DEER LAKE HYDROTECHNICAL STUDY

Prepared for

Canada - Newfoundland
Flood Damage Reduction Program

Prepared by

NOLAN, DAVIS & ASSOCIATES (1986) LIMITED

in association with

CUMMING-COCKBURN & ASSOCIATES LIMITED

March 1987

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DEER LAKE HYDROTECHNICAL STUDY

1.0 INTRODUCTION

1.1 General

Nolan, Davis & Associates (1986) Limited, in association with Cumming-Cockburn & Associates Limited, subsequent to receipt of written authorization from the Minister of the Newfoundland Department of Environment dated May 15, 1986, have carried out a hydrotechnical study of the Deer Lake area. The purpose of the study, undertaken as part of the Canada-Newfoundland Flood Damage Reduction Program, was to determine flood discharge and water levels leading to development of 1:20 and 1:100 year recurrence water surface elevations along the Upper Humber River and Deer Lake study reaches. Flood profiles determined through use of mathematical modelling techniques were then plotted on new 1:2500 scale "flood risk maps", identifying the main flood hazard areas.

The methodology and hydraulic modelling components used to attain these objectives are described in the text of the main report - Hydrotechnical Study of the Deer Lake Area.

This volume presents the field data acquired to calibrate the computer models and is limited to level measurements and field survey activities.

2.0 FIELD PROGRAM

2.1 General

The field program for the Deer Lake Hydrotechnical Study was undertaken by staff members of Nolan, Davis & Associates (1986) Limited and Cumming-Cockburn & Associates Limited. Work was initiated September 3, 1986, and completed within two weeks. During this period, a three-to-four member field crew under the supervision of Mr. Wm. Pye of Nolan, Davis & Associates completed the following activities:

1. reconnaissance survey of study area,
2. obtained bathymetric data at cross-section locations along the Upper Humber River from Deer Lake through to the Northern Peninsula Highway (Route 430),
3. obtained bathymetric data at eleven locations along the northeast shoreline of Deer Lake from the inlet of the Upper Humber River through to South Brook at the south-east end of the Lake,
4. survey of cross-sections along both sides of the Upper Humber River and around the shoreling of Deer Lake at those locations where bathymetric data had been obtained,
5. obtained photo inventory of cross-sections and structures along the Upper Humber River,

6. obtained physical dimensions of structures along the Upper Humber River,

7. transferred Geodetic elevations to temporary bench marks established at cross-section locations and two sites on Deer Lake where water level recorders had been installed.

Prior to initiating the field program, an office review of historical data and new 1:2500 scale "flood risk mapping" was undertaken. Based on this preliminary assessment, 20 tentative cross-section locations were identified within the study area, nine along the Upper Humber River and the remaining 11 along the shorelines of Deer Lake. The suitability of proposed section locations was later confirmed in the field as part of an overall reconnaissance survey by senior staff members of the study team.

2.2 Reconnaissance Survey

A reconnaissance survey of the project study area was carried out September 4 and 5, 1986, by B. Davis, P.Eng., and S. Smith, C.E.T., of Cumming-Cockburn Ltd. A preliminary assessment of site conditions was carried out by traversing

the study reachin an open 6 m boat at which time photographs were taken of both banks along the Upper Humber River. Additional information respecting structures, terrain, vegetation, soil types, etc., was obtained by viewing areas readily accessed by motor vehicle.

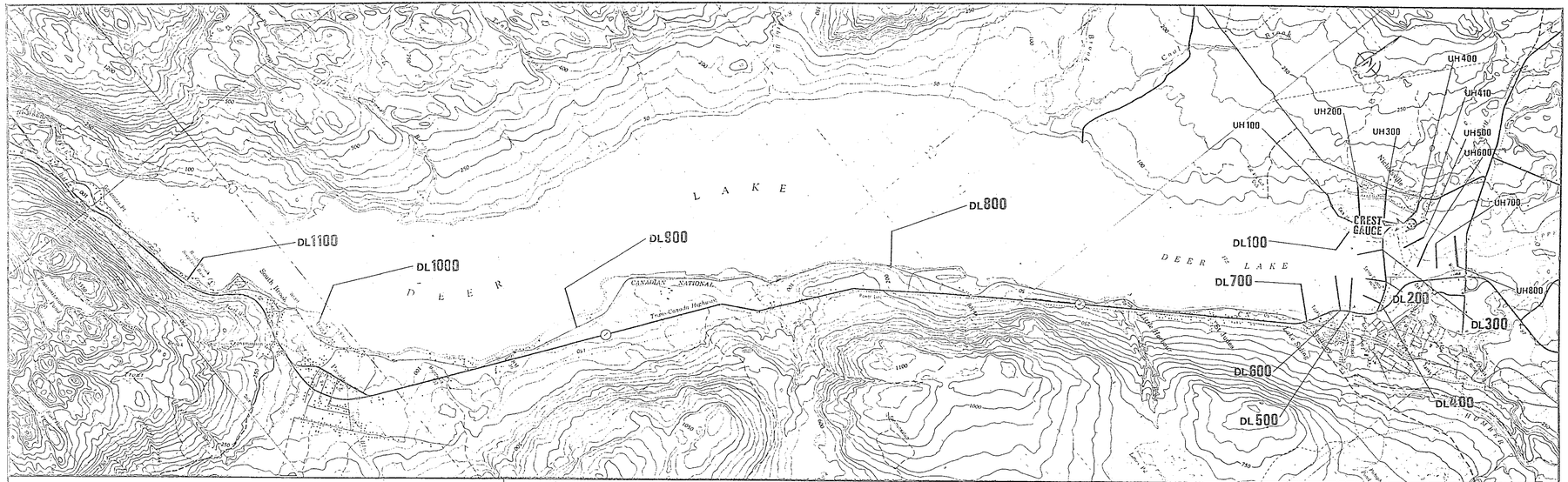
During the reconnaissance survey, 20 proposed cross-sections were located in the field from identifiable topographic features noted on the new 1:2500 mapping. Where required, proposed section locations were resited to best suit actual field conditions. Final cross-section locations were referenced along the study reach with marker stakes to facilitate follow-up survey work.

Channel configuration along the Upper Humber River, as noted during this preliminary investigation, showed little variation throughout the study reach. Based on this, it was decided that installation of only one crest gauge versus the two originally proposed would provide adequate water level data.

Initial assessment of flow velocity in the Upper Humber River at the Nicholsville Bridge was undertaken during the reconnaissance survey. Based on a series of observations for a floating object to traverse a known distance, an average stream velocity of less than 0.1 m/second was confirmed. Since stream discharge beyond September through early December would normally fluctuate only slightly, it was felt that subsequent field monitoring of velocities would yield little additional useful data.

2.3 Physical Surveys

The physical surveys carried out as part of the field program primarily comprised the collection of topographic and bathymetric data at representative locations along the Upper Humber River and on Deer Lake. Additional data defining structure type and size was collected for the Nicholsville Bridge. Details of the physical surveys are described in the following sub-sections.



LEGEND

———	CROSS-SECTION LOCATION
DL300	DEER LAKE SECTION
UH500	UPPER HUMBER RIVER SECTION
⊗	CREST GAUGE

SCALE

Kilometres 1 0 1 2 3 Kilometres

NOLAN DAVIS & ASSOCIATES (1983) LIMITED

CUMMING-COCKBURN & ASSOCIATES LIMITED

LOCATION OF FIELD SURVEYED CROSS-SECTIONS & CRESTGAUGE

CANADA NEWFOUNDLAND FLOOD DAMAGE REDUCTION PROGRAM

DEER LAKE HYDROTECHNICAL STUDY

FIGURE 1

2.4 Cross-Sections

Field surveying of cross-sections was carried out in two phases: a land survey including line cutting, transfer of benchmarks, structure measurements, and a second phase comprising bathymetric surveys to determine channel profile along the Upper Humber River and offshore profiles at various locations on Deer Lake.

Land surveyed sections along the River channel and the Lake foreshore were extended a sufficient distance from the water's edge to permit ground truthing of contours with elevations on the new 1:2500 topographic flood risk mapping. This generally involved surveying to 6 to 8 m above river level, and 5 to 15 m above Lake level. Field location of cross-sections were referenced to identifiable structures by angle and distance measurements using a GEOTEC T-24 transit. Distance measurements were carried out using a standard 30 m steel chain.

Bathymetric section lines extended into Deer Lake a maximum of 300 m or until a maximum water depth of 16 m was recorded.

In shallow areas typical of the head of the Lake, lines averaged 300 m in length. Bathymetry work along the Upper Humber River spanned the entire width of the River at each section location.

A total of nine cross-sections were completed along the Upper Humber River. These sections are identified with the subscript UH. Section profiles were taken in two areas along the shoreline of Deer Lake. Seven sections were surveyed at the northeast end of the Lake beginning at the inlet of the Upper Humber and continuing round through to the west side of the Deer Lake Power House. Four additional section profiles were taken along the shoreline over a distance of 15 km towards the southeast end of the Lake. Cross-sections taken on the lake are identified with the subscript DL.

Soundings along the UH and DL section lines were carried out through use of a 6-m outboard-driven open boat and three-man crew. For each section location a stretch rope marked off in 6-m intervals was used to define the sounding intervals and total distance from shore. At each interval the boat

was momentarily stopped and a lead weight suspended from a graduated tape lowered over the side to obtain the water depth. Sounding depths were recorded to the nearest 0.1 m. Prior to the start of each sounding line, the water level was determined relative to the T.B.M. established at each section location.

The combined length of land and water cross-sections for the 20 locations surveyed totalled 5 530 m. Line cutting and layout was carried out by a three-man crew, as was the follow-up traverse and profile field survey.

The location of all surveyed cross-sections are shown on Fig. No. 1 in Appendix A, while cross-section profiles comprise Appendix B of this volume.

2.5 Transfer of Geodetic Elevations

Conventional survey equipment and techniques were used to obtain cross-section data and transfer Geodetic elevations to temporary bench marks established at each section location. Bench mark elevations were transferred by a three-man

crew using a GEOTEC AL-23 self-levelling spirit level and standard telescopic rod. Control elevations were surveyed to third order accuracy from six Geodetic Monuments located within the study area. Survey level loops used in the transfer of Monument elevations varied in distance from 2 to 10 km. Corresponding closures ranged from 5 - 35 mm which were well within the maximum allowable error for third order levelling. A list of the Monuments used and the corresponding cross-sections referenced to the particular Monument are shown in Table No. 1 of Appendix A. Geodetic elevations used in this field survey reflect the recently adjusted elevations assigned the noted Monuments by the Geodetic Survey of Canada in 1976.

Additional level work was carried out by the field crew to establish Geodetic Datum for water level recorders installed at two locations on Deer Lake. Reference elevations were surveyed to third order accuracy from the two Geodetic Monuments noted below.

Geodetic Monument No.	Location	Elevation (m)	Remarks
389K	Deer Lake Power House	10.060	used for recorder No. D2YL999 opposite the Deer Lake Power House
395K	C.N.R. abutment at mile 385 - South Brook	10.858	used for recorder No. 02YL888 at N.A.T. dock in Pasadena

Respective counter-set elevations determined for recorders Nos. 1 and 2 were 5.110 m and 5.103 m.

2.6 Structures

The Nicholsville Bridge located 2 km upstream of Deer Lake represents the only significant potential flow constriction within the study reach. To accurately evaluate the effect on water surface profiles during flood periods, the following physical dimensions and critical elevations were obtained:

- clear span opening between piers
- height of deck soffit above channel bottom
- intermediate pier dimension
- deck surface elevation.

Field measurements for the Nicholsville Bridge are included in Appendix D of this volume.

2.7 Water Level Monitoring

Collection of hydraulic model calibration data was provided for by placing two continuous water level recorders on Deer Lake and installing a crest gauge station on the Upper Humber River.

The two automatic level recorders were supplied by the Department of Environment and installed under the direction of the CNFDRP by Environment Canada. The units were installed on the Lake August 20, 1986, by Water Survey of Canada field staff from Corner Brook; one opposite the Deer Lake Power Plant, the second opposite Newfoundland Air Transit's (N.A.T.) float-plane depot in Pasadena. Both recorders were maintained and operated throughout the study period by the Corner Brook staff of the Water Survey of Canada. Data obtained from the water level recorders was forwarded to Water Surveys Branch in Halifax for computer processing. Computer readout was subsequently forwarded to Cumming-

Cockburn Limited and used to confirm the hydraulic slope of the lake and analyze wave and water level characteristics.

2-8 Crest-Gauge-Installation

A reconnaissance survey of the Upper Humber River confirmed that installation of one crest gauge would prove adequate to obtain required water level measurements. Since the Nicholsville Bridge represented the only significant structural constraint that might impede heavy flow discharge, resulting in backwater build-up on the river, a crest gauge was installed immediately upstream of the bridge. A 2.5-m-long gauge, manufactured of PVC pipe and fittings, was secured a section of rock-filled wood-cribbing on the south bank of the river. The gauge was put in service September 11, 1986, at which time Mr. E. Young, a life-time resident living within a half km of the bridge was instructed in reading procedures and maintenance of the unit. Gauge elevation was established at 4.09 m from a level circuit tied to Geodetic Monument No. 389K, elevation 10.060 m.

Although there were no high flow events noted during the period September through December 1986, a number of readings were taken by the local observer prior to freeze-up of the gauge mid-November. Readings recorded during this period are included in Appendix C.

2.9 Photographs

Photographs along the Upper Humber River were taken by field personnel during September 1986. The photographs generally show the types of structures along the water course, as well as vegetation and physical features. A photo inventory has been included as Appendix D of this volume.

