Flood Risk Mapping Study
of the
Trout River Area

TECHNICAL APPENDICES
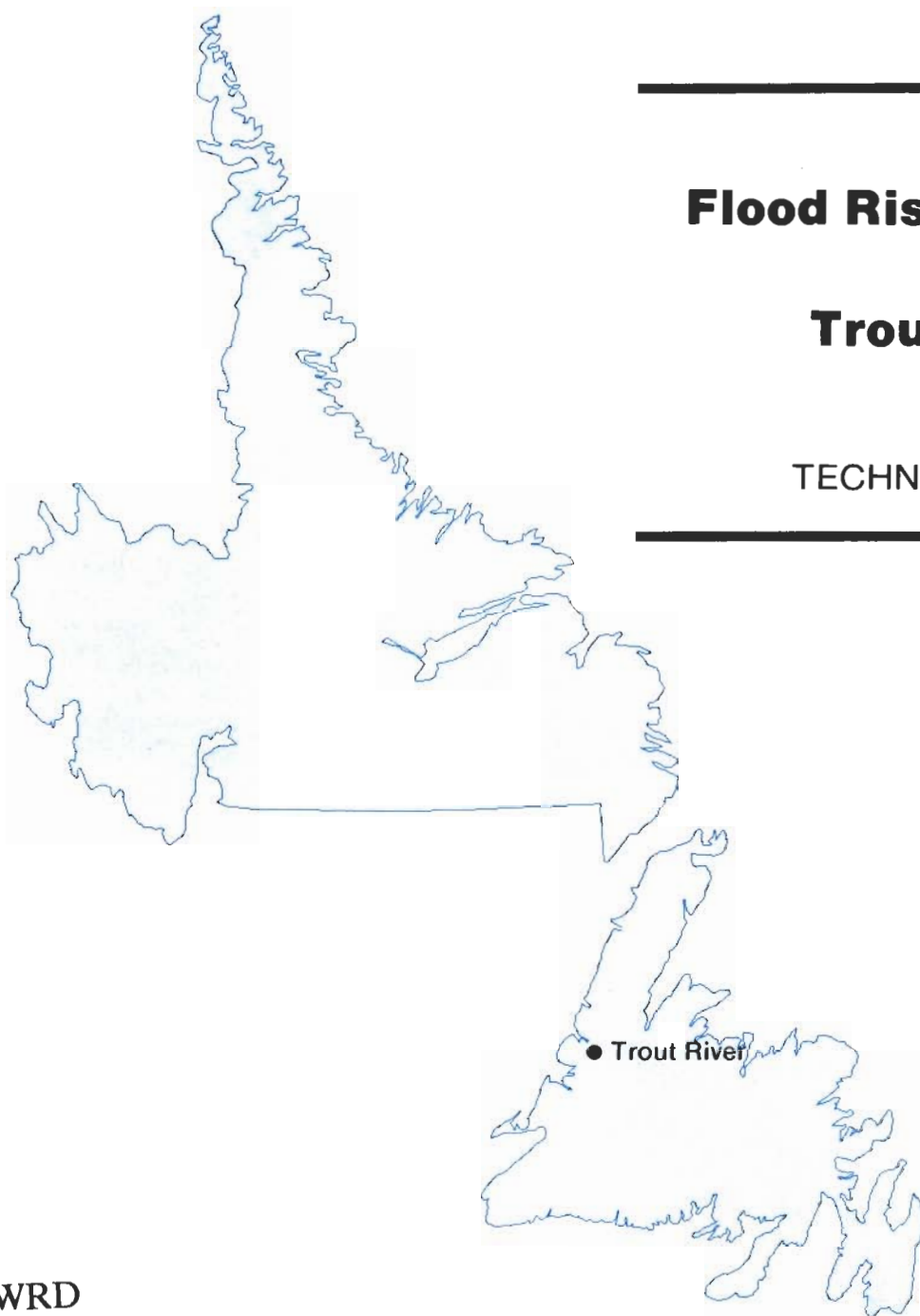
● Trout River

ISLAND ENGINEERING CO. LTD.
CORNER BROOK
NEWFOUNDLAND

TROUT RIVER HYDROTECHNICAL STUDY

FINAL REPORT

BACKGROUND DATA & SURVEY AND MONITORING

PREPARED FOR

CANADA - NEWFOUNDLAND

FLOOD DAMAGE REDUCTION PROGRAM

ST. JOHN'S   NEWFOUNDLAND

JOINTLY PREPARED BY

ISLAND ENGINEERING CO. LTD

CORNER BROOK   NEWFOUNDLAND

AND

CUMMING COCKBURN LIMITED

WILLOWDALE   ONTARIO

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I N D E X

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SECTION 1

FIELD REPORT

1.0 FIELD REPORT

1.1 <u>Introduction</u>

The objective of this study is to produce flood risk profiles and maps for Trout River and Feeder Brook. This will be achieved by conducting hydrotechnical studies on the Feeder Brook and Trout River watersheds under the following guidelines:

1. Obtain and analyze background information on local ice jams, historical flooding and hydraulic characteristics in the study area in order to document the flood problems.

