Lake Meredosia

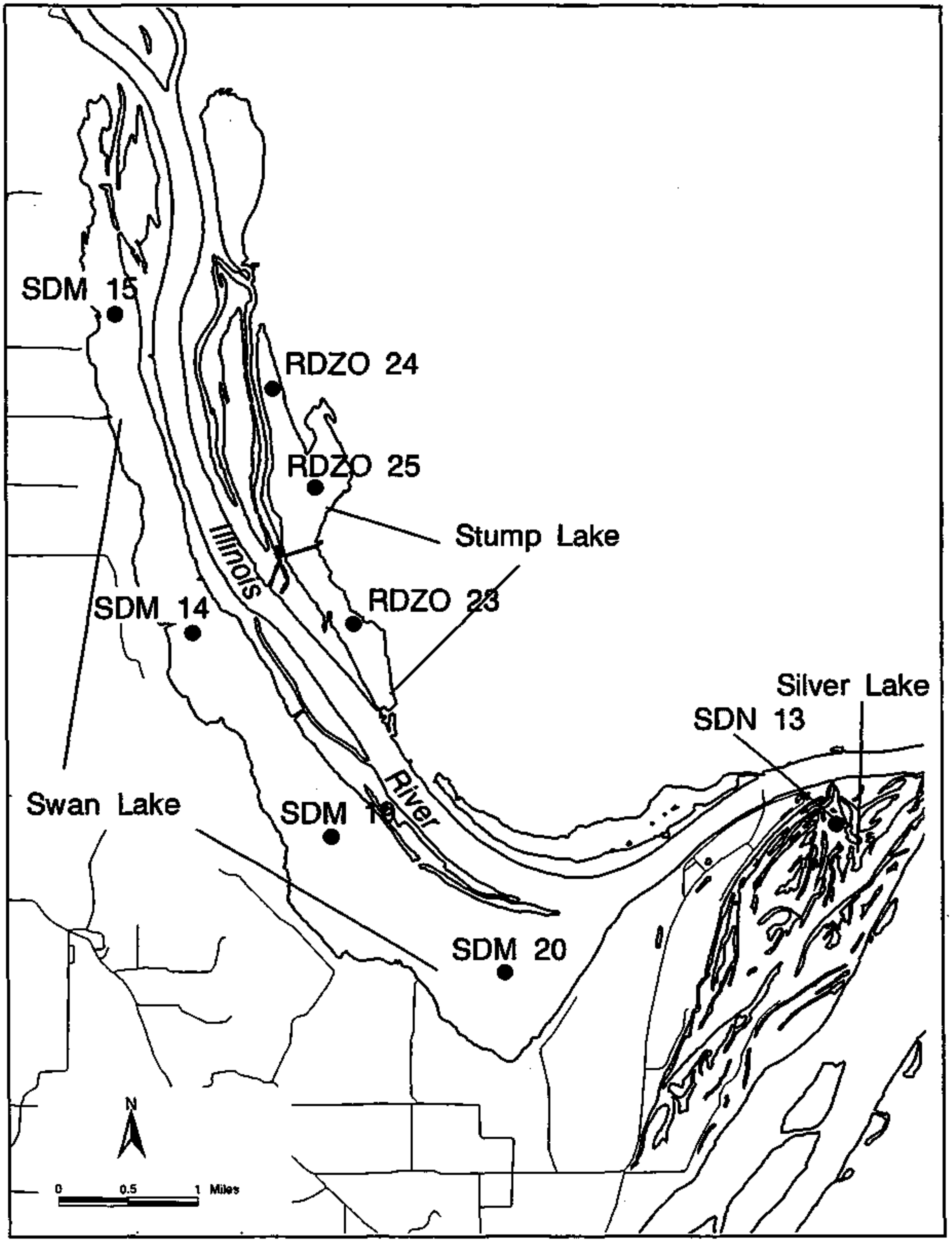

Figure 24. Sampling locations in Swan, Stump, and Silver Lakes

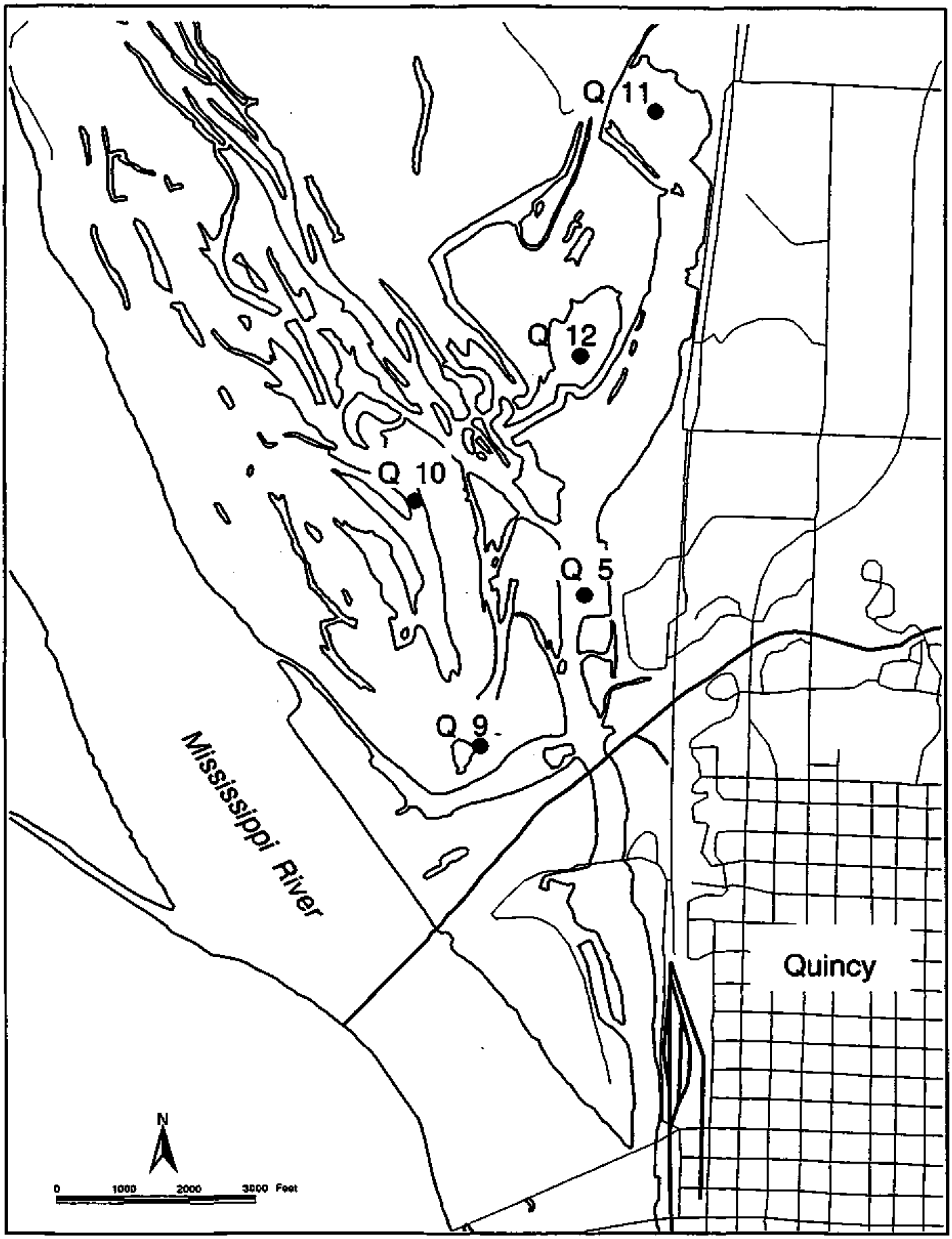

Figure 25. Sampling locations in Quincy Bay

Table 9. Summary of Sample Collection from Backwater Lakes of the Illinois and Mississippi Rivers

			Type of sample		
Location	*Date sampled*	*Sampling site*	*Water*	*Surftcial sediment*	*Sediment core*
Lake Meredosia	1/19/94	RDL1	1,2,3,4,6	7,8	9,10,12
	1/19/94	RDL 2	1,2,3,4,6	7,8	9,10,12
	1/19/94	RDL 3	1,2,3,4,6	7,8	9,10,11,12
	1/19/94	RDL 4	1,2,3,4,6	7,8	9,10,12
	3/16/94	RDL 1	5	n/a	n/a
	3/16/94	RDL 2	5	n/a	n/a
	3/16/94	RDL 3	5	n/a	n/a
	3/16/94	RDL 4	5	n/a	n/a
Quincy Bay	2/1/94	Q 5	1,2,3,4,5,6	7,8	9,10,12
	2/1/94	Q 9	1,2,3,4,5,6	7,8	9,10,12
	2/1/94	Q 10	1,2,3,4,5,6	7,8	9,10,11,12
	2/2/94	Q ll	1,2,3,4,5,6	7,8	9,10,11,12
	2/2/94	Q 12	1,2,3,4,5,6	7,8	9,10,12
Silver Lake	2/15/94	SDN 13	1,2,3,4,5,6	7,8	9,10,11,12
	2/15/94				
Swan Lake	2/15/94	SDM 14	1,2,3,4,5,6	7,8	9,10,12
	2/15/94	SDM 15	1,2,3,4,5,6	7,8	9,10,12
	2/15/94	SDM 19	1,2,3,4,5,6	7,8	9,10,12
	2/15/94	SDM 20	1,2,3,4,5,6	7,8	9,10,11,12
Stump Lake	2/22/94	RDZ0 23	1,2,3,4,5,6	7,8	9,10,12
	2/22/94	RDZ0 24	1,2,3,4,5,6	7,8	9,10,11,12
	2/22/94	RDZ0 25	1,2,3,4,5,6	7,8	9,10,12

Notes:

Water samples
1 = organics
2 = total metals
3 = total nutrients
4 = bulk
5 = VOCs
6 = toxicity

Surftcial sediment samples
7 = organics
8 = metals

Core samples
9 = organics
10 = metals
11= cesium
12 = toxicity

Water samples were collected in a standard Kemmerer water sampler and poured into 1-liter glass containers that had been rinsed with acid, acetone, DI water, and native water.

- Surface sediment samples were collected in either an epoxy-painted Ekman dredge or an epoxy-painted ponar dredge. Samples were transferred using acetone-rinsed utensils to 200 milliliter (ml) glass containers that had received an acid, acetone, DI water, and native water rinse.
- Sediment core samples were collected from the same core segments as the organics and metals samples. Samples from the CAB and the stainless steel core tubes were halved from the metals and organics sampling and combined into the same bottle types as for the surface samples.

Water and surficial sediment samples were divided into containers in the field immediately after collection. Core tubes were removed from the sampler and capped for later sample division. All samples were placed in an insulated cooler to moderate temperature changes.

Core samples were extruded onto an acetone-rinsed stainless steel plate and subdivided. The sample for organics and half of the toxicity sample were taken by cutting a 15-centimeter (cm) long sample centered on a point 25 cm below the sediment surface from the stainless steel core liner. In a similar manner, the metals and the other half of the toxicity sample were collected from the CAB liner.

All samples were delivered to the appropriate lab within 72 hours. A particular effort was made to deliver aquatic toxicology samples within 48 hours.

Laboratory Methods Used in the Analysis of Water and Sediment Samples

All water and sediment samples from the 17 sampling sites were analyzed at the IEEPA-certified Illinois State Water Survey chemistry laboratories following standard quality assurance/quality control (QA/QC) procedures. Additional or split sediment samples were also analyzed at the Illinois State Geological Survey lab for the purposes of comparing results with previous ISGS studies on the Illinois and Mississippi Rivers. Laboratory methods used at both labs are discussed in this section of the report.

Laboratory Methods Used at the Illinois State Water Survey Chemistry Lab

Metals and Trace Elements in Water. Method 200.7 - *Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry,* Revision 3.3 (USEPA, 1991a).

Inorganic Substances in Water. Method 300.0 - *The Determination of Inorganic Anions in Water by Chromatography,* Revised 1991 (USEPA, 1993).

Metals in Sediment. Method 3050 - *Acid Digestion of Sediment, Sludges, and Soils.* This digestion procedure essentially extracts metals into a matrix of nitric and hydrochloric acids. It uses hydrogen peroxide to oxidize organic components. The result would be called "total recoverable" metals (USEPA, 1986).

Pesticides Extraction and Analysis for Sediment Samples. Generally, U.S. Environmental Protection Agency (USEPA) Solid Waste Method 3550 was used for extraction, and USEPA drinking water method 507 was used for analysis. After mixing sediment, approximately 40 g of sample was weighed and mixed with approximately 120 g anhydrous sodium sulfate to form a free-flowing powder. This mixture was ground with a mortar and pestle and added to a 500 ml Erlenmeyer flask. After addition of a surrogate standard, approximately 120 ml of a mixture of methyl-t-butyl ether and acetone (75%:25%, volume:volume) was added. The mixture was then sonicated for 15-20 minutes, after which the solvent extract was decanted from the solid material. This was repeated two more times, combining extracts, followed by a final extraction with 60-80 ml for five minutes and filtration to recover all the solvent. The extract was dried with anhydrous sodium sulfate and concentrated to 10 ml in a Kuderna-Danish concentrator. An internal standard was added, and the concentrate was analyzed by gas chromatography with a J&W DB-5 capillary column and a nitrogen-phosphorus detector. Analyte identification was verified by standard spiking and analysis on a second chromatography column (J&W DB-1701).

Laboratory Methods Used at the Illinois State Geological Survey Lab

Sediment samples of approximately 5 cm increments from the sediment cores or a split of grab samples were analyzed by the following techniques for the following elements.

X-ray fluorescence spectrometry (XRF). The XRF was used for determining aluminum (Al), barium (Ba), cadmium (Cd), calcium (Ca), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), molybdenum (Mo), nickel (Ni), niobium (Nb), phosphorus (P), potassium (K), rubidium (Rb), silicon (Si), sodium (Na), strontium (Sr), sulfur (S), tin (Sn), titanium (Ti), vanadium (V), zinc (Zn), and zirconium (Zr).

Major Elements. Samples, as received, were dried overnight at 110°C. The dry samples were ignited in platinum crucibles at 1000°C for one hour to determine loss on ignition (LOI). An ignited sample (0.6 g) was mixed with dry (heated at 350°C overnight) 50 percent lithium tetraborate - 50 percent lithium metaborate flux (5.4 g) in a 95% Pt - 5% Au crucible and fused in a furnace at 1000°C for 15 minutes. This was followed by a short-cycle fusion in a Claisse Fluxer-Bis using a propane burner. After fusion, the fluxer poured the molten mixture into a 30-mm diameter Pt-5 percent Au mold to make a glass disk (specimen) upon cooling. The specimen was analyzed by a Rigaku 3371 wavelength dispersive X-ray fluorescence spectrometer with an end-window rhodium X-ray tube. Analytical concentrations (on an ignited-sample basis) were calculated by the spectrometer's computer, using calibration curves, based on natural and artificial standards plus matrix correction coefficients.

Trace Elements. Two different methods have been used for trace element analysis. In method I, a low-dilution fusion method, samples are dried at 110°C (4 to 6 hours), ashed overnight at 500°C, and cooled for 2 hours in air. An ashed sample (2.5 g) is mixed with dry 50-50 flux (5.2 g), transferred to a 95% Pt-5% Au crucible and fused in a furnace at 1000°C for 20 minutes. The fused product is ground in a SPEX mixer mill, mixed with 5 percent by weight bakelite plastic resin and pressed into a 32-mm-diameter pellet, which was heated in an oven at 110°C for 20 minutes before analysis using a Rigaku fundamental parameter calibration method. Method II is suitable for use when very volatile elements, such as chlorine, are to be determined. As-received samples are ground in a small tungsten carbide grinding container using a SPEX 8500 shatterbox. A 6.3 g portion of the ground sample is mixed with 0.7 g of CHEMPLEX X-Ray Mix in a plastic beaker and "ground" as per the as-received sample. The ground mixture is pressed into a 32-mm-diameter pellet with a cellulose or X-ray mix backing and analyzed using a Rigaku fundamental parameter calibration method.

The QA protocol for XRF was based upon the use of reference specimens to obtain instrumental drift correction factors for X-ray intensities and analysis of standard samples. The practical determination limits for major elements are: $Si0_2$ (0.1%), $A1_20_3$ (0.1%), Fe_2O_s (0.01%), CaO (0.02 %), MgO (0.1 %), K_2O (0.01%) Na_2O (0.05%), TiO_2 (0.01%), P_2O_5 (0.02%), MnO (0.01%), SrO (0.01%), BaO (0.01%), and SO_3(0.05%). The practical determination limits for trace elements are: Cd (5 parts per million or ppm), CI (20 ppm), Cr (5 ppm), Cu (5 ppm), Pb (10 ppm), Mo (2 ppm), Ni (5 ppm), Nb (2 ppm), Rb (10 ppm), Sn (5 ppm), V (5 ppm), Zn (10 ppm), and Zr (10 ppm).

Atomic Absorption Spectrometry (AAS). AAS was used for determining cadmium, copper, lead, lithium, nickel and zinc.

Duplicate samples of 0.1 g of 500°C ash are digested with 1.5 ml aqua regia (1:3:1; $HN0_3$:HC1:H_20) and 2.5 ml of concentrated hydrophrolic acid (HF) (48%) in 60-ml, tightly capped HDPE plastic bottles for 2 hours on a steam bath. The cap is then removed carefully and 25 ml of 50 g/L H3BO3 solution is added. After cooling, 200 µ.1 of a 0.50 g/ml cesium chloride solution is added and the final solution is diluted to 50 ml. Measurements are made using a Perkin-Elmer Model 306 AAS at settings recommended by the manufacturer. Calibration curves are calculated for each set of analyses using standard solutions. Analysis of standard reference materials are used to evaluate accuracy and precision of the technique. The practical determination limits are: Cd (3 ppm), Cu (5 ppm), Pb (50 ppm), Li (5 ppm), Ni (25 ppm), and Zn (2.5 ppm).

Energy Dispersive X-ray Fluorescence Spectrometry (EDX). EDX was used for determining barium, molybdenum, strontium, tin, and zirconium.

The instrumentation consists of a Kevex Si(Li) detector with a resolution of 155 electron volts or eV (FWHM) at 5.9 KeV, a 300-MCi ^{241}Am excitation source, and a Tracor Northern multichannel analyzer. A sample is ashed at 500°C, then 0.500 g of the ash is placed in a polyethylene cup and sealed with a piece of Mylar film, 0.00015 inch thick. The cup is inverted so that the sample settles as a uniform layer and is placed in an aluminum sample holder and exposed to monochromatic X-ray radiation from secondary targets of dysprosium (Dy) or tin (Sn). Count rates are obtained on samples and standards corrected for background and blanks. Concentrations are calculated from a plot of count rate versus concentration for a series of standards. The practical determination limits are: Ba (10 ppm), Mo (5 ppm), Sr (10 ppm), Sn (5 ppm), and Zr (10 ppm).

Photographic Optical Emission Spectroscopy (OEP). OEP was used for determining beryllium, boron, lead, molybdenum, silver, thallium, and vanadium.

The spectrographic procedure employs a technique involving total volatilization of a prepared sample from a cupped graphite electrode into a current-controlled direct current (d.c.) arc plasma in an atmosphere of 80 percent Ar/20 percent O_2. The spectral emission is dispersed through an Ebert-mount spectrograph of 3.4 m focal length, and the ultraviolet region of the emission spectrum is recorded on a photographic plate. Spectral intensities of the elements of interest are obtained through microphotometry of selected spectral lines. The concentrations of the respective elements in a given sample are computed from calibrated analytical curves relating spectral intensity vs. concentration generated from a series of prepared standards embracing the concentration range of interest.

A 20 milligram (mg) portion of a high-temperature (500°C) ashed sample is mixed with 80 mg of graphite powder in a Wig-L-Bug mixer. A 15-mg portion of this mixture is transferred to an undercut graphite electrode (Ultra Carbon 100-L) and compressed and vented with a special tool to obtain reproducible and stable geometry of the electrode charge during direct current arc excitation. Emission spectra are recorded in duplicate on a single spectrogram. A reference standard is exposed with each group of samples. The detection limits are for Ag (1 ppm), B (20 ppm), Be (0.3 ppm), Pb (8 ppm), Mo (10 ppm), Tl (1 ppm), and V (25 ppm).

Total Carbon, Inorganic Carbon, and Organic Carbon. Carbon was determined using a coulometric technique (Cahill and Autrey, 1987).

Total Carbon. Total carbon is determined by coulometrically titrating the amount of CO2 released from a sample combusted in an oxygen atmosphere at 950°C. A sample is weighed in to a porcelain combustion boat, which is placed in a ladle that is then moved into the combustion zone of a tube furnace. The sample size is selected so that approximately 3 mg of CO_2 is evolved. Normally for sediments, samples of 20-100 mg are used. The oxygen carrier gas sweeps the evolved gases through a catalyst to ensure all carbon is oxidized to $C0_2$, then through a series of scrubbers to remove potential interferences, and then into the CO_2 coulometer. Complete combustion is recognized by a stable coulometer display, which can be read in milligrams of carbon. Accuracy and precision are checked by running NBS reference samples and a set of sediments that have been analyzed by five independent labs.

Inorganic Carbon. Inorganic carbon is determined by coulometrically titrating the amount of CO2 released from a sample to which a known amount of acid has been added. A sample is weighed and placed in a porcelain boat at the bottom of a sample tube. Sample size is selected so that 1-3 mg of CO_2 is evolved by reaction of the acid with carbonate in the sample. Normally for sediments, samples of 20-100 mg are used. After the system has been allowed to purge, 2 ml of 2 N HC1 is dispensed into the sample tube. The tube is rotated onto a heater and the reaction is allowed to proceed until the CO_2 evolution has stopped. The evolved CO_2 is titrated coulometrically and the result is a readout in micrograms of inorganic carbon. Blanks and standard reference material are analyzed with each set of samples.

Organic Carbon. Organic carbon is determined by difference from the independent measurements of total carbon and inorganic carbon. It is felt that the most reliable procedure for the determination of organic carbon in sediments, soils, and other low organic solids (< 30 percent total carbon) is by difference.

Water Chemistry

Water samples were collected for chemical analysis at all 17 sediment sampling stations in the five lakes. The locations of the sampling sites are shown in figures 23-25. The water samples were analyzed for inorganic metals, volatile organic compounds (VOCs) and selected pesticides. Laboratory results for all the analyses are given in appendix D.

Results from the metals analysis show that all samples were within acceptable levels according to IEPA regulations. All samples were below detection limits for silver, arsenic, bismuth, boron, beryllium, cadmium, mercury, molybdenum, antimony, and cobalt. The only site that exhibited a relatively consistent pattern of higher concentrations was site 12 in Triangle Lake of Quincy Bay. The sampling site was frozen to the bottom at the time of sampling. A hole was chopped in the ice and then sampled at the surface after approximately 15 minutes. Therefore the results may be more representative of pore water than surface water conditions.

Volatile organic compounds were below the detection limits for all the samples. The three pesticides tested (simazine, atrazine, and alachor) were also below the detection limits for all the samples.

Sediment Chemistry Data

Results of sediment chemistry analyses for inorganic chemicals and pesticides are presented in this section of the report. As mentioned earlier, inorganic chemical analyses were performed both at the Illinois State Water Survey chemistry lab and the Illinois State Geological Survey geochemistry lab. Because the ISWS lab is an EPA-certified lab, the results from the ISWS lab should be consistent with data generated by the USEPA and the IEPA. However, very little historical sediment chemistry data for the Illinois and Mississippi Rivers have been analyzed following EPA procedures and standards. On the other hand, the ISGS had previously conducted chemical analysis of sediments from the Illinois and Mississippi Rivers that could be used for comparison analysis with the present data (Cahill and Steele, 1986; Cahill and Autrey, 1987). Therefore collection of sediment samples for analysis by the ISGS lab followed procedures similar to those used in their previous studies.

The concentration of metals in sediments determined by the ISWS lab is based on the "total recoverable" metals. In this procedure, the concentration of a particular metal in solution was determined after a representative sample of sediment was digested. Complete dissolution of the sediment is not achieved and thus the determination represents less than the total amount of the constituent in the sample. The concentration of metals in sediments determined by the ISGS lab is based on the "total" metal present. The term "total" is used when the analytical method assures measurement of at least 95 percent of the constituent determined in a representative sediment sample. The two data sets are therefore not directly comparable.

Inorganic Composition of Sediment Samples

Previous analysis of sediments for inorganic composition from backwater lakes associated with the Illinois River has been reported in Cahill and Steele (1986). The report includes references to previous work on Illinois River sediments through 1984. In recent years, most of the research that includes sediment composition information has been for the Upper Illinois River waterway (Cope et al., 1994; Sparks and Ross, 1992) and for Peoria Lake (Demissie and Bhowmik, 1986). The report of Cope et al. (1994) included analysis of Al, Cd, Cr, Cu, Ni, Pb, and Zn in a sediment sample collected in Peoria Lake. The report of Colman and Sanzolone (1991) included 567 samples for 46 elements of the fine-fraction of streambed material in the Upper Illinois River waterway, only. The report of Sparks and Ross (1992) included samples collected in Meredosia Lake and the entrance to Swan Lake, however, only the organic carbon content of the sediments was determined. The report of Demissie and Bhowmik (1986) includes sediment quality in a Peoria Lake core for As, Cd, Cr, Cu, Pb, Zn, and P2O5.

Results from ISGS Lab. The types of analyses performed on the sediment samples are summarized in tables 10 and 11.

The complete inorganic composition results are given in appendix E. The mean, standard deviation, percent relative standard deviation, median, maximum, minimum, and the number of "less than" values obtained in the analysis of the sediments are summarized in table 12. Agreement between analytical techniques is generally good.

Table 10. Sediment Cores Collected for Inorganic Analysis at ISGS Lab

Lake	*ISWS ID*	*Date*	*n*	*TOC*	*XRF*	*AA*	*OE*
Meredosia Lake	RDL-3	1/19/94	5	X	X	X	X
Swan Lake	SDM-20	2/15/94	5	X	X	X	X
Silver Lake	SDN-13	2/15/94	5	X	X	X	X
Stump Lake	RDZ-23	2/15/94	6	X	X	X	X
Quincy Bay-1	Q-10	2/1/94	5	X	X	X	X
Quincy Bay-2	Q-ll	2/1/94	5	X	X	X	X

Note:
n= number of subsamples.

Table 11. Sediment Samples from Splits of ISWS Samples for Inorganic Analysis

Lake	*ISWS ID*	*Date*	*n*	*TOC*	*XRF*	*AA*
Meredosia Lake	RDL-3	1/19/94	2	X	X	X
Swan Lake*	SDM-20	2/15/94	6	X	X	X
Silver Lake	SDN-13	2/15/94	2	X	X	X
Stump Lake	RDZ-23	2/15/94	2	X	X	X
Quincy Bay-1	Q-10	2/1/94	2	X	X	X
Quincy Bay-2	Q-ll	2/1/94	2	X	X	X

Notes:

* For Swan Lake the top interval of ISWS Cores 14, 15, 16, and 19 were also analyzed.

n = number of subsamples.

Table 13 compares the results from sediment collected in 1975 from Meredosia Lake and cores collected in Swan Lake and Silver Lake in 1983 to results in this report (Cahill and Steele, 1986). The organic carbon levels reported here are higher by about 0.5 percent over previous results, while for most elements the compositions are very similar.

The sediments of the Lower Illinois River are compared to the sediments of Quincy Bay in table 14. In most cases the Illinois River sediments have slightly higher levels of carbon, calcium, and a number of trace elements. In contrast, barium, molybdenum, sodium, and zirconium were higher in the Quincy Bay samples.

The composition of the surface sediment taken from the top intervals of the cores sampled is compared to the composition of the older deeper sediments in table 15. Only manganese, phosphorus and sulfur were found to be statistically different using the standard t test.

Results from ISWS Chemistry Lab. The results from the ISWS chemistry lab are given in appendix E. The tables give concentration values from 31 elements for 34 samples. Analysis was performed for a recent sediment sample (top interval) and an older sediment sample (bottom interval) at each of the 17 sampling sites. The mean, standard deviation, percent relative standard deviation, median, maximum, and the number of "less than minimum detection" values are summarized in table 16. The values for As, Bi, Hg, Se, Ag, Sn, and Tl are below the minimum detection level for all the samples.

The inorganic chemical composition of the sediment samples from the Illinois River are compared with those from the Mississippi River in table 17. The mean, maximum, and minimum values of the different elements for all the samples from the Illinois and Mississippi River are provided. In general the concentrations of the inorganic chemicals in the Illinois River sediments are higher than those of the Mississippi River sediments with the exception of four elements (Mn, Si, Ti, and Ba).

Table 12. Mean Values for the Inorganic Chemical Composition of Sediment (ISGS Lab)

Elements	*Units*	*Mean*	*Standard deviation*	*Relative standard deviation (percent)*	*Median*	*Maximum*	*Minimum*	*n "less than" values*
Total Carbon	%	2.79	0.60	21.4	2.70	4.31	1.62	0
Inorganic Carbon	%	0.48	0.26	53.5	0.51	1.00	0.02	0
Organic Carbon	%	2.31	0.53	23.0	2.19	3.88	1.59	0
Al_2O_3	%	14.53	0.92	6.3	14.52	16.16	12.44	0
CaO	%	2.91	1.19	40.9	3.02	5.24	1.00	0
Fe_2O_3	%	5.96	0.58	9.7	6.02	7.15	4.71	0
MgO	%	1.60	0.17	10.6	1.59	1.95	1.28	0
MnO_2	%	0.14	0.06	40.5	0.12	0.30	0.05	0
P_2O_5	%	0.25	0.04	17.8	0.24	0.36	0.14	0
K_2O	%	2.36	0.15	6.4	2.37	2.64	2.04	0
SiO_2	%	60.45	3.66	6.1	59.50	67.33	53.79	0
Na_2O	%	0.78	0.19	24.9	0.75	1.16	0.49	0
SO_3	%	0.26	0.14	54.3	0.23	0.55	0.06	0
TiO_2	%	0.76	0.03	4.2	0.76	0.81	0.69	0
Ba	ppm	619	47	7.6	615	732	521	0
Ba(1)	ppm	688	48	7.0	687	818	579	0
Be (3)	ppm	2	0.5	21.1	2	3	1	16
B(3)	ppm	49	10	21.0	46	82	39	16
Cd	ppm	2	1.2	52.5	2	6	1	21
Cd(2)	ppm	<1.6						47
Cr	ppm	80	9	11.4	78	112	62	0
Cu	ppm	34	9.4	27.3	33	87	24	0
Cu(2)	ppm	31	5.5	18.1	30	43	18	0
Pb	ppm	34	4.45	13.3	34	42	23	0
Pb(2)	ppm	<24						47
Pb(3)	ppm	33	6.3	19.0	32	50	22	16
Li (2)	ppm	39	5.3	13.9	38	48	28	0
Mo	ppm	2	0.7	47.1	1	3	1	29
Mo(1)	ppm	14	6.3	44.4	12	27	5	9
Mo (3)	ppm	11	0.6	5.5	11	11	10	43
Ni	ppm	46	9	20.1	44	93	35	0
Ni(2)	ppm	24	7	29.2	24	40	9	0
Nb	ppm	18	1	6.6	18	20	15	0
Rb	ppm	114	10	9.4	113	138	95	0
Ag(3)	ppm	<1						47
Sr	ppm	115	8	7.4	114	138	96	0
Sr(1)	ppm	116	17	14.4	114	212	97	0
Tl(3)	ppm	1	0.8	56.6	1	4	1	31
Sn	ppm	1	0.6	43.3	1	2	1	44
Sn(1)	ppm	8	1.6	20.1	8	12	5	13
V	ppm	118	9	7.3	121	133	97	0
V(3)	ppm	156	32	20.7	151	250	113	16
Zn	ppm	138	18	12.8	137	170	106	0
Zn(1)	ppm	100	24	24.2	102	139	66	22
Zn(2)	ppm	141	18	12.7	141	173	94	0
Zr	ppm	205	31	15.3	200	303	154	0
Zr(1)	ppm	250	44	17.6	248	374	147	0

Table 13. Comparison of 1994 Sediment Composition with Previous Data (ISGS Lab)

		Analysis Number/Lake, Date Collected, Interval						
Elements	*Units*	*R20049/ Meredosia, 1994, 0-5 (cm)*	*R12240/ Meredosia, 1975, 0-8 (cm)*	*R12249/ Meredosia, 1975, 0-8 (cm)*	*R20076/ Swan, 1994, 0-5 (cm)*	*R15045/ Swan, 1983, 0-5 (cm)*	*R20081/ Silver, 1994, 0-5 (cm)*	*RJ5041/ Silver, 1983, 0-5 (cm)*
Total Carbon	%	3.65	2.1	2.79	2.77	2.51	3.02	2.18
Inorganic Carbon	%	0.92	0.56	0.58	0.54	0.63	0.25	0.17
Organic Carbon	%	2.73	1.54	2.21	2.23	1.88	2.77	2.01
$A1_20_3$	%	14.91	13.28	15.46	14.10	16.10	14.14	16
CaO	%	5.02	2.69	2.34	3.18	3.9	1.9	1.6
Fe_20_3	%	6.61	5.28	6.72	5.93	5.57	5.79	5.21
MgO	%	1.89	1.71	1.86	1.65	1.6	1.49	1.42
MnO_2	%	0.21	0.08	0.1	0.217	0.1	0.198	0.1
P_2O_s	%	0.34	0.37	0.64	0.29	0.26	0.27	0.29
K_2O	%	2.52	2.24	2.2	2.34	2.51	2.27	2.33
SiO_2	%	54.44	61.25	52.48	60.00	60.70	62.06	62.7
NaO	%	0.52	0.85	0.44	0.93	0.66	0.99	0.71
SO_3	%	0.21	0.05	0.04	0.14		0.16	
TiO_2	%	0.71	0.87	0.82	0.75	0.78	0.77	0.83
Ba	ppm	604			598		641	
Ba(l)	ppm	664	680	590	685	751	717	725
Be (3)	ppm	2.7			2.1		2.4	
B(3)	ppm	39			40		42	
Cd	ppm	4			2		<1	
Cd(2)	ppm	<3	<7	<7	<3	<1.2	<3	<1
Cr	ppm	112	98	94	76	84	83	74
Cu	ppm	36			40		31	
Cu(2)	ppm	26	30	39	25	33	26	29
Pb	ppm	36			33		29	
Pb(2)	ppm	<50	20	28	<51	33	<51	28
Pb(3)	ppm	36			33		30	
Li (2)	ppm	45			38		38	
Mo	ppm	1			1		<1	
Mo(l)	ppm	22	1.8	2.6	18		12	
Mo (3)	ppm	<10			<10		<10	
Ni	ppm	61			44		93	
Ni(2)	ppm	21	34	43	23	27	22	18
Nb	ppm	15			17		18	
Rb	ppm	124	180	210	110	116	110	97
Ag(3)	ppm	<1			<1		<1	
Sr	ppm	124			124		113	
Sr(l)	ppm	124			127		116	
T13)	ppm	<1			<1		2	
Sn	ppm	<5			<5		<1	
Sn(l)	ppm	10			7		11	
V	ppm	115			118		116	
V(3)	ppm	169			127		127	
Zn	ppm	163			137		131	
Zn(2)	ppm	162	137	154	137	137	129	132
Zr	ppm	157			217		210	
Zr(l)	ppm	197			262		266	

Table 14. Comparison of Inorganic Chemical Composition of Sediment Samples from the Illinois River and the Mississippi River (ISGS Lab)

		Illinois River samples			*Quincy Bay samples*			*Ratio*	*of means*
Elements	*Units*	*Mean*	*Maximum*	*Minimum*	*Mean*	*Maximum*	*Minimum*		*(percent)*
Total Carbon	%	2.92	4.31	1.62	2.49	3.56	1.81	1.17	14.7
Inc. Carbon	%	0.52	1.00	0.02	0.38	0.82	0.07	1.38	27.3
Org. Carbon	%	2.40	3.88	1.60	2.11	2.86	1.59	1.14	12.0
Al_2O_3	%	14.75	16.16	12.72	14.00	15.40	12.44	1.05	5.1
CaO	%	3.10	5.24	1.07	2.48	4.48	1.00	1.25	20.0
Fe_2O_3	%	6.08	7.15	5.05	5.66	6.26	4.71	1.07	6.9
MgO	%	1.66	1.95	1.28	1.45	1.61	1.32	1.14	12.3
MnO_2	%	0.14	0.26	0.05	0.14	0.30	0.09	1.00	-0.4
P_2O_5	%	0.25	0.34	0.14	0.23	0.36	0.17	1.08	7.7
K_2O	%	2.43	2.64	2.23	2.19	2.36	2.04	1.11	9.7
SiO_2	%	59.60	67.07	53.79	62.43	67.33	57.91	0.95	-4.7
NaO	%	0.73	1.16	0.49	0.91	1.16	0.67	0.80	-24.9
SO_3	%	0.27	0.55	0.08	0.23	0.46	0.06	1.18	15.1
TiO,	%	0.76	0.81	0.70	0.76	0.79	0.69	1.00	0.3
Ba	ppm	597	659	521	671	732	623	0.89	-12.5
Be (3)	ppm	2	3	2	2	3	1	1.06	5.3
B(3)	ppm	50	82	39	47	54	40	1.06	6.1
Cd	ppm	2	6	1	2	3	1	1.08	7.6
Cr	ppm	81	112	62	76	90	67	1.07	6.9
Cu	ppm	37	87	26	29	34	24	1.25	20.1
Cu(2)	ppm	32	43	21	29	41	18	1.10	9.4
Pb	ppm	34	42	23	32	38	26	1.07	6.6
Pb(3)	ppm	34	50	23	30	38	22	1.14	12.6
Li (2)	ppm	41	48	29	33	39	28	1.24	19.0
Mo	ppm	1	3	1	2	3	1	0.82	-22.5
Ni	ppm	48	93	36	39	44	35	1.23	18.8
Ni(2)	ppm	26	40	11	20	30	9	1.30	23.0
Nb	ppm	18	20	15	18	20	17	0.98	-2.4
Rb	ppm	118	138	95	105	125	96	1.12	10.5
Sr	ppm	115	138	104	115	123	96	1.00	0.3
Sn(1)	ppm	8	11	5	9	12	6	0.93	-7.3
V	ppm	120	133	104	114	133	97	1.06	5.7
Zn	ppm	144	170	106	124	148	108	1.17	14.4
Zn(2)	ppm	147	173	104	127	149	94	1.16	13.7
Zr	ppm	198	303	154	222	265	180	0.89	-12.5
Zr(1)	ppm	242	374	147	267	326	228	0.91	-10.2

Table 15. Comparison of Inorganic Chemical Composition of Illinois and Mississippi River Sediment Samples Taken from the Top Interval (Recent) with Those Taken at the Bottom Interval (Older) (ISGS Lab)

		Top intervals		*Bottom intervals*			
Elements	*Units*	*Means*	*Standard deviation*	*Means*	*Standard deviation*	*Ratio top to bottom*	*Percent relative difference*
Total Carbon	%	3.00	0.41	2.61	0.57	1.1	13.0
Inc. Carbon	%	0.60	0.24	0.42	0.26	1.4	29.5
Org. Carbon	%	2.41	0.33	2.19	0.52	1.1	9.1
$A1_2O_3$	%	14.06	0.82	14.68	0.89	1.0	-4.4
CaO	%	3.42	1.10	2.63	1.20	1.3	23.1
Fe_2O_3	%	5.86	0.58	5.97	0.59	1.0	-1.9
MgO	%	1.63	0.17	1.57	0.03	1.0	3.8
MnO_2	%	0.19	0.05	0.10	0.02	1.9	46.2
P_2O_5	%	0.28	0.04	0.23	0.04	1.2	16.9
K_2O	%	2.30	0.14	2.38	0.15	1.0	-3.3
SiO_2	%	60.00	3.53	60.82	3.80	1.0	-1.4
Na_2O	%	0.77	0.17	0.80	0.04	1.0	-4.9
SO_3	%	0.17	0.05	0.31	0.16	0.5	-84.7
TiO_2	%	0.74	0.03	0.77	0.03	1.0	-3.1
Ba	ppm	602	47.9	629	45.2	1.0	-4.5
Be (3)	ppm	2	0.5	2	0.5	0.8	-22.2
B(3)	ppm	46	6.3	50	11.0	0.9	-10.0
Cd	ppm	2.1	1.1	2.6	1.3	0.8	-21.3
Cr	ppm	78	11.6	80	7.9	1.0	-3.1
Cu	ppm	31	4.7	36	11.0	0.9	-16.0
Cu(2)	ppm	31	6.0	30	5.4	1.0	1.2
Pb	ppm	31	3.2	35	4.6	0.9	-11.4
Pb(3)	ppm	33	3.4	33	6.8	1.0	-1.0
Li (2)	ppm	37	5.6	39	5.2	1.0	-4.2
Mo	ppm	1	0.0	2	0.8	0.6	-75.0
Ni	ppm	46	14.6	45	5.4	1.0	0.8
Ni(2)	ppm	20	4.7	26	7.3	0.7	-34.0
Nb	ppm	18	0.9	18	1.3	1.0	-2.3
Rb	ppm	109	9.6	116	10.8	0.9	-6.0
Sr	ppm	117	8.0	114	8.8	1.0	2.5
Sn(l)	ppm	8	2.0	8	1.6	0.9	-6.0
V	ppm	114	8.3	120	8.1	0.9	-5.9
Zn	ppm	134	18.0	139	17.9	1.0	-3.5
Zn(2)	ppm	139	14.5	141	18.6	1.0	-1.2
Zr	ppm	208	28.7	204	33.0	1.0	2.0
Zr(l)	ppm	252	43.7	250	45.5	1.0	0.6

Notes:

(n) = XRF, (1) = EDX, (2) = AA, (3)=OEP

Table 16. Statistical Values of the Total Recoverable Inorganic Chemical Composition of Sediment Samples (IS WS Lab)

Elements	*Units*	*Mean*	*Standard deviation*	*Relative standard deviation (percent)*	*Median*	*Maximum*	*Minimum*	*n "less than"*
Aluminum	%	1.0	0.1	14.5	1.0	1.3	0.7	0
Calcium	%	1.0	0.4	37.9	1.0	1.7	0.4	0
Iron	%	1.4	0.2	12.1	1.4	1.7	0.9	0
Magnesium	%	0.3	0.0	16.0	0.3	0.4	0.2	0
Manganese	ug/g	553.5	233.6	42.2	489.5	1071.0	255.0	0
Phosphorus	ug/g	464.7	94.8	20.4	463.0	703.0	284.0	0
Potassium	%	0.0	0.0	15.6	0.0	0.1	0.0	0
Silicon	%	0.1	0.0	38.7	0.1	0.2	0.0	0
Sodium	ug/g	65.1	10.2	15.7	65.0	95.4	48.3	0
Sulfur	ug/g	538.8	374.3	69.5	403.5	1616.0	201.0	0
Titanium	ug/g	91.9	16.0	17.4	93.1	135.2	54.9	0
Arsenic	ug/g	<7.5						34
Barium	ug/g	97.8	15.0	15.3	96.2	137.5	65.8	0
Boron	ug/g	3.0	0.5	15.6	2.9	4.0	2.5	17
Beryllium	ug/g	0.6	0.1	20.4	0.6	0.8	0.2	0
Bismuth	ug/g	<11.0						34
Cadmium	ug/g	1.0	0.0	7.8	1.0	1.1	0.9	27
Chromium	ug/g	11.5	1.3	11.3	11.5	14.0	8.0	0
Cobalt	ug/g	6.7	0.6	9.6	6.9	7.7	4.7	0
Copper	ug/g	13.1	2.1	16.2	13.5	16.5	6.9	0
Lead	ug/g	16.3	2.2	13.8	16.2	20.0	10.3	0
Lithium	ug/g	8.3	1.5	17.9	8.2	12.0	5.4	0
Mercury	ug/g	<1.7						34
Molybdenum	ug/g	1.2	0.5	41.3	1.0	1.9	0.9	30
Nickel	ug/g	14.8	2.2	14.9	14.9	18.6	8.9	0
Selenium	ug/g	<10.2						34
Silver	ug/g	<0.3						34
Antimony	ug/g	16.7			16.7	16.7	16.7	33
Tin	ug/g	<5.8						34
Strontium	ug/g	18.7	4.8	26.0	19.1	27.9	10.6	0
Thallium	ug/g	<28						34
Vanadium	ug/g	18.5	2.5	13.7	19.1	22.9	13.4	0
Zinc	ug/g	58.3	10.9	18.7	57.9	100.9	36.4	0

Table 17. Comparison of the Total Recoverable Inorganic Chemical Composition of Illinois and Mississippi River Sediment Samples (ISWS Lab)

		Illinois River Samples			*Mississippi River Samples*			*Ratio of*	*Percent*
Elements	*Units*	*Mean*	*Maximum*	*Minimum*	*Mean*	*Maximum*	*Minimum*	*means*	*difference*
Aluminum	%	1.0	1.3	0.8	1.0	1.2	0.7	1.04	3.9
Calcium	%	1.1	1.7	0.4	0.7	1.2	0.5	1.64	64.1
Iron	%	1.5	1.7	1.2	1.3	1.6	0.9	1.10	9.9
Magnesium	%	0.3	0.4	0.2	0.3	0.3	0.2	1.24	23.7
Manganese	ug/g	521.4	923.0	255.0	612.5	1071.0	295.0	0.85	-17.5
Phosphorus	ug/g	476.8	627.0	335.0	442.6	703.0	284.0	1.08	7.7
Potassium	%	0.0	0.1	0.0	0.0	0.1	0.0	1.12	11.7
Silicon	%	0.1	0.2	0.0	0.1	0.2	0.0	0.69	-45.7
Sodium	ug/g	69.2	95.4	54.0	57.7	66.3	48.3	1.20	19.9
Sulfur	ug/g	618.5	1616.0	201.0	392.7	1081.0	222.0	1.58	57.5
Titanium	ug/g	84.6	107.5	54.9	105.4	118.4	76.9	0.80	-24.6
Arsenic	ug/g	<7.5			<7.5				
Barium	ug/g	95.6	113.0	78.5	101.8	137.5	65.8	0.94	-6.5
Boron	ug/g	3.1	4.0	2.5	2.7	2.9	2.5	1.13	12.6
Beryllium	ug/g	0.6	0.8	0.4	0.5	0.7	0.2	1.25	25.0
Bismuth	ug/g	<11			<11				
Cadmium	ug/g	1.0	1.1	0.9	0.9	0.9	0.9	1.11	11.1
Chromium	ug/g	11.6	14.0	9.3	11.3	12.6	8.0	1.03	3.4
Cobalt	ug/g	6.9	7.7	5.9	6.3	7.5	4.7	1.10	9.7
Copper	ug/g	14.3	16.5	11.2	11.1	14.4	6.9	1.28	28.2
Lead	ug/g	16.9	20.0	13.9	15.1	19.0	10.3	1.13	12.5
Lithium	ug/g	8.8	12.0	6.5	7.4	8.5	5.4	1.19	19.4
Mercury	ug/g	<1.7			<1.7				
Molybdenum	ug/g	1.3	1.9	0.9	0.9	0.9	0.9	1.41	40.7
Nickel	ug/g	15.8	18.6	11.6	13.0	15.2	8.9	1.22	21.6
Selenium	ug/g	<10.2			<10.2				
Silver	ug/g	<0.3			<0.3				
Antimony	ug/g	<15.5			16.7	16.7	16.7		
Tin	ug/g	<5.8			<5.8				
Strontium	ug/g	21.1	27.9	12.0	14.3	19.2	11.3	1.48	47.6
Thallium	ug/g	<28			<28				
Vanadium	ug/g	18.8	22.9	13.5	18.1	22.3	13.4	1.04	3.5
Zinc	ug/g	60.1	71.3	43.3	55.1	100.9	36.4	1.09	9.1

The inorganic chemical composition of the top sediment layers (recent) is compared with that of the bottom sediment layers (older) for the Illinois and Mississippi Rivers in tables 18 and 19, respectively. For the Illinois River, the bottom sediment layers have higher concentrations of 16 elements, while the top sediment layers have higher concentrations of eight elements. The greatest differences are for S where the bottom sediments are 187 percent higher than the top sediments. On the other hand, for Mn, the top sediment has 91 percent higher concentrations than the bottom layer.

For the Mississippi River samples, the top sediment layers have higher concentrations of 16 elements, while the bottom layers have higher concentrations of seven elements. The greatest differences are for Mn where the top layers are 127 percent higher than the bottom layers and for S where the bottom layers are 106 percent higher than the top layers.

Pesticides in Sediment Samples

Sediment samples from the 17 sampling sites were tested for three pesticides (atrazine, simazine, and alachlor) that were reported to have been present in the floodwaters during the 1993 flood. Analysis was performed for top and bottom sediment layers to evaluate the impact of the flood on the most recent sediment layers. Laboratory results presented in table 20 show that simazine was not detected in either top or bottom sediments from all 17 sampling sites. Atrazine was not detected in any of the bottom sediments but was detected in two top sediment samples from Lake Meredosia. Alachlor was detected in 12 of the 17 top sediment samples and from three bottom sediment samples from Quincy Bay.

Table 18. Comparison of Inorganic Chemical Composition of Top and Bottom Sediment Samples from the Illinois River (ISWS Lab)

		Top intervals		*Bottom intervals*			
Elements	*Units*	*Mean*	*Standard deviation*	*Means*	*Standard deviation*	*Ratio top to bottom*	*Percent relative difference*
Aluminum	%	1.0	0.2	1.1	0.2	0.9	-5.7
Calcium	%	1.3	1.3	1.0	0.3	1.3	28.2
Iron	%	1.5	1.5	1.5	0.1	1.0	-0.5
Magnesium	%	0.3	0.3	0.3	0.0	1.1	5.3
Manganese	ug/g	684.9	685.0	357.8	68.3	1.9	91.4
Phosphorus	ug/g	533.6	536.5	420.0	51.5	1.3	27.1
Potassium	%	0.0	0.0	0.0	0.0	1.0	-0.9
Silicon	%	0.1	0.1	0.0	0.0	1.1	11.3
Sodium	ug/g	69.9	69.9	68.4	8.6	1.0	2.3
Sulfur	ug/g	319.6	319.5	917.5	391.0	0.3	-187.0
Titanium	ug/g	81.8	84.2	87.4	10.0	0.9	-6.9
Arsenic	ug/g	<7.5		<7.5			
Barium	ug/g	95.1	95.0	96.1	8.7	1.0	-1.0
Boron	ug/g	3.0	3.0	3.1	0.4	1.0	-2.7
Beryllium	ug/g	0.6	0.6	0.6	0.0	0.9	-5.6
Bismuth	ug/g	<11		<11			
Cadmium	ug/g	1.0	1.0	1.0	0.0	1.1	8.8
Chromium	ug/g	11.2	11.2	12.1	1.2	0.9	-8.1
Cobalt	ug/g	6.9	6.9	6.9	0.4	1.0	-1.2
Copper	ug/g	13.6	13.6	14.9	1.0	0.9	-8.9
Lead	ug/g	15.8	15.8	18.0	1.6	0.9	-13.8
Lithium	ug/g	8.7	8.7	8.9	1.4	1.0	-1.9
Mercury	ug/g	<1.7		<1.7			
Molybdenum	ug/g	1.5	1.5	0.9		1.6	61.1
Nickel	ug/g	14.9	14.7	16.7	1.2	0.9	-12.5
Selenium	ug/g	<10.2		<10.2			
Silver	ug/g	<0.3		<0.3			
Antimony	ug/g	<15.5		<15.5			
Tin	ug/g	<5.8		<5.8			
Strontium	ug/g	22.1	22.1	20.0	4.7	1.1	10.4
Thallium	ug/g	<28		<28			
Vanadium	ug/g	17.8	18.2	19.7	2.5	0.9	-10.1
Zinc	ug/g	58.6	58.3	61.6	6.1	1.0	-5.0

Table 19. Comparison of Inorganic Chemical Composition of Top and Bottom Sediment Samples from the Mississippi River (ISWS Lab)

		Top intervals		*Bottom intervals*			
Elements	*Units*	*Means*	*Standard deviation*	*Mean*	*Standard deviation*	*Ratio top to bottom*	*Percent relative difference*
Aluminum	%	1.1	0.0	0.9	0.2	1.1	10.7
Calcium	%	0.7	0.3	0.7	0.3	1.1	13.0
Iron	%	1.4	0.1	1.3	0.2	1.1	12.3
Magnesium	%	0.3	0.0	0.2	0.0	1.1	7.4
Manganese	ug/g	850.2	208.9	374.8	75.1	2.3	126.8
Phosphorus	ug/g	526.8	92.7	358.3	58.2	1.5	47.0
Potassium	%	0.0	0.0	0.0	0.0	1.1	7.8
Silicon	%	0.1	0.0	0.2	0.0	0.9	-11.9
Sodium	ug/g	60.2	5.8	55.2	6.0	1.1	8.9
Sulfur	ug/g	257.0	27.1	528.3	295.0	0.5	-105.6
Titanium	ug/g	104.2	19.7	106.6	8.4	1.0	-2.4
Arsenic	ug/g	<7.5		<7.5			
Barium	ug/g	105.6	16.6	97.9	27.2	1.1	7.9
Boron	ug/g	2.7	0.3	2.8	0.2	1.0	-1.9
Beryllium	ug/g	0.5	0.0	0.5	0.2	1.1	13.0
Bismuth	ug/g	<11		<11			
Cadmium	ug/g	0.9		0.9		1.0	0.0
Chromium	ug/g	11.7	0.3	10.9	1.8	1.1	7.4
Cobalt	ug/g	6.5	0.4	6.1	1.0	1.1	7.4
Copper	ug/g	11.1	0.7	11.2	2.7	1.0	-1.2
Lead	ug/g	15.0	1.5	15.2	3.4	1.0	-1.3
Lithium	ug/g	7.5	1.1	7.3	1.3	1.0	2.7
Mercury	ug/g	<1.7		<1.7			
Molybdenum	ug/g	<0.9		0.9		0.0	
Nickel	ug/g	13.6	1.1	12.4	2.4	1.1	9.4
Selenium	ug/g	<10.2		<10.2			
Silver	ug/g	<0.3		<0.3			
Antimony	ug/g	<15.5		16.7		0.0	
Tin	ug/g	<5.8		<5.8			
Strontium	ug/g	15.3	2.0	13.2	2.9	1.2	15.9
Thallium	ug/g	<28		<28			
Vanadium	ug/g	18.6	2.0	17.6	3.2	1.1	5.6
Zinc	ug/g	53.1	2.3	57.0	23.0	0.9	-7.4

Table 20. Laboratory Results of Tests for Pesticides in Sediments of Backwater Lakes

		ug/kg wet sediment					
Sample		*Top*			*Bottom*		
number	*Comments*	*Atrazine*	*Simazine*	*Alachlor*	*Atrazine*	*Simazine*	*Alachlor*
Meredosia 1		2.3	<1.5	12.9	<1.5	<1.5	<7.5
Meredosia 2		1.8	<1.5	<7.5	<1.5	<1.5	<7.5
Meredosia 3		<1.5	<1.5	<7.5	<1.5	<1.5	<7.5
Meredosia 4		<1.5	<1.5	7.6	<1.5	<1.5	<7.5
Quincy 5		<1.5	<1.5	27.4	<1.5	<1.5	8.8
Quincy 6		<1.5	<1.5	12.3	nd	nd	nd
Quincy 9		<1.5	<1.5	15.4	<1.5	<1.5	10.6
Quincy 10		<1.5	<1.5	15.4	<1.5	<1.5	13.0
Quincy 11		<1.5	<1.5	21.7	<1.5	<1.5	<7.5
Quincy 12		1.5	<1.5	49.1	<1.5	<1.5	<7.5
Silver 13		<1.5	<1.5	13.6	<1.5	<1.5	<7.5
Swan 14		<1.5	<1.5	10.4	<1.5	<1.5	<7.5
Swan 15		<1.5	<1.5	18.2	<1.5	<1.5	<7.5
Swan 16		<1.5	<1.5	11.0	nd	nd	nd
Swan 19		<1.5	<1.5	7.7	<1.5	<1.5	<7.5
Swan 20		<1.5	<1.5	9.5	<1.5	<1.5	<7.5
Stump 23		<1.5	<1.5	<7.5	<1.5	<1.5	<7.5
Stump 24		<1.5	<1.5	<7.5	<1.5	<1.5	<7.5
Stump 25		<1.5	<1.5	<7.5	<1.5	<1.5	<7.5
Meredosia 3*	Lab split - duplicate of Meredosia 3	nd	nd	nd	<1.5	<1.5	<7.5
Quincy 5*	Lab split - duplicate of Quincy 5	<1.5	<1.5	16.1	nd	nd	nd
Swan 15*	Lab split - duplicate of Swan 15	<1.5	<1.5	10.4	nd	nd	nd
Stump 25*	Lab split - duplicate of Stump 25	nd	nd	nd	<1.5	<1.5	<7.5

Notes:
nd = not determined/no sample
Backwater Lakes — Sediments (Demissie, 1-5-39587)
Pesticides: Extraction = USEPA Method 3550, Sonication; Analysis = USEPA Method 507, Capillary GQNPD
Analyst: Daniel L. Webb

Sediment Toxicity

During the process of finalizing the different components of the project, the IEPA and ISWS decided to include a component in which the toxicity of the sediment samples analyzed for chemical composition would be tested at the IEPA Ecotoxicology Laboratory in Springfield, Illinois. The goal of this component was to determine if recent sediments deposited by the 1993 flood were more toxic than the older sediments.

Data Collection Sites

Sediment and water samples for toxicity testing were collected at the 17 sampling sites from the five lakes discussed in the section on sedimentation and shown in figures 23-25. Four sampling sites were in Lake Meredosia, five in Quincy Bay, one in Silver Lake, four in Swan Lake, and three in Stump Lake.

Data Collection Procedures

Water samples for toxicity tests were collected at 50 cm (2 feet) above the lake bed. Top sediment samples were taken from the top 3 cm of the core samples. Bottom sediment samples were taken from cores 20-30 cm from the top. If core length was less than 30 cm, the bottom 10 cm of the core was taken.

Sediment core sample collection has been discussed in the section on sediment quality.

Laboratory Methods for Testing Toxicity of Water and Sediment Samples

Sample Preparation

Water Samples. Processing of water samples for toxicity testing was initiated within 24 hours of receipt by the laboratory. Water samples were warmed to 20°C and gently aerated for about 30 minutes using disposable glass pipettes providing 100 bubbles per minute of contaminant-free air following methods in EPA/600/4-90/027 (USEPA, 1991b).

Sediment Elutriation. Processing of sediment samples for toxicity testing was initiated within two weeks of receipt by the laboratory. The ISWS provided 40-70 ml of sediment from the top 0-3 cm and the bottom 15-30 cm of sediment cores. Elutriation of sediment samples was similar to that required by the Corps of Engineers or COE (U.S. Army Corps of Engineers, 1976), but with several modifications designed to enhance the probability of detecting any toxicity present in a sample.

Overlying water from the sampling site was mixed with sediment in a 2:1 volume:volume ratio, rather than the standard 4 parts distilled water to 1 part sediment used by the COE. The use of overlying site water was also designed to more closely simulate the materials biologically available in the field, since factors such as water pH can greatly affect the solubility of many materials.

The water and sediment was mixed by tumbling for 24 hours in closed containers at 4°C, rather than aerating the mixtures for 2-3 hours at room temperature as in the COE method to minimize the loss of any volatile or semivolatile materials in the mixture.

Sediment/water slurries were centrifuged at 2000 mm for 20 minutes, and the supernatants were used in toxicity tests. The COE method uses filtration to separate water from the sediment, which could result in the loss of materials that adsorb to the filters.

Water Chemistry. Ammonia and chlorine in water and elutriate samples were measured using USEPA-approved colorimetric methods (Hach, 1993). Dissolved oxygen, temperature, pH, and conductivity were evaluated using probes according to USEPA methods (USEPA, 1991b).

