LOVE CANAL REMEDIAL PROJECT
TASK V-C
IMPLEMENTATION OF A LONG-TERM MONITORING PROGRAM

JUNE 1987

FINAL REPORT

prepared by
E.C. JORDAN CO.
for
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SOLID WASTE
ALBANY, NEW YORK

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FOR

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SOLID AND HAZARDOUS WASTE
ALBANY, NEW YORK 12233

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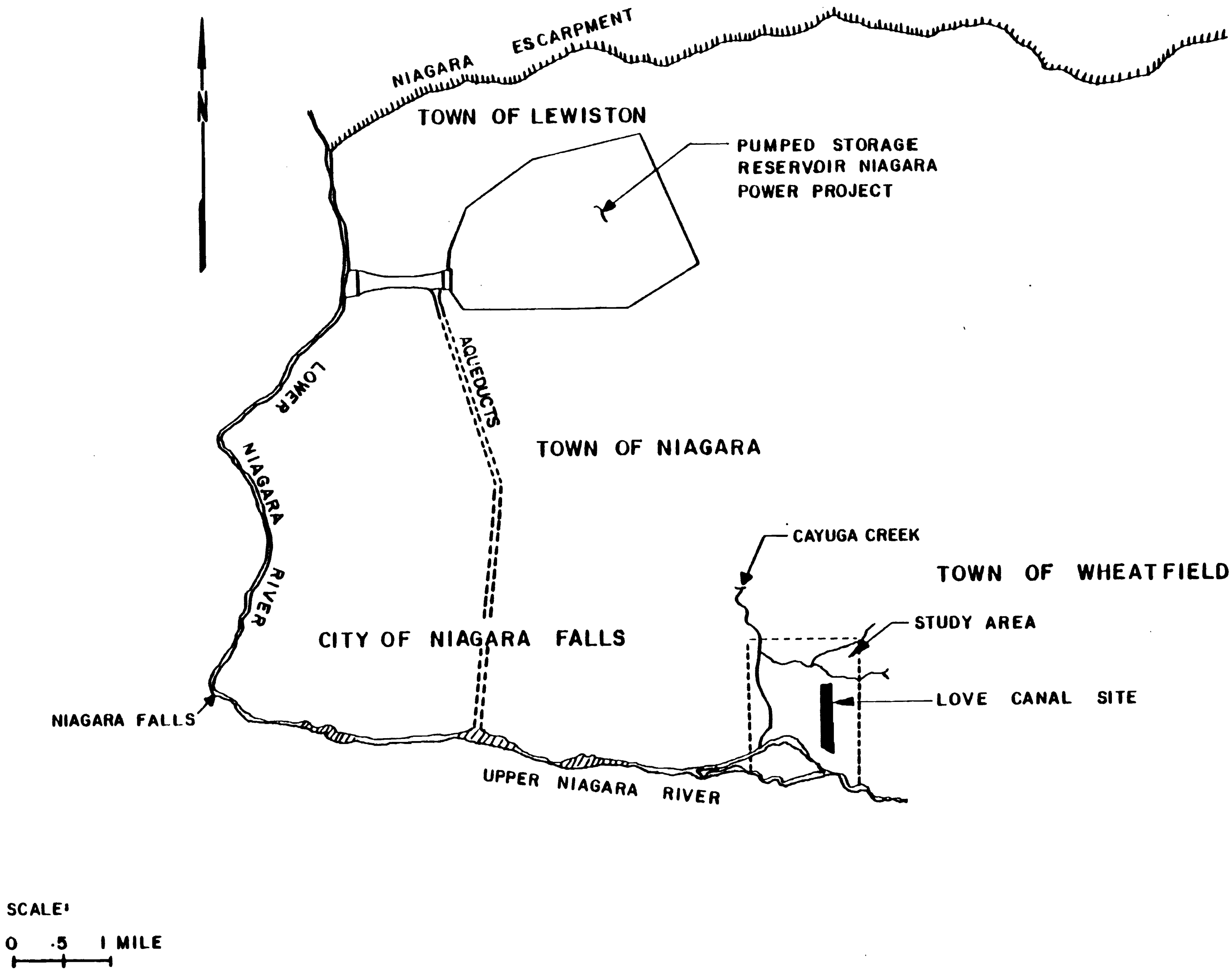
1.0 EXECUTIVE SUMMARY

Task VC of New York State Department of Environmental Conservation (NYSDEC) Love Canal Remedial Project has been performed to provide additional information regarding the geology, hydrogeology, and contaminant distribution at the Love Canal (Canal) site (see Figure 1-1) and to establish a long-term monitoring program for detection of potential migration of contaminants away from the Canal, principally in groundwater. The information and data collected will be used by NYSDEC and others in the evaluation of existing remedial measures, decisions regarding other possible remedial actions, and assessments of risk posed by the contaminants in issues of habitability.

This report describes tasks performed to gather data and establish a long-term monitoring program. It presents the data and interpretations regarding contaminant distribution, potentials for migration, and the effects of remedial measures now in place (e.g., the barrier drain and the expanded cap over the Canal site). Due to the extensive information gathered and compiled and the diverse objectives of Task VC, the information has been divided into three separate reports. This report is the primary one for the project and contains summaries of the other two. The second report is a compilation and description of water quality data generated in the first year of the monitoring program. The third report reviews modifications made to the groundwater model developed for use in Task VB based on additional information gathered in Task VC.



BASE MAP TAKEN FROM EPA "ENVIROMENTAL MONITORING AT LOVE CANAL VOL. I", MAY 1982.

FIGURE 1-1
SITE LOCATION MAP
LOVE CANAL REMEDIAL PROJECT - TASK VC

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NYSDEC contracted the E.C. Jordan Co. (Jordan) and its subcontractors to provide a scope of work which included:

- collection of soil and water samples for chemical analysis;
- making borings to collect geologic information;
- installation of piezometers to collect hydrogeologic data;
- installation of wells to serve as a long-term groundwater monitoring network; and
- presentation and interpretation of information collected.

In addition, NYSDEC provided Jordan with additional data with which to make more complete interpretations of conditions at the site. NYSDEC and Jordan worked together on all aspects of the project. Due to the phased nature of the project, field work was performed in three separate periods beginning in October 1985, and ending in November 1986.

The major accomplishments and findings of Task VC include the following:

- A network of monitoring wells along the perimeter of the Canal has been established in both the overburden soils and in the shallow fractured bedrock to permit long-term monitoring of the groundwater.

- The perimeter of wells appears to be at a distance which is beyond significant migration or presence of Love Canal related chemicals. No dioxin was detected in soils sampled at perimeter well locations.

- The site geology has been more clearly defined. More data has been obtained for the glacial till unit which appears to exhibit a wider range in grain size and permeability than has been previously described.

- Borings were completed in the Canal waste materials, encountering a variety of wastes including non-aqueous phase liquids (NAPL), municipal trash, ash, and chemical sludges.

- The bottom of the Canal was determined at 12 locations along its length and indicated a depth of between 7 to 16 feet below original ground surface.

- Soil samples taken below the wastes in the Canal showed varying degrees of alteration by the emplaced waste, ranging from no visible effects to highly stained and altered clays and silts.

- Records of leachate flow to the treatment plant suggest that the expanded cap has reduced infiltration to the barrier drain system by about 40 percent. Remaining flows to the drain may originate as upward seepage in the vicinity of the drain or from permeable zones which conduct recharge from areas beyond the cap to the drain.

- The barrier drain is exerting a significant influence on the potentials for groundwater flow in the vicinity of the drain. However, the present data base is not extensive enough in time to be able to predict the rate at which this influence will expand or the ultimate range of its influence.

- Hydrogeologic data suggests that the permeability of the glacial till varies over a range of 3.4×10^{-7} to 5.0×10^{-4} cm/sec. Additional installations have been placed to monitor the till in the more permeable areas and also where the till is thicker (in the southeast section of the site).

- Flow directions in the bedrock are apparently quite variable and are influenced by the relative strengths of the factors which control the direction and flow rate--the head of water in the Niagara River and the recharge of the aquifer at the Niagara Escarpment. Present (1986) flow directions to the south-southwest are thought to be dominant, and that the locations of bedrock monitoring wells are appropriate.

- Traces of Love Canal related compounds were detected in samples collected from surface water and sewers. The contaminated sediments in creeks have not been removed yet, and traces of contaminants remaining in sewers is not unexpected. Continued monitoring has been recommended.

- Analysis of samples of sewer backfill materials at five locations indicated significant contamination at only one location, near the intersection of Frontier Avenue and the former 99th Street.

Recommendations for frequency of water sampling and for parameters for analysis have been presented in accordance with interpretations of the present data base. The schedule for monitoring is flexible in that it specifies further analysis for confirmation of contaminants detected and for periodic re-evaluation of the program as well as when any significant changes are instituted at the Canal (e.g., modifications of operating or storage conditions). Recommendations have also been made for continued monitoring of water levels in selected piezometers to observe the expanding influence of the barrier drain and cap on groundwater flow potentials, and also to investigate the sources of remaining flow to the barrier drain.

2.0 INTRODUCTION

2.1 PROGRAM OBJECTIVES

This report presents the results of Task VC, Implementation of a Long Term Monitoring Program, of the Love Canal Remedial Project. Task VC was designed to address four major objectives. These were:

Objective A. To provide information for evaluation of the present and continuing effectiveness of remedial actions including: 1) the existing barrier drain; 2) the synthetic membrane and extended clay cap; and 3) the utility cutoff walls.

Objective B. To provide information for NYSDEC to facilitate implementation of system(s) to assess the present and long term environmental quality of the Love Canal area.

Objective C. To facilitate assessment of the extent of contamination outside the Canal as a result of lateral migration of chemicals through the ground and groundwater.

Objective D. To provide data for NYSDEC to make an evaluation of remedial alternatives including the no action alternative to remediate any contamination identified outside the Canal.

Task VC consisted of 3 phases: Phase I - installation of monitoring systems and collection of samples; Phase II - installation of supplemental monitoring systems, installation of borings and piezometers into the Canal, and analysis of monitoring well samples; and Phase III - additional sampling and analysis and preparation of the first year long term monitoring data report. The original contracted scope of Task VC was modified because of changes in the scope of the Phase II exploration program requested by the United States Environmental Protection Agency (USEPA) and NYSDEC and additional costs resulting from New York State Department of Labor determination that the Task VC program was subject to New York State Public Works Law.

2.2 Phase I

Phase I explorations commenced in September 1985 and continued into the Fall and Winter. Phase I of Task VC included:

1. The installation of 32 long term perimeter monitoring wells around the periphery of the site at a distance estimated, on the basis of available information, to be beyond the present apparent limit of migration of chemicals from the Canal;

2. Installation of 52 nested piezometers to provide measurements of piezometric heads in the soil units in the vicinity of the barrier drain to evaluate the effects of the barrier drain and recently expanded capping system;

3. Installation of 11 bedrock monitoring wells to investigate for the presence of chemicals or the potential for contaminant migration through the aquifer in the fractured dolomite underlying the site;

4. Review of preliminary geologic and water level data for the purpose of improving the locations for monitoring wells originally proposed. This review of preliminary data formed part of the basis for recommendations of work items for the Phase II (Spring 1986) field activities of Task VC; and

5. A draft interim report of Phase I findings and recommendations for Phase II.

2.3 Phase II

Phase II explorations commenced in April 1986 but were interrupted by labor union interference after approximately 10 days of field work had been completed. Although negotiations failed to resolve these problems, Phase II explorations were recommenced and completed in November 1986. The Phase II work included:

1. The installation of six additional perimeter wells;

2. The installation of 10 additional nested piezometers. These were located in existing nests to provide additional measurement of piezometric heads between the barrier drain and underlying bedrock; in the former swale

where it passed north of Colvin Boulevard; and in the thick sands and fills at the south end of the Canal near Frontier Avenue;

3. Completion of intermediate and shallow bedrock wells (10210B and 10210C, respectively) to complement the deep bedrock monitoring well (10210A) installed at the south end of the Canal in Phase I;

4. Installation of two borings within a former swale which transected the north central section of the Canal to investigate the nature of the fill soils, depth of the swale, and the potential effect upon contaminant migration;

5. Installation of four borings and two piezometers in suspected disposal pits adjacent to the Canal to investigate the depths, materials, and fluid levels within the suspected disposal pits;

6. Installation of 12 Canal borings and 11 piezometers to investigate depth of fill, materials, and fluid level within the former Canal;

7. Installation of a boring and piezometer to investigate alleged berms within the former Canal;

8. Review of the modeling effort conducted for the Task VB project with regard to the new data gathered during the Phase I field work; and

9. Preparation of written reports presenting data gathered, findings regarding the implementation of the long-term monitoring program, and a review of the groundwater model developed in Task VB.

2.4 Phase III

Phase III originally included the gathering and analysis of additional water samples. This phase was deleted to accommodate the influence of increased costs incurred in Phase II due to scope changes and interference of work by the local labor union.

2.5 Project Operation Plans

All proposed work for Superfund sites must be documented in project operations plans which must be approved prior to undertaking work. The project operations plans for the Phase I (1985) and Phase II (1986) program consisted of a work plan, a site specific health and safety plan (HASP), and a Quality Assurance Project Plan (QAPP) for each phase of the Task VC project. The plans, individually drafted for each phase, determined the conduct of all field related operations as well as defining the scope of applicable protocols for subcontracted laboratory work. Additionally, a Health and Safety Plan Addendum, identified as HASP Addendum Appendix I, was added to supplement the Phase I Task VC HASP. The HASP Addendum dealt specifically with health and safety provisions to be in effect during the installation of the Canal wells. Drafts of these documents were submitted to NYSDEC and EPA for review and comment. Modifications to the plans as required for approval by these agencies were made, and final plans were revised and approved prior to the commencement of field activities in October 1985 (Phase I) and May 1986 (Phase II).

3.0 EXPLORATION PROGRAM

3.1 INTRODUCTION

The exploration program at Love Canal consisted of Phase I and Phase II activities. The Phase I exploration program conducted by Jordan consisted of five subtasks:

- o Perimeter Survey;
- o Contaminated Area Borings and Wells;
- o Nested Piezometers;
- o Bedrock Wells; and
- o Survey to locate explorations and obtain well and piezometer elevations.

The Phase II exploration program consisted of the following subtasks:

- o Additional Perimeter Survey Wells;
- o Additional Nested Piezometers;
- o Completion of Bedrock Well Installations;
- o Canal Borings and Piezometers; and
- o Survey to locate and establish elevations for Phase II installations.

Jordan contracted John Mathes and Associates (Mathes) of Columbia, Illinois to make borings, install monitoring wells and piezometers, and excavate test pits as outlined in the Task VC Phase I and Phase II Work Plans. The survey work was subcontracted to E.S. Richards of Williamsville, New York and is discussed in Section 3.9. Excavation of test pits, part of the original project scope, was canceled as a result of increased costs due to the State's ruling that the prevailing wage rates would apply to this project.

Mathes mobilized three drill rigs, drilling tools, decontamination equipment, and personnel to the Love Canal site on October 8, 1985, to join with Jordan personnel and begin Phase I exploration activities. Drilling began on October 10 and continued in 10-day work shifts until December 12, 1985. Demobilization of drill rigs and associated equipment began December 10, 1985, and continued until winter weather conditions forced termination of demobilization operations. Some drums of waste materials, all within the fenced area of the Canal, could not be relocated until the spring.

Mathes mobilized two drill rigs to the site again on April 28, 1986, and began drilling for the Phase II program on April 30, 1986. However, work on the Phase II exploration program was temporarily suspended due to harassment by a local labor union and to await a labor dispute ruling by the State. Unscheduled demobilization of Mathes and Jordan personnel and equipment occurred from May 14 to May 16, 1986.

On November 5, 1986, Mathes mobilized one drill rig and related equipment and personnel to the Love Canal site to complete the Phase II work. Drilling began on November 6 and continued in three work shifts until November 25 when the scheduled Phase II explorations and demobilization were completed.

3.1.1 General Procedures

During Phase I and Phase II exploration programs, a Jordan drilling monitor was assigned to each drill rig. The monitor observed drilling operations, logged the geology of the borehole as observed in split spoon or tube soil sampling, provided sampling criteria for the driller, and assisted in collecting soil samples. In addition, a field operations coordinator was present at the site to assure coordination between drill rigs, adherence to health and safety requirements, adherence to drilling specifications, uniformity in documentation, and adherence to decontamination procedures. NYSDEC also had representatives present during the field operations. Occidental Chemical Corporation (OCC) had representatives present to obtain samples from boreholes adjacent to and into the Canal.

Decontamination of drill rigs and drilling tools, including split spoons, was accomplished with a high pressure steam wash at the equipment decontamination pad located at the south end of Love Canal. Decontamination of small drill tools and soil sampling tools was generally conducted at rig side with the exception of activities related to the Canal wells where equipment was steam cleaned between use. Decontamination procedures used during the exploration program are detailed in the site Health and Safety Plan and HASP Addendum Appendix I, the Quality Assurance Project Plan, and the drilling contract technical specifications.

All drilling fluids, decontamination fluids (no acetone was used for decontamination), and borehole soil cuttings generated during the exploration program were disposed of as outlined in the Health and Safety Plan and drilling contract technical specifications. All solids were drummed, labelled, and placed in storage at Love Canal. Clarified water was discharged to the Love Canal treatment plant collection system.

Ambient air conditions were monitored at all boring locations using an HNU or Photovac TIP photoionization meter. All soil samples taken from boreholes were scanned with a photoionization meter for the presence of volatile organic vapors.

3.2 PERIMETER SURVEY

Twenty borings and twenty monitoring wells were completed at Love Canal and four borings and four monitoring wells were completed at the 93rd Street School during the Phase I perimeter exploration program. Six additional borings and six monitoring wells were completed at the Love Canal site as part of Phase II of the perimeter survey (see Figure 3-1). 845 linear feet of soil drilling and 629 linear feet of well installation were completed during the Phase I and Phase II perimeter survey. Generally, the purposes of these borings and wells were to: 1) identify geologic conditions around the perimeter of Love Canal and at the 93rd Street School; 2) obtain soil samples for laboratory chemical analysis and visual classification; 3) obtain groundwater samples for laboratory chemical analysis; 4) assess the distribution of contaminant migration from the Canal; and 5) establish a network of monitoring wells to be used for long-term monitoring of the groundwater at the perimeter of the Love Canal site.

3.2.1 Borings

The depth of borings made for the perimeter survey ranged from 15 to 36 feet below the ground surface (see Table 3.1 in Appendix B). The soil borings were made with 4.25-inch inside diameter hollow stem augers. Continuous split spoon and/or tube soil samples were taken from the ground surface to the bottom of each boring. Soil sampling was conducted in accordance with the sampling protocols described in the QAPP. Soil samples collected for laboratory chemical analysis were generally collected at two depths: 1) from original ground surface to a depth of two feet; and 2) at the sand/clay interface. Additional soil samples for chemical analysis were collected from the glacial till at locations selected on the basis of elevated HNU readings. Approximately 50 soil samples from these borings were submitted for analysis.

3.2.2 Monitoring Wells

Groundwater monitoring wells were installed in boreholes at all perimeter survey boring locations. A summary of the well installations are presented on Table 3.1. The well screens were generally 10 feet long and sand packs around the screens ranged from 12.0 to 31.0 feet in length, depending on the thickness of the overburden soils. Perimeter wells 7132, 9113, 9118, and 9122 were installed to monitor the till only, while other installations intercept all overburden strata.

3.3 CONTAMINATED AREAS BORINGS AND WELLS

Previous investigations by EPA and Jordan had encountered contamination in soils at or beyond the perimeter fence at the north and south ends of the Canal. The purpose of this subtask was to place monitoring wells at a distance judged to be beyond the extent of known significant contaminant migration. Samples from borings were screened in the field using a gas chromotagraph to aid in proper placement of wells.

Thirteen borings and eight monitoring wells were completed at Love Canal during this subtask. A summary of pertinent boring and well data is presented in Table 3.1. The purposes of the borings and wells were to: 1) further assess the distribution of contamination encountered during the Task VA project; 2) obtain soil samples for field gas chromatograph (GC) screening for volatile organic compounds; 3) obtain soil samples for laboratory chemical analysis; 4) obtain soil samples for visual classification and geologic interpretation; 5) obtain groundwater samples for laboratory chemical analysis; and 6) establish monitoring wells in areas beyond significant chemical contamination (meeting NYSDEC guidance, see Appendix F) to become part of the Long Term Monitoring Program for the Love Canal site.

3.3.1 Borings

The soil borings were made with 4.25-inch inside diameter hollow stem augers. Continuous split spoon and/or split tube soil samples were taken from the ground surface to the bottom of the boring. Selected soil samples from split spoons and/or tubes were screened in the field for volatile organic compounds using a gas chromatograph (GC). If the GC screening did not detect volatile organic contamination, then a well was installed in the borehole. If contaminants were detected at levels exceeding NYSDEC guidance (Appendix F), the borehole was backfilled with a bentonite/cement slurry and a new boring was drilled further away from the Canal and the area of detected contamination.

Three borings were placed near manholes to obtain soil samples from sewer line trench materials in Phase I, and two additional borings were made in Phase II to obtain soils samples from sewer line trench materials. The sewer borings (SB-1, SB-2, SB-4, SB-5, and SB-6) were completed to depths of about 10 feet to provide additional data to assess the potential for migration through the storm sewer line backfill materials. Proposed boring SB-3, located at Frontier Ave. and 101st Street, was canceled because inspection in the field indicated that this location would not yield relevant data. The locations of the completed borings are shown on Figure 3-1. Two soil samples were taken for analysis from each boring, one at mid-depth and the other near the invert elevation of the sewer line as determined by actual inspection and measurement. Additional soil samples were taken if there were visual or photoionization meter indications of the presence of contamination.

3.3.2 Monitoring Wells

Groundwater monitoring wells were installed in boreholes at borings 7161, 8106, 8110, 9130, 9140, 10105, 10115, and 10125. These wells form part of the perimeter monitoring system. A summary of the monitoring well installation data is presented in Table 3.1.

3.4 NESTED PIEZOMETERS

Fifty-two borings with piezometers were completed at the Love Canal site during Phase I. A total of 1,163 linear feet of soil drilling and 1,278 linear feet of piezometer installation was completed for Phase I. The borings and piezometers were completed to: 1) assess piezometric conditions existing within geologic units adjacent to the barrier drain; 2) obtain soil samples for visual classification and geologic interpretation; and 3) obtain soil samples for selection of specimens by Occidental Petroleum Corporation (OCC) for laboratory chemical analysis.

In addition to borings and piezometers installed in Phase I, 11 borings with piezometers were completed at the Love Canal site as part of the Phase II exploration program. The Phase II borings and piezometers were completed to: 1) provide data to allow an interpretation of the ground water gradient adjacent to the barrier drain, particularly between the drain and the underlying bedrock; 2) provide additional groundwater data to evaluate the depth and hydrogeology of the swale north of Colvin Boulevard; and 3) evaluate the potential for groundwater to flow to the barrier drain through the thicker sand and fill deposits encountered south of Frontier Avenue during the Phase I nested piezometer and perimeter exploration program.

3.4.1 Borings

The borings and piezometer nests are identified as 1150 through 1154 series nests, 1170 through 1174 series nests, 1180 through 1184 series nests, and 1190 through 1194 series nests. The borings were designated with an "A", "B", "C", "D" or "E" suffix. Generally this designation indicates the deepest ("A") to the shallowest ("E") boring in a nest. Table 3.1 presents a summary of bore-hole and monitoring well data. The depth of the borings ranged from 7 to 41 feet below ground surface. The soil borings were made with 4.25-inch inside diameter hollow stem augers. Split-spoon samples or five-foot split-tube samples were taken continuously from the ground surface to the bottom of the deep ("A" suffixed) boring in each well nest. Normally no soil sampling was conducted at the "B", "C", "D" or "E" suffixed boring locations. However, additional soil samples were occasionally collected at "B" borings to confirm placement of piezometers in the appropriate geologic formation.

3.4.2 Piezometers

A single piezometer was installed in each borehole at each nested boring location. The piezometers were identified with designations identical to the borings. The deep piezometers ("A") were positioned in glacial till. In general, the ("B") piezometers were positioned in the lower soft silty clay and the "C" piezometers were positioned in the upper stiff silty clay. The "D" piezometer was generally positioned in the upper fractured stiff clay or fill. The well screens and sand pack generally ranged from 1.0 to 1.5 and 2.0 to 2.5 feet in length, respectively. As nearly as possible, particularly within a series, similarly suffixed wells were placed at the same elevation within a geologic stratum to permit relatively direct comparison of piezometric data. This was considered important since the relatively low hydraulic conductivity of the geologic materials would permit significant vertical hydraulic gradients to exist.

Piezometers 1161E, 1171C, 1180C, and 1191C were installed specifically to provide another data point near the barrier drain to facilitate interpretation of the influence of the drain on groundwater flow. Thus, the letter designations do not correspond with the pattern established for the other designations. These piezometers are installed slightly below the respective perimeter drain pipe elevation.

3.5 BEDROCK WELLS

Thirteen bedrock borings with monitoring wells were completed. A summary of pertinent data is presented in Table 3.1. The bedrock borings and wells were completed to: 1) evaluate the hydrogeologic characteristics of the Lockport Dolomite at selected locations both near the soil-rock interface and throughout the dolomite bedrock unit; 2) obtain groundwater samples for laboratory chemical analysis; 3) obtain rock core for visual classification and possible visual identification of potential contamination, particularly non-aqueous phase liquids (NAPL); and 4) become part of the Long-Term Monitoring Program.

3.5.1 Borings

The depth of the bedrock borings ranged from 46 to 222 feet below ground surface. The borings were made with 4-inch inside diameter flush joint casing and standard wash boring techniques. Borings 10210A, 10210B, and 10210C were advanced through overburden soils to bedrock using 6.25-inch inside diameter hollow stem augers. This provided space to facilitate reaming of the bedrock core hole diameter to 4.875 inches. Split-spoon soil samples were taken at 5-foot intervals from ground surface to the bedrock surface. No split-spoon samples were taken from borings 10225B and 10205A. Upon encountering bedrock, the borehole was flushed with clean water and rock coring commenced using clean potable water.

Six shallow bedrock borings (7205, 8210, 9205, 10205, 10220, and 10215) were advanced approximately 15 feet into bedrock using an NX size core barrel, and borings 9210 and 10225C were advanced approximately 30 feet into the bedrock. Multilevel bedrock borings (3 borings per location) were installed at locations 10210 and 10225. The multilevel bedrock borings at locations 10210 and 10225 were designated with an "A", "B", or "C" to indicate a deep, intermediate or shallow boring, respectively. Deep borings 10210A and 10225A were advanced 184 and 181 feet through the Lockport Dolomite to the top of the Rochester Shale, respectively, using an NQ wireline core barrel. Packer tests to determine permeability of the rock, were performed in the deep borings at 50-foot intervals as the borehole was advanced. After completion of coring operations, each multilevel boring was reamed using a tricone drill bit to allow for proper placement of the monitoring wells. Intermediate borings 10210B and 10225B were advanced to 106 and 139 feet into bedrock, respectively, using a tricone bit. No rock core was recovered from the intermediate or shallow borings in the rock well nests.

3.5.2 Monitoring Wells

Groundwater monitoring wells were installed in the bedrock boreholes at all completed boring locations. Pertinent data regarding the well installations are presented in Table 3.1. The depth of the single monitoring wells below ground surface ranged from 44 to 82 feet. The wellscreens were 10 feet long and sand packs around the screens ranged from about 12 to 49 feet in length. Multi-level wells were installed in separate boreholes at locations 10225 (A,B,C,) and 10210 (A, B, C). The well screens were 10 feet long and the sand packs for the multilevel wells ranged from 25 to 44 feet in length. A bentonite pellet seal approximately 2 feet thick was placed in the annular space of each borehole above the sand pack. The remaining annulus above the bentonite pellet seal was filled with bentonite/cement grout.

3.6 CANAL BORINGS AND PIEZOMETERS

Twenty one borings and fifteen piezometers were completed interior to the Love Canal barrier drain system. Specific installation locations consisted of the following:

- o Swale borings (SW-10 and SW-20);
- o Disposal pit borings and piezometers (DP-10 through DP-40);
- o Canal waste borings and piezometers (CW-series); and
- o Berm boring and piezometer (BRM-10).

Three Canal waste borings with piezometers and one swale boring were made during the period April 26 to May 7, 1986. From November 5 to November 26, 1986, an additional seventeen borings were completed and twelve piezometers were installed at various locations along the Canal.

The general objectives of the Canal borings and piezometers were to:

1. Provide fluid level data within the former Canal for use in evaluation of the effectiveness of the barrier drain and capping system;

2. Provide information regarding the nature and integrity of geologic deposits immediately below waste materials to assess the potential for wastes to migrate downward and into the dolomite bedrock; and

3. Provide samples of soils and wastes to allow physical characterization of the materials encountered in the borings.

Borings on the cap covering the Canal required penetration of the 40-mil High Density Polyethylene (HDPE) liner overlying the Canal prior to drilling. The Canal boring locations were provided with HDPE boots to create portals through the liner for the hollow stem augers while otherwise protecting and maintaining the integrity of the liner as shown as Figure 3-2. The installation of the HDPE boots was performed by Secured Landfill Contractors (SLC) of Lockport, New York, prior to beginning the drilling operations.

Boot installation locations were initially selected by NYSDEC from existing plans and in conjunction with Jordan and with concurrence of Occidental Chemical Corporation which had requested to participate in explorations of the Canal. Subsequent to the temporary delay in the Phase II program, examination of aerial photographs by NYSDEC indicated that the Canal was narrower in the South section than the previous maps had indicated. Additional boots were placed 55 feet to the west of the initial locations in the Southern sector to increase the probability of penetrating the Canal. However, the Canal appeared to become very narrow (about 30 feet wide) at the extreme south end and two additional borings, CW-105 and CW-108, were required to locate the Canal in this area. For boots that were not used, the liner was left intact, the boot trimmed to near ground surface and filled with cement.

Boot installations had been prepared at locations CW-100 and CW-110 to provide for pairs of nested piezometers. It was believed that the Canal might have been excavated deeper at the South end and that, if stratification of waste and fill materials was evident, a shallow piezometer at each of these locations might provide valuable information regarding either perched water and/or vertical hydraulic gradients within the waste materials. However, as the Canal did not appear to be overexcavated at these locations, and stratification was

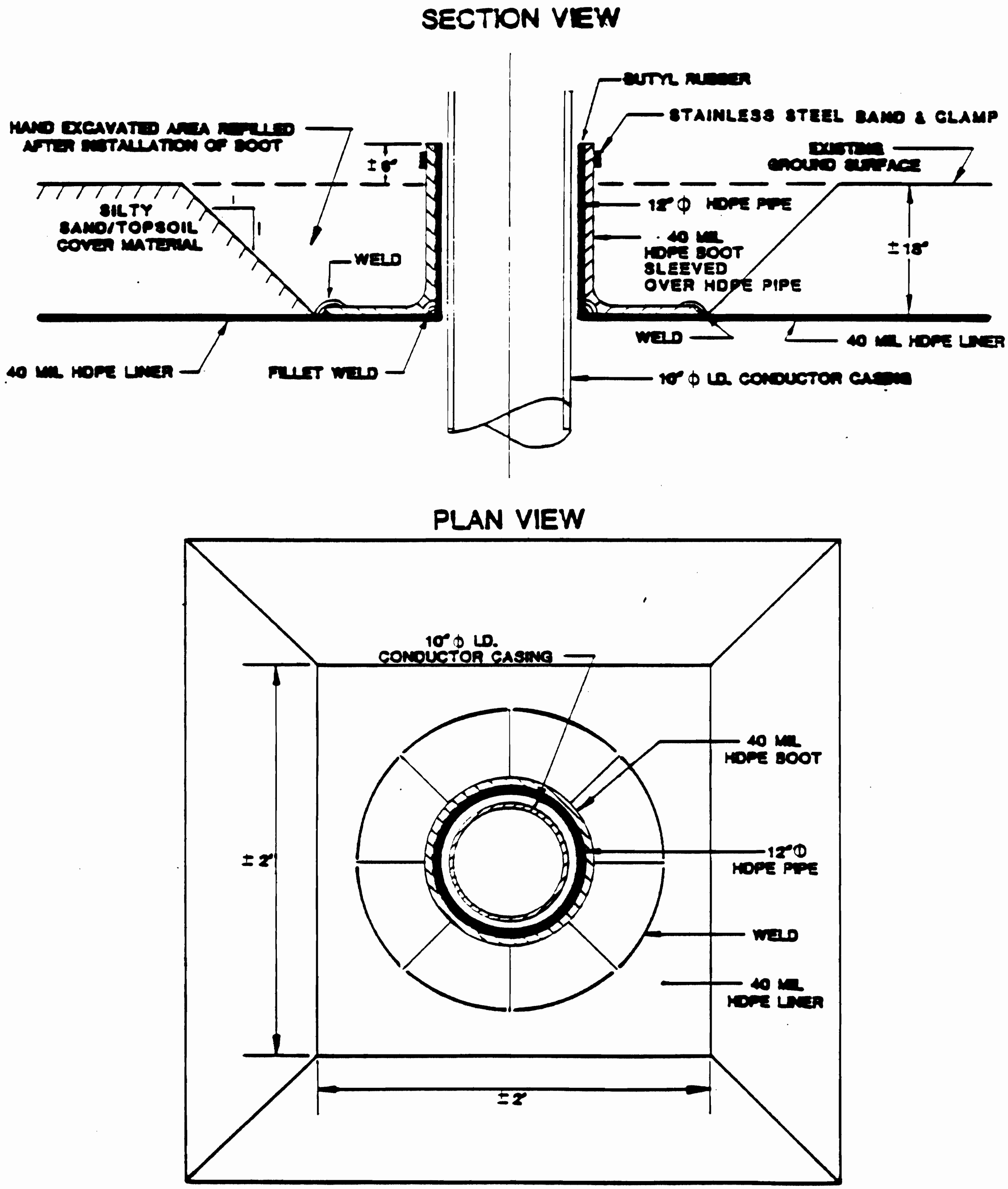

FIGURE 3-2
LINER BOOT INSTALLATION
LOVE CANAL REMEDIAL PROJECT - TASK VC

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not apparent, the proposed shallow piezometers, CW-100B and CW-110B, were not installed.

The area around the boot installation was covered with liner material, plywood, and plastic sheeting to contain potentially contaminated subsurface materials and prevent their contact with the ground surface as shown on Figure 3-3. The boring was made with dedicated 4.25-inch ID hollow stem augers inside the protective 10-inch diameter casing which extended at least 6 inches beneath the liner.

As each Canal boring was advanced, continuous 2-foot long split-spoon samples were collected beginning approximately four feet below the ground surface to the bottom of the borings. The split-spoon samples were logged by a Jordan representative and then released to representatives of OCC, United States Environmental Protection Agency (USEPA) and NYSDEC for geologic logging and collection of samples for future chemical analysis by others.

3.6.1 Swale Borings

Two swale borings, SW-10 and SW-20, were made in an attempt to locate a former drainage swale that traversed the northern end of the Canal (see Figure 3-1). The swale borings were completed to obtain information on the depth of the swale.

Borings SW-10 and SW-20 were 17 and 25 feet in depth, respectively, having been advanced deep enough to confirm undisturbed soils below the fill. Samples of

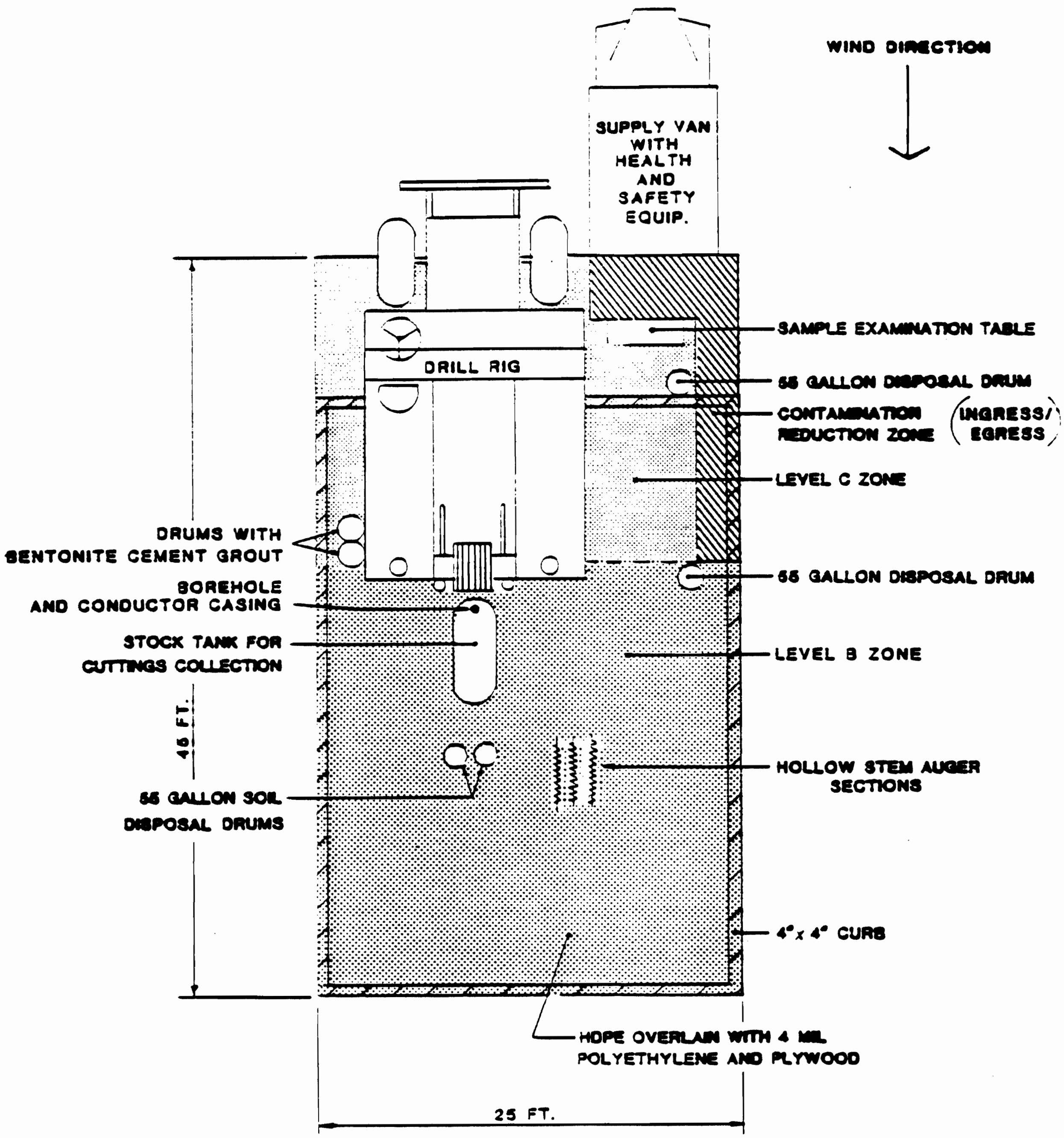

FIGURE 3-3
CANAL INSTALLATION SITE PREPARATION
LOVE CANAL REMEDIAL PROJECT - TASK VC

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soil obtained from the swale borings were collected by representatives of Occidental Chemical Corporation, USEPA and NYSDEC for chemical analysis or reference. Jordan representatives collected a reference sample of the undisturbed soils encountered at the bottom of each swale boring for retention by NYSDEC. Upon completion, two feet of pelletized bentonite was placed in the bottom of each boring and the remainder of the boring was backfilled with bentonite/cement grout.

3.6.2 Disposal Pit Borings and Piezometers

Four disposal pit borings (DP-10, DP-20, DP-30, and DP-40) were made in an attempt to locate suspected separate disposal pits existing outside of the limits of the Canal proper, and, if located, to determine the depth and characteristics of waste materials deposited within the pits. Boring locations are shown on Figure 3-1 and pertinent data presented in Table 3.1.

Piezometers were installed in DP-10 and DP-20. The depths of the piezometers below the ground surface were 26 and 17 feet, respectively. The well screens of each piezometer were one foot long and sand packs ranged from 2 to 3 feet in length. Piezometers were not installed at locations DP-30 or DP-40 since waste materials were not evident at these locations. Borings DP-30 and DP-40 were sealed with approximately two feet of pelletized bentonite and the remainder of the borehole was backfilled with cement/bentonite grout.

3.6.3 Canal Waste Borings and Piezometers

The Canal borings and wells are identified as CW-10, CW-20, CW-30, etc., through CW-90 and CW-100A, CW-105, CW-108, and CW-110A. Locations of the wells are shown on Figure 3-1 and relevant exploration data presented in Table 3.1 (Appendix B). The Canal borings ranged in depth from 17.5 feet to 29.5 feet as measured from the surface of the recently (1984) emplaced cap. In general, soil samples were collected in continuous two-foot intervals. Each Canal boring was terminated upon encountering native undisturbed soils.

Upon completion of the boring, a bentonite pellet seal approximately two feet in thickness was placed at the bottom of the boring. In jar tests, bentonite pellets exhibited swelling even in contact with the NAPL. Possible non-swelling resulting in a poor seal had been a concern. A single well was installed in each borehole location. The wells were identified with the corresponding boring location number. The screen and sand pack of each well was generally positioned entirely within fill materials of the Canal and below the original (pre-1976) ground surface elevation. Well installation data is summarized in Table 3.1 (Appendix B) with detailed logs in Appendix H.

3.6.4 Berm Borings and Piezometers

Two borings and piezometers, BRM-10 and BRM-20, were scheduled to penetrate alleged berms in the Canal. Locations for BRM-10 and BRM-20 were selected from aerial photographs. The purpose of these borings was to characterize and assess the type and condition of soil materials which make up the alleged berms. BRM-10 (see Figure 3-1) was advanced to a depth of 23.5 feet and a piezometer with a 10-foot screen interval and 13-foot long sand pack was installed in the boring. BRM-20 was canceled as the proposed location of BRM-20 did not differ from CW-60 by more than five feet. CW-50, however, appears to have encountered silty clay and clayey silt fill materials its entire depth.

3.7 MONITORING WELL AND PIEZOMETER CONSTRUCTION

Monitoring wells and piezometers installed at Love Canal during the Phase I and Phase II exploration program were constructed using threaded, flush-joint, 2-inch inside diameter, Schedule 5, type 304 stainless steel pipe. Well and piezometer screens installed in the exploration program were stainless steel wire wrap with 0.010-inch wide slot openings. The screened portions of the wells installed in the contaminated area borings, perimeter survey borings (except 7132), Canal piezometers and bedrock borings were 10 feet in length. The screened portions of piezometers installed in the nested borings, DP-20, and CW-110A were one foot in length. Each monitoring well installed in a perimeter survey boring or contaminated area boring was backfilled with silica sand to within approximately five feet of the ground surface and a bentonite pellet seal approximately two feet thick was placed in the borehole annulus above the sand pack.

The annulus of each nested piezometer was backfilled with silica sand to a minimum of one-half foot above the screen section and a bentonite pellet seal approximately two feet thick was placed above the sand pack. The length of the entire sand pack for most nested piezometers was kept to about two feet or less. The remaining annulus was backfilled with bentonite slurry to the ground surface. All shallow bedrock wells were installed in a similar manner as the nested piezometers. The annulus around the deep and intermediate bedrock well screens was backfilled with silica sand to approximately 20 feet above the screened section. The remaining annulus above the sand pack was filled with bentonite slurry tremied into the borehole.

The annulus of each Canal waste piezometer, disposal pit piezometer, and berm piezometer was backfilled with silica sand to a minimum of 0.5 feet above the screened section. A bentonite pellet seal, a minimum of two feet in thickness, was placed above the sand pack. The remaining annular space was filled with bentonite/cement grout.

A protective steel casing with a locking cap was provided for all wells and piezometers installed at Love Canal during the Task VC program. The protective steel casing was sealed about three feet into the ground with premix concrete. Additionally, at well and piezometer locations installed in the NYSDOT LaSalle Expressway right of way, flush to the ground valve boxes were installed over the standard four-inch diameter protective casing. At each Canal boring and piezometer, the bentonite/cement grout was allowed to settle and set up for approximately 24 hours. The Canal borings or piezometers were then completed by filling the remaining annular space to the top of the HDPE boot with premix concrete.

Monitoring wells installed in the perimeter survey, and bedrock explorations were developed to remove fine sediments and to create a good hydraulic connection with the groundwater system. Development of the perimeter survey wells was accomplished by conventional pumping of the wells. The nested piezometers were developed by air lift methods. Development of the bedrock wells was accomplished by both conventional pumping and by air lift methods. Due to the viscous and toxic nature of non-aqueous phase fluids generally encountered in the Canal borings, piezometers installed in Canal waste borings, disposal pit borings, and berm borings, these installations were not developed.

3.8 TEST PITS

Two test pits were scheduled for the Phase I exploration program. These were to be made in "clean" areas beyond the perimeter of the extended clay and synthetic cap for the purpose of observing the structure of the weathered clay. In situ sampling and testing of the weathered clay was to be done if deemed safe and practical. The Phase I test pit program, however, was postponed due to lack of site access clearance and inclement weather conditions. The test pit program was tentatively rescheduled for the Spring 1986, Phase II program. However, the entire test pit program was canceled due to labor problems and budgetary constraints.

3.9 SURVEY

The firm of E.S. Richards (Richards) of Williamsville, New York was subcontracted by Jordan to conduct a survey to determine location and elevation of all explorations completed during the Phase I and Phase II programs. The survey was referenced to a U.S. Geological Survey (U.S.G.S.) benchmark located at the Love Canal treatment plant. The benchmark elevation is 575.86 feet above mean sea level (MSL). Protective casing elevations and monitoring well/piezometer riser elevations were surveyed to the nearest 0.01 foot while ground surface elevation was determined to the nearest 0.1 foot. The horizontal locations of the explorations were initially referenced to an assumed grid system established by the surveyor. The assumed grid system established a baseline defined by masonry nails set by Richards at the intersections of Frontier Avenue and 100th Street and of Colvin Boulevard and 100th Street. Information provided by NYSDEC has permitted the subsequent calculation of location coordinates referred to the New York State coordinate system. Exploration coordinates and elevations are included in Appendix B.

A site plan was prepared by Richards at a scale of 1 inch equals 100 feet on the basis of the survey and base map provided by Jordan and NYSDEC. The site plan shows the location of explorations, roads, the treatment plant, limits of the Love Canal cap, and perimeter fence. Richard's site map (Figure 3-4) is included in a pocket at the end of this report (Appendix G).

4.0 SAMPLING

4.1 INTRODUCTION

Both soil and groundwater samples were collected for chemical analysis during this program. Soil samples were taken to assess the presence of Love Canal related contaminants in soils at each of the locations selected for perimeter well installation. Following the well installation, up to three rounds of groundwater sampling for chemical analysis were conducted through the Contract Laboratory Program (CLP) to establish a data base for the long-term monitoring program.

4.2 SOIL SAMPLING

The initial locations for monitor wells along the perimeter of the Canal were determined by assessing two factors. The first was that contamination was believed not to have migrated further than the security fence along much of the east and west perimeter line. These locations were presumed to be uncontaminated subject to verification by analysis of samples. In other areas, particularly along the north and south ends, where the barrier drain is closer to the fence, no such presumption was made. In areas where contamination was more probable or known to exist from Task VA explorations, a screening procedure was used to determine appropriate initial locations for wells. A boring was installed at the perimeter and soil samples were taken. A gas chromatograph

(GC) was then used to screen the samples for the presence of volatile organic compounds which would tend to be more mobile in the environment than semivolatile organic compounds. When there was an indication of significant contamination, another location for the well was selected at a greater distance from the Canal and the process repeated until acceptable conditions in soils were encountered. Once these conditions were met a boring was made, a well installed, and soil samples collected for analysis by the CLP laboratory as at other locations. This procedure resulted in siting wells 7161, 8106, and 10113 at a greater distance from the Canal than the originally proposed locations nearer the fence.

In areas believed to be uncontaminated, soil samples were obtained at each perimeter well location to assess the presence of Love Canal related contaminants. If the analyses had indicated the presence of such contaminants significantly in excess of NYSDEC guidance (see Appendix F) for the initial placement of the perimeter wells, a new location would have been selected at a greater distance from the Canal. At least two samples were taken at each location, one at the original ground surface and the second at the interface of the fill and fractured clay. It was believed that these intervals would be most likely to show the presence of contamination due to spills or runoff (the surface sample) or by groundwater transport (the deeper sample). If there were indications of contaminants at other depths in a boring, as indicated by elevated PI readings and/or staining of the soil, additional samples were collected for analysis.

In addition, five borings were completed into trench backfill materials of selected sewer lines near the Canal (see Figure 3-1). Samples were taken at mid-depth in the trench and at an elevation equal to the invert of the sewer pipe as determined by measurement in the opened manhole.

The samples were submitted to the CLP laboratory for analysis for HSL organic compounds, including dioxin. The sample identification numbers correspond to the well locations or sewer borings. The results of the analyses are presented in Section 6.3.1.

4.3 WATER SAMPLING

Water samples collected for analysis for the long-term monitoring program data base were primarily of groundwater from the perimeter and other selected monitoring wells. Samples were also taken of selected surface water and sewer locations. Three rounds of sampling and analysis were performed for most perimeter wells (depending on the date of installation). Sampling events took place in: 1) December 1985 and January 1986; 2) April 1986; and 3) November 1986. Three surface water and five sewer samples were collected only during the third sampling event. Samples were also collected for the four monitoring wells installed at the 93rd St. School. These wells have been included as part of the long-term monitoring program although this status may change in the future depending on the outcome of the recent study being conducted there. Samples were sent to the CLP for analysis for HSL volatile, semivolatile, and pesticide/PCB organic compounds.

A detailed description of the long-term monitoring program and the first year data appears in a separate report, "Love Canal Long Term Monitoring Program: First Year Monitoring Data Report" (Jordan, February, 1987). A summary of the assessment of the first year's data from the program appears in Section 6.3.2.

5.0 ANALYSES

Due to the sensitive nature of the site, it was decided that the highest quality data base possible would be required. To meet this need and to increase the number of compounds analyzed for (the priority pollutant list chemicals have been typically analyzed for in environmental samples at the Canal), analysis for hazardous substance list (HSL) compounds was requested by laboratories participating in the USEPA contract laboratory program (CLP) for both soil and water samples.

CompuChem Laboratories (CompuChem) was the analytical subcontractor for the Phase I soil samples and the first round of groundwater samples. Although the data produced by CompuChem was satisfactory, the Phase II analytical subcontract was put out to competitive bid. As a result of the solicitation, Nanco Laboratories (Nanco), the low bidder was awarded the primary analytical subcontract for the Phase II work and the second and third water sampling events. In addition, it was deemed advisable to increase the quality assurance for the project by splitting samples at approximately the ten percent level. CompuChem was awarded the secondary analytical subcontract. This also provided continuity in the data base from the first to subsequent rounds of analysis.

Soil and water were analyzed for HSL volatile, semivolatile, and pesticide/PCB organic compounds according to existing CLP and NYSDEC protocols. Soil samples were also analyzed for the presence of dioxin.

Trip blanks, sampler blanks, duplicates, and replicates were provided as required for quality assurance for water samples through the CLP and NYSDEC protocols. Similarly, duplicates and replicates were provided for the soils samples. These quality control samples complement the internal controls on analytical quality as provided for in the CLP by the participating laboratory.

6.0 EVALUATION

6.1 SITE GEOLOGY

In the discussion of the site geology that follows, thicknesses of and depths to materials in the vicinity of the Canal are taken relative to original ground surface prior to the placement of the cover over the Love Canal site by NYSDEC. With the exception of isolated features, such as drainage swales or mounds of soil, the general topography of the site prior to excavation of the Canal or area development, was between elevations 573 and 575 feet (MSL). A discussion of the regional geology and geologic history has not been included since it would only repeat previous reports (e.g., the Task VB report by Jordan, April 1985). The following section is a discussion of the influence of the newly acquired data on previous interpretations of the site geologic setting. Where recent information either fill previous data gaps or contradict prior interpretations, a more detailed discussion is included.

6.1.1 Fill and Silty Sand

The uppermost soil unit encountered at the site consists of a combination of fill materials and silty sand. As shown in Figure 6-1, the fill material is a relatively thin veneer over a silty sand to sandy silt throughout most of the site area. In general, the fill materials consist of a reworked mixture of sands and silts, with minor amounts of gravel and debris. The fill originated largely from grading operations associated with building construction and subsequent demolition that occurred at the site, and also as backfill materials around underground utilities, foundations, and road subgrades. Additionally, fill materials were apparently placed in former drainage swales of which the major one is shown in Figure 6-2.

Underlying the fill materials, or occasionally exposed at the surface, are fine sands and silts that are probably glacio-fluvial or alluvial in origin. The sands are generally light brown to brown, fine to medium-grained, uniform, and compact. Mottling, caused by seasonal fluctuations in the water table, was observed in some of the sands and silty sands. These deposits range from predominantly clean, fine sands to fine sands with thin (1 to 2mm) horizontal silt laminae.

Generally, the total combined thickness of the fill and silty sand unit ranges from approximately two to six feet (see Figure 6-1). A maximum estimated thickness of eight feet was observed in SW-20, located in the former drainage swale. As shown in Figure 6-1, a significant thickness of materials resulting from the filling of the swale occurs in the shape of an arc in the northern section of the site. Boring 1183A also indicates the swale is approximately eight feet in depth where it crosses Colvin Boulevard. Boring 1183A may have been placed into an excavation for a culvert which formerly existed beneath Colvin Boulevard as part of the swale drainage system (see Figure 6-3). The swale appears to be approximately 5.5 feet in depth where it crosses 100th Street, as indicated by boring 8130. These observations generally agree with historical survey plans of the northern section of the Canal which include cross-sections of the northern sector of the Canal and swale.

6.1.2 Lacustrine Clays and Silts

The lacustrine clays and silts form an apparently continuous layer beneath the fills and silty sands at the Love Canal site. The surface of the top of the clay unit at an average elevation of 568 to 570 feet (MSL), shown on Figure 6-4, is relatively flat. The total estimated thickness of the entire lacustrine unit at the Love Canal site is shown on Figure 6-5. Generally, the thickness of this unit ranges from 12 to 20 feet at the site. A significantly greater thickness of clay, estimated at 20 to 25 feet, was observed in borings at nested piezometer locations 1174 through 1194 (Figure 6-6) which extend in a west to east direction across the northern section of the site near Read Avenue.

The lacustrine clays and silts have been divided into two sub-units - a stiff lacustrine silt and clay, and a soft lacustrine silt and clay - based on soil structure, moisture content, and consistency. The stiff, fractured, and desiccated clay represents the upper weathered portion of the lacustrine deposits and overlies the soft, plastic, and generally massive un-weathered clay and silt. This division is important in that the fractures in the upper subunit present a greater potential for contaminant transport than the softer silts and clays below. This difference in the subunits warrants further discussion.

6.1.2.1 Stiff Clay and Silt. As shown on Figure 6-7, with the exception of some of the Canal boring locations where it has been excavated, a stiff lacustrine clay underlies the fills and silty sands throughout the site area. This clay unit consists of a very stiff to stiff, brown to reddish brown silty clay. The stiff clay is typically dry to slightly moist and well-jointed, displaying a prismatic structure. In many locations, mottling was observed in the upper 2 to 3 feet of the stiff clay unit. Varves, horizontal color bands, are typically observed in this unit. Occasional fine sand and silt horizontal laminations on the scale of 1 to 2 millimeters were observed in the stiff clay unit.

As shown on Figure 6-7, the estimated thickness of the stiff clay is generally five to six feet with a maximum observed thickness of approximately 12 feet. The thickness of the stiff clay appears to be quite uniform throughout the Love Canal site. A slightly greater thickness of stiff clay, approximately six to eight feet, was observed in the vicinity of the nested borings 1174 through 1194. This slightly increased thickness corresponds to an overall increase in the total estimated thickness of the combined clay units, as shown in Figure 6-5.

6.1.2.2 Soft Clay and Silt. The soft lacustrine clay and silt appears to form a continuous layer under the Love Canal site area. This soil unit typically consists of a reddish brown to brown, soft, plastic, silty clay to clay. This unit is generally moist to wet and has a massive structure. Varves are also frequently observed in this lacustrine unit.

The estimated thickness of the soft silts and clays are shown on Figure 6-8. In the site area, the soft clay generally ranges from 8 to 12 feet in thickness. An increased thickness of the soft clay deposits, ranging from 16 to 20 feet, was observed in the vicinity of boring 10215, located at the southwestern end of the Canal, and also in the center of the site between borings 8140, 1193, and 7105 (Figure 6-9).

6.1.3 Glacial Till

The contact between the lacustrine deposits and the glacial till varies from an abrupt change to a gradual transition. The upper transitional portion of the till consists of a silty clay, with gravel, with the silty clay having physical properties similar to the lacustrine clays. Occasionally, this transitional zone is stratified with alternating layers of silty clay and gravelly silty sand. The criteria used to distinguish the till from the lacustrine deposits is the presence of gravel, and a general increase in sand and silt content. The character of the till varies considerably across the Love Canal site. The till unit consists of a reddish-brown to brown silty sand to sandy silt with approximately 10 to 30% gravel. The till is typically widely graded, and varies from dense and only slightly moist to loose and wet. In the northwest quadrant of the site, in the vicinity of 7130 and 7132, the till appears to be stratified, and contains up to 7.5 feet of uniform fine sand. The till at this location is generally loose and quite wet. In contrast, in the southeasterly section of the site, in the vicinity of 9118, 9120 and 9122, the till is generally quite silty, dense and only slightly moist.

As shown on Figure 6-10, the estimated thickness of the till ranges from 2 to 20 feet across the site. A substantial thickness of till has been identified in the southeast quadrant of the site, in the vicinity of borings 9113 to 9125. Here the till has an estimated thickness of 16 to 20 feet. In the central section of the site, in the vicinity of the 1174 through 1194 nested piezometers, the till unit appears to be very thin. As shown on Figure 6-6, the estimated till thickness through this section is approximately 2 to 8 feet. Through the remainder of the Love Canal site, the till thickness generally ranges from 6 to 12 feet. The surface contours of the till unit are shown on Figure 6-11. The surface appears as somewhat undulating with two apparent knobs. One till knob is located in the vicinity of 9113 to 9125, the location of the thick till, while the other apparently occurs in the northeast corner of the site in the vicinity of boring 8105.

6.1.4 Bedrock

The bedrock underlying the site area is the Lockport Dolomite. This rock unit generally consists of a light gray to dark gray fossiliferous dolomite and limestone. Cavities and mineralized fractures were observed throughout this unit, most frequently in the upper 50 feet. Generally, the Lockport Dolomite is thickly bedded, with beds on the order of 1 to 3 feet thick or greater. Significant fractures in this rock unit occur along horizontal or near horizontal bedding plane partings. These fractures are especially numerous in the upper 30 feet of the rock, as can be seen in logs in Appendix H. Vertical or near vertical fractures were observed, but generally do not appear to penetrate the rock more than 10 to 20 feet. In borings 10210A and 10225A the Lockport Dolomite was approximately 180 and 170 feet thick, respectively, and underlain by the Rochester Shale.

The estimated surface contours of the Lockport Dolomite are shown on Figure 6-12. The bedrock surface appears to dip slightly from the northeast to the southwest and southeast from elevation 544 to 534 MSL. An apparent bedrock trough occurs at the southwest corner of the site. Here the bedrock surface elevation drops from a high of 538 feet MSL to 534 feet MSL. The bedrock surface in the vicinity of 9122, 9120, and 9115 appears to drop off to the southeast. This depression in the bedrock surface corresponds to the area of thick till at the site shown on Figure 6-9. An apparent bedrock high has been interpreted at the northeast corner of the site. Here the estimated bedrock surface elevation rises from 540 to 544 feet MSL.

6.1.5 Canal Fill Materials

Samples recovered from the borings made into filled sections of Love Canal consisted of a wide diversity of soil materials, such as clays, silts, sands, and gravel and various mixtures of solid and liquid wastes such as ash, wood, plastic, organic fiberous materials, and nonaqueous phase liquids (NAPL). Because of the complexity and lack of stratigraphic continuity of the fill waste deposits, the presentation of an interpretive geologic profile along the length of the Canal appears inappropriate to describe the materials encountered. In the section which follows, a generalized summary of the materials and subsurface conditions encountered in the Canal borings will be presented. The Canal boring logs are presented in Appendix H.

From the present (1987) existing ground surface, there is approximately 0.5 feet of topsoil overlying 1 to 1.5 feet of silty sand fill. A 40 mil thick, high density polyethylene (HDPE) membrane is present at approximately 1.5 to 2.0 feet below the existing ground surface. An additional minimum 0.5 feet of silty sand fill underlies the HDPE membrane. A silty clay layer approximately three to four feet in thickness (NYSDEC clay cap, c. 1980) exists below the silty sand fill. The Canal borings indicate this layer to be dry and compact and is composed of silty clay with varying amounts of sand and gravel. Fill soils composed of mixtures of sand, silt, clay, gravel, and miscellaneous debris exist below the cap. Generally, the thickness of these fill soils range from three to seven feet with the thickest fills up to 10.5 feet observed at CW-60. At most Canal boring locations traces of cinders, ash, root, and plant fibers were found mixed with fill soils from elevation 576 to 574 MSL. This zone appears to represent the approximate original ground surface and the top of the Love Canal fill and waste deposits.

All Canal borings were terminated upon reaching apparently undisturbed soils. At most boring locations, the contact between the waste deposits and non-fill soils was abrupt with little visual indications of chemical alteration of underlying natural clays. In some cases, a thin layer of organic material was noted just above undisturbed native soil. This was interpreted as sedimentation in the open canal prior to the filling. At a few locations, the underlying clays were heavily stained and altered which made interpretation of the Canal bottom depth difficult. From the interpreted observations, it appears that the bottom of the Canal ranges from elevation 558 (CW-50, CW-60, and CW-70) in the south central portion to shallower depths at elevation 567 and 565 in the southern and northern sections, respectively. Using these elevations and the approximate average original ground surface elevation of 574, it appears the Canal excavation may have ranged from 7 to 16 feet below original grade or in the central section to about the transition zone of stiff to soft silty clay. Descriptions of samples taken from Canal borings which were terminated below wastes in the stiff clays indicate the presence of NAPL in prismatic soil fractures. Table 6.1 presents estimated elevations from the Canal bottom at each of the Canal boring locations.

Waste materials were encountered in borings CW-10, CW-60, CW-70, CW-80, CW-90, and CW-105. The thickness of waste deposits encountered in these borings ranged from 5 feet (at CW-10) to 13 feet (at CW-60). The waste materials encountered were variable in composition, but generally appeared to consist of traces of soil mixed with ash, debris, and black viscous liquids. An olive green viscous liquid was encountered in boring CW-105 above the black viscous liquids. The olive green liquid was not observed at any other Canal boring locations. Numerous voids were encountered while drilling the Canal borings as evidenced by observations of the penetration rates of the hollow stem augers and split-spoon samplers.

At Canal borings CW-30 and CW-40 various amounts and mixtures of clay, silt, sand, ash, and municipal type waste were encountered below the original ground surface (approximate elevation 574± one feet MSL). The fill deposits in the vicinity of these borings appeared to be 11 to 13 feet in thickness and were variable in composition.

TABLE 6.1

ESTIMATED DEPTH OF CANAL
AT BORINGS

BORING NO.	ESTIMATED ELEVATION CANAL BOTTOM - FT(MSL)	ESTIMATED CANAL DEPTH - FT *
CW- 10	563.6	10.4
CW- 20	560.9	13.1
CW- 30	565.4	8.6
CW- 40	560.4	13.6
CW- 50	558.7	15.3
CW- 60	557.9	16.1
CW- 70	558.1	15.9
CW- 80	560.4	13.6
CW- 90	564.6	9.4
CW-105	566.7	7.3
CW-108	565.2	8.8

* - Estimated from an assumed original ground elevation of 574 feet (MSL).

Borings CW-20, CW-100A, CW-108, and CW-110A encountered fills composed of mixtures of ash, clay, sand, silt, wood, and organic matter from 5 to 9 feet in thickness below interpreted original ground surface. The presence of NAPL was noted in the fractured clay in both CW-100A and CW-110A1 which were interpreted to be outside of the Canal excavation.

Four disposal pit borings were made in an attempt to locate suspected separate disposal pits existing outside the confines of the Canal. Undisturbed stiff fractured silty clay was encountered at elevation 570 to 571 at DP-20, DP-30, and DP-40. Native stiff silty clay was encountered at elevation 566 at DP-10. Mixtures of silty clay, sand, debris, and ash varying in thickness from 3 to 12 feet were found overlying the native stiff silty clay. The presence of NAPL in the fractured clay was noted in each of the DP borings, and also in swale boring SW-10.