APPENDIX A

LOCATION PLAN - CROSS-SECTION AND CREST GAUGE

TABLE NO. 1: GEODETIC MONUMENTS

TABLE NO. 1

GEODETIC MONUMENTS
USED IN LEVEL CONTROL SURVEY

DEER LAKE HYDROTECHNICAL STUDY

GEODETIC MONUMENT NO.	LOCATION	ELEVATION (m)	CROSS-SECTIONS REFERENCED
389K	Brass tablet in southwest concrete wall at Deer Lake Power House	10.060	UH100, 200, 300, UH400, 410, 500, UH600, DL100, 200, 300, DL400, 500, 600, DL700
76F084	Brass tablet in Route 430 bridge over Upper Humber River	13.267	UH700, UH800
76F064	Brass tablet set in bedrock adjacent T.C.H. 4.6 km west of Pentecostal Church in Pasadena	31.298	DL800
397K	CN Railway - South Brook in proximity of mile post 390	21.606	DL900
396K	CN Railway bridge on South Brook mile post 388	9.616	DL1000
395K	CN Railway bridge at Herman's Brook - mile post 385	10.858	DL1100

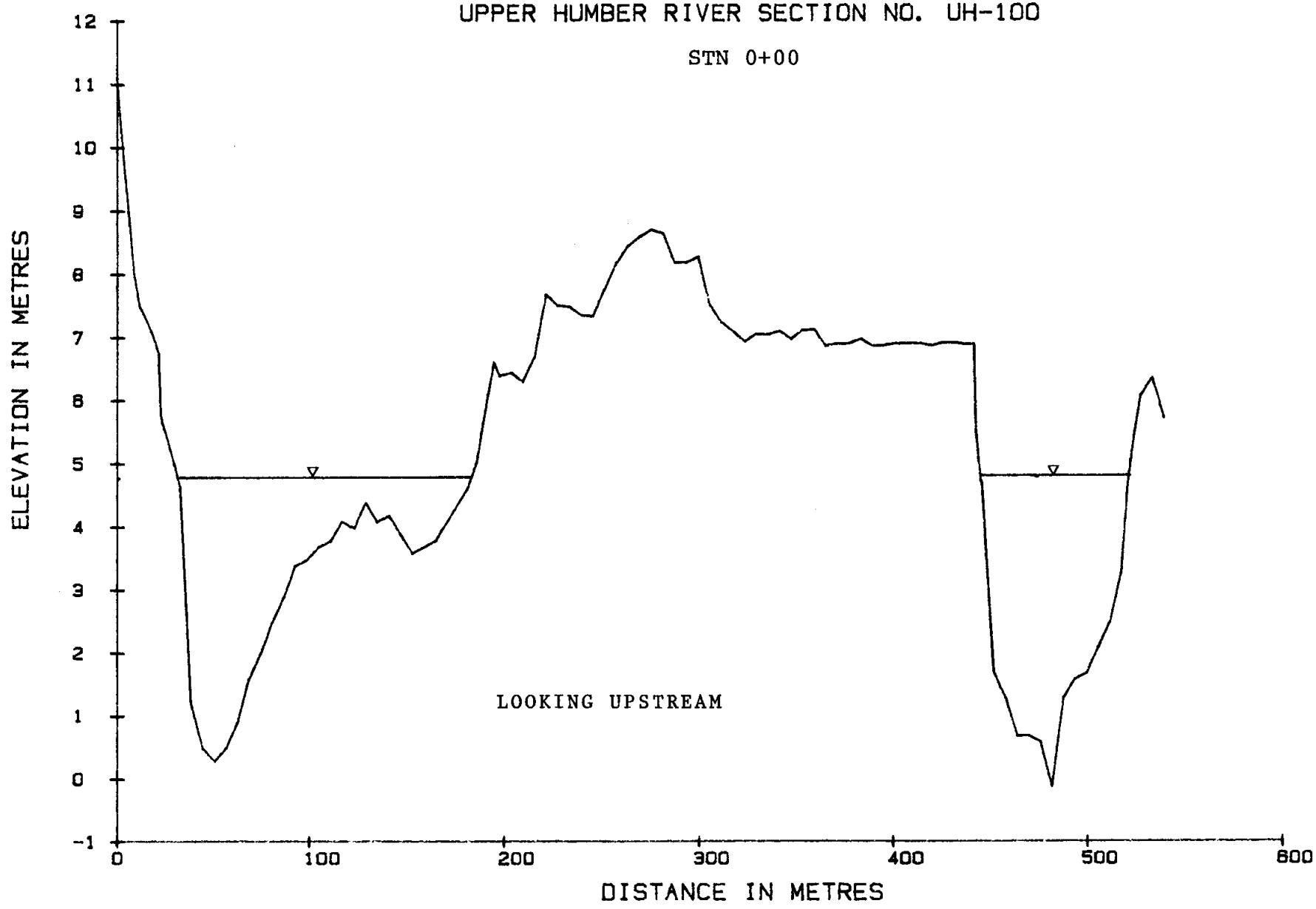
APPENDIX B

CROSS-SECTIONS: UPPER HUMBER RIVER

DEER LAKE

HYDROTECHNICAL STUDY OF THE DEER LAKE AREA
FIELD SURVEYED CROSS-SECTION PLOTS
UPPER HUMBER RIVER SECTION NO. UH-100

STN 0+00



HYDROTECHNICAL STUDY OF THE DEER LAKE AREA
FIELD SURVEYED CROSS-SECTION PLOTS
UPPER HUMBER RIVER SECTION NO. UH-200

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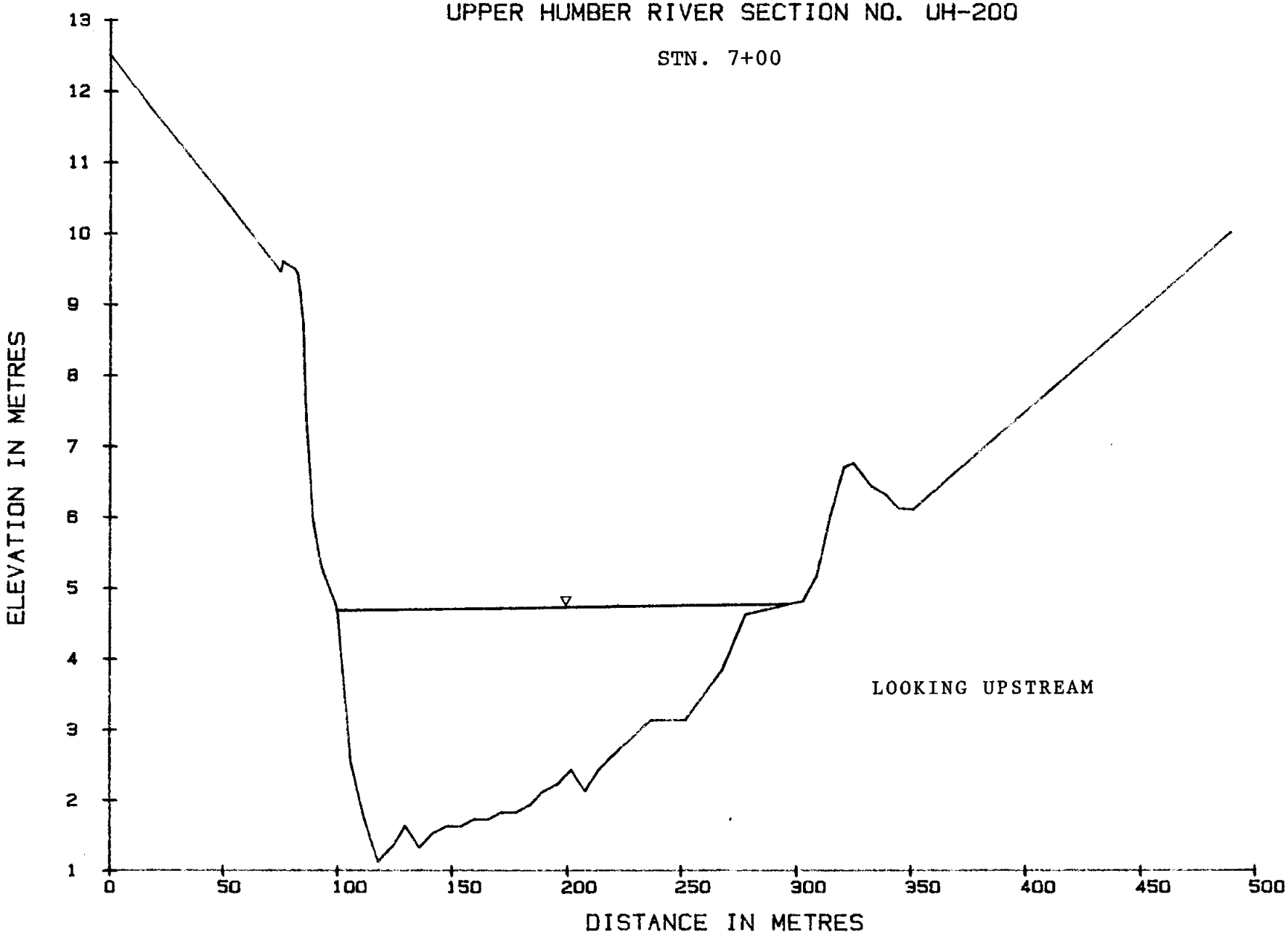

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UPPER HUMBER RIVER SECTION NO. UH-300

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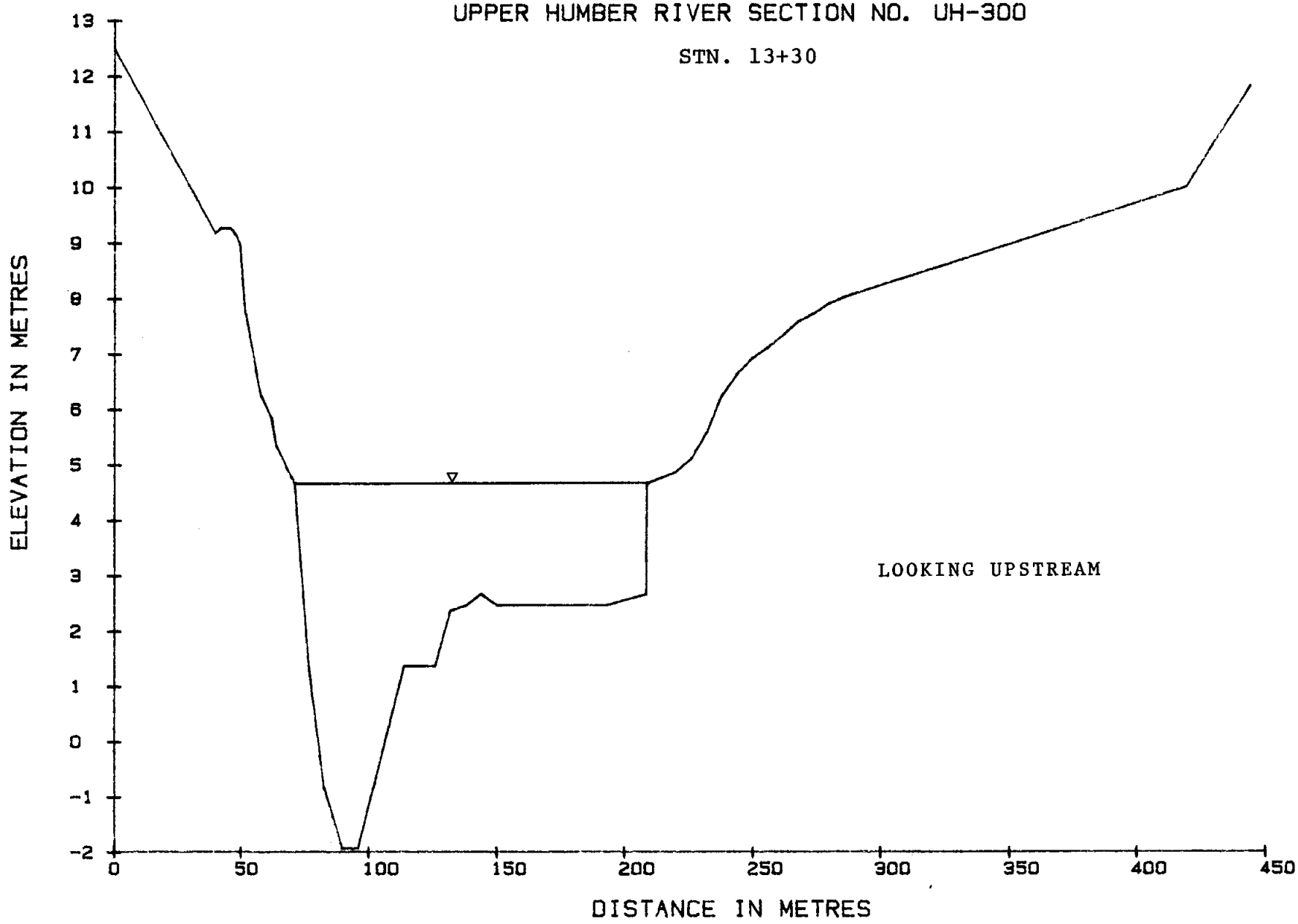