Toxicity Testing

Microtox™ Toxicity Test (Bulich, 1982). Aliquots of commercially available Microtox™ reagent (Photobacterium phosphoreum) were exposed in duplicate water samples and elutriates. Duplicate blanks (controls) contained Microtox™ diluent and the aliquot of bacteria. Using the Microtox™ instrument (a photometer), luminescence readings were taken at 5 and 15 minutes after addition of bacterial aliquots to the samples. The increase or decrease in luminescence in test samples was calculated relative to the natural luminescent decay in the control samples. A sample was considered nontoxic if there was an increase in luminescence compared to the controls, or if the decrease in luminescence was less than 20 percent, marginally toxic if there was a decrease in luminescence of between 20 and 49 percent, and toxic if the decrease in luminescence compared to the controls was 50 percent or greater.

Ceriodaphnia dubia 48-hour Acute Toxicity Test (USEPA, 1991b). Twenty C. *dubia* neonates (<24 hours old) were added to quadruplicate aliquots of negative control water (laboratory culture water), positive control water (2400 mg/L NaCl in laboratory control water), and sample water. Test containers were incubated at 20°C on a 16:8 hour light:dark cycle according to EPA/600/4-90/027 (USEPA, 1991b). The numbers of living *C. dubia* were recorded at 24 and 48 hours after test initiation. The percent mortality of organisms in each treatment was calculated. A sample was considered nontoxic if mortality was between 0 and 19 percent, marginally toxic if mortality was between 20 and 49 percent, and toxic if mortality was 50 percent or greater.

Results

The results of the toxicity tests for all the water and sediment samples are provided in appendix F. The test results show that none of the samples was toxic in the acute *Ceriodaphnia dubia* (water flea) screening test or in the Microtox test, which measures the light output of a bioluminescent bacterium. In these screening tests, a sample is considered toxic if the *C. dubia* mortality is 50 percent or greater or if the light reduction in the Microtex test is 50 percent or greater. Samples are "marginally toxic" if *C. dubia* mortality is 20 to 49 percent or the light output of the Microtox test is reduced by 20 to 49 percent. Any impact below 20 percent is considered within the range of variability of the test. Most sediment samples stimulated light output in the Microtox test. Many sediment samples contained 50 to 20 parts per million (ppm) of ammonia, which would have a stimulatory effect on the Microtox bacterium, yet would not be high enough to cause significant mortality to *C. dubia*.

Summary and Conclusions

A rare combination of climatic and hydrologic conditions in 1993 resulted in the worst flooding the Midwest has ever experienced. This natural disaster had a significant effect on Illinois, a state whose borders include 581 miles of the Mississippi River in addition to the Illinois River that flows through the center of the state. Record flooding on the Mississippi River occurred all along the Illinois border, and the Lower Illinois River surpassed previous flood records due to backwater effects from the Mississippi River combined with moderate flooding from the Illinois River basin.

Backwater lakes along the Illinois and Mississippi Rivers are important ecological, recreational, and economic resources of the state that are under stress because of continuous sediment accumulation. Due to geologic, geomorphic, and hydraulic control factors, there are more backwater lakes along the Illinois River than along the Mississippi River bordering Illinois. It is estimated that Illinois River backwaters have lost more than 70 percent of their capacity on average, with some lakes having completely filled up with sediment. The impact of a major flood such as the one in 1993 on backwater lakes has not been investigated before. The main goal of this project therefore was to assess the status of selected backwater lakes and to evaluate how the 1993 flood might have affected them.

After evaluating existing information on backwater lakes along the Illinois and Mississippi Rivers, four backwater lakes were selected for detailed investigation. Three of the lakes (Swan, Stump, and Meredosia) are located on the Illinois River, while the fourth (Quincy Bay) is located on the Mississippi River. Water and sediment samples were also collected from Silver Lake at the junction of the Mississippi and Illinois Rivers. Complete sedimentation surveys of the four lakes were conducted and compared to previous surveys where available. Six sediment cores were also collected from the five lakes for ^{137}Cs analysis to determine the rate of sedimentation for different periods since 1952, the start of atmospheric testing of nuclear weapons.

The sedimentation survey for Quincy Bay included a survey of 34 cross-sectional transects surveyed previously in 1985. Because of the complex configuration of the bay, sedimentation survey results were analyzed separately for six segments of the bay. The segments were identified as the access channel, Willow Slough, lower main bay, middle main bay, upper main bay and upper Broad Lake. The access channel that connects Quincy Bay with the Mississippi River is the most dynamic segment of the bay where bed scours of up to 6.7 feet have taken place from 1985 to 1994. There is no sediment deposition in this segment of the bay. The Willow Slough and Triangle Lake area of the bay appeared to have been impacted significantly as a result of the levee breach at the Indian Graves Drainage and Levee District during the 1993 flood. Parts of Triangle Lake were completely filled with sediment and large sand deposits in the Willow Slough area resulted from the levee breach and subsequent outwash of sand. At the same time, however, most of the Willow Slough area experienced scour of sediment as a result of the high velocities after the levee break.

The three segments of the main bay (upper, middle, lower) generally experienced moderate sedimentation with some scour in the lower main bay and the lower part of the middle main bay since 1985. The scour can be attributed to the increase of velocities in the lower part of the bay due to the significant increase in discharge into the bay from the Mississippi River through the access channel. The Broad Lake segment of the bay experienced bed scour that could have resulted after the levee break of the Indian Graves Levee during the 1993 flood.

The sedimentation survey for Lake Meredosia included a survey of eight cross-sectional transects that were surveyed previously in 1975. All transects surveyed showed sediment accumulation ranging from 0.08 to 1.25 feet from 1975 to 1994. The average sedimentation for the 19 years was estimated to be 0.5 feet.

The sedimentation survey for Swan Lake included a survey of 44 cross-sectional transects. Comparison of the 1994 survey results with the 1904 survey results shows accumulation of up to 5 feet of sediment during the 90 years between the two surveys.

The sedimentation survey for Stump Lake included a survey of 19 cross-sectional transects. Comparison of the 1994 survey results with the 1904 survey results shows that the sediment accumulation in Stump Lake is generally less than 2 feet.

The sedimentation rates determined in 1994 based on ^{137}Cs analysis were found to be consistent with previous estimates for several of the lakes. The sedimentation rates ranged from a low of 0.9 cm/yr for Stump Lake to a high of 1.6 cm/yr for Silver Lake.

Water and sediment samples were collected at 17 sampling sites from the five lakes: four in Lake Meredosia, five in Quincy Bay, one in Silver Lake, four in Swan Lake, and three in Stump Lake. Water samples were tested for organics, total metals, total nutrients, volatile organic chemicals, and toxicity. Sediment samples were tested for organics, metals, and toxicity. Sediment samples for chemical and toxicity analysis were collected at the top of the sediment core, representing recent sediment layers, and at the bottom of the sediment core, representing older sediment.

Laboratory results did not show major or consistent changes in the chemical or toxicity characteristics of the sediment or water samples that can be attributed to the 1993 flood. However, some important observations should be noted as a result of the chemical and toxicity analyses of sediment samples.

In general, sediment samples from the Dlinois River have higher concentrations of most of the trace elements tested than samples from the Mississippi River. The most consistent and significant difference in inorganic chemical composition between top and bottom sediment samples was found only in the elements of manganese, phosphorus, and sulfur. Higher concentrations of manganese and phosphorus were found in the top sediment samples as compared to the bottom samples, while the reverse is true for sulfur. Reasons for these differences are not known at the present.

Test results for the three pesticides (atrazine, simazine, and alachlor) in sediment samples indicated that simazine was not detected in either the top or bottom sediments, atrazine was detected only for two top sediment samples from Lake Meredosia, and alachlor was detected in 12 of the 17 top sediment samples and in three bottom sediment samples from Quincy Bay.

The results of the toxicity tests for all the water and sediment samples show that none of the samples were toxic in the acute *Ceriodaphnia dubia* (water flea) screening test or in the Microtox test. However, most sediment samples stimulated light output in the Microtox test. The response could have been caused by the presence of 20 to 50 ppm ammonia that would have a stimulatory effect on the Microtox bacterium and yet not high enough to be toxic.

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Appendix A. Cross-Sectional Profile Data

Table A1-1. Cross-Sectional Profile Data for Quincy Bay - Main Bay Transects

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*	*Distance from east shore (feet)*	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
Main Bay Line 1				**Main Bay Line 2**			
25	470.2	470.2		20	470.2	470.2	
29			470.4	45			470.4
49			469.9	50			467.5
54	468.8	466.9		57	464.4	462.1	
74			467.9	75			463.5
97	465.1	456.7		100			460.4
99			465.9	125			459.6
124			461.7	131	460.1	458.9	
127	460.5	453.1		150			459.8
149			458.4	175			458.8
174			456.8	200			458.7
189	456.6	450.2		203	459.2	457.1	
199			457.0	214	459.4	450.7	
211	456.9	450.2		225			459.4
224			456.8	250			459.4
249			456.8	275			459.2
252	456.8	450.4		281	459.5	451.6	
274			457.2	300			459.1
299			457.4	325			459.8
324			457.4	330	459.7	450.7	
325	456.7	450.1		350			460.2
349			457.9	375			461.4
350	459.3	451.0		391	463.3	460.7	
374			460.9	400			463.4
393	464.7	455.9		425			465.7
399			465.6	433	466.8	460.0	
424			464.3	450			467.9
449			468.2	475			469.8
455	470.2	470.2		479	470.2	470.2	
464			470.4	491			470.4
Main Bay Line 3				**Main Bay Line 4**			
30	470.2	470.2		65	470.2	470.2	470.3
60			470.4	87	466.0	461.2	
75			469.8	95			465.4
99	468.0	459.6		120			460.7
100			469.4	128	461.9	459.7	
125			469.4	145			459.9
150			469.2	170			459.6
169	467.6	460.6		195			459.4
175			467.7	200	461.1	456.2	
200			466.4	220			459.7
225			465.7	245			459.9
226	466.4	459.2		256	461.2	456.6	
250			465.3	270			459.8
275			465.1	295			459.8
277	465.5	463.3		310	460.6	455.7	
300			464.8	320			459.6

Table A1-1. Continued

Distance from east shore (feet)	1985 Elevation above NGVD (feet)	1985 Penetration (feet)	1994 Elevation above NGVD (feet)
Main Bay Line 3 (continued)			
325			464.9
345	464.3	462.7	
350			465.0
375			464.7
400			465.1
425	464.0	461.8	
425			465.0
450			464.6
475			464.3
500			464.2
507	463.7	461.5	
525			463.6
550			464.0
575	463.7	455.2	
575			464.0
600			464.3
625			462.7
650			462.6
657	462.9	461.4	
675			464.5
700			466.1
702	466.5	463.0	
725			467.7
750			469.8
759	468.2	464.8	
775			470.4
796	470.2	470.2	
Main Bay Line 6			
13			470.4
23	470.0	470.0	
25			469.4
50			467.6
63	468.3	465.0	
75			466.8
100			466.3
105	467.8	459.0	
125			466.1
150			466.0
152	467.8	460.3	
175			466.1
192	467.3	460.4	
200			466.1
225			466.2
250			466.4
253	468.5	460.7	
275			466.6
300			466.9

Distance from east shore (feet)	1985 Elevation above NGVD (feet)	1985 Penetration (feet)	1994 Elevation above NGVD (feet)
Main Bay Line 4 (continued)			
345			460.5
370			461.8
373	462.4	457.4	
395			463.0
418	464.9	459.6	
420			464.5
445			466.2
470	466.9	460.2	
470			467.4
495			469.0
512	469.2	463.6	
520			470.3
532	470.2	470.2	
Main Bay Line 7			
10			470.4
17	470.0	470.0	
25			469.7
48	469.3	465.9	
50			468.7
75			467.7
100			466.8
107	466.7	462.9	
125			466.3
150			466.1
161	465.8	462.6	
175			466.0
200			466.1
218	465.7	461.6	
225			466.1
250			466.1
275			466.2
286	465.6	461.3	
300			466.1

Table A1-1. Continued

Distance from east shore (feet)	1985 Elevation above NGVD (feet)	1985 Penetration (feet)	1994 Elevation above NGVD (feet)
Main Bay Line 6 (continued)			
325			467.2
328	469.2	458.5	
350			467.3
375			468.0
392	469.6	462.4	
400			469.5
422			470.4
424	469.8	463.9	
453	469.8	470.0	
Main Bay Line 8			
7			470.2
25			469.9
39	470.2	470.2	
50			469.6
70	469.0	466.2	
75			469.4
100			469.4
125			469.2
131	468.5	465.7	
150			469.0
175			468.8
191	468.2	464.1	
200			468.6
225			468.2
246	468.1	464.1	
250			468.1
275			467.9
295	467.7	464.0	
300			467.7
325			467.5
346	467.2	462.7	
350			467.2
375			466.7
392	466.0	462.3	
400			466.4
425			466.5
450			467.0
465	465.7	460.7	
475			467.4
500			467.6
516	466.7	462.2	
525			467.7
550			467.9
572	467.4	462.7	
575			468.0
600			468.3
625			468.6

Distance from east shore (feet)	1985 Elevation above NGVD (feet)	1985 Penetration (feet)	1994 Elevation above NGVD (feet)
Main Bay Line 7 (continued)			
325			468.8
333	469.0	468.5	
341			470.4
346	470.0	470.0	
Main Bay Line 9			
12			470.3
25			469.8
50			469.3
57	470.2	470.2	
75			468.9
100			468.4
116	468.5	460.9	
125			466.8
150			466.1
175			466.3
188	468.0	459.2	
200			466.9
225			467.2
230	468.0	459.0	
250			467.5
275			467.8
300			468.2
307	467.5	461.4	
325			468.4
350			468.8
370	468.7	462.5	
375			469.0
400			469.4
416	469.4	460.8	
425			469.7
450			469.9
475	469.8	469.8	
475			469.8
500			469.8
525			469.8
526	470.0	470.0	
550			469.8
570	470.0	470.0	
575			469.7
600			469.6
616	469.7	469.7	
625			469.5

Table A1-1. Continued

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*	*Distance from east shore (feet)*	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
Main Bay Line 8 (continued)				**Main Bay Line 9 (continued)**			
637	468.3	462.6		650			469.4
650			468.9	664	469.4	469.4	
675			469.3	675			469.3
683	469.0	462.7		700			469.1
700			469.3	712	468.5	462.8	
725			469.3	725			468.9
739	469.4	462.5		750			468.6
750			469.5	775			468.5
772	469.7	463.1		778	467.5	462.2	
775			469.7	800			468.4
797			470.2	822	468.0	461.0	
837	470.2	470.2		825			468.0
				850			467.8
				875			467.4
				894	466.8	462.3	
				900			467.3
				925			467.3
				950			467.9
				973	468.2	466.0	
				975			468.2
				1000			469.4
				1009			470.3
				1061	470.2	470.2	
Main Bay Line 10				**Main Bay Line 11**			
23	470.0	470.0		22	470.0	470.0	
47			470.2	25			470.4
69	467.7	461.8		50			467.1
75			467.8	75			466.6
100			467.7	100			466.5
122	467.3	458.9		102	465.7	456.6	
125			467.6	125			466.4
150			467.5	150			466.7
165	467.3	456.0		161	466.2	455.5	
175			467.5	175			466.7
200			467.5	200			466.8
225			467.7	214	466.5	456.0	
228	467.3	457.7		225			467.0
250			467.7	250			467.0
275			467.7	275			467.0
276	467.4	457.6		300	466.5	456.0	
300			467.8	300			467.0
325			467.9	325			467.0
350			467.9	350			467.0
375			467.8	371	466.5	455.0	
382	467.5	457.5		375			467.0
400			467.9	400			467.1

Table A1-1. Continued

Distance from . east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*	*Distance from east shore (feet)*	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
Main Bay Line 10 (continued)				Main Bay Line 11 (continued)			
423	467.6	459.4		425			467.2
425			467.9	450			467.1
450			467.9	452	466.7	455.4	
475			467.9	475			467.2
500			467.9	500			467.2
525			467.9	506	466.5	455.5	
550			468.0	525			467.3
559	467.8	458.7		550			467.2
575			468.0	563	466.8	455.5	
600			468.0	575			467.2
625			468.0	600			467.3
640	467.8	459.4		625			467.3
650			468.0	648	467.2	456.7	
675			468.0	650			467.3
700			468.0	675			467.4
725			468.0	690	467.8	458.1	
750			468.1	700			467.4
767	468.0	461.4		725			467.4
775			468.2	750			467.4
800			468.2	775			467.4
825			468.2	791	466.9	462.5	
838	468.1	462.2		800			467.5
850			468.2	818	468.2	464.4	
875			468.4	825			467.5
900			468.5	850			467.7
922	468.3	462.9		868	467.6	466.1	
925			468.5	875			467.3
950			468.6	900			468.0
975			468.7	902	467.6	464.7	
1000			468.8	925			468.1
1001	468.8	463.6		950			468.2
1025			468.9	975			468.3
1050			468.9	1000			468.3
1072	468.9	464.2		1021	467.9	463.1	
1075			469.0	1025			468.4
1100			468.9	1050			468.5
1125			468.9	1075			468.5
1150			469.0	1100			468.5
1175			469.1	1125			468.6
1184	469.2	464.6		1127	468.0	462.8	
1200			469.2	1150			468.6
1225			469.2	1175			468.6
1243	469.5	464.9		1194	467.9	463.2	
1250			469.3	1200			468.7
1275			469.4	1220			469.0
1300			469.4	1243			470.4
1325			469.4	1258	470.0	470.0	
1350			469.3				

Table A1-1. Continued

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*	*Distance from east shore (feet)*	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
Main Bay Line 10 (continued)							
1375			469.4				
1400			469.5				
1425			469.5				
1450			469.6				
1475			469.6				
1500			469.6				
1525			469.7				
1550			469.7				
1575			469.7				
1600			469.8				
1630			470.2				
1632	470.0	470.0					
Main Bay Line 12				**Main Bay Line 13**			
25	470.3	470.3		26			470.4
30			470.4	28	470.3	470.3	
50			468.6	50			468.1
62	467.6	465.5		75			467.4
75			467.7	92	466.9	460.8	
100			467.2	100			467.6
116	466.3	460.0		125			467.7
125			466.9	148	466.9	460.3	
150			466.7	175			467.6
153	466.0	460.1		200			467.6
175			466.5	225			467.5
200			466.4	226	466.8	459.7	
207	465.8	459.1		250			467.4
225			466.4	275			467.4
250			466.3	278	466.8	460.3	
270	465.7	457.6		300			467.4
275			466.4	324	466.8	460.0	
300			466.4	325			467.4
325			466.4	350			467.4
338	465.7	457.3		375	467.2	461.1	
350			466.4	375			467.4
375			466.5	400			467.6
397	465.7	457.5		425			467.8
400			466.5	428	467.7	462.8	
425			466.5	450			468.0
450			466.6	475			468.1
467	465.9	457.3		491	467.9	463.1	
475			466.7	500			468.1
500			466.7	525			468.2
522	466.0	457.2		535	467.8	463.1	
525			466.8	550			467.9
550			466.8	575			468.5
575			466.9	600			468.7
594	466.2	457.3		613	468.7	464.7	

Table A1-1. Continued

Main Bay Line 12 (continued)

Distance from east shore (feet)	1985 Elevation above NGVD (feet)	1985 Penetration (feet)	1994 Elevation above NGVD (feet)
600			467.0
625			467.1
650			467.2
655	466.4	457.3	
675			467.4
700			467.5
725			467.7
729	466.8	461.8	
750			467.7
775			467.7
789	467.6	467.4	
800			467.3
825			468.2
827	467.4	465.3	
850			468.4
875			468.5
884	467.8	465.1	
900			468.8
925			469.3
950			470.4
957	470.3	470.3	

Main Bay Line 13 (continued)

Distance from east shore (feet)	1985 Elevation above NGVD (feet)	1985 Penetration (feet)	1994 Elevation above NGVD (feet)
625			469.1
650			469.5
658			470.4
673	470.3	470.3	

Main Bay Line 14

Distance from east shore (feet)	1985 Elevation above NGVD (feet)	1985 Penetration (feet)	1994 Elevation above NGVD (feet)
20			470.2
25			468.7
28	470.3	470.3	
50			468.6
75			468.6
100			468.6
125			468.9
131	467.9	464.6	
150			469.2
175			469.1
192	468.3	463.4	
200			469.2
225			468.9
250			468.6
275			468.3
286	468.0	462.2	
295	468.1	462.0	
300			468.0
325			467.8
350			467.7
364	467.5	460.3	
375			467.5
400			467.6
409	467.4	460.6	
425			467.7

Main Bay Line 15

Distance from east shore (feet)	1985 Elevation above NGVD (feet)	1985 Penetration (feet)	1994 Elevation above NGVD (feet)
25			470.2
33	470.3	470.3	
50			466.8
61	466.7	463.9	
75			466.9
100			467.2
107	466.6	463.6	
125			467.3
150			467.3
175			467.2
184	467.1	463.2	
200			467.2
225			467.2
250			467.2
256	467.1	459.9	
275			467.2
300			467.1
301	467.2	460.2	
325			467.1
338	467.0	460.2	
350			467.0
375			467.0
400			467.0
405	466.9	456.5	
425			467.0

Table A1-1. Continued

Main Bay Line 14 (continued)

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
450			467.8
470	467.7	461.7	
475			467.9
500			467.9
525			468.0
531	467.8	461.9	
550			468.0
575			468.0
600			468.1
608	467.9	460.9	
625			468.2
650			468.2
675	468.0	460.2	
675			468.3
700			468.4
725			468.5
750			468.5
775			468.8
800	468.6	463.7	
800			468.9
825			469.0
850			469.4
874	470.3	470.3	
880			470.2

Main Bay Line 15 (continued)

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
450			467.0
475			467.0
500	466.9	459.9	
500			466.9
525			466.9
550			466.9
558	467.0	459.7	
575			467.0
600			467.0
625			467.0
640	466.9	459.1	
650			467.0
675			467.0
700			467.0
707	467.1	460.2	
725			467.0
750			467.1
775			467.1
779	467.1	460.9	
800			467.1
825			467.1
842	467.1	461.0	
850			467.2
875			467.2
900			467.2
925			467.2
926	467.1	461.3	
950			467.2
972	467.3	461.4	
975			467.2
1000			467.2
1025			467.3
1050			467.3
1053	467.3	461.8	
1075			467.3
1100			467.3
1104	467.3	461.5	
1125			467.3
1150			467.3
1160	467.1	459.3	
1175			467.3
1200			467.4
1225			467.4
1236	467.0	458.6	
1250			467.5
1275			467.6
1280	467.0	458.9	
1300			467.7

Table A1-1. Continued

Main Bay Line 15 **(continued)**

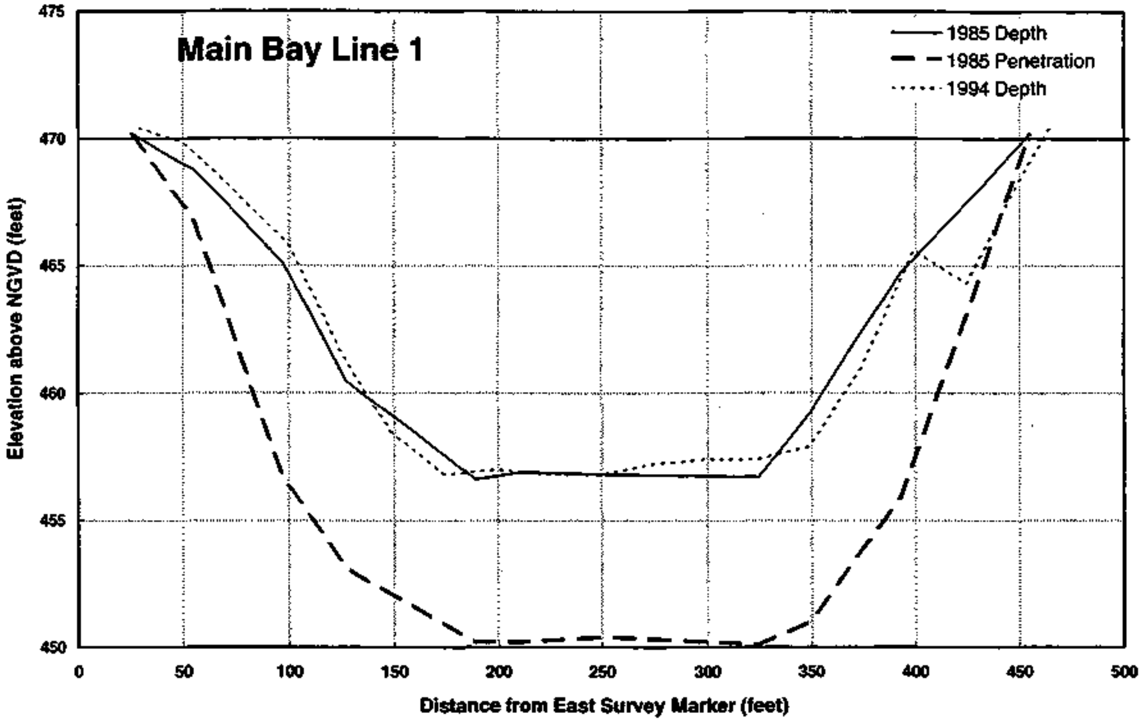
Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
1325			467.8
1335	467.5	462.6	
1350			468.0
1375			468.1
1400			468.2
1425			468.3
1431	468.1	465.4	
1450			468.3
1475			468.3
1490	468.2	464.4	
1500			468.9
1565			470.2
1599	470.3	470.3	

Main **Bay** Line 16

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
25			470.2
33	470.3	470.3	
50			466.2
75			466.7
100			467.2
125			467.3
150			467.4
175			467.4
200			467.4
204	467.1	463.1	
225			467.4
250			467.4
270	467.2	462.4	
275			467.3
300			467.3
325			467.2
346	467.1	461.3	
350			467.2
375			467.2
400			467.2
425			467.1
438	466.9	460.5	
450			467.1
475			467.1
500			467.1
525			467.0
539	467.0	459.8	
550			467.0
575			467.0
600			467.0
625			467.0
628	466.7	460.7	
650			467.0
675			467.0
700			467.0
704	466.7	460.8	
725			467.0
750			467.0
775	467.2	460.5	
775			467.0
800			467.0
825			467.1
850			467.1
864	466.9	461.6	
875			467.1
900			467.1
925			467.2
932	466.9	461.2	

Table A1-1. Concluded

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
Main Bay Line 16 (continued)			
950			467.2
975			467.2
980	467.0	463.4	
1000			467.2
1025			467.2
1044	467.3	462.2	
1050			467.3
1075			467.3
1100			467.3
1116	467.3	463.1	
1125			467.4
1150			467.4
1175			467.5
1194	467.3	463.3	
1200			467.6
1225			467.7
1250			467.7
1275			467.8
1288	467.6	465.0	
1300			467.9
1325			468.0
1346	467.8	464.5	
1350			468.1
1375			468.1
1400			468.4
1411	468.1	465.2	
1425			468.4
1450			468.7
1470	468.4	466.0	
1475			468.8
1500			468.9
1525			469.0
1550			469.1
1574	469.1	'465.4	
1575			469.1
1600			469.3
1625			469.4
1642	469.4	467.4	
1650			469.2
1690			470.2
1697	468.9	462.7	
1740	470.3	470.3	



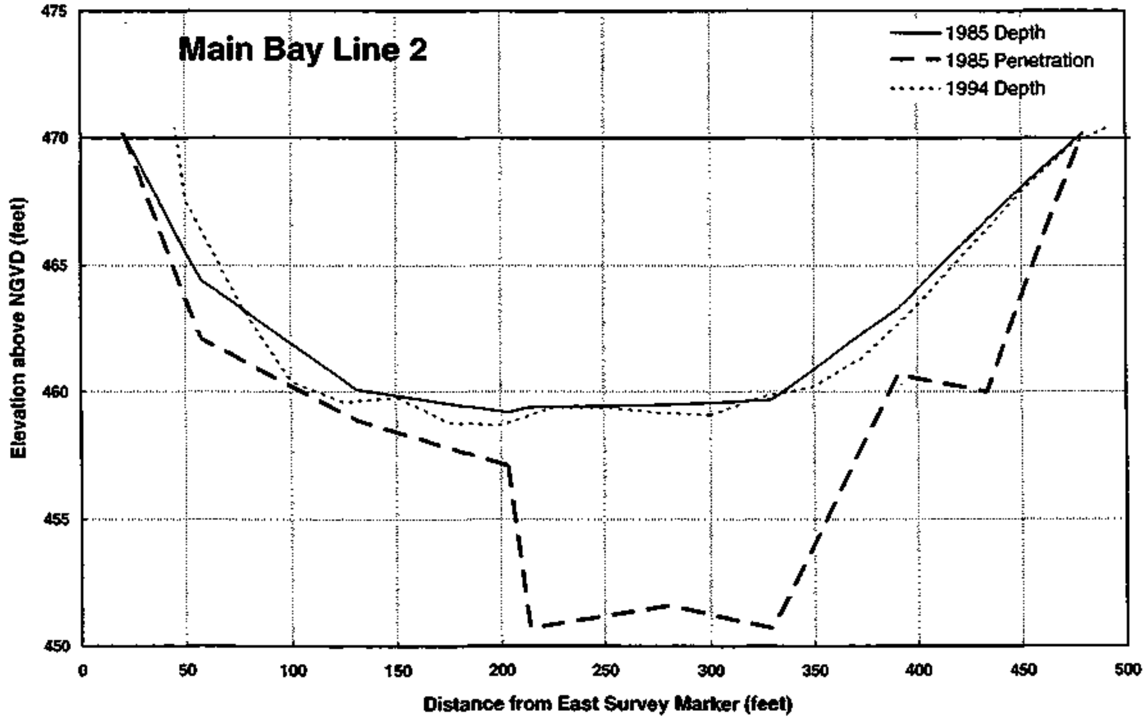
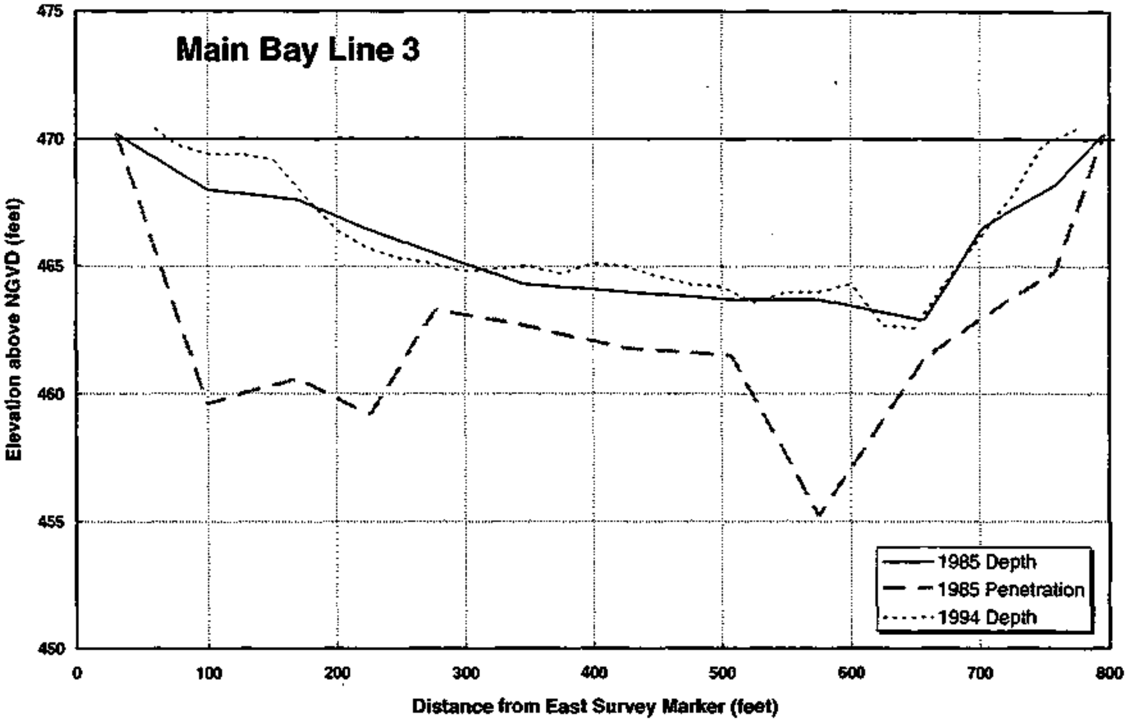


Figure A1 - 1. Cross-Sectional Profiles for Quincy Bay - Main Bay Transects



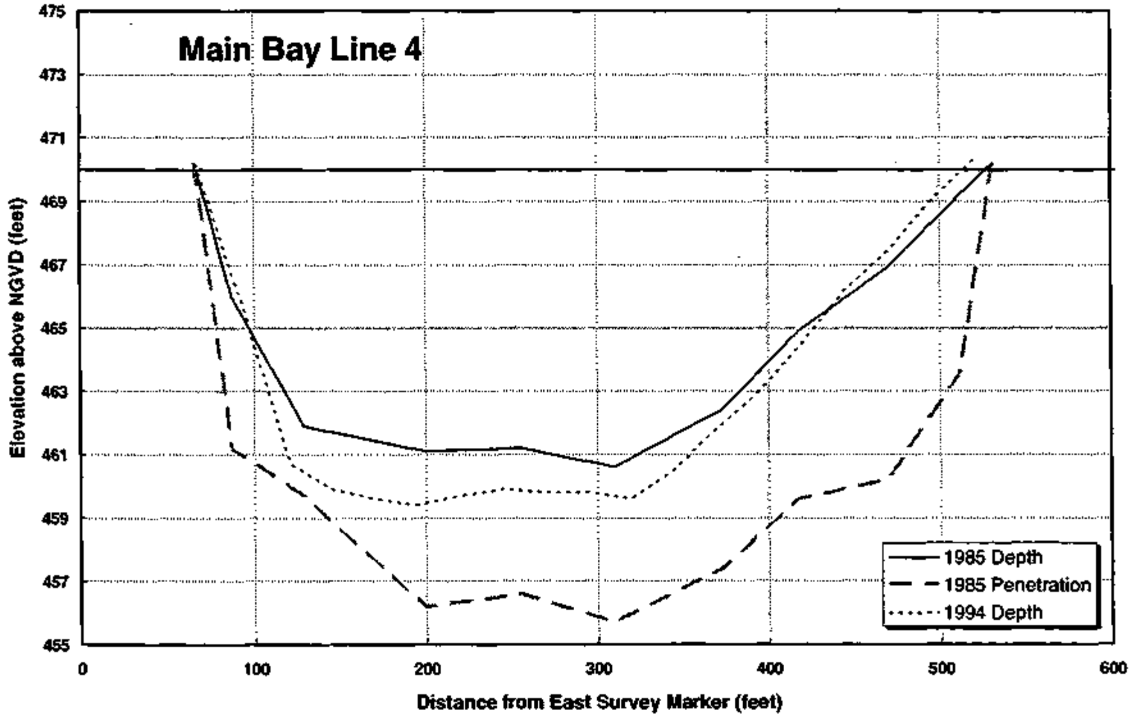


Figure A1-1. Continued

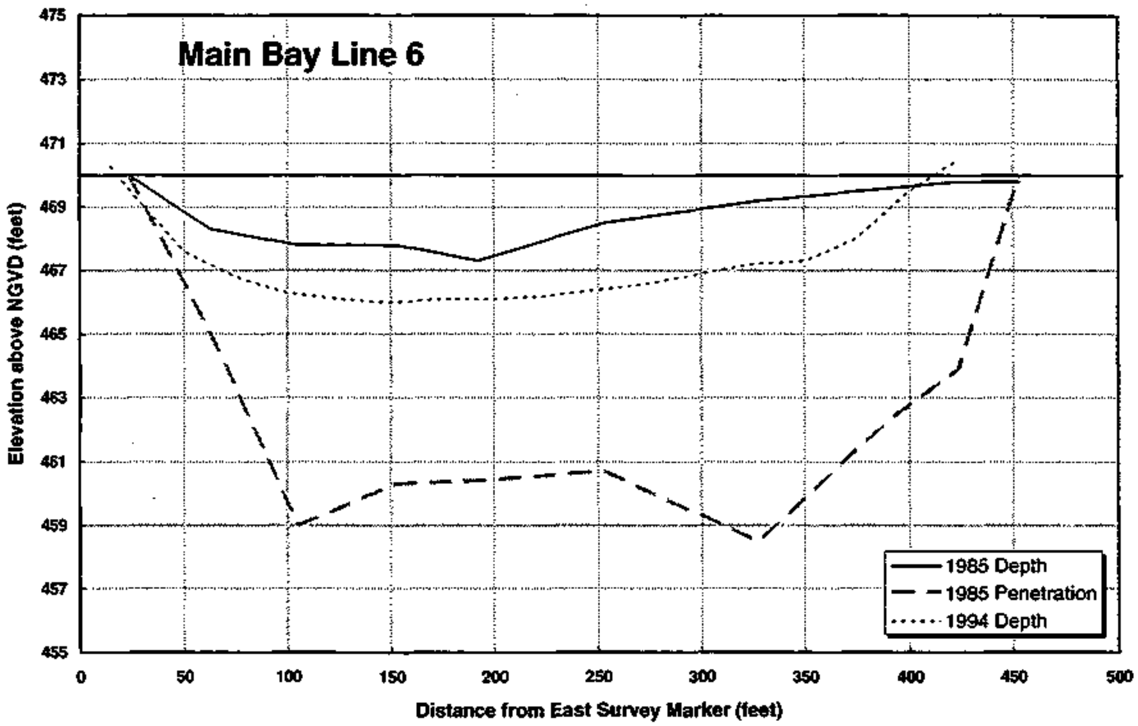
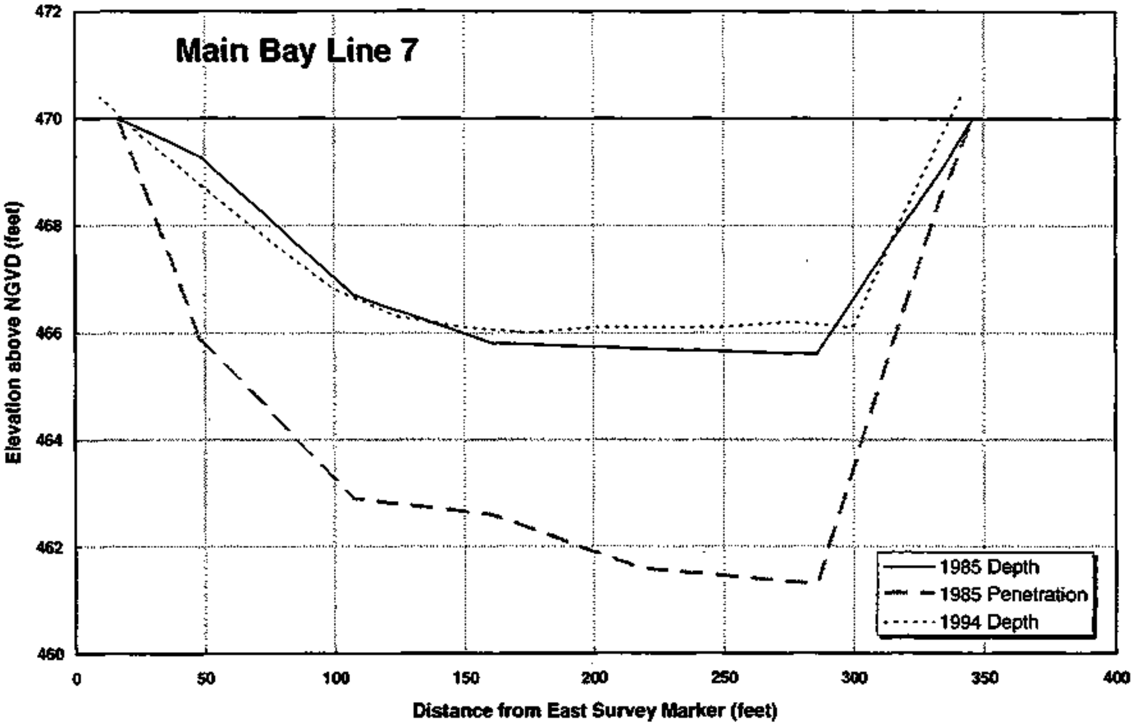


Figure A1-1. Continued



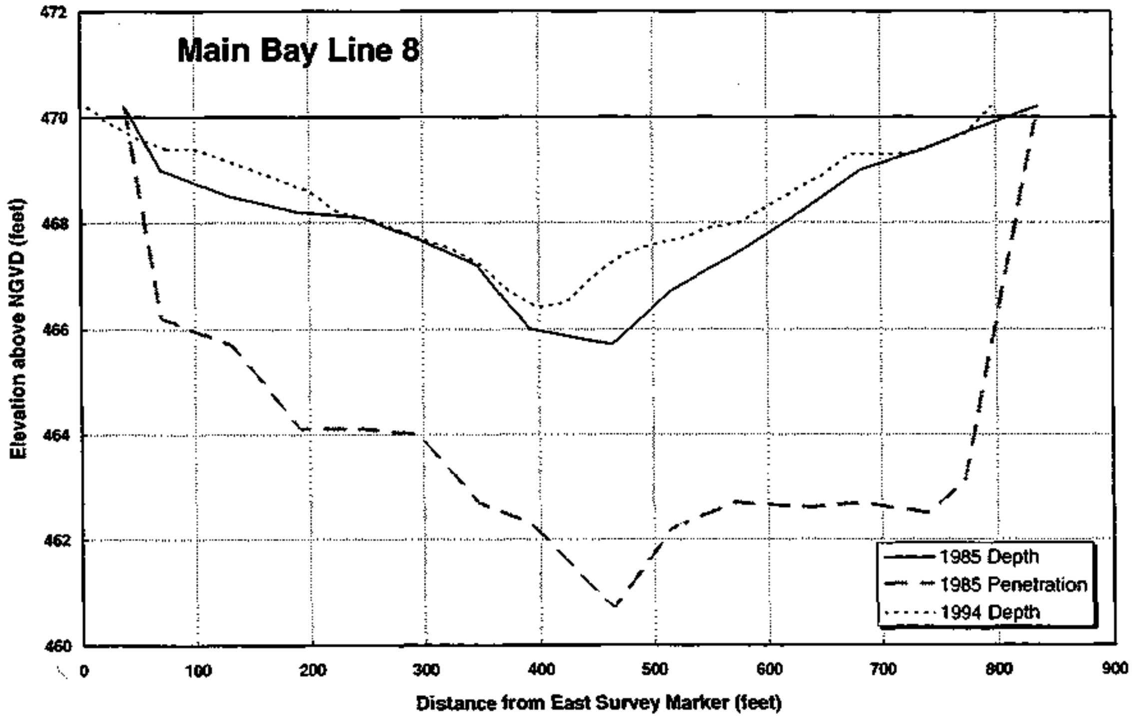
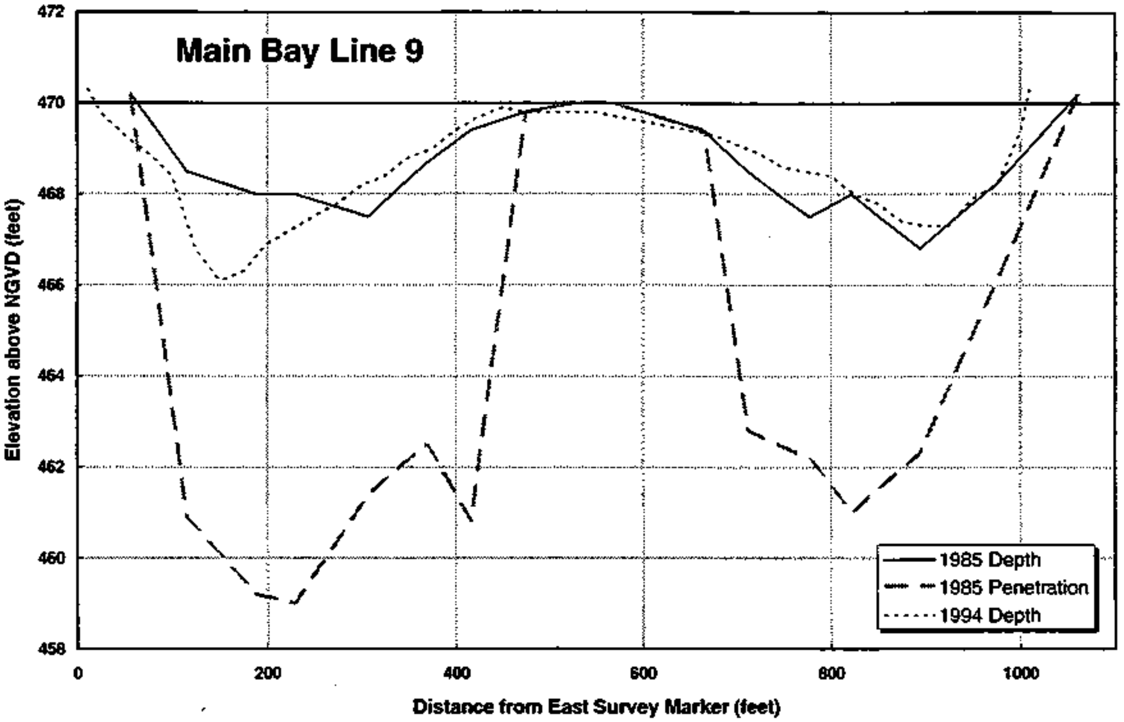


Figure A1-1. Continued



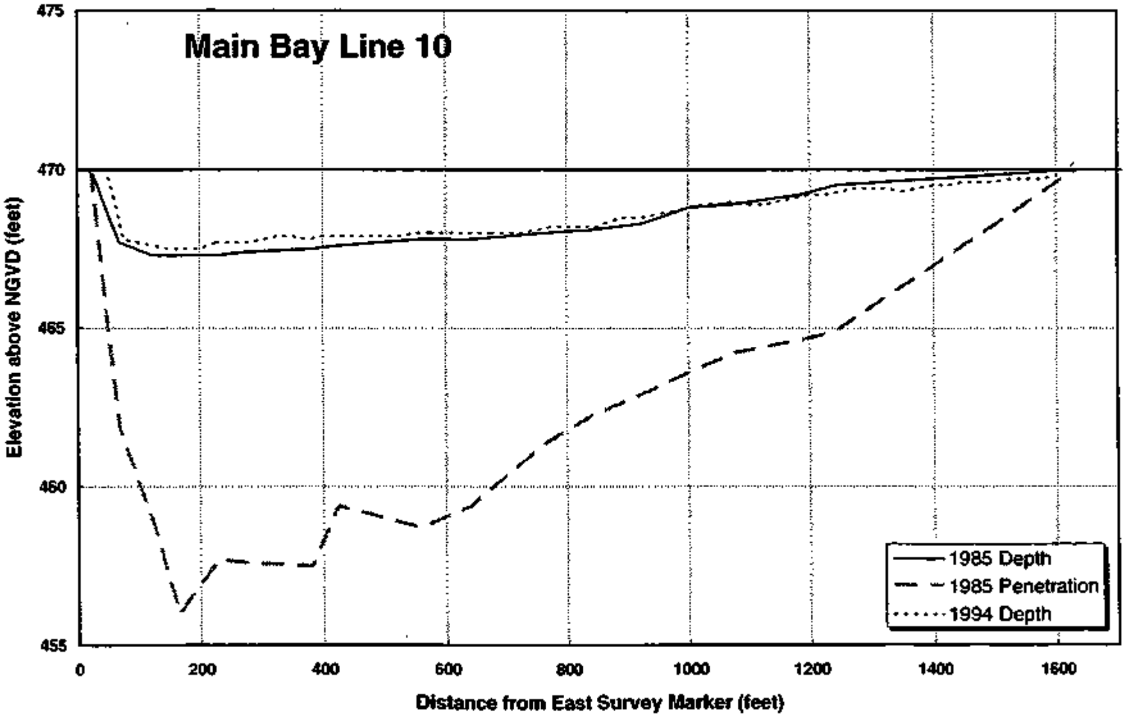
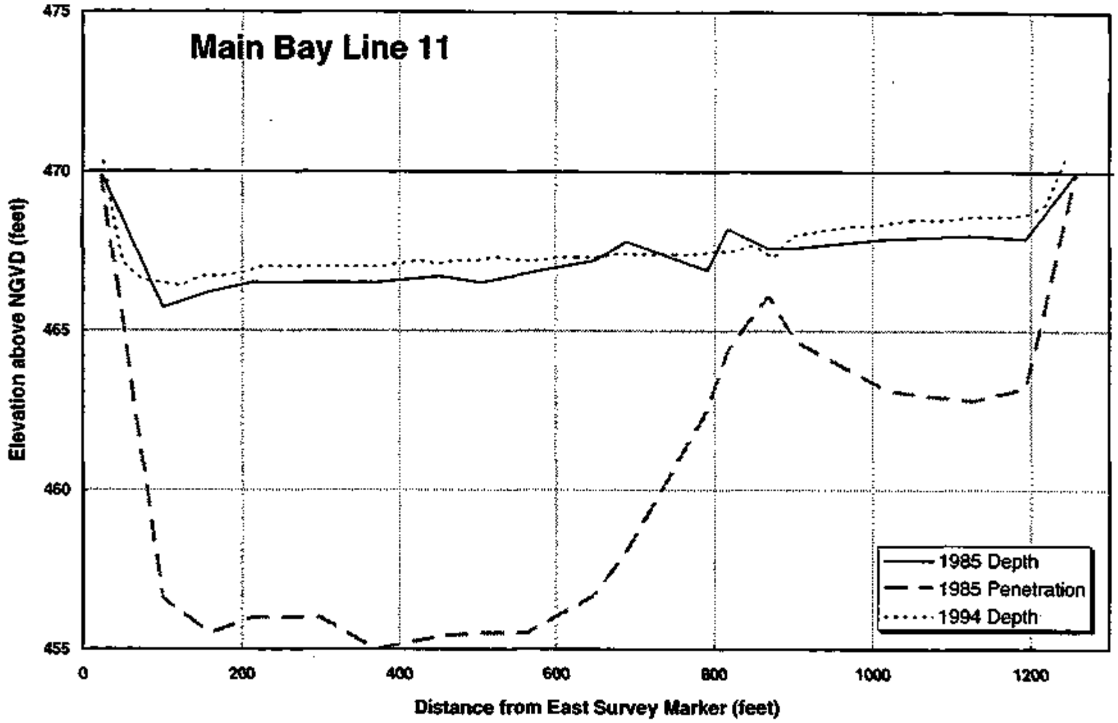


Figure A1-1. Continued



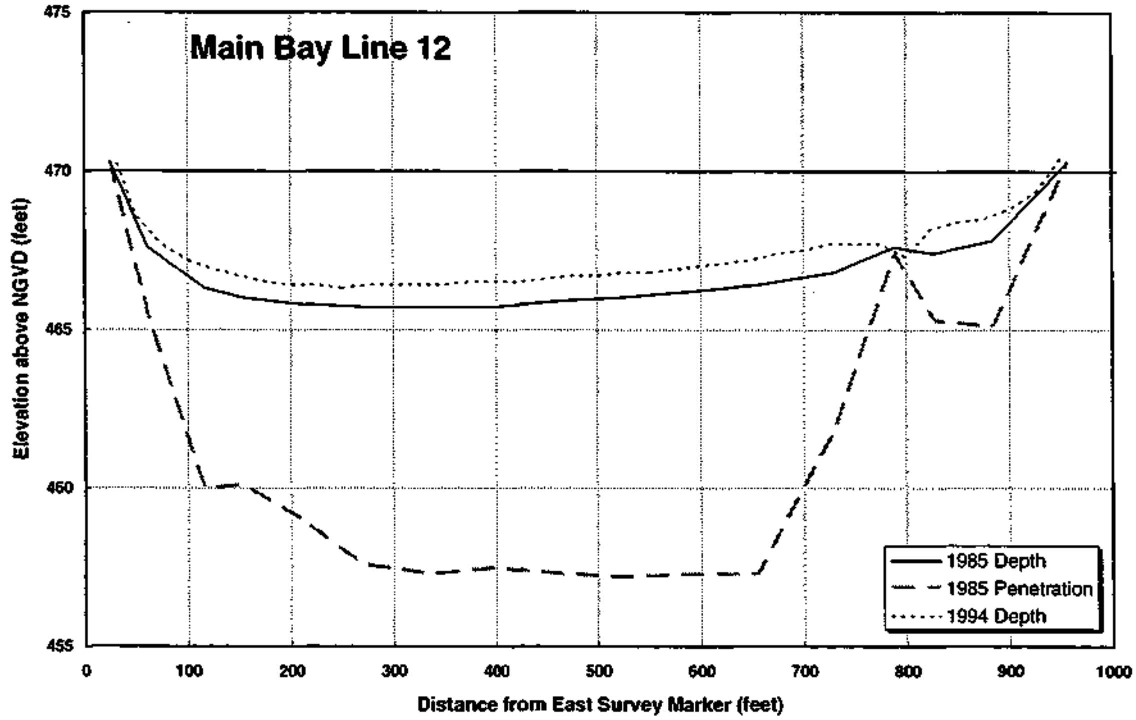
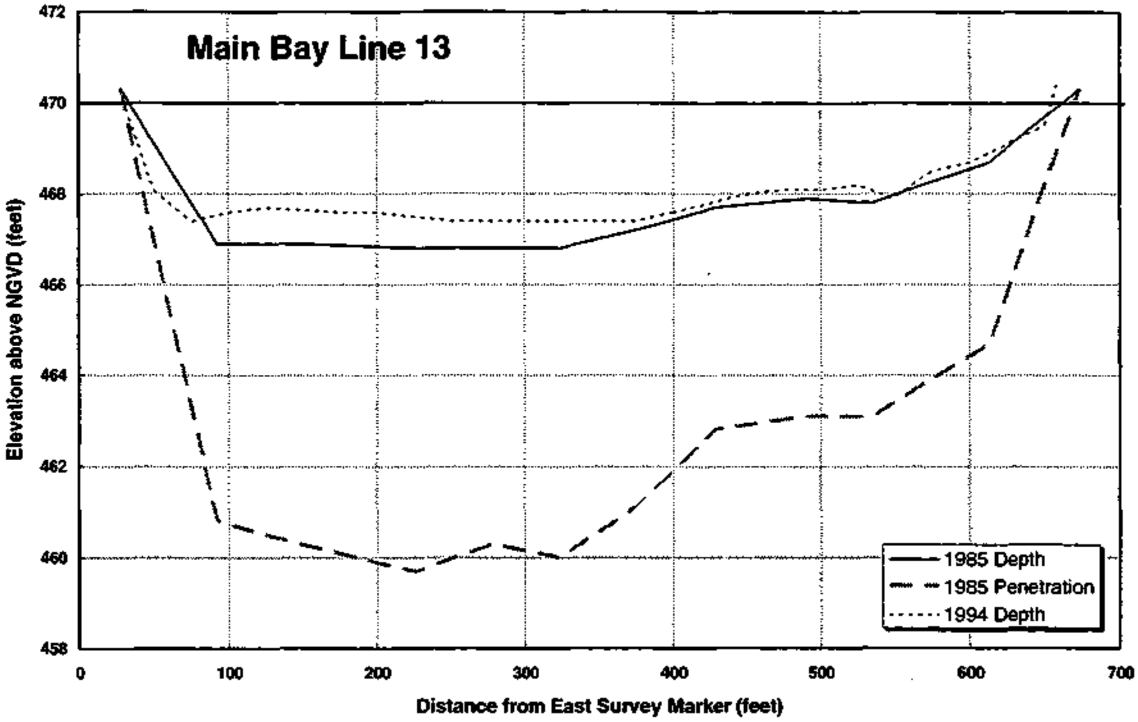


Figure A1-1. Continued



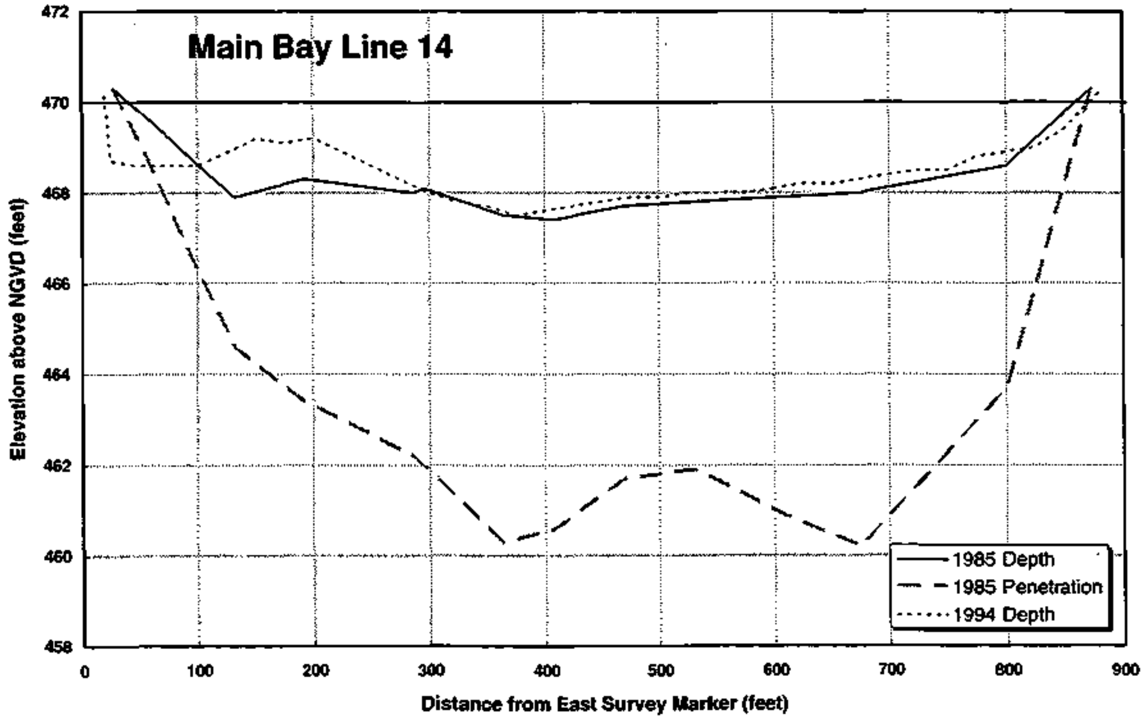
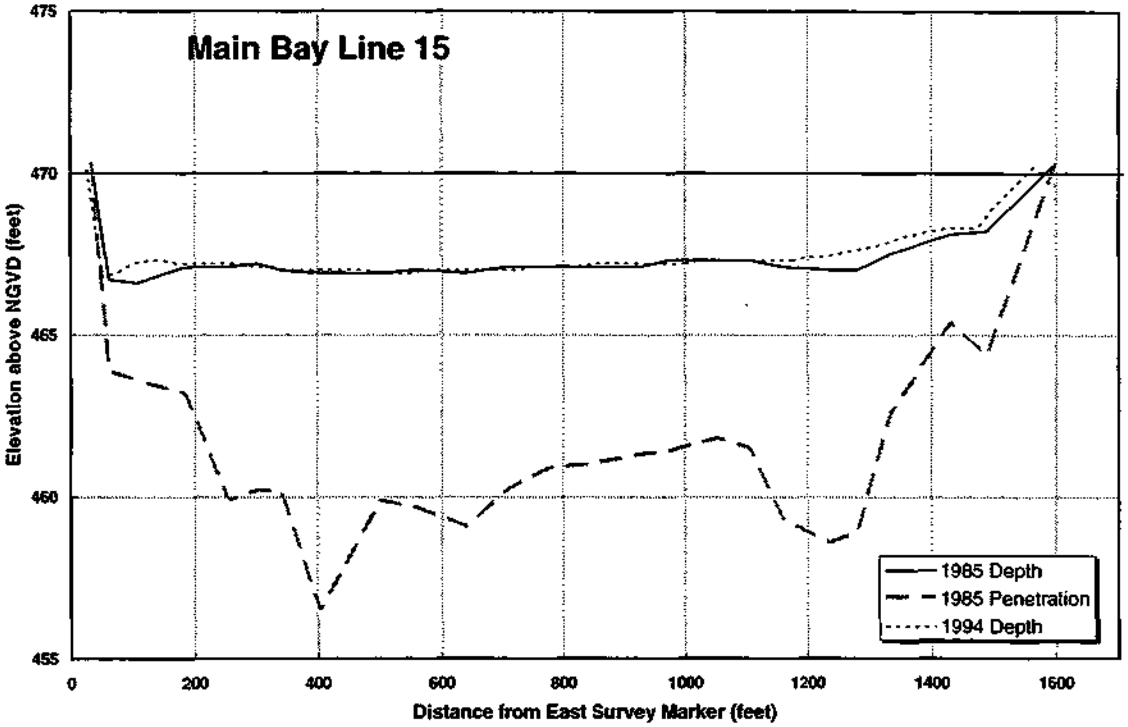