Boring BRM-10 was made in an attempt to locate a soil berm which may have had been constructed across the Love Canal. Boring BRM-10 encountered black ash and clay fill soils at approximately elevation 573. Black viscous liquids and slurries of ash, soil and liquids were encountered at elevation 570. Undisturbed soft plastic silty clay was encountered below the waste deposits at approximately elevation 562. An assessment of boring BRM-10 indicates that the boring was not advanced through the suspected berm as evidence by encountering an 8-foot thick zone of liquid wastes and soils mixed with liquid wastes. A berm may have been encountered at boring location CW-50 as evidenced by the lack of waste materials. This boring encountered an approximately 2-foot thick layer of black ash overlying 9 feet of stiff clay fill soils from the original ground surface.

6.2 HYDROGEOLOGY

6.2.1 Overview

The Task VB report contains a detailed description of the hydrogeology of the site based on then currently available information. Since that report, considerable other data has been obtained to refine the interpretations made at that time. These data include: 1) water level data, including the new wells and piezometers installed in Task VC; 2) flow data to the barrier drain system; 3) hydraulic conductivity test data; and 4) additional borings to describe geologic influences on flow. The purpose of obtaining this data is to improve the understanding and monitoring the potentials for contaminant transport more completely, and to assess the effectiveness of remedial actions at the site, principally, the operation of the barrier drain system and the recently expanded cap over the Canal.

6.2.2 Hydrogeologic Summary

The hydrogeology at the Love Canal site is comprised of two aquifers separated by an aquitard. There is a shallow water table aquifer in surficial sands and fills and fractured clay and a deeper confined aquifer in the upper highly fractured dolomitic bedrock and more permeable tills. These aquifers are separated by an aquitard of lacustrine clays and low permeability tills. The geology of these units has been discussed in Section 6.1.

Flow in the shallow aquifer is determined by a number of factors including: 1) areas of limited recharge such as the capping system over the Canal and possibly by extensive paved areas such as the streets; 2) areas of normal recharge such as the open areas between streets and away from the Canal cap; 3) variations in the thickness of the more permeable water bearing units; 4) interception of shallow flows by drainage structures (e.g., runoff controls and the barrier drain system); 5) active storm and sanitary sewers and housedrains; 6) the establishment of hydraulic gradients by and toward the barrier drain; and 7) the hydraulic conductivity of the soils. Except in the vicinity of the drains, the hydraulic gradient in the area is relatively small leading to low groundwater flow velocities in the shallow aquifer. Although there are not enough water level data locations to be able to define separate hydrogeologic regimes for areas at the Canal, it is possible that such separate regimes do exist and that flow in the shallow aquifer is best pictured as flow within areas confined laterally by groundwater divides or other hydraulic barriers. Flows would then principally be toward drains and as downwardly directed seepage (see section 6.2.3.1, also). Recharge is limited in some areas and runoff and evapotranspiration play an important part in defining the water balance of an area.

In the shallow bedrock aquifer, flow is principally controlled by the recharge to the Niagara Escarpment to the north and the head in the Niagara River to the south (see Figure 1-1). The Escarpment recharges the fractured dolomite, and there are indications that the River is in hydraulic connection with the dolomite. Generally, small gradients and the potential for moderate changes in head, both to the north and south of the site, can effect changes in flow direction. These are discussed further in section 6.2.3.3. Shallow bedrock groundwater flow in the vicinity of the site appears to be predominantly to the south-southwest. Although there are well defined vertical fractures in the dolomite trending northeast-southwest and northwest-southeast, there appears to be extensive horizontal fracturing which may be conducting most of the flow and not allowing the potential anisotropy due to the vertical fracturing to be significant in characterizing the aquifer. It is this extensive fracturing which has encouraged the modeling of this unit as a porous medium.

6.2.3 Recent Hydrogeologic Data

The expansion of the cap in 1984 was performed to limit direct recharge to the shallow aquifer in the vicinity of the barrier drain. This improvement would theoretically allow the barrier drain to establish a broader range of influence in the vicinity of the Canal. The drain would create a hydraulic gradient which would be directed toward the drain and which would ultimately extend to the limits of the Canal cap and possibly some distance beyond as suggested by the computer groundwater modeling done in Task VB (Jordan, 1985). The gradient toward the barrier drain would also be apparent in all overburden strata, although to differing degrees. This would also tend to limit the potential for contaminant transport through the groundwater and possibly induce the retrieval of some contamination as the range of influence of the drain increases over time. The purpose of the installation of the nested piezometers was to provide data with which to define the influence of the barrier drain and cap on the shallow groundwater flow over time. The demonstration of a hydraulic gradient directed inwardly toward the barrier drain is considered to be one of the most positive indications of no further potential for significant lateral migration of contaminants away from the Canal in the shallow overburden aquifer.

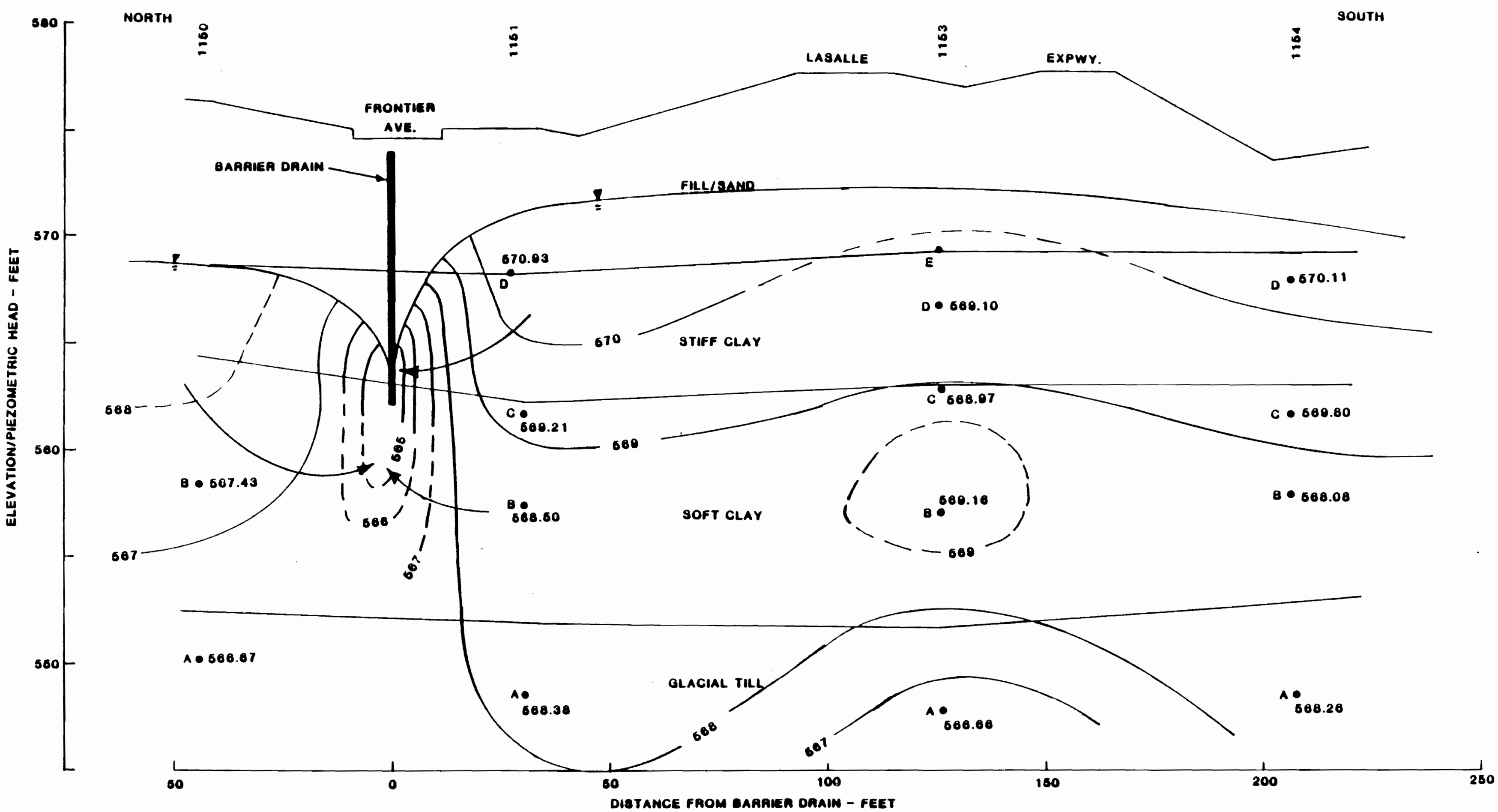
One purpose of this project was to gather data which would provide the basis for assessing the effectiveness of the barrier drain/cap system remedial action. Data which are most appropriate for this evaluation are the water level measurements taken in the five series of piezometers and the data for flows collected by the barrier drain. Also available are water level measurements taken in bedrock wells by NYSDEC at approximately monthly intervals and records of leachate flow to the treatment plant. These data are presented and discussed in the following sections.

<u>6.2.3.1 Nested Piezometer Water Level Data</u>. Water levels have been measured in the perimeter wells by Jordan, and in the nested piezometers and selected bedrock wells by NYSDEC. The NYSDEC data, comprised of nearly monthly readings for the past few years, provides an extensive data base for interpretations of groundwater flow in the bedrock and in the vicinity of the barrier drain. The NYSDEC data for the past two years and the Jordan data are presented in Appendix C and forms the basis for much of the following discussion. The piezometer data is also presented as hydrographs (Appendix D) for selected groupings of piezometers. This section discusses the water level data taken in the nested piezometers, and section 6.2.3.3 discusses the data for the bedrock wells.

The piezometric (water level) data has been plotted on profiles of the piezometers and contoured to represent potentials for flow at the times of data collection. Interpretations of the data have been made to look for trends that might reflect the development of the influence of the barrier drain over time (see Figures 6-13 to 6-18).

Based on reviews of the hydrographs and tabulated data, inferences of significant changes in the potentials of flow to the barrier drain over the past one or two years cannot be made. However, this is probably due to the fact that even in the more permeable strata, hydraulic gradients are small and groundwater flow to the drain occurs slowly. There has not been enough time for the effects to be noted, particularly since there is some variability in the data due to seasonal changes and fluctuations in the head of the Niagara River (see Section 6.2.3.3) The interpretations of the data do indicate, however, the presence of significant potentials of flow to the drain and, in some cases, the presence of a groundwater divide in the overburden materials (see Figures 6-13 and 6-18). This divide, indictive of the extent of influence of the drain, is expected to move outward from the drain toward the edge of the expanded cap with time.

Only one set of liquid level measurements in the Canal piezometers was available at the time of this report. This data is presented in Table 6.2. The liquid levels in the Canal range from elevation 566.1 in BRM-10 to 576.2 in CW-20, 150 feet north of BRM-10. Proceeding from BRM-10 southerly 125 feet to CW-30, the liquid level increases nearly 4.5 feet. Liquid levels do not vary



NOTES:

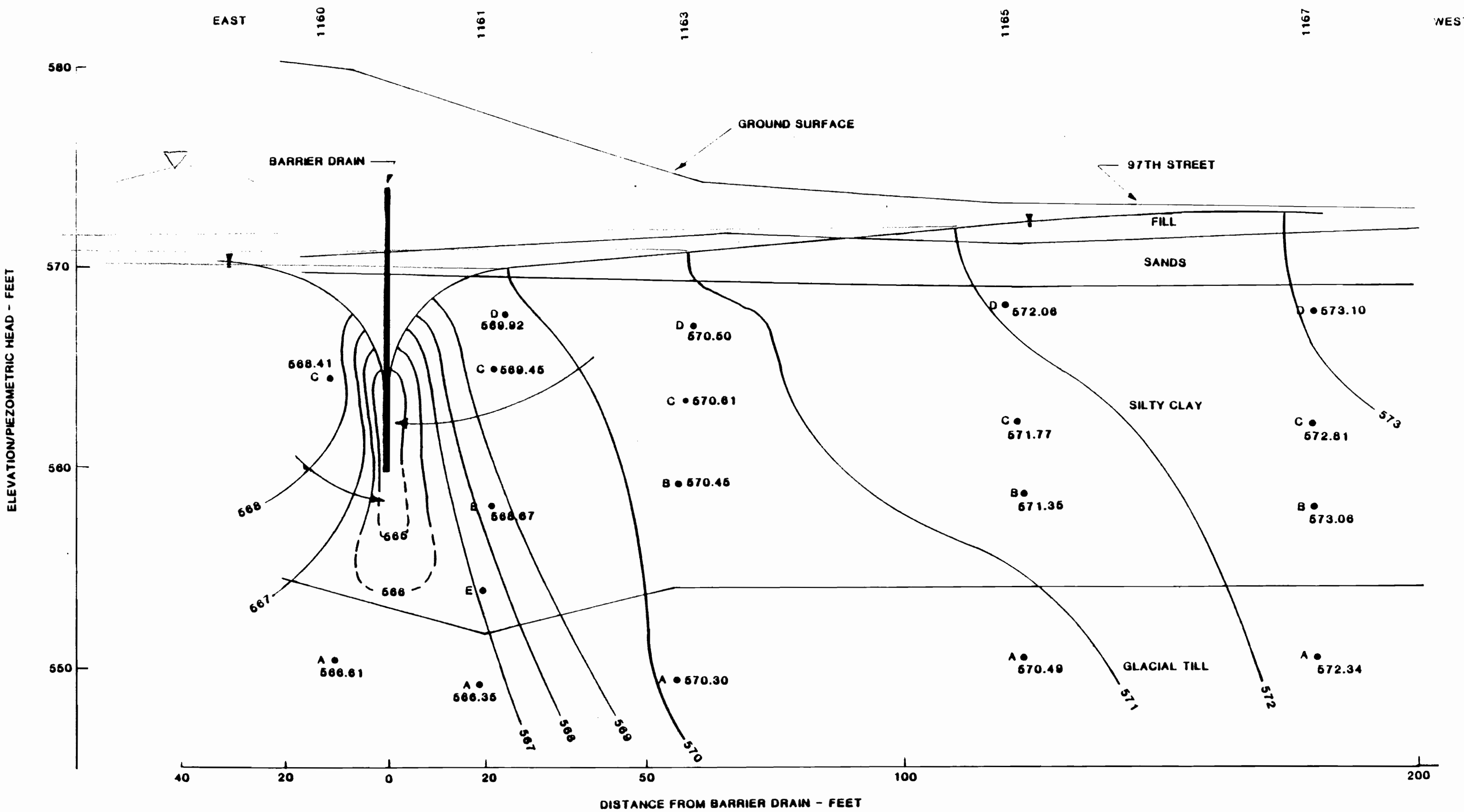
1. POINTS USED TO PLOT HEADS REPRESENT THE MIDPOINT OF THE SAND PACK ABOUT THE SCREEN EXCEPT THE D PIEZOMETERS WHICH ARE TAKEN AS THE BOTTOM OF THE SAND INTERVAL.
2. THE WATER TABLE AND SEEPAGE FACE AT THE BARRIER DRAIN ARE INFERRED FROM THE HEAD DATA.

LEGEND:

- ● POINT PLOTTED AS HEAD AT A,B,C,D OR E WELL
- 568.44 MEASURED HEAD
- 568 CONTOURED HEAD
- ▼ GROUNDWATER TABLE
- ——► GROUNDWATER FLOW

FIGURE 6-13
INTERPRETIVE GROUNDWATER POTENTIALS TO THE BARRIER DRAIN - DATA OF 12/4/86
1150 SERIES PIEZOMETERS
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C. JORDAN CO.



NOTES:

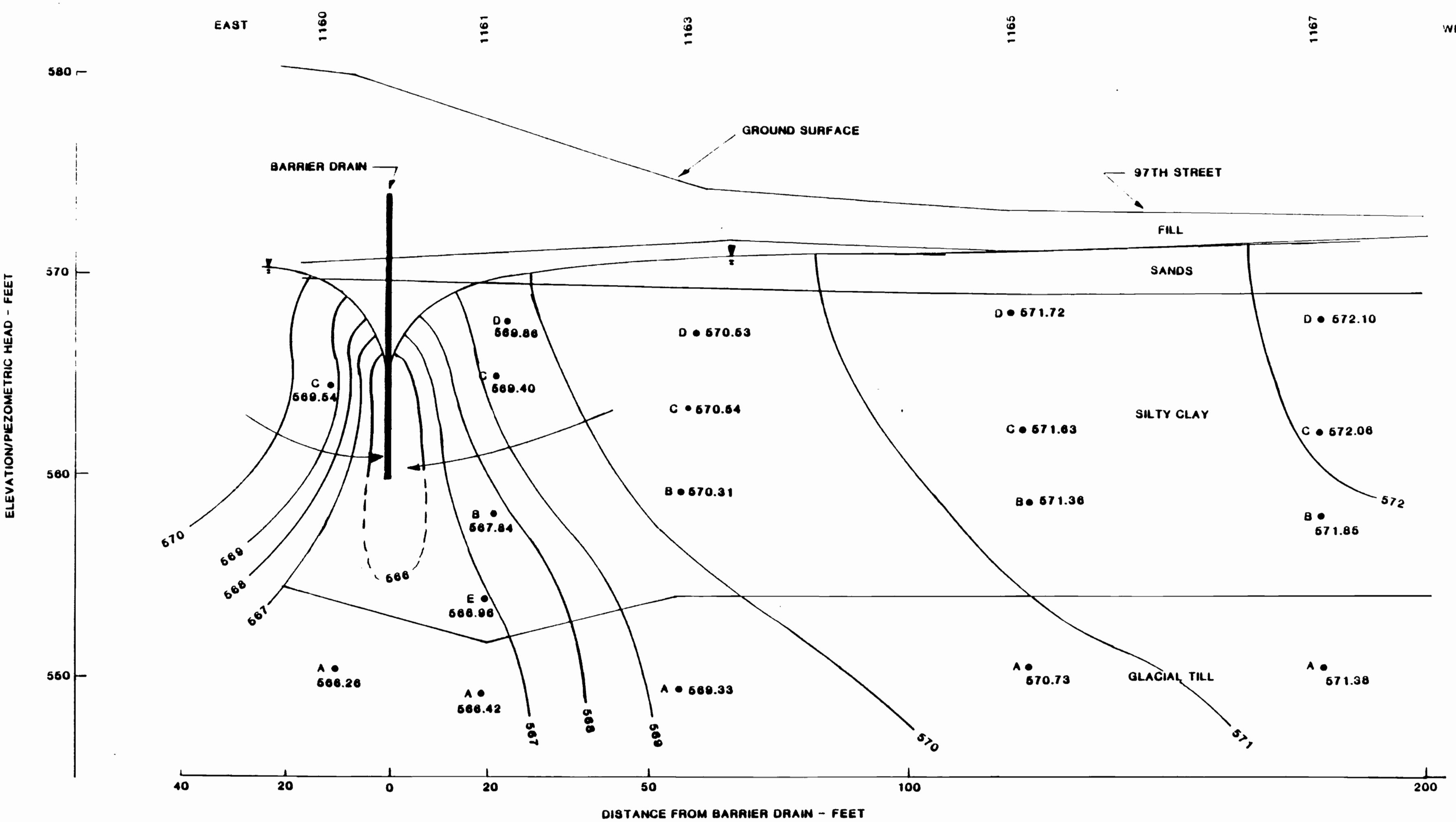
1. POINTS USED TO PLOT HEADS REPRESENT THE MIDPOINT OF THE SAND PACK ABOUT THE SCREEN EXCEPT THE D PIEZOMETERS WHICH ARE TAKEN AS THE BOTTOM OF THE SAND INTERVAL.
2. THE WATER TABLE AND SEEPAGE FACE AT THE BARRIER DRAIN ARE INFERRED FROM THE HEAD DATA.

LEGEND:

● POINT PLOTTED AS HEAD AT A,B,C,D OR E WELL.
569.23 MEASURED HEAD
— 568 — CONTOURED HEAD
▼ GROUNDWATER TABLE
——▶ GROUNDWATER FLOW

FIGURE 6-14
INTERPRETIVE GROUNDWATER POTENTIALS TO THE BARRIER DRAIN - DATA OF 3/11/85
1160 SERIES PIEZOMETERS
LOVE CANAL REMEDIAL PROJECT - TASK VC

126504



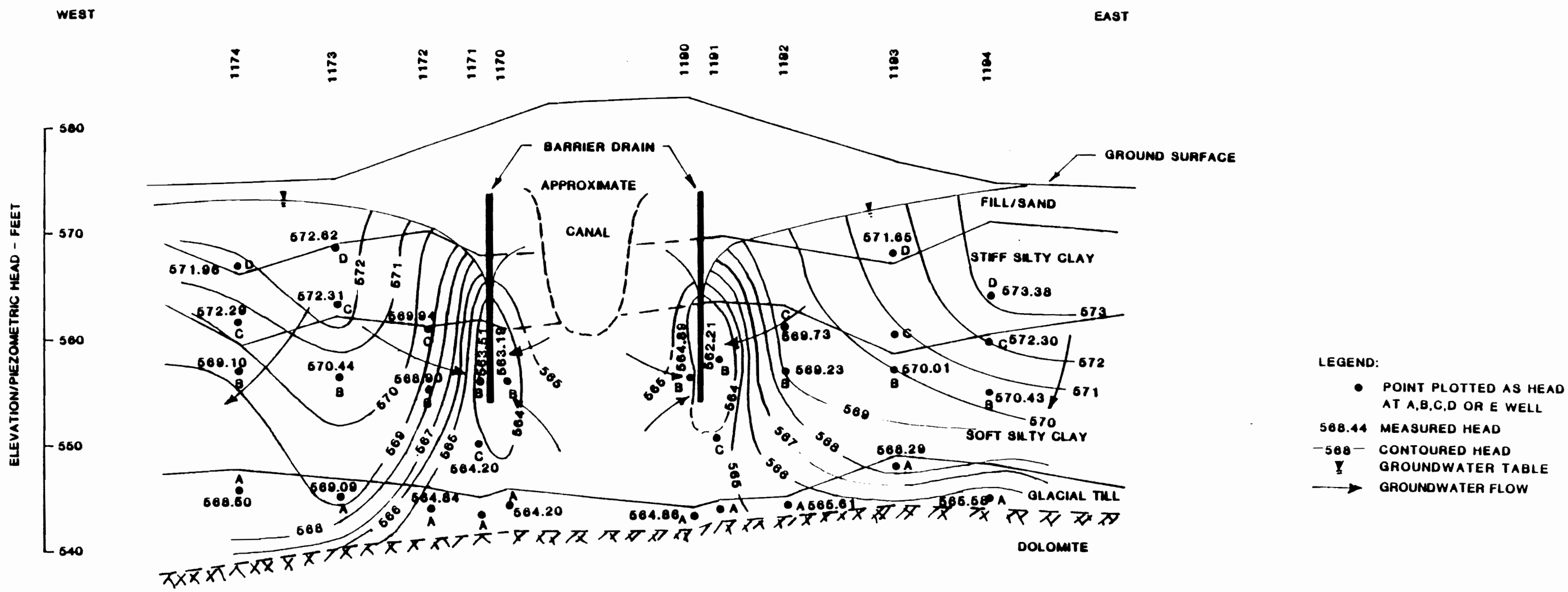
NOTES:

1. POINTS USED TO PLOT HEADS REPRESENT THE MIDPOINT OF THE SAND PACK ABOUT THE SCREEN EXCEPT THE D PIEZOMETERS WHICH ARE TAKEN AS THE BOTTOM OF THE SAND INTERVAL.
2. THE WATER TABLE AND SEEPAGE FACE AT THE BARRIER DRAIN ARE INFERRED FROM THE HEAD DATA.

LEGEND:

- ● POINT PLOTTED AS HEAD AT A,B,C,D OR E WELL.
- 569.23 MEASURED HEAD
- — 568 — CONTOURED HEAD
- ▼ GROUNDWATER TABLE
- ——► GROUNDWATER FLOW

FIGURE 6-15
INTERPRETIVE GROUNDWATER POTENTIALS TO THE BARRIER DRAIN - DATA OF 12/29/86
1160 SERIES PIEZOMETERS
LOVE CANAL REMEDIAL PROJECT - TASK VC



NOTES: 1. POINTS USED TO PLOT HEADS REPRESENT THE MIDPOINT OF THE SAND PACK ABOUT THE SCREEN EXCEPT THE D PIEZOMETERS WHICH ARE TAKEN AS THE BOTTOM OF THE SAND INTERVAL.

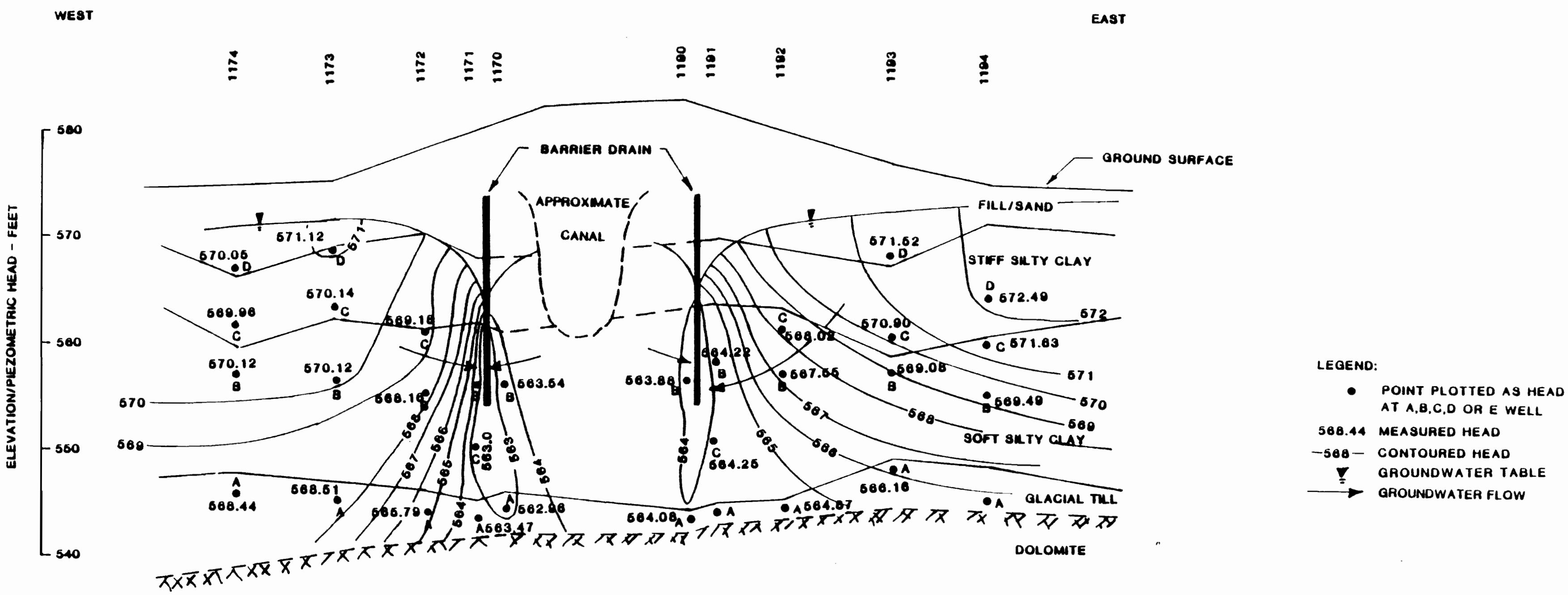
2. THE WATER TABLE AND SEEPAGE FACE AT THE BARRIER DRAIN ARE INFERRED FROM THE HEAD DATA.

APPROXIMATE HORIZONTAL SCALE

FIGURE 6-16
INTERPRETIVE GROUNDWATER POTENTIALS
TO THE BARRIER DRAIN - DATA OF 5/13/86
1170 AND 1190 SERIES PIEZOMETERS
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C. JORDAN CO.

126804



NOTES: 1. POINTS USED TO PLOT HEADS REPRESENT THE MIDPOINT OF THE SAND PACK ABOUT THE SCREEN EXCEPT THE D PIEZOMETERS WHICH ARE TAKEN AS THE BOTTOM OF THE SAND INTERVAL .

2. THE WATER TABLE AND SEEPAGE FACE AT THE BARRIER DRAIN ARE INFERRED FROM THE HEAD DATA.

APPROXIMATE HORIZONTAL SCALE

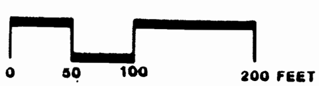
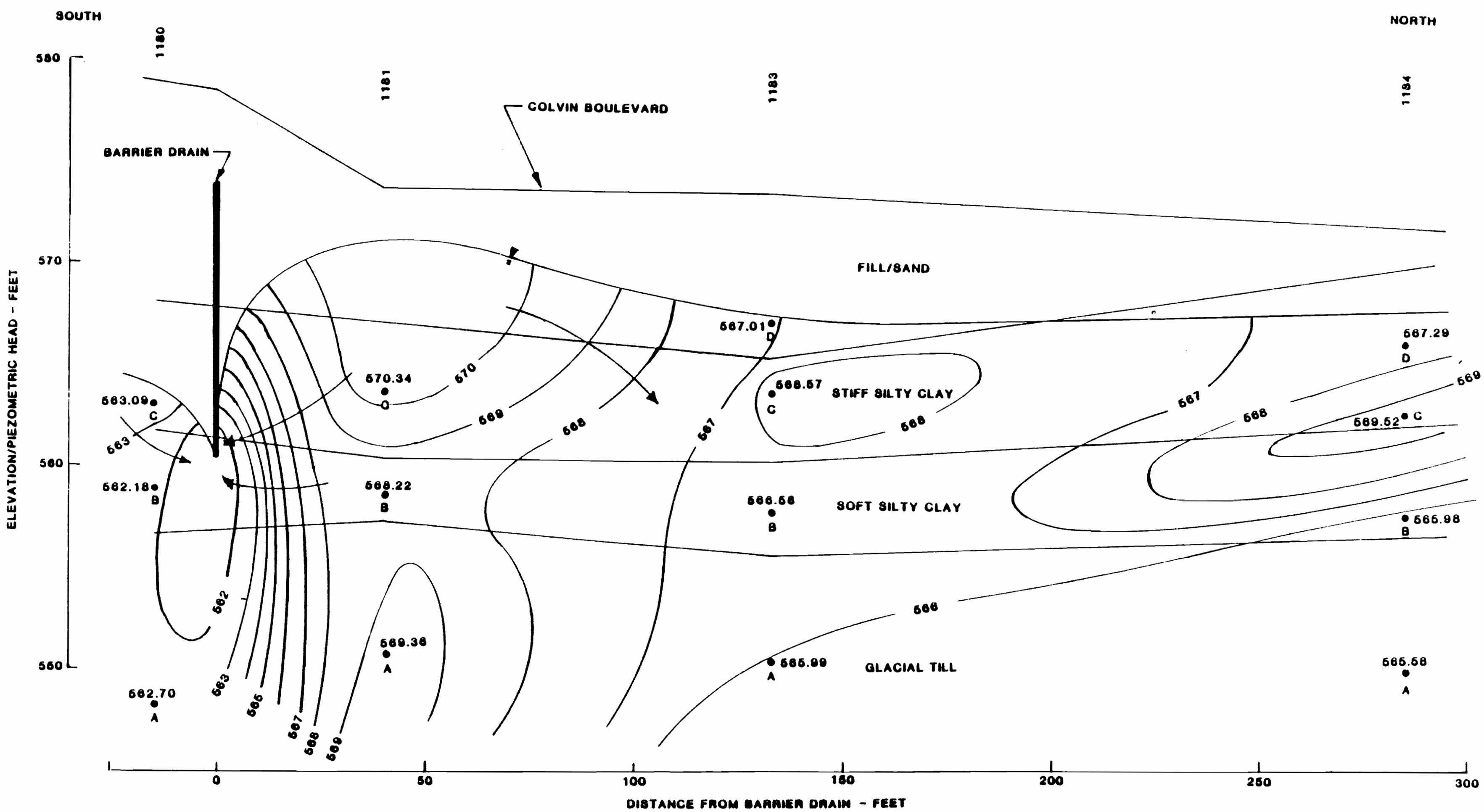


FIGURE 6-17
INTERPRETIVE GROUNDWATER POTENTIALS
TO THE BARRIER DRAIN - DATA OF 10/31/86
1170 AND 1190 SERIES PIEZOMETERS
LOVE CANAL REMEDIAL PROJECT - TASK VC

ECJORDAN CO.



NOTES:

1. POINTS USED TO PLOT HEADS REPRESENT THE MIDPOINT OF THE SAND PACK ABOUT THE SCREEN EXCEPT THE D PIEZOMETER WHICH ARE TAKEN AS THE BOTTOM OF THE SAND INTERVAL.
2. THE WATER TABLE AND SEEPAGE FACE AT THE BARRIER DRAIN ARE INFERRED FROM THE HEAD DATA.

LEGEND:

- ● POINT PLOTTED AS HEAD AT A,B,C,D OR E WELL
- 569.23 MEASURED HEAD
- 568 CONTOURED HEAD
- ▼ GROUNDWATER TABLE
- → GROUNDWATER FLOW

FIGURE 6-18
INTERPRETIVE GROUNDWATER POTENTIALS TO THE BARRIER DRAIN - DATA OF 12/29/86
1180 SERIES PIEZOMETERS
LOVE CANAL REMEDIAL PROJECT -TASK VC

E.C. JORDAN CO.

TABLE 6.2

LIQUID LEVELS IN CANAL PIEZOMETERS

Well/ Piezometer	Top of Riser Elevation	Depth to Liquid(1)	Liquid Surface Elevation
CW-10	585.79	10.4	575.4
CW-20	586.90	10.7	576.2
BRM-10	585.29	19.2	566.1
CW-30	586.14	15.4	570.7
CW-40	587.00	(2)	--
CW-50	589.19	21.2 (3)	568.0
CW-60	589.20	21.3	567.9
CW-70	584.57	15.1	569.5
CW-80	586.59	16.3	570.3
CW-90	586.73	16.1	570.6
CW-105	586.43	11.8	574.6
CW-108	585.41	14.7	570.7

Notes:

(1) Measured by NYSDEC, 2/25/87.
(2) CW-40 has a temporary block.
(3) CW-50 appears to be in a clayey fill material.

as much from CW-50 through CW-108 with the exception of CW-105 which is about four feet higher than in the neighboring Canal piezometers CW-90 and CW-108. Note also that the liquid levels in CW-10, CW-20, and CW-105 are at or above the former original ground surface at 574 to 575 MSL. This may indicate that mounding of infiltration may have occurred. However, due to the limited data, rates of dewatering of the Canal cannot be calculated.

The liquid levels along the length of the Canal will be subject to many factors. Among these are:

- The hydrogeologic setting at the location;
- the effectiveness of previous cover materials to prevent infiltration;
- the hydraulic connection of the Canal with the barrier drain or laterals;
- the physical characteristics of liquids at a location (e.g., NAPL versus water behavior); and
- the presence of berms or waste materials of lower permeability which might inhibit the attainment of a uniform liquid level along the length of the Canal.

It is probably premature to begin in-depth analyses of the hydrology of the Canal and fill materials with only one data set of liquid levels. However, the data suggest that a variety of possible influences may be present at a given location and that, at a given position along the length of the Canal, the effectiveness of the drain and cap as remedial actions will vary, particularly in determining how long it takes to develop the extent of the influence.

6.2.3.2 Treatment Plant Flow Data

The Love Canal treatment plant, operated by NYSDEC, has been collecting leachate from the barrier drain for treatment for over seven years. The leachate collects in the main pipes and laterals (which extend from the mains in toward the wastes) of the drain under gravity and pressure potentials created by the elevation of the drain pipe. The main drain pipes tilt toward the four pump stations which work on level control and deliver the leachate through force mains to storage tanks located behind the treatment plant. The treatment plant is operated intermittently to respond to the drain flow rate which appears to be a function of precipitation and the accumulation of leachate.

The sources of water to the drain system include: 1) recharge which infiltrates into the shallow soils and moves toward the drain under the influence of the hydraulic gradient created by the drain; 2) water which comes out of storage as the soils are dewatered; and 3) seepage through the till to the drain. The seepage occurs largely under the influence of the piezometric potential difference between the elevation of the drain and the hydraulic potential in the tills which is controlled by the elevation of the Niagara

River. A leak in the hydrant at the southeast corner of the site near the former 99th Street was another source of water to the drain. However, the hydrant is nearly 250 feet away from the drain and an influence on the flow rate to the drain has not been demonstrated. Since the leak has been fixed recently, continued flow data may indicate whether this has been a significant source or not.

Table 6.3 presents time weighted monthly and annual flow rates calculated from the totalized flow records maintained by the treatment plant personnel. These flow rates are derived by dividing the total flow processed in a month by the number of minutes in the month and similarly for the year. These average monthly and annual flow rates for the facility are more easily compared than the totalized flow. Note that the new expanded cap was completed in November 1984. This is apparent from the significantly different flow rates beginning in mid-1984 as compared with like months in the previous years. The present flow rate appears to have stabilized at about 5 gallons per minute (gpm) averaged over the course of the year. Despite the fact that the potential for recharge by infiltration has been drastically curtailed by the expanded and relatively impermeable cap, the data still reflect what appears to be a seasonal fluctuation. Flow rates go up in the spring and fall when rains raise water tables and river levels and go down in summer when the reverse is true. This suggests that the flow rate remaining may be largely derived from upward seepage into the barrier drain. The head differentials between the River stage and the barrier drain elevation may reach 10 feet or more depending on the particular stretch of drain and the season. Another possible source is flow to

TABLE 6.3

AVERAGE TREATMENT PLANT FLOWS*

	1980	1981	1982	1983	1984	1985	1986**
January	11.37	4.72	13.94	8.96	5.65	5.36	6.01
February	5.75	15.75	5.56	8.03	5.14	11.19	3.85
March	8.75	8.77	9.71	13.01	8.94	8.51	6.35
April	15.39	7.50	22.12	12.73	7.86	5.02	4.65
May	12.05	8.09	5.88	7.99	5.96	2.82	2.89
June	7.14	4.18	6.51	2.97	4.42	2.38	5.06
July	5.39	5.12	11.62	3.35	2.86	2.05	4.64
August	5.43	5.14	4.57	4.14	6.08	1.87	3.17
September	5.93	5.43	2.27	4.12	3.56	2.14	2.95
October	8.83	7.17	2.12	7.00	3.97	2.44	6.90
November	6.02	9.76	9.14	19.43	3.68	9.53	3.83
December	11.08	11.67	14.64	12.42	3.66	7.40	8.70
Monthly Average	8.59	7.78	9.01	8.68	5.15	5.06	4.93

* The flows presented are average flows, in gpm, calculated from totalized flows recorded for each month. The plant is operated intermittently so that instantaneous flow rates at the time of processing will be much higher than the average flow for the month as tabulated.

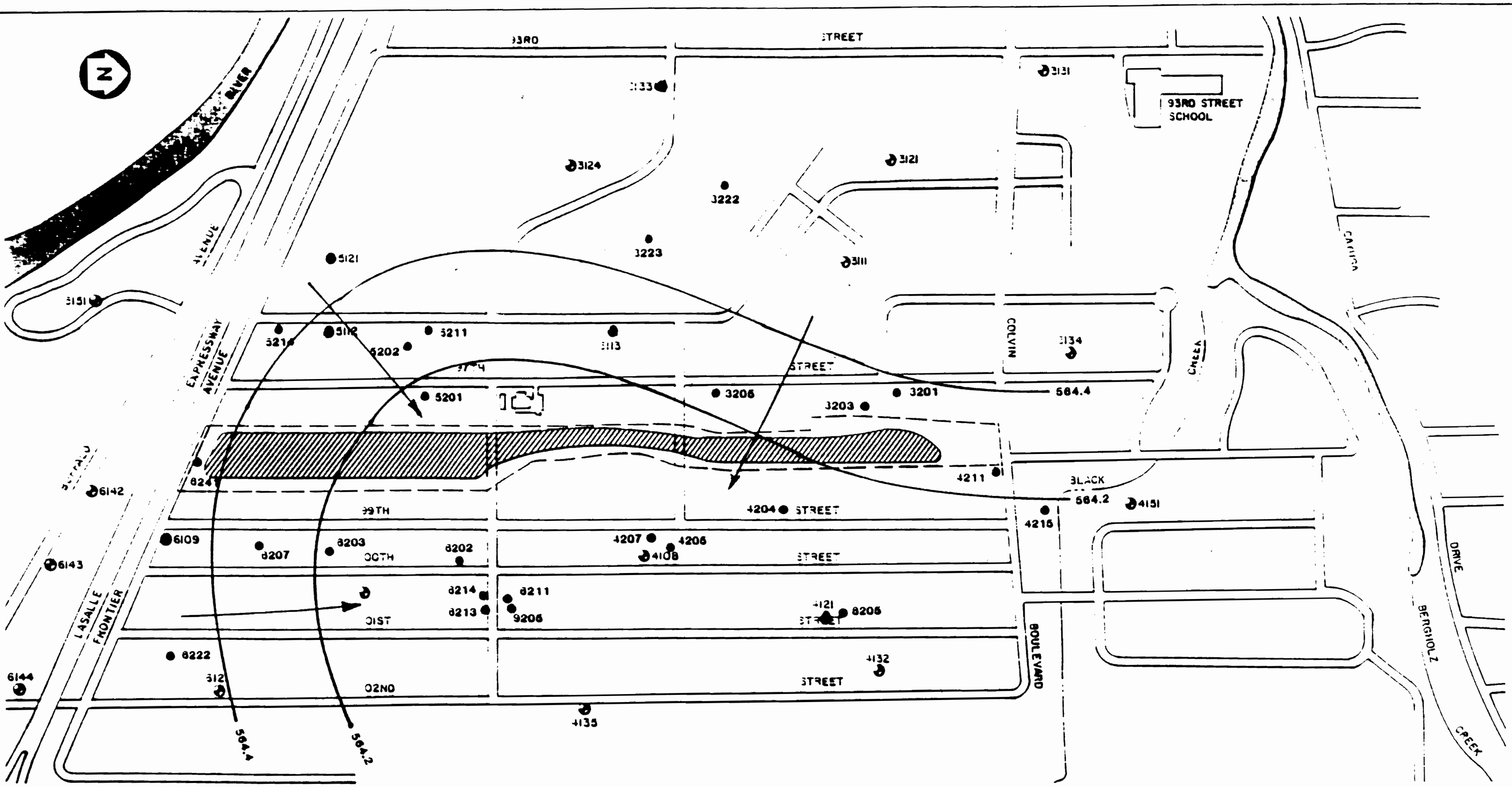
** The flow rates for 1986 have been corrected for the additional volume contributed by the sewer cleanup operations conducted in April through August.

Total monthly flow data supplied by NYSDEC.

the drain in shallow permeable soils where the cap does not extend far from the drain, e.g., at the north (see Figure 6-3) and south (see Figure 6-19) ends. Piezometers 1151D and 1153E were installed to help assess the potential for flow at the south end, but not enough data are yet available to make this evaluation.

6.2.3.3 Other Water Level Data. NYSDEC also collected water level data for selected bedrock wells, and Jordan measured water levels in the perimeter wells as part of the standard operating procedure for sampling wells. These data are tabulated in Appendix C. While the water level data for the overburden perimeter wells is of limited use in interpreting groundwater flow patterns, the bedrock well water level data can be interpreted to infer groundwater flow in the shallow bedrock aquifer. Figures 6-20 and 6-21 show the contoured water level data for January 1985, and December 1986, respectively. Groundwater flow direction is assumed to be perpendicular to the contours which represent potentials for flow. In Figure 6-20, flow is interpreted to be to the north and east as the head in the Niagara River apparently dominates the recharge factor. Later, as shown in Figure 6-21, the recharge factor appears to dominate and the flow is south-southwest, the direction which previous studies have generally reported.

Since the two data sets indicated such different flow directions, the other sets of data were contoured to show the changing directions over time. These contour plots are included as Appendix E. The plots show the gradual reversal of the principal flow directions which takes place in October through December, 1985. The series of plots suggests a very dynamic flow system. The interpre-



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

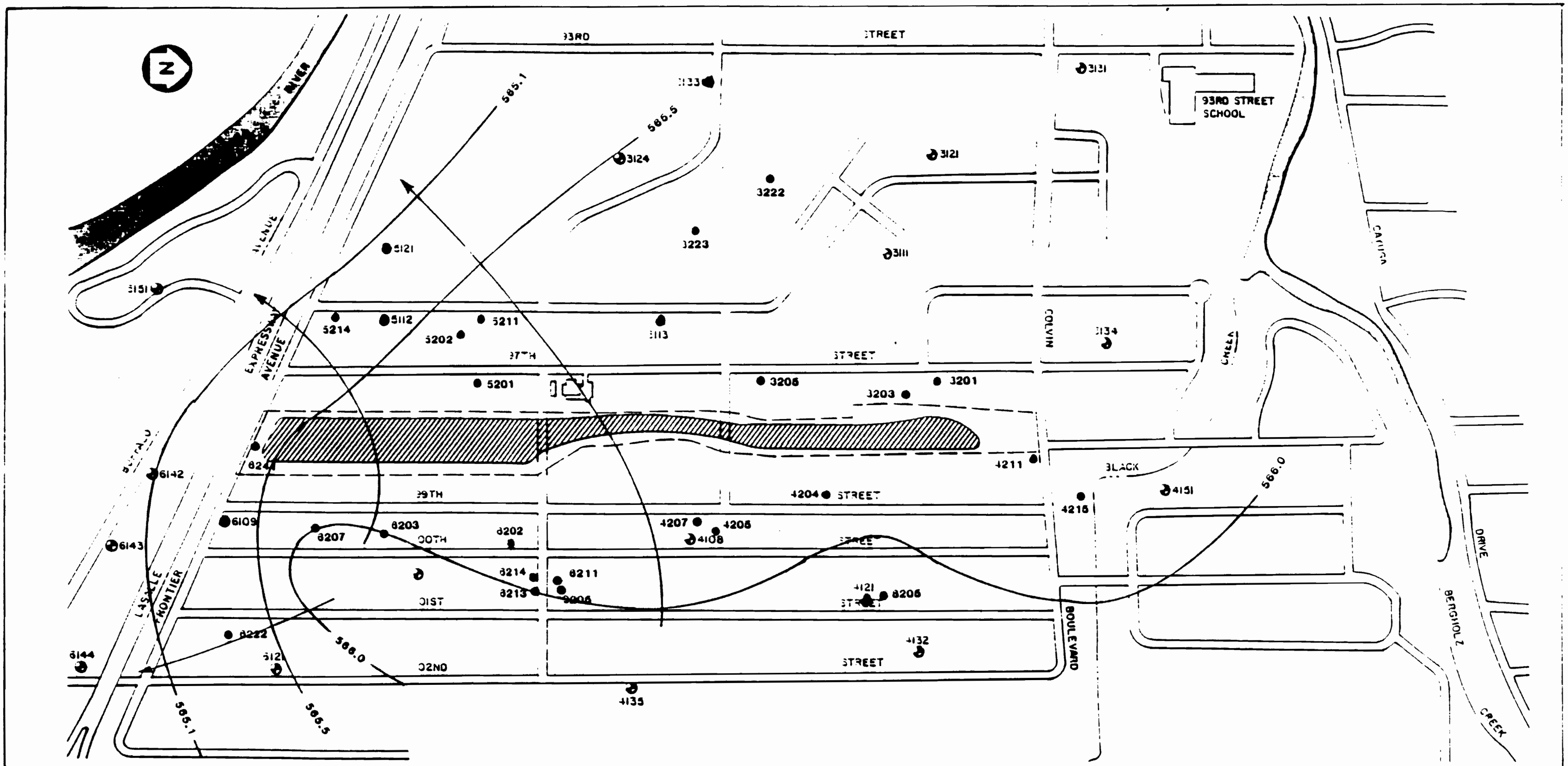
- ● DATA POINT FOR CONTOURS
- 584.0 GROUNDWATER POTENTIAL
- → INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- ---- LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

FIGURE 6-20
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 1/31/85
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE
WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- → INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - LOCATION OF BARRIER DRAIN

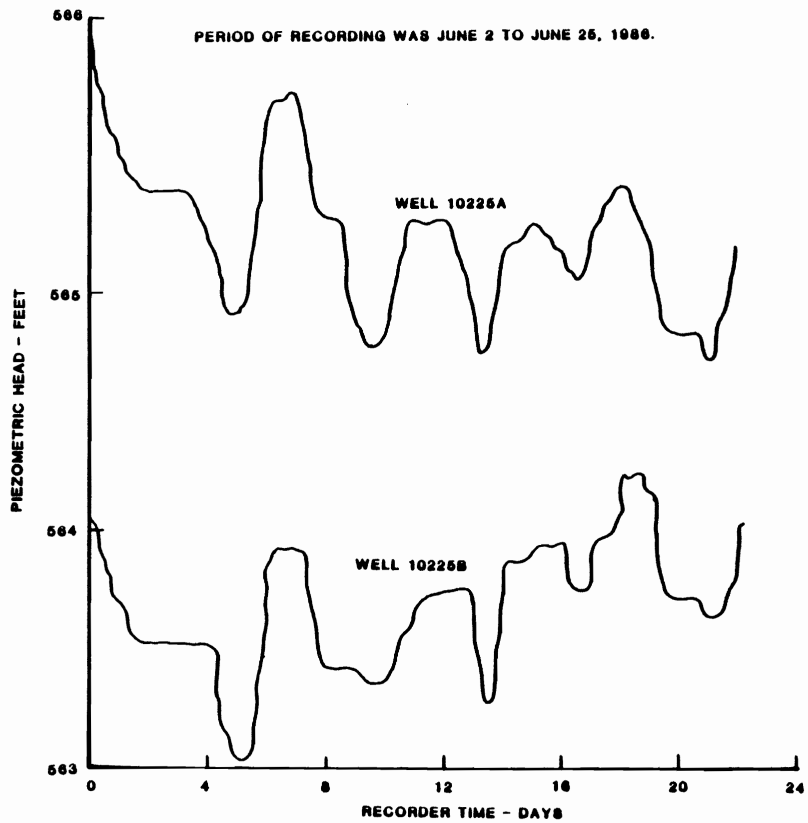
APPROXIMATE SCALE
0 400 800 FEET

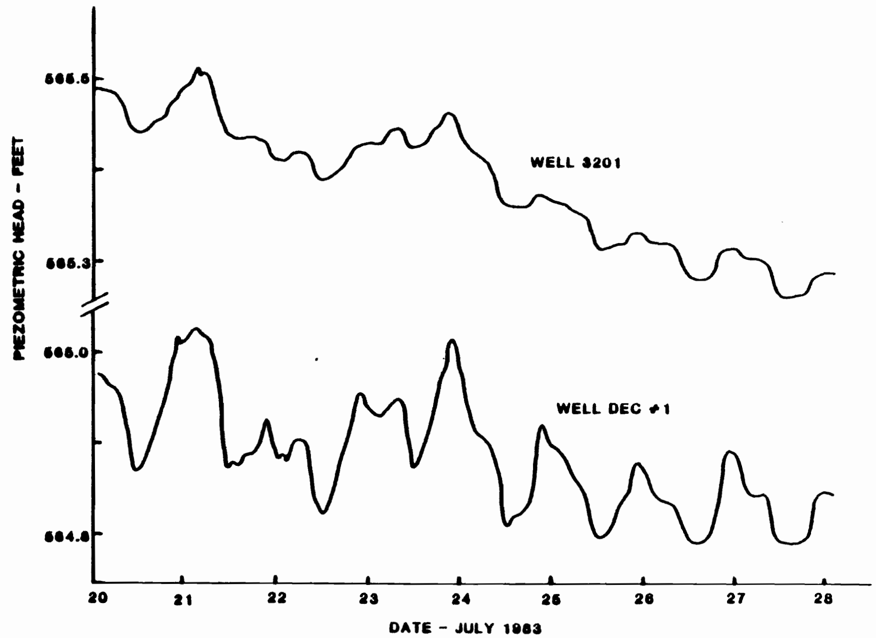
FIGURE 6-21
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 12/27/86
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.

tation of the data suggests that some of the wells are in better contact with the fractured bedrock aquifer than others and that some of the data represent transient behavior in which responses in some wells may lag that in others. These transient responses appear as sinks or sources in the contoured data. Another factor complicating the interpretation of the data is that the elevation of the surface of the Niagara River fluctuates daily as water is alternately drawn off by the Power Authority. These daily fluctuations result in pressure waves in the bedrock aquifer. The changes in the measurements of levels in the wells can be significant as Figure 6-22 shows. While individual wells will respond differently to the variations in River level depending on the degree of hydraulic connection, there may also be a proportional relationship decreasing with distance from the River. Since the collection of the water level data occurs over one or two days, the data collected includes some variability due to the fluctuation of the River. When the gradients are low in the aquifer, this variability, as well as variations due to changes in barametric pressure changes, can create problems with interpretation of flow. Data for August 1986, could not be contoured since there was no apparent pattern to the data.

Despite the inherent variability in the data, the general inferences of flow directions are probably significant enough to indicate real shifts in the direction of flow in the shallow bedrock aquifer. This is important to note for two reasons. One is that the monitoring wells in the perimeter bedrock monitoring system are positioned based on a presumption that the south-southwest direction of flow is predominant. If long-term water level data indicate that this is not the case, the water quality data must be viewed according to





NOTE: RECORDERS SET AND MAINTAINED AND DATA PROVIDED BY NYSDEC.

FIGURE 6-22
PIEZOMETRIC HEAD OSCILLATIONS
IN SHALLOW BEDROCK AQUIFER
LOVE CANAL REMEDIAL PROJECT - TASK VC

which wells are upgradient and which are downgradient. If flow directions vary significantly in the long term, the present configuration of wells may not be adequate for purposes of monitoring potential impacts of the Canal wastes on the bedrock aquifer. The second consideration is that the reversal of flow, if it occurs frequently, may significantly affect estimates of travel times for water soluble contaminants in the bedrock aquifer.

Limited water level data are available for the nested bedrock wells 10210 A, B, C and 10225 A, B, C. The data suggest a predominantly upward gradient from the lower dolomite to the fractured upper dolomite. This appears to be true at both locations and for each pair "A to B" and "B to C". Maximum upward gradients for A to B wells were 0.0395 and 0.0268 feet/feet at 10210 and 10225, respectively. Upward gradients for B to C wells were much weaker being 0.00131 and 0.00094 at 10210 and 10225, respectively. This observation, if substantiated by further monitoring, is important in that the upward gradients will tend to decrease the potential for downward migration of contaminants in general and for water soluble compounds in particular.

6.3 CHEMICAL DATA

6.3.1 Soils Data

Examination of the chemical data for HSL organic compounds in soils indicates that the locations selected for the monitoring well installations are relatively uncontaminated, both with respect to the number and concentrations of compounds encountered and the guidance (see Appendix F) which NYSDEC established for determining the probable extent of significant migration from the Canal. The chemical data are tabulated in Appendix A and presented graphically on Figures 6-23 and 6-23a (see Appendix G).

Most soil samples showed relatively low concentrations of methylene chloride and acetone as well as bis(2-ethylhexyl)phthalate. The presence of these compounds at such low concentrations may be attributable to laboratory introduced contamination. Only in two instances were contaminants in soils noted at concentrations which exceeded the NYSDEC guidance. These were in borings 9105 and 10105 where the guidance of 10.5 ppb for napthalene was exceeded. Total concentrations for polynuclear aromatic compounds (PNAs) in each of these sample locations were 1268 and 1061 ppb, respectively, indicating fairly weak sources of PNAs. The presence of the PNAs (which are commonly found in ash or unrefined petroleum products) in 10105 may be due to the fact that an old railroad bed was located here and that the contamination detected may be unrelated to contaminants in the Canal. Analyses of soil samples in this vicinity during the Task VA investigation also showed the presence of PNAs. In that study, the soil samples containing the PNAs were also judged to have been of fill materials placed above the natural ground surface.

Dioxin was a parameter of particular interest in the soil sample analyses due to the toxicity attributed to the compound and the fact that it had been detected at several locations in the vicinity of the Canal. Over 80 samples from the perimeter well locations were analyzed for dioxin. No dioxin at above detectable limits was reported. Since the soil matrix can affect the detection limits for individual samples, careful note was taken of the range of detection limits relative to the guidance of 1 ppb of dioxin in soils. The detection limits for the sample ranged from 0.02 to 1.55 ppb. The latter value was the only instance where the detection limit exceeded the guidance of 1 ppb. The average value for the detection limit for dioxins in the soil samples was 0.15 ppb with a standard deviation of 0.21 ppb.

The sewer line boring soil samples were relatively clean except at SB-2 and SB-5. The deep sample in SB-2, near the intersection of Frontier Ave. and 95th Street, showed low concentrations of gamma-BHC (1.6 ppb) and 4,4'-DDT (8.2 ppb). The mid-depth sample in SB-5, near the intersection of Frontier Avenue and the former 99th Street, showed elevated concentrations of several chemicals including Love Canal related compounds. Chief among these were: toluene (340 ppb); chlorobenzene (540 ppb); polychlorinated benzenes and phenols (8600 ppb); PNAs and chlorinated PNAs (6000 ppb); isomers of BHC (3100 ppb); endosulfan I (1721 ppb); and methoxychlor (1953 ppb). The deeper sample in SB-5 showed similar compounds, but at lesser concentrations. These included: chlorobenzene (26 ppb); trichlorobenzene (1010 ppb); chloronaphthalene (660 ppb); benzo(a)pyrene (470 ppb); and alpha-BHC (139 ppb).

6.3.2 Groundwater, Surface Water and Sewer Samples

Water quality data has been compiled and presented in detail in a separate report entitled "Love Canal Long-Term Monitoring Program: First Year Monitoring Data Report" (Jordan, 1987). This report indicates that, while there have been evidences of lateral migration of contaminants away from the Canal (in well 10135, 85 feet outside of the barrier drain), the locations selected for the monitoring wells have shown very little presence of Love Canal related compounds in groundwater. The presence of contaminants in 10135 was consistent with analyses of samples from the 1160 series of piezometers in 1982. While there are few indications of significant contaminants in the groundwater in samples from the perimeter wells, the adequacy of the perimeter monitoring well network will have to be evaluated by the New York State Department of Health.

Surface water samples taken in Black, Bergholtz, and Cayuga Creeks contained trace concentrations of Love Canal related contaminants (such as benzoic acid and BHC). This presence is likely due to known contaminants in creek sediments.

Samples of water from sanitary and storm sewers showed the presence of relatively low levels of Love Canal related chemicals, although one sample was reported to have 4.8 ppb of alpha-BHC. The presence of these compounds at the low concentrations encountered is not surprising even though sewers have recently been extensively cleaned in the Love Canal area. It would be difficult to remove all contaminants from previously high concentrations to non-detectable levels. It should also be noted that only one round of sampling of surface water and sewers was done. Any final assessment of the data should await additional data for confirmation of the presence and concentrations of contaminants.

7.0 GROUNDWATER MODELING

The Task VB monitoring program design used groundwater flow modeling as a tool for understanding the hydrogeology of the site. The modeling assumed a simple geology and uniform hydrogeologic properties within geologic units based on the limited information then available. (See "Love Canal Remedial Project: Long-Term Monitoring Program Design", Jordan, April, 1985). The Task VC project included a subtask to refine the model based on geologic and hydrogeologic information gathered during the Task VC field activities.

The modeling performed in Task VB used the United States Geologic Surveys' (USGS) Trescott-Larsen model. Since then, this model has been updated and reissued as the USGS Modular Flow model. Jordan has included a revision from the older numerical model to the newer one as part of the subtask. The model refinement includes a change of model grid overlaying the site, as well as modifications of the vertical configuration of the model to reflect the recently acquired geologic and hydrogeologic information. The modeling subtask is presented in a separate report, "Love Canal Remedial Project (Task VC): Groundwater Flow Model Update" (Jordan, 1987), due to the additional length it would add to this report and because the subject matter would not be of general interest. The modeling update report reaches no new conclusions regarding the modeling (conclusions were presented in considerable detail in the Task VB report), but simply describes the changeover and the modifications to the data files for future use by NYSDEC.

8.0 CONCLUSIONS

Several conclusions relevant to the objectives of the program can be made based on data collected in Task VC in addition to, or in conjunction with, other data gathered by previous studies and current on-going programs of measurement and evaluation by NYSDEC. The most pertinent of these include the following:

1. A perimeter groundwater monitoring system has been located about the Canal at a distance which appears to be beyond significant migration of Love Canal related compounds relative to NYSDEC guidance for initial placement. Final determinations of the adequacy of this perimeter monitoring system will have to be made by the appropriate New York State agencies.

2. Elevated concentrations of Love Canal related compounds were consistently detected in groundwater samples from well 10135 located about 85 feet outside the barrier drain.

3. No significantly elevated concentrations of Love Canal related compounds were consistently detected in groundwater samples from perimeter monitoring wells. Acetone was frequently reported in groundwater samples from perimeter wells at elevated levels (as high as 9 mg/l). However, it is not established that the acetone is a Love Canal derived compound, nor has any criterion been established for acceptable levels related to risk assessment. No dioxin was detected in soil samples at perimeter well installations, nor at well location 10135 near the Canal.

4. Love Canal related compounds, notably isomers of BHC, were detected in surface water samples (up to 0.12 ppb) and in sewer line water samples (up to 4.87 ppb). The presence of these compounds in surface water may be derived from contaminated sediments. These sediments in creeks are to be removed. However, a program of sewer line cleaning has already been conducted. The presence of these compounds in sewer lines at relatively low levels was not surprising given the large amounts of sediments with high concentrations originally present. Also, the results represent only one round of sampling. Further monitoring of these locations must be done to provide sufficient data for proper assessment.

5. While three rounds of sampling and analysis have been performed for most wells, there are some wells for which the base line data is not complete. An assessment for water quality in these few wells cannot be addressed until the base line is complete.

6. Interpretation of water level data collected for the nested piezometers indicates that the barrier drain exerts a significant influence on groundwater flow in the vicinity of the drain and in all overburden soil strata. While the data have not been gathered over a long enough time period to demonstrate trends, the understanding of the hydrogeology of the site (supported by groundwater flow modeling) suggests that the range of influence of the drain will continue to expand. This is largely a consequence of the combined influence of the expanded cap and the barrier drain.

7. Average annual leachate flows to the treatment plant have decreased 40 percent from pre-expanded cap flow rates to a current average rate of five gallons per minute. The monthly flow data still suggest that the flows are related to precipitation events or periods. Major possible sources for the present flow include seepage from the bedrock to the barrier drain and lateral flow through highly permeable recharge areas beyond the cap to the interceptor trench which contains the drain. A leak at a fire hydrant at the south end of the site near the former 99th Street has also been suggested as a source. Recently installed piezometers at the south end of the Canal will provide data to help determine the relative contributions of possible sources. The leak in the fire hydrant has been repaired.

8. Water level data collected for the shallow bedrock aquifer indicate a present south-southwest groundwater flow direction. However, data collected in the early part of 1985 suggest that the relative magnitude of the factors controlling flow can shift such that flow becomes northerly and easterly. Previous reports indicate a predominantly southerly flow which is the present direction. If this is the case, the bedrock aquifer monitoring wells are appropriately placed to monitor that aquifer.

9. Geologic and hydrogeologic information indicate a wide degree of variability in the character of the till overlying bedrock. This is apparent in the visual observations of the till materials and the calculation of hydraulic conductivity from testing data. The concern for the variability of the till has been addressed by the installation of four wells (7132,

9113, 9118, and 9122) which monitor just the till in areas where the till is thicker and/or more permeable.

10. Contamination was detected in sewer line backfill materials in the storm sewer on the south side of Frontier Avenue near 99th Street (SB-5). The contamination appeared to be limited to this location which is next to and outside the utility cutoff at the south end of 99th Street. Contamination did not appear to be significant in the same sewer line 100 feet further to the east (SB-6).

11. At the locations probed by the Canal borings, the Canal depth ranged from about 7 to 16 feet below original grade. The condition of clays underlying the Canal wastes varied considerably. Some samples showed no apparent impact by the Canal wastes while in other locations, the natural soils underlying the wastes were highly stained, in some instances throughout the length of the 2-foot split spoon sample taken at the bottom of the Canal boring. Where the underlying clays were fractured and NAPL was present, NAPL was found in the fractures of the clay.

12. In some explorations which appeared to be outside the Canal, (CW-100A, CW-100A1, SW-10, DP-10, DP-20, DP-30, and DP-40) NAPL was found to be present in the fractured clay. This suggests some lateral migration of NAPL away from the Canal through the fractured clay.

13. Based on one round of measurements taken in piezometers in the Canal, liquid levels in the Canal vary along the length of the Canal. Some

liquid levels are above the estimated original ground surface which suggests mounding of infiltration at some time in the past. Other measured liquid levels in the Canal are as low as six feet below original ground surface. Current data are insufficient to indicate dewatering rates of the Canal by the barrier drain.