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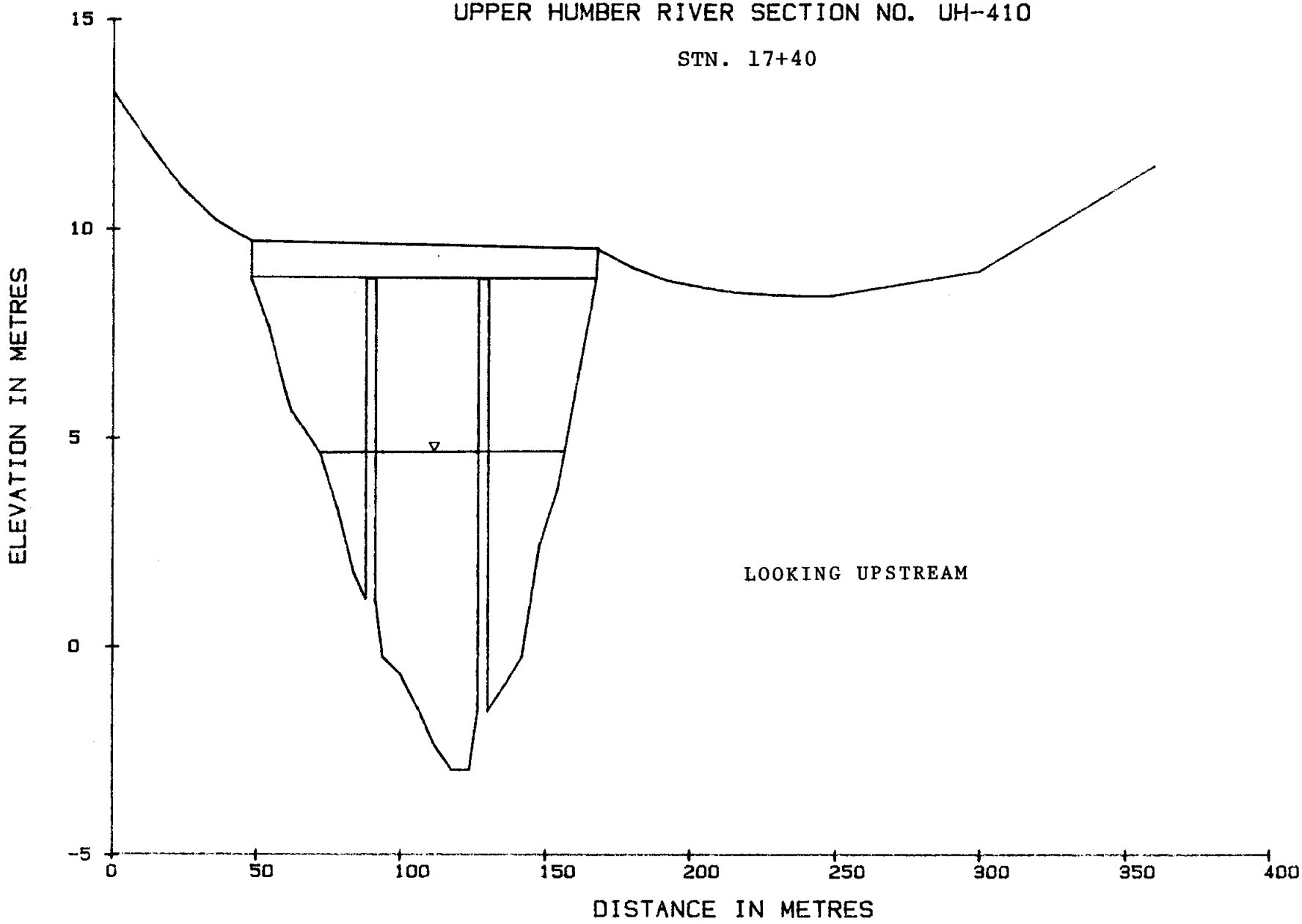
FIELD SURVEYED CROSS-SECTION PLOTS
UPPER HUMBER RIVER SECTION NO. UH-410

STN. 17+40



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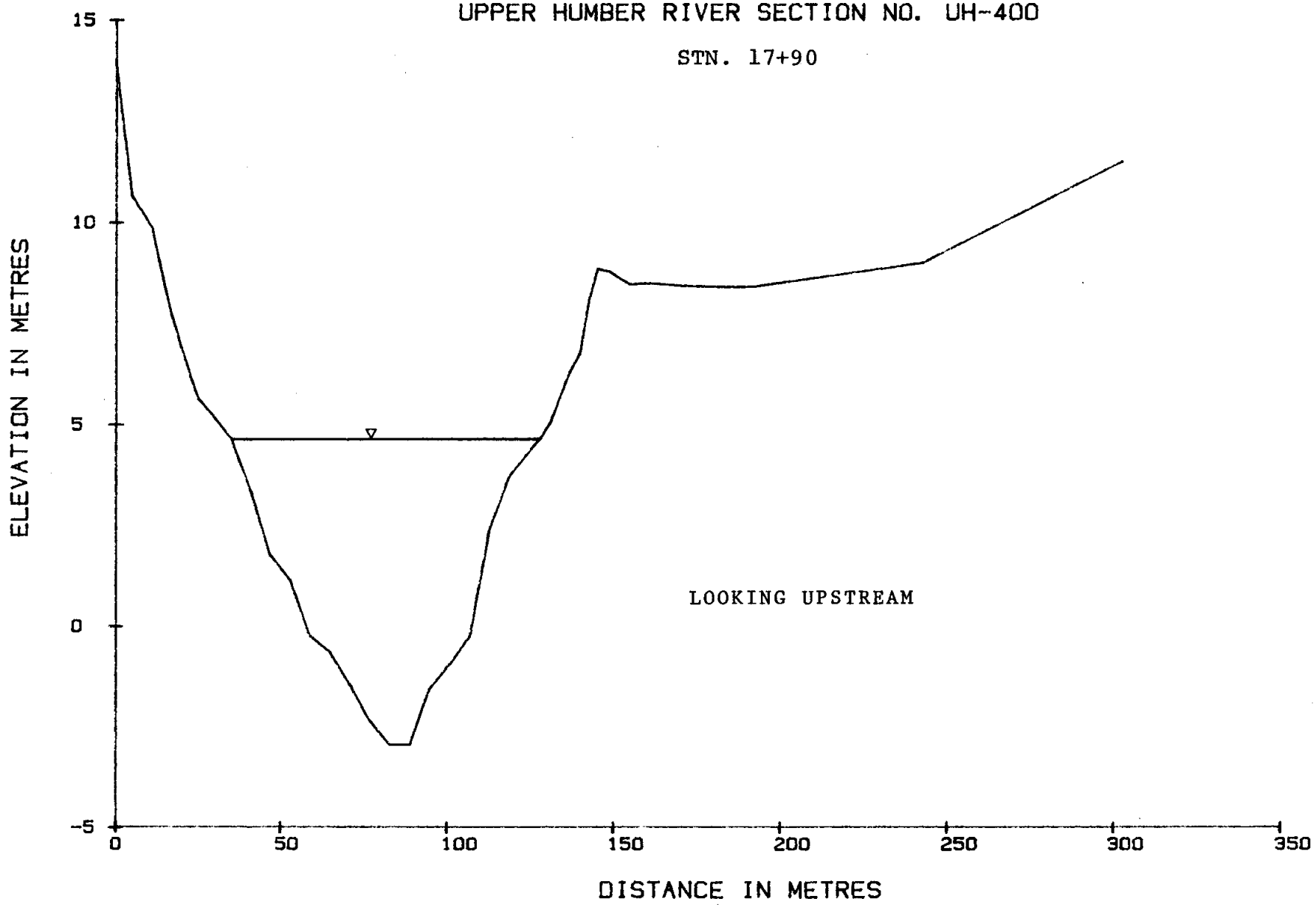
UPPER HUMBER RIVER SECTION NO. UH-400

STN. 17+90



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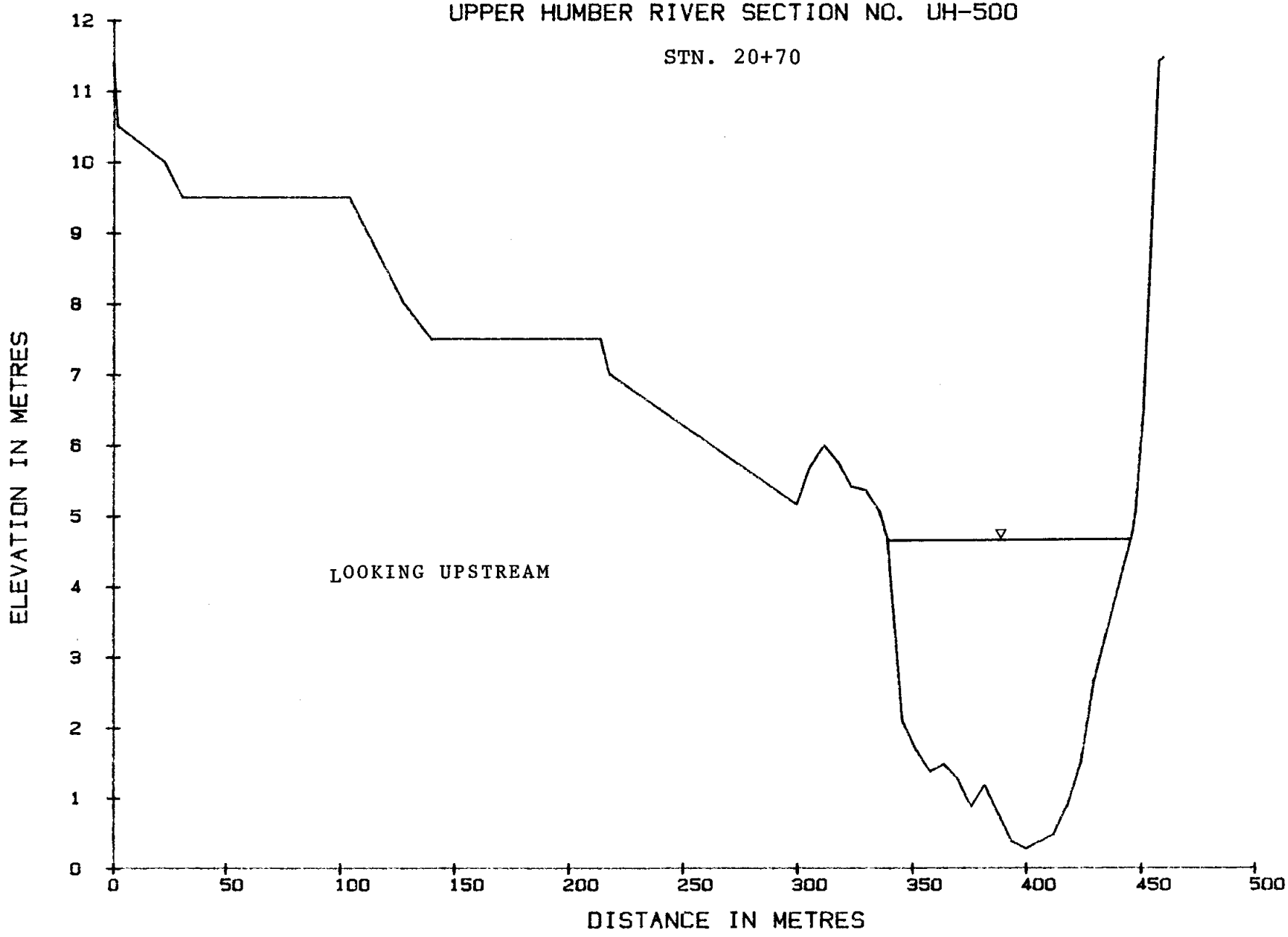
UPPER HUMBER RIVER SECTION NO. UH-500

STN. 20+70



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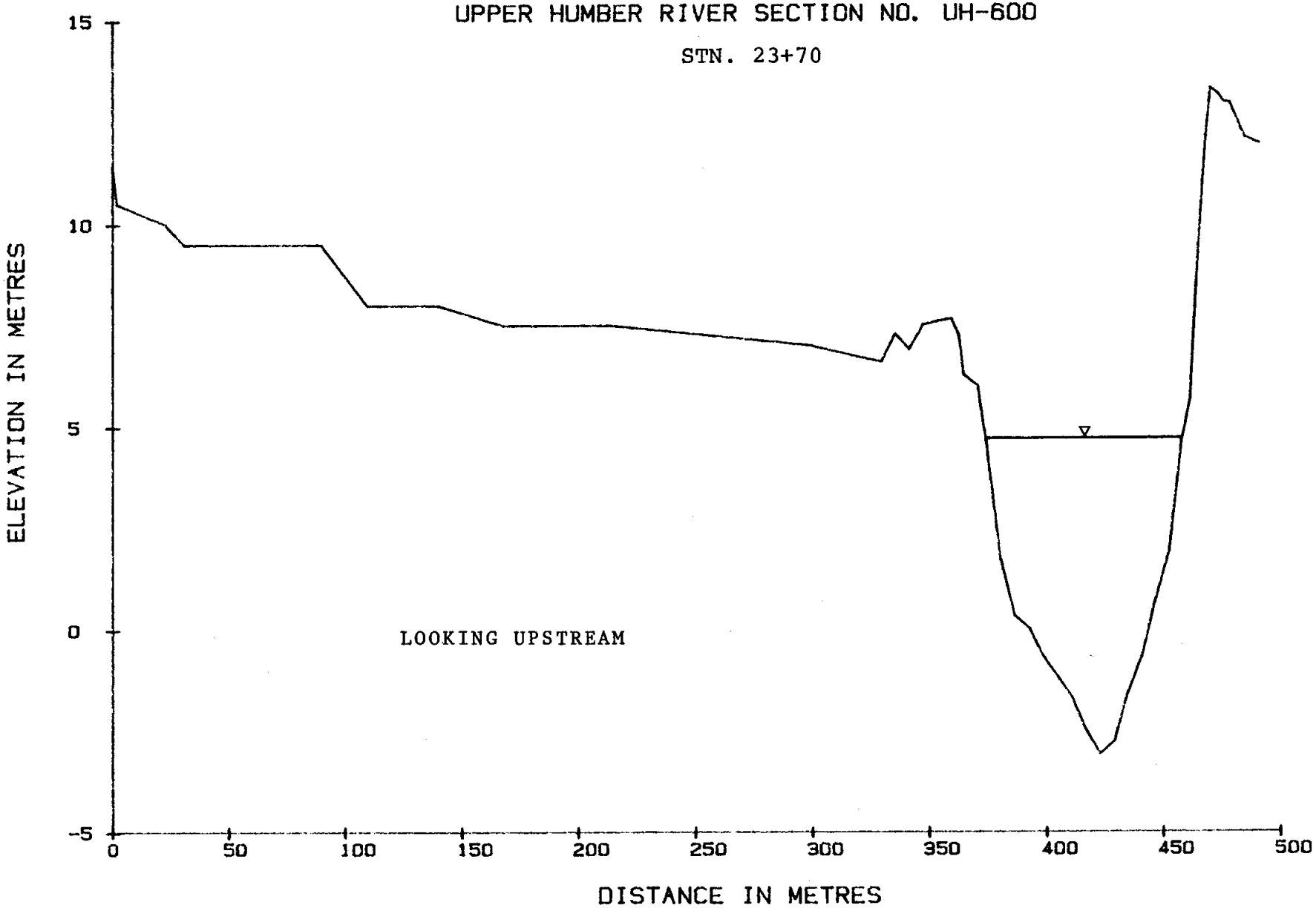
FIELD SURVEYED CROSS-SECTION PLOTS
UPPER HUMBER RIVER SECTION NO. UH-600