Figure A1-1. Continued



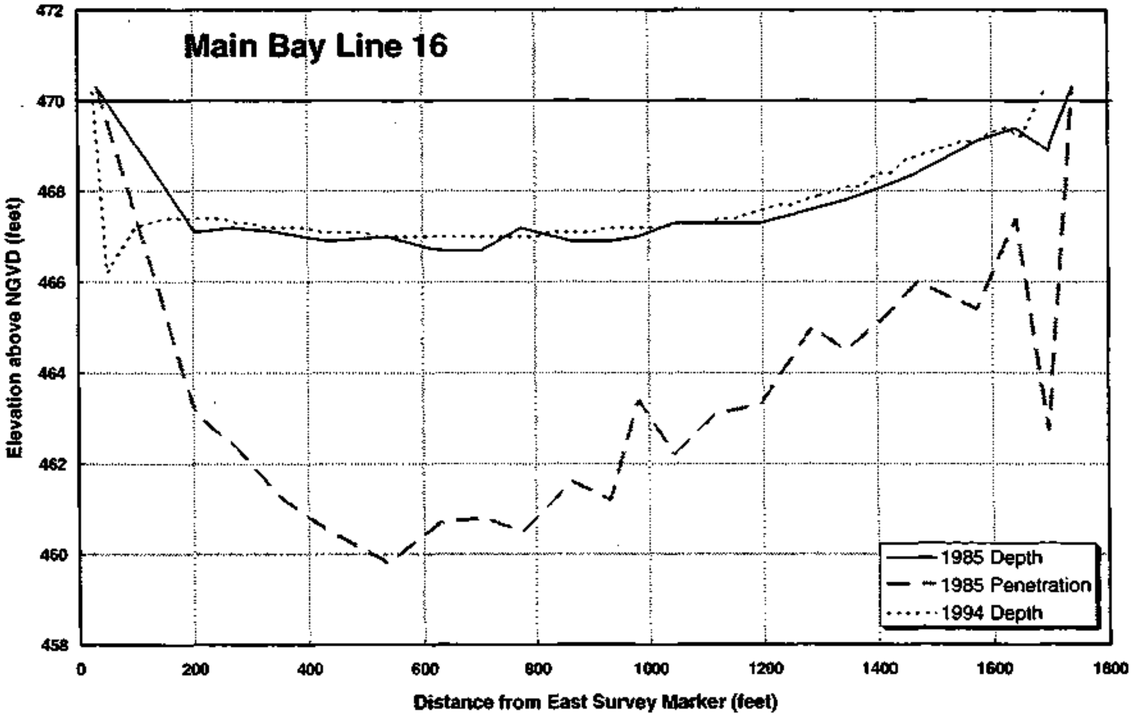


Figure A1-1. Concluded

Table A1-2. Cross-Sectional Profile Data for Quincy Bay - Willow Slough Transects

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*	*Distance from east shore (feet)*	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
Willow Slough Line 1				**Willow Slough Line 2**			
17			470.5	7			470.5
23	470.0	470.0		17	470.0	470.0	
25			470.1	25	469.5	468.2	469.8
50	469.4	467.0	469.3	50	468.7	465.5	468.4
75	469.1	467.2	468.7	75	468.7	464.8	468.5
100	469.0	465.7	468.3	100	468.8	464.6	468.5
125	468.3	464.9	468.0	125	468.7	466.3	468.5
150	468.0	464.0	468.0	150	468.5	462.1	468.1
175	467.8	465.0	467.7	175	468.5	459.6	468.3
200	468.0	466.6	467.5	200	468.3	460.8	468.4
225	468.2	464.9	467.4	225	468.1	463.2	468.3
250	468.7	463.8	468.2	250			470.5
275	469.7	465.6	470.0	253	470.0	470.0	
290	470.0	470.0					
295			470.5				
Willow Slough Line 3				**Willow Slough Line 4**			
7	470.0	470.0		9	470.0	470.0	
12			470.5	15			470.5
25	469.2	464.1	469.6	25	469.1	466.8	469.5
50	468.8	464.9	468.7	50	468.5	466.0	468.4
75	468.6	467.3	468.5	75	468.7	467.5	468.3
100	468.5	467.7	468.2	100	468.7	468.5	468.3
125	468.2	466.9	467.8	125	468.2	467.8	467.9
150	468.0	465.9	467.4	150	467.6	467.2	467.5
175	468.0	463.1	467.2	175	466.0	465.1	466.0
200	468.0	464.0	467.1	200	465.7	464.2	465.0
225	468.0	465.3	467.0	225	465.9	464.6	465.2
250	468.0	466.4	467.1	250	466.7	466.0	465.8
275	468.1	466.4	467.2	275	468.0	466.5	467.3
300	468.3	467.4	467.5	300	468.6	468.0	468.1
325	468.7	467.7	467.9	325	469.0	468.4	468.5
350	468.9	466.8	468.4	350	469.1	466.9	468.7
375	469.2	466.2	468.7	375	469.4	466.2	469.3
400	469.2	466.3	468.8	390	470.0	470.0	
425	469.3	467.0	468.9	396			470.5
450			469.4				
454	470.0	470.0					
463			470.5				
Willow Slough Line 5				**Willow Slough Line 6**			
15			470.5	28			470.5
19	469.9	469.9		38	469.9	469.9	
25	468.3	465.9		50	469.4	466.4	469.1
50	462.2	456.0	462.8	75	466.9	465.7	466.7
75	459.2	450.5	460.9	100	463.3	461.7	463.2
100	457.3	447.2	459.0	125	463.8	463.6	463.0
125	455.8	445.4	457.6	150	463.6	463.3	463.3

Table A1 -2. Concluded

Willow Slough Line 5 (continued)

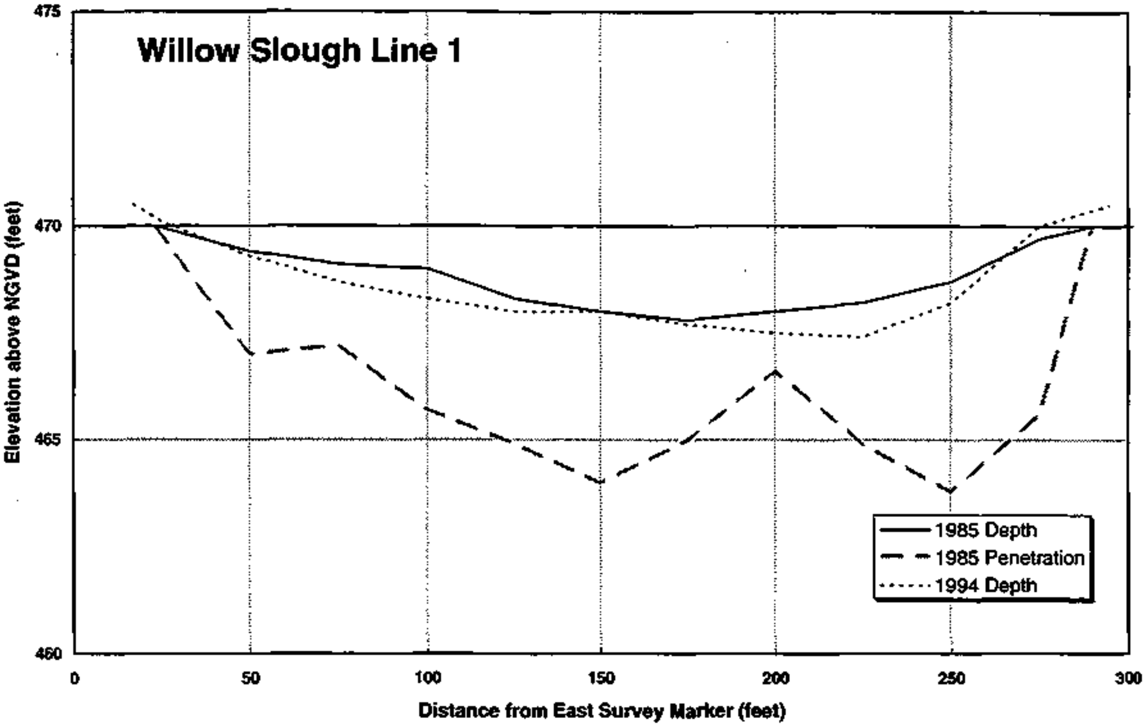
Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
150	453.9	444.1	455.9
175	451.9	442.7	454.1
200	451.2	443.4	453.1
225	450.9	443.7	453.2
250	450.8	442.4	453.3
275	451.7	444.4	454.3
300	456.6	451.1	458.5
325	464.3	460.8	464.5
343	469.9	469.9	
348			470.5

Willow Slough Line 6 (continued)

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
175	463.6	463.4	463.1
200	463.8	463.2	463.3
225	467.6	467.0	466.5
250	467.9	466.2	467.4
275	468.7	467.2	468.0
300			469.6
302	469.9	469.9	
307			470.5

Willow Slough Line 7

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
0			
19			470.5
36			469.4
43	469.9	469.9	
50	469.3	468.5	
61			468.5
75	468.1	467.9	
86			467.8
100	467.7	466.1	
111			467.0
125	467.4	464.7	
136			466.6
150	467.4	463.6	
161			466.8
175	467.7	466.7	
186			467.6
200	467.9	467.1	
211			467.6
225	467.9	467.1	
236			467.0
250	468.0	465.6	
261			467.5
275	468.7	465.3	
286			469.1
298	469.9	469.9	
298			470.5



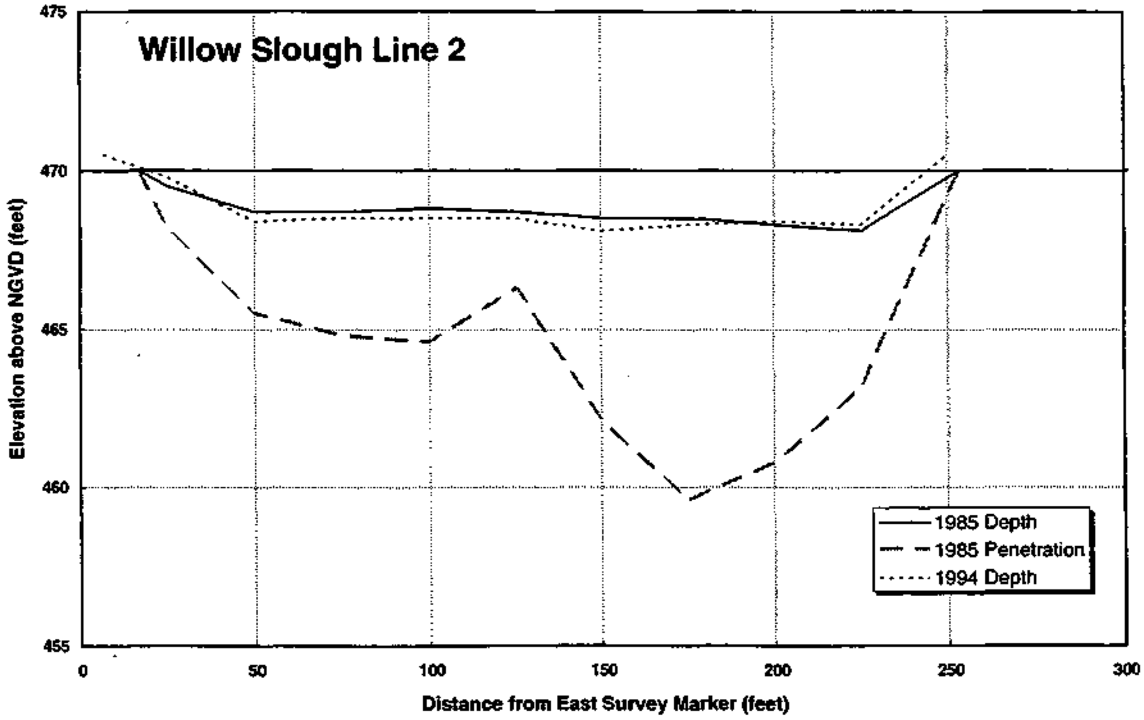
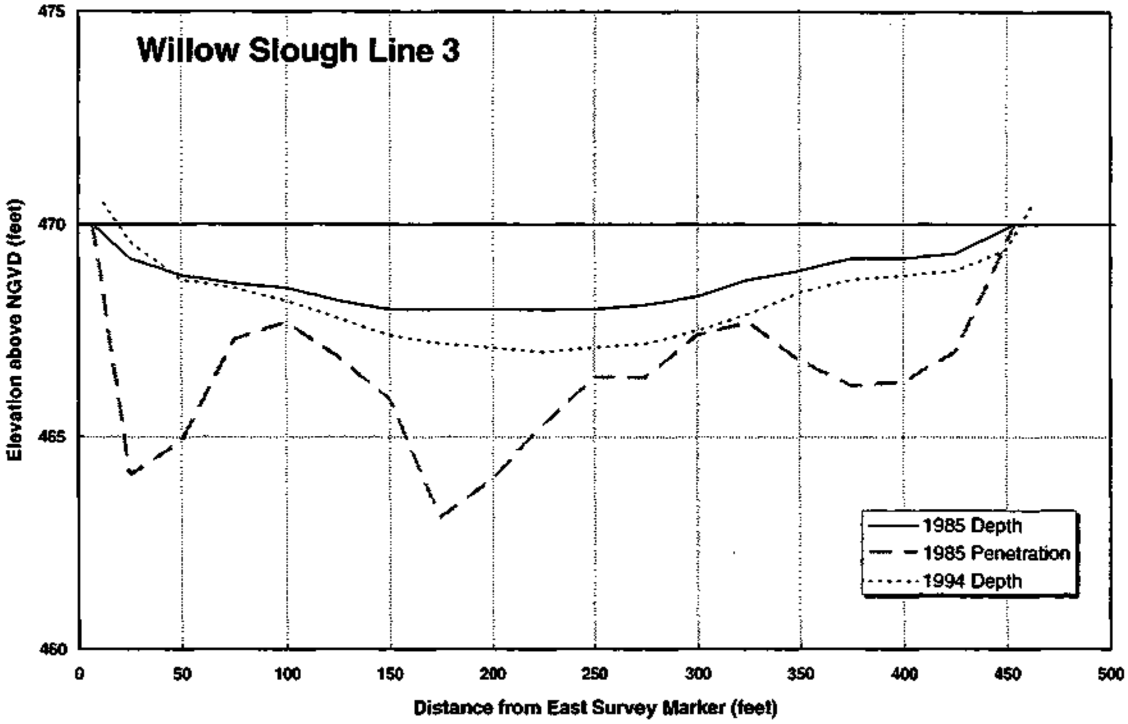


Figure A1-2. Cross-Sectional Profiles for Quincy Bay - Willow Slough Transects



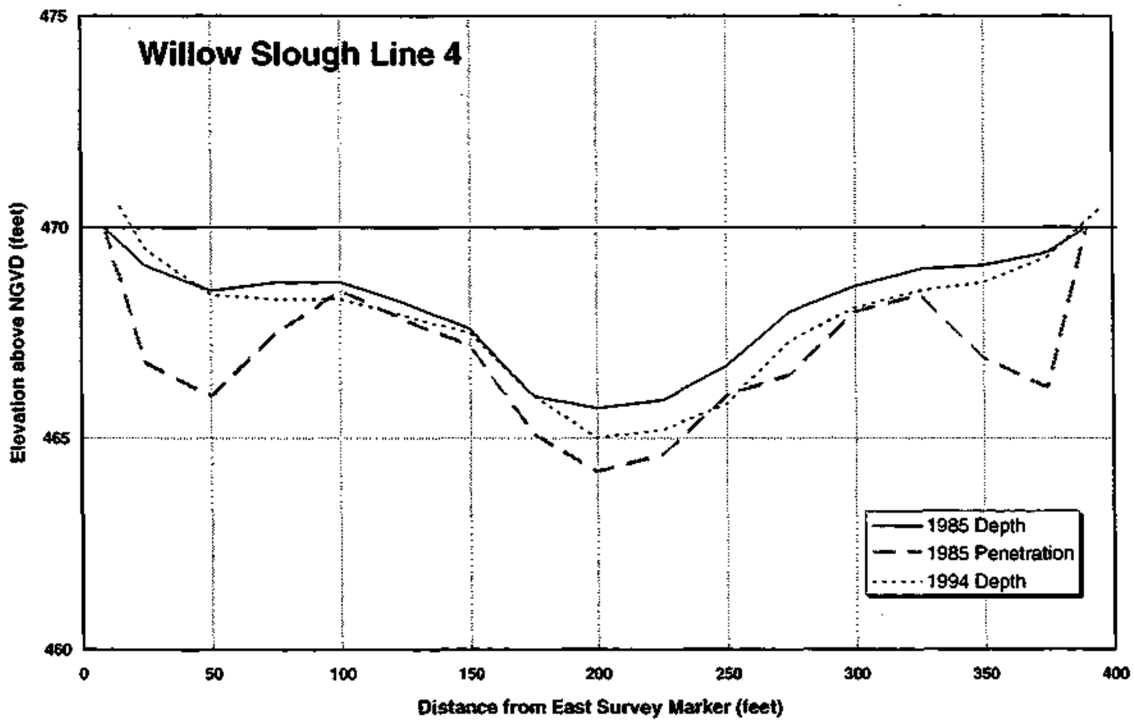
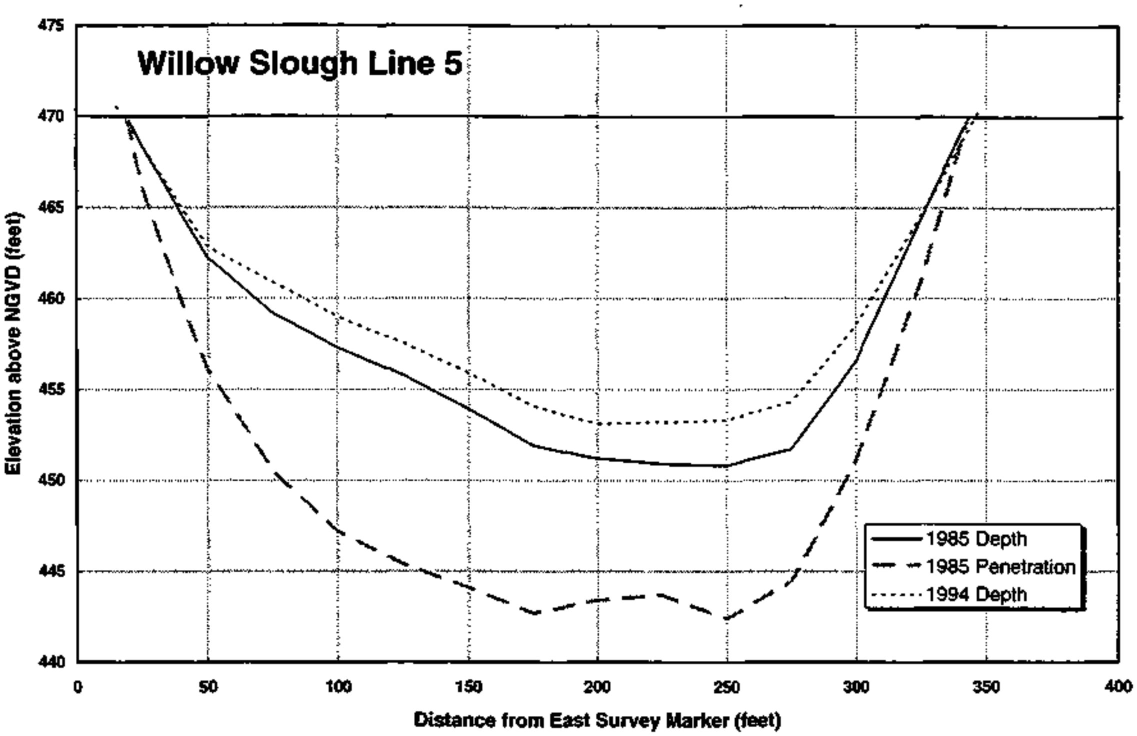


Figure A1 -2. Continued



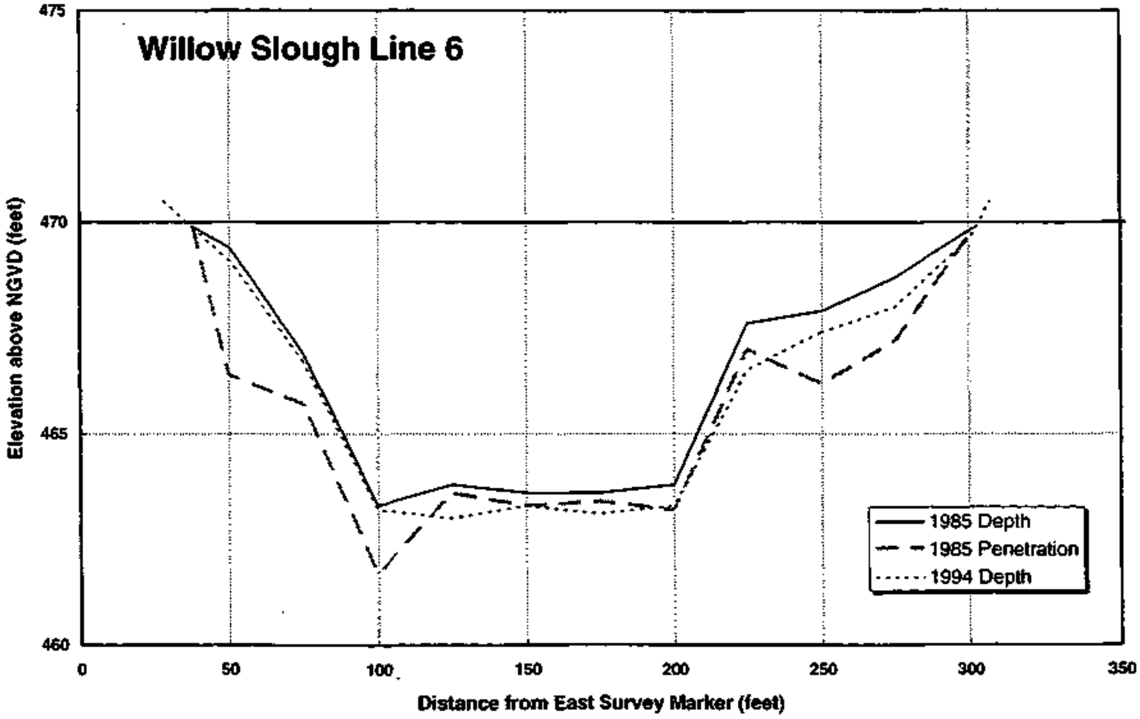


Figure A1-2. Continued

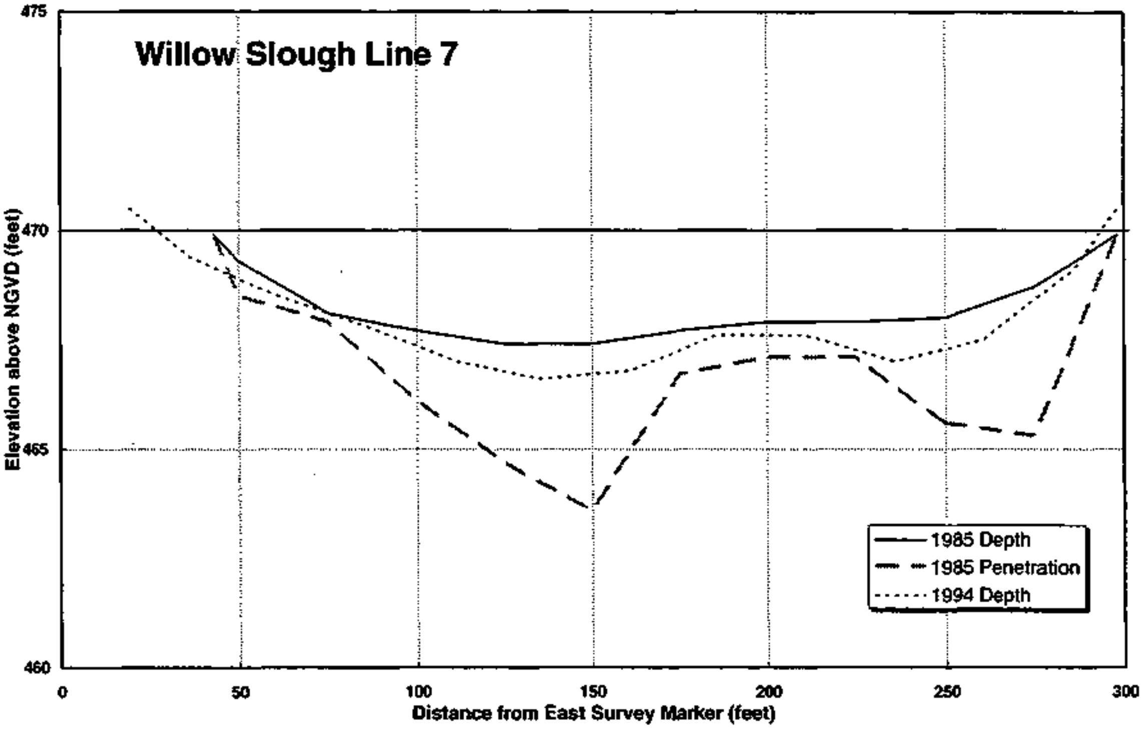


Figure A1-2. Concluded

Table A1-3. Cross-Sectional Profile Data for Quincy Bay - Broad Lake Transects

Upper Broad Lake Line 3

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
35			470.30
37	469.90		
57			469.60
75	469.50		
82			469.10
100	469.20		
107			468.90
125	469.10		
132			468.80
150	469.10		
157			468.70
175	469.00		
182			468.60
200	468.90		
207			468.50
225	468.80		
232			468.30
250	468.80		
257			468.20
275	468.80		
282			468.30
300	468.80		
307			468.30
325	468.80		
332			468.30
350	468.70		
357			468.40
375	468.90		
382			469.30
392	469.90		470.30

Upper Broad Lake Line 5

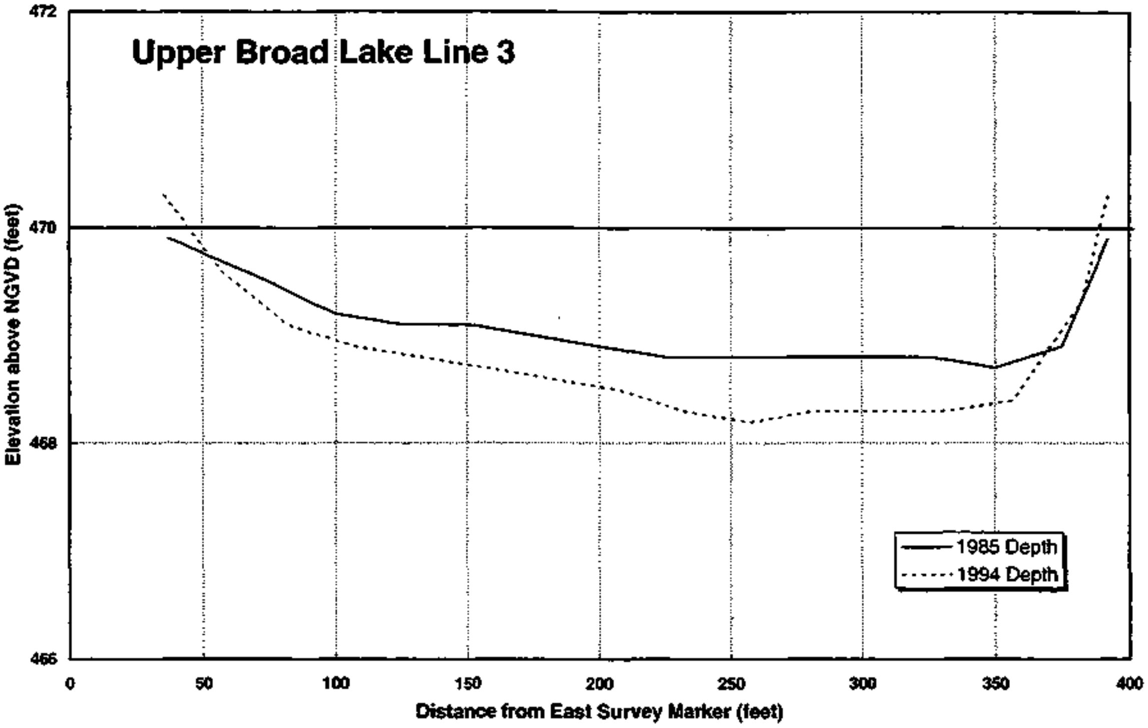
Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
20	469.90	469.90	
20			470.30
31			469.20
50	469.60	468.80	
56			468.90
75	469.20	468.60	
81			468.60
100	469.00	468.40	
106			468.50
125	469.00	468.10	
131			468.40
150	468.80	467.50	
156			468.40
175	468.50	467.40	
181			468.50
200	468.60	467.00	

Upper Broad Lake Line 4

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
48			470.30
53	469.90	469.90	
68			469.50
75	469.60	468.70	
93			468.40
100	468.90	467.10	
118			468.00
125	468.50	466.10	
143			467.70
150	468.30	466.80	
168			467.70
175	468.10	464.30	
193			467.70
200	468.00	464.00	
218			467.60
225	468.00	464.00	
243			467.50
250	467.90	463.90	
268			467.60
275	467.90	463.90	
293			467.90
300	468.00	464.00	
318			468.40
343	469.90	469.90	470.30

Table A1-3. Concluded

Distance from east shore (feet)	1985 Elevation above NGVD (feet)	1985 Penetration (feet)	1994 Elevation above NGVD (feet)
Upper Broad Lake Line 5 (continued)			
206			468.60
225	468.60	466.20	
231			468.90
250	468.60	466.50	
256			468.90
275	468.50	464.20	
281			468.70
300	468.40	463.90	
306			468.60
325	468.40	463.80	
331			468.50
350	468.40	464.60	
356			468.60
375	468.60	466.00	
381			468.70
400	468.90	467.50	
406			468.90
425	469.50	468.70	
431			469.30
456			470.00
460	469.90	469.90	
465			470.30



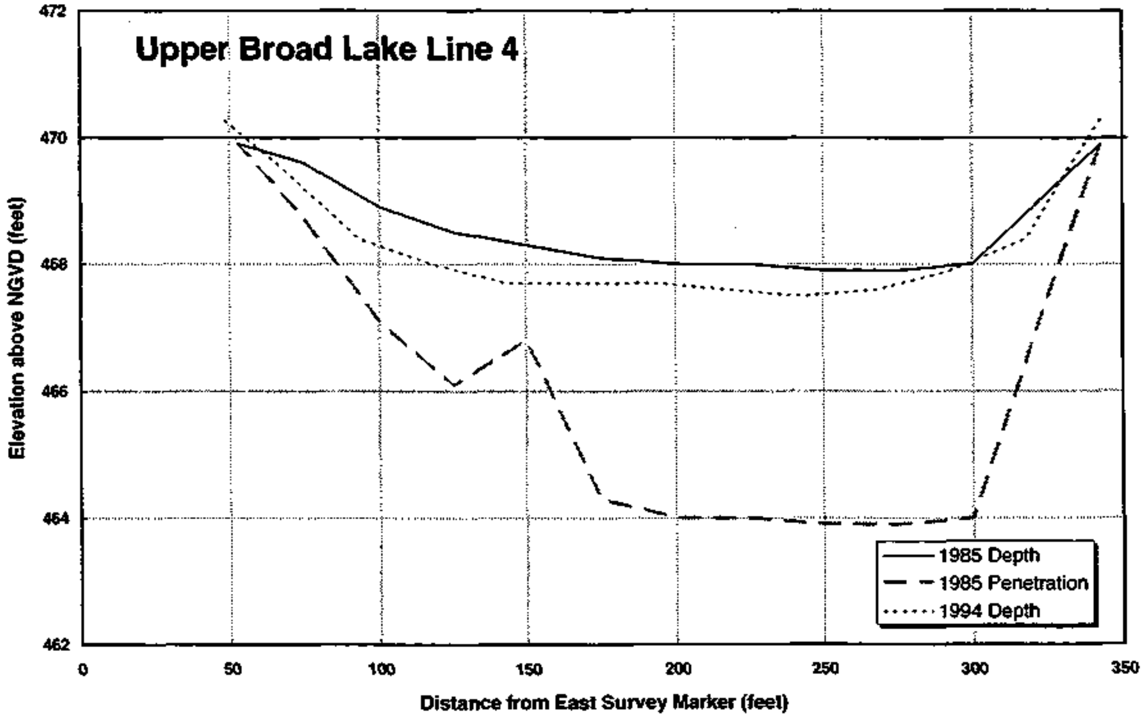


Figure A1-3. Cross-Sectional Profiles for Quincy Bay - Broad Lake Transects

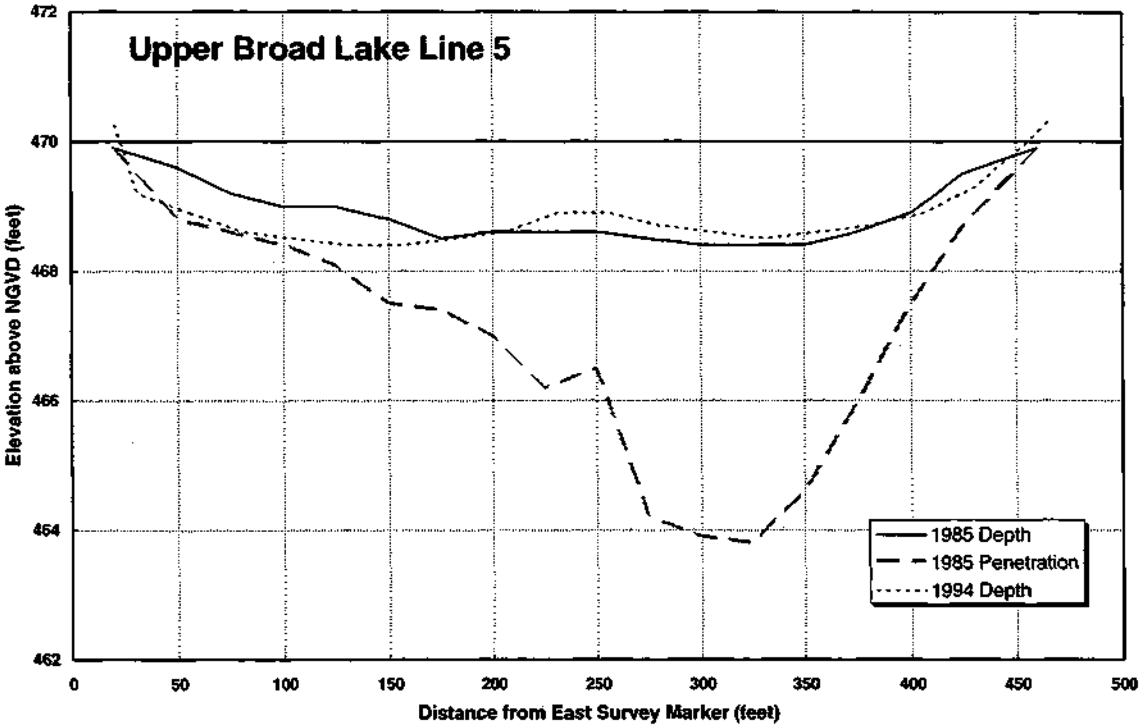


Figure A1-3. Concluded

Table A1-4. Cross-Sectional Profile Data for Quincy Bay - Access Channel Transects

Access Channel Line 1

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
0			470.0
10	470.0	470.0	
58			467.0
96	465.1	465.1	
110	466.4	466.4	
117			465.2
175			464.3
179	465.7	465.7	
234			463.3
240	465.1	465.1	
292			462.4
325	465.3	460.2	
350			463.4
380	468.3	462.5	
409			464.6
436	469.3	465.0	
467			465.4
493	468.5	463.7	
526			466.0
529	468.6	463.4	
584	470.0	470.0	470.0

Access Channel Line 2

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
20	470.0	470.0	
58			468.5
99	467.1	467.1	
116			468.0
163	466.3	466.3	
174			466.0
220	465.4	464.7	
232			465.1
290			464.1
296	465.3	464.3	
348			463.5
387	465.8	460.3	
406			463.0
461	468.3	462.7	
464			461.5
522			465.1
539	469.1	463.7	
580	470.0	470.0	470.0

Access Channel Line 3

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
89	470.0	470.0	
90			470.0
136			466.9
181			464.5
196	465.6	465.6	
227			462.8
272			463.3
318			462.7
327	464.6	459.3	
363			462.2
408	465.1	459.8	
409			461.4
454			460.5
480	467.1	461.0	
500			463.0
545	470.0	470.0	470.0

Access Channel Line 4

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
20			470.0
22	470.0		
53			466.0
85			464.3
102	464.4		
118			462.8
150			461.1
174	461.0		
183			459.8
215			459.0
246	461.6		
248			458.5
280			458.0
298	462.8		
313			463.5
330	467.3		
345	470.0		470.0

Access Channel Line 5

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
24	470.0		470.0
40	469.0		
51			466.8
78			466.1
101	466.0		
105			466.4

Access Channel Line 6

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
45	470.0		470.0
87			463.0
96	466.1		
128			461.7
136	461.6		
170			461.4

Table A1-4. Concluded

Access Channel Line 5 (continued)

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
132			465.7
159	463.1		464.2
186			463.2
213			462.0
240	450.0		452.0
263	461.3		
267			448.5
294	470.0		470.0

Access Channel Line 6 (continued)

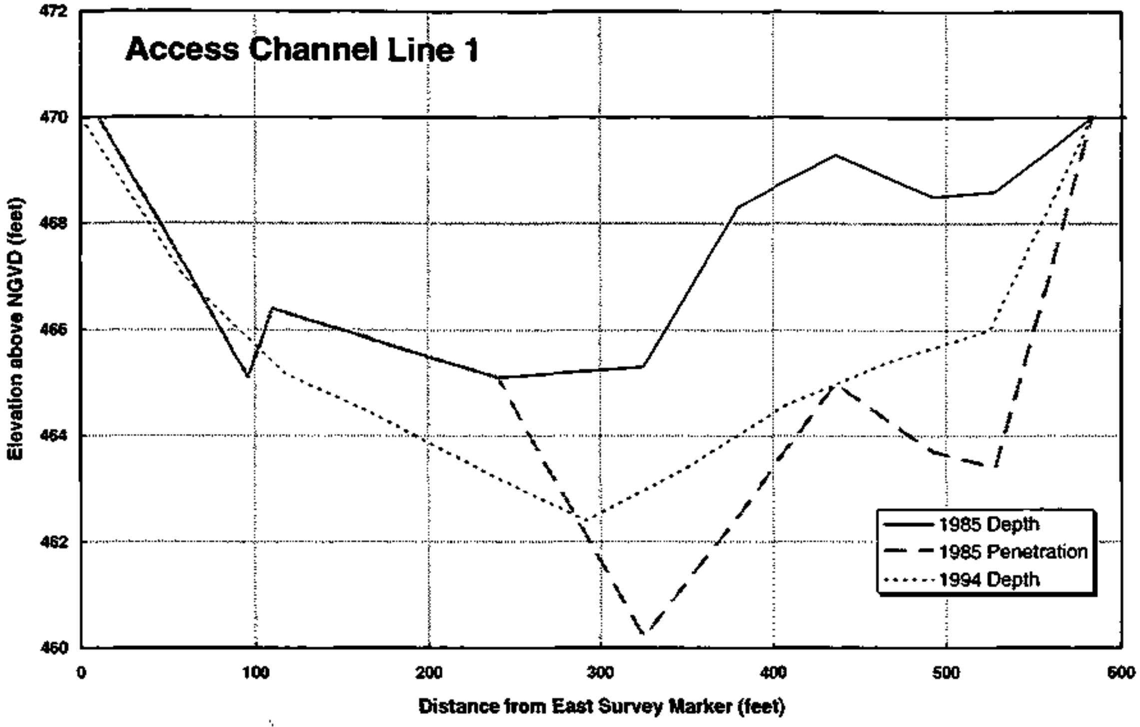
Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
190	461.4		
212			462.8
244	462.7		
254			463.2
290	464.1		
295			463.2
337			462.7
345	463.6		
379			462.0
410	462.1		
420			461.7
448	465.8		
462	470.0		470.0

Access Channel Line 7

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
10	470.5		470.0
25	463.5		
33			462.7
50	453.5		
56			453.0
75	448.5		
79			447.0
100	448.2		
102			445.5
125	448.1		447.8
148			448.1
150	448.4		
171			450.3
175	452.5		
194			451.2
200	461.0		
217			459.7
223	470.5		
240			470.0

Access Channel Line 8

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
25	469.9		470.0
38			456.0
50	451.8		449.0
63			444.0
75	448.6		445.0
88			444.0
100	445.9		442.5
113			441.8
125	451.5		444.8
138			454.5
150	469.9		470.0



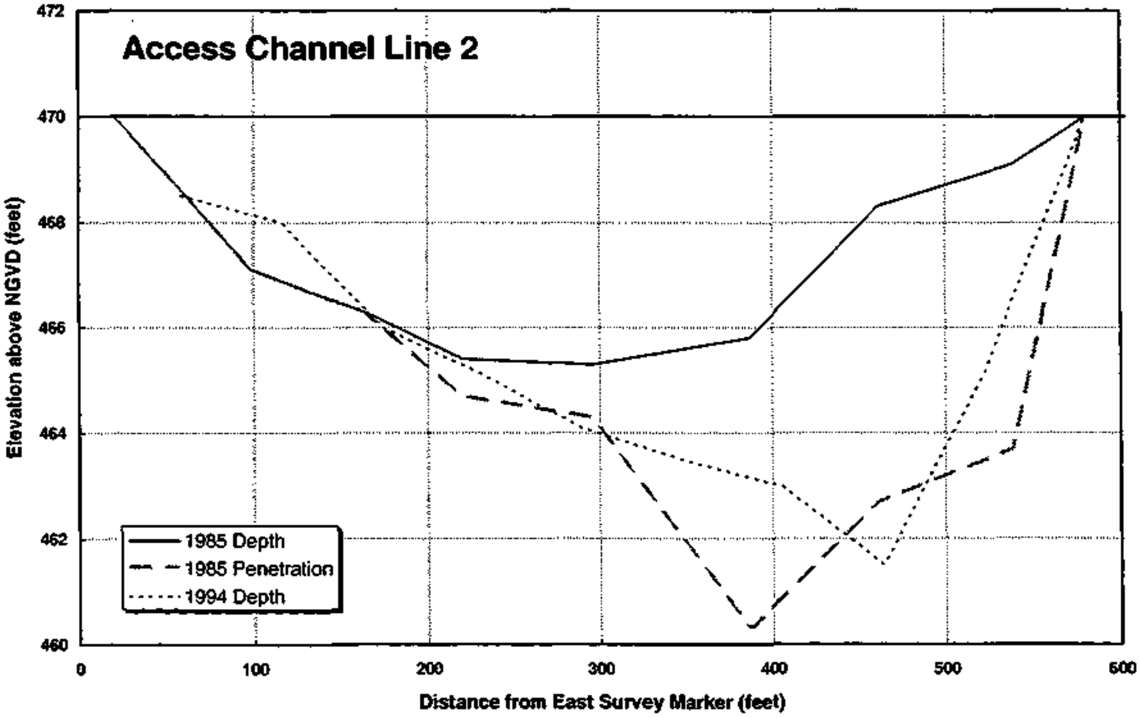
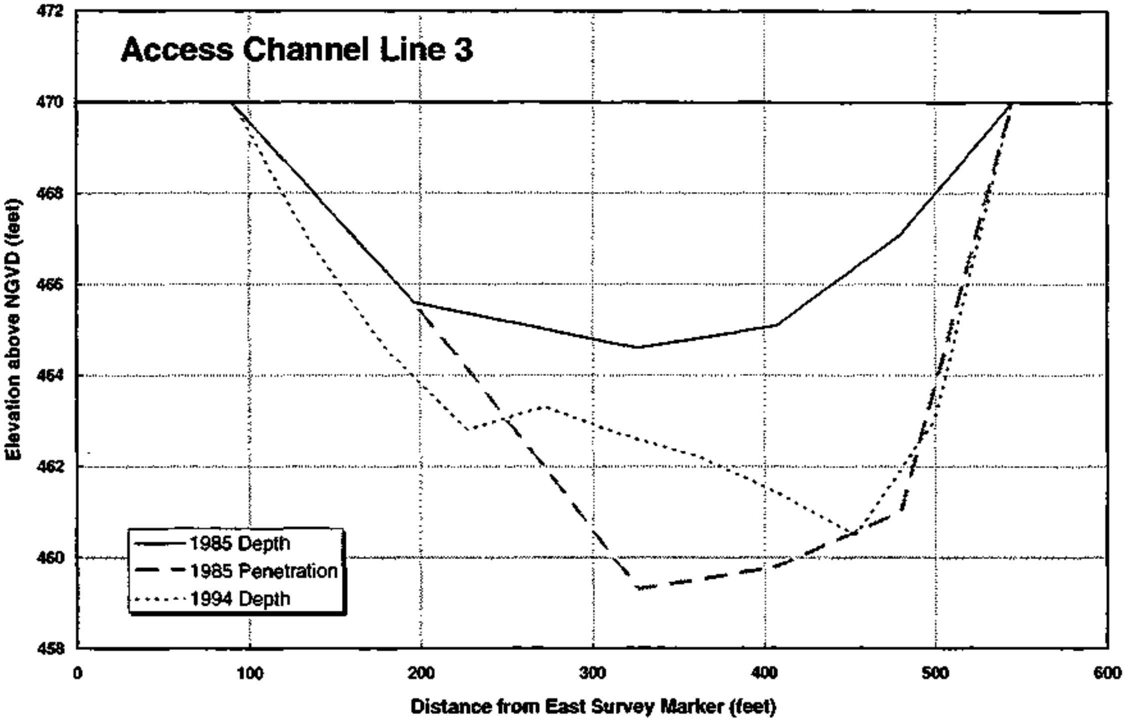


Figure A1-4. Cross-Sectional Profiles for Quincy Bay - Access Channel Transects



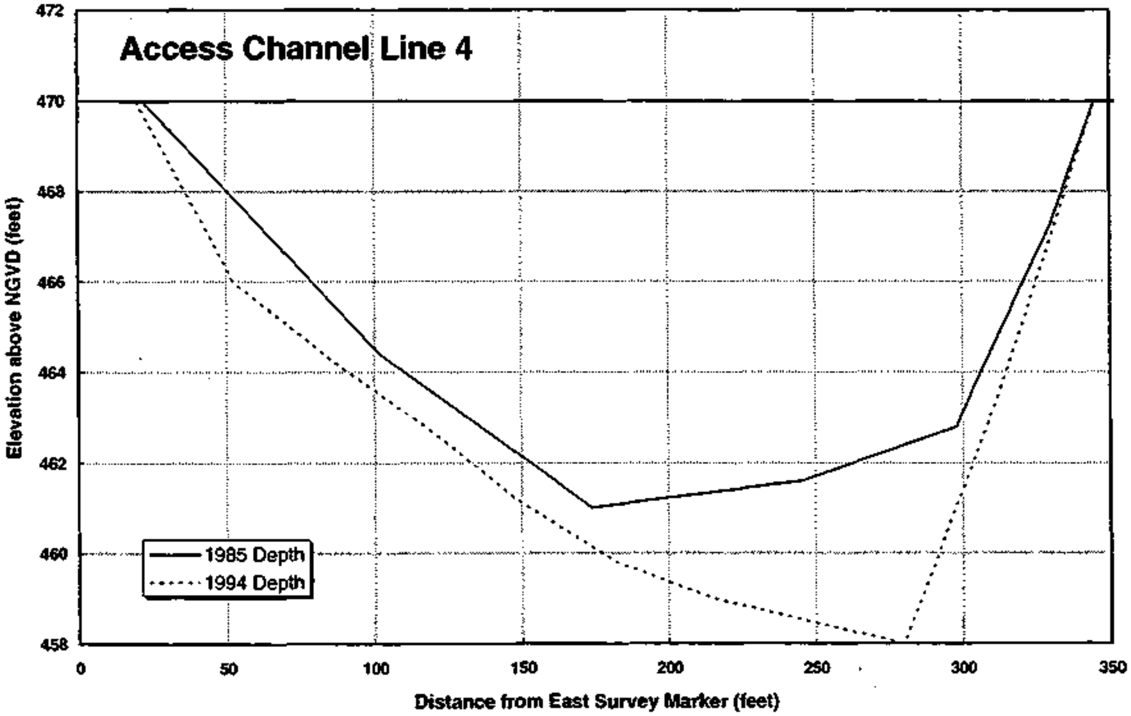
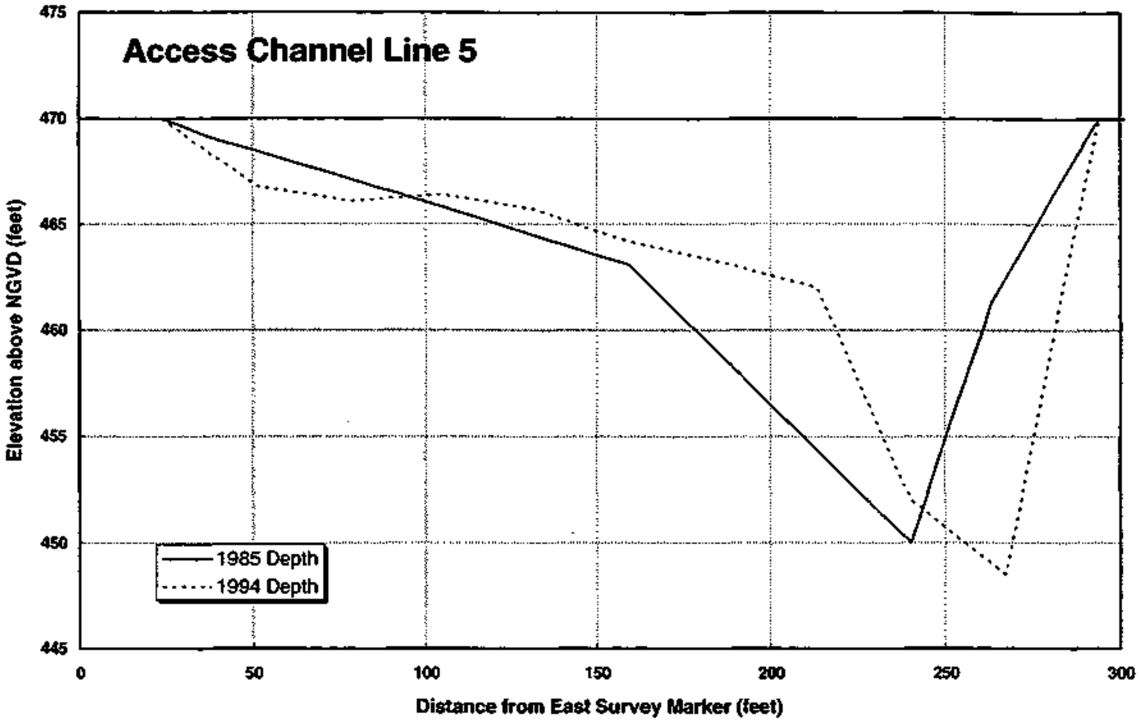


Figure A1-4. Continued



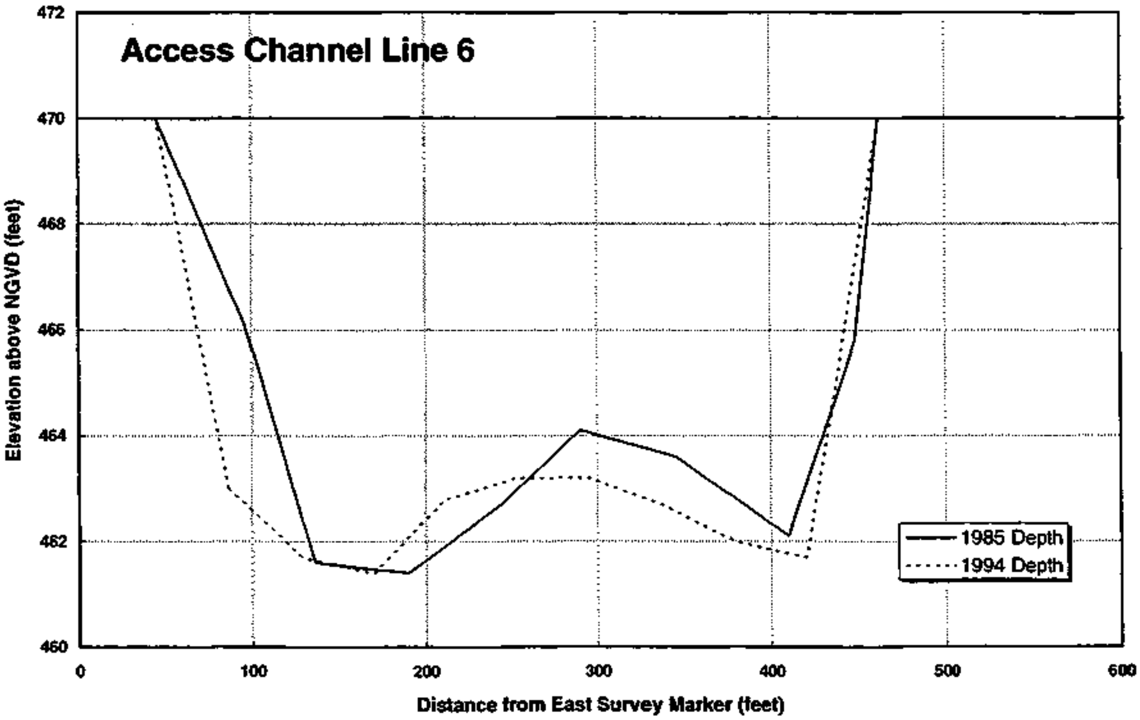
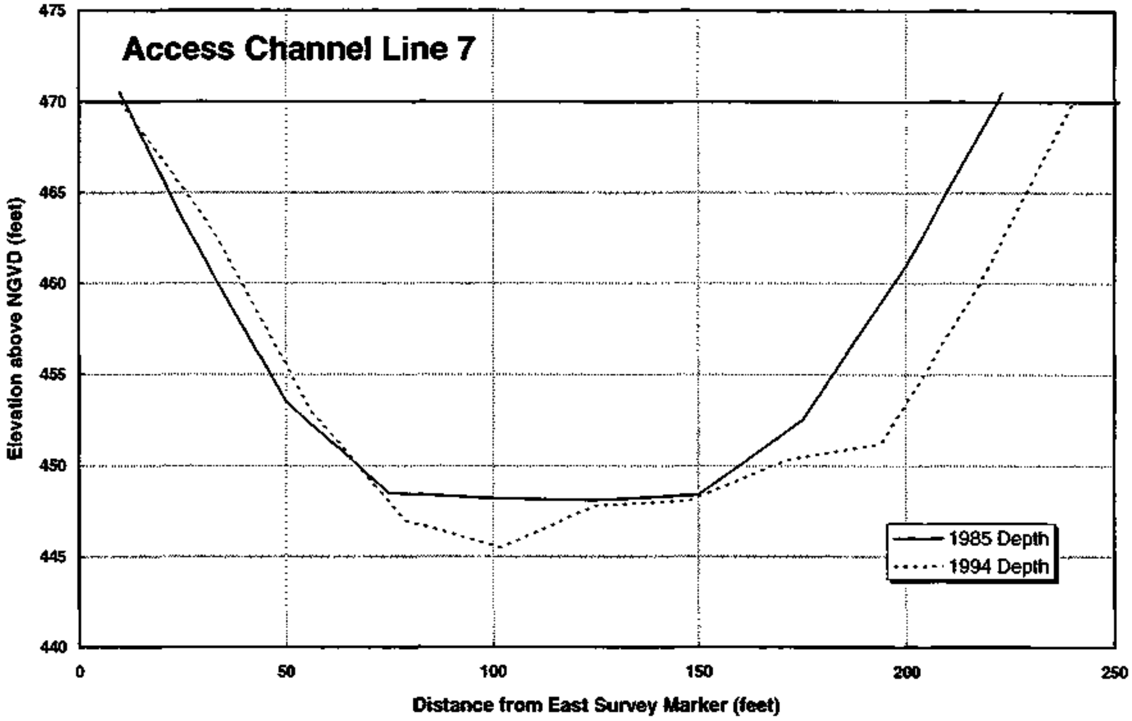


Figure A1-4. Cross-Sectional Profiles for Quincy Bay - Access Channel Transects



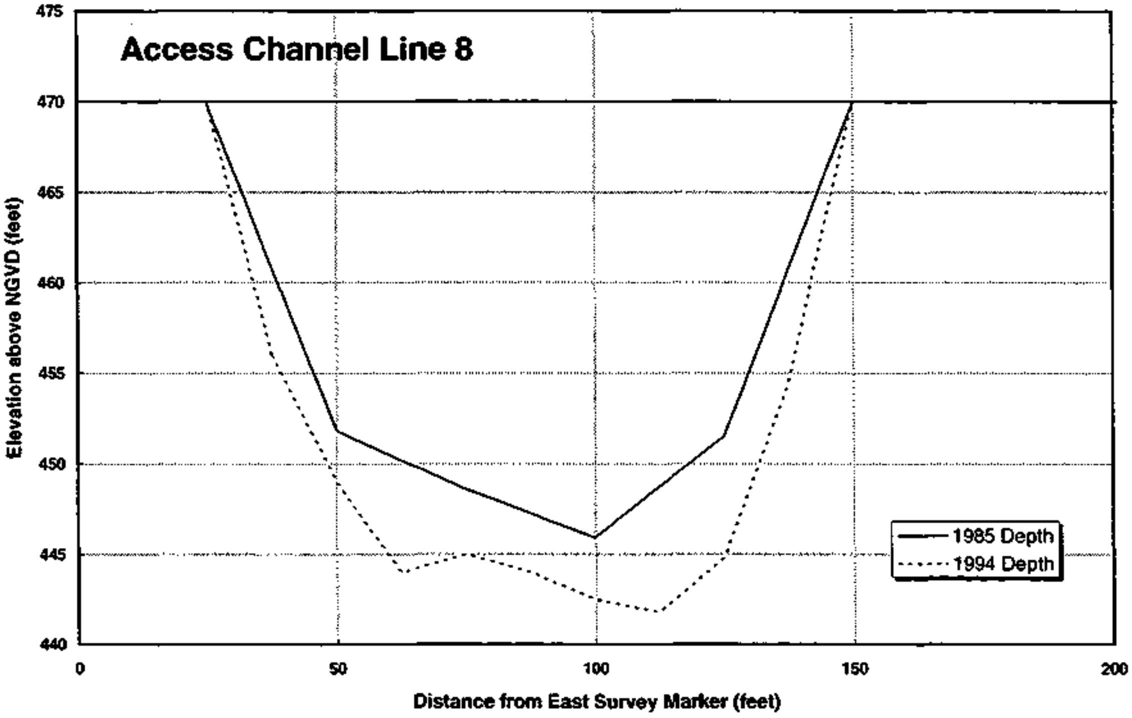


Figure A1-4. Concluded

Table A1-5. Cross-Sectional Profile Data for Quincy Bay - Triangle Lake Transects