2. Obtain and review background climatological, hydrometric and tidal information relevant to flood conditions in the study area.

3. Analyze the influence of ice jams on flooding in the study area.

4. Determine the influence of local physiographic and cultural factors on flooding conditions in the watershed.

   The field program was undertaken by staff members of Island Engineering Co. Ltd. and Cumming-Cockburn and Associates Ltd.

   Arrangements were made with a local resident, Mr. Fred Crocker, to take crest gauge readings. As well, Mr. Crocker was engaged to assist with the surveying activities.

   Mr. Bill Mullins and Mr. Paul Noseworthy, Water Resources Branch, Environment Canada, Water Resources Branch, were engaged to monitor stream flow velocities. The following sections describe the field program which primarily comprised stream flow measurements, and physical surveys related reconnaissance activities.

1.2 Field Program

Physical aspects of the field program included installation of crest gauges and subsequent collection of stream discharge data and water level measurements during runoff conditions.

In addition, all structures along both Trout River and Feeder Brook were identified by photographs and physical dimensions obtained.

Cross-sections of the channel and flood plain at various locations along both watercourses were surveyed as part of the initial field program.

To supplement the physical aspects of the field program, field investigators conducted interviews with long time residents of the area to obtain a better understanding of past floods, their causes, and their severity. These interviews resulted in our obtaining relevant information and photographic documentation of past floods.

1.3 Crest Gauge Stations

Upon reviewing the existing mapping for the area, it was decided that three crest gauges would be adequate to obtain the required water level measurements. This was also confirmed in the field and the gauges were placed where required.

The gauges were located in the main stream channel and where structural or natural constraints such as bridges or islands could impede the flow and thus cause backwater buildup.

Three 2.2 m long crest gauges were constructed using 50 mm A.B.S. piped closed at both ends. Small holes were drilled approximately 300 mm from the bottom of the pipe to allow water to enter.

A square wooden measuring rod was then put in the tube. Ground cork was also put in the tube. The cork would stick to the wooden rod indicating the maximin water level. These crest gauges were installed on May 9, 1989.

Elevations for the crest gauges were established relative to Geodetic Datum and the level circuits for the cross sections. The gauges were tied into Geodetic Benchmark 77.

031, set in concrete on the foundation wall of Jakeman Central High School in the Community of Trout River.

The locations of the crest gauges and Geodetic Benchmarks are listed in Section A of this summary report.

Photographs will accompany the location and description of the crest gauges.

1.4 Physical Surveys

Physical surveys carried out as part of the field program included defining structure types and sizes along both watercourses, obtaining cross-sections of both streams and also flood plains.

These aspects of the physical survey are referenced to Geodetic datum and large scale topographic mapping of the area.

These field measurements are described in greater detail in the following sub-sections.

1.4.1 Obstructions

Obstructions along Trout River and Feeder Brook cause the flow in both streams to be somewhat impeded. Therefore, physical dimensions and critical elevations, as noted below, were obtained.

Bridges
Clear span opening between piers.
Height of bridge deck above the channel bottom.
Intermediate pier dimensions.
Deck surface elevation.
Depth of flow at centre of span or channel.

Culverts
No. of culverts.
Size of culverts.
Invert elevation.
Elevation of road above culverts.

Islands
Size.
Elevation of highest point.

The pertinent data sheets and photographs for each of the aforementioned structures are included in Section B of this report.

The photographs were taken during the period of May 8 - 10, 1989.

1.5 Cross Sections

Prior to the start of the cross sectioning survey, both streams were traversed in order to select the locations of the cross section points. Using a Wild Nako Level, temporary bench marks and turning points were established to be used as vertical control.

Field personnel then proceeded to survey cross sections, starting at a cross section on the Government Wharf, which is located at the mouth of Trout River. Cross sections 1 and 2 were done on May 9, 1989 using a Nikon N.T.D. 4 E.D.M. Theodolite. Field location of the lines was determined by angle and distance measurements from existing landmarks. Subsequent measurements were performed in the same manner.

