

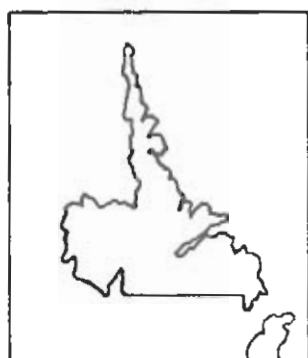


Canada - Newfoundland
**Flood
Damage
Reduction
Program**

Hydrotechnical Study of the Placentia Area Flood Plain

FIELD REPORT

Volume 2 of 2



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SHAWMONT - MARTEC LIMITED
OCEAN SCIENCE AND ENGINEERING CONSULTANTS



Department of
Environment



Environment
Canada

CANADA - NEWFOUNDLAND

FLOOD DAMAGE REDUCTION PROGRAM

ENVIRONMENT CANADA

DEPARTMENT OF ENVIRONMENT

FIELD REPORT
FOR
HYDROTECHNICAL STUDY
OF THE
PLACENTIA AREA FLOOD PLAIN
(Volume 2 of 2)

Prepared By:
SHAWMONT MARTEC LIMITED

SMR-05-84

April, 1985



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Dr. Wasi Ullah, Chairman
Technical Committee
Canada-Newfoundland Flood Damage Reduction Program
Department of Environment
Government of Newfoundland & Labrador
Elizabeth Towers
100 Elizabeth Avenue
St. John's, Newfoundland
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Dear Dr. Ullah:

We are pleased to submit Volume 2 of 2 of our final report on the "Hydrotechnical Study of the Placentia Area Flood Plain". This Volume contains the field report for the study and incorporates, where possible, the Technical Committee's comments on the previous draft report.

This supplementary volume to the main report provides a summary of the information collected in the field which included a physical survey of the study area, a history of previous flooding and a program of oceanographic monitoring. This information was used during the study to assess the degree of flooding problems in the Placentia area, to determine the flood risk contours and to develop recommendations for remedial measures.

Yours very truly,

A.D. Peach, P. Eng.,
Vice President

DHB/cb

TABLE OF CONTENTS

	<u>Page</u>
TABLE OF CONTENTS	
<u>PART ONE - INTRODUCTION</u>	
1.1 PROJECT AUTHORIZATION	1-1
1.2 GENERAL	1-1
1.3 OBJECTIVES	1-1
<u>PART TWO - INVESTIGATION OF PREVIOUS FLOOD EVENTS AND LAND USE</u>	
2.1 GENERAL	2-1
2.2 PREVIOUS FLOOD EVENTS	2-2
2.3 LAND USE	2-8
<u>PART THREE - PHYSICAL SURVEY</u>	
3.1 GENERAL	3-1
3.2 TOPOGRAPHIC SURVEY FOR FLOOD PLAIN MAPPING	3-1
3.3 BATHYMETRY AND FLOW MEASUREMENTS	3-3
3.4 STRUCTURES	3-5
<u>PART FOUR - OCEANOGRAPHIC MONITORING</u>	
4.1 GENERAL	4-1
4.2 INSTRUMENTATION	4-1
4.3 EQUIPMENT DEPLOYMENT AND RECOVERY	4-2
APPENDIX I - TABLES	
APPENDIX II - PHOTOGRAPHS	
APPENDIX III - FIGURES	
APPENDIX IV - DRAWINGS	

PART ONE
INTRODUCTION

1.1 PROJECT AUTHORIZATION

On 1983 10 04, ShawMont Martec Limited was authorized by the Newfoundland Department of Environment, on behalf of the Canada-Newfoundland Flood Damage Reduction Program, to carry out a hydrotechnical study of the Placentia Area flood plain.

1.2 GENERAL

The purpose of the study was to assess the flooding problem in the Placentia area, to determine the 1:20 year and 1:100 year flood contours and to recommend remedial measures (structural and non-structural) to minimize future flood damage. In accordance with the terms of reference and the proposal for this work, a field program was undertaken to confirm and/or investigate particular site specific physical parameters. This field program included:

- an investigation of previous flood events,
- a physical survey, and
- oceanographic monitoring.

1.3 OBJECTIVES

The overall objective of the field program was to gather the information necessary to calibrate the computer models that will be used to mathematically represent the physical parameters of Placentia and thereby identify conditions that cause flooding in the area.

In particular, the specific objectives were:

- to carry out a topographic survey to confirm the available mapping, especially the elevation and contour detail in the flood plain,
- to obtain meteorologic data such as wind speed and direction, atmospheric pressure and air temperature,

1.2 OBJECTIVES (Cont'd)

- to obtain oceanographic data such as wave measurements and water surface elevations throughout the study area to establish the interrelationships of water levels in Placentia Road, Northeast Arm, Southeast Arm and Swan Arm,
- to obtain hydraulic data such as water velocities through the hydraulic controls at the "Gut" lift bridge, the "Narrows" and MacDonald Gut,
- to interview local residents and officials to collect anecdotal data on previous flood events to enable correlation with water levels, areal extent of flooding and estimates of damages, and
- to investigate future land use.

PART TWO

INVESTIGATION OF PREVIOUS FLOOD EVENTS AND LAND USE

GENERAL

The Town of Placentia is located on a beach near the confluence of two estuaries where the action of waves and currents have, over the years, created a low, broad expanse of coarse material (Drawing 1). Mapping and documentation as early as 1709 refer to the townsite as "The Great Beach" A reproduction of this early map is shown in Figure 1. This beach is bounded by an inlet off Placentia Bay, called the "Road", to the west; Southeast Arm to the south; Swan Arm to the east and Northeast Arm to the northeast.

Tidal waters flow through the "Gut", which is the opening between the north end of the beach and the Town of Jersey side on the north shore of the Road, into Northeast Arm. From Northeast Arm, the tidal waters flow through a long narrow passage, called "The Narrows", along the east side of the beach and into Swan Arm and thence into Southeast Arm through MacDonald Gut. On the ebb tide, the tide waters reverse direction and flow back through the Gut into Placentia Bay via the Road.

Under certain climatic conditions the water level in Swan Arm and Southeast Arm is raised and the Town is flooded from the south and east. Flooding usually begins along Riverside Drive and O'Rielly Street (See Drawing 2 and Photos 1 and 2). The northern and western movement of flood waters continues depending on actual levels of water in Swan Arm and the force of wind aggravating overtopping of the breastwork along the Narrows (See Photos 3 and 4).

2.1 GENERAL (Cont'd)

The area of Placentia adjacent to Southeast Arm is low-lying ground. Flooding usually occurs in this area at the same time as the Town is being flooded from Swan Arm and usually extends south to the region known as "the Blockhouse" or "Neck". In extreme storm conditions with an onshore wind, the beach to the west is overtopped and on occasion the Town has been flooded from Placentia Road.

Potential areas for land development in the Town of Placentia will have to be evaluated by considering the flood plain defined and the flood risk contours.

2.2 PREVIOUS FLOOD EVENTS

The Towns of Placentia and Jerseyside have experienced minor flooding as a relatively common occurrence over the decades. The value of property damage has generally increased with each succeeding flood because new construction has increased the number of buildings affected and a rise in the standard of living has increased the amenities to which residents have become accustomed.

To develop a history of previous flood events, interviews were carried out with a cross-section of residents from all areas of Placentia and the affected area of Jerseyside. Officials from various regulatory agencies were also contacted. A detailed list of those interviewed is shown on Table 1 in Appendix I.

The first noted flooding was on February 3, 1904. Other floods have been recalled by some of the more senior residents in September 1955, and the winter of 1960. More recently, there was flooding on March 18, 1976, January 20, 1977, January 10 and 16, 1982 and of course the latest events of December 22 and 25, 1983.

2.2 PREVIOUS FLOOD EVENTS (Cont'd)

The larger portion of damage from flooding in the area has been confined to Placentia with only a small number of residents affected in Jerseyside. Residents in Jerseyside report that, during violent storms, waves overtop the seawall on the seaward side to the west of the Town (Photo 5). They also report that tidal flooding has affected residents adjacent to the shoreline of Northeast Arm, just north of the lift bridge (Photo 6). Over the years this section of shoreline has been built up behind a breastwork and damage from high tides has subsequently been reduced.

The worst flooding experienced by the Towns of Placentia and Jerseyside was during the more recent events. These events are described below.

January 10, 1982

On this date an unusually high tide was driven by generally southeasterly winds. The breastwork along the east side of Placentia could not contain the high water and waves in Swan Arm and was overtopped. Photos 7 to 9 are indicative of the flood conditions in this area. For comparison purposes Photo 10 was taken during a flood in 1960. See Drawing 3 for the key to photo locations.

Eyewitnesses described the event as occurring between 10:00 a.m. and 1:00 p.m. In the central part of the Town near the Roman Catholic Church, the water rose to the lower floor level of most homes in a matter of minutes. This water level remained for a day or two. The duration of flooding of homes varied, depending on their elevation but was approximately 1 to 3 days.

In the northern end of Placentia, and the southern end near Swan Arm, the water ponded in the lowest areas. In some cases water was present for up to two weeks where residual water from this flood was supplemented by a second flood a week later. The flooded area extended over the central and eastern areas of the Town, westward to the Highroad (Drawing 2). This road provided a natural barrier and limited the damage. Several homes near the Neck were also flooded at this time. These homes have a recurring problem of flooding from Southeast Arm even when most parts of the Town are dry.

Based on the water levels reported, the maximum water level during this flood was approximately 1.7 m.

January 16, 1982

On this date a winter storm with strong south westerly winds pounded the beach to the west of Placentia. Sometime around midnight the waves broke through the beach and washed across the Beach Road in the area of Laval High School (Drawing 2). Water flowed eastward across the low ground between the Beach Road and the Highroad. The higher ground near the toe of Dixon Hill provided a natural divide and water flowed southward into Southeast Arm and eastward into the Narrows and Swan Arm.

Residents have described the scene graphically and equated the Highroad to a river with water flowing

2.2 PREVIOUS FLOOD EVENTS (Cont'd)

northward. The water flowed across the lower sections of the Town to the north and east. The water ponded in the lowest areas which, in some cases, were still underwater from the flood a week earlier. Some residents reported residual water in their homes for up to two weeks. Photo 11 shows water in the south end of the Town after the beach was breached.

On the same night, the beach was also breached at the north end of the Town near the intersection of the Beach Road and the Highroad. Most of the homes and businesses were flooded between these two roads and water flowed into the northeastern section of the Town. One resident on the east side of the Highroad reported that, for the first time in over 30 years, he had water in his basement.

In Jerseyside the waves also overtopped the sea wall to the west, washed across the ball field and ponded in the low section of the Town on the approach to the Gut Bridge.

From other interviews it is clear that the events of January 16 were a very rare occurrence indeed. One resident, who is 83 years old, said it was the first time he had seen such a flood.

Because of the nature of flooding from the ocean side of Placentia during this particular storm, it was impossible to ascertain a maximum water level. A very large area of Town was affected but except for the lower sections, the water flowed away from the homes relatively quickly.

Later in 1982, the Department of Transportation and Communication raised and extended an existing wooden sea wall originally built in 1967 near the Neck. This wall was extended northward from the Neck up to a point opposite the south end of the District Vocational School (Photos 12 and 13). The residents feel confident this measure will reduce or even eliminate any future flooding from the west. The residents have also suggested that this wall be extended even further northward.

Subsequent to the two flood events of January, 1982, a representative of the Placentia Town Council contacted all flood victims with a questionnaire. The completed forms were obtained from the MHA for the area, Mr. William Patterson, for our review. The flood victims had been asked to summarize the damage and to identify the height of water adjacent to and inside their homes during the floods. Approximately 130 households responded to the survey and the estimated damage was in the order of \$300,000.

A problem highlighted by most of the residents was that of power outages caused by the flooding. At the time it was suggested that the outages were caused by a build up of ice and salt spray on the cable terminals of the infeed line adjacent to the lift bridge. Discussions with Newfoundland Light and Power officials have indicated that this problem has been rectified. Power outages attributed to high waves and flooding in the Town were not a factor during the flood events of December, 1983. Newfoundland Light and Power did indicate that there were outages but these were caused by the excessive winds on Christmas Day. Winds were recorded at Argentia in the range of 50 to 70 knots for that date.

Because flooding occurred during January, the loss of power caused additional hardships to those already affected. Frozen pipes and loss of heat even plagued those fortunate enough to be living in the dry parts of the Town.

December 22, 1983

At approximately 11 a.m. on this date the water level rose in the Narrows and overtopped the breastwork beginning near the southern end adjacent to the Placentia Cottage Hospital. The water continued to rise rapidly for an hour or two and then receded before late afternoon. It was reported that approximately 75 homes were affected of which 30 had to be evacuated. Photos 14 to 19 show the extent of the flooding. A CBC film recorded the event showing the volunteer fire department assisting in the evacuation operation of homes as well as the Cottage Hospital. The water level peaked at an elevation of approximately 1.9 m, the highest recorded in recent years.

December 25, 1983

Only three days after the record high water levels, the breastwork along the Narrows was again overtopped.

The same areas were affected but residents reported that the water level reached an elevation which was equated to approximately 1.7 m, similar to the flood of January 10, 1982. On this occasion the situation was aggravated by frequent power outages caused by storm force winds. Once again many residents had to be evacuated.

2.2 PREVIOUS FLOOD EVENTS (Cont'd)

Table 2 in Appendix I summarizes the environmental conditions and water levels during the most recent events. The data indicates that flooding occurs during a high tide situation during the passage of a storm with associated low pressure and strong winds from the west. It is noted that, although the flooding on January 10, 1982 occurred with winds from the southeast, the winds had been from the west for sometime prior to the day of the flooding.

2.3 LAND USE

Inquiries were made with officials of the Planning Section of the Department of Municipal Affairs. It was learned that a comprehensive land use plan is currently being compiled for the areas bounded by all communities in the general vicinity of and including Placentia. The Planning Section showed an interest in reviewing the findings of the final report for this study to help identify potential development zones that might be affected by future floods.