9.0 RECOMMENDATIONS

The Task VC program has provided much data needed in the assessment of present conditions at the Canal, particularly at locations selected for a perimeter monitoring system. This section presents recommendations for schedules for continued data gathering to permit assessment of conditions at the Canal relative to the objectives of the program. In addition, other recommendations are made that, while the resulting data may not significantly add to direct measurement of potential contaminant migration, may provide information which makes the understanding of the site more complete for more accurate determinations of potential risks.

1. Baseline data for HSL organic compounds should continue to be provided at perimeter locations where a complete baseline of at least three analytical events does not yet exist. At other perimeter locations, annual analyses for only HSL volatile organic compounds appears appropriate. Each five years, analysis should be performed for the complete HSL organics parameters. Any significant positive detections at a well should be confirmed with a second sample for analysis. Any location showing significant concentrations of contaminants other than VOA should continue to be analyzed for that parameter until sufficient data exists for an accurate assessment.

2. The frequency and selected parameters of analyses performed for water quality determinations should be reviewed at least every five years and

1.87.34
0104.0.0

whenever any major change is instituted at the Canal (e.g., the proposed storage of contaminated creek sediments at the Canal).

3. Water level data should continue to be collected monthly for at least another year to provide satisfactory baseline data. It may then be possible to specify less frequent measuring events, particularly in wells which evidence little change. For bedrock wells, the aquifer system may warrant frequent sampling as the system appears to be quite dynamic. Quarterly measurement of water levels is recommended as a minimum frequency. The measurement schedule should include all Canal piezometers.

4. The nested piezometers afford an opportunity to directly evaluate the distance of contaminant migration at five locations. A screening for VOA only may provide an accurate first measure of migration since toluene and some chlorinated hydrocarbons are known to be present in high concentrations in the leachate and in some 1160 series piezometers.

5. The degree of hydraulic connection of each well used to measure water levels in the bedrock aquifer should be evaluated. This may be done by installing water level recorders to provide continuous records of fluctuations in the bedrock aquifer caused by the raising and lowering of the River by the Power Authority. This information may be used to help interpret groundwater flow in the fractured bedrock. The more responsive wells can be selected to provide data that eliminates some of the variability that may be due to lags in registering pressure variations.

6. A program of testing to determine hydraulic conductivity of the various geologic units as measured in selected nested piezometers should be instituted to acquire at least three test results in a given well and for several locations about the site for each stratum. Although tests in perimeter wells will not provide point values, they may be used to indicate zones of relatively high or low permeability which will suggest zones of potentially high groundwater flow. Tests conducted in perimeter wells are preferentially rising head tests since upper seals may be well above the water table and introduction of too much clean water into less permeable formations may be difficult to completely purge prior to subsequent sampling events for water quality determinations.

7. A gaging station should be established to continuously monitor the elevation of the Niagara River. This factor may also be related to flows to the treatment plant and interpretation of piezometric data for the bedrock aquifer.

8. The contributions to the total leachate from the various quadrants of the barrier drain system can be determined from individual pump flow rates and duration of pumping. This would help identify more permeable zones in the groundwater regime and sources of flow to the drains. Chemical analyses of samples from different quadrants may also give indications of potentials for migration and qualitative chemical distribution.

APPENDIX A

ANALYTICAL DATA FOR
SOIL SAMPLES

LOVE CANAL
TASK VC
SOIL AND DUPLICATE
SAMPLE ANALYSES

ID	7105S	7105D	7115S	7115D	7117S	7120S	7120D	7125S	7125D	7130S	7130D	7135S	7135D	7140S	7140D
DEPTH(FT)	.3-.8	4.8	3.2-3.4	5.2-5.6	2.0	2.0	5.5	0.5	4.0	0.5	3.5	1.5	5.0	0.4-0.6	4.2-4.4
MOISTURE	9%	24%	20%	18%	23%	23%	7%	14%	4%	21%	7%	37%	48%	18%	22%
pH	7.75	8.47	7.7	7.9	6.8	7.4	8.0	9.10	8.6	8.10	7.49	8.1	7.5	7.2	8.2
DUPLICATE OF					7102S										
COMPOUNDS															
VOA															
METHYLENE CHLORIDE	24 B	19 B	5.7 JB	34 B	7.1 B	9.7 B	11 B	20 B	12 B	13 B	27 B	44 B	10 B	7.0 B	13 B
ACETONE	9.7 J	6.8 J	8.1 JB	7.2 JB	3.9 J			5.5 J	33	7 J	5.8 J	14 JB			
2-BUTANONE															
BENZENE					1.5 J										
TOLUENE															
CHLOROFORM													4.4 JB		
1,1,1-TRICHLOROETHANE															
SVOA															
BIS(2-ETHYLHEXYL)PHTHALATE	78 J	53 J			240 J	280 J	99 J	180 J		820	150 J	450 J	120 J		
DI-N-BUTYLPHTHALATE							150 J			51 J					
DI-N-OCTYLPHTHALATE															
BUTYLBENZYLPHTHALATE															
DIETHYLPHTHALATE											53 J				
FLUORANTHENE						57 J									
PYRENE						57 J				43 J		59 J			
BENZO(a)PYRENE						44 J									
BENZO(a)ANTHRACENE												64 J			
BENZO(b)FLUORANTHENE												59 J			
BENZO(k)FLUORANTHENE												59 J			
PHENANTHRENE															
CHRYSENE															
NAPHTHALENE															
2-METHYLNAPHTHALENE															
1,2,4-TRICHLOROBENZENE															
1,2,3,4-TETRACHLOROBENZENE															
BENZOIC ACID					48 J										
N-NITROSODIPHENYLAMINE					97 J		150 J								
DIELDRIN															
ENDRIN															
PEST/PCB															
4,4'-DDD															
4,4'-DDE						15									
4,4'-DDT															
a-BHC												45			
b-BHC												150			
d-BHC															
g-BHC(LINDANE)															
AROCLOR 1260						72									
DIELDRIN															
CHLORDANE															
DIOXIN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

LOVE CANAL
TASK VC
SOIL AND DUPLICATE
SAMPLE ANALYSES

ID	7141S	7145S	7145D	7150S	7150D	7155S	7155D	7161S	7161D	8106S	8106D	8106T	8107D	8110S	8110D
DEPTH(FT)	4.2-4.4	0.8-1.0	4.6-4.8	0.5-0.8	6.4-6.9	0.8-1.0	4.8	0.0-1.3	2.8-3.4	1.0-1.3	2.2-2.7	13.2-13.8	2.2-2.7	2.8-3.2	5.5-5.8
MOISTURE	21%	14%	21%	21%	32%	19%	6%	21%	17%	17%	15%	13%	15%	17%	17%
pH	8.5	8.4	8.4	7.3	7.0	7.68	7.5	8.1	8.4	8.4	8.2	8.5	8.0	6.7	8.2
DUPLICATE OF	7140S												8106D		
COMPOUNDS															
VOA															
METHYLENE CHLORIDE	8.9 B	57 B	14 B	13	23 B	9.5 B	89 B	12 B	13 B	24 B	46 B	38 B	11 B	21 B	16 B
ACETONE		250 B		6.9 JB	140 B			5 JB	14 B	14 B	8.3 JB	860 B	5.2 JB	12 JB	6.8 JB
2-BUTANONE					16				4.1 JB	4.6 JB			4 JB	4.9 JB	4.2 JB
BENZENE															
TOLUENE															
CHLOROFORM								1.4 J							
1,1,1-TRICHLOROETHANE				2.7 J											
SVOA															
BIS(2-ETHYLHEXYL)PHTHALATE	51					130 J	82 J	100 JB		200 JB	3800 B	38 JB	56 JB	220 JB	91 JB
DI-N-BUTYLPHTHALATE						46 J					47 J				
DI-N-OCTYLPHTHALATE											200 J				
BUTYLBENZYLPHTHALATE															
DIETHYLPHTHALATE															
FLUORANTHENE				69 J											
PYRENE				60 J											
BENZO(a)PYRENE															
BENZO(a)ANTHRACENE															
BENZO(b)FLUORANTHENE															
BENZO(k)FLUORANTHENE															
PHENANTHRENE				47 J											
CHRYSENE				73 J											
NAPHTHALENE															
2-METHYLNAPHTHALENE															
1,2,4-TRICHLOROBENZENE															
1,2,3,4-TETRACHLOROBENZENE															
BENZOIC ACID															
N-NITROSODIPHENYLAMINE															
DIELDRIN															
ENDRIN															
PEST/PCB															
4,4'-DDD															
4,4'-DDE				5.8											
4,4'-DDT				8.7											
a-BHC															
b-BHC															
d-BHC															
g-BHC(LINDANE)															
AROCLOR 1260															
DIELDRIN															
CHLORDANE															
DIOXIN	ND(0.74)	ND([illegible])		ND([illegible])	ND([illegible])	ND([illegible])	ND([illegible])	ND([illegible])	ND([illegible])	ND(0.10)	ND(0.14)	ND(0.09)	ND([illegible])	ND([illegible])	ND([illegible])

LOVE CANAL
TASK VC
SOIL AND DUPLICATE
SAMPLE ANALYSES

ID	8113S	8115S	8115D	8120S	8120D	8123D	8125S	8125D	8127S	8130S	8130D	8140S	8140D	8140T	9105S	9105D
DEPTH(FT)	3.0	3.0	4.0	0.7	2.5	4.5	0.25	4.5	0.0-1.0	0.0-1.0	4.5	1.0-1.5	5.0	1.0	0.5	4.5
MOISTURE	17%	15%	0%	22%	7%	0%	2%	0%	31%	10%	19%	26%	12%	NA	9%	6%
pH	7.89	8.1	8.2	6.8	7.4	8.42	8.11	8.37	7.45	7.44	8.30	7.7	8.43	NA	8.19	8.45
DUPLICATE OF	8115S					8125D			8130S							
COMPOUNDS																
VOA																
METHYLENE CHLORIDE	12 B	7.4 B	4.5 JB	11 B	5.0 JB	11 B	9.6 B	9.6 B	9.2 B	32 B	74 B	35 B	4.8 JB		36 B	9.8 B
ACETONE	5.3 J					7.6 JB		8.1 JB	20	8.5 JB	3000		160		49	40
2-BUTANONE																
BENZENE																
TOLUENE																
CHLOROFORM						1.2 J	1.1 JB	1.9 J				2.6 J				
1,1,1-TRICHLOROETHANE												4.8 J				
SVOA																
BIS(2-ETHYLHEXYL)PHTHALATE	94 J	110 J			120 J			56 J	63 J	5200	58 J	64 J		140 J	230 J	160 J
DI-N-BUTYLPHTHALATE		75 J	37 J	120 J						240 J					36 J	
DI-N-OCTYLPHTHALATE										820						
BUTYLBENZYLPHTHALATE										260 J						
DIETHYLPHTHALATE														37 J		
FLUORANTHENE									73 J						66 J	
PYRENE				52 J					88 J						100 J	
BENZO(a)PYRENE															66 J	
BENZO(a)ANTHRACENE															66 J	
BENZO(b)FLUORANTHENE									98 J						230 J	
BENZO(k)FLUORANTHENE									98 J						230 J	
PHENANTHRENE																
CHRYSENE															110 J	
NAPHTHALENE															160 J	
2-METHYLNAPHTHALENE															240 J	
1,2,4-TRICHLOROBENZENE																
1,2,3,4-TETRACHLOROBENZENE																
BENZOIC ACID																
N-NITROSODIPHENYLAMINE			37 J	65 J	44 J											
DIELDRIN																
ENDRIN																
PEST/PCB																
4,4'-DDD																
4,4'-DDE																
4,4'-DDT									12			10				
a-BHC																
b-BHC																
d-BHC																
g-BHC(LINDANE)																
AROCLOR 1260																
DIELDRIN									22							
CHLORDANE									64							
DIOXIN	ND(0.07)	ND(0.14)	ND(0.03)	ND(0.09)	ND(0.08)	ND(0.02)	ND(0.05)	ND(0.02)	ND(0.07)	ND(0.03)	ND(0.04)	ND(0.07)	ND(0.04)	ND(0.04)	ND(0.02)	ND(0.08)

LOVE CANAL
TASK VC
SOIL AND DUPLICATE
SAMPLE ANALYSES

ID	9110S	9110D	9115S	9115D	9120S	9120D	9120T	9125S	9125D	9130S	9130D	9140S	9140D	10105S	10105D
DEPTH(FT)	0.5-1.0	5.0	1.8-2.2	4.3-4.7	0.5-0.9	5.0	18.0-18.5	0.3-0.4	4.0	0.0-1.0	4.7	8.0-8.5	8.5-9.5	2.0	8.5
MOISTURE	22%	15%	18%	24%	17%	9%	9%	18%	21%	17%	19%	21%	21%	31%	17%
pH	7.9	8.55	NA	ND	7.8	8.54	8.60	7.9	8.33	8.1	8.0	8.2	8.2	8.1	8.0
DUPLICATE OF															
COMPOUNDS															
VOA															
METHYLENE CHLORIDE	93 B	12 B	22 B	13 B	18 B	9.3 B	610 B	23 B	43 B	20 B	12 B	8.2 B	18 B	14 B	13 B
ACETONE	12	140	9 JB	3600 B		47 B	9200 B		630	42	38	94	62	36	43
2-BUTANONE			7.3 JB				4500 B								
BENZENE															
TOLUENE															
CHLOROFORM	1.5 J		3 J	2.8 J					4.2 JB	2.5 J	2.3 J				
1,1,1-TRICHLOROETHANE															
SVOA															
BIS(2-ETHYLHEXYL)PHTHALATE	70 J		93 JB	100 JB	61 J	210 J	65 J	74 J	43 J	160 J		47 J		410 J	
DI-N-BUTYLPHTHALATE						52 J									
DI-N-OCTYLPHTHALATE						140 J									
BUTYLBENZYLPHTHALATE								130 J							
DIETHYLPHTHALATE											68 J				
FLUORANTHENE								110 J						180 J	
PYRENE								110 J						170 J	
BENZO(a)PYRENE								83 J							
BENZO(a)ANTHRACENE								91 J						120 J	
BENZO(b)FLUORANTHENE								150 J							
BENZO(k)FLUORANTHENE								74 J						160 J	
PHENANTHRENE								99 J						150 J	
CHRYSENE								91 J						150 J	
NAPHTHALENE														54 J	
2-METHYLNAPHTHALENE								50 J						78 J	
1,2,4-TRICHLOROBENZENE															
1,2,3,4-TETRACHLOROBENZENE															
BENZOIC ACID															
N-NITROSODIPHENYLAMINE										49 J		60 J	60 J		
DIELDRIN															
ENDRIN															
PEST/PCB															
4,4'-DDD															
4,4'-DDE										4.5 J				2.4 J	
4,4'-DDT	27									5.7				9.3	
a-BHC															
b-BHC															
d-BHC															
g-BHC(LINDANE)															
AROCLOR 1260															
DIELDRIN															
CHLORDANE															
DIOXIN	ND(0.07)	ND(0.07)	ND(0.07)	ND(0.16)	ND(0.12)	ND(0.09)	ND(0.06)	ND(0.12)	ND(0.06)	ND(0.12)	ND(0.23)	ND(0.15)	ND(0.18)	ND(0.12)	(0.25)

LOVE CANAL
TASK VC
SOIL AND DUPLICATE
SAMPLE ANALYSES

ID	10113S	10113D	DUP-1S	DUP-1D	10115S	10115D	10115T	10125S	10125D	10127D	10130S	10130D	10135S	10135D	10140S
DEPTH(FT)	0.2-1.0	4.6-5.0	0.2-1.0	4.6-5.0	4.2-5.2	8.0-10.0	30.5-31.5	1.0-1.6	5.1-5.5	4.6	2.0	4.6	2.8	4.7	1.1
MOISTURE	22%	17%	17%	13%	3%	22%	16%	20%	22%	13%	16%	15%	14%	15%	27%
pH	7.8	8.6	7.5	8.6	8.4	8.5	8.5	8.0	8.3	8.18	7.9	8.26	8.0	8.2	6.9
DUPLICATE OF			10113S	10113D						10130D					
COMPOUNDS															
VOA															
METHYLENE CHLORIDE	10 B	161 B	8.0 B	10 B	18 B	15 B	7.4 B	8.7 B	10 B	44 B	6.1 B	9.5 B	19 B	21 B	30
ACETONE		1300 B	8.0 JB	20 B	25 B	430	50 B	31	16			2.4 J	5.7 JB	12 B	22
2-BUTANONE		190													
BENZENE			0.2 JB	0.3 JB											
TOLUENE			2.0 J											1.5 J	
CHLOROFORM								2.4 J	1.7 J						
1,1,1-TRICHLOROETHANE			0.5 JB												
SVOA															
BIS(2-ETHYLHEXYL)PHTHALATE	420 J	680 J		980	360	940				610	330 J	810		96	
DI-N-BUTYLPHTHALATE									43 J		89 J				706 B
DI-N-OCTYLPHTHALATE															
BUTYLBENZYLPHTHALATE															
DIETHYLPHTHALATE															
FLUORANTHENE													67		
PYRENE													63 J		
BENZO(a)PYRENE															
BENZO(a)ANTHRACENE															
BENZO(b)FLUORANTHENE															
BENZO(k)FLUORANTHENE															
PHENANTHRENE															
CHRYSENE															
NAPHTHALENE															
2-METHYLNAPHTHALENE															
1,2,4-TRICHLOROBENZENE													82 J		
1,2,3,4-TETRACHLOROBENZENE													160 J		
BENZOIC ACID															
N-NITROSODIPHENYLAMINE					35 J	70 J	44 J		43 J						
DIELDRIN															2.10 J
ENDRIN															2.30 J
PEST/PCB															
4,4'-DDD															
4,4'-DDE	2.08 J							10							
4,4'-DDT								7.6							
a-BHC	1.04 J		0.97 J	2.32 J									120	6.1	
b-BHC														5.3	
d-BHC													53	4.0	
g-BHC(LINDANE)													68	3.1	
AROCLOR 1260															
DIELDRIN															
CHLORDANE															
DIOXIN					ND(0.22)	ND(0.17)	ND(0.41)	ND(0.11)	ND(0.20)	ND(0.64)	ND(0.06)	ND(0.05)	ND(0.37)	ND(0.25)	

LOVE CANAL
TASK VC
SOIL AND DUPLICATE
SAMPLE ANALYSES

ID	101400	101450	10150S	101500	SB-1S	SB-1D	SB-2S	SB-2D	SB-2A	SB-4S	SB-4D	SB-6S	SB-6D
DEPTH(FT)	5.6	2.0	1.0	4.5	4.0-6.0	8.0-10.0	3.5-4.0	8.2-8.7	3.5-4.0	3.5-3.7	8.0-8.4	6.0	10.0
MOISTURE	21%	4%	24%	16%	7%	4%	15%	22%	17%	17%	21%	19%	7%
pH	7.9	7.6	7.7	8.4	8.0		8.4	8.3	8.5	8.1	8.3	8.9	9.1
DUPLICATE OF									SB-2S				
COMPOUNDS													
VOA													
METHYLENE CHLORIDE		6.0 B	8.6 B	9.2 B	20 B	10 B	4.1 JB	110 B	21 B	100 B	34 B	29	11 B
ACETONE		5.9 JB			200	6.5 JB			390	100 B	420 B	18	82 B
2-BUTANONE		3.5											
BENZENE													
TOLUENE											1.6 J		
CHLOROFORM						2.0 JB							
1,1,1-TRICHLOROETHANE												2.0 J	2 J
SVOA													
BIS(2-ETHYLHEXYL)PHTHALATE		140 JB	230 J	300 J		74 J		48 J			170 J	1200	770 B
DI-N-BUTYLPHTHALATE	730 B			52 J									
DI-N-OCTYLPHTHALATE													
BUTYLBENZYLPHTHALATE													
DIETHYLPHTHALATE													
FLUORANTHENE			160J										
PYRENE			150 J										
BENZO(a)PYRENE			72 J										
BENZO(a)ANTHRACENE			86 J										
BENZO(b)FLUORANTHENE			180 J										
BENZO(k)FLUORANTHENE													
PHENANTHRENE			81 J										
CHRYSENE			150 J										
NAPHTHALENE													
2-METHYLNAPHTHALENE													
1,2,4-TRICHLOROBENZENE													
1,2,3,4-TETRACHLOROBENZENE													
BENZOIC ACID													
N-NITROSODIPHENYLAMINE													
DIELDRIN													
ENDRIN													
PEST/PCB													
4,4'-DDD			23										
4,4'-DDE			12										
4,4'-DDT			40					8.2					
a-BHC													0.87 J
b-BHC													
d-BHC													
g-BHC(LINDANE)								1.6 J					
AROCLOR 1260													
DIELDRIN													
CHLORDANE													
DIOXIN		ND(0.11)	ND(0.32)	ND(0.04)	ND(0.18)	ND(0.08)	ND(0.10)	ND(0.57)	ND(0.13)	ND(0.08)	ND([illegible])		

LOVE CANAL
TASK VC
SOIL SAMPLE ANALYSES

COMPOUNDS		
ID	SB-5S	SB-5D
DEPTH	6.0	10.0
MOISTURE	17%	19%
pH	8.8	8.5
VOA		
METHYLENE CHLORIDE	7 B	8 B
ACETONE	160 B	54 B
BENZENE	22 B	
TOLUENE	340	6
CHLOROBENZENE	540	26
SVOA		
1,4-DICHLOROBENZENE	2300	
1,2-DICHLOROBENZENE	703	
2,4-DICHLOROPHENOL	2700	
1,2,4-TRICHLOROBENZENE	2900	1010
NAPHTHALENE	720	
4-CHLORO-3-METHYLPHENOL	880	
2-CHLORONAPHTHALENE	3500	660 J
4-NITROPHENOL	1200J	
DIBENZOFURAN	400 J	
2,4-DINITROTOLUENE	3900	
PHENANTHRENE	360	
FLUORANTHENE	470 J	
BIS(2-EH)PHTHALATE	2200	820
BENZO(a)PYRENE		470 J
PEST/PCB		
a-BHC	3041.84	139.67
b-BHC	74.14 J	
ENDOSULFAN I	1721.17	
METHOXYCHLOR	1953.08	
DIOXIN		

APPENDIX B

GEOLOGIC AND SURVEY DATA

LOVE CANAL REMEDIAL PROJECT PF
TASK VC LONG TERM MONITORING
BORING AND WELL DATA

BORING & WELL ID	X NORTH COORD.	Y EAST COORD.	GROUND ELEV. (ft.)	TOP OF RISER ELEV. (ft.)	FILL THICK (ft.)	STIFF CLAY ELEV. (ft.)	STIFF CLAY THICK (ft.)	SOFT CLAY ELEV. (ft.)	SOFT CLAY THICK (ft.)	TILL ELEV. (ft.)	TILL THICK (ft.)	DOLOM ELEV. (ft.)	BOTTOM BORING (ft.)	BOTTOM BORING ELEV. (ft.)	BOTTOM SCREEN DEPTH (ft.)	BOTTOM SCREEN ELEV. (ft.)	TOP SCREEN DEPTH (ft.)	TOP SCREEN ELEV. (ft.)	SAND INTERVAL TOP ELEV. (ft.)	SAND INTERVAL BOTTOM ELEV. (ft.)
7105	1122663	401752	574.8	577.80	5.0	569.8	4.0	565.8	17.7	548.1	****	****	31.5	543.3	31.0	543.8	21.0	553.8	569.0	543.3
7115	1122965	401751	574.7	578.66	5.4	569.3	5.5	563.8	16.0	547.8	****	****	33.0	541.7	31.1	543.6	21.1	553.6	570.7	541.7
7120	1123250	401746	575.0	577.89	5.5	569.5	5.5	564.0	15.0	549.0	****	****	31.2	543.8	30.3	544.7	20.3	554.7	569.0	543.8
7125	1123536	401723	574.3	577.43	4.0	570.3	4.0	566.3	12.5	553.8	****	****	26.5	547.8	24.5	549.8	14.5	559.8	568.3	548.8
7130	1123916	401731	574.3	576.74	3.5	570.8	8.5	562.3	8.5	553.8	****	****	28.0	546.3	27.0	547.3	17.0	557.3	569.3	564.3
7132	1124055	401770	574.6	577.41	2.5	572.1	6.8	565.3	8.2	557.1	****	****	29.0	545.6	28.0	546.6	22.7	551.9	553.6	545.6
7135	1125017	400902	573.4	576.55	7.0	566.4	7.0	559.4	8.8	550.6	****	****	26.0	547.4	25.5	547.9	15.5	557.9	568.4	547.4
7140	1125221	401236	573.5	576.73	4.0	569.5	10.0	559.5	9.7	549.8	****	****	25.3	548.2	24.9	548.6	14.9	558.6	569.5	548.2
7145	1125248	400794	573.9	577.25	4.8	569.1	8.0	561.1	8.7	552.4	****	****	25.3	548.6	24.8	549.1	14.7	559.2	569.9	548.6
7150	1125025	400597	574.2	577.34	7.0	567.2	7.0	560.2	8.2	552.0	****	****	25.7	548.5	25.3	548.9	15.3	558.9	570.2	548.5
7155	1124174	401812	573.2	576.37	4.0	569.2	7.0	562.2	10.5	551.7	****	****	26.9	546.3	25.6	547.6	15.6	557.6	567.5	546.3
7161	1124245	402071	573.0	576.54	2.0	571.0	4.5	566.5	9.5	557.0	****	****	21.5	551.5	21.7	551.3	11.7	561.3	568.0	551.3
8106	1124277	402577	573.1	575.76	3.0	570.1	9.0	561.1	6.0	555.1	****	****	18.0	555.1	17.3	555.8	7.3	565.8	567.5	555.8
8110	1123967	402431	576.5	579.19	6.0	570.5	7.0	563.5	10.0	553.5	****	****	27.0	549.5	24.0	552.5	13.7	562.8	572.0	551.5
8115	1123774	402509	574.6	577.99	4.0	570.6	7.0	563.6	9.0	554.6	****	****	29.2	545.4	27.9	546.7	17.4	557.2	569.3	547.6
8120	1123580	402621	573.6	576.47	2.5	571.1	9.0	562.1	10.5	551.6	****	****	28.5	545.1	28.0	545.6	18.0	555.6	567.8	545.1
8125	1123275	402618	573.6	577.46	2.5	571.1	8.5	562.6	15.0	547.6	****	****	28.0	545.6	27.6	546.0	17.6	556.0	567.8	545.6
8130	1122980	402610	574.6	578.48	4.5	570.1	6.5	563.6	16.0	547.6	****	****	30.2	544.4	29.5	545.1	19.5	555.1	568.8	544.3
8135	1122723	402606	574.7	NA	5.5	569.2	7.5	561.7	13.5	548.2	****	****	28.0	546.7	NA	NA	NA	NA	NA	NA
8140	1122517	402603	574.7	578.22	5.0	569.7	6.0	563.7	17.0	546.7	****	****	32.0	542.7	31.0	543.7	21.0	553.7	567.9	542.7
9105	1122279	402598	573.9	577.07	4.5	569.4	6.5	562.9	13.0	549.9	****	****	29.9	544.0	29.3	544.6	19.3	554.6	568.3	544.0
9110	1122028	402598	573.9	576.88	5.0	568.9	6.0	562.9	8.0	554.9	****	****	24.5	549.4	24.0	549.9	14.0	559.9	568.0	549.4
9113	1121872	402594	573.4	576.30	4.0	569.4	7.8	561.6	5.7	555.9	****	****	35.6	537.8	34.0	539.4	23.5	549.9	551.4	539.0
9115	1121716	402587	574.0	577.16	7.3	566.7	5.0	561.7	7.5	554.2	****	****	19.5	554.5	17.9	556.1	7.9	566.1	570.5	555.9
9118	1121565	402589	574.1	576.67	4.0	570.1	6.0	564.1	6.0	558.1	****	****	36.0	538.1	33.8	540.3	23.3	550.8	ERR	539.9
9120	1121416	402586	574.2	576.97	4.5	569.7	6.5	563.2	8.0	555.2	****	****	21.0	553.2	20.5	553.7	10.5	563.7	568.0	555.2
9122	1121271	402586	573.3	575.89	4.0	569.3	7.3	562.0	6.7	555.3	****	****	34.5	538.8	33.6	539.7	21.5	551.8	555.9	539.3
9125	1121119	402589	573.5	516.54	4.0	569.5	5.0	564.5	10.5	554.0	****	****	26.0	547.5	23.9	549.6	13.9	559.6	567.3	547.5
9130	1120802	402524	574.3	576.77	5.5	568.8	5.5	563.3	14.0	549.3	****	****	31.0	543.3	30.5	543.8	20.5	553.8	570.4	543.3
9140	1120795	402145	578.9	578.24	9.5	569.4	6.5	562.9	10.5	552.4	****	****	29.5	549.4	29.0	549.9	19.0	559.9	573.9	549.4
10105	1120904	401906	577.3	577.05	8.5	568.8	5.5	563.3	11.0	552.3	****	****	30.5	546.8	29.3	548.0	19.3	558.0	571.8	547.0
10112	1120693	401774	577.8	NA	7.0	570.8	7.0	563.8	13.0	550.8	****	****	29.2	548.6	NA	NA	NA	NA	NA	NA
10113	1120887	401752	573.4	573.22	2.9	570.5	5.5	565.0	16.0	549.0	****	****	28.2	545.2	27.8	545.6	17.1	556.3	569.9	545.2
10115	1121166	401702	575.1	578.14	6.0	569.1	8.0	561.1	12.5	548.6	****	****	33.7	541.4	32.7	542.4	22.7	552.4	572.1	541.3
10125	1121413	401744	575.1	578.51	5.3	569.8	7.7	562.1	13.0	549.1	****	****	28.5	546.6	30.4	544.7	20.4	554.7	570.8	544.1
10130	1121640	401741	574.2	577.10	6.5	567.7	4.5	563.2	13.5	549.7	****	****	28.6	545.6	28.0	546.2	18.0	556.2	568.5	545.6
10135	1121789	401914	577.1	580.35	8.0	569.1	5.0	564.1	11.0	553.1	****	****	29.8	547.3	29.5	547.6	19.5	557.6	573.3	547.3
10140	1121908	401715	574.7	577.76	3.2	571.5	11.8	559.7	15.0	544.7	****	****	29.0	545.7	28.2	546.5	18.2	556.5	570.2	546.2
10145	1122108	401723	574.0	577.10	4.0	570.0	7.0	563.0	15.0	548.0	****	****	33.4	540.6	32.8	541.2	22.8	551.2	568.3	540.6
10150	1122407	401741	574.2	576.87	7.0	567.2	7.0	560.2	12.5	547.7	****	****	32.2	542.0	31.0	543.2	21.0	553.2	568.5	542.1
1150A	1121033	402009	576.5	579.80	7.8	568.7	4.4	564.3	12.2	552.1	****	****	27.4	549.1	27.0	549.5	26.0	550.5	551.1	549.1
1150B	1121025	402010	576.1	578.08	7.3	568.8	4.5	564.3	12.2	552.1	****	****	18.5	557.6	18.0	558.1	17.0	559.1	559.6	557.6

LOVE CANAL REMEDIAL PROJECT PF
TASK VC LONG TERM MONITORING
BORING AND WELL DATA

BORING & WELL ID	X NORTH COORD.	Y EAST COORD.	GROUND ELEV. (ft.)	TOP OF RISER ELEV. (ft.)	FILL THICK (ft.)	STIFF CLAY ELEV. (ft.)	STIFF CLAY THICK (ft.)	SOFT CLAY ELEV. (ft.)	SOFT CLAY THICK (ft.)	TILL ELEV. (ft.)	TILL THICK (ft.)	DOLOM ELEV. (ft.)	BOTTOM BORING (ft.)	BOTTOM BORING ELEV. (ft.)	BOTTOM SCREEN DEPTH (ft.)	BOTTOM SCREEN ELEV. (ft.)	TOP SCREEN DEPTH (ft.)	TOP SCREEN ELEV. (ft.)	SAND INTERVAL TOP ELEV. (ft.)	SAND INTERVAL BOTTOM ELEV. (ft.)
1151A	1120966	402002	575.2	578.06	7.1	568.1	5.8	562.3	10.5	551.8	####	####	27.7	547.5		575.2		575.2	575.2	547.5
1151B	1120962	402008	575.2	578.08	7.1	568.1	5.8	562.3	10.5	551.8	####	####	18.7	556.5	18.5	556.7	17.5	557.7	558.7	556.5
1151C	1120960	402014	575.1	578.27	7.0	568.1	6.0	562.1	10.5	551.6	####	####	14.5	560.6	14.0	561.1	13.0	562.1	563.2	560.6
1151D	1120958	402020	575.2	578.36	7.1	568.1	6.0	562.1	10.5	551.6	####	####	6.9	568.3	5.9	569.3	5.0	570.2	572.2	568.1
1153A	1120861	401998	577.7	577.46	8.1	569.6	6.3	563.3	11.5	551.8	####	####	32.0	545.7	31.0	546.7	30.0	547.7	548.8	546.7
1153B	1120867	401985	577.5	576.67	7.9	569.6	6.3	563.3	11.5	551.8	####	####	21.2	556.3	21.2	556.3	20.2	557.3	558.3	556.3
1153C	1120864	401991	577.6	577.68	8.0	569.6	6.5	563.1	11.5	551.6	####	####	21.0	556.6	15.5	562.1	14.5	563.1	564.6	561.6
1153D	1120870	401977	577.7	577.31	8.1	569.6	6.3	563.3	11.5	551.8	####	####	11.0	566.7	11.5	566.2	10.5	567.2	568.2	566.0
1153E	1120874	401971	577.4	576.80	8.1	569.3	6.3	563.0	11.5	551.5	####	####	9.0	568.4	8.4	569.0	7.3	570.1	570.5	568.4
1154A	1120780	401965	574.6	572.87	5.0	569.6	6.5	563.1	10.0	553.1	####	####	29.0	545.6	27.0	547.6	26.0	548.6	549.5	547.6
1154B	1120784	401977	574.5	573.93	4.9	569.6	6.5	563.1	10.0	553.1	####	####	17.6	556.9	17.5	557.0	16.5	558.0	559.0	556.9
1154C	1120786	401972	574.4	574.03	4.8	569.6	6.5	563.1	10.0	553.1	####	####	13.5	560.9	13.5	560.9	12.5	561.9	562.9	560.9
1154D	1120788	401968	574.3	573.81	4.7	569.6	6.5	563.1	10.0	553.1	####	####	7.0	567.3	7.0	567.3	6.0	568.3	569.3	567.1
1161E	1121611	401989	580.7	583.81	###	####	####	####	####	####	####	####	27.9	552.8	27.7	553.0	26.7	554.0	554.9	552.8
1170A	1123025	402062	581.2	584.68	13.1	568.1	6.8	561.3	15.1	546.2	####	####	37.4	543.8	37.0	544.2	36.0	545.2	545.8	543.8
1170B	1123011	402058	581.3	584.56	13.2	568.1	7.0	561.1	15.0	546.1	####	####	25.6	555.7	25.0	556.3	24.0	557.3	557.8	555.6
1171A	1123025	402037	580.2	583.37	12.1	568.1	5.8	562.3	16.6	545.7	####	####	37.3	542.9	37.1	543.1	36.0	544.2	544.7	542.9
1171B	1123008	402036	580.4	583.63	12.3	568.1	5.8	562.3	16.6	545.7	####	####	25.0	555.4	24.5	555.9	23.5	556.9	557.4	555.4
1171C	1122997	402036	580.2	583.26	12.3	567.9	5.8	562.1	16.6	545.5	####	####	30.6	549.6	30.4	549.8	29.4	550.8	552.3	549.6
1172A	1123020	401988	578.5	581.73	8.3	570.2	8.7	561.5	15.4	546.1	####	####	35.1	543.4	34.5	544.0	33.5	545.0	545.6	543.4
1172B	1123008	401987	578.6	581.78	8.4	570.2	8.5	561.7	15.4	546.3	####	####	25.1	553.5	24.0	554.6	23.0	555.6	556.6	554.1
1172C	1122995	401987	578.5	581.77	8.3	570.2	8.7	561.5	15.4	546.1	####	####	18.5	560.0	18.0	560.5	17.0	561.5	562.5	560.0
1173A	1123022	401906	575.3	578.14	5.9	569.4	7.0	562.4	15.0	547.4	####	####	30.8	544.5	29.9	545.4	28.9	546.4	546.9	544.5
1173B	1123011	401897	575.3	578.36	5.9	569.4	7.0	562.4	15.0	547.4	####	####	20.5	554.8	20.0	555.3	19.0	556.3	556.9	544.8
1173C	1122998	401897	575.3	578.45	5.9	569.4	7.0	562.4	15.0	547.4	####	####	12.5	562.8	12.0	563.3	11.0	564.3	564.8	562.8
1173D	1122990	401897	575.5	578.60	6.1	569.4	7.1	562.3	15.0	547.3	####	####	7.0	568.5	6.5	569.0	5.5	570.0	570.7	568.5
1174A	1123016	401820	574.5	577.77	8.2	566.3	6.7	559.6	11.5	548.1	####	####	29.7	544.8	29.7	544.8	28.7	545.8	547.5	544.8
1174B	1123009	401820	574.6	577.73	8.3	566.3	6.7	559.6	11.5	548.1	####	####	18.2	556.4	18.0	556.6	17.0	557.6	558.4	556.3
1174C	1123000	401820	574.6	578.14	8.3	566.3	6.7	559.6	11.5	548.1	####	####	13.5	561.1	13.5	561.1	12.5	562.1	563.1	561.1
1174D	1122991	401821	574.6	577.78	8.3	566.3	6.7	559.6	11.5	548.1	####	####	7.5	567.1	7.5	567.1	6.5	568.1	569.1	567.1
1180A	1124155	402245	579.4	582.59	11.0	568.4	6.6	561.8	5.0	556.8	####	####	32.6	546.8	31.5	547.9	30.5	548.9	549.6	546.8
1180B	1124152	402236	579.5	582.47	11.1	568.4	6.6	561.8	5.0	556.8	####	####	21.6	557.9	21.1	558.4	20.1	559.4	560.1	557.9
1180C	1124149	402225	579.7	583.27	11.1	568.6	6.6	562.0	5.0	557.0	####	####	17.1	562.6	16.5	563.2	15.5	564.2	564.9	562.6
1181A	1124201	402285	574.0	576.81	6.5	567.5	7.0	560.5	3.0	557.5	####	####	24.0	550.0	24.0	550.0	23.0	551.0	552.0	549.5
1181B	1124201	402278	574.0	577.15	6.5	567.5	7.0	560.5	3.0	557.5	####	####	16.5	557.5	16.0	558.0	15.0	559.0	560.1	557.5
1181C	1124201	402270	574.1	577.07	6.6	567.5	7.0	560.5	3.0	557.5	####	####	11.3	562.8	11.3	562.8	10.3	563.8	565.1	562.8
1183A	1124266	402350	573.8	576.62	8.1	565.7	5.0	560.7	4.7	556.0	####	####	24.4	549.4	23.5	550.3	22.5	551.3	551.7	549.3
1183B	1124266	402343	573.8	576.54	8.1	565.7	5.0	560.7	4.7	556.0	####	####	17.0	556.8	16.5	557.3	15.5	558.3	558.8	556.8
1183C	1124265	402333	573.8	577.33	8.1	565.7	5.0	560.7	4.7	556.0	####	####	11.0	562.8	10.9	562.9	9.0	564.8	566.8	562.8
1183D	1124264	402325	573.8	576.91	8.1	565.7	5.0	560.7	4.7	556.0	####	####	7.5	566.3	7.0	566.8	6.0	567.8	568.3	566.3

LOVE CANAL REMEDIAL PROJECT PF
TASK VC LONG TERM MONITORING
BORING AND WELL DATA

BORING & WELL ID	X NORTH COORD.	Y EAST COORD.	GROUND ELEV. (ft.)	TOP OF RISER ELEV. (ft.)	FILL THICK (ft.)	STIFF CLAY ELEV. (ft.)	STIFF CLAY THICK (ft.)	SOFT CLAY ELEV. (ft.)	SOFT CLAY THICK (ft.)	TILL ELEV. (ft.)	TILL THICK (ft.)	DOLOM ELEV. (ft.)	BOTTOM BORING (ft.)	BOTTOM BORING ELEV. (ft.)	BOTTOM SCREEN DEPTH (ft.)	BOTTOM SCREEN ELEV. (ft.)	TOP SCREEN DEPTH (ft.)	TOP SCREEN ELEV. (ft.)	SAND INTERVAL TOP ELEV. (ft.)	SAND INTERVAL BOTTOM ELEV. (ft.)
1184A	1124430	402389	572.3	575.08	2.0	570.3	7.5	562.8	5.5	557.3	####	####	23.2	549.1	22.7	549.6	21.5	550.8	551.3	549.1
1184B	1124442	402391	571.9	575.54	2.0	569.9	7.5	562.4	5.5	556.9	####	####	15.5	556.4	14.9	557.0	14.0	557.9	558.4	556.4
1184C	1124430	402399	572.2	575.08	2.0	570.2	7.5	562.7	5.5	557.2	####	####	9.8	562.4	9.5	562.7	8.5	563.7	564.2	562.4
1184D	1124440	402400	571.9	574.95	2.0	569.9	7.5	562.4	5.5	556.9	####	####	5.0	566.9	4.5	567.4	3.5	568.4	568.9	566.9
1190A	1123016	402224	583.0	586.53	13.3	569.7	5.9	563.8	19.2	544.6	####	####	40.5	542.5	40.2	542.8	39.2	543.8	544.6	542.5
1190B	1123023	402223	583.1	586.22	13.4	569.7	5.7	564.0	19.2	544.8	####	####	27.4	555.7	27.0	556.1	26.0	557.1	558.2	555.6
1191A	1123024	402249	582.0	584.91	12.0	570.0	6.0	564.0	18.4	545.6	####	####	38.0	544.0	38.0	544.0	37.0	545.0	545.3	543.6
1191B	1123014	402249	582.0	584.90	12.0	570.0	6.0	564.0	18.4	545.6	####	####	38.9	543.1	24.5	557.5	23.5	558.5	559.5	557.0
1191C	1123036	402251	582.1	585.18	12.0	570.1	6.0	564.1	18.4	545.7	####	####	32.3	549.8	31.1	551.0	30.1	552.0	553.1	550.6
1192A	1123026	402301	580.3	583.43	11.3	569.0	5.2	563.8	18.0	545.8	####	####	36.3	544.0	36.2	544.1	35.2	545.1	545.8	543.8
1192B	1123015	402301	580.3	583.46	11.3	569.0	5.2	563.8	18.0	545.8	####	####	36.3	544.0	23.4	556.9	22.4	557.9	558.3	556.3
1192C	1123040	402300	580.4	583.85	11.4	569.0	5.2	563.8	18.0	545.8	####	####	20.0	560.4	19.5	560.9	18.5	561.9	562.4	560.4
1193A	1123018	402407	577.0	579.97	9.5	567.5	8.5	559.0	9.5	549.5	####	####	28.0	549.0	29.1	547.9	28.1	548.9	549.3	547.6
1193B	1123024	402417	576.7	579.45	9.2	567.5	8.5	559.0	9.5	549.5	####	####	19.4	557.3	19.1	557.6	18.9	557.8	558.3	556.3
1193C	1123035	402417	576.5	579.60	9.0	567.5	8.5	559.0	9.5	549.5	####	####	16.6	559.9	16.0	560.5	15.0	561.5	561.9	559.9
1193D	1123047	402416	576.6	579.60	9.1	567.5	8.5	559.0	9.5	549.5	####	####	10.0	566.6	8.5	568.1	7.5	569.1	570.2	568.1
1194A	1123015	402494	575.3	578.40	3.7	571.6	11.0	560.6	11.7	548.9	####	####	31.0	544.3	31.0	544.3	30.0	545.3	546.0	544.3
1194B	1123023	402495	575.3	578.03	3.7	571.6	11.0	560.6	11.7	548.9	####	####	21.3	554.0	21.0	554.3	20.0	555.3	556.3	554.3
1194C	1123032	402496	575.3	578.56	3.7	571.6	11.0	560.6	11.7	548.9	####	####	16.5	558.8	16.5	558.8	15.5	559.8	561.3	558.8
1194D	1123041	402496	575.2	578.54	3.6	571.6	11.0	560.6	11.7	548.9	####	####	11.8	563.4	11.5	563.7	10.5	564.7	565.7	563.4
7205	1123557	401721	574.1	577.32	3.4	570.7	7.5	563.2	8.0	555.2	14	541.2	49.6	524.5	48.0	526.1	32.7	541.4	538.1	524.5
8210	1123512	402871	573.7	576.83	5.5	568.2	6.5	561.7	10.0	551.7	7	544.7	44.9	528.8	43.8	529.9	33.5	540.2	542.2	528.9
9205	1122237	402747	574.5	577.66	3.7	570.8	8.2	562.6	9.0	553.6	12	541.6	49.7	524.8	48.7	525.8	38.7	535.8	538.0	524.8
9210	1120700	402355	582.4	581.91	7.0	575.4	14.0	561.4	9.0	552.4	16.2	536.2	83.2	499.2	82.3	500.1	72.3	510.1	533.1	499.1
10205	1120820	402085	578.4	578.12	3.5	574.9	9.5	565.4	14.0	551.4	12	539.4	55.1	523.3	54.3	524.1	43.3	535.1	536.9	523.3
10210A	1120922	401866	577.2	576.63	8.0	569.2	4.0	565.2	14.0	551.2	12.6	538.6	222.3	354.9	217.0	360.2	206.9	370.3	390.5	356.3
10210B	1120927	401858	577.1	577.03	7.9	569.2	4.0	565.2	14.0	551.2	12.6	538.6	144.0	433.1	140.3	436.8	129.8	447.3	467.6	436.4
10210C	1120931	401849	577.1	576.69	7.9	569.2	4.0	565.2	14.0	551.2	12.6	538.6	86.5	490.6	84.0	493.1	74.0	503.1	535.6	490.6
10215	1121043	401598	578.2	577.44	8.5	569.7	5.5	564.2	17.0	547.2	14.5	532.7	61.0	517.2	59.4	518.8	48.8	529.4	531.2	517.5
10220	1121652	401735	574.0	576.78	6.0	568.0	6.0	562.0	16.2	545.8	6	539.8	49.2	524.8	47.3	526.7	36.6	537.4	538.0	526.7
10225A	1122361	401740	574.5	576.93	4.1	570.4	7.9	562.5	15.0	547.5	5.4	542.1	213.7	360.8	210.0	364.5	200.0	374.5	399.5	360.8
10225B	1122365	401742	574.4	577.04	4.0	570.4	7.9	562.5	15.0	547.5	5.4	542.1	138.6	435.8	137.7	436.7	127.7	446.7	484.4	436.7
10225C	1122714	401751	575.2	578.14	5.4	569.8	4.0	565.8	17.5	548.3	8.1	540.2	63.2	512.0	62.5	512.7	52.5	522.7	537.2	511.6
CW-10	1123852	402143	582.8	585.79	19.2	563.6	0.5	563.1	###	####	####	####	21.0	561.8	17.5	565.3	7.0	575.8	577.5	564.8
CW-20	1123632	402142	583.7	586.90	22.8	####	###	560.9	###	####	####	####	23.2	560.5	22.1	561.6	11.7	572.0	574.0	561.2
CW-30	1123352	402141	581.9	585.29	18.0	####	###	563.9	###	####	####	####	20.0	561.9	17.0	564.9	6.2	575.7	576.9	564.4
CW-40	1123011	402140	583.7	587.00	21.5	####	###	562.2	###	####	####	####	22.9	560.8	21.7	562.0	11.2	572.5	574.7	561.4
CW-50	1122481	402135	585.7	589.19	27.0	####	###	558.7	###	####	####	####	29.5	556.2	27.5	558.2	16.9	568.8	571.7	557.4
CW-60	1122261	402134	586.4	589.20	28.5	####	###	557.9	###	####	####	####	30.0	556.4	28.5	557.9	13.5	572.9	575.4	557.6
CW-70	1122073	402103	581.6	584.57	23.5	####	###	558.1	###	####	####	####	25.5	556.1	23.3	558.3	12.4	569.2	569.6	552.5
CW-80	1121929	402101	583.5	586.59	23.1	####	###	560.4	###	####	####	####	25.0	558.5	22.0	561.5	11.9	571.6	573.2	560.5
CW-90	1121802	402101	584.6	586.73	20.0	####	###	564.6	###	####	####	####	24.5	560.1	21.5	563.1	10.6	574.0	575.6	562.1

LOVE CANAL REMEDIAL PROJECT PF
TASK VC LONG TERM MONITORING
BORING AND WELL DATA

BORING & WELL ID	X NORTH COORD.	Y EAST COORD.	GROUND ELEV. (ft.)	TOP OF RISER ELEV. (ft.)	FILL THICK (ft.)	STIFF CLAY ELEV. (ft.)	STIFF CLAY THICK (ft.)	SOFT CLAY ELEV. (ft.)	SOFT CLAY THICK (ft.)	TILL ELEV. (ft.)	TILL THICK (ft.)	DOLOM ELEV. (ft.)	BOTTOM BORING (ft.)	BOTTOM BORING ELEV. (ft.)	BOTTOM SCREEN DEPTH (ft.)	BOTTOM SCREEN ELEV. (ft.)	TOP SCREEN DEPTH (ft.)	TOP SCREEN ELEV. (ft.)	SAND INTERVAL TOP ELEV. (ft.)	SAND INTERVAL BOTTOM ELEV. (ft.)
CW-100A	1121404	402103	585.3	NA	17.5	567.8	***	****	***	****	****	****	19.5	565.8	NW	585.3	NW	585.3	NA	NA
CW-105	1121279	402117	583.7	586.43	17.0	566.7	***	****	***	****	****	****	21.0	562.7	18.0	565.7	7.8	575.9	NA	NA
CW-108	1121103	402119	582.7	585.21	17.5	565.2	***	****	***	****	****	****	21.5	561.2	17.5	565.2	6.8	575.9	576.7	564.7
CW-110A	1121053	402104	580.9	NA	12.0	568.9	***	****	***	****	****	****	17.5	563.4	16.5	564.4	16.2	564.7	NA	NA
CW-110A1	1121053	402159	582.7	585.87	11.6	571.1	***	****	***	****	****	****	17.5	565.2	16.5	566.2	15.0	567.7	569.7	NA
SW-10	1124022	402087	581.7	NA	13.0	568.7	***	****	***	****	****	****	17.0	564.7	NW	581.7	NW	581.7	NA	NA
SW-20	1123370	402078	580.5	NA	14.0	566.5	***	****	***	****	****	****	19.0	561.5	NW	NA	NW	NA	NA	NA
DP-10	1122259	402216	586.1	589.34	20.0	566.1	2.5	563.6	***	****	****	****	27.0	559.1	26.0	560.1	25.0	561.1	562.4	559.1
DP-20	1121629	402049	583.4	586.70	14.0	569.4	***	****	***	****	****	****	19.5	563.9	16.9	566.5	15.9	567.5	568.1	563.9
DP-30	1121132	402087	581.9	NA	12.0	569.4	***	****	***	****	****	****	17.3	564.6	NW	581.9	NW	NW	NA	NA
DP-40	1121219	402187	582.2	NA	12.0	570.2	***	****	***	****	****	****	14.9	567.3	NW	582.2	NW	NW	NA	NA
BRM-10	1123489	402142	582.9	586.14	16.5	566.4	3.0	563.4	***	****	****	****	23.5	559.4	19.8	563.1	8.7	574.2	574.9	559.4

APPENDIX C

TABLES OF WATER LEVEL DATA

LOVE CANAL TASK VC
PERIMETER WELL WATER LEVELS

WELL ID	TOP OF RISER	ROUND 1 12/12/85	ROUND 1 1/20/86	ROUND 2 4/24/86	ROUND 3 11/1/86	ROUND 4 2/3/86
4108	578.40	569.94		570.47	569.69	
4215	575.57		566.94	565.98	564.94	
5102	578.52	570.20		570.96	570.29	
7105	577.80	563.32		570.39	569.69	571.60
7115	578.66			571.41	570.50	570.66
7120	577.89	568.95		572.66	572.00	
7125	577.43	571.36		573.61	572.27	574.33
7130	576.74	565.39		565.70	565.68	
7135	576.55	567.17		566.32	567.33	
7140	576.73	565.43		566.35	565.91	
7145	577.25	561.95		572.49	571.03	
7150	577.34	569.75		569.75	568.75	
7155	576.37	565.05		565.68	565.33	
7161	576.54	562.20		562.50	562.47	
7205	577.32	566.82		565.87	565.32	
8106	575.96	567.96		567.94	567.55	
8110	579.19	569.64		571.11	569.51	570.79
8115	577.99	571.69		573.54	571.71	573.49
8120	576.47	560.00		568.57	567.23	567.97
8125	577.46	565.20		566.63	565.26	567.06
8130	578.48	565.26		566.57	565.16	566.98
8140	578.22	561.84		568.85	568.23	570.12
8210	576.83		567.40	566.15	565.87	567.23
9105	577.07	553.60		563.22	563.82	567.87
9110	576.88	565.42		566.23	565.48	567.08
9113	576.30				567.20	567.30
9115	577.16			570.65	567.58	571.46
9118	576.67				566.20	567.17
9120	576.97	569.39		571.64	569.97	572.17
9122	575.89				565.89	567.39
9125	576.54	566.74		569.29	568.79	570.44
9130	576.77	559.14		571.58	570.36	571.07
9140	578.24	570.17		570.33	570.24	
9205	577.66		567.05	565.86	566.03	566.96
9210	581.91		566.13	565.48	565.03	
10105	577.05	563.76		569.17	569.14	
10115	578.14	566.35		566.69	565.14	567.54
10125	578.51	572.36		574.17	571.49	573.21
10130	577.10	567.10		572.95	571.35	573.20
10135	580.35	567.80		572.51	571.39	
10140	577.76					574.36
10145	577.10	554.74		568.70	566.50	573.30

10150	576.87	565.13		565.89	565.62	566.97
10205	578.12		565.96	565.36	565.01	
10210A	576.63		572.23	569.88	568.23	
10210B	576.97				565.12	
10210C	577.16				565.04	
10215	577.44		565.89	565.39	564.75	
10220	576.78		566.25	565.55	565.09	
10225A	576.93		567.70	567.93	563.73	567.33
10225B	577.04		566.35	565.77	566.72	567.34
10225C	578.14	564.96		565.71	565.33	566.84

LOVE CANAL WATER LEVEL DATA
NESTED PIEZOMETERS
JANUARY 1985 TO DATE

DATE	850114	850131	850221	850311	850411	850514	850611	850722	850822	850923	851021	851111	851210	860116	860206	860429	860514	860604
TIME	0.04	0.08	0.14	0.19	0.28	0.37	0.44	0.56	0.64	0.73	0.81	0.86	0.94	1.04	1.08	1.32	1.36	1.42
WELL																		
1150A																561.08	562.16	564.30
1150B																566.70	566.92	567.45
1151A																566.10	566.03	567.35
1151B																563.31	573.15	569.13
1151C																	571.28	571.29
1151D																		
1153A																560.81	562.29	564.64
1153B																568.28	566.67	568.76
1153C																566.80	569.19	569.98
1153D																569.53	569.41	570.18
1153E																		
1154A																569.85	569.30	570.31
1154B																569.02	568.94	569.68
1154C																567.43	567.78	568.84
1154D																569.72	569.12	570.05
1160A	571.98	566.11	566.35	566.61	566.11	565.62	565.22	565.16	565.26	565.60	565.66	566.02	566.67	568.51	565.91	569.75	570.65	566.15
1160C	570.64	569.16	569.36	568.41	569.29	569.45	569.49	569.73	569.84	570.12	570.06	569.82	569.84	566.76	569.30	569.25	569.72	569.79
1161A	567.11	565.73	566.05	566.35	566.08	566.03	565.25	565.27	565.28	565.56	565.71	565.95	566.58		565.92	563.43	564.73	565.69
1161B	573.78	568.64	568.41	568.67	567.58	567.21	566.98	567.29	567.34	567.61	567.68	568.07	568.16	567.30	567.14	566.85	567.65	568.27
1161C	570.00	569.12	569.29	569.45	569.29	569.41	569.68	569.89	569.93	569.88	569.81	569.60	569.73	568.98	569.09	569.30	570.23	570.48
1161D	570.07	570.03	569.94	569.92	569.83	569.95	569.68	570.22	570.45	570.24	570.24	570.05	570.14	569.56	569.67	570.34	571.01	571.16
1161E																	559.46	565.68
1162A	569.84	569.58	569.27	569.05	568.62	568.22	567.24	567.72	567.90	568.06	568.29	568.42	568.78	568.21	568.09	566.66	567.87	568.27
1162C	570.44	570.27	570.09	570.22	570.69	570.37	571.08	571.19	570.82	570.71	570.46	570.38	570.57	569.92	570.01	570.32	571.06	571.25
1162D	570.48	570.37	570.20	570.40	570.45	569.71	570.55	570.60	571.01	570.89	570.55	570.58	570.71	570.11	570.26	570.69	571.33	571.45
1163A	574.21	570.81	570.54	570.30	569.83	568.36	571.05	569.37	569.54	569.85	569.96	569.97	569.98	569.36	569.22	568.93	569.63	569.79
1163B	571.15	570.20	570.40	570.45	570.45	569.53	570.16	570.97	571.00	570.97	570.83	570.66	570.61	569.89	569.97	570.19	571.04	571.45
1163C	570.99	570.79	570.56	570.61	570.79	571.12	569.31	571.62	571.73	571.66	571.23	571.00	570.91	570.17	570.40	571.18	572.13	572.35
1163D	572.85		570.67	570.50	570.40	570.23	570.70	570.15								572.00	572.55	572.38
1165A	571.27	570.59	570.77	570.49	570.46	570.37	570.42	570.58	570.57	570.91	570.97	571.00	571.22	570.66	570.50	570.22	570.92	571.00
1165B	571.55	571.32	571.12	571.35	571.58	571.53	571.62	570.00	571.59	571.55	571.52	571.50	571.75	571.22	571.26	571.42	572.14	572.28
1165C		571.05	570.78	571.77	572.21	572.27	572.30	571.13	571.95	571.75	571.53	571.61	572.00	571.00	571.61	572.25	572.92	573.03
1165D	571.53	571.18	571.15	572.06	572.35	572.45	572.37		571.93	571.74	571.38	571.56	571.96	571.31	571.50	572.52	573.08	573.14
1167A	571.71	571.02	571.62	572.34	571.80	571.23	571.09	571.25	571.13	571.11	571.77	572.42	572.54	573.49	571.32	571.23	571.64	571.94
1167B	571.71	571.56	572.26	573.06	572.28	572.08	571.99	571.76	571.41	571.36	572.26	571.86	572.91	572.14	572.16	571.89	572.35	572.62
1167C	571.74	571.43	571.88	572.81	572.66	572.39	572.37	571.94	571.62	571.49	571.51	571.24	572.78	573.99	571.54	572.33	572.83	573.09
1167D	571.80	571.56	572.33	573.10	572.64	572.27	572.29	571.03	571.67		571.96	573.07	572.89	572.02	572.26	572.21	572.58	572.82
1170A																563.95	564.20	564.41
1170B																562.83	563.19	563.48
1171A																564.93	566.42	566.81
1171B																563.69	564.20	564.45

LOVE CANAL WATER LEVEL DATA
NESTED PIEZOMETERS
JANUARY 1985 TO DATE

DATE	850114	850131	850221	850311	850411	850514	850611	850722	850822	850923	851021	851111	851210	860116	860206	860429	860514	860604
TIME	0.04	0.08	0.14	0.19	0.28	0.37	0.44	0.56	0.64	0.73	0.81	0.86	0.94	1.04	1.08	1.32	1.36	1.42
1171C																	563.67	560.76
1172A																563.75	564.84	565.53
1172B																568.30	568.90	568.97
1172C																569.20	569.94	569.95
1173A																568.46	569.09	570.74
1173B																569.72	570.44	572.22
1173C																571.42	572.31	572.46
1173D																572.41	572.62	572.85
1174A																567.14	568.50	570.94
1174B																569.23	569.10	571.97
1174C																573.10	572.79	573.99
1174D																572.26	571.96	572.75
1180A																559.58	560.77	562.62
1180B																561.80	561.75	562.32
1180C																	564.35	
1181A																568.46	567.49	569.92
1181B																566.83	567.43	568.53
1181C																569.88	569.03	568.59
1183A																565.10	564.76	565.60
1183B																566.13	565.41	566.58
1183C																568.49	567.75	568.72
1183D																	567.56	568.27
1184A																		
1184B																		
1184C																		
1184D																		
1190A																565.44	564.86	567.00
1190B																564.76	564.89	564.78
1191A																567.11	567.49	567.44
1191B																565.77	566.25	566.33
1191C																	562.21	564.54
1192A																565.51	565.61	565.83
1192B																568.21	569.23	569.45
1192C																568.67	569.73	570.15
1193A																566.86	568.29	567.32
1193B																569.11	570.01	570.17
1193C																571.21	572.12	572.27
1193D																572.14	571.65	573.10
1194A																565.59	565.58	566.07
1194B																569.84	570.43	570.52
1194C																571.24	572.30	572.54
1194D																572.61	575.38	573.49

LOVE CANAL WATER LEVEL DATA
NESTED PIEZOMETERS
JANUARY 1985 TO DATE

WELL	DATE TIME	860730 1.58	860826 1.65	860930 1.75	861031 1.83	861204 1.93	861229 1.99
1150A		566.65	566.56	566.41	566.56	566.67	568.23
1150B		567.47	566.87	567.02	566.97	567.43	567.66
1151A		567.98	566.99	567.43	567.88	568.38	569.16
1151B		569.14	568.89	568.12	568.31	568.50	568.96
1151C		570.23	569.09	568.68	569.23	569.21	569.87
1151D						570.93	571.35
1153A		566.88	566.84	566.99	566.27	566.66	
1153B		569.35	568.58	568.48	567.87	569.16	569.55
1153C		569.95	569.17	568.95	569.24	568.97	569.47
1153D		570.11	569.12	569.01	569.38	569.10	
1153E							
1154A		569.51	568.50	569.30	568.88	568.26	572.32
1154B		569.15	568.56	568.56	568.56	568.08	569.24
1154C			568.38	568.25	570.13	569.80	569.53
1154D		570.31	568.36	569.11	570.41	570.11	571.54
1160A		565.97	564.95	564.70	564.89	565.24	566.26
1160C		569.48	568.99	568.99	568.99		569.54
1161A		566.30	565.36	565.45	564.03	565.56	566.42
1161B		568.11	566.92	566.92	565.97	566.92	567.84
1161C		569.81	569.24	569.05	567.84	568.94	569.40
1161D		570.41	569.99	569.84	569.57	569.34	569.86
1161E		566.64	565.60	565.75	565.56	566.21	566.96
1162A		568.48	567.67	567.72	567.80	567.79	568.48
1162C		570.44	570.02	569.84	569.70	569.57	570.10
1162D		571.33	570.33	570.20	569.66	570.00	570.32
1163A		570.03	569.43	569.43	568.18	569.41	569.73
1163B		571.57	570.65	570.33	570.17	569.89	570.31
1163C		571.44	571.08	570.86	570.55	570.33	570.54
1163D		571.20	570.65	570.65	570.52	570.18	570.53
1165A		571.02	570.27	571.33	570.51	570.45	570.73
1165B		572.01	571.17	570.32	570.98	570.93	571.36
1165C		571.86	571.52	571.27	571.26	571.02	571.63
1165D		572.04	571.66	571.81	571.00	571.18	571.72
1167A		570.99	569.22	571.17	570.77	571.27	571.38
1167B		571.52	572.44	571.60	571.14	571.76	571.85
1167C		572.55	571.48	570.38	569.95	571.92	572.06
1167D		571.58	571.38	572.16	571.38	572.04	572.10
1170A		563.92	563.12	564.54	562.96	563.02	564.47
1170B		562.96	562.43	562.14	563.54	562.03	563.14
1171A		566.09	565.64	565.07	563.47	564.27	565.06
1171B		563.80	563.00	563.70	563.00	562.90	564.02