Since the two streams were too fast to get a profile during the time of the initial surveying of the stream beds by wading or by boat, it was decided that only land sections be taken at this time. Bottom profiles would have to be taken at a time when the water conditions were more appropriate. A total of thirteen cross sections were taken on land, eleven on Trout River and two on Feeder Brook. The land sections on Trout River started at the mouth of the river itself, where it runs into the harbour, and proceeded upstream to where the it runs out of Trout River Pond.
These land cross sections varied in length from 70 m to 264 m.

Land sections on Feeder Brook began at $\pm$ 10 m downstream from the bridge over the brook to a point $\pm$ 430 m upstream from the bridge.

Two sections were taken varying in length from 14 m to 30 m.

Bottom cross sections of both Trout River and Feeder Brook were surveyed on June 16, 1989, and varied in width from 22 m to 42 m.

1.6 Discharge Measurements

Two stations, one on each of the watercourses, were established to facilitate stream discharge measurements as part of the field monitoring program.

The station on Trout River was located at the upstream rail on the bridge over Trout River at the outlet of Trout River Pond. This Bridge is designated as B1.

The station on Feeder Brook was located $\pm$ 10 m downstream from the bridge over Feeder Brook. This bridge is designated as B2.

On May 17 and May 30, 1989, flow measurements were taken by using a 50 lb leaded weight with an automatic current meter. Twenty (20) vertical sections were taken over the span of the river and a discharge rate of 36.7 m^3/sec was calculated.

Flow measurements at B2 were taken by wading. Twenty-one (21) vertical sections were taken over the span of the brook and a discharge rate of 1.63 m^3/sec was calculated.

On May 30, 1989, the same procedure was repeated to obtain the low flow measurements. Flow measurement at B1 was 20.7 m^3/sec and at B2 was 0.769 m^3/sec.   The charge calculations are included in Section "C".

The monitoring program continued for 1 $\frac{1}{2}$ months, terminating on July 22, 1989. During this period river elevations were obtained during periods of rainfall and during normal periods.

Two significant problems were encountered during the monitoring program.

(1)   There was no significant amount of rainfall in the
        Trout River area during the monitoring period.
        Although the snowfall received during the 1988 - 1989
        winter months was normal for the area, gradual melting
        of the snow in the surrounding hills eliminated large
        spring floods. As a result, there were no flood
        events.

(2)   Although the crest gauges were not destroyed, they
        had been tampered with on numerous occasions.

        However, the gauges could be adjusted to their
        original position and measurements taken by the normal
        procedure.

TABLE I

CREST GAUGE LOCATIONS
FOR
TROUT RIVER HYDROTECHNICAL STUDY

TEST GAUGE NO.	LOCATION
1	On wooden retaining wall adjacent to cross section line #2, roadside of Trout River.
2	On wooden retaining wall near Jakeman Central High School, roadside of Trout River.
3	Between large rocks underneath Bridge #1 at the mouth of Trout River Pond.

TABLE 2

LIST OF GEODETIC BENCHMARKS
USED FOR SURVEY CONTROL
TROUT RIVER HYDROTECHNICAL STUDY

Benchmark Number	Elevation	Description of Location
77F033	4.796	Anglican Church, tablet in north of front concrete foundation, 50 cm from northwest corner, 90 cm below wooden clapboard siding. Latitude: 49 - 28.8 Longitude: 58 - 07.8
77F031	2.227	Jakeman Central High School, tablet in East or front concrete foundation. 1.0 m from southeast corner, 65 cm below siding. Latitude: 49 - 28.4 Longitude: 58 - 07.8

TROUT RIVER WATER LEVELS

DATE	TIME	GAUGE #1 SHED (cm)	GAUGE #2 SCHOOL (cm)	GAUGE #3 POND (cm)	CLIMATIC CONDITION
May 8		52.07	76.20	109.22	
May 9		92.00	76.20	109.22	
May 10		93.98	74.93	106.68	
May 12	5:00 p.m.	85.00	74.50	112.50	Before Rain
May 14	1:15 p.m.	116.50	75.50	116.50	After Rain
May 16	5:30 p.m.	117.5	72.00	106.50	
May 18	6:00 p.m.	97.50	61.50	104.00	
May 22	7:15 p.m.	117.00	61.00	89.00	
May 25	12:00 a.m.	112.00	54.00	68.00	Before Rain
May 31	9:30 a.m.	151.00	48.00	55.00	
June 6	9:00 a.m.	160.00 T	44.00	57.00 T	
June 13	10:15 a.m.	152.00	31.00	54.00	
June 20	8:00 a.m.	STOLEN	12.00	STOLEN	
June 27	11:00 a.m.		11.00		Before Rain
June 30	4:00 p.m.		42.00		After Rain
July 4	10:30 a.m.		25.00		
July 11	6:00 p.m.		12.00		
July 18	11:00 a.m.		8.00		
July 22			6.00		

NOTES :

T – The guage was tampered with.