An area with potential for future development is in the southern section of Placentia as bounded by the Highroad to the north and west, Dixon Hill to the east and Southeast Arm to the south.

At present, preliminary planning is underway for a senior citizen's home. The tentative location being considered is a site to the north east of Dalfen's Mall. Final grades of any future structures in this area will have to take into account expected flood elevations.

2.3 LAND USE (Cont'd)

Another area with potential for future development is on land bounded by the Beach Road and the Highroad. Areas near the northern intersection of these roads have been flooded by percolation through the beach material. During the storm of January 16, 1982 the area near Laval High School and southwards received considerable damage from waves overtopping the beach. This appears to be an isolated occurrence and does not appear to pose the same hazard with the frequency of flooding in other sections of the Town.

PART THREE
PHYSICAL SURVEY

3.1 GENERAL

The terms of reference for this study specified that available mapping was to be used for flood plain mapping and that a field survey was to be undertaken in sufficient detail to verify the contour information in the flood plain areas on this mapping.

Early in the survey, it was realized that the flood plain area, for the most part, had so little relief that the contour interval (5 feet) on the available mapping, which was prepared in 1971, was not sufficient to permit accurate flood mapping. It was then decided that the field survey should be sufficiently detailed to permit development of one foot interval contours in the flood plain areas.

3.2 TOPOGRAPHIC SURVEY FOR FLOOD PLAIN MAPPING

The datum for the mapping was established as Geodetic. Two geodetic bench marks were used for vertical control of the survey. These were:

<u>GSC Number</u>	<u>Elevation</u>	<u>Location</u>
76F612	1.349	R.C. Church
76F613	4.863	Lift Bridge

Available mapping provided the horizontal control of the survey. Since flood contours are most meaningful when located relative to existing structures, available mapping was photographically enlarged to a workable scale of 1:600 and all surveyed points were located on this mapping relative to existing structures.

3.2 TOPOGRAPHIC SURVEY FOR FLOOD PLAIN MAPPING (Cont'd)

The survey commenced on October 31, 1983. Initially, a series of temporary bench marks were established throughout the Towns of Placentia and Jerseyside at convenient and identifiable locations. Instrument set up points were selected to maximize areal coverage for each instrument set up. These points were referenced to existing structures and located on the large scale mapping.

A Geotec T-24 theodolite was then set up over each point and a series of radial lines was run from each. The direction of each radial line was referenced to a known feature on existing mapping. Along each radial line, one or more stations were selected for which the ground elevations and distances from the instrument were noted. Wherever possible, stations were selected adjacent to existing structures. A Philadelphia rod was used to determine elevations and stadia was used to calculate distances.

This information was plotted on the large scale mapping and contours with a 0.3 metre interval were then produced. The 1:600 scale mapping was subsequently reduced to the original scale of 1:2,500.

Using available photographs and information received from residents of Placentia, the maximum flood levels of particular flood events were determined. The areal extent of particular flood events are shown on Drawing 3.

Bathymetry

Existing bathymetry and structures in the study area could be influential factors in the flooding problem. All available bathymetry was reviewed and where areas of potential hydraulic control were identified, cross-sections were taken to determine the flow area. This information was necessary for the computer modelling which was subsequently carried out to determine the hydraulic characteristics of various scenarios. Cross-sections were taken in the Gut at the lift bridge, the Narrows and in MacDonald Gut. These are shown in Appendix III.

Each cross-section was taken using a graduated rope stretched across the section of channel to be sounded. A calibrated depth sounder was positioned in a small boat and the boat was manoeuvred across the channel. Soundings were recorded at 5 metre intervals along the rope. The water level was taken at the time of the soundings and all recordings were related to geodetic datum.

Four lines were cross-sectioned in the Gut at the lift bridge. (Stations 6, 7, 9 and 10). In the Narrows, 6 lines were cross-sectioned (Stations 1-5 and Station 8) and in MacDonald Gut, the passage separating Swan Arm from Southeast Arm, a total of 4 lines were cross-sectioned. (Stations A - D). The locations of all the lines are shown on Drawing 1.

Flow Measurements

To aid in assessing the hydraulic properties of the study area, the surface velocity of water flowing

3.3 BATHYMETRY AND FLOW MEASUREMENTS (Cont'd)

Flow Measurements (Cont'd)

through the Narrows and under the lift bridge in the Gut was measured by timing the movement of floats over a set distance. The following table summarizes the information determined from the flow measurements taken on December 21, 1983 during the ebb tide:

Location	Vel. (m/s)	W.L. (m)	Date/Time
Narrows	1.8	0.03	83-12-21/11:55
Gut	2.0	0.40	83-12-21/14:15

The average surface velocities were calculated to be 2 metres per second (4 knots) at mid-channel through the Gut and 1.8 metres per second in the Narrows. The velocities would vary depending on the tidal cycle and meteorological conditions. Some residents estimated the flows through the Gut to be double the measured value at certain times.

3.3 BATHYMETRY AND FLOW MEASUREMENTS (Cont'd)

Flow Measurements (Cont'd)

Observations by Mr. A. Southmayd and Mr. I. Collin in the month of July, 1709 indicated that the current in the Gut reached a velocity of 6 knots. They also recorded the width of the Gut as 75 metres. The only reference to the depth of the channel was that it was sufficient for any laden vessel of the time.

Water Level Measurements

To develop an estimate of the relationship of the water levels in the arms, simultaneous water surface elevations were taken at 4 stations through the Narrows at regular intervals of the tidal cycle. These measurements were used in verifying the timing of the tidal water level gauges and the magnitude of the attenuation and time lag between Swan Arm and Northeast Arm. The locations of these stations are shown on Drawing 1. The results are shown in Figure 2. It can be seen that there is a time lag of approximately 1 hour in flood crests when comparing the elevations at the Gut and in Swan Arm.

3.4 STRUCTURES

There are several existing structures that could possibly influence the transport of sediment or flow patterns in the Placentia area.

Spanning the Gut is a steel lift bridge built in 1960. The bridge structure is shown in Photo 20 and is detailed in Figure 3. The two main bridge piers are constructed of steel sheet piles filled with concrete. The abutments are reinforced concrete blocks founded on steel piling.

3.4 STRUCTURES (Cont'd)

On the northern end of the beach to the west of Placentia, two timber crib groins were constructed in 1983 (Photo 21). The installation of these groins was recommended by Woodward Clyde Consultants in their 1982 report on the "Hydraulic and Physical Character of Placentia in Relation to the Fishing Industry". The purpose of the groins was to trap the sediment moving northwards along the beach towards the Gut and thereby reduce the amount of silt and sand being carried through the Gut and eventually into the Narrows and Northeast Arm. The effectiveness of these groins has not been established but it can be seen that transported material has been deposited on the south side of each structure.

On the east side of Placentia at the northern end of the Narrows, there is a piled timber wharf. (Photo 22). This wharf served as the main tie up facility for the larger boats that transported general cargo over the decades. From the southern end of this structure a timber breastwork extends southward along the full length of the Narrows to Swan Arm (Photo 1). This structure was built approximately 15 years ago and now serves as a berthing area for small open boats and small long liners. The area bounded by the breastwork had been filled in over the years prior to its construction. Residents in the area have noted the boundaries of the original channel which indicate that infilling has reduced the channel width by up to 30 metres in some places.

PART FOUR
OCEANOGRAPHIC MONITORING

4.1 GENERAL

This aspect of the field program included recording the wind speed and direction, atmospheric pressure, the air temperature, the water level and wave height for a monitoring period of one complete tidal cycle during November/December 1983. In addition, spot measurements were made of current velocity, water temperature and conductivity. The locations of these data acquisition points are shown on Drawing 1. The ultimate objective of this oceanographic monitoring was to calibrate the hydraulic model to be used to mathematically represent the physical parameters at Placentia.

4.2 INSTRUMENTATION

The instrumentation chosen to measure and record the atmospheric data (ie. maximum and average wind speed, direction, air pressure and temperature) was the Aanderaa Automatic Weather Station (See Figure 4). A separate sensor was used to measure each parameter at 10 minute intervals. The data, recorded on 1/4 inch magnetic tape, was processed and the information was analyzed using computer programs and archived in computer files. The sensing unit was bolted to the top section of the Sir Ambrose Shea lift bridge (Photo 23).

Sea data instruments were chosen to measure the conditions in the water. Three TDR-2A tide gauges with temperature and pressure sensors were located in the study

4.2 INSTRUMENTATION (Cont'd)

area; one in Northeast Arm in the vicinity of the bridge, one in Southeast Arm, and one in Swan Arm. This data was processed into water level information at five minute intervals. A Sea Data 635-11 wave and tide recorder was moored in Placentia Road to provide information on the wave climate and water level fluctuations in this area. This instrument also used pressure and temperature sensors to measure the high frequency fluctuations in water level (waves) and also the lower frequency cycles (tides). These Sea Data instruments, and their mooring configurations, are shown schematically in Figure 5. The advantage of using pressure sensitive instruments located on the sea floor is that they are less susceptible to malfunction due to interference from severe sea states, ice, or public mischief. The necessary condition of positioning the instruments in a location at which the density of the water column did not vary significantly was taken into consideration when the instrument sites were chosen.

4.3 EQUIPMENT DEPLOYMENT AND RECOVERY

The original deployment program was scheduled to be carried out during the first week in November 1983. Due to equipment acquisition delays, the work in the field was ultimately performed between November 14 and November 17, 1983. The deployment team consisted of Peter Chandler and one diver. In addition a locally hired boat and operator assisted in the deployment operation.

4.3

EQUIPMENT DEPLOYMENT AND RECOVERY (Cont'd)

The instruments were commissioned and deployed at the following times:

<u>Instrument</u>	<u>Commissioned</u>	<u>Deployed</u>
TDR-2A-S/N243	2130 - Nov. 15/83	1100 - Nov. 16/83
TDR-2A-S/N244	2130 - Nov. 15/83	1130 - Nov. 16/83
TDR-2A-S/N146	2130 - Nov. 15/83	1230 - Nov. 16/83
635-11-S/N113	2200 - Nov. 15/83	1630 - Nov. 16/83
Weather Station	1130 - Nov. 16/83	1130 - Nov. 17/83

The equipment was recovered on December 14 and December 15, 1983. The recovery team consisted of Brian Garrett and one diver, assisted by a locally hired boat and operator.

The instruments were recovered and decommissioned at the following times:

<u>Instrument</u>	<u>Recovered</u>	<u>Decommissioned</u>
TDR-2A-S/N243	1042 - Dec. 14/83	1034 - Dec. 15/83
TDR-2A-S/N244	1030 - Dec. 14/83	1027 - Dec. 15/83
TDR-2A-S/N146	1108 - Dec. 14/83	1043 - Dec. 15/83
635-11-S/N113	1400 - Dec. 14/83	0958 - Dec. 15/83
Weather Station	1800 - Dec. 14/83	0943 - Dec. 15/83

APPENDIX I

TABLES

TABLE 1

PERSONS INTERVIEWED

Mr. William Barron, Businessman, Placentia
Mr. William Brennan, Department of Transportation & Communication
Mr. Felix Collins, Mayor, Town of Placentia
Mr. John Careen, Resident, Placentia
Mr. Nick Careen, Placentia Area Development Association
Mr. G. Eveley, P. Eng., Small Craft Harbours
Ms. Edna Hall, Parks Canada
Mr. Joe Kelly, Town Clerk, Placentia
Ms. Margret Kelly, Hotel Operator, Placentia
Mr. R. Kennedy, P. Eng., Delcan
Mr. Jerome Kerivan, Resident, Jersyside
Mr. Leo Kerivan, Resident, Jersyside
Mr. R. Kielly, P. Eng., Delcan
Mr. Doug Manning, Businessman, Placentia
Mr. Leonard Miller, Former Mayor, Placentia
Mr. Maurice Murray, Fire Chief, Placentia
Ms. Veronica Murray, Resident, Jersyside
Mr. Eldon Oja, Environment Canada
Mr. Leo Palmeroy, Resident, Placentia
Mr. David Patterson, Businessman, Placentia
Mr. William Patterson, M.H.A., Placentia
Mr. William Patterson, Businessman, Placentia
Mr. S. Pearson, P. Eng., Department of Transportation and
Communication
Mr. J. Simmons, P. Eng., Newfoundland Light & Power
Ms. Bobbie Robertson, Newfoundland Historic Trust
Mr. J. Tennant, Department of Municipal Affairs
Mr. Raymond Whelan, Resident, Jersyside
Mr. T. Whelan, P. Eng., Former Resident, Jersyside

TABLE 2

CONDITIONS EXISTING DURING PREVIOUS FLOODS

DATE

CONDITION	Jan. 20/21 1977	Jan. 10 1982	Jan. 17 1982	Dec. 22 1983	Dec. 25 1983
Time	Not Known	10 am to 1pm	11pm to 1am	11 am	Noon
Lunar Cycle	New Moon	Full Moon	Last Quarter	New Moon	Last Quarter
Wind Direction	Not Available	SSW	SW	NNW	SSW
Wind Velocity (Knots)	Not Available	50 Knots Gusting to 75	45 Knots Gusting to 58	30 Knots Gusting to 40	50 Knots Gusting to 70
Atmos. Pressure (Millibars) (Normal = 1013 mb)	Not Available	976	964	1013	963
Max. Water Level (MWL) in metres (geodetic)	Not Available	1.7	Variable	1.9	1.7
Predicted MWL for Time of Event (geodetic)	0.9	1.1	1.0	1.0	0.7
Predicted MWL for Month (geodetic)	0.9	1.1	1.1	1.0	1.0
Date of Predicted MWL for Month	Jan. 19/20	Jan. 10/11	Jan. 10/11	Dec. 21	Dec. 21
Fresh Water Inflow (NE River)				1.15m ³ /s	1.55m ³ /s

APPENDIX II

PHOTOGRAPHS

(For Photograph Locations See Drawing 3)



Photo No. 1

The Narrows with Swan Arm in background.