LOVE CANAL WATER LEVEL DATA
NESTED PIEZOMETERS
JANUARY 1985 TO DATE

DATE	860730	860826	860930	861031	861204	861229
TIME	1.58	1.65	1.75	1.83	1.93	1.99
1171C	565.31	569.61	564.04	564.09	557.41	564.03
1172A	565.75	565.52	565.71	565.79	566.08	566.98
1172B	568.62	568.23	568.18	568.16	568.17	569.04
1172C	569.35	569.03	568.81	569.11	568.96	569.65
1173A		569.52	569.66	568.51	569.66	570.31
1173B		569.91	568.71	570.12	569.96	570.57
1173C		571.35	571.22	570.14	571.35	571.87
1173D		571.20	571.55	571.12	571.53	572.20
1174A		568.23	568.17	568.44	568.61	569.18
1174B		569.96	570.03	570.12	570.40	570.79
1174C		571.67	571.39	569.96	571.11	571.60
1174D		570.89	570.98	570.05	572.08	572.43
1180A	562.21	562.02	561.74	561.97	561.94	562.70
1180B	561.96	561.20	561.22	561.01	560.82	562.18
1180C	562.81	562.15	562.45	562.45	562.45	563.09
1181A	568.77	567.95	568.66	568.78	569.36	569.36
1181B		567.52	566.36	567.76	568.12	566.22
1181C	568.47	568.50	569.10	567.25	570.97	570.34
1183A	565.60	564.43	564.71	564.61	565.25	565.99
1183B	566.44	565.20	565.21	565.80	565.73	566.56
1183C	568.53	566.70	567.60	567.68	568.23	568.57
1183D	568.09	566.67	567.19	567.00	566.93	567.01
1184A					565.77	565.58
1184B					566.23	565.98
1184C					568.77	569.52
1184D					567.18	567.29
1190A		564.11	565.76	564.08		
1190B		564.88	564.01	563.88		565.28
1191A		566.61	570.05	566.70	567.83	567.62
1191B		565.50	565.50	564.25	565.18	566.09
1191C		564.25	564.43	564.22	567.43	564.23
1192A		564.08	565.03	564.87	566.13	566.03
1192B		568.95	569.03	567.55	568.48	569.35
1192C		569.85	570.11	568.02	569.79	570.33
1193A	566.43	565.99	566.07	566.16	566.93	567.35
1193B	569.19	568.90	563.05	569.08	568.90	569.86
1193C	571.36	570.83	570.76	570.90	570.49	571.36
1193D	571.73	571.33	571.44	571.52	571.35	572.16
1194A	565.30	564.53	565.24	564.72	566.34	566.07
1194B	569.29	569.17	568.65	567.18	569.49	570.37
1194C	571.42	571.18	570.83	571.20	571.63	572.35
1194D	572.21	571.72	571.62	571.63	572.49	573.14

LOVE CANAL WATER LEVEL DATA
SELECTED BEDROCK WELLS
NYSDEC DATA
JANUARY 1985 TO DATE

	DATE	850114	850131	850221	850311	850412	850515	850611	850723	850822	850924	851022	851111	851210	860115	860206	860303	860429	860513
WELL	TIME	0.04	0.08	0.14	0.19	0.28	0.37	0.44	0.56	0.64	0.73	0.81	0.86	0.94	1.04	1.08	1.17	1.32	1.36
3201			564.43	564.19	564.88	563.90	563.99	563.63	563.60	564.39	564.30	564.67	566.76	565.60	565.31	565.70	564.99	565.40	564.84
3203			564.26	564.17	565.09	563.64	563.36	563.63	563.64	564.37	564.30	564.71	566.81	565.55	565.29	565.65	565.15	565.37	564.89
3205			564.21	564.02	564.56	566.60	563.26	563.61	563.59	564.60	564.63	564.95	567.09	565.81	565.55	565.82	565.28	565.49	565.10
3211								565.78											
3213				563.91	564.90	563.58	563.25	563.51	563.59	564.60	564.67	565.00	568.10	565.99	565.51	565.91	565.19	565.49	565.05
3222				564.32	565.13	563.94	563.74	564.02	563.81	564.52	564.56	564.83	566.79	565.60	565.33	565.74	565.19	565.34	564.96
3223		564.94		564.89	565.16	564.06	563.90	564.07	564.06	564.47	564.49	564.85	566.51	565.56	565.23	565.63	565.03	565.16	564.85
3233				564.52	565.58	565.01	563.98	564.14	564.03	564.47	564.46	564.73	566.34	565.25	565.21	565.12	564.87	566.00	564.73
3251		564.57		564.50	565.23	565.89	563.89	563.81	563.91	564.37	564.29	564.52	566.54	565.69	565.42	565.64	565.07	566.34	564.86
4204			564.16	563.95	564.54	563.50	563.18	572.13	563.52	564.58	564.50	564.92	567.04	565.83	565.49	565.84	565.19	565.47	565.76
4205			564.00	563.88	564.43	563.34	563.08	563.13	563.37	564.53	564.62	564.90	567.02	565.73	565.48	565.91	565.30	565.44	565.73
4206			564.06	563.84	564.47	563.41	563.02	563.33	563.49	564.59	564.60	564.99	567.03	565.79	565.50	565.85	565.12	565.02	565.72
4207			564.03	563.80	564.50	563.35	562.93	563.41	563.30	564.51	564.50	564.93	567.17	565.76	565.46	565.82	565.24	567.14	565.50
4211			564.25		565.36	563.80	563.33	563.67	563.66	564.48	564.44	564.81	566.98	565.69	565.39	565.68	565.16	565.36	564.97
4215				565.39	565.36	564.37	563.57	563.60	563.72	564.45	564.40	564.65	566.57	566.02	565.52	565.81	565.27	563.23	564.89
4221				563.93	565.06	563.59	563.21	563.45	563.52	564.51	564.50	564.99	567.49	565.91	565.45	566.13	565.36	565.48	565.05
5201			564.18	568.14	564.43	563.79	563.09	563.48	563.51	564.47	564.40	564.80	567.34	565.75	565.46	565.97	565.25	565.45	565.64
5203		564.53	564.34	561.30	564.56	563.60	563.37	563.52	563.52	564.55	564.65	564.82	566.79	565.61	565.42	565.73	565.04	565.33	565.50
5204			564.33	564.86	564.37	563.62	563.29	563.71	563.64	564.43	564.48	564.83	566.70	565.57	565.45	565.73	565.12	565.32	565.72
5205			565.03	562.20	564.30	563.93	564.07	564.60	564.34	564.55	564.55	564.70	565.37	564.90	565.25	565.02	564.73	564.83	565.40
5211				563.96	564.92	564.13	564.13	563.50	563.60	564.59	564.65	564.93	568.10	565.69	565.58	565.90	565.30	565.48	565.09
5212				564.12	564.15	564.12	564.10	564.16	564.24	564.34	564.37	564.40	564.44	564.75	565.29	564.44	564.61	564.76	564.77
5213				564.45	564.41	563.71	564.32	564.64	564.44	564.59	564.81	564.72	565.44	564.88	565.32	564.96	564.80	564.99	564.61
5214				564.44	564.56	563.70	564.32	564.58	564.44	564.66	564.75	564.70	565.49	564.92	565.30	564.98	564.76	564.91	564.61
5221				564.46	564.58	564.20	564.43	564.62	564.41	564.70	564.79	564.64	565.33	564.87	565.20	564.91	564.78	564.92	564.63
5222				564.11	564.80	563.64	563.26	563.45	563.72	564.65	564.76	565.06	567.29	565.77	565.53	565.77	565.31	565.54	565.15
6201			564.02	563.86	564.19	563.71	563.52	563.27	563.39	564.50	564.52	564.93	567.10	565.84	565.45	565.88	565.30	565.53	565.77
6203			564.18	563.91	564.65	563.80	563.12	563.36	563.45	564.47	564.67	565.02	567.06	565.98	565.53	565.99	565.41	565.62	565.85
6207				564.15	565.23	563.85	563.47	563.56	563.66	564.49	564.78	565.14	566.62	566.07	565.62	565.98	565.64	566.09	565.86
6209			564.55	564.13	564.02	563.43	563.67	564.00	563.98	564.58	564.68	564.80	565.55	565.05		565.08	564.62	565.08	565.45
6211		564.24		563.79	564.83	563.36	562.93	563.33	563.41	564.73	564.67	565.06	567.60	565.86	565.51	566.01	565.35	565.53	565.12
6212						563.40	563.08	563.24	563.48	564.72	564.68	565.07	567.38	565.88	565.41	566.07	565.37	565.61	565.16
6213				563.62	564.63	563.35	562.90	563.23	563.42	564.60	564.71	565.05	567.49	565.62	565.57	566.01	565.38	565.52	565.12
6214				564.07	564.03	563.86	563.24	563.23	563.37	564.55	564.63	564.79	565.31	566.09	565.36	565.66	565.68	565.69	565.48
6222				564.54	565.49	563.67	563.82	564.05	563.99	564.67	564.75	564.77	565.78	565.14	565.52	565.24	564.88	565.09	565.79
6241		564.97		564.20	564.65	563.54	563.87	563.91	564.03	564.73	564.68	564.81	565.72	565.19	565.26	565.22	564.95	565.14	564.80
7205																			564.91
8210																			565.14
9205																			565.17
9210																			564.79

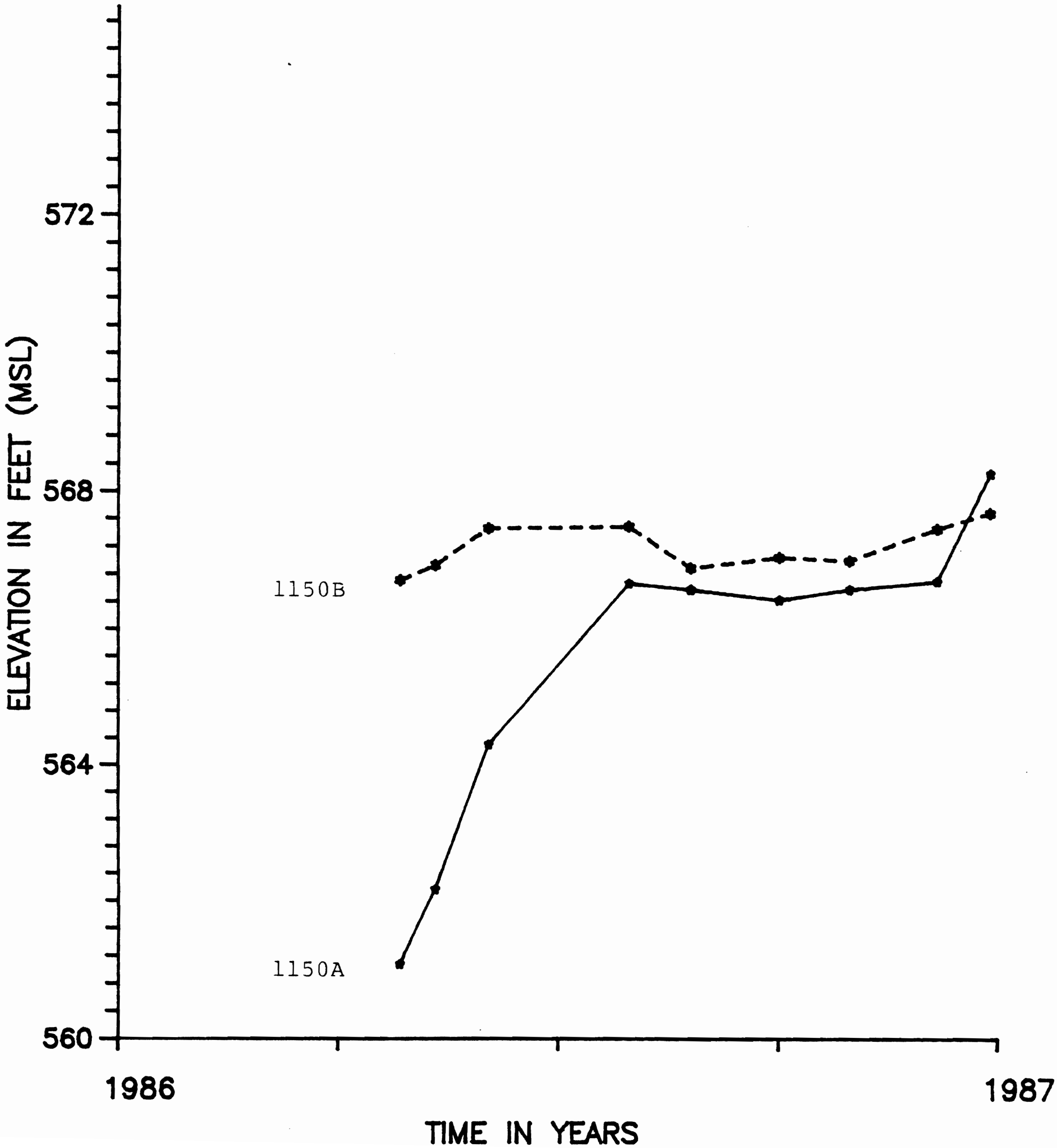
LOVE CANAL WATER LEVEL DATA
SELECTED BEDROCK WELLS
NYSDEC DATA
JANUARY 1985 TO DATE

WELL	DATE / TIME	860604 / 1.42	860730 / 1.58	860826 / 1.65	860930 / 1.75	861030 / 1.83	861204 / 1.93	861229 / 1.99
3201		568.48	565.67	564.88	567.81	564.15	565.90	565.69
3203		565.71	565.49	564.13	565.16	564.21	565.60	565.72
3205		563.33		564.40	562.58	564.36	566.14	565.92
3211								
3213		566.29	565.70	564.68	565.55	564.80	565.92	565.94
3222		565.78	565.60	564.38	565.09	564.56	565.52	565.74
3223		565.83						
3233		565.73	565.48	564.13	564.76	564.12	565.27	565.49
3251		565.72	565.52	563.94	564.52	564.26	565.54	565.79
4204		566.09	565.91	564.58	565.06	564.56	566.11	565.88
4205		565.82		564.28	565.35	564.50	566.06	565.88
4206		566.10	565.37	564.41	565.57	564.44	565.81	565.92
4207		565.92	565.50	564.32	565.50	564.20	565.90	565.88
4211		565.98	565.71	564.28	565.36	564.46	566.26	565.83
4215		566.09	565.87	564.39	564.77	564.44	566.03	565.97
4221		566.09	565.65	564.56	565.35	564.61	565.92	566.07
5201		565.96	565.64	564.15		564.44	566.32	565.90
5203		565.85	563.16	564.35	565.14	564.49	566.18	565.64
5204		565.99	564.89	565.09	565.19	564.39	565.94	565.66
5205		565.52	565.43	564.14	564.53	564.15	565.58	565.09
5211		566.22						
5212		566.03	569.72	567.69	571.39	570.39		
5213		565.63		564.22	564.48	564.47		
5214		565.69	565.44	564.25	564.48	564.04	565.09	565.07
5221		565.60	565.35	563.98	564.06	564.23	565.28	565.10
5222		566.01	565.85	564.54	565.52	564.87	565.93	565.93
6201		565.95	565.67	564.43	565.62	564.45	566.16	
6203		566.08	565.95	564.68	565.65	563.65	566.44	566.06
6207		566.13	566.08	565.05	565.59	564.49	566.39	566.25
6209		565.63	565.55	564.42	564.60	564.22	565.48	565.30
6211		566.16	565.80	564.56	565.29	564.80	565.73	565.98
6212		566.09	565.83	564.67	565.38	564.77	565.59	566.04
6213		566.02	565.85	564.80	565.39	564.87	566.14	566.04
6214		566.17	565.99	564.95	564.41	564.95	566.18	565.81
6222		565.77	565.29	564.37	564.58	564.29	565.12	565.39
6241		565.70	565.48	564.35	564.55	564.36	565.23	565.34
7205		565.88	565.09					
8210		566.18	565.75	564.64	565.54	564.63	566.20	566.30
9205		566.12	565.86	564.89	565.48	564.77	565.66	566.18
9210		565.64						

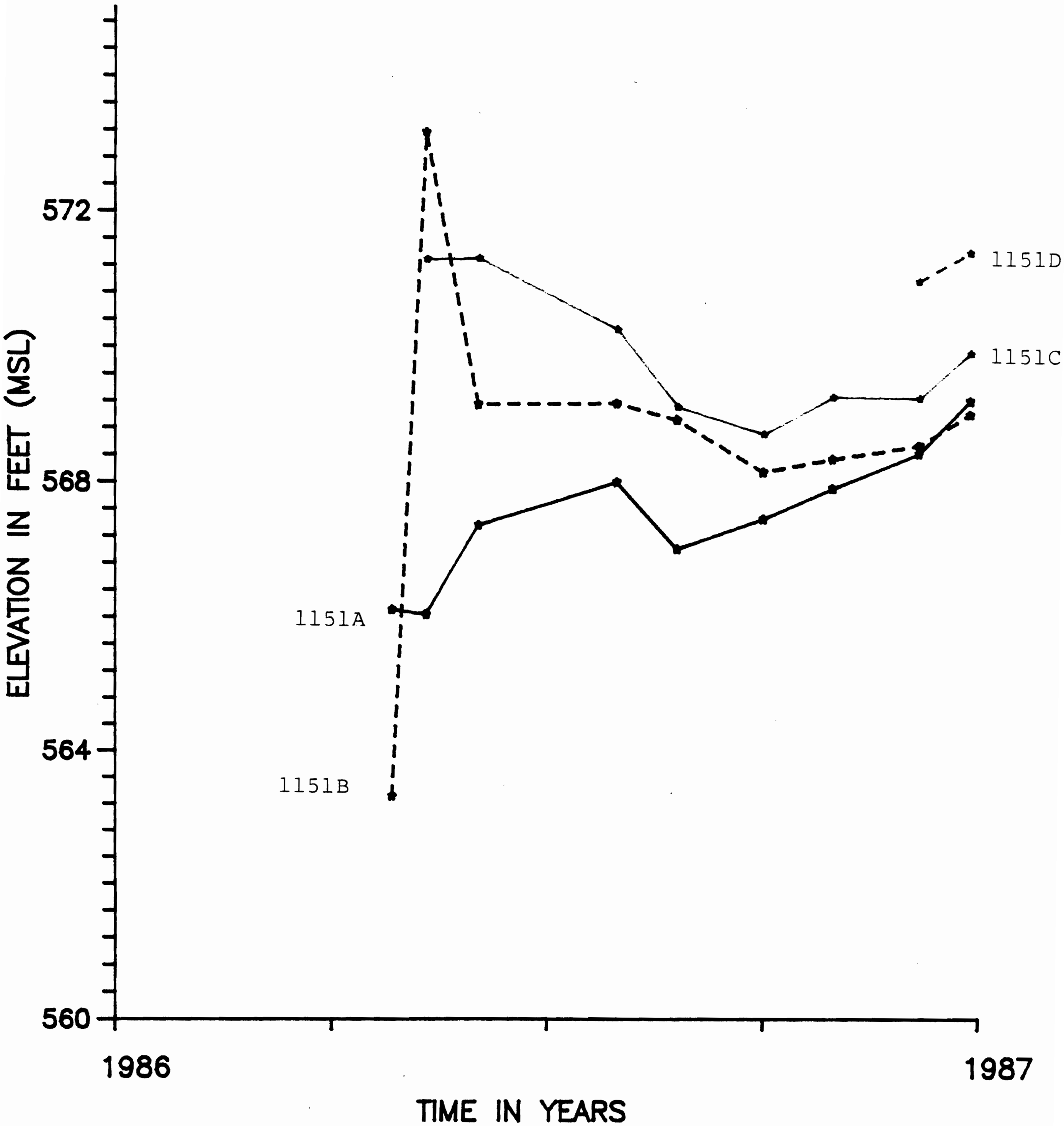
APPENDIX D

PIEZOMETER HYDROGRAPHS

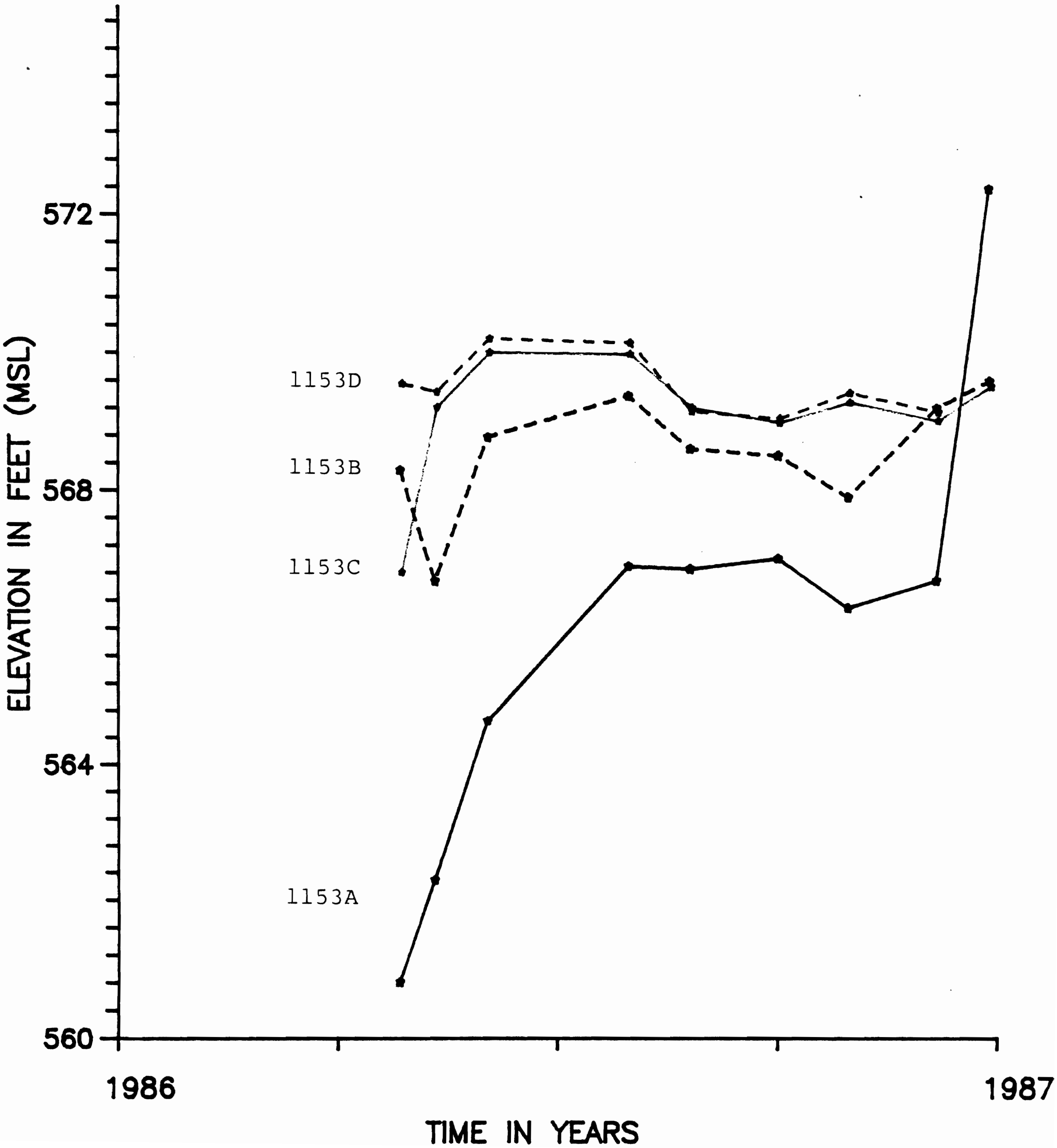
PIEZOMETERS 1150A, 1150B



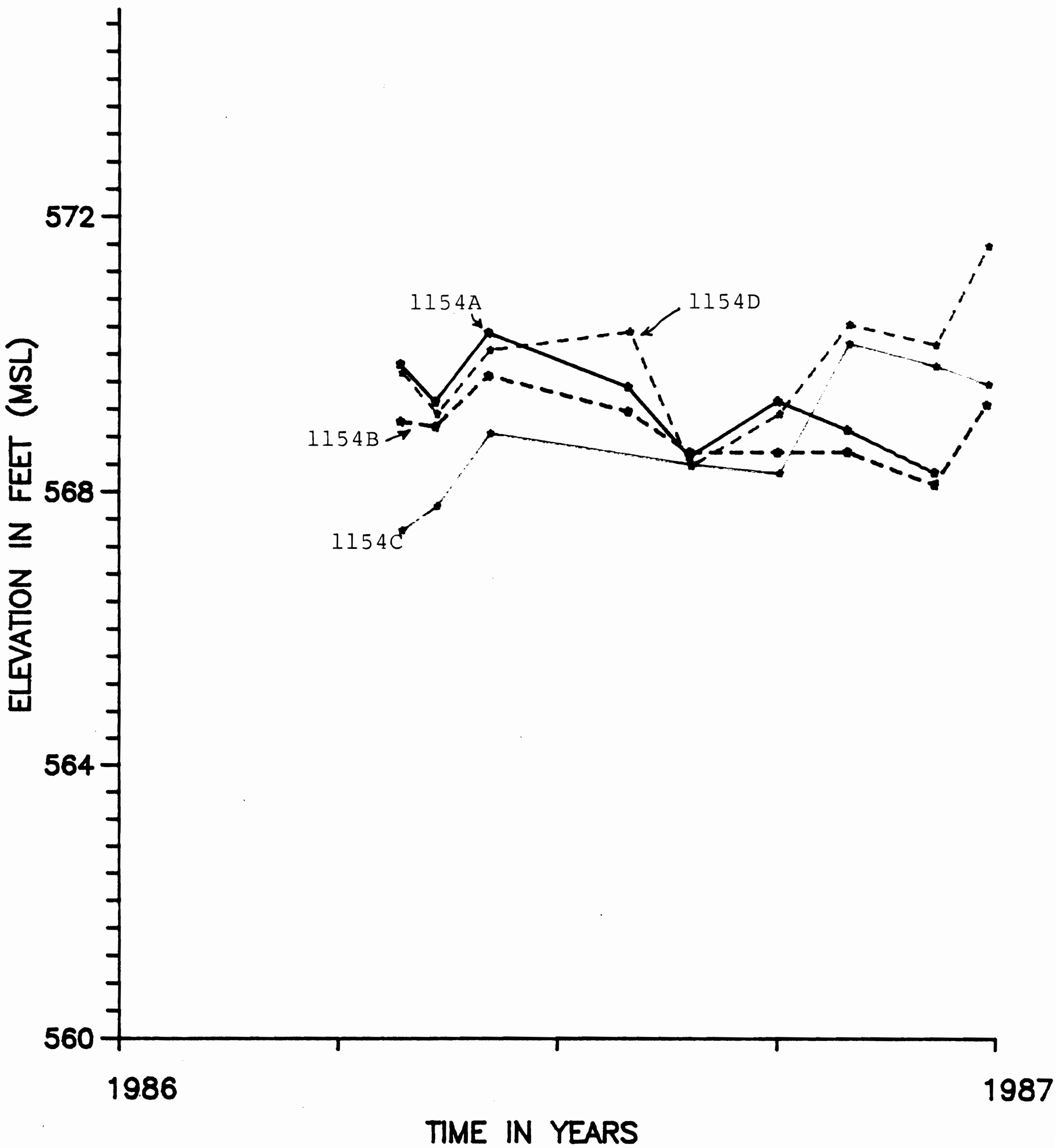
PIEZOMETERS 1151A, 1151B, 1151C, 1151D



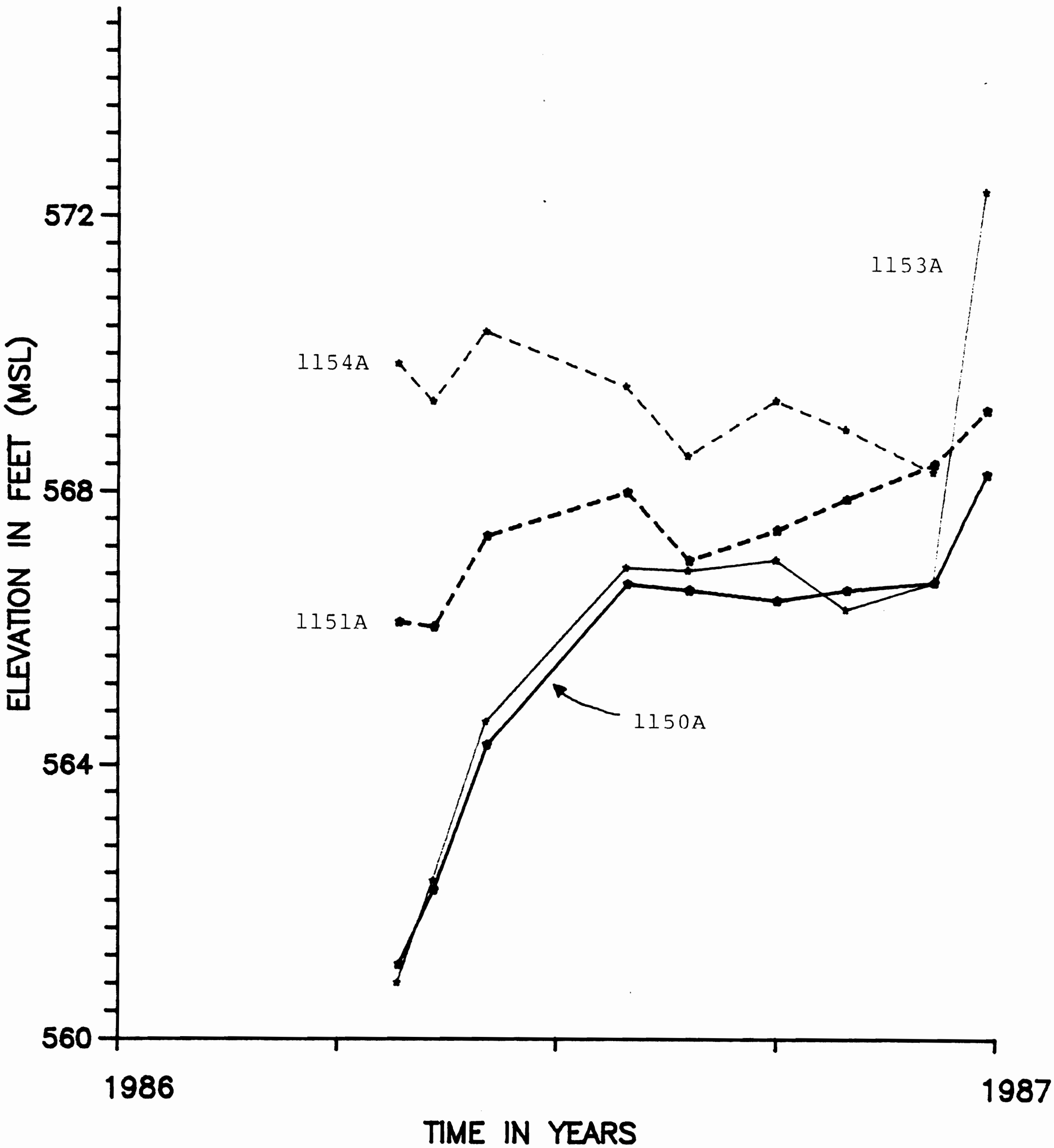
PIEZOMETERS 1153A, 1153B, 1153C, 1153D



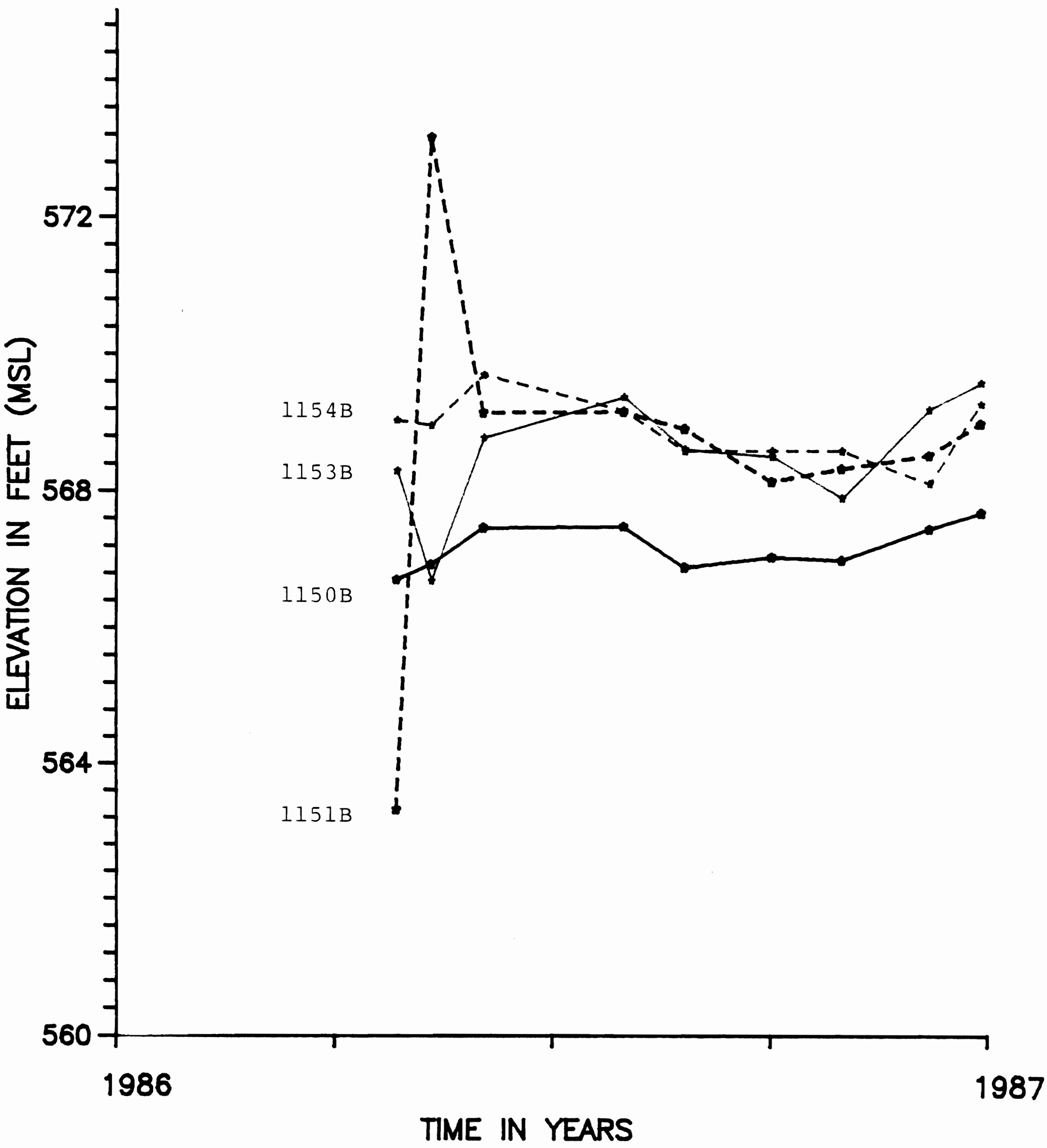
PIEZOMETERS 1154A, 1154B, 1154C, 1154D



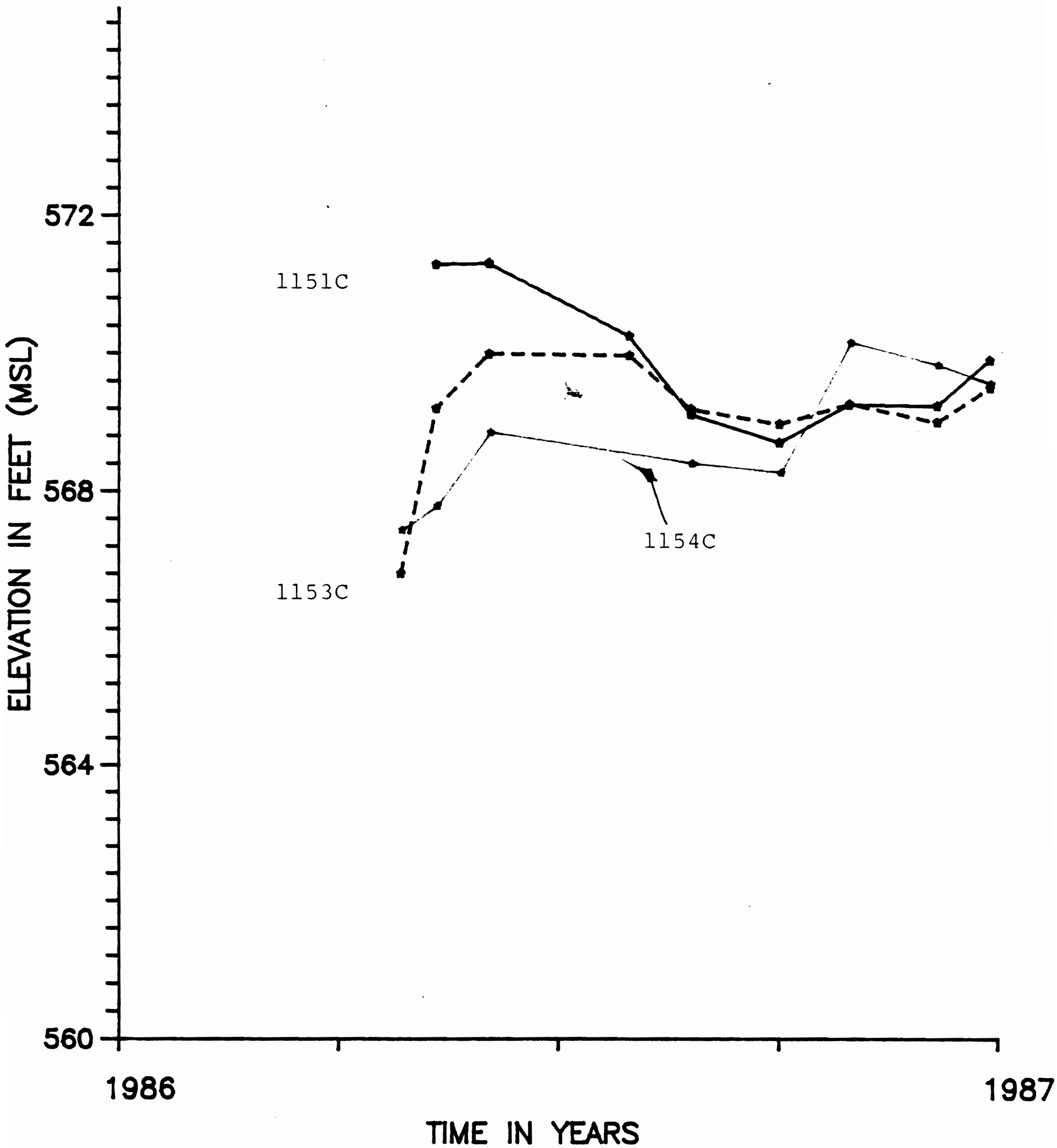
PIEZOMETERS 1150A, 1151A, 1153A, 1154A



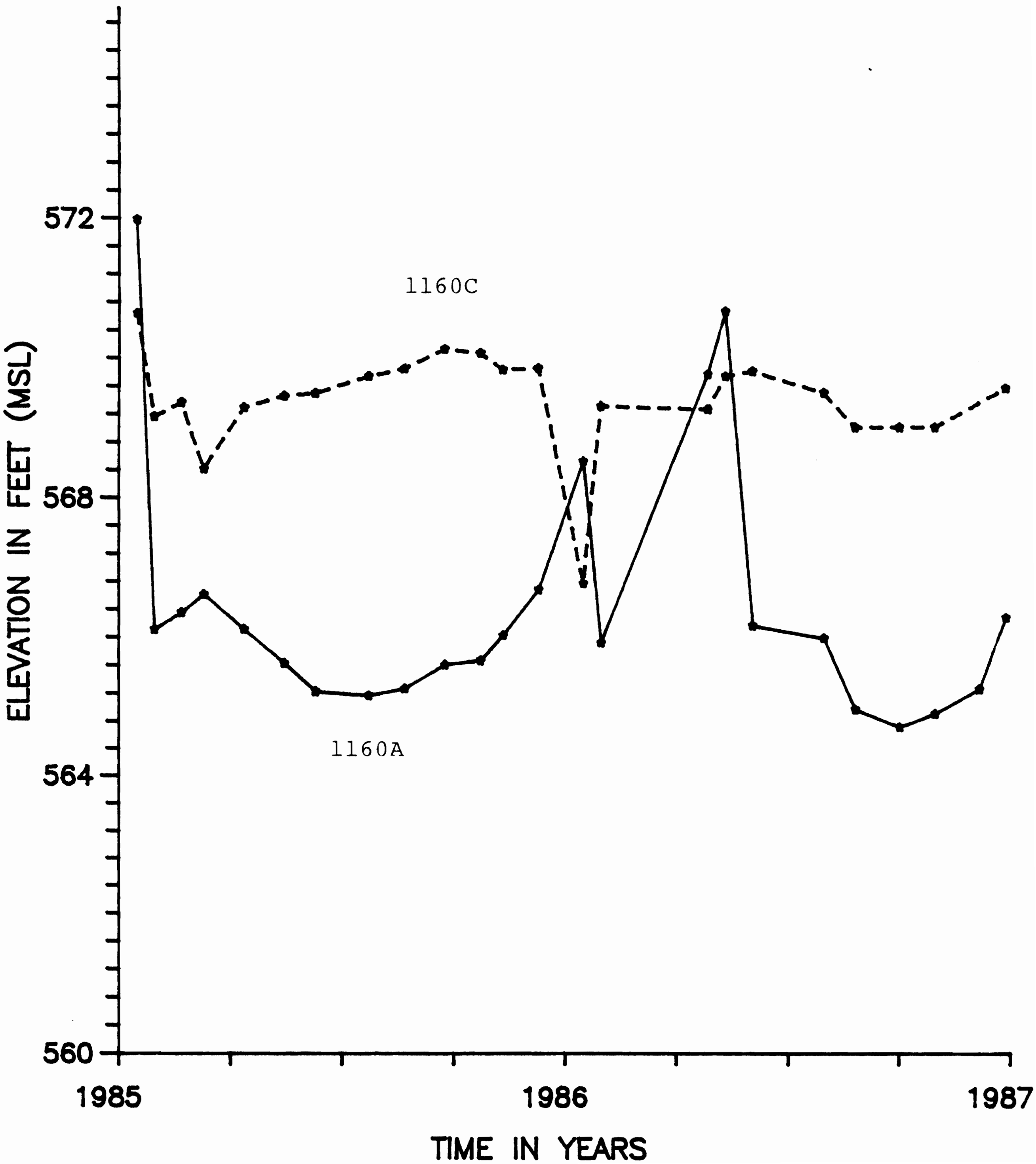
PIEZOMETERS 1150B, 1151B, 1153B, 1154B



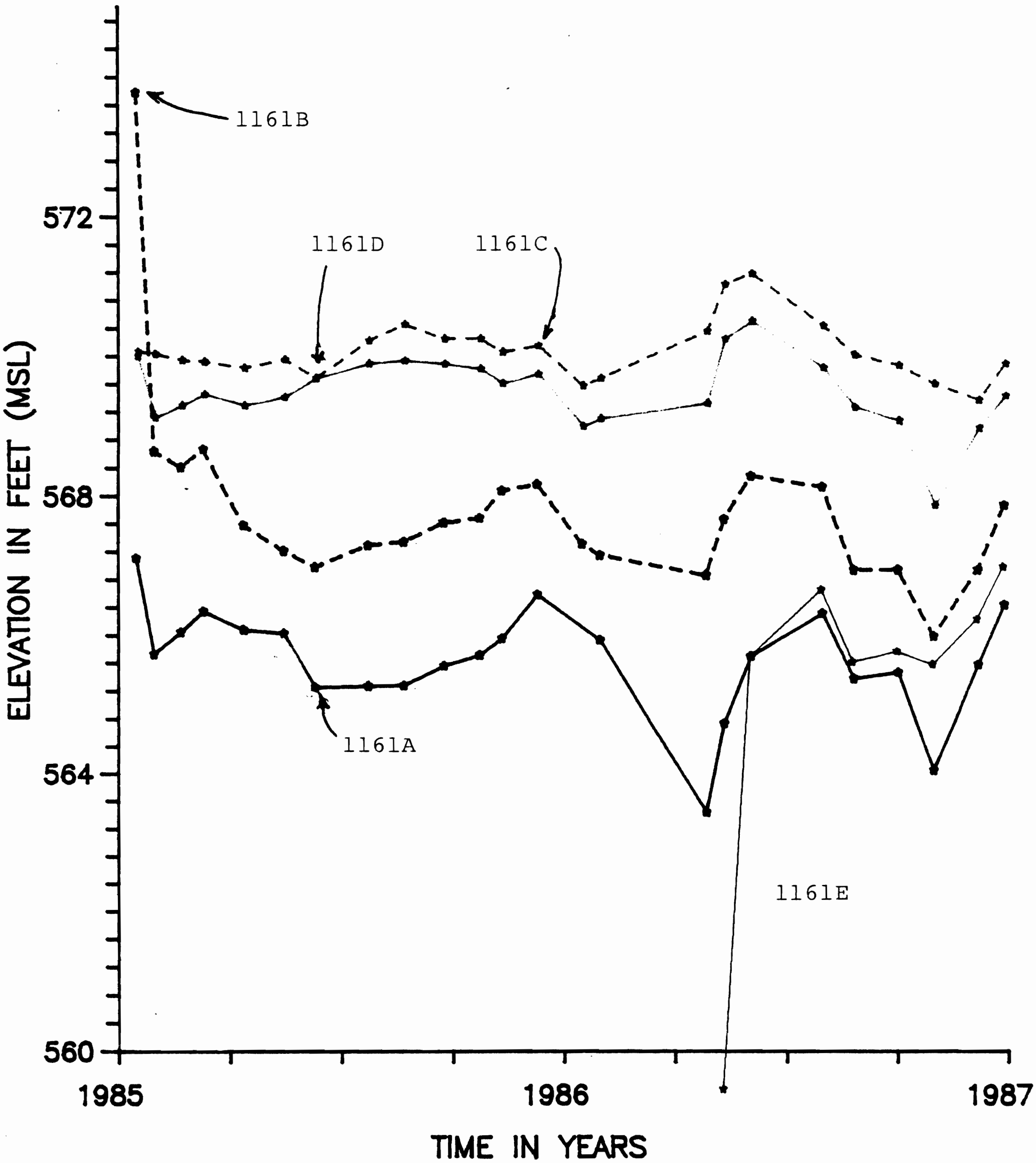
PIEZOMETERS 1151C, 1153C, 1154C



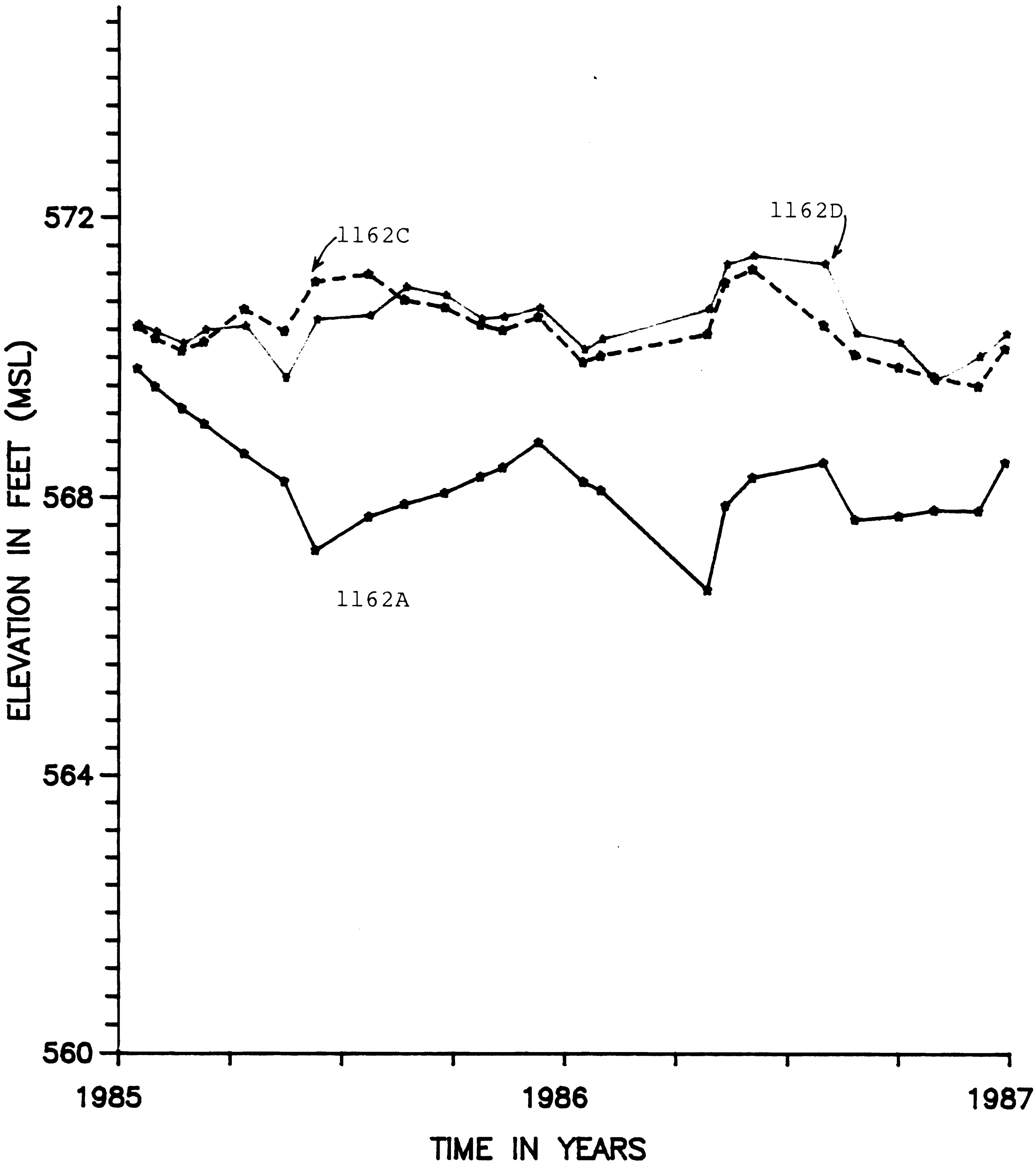
PIEZOMETERS 1160A, 1160C



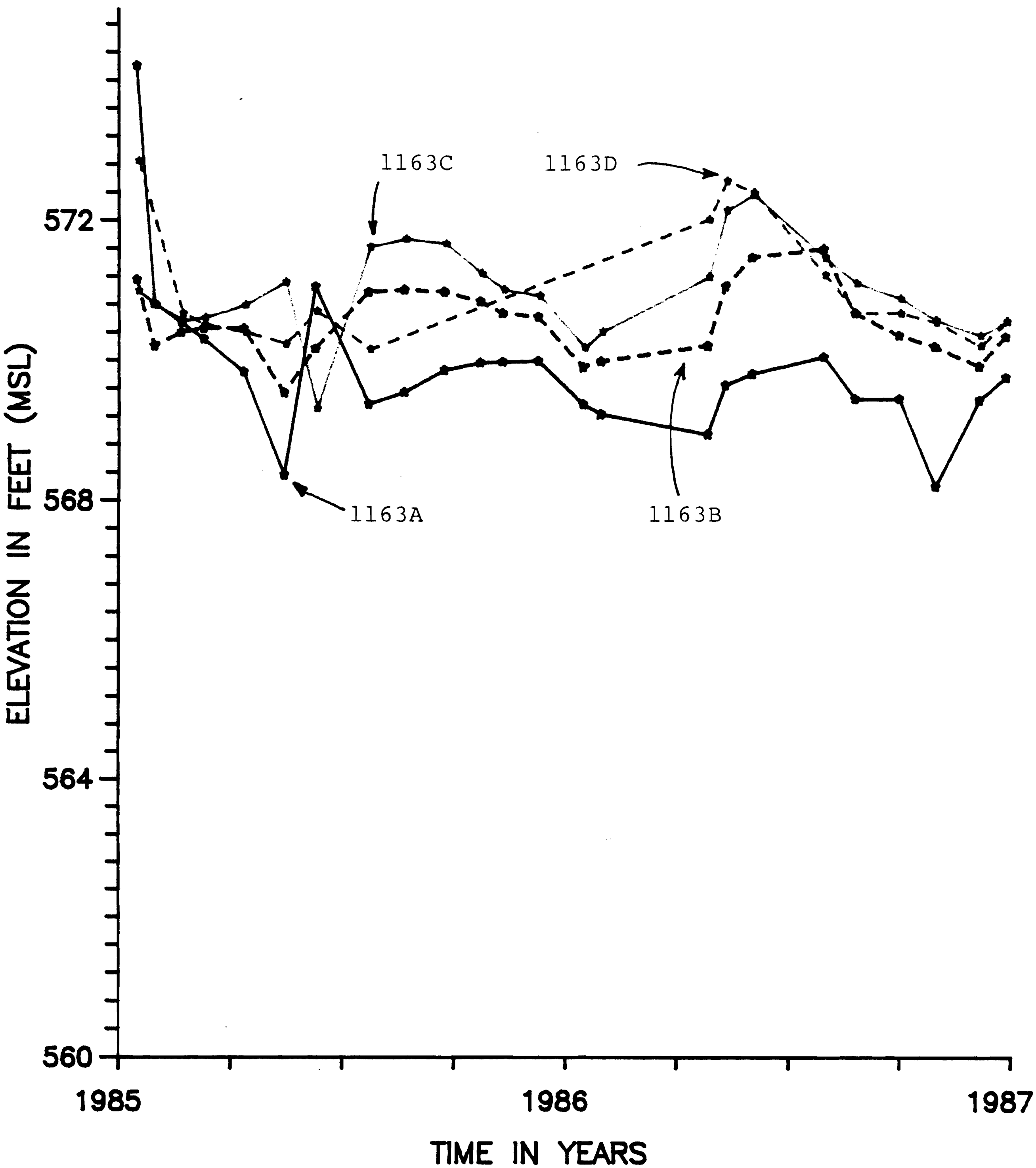
PIEZOMETERS 1161A, 1161B, 1161C, 1161D, 1161E



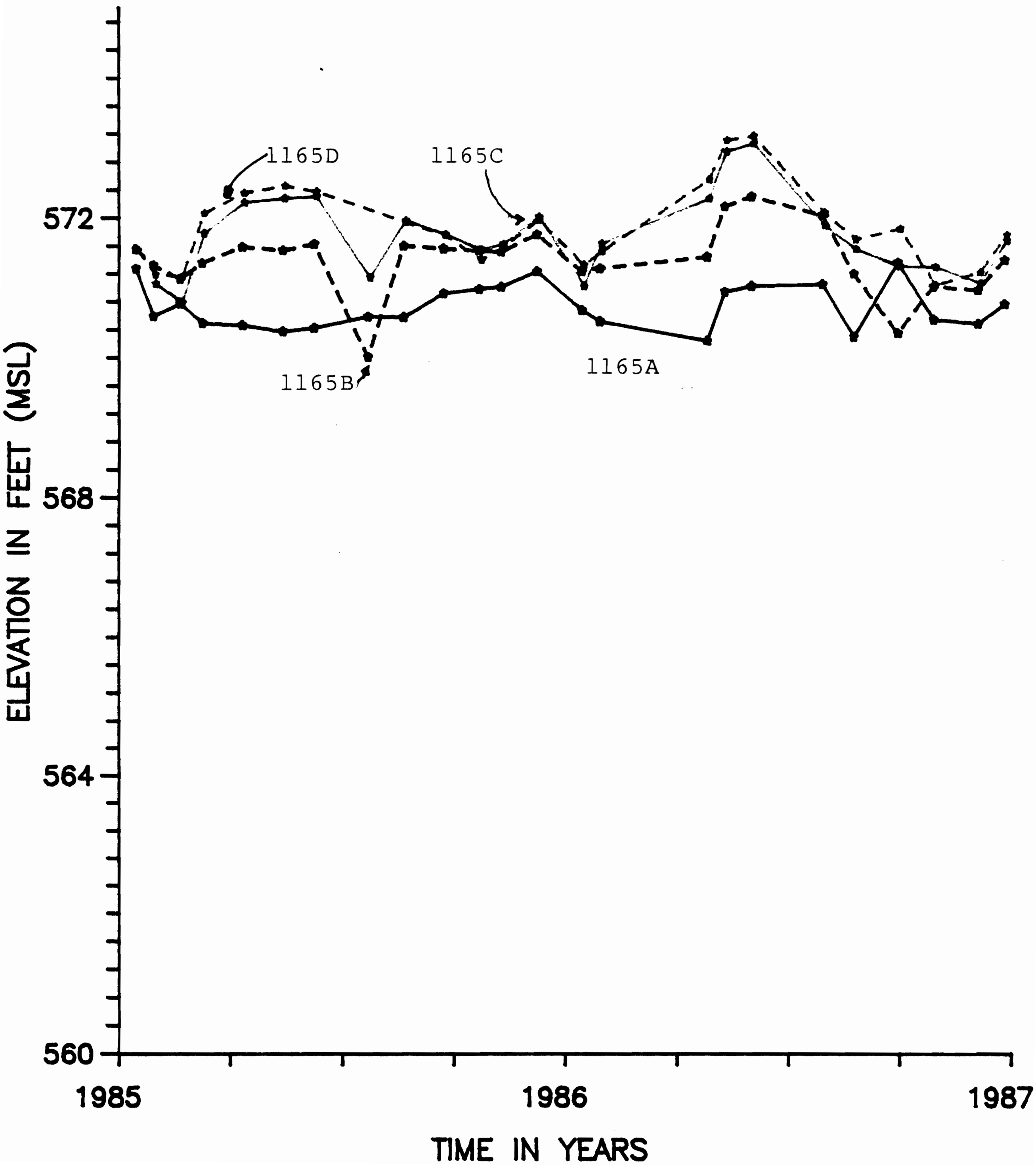
PIEZOMETERS 1162A, 1162C, 1162D

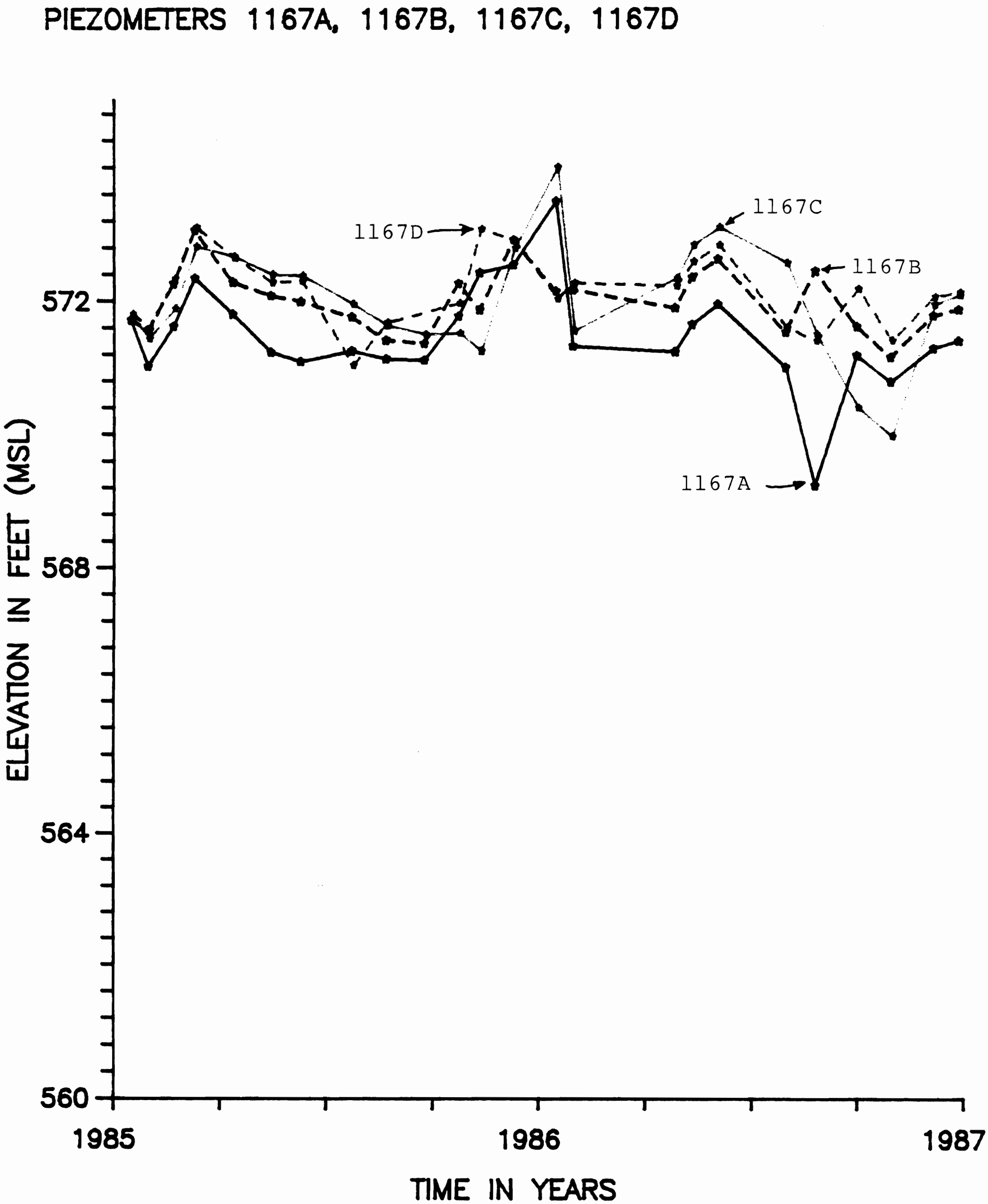


PIEZOMETERS 1163A, 1163B, 1163C, 1163D

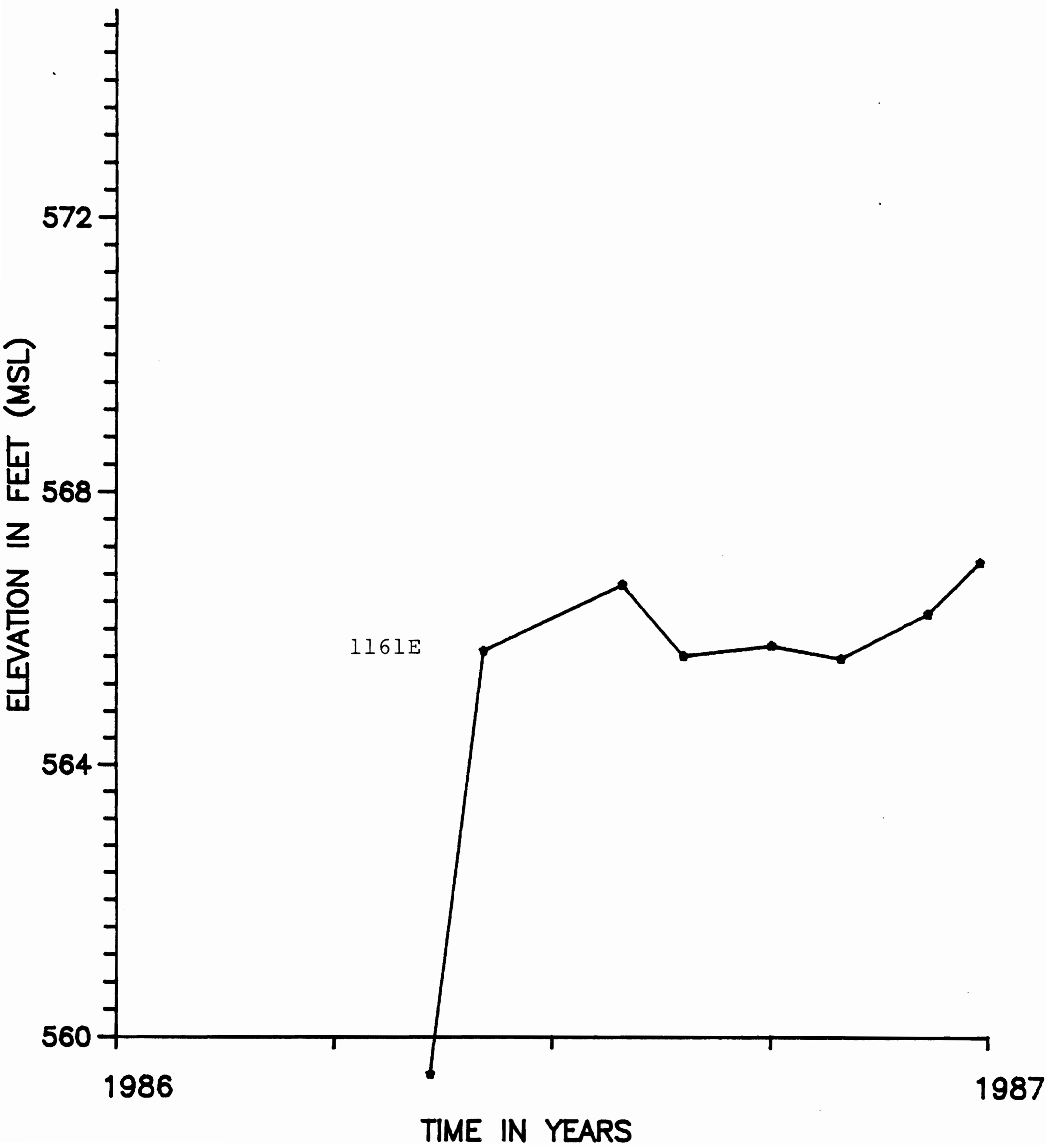


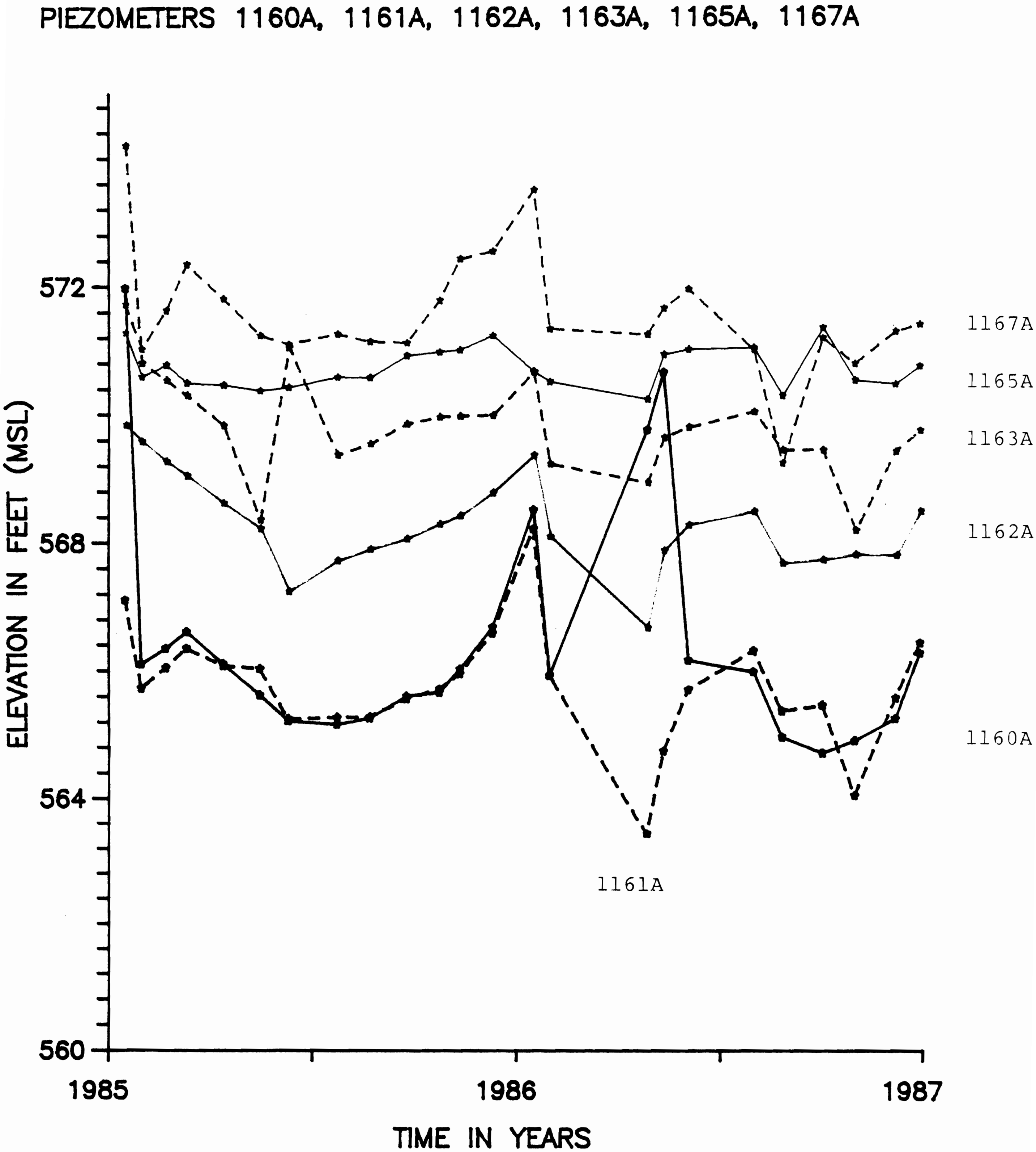
PIEZOMETERS 1165A, 1165B, 1165C, 1165D

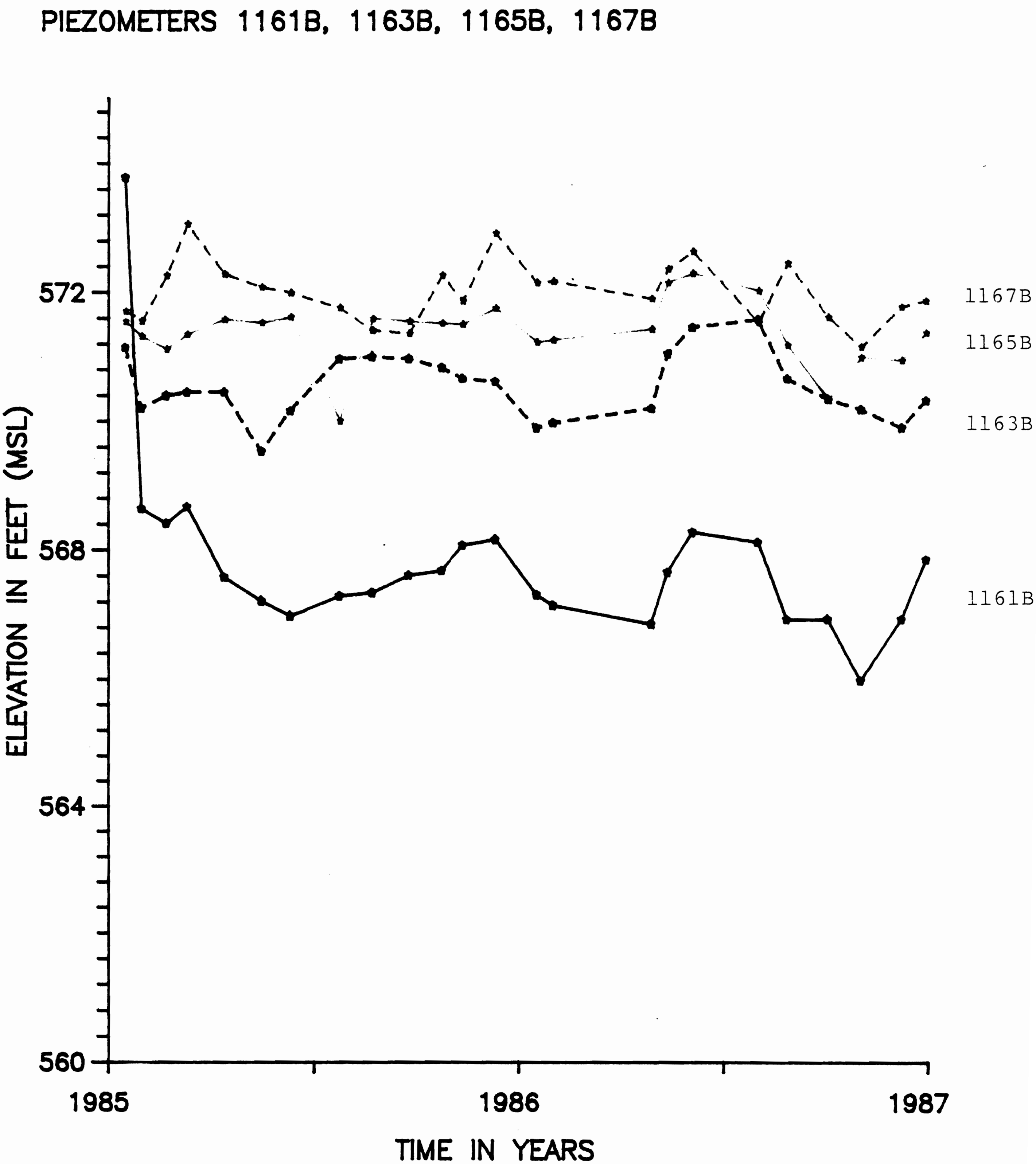



PIEZOMETERS 1167A, 1167B, 1167C, 1167D
1167D
1167C
1167B
1167A
572
568
564
560
ELEVATION IN FEET (MSL)
1985
1986
1987
TIME IN YEARS