STOLEN – The guage was no longer in place.

SECTION 2

BACKGROUND

2.0 BACKGROUND

2.1 Interviews

On May 8, 9, and 10. 1989 interviews were held with residents of Trout River and other people knowledgable of the area. Further interviews were held in June and July, 1989.

Mr. David Hann of Trout River indicated there is frequent flooding on the road. Some years the ice in the Lower Trent River Pond melts in place, staying in the pond as it did in 1989. Other years the ice breaks up and flows down the river, jamming at downstream locations. Precise locations of these ice jams were not indicated.

Mr. Issac Crocker has live in the first house upstream of the bridge, on the east side of the river, west of the road, for the past 40 years. Before that he lived on the other side of the river. He has seen ice pans two to three feet thick and twenty feet long going past house. They do not jam up and cause flooding at the bridge. He has not been flooded from the river since a 1 meter high retaining wall was installed along the river with fill placed behind it.
The wall was constructed in the mid 1970's and is currently only in fair condition.

Mr. Fred Crocker lives near Isaac Crocker but approximately 35 m east of the road, further from the river. He indicated that some ice occasionally backs up at the bridge, but never enough to cause flooding. The tide comes up as far as the bridge but does not seem the make the problems any worse.

Mr. Crocker said that flooding in town (he has had water in his yard) occurs upstream at the confluence of the "Feeder" and Trout River. Ice comes down the Feeder and backs up at the bridge and culverts. Water flows across the road, and down the road into town. 1989 is the first year he had not seen flooding of the road.

Ice flowing down Trout River also accumulates in the shallows at the outlet of the Feeder and combines with ice from the Feeder causing water backup.

Mr. Walter Crocker lives in the first house downstream of the Feeder, on the east side of the road. Mr. Crocker says that the road has not flooded since the new bridge was built (about 1976) and the four culverts placed at the location of the old bridge. With the old bridge, sheet ice from the Feeder used to back up at the bridge and flood the road.

Mr. Barnes said that the largest flood ever was in 1938. That year, a barn at the fork in the road (with Hwy. 431) was washed away during the spring flood.

Mrs. Mary Crocker said there was another big flood about 30 years ago (1959). Photographs taken at that time by a local resident are shown in Figure 2.1.

Mr. Murdock Brake, an elderly resident of Trout River, has lived most of his life in a house located on the east side of the river, west of the road, about 600 meters north of the Big Feeder Brook. Mr. Brake indicated the last two large floods that he could recall occurred in 1976 and 1983, respectively. He has seen ice jams at the Trout River bridge, but has not seen any flooding of the town as a result of these ice jams since the retaining wall was built. Mr. Brake said that the major cause of flooding in the last 15 years has been from the Big and Small Feeder Brooks.

Discussions with Mr. H. Smith, Public Works Canada, in Rocky Harbour, indicated that Public Works has no information concerning the Trout River flooding problems.

A meeting was also held with Mr. P. Caines, Chief Park Warden for Gros Morne National Park. After discussion with other staff members, it was determined that Parks Canada had no photographs or records on Trout River. When the new bridge was built at Lower Trout River Pond, some research was done into high water marks but all information was verbal.

When it is needed, Parks Canada gets tidal information from the Coast Guard.

2.2 Historical Floods

2.2.1 History of Flooding

Winter 1985/86: According to Mr. Howard Crocker, the Mayor of Trout River in 1989, ice which formed on the Feeder Brook broke up and was flushed downstream to jam at the confluence of the Feeder with Trout River. In this incident a local road was closed die to water an ice flowing across it. There were no reports of any property damage. Mr. Crocker stated that this type of flooding occurs every two or three days.

1980-82: Floods have also occurred as a result of ice jams near the island in Trout River. Sometime between 1980 and 1982 an ice jam near this island resulted in the grounds surrounding the local school being flooded. There were no reports of property damage from this flood. According to residents this type of flooding occurs less frequently than the type of event noted above.

Spring 1976: The Trout River bridge was damaged by ice and high water. Scouring was reported around the centre pier and settling resulted. Ice also damaged the planking on the nose of the piers. No other damage was reported.