Date: November, 1983



Photo No. 2

Eastern side of Placentia looking south from lift bridge.

Date: November, 1983



Photo No. 3

Riverside Drive adjacent to the Narrows looking north.

Date: January 10, 1982



Photo No. 4

Riverside Drive adjacent to the Narrows looking south.

Date: January 10, 1982



Photo No. 5

Seawall adjacent to Battery on west side of Jersey side.

Date: November, 1983



Photo No. 6

Breastwork on southeast side of Jersey side.

Date: November, 1983



Photo No. 7

Placentia Cottage Hospital.

Date: January 10, 1982



Photo No. 8

Anglican Church and Cemetery.

Date: January 10, 1982



Photo No. 9

Flynn Street looking east.

Date: January 10, 1982



Photo No. 10

Blenhelm Street looking east. Circa 1960.



Photo No. 11

Blockhouse Road near Aylward's Mall.

Date: January 17, 1982



Photo No. 12

Seawall along beach on west side of Placentia.

Date: October, 1983

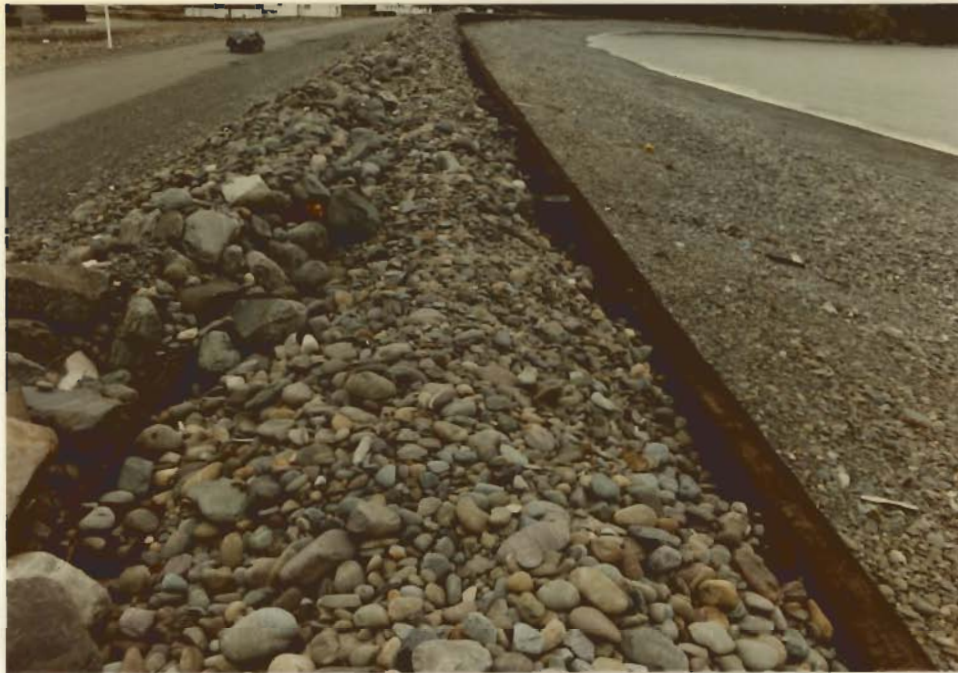


Photo No. 13

Seawall with ballast adjacent to Beach Road, on west side of Placentia.

Date: October, 1983



Photo No. 14

Newfoundland Light & Power substation south of lift bridge.

Date: December 22, 1983



Photo No. 15

Backyards between Roache Street and Blenheim Street
behind Manning's Pharmacy.

Date: December 22, 1983



Photo No. 16

Junction of Flynn Street and Banker's Road looking
east.

Date: December 22, 1983



Photo No. 17

Blenhelm Street adjacent to Manning's Pharmacy.

Date: December 22, 1983



Photo No. 18

Swan's Road at intersection of Jubilee Road and Riverside Drive South looking toward Dixon Hill. Water level shown has receded from the maximum attained.

Date: December 22, 1983



Photo No. 19

Lower floor of Manning's Pharmacy. Notice water level outside door which is below the maximum attained.

Date: December 22, 1983



Photo No. 20

Sir Ambrose Shea lift bridge looking Northwest.

Date: November, 1983



Photo No. 21

Groins on beach along west side of Placentia.
Notice the accumulation of material on south side
of groins.

Date: November, 1983



Photo No. 22

North end of Narrows and beach to southeast of lift bridge.

Date: November, 1983



Photo No. 23

Wind measurement instruments mounted on top of Sir Ambrose Shea lift bridge.

Date: November, 1983

APPENDIX III

FIGURES

Map of Placentia 1709

Tidal Water Levels

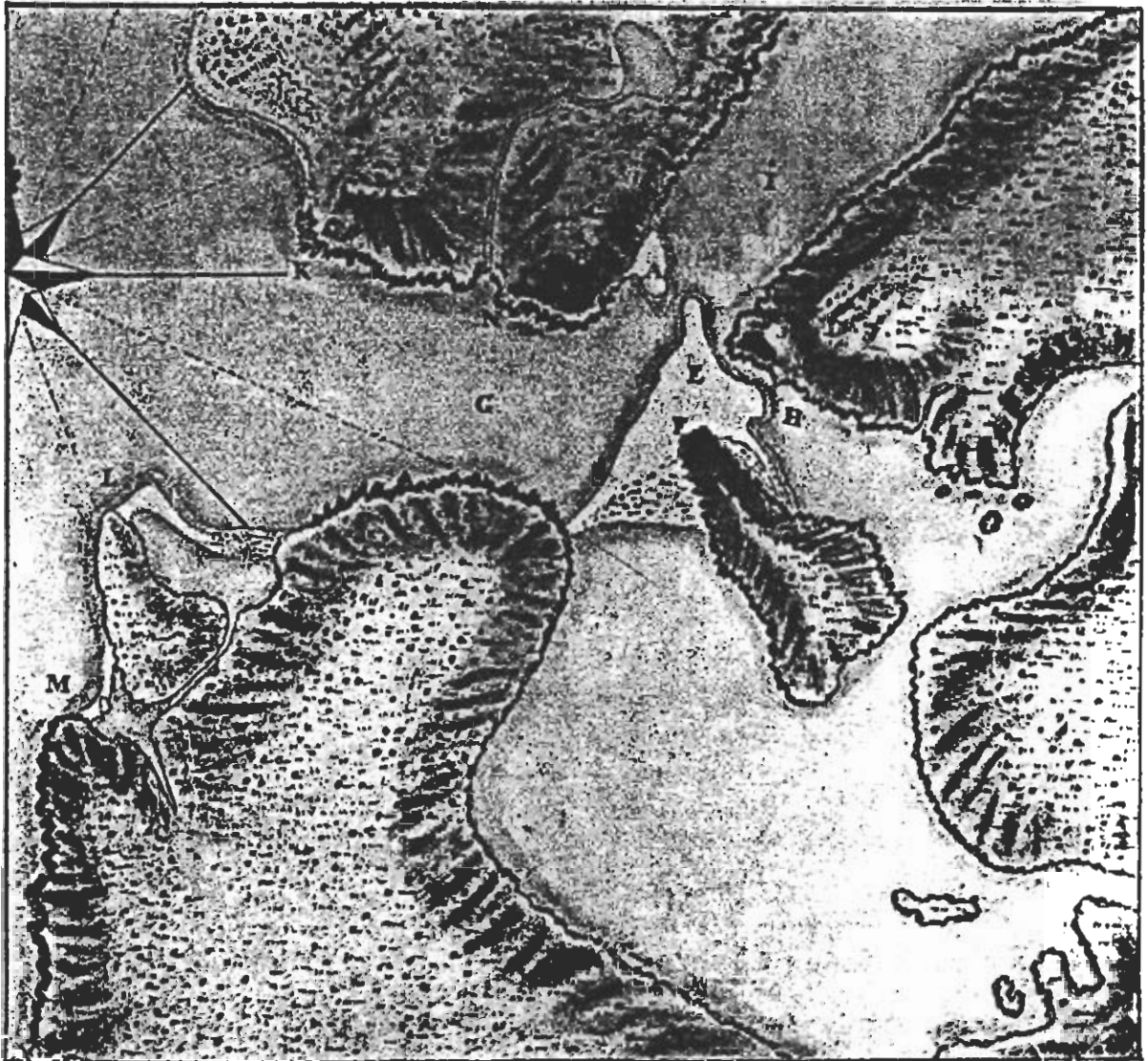
Sir Ambrose Shea Lift Bridge

Self Recording Weather Station

Water Level Measuring Instruments

Cross Sections from Field Survey

Map of Placentia 1709

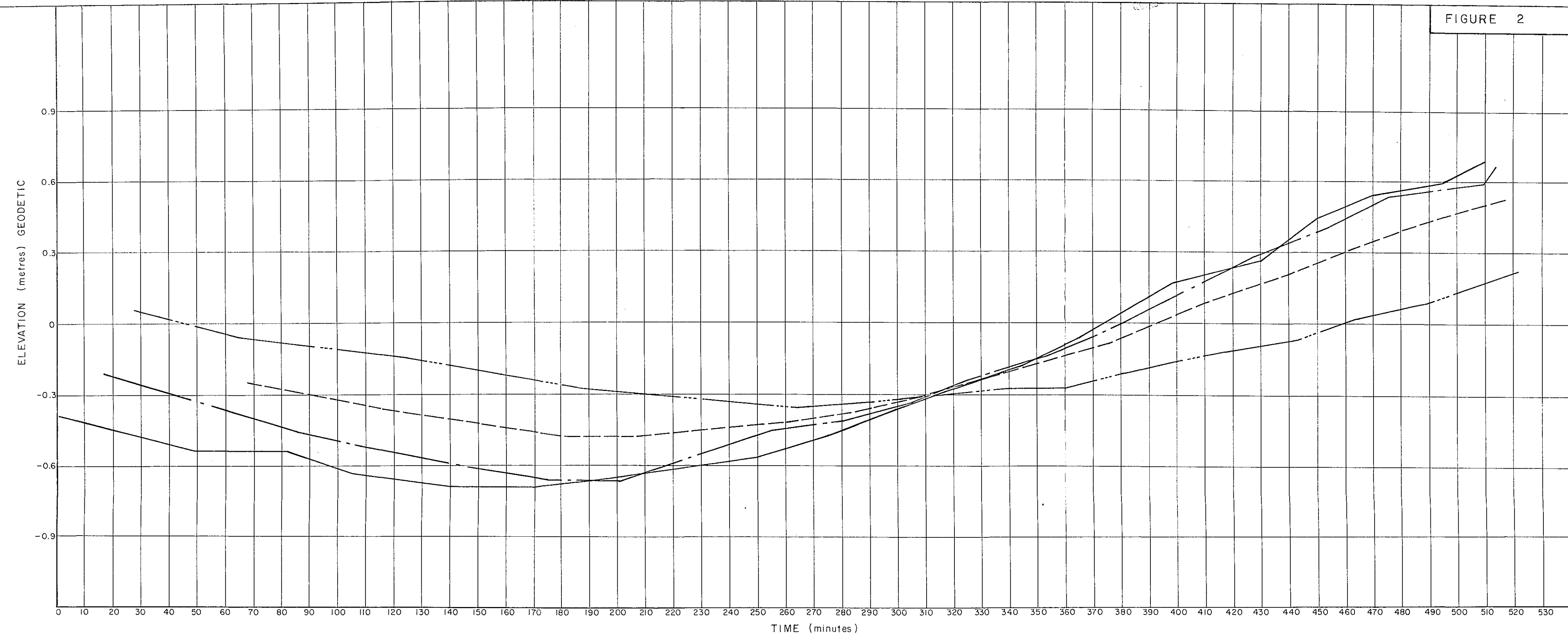


- A Position of the fort.
- B Redoubt mountain.
- C Gaillardin mountain.
- D Mountain known as the Old Fort.
- E The Great Beach.
- F Rocky promontory from which freestone was obtained.
- G The roads where the ships moored.
- H Entrance to the little bay known as Rivière d'Ascaigne.
- I Part of the harbour.
- K Crèvecoeur heights where there is a battery of 6 cannons:
4 of 12 pound balls and 2 of 24.
- L Pointe Verte.
- M Le Bergeron.
- N La Fontaine battery
- O Battery below the redoubt.