Distance from east shore (feet)	*1985 Elevation above NGVD (feet)*	*1985 Penetration (feet)*	*1994 Elevation above NGVD (feet)*
Triangle Lake Line 2			
50			470.3
100			469.4
150			469.4
200			469.4
250			469.4
300			469.4
350			469.5
400			469.4
450			469.5
500			469.5
550			469.5
600			469.4
650			469.5
700			469.4
750			469.4
800			469.4
850			469.5
900			469.5
950			469.5
1000			469.5
1050			469.4
1100			469.1
1150			470.3

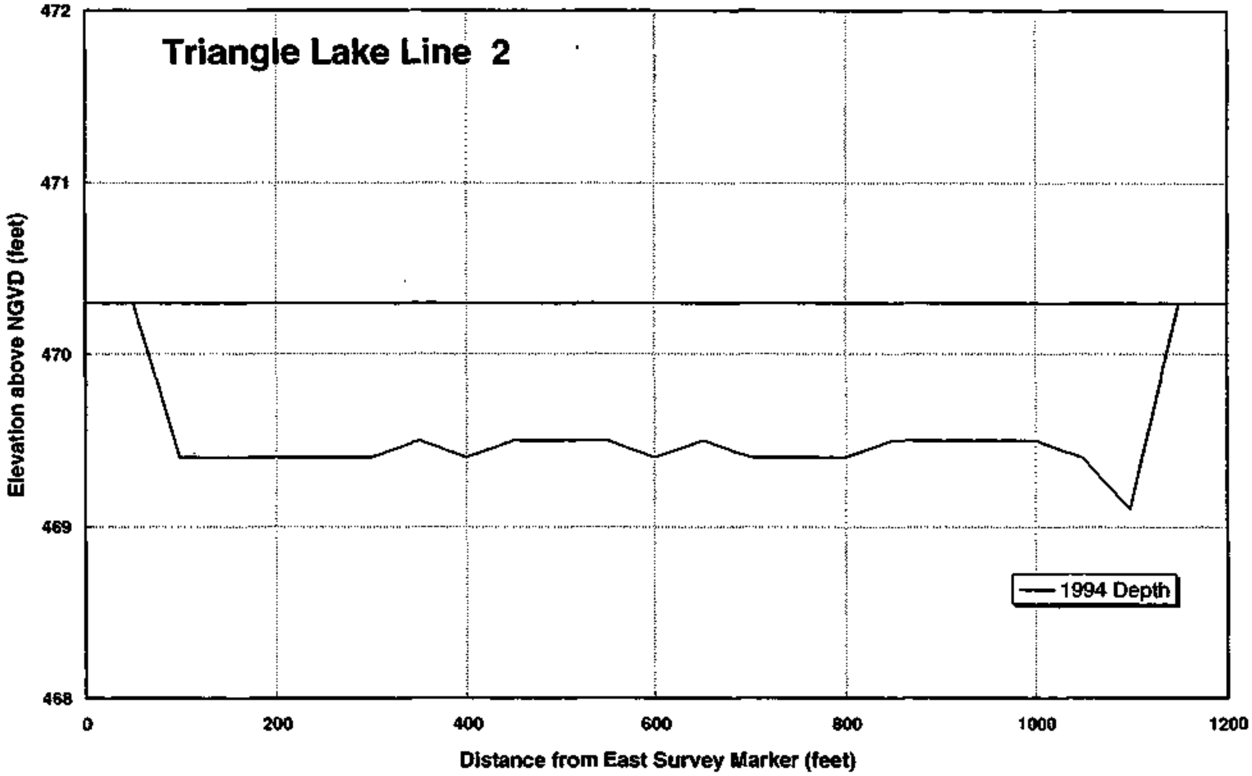


Figure A1-5. Cross-Sectional Profiles for Quincy Bay - Triangle Lake Transects

Table A2. Cross-Sectional Profile Data for Lake Meredosia Transects

Meredosia Line 2

Distance from east shore (feet)	*1975 Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
0	456.1	
212	444.3	
444	431.2	
887	426.6	
1271	426.6	
1529	425.9	
1567	424.1	
1605	423.0	
1716	422.7	
1836	422.7	
1996	422.8	
2151	422.9	
2281	423.1	
2411	422.4	
2541	424.1	
2641	425.6	
2833	424.1	
2971	423.3	
3081	422.9	
3181	422.5	
3244		423.1
3301	422.0	
3318		422.7
3441	421.9	
3458		422.5
3541	421.6	
3583		422.4
3678		422.4
3701	421.3	
3761	421.4	
3825		422.5
3861	421.4	
3959		422.4
3996	421.4	
4074		422.4
4101	421.5	
4196		422.7
4221	421.5	
4296	421.6	
4330		422.6
4381	421.6	
4421	421.8	
4471		422.7
4601	421.8	
4616		422.7
4701	422.1	
4741		422.9
4806	422.2	

Meredosia Line 3

Distance from east shore (feet)	*1975 Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
0	432.6	
208	429.6	
240	431.2	
307	429.4	
323	424.1	
358	422.5	
394	424.1	
408	428.5	
647	429.6	
666	424.1	
703	423.1	
767	422.7	
927	422.7	
1077	422.6	
1307	422.0	
1427	422.1	
1597	422.7	
1727	423.2	
1816		423.3
1827	423.6	
1860		423.2
1887	423.8	
1929		423.1
2003		423.1
2007	423.7	
2092		422.9
2147	423.7	
2166		422.9
2287	423.4	
2292		422.6
2407	422.9	
2474		422.2
2547	422.2	
2629		422.0
2647	421.7	
2729		421.7
2747	421.3	
2804		421.8
2894		421.7
2947	421.1	
3004		421.8
3135		421.9
3167	421.1	
3208		421.9
3316		421.8
3327	421.1	
3405		422.0
3447	421.2	

Table A2. Continued

Distance from east shore (feet)	*1975 Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*	*Distance from east shore (feet)*	*1975 Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
Meredosia Line 2 (continued)			**Meredosia Line 3 (continued)**		
4843		**423.0**	**350(3**		**422.0**
4899	**422.7**		**3567**	**421.3**	
4923		**423.3**	**3593**		**422.0**
4951	**424.1**		**3680**		**421.9**
4961	**425.3**		**3717**	**421.5**	
			3791		**422.2**
			3882		422.3
			3907	421.9	
			3968		422.5
			4027	422.5	
			4058		422.5
			4127	**423.4**	
			4144		**422.7**
			4171	**424.1**	
			4187	**424.4**	
			4212		**422.9**
			4288		423.0
Meredosia Line 4			**Meredosia Line 5**		
0	**453.9**		**0**	**451.6**	
98	**430.7**		**45**	**437.6**	
147	**426.1**		**120**	**427.3**	
260	**415.9**		**167**	**421.8**	
370	**426.1**		**222**	**427.3**	
392	**430.0**		**228**	**433.1**	
599	**430.1**		**604**	**425.5**	
843	**431.4**		**653**	**424.1**	
1181	**425.8**		**684**	**422.6**	
1202	**424.1**		**729**	**421.6**	
1216		**423.5**	**809**	**421.0**	
1243	**423.6**		**848**		**421.1**
1296	**421.9**		**904**	**420.6**	
1317		**423.1**	**1009**	**420.3**	
1374	421.5		1028		420.2
1463		423.0	1044	420.1	
1505	421.1		1104	420.0	
1610		422.8	1146		420.2
1611	**420.8**		**1194**	**419.9**	
1716	**420.5**		**1284**		**420.0**
1784		**422.5**	**1304**	**419.7**	
1831	**420.0**		**1364**	**419.6**	
1941		422.0	1451		420.0
2001	**419.5**		**1489**	**419.6**	
2111	**419.8**		**1544**	**419.5**	
2111	**420.0**		**1576**		**419.8**
2173		**422.2**	**1624**	**419.6**	
2381	420.3		1704	419.5	
2411		**422.1**	**1719**		**419.8**

Table A2. Continued

Distance from east shore (feet)	*1975 Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*	*Distance from east shore (feet)*	*1975 Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
Meredosia Line 4 (continued)			**Meredosia Line 5 (continued)**		
2461	420.4		1804	419.5	
2541	420.5		1860		419.8
2601	420.5		1964	419.5	
2642		421.8	1977		419.5
2661	420.6		2004	419.6	
2741	420.5		2104	419.6	
2801	420.7		2154		419.8
2856		421.3	2244	419.9	
2961	420.7		2264	419.9	
3001	420.6		2293		420.1
3024		421.7	2399		420.4
3141	420.6		2440	420.1	
3273		421.4	2529		420.8
3281	420.6		2544	420.1	
3421	419.4		2624	420.7	
3489		421.3	2640		420.8
3601	420.6		2724	421.0	
3730		421.6	2746		421.3
3927		421.8	2824	422.3	
4021	421.4		2858		422.2
4091	421.9		2932		422.4
4154		422.2	2964	424.1	
4161	422.7		2969	424.2	
4181	424.1				
4193	424.2				
4340		422.5			
4553		423.3			
Meredosia Line 6			**Meredosia Line 7**		
0	452.2		0	453.2	
52	438.5		71	434.1	
165	426.4		187	424.1	
182	425.2		221	420.4	
200	426.4		276	424.1	
212	432.6		327	431.3	
365	425.7		477	424.1	
383	424.1		510	422.7	
423		422.7	510		422.6
437	422.0		537		422.6
471		422.4	558	421.6	
500	421.6		611		421.8
558		422.1	634	421.4	
605	421.4		699		421.7
684		421.9	729	421.1	
720	421.2		792		421.4
782		421.7	834	420.6	
869		421.4	882		420.8
875	420.9		963		420.7

Table A2. Continued

Meredosia Line 6 (continued)

Distance from east shore (feet)	1975 Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
972		421.2
1040	420.4	
1073		420.8
1153		420.8
1205	420.2	
1213		420.6
1306		420.3
1425	419.9	
1460		420.2
1555		420.1
1605	419.7	
1664		420.0
1760		420.1
1765	419.6	
1851		420.1
1965	419.7	
1980		420.1
2096		420.3
2125	419.7	
2196		420.2
2300		420.2
2325	419.7	
2405	419.8	
2441		420.3
2545	419.8	
2582		420.4
2665	419.9	
2676		420.5
2777	419.9	
2806		420.3
2857	420.0	
2967	420.0	
2997		420.9
3092	420.3	
3109		420.8
3217	420.5	
3256		421.3
3277	420.7	
3352	420.9	
3369		421.6
3428		421.9
3447	421.3	
3507	421.7	
3567	422.6	
3602	424.1	
3617	424.6	
3994	425.7	
4295	425.3	

Meredosia Line 7 (continued)

Distance from east shore (feet)	1975 Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
964	420.3	
1084		420.5
1144	420.0	
1174		420.7
1234	420.1	
1285		420.8
1376		420.9
1464	420.4	
1486		421.0
1605		421.0
1624	420.5	
1717		421.0
1804	420.5	
1812		421.1
1937		421.0
1944	420.5	
2032		421.0
2152		421.0
2184	420.4	
2253		421.1
2324	420.5	
2371		421.0
2424	420.4	
2604	420.5	
2679		421.0
2704	420.5	
2809		421.1
2824	420.5	
2884		421.1
2991		421.2
3044	420.6	
3066		421.2
3152		421.2
3164	420.6	
3235		421.2
3274	420.6	
3352		421.3
3454	420.7	
3463		421.3
3584		421.4
3674	420.8	
3692		421.6
3794		421.8
3874	421.1	
3932		422.0
4054	421.8	
4059		422.2
4174	422.3	

Table A2. Continued

Distance from east shore (feet)	*1975 Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*	*Distance from east shore (feet)*	*1975 Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
Meredosia Line 6 (continued)			**Meredosia Line 7 (continued)**		
4469	425.7		4243		423.0
4635	427.1		4254	423.2	
4692	430.0		4291	424.1	
4776	433.9		4304	424.5	
5141	434.9				
5476	432.8				
5752	434.6				
6297	432.2				
6422	425.9				
6598	424.2				
6773	425.9				
6788	426.5				
7080	428.7				
7225	432.7				
7330	433.3				
7508	428.4				
7616	426.6				
7711	424.8				
7797	427.1				
8000	427.5				
8320	427.7				
8747	427.9				
8882	428.4				
9212	430.5				
9537	433.4				
9699	434.5				
9786	434.6				
9829	435.2				
9933	432.0				
9996	425.8				
10079	420.9				
Meredosia Line 8			**Meredosia Line 9**		
0	453.8		0	453.7	
70	435.0		84	432.0	
166	424.1		109	430.3	
196	418.7		145	424.1	
251	417.6		177	421.3	
281	418.6		226	415.6	
311	424.1		237	415.5	
326	430.8		285	417.5	
486	427.2		318	424.1	
515	424.1		325	427.4	
520		422.7	329		422.7
528	422.5		341	427.6	
566	421.6		395	425.7	
569		422.1	404		422.5
611	421.2		406	424.1	

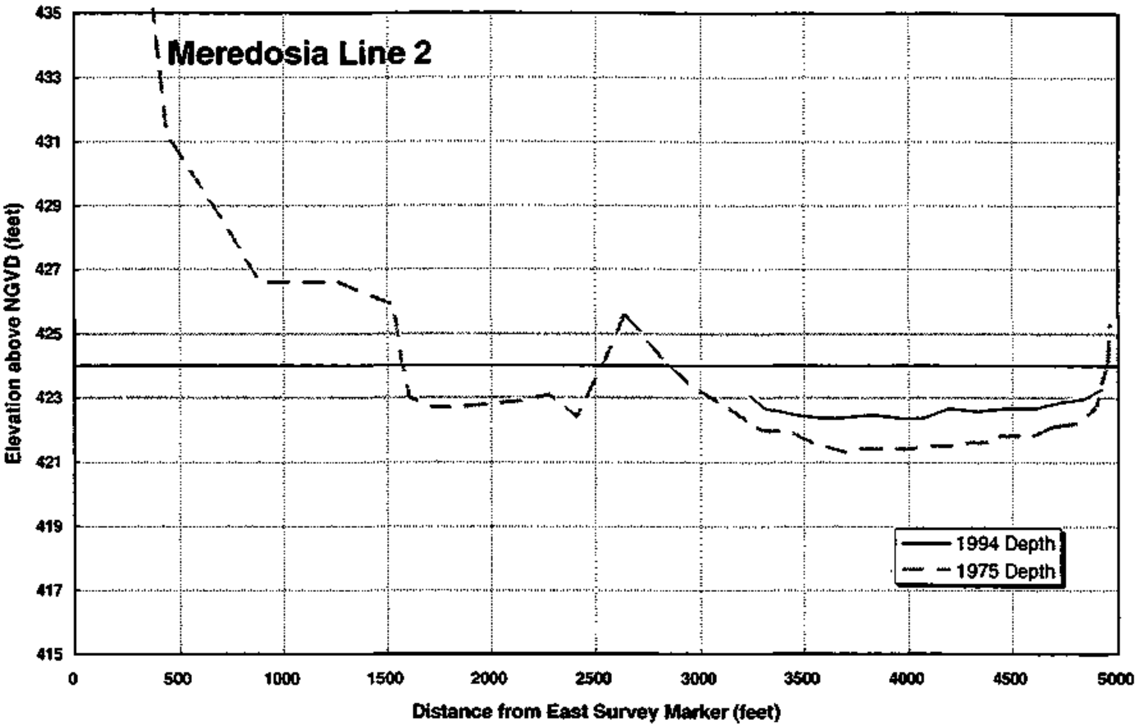
Table A2. Concluded

Meredosia Line 8 (continued)

Distance from east shore (feet)	1975 Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
659		421.9
670	421.2	
751	421.0	
767		421.7
811	420.9	
859		421.6
901	420.8	
954		421.6
976	420.8	
1052		421.6
1071	420.8	
1155		421.8
1226	420.7	
1276		421.7
1346	421.0	
1366		421.7
1426	421.1	
1471		421.8
1506	421.2	
1570		421.8
1606	421.2	
1675		421.9
1686	421.3	
1766	421.4	
1779		421.8
1866	421.4	
1905		422.1
1986	421.5	
2015		422.1
2112		422.1
2146	421.9	
2201		422.2
2206	422.2	
2295		422.2
2346	422.1	
2398		422.4
2466	422.1	
2546	422.0	
2595		422.6
2666	422.2	
2669		422.5
2756		422.7
2766	422.7	
2846	424.1	
2849		423.2
2858	424.9	

Meredosia Line 9 (continued)

Distance from east shore (feet)	1975 Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
427	422.9	
478	421.8	
521		422.2
545	421.6	
618		421.9
640	421.6	
719	421.2	
721		421.9
735	421.3	
834	421.1	
847		421.9
905	421.1	
935	421.1	
937		421.9
1033		422.2
1045	421.2	
1075	421.3	
1105	421.4	
1141		422.4
1155	421.4	
1195	421.5	
1225		422.5
1270	421.6	
1290	421.7	
1323		422.8
1340	421.8	
1399		422.7
1415	422.1	
1455	422.2	
1475	422.2	
1484		422.9
1515	422.4	
1549		423.2
1575	422.4	
1581		423.4
1615	421.8	
1675	422.8	
1695	423.0	
1755	424.1	
1761	424.3	



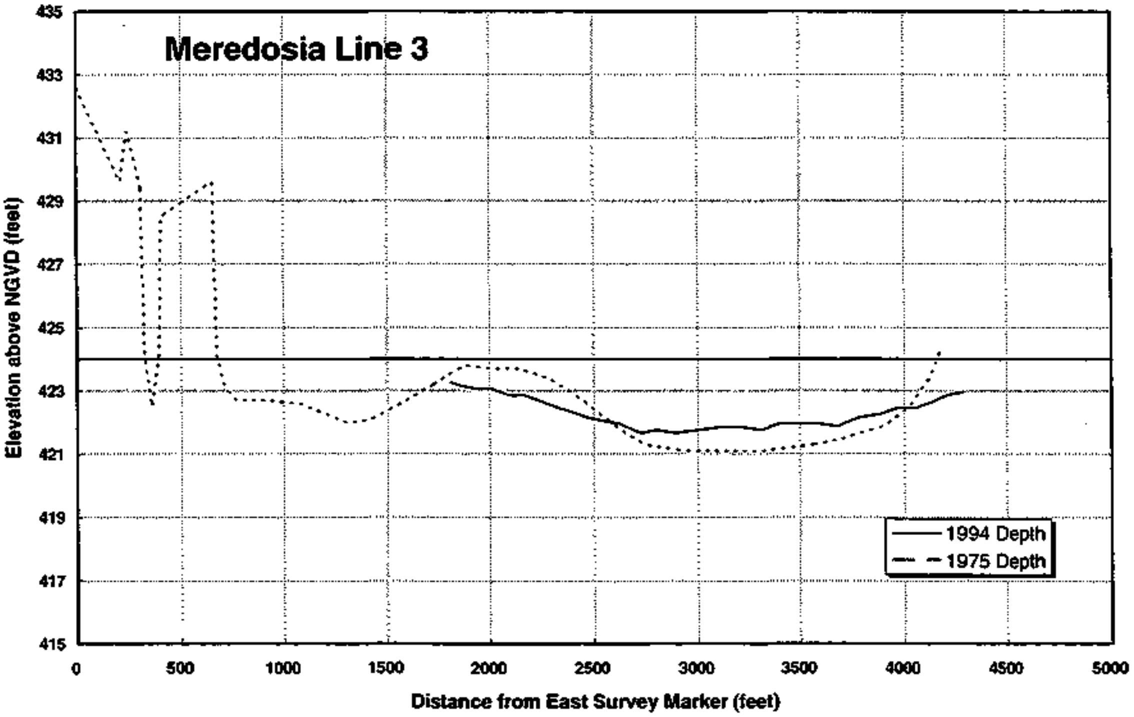
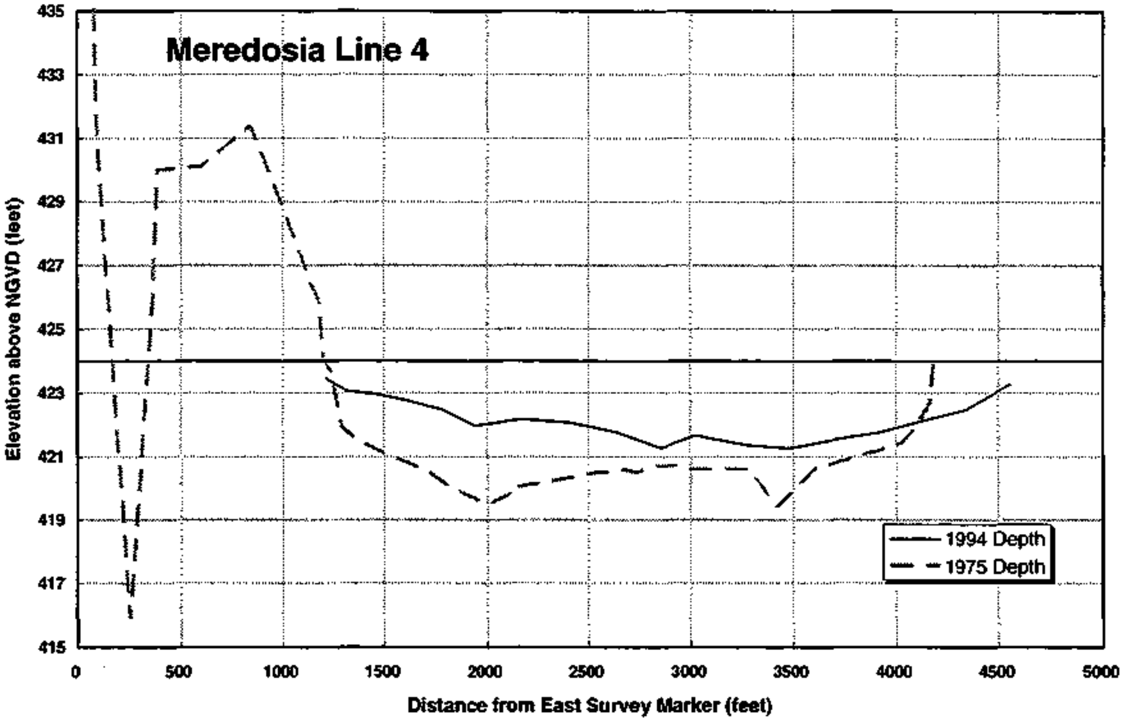


Figure A2. Cross-Sectional Profiles for Lake Meredosia Transects



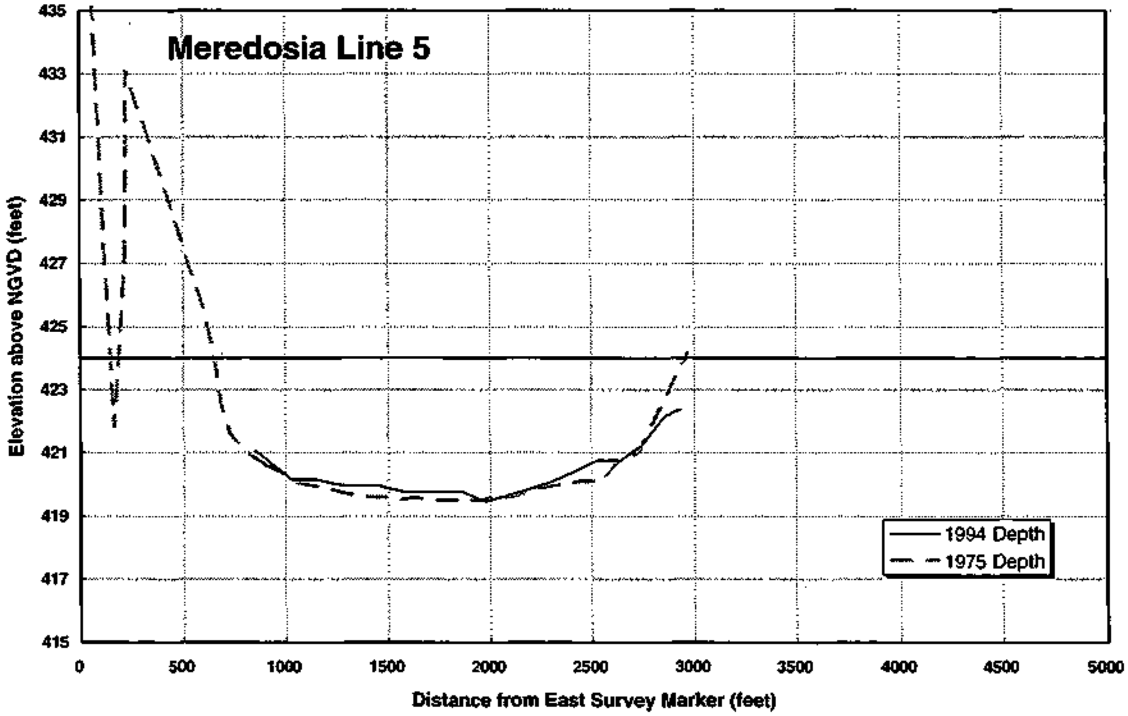
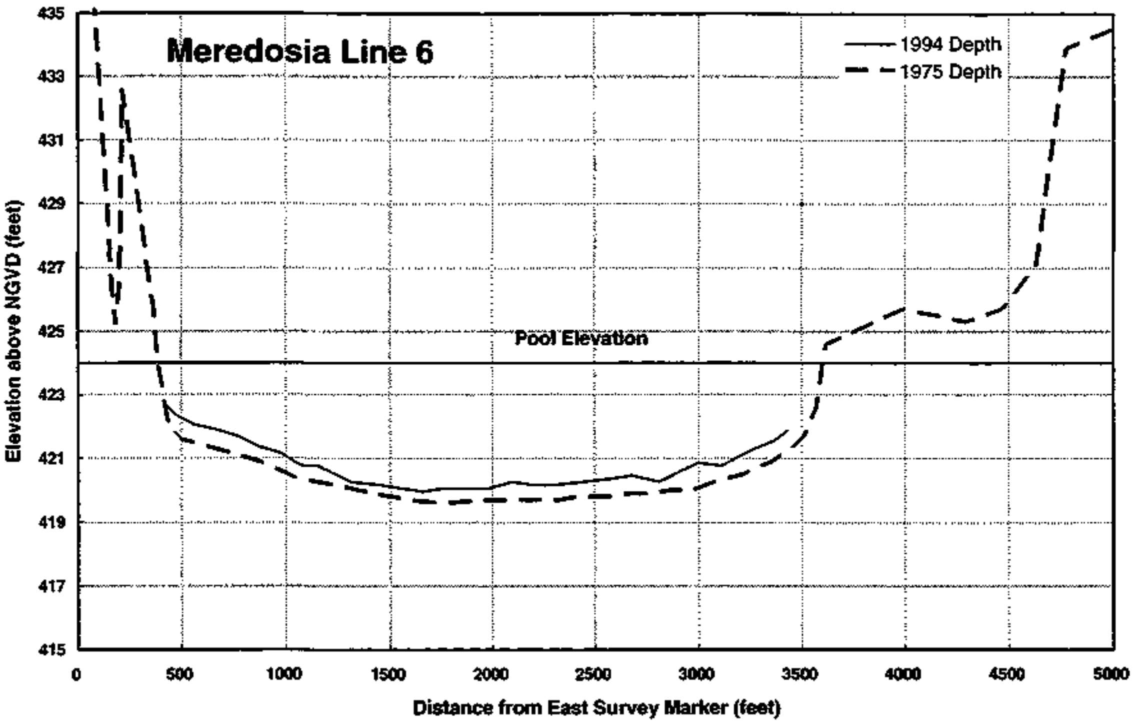


Figure A2. Continued



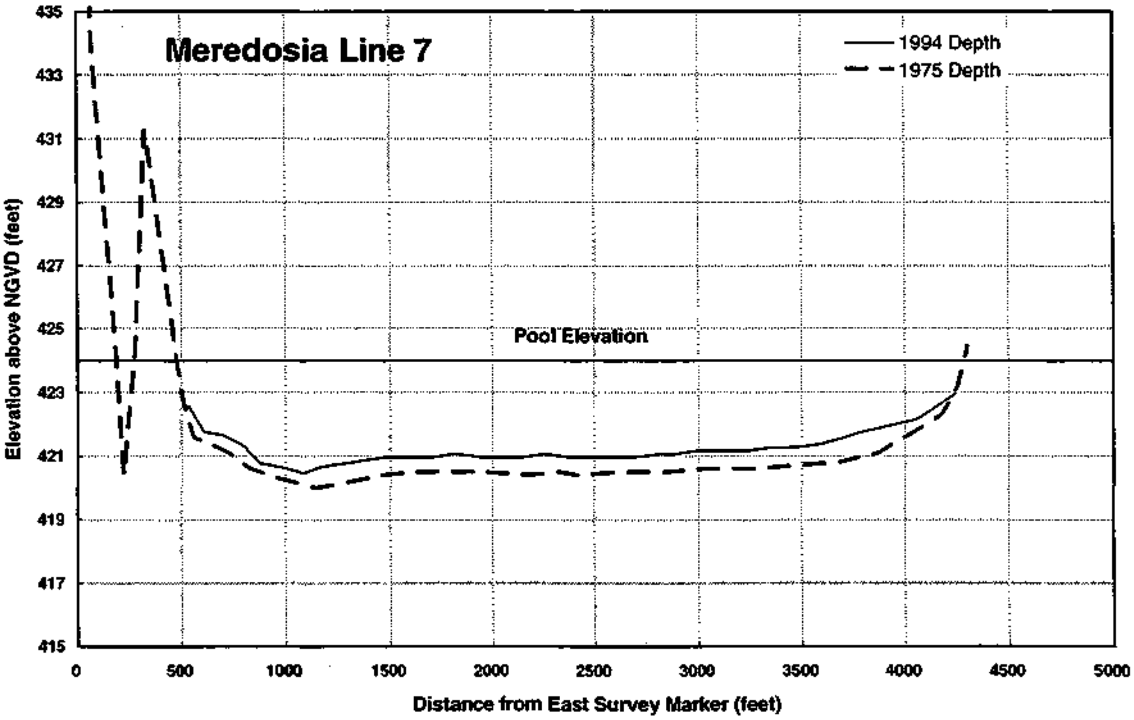
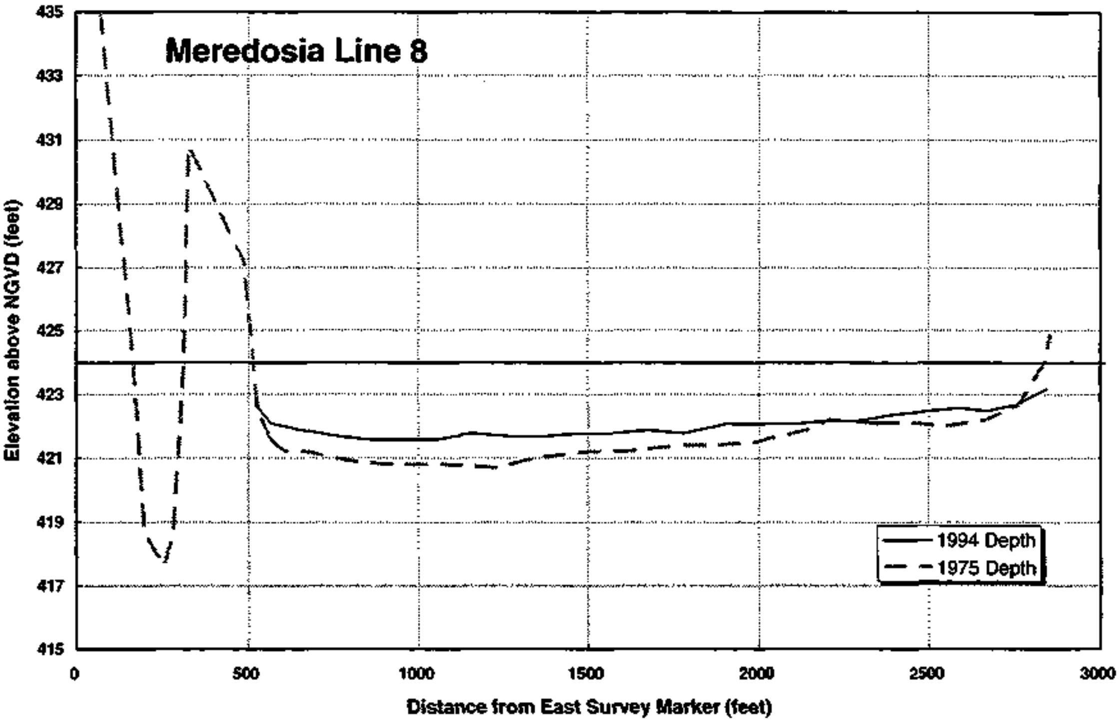


Figure A2. Continued



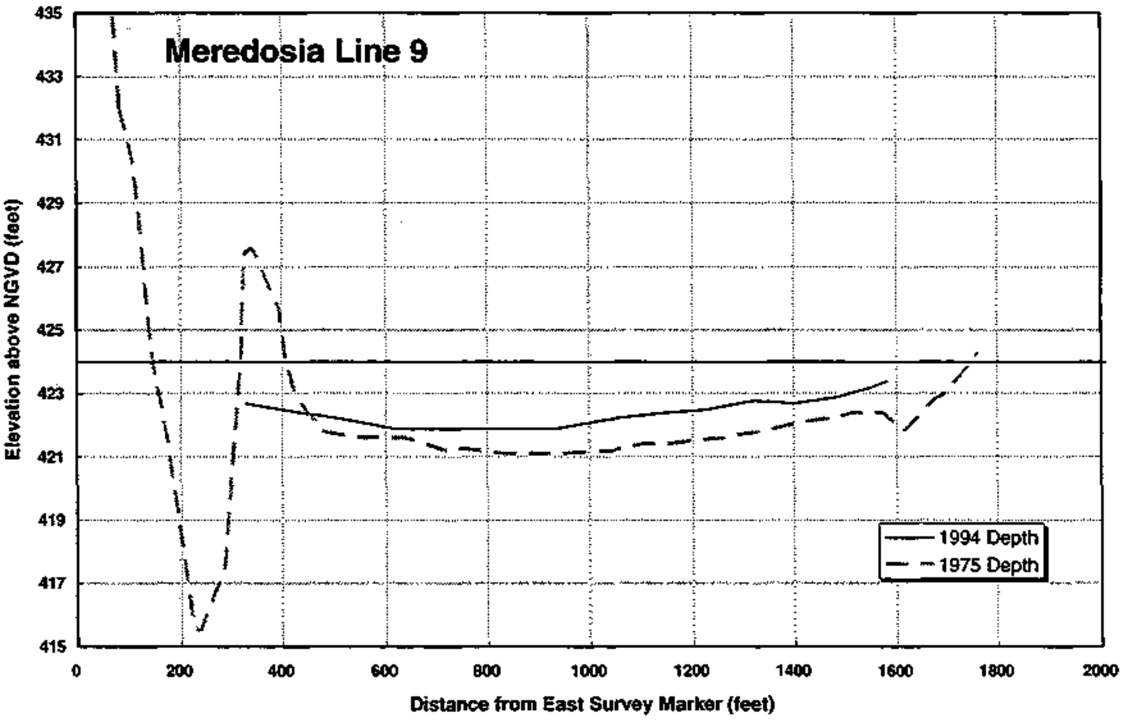


Figure A2. Concluded

Table A3. Cross-Sectional Profile Data for Swan Lake Transects

Swan Lake Line 3900

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
0		419.00
29		418.69
76		418.49
164		418.29
321		417.99
461		417.79
598		417.69
718		417.19
851		417.19
1045		416.79
1427		416.79
1544		416.79
1674		416.79
1809		416.79
1946		416.79
2117		416.79
2388		416.79
2571		416.99
2853		416.99
3014		417.29
3154		417.09
3291		417.29
3443		417.29
3654		417.29
3778		417.59
3886		417.49
4044		417.59
4174		417.59
4280		417.59
4430		417.59
4559		417.59
4669		417.59
4922		417.69
5108		417.69
5199		417.69
5336		417.79
5451		417.79
5604		417.79
5929		417.79
6072		417.79
6216		417.79
6329		417.79
6442		417.89
6606		417.99
6769		417.99
7016		419.00

Swan Lake Line 3927

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
0		419.00
37		418.29
112		417.99
347		417.69
528		417.49
738		417.09
859		417.09
1055		416.89
1171		416.89
1300		416.69
1491		416.69
1721		416.69
1874		416.69
2003		416.69
2166		416.59
2318		416.69
2500		416.59
2691		416.69
2861		417.09
3196		417.29
3362		417.59
3514		417.69
3635		418.29
4503		419.00

Table A3. Continued

Swan Lake Line 3953

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
0	418.70	419.00
75	417.70	
215		418.19
225	416.70	
271		418.09
406		417.89
563	415.70	
655		417.49
675	414.70	
788	413.70	
825		417.29
863	412.70	
992		417.09
1156		417.09
1465		416.89
1670		416.89
1688	412.70	
1812		416.89
2007		416.89
2100	413.70	
2288	414.70	
2408		416.89
2632		416.89
2700	415.70	
2869		416.89
3075	415.70	
3214		417.29
3526		417.29
3825	415.70	
3855		417.39
4375		417.69
4625		417.89
4725	416.70	
4974		418.19
5175	417.70	
5257		418.49
5504		418.74
5625	418.70	
5641		419.00

Swan Lake Line 3979

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
0		419.00
184		418.89
241		418.69
314		418.59
396		418.39
468		418.19
582		417.89
691		417.69
805		417.59
924		417.49
1044		417.49
1163		417.49
1275		417.59
1380		417.49
1510		417.49
1618		417.49
1745		417.49
1907		417.69
2090		417.59
2218		417.69
2318		417.69
2455		417.69
2561		417.79
2877		417.99
3241		418.29
3603		418.29
3916		418.39
3985		418.39
4176		418.49
4361		418.69
4513		418.79
4834		419.00

Swan Lake Line 3999

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
0		419.00
691		418.59
907		418.39
1096		418.29
1263		418.39
1444		418.59
1533		418.49

Swan Lake Line 8359

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
0		419.00
90		418.39
345		417.99
669		417.49
1128		416.69
1433		416.99
1985		416.99

Table A3. Continued

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*	*Distance from east shore (feet)*	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
Swan Lake Line 3999 (continued)			**Swan Lake Line 8359 (continued)**		
1701		418.39	2262		416.89
1796		418.49	2523		416.99
1945		418.59	2692		417.19
1997		418.49	2995		417.49
2071		418.59	3274		417.99
2136		418.59	3487		418.29
2189		418.59	3542		418.39
2232		419.00	3694		418.59
			3791		418.89
			4328		419.00
Swan Lake Line 8379			**Swan Lake Line 8399**		
0		419.00	0	418.70	419.00
149		418.17	75	417.70	
204		418.07	122		418.57
295		417.97	188	416.70	
362		417.77	244		418.27
446		417.77	405		417.97
512		417.57	413	415.70	
607		417.27	553		417.67
684		417.17	750	414.70	
751		417.07	784		416.87
829		416.97	975	413.70	
889		416.77	1117		416.47
982		416.77	1369		417.57
1055		416.67	1556	411.70	
1136		416.57	1593		418.07
1244		416.87	1866		418.37
1399		416.97	2064		418.37
1616		417.47	2138	413.70	
1781		418.07	2213	414.70	
2092		418.67	2338		418.67
2313		418.97	2400	415.70	
3099		419.00	2684		418.67
			2942		418.67
			3075	416.70	
			3654		419.00
			3750	417.70	
			3975	418.70	
Swan Lake Line 8418			**Swan Lake Line 8438**		
0		419.00	0		419.00
248		418.67	622		418.67
437		418.47	690		418.47
760		418.37	752		418.17
849		418.17	831		418.07
925		417.87	939		417.77
1188		417.47	1013		417.47

Table A3. Continued

Swan Lake Line 8418 (continued)

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
1395		417.07
1543		416.97
1667		416.37
1826		416.47
1943		416.47
2056		416.47
2179		416.67
2310		416.97
2413		416.97
2530		416.97
2650		416.97
2779		417.17
2930		417.27
3027		417.37
3124		417.47
3231		417.67
3414		417.97
3548		418.27
3612		418.37
3664		419.00

Swan Lake Line 8438 (continued)

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
1066		417.07
1141		416.77
1191		416.57
1265		416.37
1353		416.37
1526		416.17
1609		416.37
1689		416.37
1912		416.57
2026		417.07
2102		417.47
2190		417.97
2295		418.27
2360		418.27
2401		418.57
2737		419.00

Swan Lake Line 8457

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
0		419.00
380		418.97
451		418.37
531		417.07
605		416.57
681		416.37
752		415.97
820		415.77
915		415.87
982		415.87
1100		416.07
1181		416.27
1252		416.37
1331		416.37
1419		416.57
1500		416.87
1593		417.07
1695		417.07
2052		417.97
2275		418.47
2335		418.47
2401		419.00

Swan Lake Line 8477

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
0		419.00
273		418.37
327		417.37
593		416.47
623		416.47
717		416.77
805		417.07
912		417.07
1031		417.47
1127		417.67
1219		417.77
1310		418.27
1360		418.27
1413		418.47
1471		418.37
1526		418.37
1568		418.77
1613		419.00

Swan Lake Line 8497

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
0	418.70	419.00
75	417.70	

Swan Lake Line 8517

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
0		419.00
414		418.60

Table A3. Continued

Swan Lake Line 8497 (continued)

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
150	416.70	
263	415.70	
323		418.60
338	414.70	
373		418.10
419		417.70
450	413.70	
469		417.50
520		417.40
574		416.90
638	411.70	
647		416.80
710		416.70
767		416.60
825	413.70	
834		416.80
898		416.80
960		416.90
1019		417.00
1125		417.10
1228		417.20
1238	414.70	
1294		417.30
1377		417.30
1431		417.30
1500	415.70	
1516		417.40
1543		417.50
1598		417.60
1650	416.70	
1680		417.80
1715		418.00
1763	417.70	
1783		418.20
1838	418.70	
1845		418.40
1853		418.60
1869		419.00

Swan Lake Line 8536

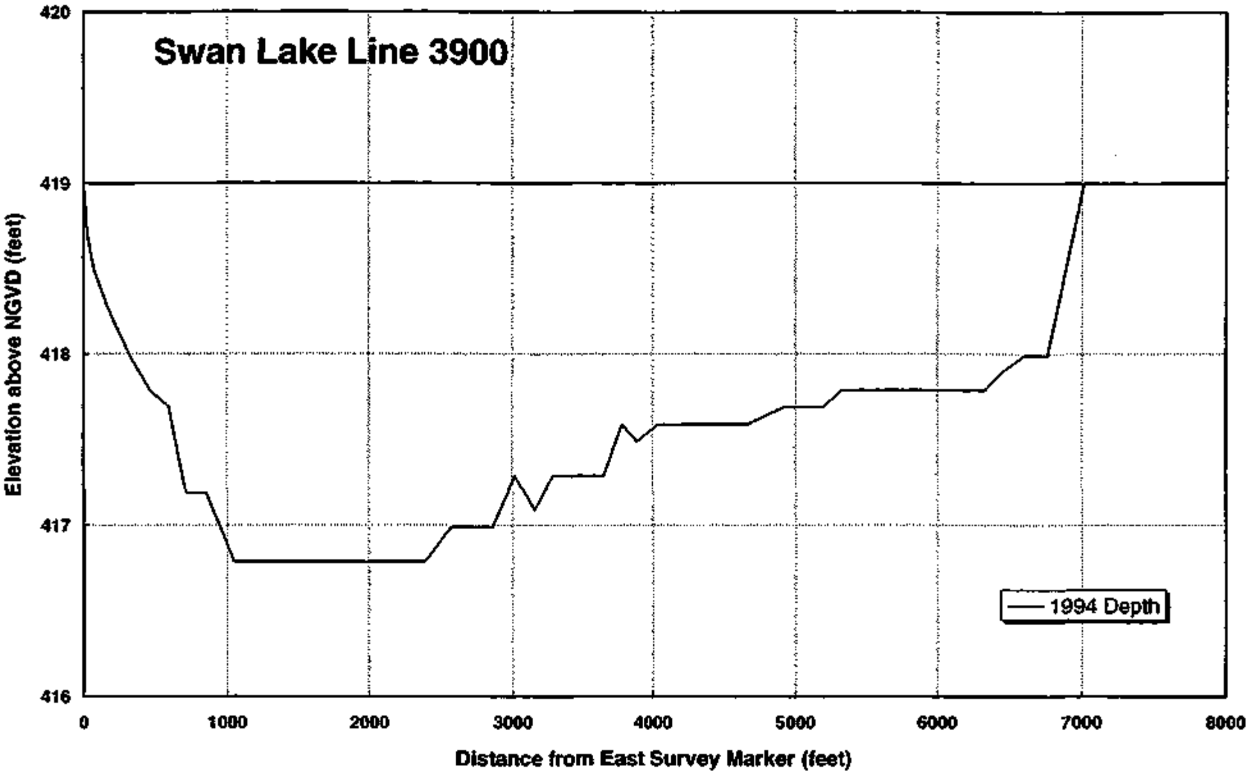
Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
0		419.00
409		418.70
437		418.60
464		418.40
522		418.10
601		417.70
646		417.60
759		417.40

Swan Lake Line 8517 (continued)

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
469		417.70
547		417.20
628		416.80
708		416.50
791		416.40
865		416.30
941		416.30
1024		416.30
1100		416.50
1150		416.60
1260		416.80
1344		417.00
1414		417.30
1493		417.50
1568		418.00
1634		418.40
1648		418.50
,1716		419.00

Table A3. Concluded

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
Swan Lake Line 8536 (continued)		
832		417.30
901		417.10
934		417.20
1064		416.80
1178		417.10
1265		417.40
1324		417.40
1393		417.40
1431		417.60
1514		417.80
1541		418.10
1599		418.40
1640		418.50
1966		419.00



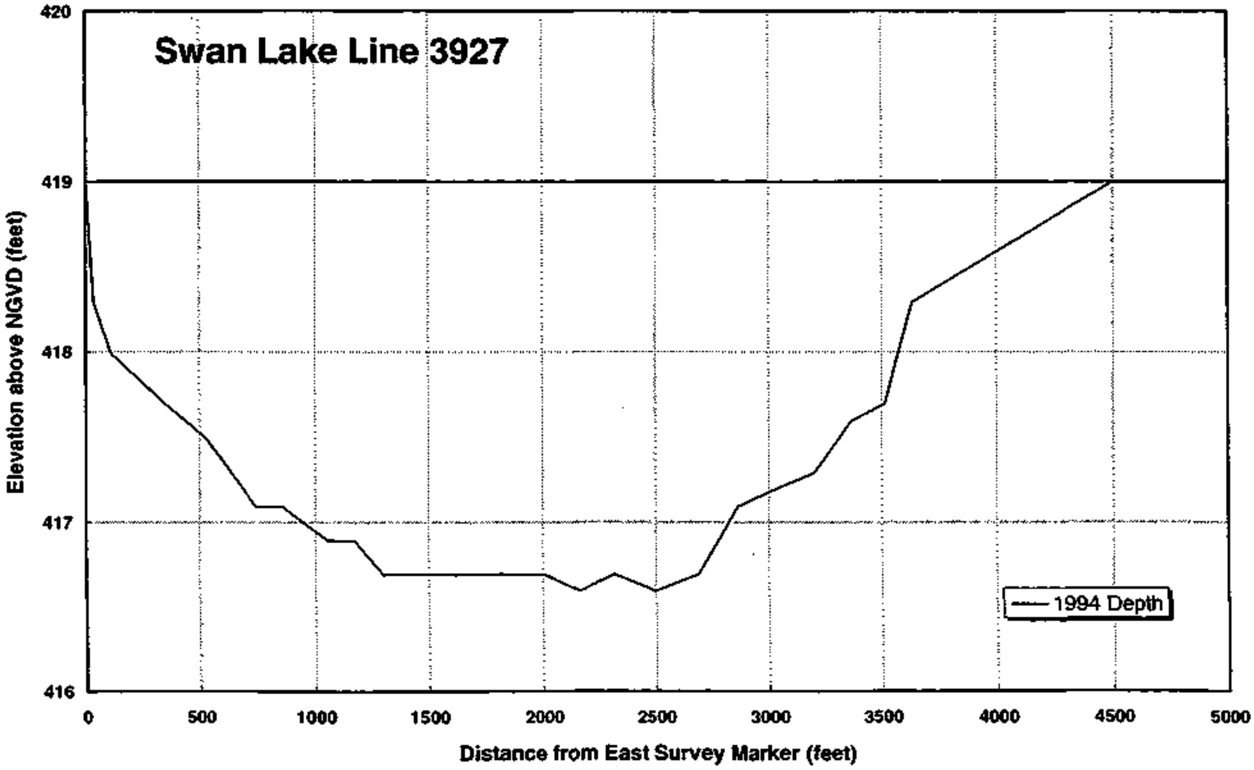
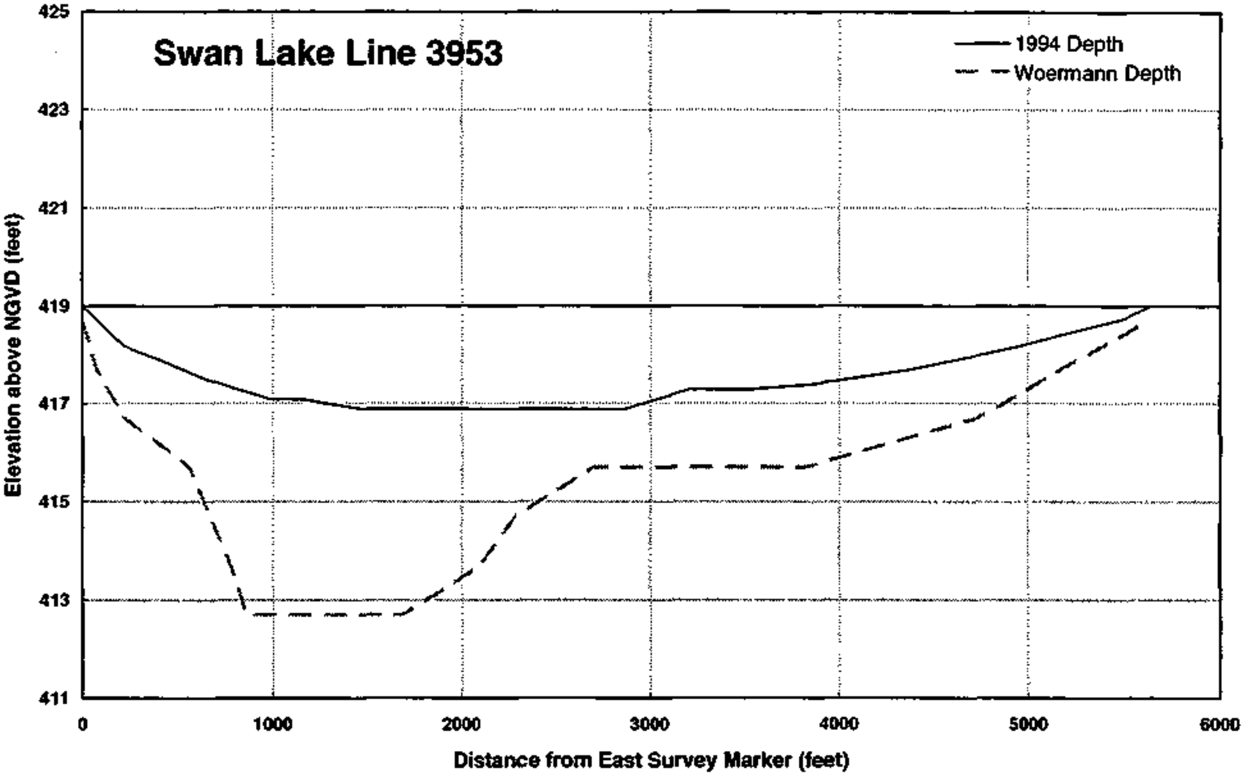
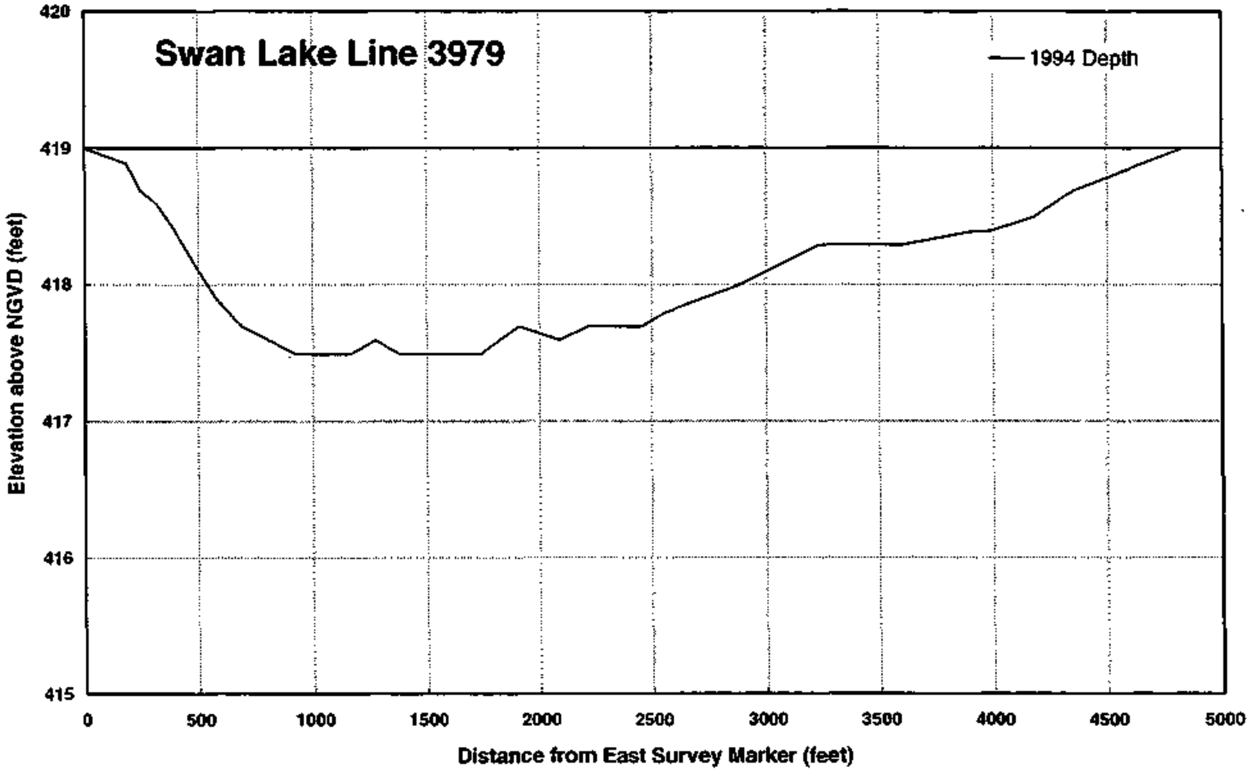


Figure A3. Cross-Sectional Profiles for Swan Lake Transects





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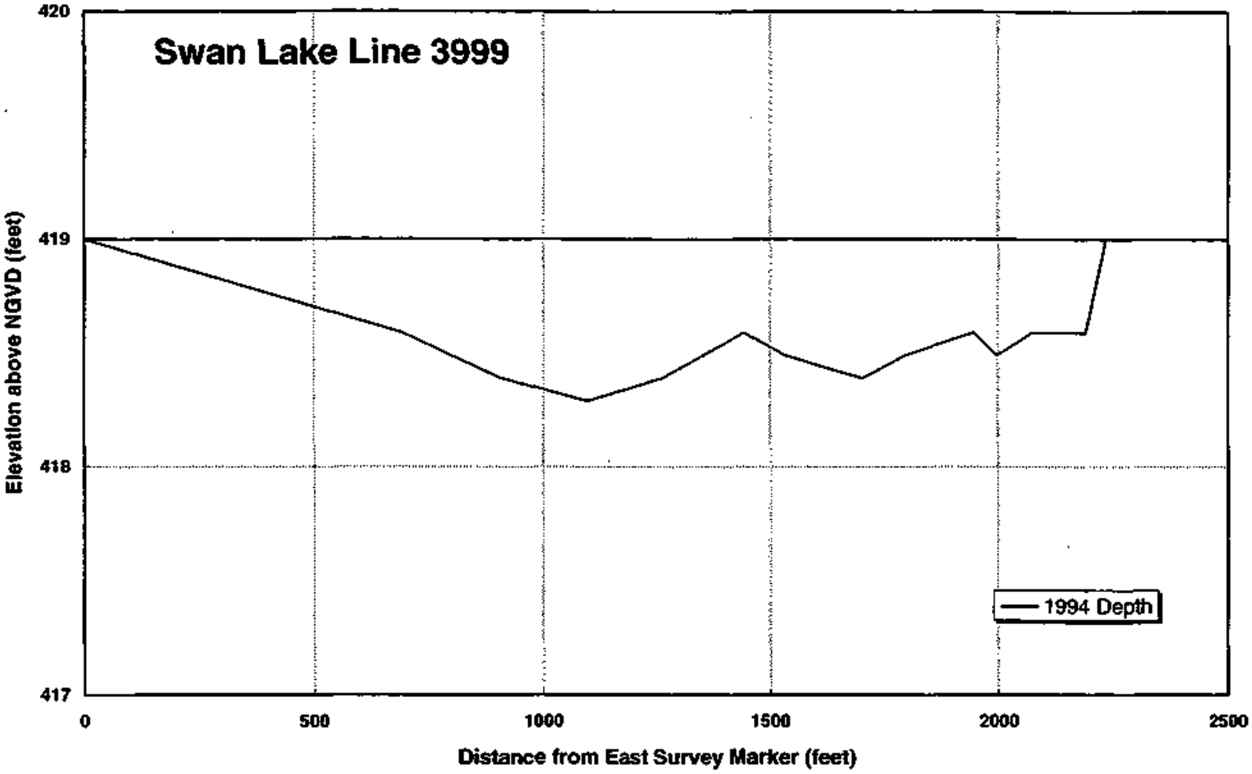