2.2.2 Nature of Flooding

The known floods which have occurred in the Trout River area appear to have been as a result of ice jams, usually at the confluence of Feeder Brook with Trout River, and less frequently at the island in the river of near the bridge in the community. There have been no reports of floods from high fresh water flows or of floods related to high tides alone.

We have been informed by the residents of Trout River that the flooding in the last 15 years has not been caused by Trout River but by two small tributaries which flow into the river known as the Big and Small Feeder brooks. Before 1975 the runoff was handled by the two Feeder brooks and each brook contained its own bridge. In 1975 or 1976 the Department of Highways tried to rechannel all of the runoff into Big Feeder Brook by eliminating the bridge on the Small Feeder and placing four 1.2 meter culverts in its place. Eighty meters downstream from the pump house where the Big Feeder and Small Feeder intersect a gravel retaining wall was constructed to eliminate the flow of water into the Small Feeder. A new bridge was then constructed over the Big Feeder. This was an attempt by the Department of Highways to eliminate the problem of flooding caused by ice jamming at both of the old bridges. Ten to fifteen meters above the area where the gravel retaining wall was constructed, a bend in the Big Feeder caused ice to accumulate during the quick runoff. Water built up behind the ice and flowed over the gravel retaining wall into the Small Feeder down towards the four culverts. Snow buildup around the four culverts from natural snow fall and winter snow clearing caused the culverts to block up. The water that flowed into the Small Feeder built up behind the blocked culverts until it reached a level where it flowed onto the road and into surrounding fields. Ice build up at

big Feeder Bridge added to the flooding problem. Another
problem area is where the Big Feeder and Trout River
intersect. If this area is blocked with ice from Trout River
then ice flowing down the Big Feeder has nowhere to go and
adds to the ice jam. Water builds up behind the ice,
resulting in the surrounding area being flooded. This
flooding does not seem to be as serious as the first one
mentioned.

2.3 Previous Studies

2.3.1 Regional Flood Frequency Analysis for the Island of Newfoundland.

A study was carried out with the objective of providing a
technique for estimating the 20 and 100 year recurrence
interval instantaneous flood flows for the Island of
Newfoundland. The results are described in the report
"Regional Flood Frequency Analysis for the Island of
Newfoundland". These are extensively used in the estimation
of flood flows for a variety of projects including flood risk
mapping, remedial measures studies, the design of spillways,
bridges, and other hydraulic structures.

2.4 Existing Data

2.4.1 Hydrometric Data

Data from five hydrometric stations in the area would be used.
These stations are:

1.   02YF001 Cat Arm River above Great Cat Arm
2.   02YJ001 Harry's River below Highway Bridge
3.   02YK002 Lewassechjeech Brook at Little Grand Lake
4.   02YK003 Sheffield River near the TCH
5.   02YK004 Hinds Brook near Grand Lake

Physiographic and hydrometric data for each of these stations
is shown in Table 2.1. The locations of these hydrometric
stations and others is shown on Figure 2.2.

Regression equations and results for both the entire Island
and for the North Region for the 20 and 100 year storms are
shown in Appendix A. The parameter range used for the
analysis is given in Table 2.2.

TABLE 2.1 (Part 1)

PHYSIOGRAPHIC AND HYDROMETEOROLOGIC DATA BASE

STATION NAME AND NUMBER	DRAINAGE AREA (sq. km)	LAKE AREA (sq. km)	SWAMP AREA (sq. km)	FOREST AREA (sq. km)	BARREN AREA (sq. km)	LENGTH OF MAIN CHANNEL (km)	ELEVATION OF BASIN DIVIDE IN VICINITY OF MAIN CHANNEL (m)	SLOPE OF MAIN CHANNEL (%)	DRAINAGE DENSITY (km/sq. km)	SHAPE FACTOR	OVERBURDEN THICKNESS (m)
Cat Arm River above Great Cat Arm (02YF001)	611	51.39	28.91	420.69	110.01	30.17	250	0.829	0.582	1.86	2.19
Harry's River below Highway Bridge (02YJ001)	640	35.43	55.24	505.48	43.85	60.00	509	0.848	1.12	1.81	4.62
Lewaseechjeech Brook at Little Grand Lake (02YK002)	470	46.47	29.05	258.25	136.23	54.88	560.8	1.022	0.627	2.32	0.98
Sheffield River near Trans Canada Highway (02YK003)	391	37.36	29.7	264.59	59.34	38.09	378	0.992	0.191	1.98	19.8
Hinds Brook near Grand Lake (02YK004)	529	62.54	125.41	186.26	154.79	49.29	320.1	0.649	0.637	1.78	12.5

TABLE 2.1 (PART 2)