STN. 23+70



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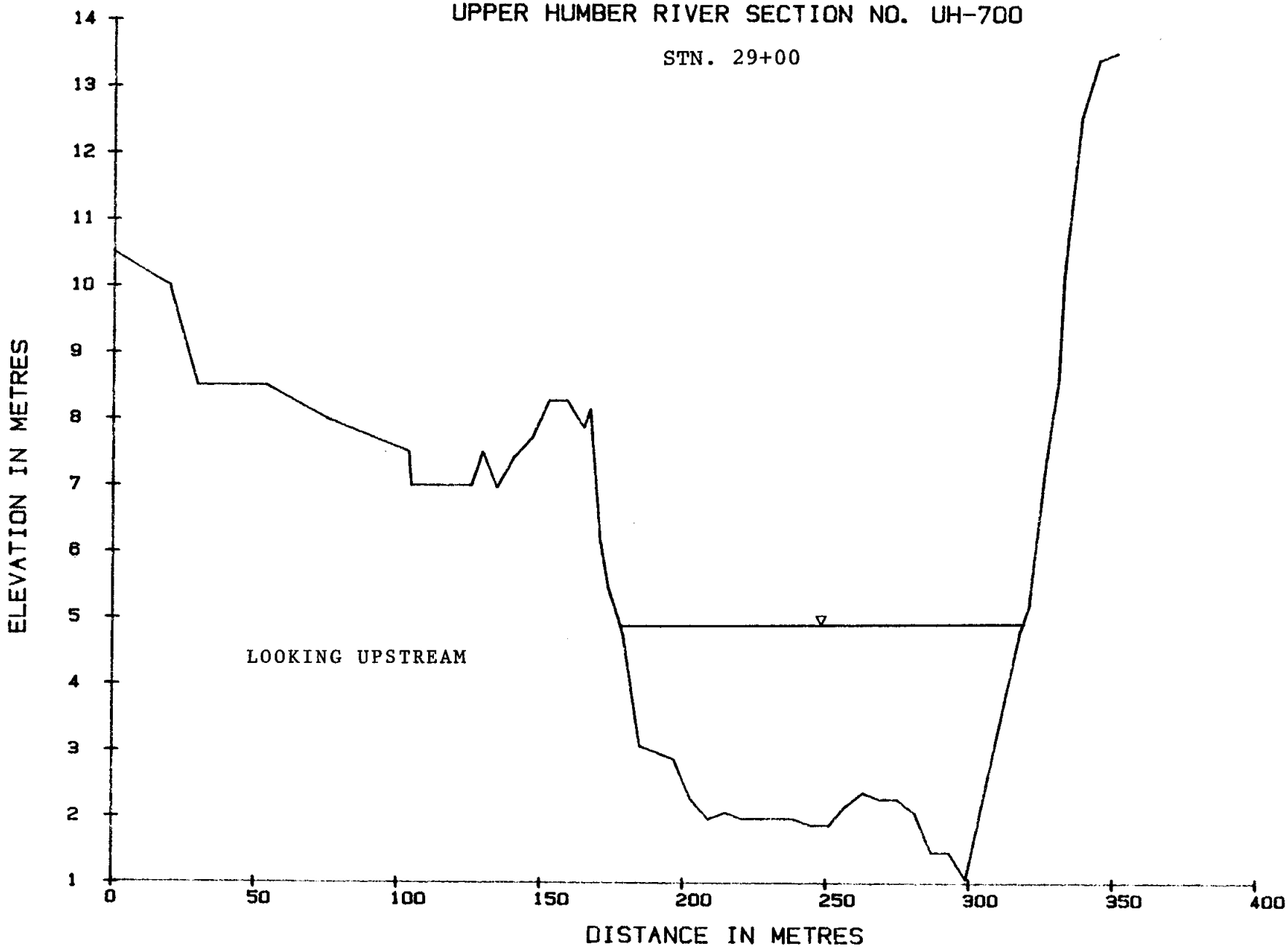
FIELD SURVEYED CROSS-SECTION PLOTS
UPPER HUMBER RIVER SECTION NO. UH-700



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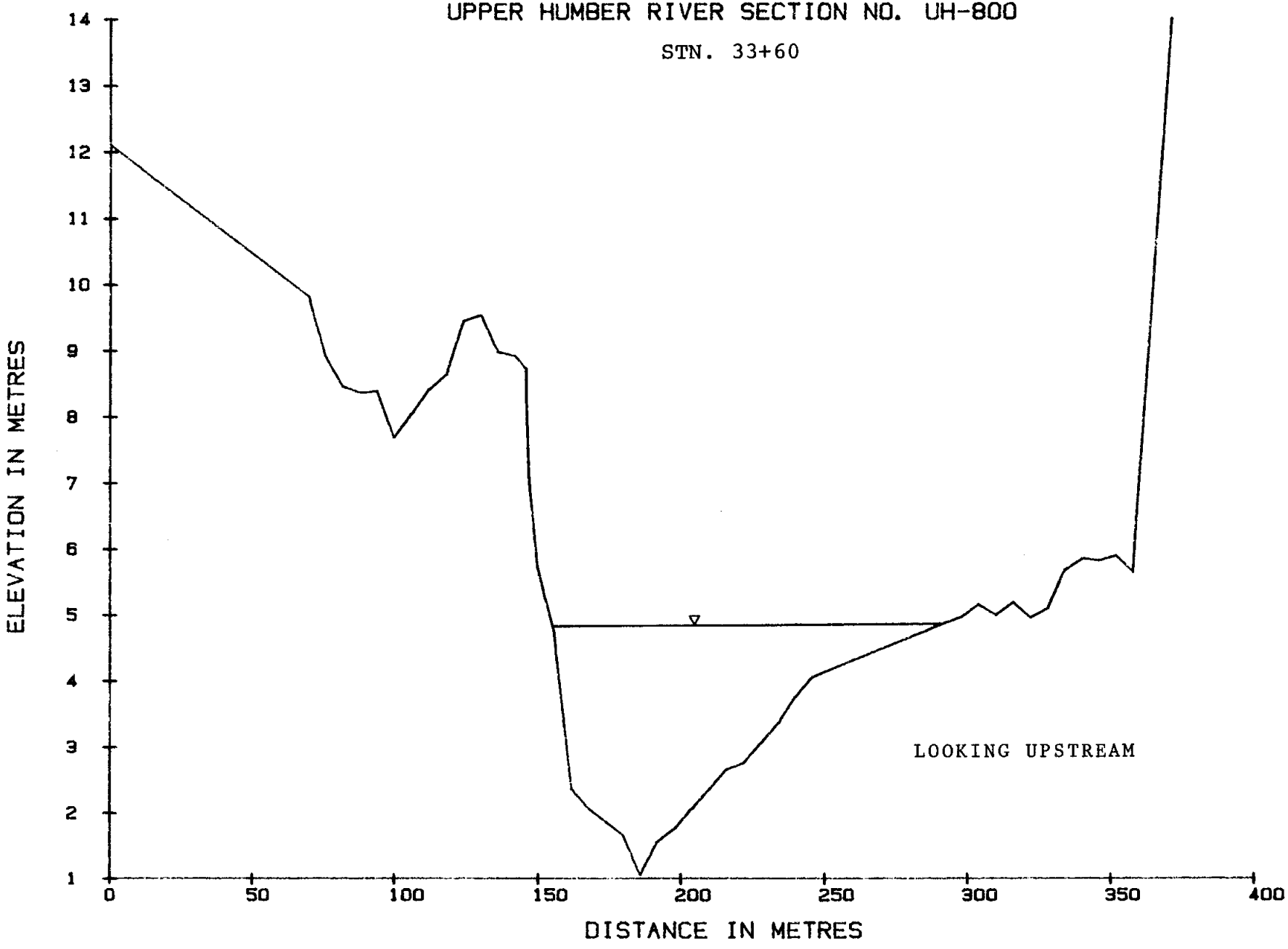
UPPER HUMBER RIVER SECTION NO. UH-800

STN. 33+60



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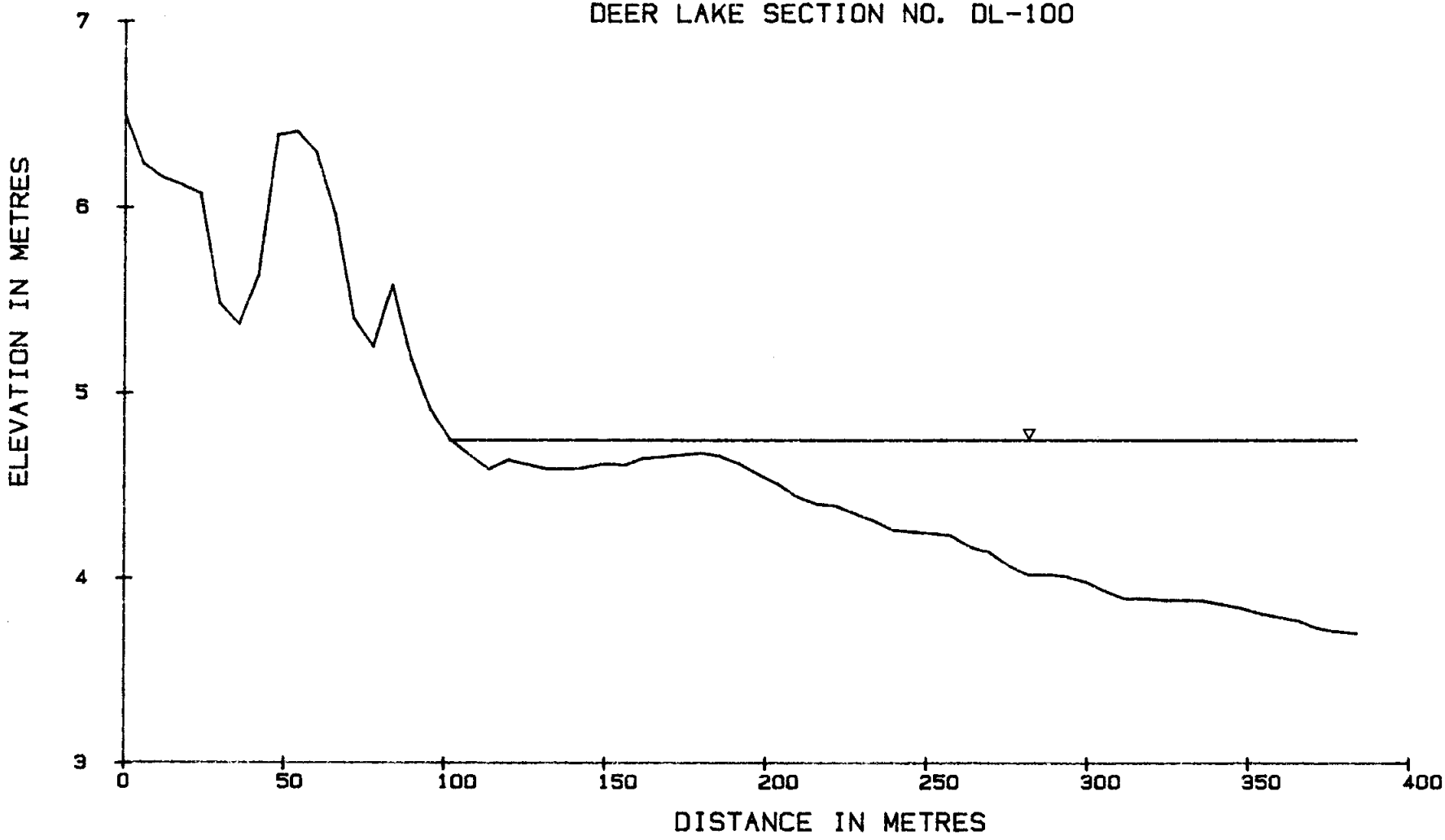
FIELD SURVEYED CROSS-SECTION PLOTS
DEER LAKE SECTION NO. DL-100