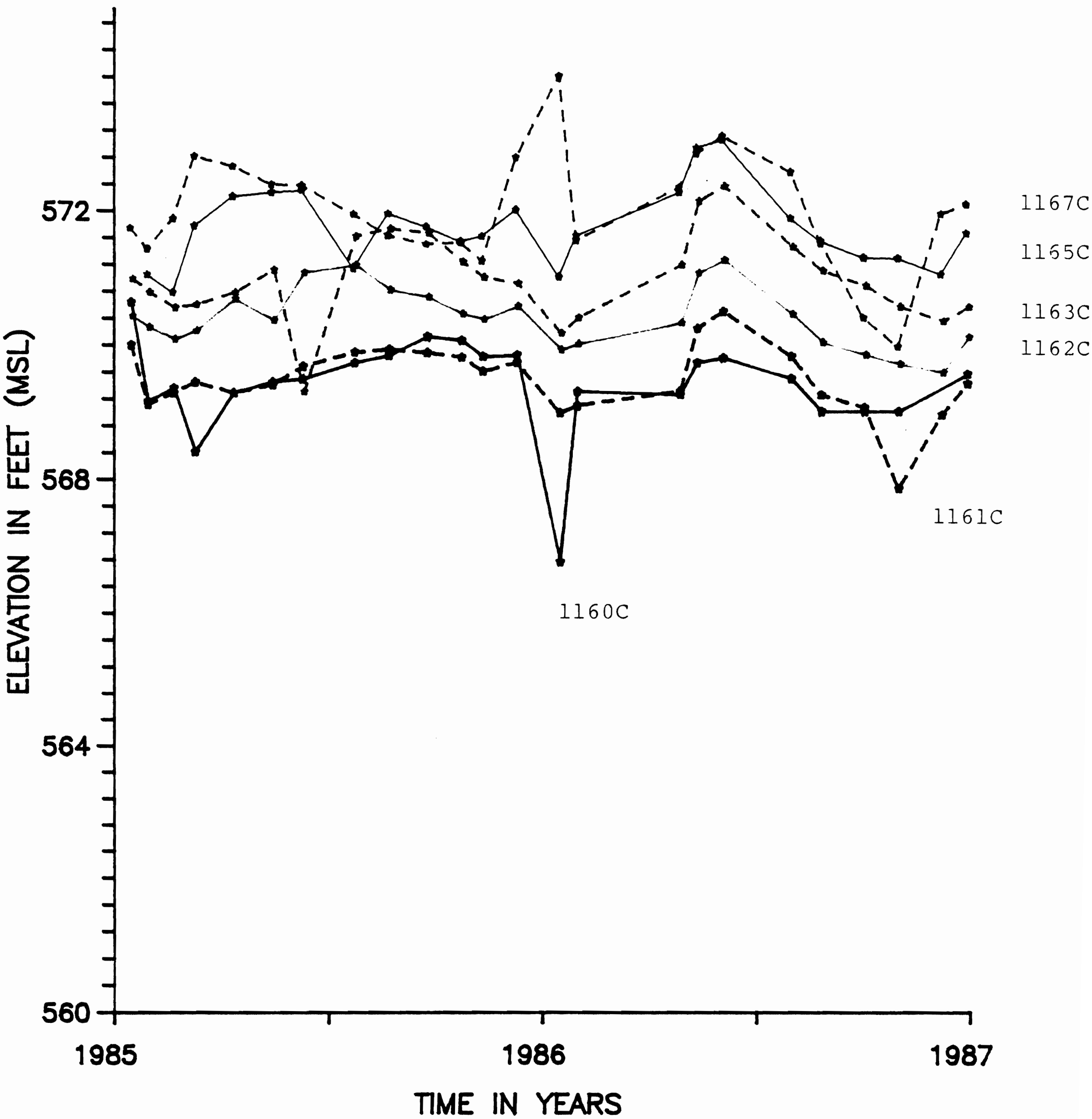
PIEZOMETER 1161E



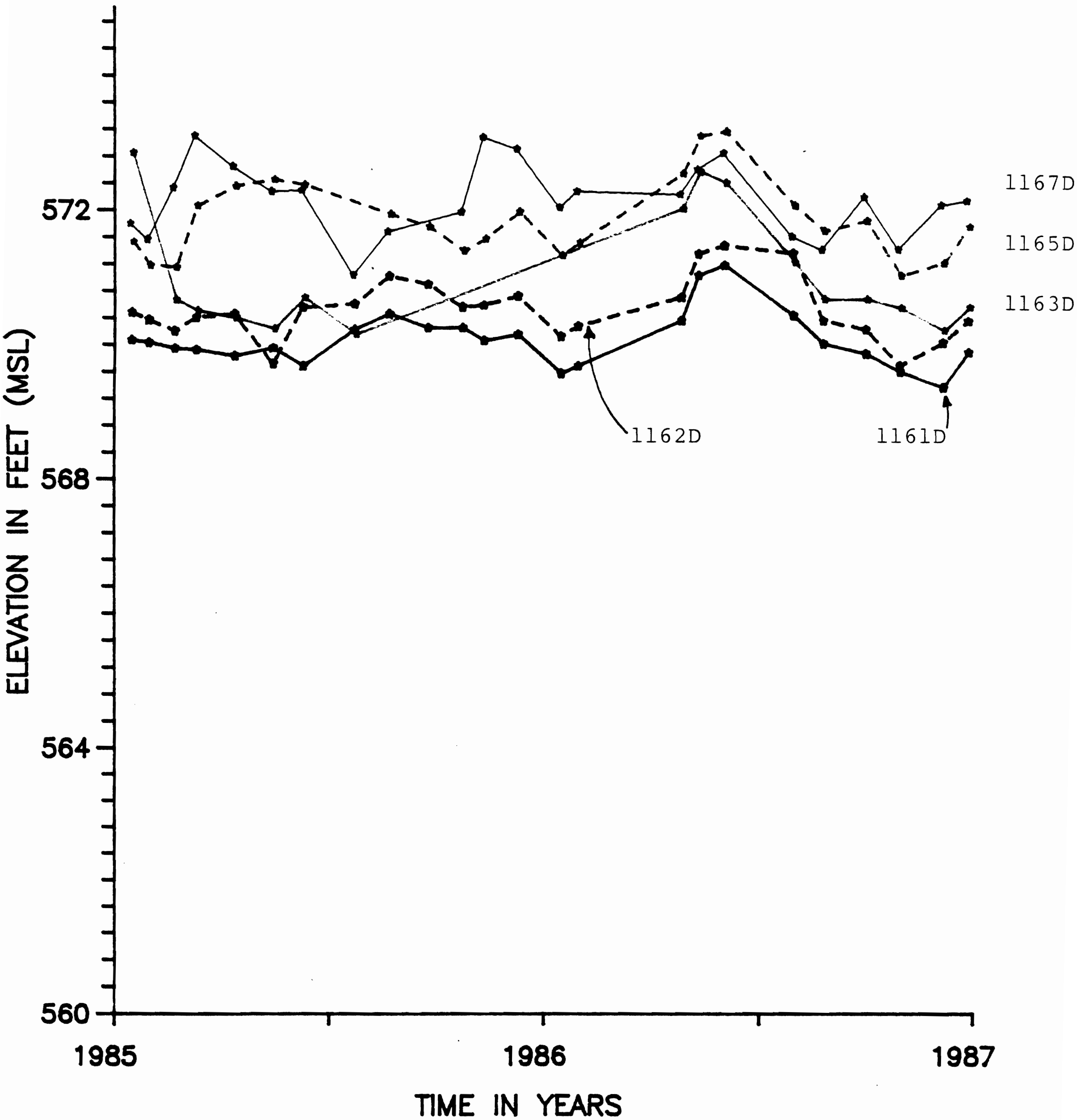

PIEZOMETERS 1160A, 1161A, 1162A, 1163A, 1165A, 1167A
ELEVATION IN FEET (MSL)
572
568
564
560
1985
1986
1987
TIME IN YEARS
1167A
1165A
1163A
1162A
1160A
1161A


PIEZOMETERS 1161B, 1163B, 1165B, 1167B
ELEVATION IN FEET (MSL)
572
568
564
560
1985
1986
1987
TIME IN YEARS
1167B
1165B
1163B
1161B

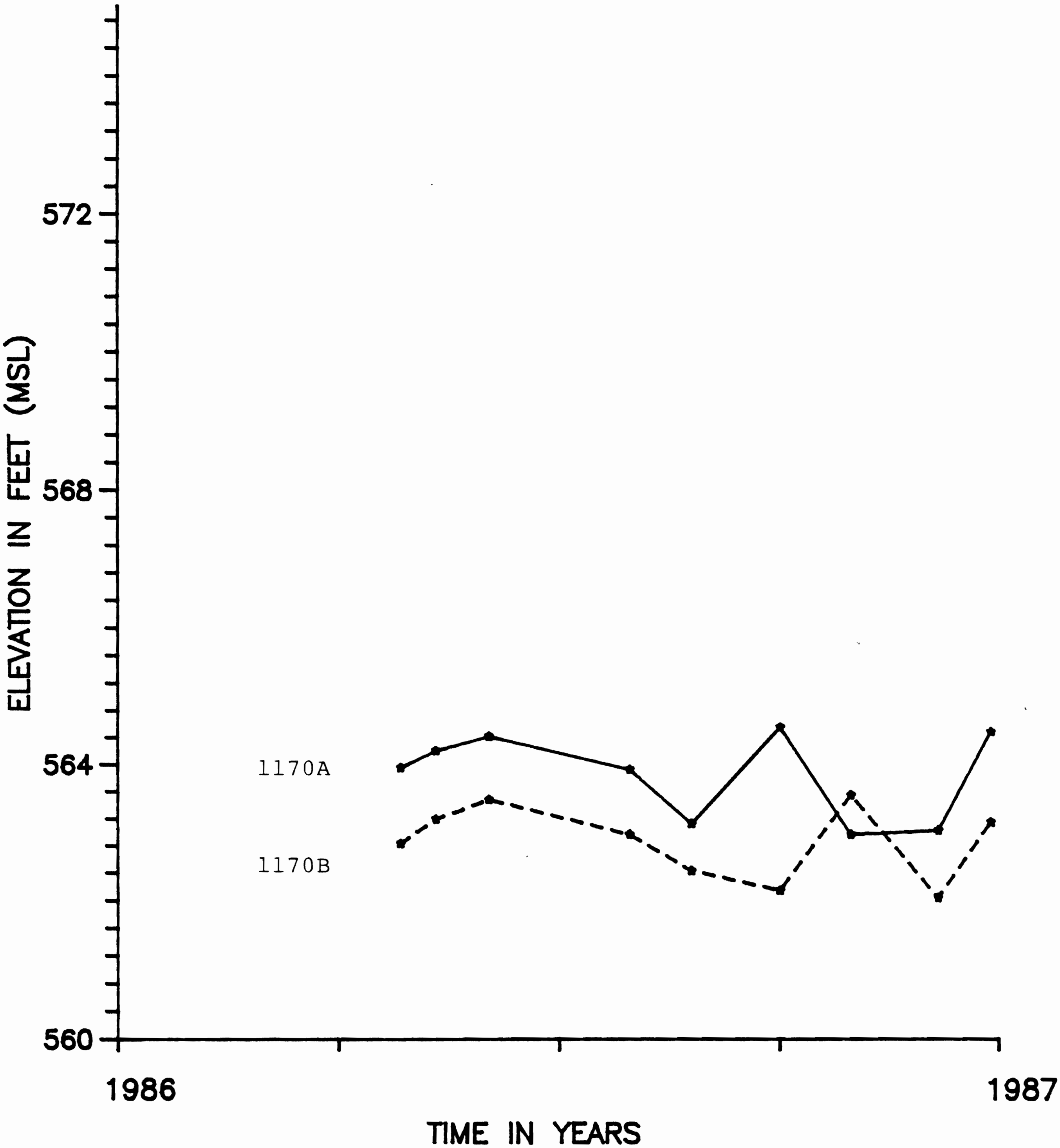
PIEZOMETERS 1160C, 1161C, 1162C, 1163C, 1165C, 1167C



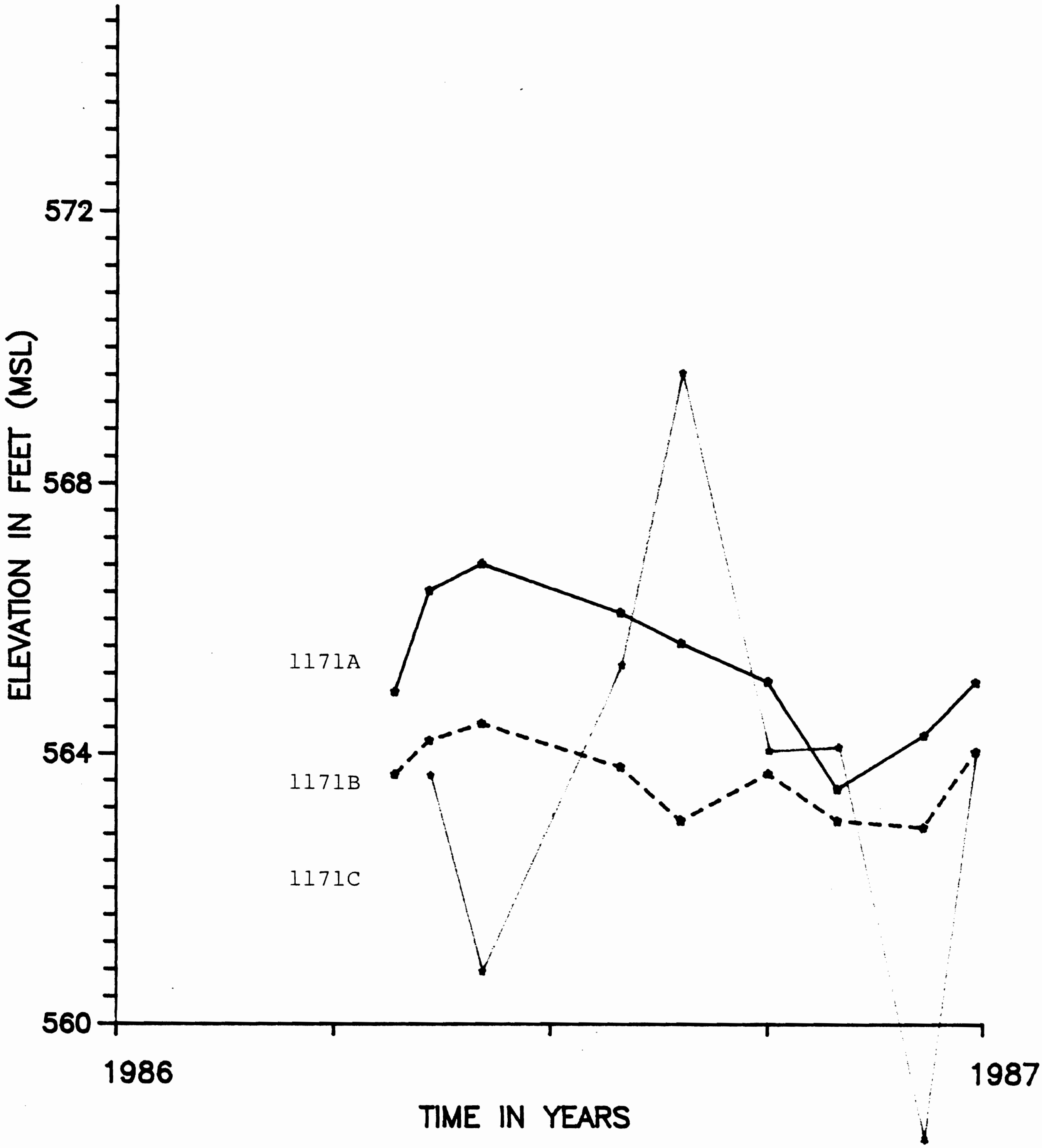
PIEZOMETERS 1161D, 1162D, 1163D, 1165D, 1167D

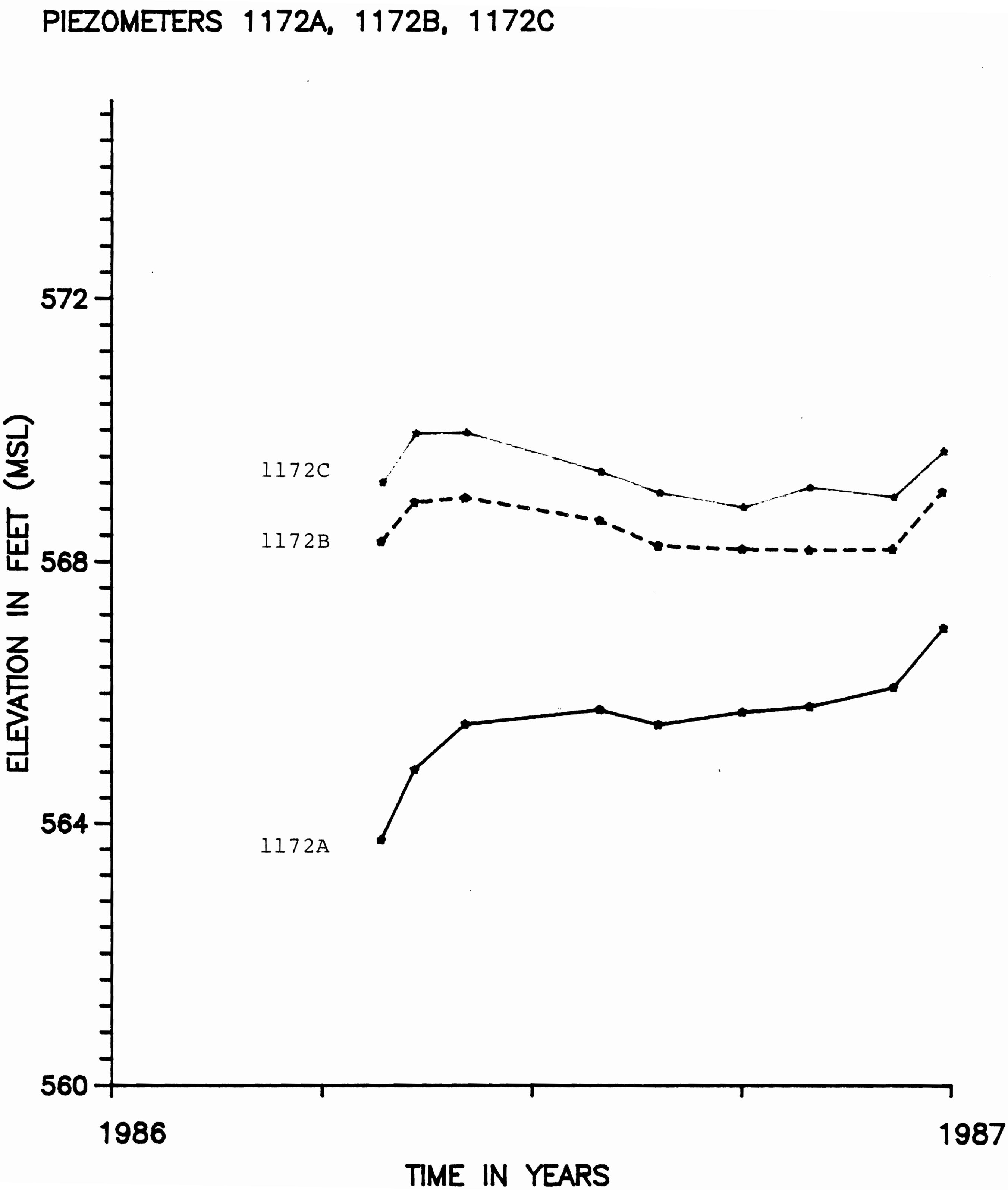


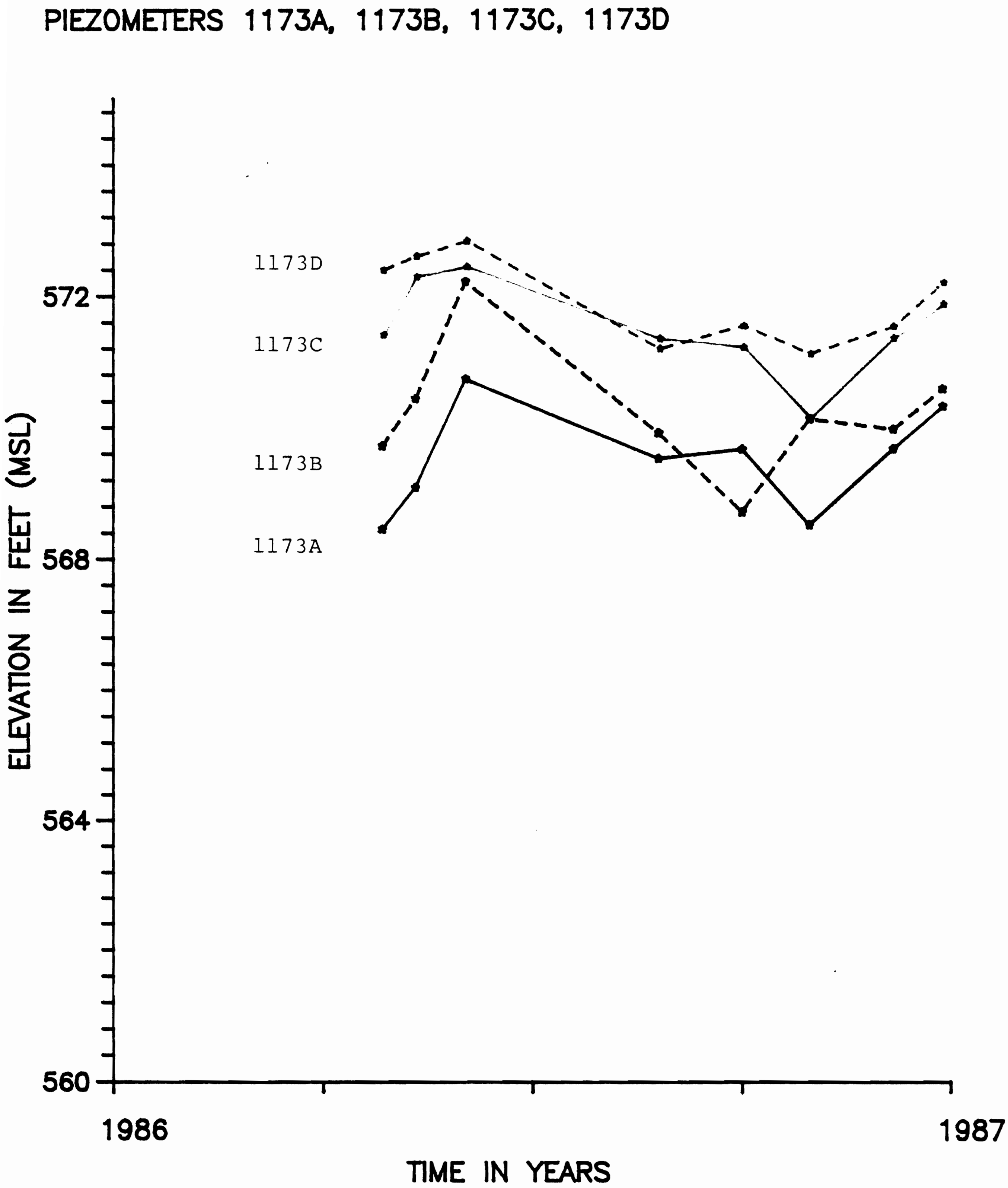
PIEZOMETERS 1170A, 1170B

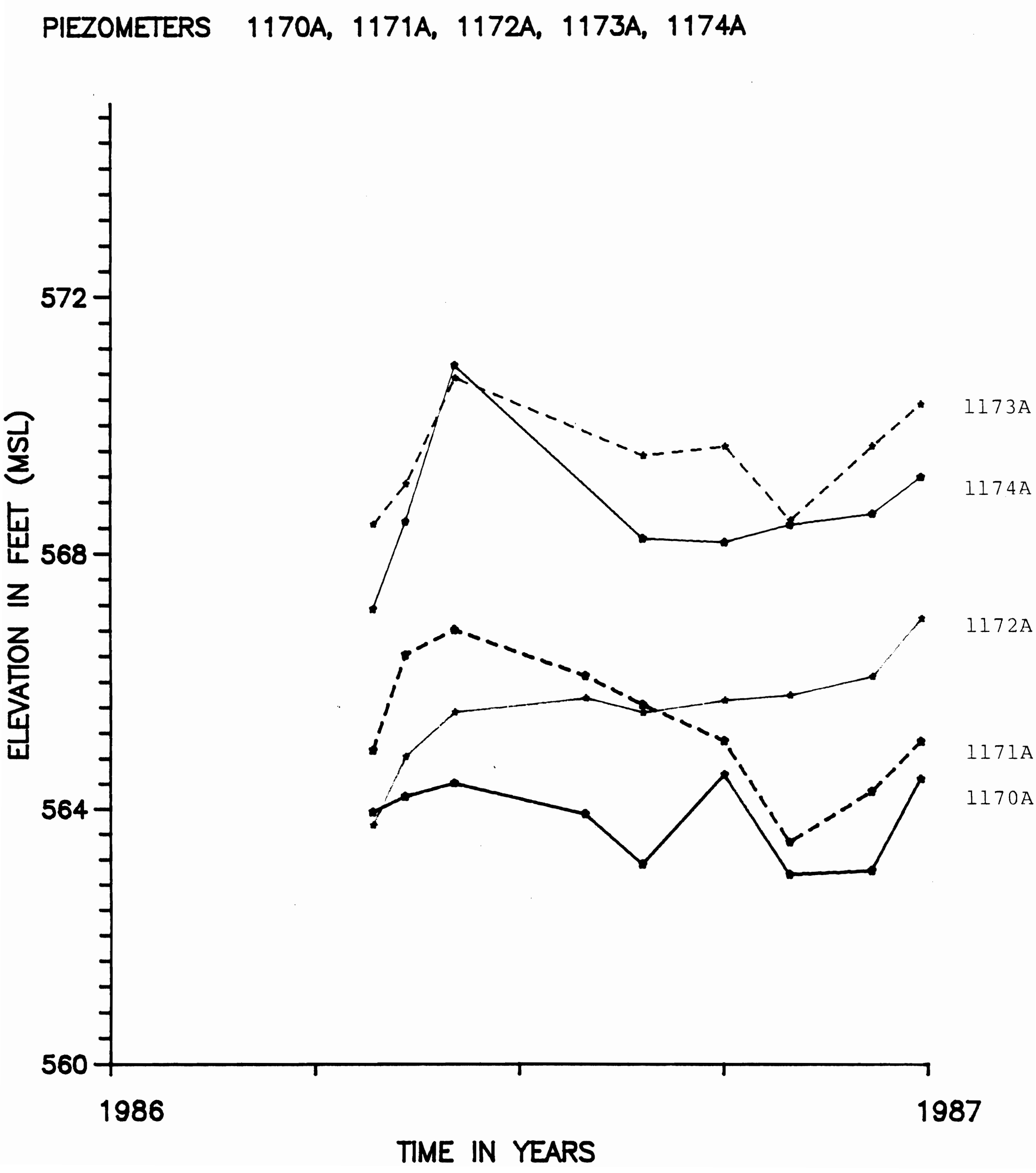


PIEZOMETERS 1171A, 1171B, 1171C

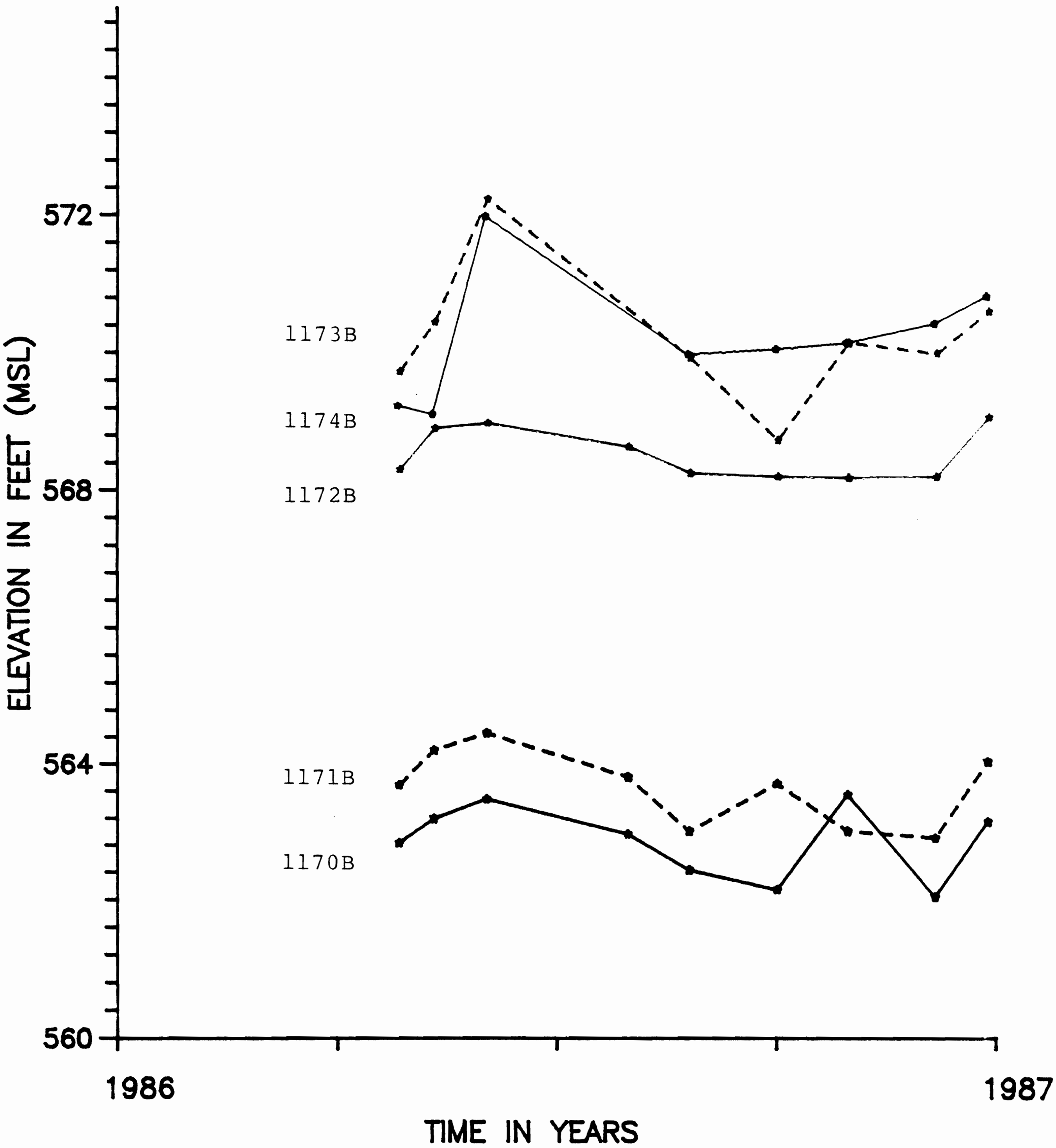



PIEZOMETERS 1172A, 1172B, 1172C
ELEVATION IN FEET (MSL)
572
568
564
560
1172C
1172B
1172A
1986
1987
TIME IN YEARS

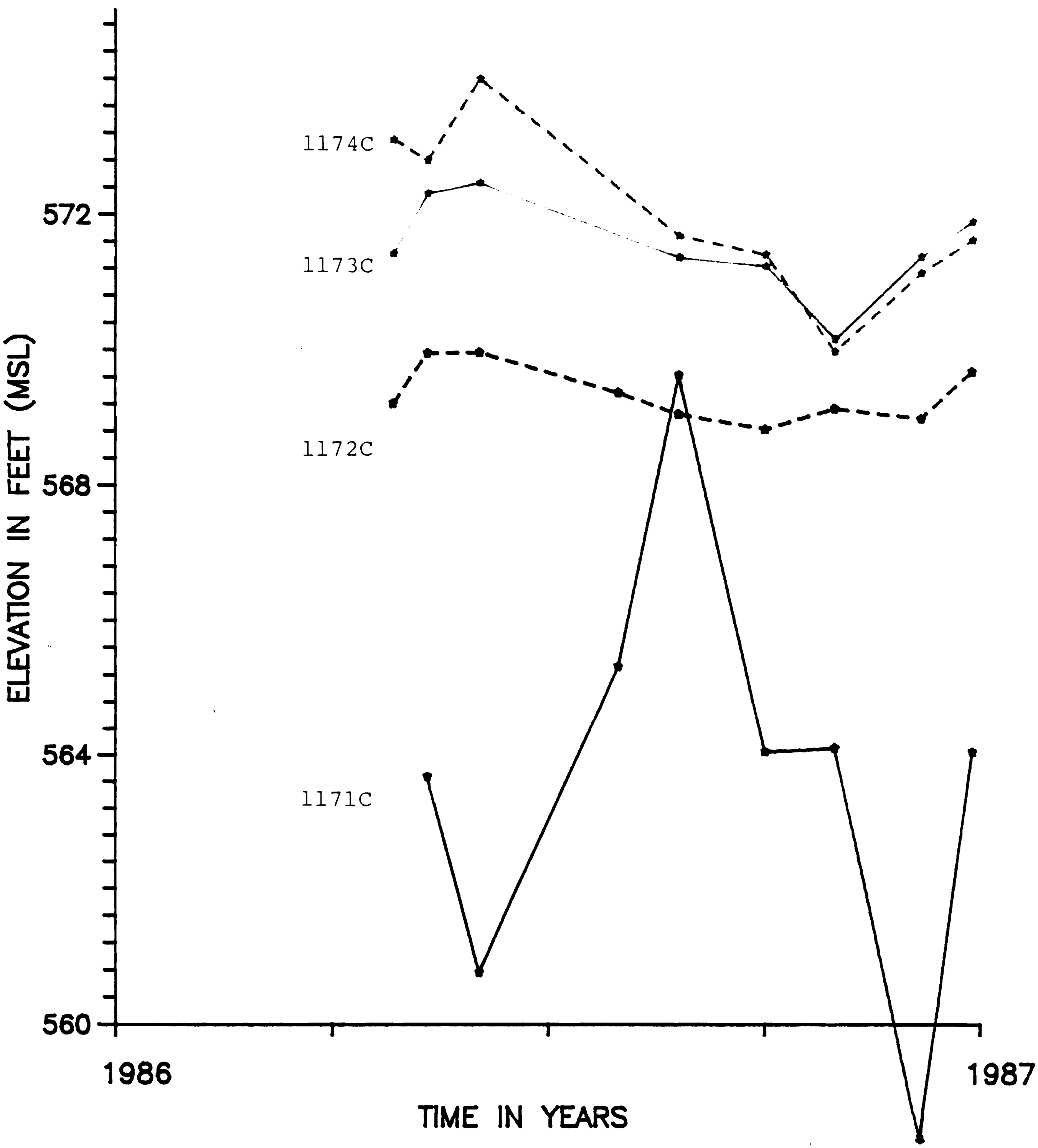

PIEZOMETERS 1173A, 1173B, 1173C, 1173D
1173D
1173C
1173B
1173A
572
568
564
560
ELEVATION IN FEET (MSL)
1986
1987
TIME IN YEARS


PIEZOMETERS 1170A, 1171A, 1172A, 1173A, 1174A
ELEVATION IN FEET (MSL)
572
568
564
560
1986
1987
TIME IN YEARS
1173A
1174A
1172A
1171A
1170A

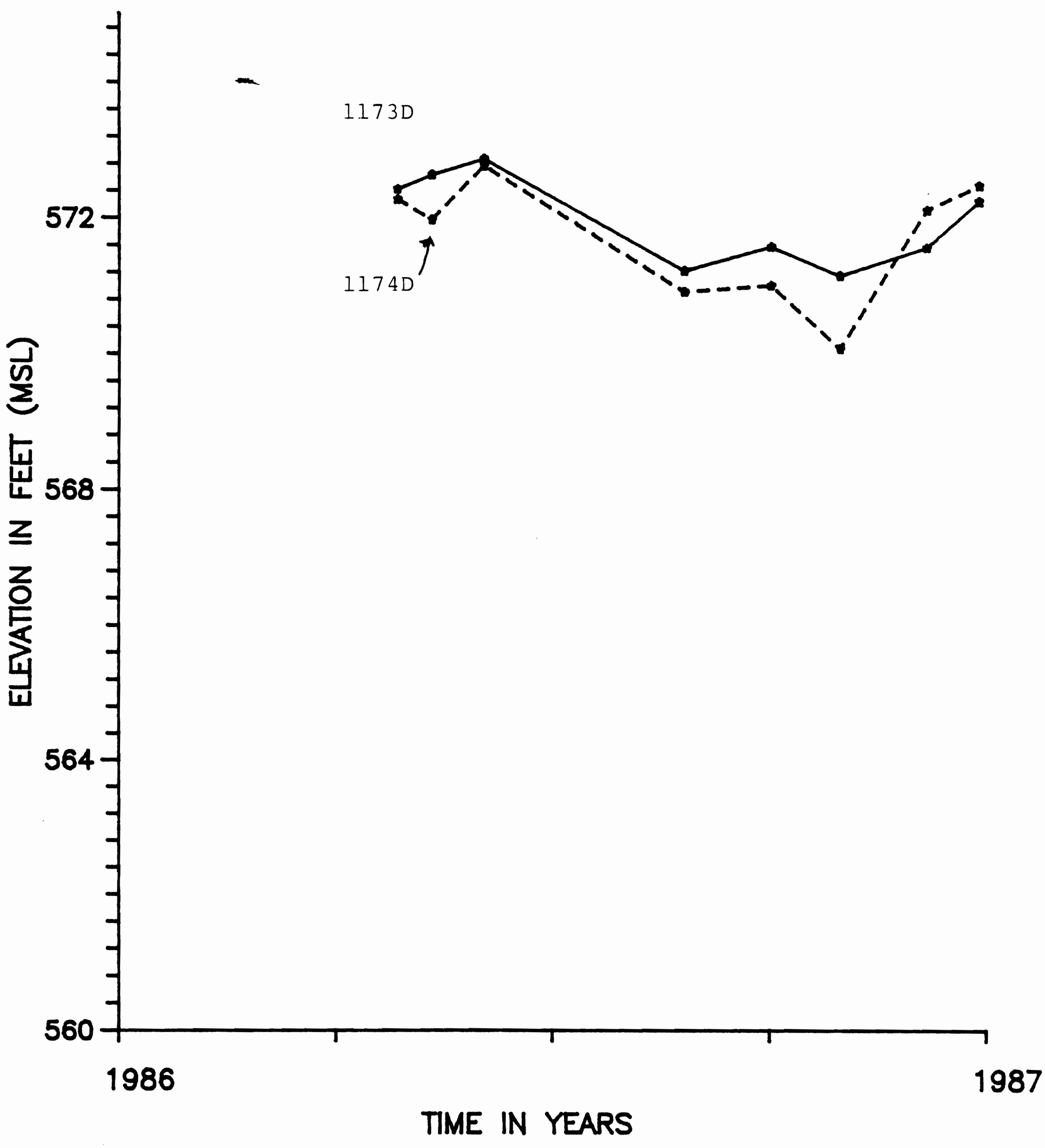
PIEZOMETERS 1170B, 1171B, 1172B, 1173B, 1174B