PHYSIOGRAPHIC AND HYDROMETEOROLOGIC DATA BASE

STATION NAME AND NUMBER	AREA CONTROLLED BY LAKE & SWAMP (%)	MEAN ANNUAL RUNOFF (mm)	MEAN SNOWPACK WATER EQUIVALENT AT BASIN CENTROID ON MARCH 20 (mm)	24 HOUR, 25 YEAR RETURN PERIOD STORM RAINFALL AT CENTROID (mm)	Q exp P Base 2 (cu. m/s)	Q exp P Base 10 (cu. m/s)	Q exp P Base 20 (cu. m/s)	Q exp P Base 100 (cu. m/s)	LATITUDE (degrees)	LONGITUDE (degrees)
Cat Arm River above Great Cat Arm (02YF001)	100	1420	430	84	271	379	417	499	50.16	57.050
Harry's River below Highway Bridge (02YJ001)	75	1321	250	82	321	530	617	825	48.747	58.000
Lewaseechjeech Brook at Little Grand Lake (02YK002)	100	1162	270	84	86.3	131	147	183	48.569	57.653
Sheffield River near Trans Canada Highway (02YK003)	94	856	260	78	74	98	103	113	49.282	56.597
Hinds Brook near Grand Lake (02YK004)	95	984	250	80	91.3	126	138	164	48.963	57.018

Table 2.2

PARAMETER RANGE USED IN ANALYSIS*

ENTIRE ISLAND

DA	3.9	to 4400	km^2
MAR	788	to 2124	mm
ACLS	55	to 100%	
SHAPE	1.24	to 2.45	

NORTH REGION

DA	237	to 4400	km^2
MAR	788	to 1420	mm
LATITUDE	48.379	to 50.943	degrees

SOUTH REGION

DA	3.9	to 2640	km^2
MAR	929	to 2124	mm
ACLS	55	to 100%	
SHAPE	1.24	to 2.45	

*   These parameter ranges are presented for general guidance only. If, when computing flood flows using the equations presented in this report, the value of the above parameters falls near the extremities of or outside these ranges, then the estimates of flood flows will questionable.

SOURCE: REGIONAL FLOOD FREQUENCY ANALYSIS FOT THE ISLAND OF NEWFOUNDLAND

TABLE 2.3

EXAMPLE OF LARK HARBOUR TIDE DATA

```
0      164LARK HARBOUR NFLD                                          -        NST -
0   1  164   93   55   21   -8  -28  -13    0   51   90  139  177  205-
0   1  164  214  200  165  127   92   66   56   76   98  129  142  153-
0   2  164  142  112   71   40   13   -1   11   33   80  119  157  201-
0   2  164  219  232  219  196  165  140  121  109  128  144  161  169-
0   3  164  167  157  126   89   55   29   13   18   39   69  111  141-
0   3  164  174  189  191  175  150  120   95   87   90  105  130  151-
0   4  164  168  169  164  134  109   82   56   53   56   79  100  133-
0   4  164  154  177  175  163  151  118  102   77   77   82  100  119-
0   5  164  137  152  156  150  132  112   93   76   73   80   97  114-
0   5  164  139  151  164  166  155  142  122  100   86   84   90  106-
0   6  164  127  139  153  158  155  141  120  101   82   73   71   83-
0   6  164   99  116  129  143  139  132  119  100   83   70   72   75-
0   7  164   97  108  124  135  145  143  133  119  106   95   92   95-
0   7  164  108  119  130  137  150  141  133  114   99   81   71   69-
0   8  164   77   89  101  119  131  138  136  128  116   98   84   75-
0   8  164   74   83   92  103  117  121  120  108   97   78   63   52-
0   9  164   57   60   76   96  113  132  144  147  140  127  113   94-
0   9  164   83   82   84   96  103  113  117  116  107   79   71   47-
0  10  164   39   40   48   71   89  123  147  162  163  160  157  132-
0  10  164  140  127  135  144  169  192  203  218  214  198  167  143-
0  11  164  114   90   60   79   97  111  136  155  165  156  142  126-
0  11  164  108   91   84   94  110  129  150  171  177  172  162  140-
0  12  164  119   97   87   89  103  127  154  179  192  196  183  162-
0  12  164  127  103   86   80   86   97  114  129  141  138  126  101-
0  13  164   71   43   30   30   37   68  105  135  166  179  184  168-
0  13  164  144  116   94   80   80   91  109  129  141  150  139  121-
0  14  164   95   66   46   37   46   66   99  142  173  183  204  210-
0  14  164  183  165  132  102   99   95  119  133  156  168  166  153-
0  15  164  122   90   59   41   35   42   72  105  148  171  189  193-
0  15  164  183  164  135  112   94   89  101  118  143  164  176  174-
0  16  164  154  124   92   62   45   44   61   91  126  157  187  197-
0  16  164  197  177  148  119   94   82   83   99  124  149  166  172-
0  17  164  169  145  112   82   60   52   59   83  117  151  179  200-
0  17  164  205  199  174  143  108   87   75   80  100  117  137  147-
0  18  164  141  123   96   68   43   26   22   34   63   98  134  165-
0  18  164  181  185  166  135  109   82   70   66   86  107  129  149-
0  19  164  153  151  130  101   73   51   41   42   60   95  116  145-
0  19  164  163  173  160  136  103   79   59   56   67   90  116  130-
0  20  164  147  142  134  109   87   58   45   44   52   80  104  134-
0  20  164  148  159  160  144  131  111   80   65   56   65   83  104-
0  21  164  130  140  150  142  127  108   84   64   58   63   84   96-
0  21  164  131  151  163  165  155  147  109  100   77   85   92  102-
0  22  164  132  149  170  179  176  168  147  126  103   98   89  102-
0  22  164  119  136  152  160  162  152  130  105   83   66   61   66-
0  23  164   88  108  130  150  166  168  160  142  127  105   92   90-
0  23  164   96  112  126  142  153  156  144  126  102   80   62   55-
0  24  164   63   80  105  127  149  167  171  164  149  130  109   89-
0  24  164   84   90   98  117  131  144  148  138  125   96   77   56-
0  25  164   52   56   70   99  130  154  178  181  176  155  134  107-
0  25  164   88   79   77   94  101  123  123  141  126  112   93   68-
0  26  164   61   44   50   82  125  161  201  233  242  233  203  172-
```