Source: Public Archives Canada

Figure 1

FIGURE 2



LEGEND

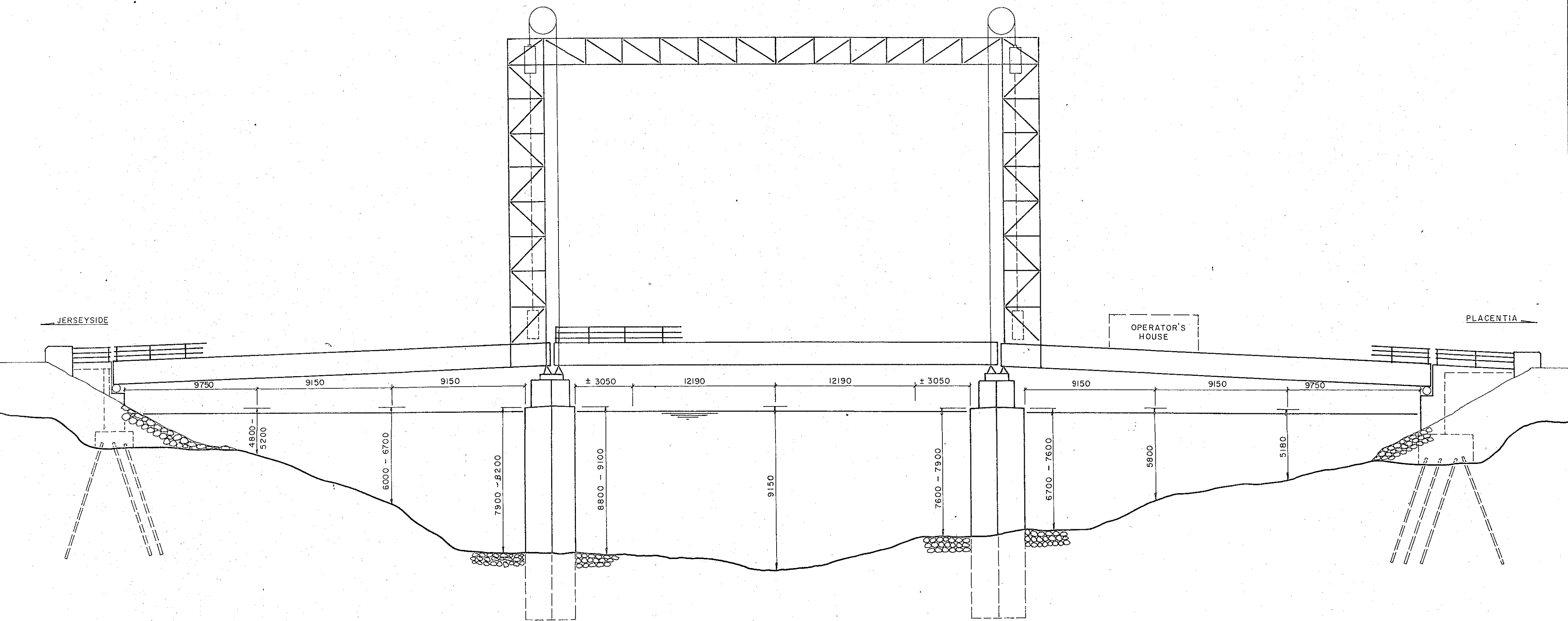
Station*

- BRIDGE
 - WHARF
 - END OF CHANNEL
 - FISHERIES & OCEANS
- * (FOR STATION LOCATIONS SEE DWG. 3)

TIDE FLUCTUATION vs TIME — PLACENTIA, NOV. 1, 1983

TIDAL WATER LEVELS

FIGURE 3



NOTE: SOUNDINGS DONE BY DEPARTMENT OF TRANSPORTATION,
BRIDGE INSPECTION DIVISION - NOVEMBER, 1983

SIR AMBROSE SHEA
LIFT BRIDGE

Self Recording Weather Station

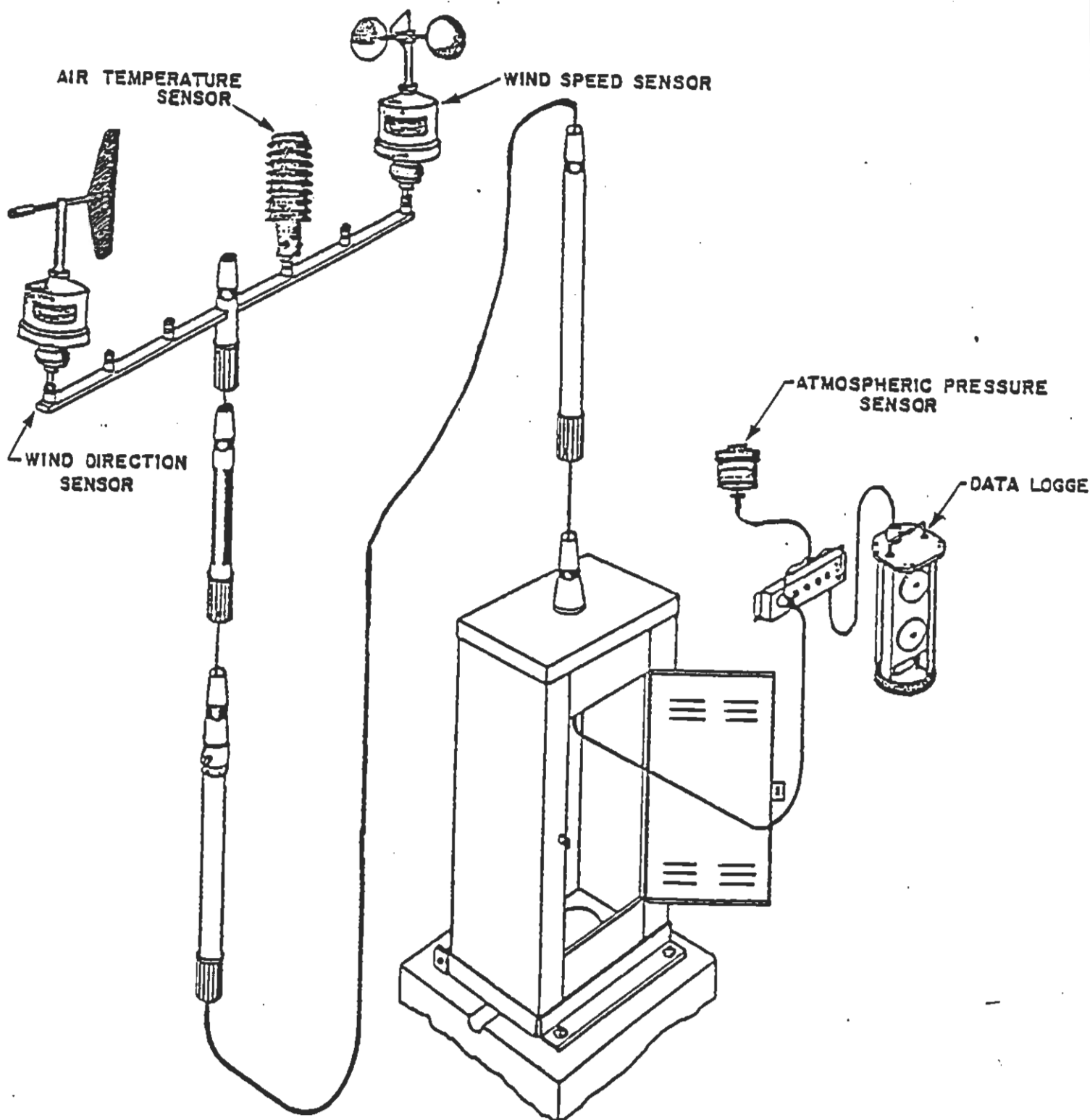
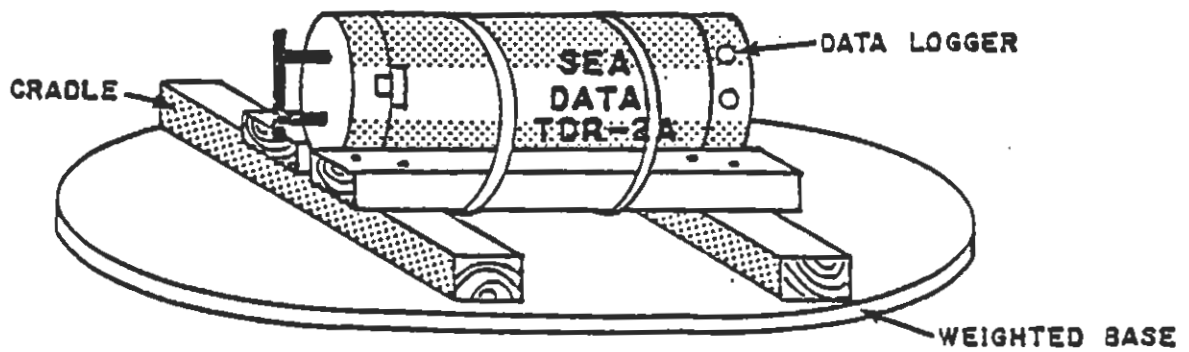


Figure 4

Water Level Measuring Instruments

TDR-2A WATER LEVEL RECORDER



635-11 WAVE AND TIDE RECORDER

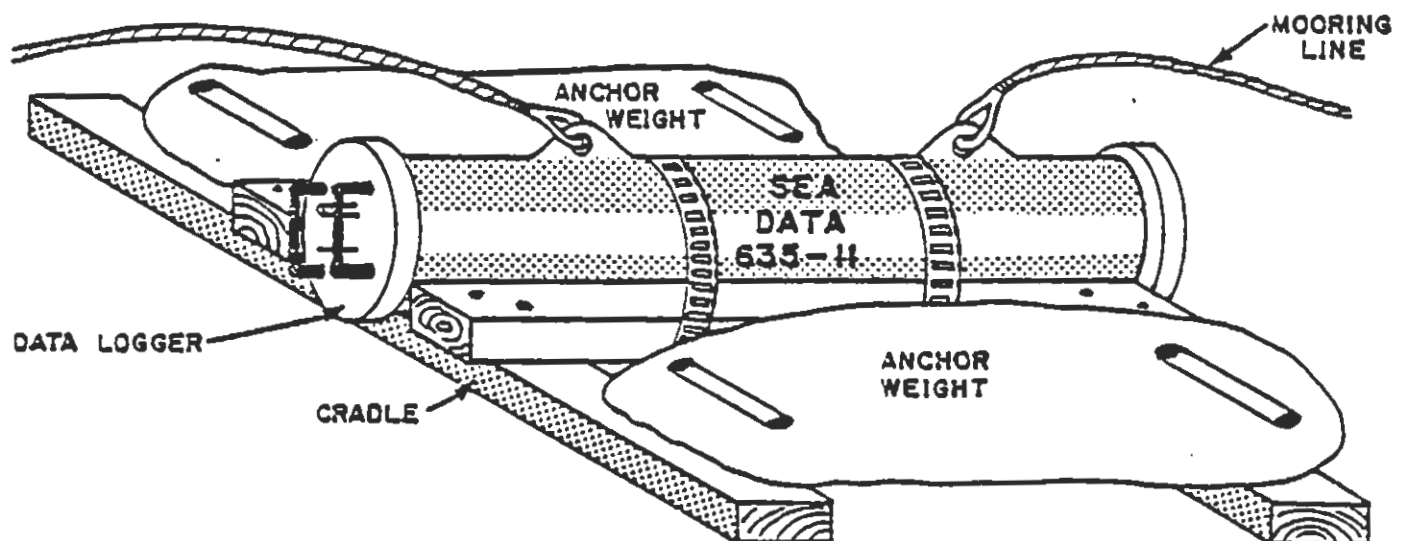
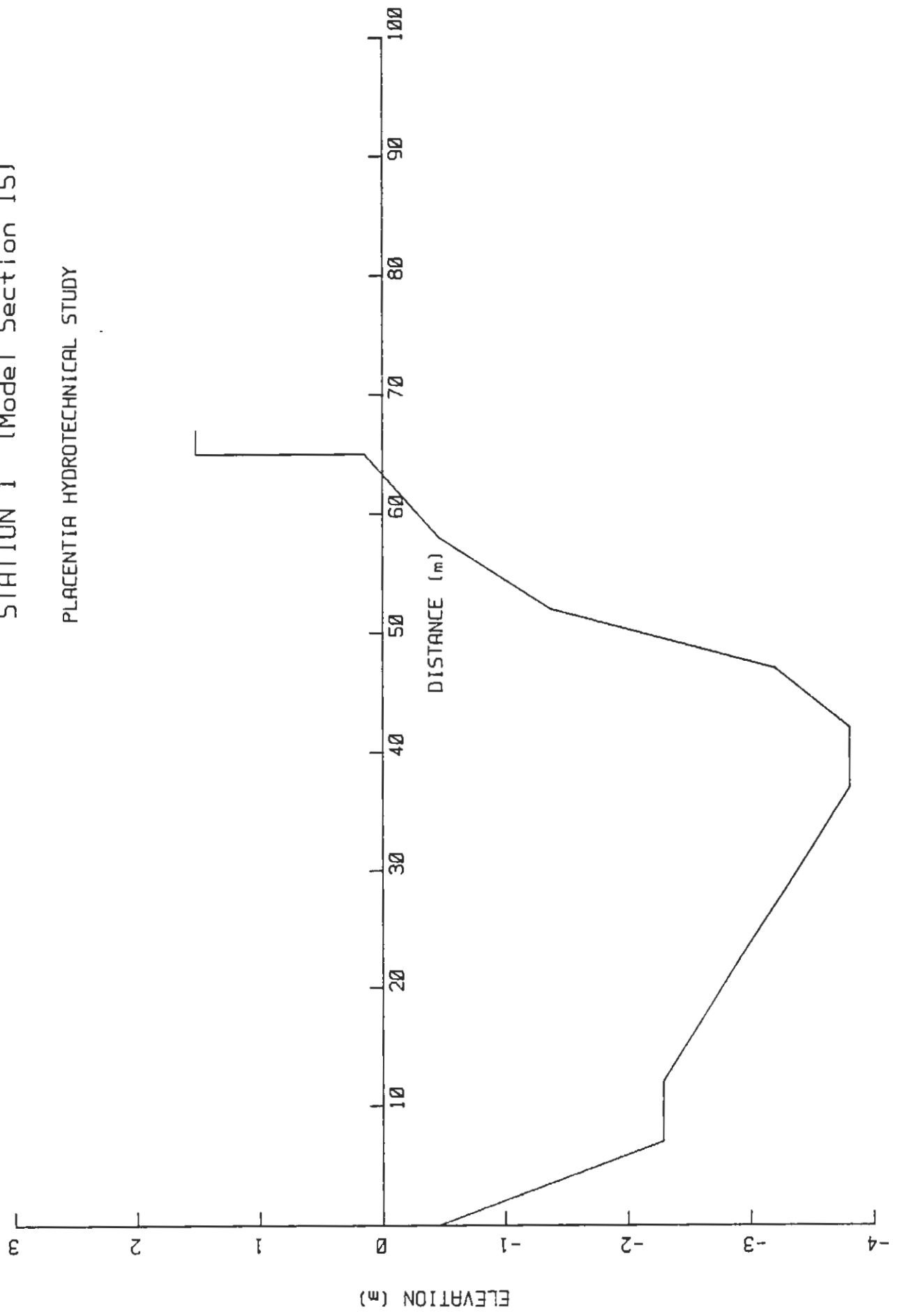