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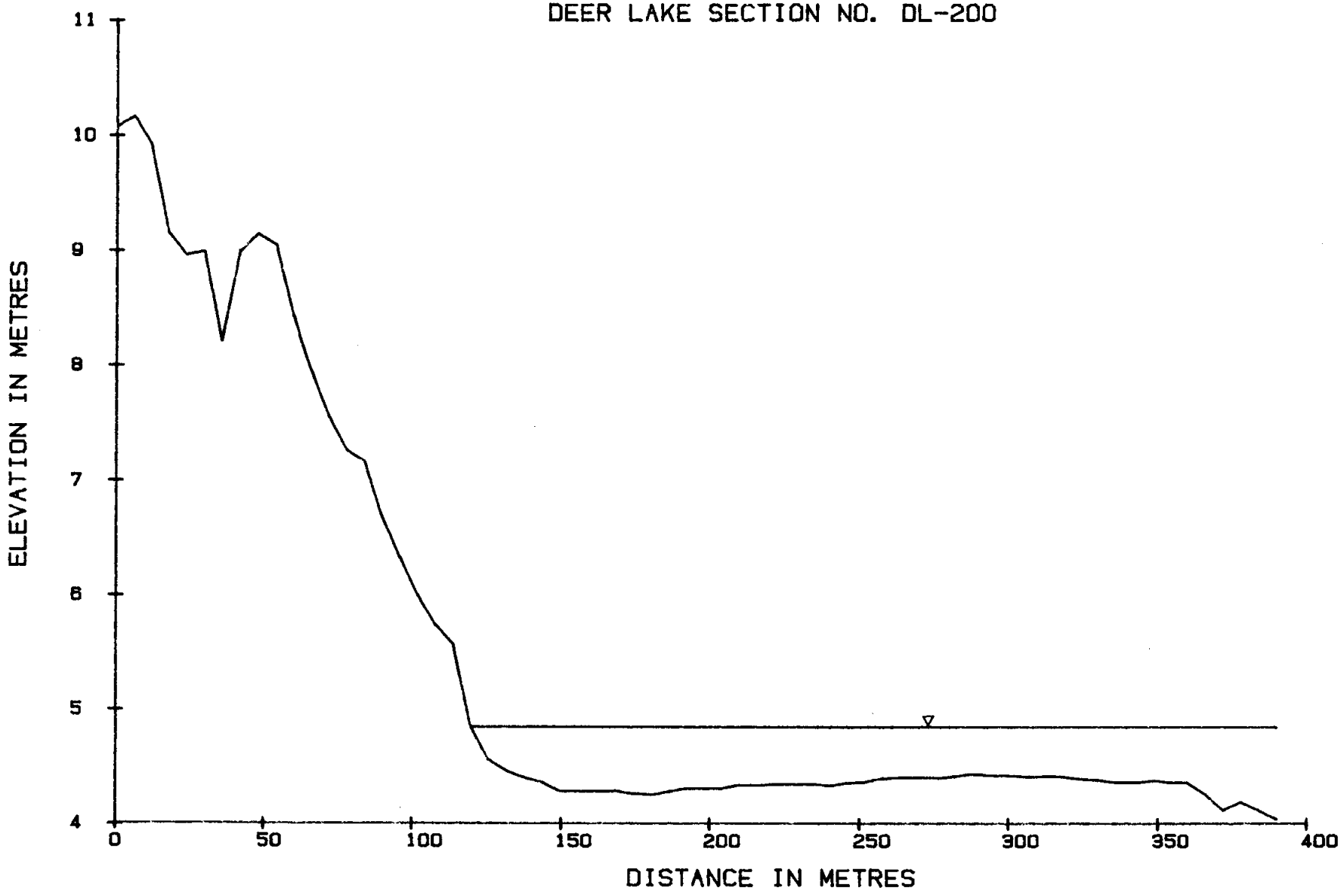

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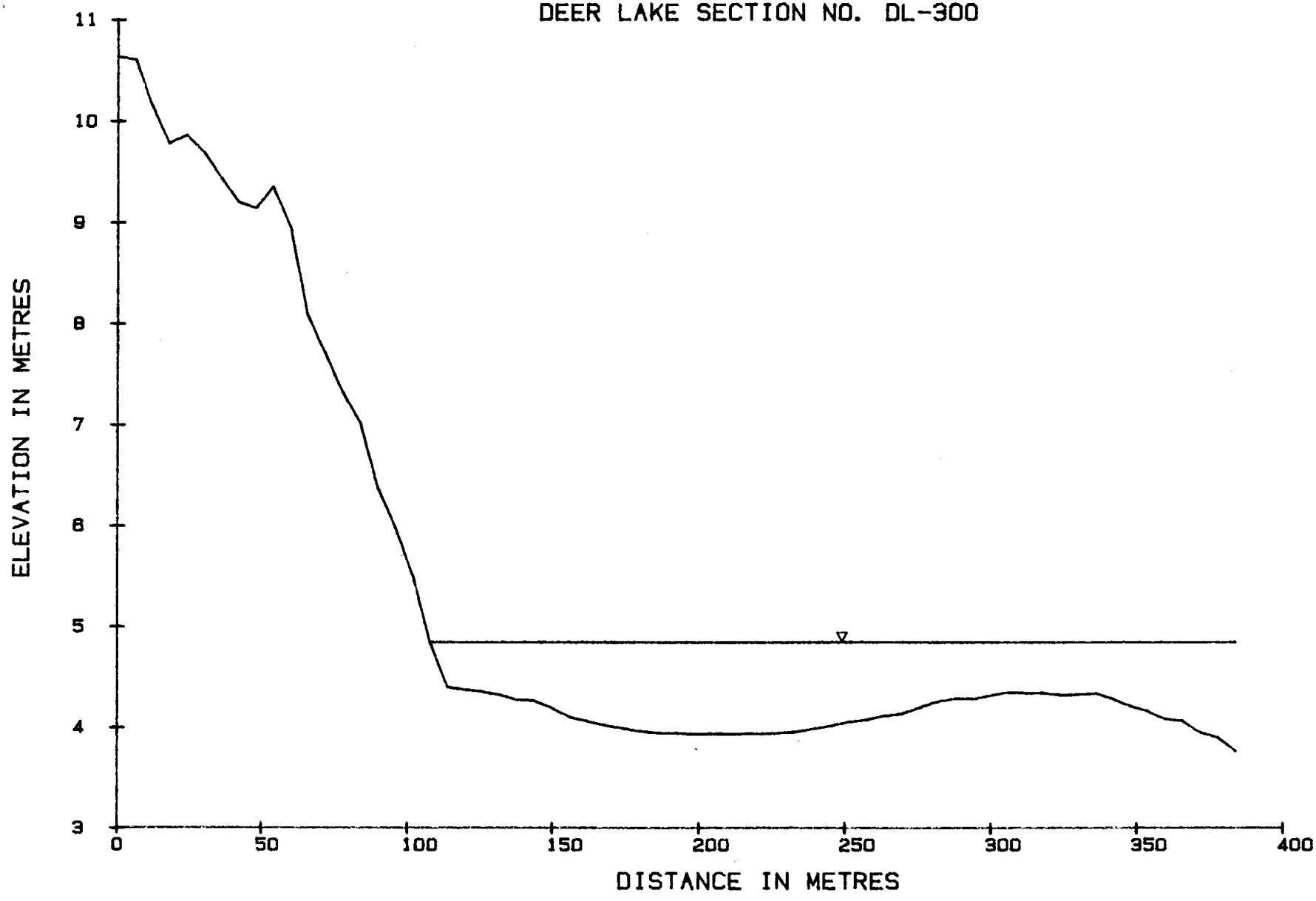
DEER LAKE SECTION NO. DL-300



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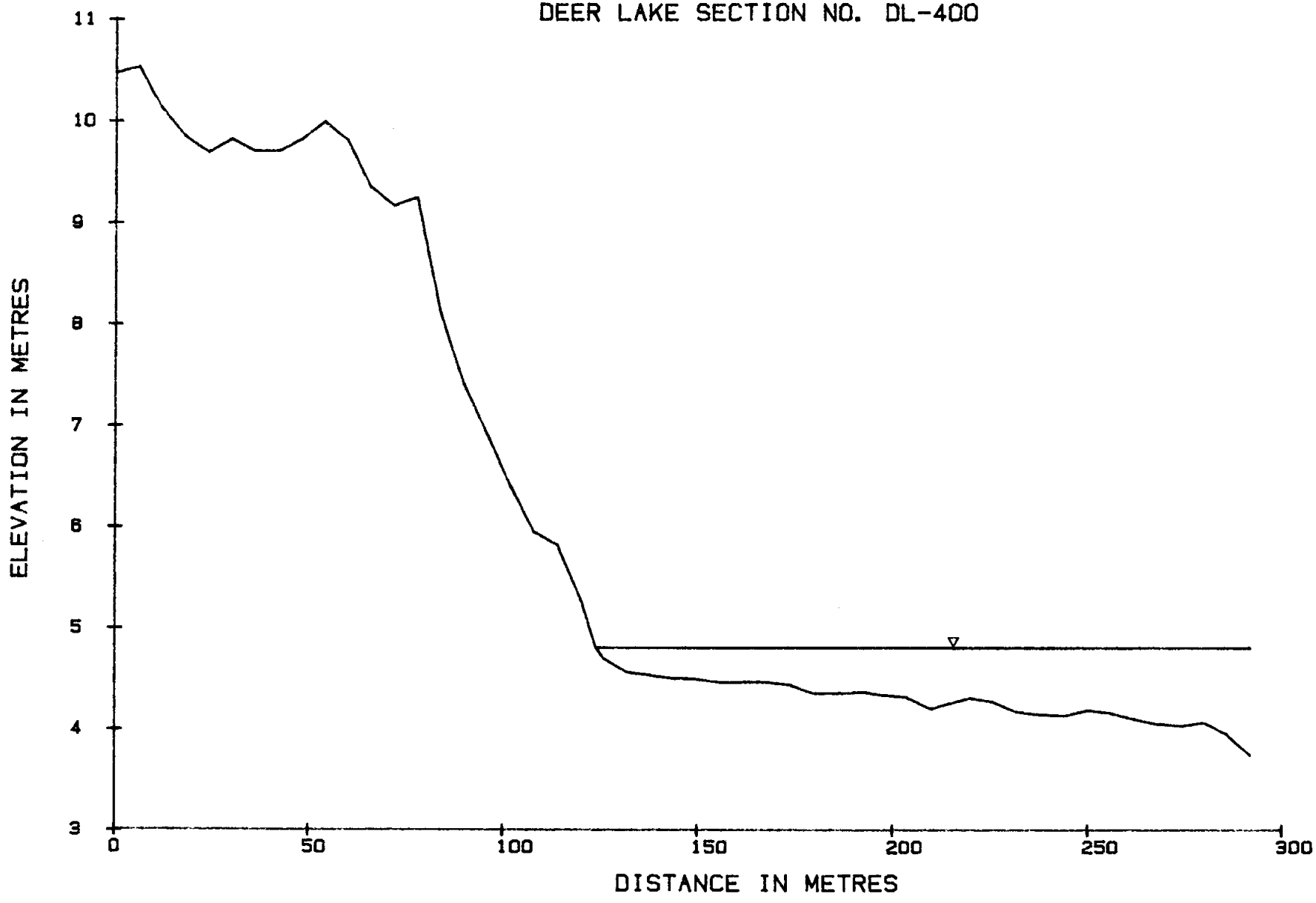

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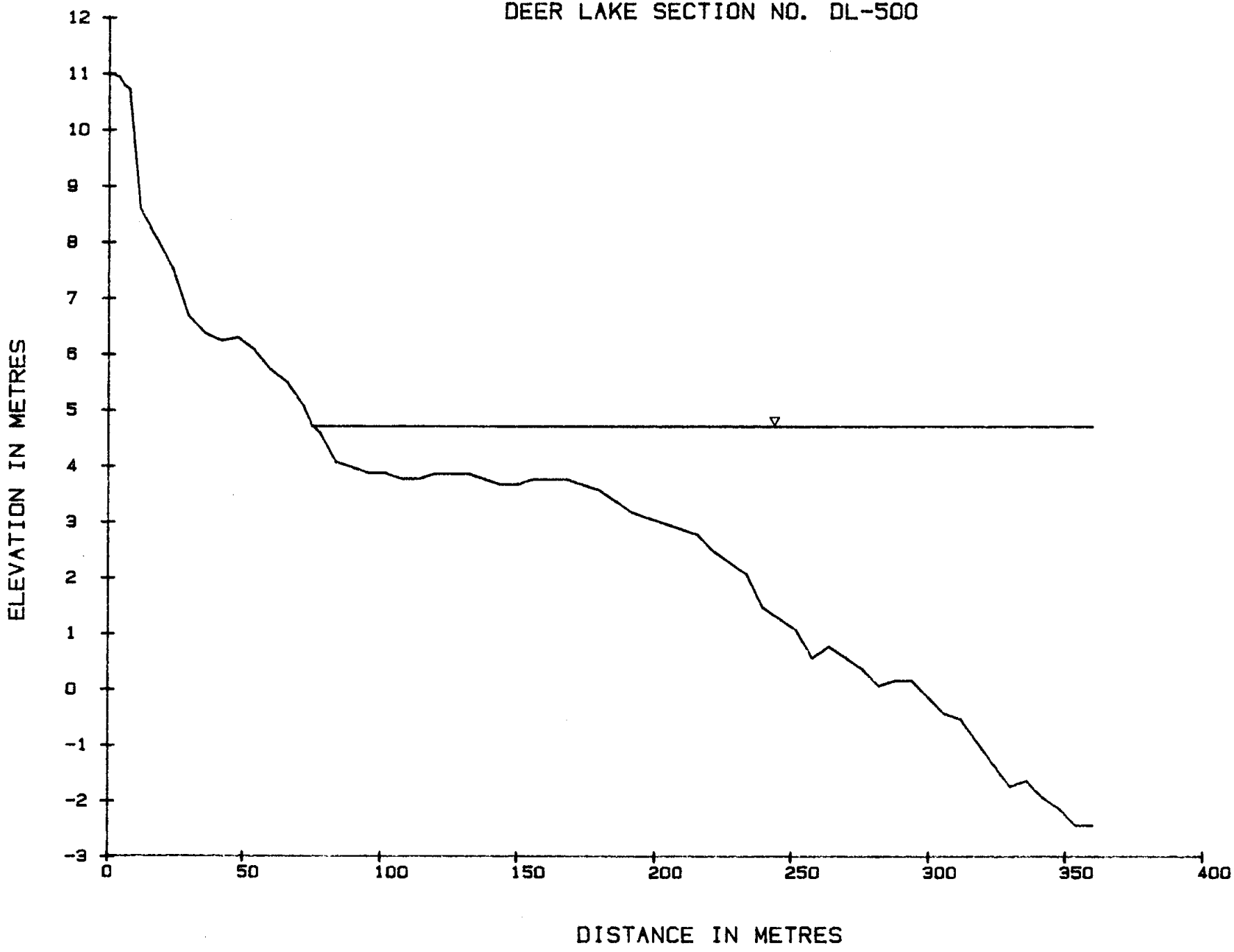
DEER LAKE SECTION NO. DL-500