2.4.2 Tidal Data

Hourly tidal data for the Lark Harbour station was obtained for the period 1963-1988. These data were provided by Environment Canada (Marine Environmental Data Service) and the Department of Fisheries and Oceans in hard copy tabular form (150 pages). (See Table 2.3 for an example page of the data format.)

In addition two recent investigations on tides and extreme water levels at Cox's Cove and Parson's Pond were obtained and reviewed.[1] [2] The results of these analyses are summarized in Tables 2.4 and 2.7.

No local tidal measurements were found. In the absence of local tidal measurement, tidal information will be derived from the regional reference point at Harrington Harbour. Comparisons will then be made to the above noted investigations in order to determine the modification in water level necessary to approximate storm surge effects. Interpolation of results from Table 2.4 to 2.7 will be utilized and/or referred to for comparison purposes.

2.4.3 Field Surveys

Field Surveys of channel and floodplain characteristics were carried out along the Trout River in the spring of 1989 by staff from Island Engineering and Cumming Cockburn Limited. These studies are discussed in Section 3.0 of this report.

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[1] Martec Limited "Historical Flooding Review and Flood Risk Mapping Study for Cox's Cove", Canada-Newfoundland Flood Damage Reduction Program, Newfoundland Department of Environment, Environment Canada, December 1988.

[2] Martec Limited, "Historical Flooding Review and Flood Risk Mapping Study for Parson's Pond", Canada-Newfoundland Flood Damage Reduction Program, Newfoundland Department of Environment, Environment Canada, December 1988.

TABLE 2.4

EXTREMAL ANALYSIS OF PARSON'S POND
WATER LEVEL DATA

Ordered Input Data (m above)		Surge Year	Probability	Return Period
Chart Datum	Geodetic Datum			
2.95	1.06	1985	.041	24.342
2.91	1.02	1970	.095	10.511
2.86	.97	1983	.149	6.703
2.81	.92	1966	.203	4.920
2.81	.92	1968	.257	3.887
2.80	.91	1971	.311	3.212
2.78	.89	1973	.365	2.737
2.76	.87	1977	.419	2.384
2.75	.86	1969	.474	2.112
2.74	.85	1982	.528	1.895
2.72	.83	1974	.582	1.719
2.71	.82	1981	.636	1.573
2.71	.82	1972	.690	1.450
2.70	.81	1965	.744	1.344
2.69	.80	1986	.798	1.253
2.69	.80	1979	.852	1.174
2.60	.71	1978	.906	1.104
2.57	.68	1967	.960	1.042

	Input Data	Three-Parameter Lognormal Transformation
mean	2.7512	0.2908
standard deviation	0.1000	0.0714
coefficient of skew	0.2170	-0.0016
coefficient of kurtosis	3.9594	3.9506

TABLE 2.5

WATER LEVEL AT PARSON'S POND
FOR SELECTED RETURN PERIODS

Three-Parameter Lognormal Distribution fitted by Maximum
Likelihood.