Figure 5

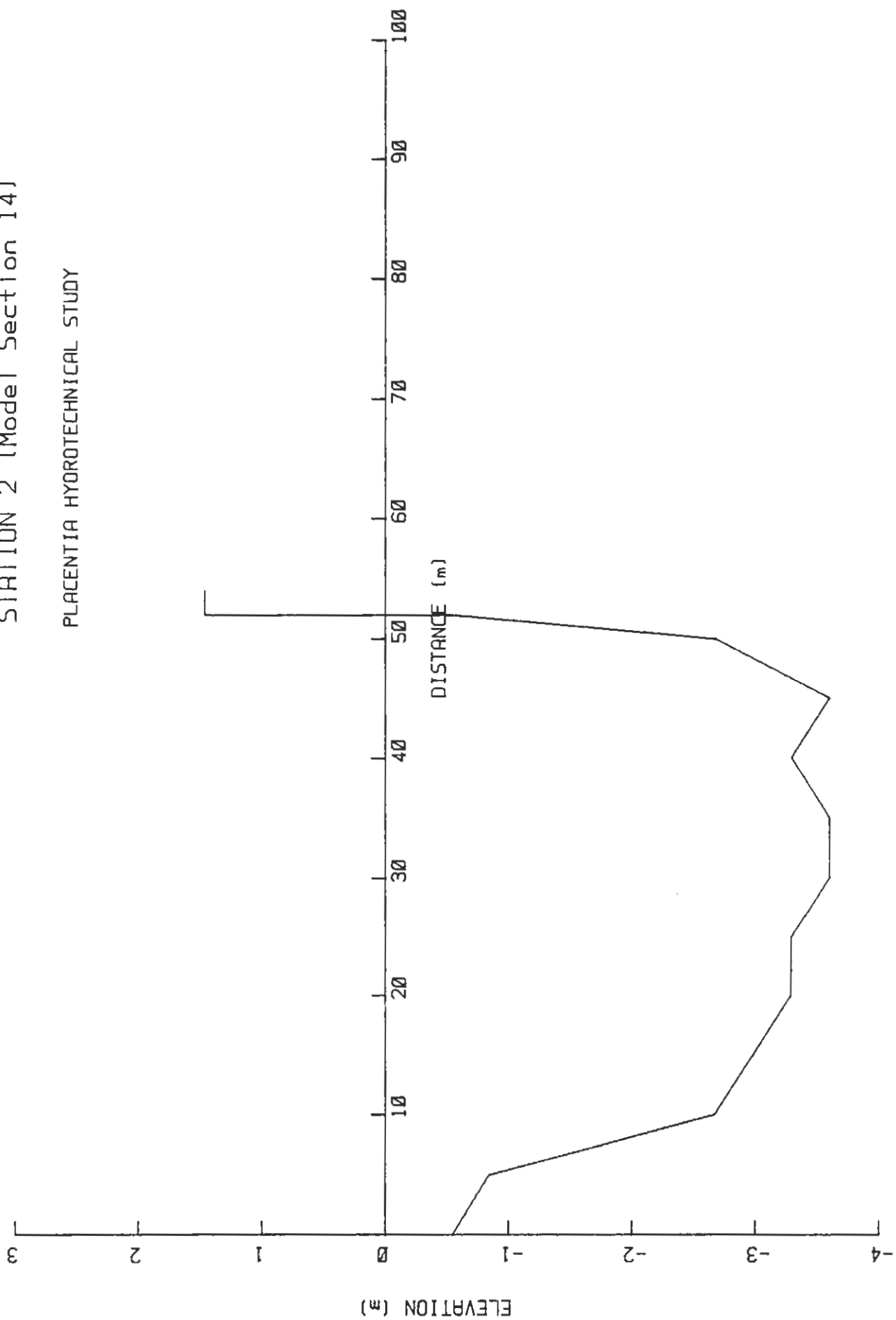
STATION 1 (Model Section 15)

PLACENTIA HYDROTECHNICAL STUDY

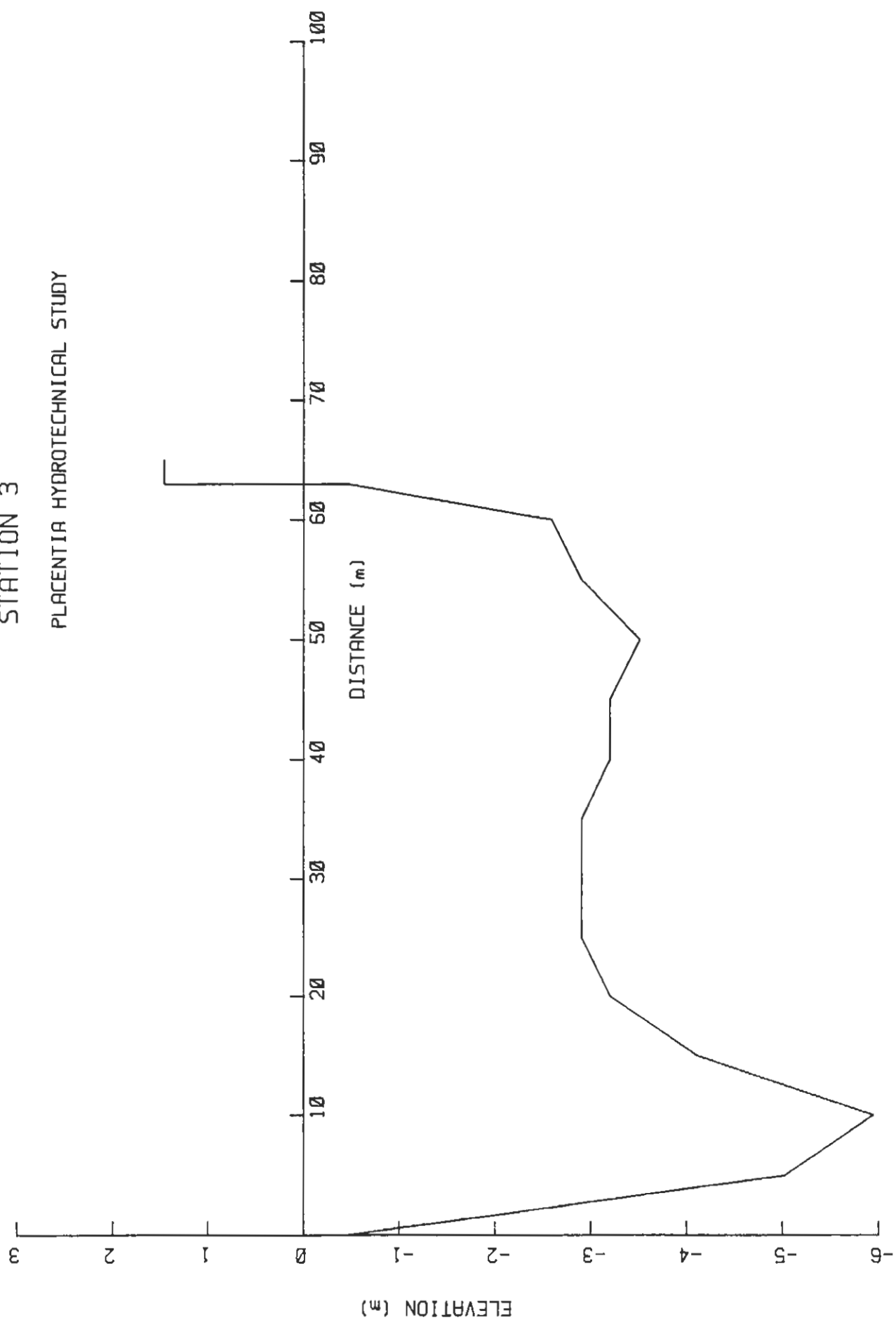


STATION 2 (Model Section 14)

PLACENTIA HYDROTECHNICAL STUDY

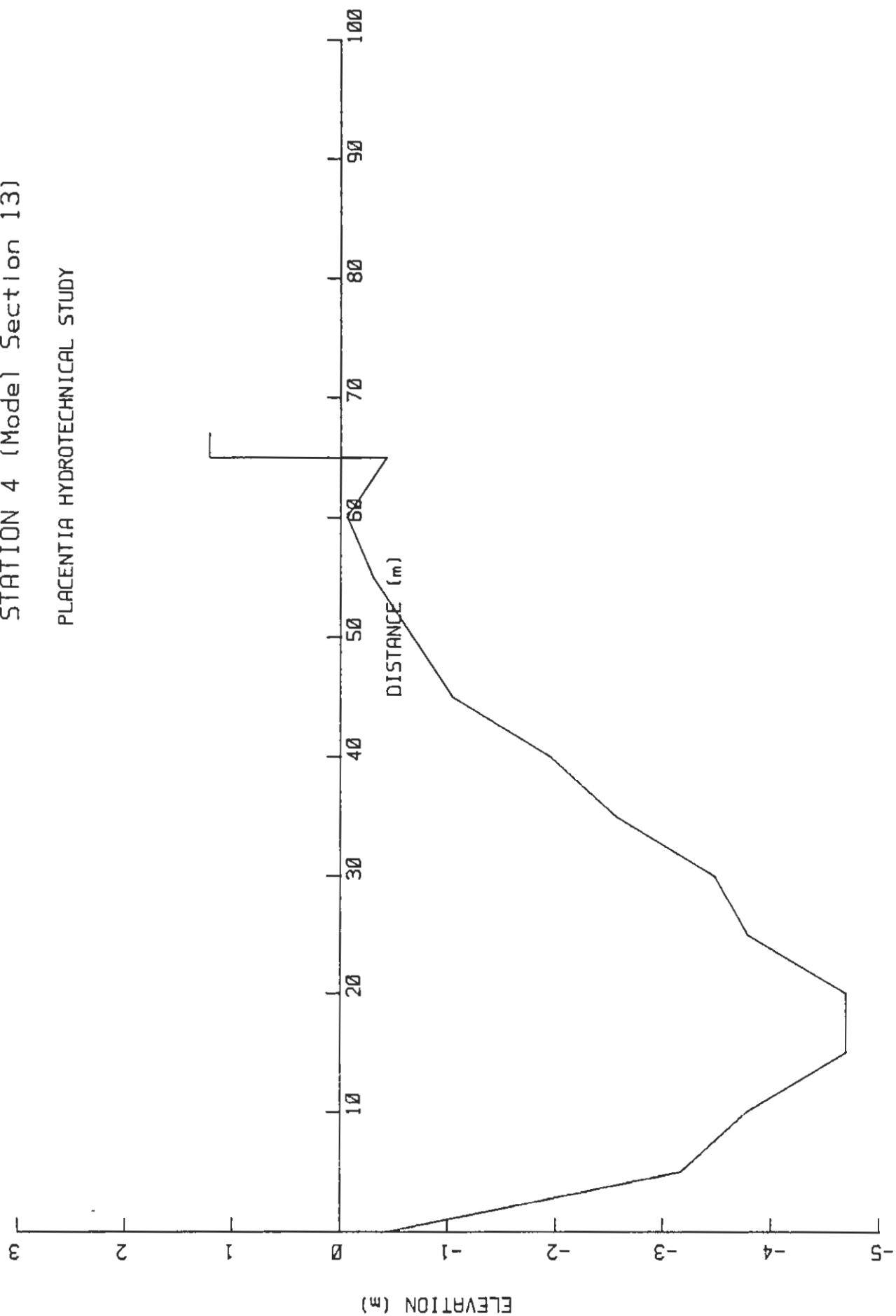


STATION 3
PLACENTIA HYDROTECHNICAL STUDY



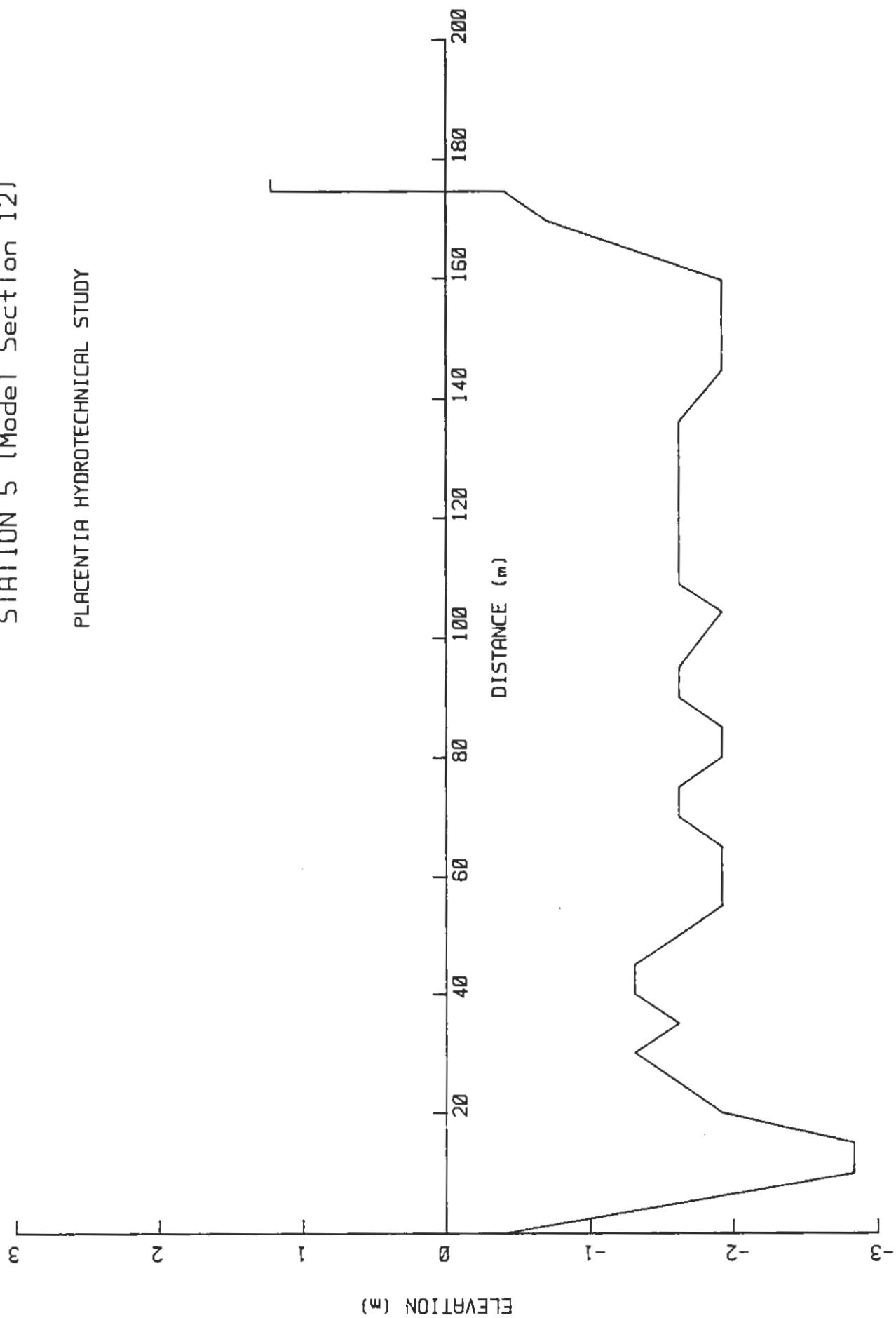
STATION 4 (Model Section 13)