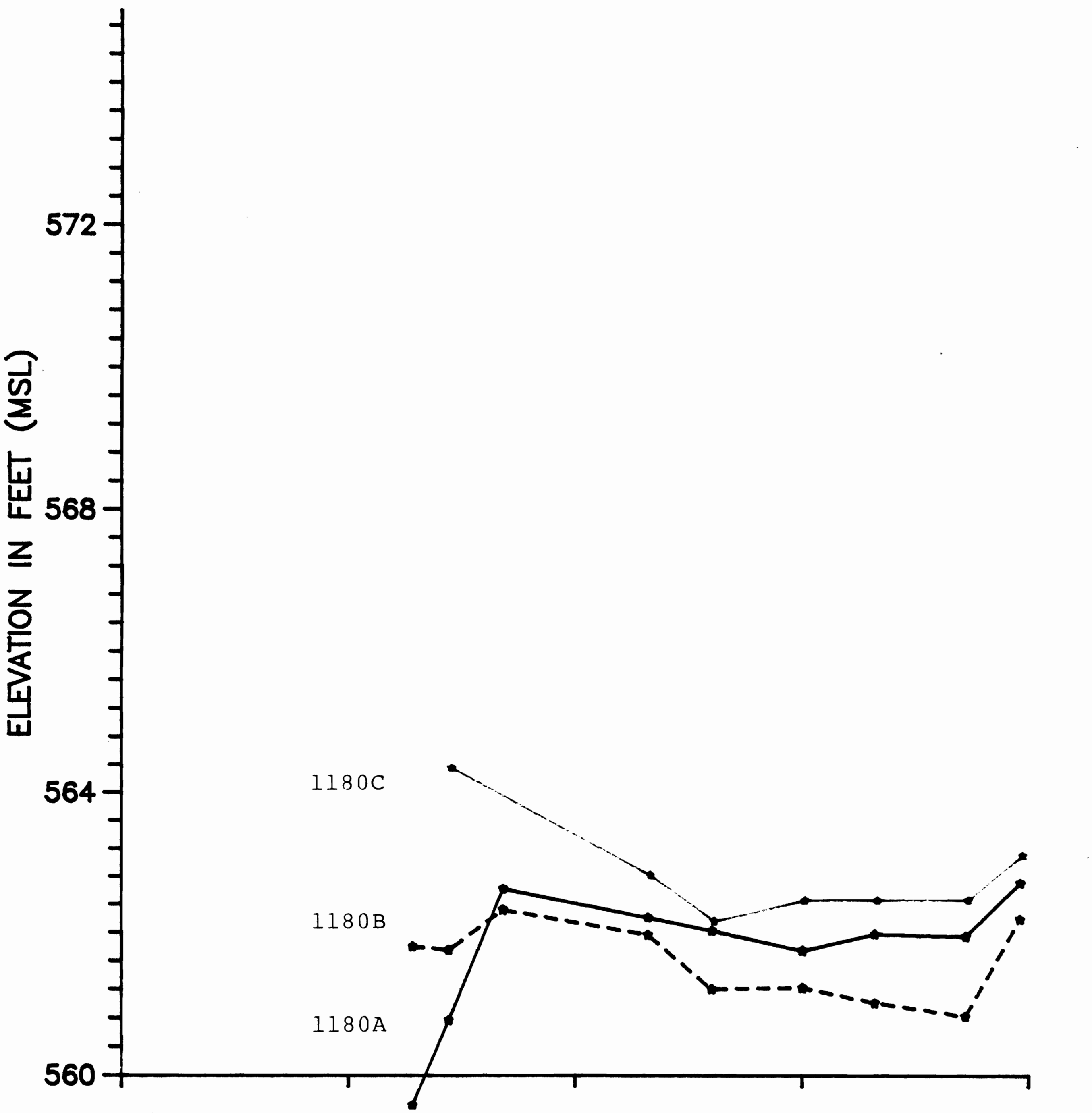
PIEZOMETERS 1171C, 1172C, 1173C, 1174C



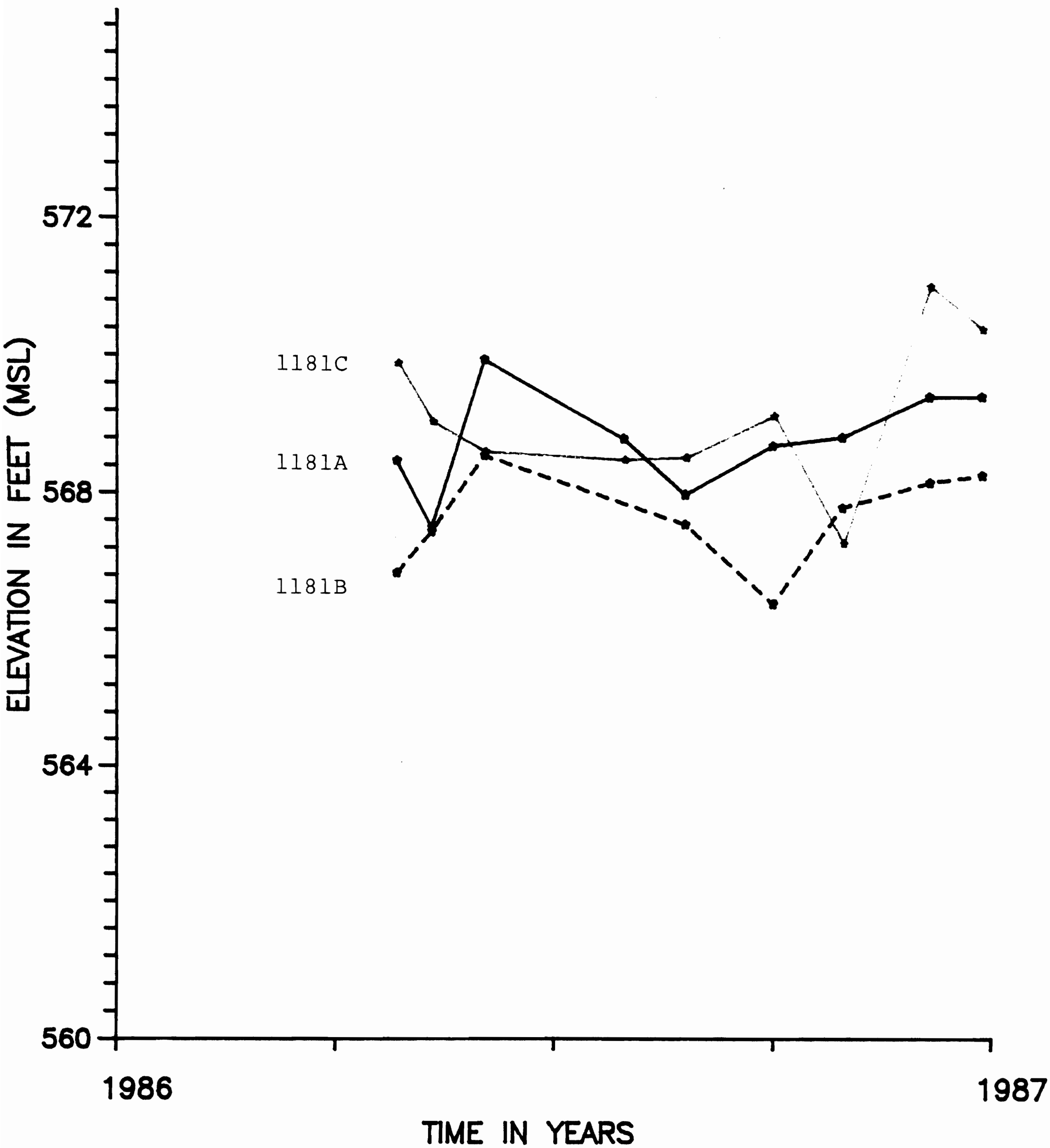
PIEZOMETERS 1173D, 1174D



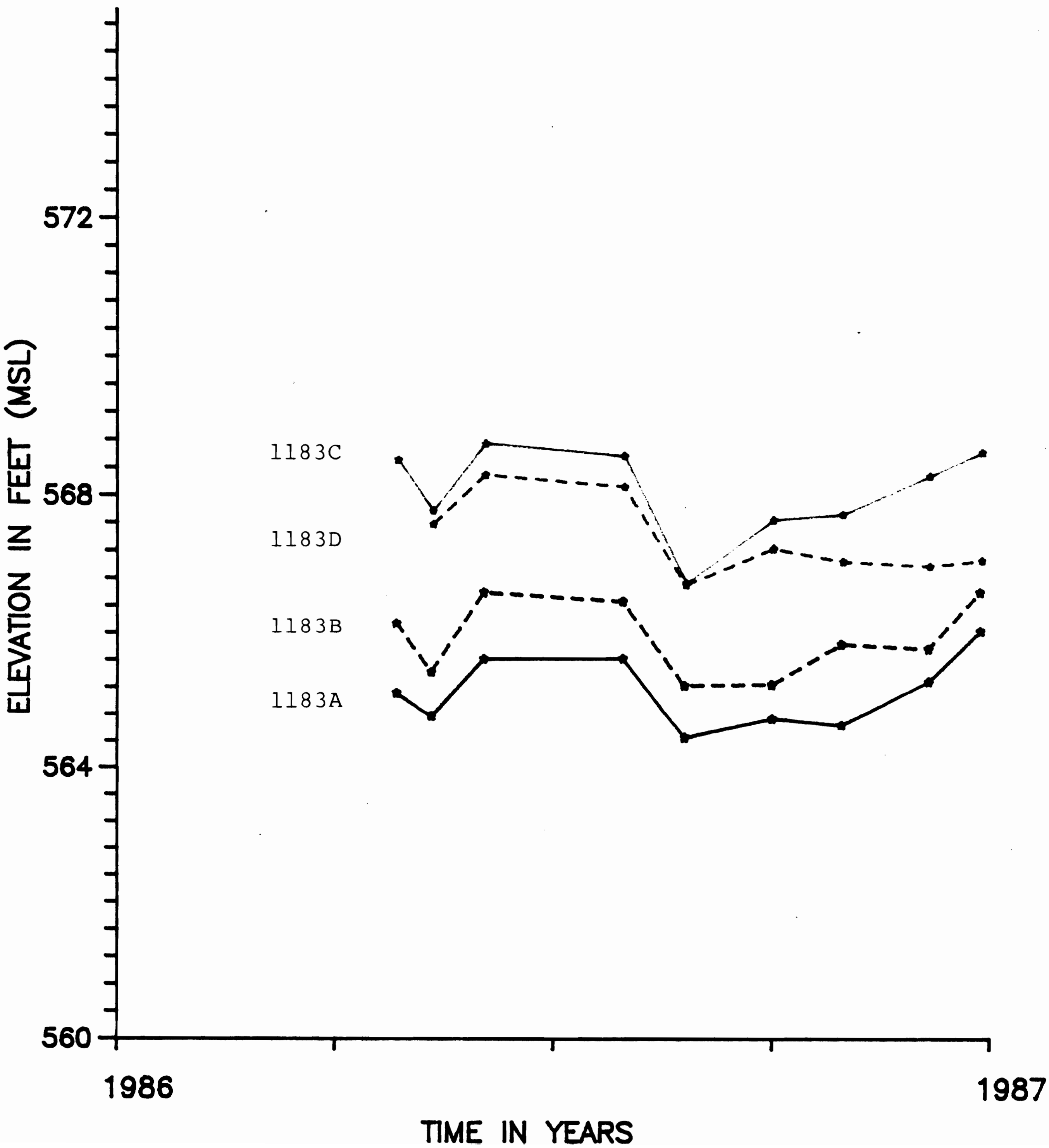
PIEZOMETERS 1180A, 1180B, 1180C



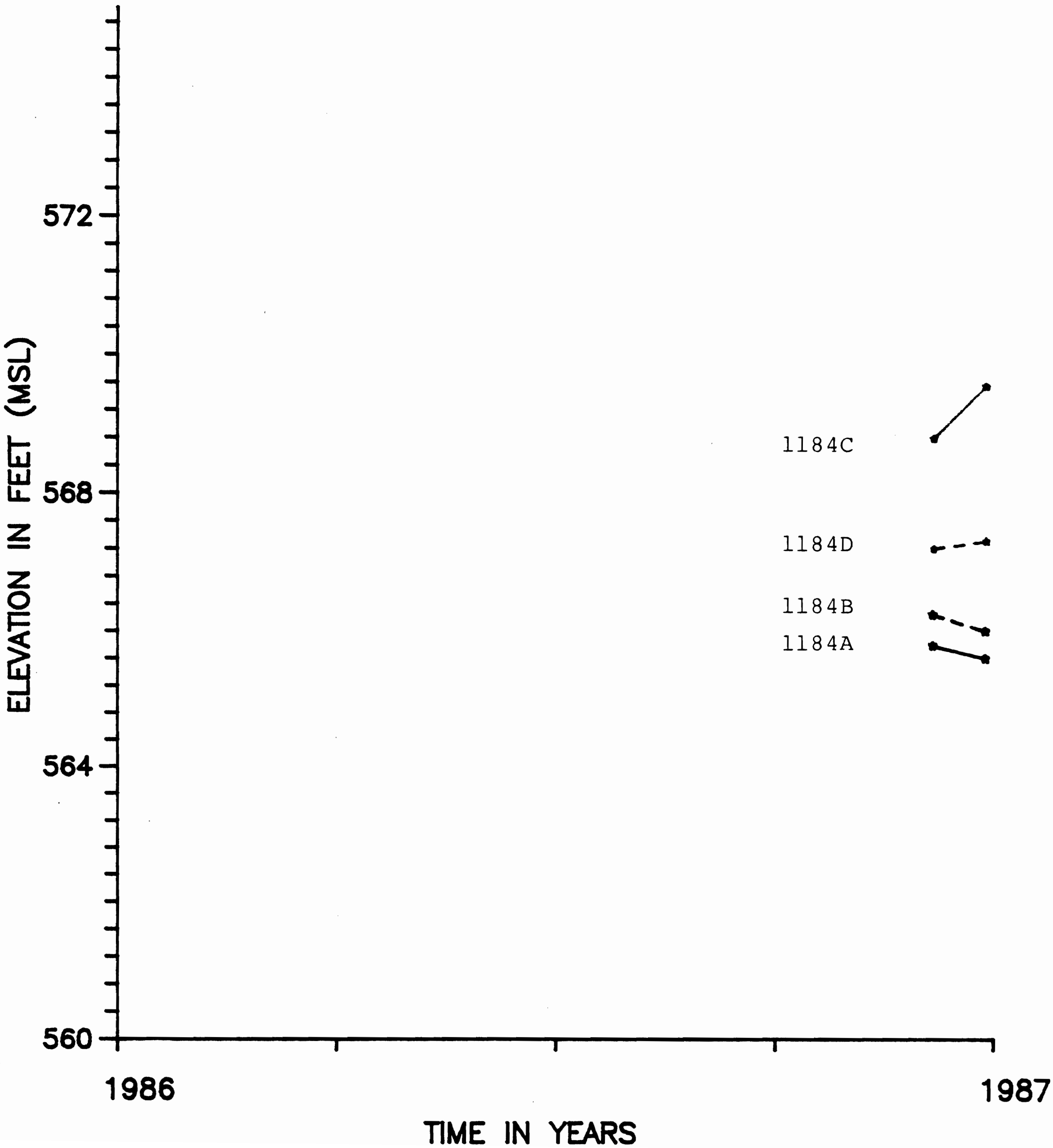
PIEZOMETERS 1181A, 1181B, 1181C



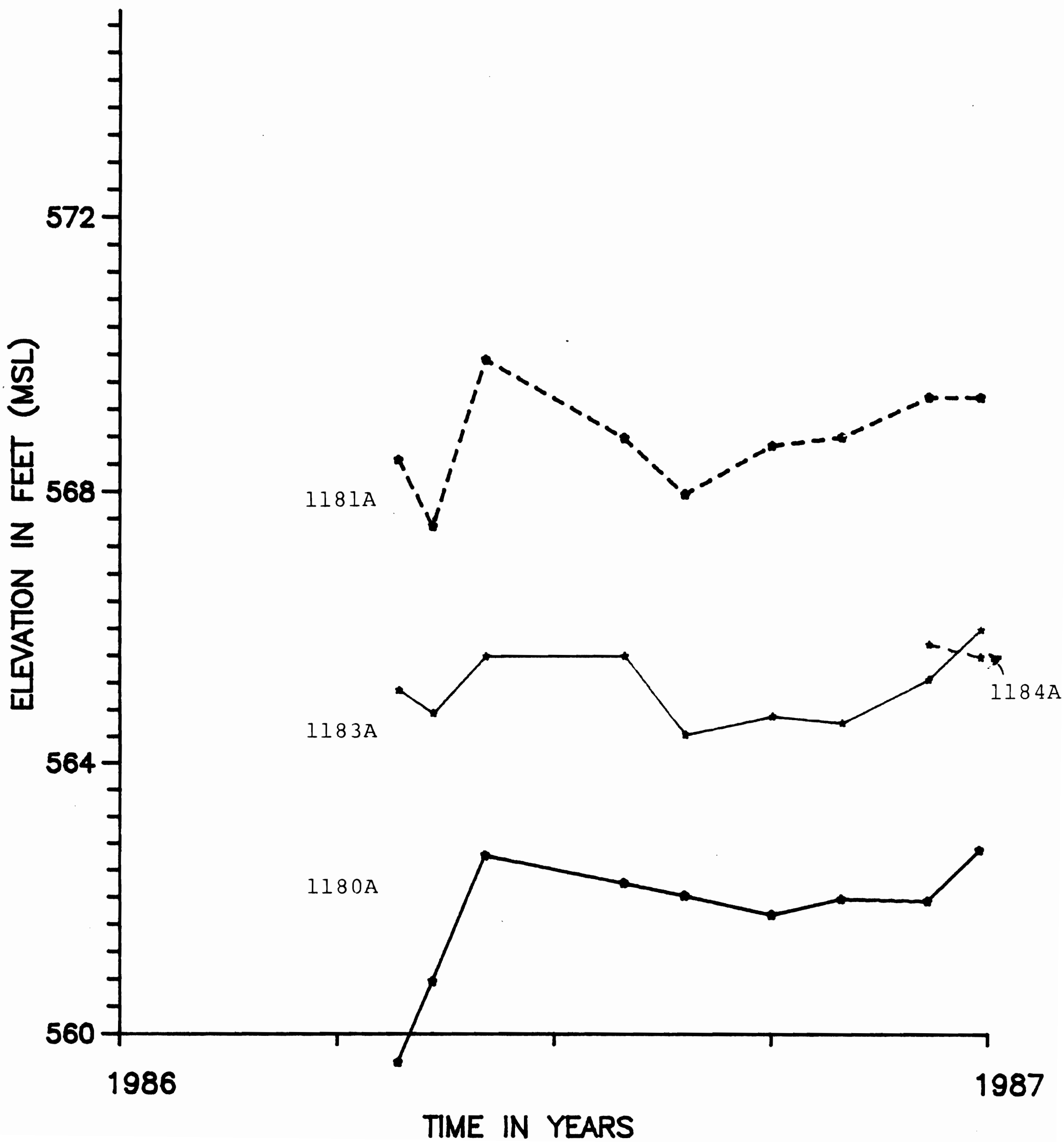
PIEZOMETERS 1183A, 1183B, 1183C, 1183D



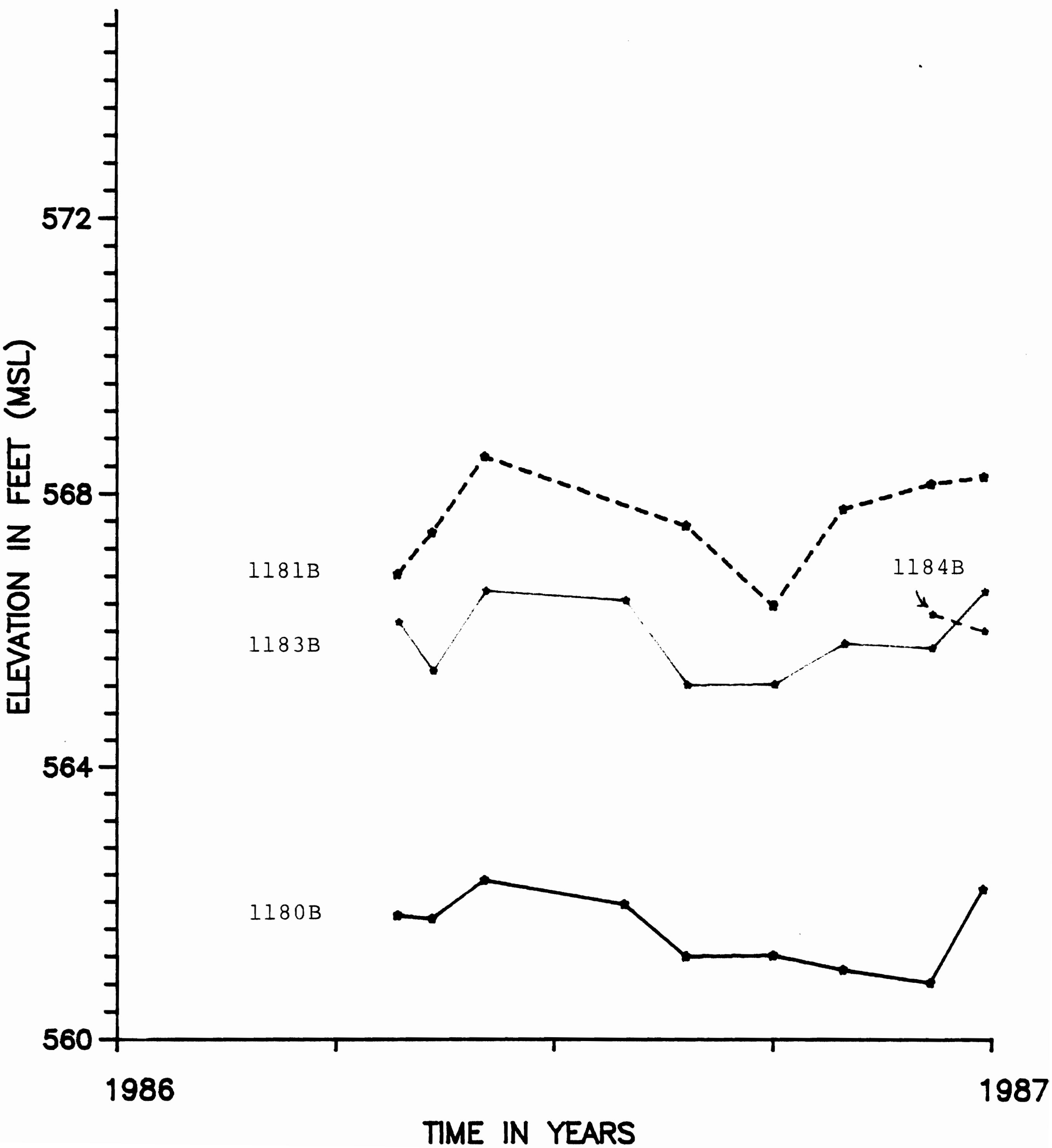
PIEZOMETERS 1184A, 1184B, 1184C, 1184D



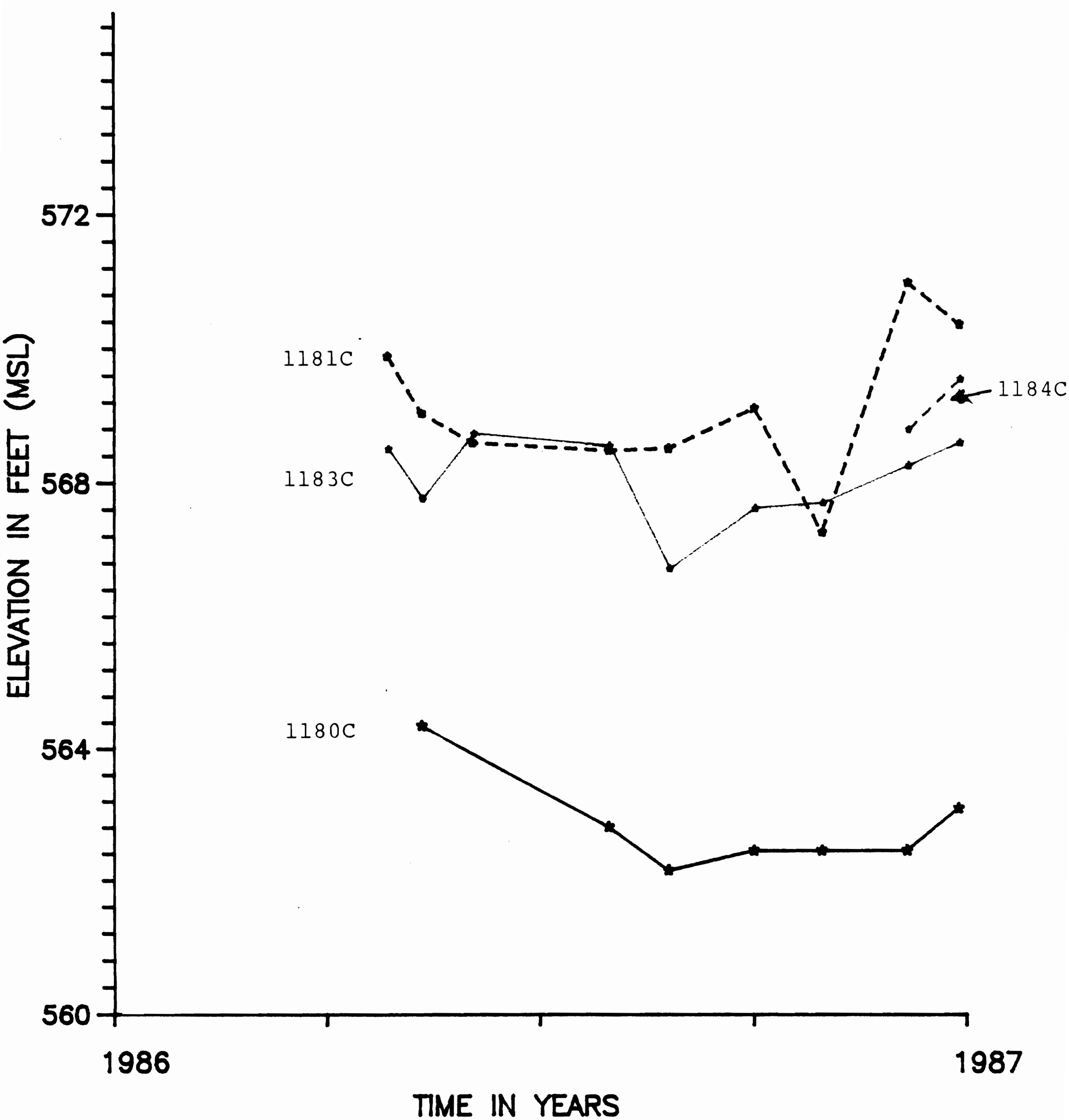
PIEZOMETERS 1180A, 1181A, 1183A, 1184A



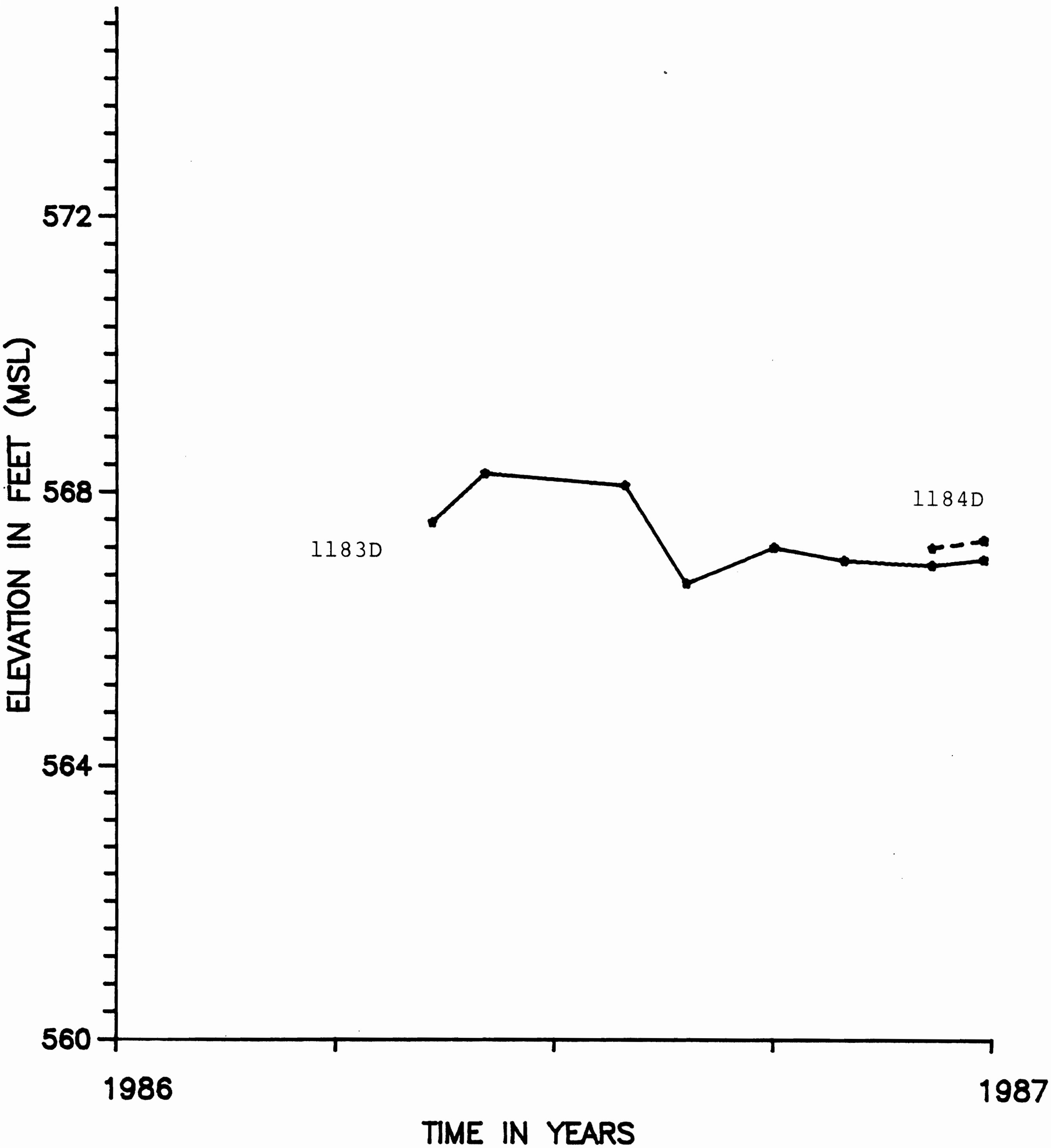
PIEZOMETERS 1180B, 1181B, 1183B, 1184B



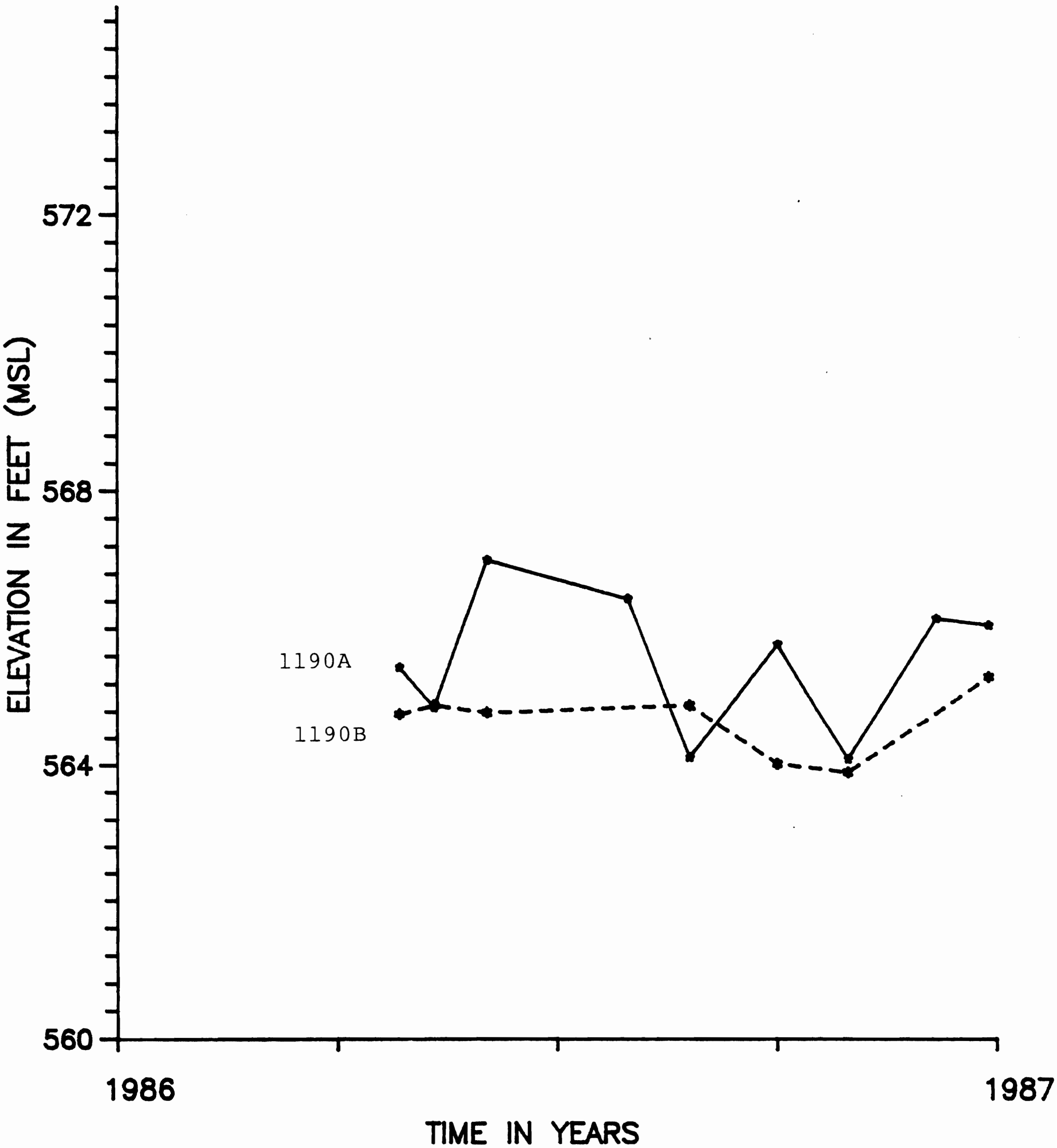
PIEZOMETERS 1180C, 1181C, 1183C, 1184C



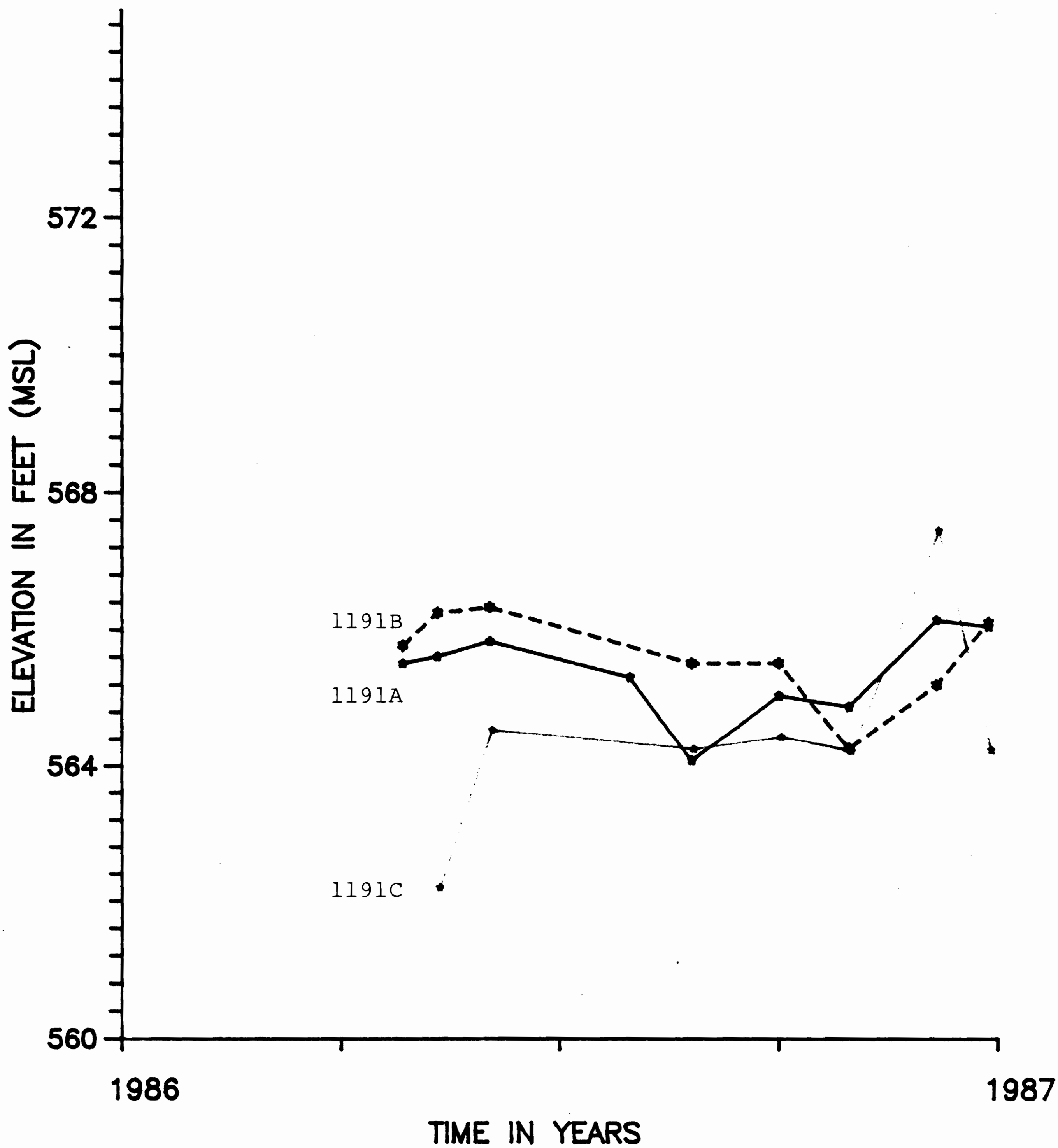
PIEZOMETERS 1183D, 1184D



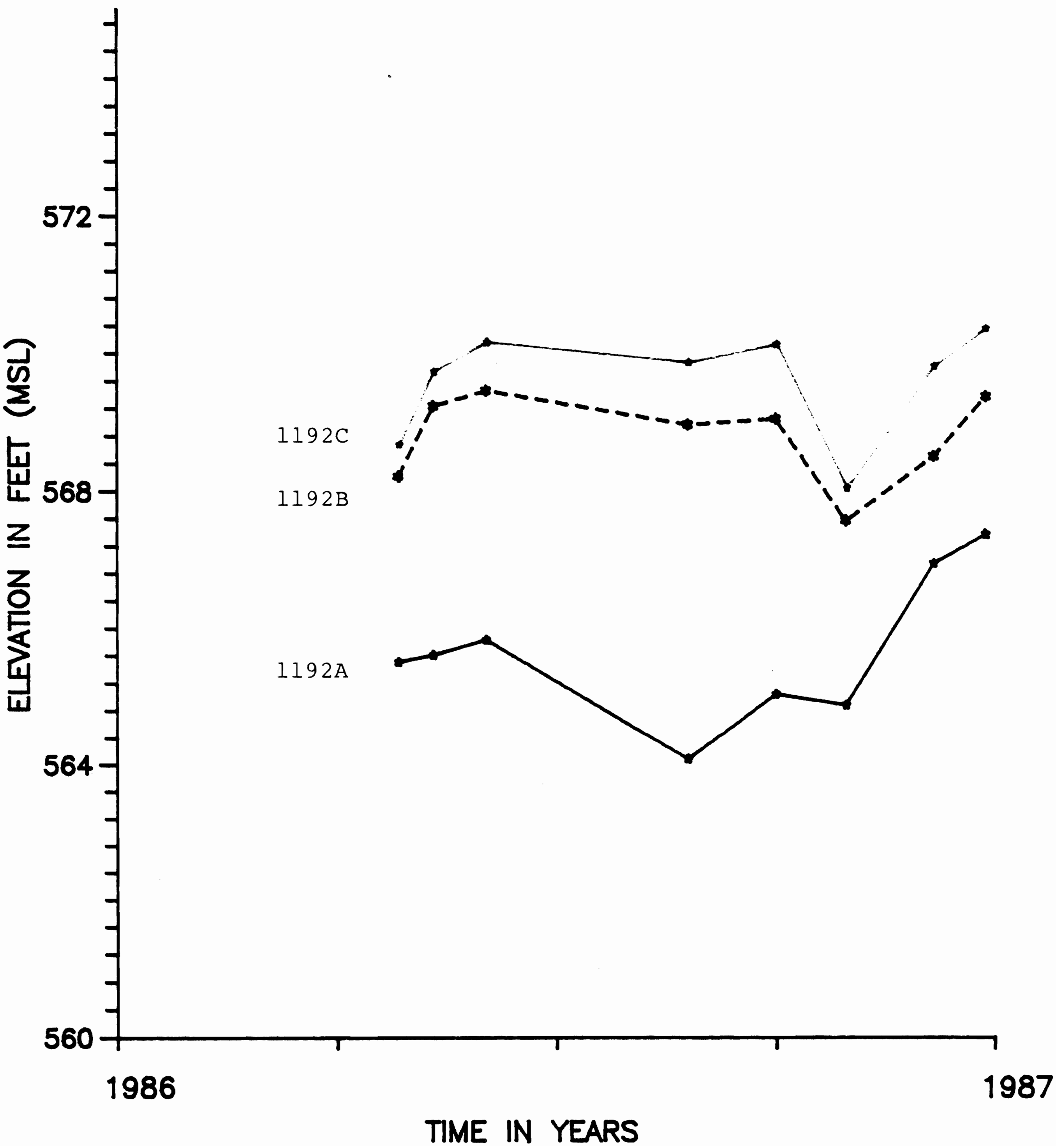
PIEZOMETERS 1190A, 1190B

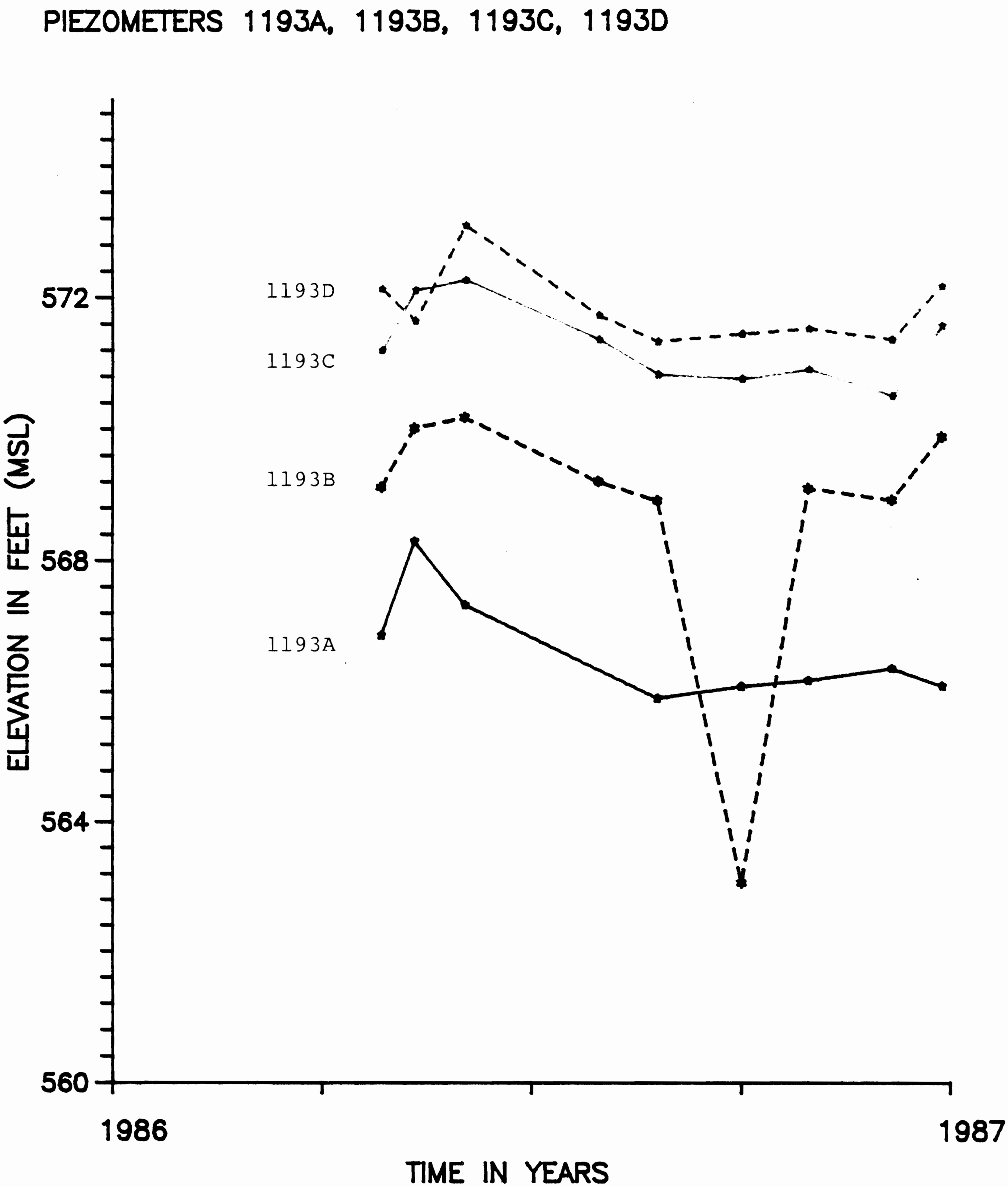


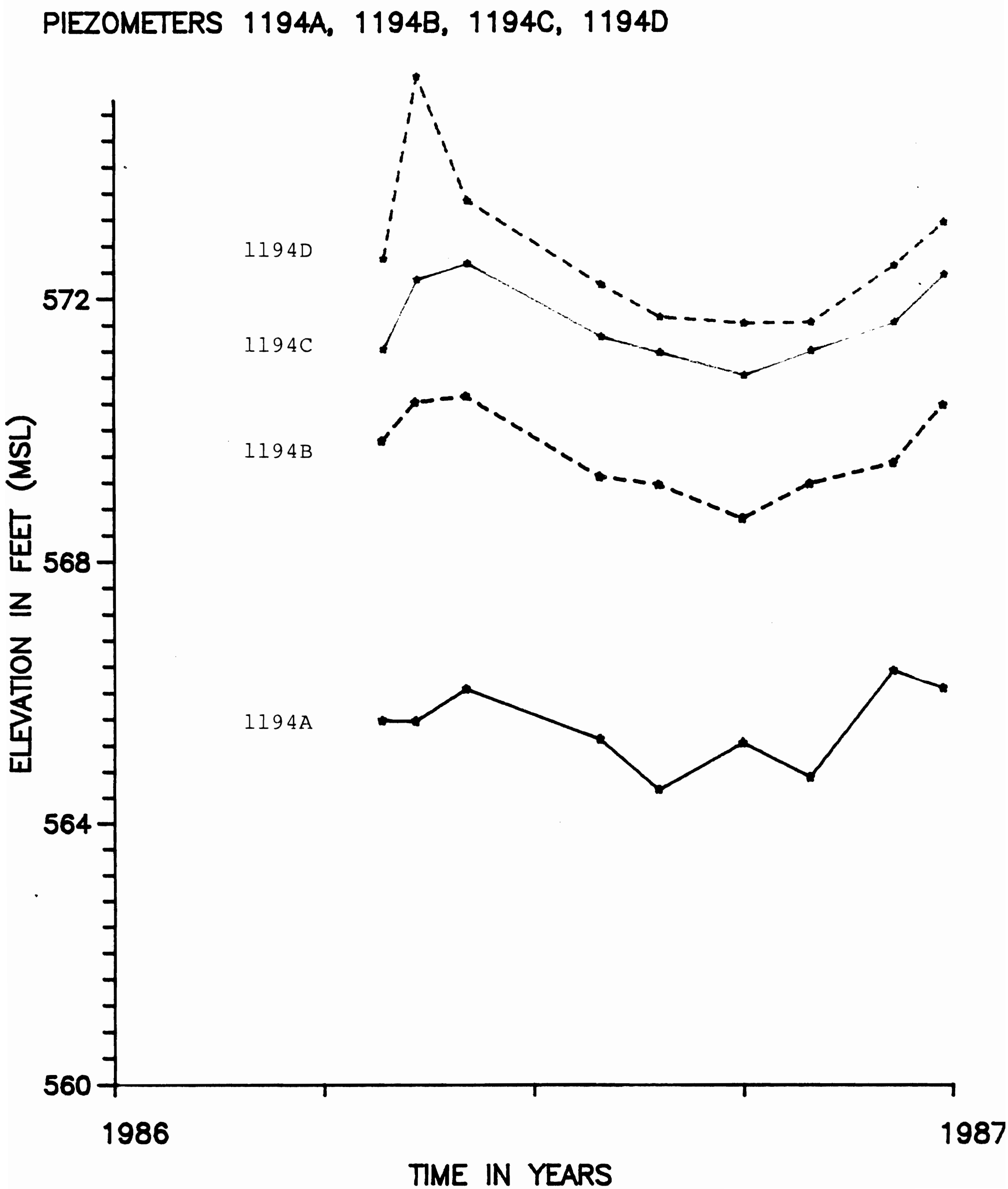
PIEZOMETERS 1191A, 1191B, 1191C



PIEZOMETERS 1192A, 1192B, 1192C

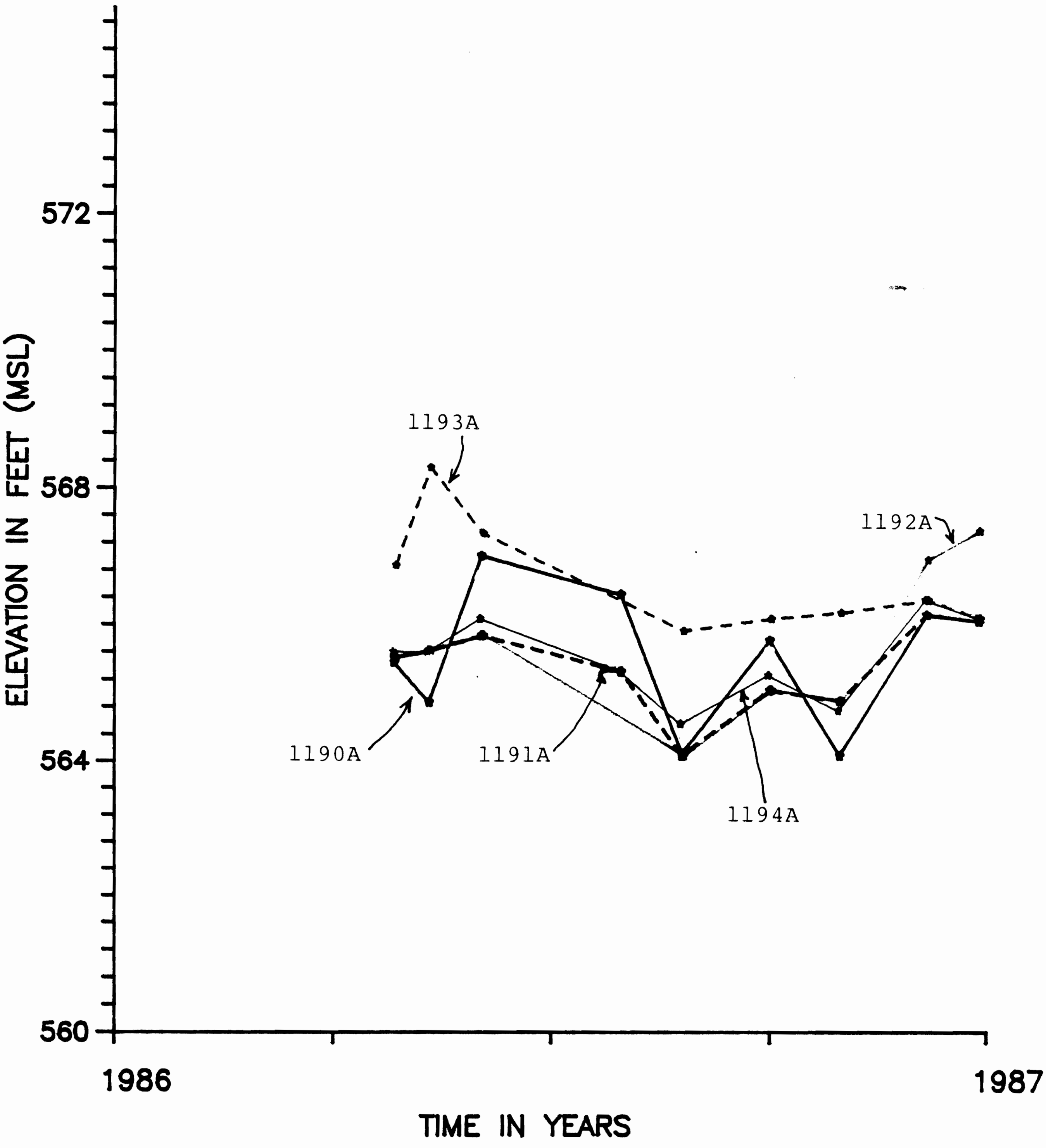



PIEZOMETERS 1193A, 1193B, 1193C, 1193D
1193D
1193C
1193B
1193A
572
568
564
560
ELEVATION IN FEET (MSL)
1986
1987
TIME IN YEARS

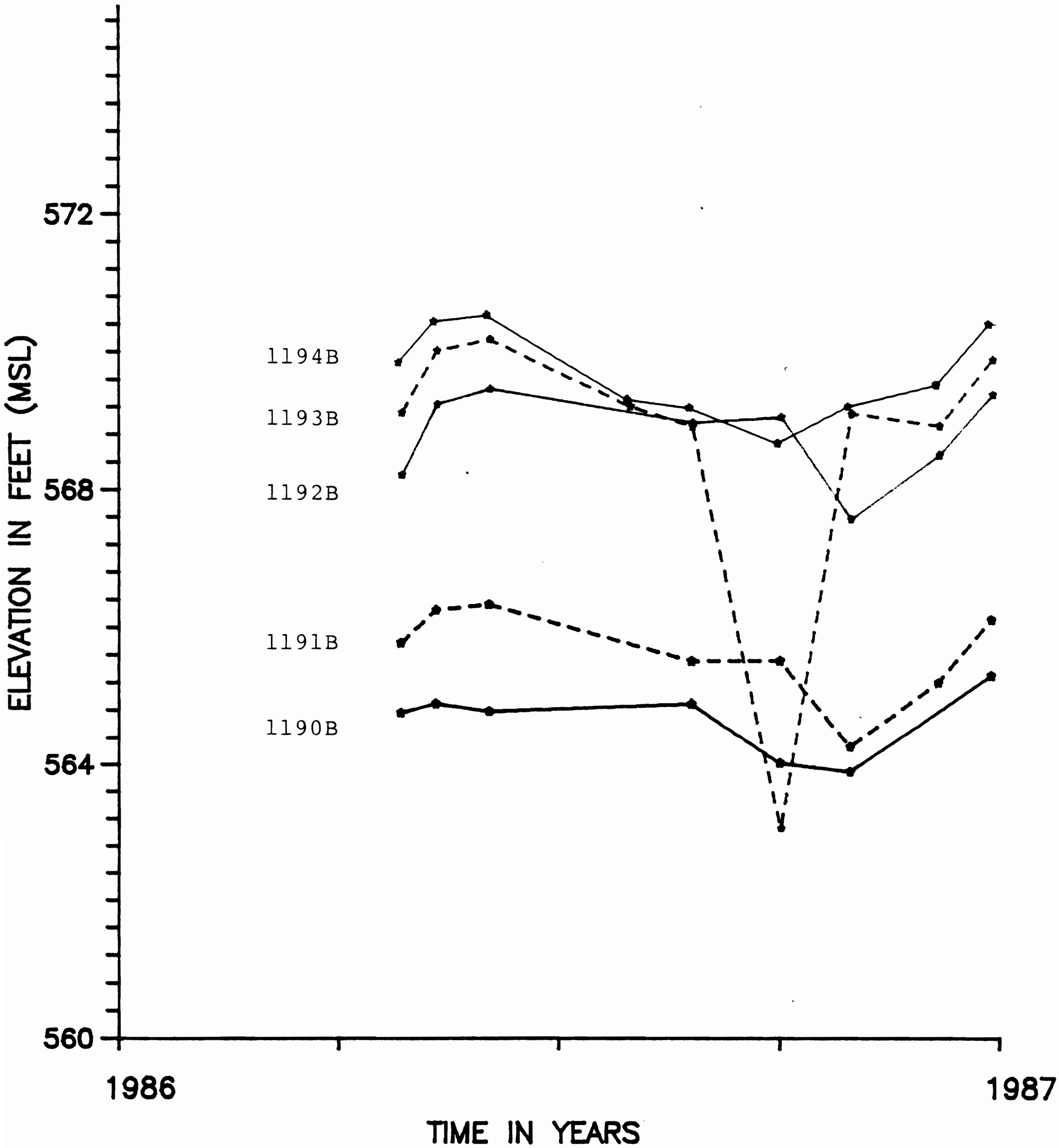


PIEZOMETERS 1194A, 1194B, 1194C, 1194D
1194D
1194C
1194B
1194A
572
568
564
560
ELEVATION IN FEET (MSL)
1986
1987
TIME IN YEARS

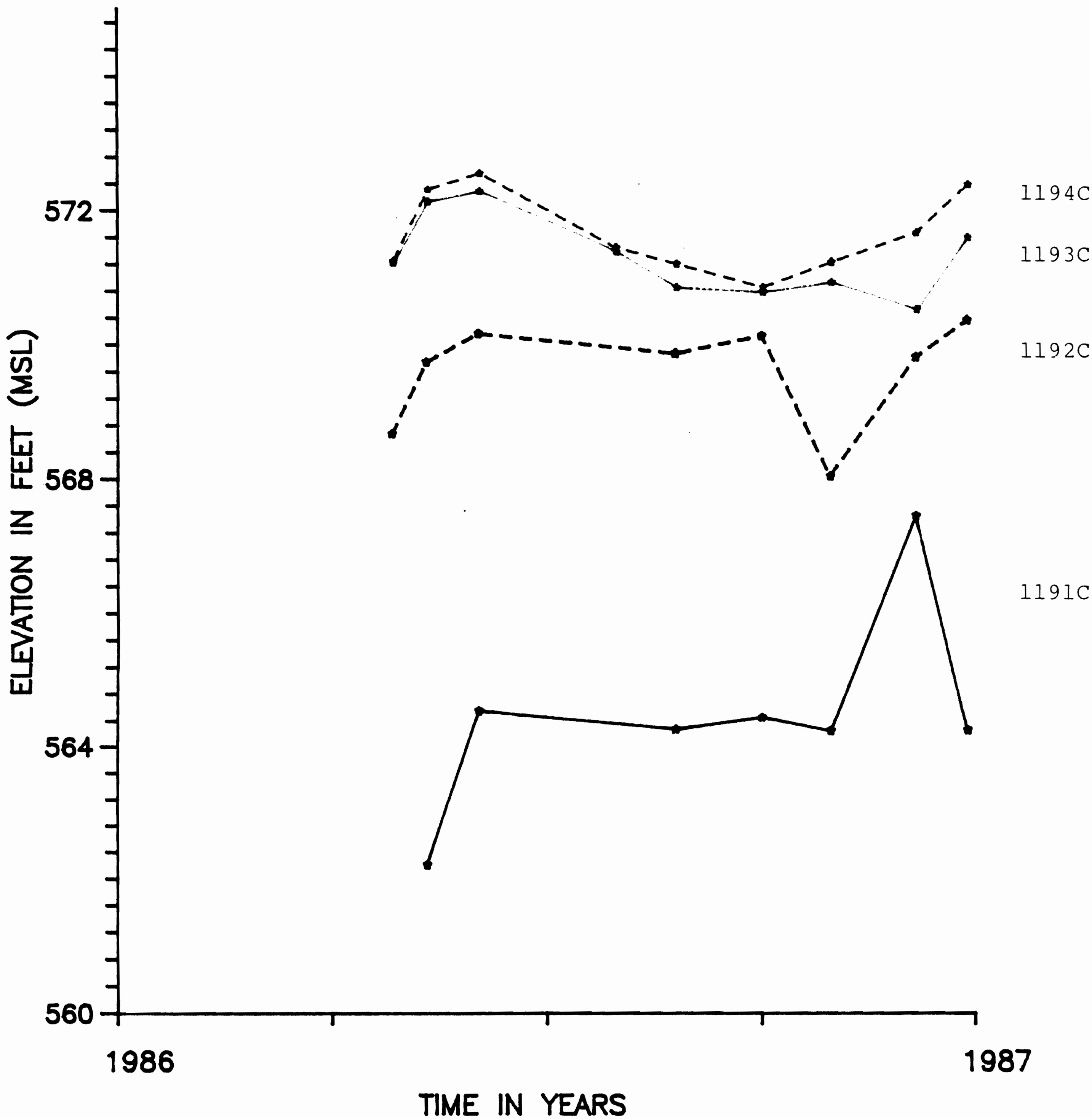
PIEZOMETERS 1190A, 1191A, 1192A, 1193A, 1194A



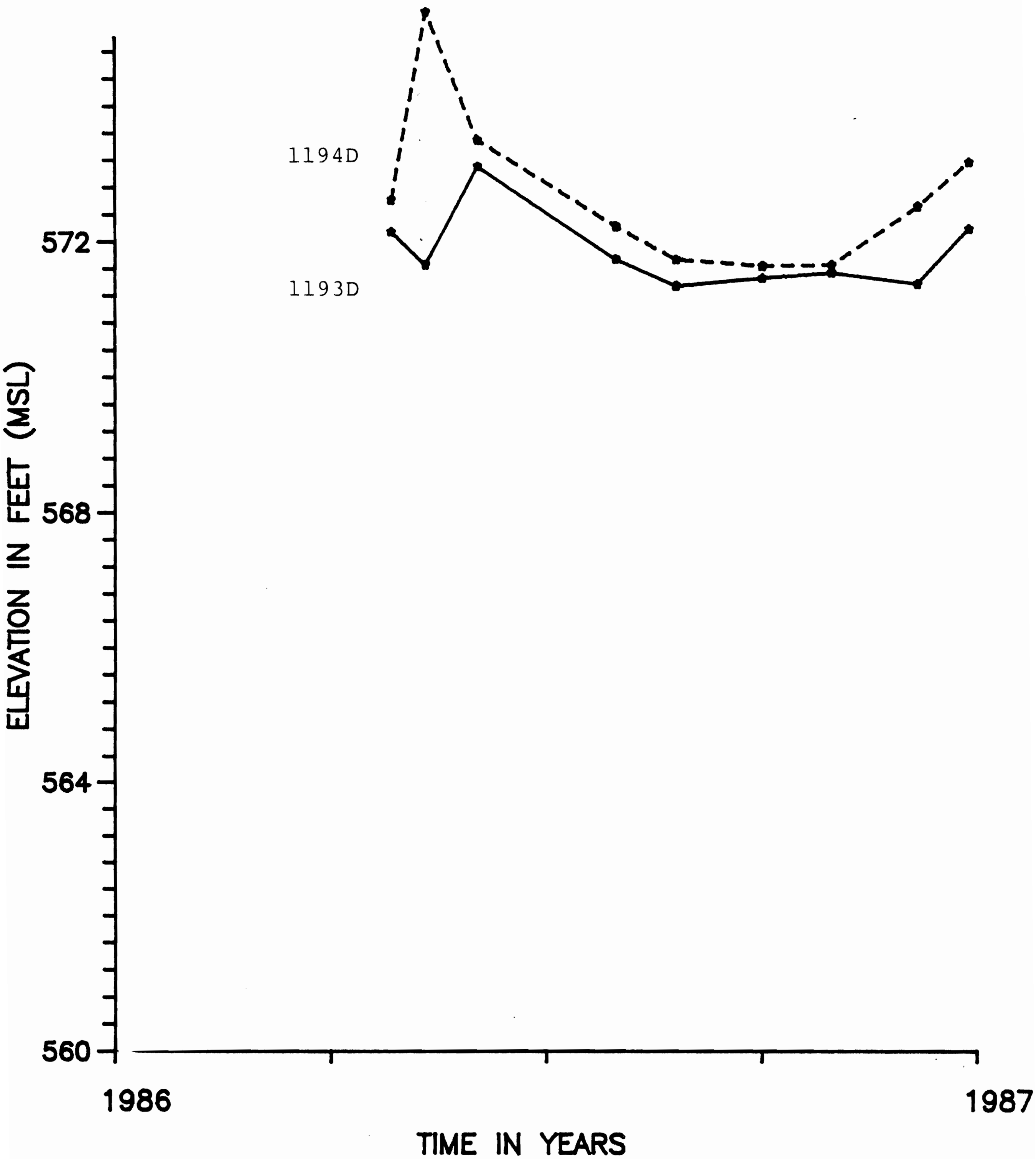
PIEZOMETERS 1190B, 1191B, 1192B, 1193B, 1194B



PIEZOMETERS 1191C, 1192C, 1193C, 1194C

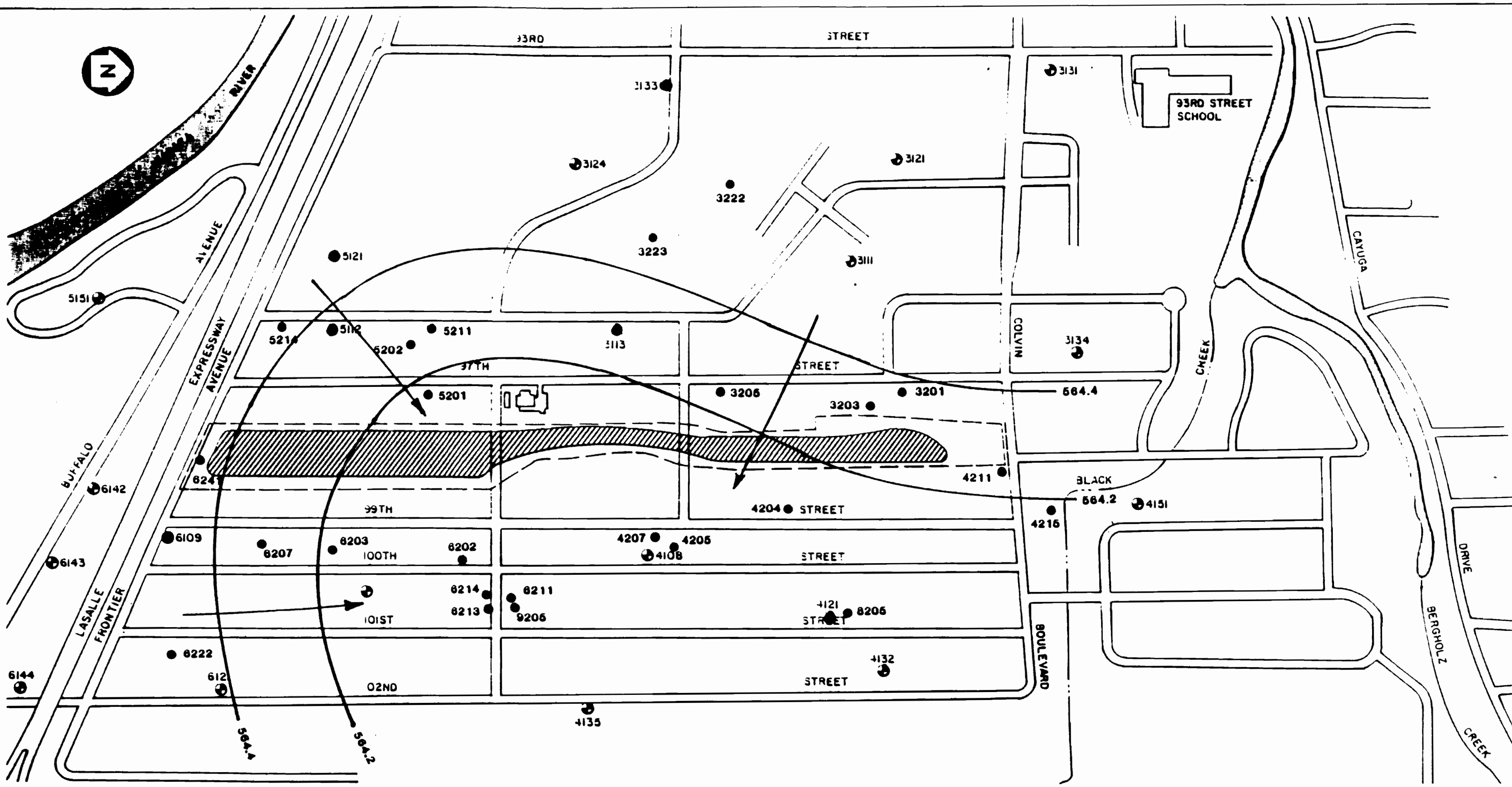


PIEZOMETERS 1193D, 1194D



APPENDIX E

CONTOURS OF GROUNDWATER POTENTIALS IN SHALLOW BEDROCK



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCAT ION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

APPROXIMATE SCALE

0 400 800 FEET

LEGEND

● DATA POINT FOR CONTOURS

564.0 GROUNDWATER POTENTIAL

——► INFERRED FLOW DIRECTION

4108 NYSDEC WELL CODE NUMBER

- - - - LOCATION OF BARRIER DRAIN

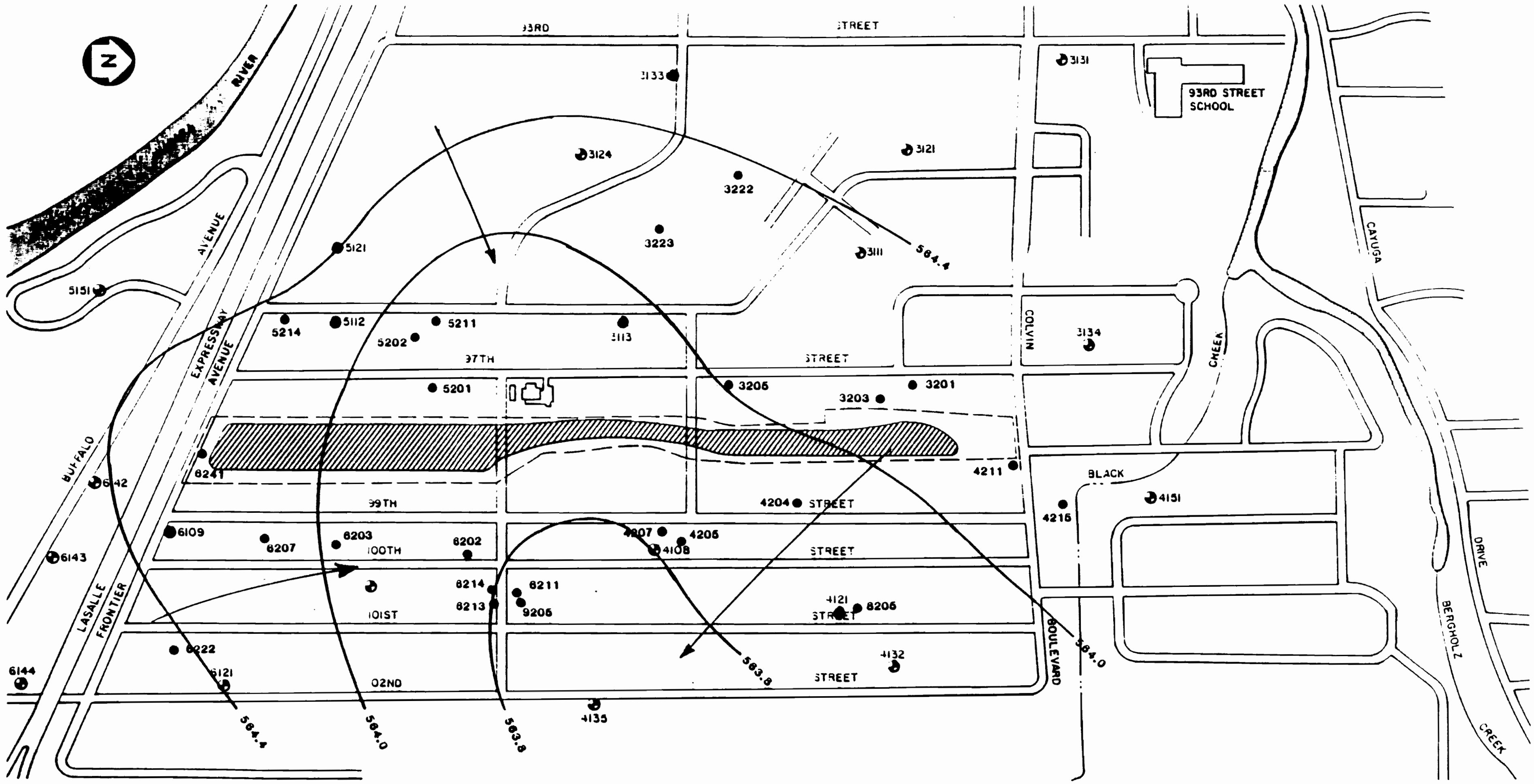
FIGURE E- 1

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 1/31/85

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCAT ION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- — 564.0 - GROUNDWATER POTENTIAL
- ⟶ INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

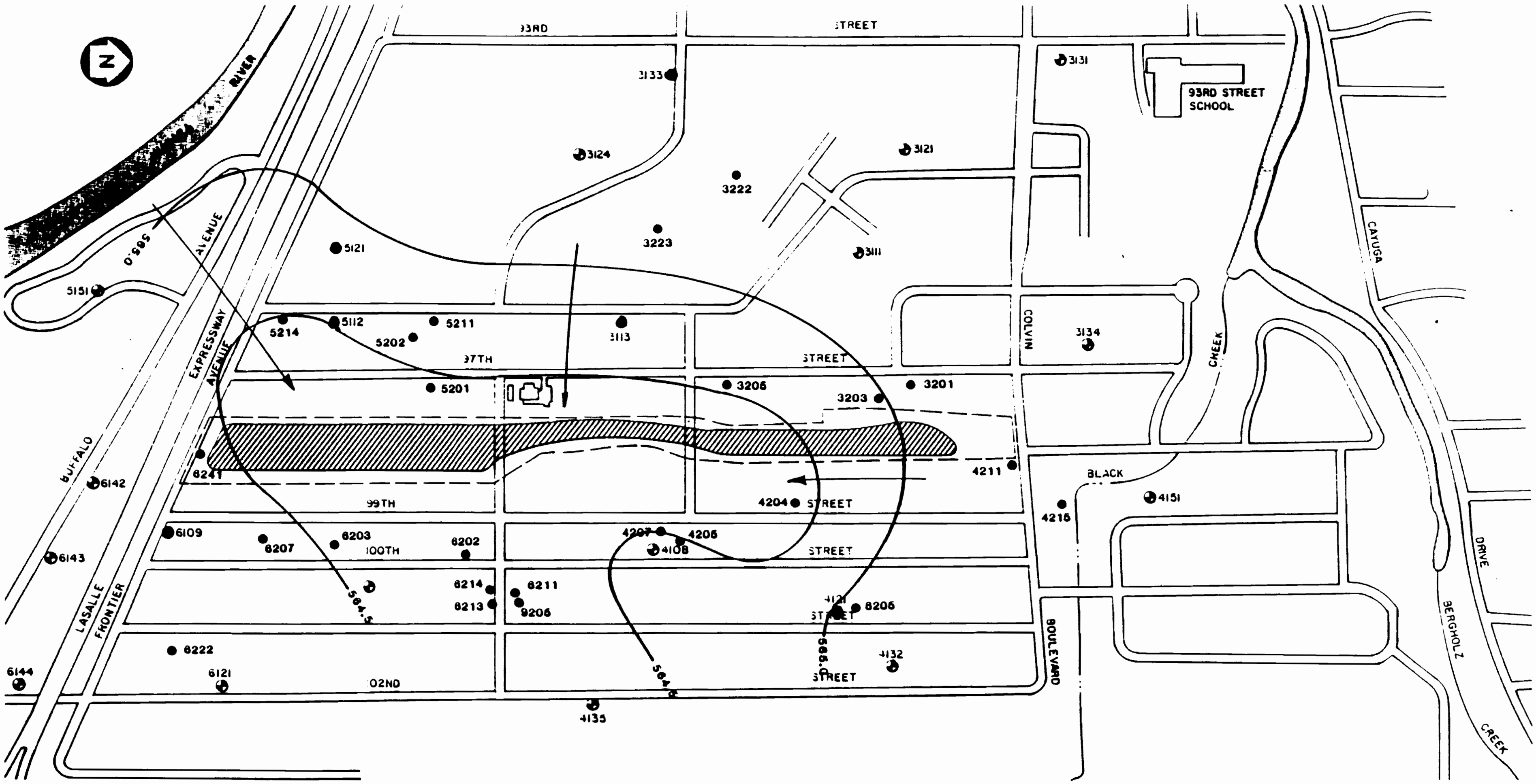
FIGURE E- 2

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 2/21/85

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

● DATA POINT FOR CONTOURS
564.0 GROUNDWATER POTENTIAL
→ INFERRED FLOW DIRECTION
4108 NYSDEC WELL CODE NUMBER
- - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

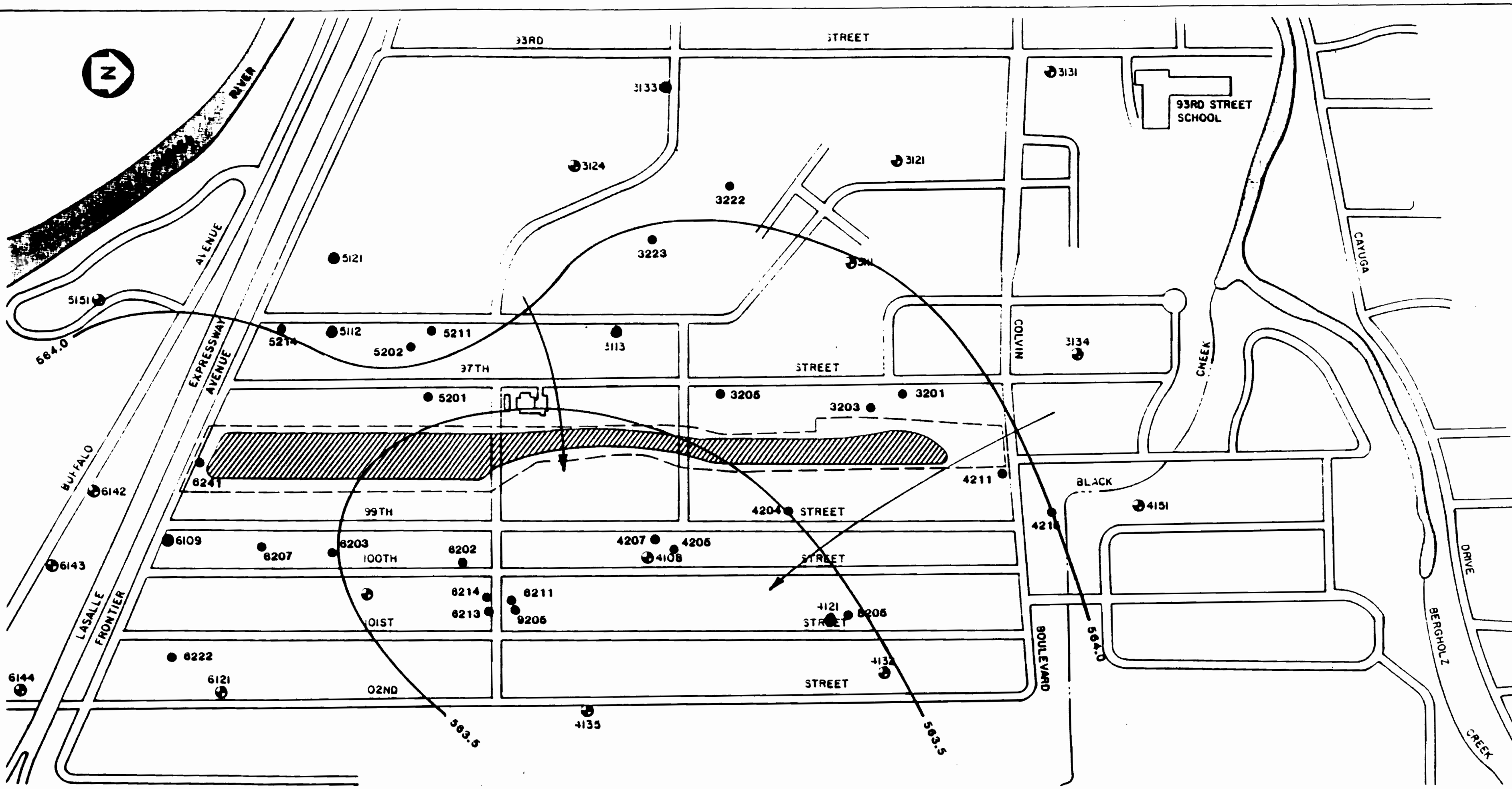
FIGURE E- 3

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 3/11/85

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE
WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCAT ION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