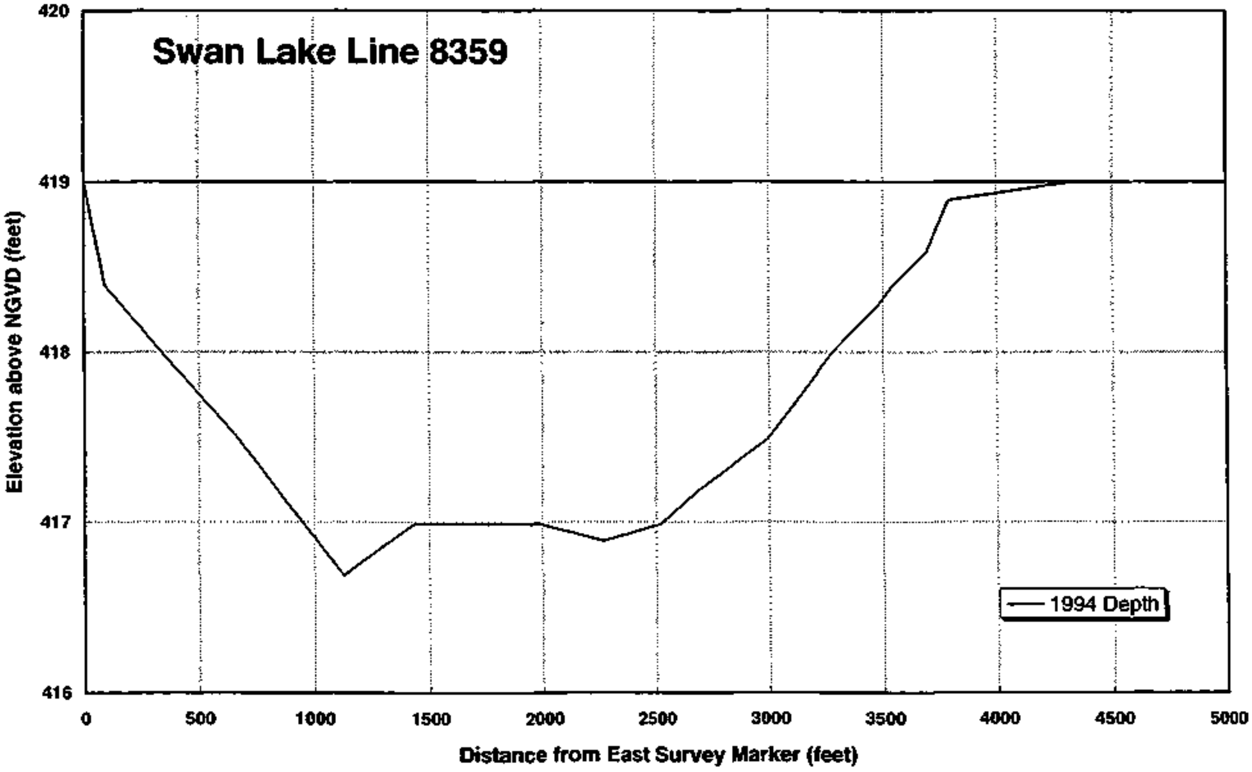
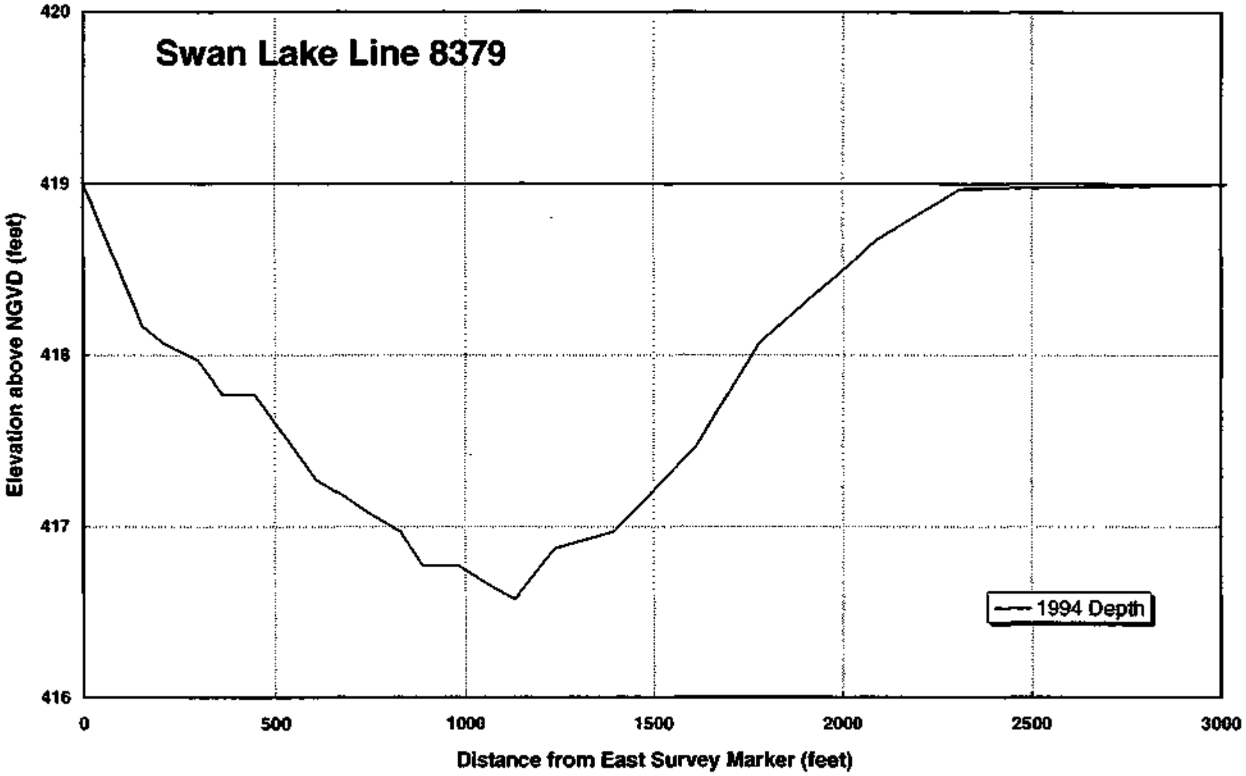
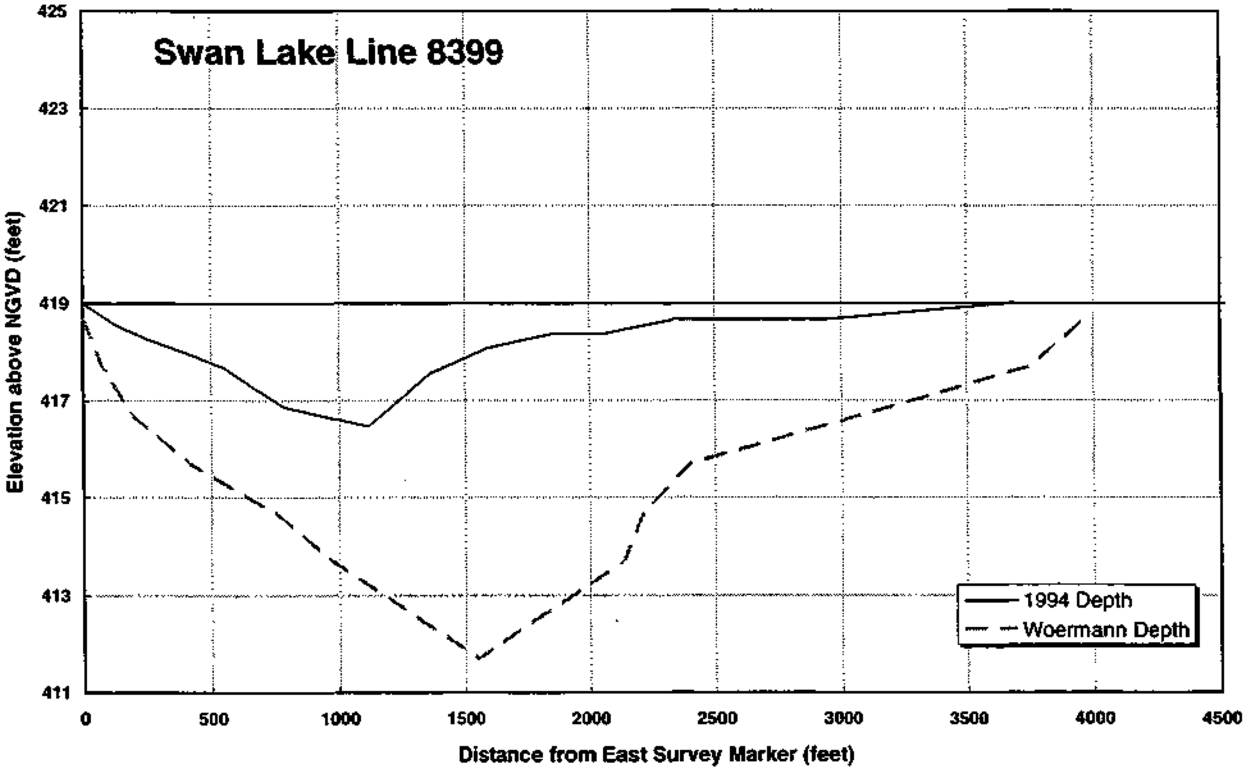


Figure A3. Continued





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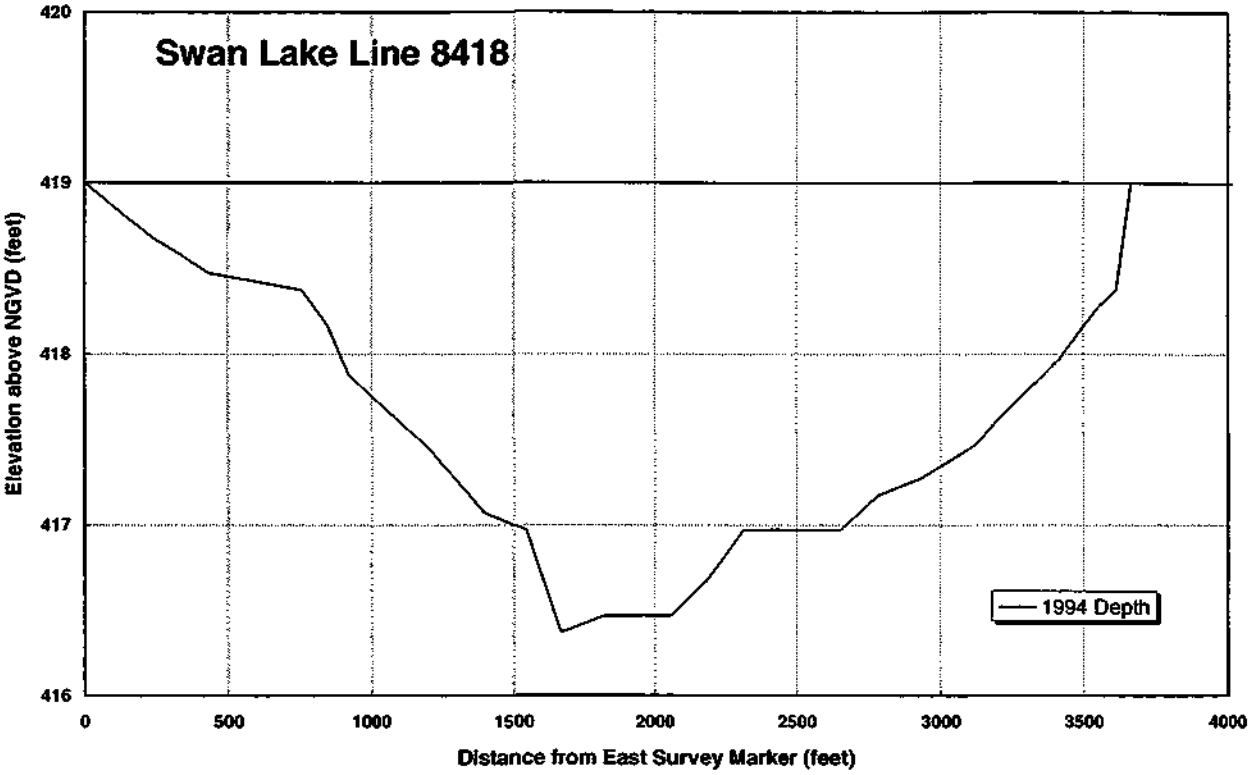

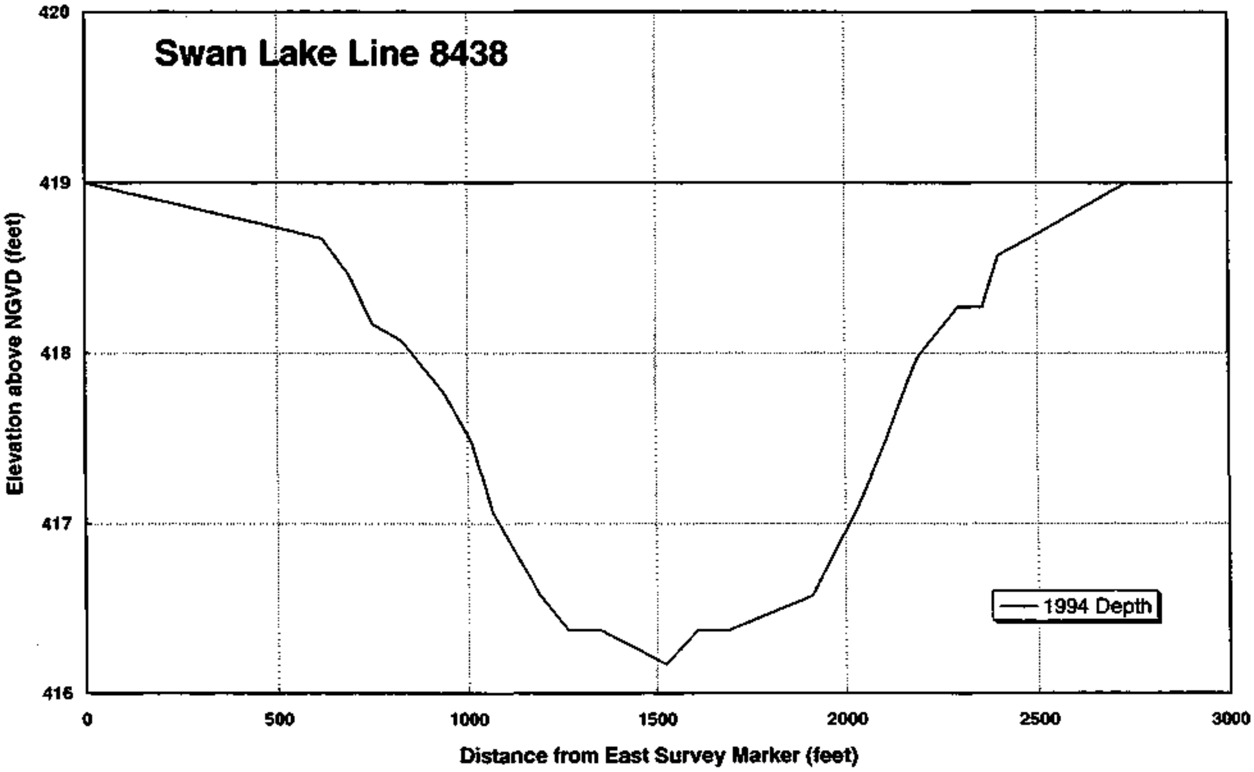

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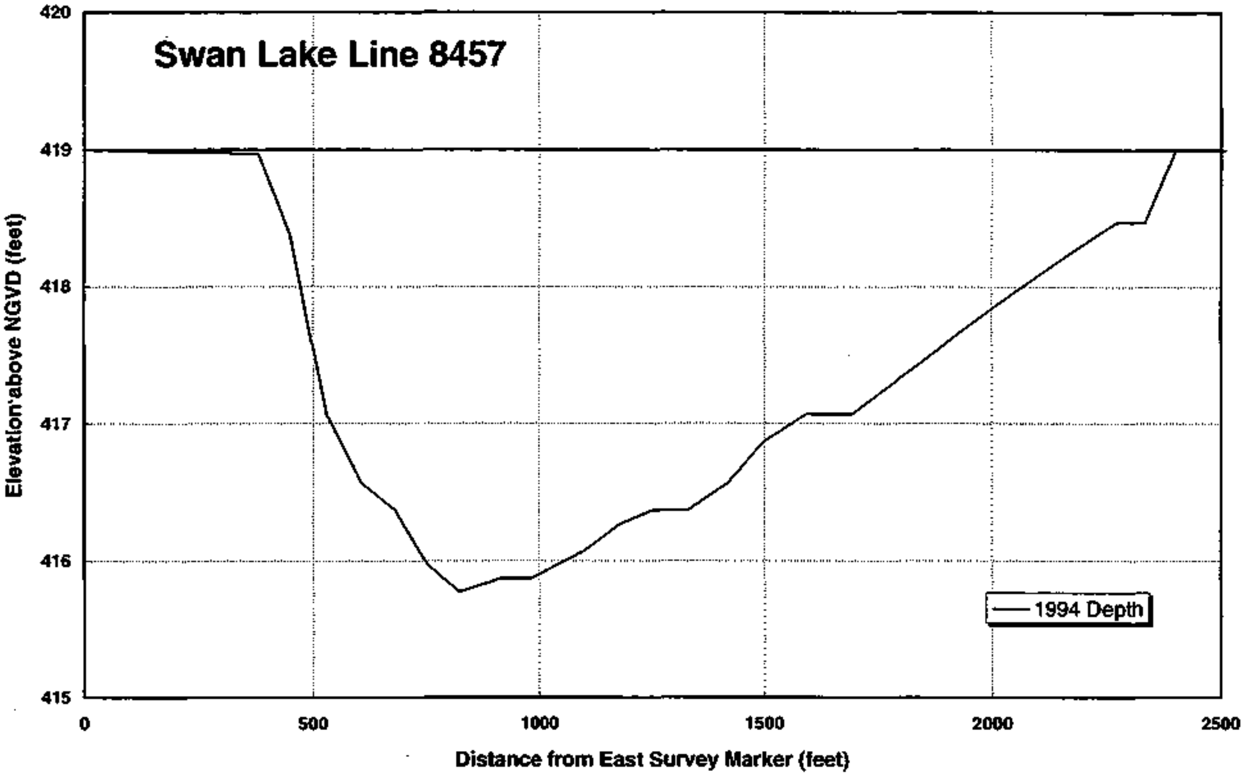

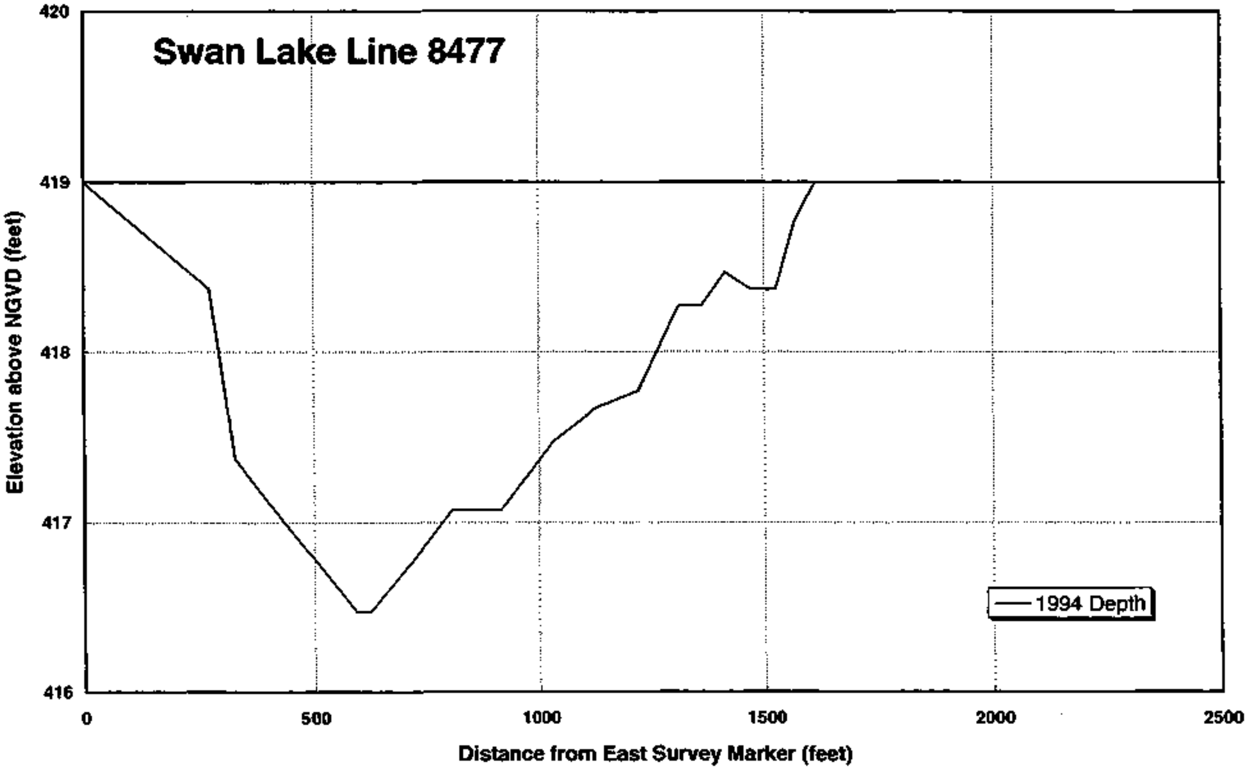

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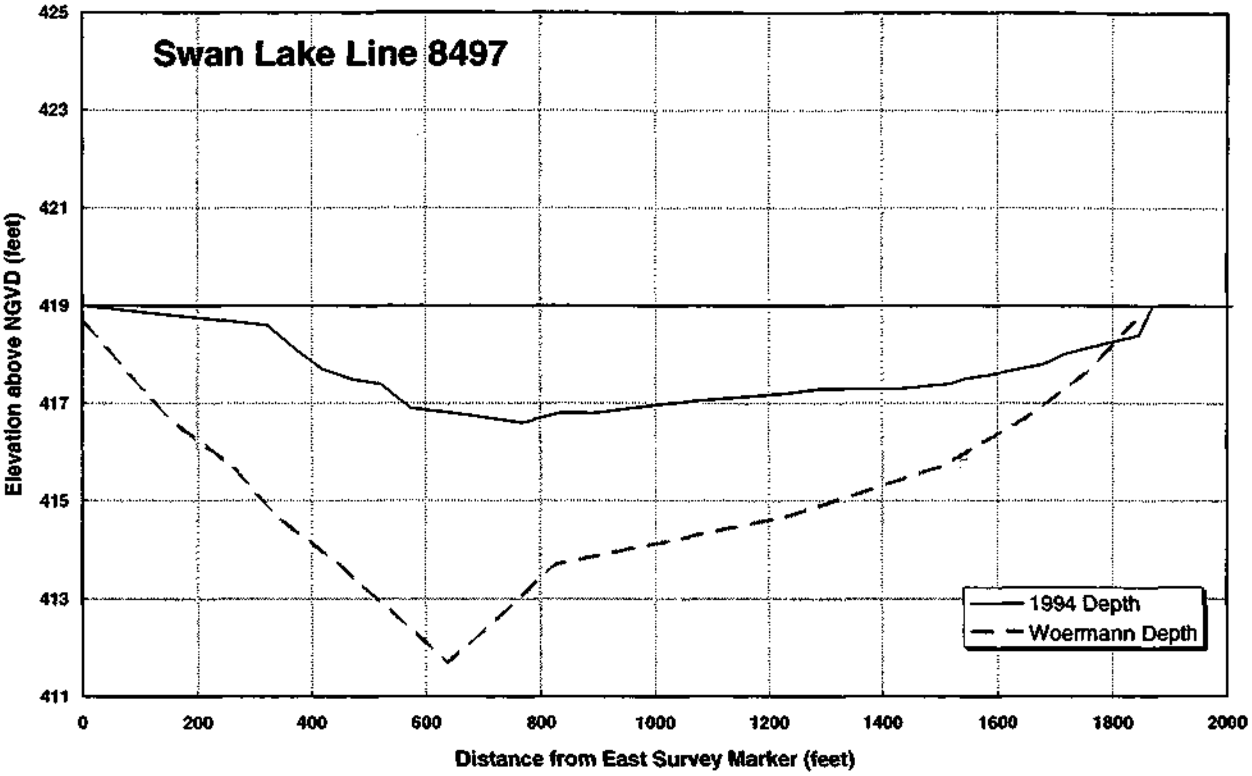

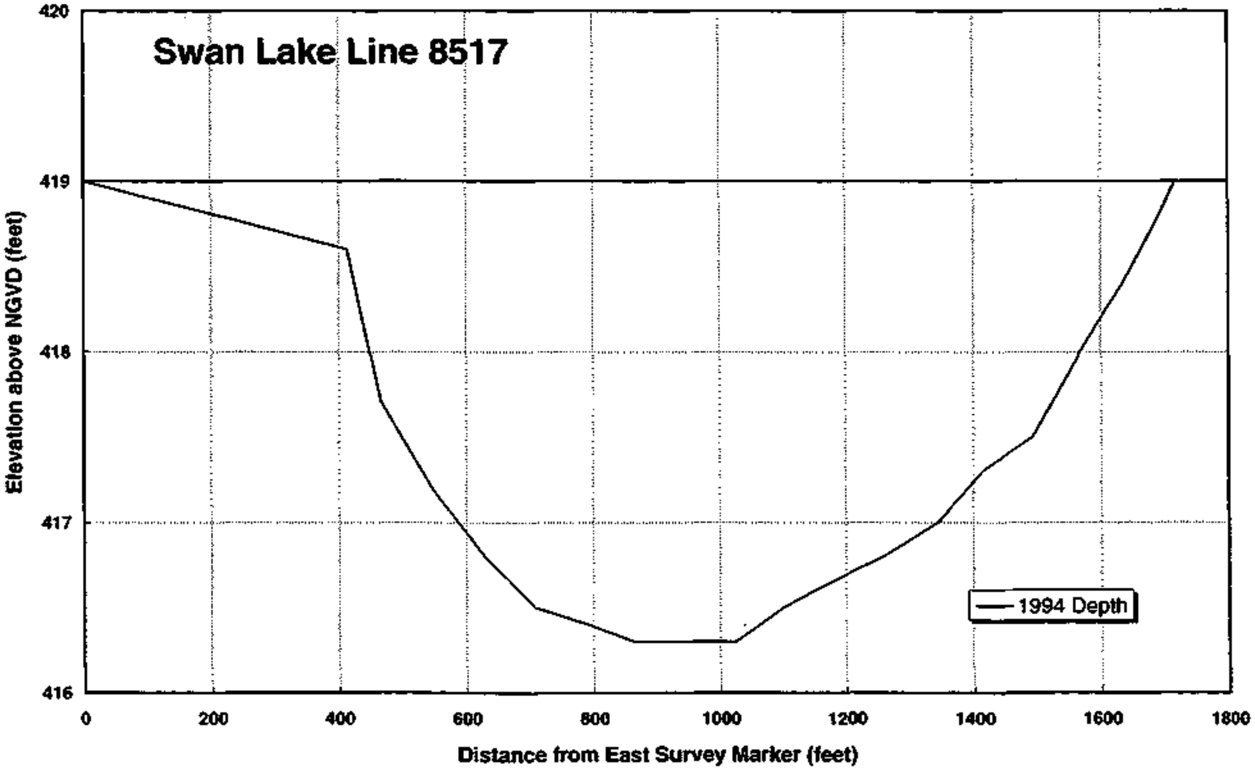

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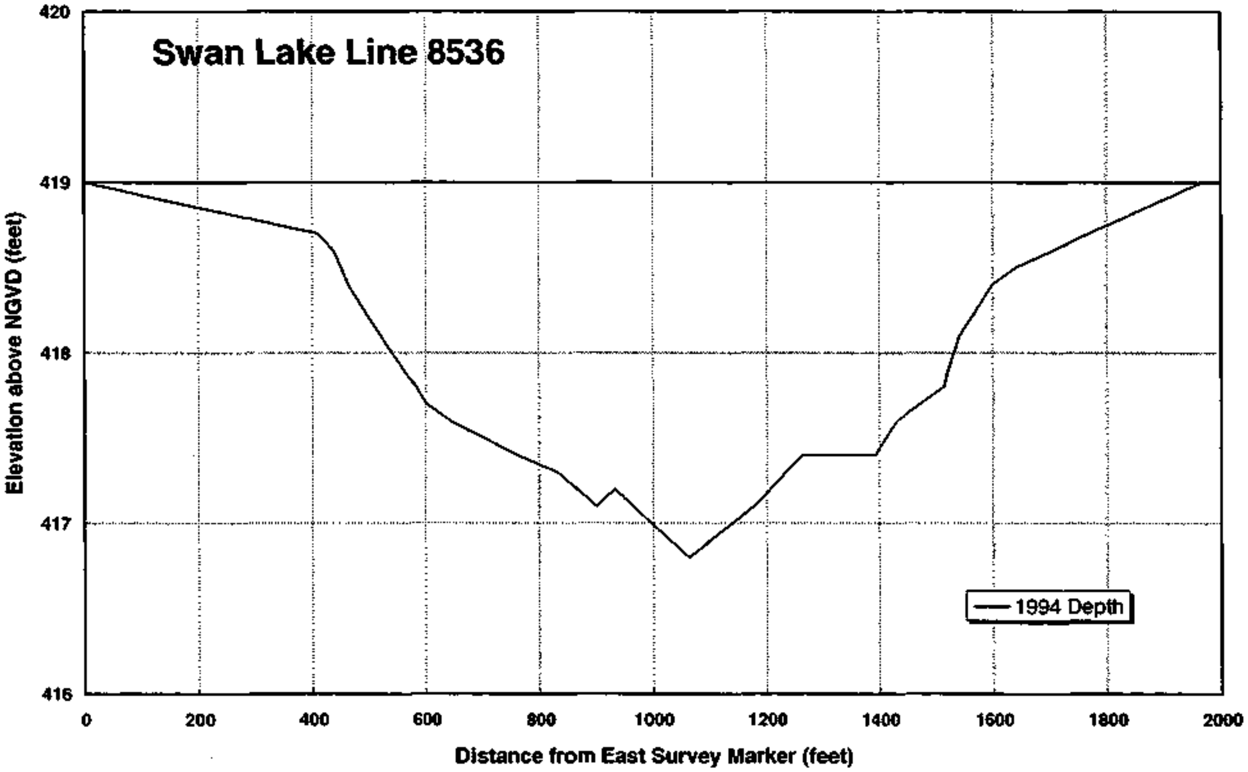


Figure A3. Concluded

Table A4. Cross-Sectional Profile Data for Stump Lake Transects

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*	*Distance from east shore (feet)*	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
Stump Lake Line 515			**Stump Lake Line 524**		
0		420.6	0		420.6
2		418.8	25		419.1
11		418.9	63		418.7
59		418.9	131		418.6
107		418.9	235		418.7
158		419.1	279		418.7
185		419.1	382		418.8
792		420.6	475		418.7
			585		418.7
			667		418.9
			746		418.9
			812		419.1
			823		419.2
			1073		420.6
Stump Lake Line 552			**Stump Lake Line 569**		
0		420.6	0		420.6
360		419.1	41		419.1
396		419.0	76		418.8
475		419.0	135		418.7
553		419.0	203		418.7
631		418.9	282		418.6
710		419.0	351		418.6
790		418.8	427		418.6
857		418.9	500		418.7
931		419.0	558		418.5
964		419.0	623		418.5
1154		420.6	689		418.6
			745		418.6
			794		418.8
			851		418.8
			893		419.0
			954		419.2
			993		419.2
			1236		420.6
Stump Lake Line 570			**Stump Lake Line 583**		
0		420.6	0		420.6
330		419.0	57		419.1
374		419.0	102		419.0
436		419.0	165		418.9
508		418.9	259		418.7
587		418.8	315		418.7
669		418.8	379		418.6
759		418.9	443		418.7
830		418.6	510		418.6
904		418.8	599		418.5
980		418.8	672		418.6

Table A4. Continued

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
Stump Lake Line 570 (continued)		
1074		418.9
1140		419.0
1152		419.0
1324		420.6
Stump Lake Line 599		
0		420.6
1446		419.0
1515		419.0
1595		418.9
1672		419.0
1746		418.9
1862		418.8
1930		418.9
2000		418.9
2066		418.8
2129		418.8
2218		418.8
2285		418.8
2367		418.7
2426		418.6
2489		418.6
2568		418.7
2635		418.7
2702		418.9
2773		419.0
2841		419.0
2888		419.0
Stump Lake Line 635		
0	419.7	420.6
113	418.7	
309		419.2
338	417.7	

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
Stump Lake Line 583 (continued)		
757		418.6
835		418.8
926		418.6
999		418.7
1060		419.0
1090		419.1
1315		420.6
Stump Lake Line 619		
0	420.7	420.6
113	419.7	
975	418.7	
1446		419.0
1515		419.0
1595		418.9
1672		419.0
1746		418.9
1862		418.8
1930		418.9
2000		418.9
2066		418.8
2129		418.8
2218		418.8
2285		418.8
2367		418.7
2426		418.6
2489		418.6
2568		418.7
2635		418.7
2702		418.9
2773		419.0
2841		419.0
2888		419.0
3131		420.6
3225	417.7	
3375	416.7	
3638	415.2	
3863	416.7	
3975	417.7	
4050	418.7	
4125	419.7	
4275	420.7	
Stump Lake Line 636		
0	420.7	
75	419.7	
450	418.7	
817		419.0

Table A4. Continued

Stump Lake Line 635 (continued)

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
354		419.1
400		419.1
465		419.1
517		418.9
568		418.9
620		418.8
678		418.7
743		418.7
813		418.6
875		418.5
937		418.5
1003		418.5
1055		418.7
1123		419.1
1160		419.2
1399		420.6
1613	417.7	
1875	418.7	
2025	419.7	

Stump Lake Line 636 (continued)

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
912		419.0
1033		419.0
1103		419.0
1174		418.9
1251		418.9
1343		418.9
1425		418.9
1516		418.8
1601		418.8
1701		418.8
1802		418.8
1911		418.8
2002		418.8
2075		418.9
2169		418.9
2252		418.9
2330		418.9
2414		418.9
2509		418.9
2602		418.9
2680		418.9
2759		419.0
2839		418.6
2881		419.1
2918		419.0
3075	415.2	
3115		420.6
3188	417.7	
3450	416.7	
4238	416.7	
4313	417.7	
4388	418.7	
4425	419.7	

Stump Lake Line 662

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
0		420.6
60		419.1
94		419.0
145		418.8
190		418.7
245		418.7
307		418.6
438		418.4
508		418.6
581		419.1
645		419.2
652		419.2
870		420.6

Stump Lake Line 694

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
0		420.6
285		419.0
343		419.0
416		418.9
506		418.9
582		418.9
655		418.9
720		418.8
786		418.9
862		418.8
940		418.7
1018		418.9
1093		418.9

Table A4. Continued

Stump Lake Line 694 (continued)

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
1173		418.9
1247		419.0
1323		419.0
1396		419.1
1469		419.1
1538		419.2
1611		419.2
1678		419.2
1705		419.2
1985		420.6

Stump Lake Line 705

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation, above NGVD (feet)*
0		420.6
193		419.2
214		419.1
274		418.9
337		418.8
405		418.7
470		418.6
539		418.6
603		418.7
670		418.8
729		418.9
810		419.2
1127		420.6

Stump Lake Line 706

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
0		420.6
302		419.1
370		419.0
444		419.0
515		419.0
600		419.0
693		418.9
778		418.9
859		419.0
939		419.1
1019		419.1
1049		419.1
1477		420.6

Stump Lake Line 717

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation, above NGVD (feet)*
0		420.6
273		419.2
342		419.0
389		418.9
444		418.8
500		418.7
552		418.6
617		418.6
678		418.6
742		418.7
799		418.8
868		419.0
929		419.1
971		419.2
1261		420.6

Stump Lake 742

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
0		420.6
296		419.2
321		419.1
375		419.0
437		419.0
496		418.8
562		419.0
628		419.0
698		419.0
762		419.0
826		419.0
865		419.0
905		419.1
955		419.2
1243		420.6

Stump Lake Line 743

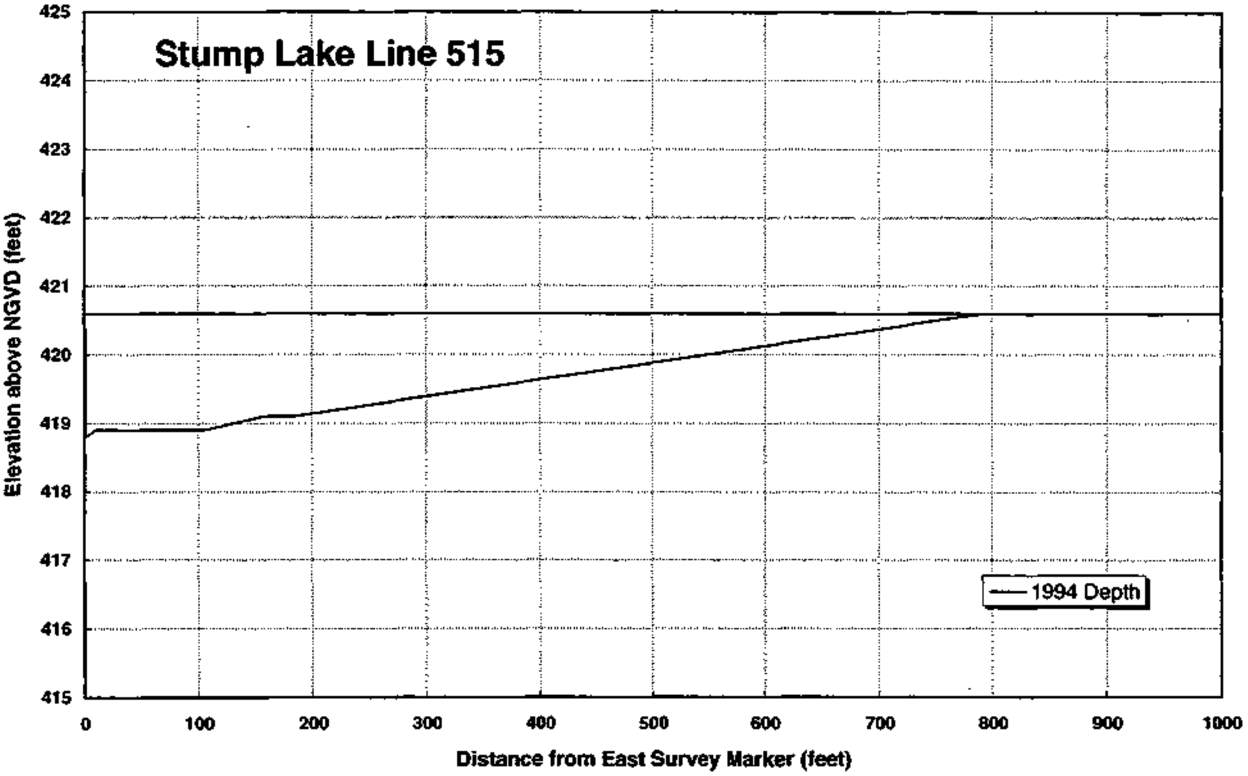
Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation, above NGVD (feet)*
0		420.6
493		419.0
532		419.0
588		419.0

Stump Lake Line 754

Distance from east shore (feet)	*Woermann Elevation above NGVD (feet)*	*1994 Elevation above NGVD (feet)*
0		420.6
398		419.0
454		418.9
524		418.6

Table A4. Concluded

Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)	Distance from east shore (feet)	Woermann Elevation above NGVD (feet)	1994 Elevation above NGVD (feet)
Stump Lake Line 743 (continued)			**Stump Lake Line 754 (continued)**		
657		418.8	610		418.5
717		419.0	676		418.5
758		419.0	734		418.8
918		420.6	862		420.6
Stump Lake Line 755			**Stump Lake Line 769**		
0		420.6	0		420.6
371		419.0	396		419.0
406		419.0	445		419.0
475		418.7	504		419.0
530		418.6	566		418.8
588		418.5	626		418.8
646		418.6	659		418.9
695		418.7	731		420.6
789		419.0			
872		420.6			



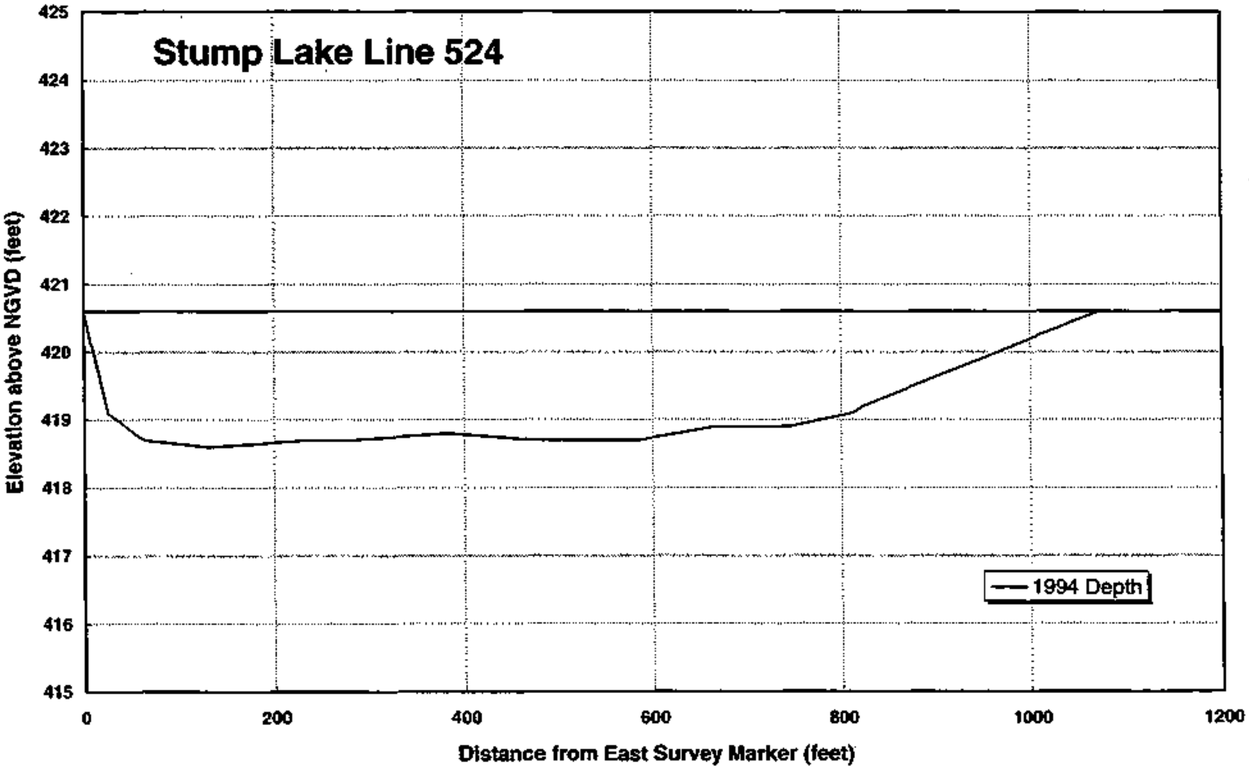
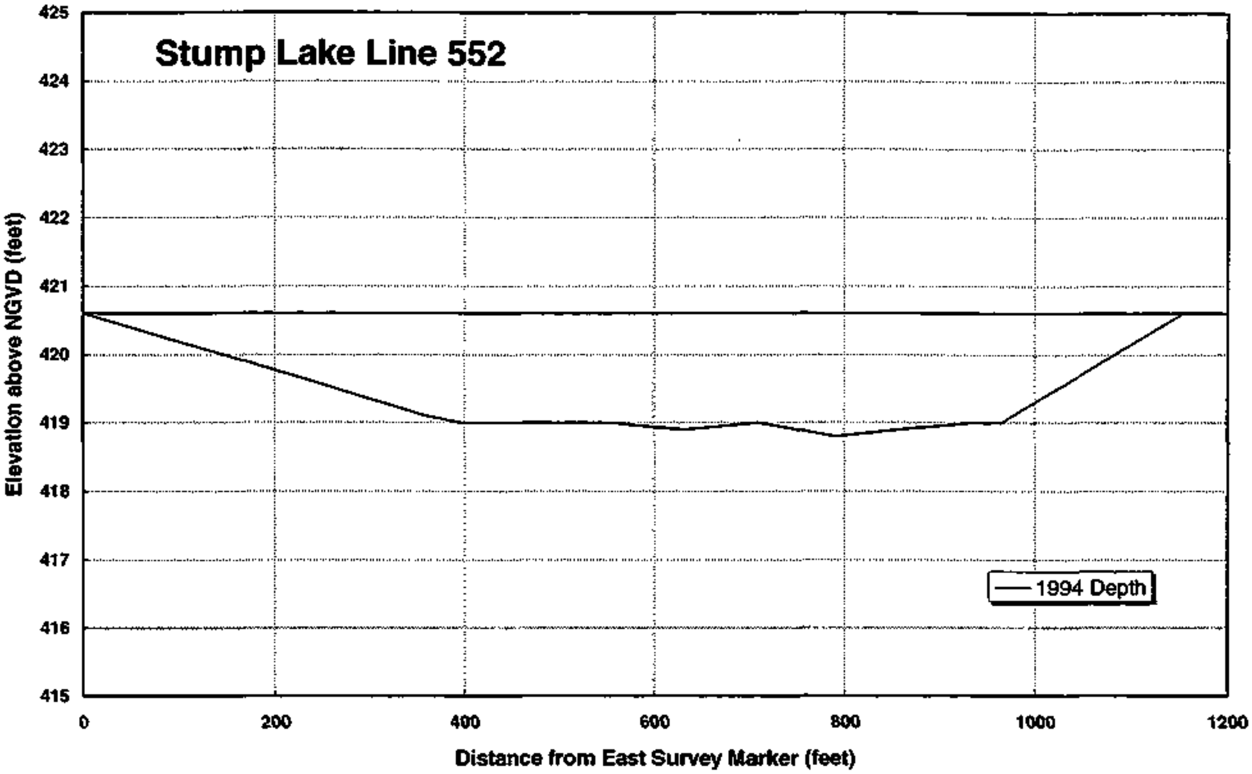
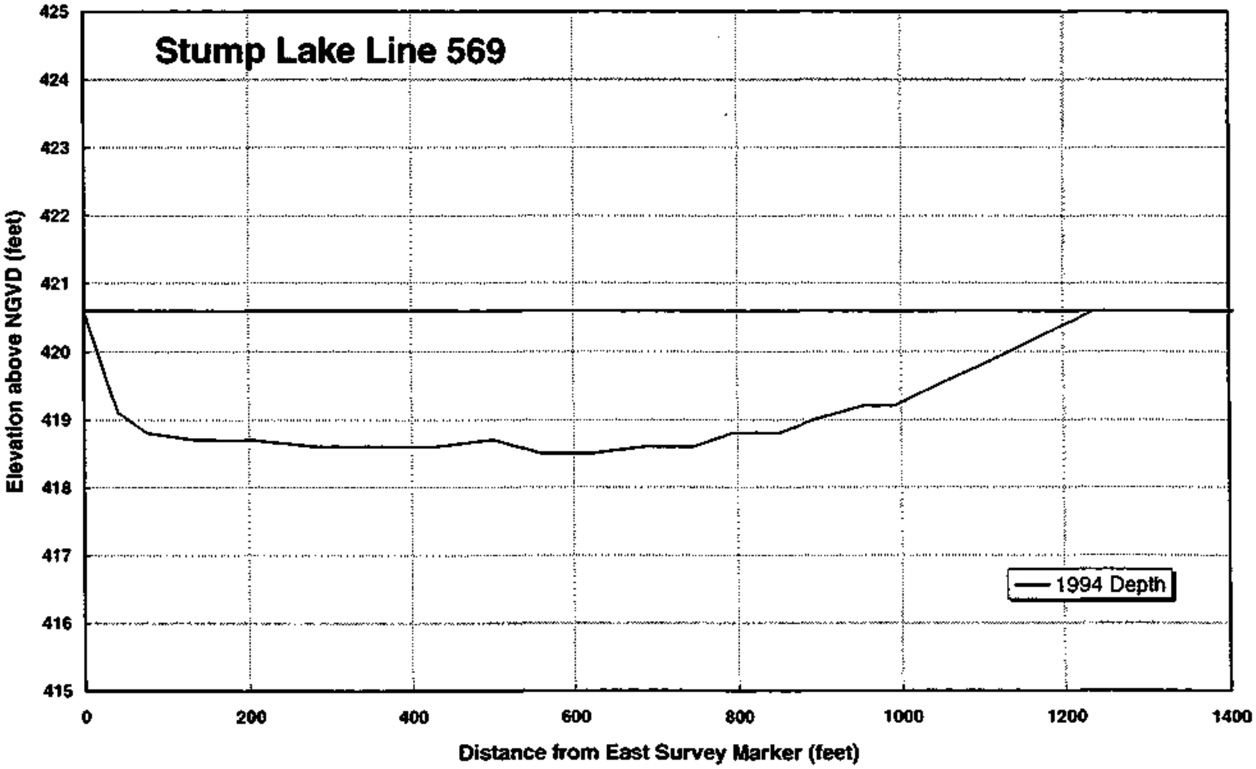


Figure A4. Cross-Sectional Profiles for Stump Lake Transects





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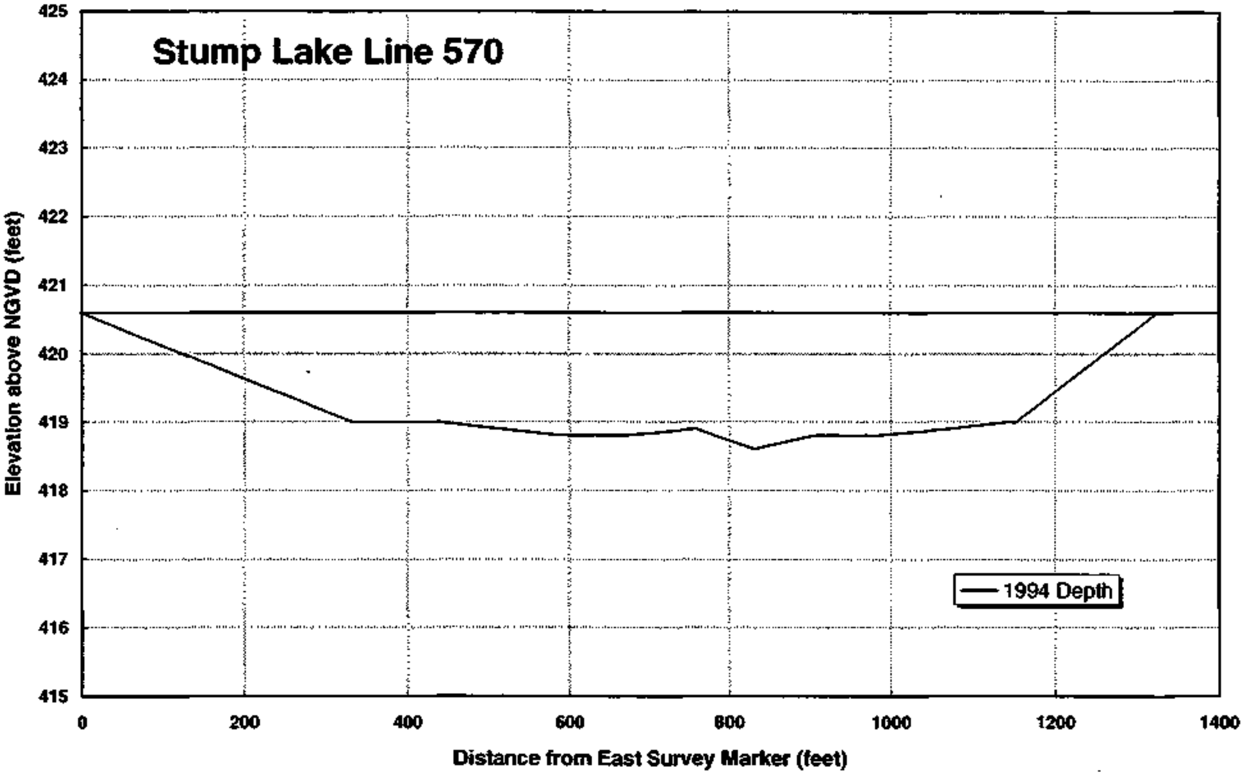

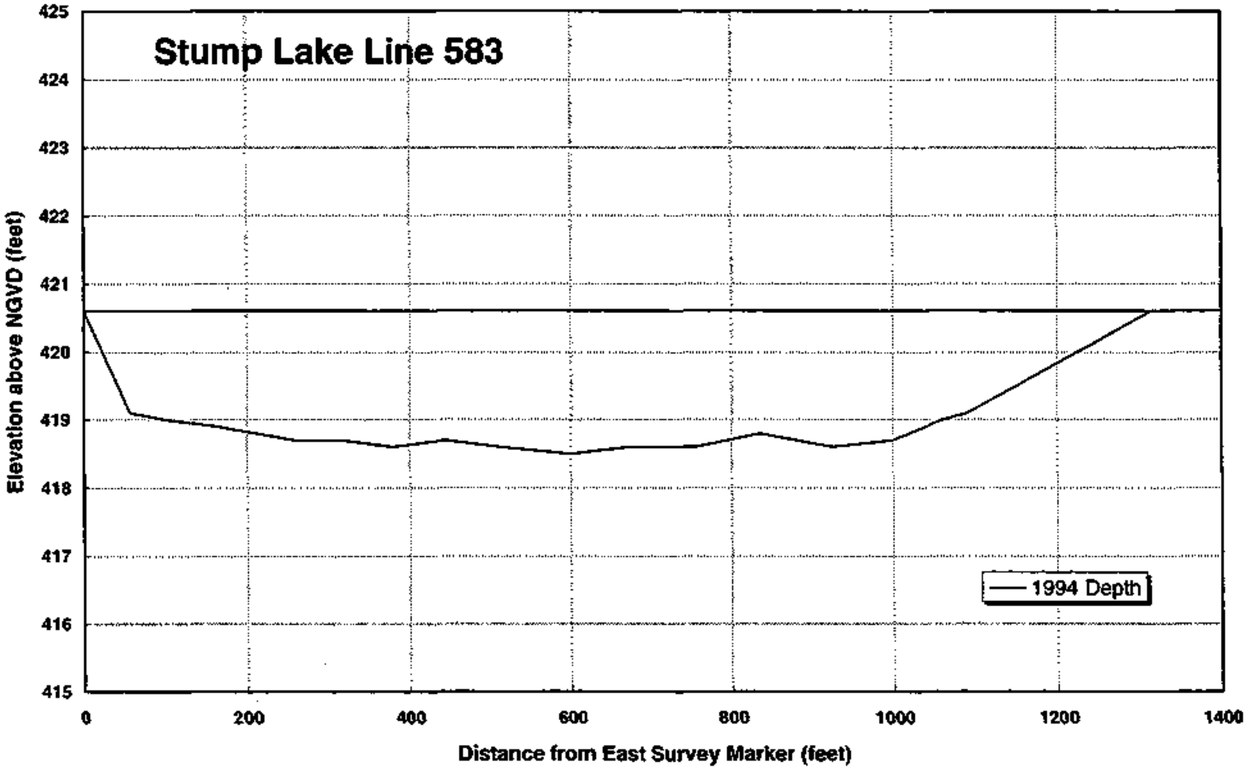

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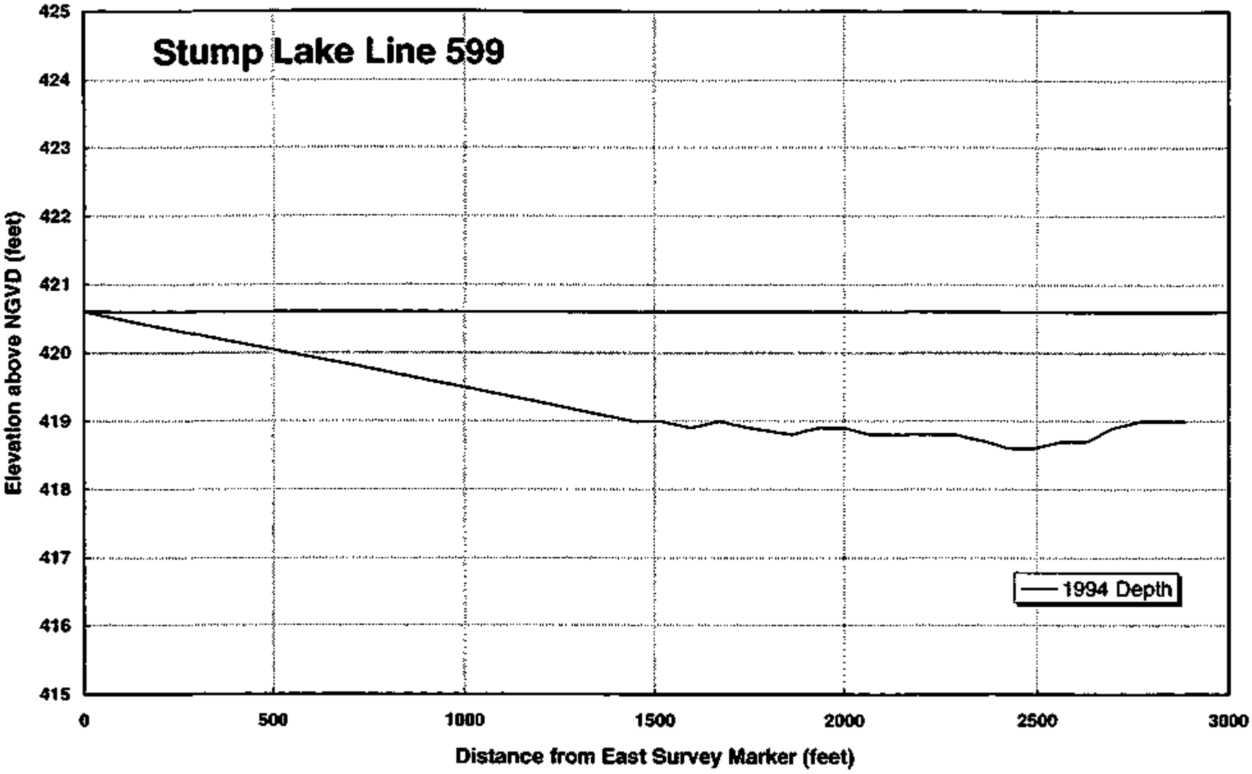

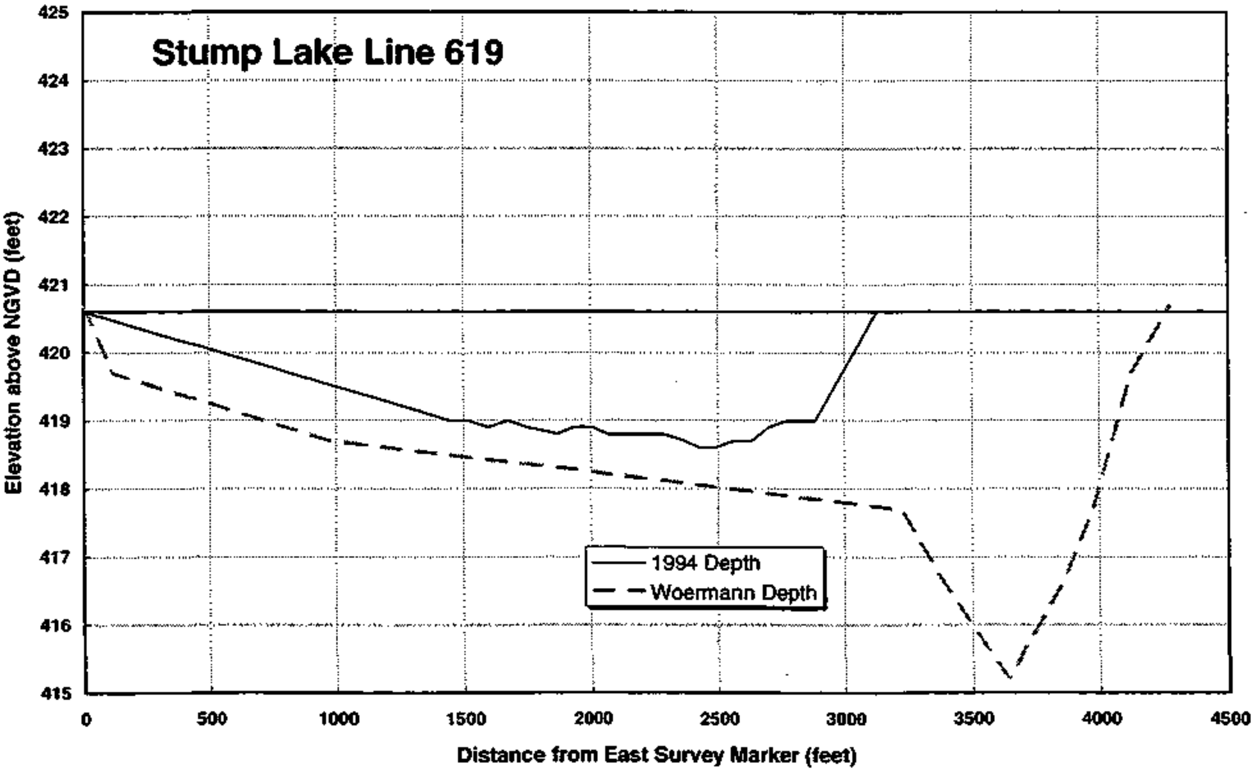

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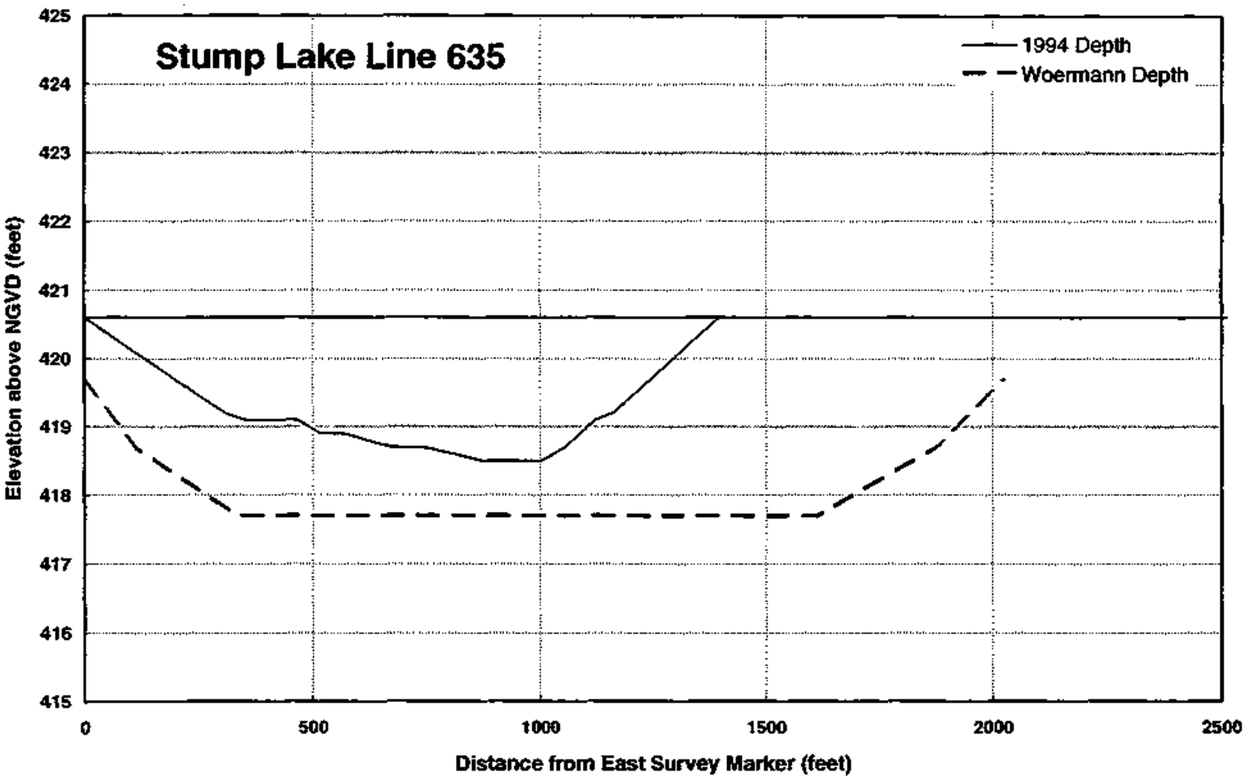