PLACENTIA HYDROTECHNICAL STUDY



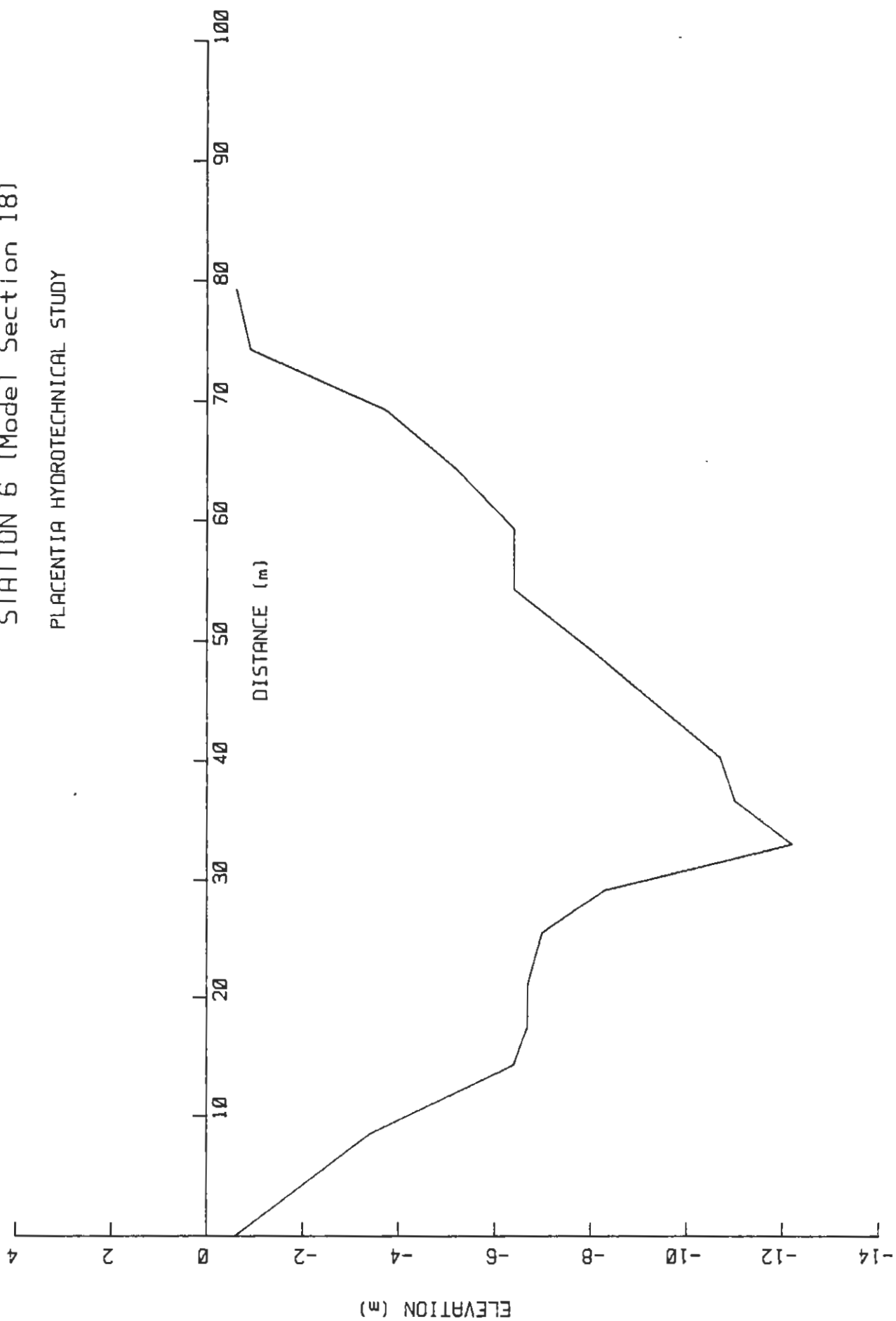
STATION 5 (Model Section 12)

PLACENTIA HYDROTECHNICAL STUDY



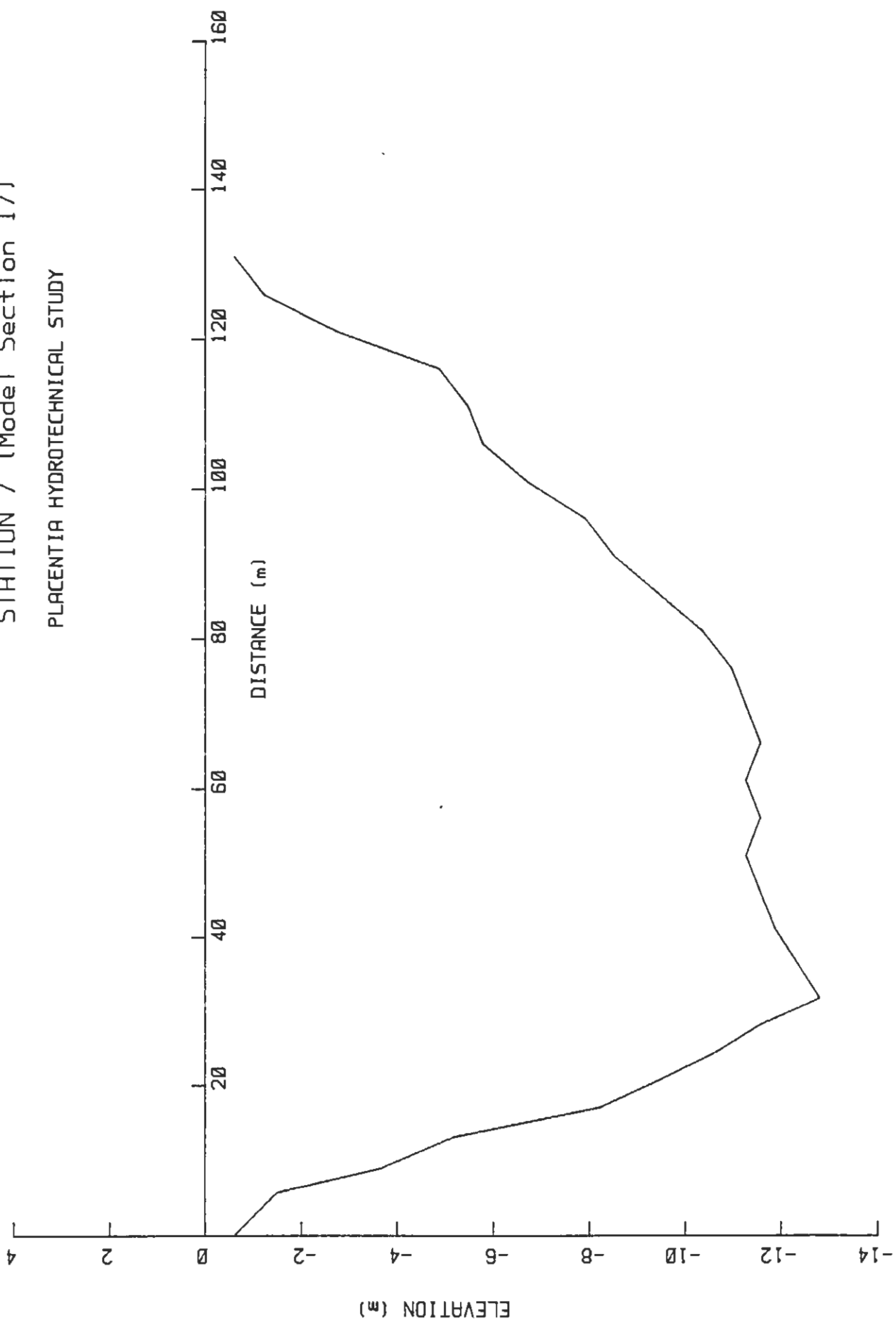
STATION 6 (Model Section 18)

PLACENTIA HYDROTECHNICAL STUDY



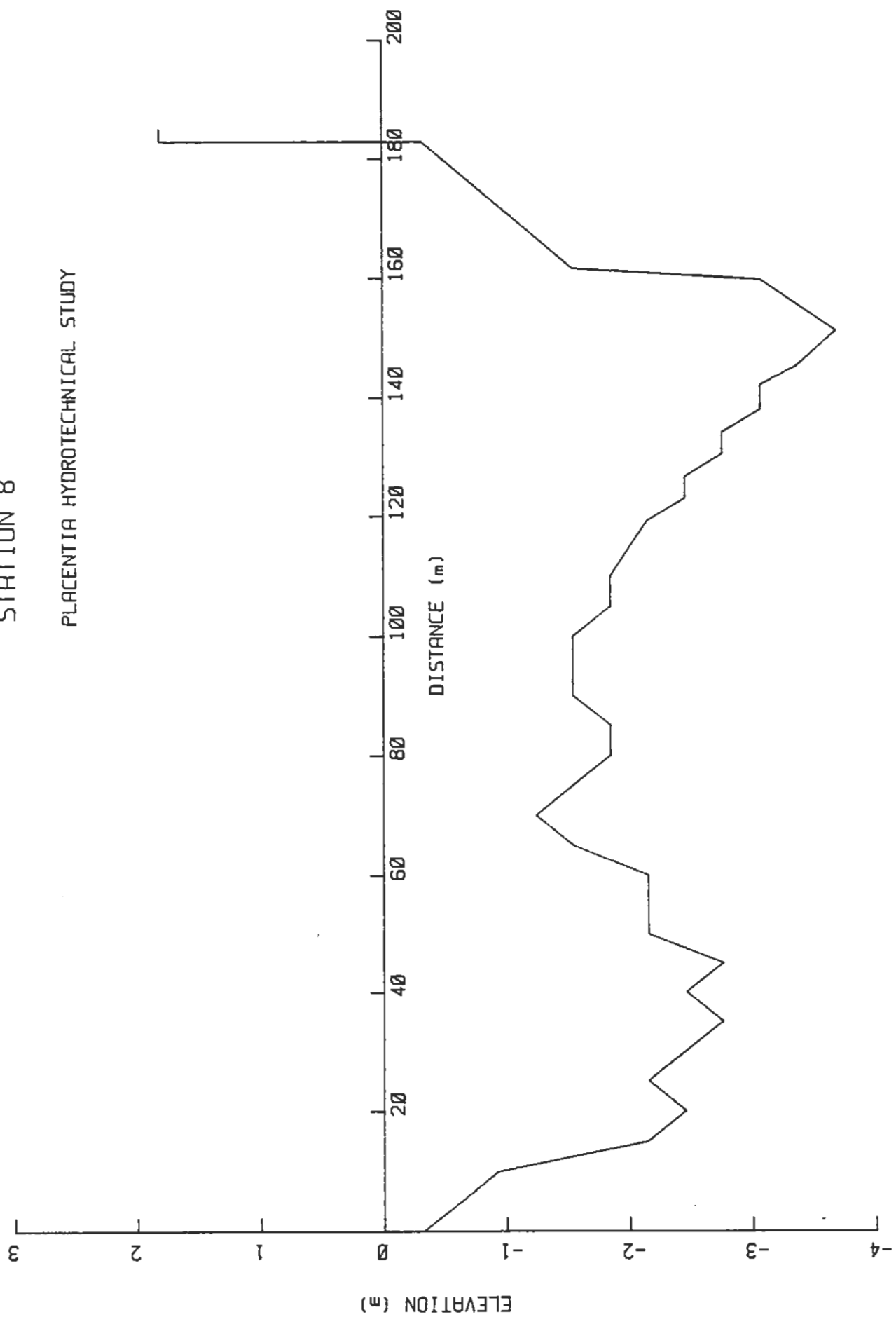
STATION 7 (Model Section 17)