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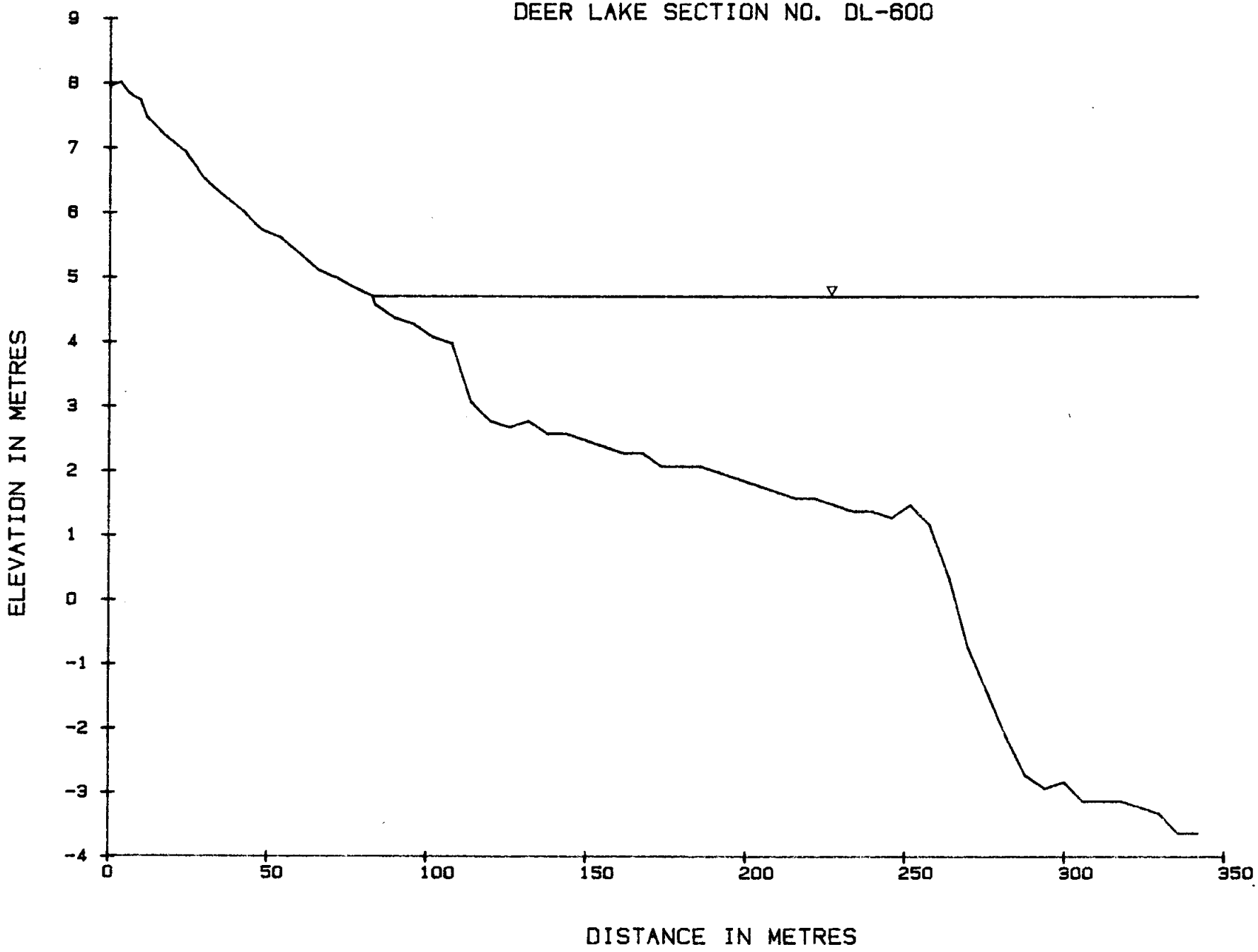
DEER LAKE SECTION NO. DL-600



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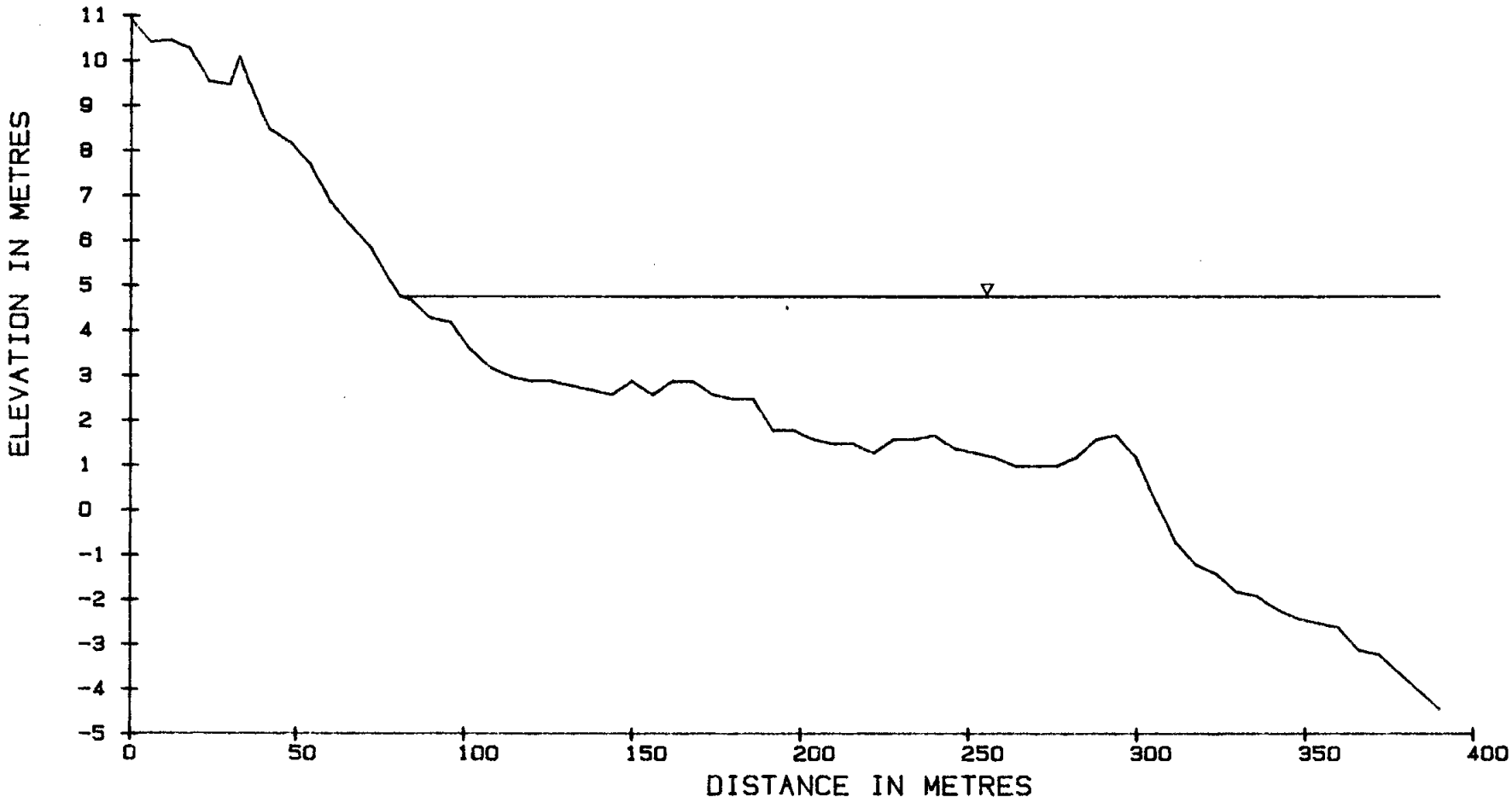
DEER LAKE SECTION NO. DL-700



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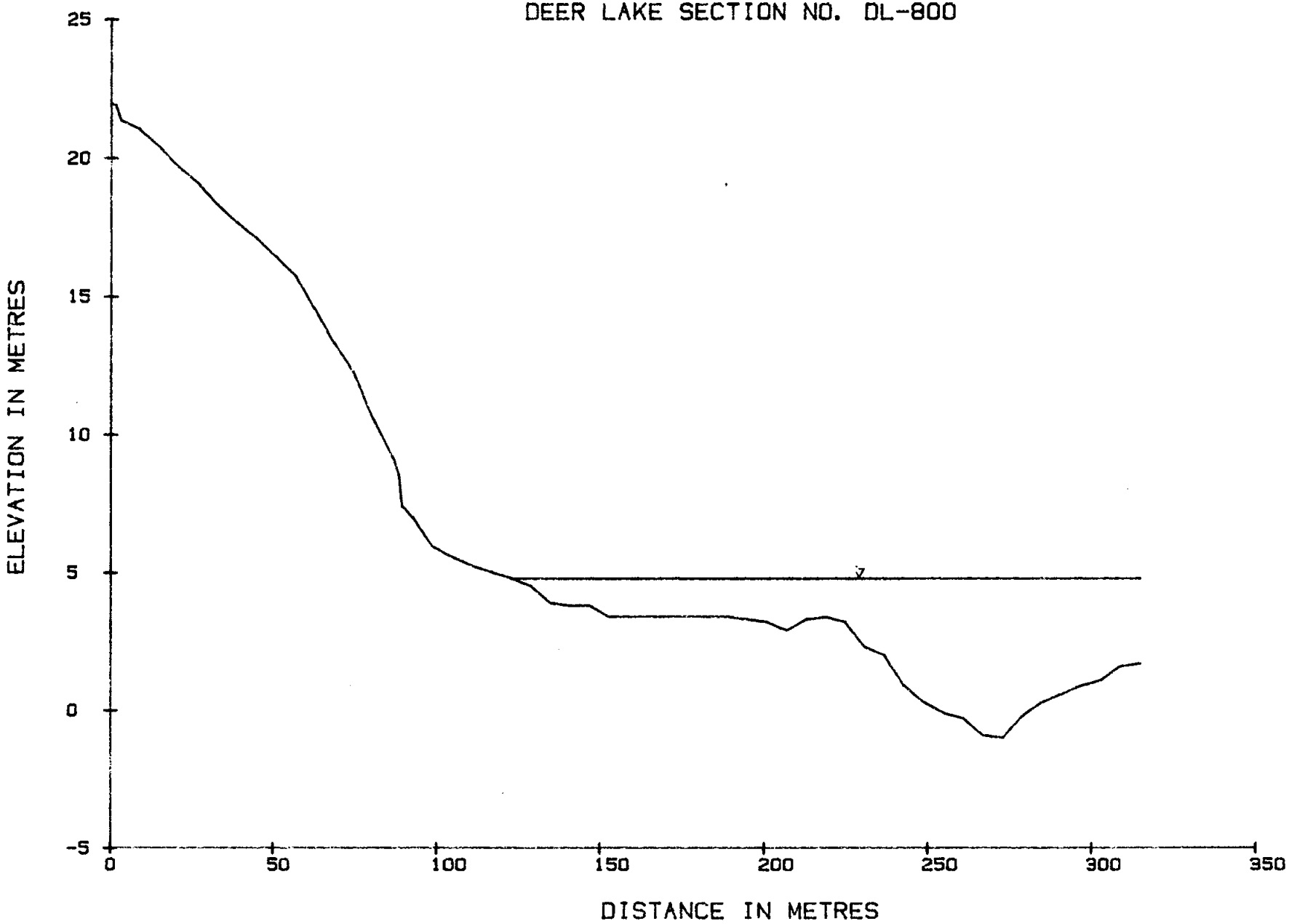
DEER LAKE SECTION NO. DL-800