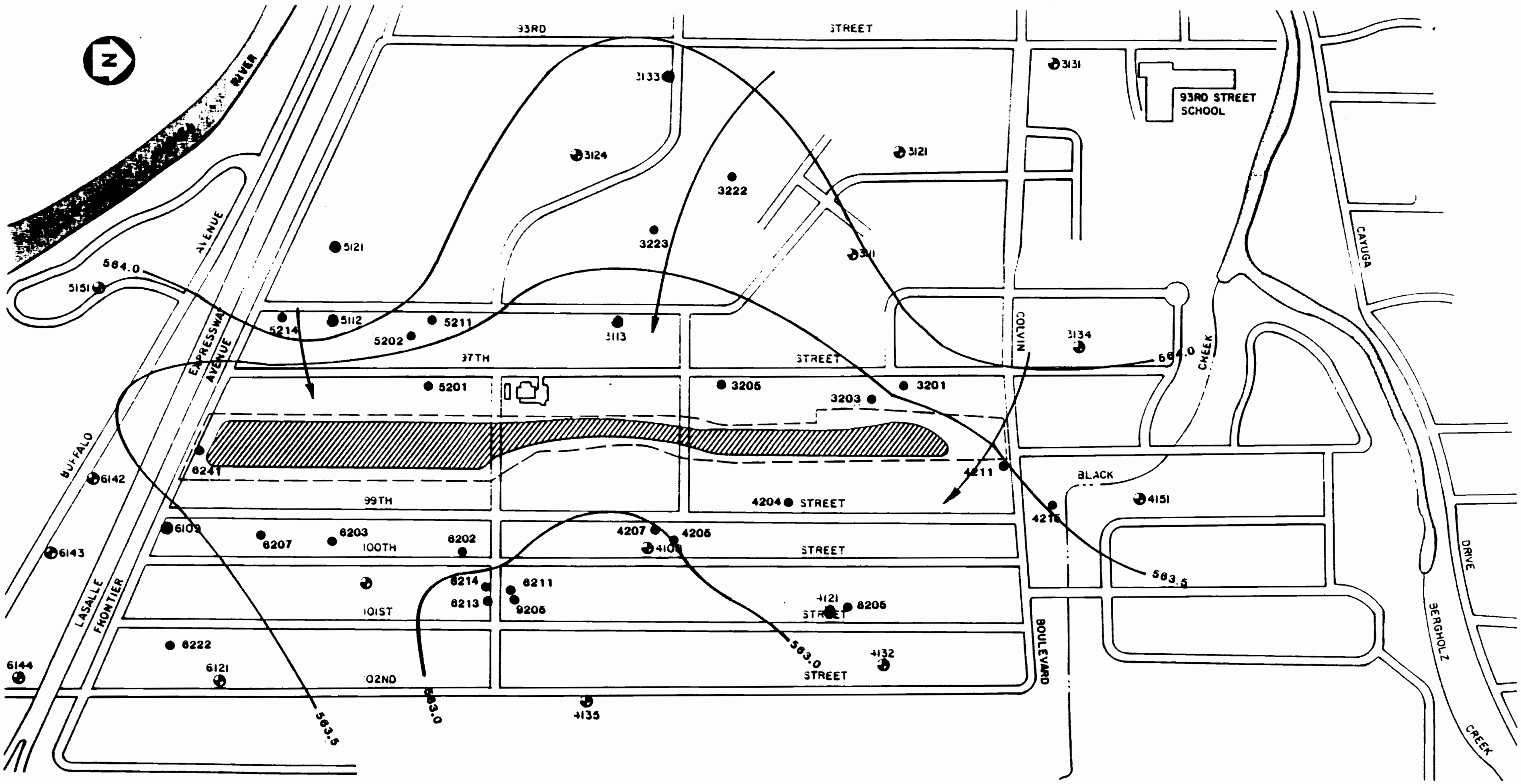
LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ——► INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- ---- LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE
0 400 800 FEET

FIGURE E- 4
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 4/12/85
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- → INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- ---- LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

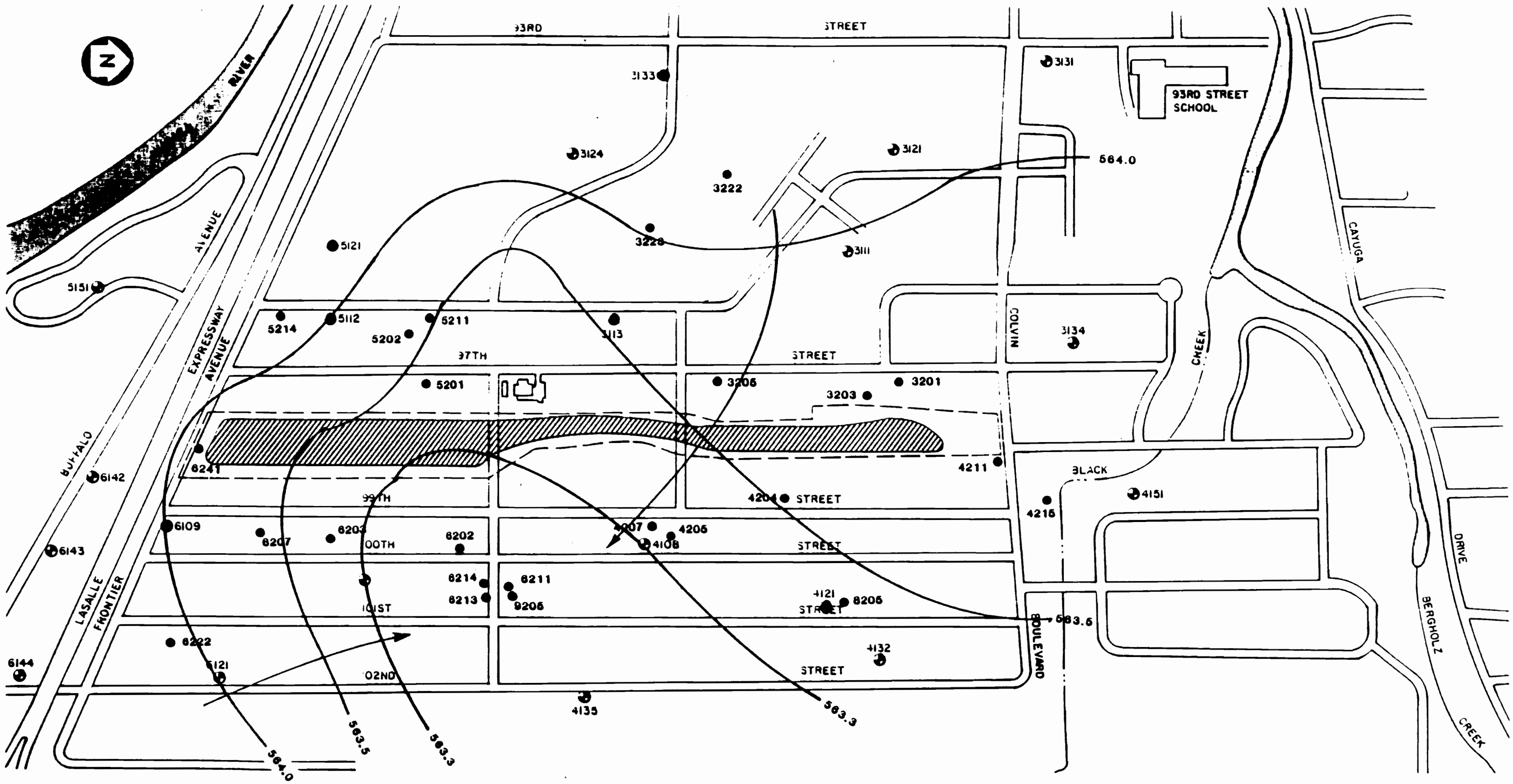
FIGURE E- 5

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 5/15/85

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

● DATA POINT FOR CONTOURS
564.0 GROUNDWATER POTENTIAL
→ INFERRED FLOW DIRECTION
4108 NYSDEC WELL CODE NUMBER
---- LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

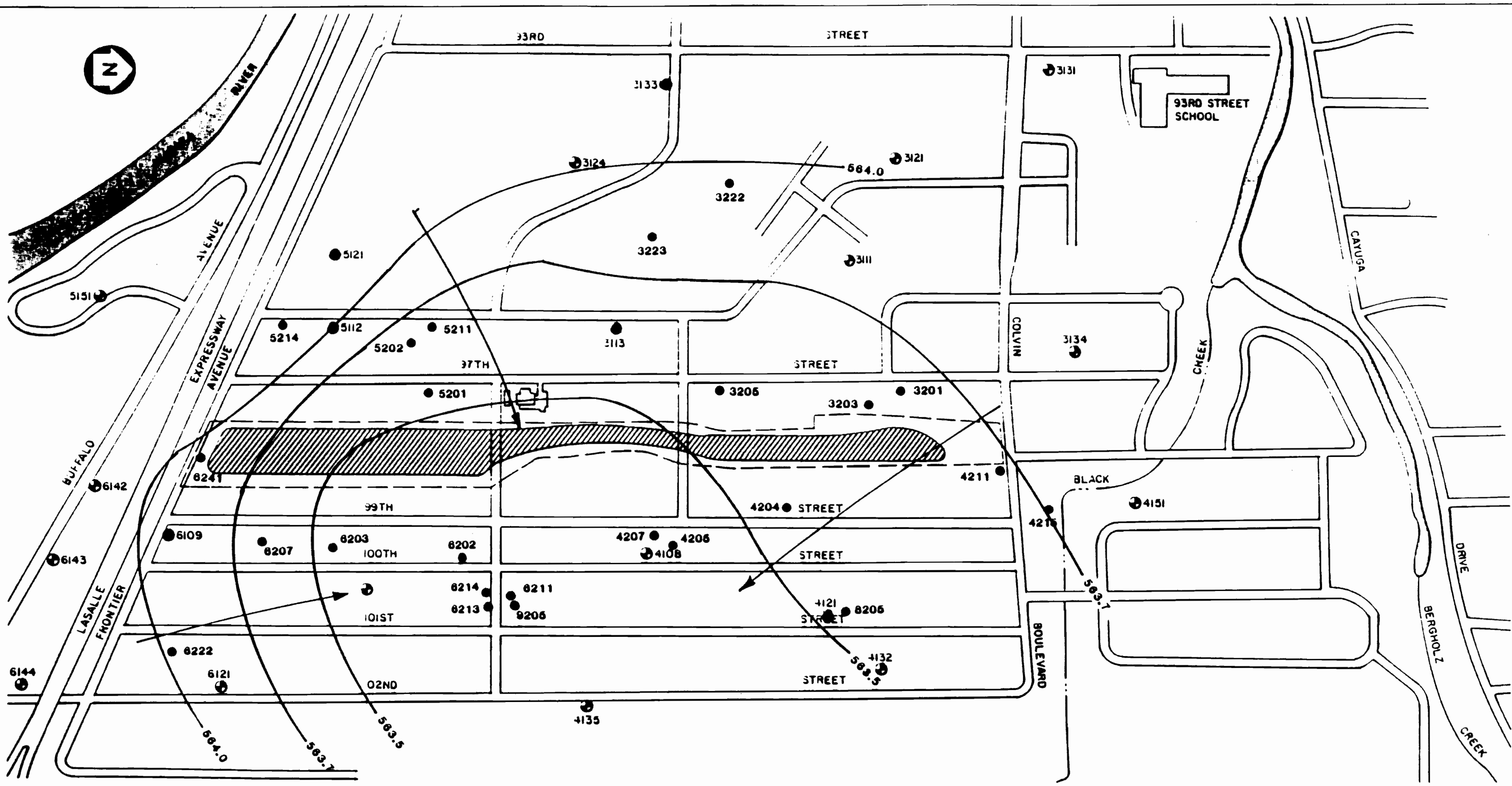
FIGURE E- 6

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 6/11/85

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE
WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

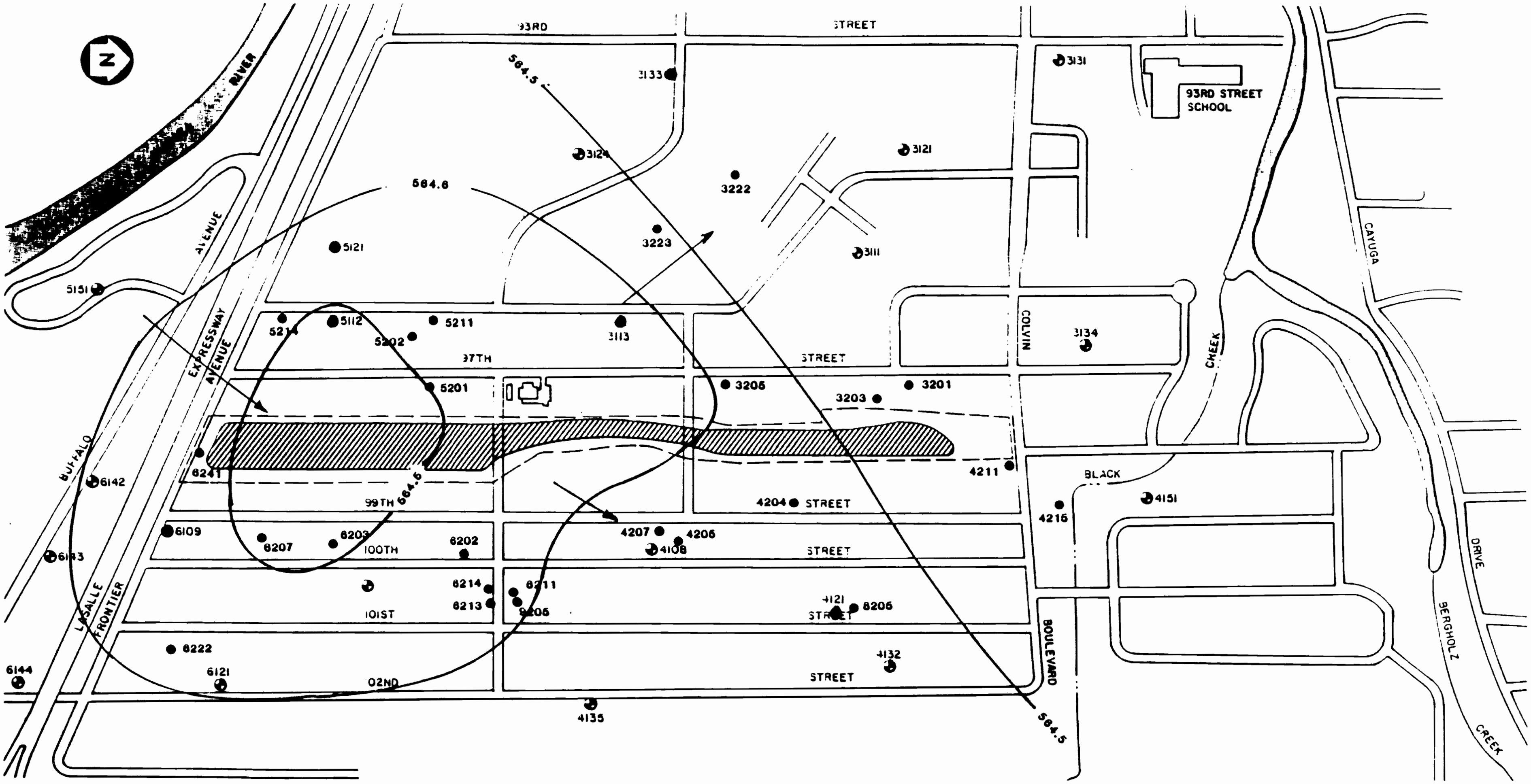
LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ——► INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE
0 400 800 FEET

FIGURE E- 7
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 7/23/85
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- → INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- ---- LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

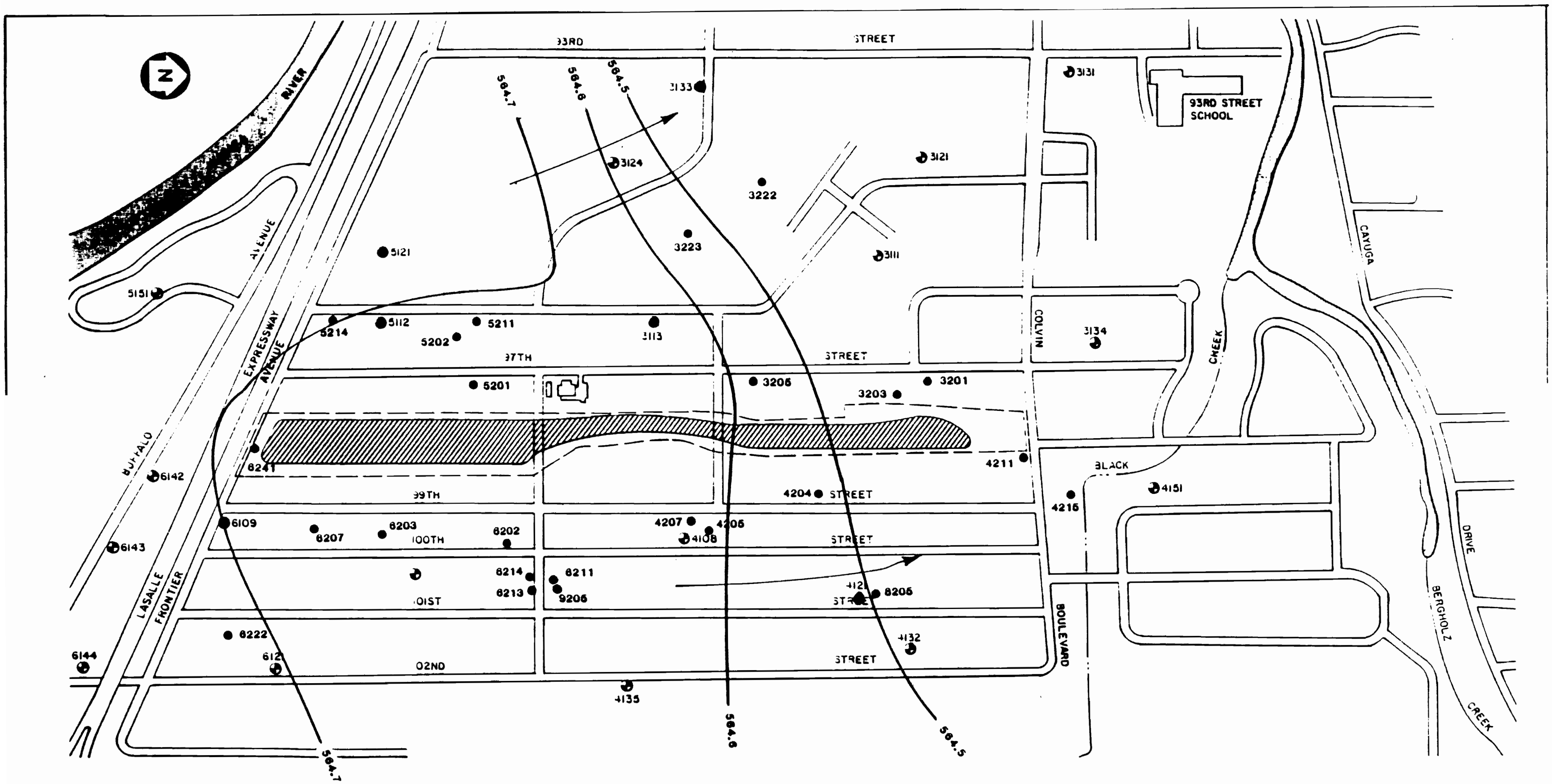
FIGURE E- 8

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 8/22/85

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCAT ION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- → INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- ---- LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

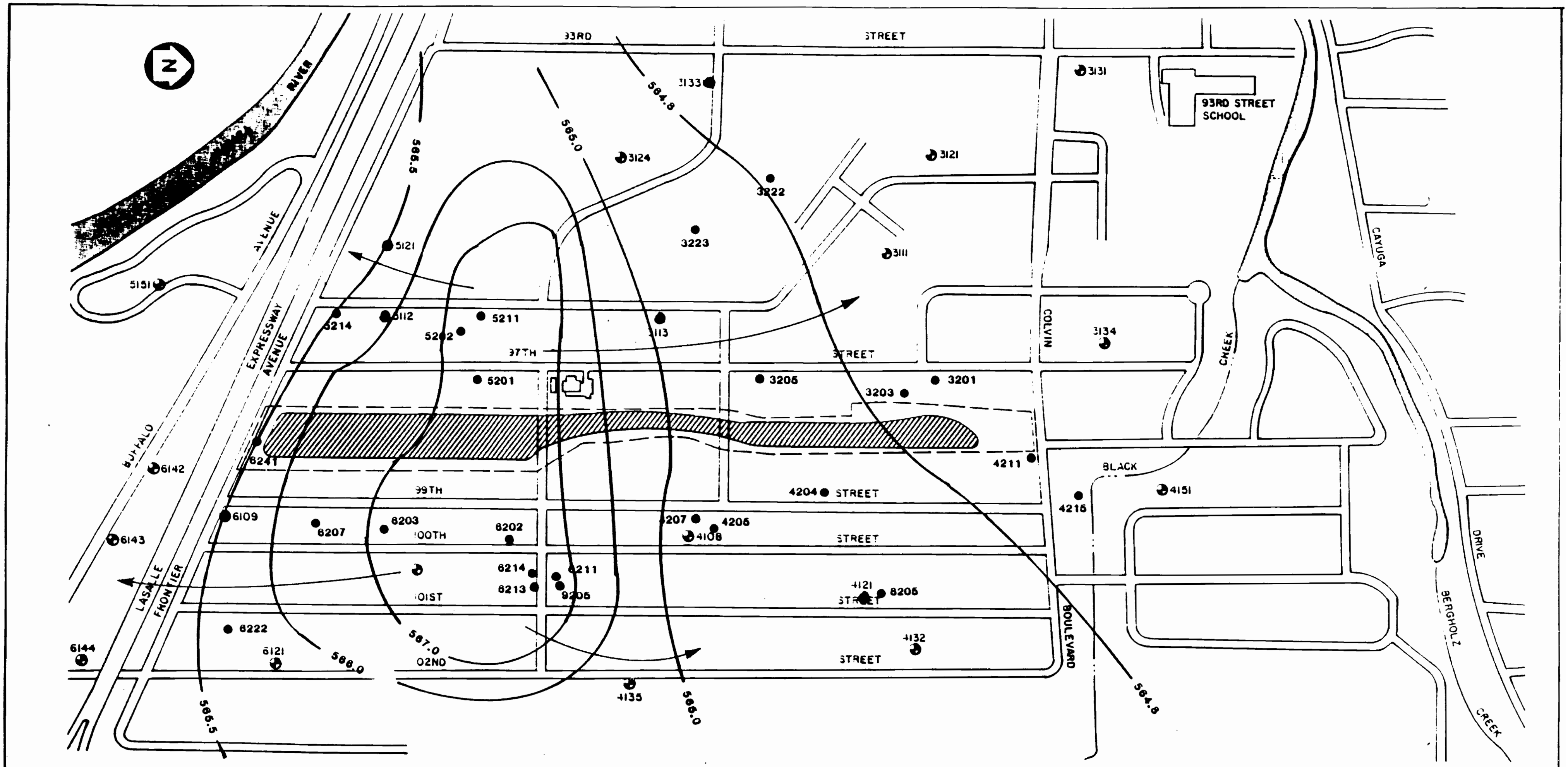
FIGURE E- 9

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 9/24/85

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- → INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

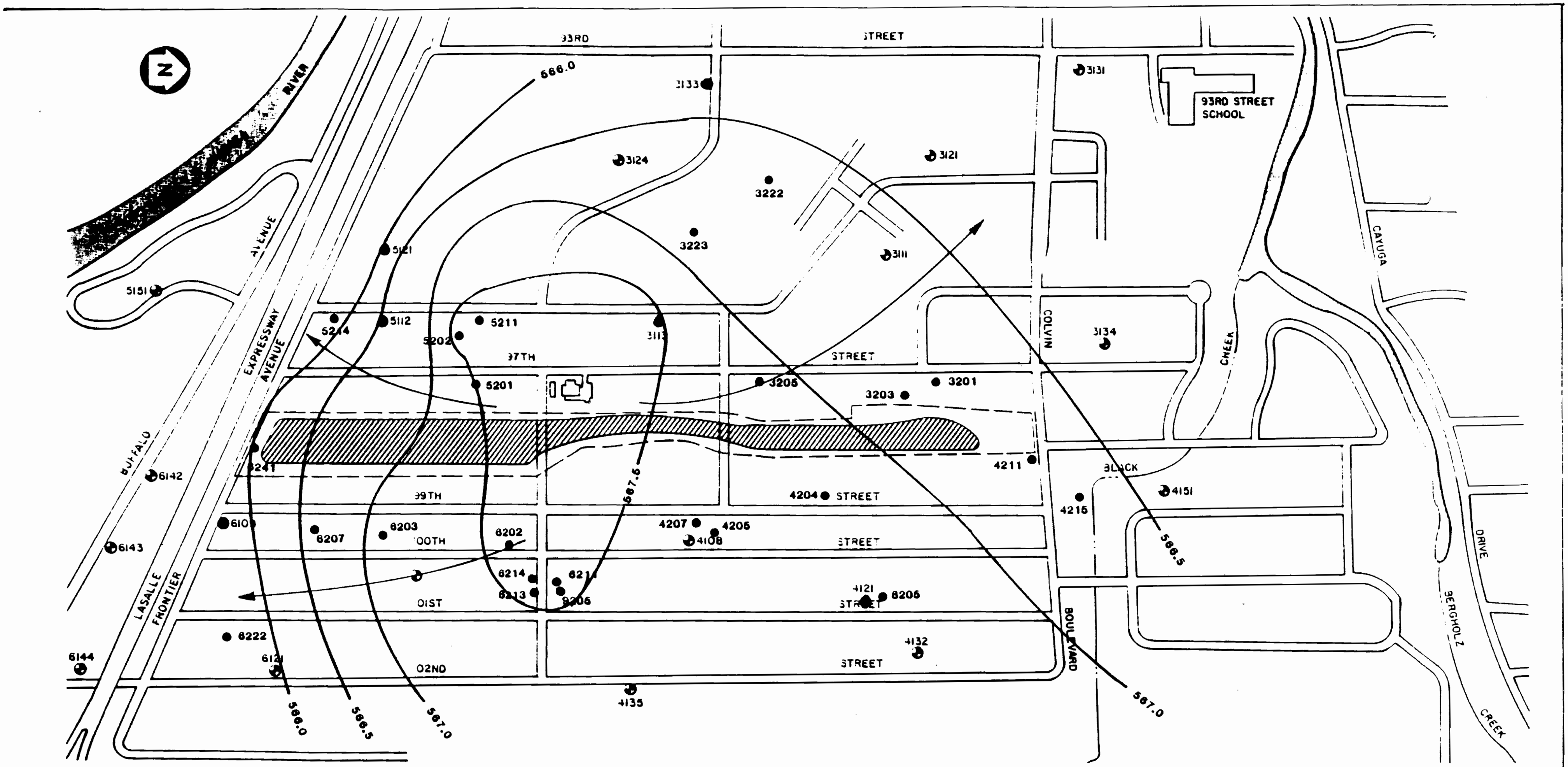
FIGURE E- 10

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 10/22/85

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

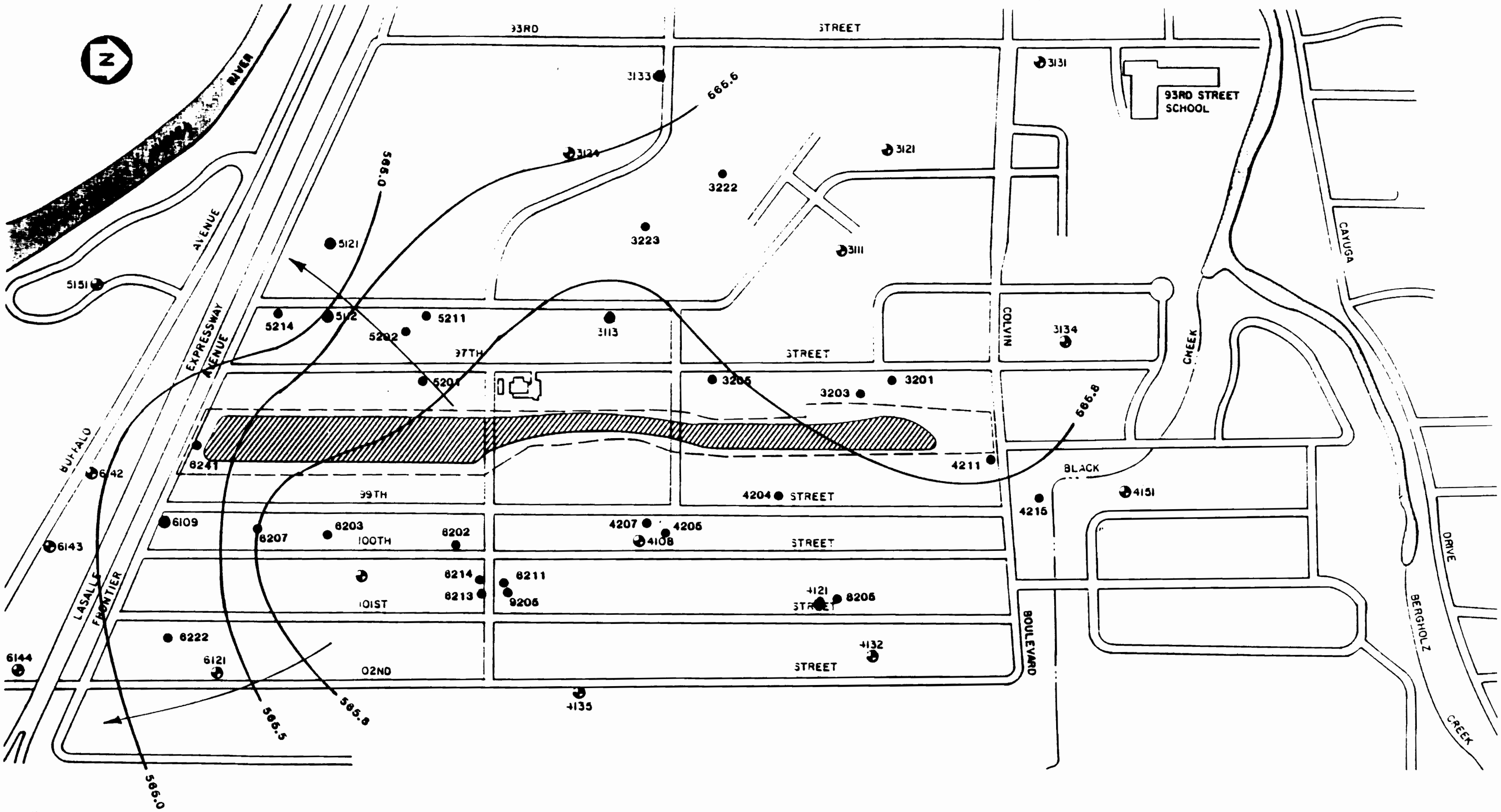
- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ——► INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

FIGURE E- 11
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 11/11/85
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



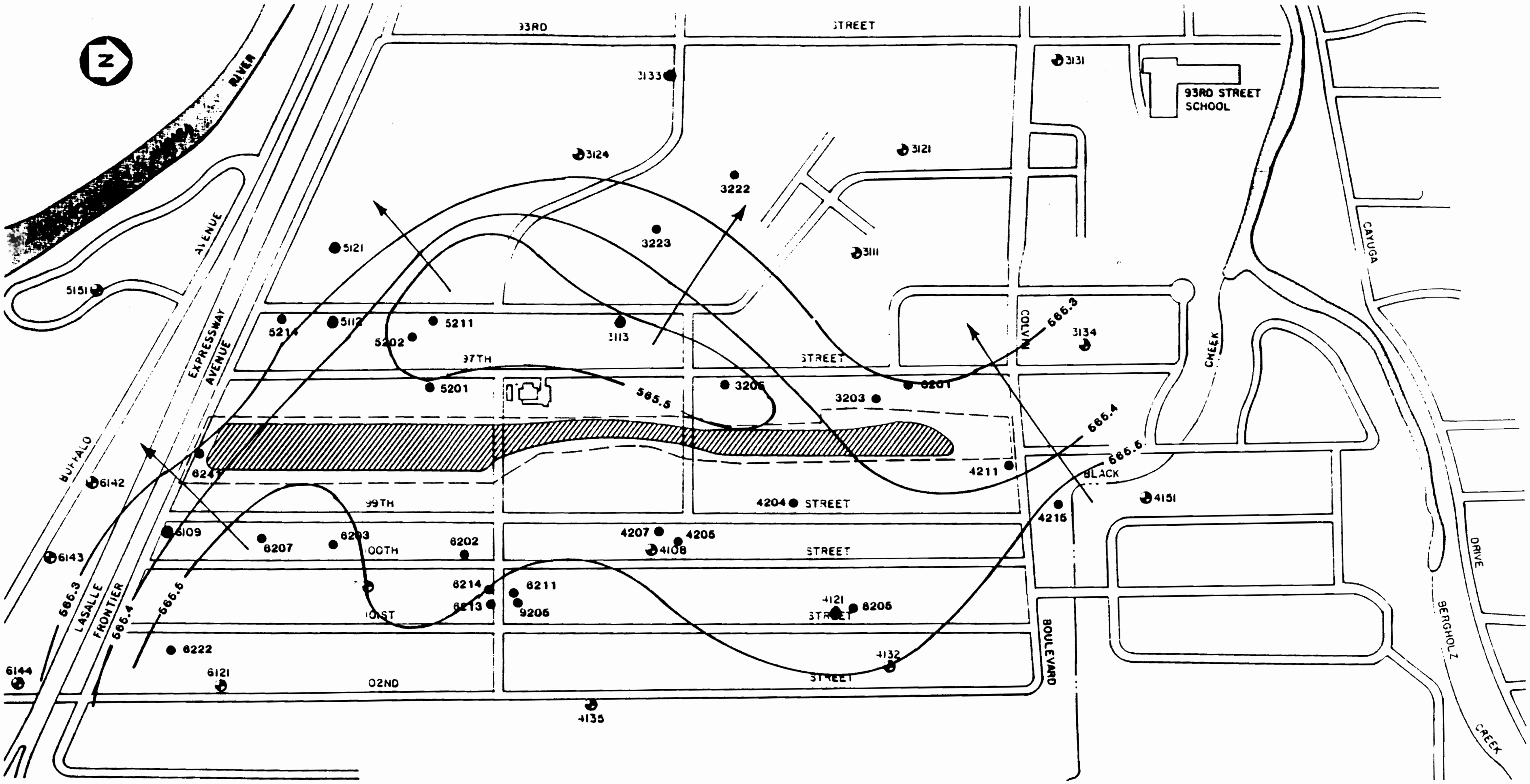
NOTE
WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND
- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ⟶ INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- ---- LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE
0 400 800 FEET

FIGURE E- 12
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 12/10/85
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ——► INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

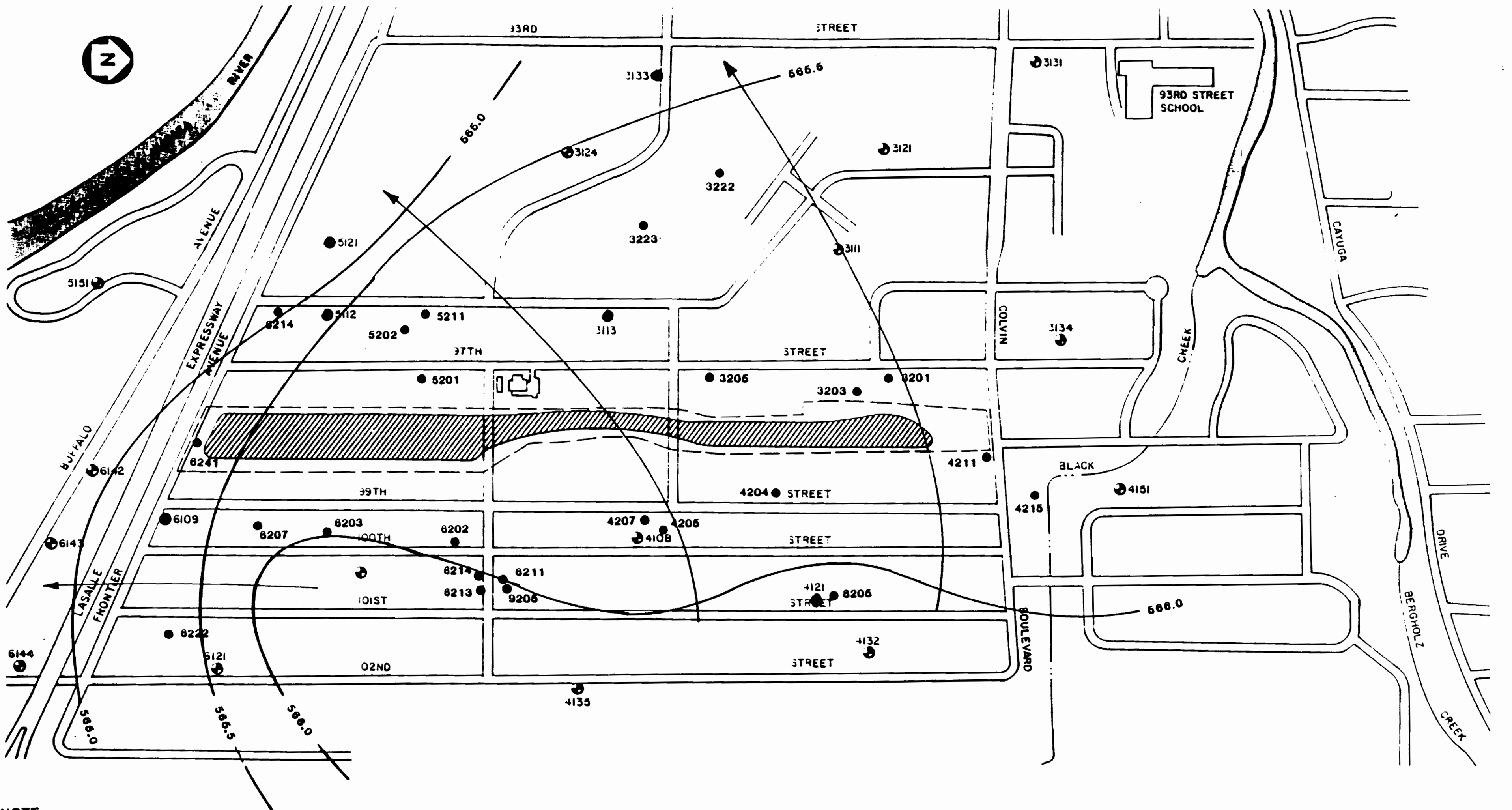
FIGURE E- 13

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 1/15/86

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

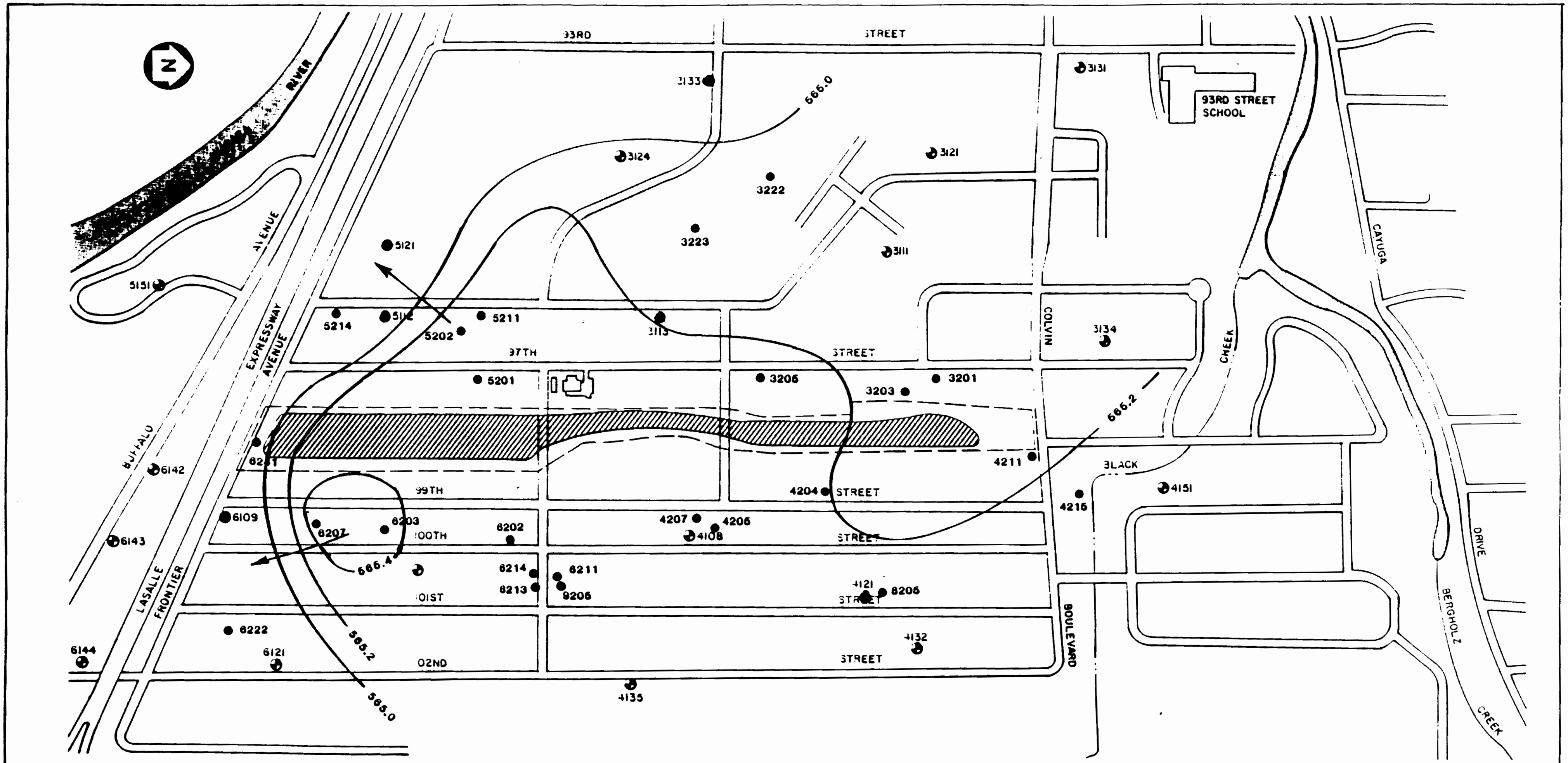
- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ——► INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

FIGURE E- 14
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 2/6/86
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

APPROXIMATE SCALE

0 400 800 FEET

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ⟶ INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - - LOCATION OF BARRIER DRAIN

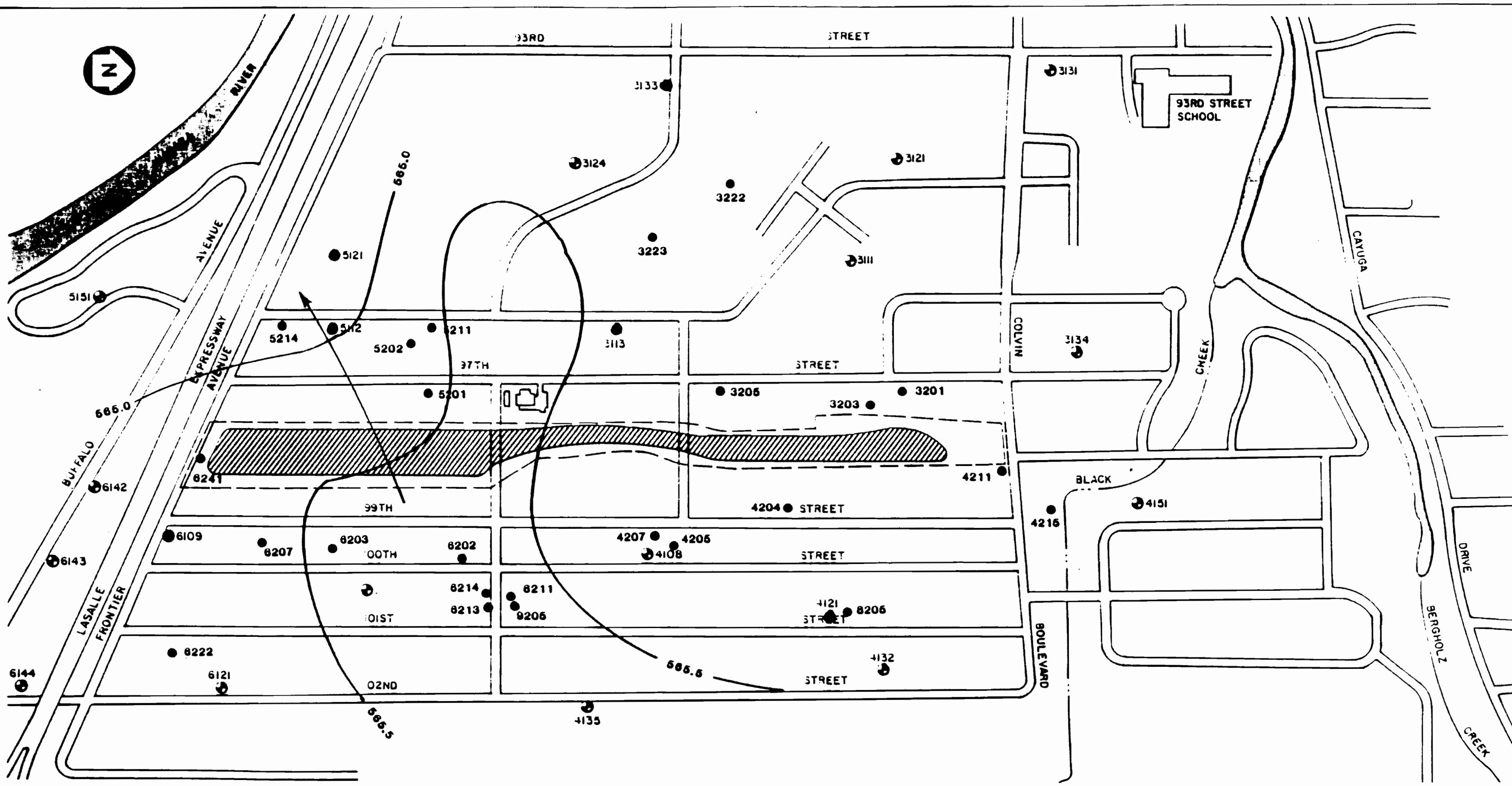
FIGURE E- 15

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 3/3/86

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE
WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

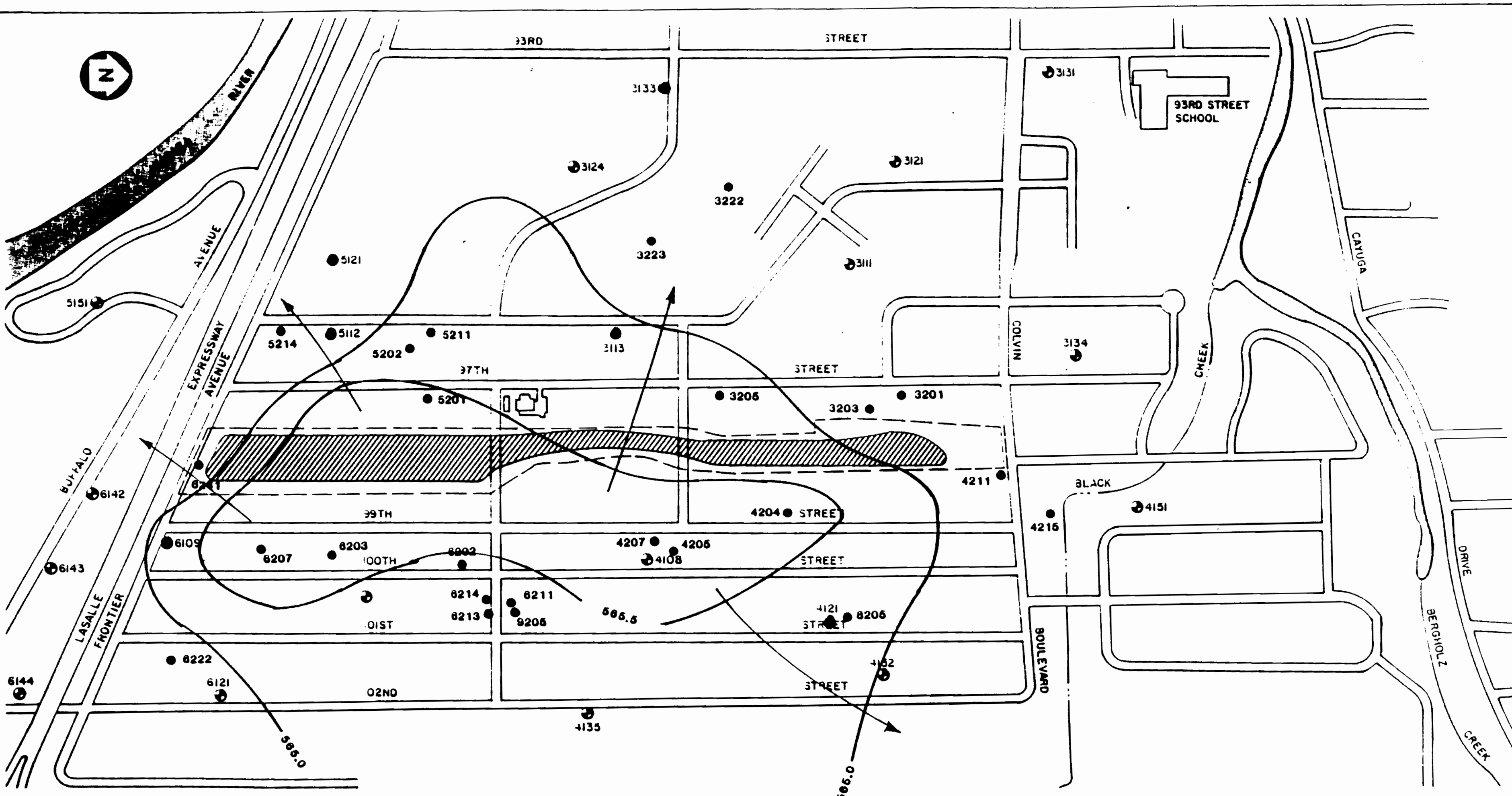
LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- → INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- ---- LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE
0 400 800 FEET

FIGURE E- 16
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 4/29/86
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 584.0 GROUNDWATER POTENTIAL
- ——► INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

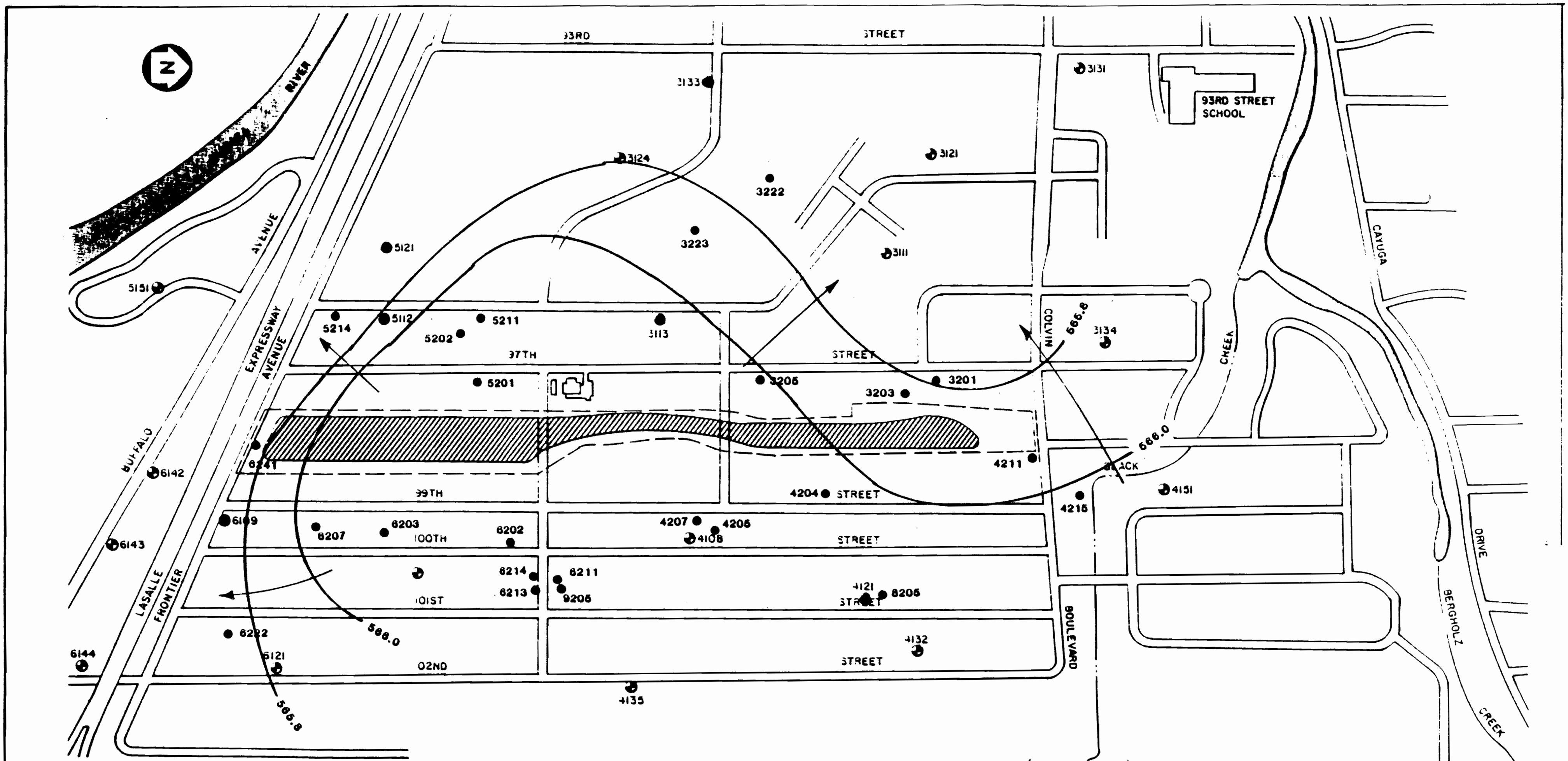
FIGURE E- 17

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 5/13/86

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE
WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

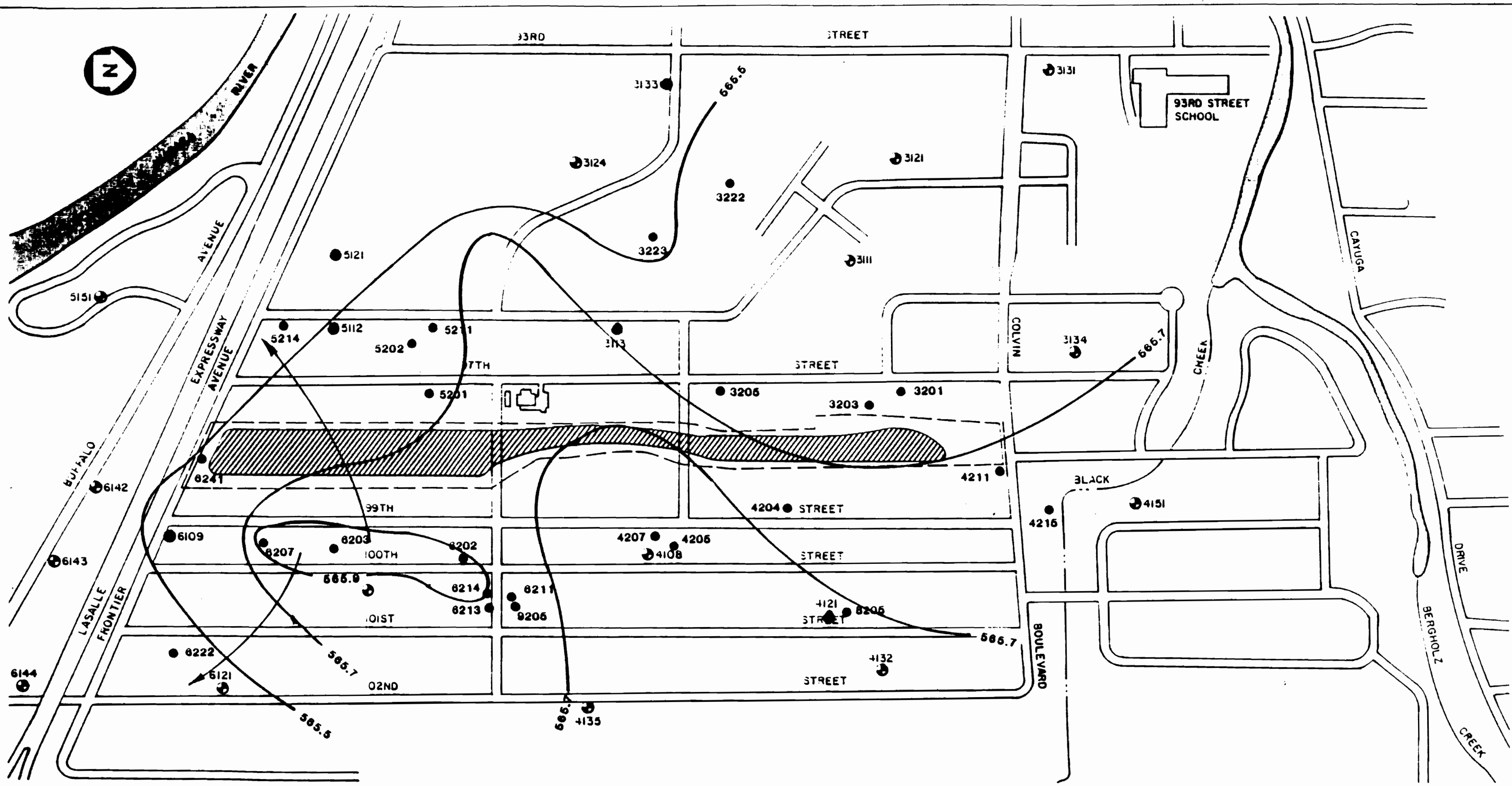
LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ⟶ INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- ---- LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE
0 400 800 FEET

FIGURE E- 18
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 6/4/86
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ——► INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

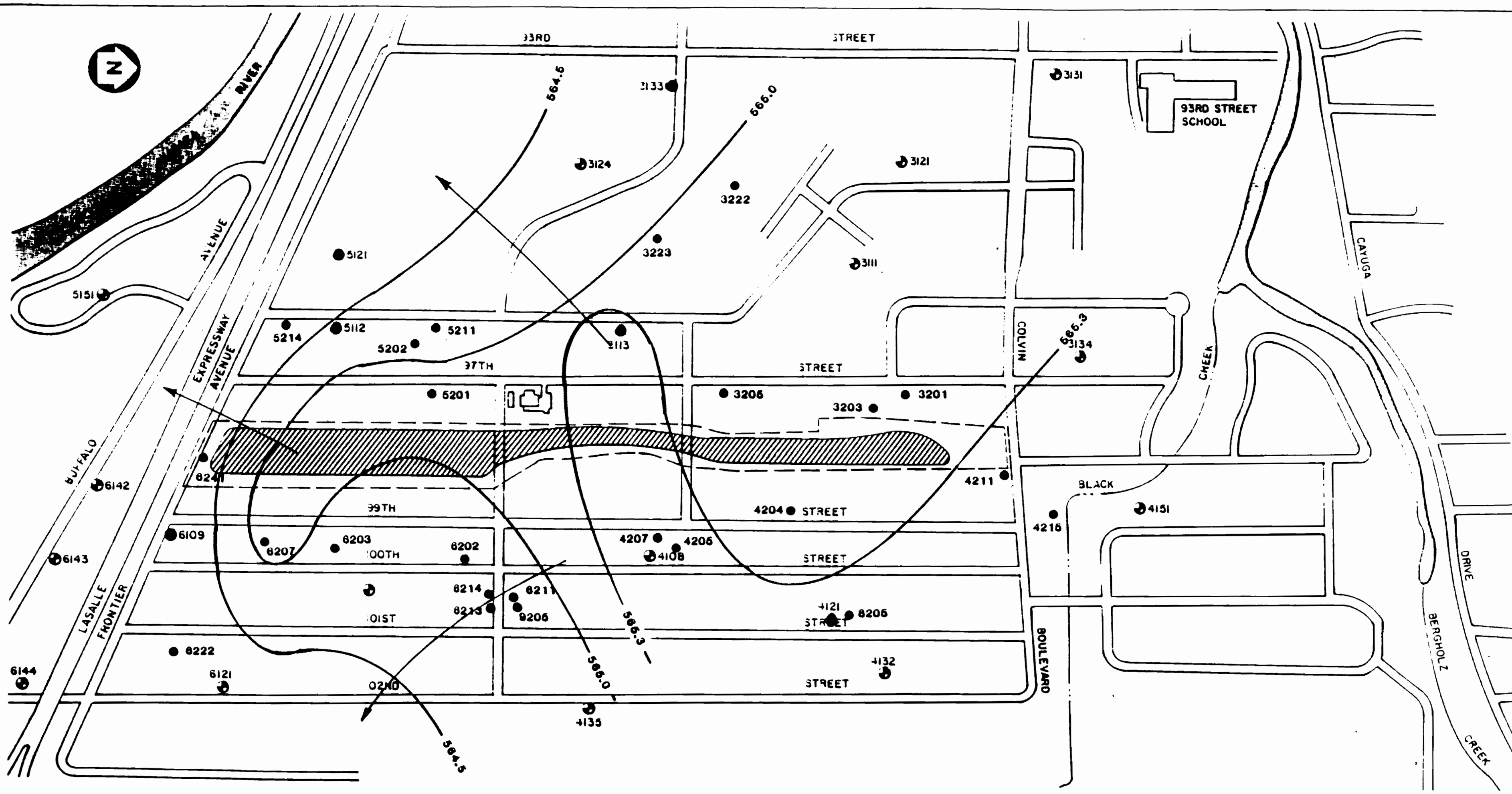
FIGURE E- 19

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 7/30/86

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ⟶ INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

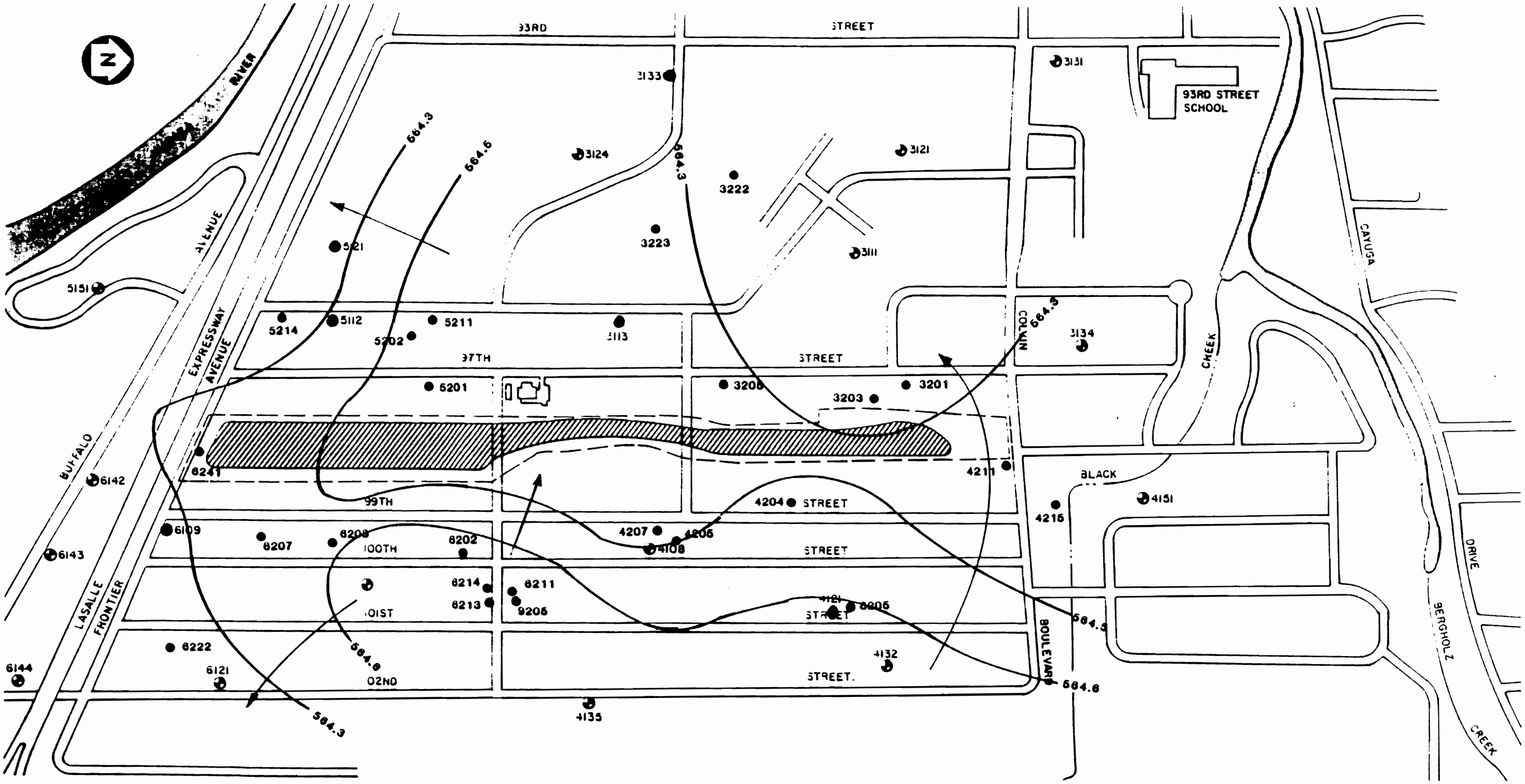
FIGURE E- 20

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 9/30/86

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- → INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

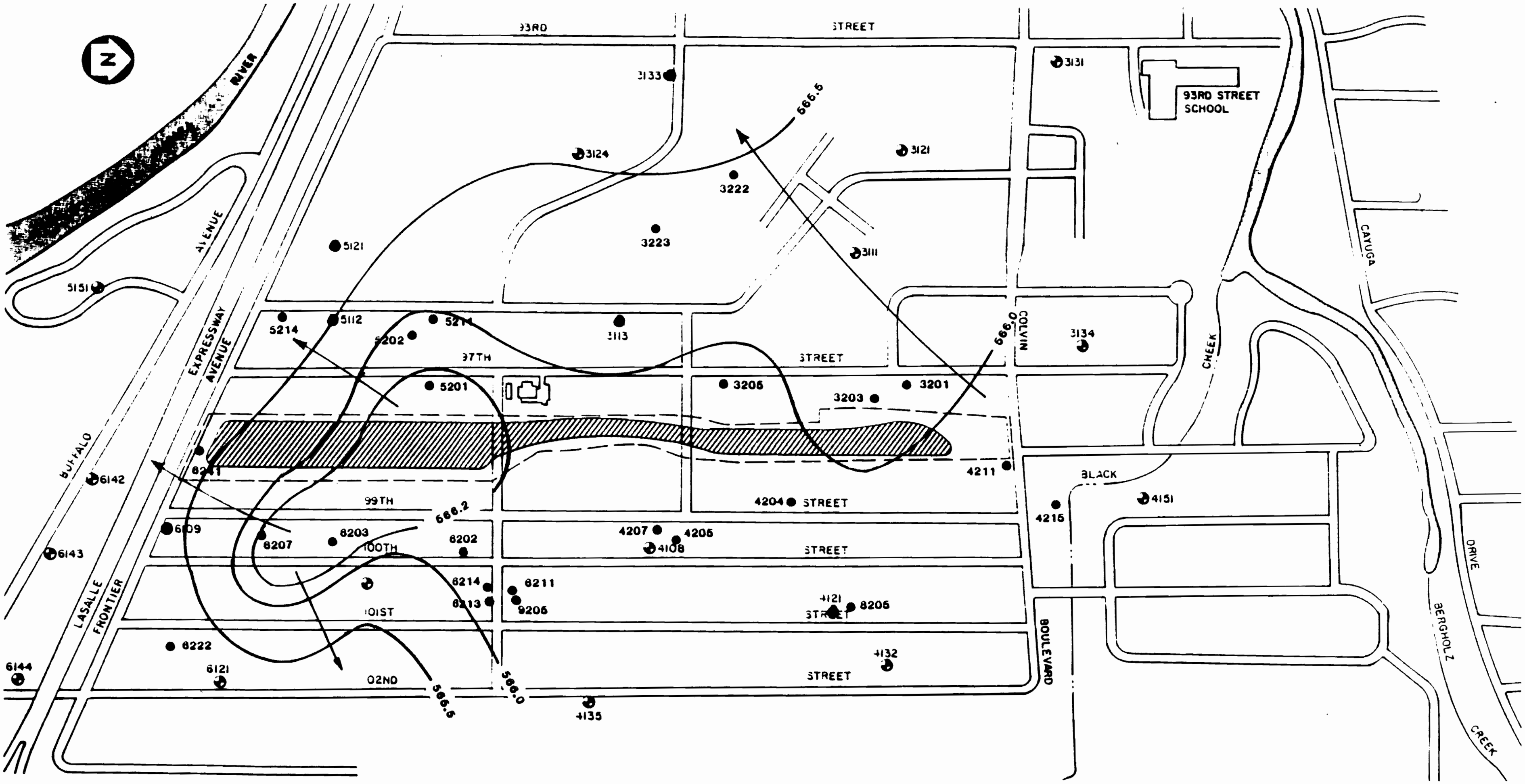
FIGURE E-21

INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS

DATA OF 10/30/86

LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCATION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

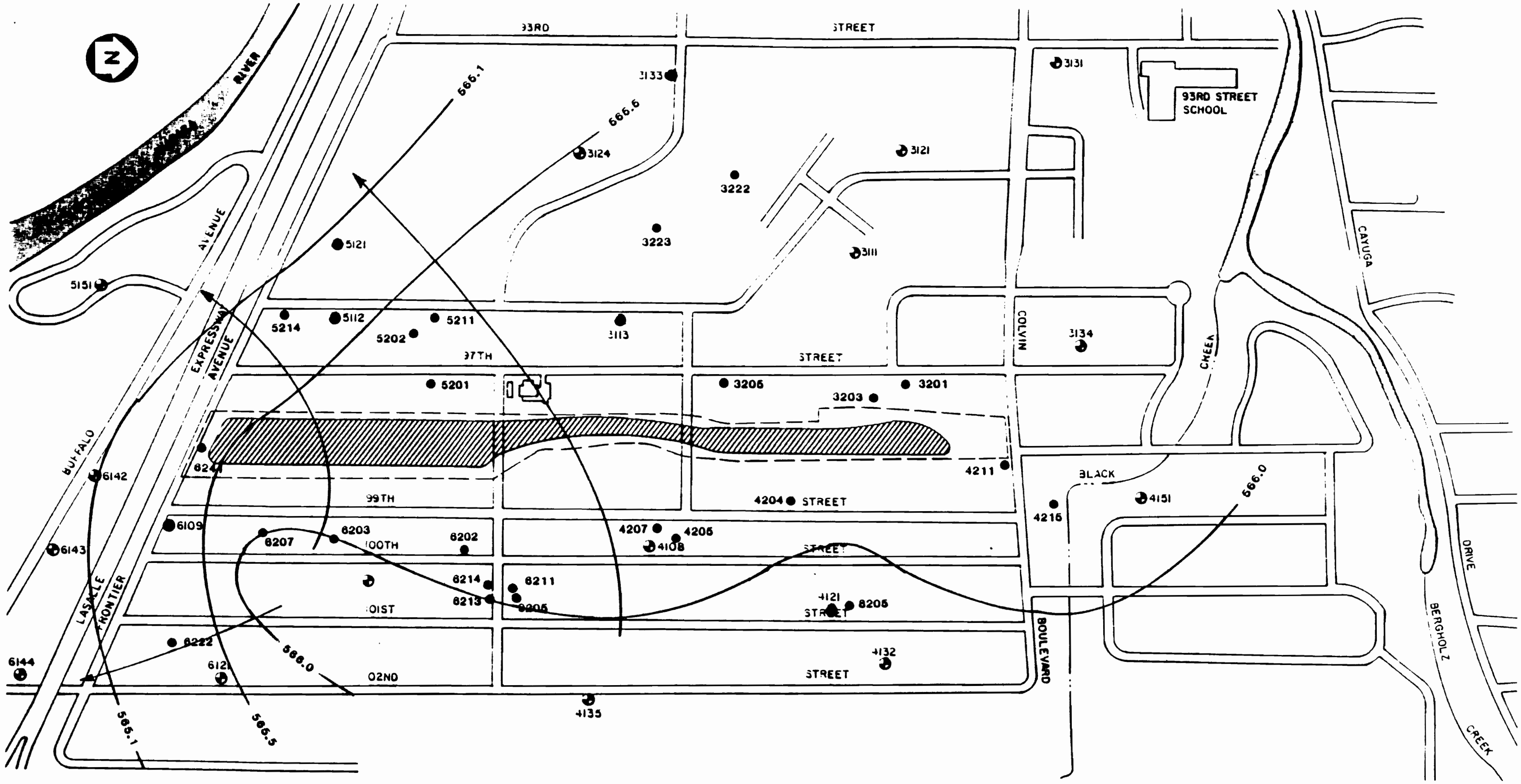
● DATA POINT FOR CONTOURS
564.0 GROUNDWATER POTENTIAL
—► INFERRED FLOW DIRECTION
4108 NYSDEC WELL CODE NUMBER
- - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

FIGURE E- 22
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 12/5/86
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.