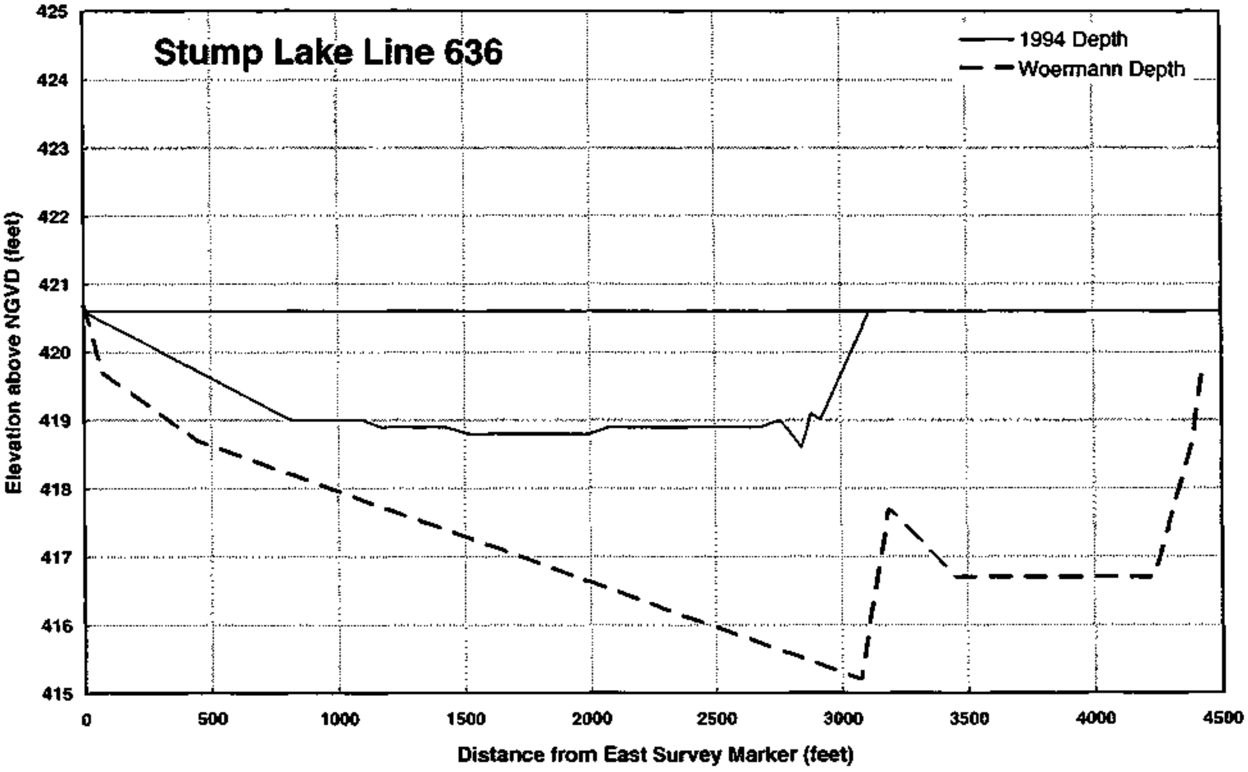

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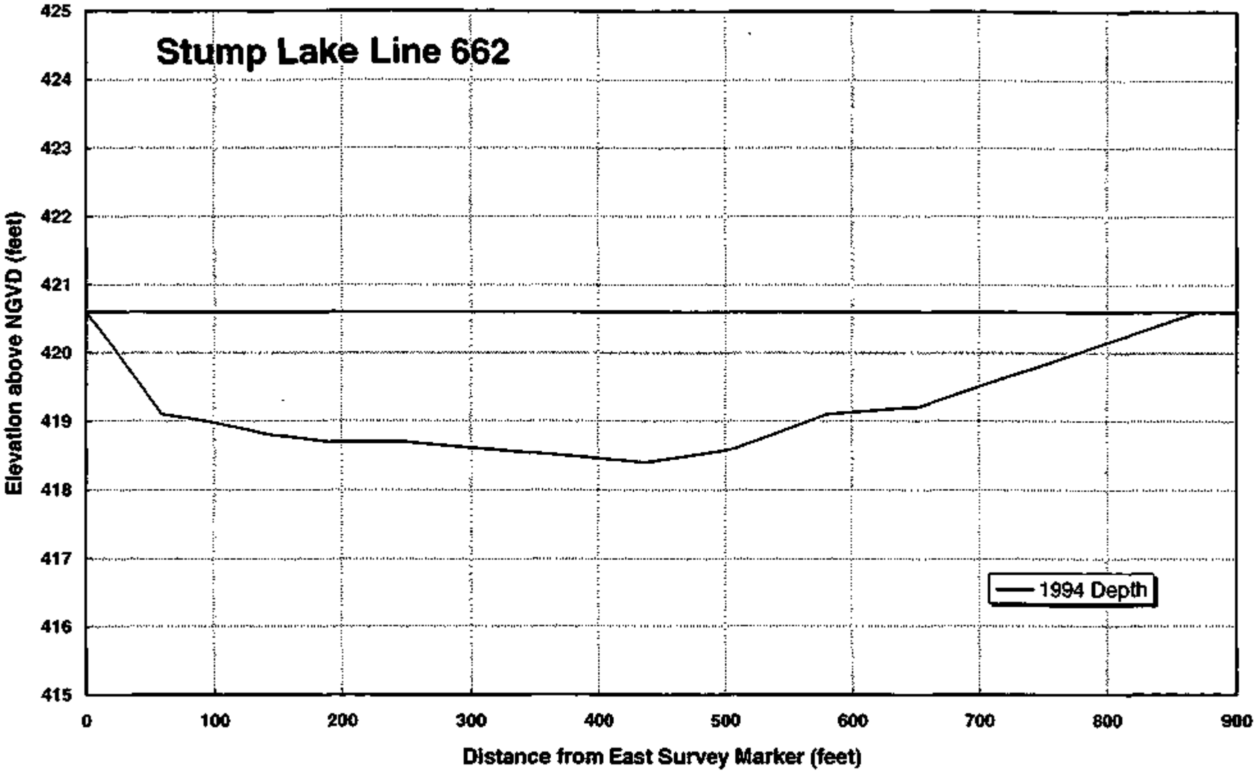

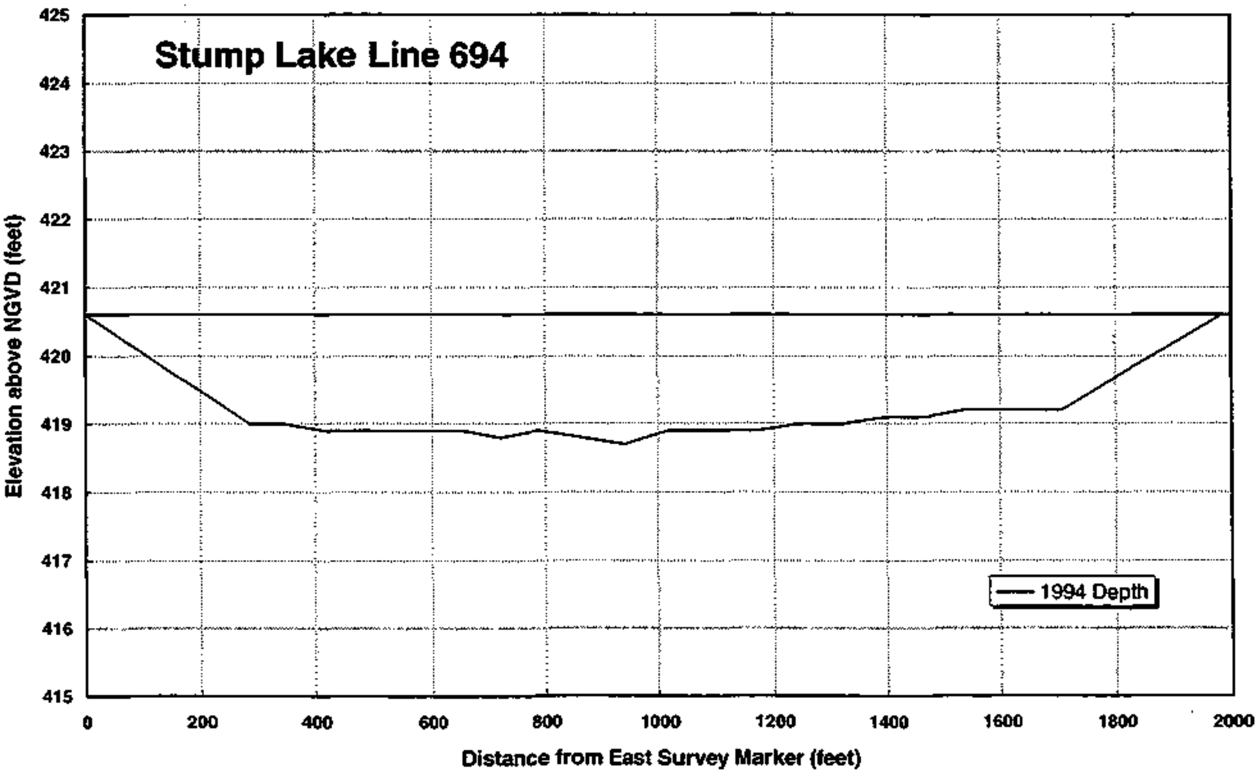

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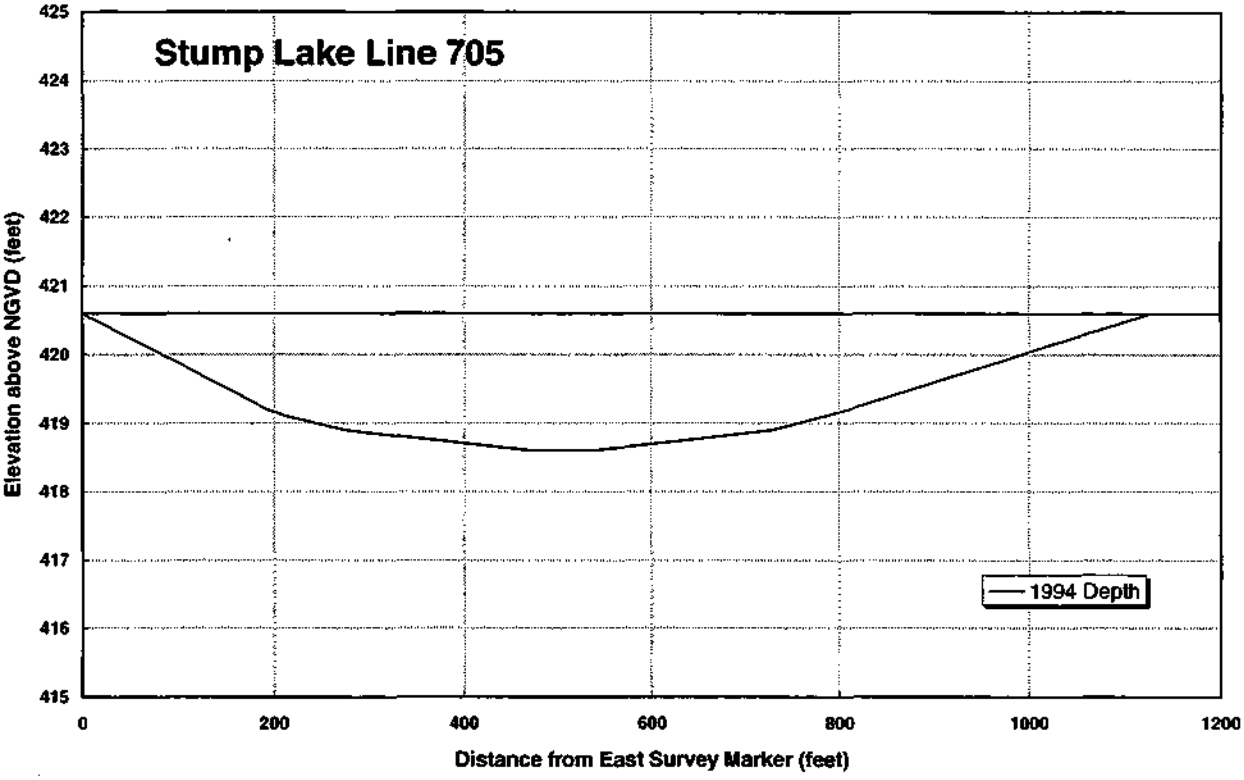

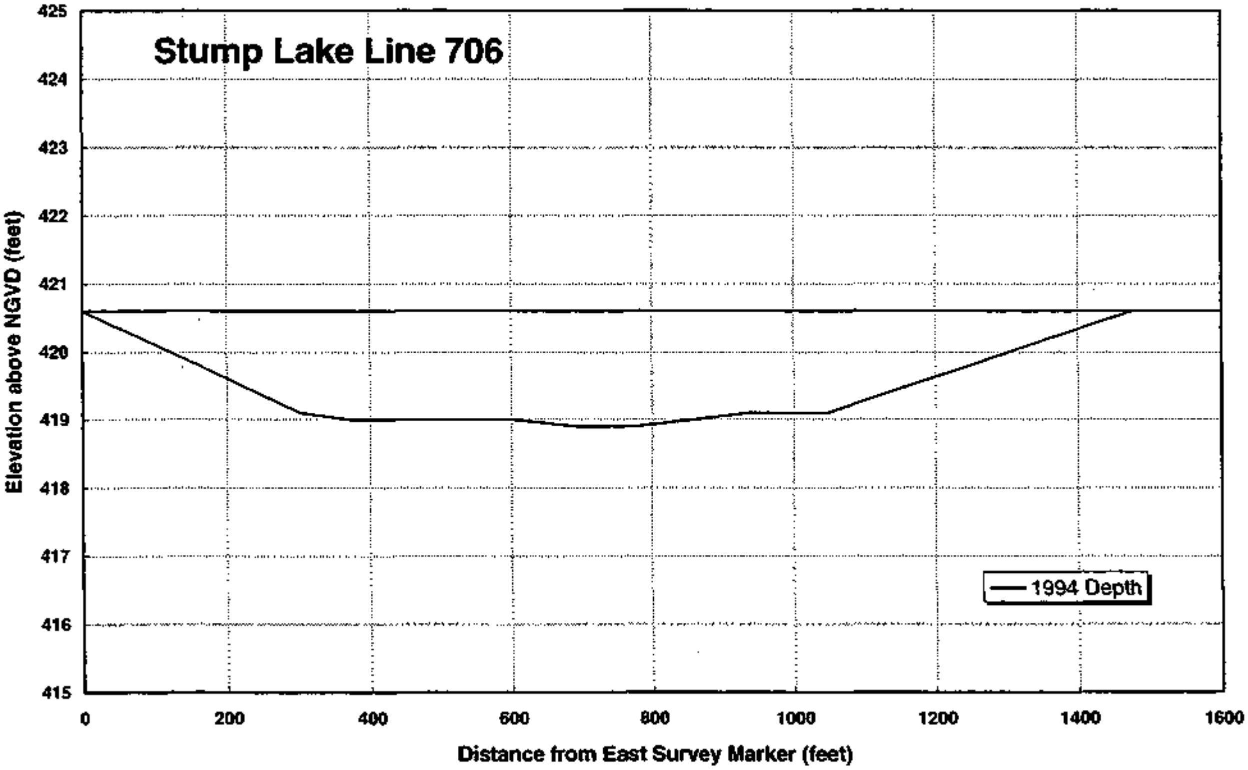

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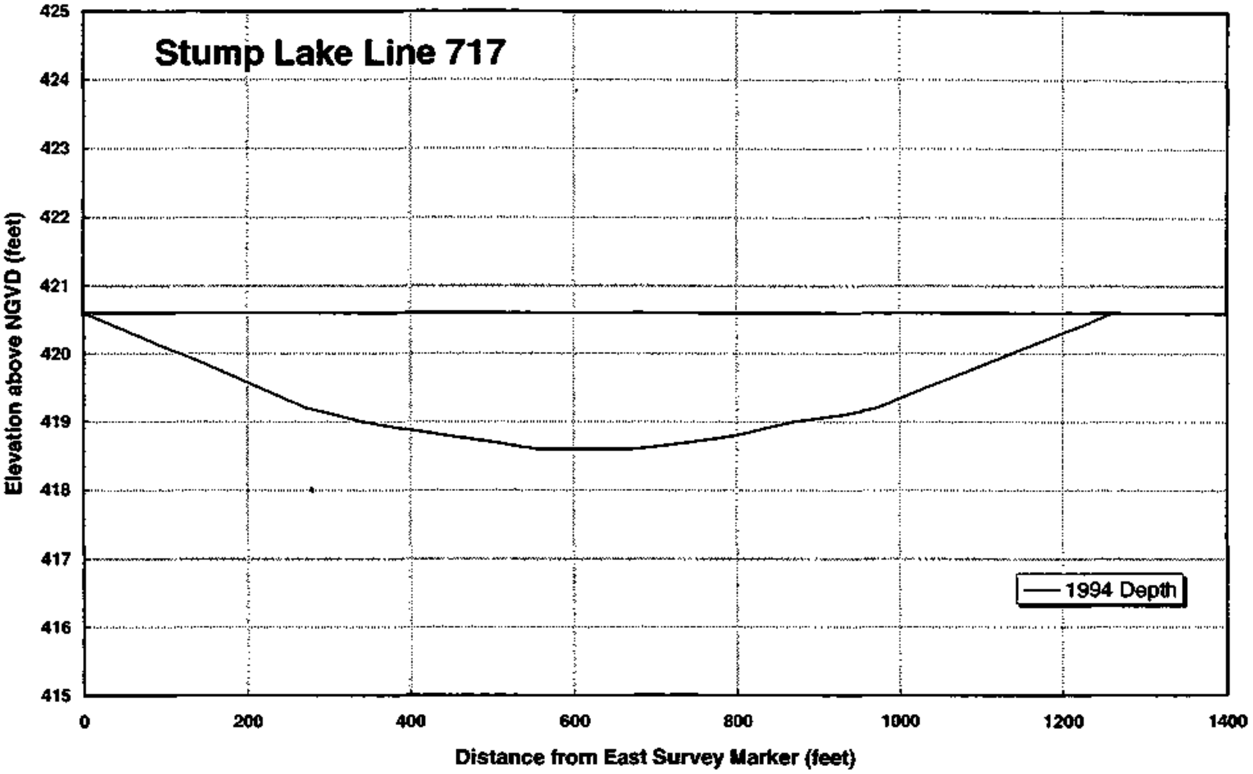

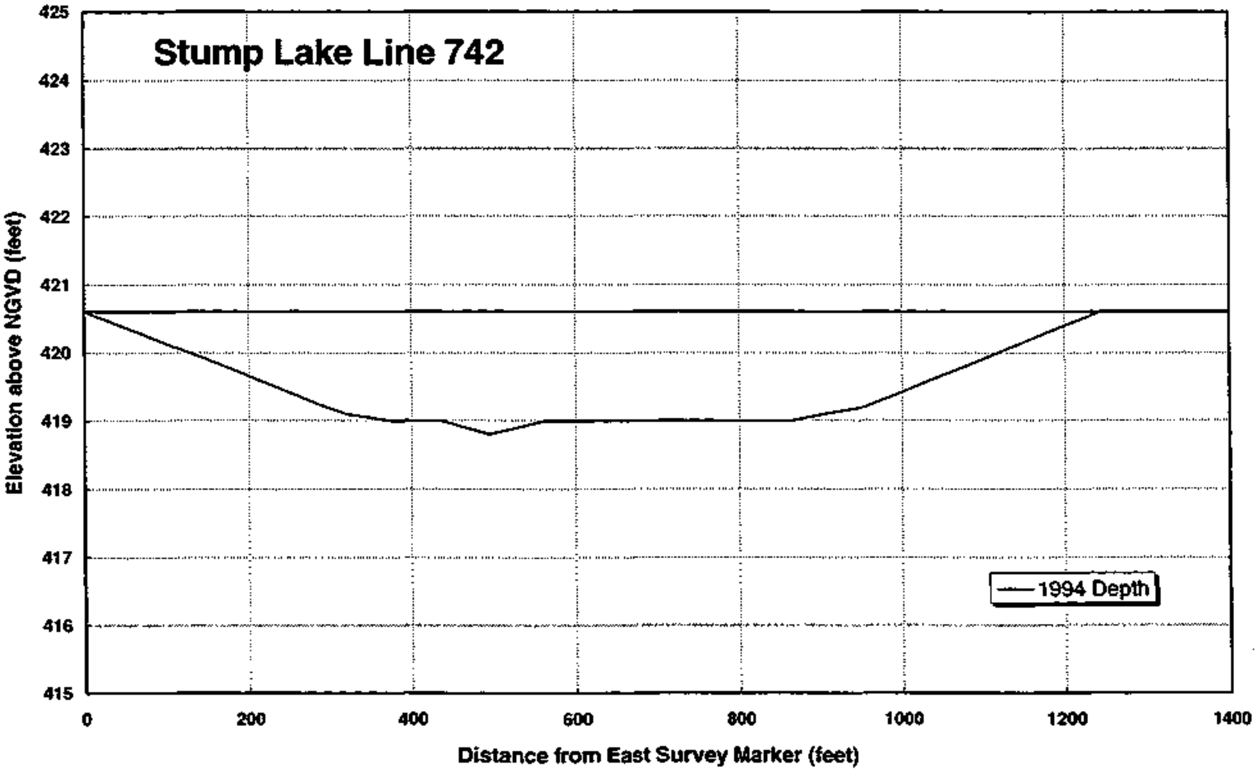

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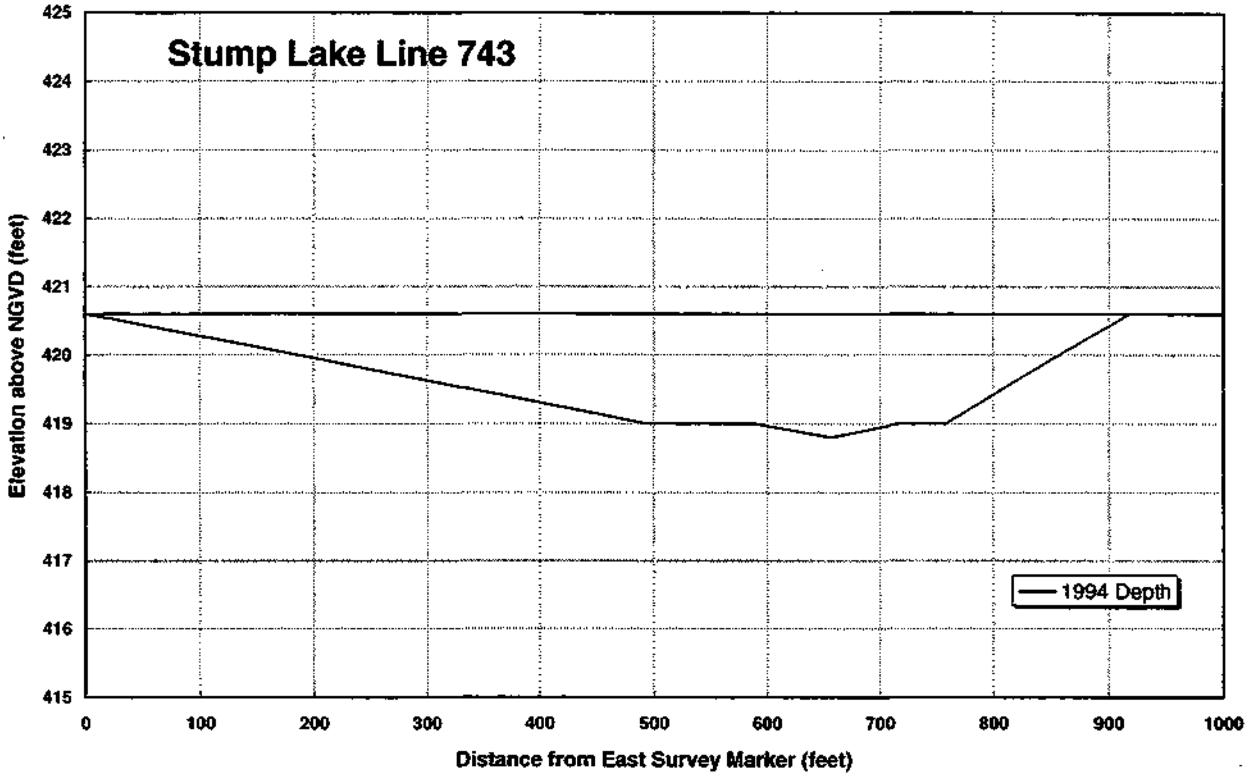


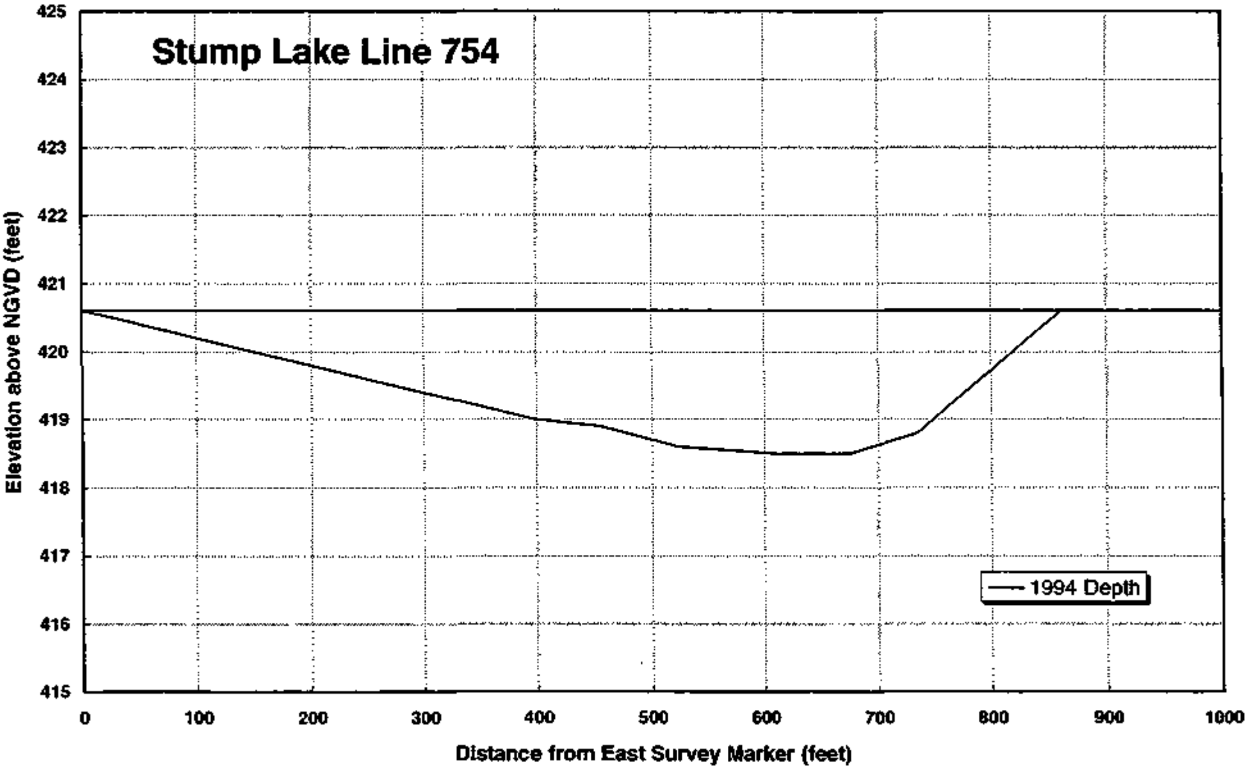
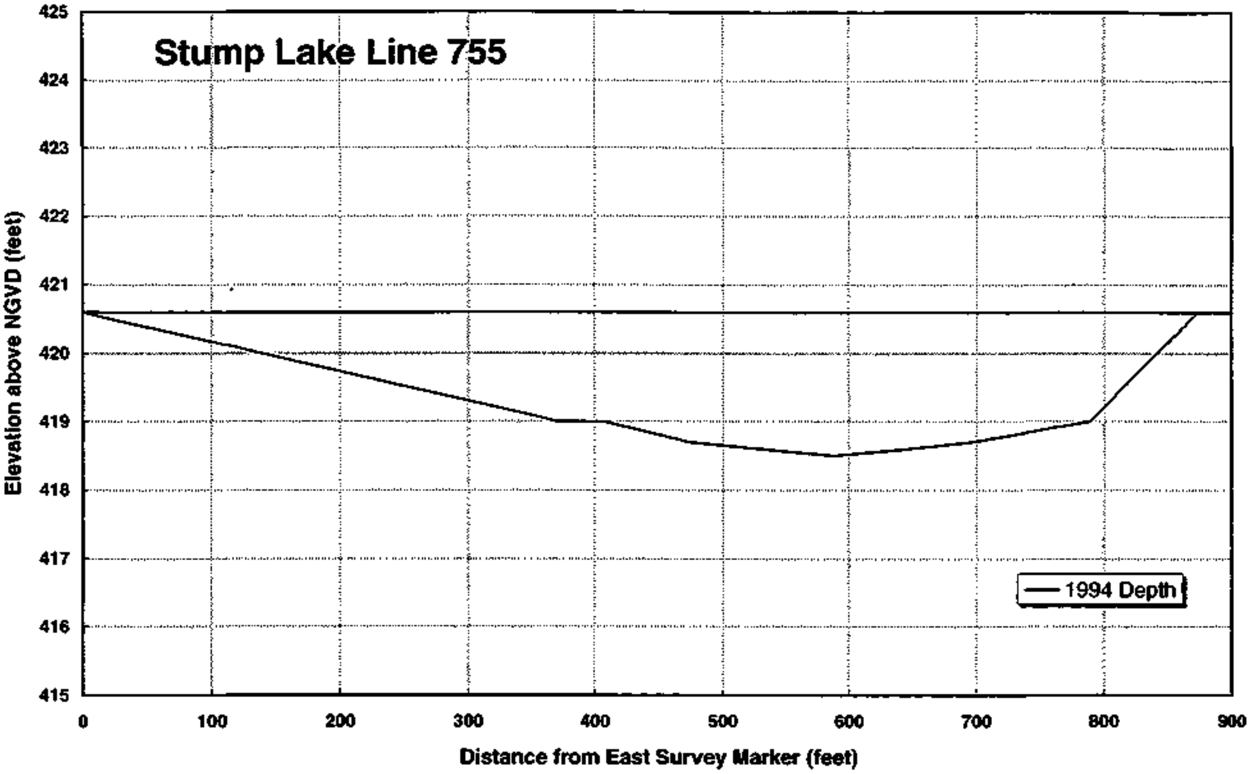


Figure A4. Continued



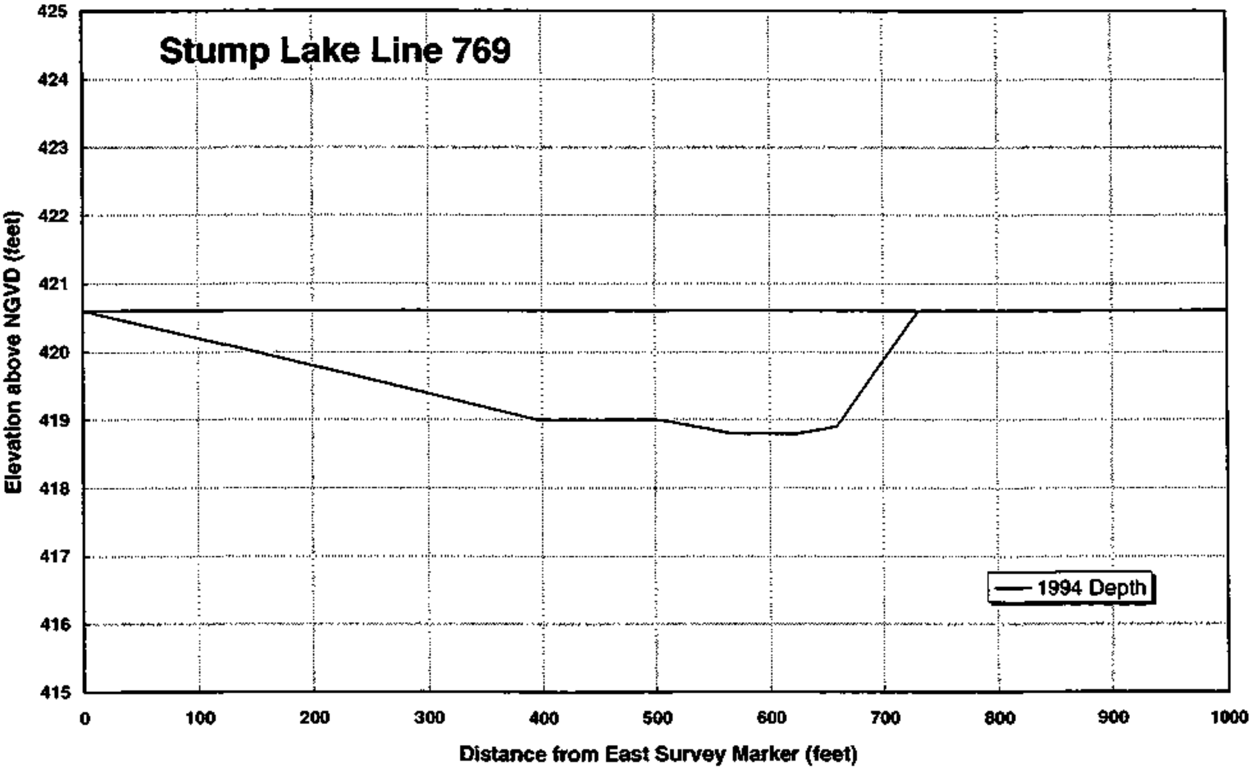
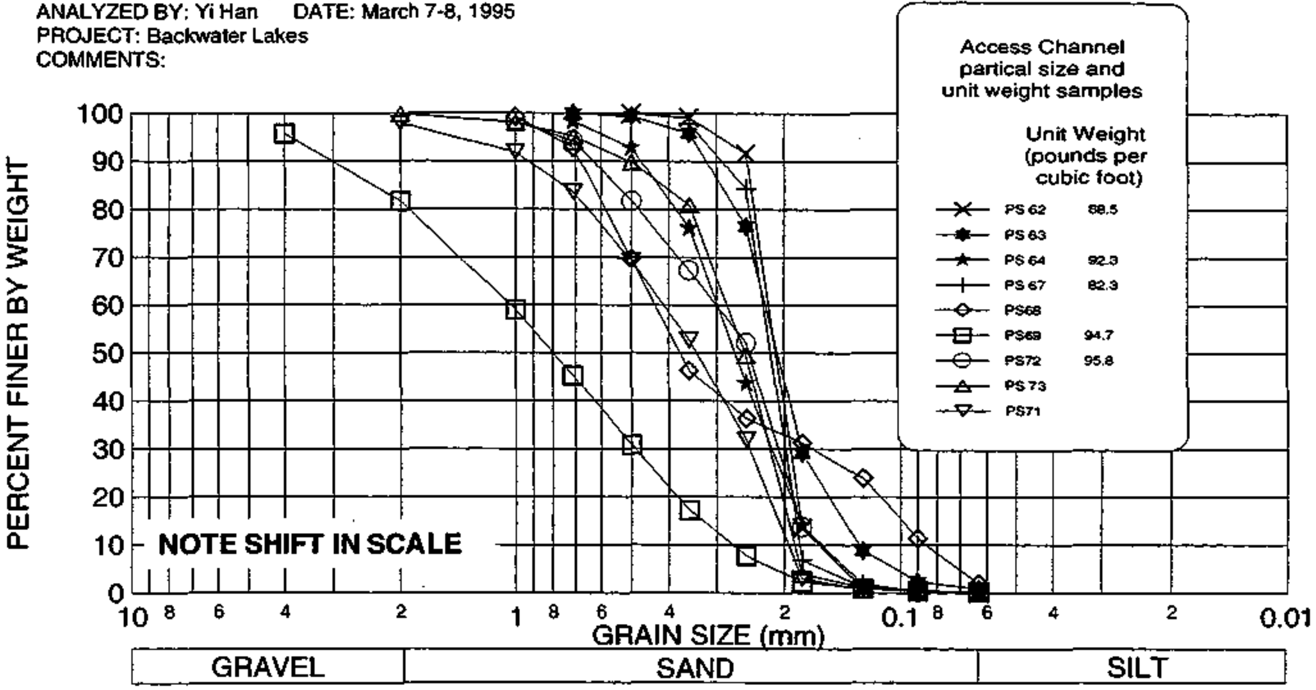


Figure A4. Concluded

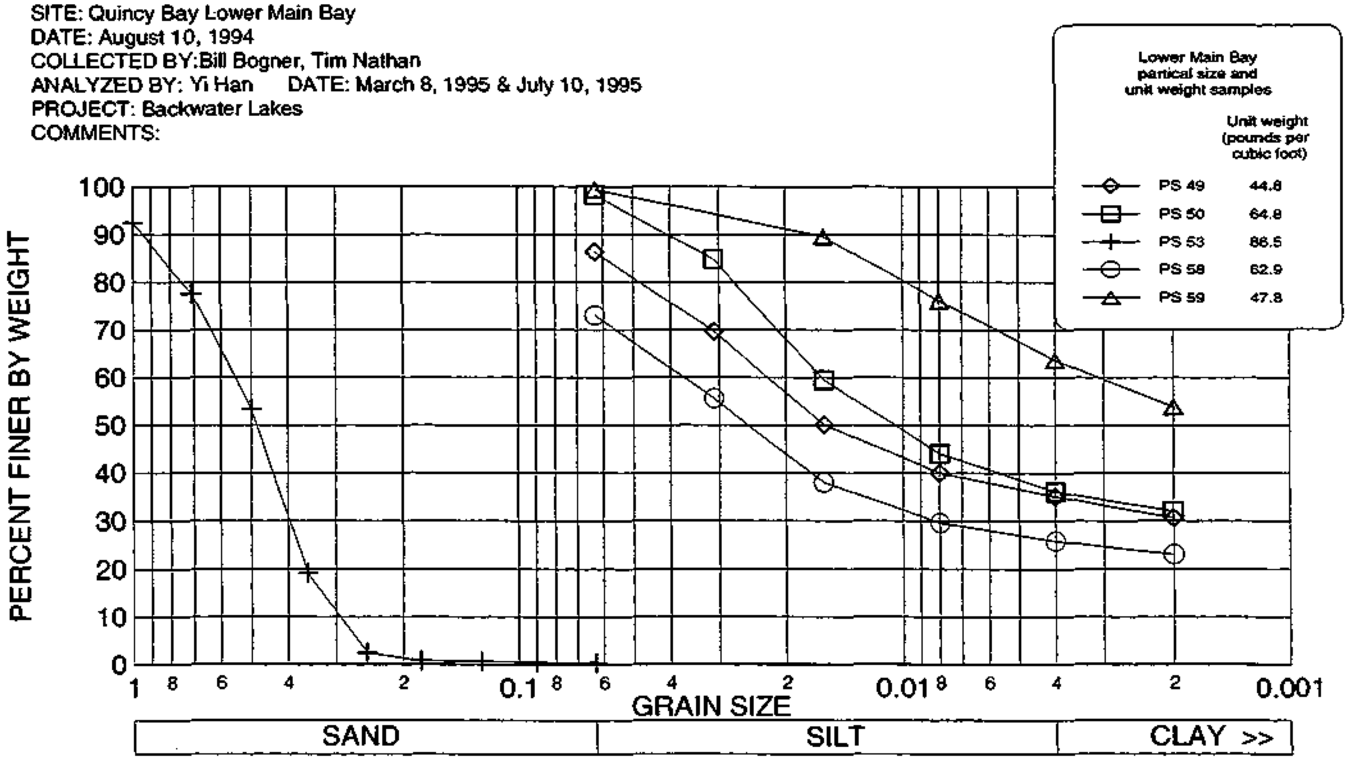
Appendix B. Particle Size Distribution of Sediment Samples

ILLINOIS STATE WATER SURVEY
SEDIMENT LABORATORY

SITE: Quincy Bay Access Channel
DATE: August 10, 1994
COLLECTED BY:Bill Bogner, Tim Nathan
ANALYZED BY: Yi Han DATE: March 7-8, 1995
PROJECT: Backwater Lakes
COMMENTS:

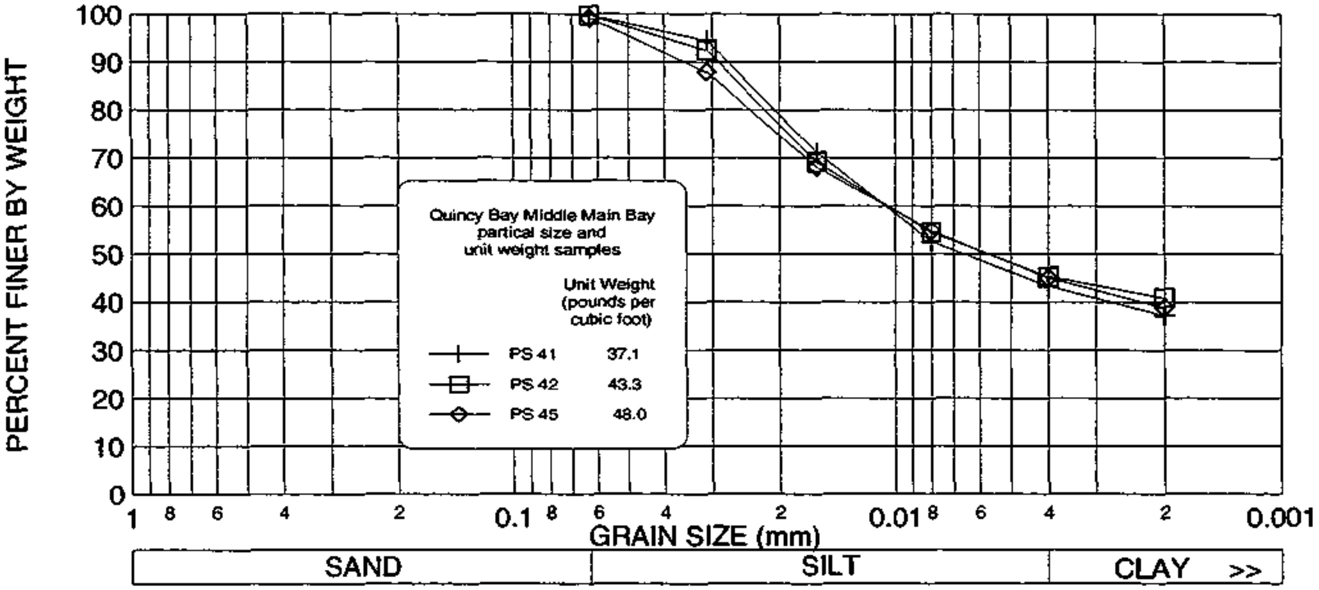


SITE: Quincy Bay Lower Main Bay
DATE: August 10, 1994
COLLECTED BY:Bill Bogner, Tim Nathan
ANALYZED BY: Yi Han DATE: March 8, 1995 & July 10, 1995
PROJECT: Backwater Lakes
COMMENTS:

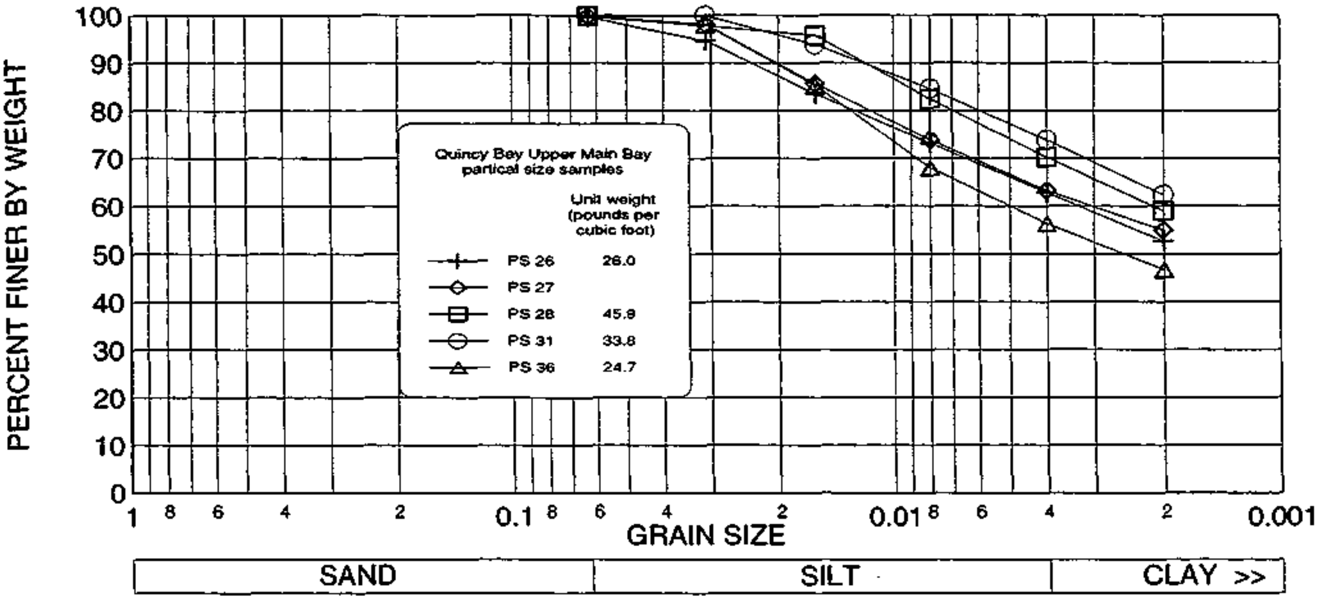


ILLINOIS STATE WATER SURVEY
SEDIMENT LABORATORY

SITE: Middle Main Bay
DATE: August 10,1994
COLLECTED BY: Bill Bogner, Tim Nathan
ANALYZED BY:Yi Han DATE: June 30, 1995
PROJECT: Backwater Lakes
COMMENTS:

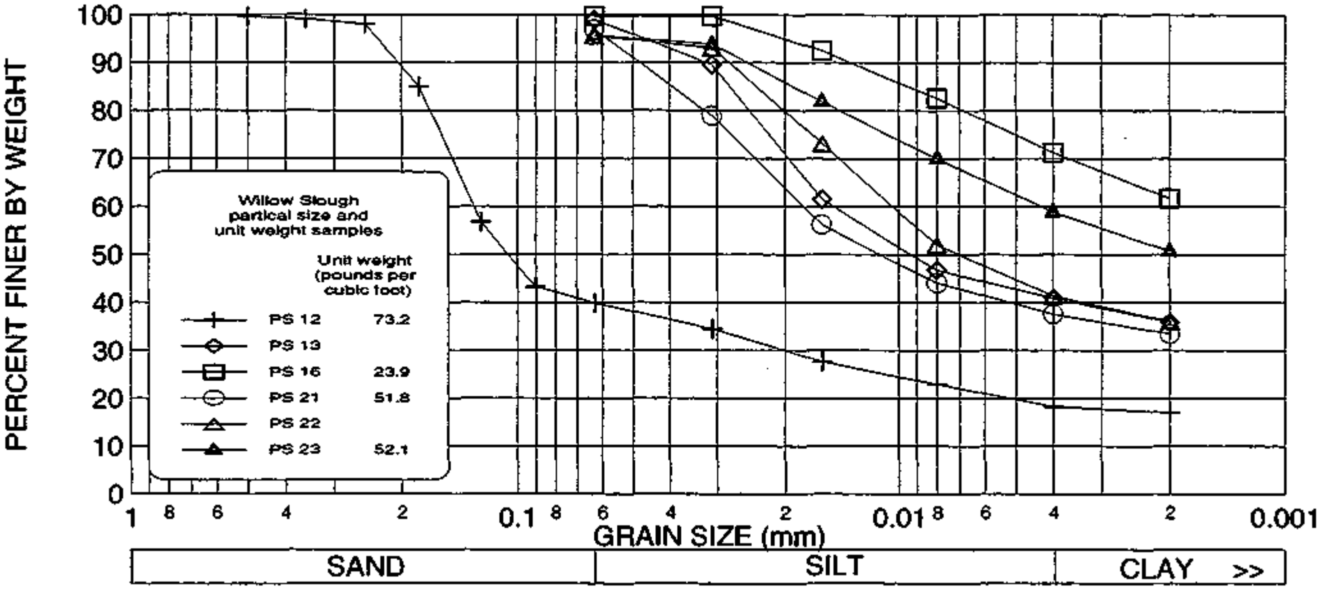


SITE: Upper Main Bay
DATE: August 10, 1994
COLLECTED BY: Bill Bogner, Tim Nathan
ANALYZED BY:Yi Han DATE: June 30, 1995
PROJECT: Backwater Lakes
COMMENTS:

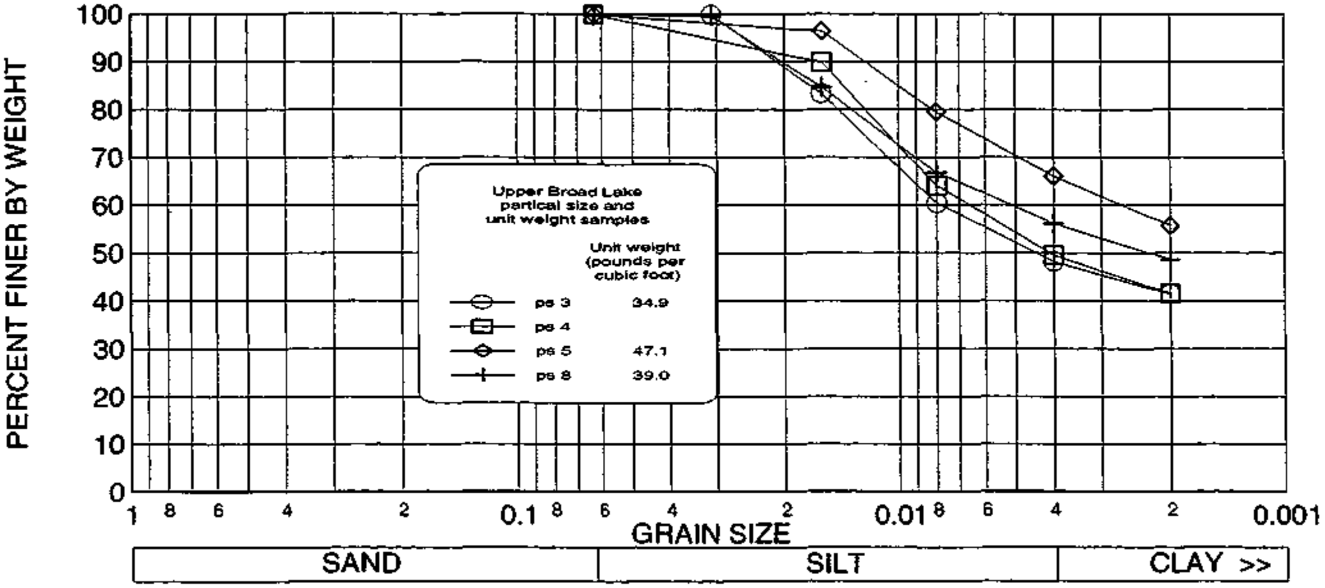


ILLINOIS STATE WATER SURVEY
SEDIMENT LABORATORY

SITE: Quincy Bay Willow Slough
DATE: August 10.1994
COLLECTED BY: Bill Bogner, Tim Nathan
ANALYZED BY: Yi Han DATE: June 23 &30, 1995
PROJECT: Backwater Lakes
COMMENTS:

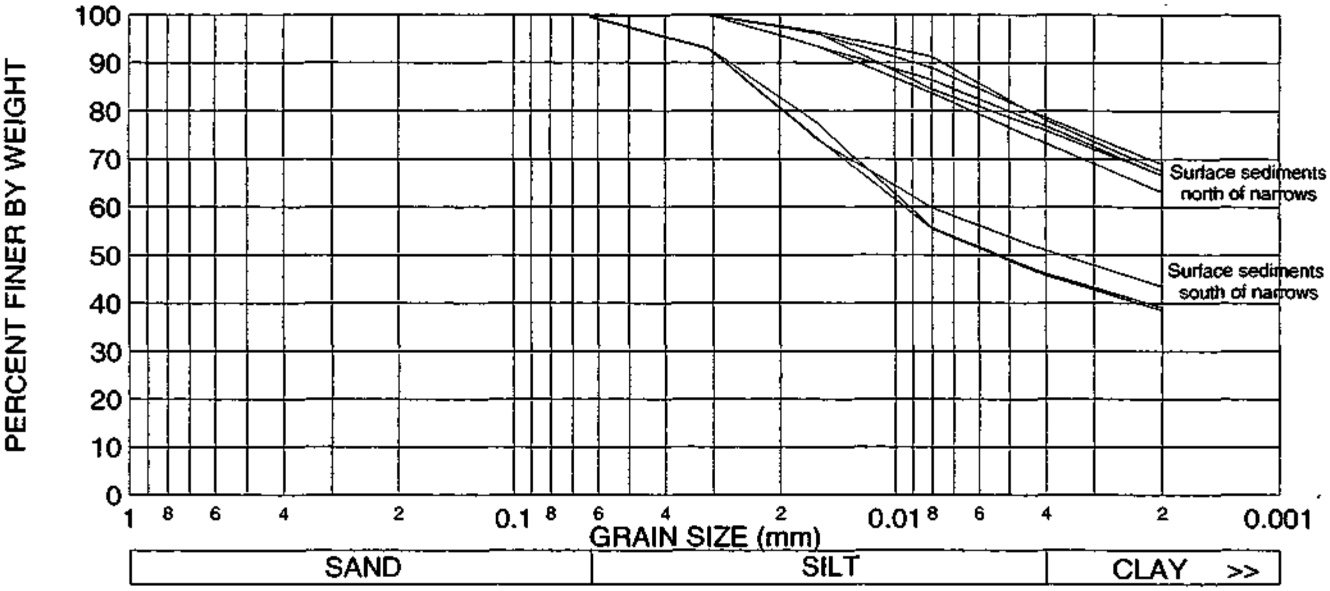


SITE: Quincy Bay Upper Broad Lake
DATE: August 10.1994
COLLECTED BY: Bill Bogner, Tim Nathan
ANALYZED BY: Yi Han DATE: June 23, 1995
PROJECT: Backwater Lakes
COMMENTS:

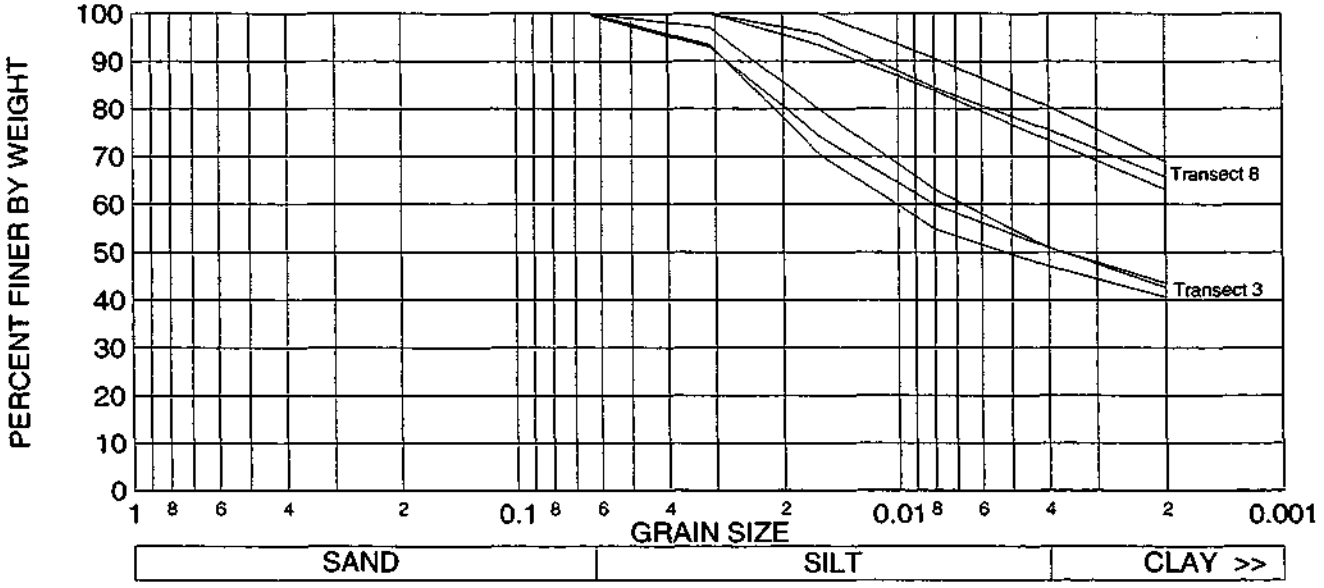


ILLINOIS STATE WATER SURVEY
SEDIMENT LABORATORY

SITE: Lake Meredosia
DATE: August 9,1994
COLLECTED BY: Bill Bogner, Tim Nathan
ANALYZED BY: Yi Han DATE: July 10;17;21, 1995
PROJECT: Backwater Lakes
COMMENTS:

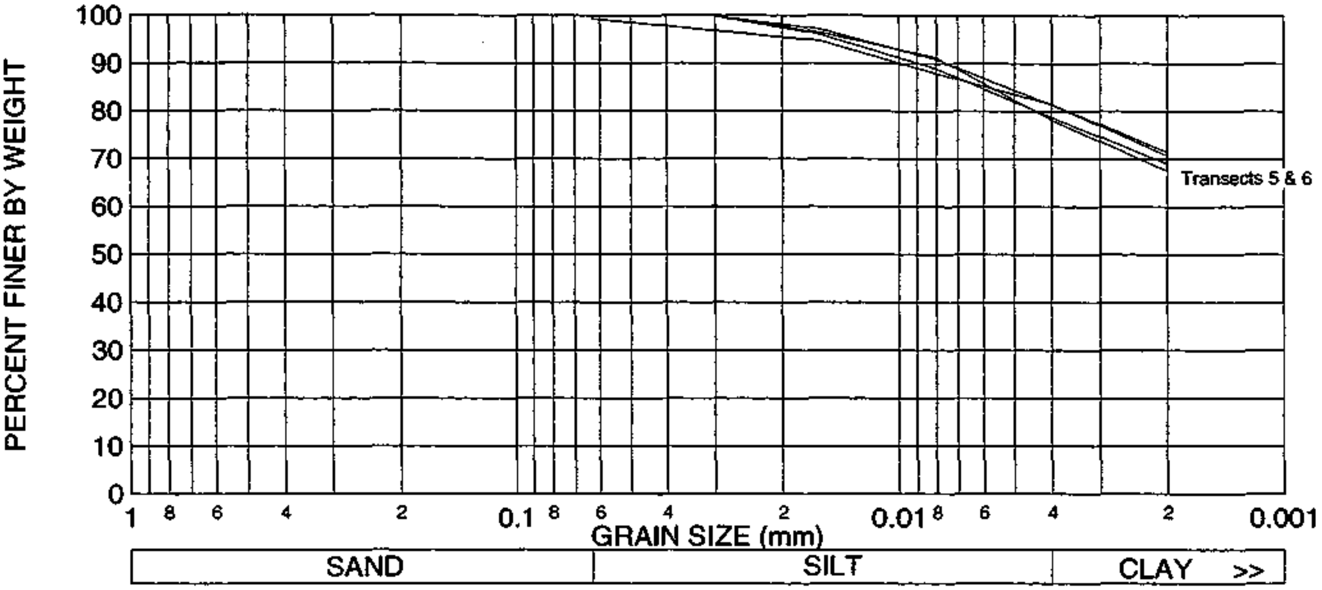


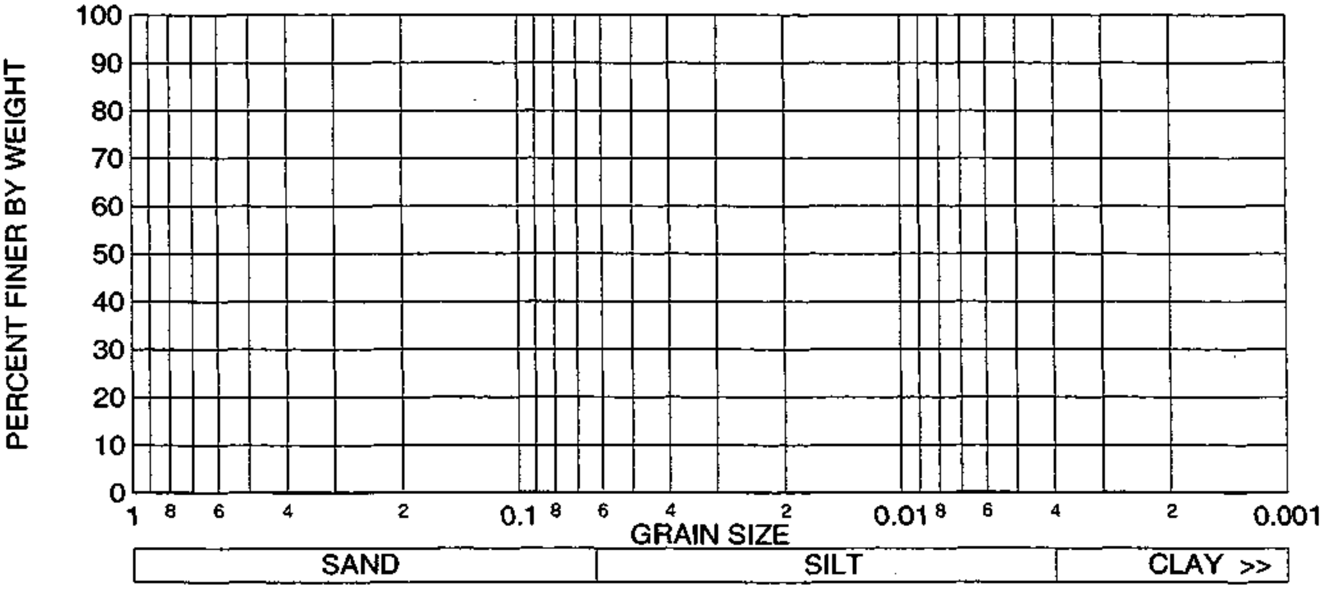
SITE: Lake Meredosia
DATE: August 9,1994
COLLECTED BY: Bill Bogner, Tim Nathan
ANALYZED BY: Yi Han DATE: July 10;17;21, 1995
PROJECT: Backwater Lakes
COMMENTS:



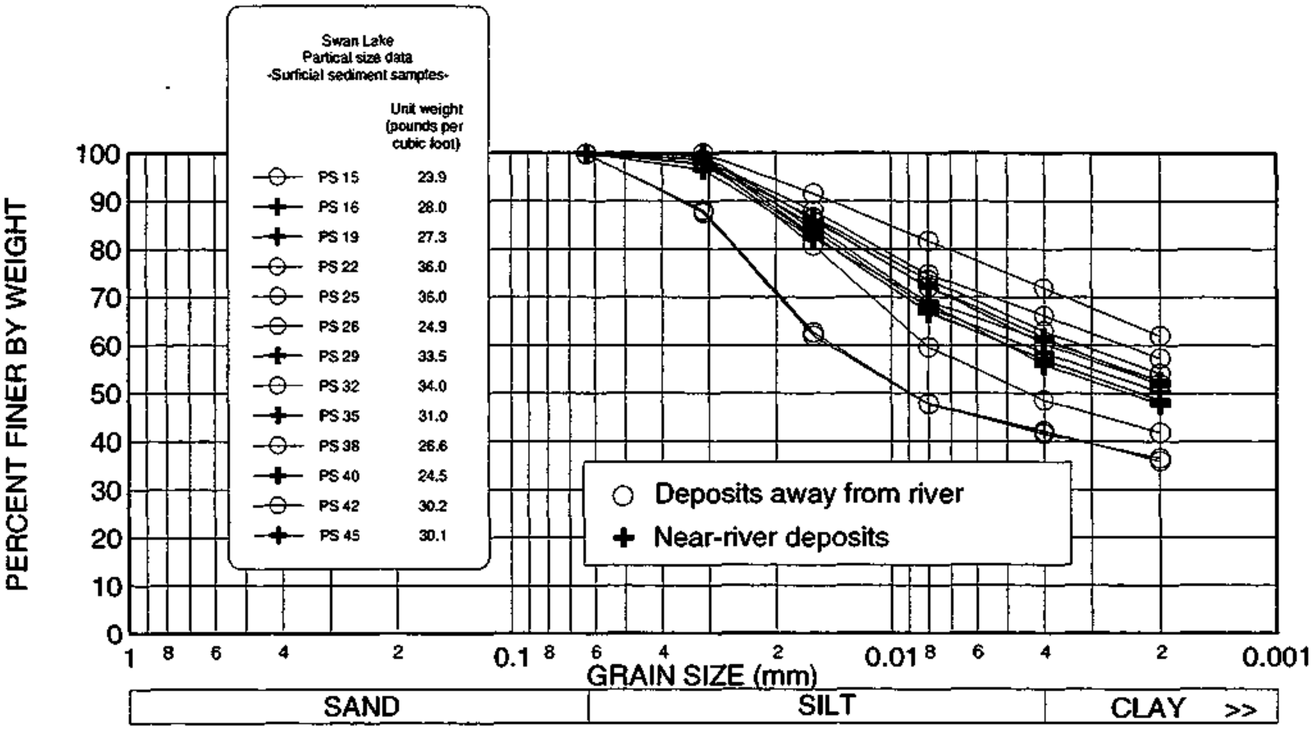
ILLINOIS STATE WATER SURVEY
SEDIMENT LABORATORY

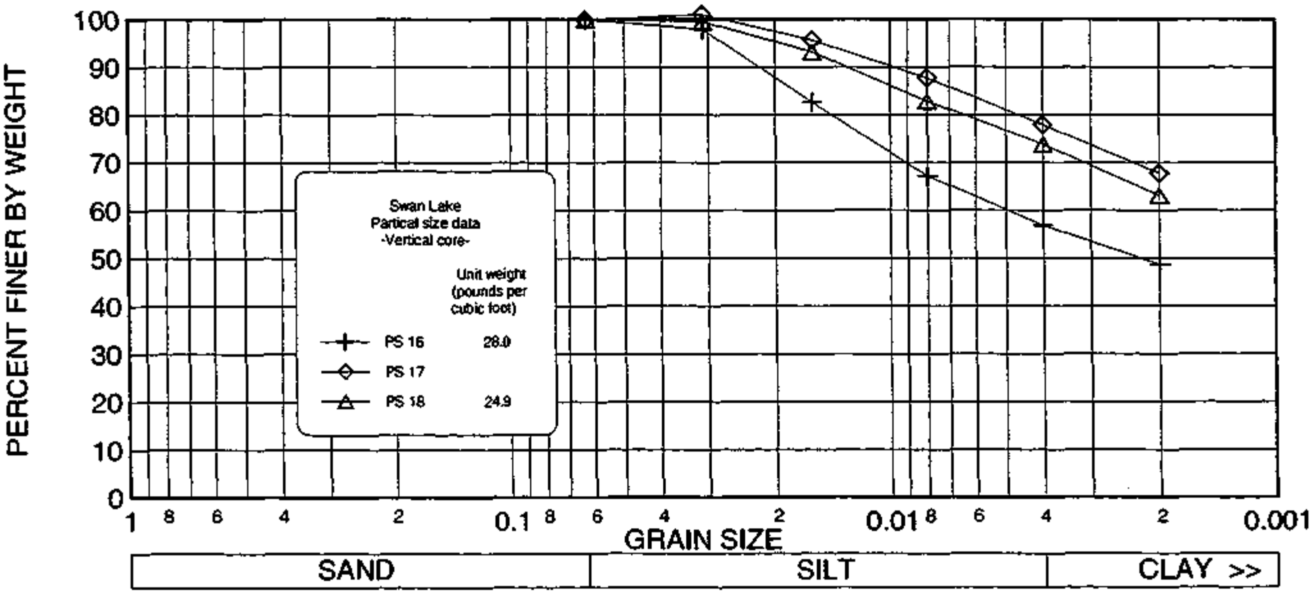
SITE: Lake Meredosia
DATE: August 9, 1994
COLLECTED BY: Bill Bogner, Tim Nathan
ANALYZED BY: Yi Han DATE: July 10;17;20 1995
PROJECT: Backwater Lakes
COMMENTS:



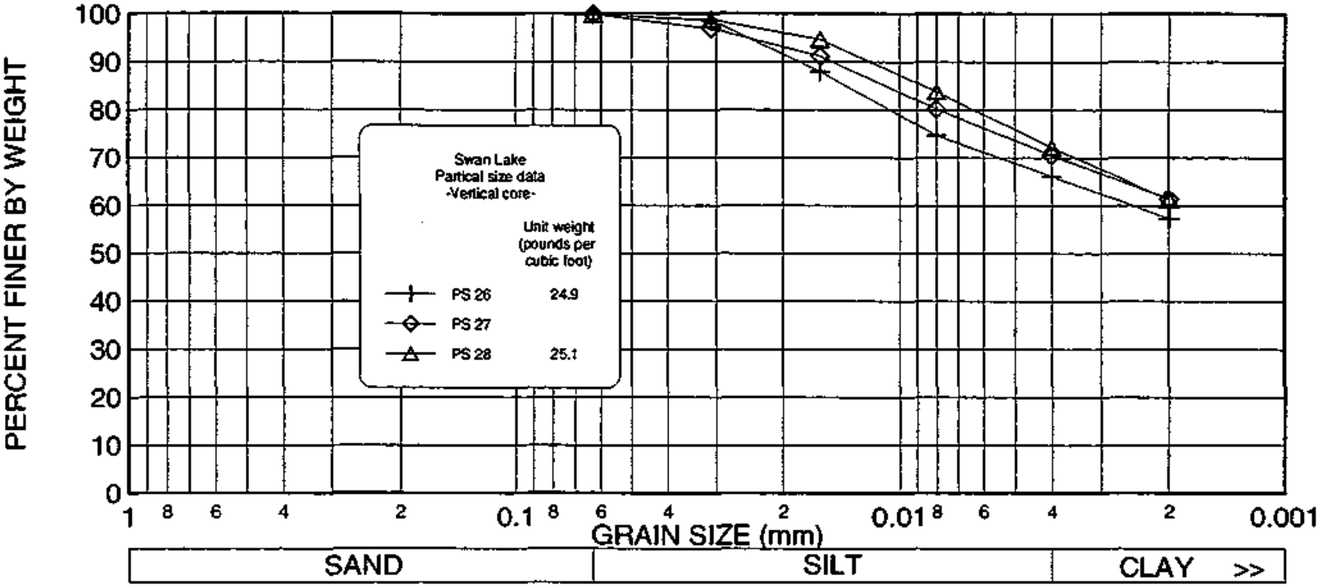


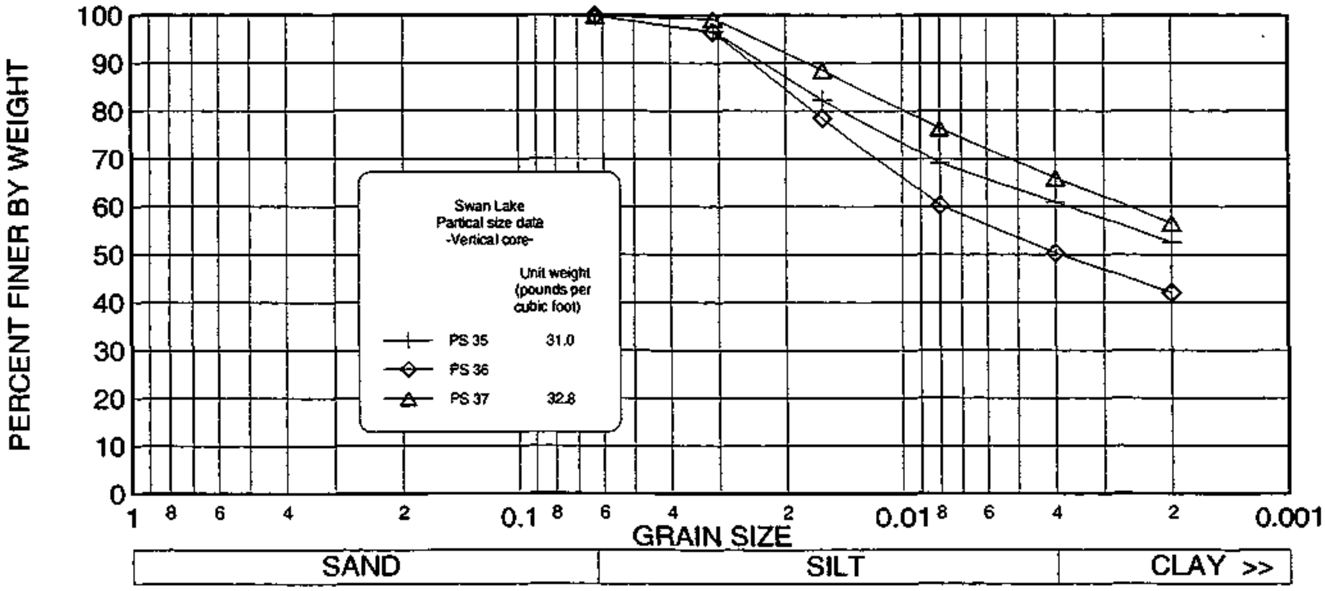
ILLINOIS STATE WATER SURVEY
SEDIMENT LABORATORY



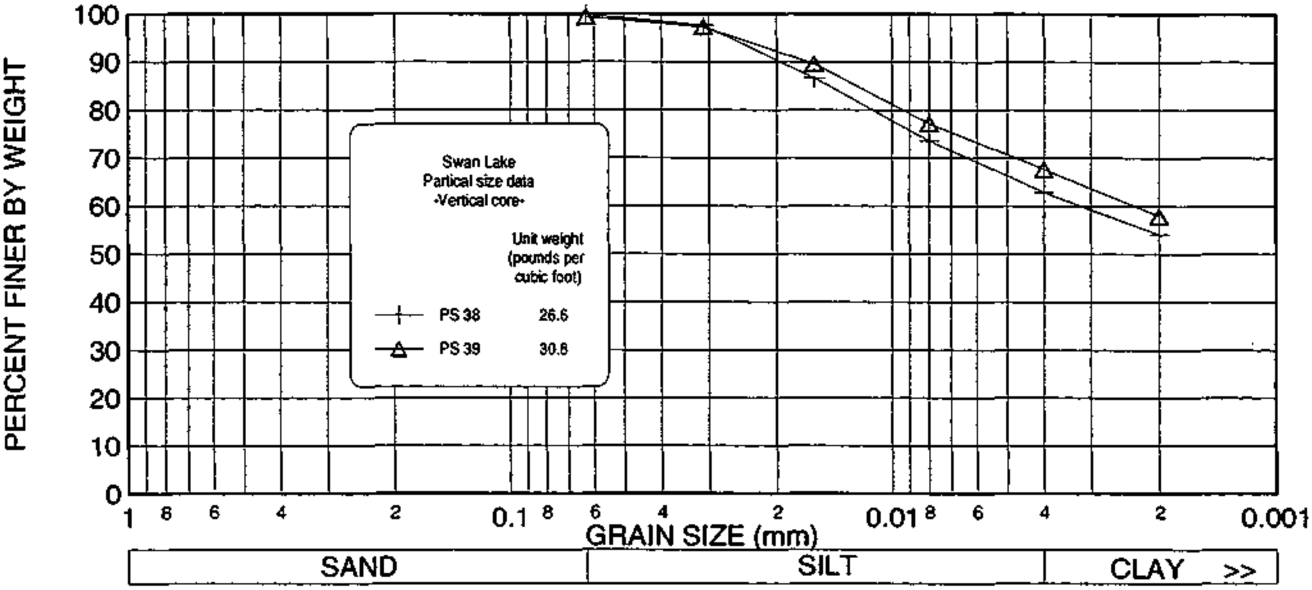


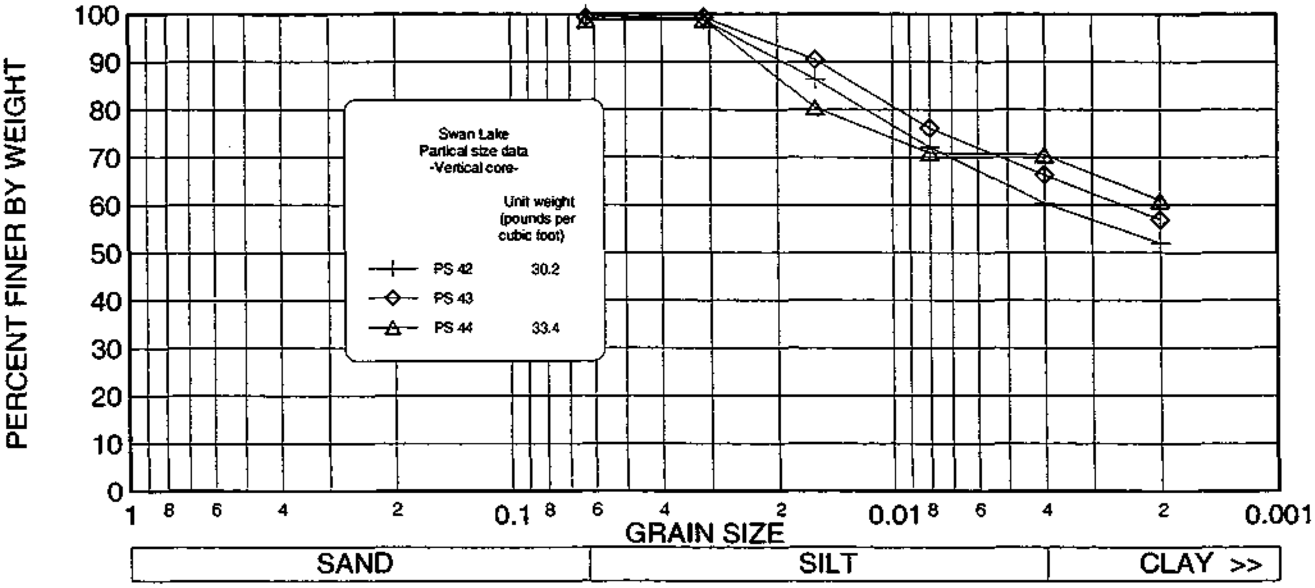
ILLINOIS STATE WATER SURVEY
SEDIMENT LABORATORY





ILLINOIS STATE WATER SURVEY
SEDIMENT LABORATORY





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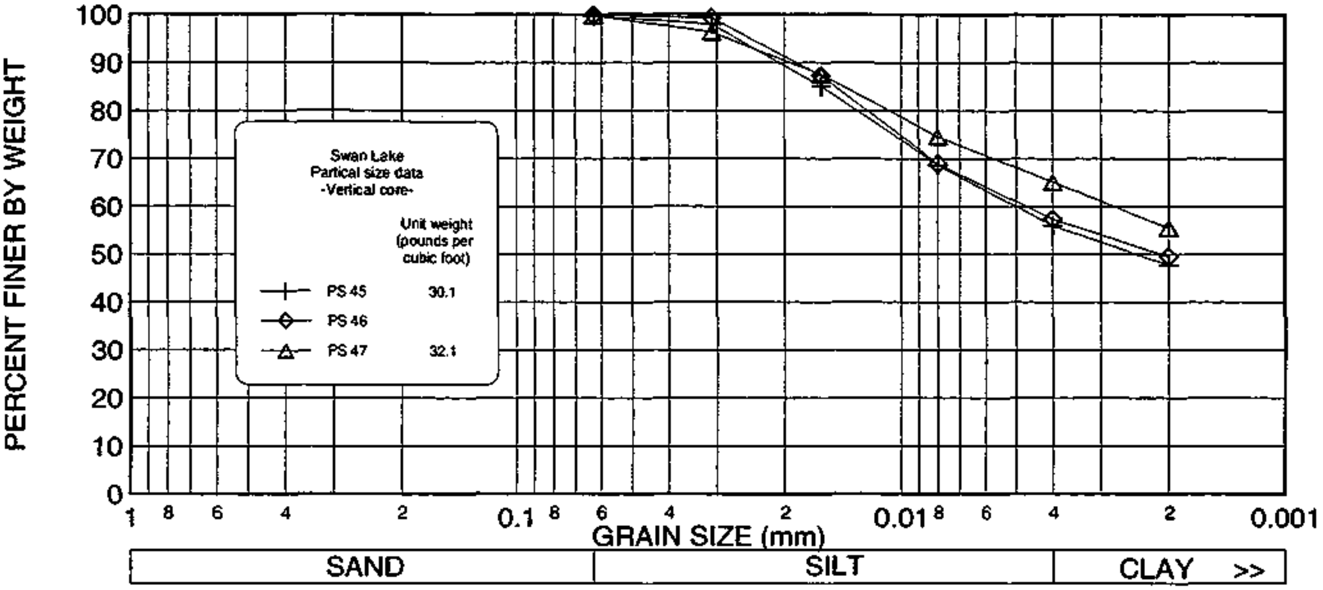
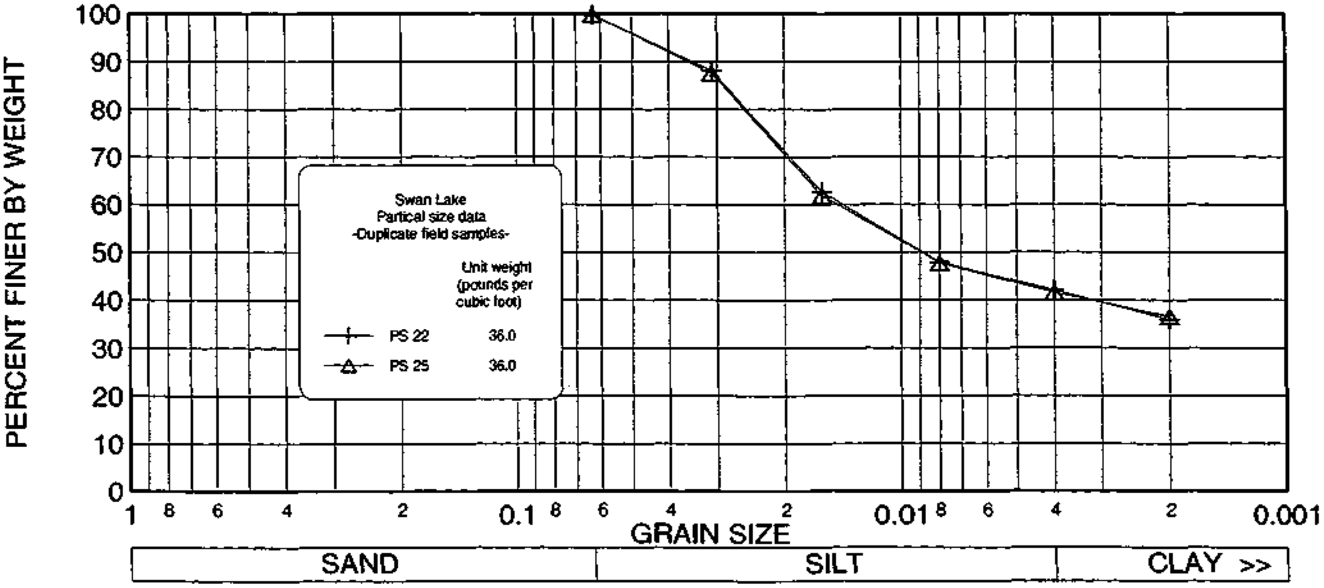
SEDIMENT LABORATORY





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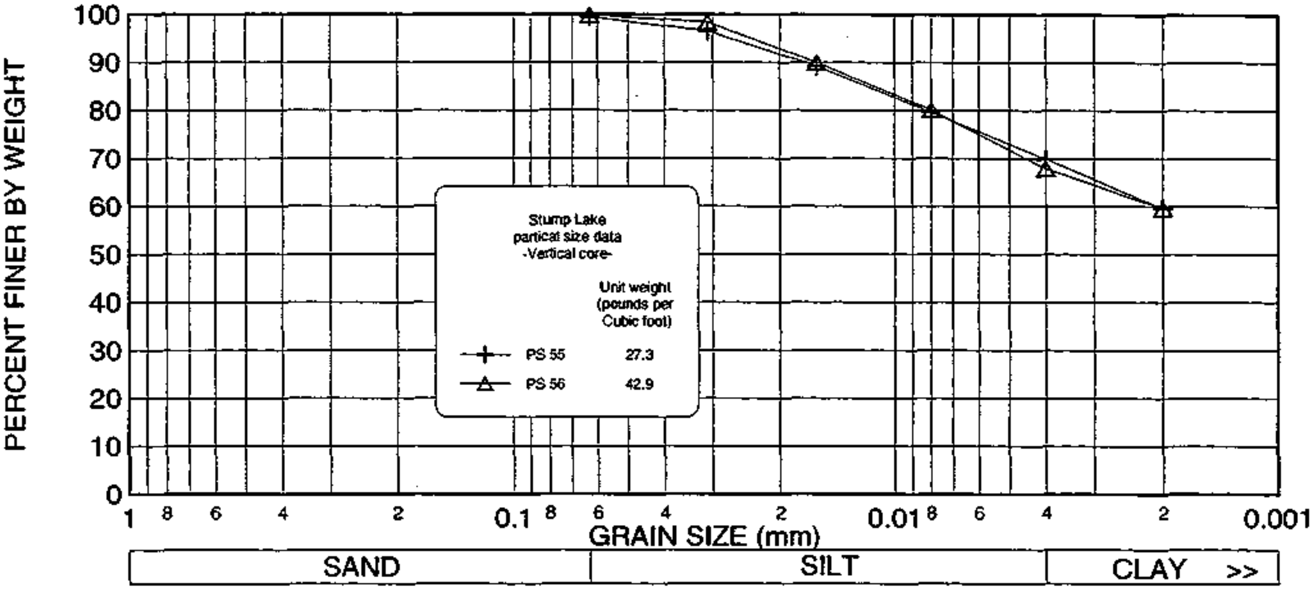

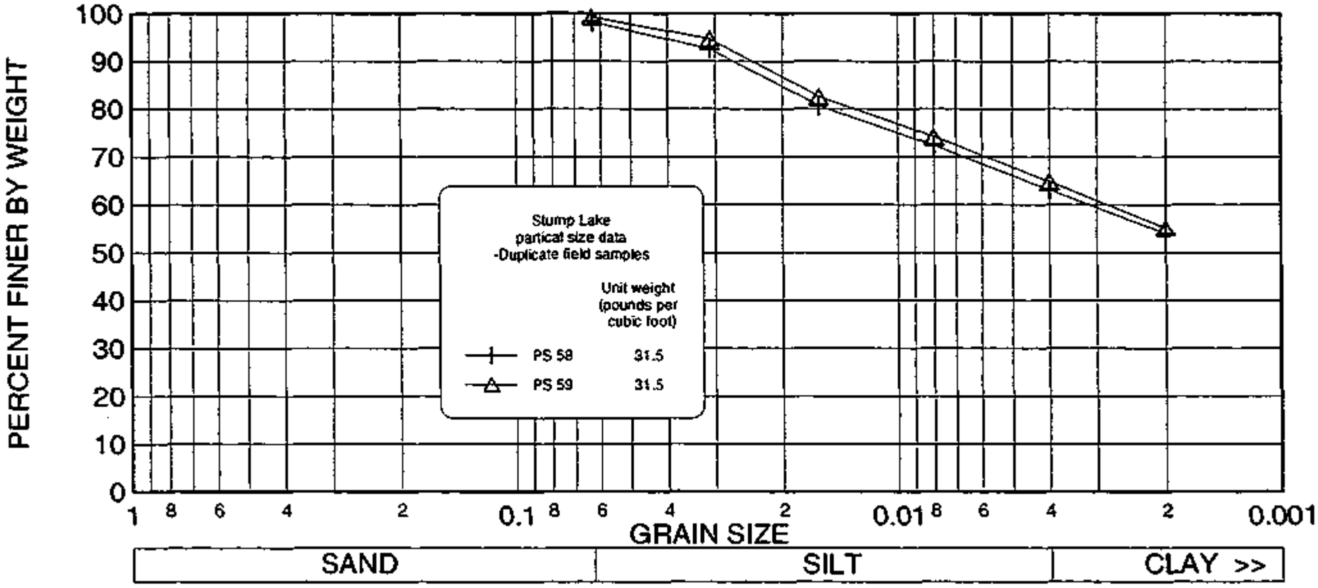

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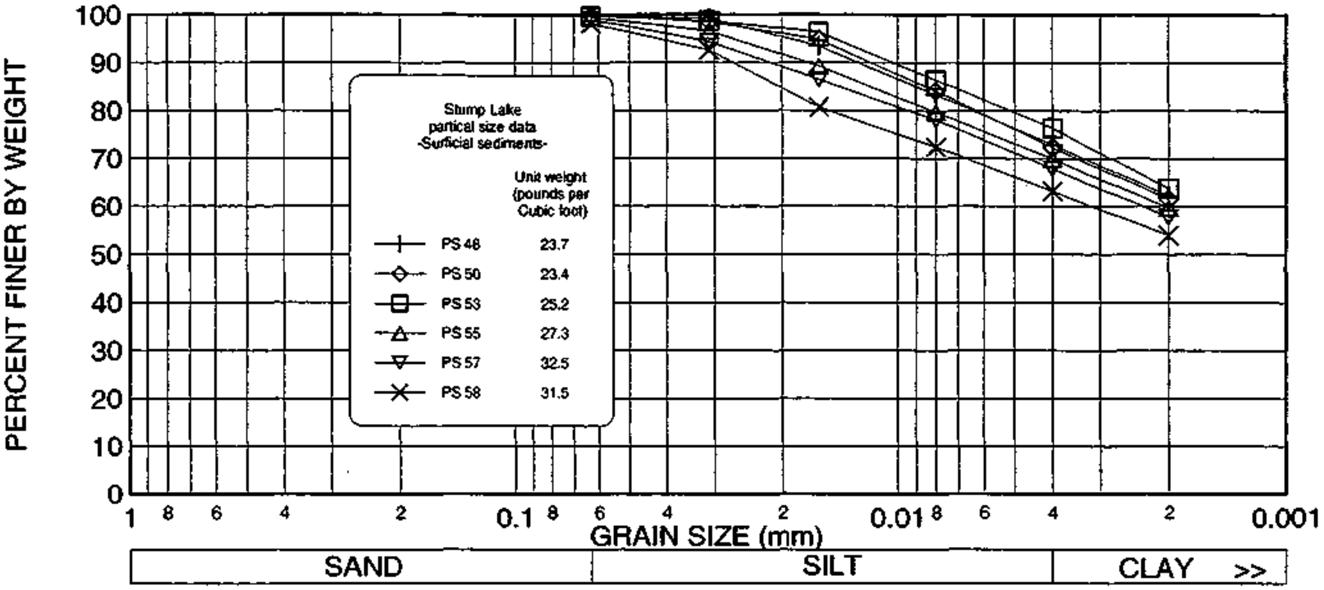
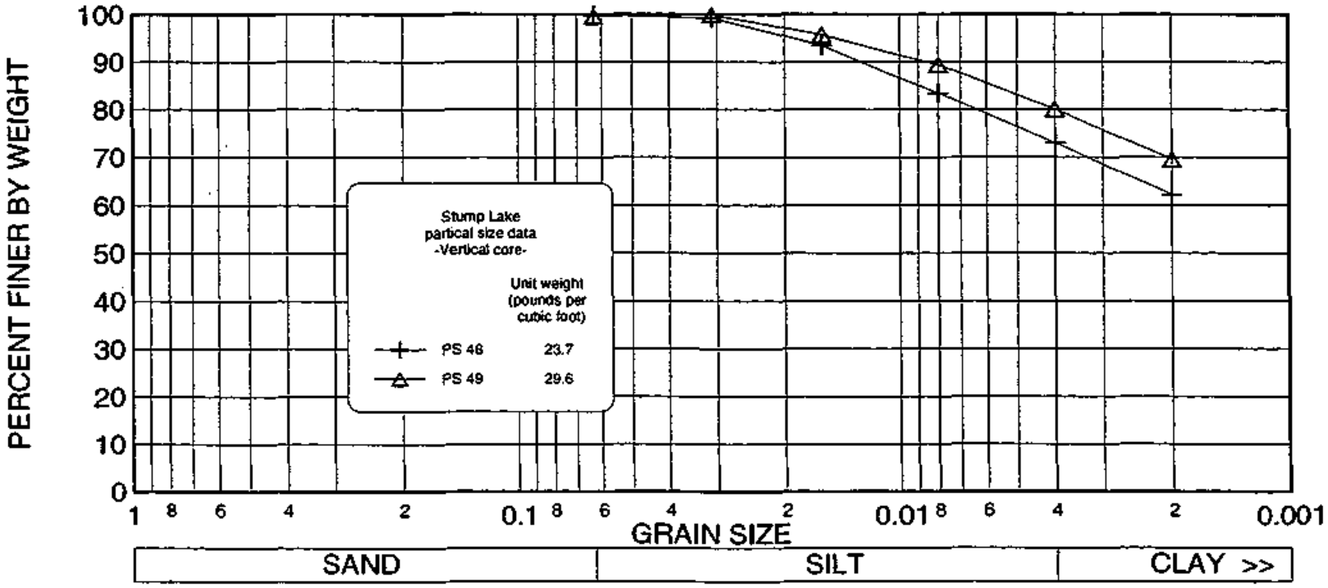
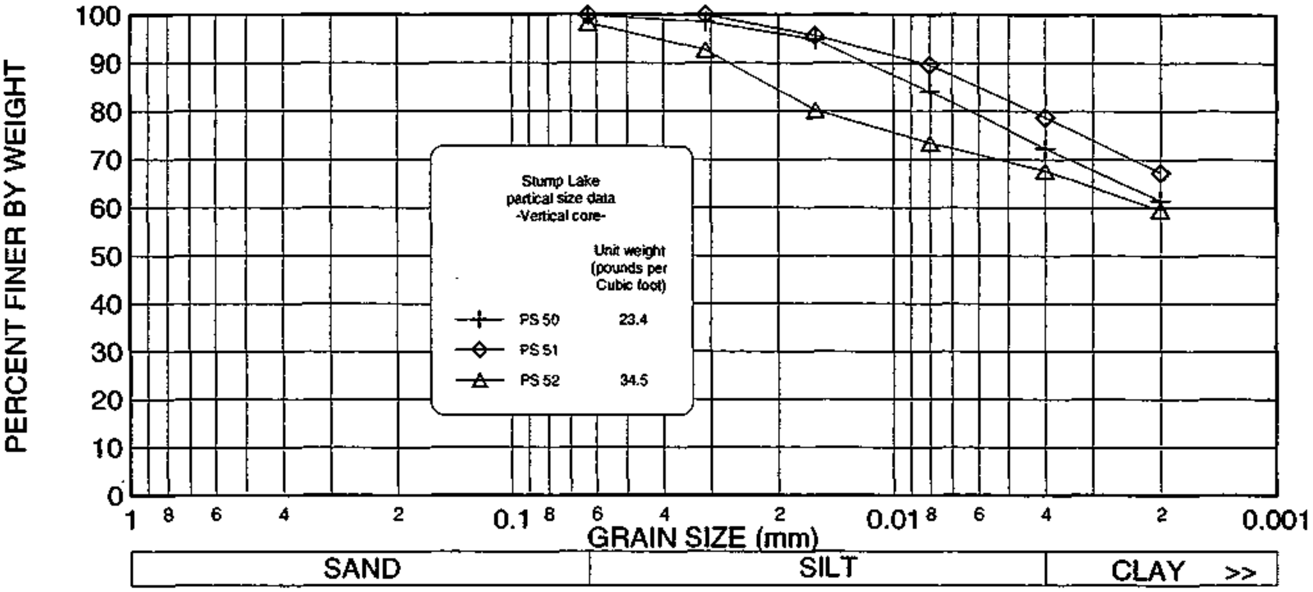
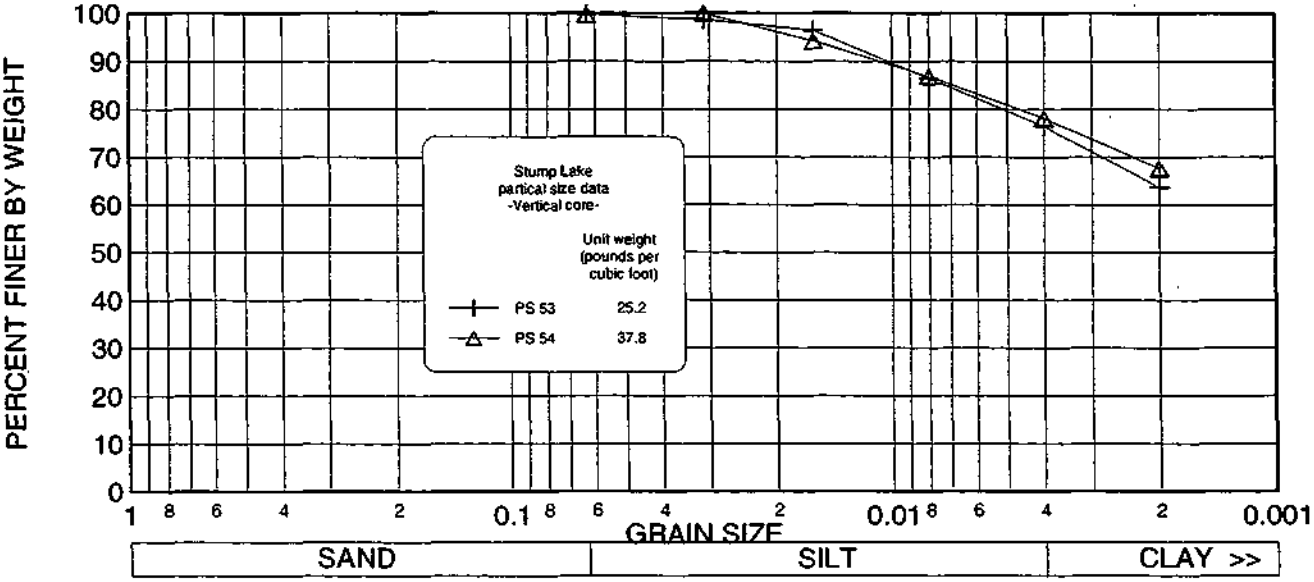




ILLINOIS STATE WATER SURVEY
SEDIMENT LABORATORY





Appendix C. Description of Sampling Sites and Field Conditions during Sampling

Description of Sampling Sites and Conditions

Location: Lake Meredosia

Date: 1/19/94

Personnel: B. Bogner, J. Slowikowski, N. Johnson

Site: RDL 1 (M1)

Location: Line 8 of Lee and Stall's 1976 *survey,* 370 meters (m) from the north end of the pump station outlet at an azimuth of 291.

Time	Depth	Temp.	pH	DO	Cond.
1100	0.46 m	0.8	7.9	10.2	678

Comments: Water samples were dipped from the surface at this site. The lever-actuated top valve was used, but the cores were short. There was a sufficient amount of sample in the metals core to sample a 20-30 centimeters (cm) section. The organics core was short and had to be sampled from a 8-18 cm section (cores were extruded and cut at the IEPA toxicology lab in the evening). Toxicology samples were collected from the metals sediment core. The top 2.5 cm was collected and a thin slice was taken off the metals core sample section for the deeper cut.

Site: RDL2 (M2)

Location: Line 6 of the 1975 survey; 800 m from a tree flagged on the shoreline at an azimuth of 308.

Time	Depth	Temp.	DO	• Cond.
1400	1.07 m	*	*	*

* = Hydrolab not functioning due to cold.

Comments: The flap gate top valve was used, however, the cores were still short. The organics core was sufficient for a 20-30 cm section to be sampled, but the metals core was sampled from a 15-25 cm section (cores were extruded and cut at the IEPA toxicology lab in the evening). The toxicology samples were collected form the metals core. The top 2.5 cm was collected and a thin slice was taken off the metals core sample section for the deeper cut.

Site: RDL 3(M3)

Location: Line 5 of the 1975 survey; 350 m from the shoreline at red cottage at an azimuth of 284.

Time	Depth	Temp.	DO	Cond.
1630	1.25 m	2.2	*	640

* = Hydrolab readings variable.

Comments: The flap gate top valve was used at this site and the cores were longer and the sediments heavier. Both cores were sampled from 20-30 cm sections (cores were extruded and cut at the IEPA toxicology lab in the evening). The toxicology samples were collected form the metals sediment core. The top 2.5 cm was collected for the surface sample and a thin slice was taken off the metals core sample for the deeper cut. A cesium core was collected at this site.

***Site:* RDL 4(M3)**

Location: Line 3 of the 1975 survey; 450 m from flagged tree off shoreline at an azimuth of 278.

Time	Depth	Temp.	DO	Cond.
1900	0.46 m	*	*	*

* = Hydrolab not functioning due to cold

Comments: The flap gate top valve was used, but the cores were short. There was sufficient sample in the organics core to sample a 20-30 cm section. A 14-24 cm section of the metals core was sampled (cores were extruded and cut at the IEPA toxicology lab in the evening). The toxicology samples were collected from the sediment metals core. The top 2.5 cm was collected for the surface sample and a thin slice was taken off the metals core sample for the deeper cut. Sampling was completed at 1800 hours.

Location: Lake Meredosia - Sampling collection of VOCs

Date: 3/16/94

Personnel: N. Johnson, J. Slowikowski

***Site:* RDL 1 (M1)**

Time	Temp.	Cond.	DO
1737	8.8	593	19.6

Comments: The lake is very high and contains Illinois River water. The road through Shady Acres was flooded, therefore we launched the boat from a road adjacent to the county line.

***Site:* RDL 2(M2)**

Time	Temp.	Cond.	DO
1758	8.2	612	19.6

***Site:* RDL 3(M3)**

Time	Temp.	Cond.	DO
1825	8.0	610	19.6

***Site:* RDL 4(M4)**

Time	Temp.	Cond.	DO
1850	7.9	627	18.8

Note: All VOC samples were preserved with Hcl.

Location: **Quincy Bay**

Date: 2/1/94-2/2/94

Personnel: B. Bogner and N. Johnson

Site: Q5

Location: MMB 8, 200 m west from cement marker adjacent to launch ramp at Sid Simpson State Park.

Time	Depth	Temp.	pH	DO	Cond.
1040	0.86 m	0.9	9.2	14.6	616

Comments: Q6 is a field duplicate of Q5; Q7 and Q8 are QC samples.

Site: Q9

Location: LBL 1, 110 m north of fence post with buried concrete marker, backsight 328, west side of lake approximately 1/4 of the way north.

Time	Depth	Temp.	pH	DO	Cond.
1240	0.3 m	0.5	10.3	*	512

*= Hydrolab reading variable

Comments: Original site was located 130 m north of fence post, however, this site was frozen to the bottom. All water samples were taken at the surface. Encountered difficulty coring at this site; took several cores before we had enough sediment. Surficial sediment samples were taken 3 feet to the west. The core samples had a heavy layer of organic material at the top and very silty material underneath.

Site: Q10

Location: UBL 4, 41 m from marked tree

Time	Depth	Temp.	pH	DO	Cond.
1500	0.66m	1.7	7.2	*	*

Comments: A cesium core sample was taken here.

Site: Q11

Location: UMB 16, 205 m from marker, 286 azimuth

Time	Depth	Temp.	pH	DO	Cond.
0900	0.91m	1.6	8.5	*	611

Comments: A cesium core sample was taken here.

Site: 012

Location: TL 2,175 m from survey marker, 166 azimuth

Time	Depth	Temp.	pH	DO	Cond.
1045	0.13 m	*	*	*	*

Comments: No Hydrolab data due to shallow water. Water samples were taken at the surface due to shallow depth. This site was frozen to the bottom, therefore, the water samples may be representative of pore water.

Location: Swan Lake

Date: 2/15/94

Personnel: B. Bogner, E. Ratcliff (NHS-LTRM)

Site: SDN 13 (Silver 13)

Location: Approximately 488 m south of opening to Illinois River.

Time	Depth	Temp.	DO
0915	0.4 m	1.5	17.6

Comments: Hydrolab was not available for use on this trip. The ice was very thin; approximately 2 inches thick. A cesium core sample was taken here. Core samples were sectioned at the motel.

Site: SDM 14 (Swan 14)

Location: 290 m from COE marker MECO 8.

Time	Depth	Temp.	DO
1130	0.9 m	4.2	16.4

Comments: There was 4-5 inches of rotten ice cover at this site. The water was muddied slightly by the Secchi disk before sampling. Core sample was sectioned at the motel. The metals core was sectioned at 15-25 cm.

Site: ***SDM** 15* (Swan 15)

Location: 110 m from northeast corner of transmission tower and approximately 50 m north of lines.

Time	Depth	Temp.	DO
1230	0.6 m	3.8	13.4

Comments: Secchi disk muddied the water before sampling. Again, there was 4-5 inches of rotten ice. Core samples were sectioned at the motel. The field blank for the water samples was filled on 2/16.

***Site:* SDM 19** (Swan 19)

Location: 350 m from easterly shore, across from creek mouth.

Time	Depth	Temp.	DO
1400	0.3m	3.5	>20

Comments: This site was sampled from the hovercraft. There was 2 inches of rotten ice cover. Cores were sectioned at the IEPA toxicology lab on 2/16. The organics core was sectioned at 15-25 cm.

***Site:* SDM 20** (Swan 20)

Location: 500 m from western shore, 400 m north from tip of dividing bar.

Time	Depth	Temp.	DO
1445	0.7 m	2.0	>20

Comments: There was 3 inches of rotten ice at this site. This site was sampled from the hovercraft. Core samples were sectioned at the IEPA toxicology lab on 2/16.

Location: Stump Lake

Date: 2/22/94

Personnel: N. Johnson, J. Slowikowski

***Site:* RDZO 23** (Stump 23)

Location: 160 m from either shore, across from point northwest of boat ramp at Pere Marquette.

Time	Depth	Temp.	Cond.	DO
0845	0.6 m	6.7	505	10.1

Comments: Water samples were dipped due to depth. No field blank was taken for VOCs.

***Site:* RDZO 24** (Stump 24)

Location: Middle of large pool north of dividing road, approximately 460 m west of shore and south of point.

Time	Depth	Temp.	Cond.	DO
1050	0.5 m	6.5	481	9.4

Comments: Water samples were dipped 1 foot from surface.

Site: RDZO 25 (Stump 25)

Location: Midpoint across from boat channel and point.

Time	Depth	Temp.	Cond.	DO
1200	0.4m	6.6	527	9.2

Comments: Water samples were dipped at surface.

Note: All cores had a heavy layer of vegetation at 30 cm below the sediment surface. In addition, the bottom 15 cm of each core was comprised of very heavy clay.

Appendix D. Water Chemistry Data

Table D1. Inorganic Chemistry of Water Samples

	Lake Meredosia				*Quincy Bay*				
Sample number	*12*		*3*	*4*	*5*	*9*	*10*	*11*	*12*
Analyte	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*
silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
aluminum	0.51	0.215	0.294	0.314	0.270	0.237	0.203	0.557	14.6
arsenic	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21
bismuth	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
boron	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
barium	0.06	0.057	0.057	0.064	0.095	0.055	0.075	0.114	0.230
beryllium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
calcium	82.98	78.6	75.3	89.9	69.5	58.9	66.7	71.0	69.5
cadmium	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024
cobalt	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011
chromium	<0.007	0.199	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	0.013
copper	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	0.014
iron	0.71	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013
mercury	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
potassium	2.37	2.63	3.27	3.46	2.37	<1.42	1.51	<1.42	4.62
lithium	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.007
magnesium	34.17	36.0	35.4	40.2	27.3	27.4	28.6	32.0	30.2
manganese	0.41	0.361	0.159	0.630	0.565	0.813	1.31	0.322	0.931
molybdium	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
sodium	12.98	15.401	15.582	17.350	12.391	11.606	10.421	13.340	13.375
nickel	<0.035	0.098	<0.035	0.046	<0.035	<0.035	<0.035	<0.035	0.036
phosphorous	<0.44	<0.44	<0.44	<0.44	<0-44	<0.44	<0.44	<0.44	0.56
lead	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	0.069	0.070	0.066
sulfur	16.71	18.1	18.3	19.7	13.3	12.4	11.9	16.5	17.2
antimony	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44
selenium	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.17
silicon	6.75	2.55	2.15	3.54	4.58	2.41	1.28	4.78	34.6
tin	<0.10	<0.10	<0.10	<0.10	0.12	<0.10	<0.10	<0.10	<0.10
strontium	0.14	0.164	0.159	0.183	0.135	0.115	0.143	0.138	0.154
titanium	0.01	<0.008	<0.008	<0.008	0.008	<0.008	<0.008	0.019	0.422
thallium	<0.35	<0.35	<0.35	<0.35	<0-35	<0.35	<0.35	<0.35	<0.35
vanadium	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.025
zinc	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.057
F	0.33	0.36	0.37	0.39	0.20	0.14	0.12	0.18	0.17
Cl	18.40	24.3	24.4	24.6	36.8	19.9	22.6	36.1	28.3
N02-N	<0.03	<0.03	<0.03	<0.03	<003	<0.03	<0.03	<0.03	<0.03
N03-N	0.60	<0.02	<0.02	0.20	4.16	0.55	0.03	1.04	1.27
o-P04-P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
S04	48.80	53.9	54.4	59.0	42.1	36.1	31.4	48.3	47.0

Table D1. Continued

	Silver Lake	Swan Lake				Stump Lake		
Sample number	*13*	*14*	*15*	*19*	*20*	*23*	*24*	*25*
Analyte	*(m&/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*
silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
aluminum	2.12	0.361	0.495	0.115	0.300	0.763	3.04	1.55
arsenic	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21
bismuth	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
boron	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
barium	0.087	0.049	0.059	0.037	0.049	0.053	0.079	0.071
beryllium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
calcium	52.1	50.9	66.4	46.6	56.7	55.6	56.9	62.4
cadmium	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024
cobalt	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011
chromium	0.010	0.010	0.011	<0.007	<0.007	<0.007	<0.007	<0.007
copper	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
iron	<0.013	<0.013	<0.013	0.163	0.343	0.825	3.36	1.79
mercury	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
potassium	<1.42	2.50	2.86	<1.42	3.08	<1.42	2.76	2.47
lithium	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
magnesium	191	32.2	31.6	26.3	29.2	28.5	23.8	27.1
manganese	1.37	0.103	0.201	0.089	0.073	0.099	0.259	0.274
molybdium	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
sodium	7.259	13.006	11.885	8.360	35.607	9.059	9.343	9.914
nickel	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035
phosphorous	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44
lead	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054	<0.054
sulfur	4.37	17.7	16.2	12.1	21.2	13.0	11.0	12.3
antimony	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44
selenium	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Silicon	8.77	1.07	2.03	2.89	1.83	2.46	8.31	4.72
tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
strontium	0.114	0.134	0.145	0.097	0.154	0.114	0.123	0.131
titanium	0.072	0.011	0.021	<0.008	0.011	0.022	0.101	0.043
thallium	<0-35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	0.49
vanadium	<0.006	<0.006	0.012	<0.006	<0.006	<0.006	<0.006	0.014
zinc	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
F	0.13	0.14	0.14	0.16	0.20	0.12	0.12	0.13
Cl	17.1	22.8	21.4	16.6	58.2	15.8	17.6	16.7
N02-N	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
N03-N	0.04	<0.02	0.16	2.57	2.33	<0.02	<0.02	<0.02
o-PO4-P	<01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
S04	12.1	51.3	50.4	36.5	63.8	37.4	32.7	37.1

Table D1. Continued

	Quality Control/Quality Assurance					
Sample number:	*5-B*	*6*	*7*	*8*	*15-B*	*16*
Analyte	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*
silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
aluminum	0.295	0.293	<0.030	<0.030	0.448	0.247
arsenic	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21
bismuth	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
boron	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
barium	0.094	0.108	<0.002	<0.002	0.060	0.056
beryllium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
calcium	68.6	74.5	<0.04	<0.04	66.8	65.3
cadmium	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024
cobalt	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011
chromium	<0.007	<0.007	<0.007	<0.007	0.010	<0.007
copper	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
iron	<0.013	<0.013	<0.013	<0.013	0.582	0.401
mercury	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
potassium	2.44	2.50	<1.42	<1.42	2.66	2.31
lithium	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
magnesium	27.0	28.8	<0.024	<0.024	31.9	31.3
manganese	0.561	0.474	<0.005	<0.005	0.201	0.186
molybdium	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
sodium	12.286	13.090	0.000	-0.010	11.974	11.605
nickel	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035
phosphorous	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44
lead	<0.054	<0.054	<0.054	0.077	<0.054	<0.054
sulfur	13.3	13.9	<0.48	<0.48	17.3	16.6
antimony	0.52	<0.44	<0.44	<0.44	0.64	<0.44
selenium	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
silicon	4.56	5.89	<0.07	<0.07	1.91	1.52
tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
strontium	0.135	0.140	<0.004	<0.004	0.147	0.142
titanium	<0.008	<0.008	<0.008	<0.008	0.010	<0.008
thallium	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35
vanadium	<0.006	0.006	<0.006	<0.006	0.014	<0.006
zinc	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
F	0.20	0.19	<0.10	<0.10	0.14	0.14
Cl	36.8	36.1	0.3	<0.3	21.3	20.9
N02-N	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
N03-N	4.01	3.77	0.03	<0.02	0.16	0.16
0-P04-P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
S04	39.6	40.8	<0.9	<0.9	50.4	49.1

Table D1. Concluded

	Quality Control/Quality Assurance					Minimum
Sample number	*17*	*18*	*21*	*22*	*25-B*	*detection*
Analyte	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*
silver	<0.006	<0.006	<0.006	<0.006	<0.006	0.006
aluminum	<0.030	<0.030	<0.030	<0.030	1.63	0.030
arsenic	<0.21	<0.21	<0.21	<0.21	<0.21	0.21
bismuth	<0.25	<0.25	<0.25	<0.25	<0.25	0.25
boron	<0.33	<0.33	<0.33	<0.33	<0.33	0.33
barium	<0.002	<0.002	<0.002	<0.002	0.073	0.002
beryllium	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
calcium	0.689	1.297	<0.04	0.093	62.9	o.04
cadmium	<0.024	<0.024	<0.024	<0.024	<0.024	0.024
cobalt	<0.011	<0.011	<0.011	<0.011	<0.011	0.011
chromium	<0.007	<0.007	<0.007	<0.007	<0.007	o.007
copper	<0.007	<0.007	<0.007	<0.007	<0.007	o.007
iron	<0.013	0.035	<0.013	<0.013	1.83	0.013
mercury	<0.07	<0.07	<0.07	<0.07	<0.07	0.07
potassium	<1.42	<1.42	<1.42	<1.42	2.63	1.42
lithium	<0.006	<0.006	<0.006	<0.006	<0.006	0.006
magnesium	0.057	0.067	<0.024	<0.024	27.4	0.024
manganese	<0.005	<0.005	<0.005	<0.005	0.280	0.005
molybdium	<0.040	<0.040	<0.040	<0.040	<0.040	0.040
sodium	0.222	0.376	-0.005	0.000	10.013	0.024
nickel	<0.035	<0.035	<0.035	<0.035	<0.035	0.035
phosphorous	<0.44	<0.44	<0.44	<0.44	<0.44	0.44
lead	<0.054	<0.054	<0.054	<0.054	<0.054	0.054
sulfur	<0.48	<0.48	<0.48	<0.48	12.4	o.48
antimony	<0.44	<0.44	<0.44	<0.44	<0.44	o.44
selenium	<0.15	<0.15	<0.15	<0.15	<0.15	o.15
silicon	<0.07	<0.07	0.08	<0.07	5.02	o.07
tin	<0.10	<0.10	<0.10	<0.10	<0.10	o.10
strontium	<0.004	<0.004	<0.004	<0.004	0.135	0.004
titanium	<0.008	<0.008	<0.008	<0.008	0.049	0.OO8
thallium	<0.35	<0.35	<0.35	<0.35	0.35	o.35
vanadium	<0.006	<0.006	<0.006	<0.006	0.016	0.OO6
zinc	<0.015	<0.015	<0.015	<0.015	<0.015	0.015
F	<0.10	<0.10	<0.10	<0.10	0.13	0.10
CI	<0.3	<0.3	<0.3	<0.3	17.0	o.3
N02-N	<0.03	<0.03	<0.03	<0.03	<0.03	0.03
N03-N	<002	<0.02	<0.02	<0.02	<0.02	0.02
o-PO4-P	<0.1	<0.1	<0.1	<0.1	<0.1	o.1
SO4	<0.9	<0.9	<0.9	<0.9	37.2	0.9