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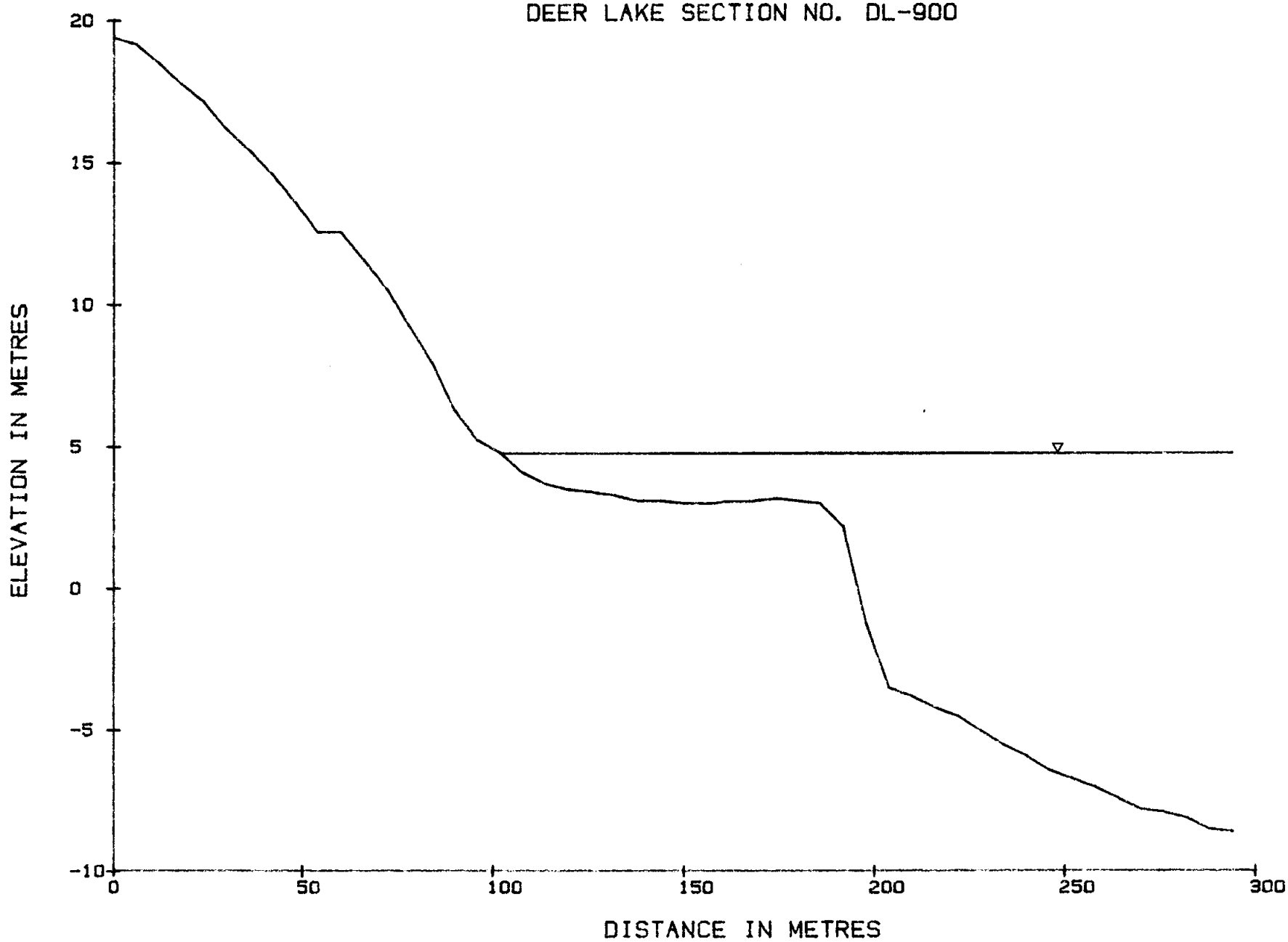
DEER LAKE SECTION NO. DL-900



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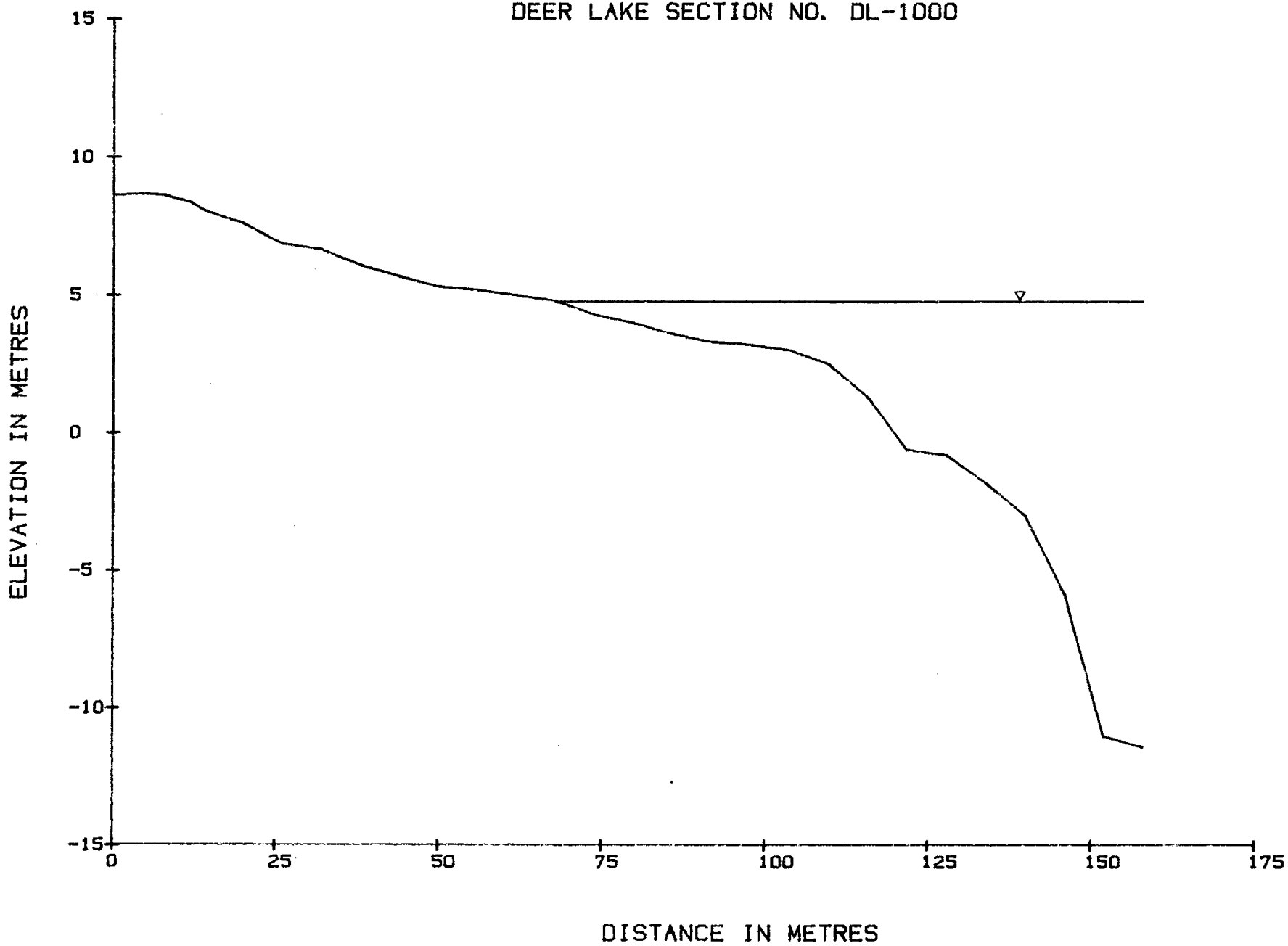
FIELD SURVEYED CROSS-SECTION PLOTS
DEER LAKE SECTION NO. DL-1000



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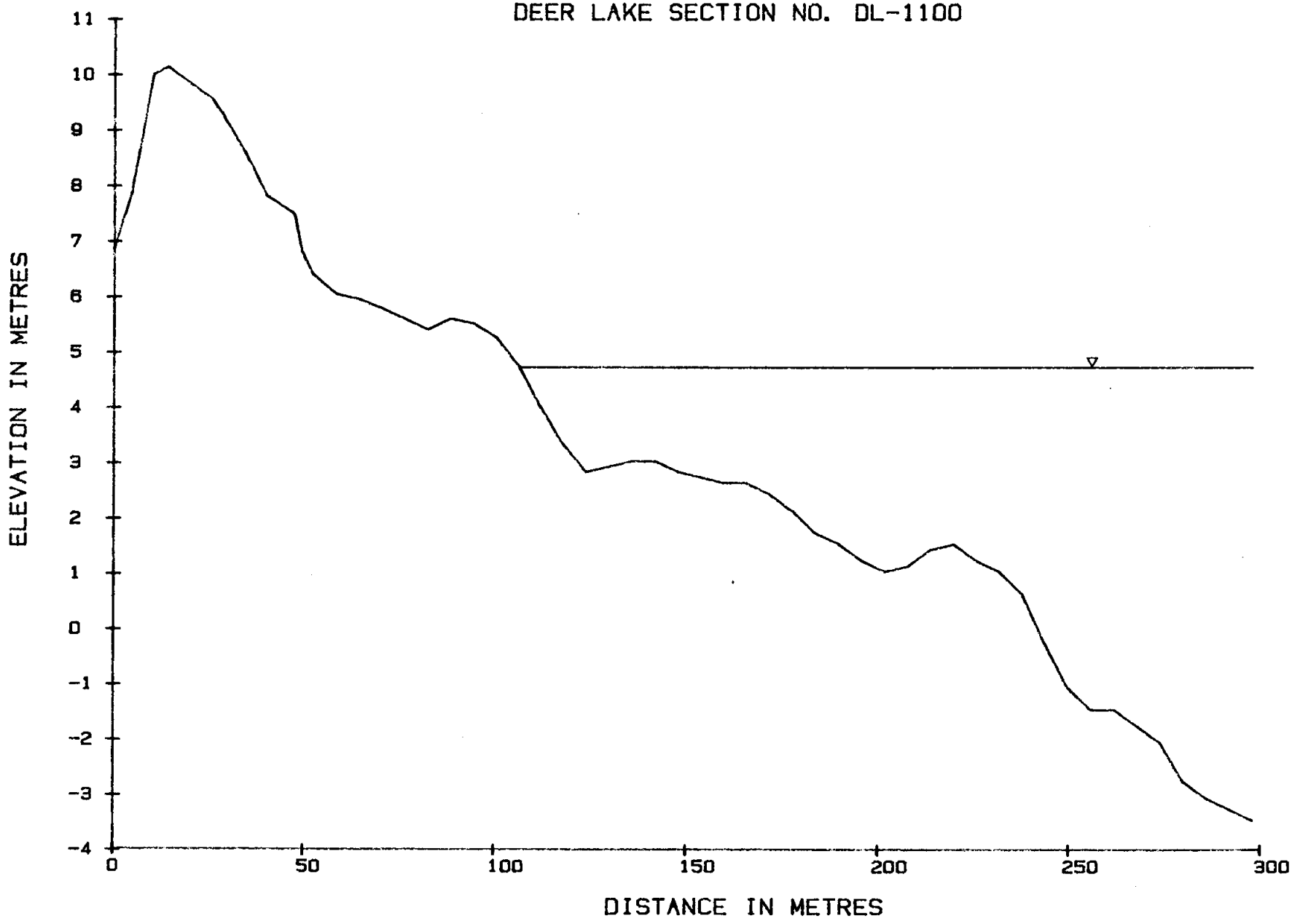


APPENDIX C

CREST-GAUGE READINGS

DEER LAKE HYDROTECHNICAL STUDY

NOLAN DAVIS & ASSOCIATES (1986) LIMITED CUMMING-COCKBURN & ASSOCIATES LIMITED

CANADA - NEWFOUNDLAND FLOOD DAMAGE REDUCTION PROGRAM

Gauge No. 1

Gauge Datum: Geodetic

Measured by: E. Young
Field Observer

Type: Crest

Location: Upper Humber River at Nicholsville Bridge

I) Survey Data Table

Date 1986	Time In	Time Out	Gauge Reading (m)	Photograph Number Looking Upstream	Photograph Number Looking D/Stream	Ice Conditions Yes	Ice Conditions No	Ice Thickness (ft.)	Condition of Watercourse (Description)	Condition of Gauge Operational	Condition of Gauge Non-Operational	Condition of Culvert/Bridge Plugged	Condition of Culvert/Bridge Open Flow
Sept 11		1340	0.63				x		normal seasonal flow	x			x

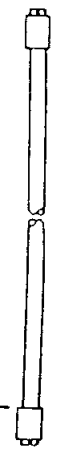
II) General Comments on Condition of Watercourse

Date:

11/09/86

Comments:

Seasonal weather, river lower than August levels



4.09 m

DEER LAKE HYDROTECHNICAL STUDY

NOLAN DAVIS & ASSOCIATES (1980) LIMITED — CUMMING-COCKBURN & ASSOCIATES LIMITED

CANADA-NEWFOUNDLAND FLOOD DAMAGE REDUCTION PROGRAM

Gauge No. 1

Type: Crest

Gauge Datum: Geodetic

Measured by: E. Young
Field Observer

Location: Upper Humber River at Nicholsville Bridge

I) Survey Data Table

Date 1986	Time In	Time Out	Gauge Reading (m)	Photograph Number Looking Upstream	Photograph Number Looking D/Stream	Ice Conditions Yes	Ice Conditions No	Ice Thickness (ft.)	Condition of Watercourse (Description)	Condition of Gauge Operational	Condition of Gauge Non-Operational	Condition of Culvert/Bridge Plugged	Condition of Culvert/Bridge Open Flow
Oct 2		1410	0.88				x	-	normal seasonal flow	x			x

II) General Comments on Condition of Watercourse

Date:

02/10/86

Comments:

Seasonal weather, slight increase in water level

4.09 m

DEER LAKE HYDROTECHNICAL STUDY

NOLAN DAVIS & ASSOCIATES (1986) LIMITED CUMMING-COCKBURN & ASSOCIATES LIMITED

CANADA-NEWFOUNDLAND FLOOD DAMAGE REDUCTION PROGRAM

Gauge No. 1

Type: Crest

Gauge Datum: Geodetic

Measured by: E. Young
Field Observer

Location: Upper Humber River at Nicholsville Bridge

I) Survey Data Table

Date 1986	Time In	Time Out	Gauge Reading (m)	Photograph Number Looking Upstream	Photograph Number Looking D/Stream	Ice Conditions Yes	Ice Conditions No	Ice Thickness (ft.)	Condition of Watercourse (Description)	Condition of Gauge Operational	Condition of Gauge Non-Operational	Condition of Culvert/Bridge Plugged	Condition of Culvert/Bridge Open Flow
Oct 10		1050	1.13				x	-	normal	x			x
Oct 18		1330	1.13				x	-	normal	x			x
Nov 12		1130	1.13				x	-	normal		x		x

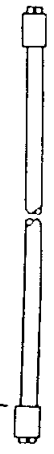
II) General Comments on Condition of Watercourse

Date:

12/11/86

Comments:

Unseasonably cold weather has frozen gauge; outside reading taken from water level to bottom of gauge.