PLACENTIA HYDROTECHNICAL STUDY



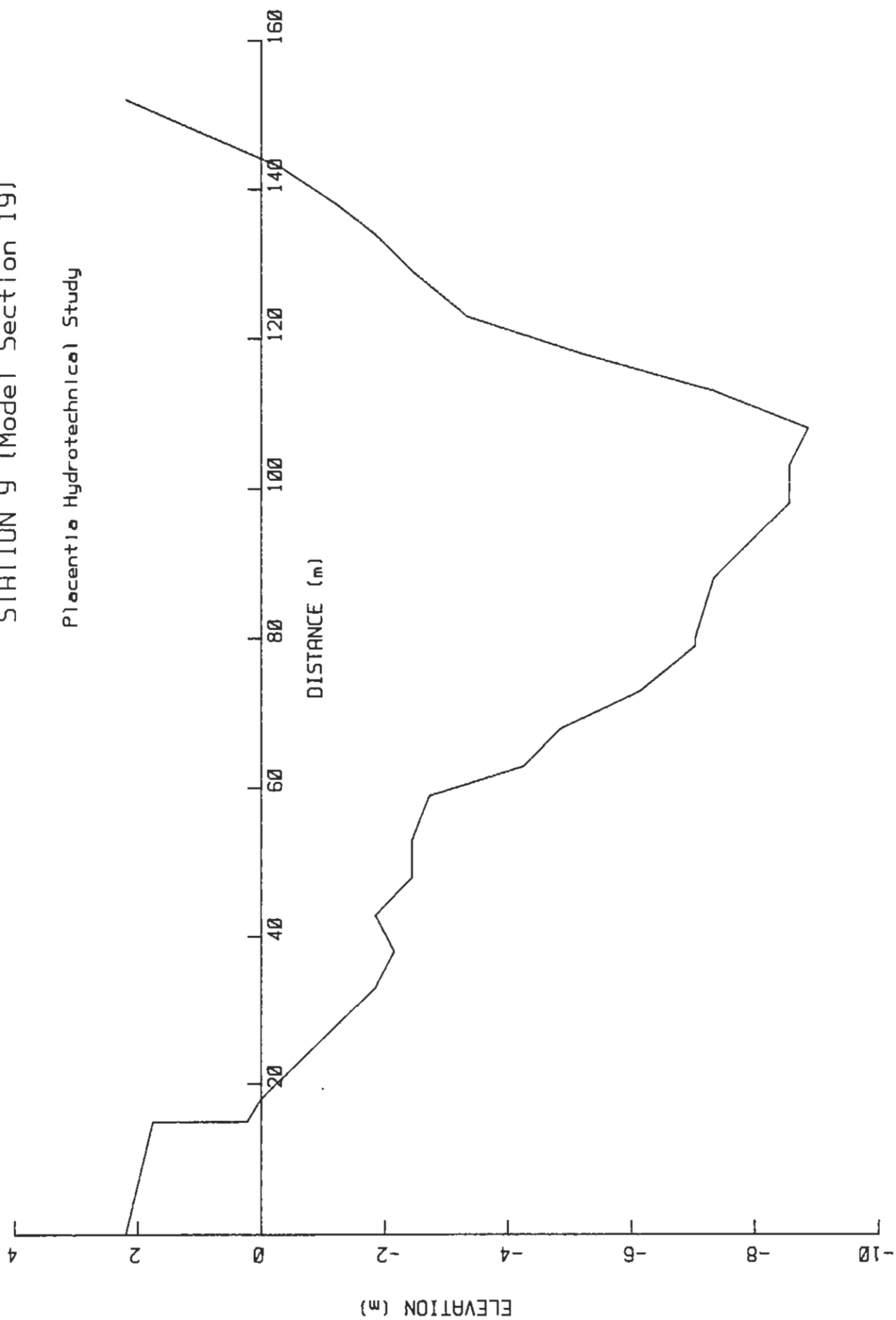
STATION 8

PLACENTIA HYDROTECHNICAL STUDY



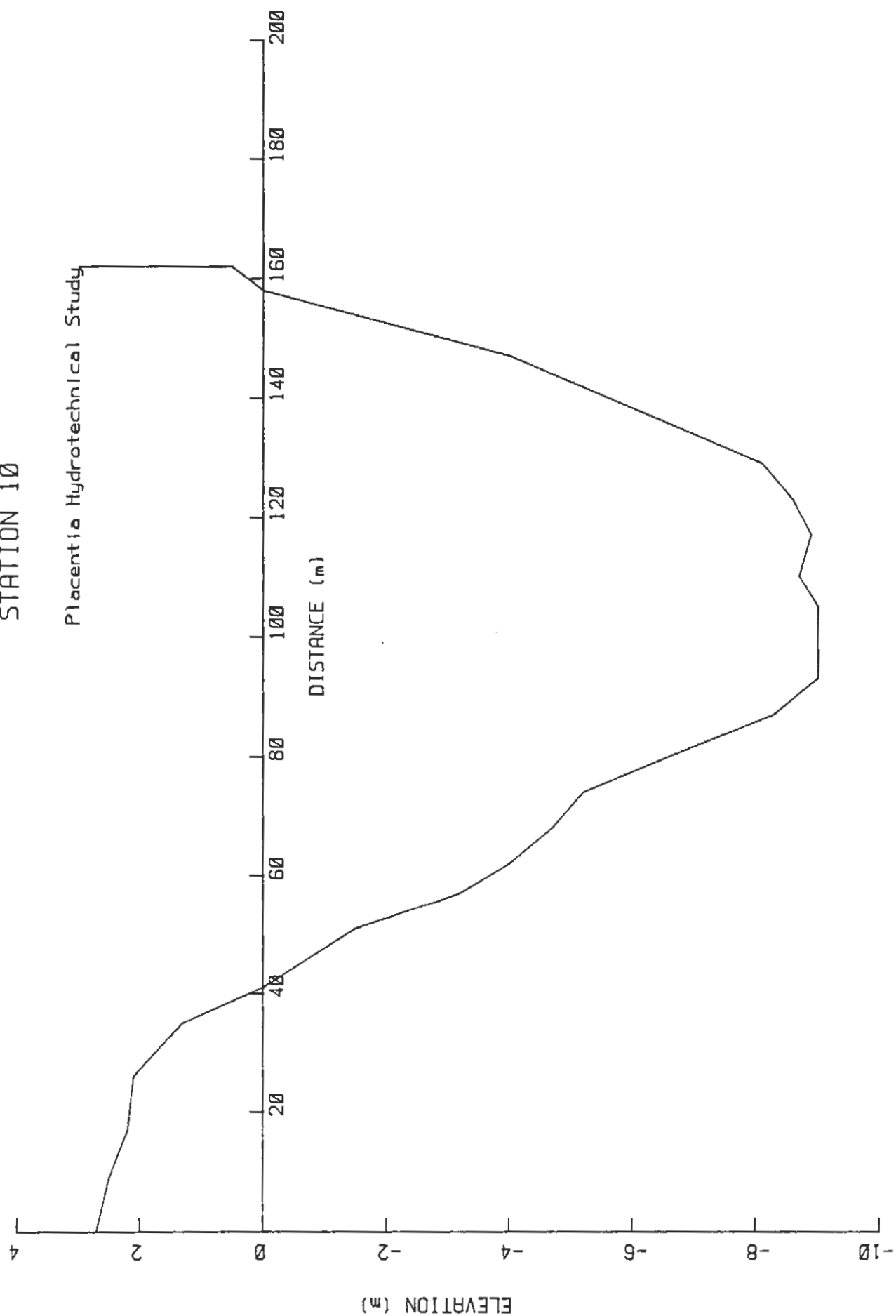
STATION 9 (Model Section 19)