NOTE

WELLS ARE TYPICALLY IN PAIRS. WHILE A WELL LOCAT ION MAY BE INDICATED BY THE OVERBURDEN WELL ID, THE POTENTIAL IN THE BEDROCK WELL IS CONTOURED.

LEGEND

- ● DATA POINT FOR CONTOURS
- 564.0 GROUNDWATER POTENTIAL
- ⟶ INFERRED FLOW DIRECTION
- 4108 NYSDEC WELL CODE NUMBER
- - - - - LOCATION OF BARRIER DRAIN

APPROXIMATE SCALE

0 400 800 FEET

FIGURE E- 23
INTERPRETIVE BEDROCK GROUNDWATER POTENTIALS
DATA OF 12/27/86
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C.JORDAN CO.

APPENDIX F

NYSDEC SOIL AND WATER GUIDANCE

TABLE F.1

NYSDEC GUIDANCE FOR THE INITIAL PLACEMENT OF MONITORING WELLS

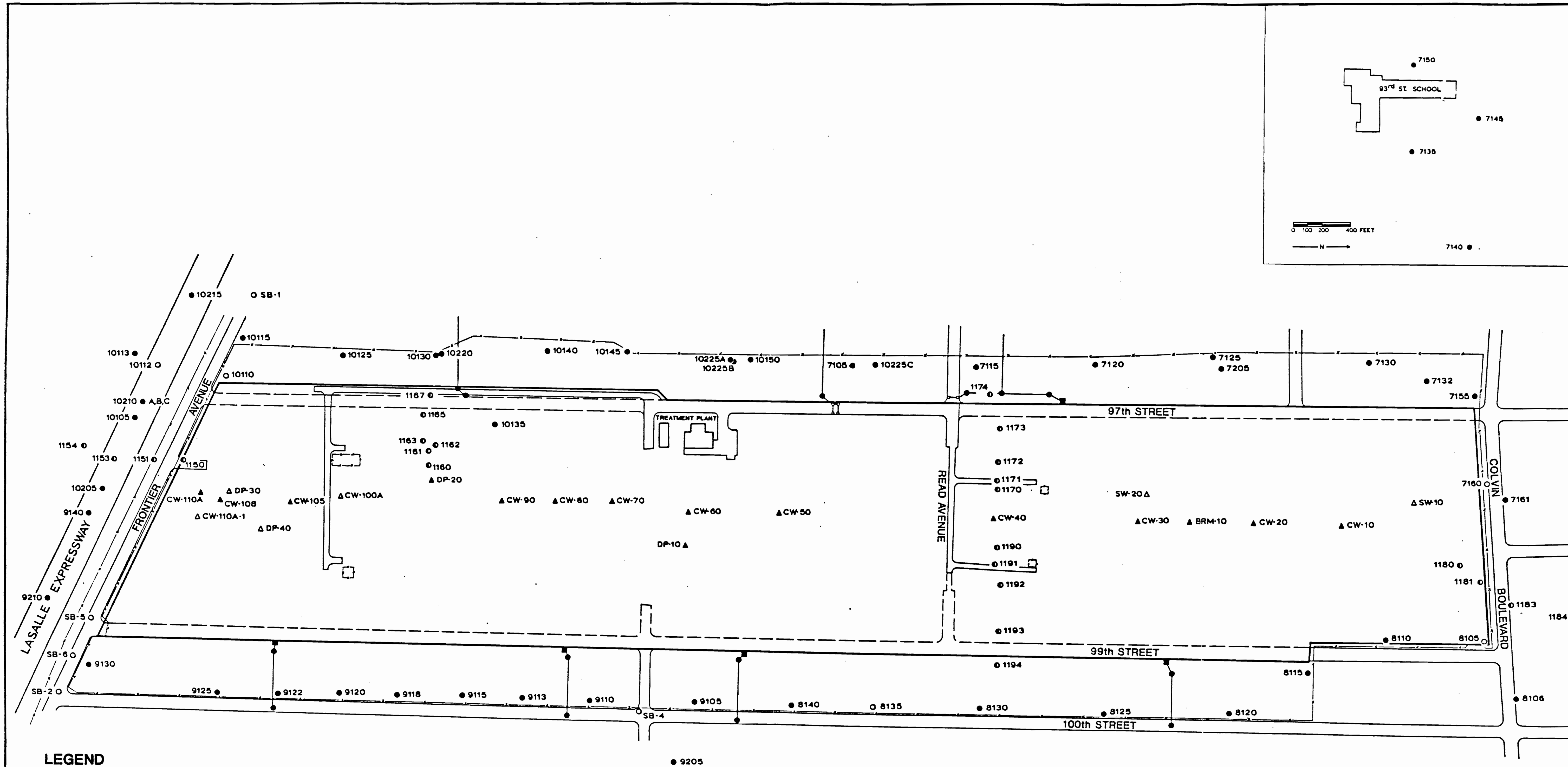
	Standard	Criteria	Drinking Water Standard	Detect Limits	Perimeter Survey Criteria
Chloroform	100	0.2	--	5	100
1,2,3 - Trichlorobenzene	--	10	--	10	15
Chlorobenzene	--	20	--	5	20
Toluene	--	50	--	5	50
Benzene	N.D.	1.5	N.D.	5	5
Trichloroethylene	10	5	N.D.	5	10
1,2 Trans-Dichloroethylene	--	50	--	5	50
Gamma BHC	N.D.	0.2[5]	4.0	.05/2*	4.0
Delta BHC	N.D.	0.2[5]	--	.05/2*	.2/2*
1,2 - Dichlorobenzene	4.7	30	750	10	750
Tetrachloroethylene	--	2	--	5	5
1,4 - Dichlorobenzene	4.7	30	750	10	750
1,1,2,2 - Tetrachloroethane	--	0.3	--	5	5
Phenol	--	1	--	10	10
Alpha BHC	N.D.	0.2[5]	--	.05/2*	.2/2*
Hexachlorobenzene	0.35	0.04	--	10	10
2,4,5 - Trichlorophenol	--	1	--	10	10
4-Chloro-3-Methyl phenol	1	1	--	10	10
2 - Chloronaphthalene	--	10	--	10	10
2,4 - Dichlorophenol	--	0.3	--	10	10
1,3 - Dichlorobenzene	--	20	750	10	750
Hexachlorobutadiene	--	0.4	--	10	10
1,1,2 - Trichloroethane	--	0.5	200	5	200
Ethyl Benzene	--	50	--	5	50
Carbon Tetrachloride	5	0.3	N.D.	5	5
2 - Chlorophenol	1	1	--	10	10
Pyrene	--	0.2	--	10	10
Naphthalene	--	10	--	10	10
Beta BHC	--	.2[5]	--	.05/2*	.2/2*
1,2,3,4 Tetrachlorobenzene	--	10	--	--	10

1
2
3
4
5 sum of all isowers
* water/soil

Note: This guidance does not constitute the establishement of acceptable limits of contaminants in soils.

APPENDIX G

OVERSIZE FIGURES



LEGEND

- PIEZOMETER LOCATION
- CANAL WELL LOCATION
- CANAL BORING LOCATION
- PERIMETER WELL LOCATION
- PERIMETER BORING LOCATION

0' 500'

N →

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NOTE

BEDROCK WELLS ARE SYMBOLIZED AS PERIMETER WELLS. IF THE HUNDREDS DIGIT IN THE PERIMETER WELL NUMBER IS A "1", THE WELL IS IN THE OVERBURDEN. IF IT IS A "2" THEN IT IS A BEDROCK WELL.

FIGURE 3-1
SITE EXPLORATIONS

LOVE CANAL REMEDIAL PROJECT - TASK VC
E.C. JORDAN CO.

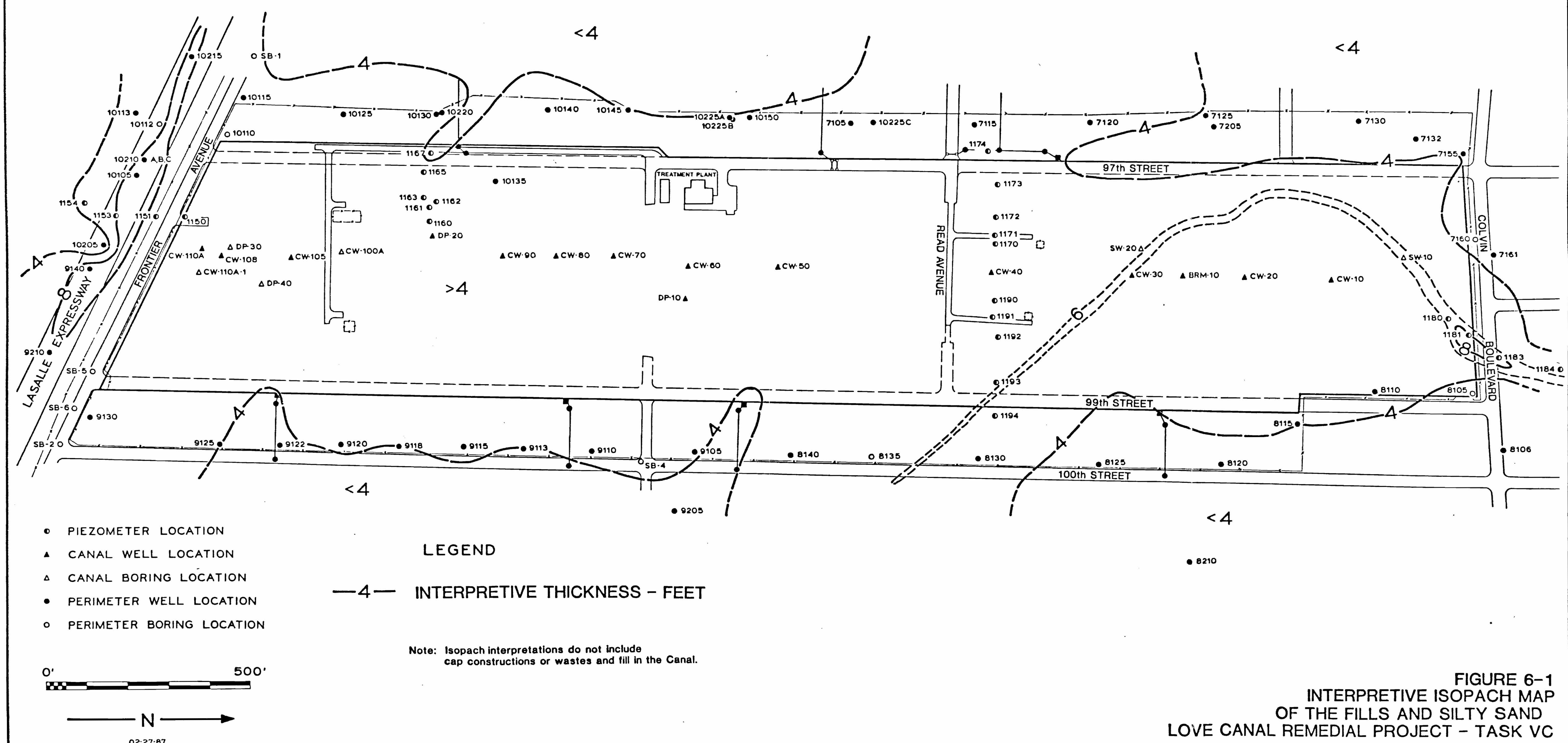
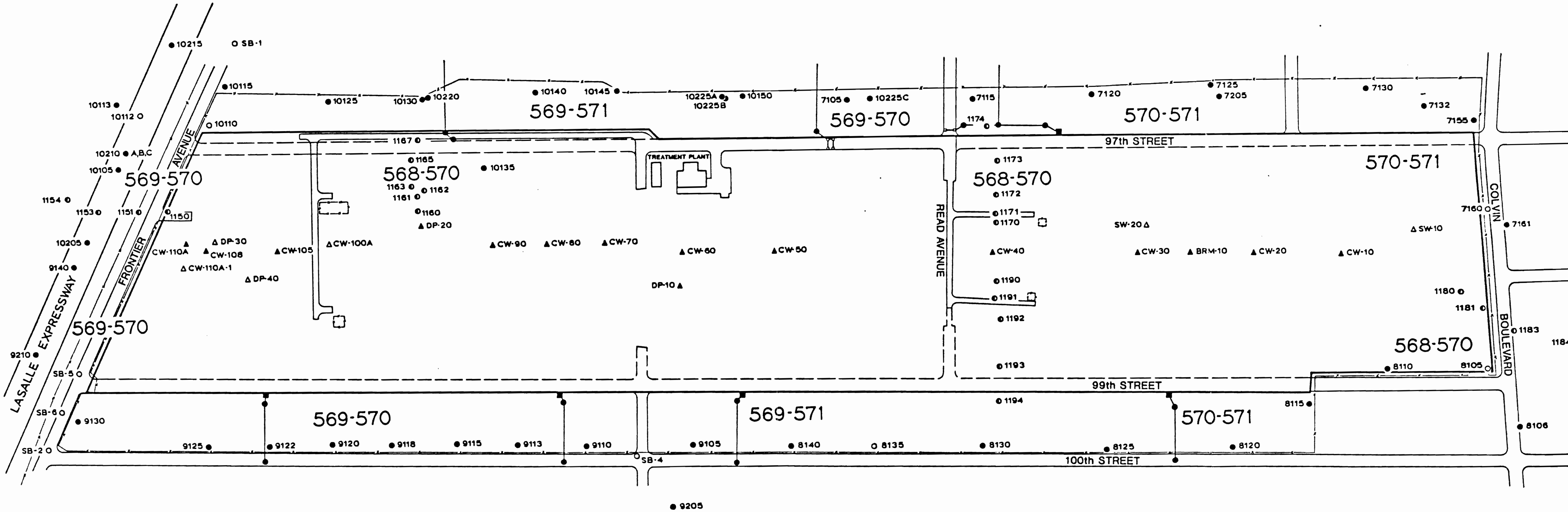


FIGURE 6-1
INTERPRETIVE ISOPACH MAP
OF THE FILLS AND SILTY SAND
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C. JORDAN CO.



LEGEND

- PIEZOMETER LOCATION
- CANAL WELL LOCATION
- CANAL BORING LOCATION
- PERIMETER WELL LOCATION
- PERIMETER BORING LOCATION

570-571 INTERPRETIVE SURFACE ELEVATION - FEET (MSL)

0' 500'

N

02-27-87

Notes: Lack of relief for this surface prevents drawing of meaningful contours.
Interpretations do not include Canal excavation and waste emplacement.

FIGURE 6-4
INTERPRETIVE SURFACE
OF THE LACUSTRINE CLAYS AND SILTS
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C. JORDAN CO.

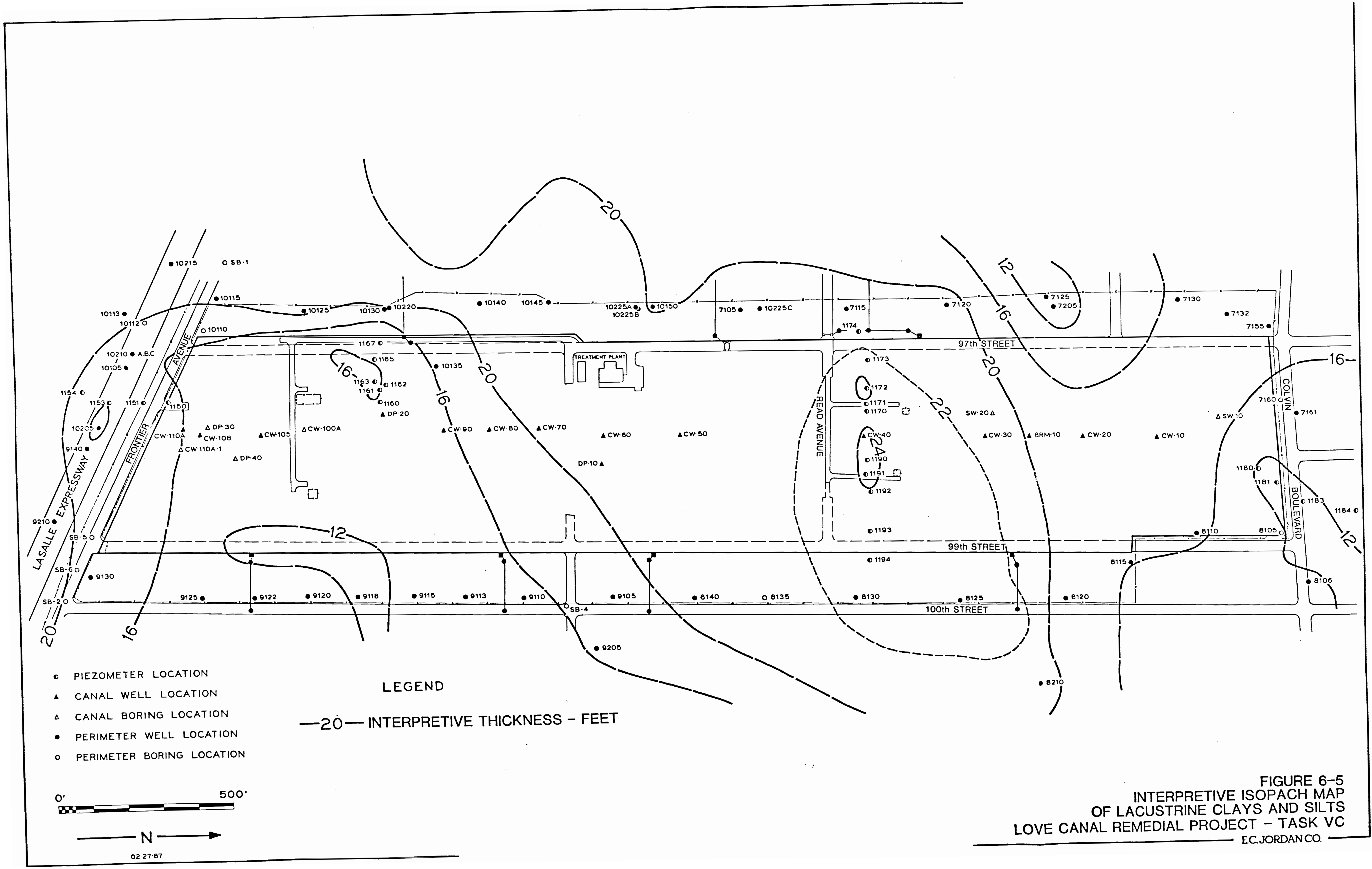


FIGURE 6-5
INTERPRETIVE ISOPACH MAP
OF LACUSTRINE CLAYS AND SILTS
LOVE CANAL REMEDIAL PROJECT - TASK VC
E.C. JORDAN CO.

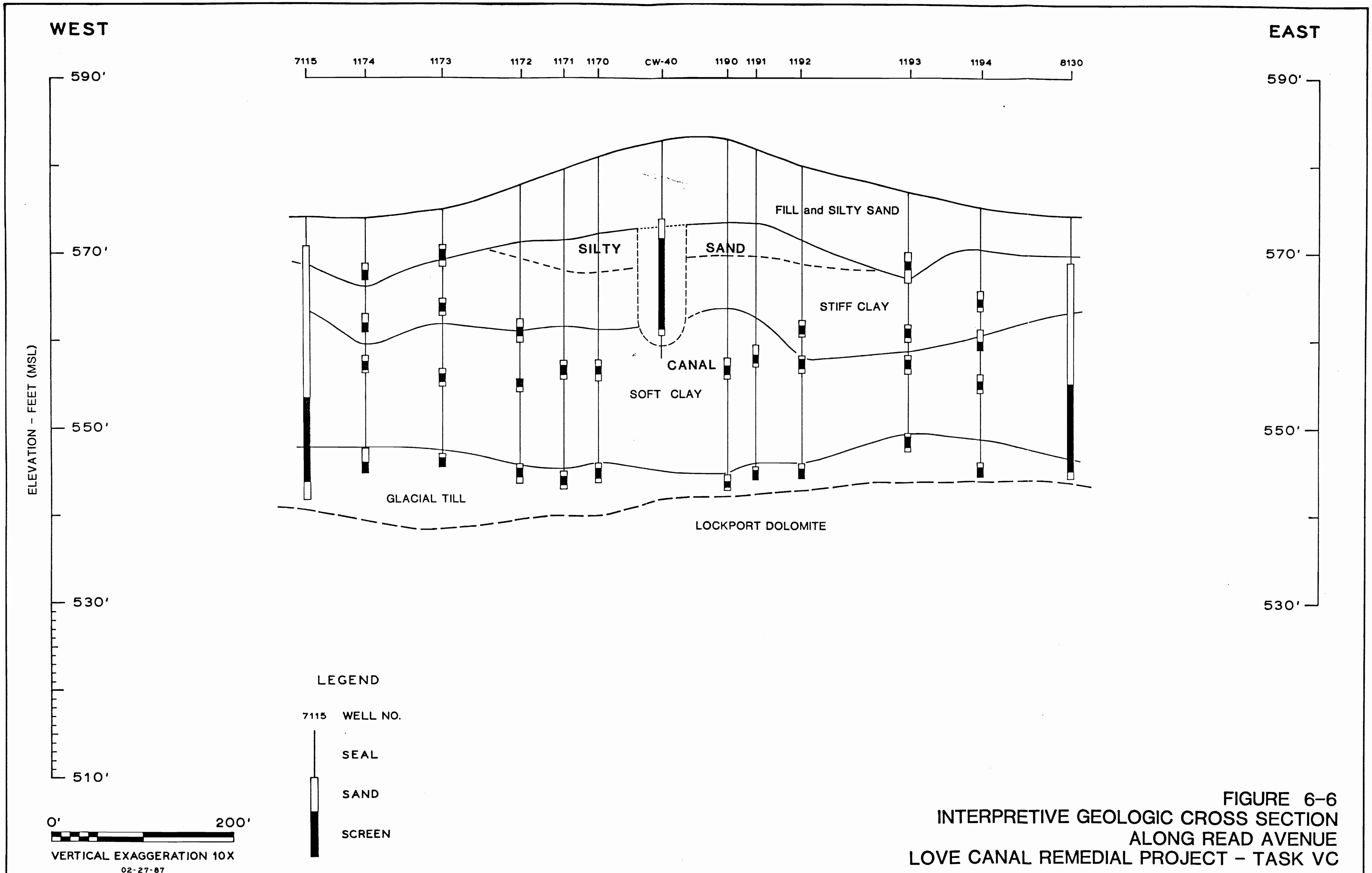
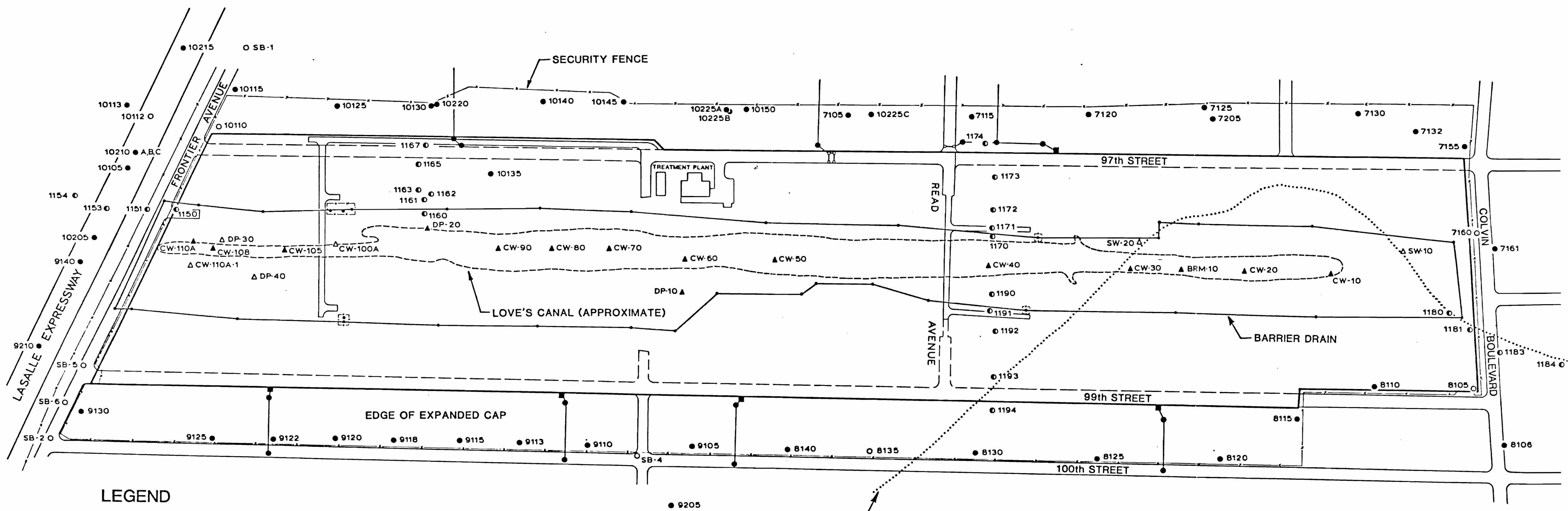


FIGURE 6-6
INTERPRETIVE GEOLOGIC CROSS SECTION
ALONG READ AVENUE
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C. JORDAN CO.



LEGEND

- ◐ PIEZOMETER LOCATION
- ▲ CANAL WELL LOCATION
- △ CANAL BORING LOCATION
- ● PERIMETER WELL LOCATION
- ○ PERIMETER BORING LOCATION

Note: There are two to five separate installations at each piezometer nest location.
Approximate location of swale and Canal taken from 1938 aerial photo provided by NYSDEC.

0' 500'

N →

02-27-87

FIGURE 6-2
SITE FEATURES
LOVE CANAL REMEDIAL PROJECT - TASK VC
E.C. JORDAN CO.

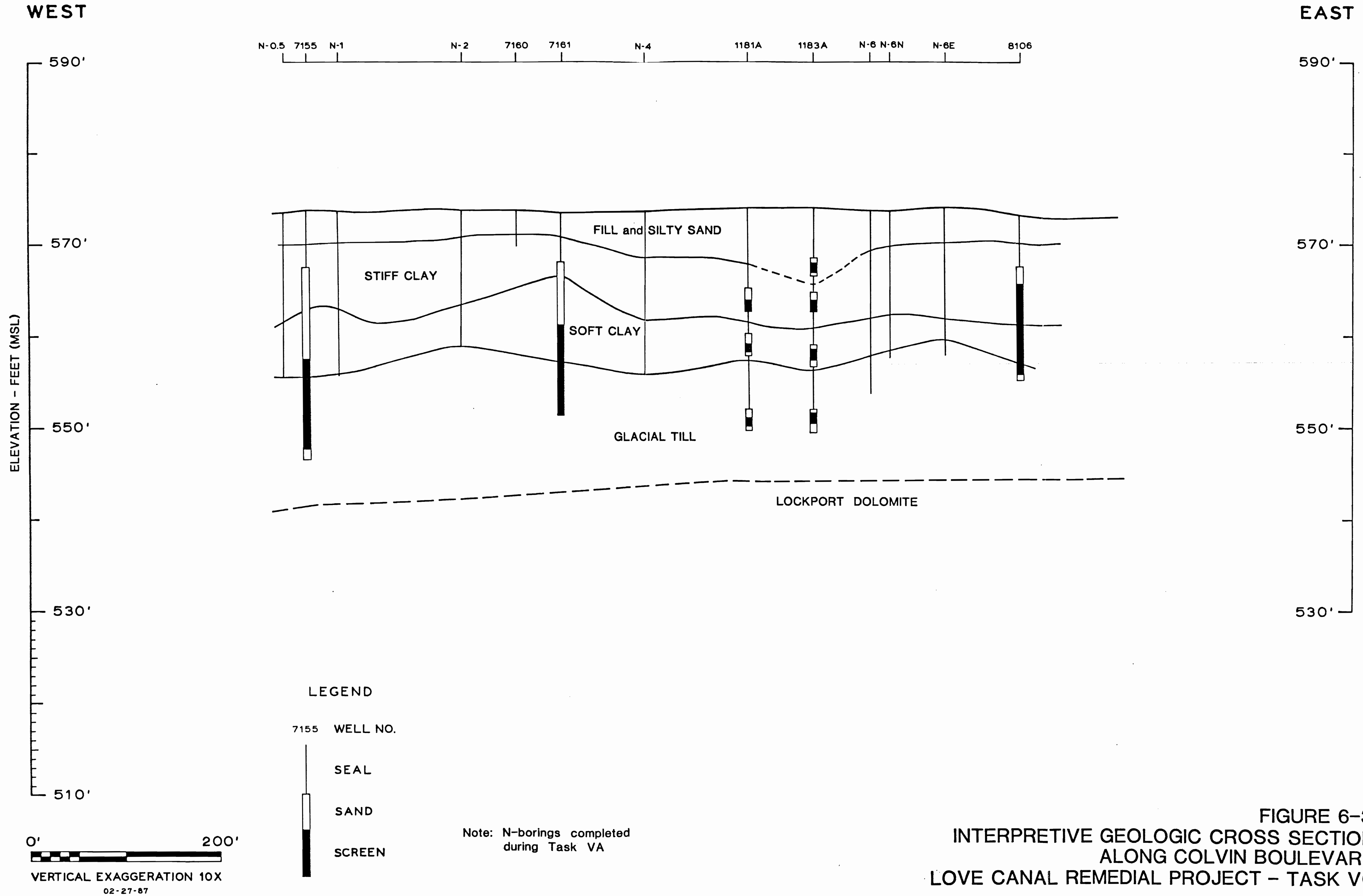


FIGURE 6-3
INTERPRETIVE GEOLOGIC CROSS SECTION
ALONG COLVIN BOULEVARD
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C. JORDAN CO.

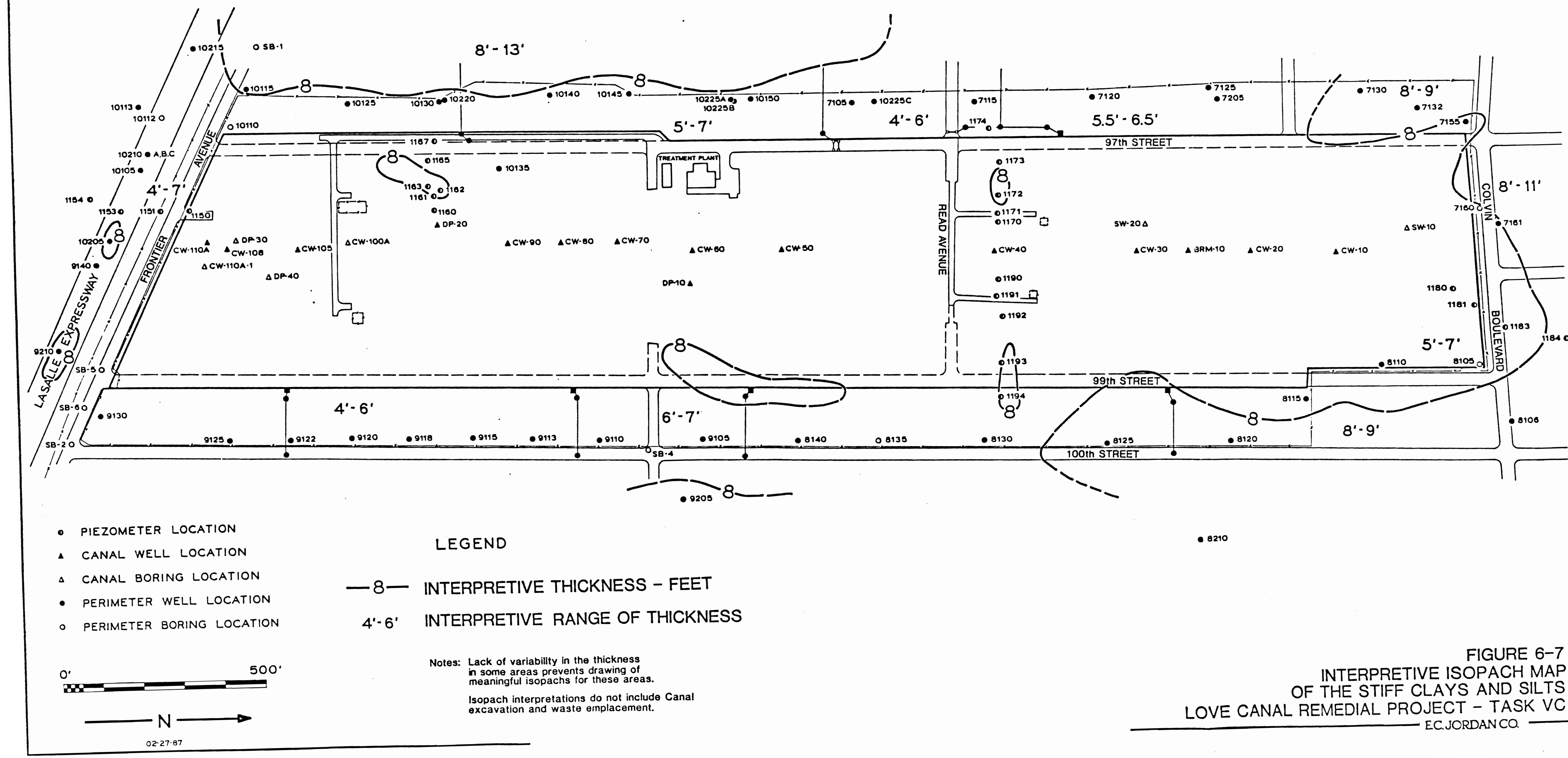


FIGURE 6-7
INTERPRETIVE ISOPACH MAP
OF THE STIFF CLAYS AND SILTS
LOVE CANAL REMEDIAL PROJECT - TASK VC
E.C. JORDAN CO.

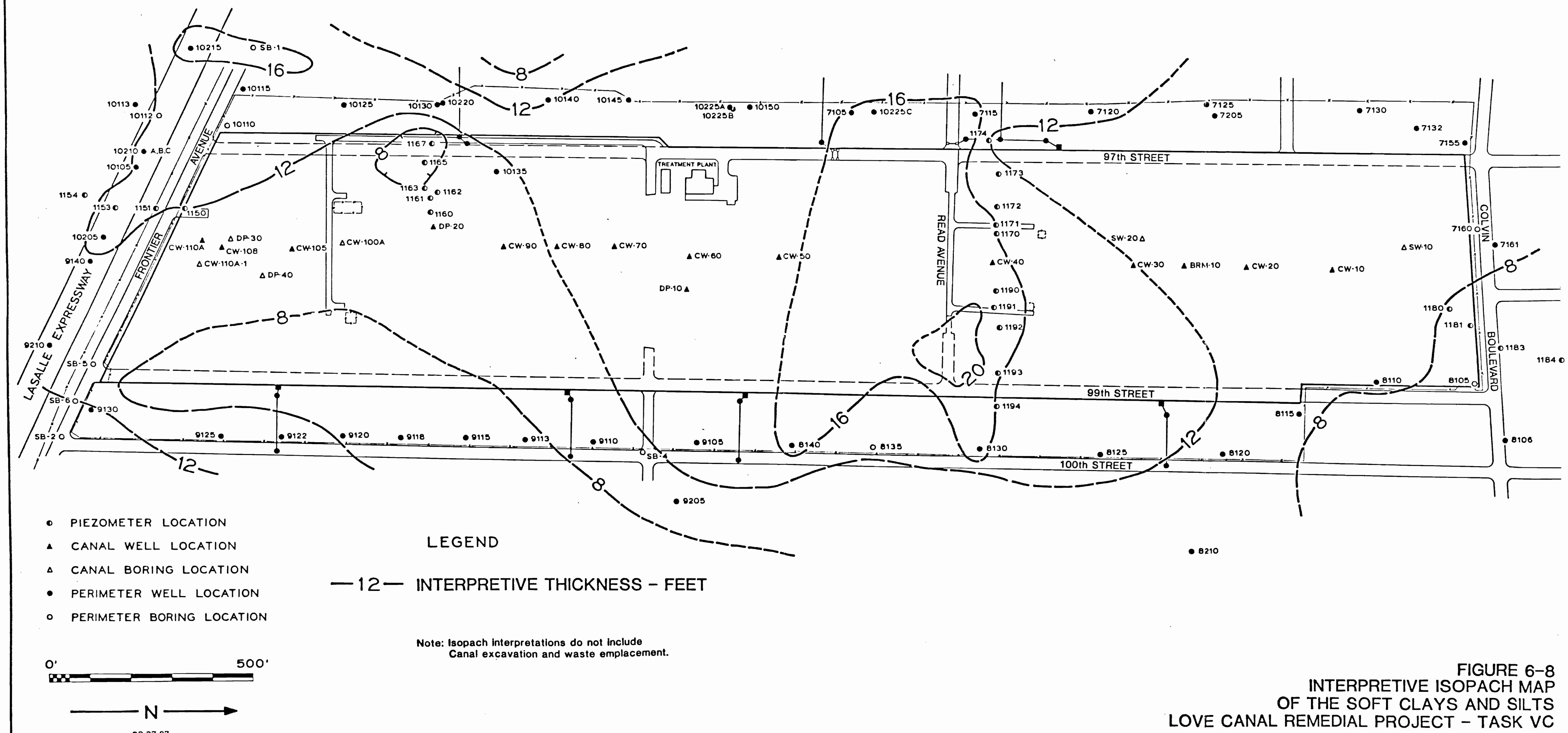


FIGURE 6-8
INTERPRETIVE ISOPACH MAP
OF THE SOFT CLAYS AND SILTS
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C. JORDAN CO.

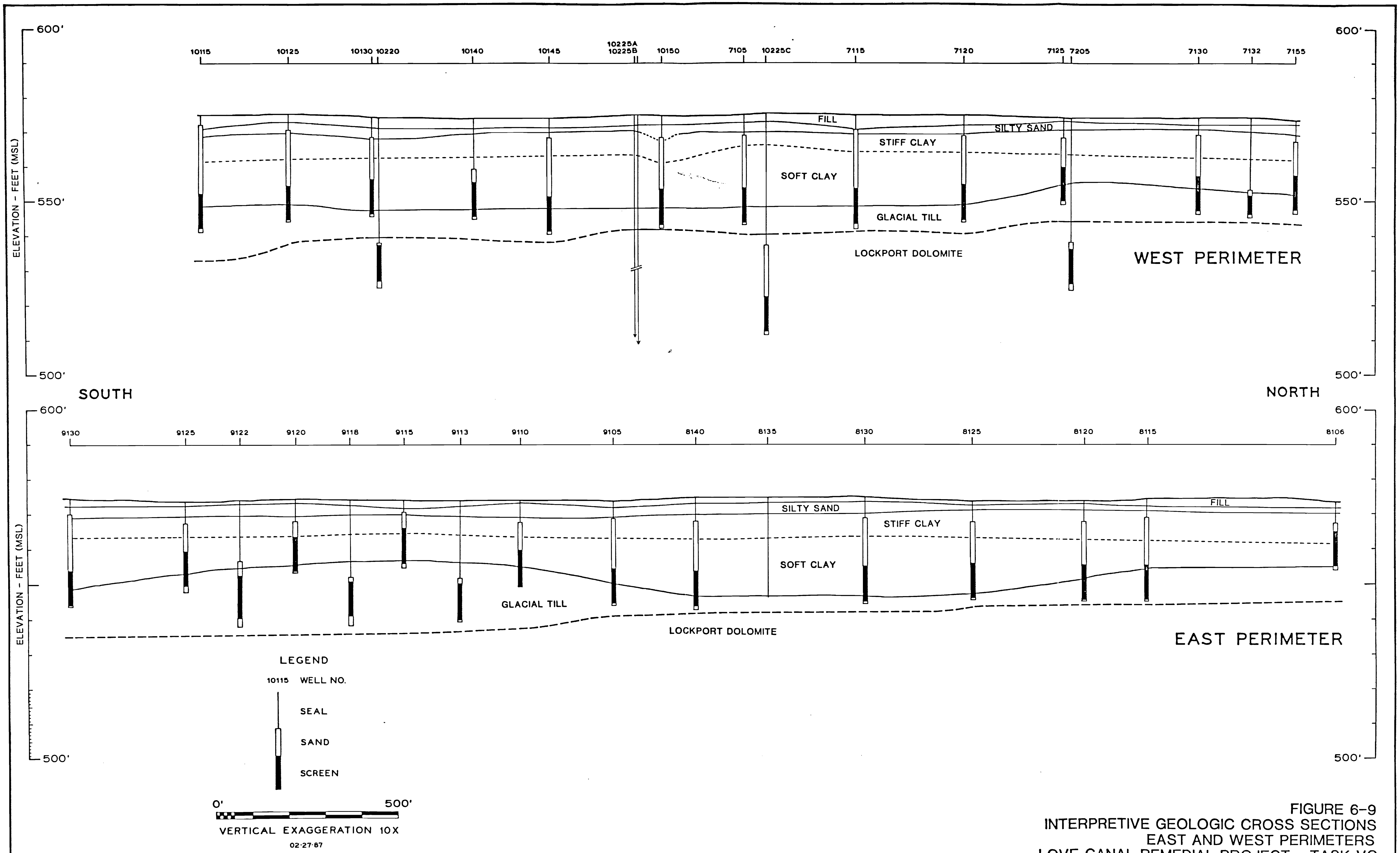


FIGURE 6-9
INTERPRETIVE GEOLOGIC CROSS SECTIONS
EAST AND WEST PERIMETERS
LOVE CANAL REMEDIAL PROJECT - TASK VC
E.C. JORDAN CO.

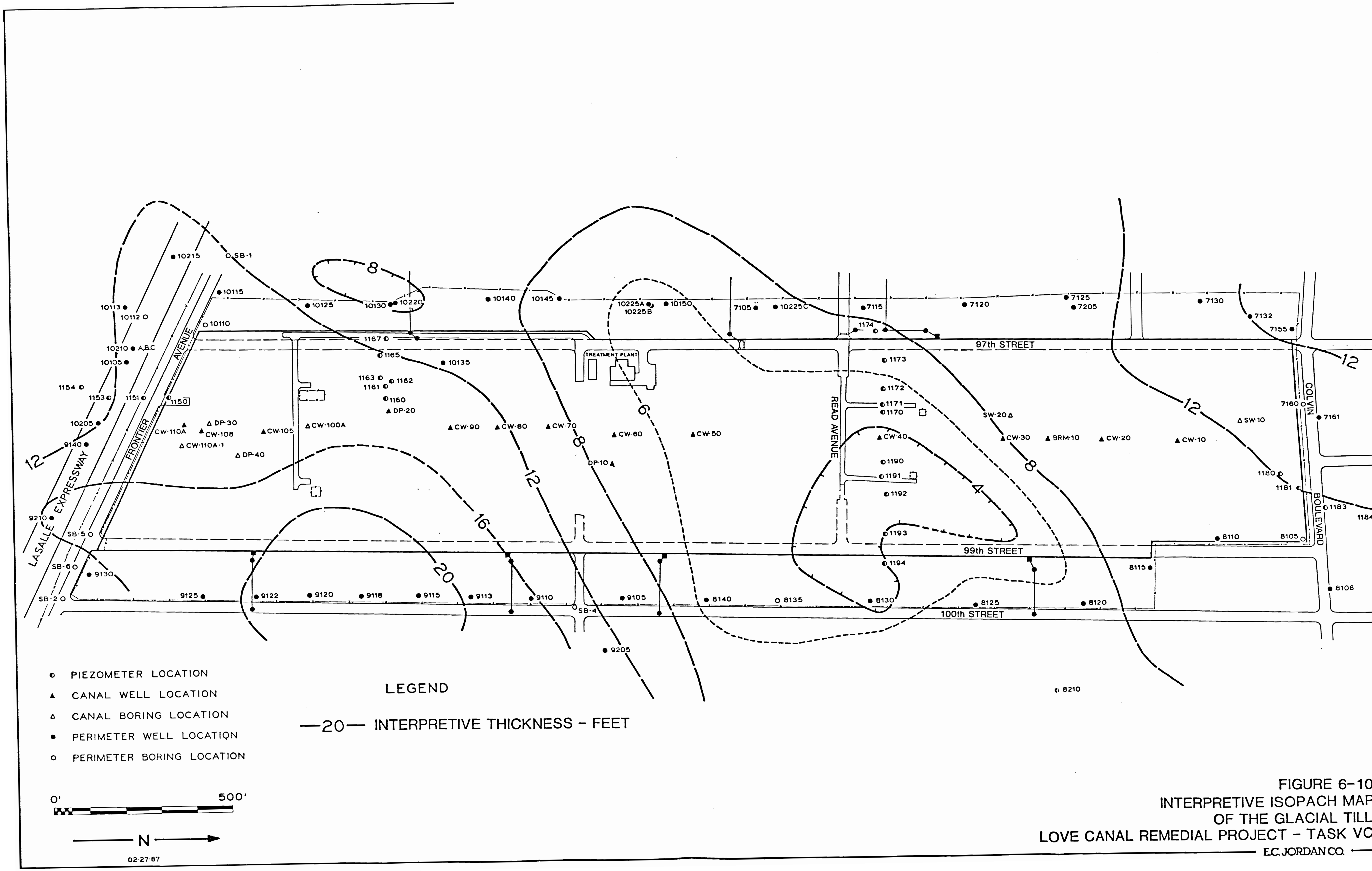


FIGURE 6-10
INTERPRETIVE ISOPACH MAP
OF THE GLACIAL TILL
LOVE CANAL REMEDIAL PROJECT - TASK VC
E.C. JORDAN CO.

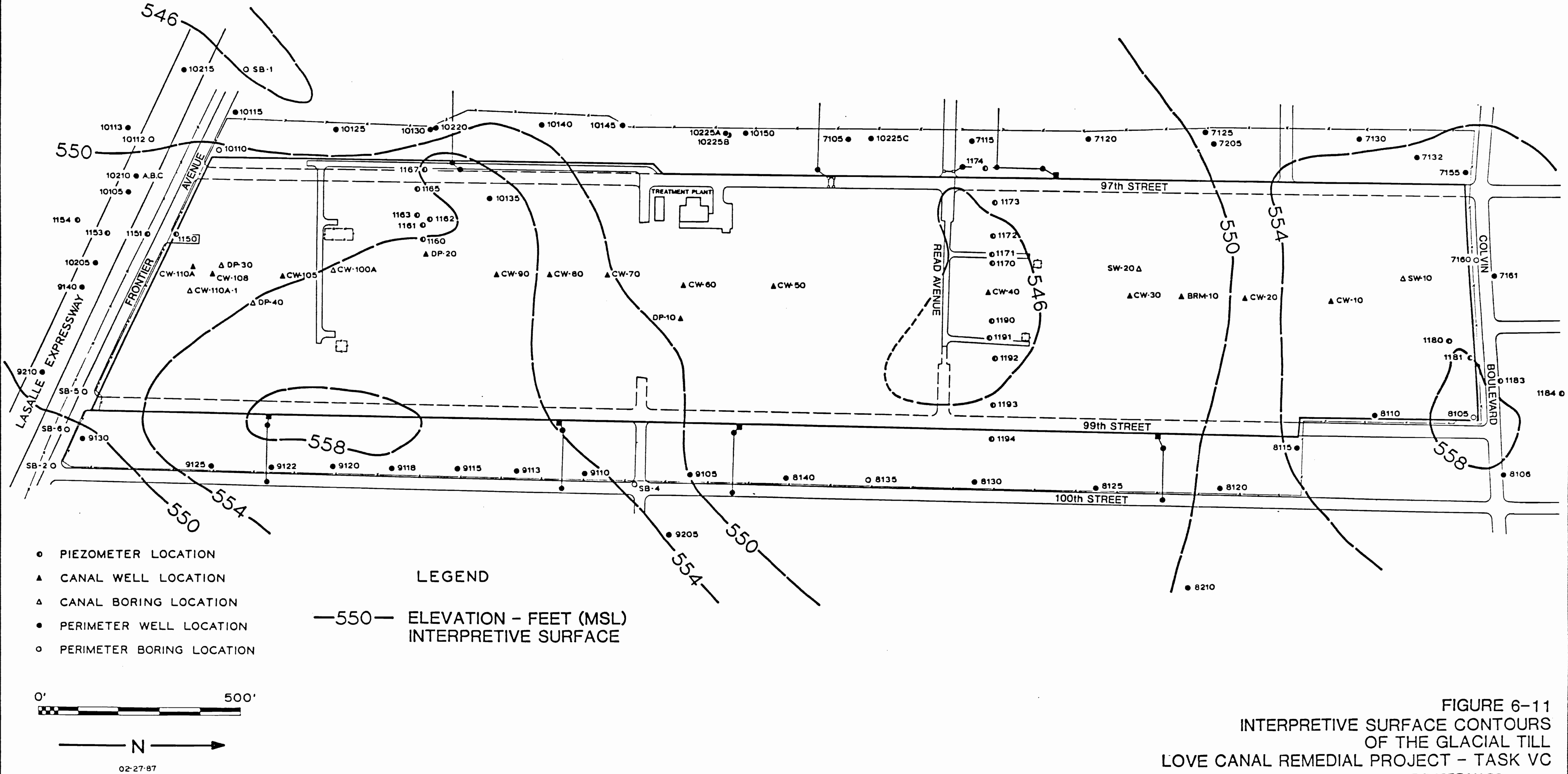


FIGURE 6-11
INTERPRETIVE SURFACE CONTOURS
OF THE GLACIAL TILL
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C. JORDAN CO.

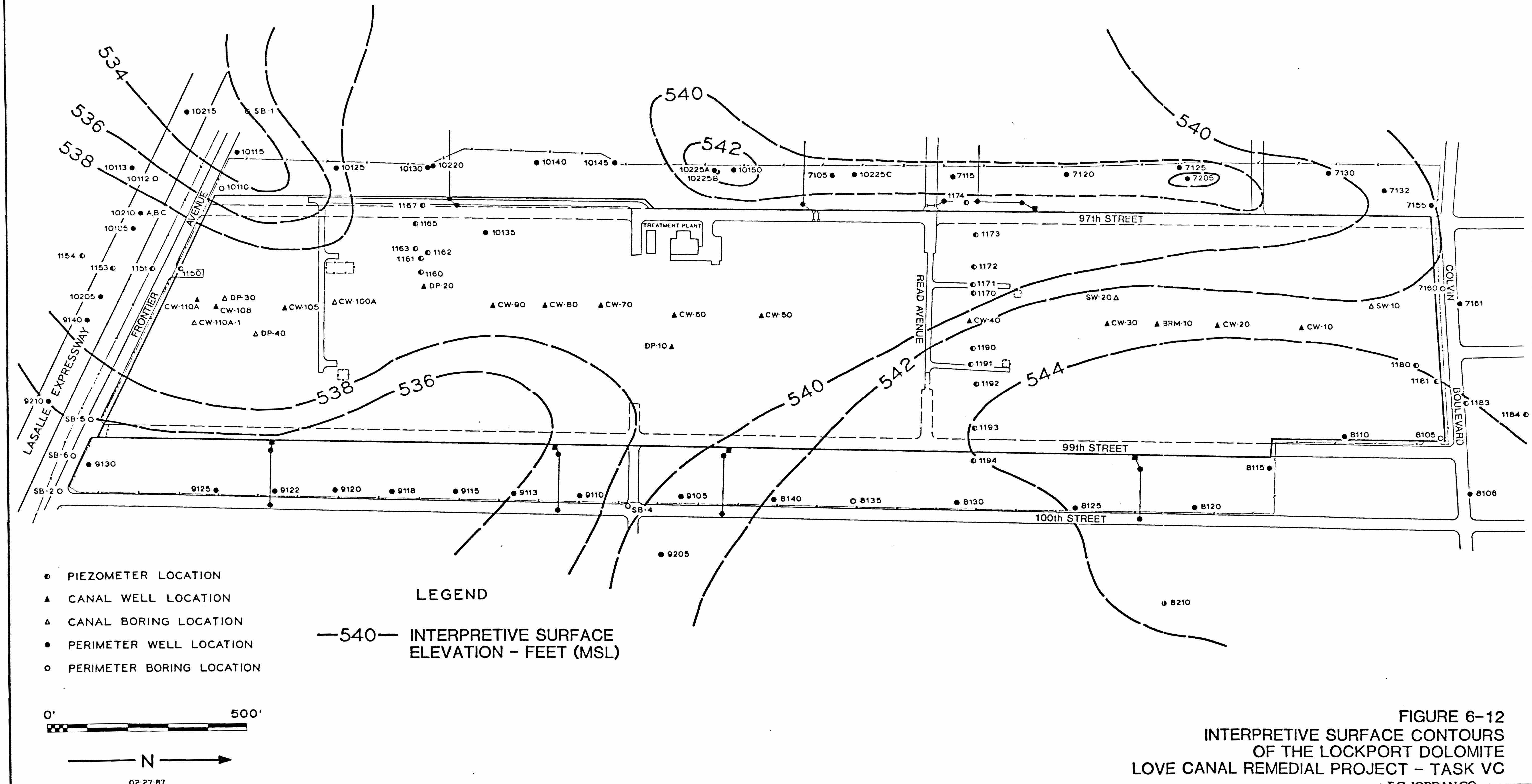


FIGURE 6-12
INTERPRETIVE SURFACE CONTOURS
OF THE LOCKPORT DOLOMITE
LOVE CANAL REMEDIAL PROJECT - TASK VC

E.C. JORDAN CO.

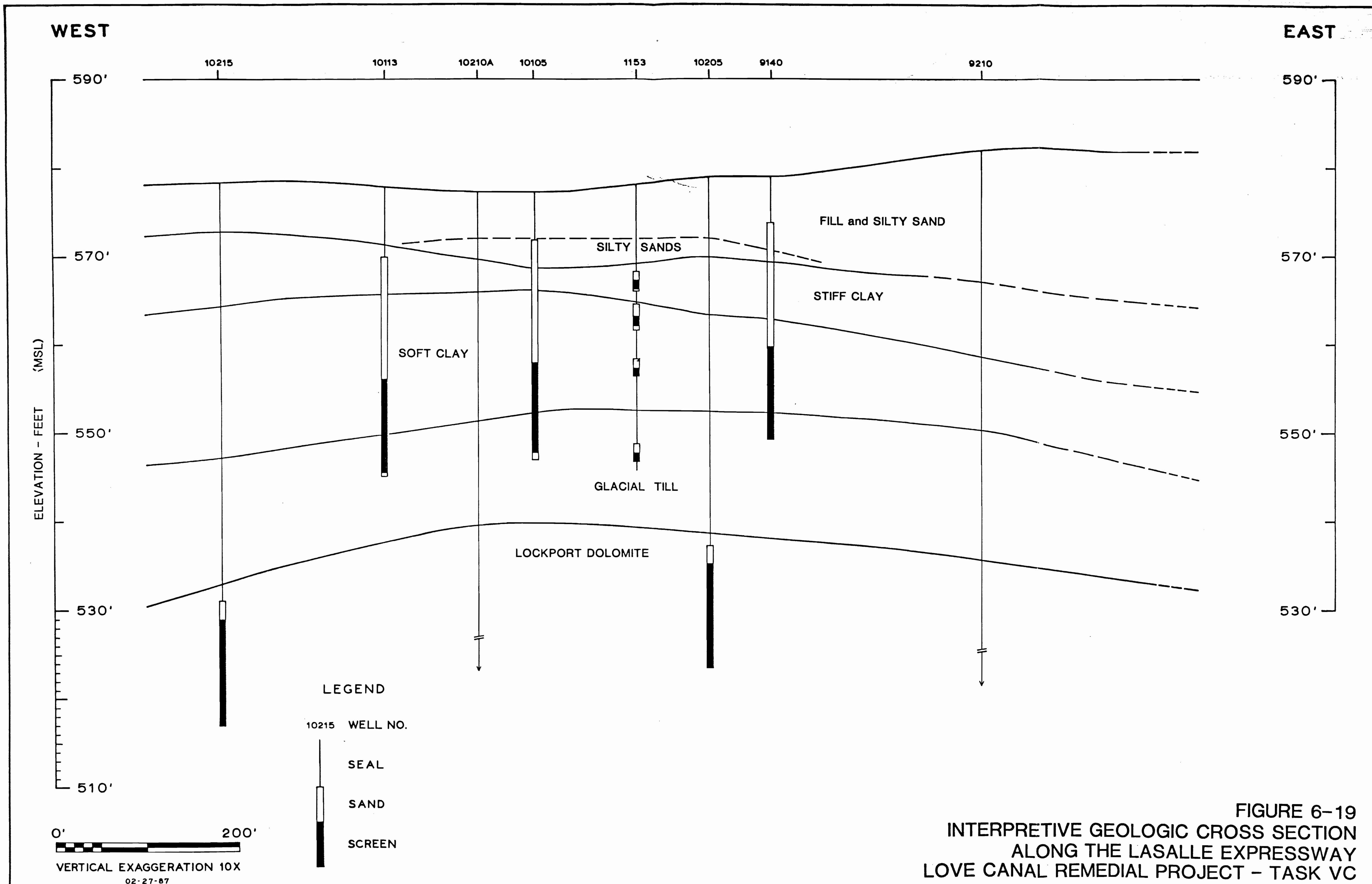


FIGURE 6-19
INTERPRETIVE GEOLOGIC CROSS SECTION
ALONG THE LASALLE EXPRESSWAY
LOVE CANAL REMEDIAL PROJECT - TASK VC
E.C. JORDAN CO.