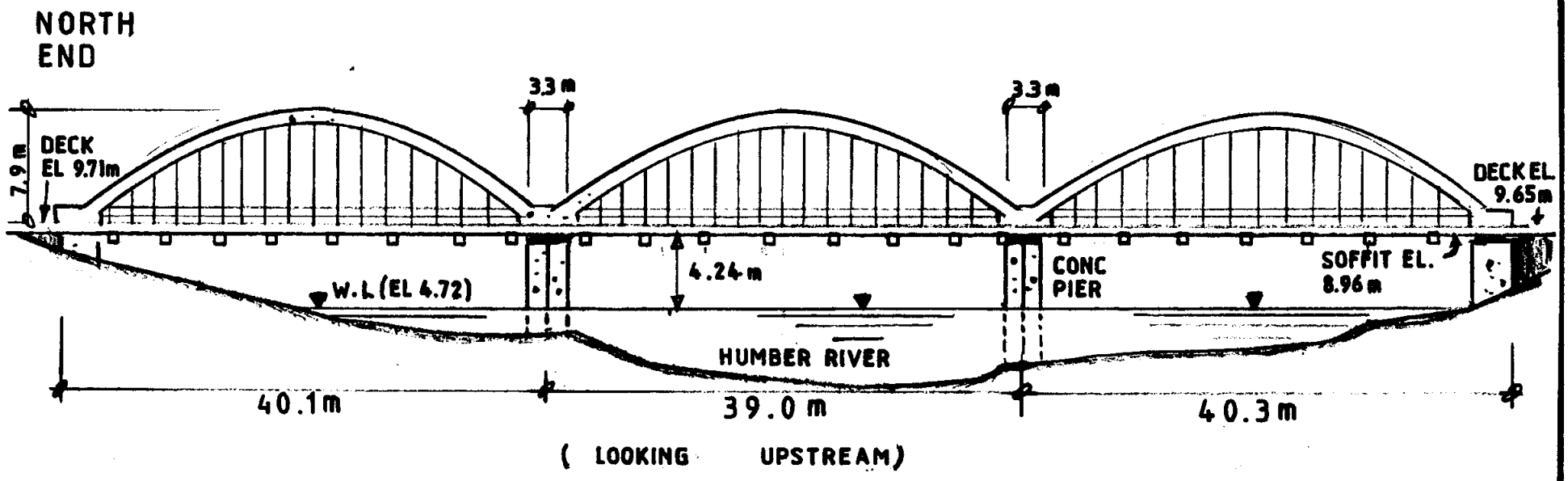


4.09 m

APPENDIX D

PHYSICAL DIMENSIONS: NICHOLSVILLE BRIDGE

PHOTO INVENTORY

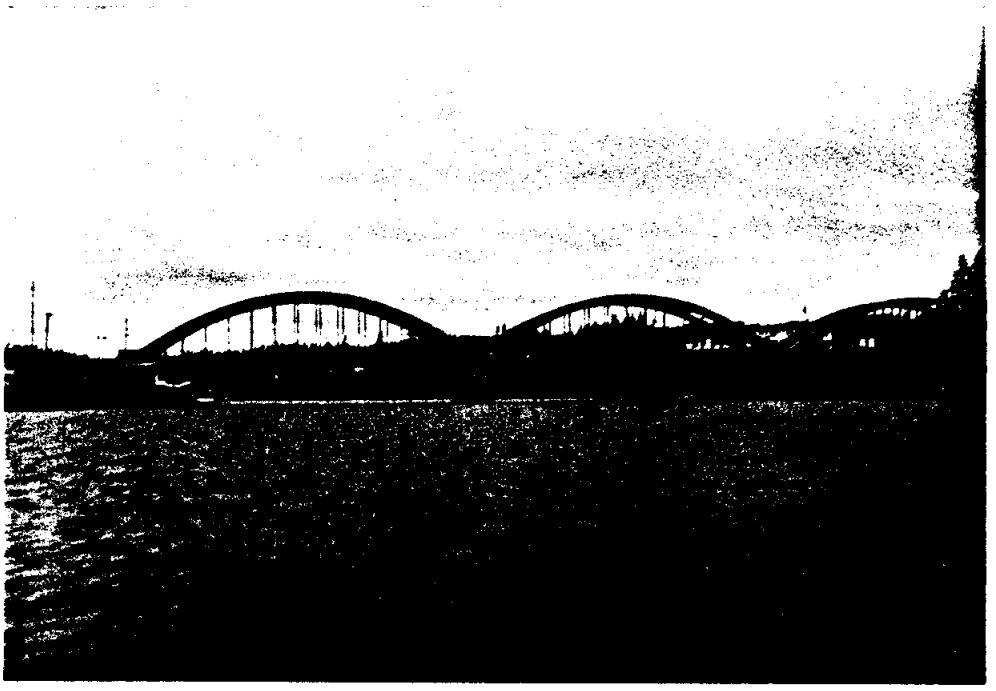


NICHOLSVILLE BRIDGE

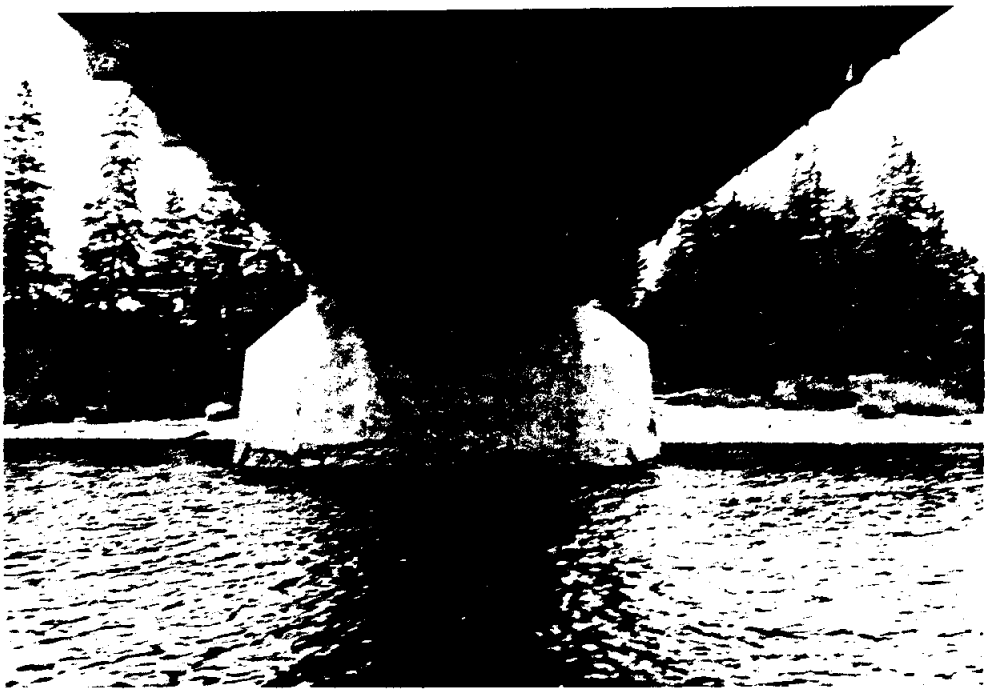
SCALE 1:500

Upper Humber River - south embankment at Section UH100

Upper Humber River - south embankment in area of Section UH300



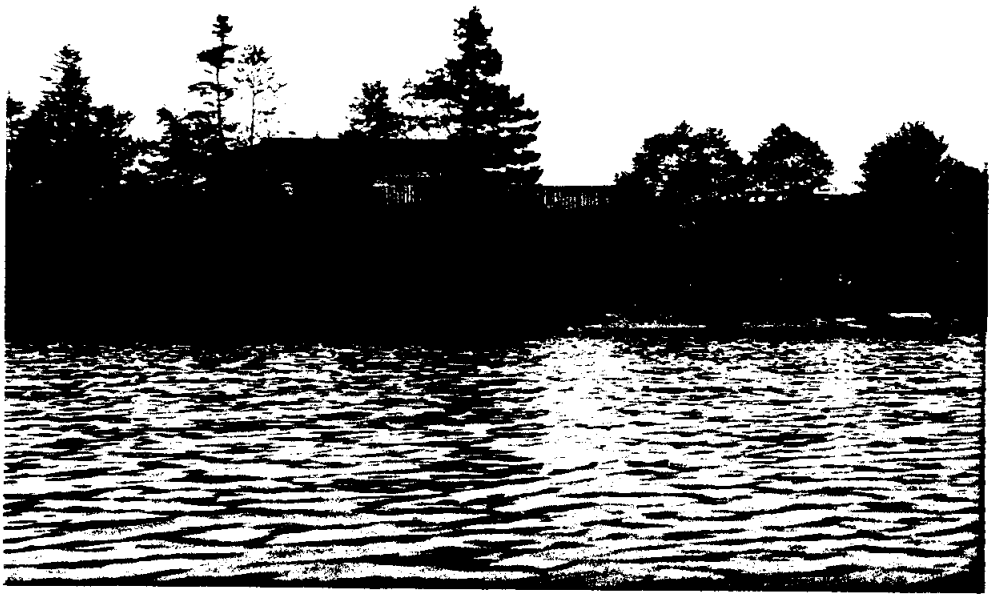
Nicholsville Bridge - looking upstream



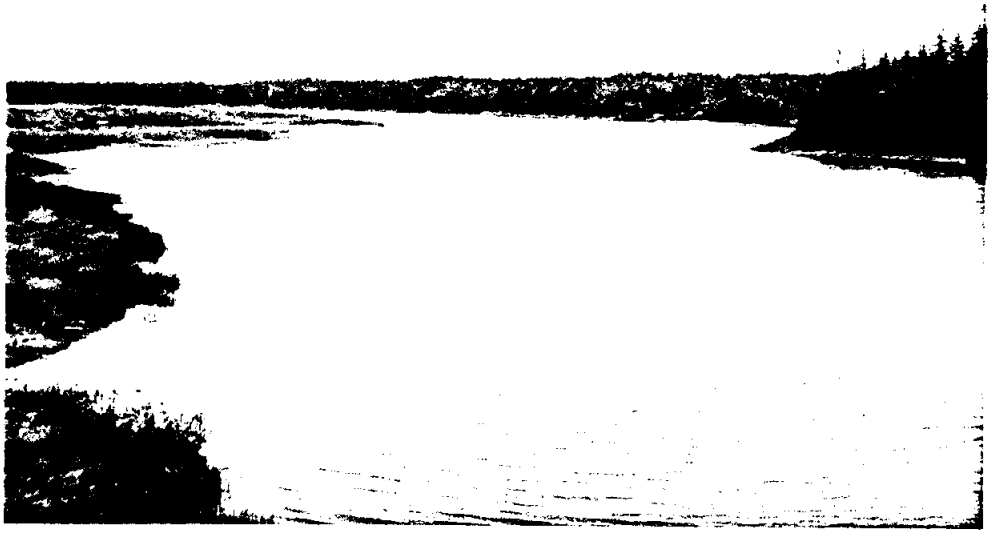
Nicholsville Bridge - underside looking at north embankment

Upper Humber River - south embankment at Section UH400 showing cribwork

Crest gauge location - south embankment of Upper Humber River immediately upstream of Nicholsville Bridge

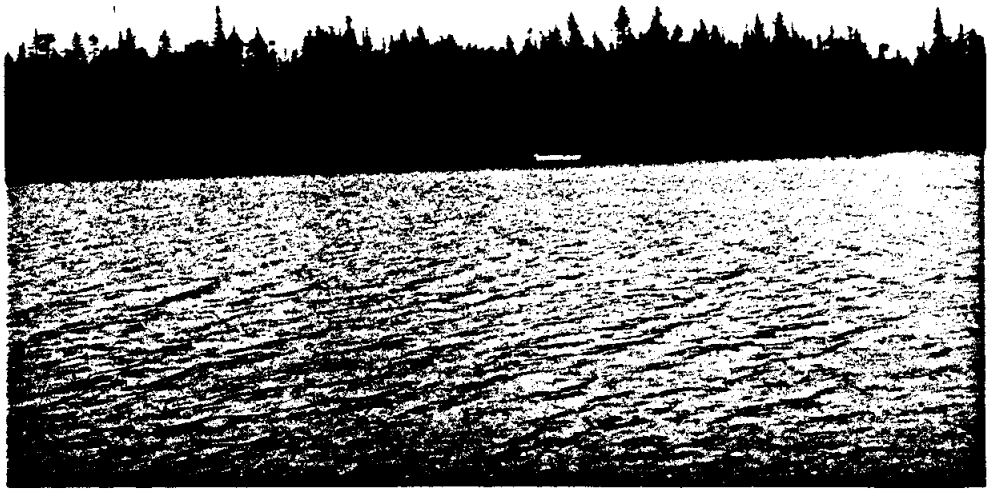


Upper Humber River - south embankment at Section UH500



Upper Humber River - looking upstream from Section UH500 towards Section UH600

Upper Humber River - looking upstream from Section UH800 with Route 430 bridge crossing in background



Upper Humber River - south embankment at Section UH800