Placentia Hydrotechnical Study

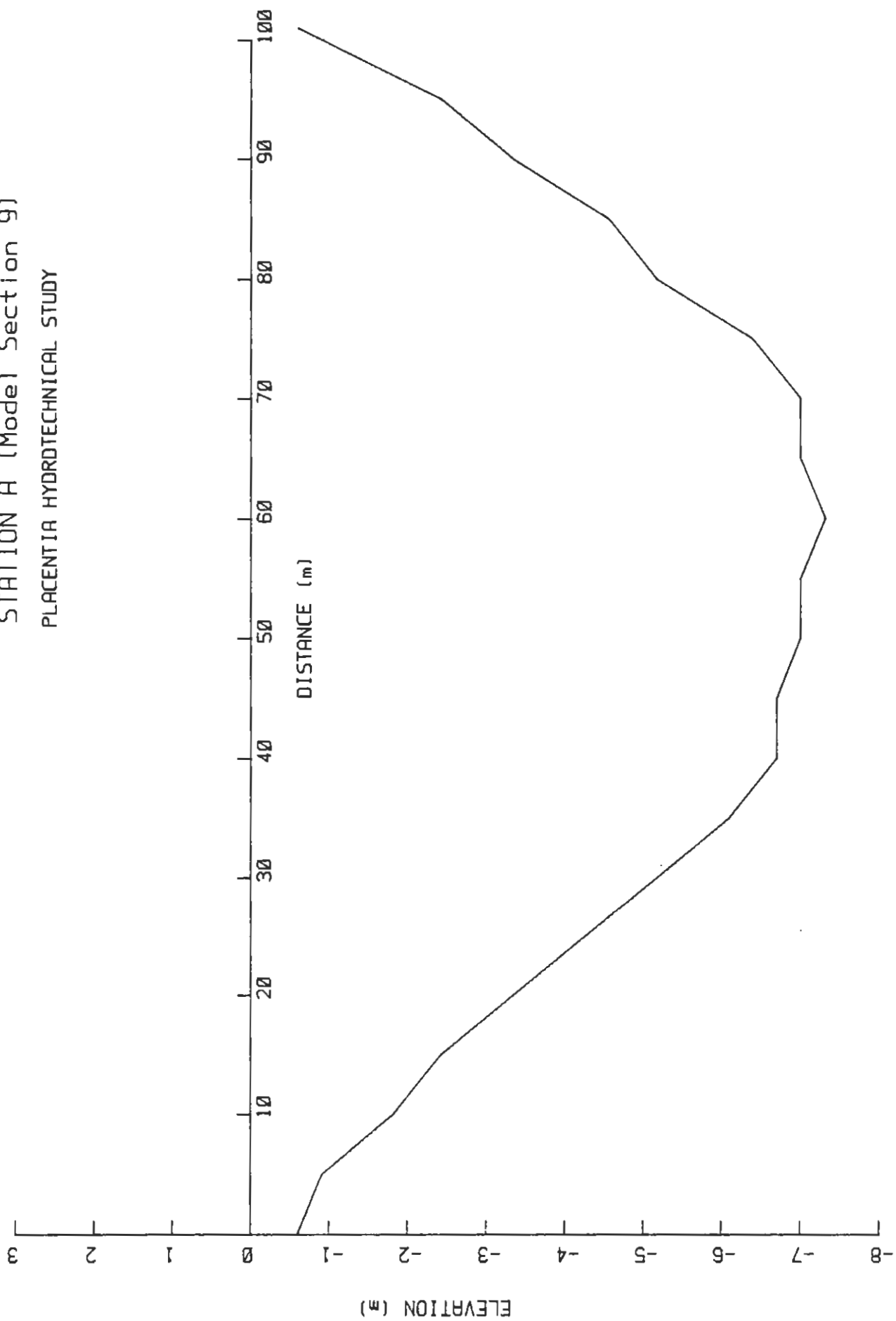


STATION 10

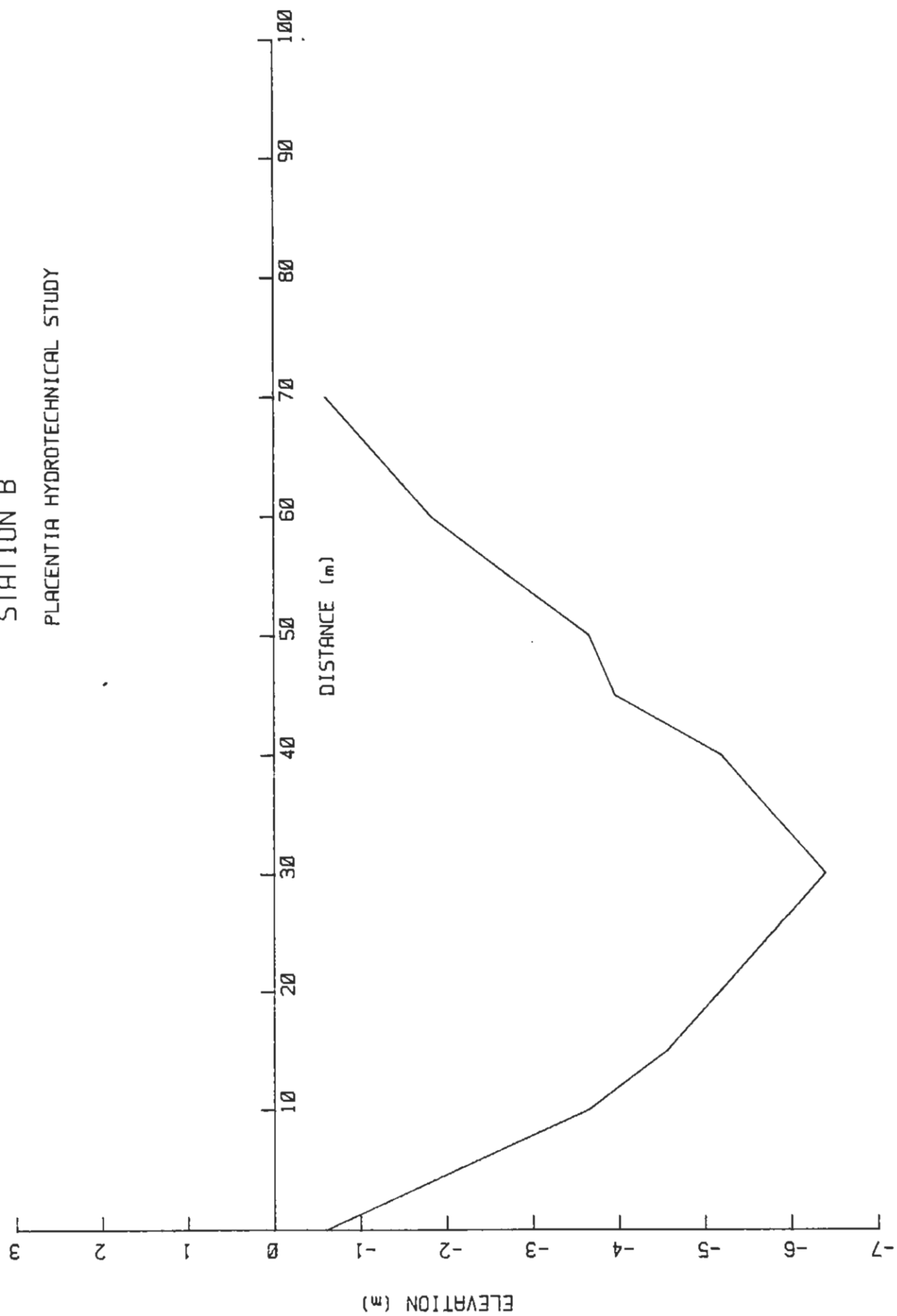
Placentia Hydrotechnical Study



STATION A (Model Section 9)
PLACENTIA HYDROTECHNICAL STUDY

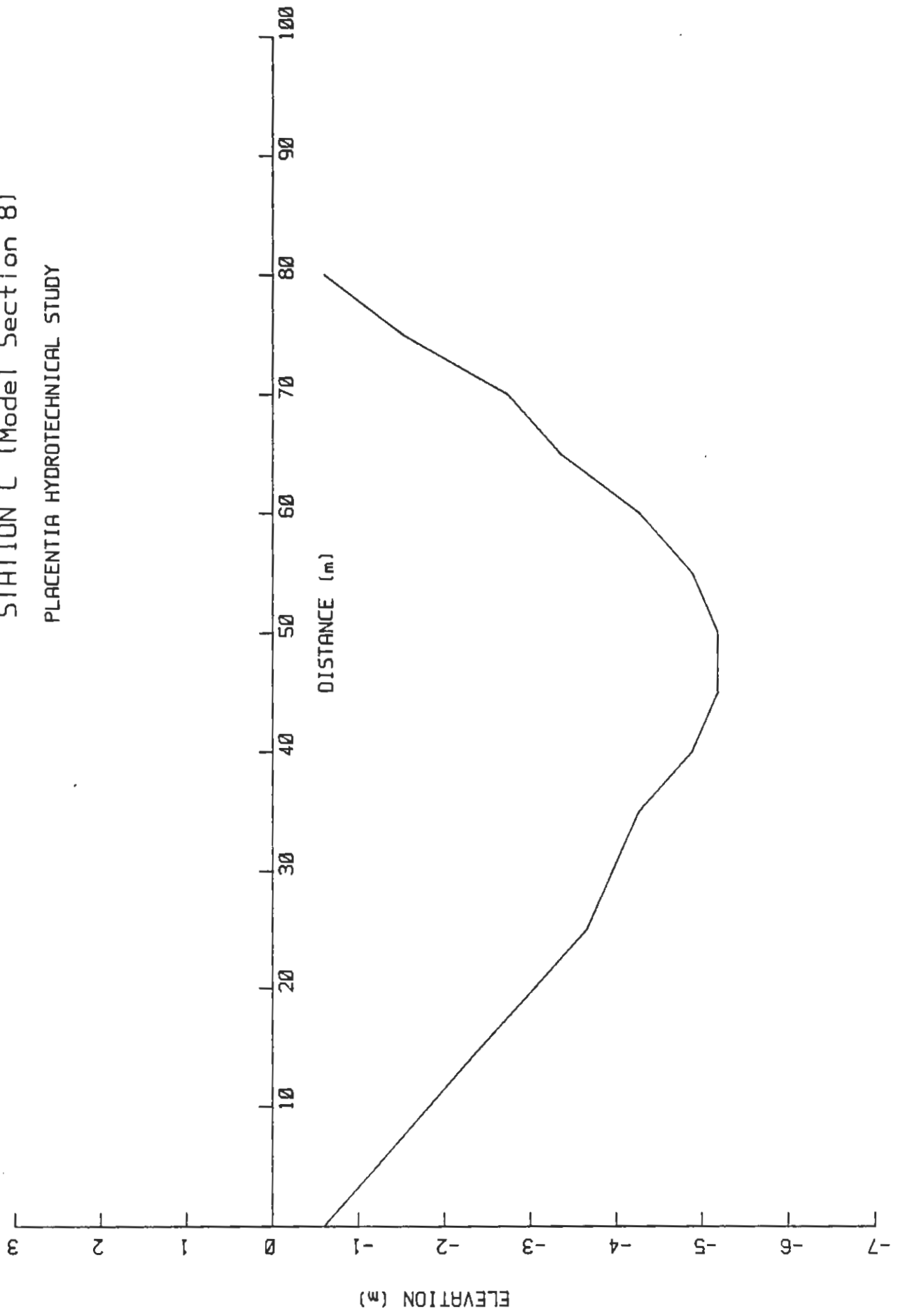


STATION B
PLACENTIA HYDROTECHNICAL STUDY



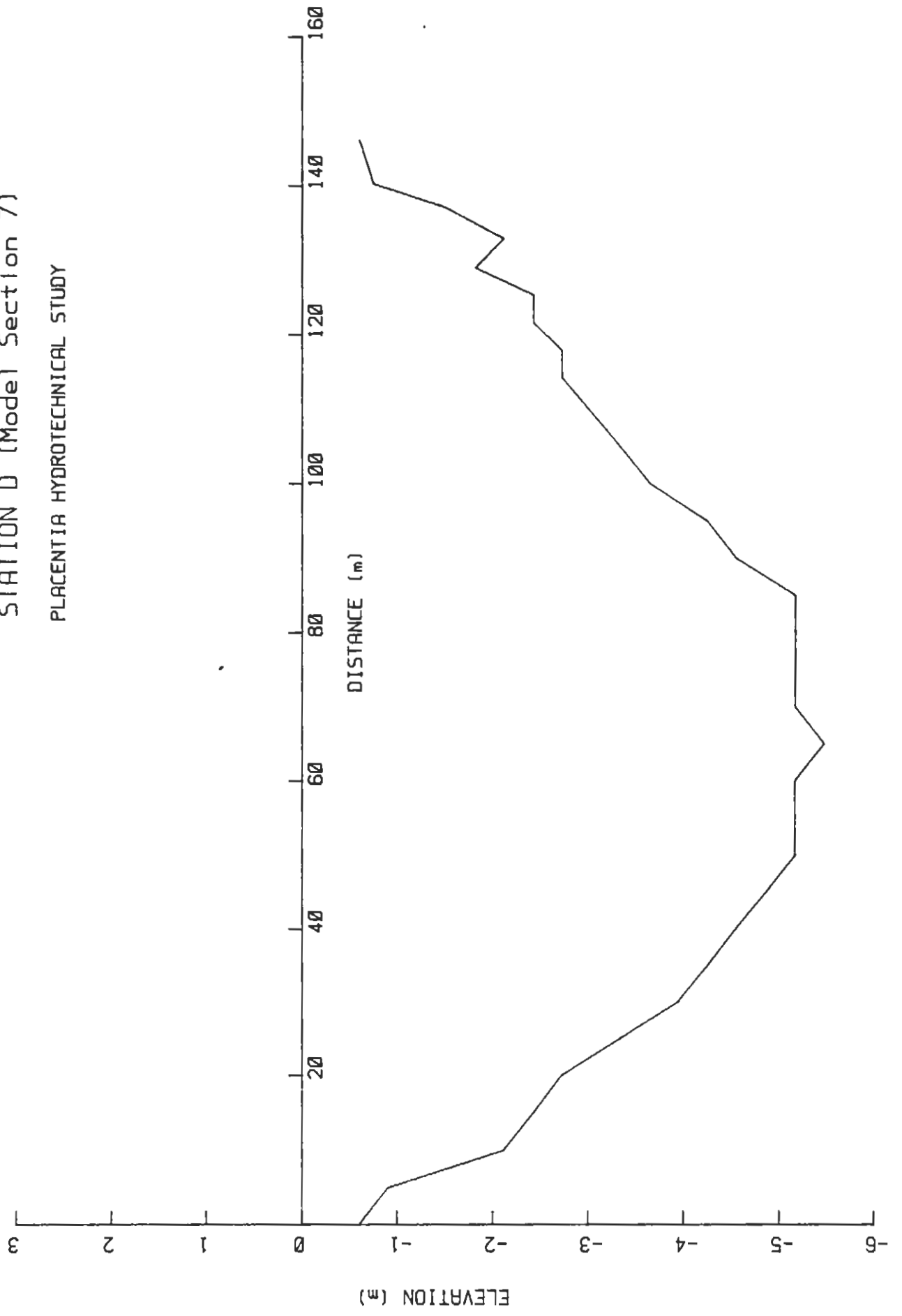
STATION C (Model Section 8)

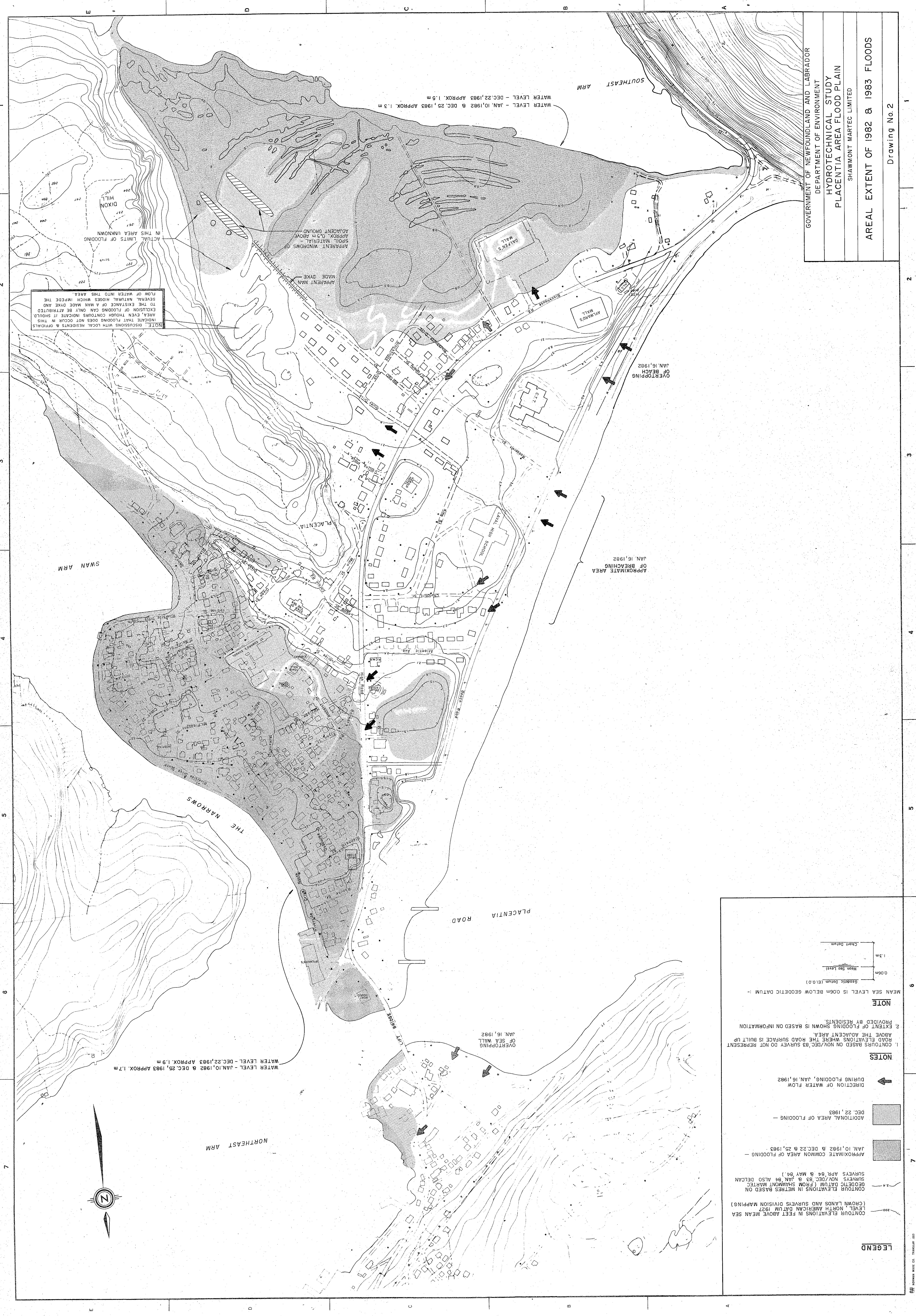
PLACENTIA HYDROTECHNICAL STUDY



STATION D (Model Section 7)

PLACENTIA HYDROTECHNICAL STUDY





LEGEND

CONTOUR ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (NORTH AMERICAN DATUM 1927)

CONTOUR ELEVATIONS IN METERS BASED ON GEODETIC DATUM (FROM SHAWMONT MARTEC SURVEYS APR. 84 & MAY 84)

SURVEYS NOV/DEC 83 & JAN 84 ALSO DELCAN

APPROXIMATE COMMON AREA OF FLOODING - JAN. 10, 1982 & DEC. 22 & 25, 1983

ADDITIONAL AREA OF FLOODING - DEC. 22, 1983

DIRECTION OF WATER FLOW

NOTES

1. CONTOURS BASED ON NOV/DEC. 83 SURVEY DO NOT REPRESENT ROAD ELEVATIONS WHERE THE ROAD SURFACE IS BUILT UP ABOVE THE ADJACENT AREA.

2. EXTENT OF FLOODING SHOWN IS BASED ON INFORMATION PROVIDED BY RESIDENTS.

NOTE

MEAN SEA LEVEL IS 0.06m BELOW GEODETIC DATUM :-

Chart Datum
Mean Sea Level
Geodetic Datum (E.I.0.0)

1.3m
0.06m

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF ENVIRONMENT
HYDROTECHNICAL STUDY
PLACENTIA AREA FLOOD PLAIN
SHAWMONT MARTEC LIMITED
AREAL EXTENT OF 1982 & 1983 FLOODS
Drawing No. 2



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF ENVIRONMENT
HYDROTECHNICAL STUDY
PLACENTIA AREA FLOOD PLAIN
SHAWMONT MARTEC LIMITED
PHOTOGRAPH LOCATIONS
Drawing No. 3

LEGEND

⑧ PHOTOGRAPH LOCATIONS

— (BROWN LANDS AND SURVEYS DIVISION MAPPIING)
LEVEL, NORTH AMERICAN DATUM 1927

— (2.4)
CONTOUR ELEVATIONS IN METRES BASED ON
GEODETIC DATUM (FROM NOV./DEC. 83 SURVEY)

NOTE

MEAN SEA LEVEL IS 0.06m BELOW GEODETIC DATUM :-

Chart Datum
1.3m
Mean Sea Level
0.06m
Geodetic Datum (EL.0.0)