Table D2. Volatile Organic Compounds (VOCs) in Water Samples

		Concentration, ug/L								
		Lake Meredosia				Quincy Bay				
	Sample number		1 2	3	4	5	5-LS	6	7	8
Analyte	Date analyzed:	3/30/94	3/30/94	3/30/94	3/30/94	2/14/94	2/15/94	2/15/94	2/15/94	2/14/94
dichlorodifluoromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
chloromethane		<1-5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Vinyl Chloride		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
bromomethane		<1-5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
chloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trichlorofluoromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
dichloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
t-1,2-dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,2-dichloropropane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
c-1,2-dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
chloroform		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.8	<0.5
bromochloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-trichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
carbon tetrachloride		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-dichloropropane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
bromodichloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
dibromomethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
c-1,3-dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
toluene		<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	<0.5	<0.5
t-1,3-dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-trichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-dichloropropane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tetrachloroethylene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
dibromochloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-dibromoethane		<1.0	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
chlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1,2-tetrachloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
ethyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m + pxylene		<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	<0.5
o-xylene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
styrene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
isopropyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
bromoform		<1.0	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-tetrachloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-trichloropropane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-propyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
bromobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-trimethylbenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-chlorotoluene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-chlorotoluene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
t-butyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-trimethylbenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-butyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
para-isopropyltoluene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-dichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-dichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-butyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-dichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-dibromo-3-chloropropane		<1.0	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-trichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
hexachlorobutadiene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
naphthalene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-trichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table D2. Continued

		Concentration, ug/L									
		Quincy Bay				Silver L.	*Swan Lake*				
	Sample number	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*15-LS*	*16*	*17*
Analyte	*Date analyzed:*	*2/15/94*	*2/15/94*	*2/15/94*	*2/15/94*	*2/17/94*	*2/17/94*	*2/17/94*	*2/18/94*	*2/17/94*	*2/18/94*
dichlorodifluoromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
chloromethane		<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Vinyl Chloride		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
bromomethane		<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
chloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trichlorofluoromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8
dichloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
t-1,2-dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
2,2-dichloropropane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
c-1,2-dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
chloroform		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.9
bromochloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-trichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	479
1,1-dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
carbon tetrachloride		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0
1,2-dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0
benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-dichloropropane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
bromodichloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
dibromomethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
c-1,3-dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
toluene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
t-1,3-dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-trichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-dichloropropane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tetrachloroethylene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
dibromochloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-dibromoethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
chlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1,2-tetrachloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
ethyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m + pxylene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
o-xylene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
styrene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
isopropyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
bromoform		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-tetrachloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-trichloropropane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-propyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
bromobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-trimethylbenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-chlorotoluene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-chlorotoluene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
t-butyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-trimethylbenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-butyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
para-isopropyltoluene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-dichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-dichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-butyl benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-dichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-dibromo-3-chloropropane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-trichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
hexachlorobutadiene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
naphthalene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-trichlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table D3. Concluded

	Concentration, ug/L								
	Swan Lake				*Stump Lake*				
Sample number:	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*25-LS*
Analyte *Date analyzed:*	*2/18/94*	*2/18/94*	*2/18/94*	*2/23/94*		*2/23/94*	*2/23/94*	*2/23/94*	*2/23/94*
dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	no	<0.5	<0.5	<0.5	<0.5
chloromethane	<1.5	<1.5	<1.5	<1.5	bottles	<1.5	<1.5	<1.5	<1.5
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
bromomethane	<1-5	<1.5	<1.5	<1.5		<1.5	<1.5	<1.5	<1.5
chloroethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,1-dichloroethene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
dichloromethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
t-1,2-dichloroethene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,1-dichloroethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
2,2-dichloropropane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
c-1,2-dichloroethene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
chloroform	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
bromochloromethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,1,1-trichloroethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,1-dichloropropene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
carbon tetrachloride	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,2-dichloroethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
benzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
trichloroethene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,2-dichloropropane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
bromodichloromethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
dibromomethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
c-1,3-dichloropropene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
toluene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
t-1,3-dichloropropene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,1,2-trichloroethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,3-dichloropropane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
tetrachloroethylene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
dibromochloromethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,2-dibromoethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
chlorobenzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,1,1,2-tetrachloroethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
ethyl benzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
m + pxylene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
o-xylene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
styrene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
isopropyl benzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
bromoform	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,1,2,2-tetrachloroethane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,2,3-trichloropropane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
n-propyl benzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
bromobenzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,3,5-trimethylbenzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
2-chlorotoluene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
4-chlorotoluene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
t-butyl benzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,2,4-trimethylbenzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
sec-butyl benzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
para-isopropyltoluene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,3-dichlorobenzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,4-dichlorobenzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
n-butyl benzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,2-dichlorobenzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,2-dibromo-3-chloropropane	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,2,4-trichlorobenzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
hexachlorobutadiene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
naphthalene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
1,2,3-trichlorobenzene	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5

Table D3. Pesticides in Water Samples

Sample	*Date collected*	*Date extracted*	*Simazine P91L*	*Atrazine P91L*	*Alachlor P91L*
Lake Meredosia					
1	01/19/94	01/21/94	<0.2	<0.2	<0.4
2	01/19/94	Sample broken	---	---	---
3	01/19/94	01/21/94	<0.2	<0.2	<0.4
4	01/19/94	01/21/94	<0.2	<0.2	<0.4
Quincy Bay					
5	02/01/94	02/03/94	<0.2	<0.2	<0.4
5-LS	02/01/94	02/03/94	<0.2	<0.2	<0.4
**6	02/01/94	02/03/94	<0.2	<0.2	<0.4
*7	02/01/94	02/03/94	<0.2	<0.2	<0.4
*8	02/01/94	02/03/94	<0.2	<0.2	<0.4
9	02/01/94	02/03/94	<0.2	<0.2	<0.4
10	02/01/94	02/03/94	<0.2	<0.2	<0.4
11	02/02/94	02/03/94	<0.2	<0.2	<0.4
12	02/02/94	02/03/94	<0.2	<0.2	<0.4
Silver Lake					
13	02/15/94	02/17/94	<0.2	<0.2	<0.4
Swan Lake					
14	02/15/94	02/17/94	<0.2	<0.2	<0.4
15	02/15/94	02/17/94	<0.2	<0.2	<0.4
15-LS	02/15/94	02/17/94	<0.2	<0.2	<0.4
**16	02/15/94	02/17/94	<0.2	<0.2	<0.4
17	02/15/94	02/18/94	<0.2	<0.2	<0.4
18	02/15/94	02/18/94	<0.2	<0.2	<0.4
19	02/15/94	02/17/94	<0.2	<0.2	<0.4
20	02/15/94	02/17/94	<0.2	<0.2	<0.4
*21	02/21/94	02/25/94	<0.2	<0.2	<0.4
Stump Lake					
*22	02/22/94	02/25/94	<0.2	<0.2	<0.4
23	02/22/94	02/25/94	<0.2	<0.2	<0.4
24	02/22/94	02/25/94	<0.2	<0.2	<0.4
25	02/22/94	02/25/94	<0.2	<0.2	<0.4
25-LS	02/22/94	02/25/94	<0.2	<0.2	<0.4

Notes:
* Field Blank/Trip Blank
** Duplicate Sample
LS = Laboratory Split

Appendix E. Sediment Chemistry Data

Table E1. Results of Inorganic Chemical Composition Analaysis for Top and Bottom Sediment Samples by the ISWS Chemistry Lab

		Sampling Location							
Elements	*Units*	*Meredosia 1 Top*	*Meredosia 1 Bottom*	*Meredosia 2 Top*	*Meredosia 2 Bottom*	*Meredosia 3 Top*	*Meredosia 3 Bottom*	*Meredosia 4 Top*	*Meredosia 4 Bottom*
Aluminum	%	0.98	1.14	0.92	1.27	1.33	1.11	0.93	0.84
Calcium	%	1.42	1.29	1.7	1.16	1.71	1.14	1.15	1.05
Iron	%	1.45	1.56	1.5	1.68	1.74	1.59	1.46	1.34
Magnesium	%	0.34	0.32	0.34	0.36	0.39	0.33	0.37	0.36
Maganese	ug/g	684	446	780	348	923	408	671	344
Phosphorus	ug/g	502	459	600	404	621	483	529	409
Potassium	%	0.1	0.11	0.09	0.13	0.13	0.11	0.09	0.08
Silicon	%	0.15	0.17	0.08	0.14	0.15	0.1	<• 0.12	0.1
Sodium	ug/g	70.2	67.8	73.8	83.9	83.5	68.6	68.1	67.2
Sulfur	ug/g	321	894	338	1616	300	1075	245	577
Titanium	ug/g	54.9	95.2	93.7	88.1	76.1	87.5	92.8	77.8
Arsenic	ug/g	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5
Barium	ug/g	95.9	101.7	102.9	104.4	113	100	89.8	78.5
Boron	ug/g	<2.5	3.4	<2.5	3.7	3.5	3.1	2.7	<2.5
Beryllium	ug/g	0.66	0.63	0.64	0.67	0.74	0.64	0.61	0.55
Bismuth	ug/g	<11	<11	<11	<11	<11	<11	<11	<11
Cadmium	ug/g	<0.9	1	<0.9	<0.9	<0.9	<0.9	1	<0.9
Chromium	ug/g	11.4	13	10.5	13.5	14	12.8	10.8	10.9
Cobalt	ug/g	6.6	7.2	6.9	7.3	7.7	6.9	6.9	6.5
Copper	ug/g	14	15.4	14.4	15.7	15.5	15.5	13.4	13.2
Lead	ug/g	15.9	17.1	16	20	17.1	19	15.8	15.1
Lithium	ug/g	9.4	9.3	8	10.5	12	9.4	8.8	7.7
Mercury	ug/g	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7
Molybdenum	ug/g	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Nickel	ug/g	16.3	16.7	14.6	17.2	16.9	16.9	15.1	14.8
Selenium	ug/g	<10.2	<10.2	<10.2	<10.2	<10.2	<10.2	<10.2	<10.2
Silver	ug/g	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Antimony	ug/g	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5
Tin	ug/g	<5.8	<5.8	<5.8	<5.8	<5.8	<5.8	<5.8	<5.8
Strontium	ug/g	21.9	22.2	25.9	22.6	27.8	21.2	20	17.8
Thallium	ug/g	<28	<28	<28	<28	<28	<28	<28	<28
Vanadium	ug/g	13.5	20.1	16.7	22.9	21.5	20.2	16.2	15.7
Zinc	ug/g	62.9	65.4	63.1	71.3	70.6	68.8	61	58.5

Table E1. Continued

		Sampling Location					
Elements	*Units*	*Quincy Bay 5 Top*	*Quincy Bay 5 Bottom*	*Quincy Bay 9 Top*	*Quincy Bay 9 Bottom*	*Quincy Bay 10 Top*	*Quincy Bay 10 Bottom*
Aluminum	%	0.95	0.83	1	0.68	1.04	1.04
Calcium	%	0.54	0.49	0.76	0.63	0.67	0.5
Iron	%	1.42	1.19	1.3	0.9	1.32	1.29
Magnesium	%	0.24	0.21	0.28	0.2	0.28	0.26
Maganese	ug/g	676	323	656 •	391	650	356
Phosphorus	ug/g	461	327	521	337	442	455
Potassium	%	0.08	0.07	0.09	0.07	0.09	0.1
Silicon	%	0.16	0.17	0.11	0.22	0.11	0.21
Sodium	ug/g	67.1	50.9	60.1	56.8	57.1	65
Sulfur	ug/g	266	505	242	289	253	400
Titanium	ug/g	135.2	118.4	101	108.2	76.9	112.7
Arsenic	ug/g	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5
Barium	ug/g	92.7	83.5	90.8	65.8	93.4	96.3
Boron	ug/g	2.9	<2.5	2.5	2.9	<2.5	<2.5
Beryllium	ug/g	0.49	0.29	0.47	0.24	0.49	0.49
Bismuth	ug/g	<11	<11	<11	<11	<11	<11
Cadmium	ug/g	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Chromium	ug/g	11.6	9.3	11.4	8	12.1	12
Cobalt	ug/g	6.8	5.1	6.3	4.7	6	6.4
Copper	ug/g	10.7	9.6	10	6.9	10.6	10.9
Lead	ug/g	13.6	11.8	13.1	10.3	15.3	15.2
Lithium	ug/g	7.2	6.1	7.6	5.4	8.2	8.1
Mercury	ug/g	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7
Molybdenum	ug/g	<0.9	0.9	<0.9	<0.9	<0.9	<0.9
Nickel	ug/g	12	10.4	13.8	8.9	13.5	12.2
Selenium	ug/g	<10.2	<10.2	<10.2	<10.2	<10.2	<10.2
Silver	ug/g	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Antimony	ug/g	<15.5	16.7	<15.5	<15.5	<15.5	<15.5
Tin	ug/g	<5.8	<5.8	<5.8	<5.8	<5.8	<5.8
Strontium	ug/g	13.4	10.6	14.9	11.3	14.7	12.7
Thallium	ug/g	<28	<28	<28	<28	<28	<28
Vanadium	ug/g	20.4	15.9	17.6	13.4	18	19.1
Zinc	ug/g	49.5	40.6	53.3	36.4	53.9	51.4

Table E1. Continued

		Sampling Location					
Elements	*Units*	*Quincy Bay 11 Top*	*Quincy Bay 11 Bottom*	*Quincy Bay 12 Top*	*Quincy Bay 12 Bottom*	*Silver 13 Top*	*Silver 13 Bottom*
Aluminum	%	1.13	1.13	1.17	1.07	1.01	0.94
Calcium	%	1.22	1.23	0.68	0.58	0.55	0.48
Iron	%	1.55	1.44	1.53	1.63	1.44	1.17
Magnesium	%	0.27	0.28	0.26	0.26	0.26	0.27
Maganese	ug/g	1071	373	1045	511	1003	295
Phosphorus	ug/g	703	284	525	382	509	365
Potassium	%	0.1	0.09	0.1	0.09	0.09	0.09
Silicon	%	0.2	0.1	0.14	0.06	0.12	0.18
Sodium	ug/g	66.3	58.1	58.4	48.3	51.9	52.2
Sulfur	ug/g	303	1081	222	593	256	302
Titanium	ug/g	113.3	94.3	106	102.8	92.5	103.4
Arsenic	ug/g	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5
Barium	ug/g	130.4	122.8	120.7	137.5	105.7	81.4
Boron	ug/g	<2.5	<2.5	<2.5	<2.5	<2.5	2.6
Beryllium	ug/g	0.56	0.69	0.64	0.67	0.56	0.46
Bismuth	ug/g	<11	<11	<11	<11	<11	<11
Cadmium	ug/g	<0.9	0.9	<0.9	<0.9	0.9	<0.9
Chromium	ug/g	11.8	12.1	11.7	11.2	11.4	12.6
Cobalt	ug/g	6.2	6.7	6.9	7.5	6.9	6
Copper	ug/g	11.7	13.2	11.8	14.4	11.5	12.1
Lead	ug/g	14.4	19	16.4	17.1	16.9	17.5
Lithium	ug/g	8.1	8.5	8.4	7.1	5.4	8.5
Mercury	ug/g	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7
Molybdenum	ug/g	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Nickel	ug/g	13	13.7	14	14.3	15.2	15
Selenium	ug/g	<10.2	<10.2	<10.2	<10.2	<10.2	<10.2
Silver	ug/g	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Antimony	ug/g	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5
Tin	ug/g	<5.8	<5.8	<5.8	<5.8	<5.8	<5.8
Strontium	ug/g	19.2	18.6	15.4	13.9	14.4	12.3
Thallium	ug/g	<28	<28	<28	<28	<28	<28
Vanadium	ug/g	20.1	19.1	20.1	22.3	15.4	15.9
Zinc	ug/g	51.3	55.1	55.3	100.9	55.3	57.8

Table E1. Continued

		Sampling Location							
Elements	Units	Swan 14 Top	Swan 14 Bottom	Swan 15 Top	Swan 15 Bottom	Swan 19 Top	Swan 19 Bottom	Swan 20 Top	Swan 20 Bottom
Aluminum	%	1.17	1.21	0.97	1.14	0.8	1.03	1.04	1.27
Calcium	%	1.2	0.94	0.84	0.87	1.48	1.22	1.16	1.43
Iron	%	1.51	1.6	1.37	1.53	1.23	1.54	1.42	1.53
Magnesium	%	0.33	0.33	0.31	0.32	0.26	0.31	0.3	0.34
Maganese	ug/g	468	362	610	385	530	468	790	357
Phosphorus	ug/g	465	380	493	468	415	435	501	370
Potassium	%	0.11	0.11	0.1	0.1	0.08	0.09	0.1	0.12
Silicon	%	0.11	0.11	0.13	0.07	0.08	0.09	0.11	0.12
Sodium	ug/g	69.9	80.5	59.8	65	58.5	66.3	95.4	75.3
Sulfur	ug/g	317	1613	209	971	293	616	201	930
Titanium	ug/g	76.6	96.4	69.8	79.7	96.7	107.5	81.7	75.1
Arsenic	ug/g	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5
Barium	ug/g	91	104.3	80.2	92.4	81.6	96.4	96	100.5
Boron	ug/g	2.6	<2.5	<2.5	2.8	2.5	<2.5	3.5	2.6
Beryllium	ug/g	0.63	0.73	0.52	0.62	0.42	0.68	0.57	0.62
Bismuth	ug/g	<11	<11	<11	<11	<11	<11	<11	<11
Cadmium	ug/g	1.1	<0.9	1	<0.9	<0.9	<0.9	<0.9	0.9
Chromium	ug/g	12.4	13	11	12.5	9.5	11.2	11.4	13.6
Cobalt	ug/g	7	7	6.7	6.8	5.9	7	6.8	7.3
Copper	ug/g	13.9	15.6	12.6	14.5	11.2	14.2	12.4	14.7
Lead	ug/g	15	18.7	14.7	16.1	13.9	17.8	15.7	19.9
Lithium	ug/g	9.9	10.2	8.7	9.6	6.5	7.7	8.7	11.2
Mercury	ug/g	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7
Molybdenum	ug/g	<0.9	<0.9	<0.9	<0.9	<0.9	0.9	<0.9	<0.9
Nickel	ug/g	15.4	17	14.8	16.9	11.6	15.8	13.9	16.9
Selenium	ug/g	<10.2	<10.2	<10.2	<10.2	<10.2	<10.2	<10.2	<10.2
Silver	ug/g	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Antimony	ug/g	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5
Tin	ug/g	<5.8	<5.8	<5.8	<5.8	<5.8	<5.8	<5.8	<5.8
Strontium	ug/g	21.7	21.4	16.5	18.8	23.9	24.3	22.1	27.9
Thallium	ug/g	<28	<28	<28	<28	<28	<28	<28	<28
Vanadium	ug/g	19.3	20.8	16.8	21.8	16.4	21.5	17.5	20.7
Zinc	ug/g	58.1	64.6	54.2	60.7	43.3	54.9	55.3	62.5

Table E1. Concluded

		Sampling Location						
Elements	*Units*	*Stump 23 Top*	*Stump 23 Bottom*	*Stump 24 Top*	*Stump 24 Bottom*	*Stump 25 Top*	*Stump 25 Bottom*	*Minimum detection limit*
Aluminum	%	0.82	0.83	1.12	0.96	1.02	0.93	0.001
Calcium	%	1.46	0.48	1.05	0.96	0.91	0.44	0.004
Iron	%	1.31	1.23	1.68	1.42	1.59	1.32	0.001
Magnesium	%	0.3	0.22	0.33	0.27	0.3	0.23	0.001
Maganese	ug/g	585	260	803	303	690	255	0.1
Phosphorus	ug/g	544	383	573	494	627	335	21
Potassium	%	0.08	0.08	0.1	0.08	0.1	0.08	0.002
Silicon	%	0.07	0.04	0.12	0.07	0.06	0.05	0.007
Sodium	ug/g	58.7	54	67.6	62	63.7	61.6	4.7
Sulfur	ug/g	407	645	421	669	464	486	16
Titanium	ug/g	77.2	93.3	93.4	76.8	86.7	84.1	0.5
Arsenic	ug/g	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5	7.5
Barium	ug/g	85.6	83	105.6	102.7	104.3	92.7	0.15
Boron	ug/g	4	<2.5	2.6	<2.5	2.9	<2.5	2.5
Beryllium	ug/g	0.53	0.54	0.69	0.69	0.73	0.75	0.12
Bismuth	ug/g	<11	<11	<11	<11	<11	<11	11
Cadmium	ug/g	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	0.9
Chromium	ug/g	9.3	10.1	11.7	11.7	11.1	10.8	0.6
Cobalt	ug/g	6.4	6	7.3	7.4	7.3	7	0.5
Copper	ug/g	12.9	13.6	14.7	16.5	15.1	14.5	0.4
Lead	ug/g	15	16.9	16.3	18.8	18.9	18.9	4
Lithium	ug/g	6.9	7.1	9	7.7	8.2	7.5	0.6
Mercury	ug/g	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	1.7
Molybdenum	ug/g	1.9	<0.9	1	<0.9	<0.9	<0.9	0.9
Nickel	ug/g	13.2	14.9	17.3	18.4	14.5	18.6	2.5
Selenium	ug/g	<10.2	<10.2	<10.2	<10.2	<10.2	<10.2	10.2
Silver	ug/g	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.3
Antimony	ug/g	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	15.5
Tin	ug/g	<5.8	<5.8	<5.8	<5.8	<5.8	<5.8	5.8
Strontium	ug/g	23.8	12	20.8	19.4	19	12.8	0.2
Thallium	ug/g	<28	<28	<28	<28	<28	<28	28
Vanadium	ug/g	17	16.4	21.4	20	20	16.1	0.7
Zinc	ug/g	50.5	50.2	65.7	62.3	60.4	57.9	0.4

Table E2. Inorganic Chemical Composition Analysis of Sediment Cores by the ISGS Lab

		Analysis Number/Lake, Depth Interval						
Elements	*Units*	*R20145/ Meredosia Top*	*R21046/ Meredosia Bottom*	*R20049/ Meredosia 0-5*	*R20050/ Meredosia 15-20*	*R20051/ Meredosia 30-35*	*R20052J Meredosia 45-50*	*R20053/ Meredosia 60-63*
Total Carbon	%	3.69	3.19	3.65	2.99	2.74	2.67	2.83
Inorganic Carbon	%	1.00	0.61	0.92	0.67	0.55	0.42	0.41
Organic Carbon	%	2.69	2.58	2.73	2.32	2.19	2.25	2.42
Aluminum Oxide	%	15.09	15.85	14.91	15.43	15.85	15.61	16.16
Calcium Oxide	%	5.24	3.72	5.02	3.83	3.21	2.45	2.42
Iron Oxide	%	6.56	6.66	6.61	6.68	6.96	6.62	7.15
Magnesium Oxide	%	1.95	1.90	1.89	1.85	1.84	1.74	1.81
Manganese Dioxide	%	0.24	0.13	0.21	0.12	0.13	0.11	0.12
Phosphorus	%	0.32	0.26	0.34	0.30	0.27	0.20	0.22
Potassium Oxide	%	2.44	2.54	2.52	2.58	2.62	2.52	2.64
Silicon Dioxide	%	53.79	56.37	54.44	56.35	56.91	54.04	57.42
Sodium Oxide	%	0.50	0.50	0.52	0.54	0.54	0.49	0.52
Sulfur Trioxide	%	0.16	0.45	0.21	0.42	0.46	0.41	0.45
Titanium Oxide	%	0.70	0.73	0.71	0.72	0.75	0.71	0.76
Barium	ppm	567	544	604	632	637	659	659
Barium (1)	ppm	638	652	664	680	686	729	721
Beryllium (3)	ppm	NA	NA	2.7	2.6	3.2	2.1	1.6
Boron (3)	ppm	NA	NA	39	48	41	42	44
Cadmium	ppm	2	4	4	6.0	2.0	3	2
Cadmium (2)	ppm	<1.6	<1.6	<3	<3	<3	<3	<3
Chromium	ppm	91	81	112	89	111	80	90
Copper	ppm	36	39	36	37	36	35	33
Copper (2)	ppm	37	41	26	30	30	30	32
Lead	ppm	36	41	36	40	37	32	35
Lead (2)	ppm	<24	<24	<50	<50	<50	<50	<50
Lead (3)	ppm	NA	NA	36	42	50	31	32
Lithium (2)	ppm	44	45	45	42	46	47	48
Molybdenum	ppm	<2	2	1	2	3	1	1
Molybdenum (1)	ppm	7	9	22	22	22	19	16
Molybdenum (3)	ppm	NA	NA	<10	11	10	<10	10
Nickel	ppm	50	49	61	51	61	47	49
Nickel (2)	ppm	24	29	21	34	34	34	34
Niobium	ppm	18	17	15	16	16	16	17
Rubidum	ppm	126	130	124	128	130	138	134
Silver (3)	ppm	NA	NA	<1	<1	<1	<1	<1
Strontium	ppm	118	107	124	117	111	106	105
Strontium (1)	ppm	113	109	124	115	118	109	106
Thallium (3)	ppm	NA	NA	<1	1	1	1	<1
Tin	ppm	<1	1	<5	<5	<5	<5	<5
Tin(1)	ppm	6	6	10	10	9	9	9
Vanadium	ppm	122	129	115	123	122	133	130
Vanadium (3)	ppm	NA	NA	169	202	191	250	249
Zinc	ppm	164	169	163	167	170	164	161
Zinc (2)	ppm	164	173	162	161	165	166	166
Zirconium	ppm	183	187	157	155	156	154	161
Zirconium (1)	ppm	147	150	197	194	196	192	205

Table E2. Continued

		Analysis Number/Lake, Depth Interval							
Elements	*Units*	*R20157/ Swan 14, Top*	*R20158/ Swan 15, Top*	*R20159/ Swan 16, Top*	*R20160/ Swan 19, Top*	*R20155/ Swan 20, Top*	*R20156/ Swan 20, Btm*	*R20076/ Swan 20, 0-5*	*R20077/ Swan 20, 15-20*
Total Carbon	%	3.03	2.58	2.66	2.68	2.93	2.56	2.77	2.83
Inorganic Carbon	%	0.72	0.51	0.51	0.88	0.74	0.78	0.54	0.92
Organic Carbon	%	2.31	2.07	2.15	1.80	2.19	1.78	2.23	1.91
Aluminum Oxide	%	14.96	13.97	14.08	12.72	14.25	14.63	14.10	14.04
Calcium Oxide	%	4.02	2.90	2.91	4.73	4.08	4.38	3.18	5.20
Iron Oxide	%	6.18	5.63	5.68	5.05	5.96	6.09	5.93	5.98
Magnesium Oxide	%	1.80	1.72	1.72	1.48	1.71	1.72	1.65	1.70
Manganese Dioxide	%	0.14	0.18	0.16	0.16	0.22	0.13	0.217	0.13
Phosphorus	%	0.26	0.26	0.26	0.22	0.27	0.22	0.29	0.25
Potassium Oxide	%	2.36	2.40	2.41	2.23	2.32	2.38	2.34	2.36
Silicon Dioxide	%	57.39	61.76	61.49	61.80	58.76	58.28	60.00	57.05
Sodium Oxide	%	0.60	0.75	0.72	0.84	0.66	0.65	0.93	0.87
Sulfur Trioxide	%	0.16	0.15	0.12	0.17	0.15	0.28	0.14	0.24
Titanium Oxide	%	0.74	0.77	0.78	0.71	0.74	0.76	0.75	0.73
Barium	ppm	552	541	521	579	571	594	598	586
Barium (1)	ppm	616	615	612	579	681	631	685	645
Beryllium (3)	ppm	NA	NA	NA	NA	NA	NA	2.1	2.3
Boron (3)	ppm	NA	NA	NA	NA	NA	NA	40	42
Cadmium	ppm	1	3	1	<2	2	<2	2	1
Cadmium (2)	ppm	<1.5	<1.6	<1.6	<1.7	<1.6	<1.6	<3	<3
Chromium	ppm	76	77	71	62	76	80	76	72
Copper	ppm	32	30	30	26	29	34	40	36
Copper (2)	ppm	43	30	32	32	34	34	25	21
Lead	ppm	33	28	28	29	33	36	33	33
Lead (2)	ppm	<23	<25	<24	<25	<24	<24	<51	<49
Lead (3)	ppm	NA	NA	NA	NA	NA	NA	33	32
Lithium (2)	ppm	42	38	37	29	38	41	38	38
Molybdenum	ppm	<5	<5	<5	1	<2	<2	1	<1
Molybdenum (1)	ppm	<2	<2	<2	<2	<5	<5	18	18
Molybdenum (3)	ppm	NA	NA	NA	NA	NA	NA	<10	<10
Nickel	ppm	42	44	43	36	40	52	44	49
Nickel (2)	ppm	28	17	14	14	19	25	23	21
Niobium	ppm	18	18	18	17	18	18	17	16
Rubidum	ppm	116	110	110	95	109	113	110	111
Silver (3)	ppm	NA	NA	NA	NA	NA	NA	<1	<1
Strontium	ppm	112	109	109	138	120	126	124	137
Strontium (1)	ppm	112	114	112	131	115	125	127	136
Thallium (3)	ppm	NA	NA	NA	NA	NA	NA	<1	<1
Tin	ppm	<1	<1	<1	<1	<5	<5	<5	<5
Tin (1)	ppm	<5	<5	<5	<5	<5	<5	7	8
Vanadium	ppm	123	116	119	104	116	125	118	116
Vanadium (3)	ppm	NA	NA	NA	NA	NA	NA	127	146
Zinc	ppm	140	130	129	106	136	142	137	138
Zinc (2)	ppm	153	137	138	116	143	151	137	136
Zirconium	ppm	182	223	223	229	194	194	217	191
Zirconium (1)	ppm	227	280	277	261	304	230	262	236

Table E2. Continued

		Analysis Number/Lake, Depth Interval							
		R20078	*R20079*	*R20080*	*R20147*	*R20148*	*R20081*	*R20082*	*R20083*
		Swan 20	*Swan 20*	*Swan 20*	*Silver*	*Silver*	*Silver*	*Silver*	*Silver*
Elements	*Units*	*30-35*	*40-45*	*50-54*	*Top*	*Btm*	*0-5*	*10-15*	*25-30*
Total Carbon	%	2.50	2.49	2.55	2.94	2.00	3.02	2.52	2.12
Inorganic Carbon	%	0.82	0.76	0.57	0.25	0.19	0.25	0.18	0.21
Organic Carbon	%	1.68	1.73	1.98	2.69	1.81	2.77	2.34	1.91
Aluminum Oxide	%	14.47	15.57	15.23	14.52	13.51	14.14	14.4	13.64
Calcium Oxide	%	4.15	3.94	3.31	1.86	1.54	1.9	1.49	1.53
Iron Oxide	%	6.07	6.13	6.57	5.92	5.10	5.79	5.71	5.36
Magnesium Oxide	%	1.64	1.61	1.63	1.54	1.48	1.49	1.51	1.44
Manganese Dioxide	%	0.11	0.10	0.077	0.26	0.09	0.198	0.109	0.102
Phosphorus	%	0.24	0.26	0.2	0.27	0.21	0.27	0.26	0.22
Potassium Oxide	%	2.38	2.42	2.47	2.24	2.37	2.27	2.35	2.35
Silicon Dioxide	%	58.77	59.01	58.49	61.61	66.33	62.06	63.36	66.2
Sodium Oxide	%	0.86	0.91	0.84	0.74	0.87	0.99	1.02	1.08
Sulfur Trioxide	%	0.35	0.40	0.43	0.09	0.08	0.16	0.16	0.08
Titanium Oxide	%	0.75	0.76	0.77	0.78	0.81	0.77	0.8	0.8
Barium	ppm	607	615	608	632	614	641	592	631
Barium (1)	ppm	674	704	706	694	675	717	692	703
Beryllium (3)	ppm	1.9	1.9	2.4	NA	NA	2.4	2.4	2.3
Boron (3)	ppm	41	40	42	NA	NA	42	45	53
Cadmium	ppm	4	2	3	<2	2	<1	<1	<1
Cadmium (2)	ppm	<3	<3	<3	<1.5	<1.6	<3	<3	<3
Chromium	ppm	78	77	80	78	80	83	76	79
Copper	ppm	44	52	87	29	28	31	33	37
Copper (2)	ppm	28	26	31	29	32	26	25	24
Lead	ppm	37	37	39	30	36	29	29	35
Lead (2)	ppm	<51	<51	<51	<23	<25	<51	<51	<51
Lead (3)	ppm	24	23	41	NA	NA	30	30	30
Lithium (2)	ppm	38	41	41	39	35	38	37	36
Molybdenum	ppm	<1	<1	<1	<2	<2	<1	<1	<1
Molybdenum (1)	ppm	18	11	11	10	10	12	11	10
Molybdenum (3)	ppm	<10	<10	<10	NA	NA	<10	<10	<10
Nickel	ppm	47	49	48	40	42	93	42	48
Nickel (2)	ppm	28	40	35	23	22	22	28	25
Niobium	ppm	17	18	19	18	19	18	20	19
Rubidum	ppm	116	115	121	111	107	110	111	108
Silver (3)	ppm	<1	<1	<1	NA	NA	<1	<1	<1
Strontium	ppm	133	127	116	106	108	113	107	112
Strontium (1)	ppm	135	129	115	107	110	116	114	114
Thallium (3)	ppm	<1	<1	<1	NA	NA	2	1	1
Tin	ppm	<5	<5	<5	1	<5	<1	<1	<1
Tin(1)	ppm	7	9	9	6	5	11	9	9
Vanadium	ppm	121	121	128	118	112	116	117	110
Vanadium (3)	ppm	159	120	141	NA	NA	127	130	151
Zinc	ppm	145	148	146	130	134	131	129	136
Zinc (2)	ppm	143	147	144	131	142	129	129	141
Zirconium	ppm	195	192	173	201	234	210	223	234
Zirconium (1)	ppm	241	252	222	252	304	266	287	298

Table E2. Continued

		Analysis Number/Lake, Depth Interval							
Elements	*Units*	*R20084/ Silver, 40-45*	*R20085/ Silver, 50-54*	*R20149/ Stump, Top*	*R20150/ Stump, Btm*	*R20104/ Stump, 0-5*	*R20105/ Stump, 10-15*	*R20106/ Stump, 20-25*	*R20107/ Stump, 30-35*
Total Carbon	%	2.06	3.24	3.53	4.31	3.3	3.26	3.6	4.2
Inorganic Carbon	%	0.37	0.43	0.56	0.43	0.62	0.58	0.34	0.46
Organic Carbon	%	1.69	2.81	2.97	3.88	2.68	2.68	3.26	3.74
Aluminum Oxide	%	13.35	14.39	15.92	15.38	14.93	14.87	15.75	15.09
Calcium Oxide	%	2.03	2.56	3.43	3.07	3.31	3.28	2.36	3.02
Iron Oxide	%	5.14	5.87	6.76	6.07	6.61	6.12	6.51	6.17
Magnesium Oxide	%	1.52	1.57	1.84	1.66	1.66	1.65	1.68	1.53
Manganese Dioxide	%	0.104	0.111	0.22	0.09	0.15	0.09	0.09	0.09
Phosphorus	%	0.28	0.28	0.30	0.23	0.30	0.20	0.26	0.24
Potassium Oxide	%	2.44	2.4	2.53	2.39	2.50	2.50	2.54	2.46
Silicon Dioxide	%	65.2	61.11	59.79	56.78	58.45	59.50	57.93	58.09
Sodium Oxide	%	1.16	0.93	0.62	0.55	0.62	0.61	0.52	0.59
Sulfur Trioxide	%	0.23	0.53	0.23	0.30	0.28	0.45	0.55	0.40
Titanium Oxide	%	0.8	0.78	0.79	0.75	0.76	0.78	0.77	0.75
Barium	ppm	551	593	581	603	593	588	616	583
Barium (1)	ppm	671	697	660	652	660	662	690	643
Beryllium (3)	ppm	2.7	2.8	NA	NA	1.6	2.2	3.3	3.2
Boron (3)	ppm	61	57	NA	NA	52	49	82	76
Cadmium	ppm	<1	<1	<2	1	1	3	<1	1
Cadmium (2)	ppm	<3	<3	<1.5	<1.5	<1.5	<1.6	<1.6	<1.6
Chromium	ppm	74	78	79	81	79	78	80	87
Copper	ppm	37	36	32	38	39	34	37	37
Copper (2)	ppm	32	34	34	38	39	34	37	37
Lead	ppm	34	42	32	39	35	32	40	38
Lead (2)	ppm	<51	<51	<23	<23	<27	<27	<28	<27
Lead (3)	ppm	30	38	NA	NA	37	41	37	41
Lithium (2)	ppm	36	37	43	44	46	43	47	45
Molybdenum	ppm	<1	<1	1	1	1	2	2	1
Molybdenum (1)	ppm	10	18	9	8	8	5	<5	7
Molybdenum (3)	ppm	<10	<10	NA	NA	<10	<10	11	<10
Nickel	ppm	49	46	43	50	45	43	45	52
Nickel (2)	ppm	37	28	26	31	22	29	26	34
Niobium	ppm	18	19	19	19	18	18	19	17
Rubidum	ppm	106	114	119	123	120	120	130	124
Silver (3)	ppm	<1	<1	NA	NA	<1	<1	<1	<1
Strontium	ppm	114	112	111	110	112	114	106	112
Strontium (1)	ppm	116	117	107	104	109	112	97	107
Thallium (3)	ppm	1	<1	NA	NA	4	2	2	1
Tin	ppm	<1	<1	<1	<1	<2	<2	<2	<2
Tin(1)	ppm	9	8	<5	<5	7	7	8	8
Vanadium	ppm	111	122	123	129	121	125	130	124
Vanadium (3)	ppm	152	138	NA	NA	135	152	176	113
Zinc	ppm	143	146	143	154	168	143	156	151
Zinc (2)	ppm	140	148	147	156	173	143	161	157
Zirconium	ppm	241	204	174	199	178	186	169	187
Zirconium (1)	ppm	304	256	218	223	219	232	202	228

Table E2. Continued

		Analysis Number/Lake, Depth Interval							
Elements	*Units*	*R20108/ Stump, 40-45*	*R20109/ Stump, 50-55*	*R20153/ Quincy-1, Top*	*R20154/ Quincy-1, Btm*	*R20054/ Quincy-1, 0-5*	*R20055/ Quincy-1, 15-20*	*R20056/ Quincy-1, 30-35*	*R20057/ Quincy-1, 45-50*
Total Carbon	%	3.25	1.62	2.55	2.15	2.41	2.35	2.15	2.50
Inorganic Carbon	%	0.04	0.02	0.36	0.19	0.35	0.27	0.25	0.17
Organic Carbon	%	3.21	1.60	2.19	1.96	2.06	2.08	1.90	2.33
Aluminum Oxide	%	15.65	14.30	12.85	13.50	12.44	13.38	12.82	14.88
Calcium Oxide	%	1.09	1.07	2.41	1.73	2.14	1.79	1.66	1.45
Iron Oxide	%	5.85	5.22	4.97	5.06	4.71	5.15	4.84	6.13
Magnesium Oxide	%	1.45	1.28	1.41	1.39	1.36	1.38	1.32	1.47
Manganese Dioxide	%	0.06	0.05	0.17	0.11	0.099	0.11	0.11	0.13
Phosphorus	%	0.20	0.14	0.22	0.24	0.21	0.24	0.24	0.24
Potassium Oxide	%	2.53	2.38	2.16	2.25	2.23	2.28	2.27	2.34
Silicon Dioxide	%	61.36	67.07	65.09	66.07	66.85	65.52	67.33	62.62
Sodium Oxide	%	0.66	0.83	0.90	0.87	0.96	0.91	0.99	0.75
Sulfur Trioxide	%	0.23	0.13	0.14	0.10	0.18	0.17	0.16	0.22
Titanium Oxide	%	0.79	0.81	0.77	0.79	0.78	0.79	0.79	0.79
Barium	ppm	623	570	623	650	650	658	662	695
Barium (1)	ppm	696	633	687	647	704	717	735	745
Beryllium (3)	ppm	3.0	2.5	NA	NA	1.4	3.0	2.6	3.1
Boron (3)	ppm	64	53	NA	NA	54	54	45	50
Cadmium	ppm	<1	<1	<2	2	<5	<5	<5	<5
Cadmium (2)	ppm	<1.6	<1.7	<1.5	<1.6	<3	<3	<3	<3
Chromium	ppm	80	89	67	72	71	90	68	77
Copper	ppm	39	31	24	25	26	27	26	33
Copper (2)	ppm	34	24	25	28	20	18	25	26
Lead	ppm	31	23	26	27	27	28	29	36
Lead (2)	ppm	<29	<30	<23	<23	<50	<50	<48	<50
Lead (3)	ppm	31	32	NA	NA	28	29	23	38
Lithium (2)	ppm	45	39	30	32	28	32	29	39
Molybdenum	ppm	<1	<1	<2	<2	<2	2	3	1
Molybdenum (1)	ppm	9	6	<5	<5	24	27	25	26
Molybdenum (3)	ppm	<10	<10	NA	NA	<10	<10	<10	<10
Nickel	ppm	46	48	35	38	37	44	35	42
Nickel (2)	ppm	25	11	16	24	24	9	15	25
Niobium	ppm	19	20	19	20	18	17	20	18
Rubidum	ppm	128	113	98	103	96	103	99	116
Silver (3)	ppm	<1	<1	NA	NA	<1	<1	<1	<1
Strontium	ppm	104	117	118	113	122	117	116	106
Strontium (1)	ppm	100	109	106	212	121	115	119	105
Thallium (3)	ppm	2	1	NA	NA	<1	<1	<1	<1
Tin	ppm	<2	<2	<1	<1	<5	<5	<5	<5
Tin(1)	ppm	8	8	<5	<5	8	11	10	12
Vanadium	ppm	125	111	103	113	97	110	104	122
Vanadium (3)	ppm	143	172	NA	NA	134	153	137	161
Zinc	ppm	136	106	118	114	116	119	121	148
Zinc (2)	ppm	136	104	125	125	112	116	94	149
Zirconium	ppm	210	303	265	242	255	226	241	199
Zirconium (1)	ppm	258	374	278	236	326	282	305	248

Table E2. Concluded

		Analysis Number/Lake, Depth Interval							
		R20058	*R20151*	*R20152*	*R20098*	*R20099*	*R20100*	*R20101*	*R20102*
		Quincy-1	*Quincy-2*	*Quincy-2*	*Quincy-2*	*Quincy-2*	*Quincy-2*	*Quincy-2*	*Quincy-2*
Elements	*Units*	*60-63*	*Top*	*Btm*	*0-5*	*15-20*	*30-35*	*45-50*	*60-65*
Total Carbon	%	2.03	3.56	2.70	3.26	3.01	2.54	1.81	1.82
Inorganic Carbon	%	0.07	0.70	0.64	0.61	0.82	0.57	0.22	0.1
Organic Carbon	%	1.96	2.86	2.06	2.65	2.19	1.97	1.59	1.72
Aluminum Oxide	%	15.09	13.97	14.59	14.01	14.34	14.89	13.85	15.4
Calcium Oxide	%	1.00	4.01	3.98	3.68	4.48	3.42	1.78	1.18
Iron Oxide	%	5.91	6.17	6.26	6.08	6.02	6.13	5.84	5.99
Magnesium Oxide	%	1.42	1.51	1.57	1.55	1.61	1.59	1.34	1.41
Manganese Dioxide	%	0.09	0.30	0.12	0.234	0.123	0.119	0.111	0.097
Phosphorus	%	0.25	0.36	0.17	0.29	0.18	0.21	0.19	0.21
Potassium Oxide	%	2.36	2.04	2.08	2.09	2.04	2.11	2.18	2.29
Silicon Dioxide	%	59.95	58.01	59.15	58.45	57.91	59.07	64.61	63.42
Sodium Oxide	%	0.67	0.71	0.75	1.05	0.99	1.02	1.16	1.00
Sulfur Trioxide	%	0.06	0.17	0.41	0.23	0.44	0.46	0.44	0.08
Titanium Oxide	%	0.77	0.69	0.74	0.7	0.71	0.74	0.76	0.79
Barium	ppm	732	670	653	684	653	679	685	702
Barium (1)	ppm	780	720	710	757	739	745	777	818
Beryllium (3)	ppm	2.3	NA	NA	2.0	1.6	2.1	2.6	2.4
Boron (3)	ppm	40	NA	NA	46	42	42	46	52
Cadmium	ppm	<5	<2	1	3	<3	2	<3	3
Cadmium (2)	ppm	<3	<1.5	<1.5	<1.6	<1.6	<1.5	<1.7	<1.6
Chromium	ppm	77	76	78	73	74	80	73	82
Copper	ppm	33	29	31	30	33	34	30	29
Copper (2)	ppm	28	30	35	32	33	41	29	30
Lead	ppm	36	32	38	31	35	38	36	28
Lead (2)	ppm	<47	<23	<23	<29	<28	<27	<29	<28
Lead (3)	ppm	33	NA	NA	32	35	32	28	22
Lithium (2)	ppm	38	34	35	33	34	34	32	33
Molybdenum	ppm	1	<2	<2	<2	<2	<2	<2	<2
Molybdenum (1)	ppm	22	7	9	12	16	15	17	12
Molybdenum (3)	ppm	<10	NA	NA	<10	<10	<10	<10	<10
Nickel	ppm	41	41	38	36	43	39	40	40
Nickel (2)	ppm	20	18	23	11	30	23	20	24
Niobium	ppm	18	17	17	18	17	19	18	20
Rubidum	ppm	125	100	105	103	104	108	100	113
Silver (3)	ppm	<1	NA	NA	<1	<1	<1	<1	<1
Strontium	ppm	96	114	119	118	123	117	119	108
Strontium (1)	ppm	97	107	114	112	115	118	119	107
Thallium (3)	ppm	<1	NA	NA	1	<1	<1	1	1
Tin	ppm	<5	<1	2	<5	<5	<5	<5	<5
Tin(1)	ppm	10	<5	<5	<5	6	7	6	8
Vanadium	ppm	133	100	105	116	121	125	114	128
Vanadium (3)	ppm	135	NA	NA	151	160	173	124	153
Zinc	ppm	142	125	129	124	125	129	108	111
Zinc (2)	ppm	143	128	130	138	136	139	118	119
Zirconium	ppm	180	210	230	200	216	208	246	194
Zirconium (1)	ppm	228	236	263	247	272	261	309	247

Appendix F. Sediment Toxicity Data

Table F1. Toxicity Test Results for Water Samples from Meredosia Lake

Sample number, date/time collected	*Sample description*	*% Mortality in sample* *Ceriodaphnia*	*Microtox results (percent light increase or decrease)*
011994-S1 01/19/94 1100	Water sample from Site M-1 in Meredosia Lake	0 at 24 hr 0 at 48 hr	+ 10 at 5 min + 8 at 15 min
011994-S2 01/19/94 1100	Water sample from Site M-2 in Meredosia Lake	0 at 24 hr 0 at 48 hr	- 7 at 5 min -7 at 15 min
011994-S3 01/19/94 1100	Water sample from Site M-3 in Meredosia Lake	0 at 24 hr 0 at 48 hr	+4 at 5 min + 8 at 15 min
011994-S4 01/19/94 1100	Water sample from Site M-4 in Meredosia Lake	0 at 24 hr 0 at 48 hr	-12 at 5 min -9 at 15 min
QC Samples			
Negative control	Laboratory culture water	0 at 24hr 0 at 48 hr	N/A
Positive control 1	2400 ppm NcCI in laboratory culture water	5 at 24 hr 55 at 48 hr	N/A
Positive control 2	Osmotically adjusted Pentachlorophenol	N/A	EC50 = 1.3 ppm at 5 min EC50 = 1.1 ppm at 15 min

Table F2. Toxicity Test Results for Sediment Samples from Meredosia Lake

Sample number, date/time collected	*Sample description*	*% Mortality in sample* *Ceriodaphnia*	*Microtox results (percent light increase or decrease)*
011994-S5 01/19/94 1100	Top sediment from Site M-1 in Meredosia Lake	0 at 24 hr 0 at 48 hr	+ 15 at 5 min + 19 at 5 min
011994-S5 01/19/94 1100	Bottom sediment from Site M-1 in Meredosia Lake	0 at 24 hr 0 at 48 hr	+ 16 at 5 min + 20 at 15 min
011994-S6 01/19/94 1100	Top sediment from Site M-2 in Meredosia Lake	0 at 24 hr 0 at 48 hr	+ 28 at 5 min + 36 at 15 min
011994-S6 01/19/94 1100	Bottom sediment from Site M-2 in Meredosia Lake	0 at 24 hr 0 at 48 hr	+24 at 5 min + 38 at 15 min
011994-S7 01/19/941100	Top sediment from Site M-3 in Meredosia Lake	0 at 24 hr 0 at 48 hr	+ 15 at 5 min +19 at 15 min
011994-S7 01/19/94 1100	Bottom sediment from Site M-3 in Meredosia Lake	0 at 24 hr 0 at 24 hr	+ 22 at 5 min + 35 at 15 min
011994-S8 01/19/94 1100	Top sediment from Site M-4 in Meredosia Lake	0 at 24 hr 0 at 48 hr	+15 at 5 min + 17 at 15 min
011994-S8 01/19/94 1100	Bottom sediment from Site M-4 in Meredosia Lake	0 at 24 hr 0 at 48 hr	+26 at 5 min + 38 at 15 min
QC Samples			
Negative control	Laboratory culture water	0 at 24 hr 0 at 48 hr	N/A
Positive control 1	2400 ppm NaCl in laboratory culture water	5 at 24 hr 55 at 48 hr	N/A
Positive control 2	Osmotically adjusted Pentachlorophenol	N/A	EC50 = 1.5 ppm at 5 min EC50 = 1.0 ppm at 15 min

Table F3. Toxicity Test Results for Water Samples from Quincy Bay

Sample number, date/time collected	*Sample description*	*% Mortality in sample* *Ceriodaphnia*	*Microtox results (percent light increase or decrease)*
020294-S1 02/01/94 1240	Water sample from Site Q-9 in Quincy Bay	0 at 24 hr 0 at 48 hr	+ 18 at 5 min + 30 at 15 min
020294-S1 02/01/94 1500	Water sample from Site Q-10 in Quincy Bay	0 at 24 hr 0 at 48 hr	+11 at 5 min + 27 at 15 min
020294-S3 02/01/94 1040	Water sample from Site Q-5 in Quincy Bay	0 at 24 hr 0 at 48 hr	-10 at 5 min + 2 at 15 min
020294-S4 02/02/94 0900	Water sample from Site Q-11 in Quincy Bay	0 at 24 hr 0 at 48 hr	+ 18 at 5 min + 38 at 15 min
020294-S5 02/02/94 1045	Water sample from Site Q-12 in Quincy Bay	0 at 24 hr 0 at 48 hr	-18 at 5 min -11 at 15 min
QC Samples			
Negative control	Laboratory culture water	0 at 24 hr 0 at 48 hr	N/A
Positive control 1	2400 ppm NaCl in laboratory culture water	80 at 24 hr 95 at 48 hr	N/A
Positive control 2	Osmotically adjusted Pentachlorophenol	N/A	EC50 = 1.6 ppm at 5 min EC50 = 1.0 ppm at 15 min

Table F4. Toxicity Test Results for Sediment Samples from Quincy Bay

Sample number, date/time collected	*Sample description*	*% Mortality in sample* *Ceriodaphnia*	*Microtox results (percent light increase or decrease)*
020294-S6 02/01/94 1240	Top sediment from Site Q-9 in Quincy Bay	0 at 24 hr 10 at 48 hr	+24 at 5 min +46 at 5 min
020294-S6 02/01/94 1240	Bottom sediment from Site Q-9 in Quincy Bay	0 at 24 hr 0 at 48 hr	+20 at 5 min + 41 at 15 min
020294-S7 02/01/94 1500	Top sediment from Site Q-10 in Quincy Bay	0 at 24 hr 0 at 48 hr	+36 at 5 min + 51 at 15 min
020294-S7 02/01/94 1500	Bottom sediment from Site Q-10 in Quincy Bay	0 at 24 hr 0 at 48 hr	+ 33 at 5 min + 52 at 15 min
020294-S8 02/01/94 1040	Top sediment from Site Q-5 in Quincy Bay	0 at 24 hr 5 at 48 hr	+ 26 at 5 min +62 at 15 min
020294-S8 02/01/94 10 40	Bottom sediment from Site Q-5 in Quincy Bay	0 at 24 hr 10 at 24 hr	+22 at 5 min +34 at 15 min
020294-S9 02/02/94 0900	Top sediment from Site Q-11 in Quincy Bay	0 at 24 hr 10 at 48 hr	+ 18 at 5 min + 51 at 15 min
020294-S9 02/02/94 0900	Bottom sediment from Site Q-11 in Quincy Bay	0 at 24 hr 10 at 48 hr	+27 at 5 min + 36 at 15 min
020294-S10 02/02/94 1045	Top sediment from Site Q-12 in Quincy Bay	0 at 24 hr 0 at 48 hr	+22 at 5 min +54 at 15 min
020294-S10 02/02/94	Bottom sediment from Site Q-12 in Quincy Bay	0 at 24 hr 10 at 48 hr	+33 at 5 min + 49 at 15 min
QC Samples			
Negative control	Laboratory culture water	0 at 24 hr 0 at 48 hr	N/A
Positive control 1	2400 ppm NaCl in laboratory culture water	25 at 24 hr 50 at 48 hr	N/A
Positive control 2	Osmotically adjusted Pentachlorophenol	N/A	EC50 = 1.4 ppm at 5 min EC50 = 1.0 ppm at 15 min

Table F5. Toxicity Test Results for Water Samples from Silver and Swan Lakes

Sample number, date/time collected	*Sample description*	*% Mortality in sample*	*Microtox results (percent light increase or decrease)*
		Ceriodaphnia	
021694-S1 02/16/94 0915	Water sample from Site 13 in Silver Lake	0 at 24 hr 5 at 24 hr	- 34 at 5 min - 36 at 15 min
021694-S2 02/16/94 1130	Water sample from Site 14 in Silver Lake	0 at 24 hr 0 at 48 hr	- 31 at 5 min - 32 at 15 min
021694-S3 02/15/94 1230	Water sample from Site 15 in Swan Lake	0 at 24 hr 0 at 48 hr	- 43 at 5 min . - 43 at 15 min
021694-S4 02/15/94 1400	Water sample from Site 19 in Swan Lake	0 at 24 hr 0 at 48 hr	+ 7 at 5 min + 15 at 15 min
021694-S5 02/15/94 1445	Water sample from Site 20 in Swan Lake	0 at 24 hr 0 at 48 hr	-21 at 5 min -14 at 15 min
QC Samples			
Negative control	Laboratory culture water	0 at 24 hr 0 at 48 hr	N/A
Positive control 1	2400 ppm NaCl in laboratory culture water	40 at 24 hr 85 at 48 hr	N/A
Positive control 2	Osmotically adjusted Pentachlorophenol	N/A	EC50 = 1.7 ppm at 5 min EC50 = 1.1 ppm at 15 min

Table F6. Toxicity Test Results for Sediment Samples from Silver and Swan Lakes

Sample number, date/time collected	*Sample description*	*% Mortality in sample* *Ceriodaphnia*	*Microtox results (percent light increase or decrease)*
021694-S6 02/16/94	Top sediment from Site 13 in Silver Lake	0 at 24 hr 0 at 48 hr	+ 28 at 5 min +30 at 15 min
021694-S6 02/16/94	Bottom sediment from Site 13 in Silver Lake	0 at 24 hr 5 at 48 hr	+ 20 at 5 min +27 at 15 min
021694-S7 02/15/94	Top sediment from Site 14 in Silver Lake	0 at 24 hr 0 at 48 hr	+ 58 at 5 min +69 at 15 min
021694-S7 02/15/94	Bottom sediment from Site 14 in Silver Lake	0 at 24 hr 10 at 48 hr	+ 12 at 5 min +24 at 15 min
021694-S8 02/15/94	Top sediment from Site 15 in Swan Lake	0 at 24 hr 0 at 48 hr	+ 53 at 5 min +69 at 15 min
021694-S8 02/15/94	Bottom sediment from Site 15 in Swan Lake	0 at 24 hr 0 48 hr	+ 19 at 5 min +27 at 15 min
021694-S9 02/15/94	Top sediment from Site 19 in Swan Lake	0 at 24 hr 5 at 48 hr	+ 54 at 5 min + 68 at 15 min
021694-S9 02/15/94	Bottom sediment from Site 19 in Swan Lake	0 at 24 hr 0 at 48 hr	+ 25 at 5 min +32 at 15 min
021694-S10 02/15/94	Top sediment from Site 20 in Swan Lake	0 at 24 hr 5 at 48 hr	+ 58 at 5 min +72 at 15 min
021694-S10 02/15/94	Bottom sediment from Site 20 in Swan Lake	0 at 24 hr 0 at 48 hr	+22 at 5 min + 38 at 15 min
QC Samples			
Negative control	Laboratory culture water	0 at 24 hr 5 at 48 hr	N/A
Positive control 1	2400 ppm NaCl in laboratory culture water	50 at 24 hr 95 at 48 hr	N/A
Positive control 2	Osmotically adjusted Pentachlorophenol	N/A	EC50 = 1.1 ppm at 5 min EC50 = 1.3 ppm at 15 min

Table F7. Toxicity Test Results for Water Samples from Stump Lake

Sample number, date/time collected	*Sample description*	*% Mortality in sample* *Ceriodaphnia*	*Microtox results (percent light increase or decrease)*
022294-S1 02/22/94 0845	Water sample from Site 23 in Stump Lake	0 at 24 hr 0 at 48 hr	-21 at 5 min -14 at 15 min
022294-S2 02/22/94 1050	Water sample from Site 24 in Stump Lake	0 at 24 hr 0 at 48 hr	-11 at 5 min - 2 at 15 min
022294-S3 02/22/94 1200	Water sample from Site 25 in Stump Lake	0 at 24 hr 4 at 48 hr	-18 at 5 min - 9 at 15 min
QC Samples			
Negative control	Laboratory culture water	0 at 24 hr 0 at 48 hr	N/A
Positive control 1	2400 ppm NaCl in laboratory culture water	75 at 24 hr 100 at 48 hr	N/A
Positive control 2	Osmotically adjusted Pentachlorophenol	N/A	EC50 = 1.7 ppm at 5 min EC50 = 1.1 ppm at 15 min

Table F8. Toxicity Test Results for Sediment Samples from Stump Lake

		% Mortality in sample	*Microtox results (percent light increase or decrease)*
Sample number, date/time collected	*Sample description*	*Ceriodaphnia*	
022294-S4 02/22/94	Top sediment from Site 23 in Stump Lake	5 at 24 hr 5 at 48 hr	+ 54 at 5 min +66 at 15 min
022294-S4 02/22/94	Bottom sediment from Site 23 in Stump Lake	0 at 24 hr 0 at 48 hr	+ 63 at 5 min +75 at 15 min
022294-S5 02/22/94	Top sediment from Site 24 in Stump Lake	0 at 24 hr 5 at 48 hr	+49 at 5 min + 59 at 15 min
022294-S5 02/22/94	Bottom sediment from Site 24 in Stump Lake	5 at 24 hr 10 at 48 hr	+ 48 at 5 min +59 at 15 min
022294-S6 02/22/94	Top sediment from Site 25 in Stump Lake	5 at 24 hr 5 at 48 hr	+ 44 at 5 min + 57 at 15 min
022294-S6 02/22/94	Bottom sediment from Site 25 in Stump Lake	0 at 24 hr 10 at 24 hr	+ 44 at 5 min + 62 at 15 min
QC Samples			
Negative control	Laboratory culture water	0 at 24 hr 0 at 48 hr	N/A
Positive control 1	2400 ppm NaCl in laboratory culture water	5 at 24 hr 50 at 48 hr	N/A
Positive control 2	Osmotically adjusted Pentachlorophenol	N/A	EC50 =1.5 ppm at 5 min EC50 = 1.2 ppm at 15 min

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