RETURN PERIOD (year)	ESTIMATE (m above)		90% CONFIDENCE LIMITS (m above)	
	Chart Datum	Geodetic Datum	Chart Datum	Geodetic Datum
5	2.83	0.94	2.79 - 2.88	0.90 - 0.99
10	2.88	0.99	2.82 - 2.93	0.93 - 1.04
20	2.92	1.03	2.84 - 2.99	0.95 - 1.10
50	2.96	1.07	2.87 - 3.05	0.98 - 1.16
100	2.99	1.10	2.88 - 3.10	0.99 - 1.21
200	3.02	1.13	2.88 - 3.15	0.99 - 1.26

Source: Martec Limited, "Historical Flooding
Review and Flood Risk Mapping Study for
Parson's Pond", Canada-Newfoundland and
Flood   Damage   Reduction   Program,
Newfoundland Department of Environment,
Enviroment Canada, December 1988.

TABLE 2.6

EXTERNAL ANALYSIS OF LARK HARBOUR/COX'S COVE WATER LEVEL DATA

Ordered Input Data (m above)		Surge Year	Probability	Return Period
Chart Datum	Geodetic Datum			
2.79	1.75	1970	.041	24.342
2.58	1.54	1981	.095	10.511
2.57	1.53	1966	.149	6.703
2.56	1.52	1983	.203	4.920
2.56	1.52	1985	.257	3.887
2.51	1.47	1968	.311	3.212
2.49	1.45	1977	.365	2.737
2.49	1.45	1969	.419	2.384
2.47	1.43	1971	.474	2.112
2.44	1.40	1965	.528	1.895
2.42	1.38	1979	.582	1.719
2.39	1.35	1982	.636	1.573
2.37	1.33	1974	.690	1.450
2.35	1.31	1972	.744	1.344
2.33	1.29	1978	.798	1.253
2.30	1.26	1986	.852	1.174
2.30	1.26	1967	.906	1.104
2.28	1.24	1973	.960	1.042

	Input Data	Three-Parameter Lognormal Transformation
mean	2.4556	-1.1956
standard deviation	.100	.4041
coefficient of skew	.7935	-.1260
coefficient of Kurtosis	4.6276	2.9764

Source: Martec Limited, "Historical Flooding Review and Flood Risk Mapping Study for Cox's Cove", Canada-Newfoundland and Flood Damage Reduction Program, Newfoundland Department of Environment, Environment Canada, December 1988.

TABLE 2.7

WATER LEVEL AT LARK HARBOUR/COX'S COVE
FOR SELECTED RETURN PERIODS

Three-Parameter Lognormal Distribution fitted by Maximum Likelihood.

RETURN PERIOD (year)	ESTIMATE (m above)		90% CONFIDENCE LIMITS (m above)	
	Chart Datum	Geodetic Datum	Chart Datum	Geodetic Datum
5	2.55	1.52	2.47 - 2.63	1.45 - 1.59
10	2.63	1.60	2.52 - 2.74	1.49 - 1.71
20	2.71	1.68	2.56 - 2.87	1.52 - 1.83
50	2.82	1.78	2.59 - 3.05	1.56 - 2.01
100	2.90	1.86	2.61 - 3.19	1.57 - 2.16
200	2.98	1.95	2.61 - 3.35	1.58 - 2.31

Source: Martec Limited, "Historical Flooding Review and Flood Risk Mapping Study for Cox's Cove", Canada-Newfoundland and Flood Damage Reduction Program, Newfoundland Department of Environment, Enviroment Canada, December 1988.

SECTION 3

STUDY OF ICE CONDITIONS

3.0 STUDY OF ICE CONDITIONS

During the months of December, 1989, and January, 1990, the entire northern peninsula was subject to prolonged periods of extreme cold temperatures. This resulted in the freezing of the majority of rivers and waterways in the vicinity of the Community of Trout River. Those waterways that did not freeze completely were filled with pans of ice. This type of weather condition is consistent with normal winter conditions in the region. These conditions usually continue until spring. However, on January 25, 1990, weather conditions changed drastically. From January 25 to the 28 temperatures rose to above freezing levels and there was constant rain. By January 27, 1990, the change in weather conditions had caused considerable flooding in the Community of Trout River. The main reason for the flooding was a build-up of ice at the mouth of Trout River. This ice build-up, combined with the rapidly melting ice and snow up-stream, caused the river to overflow its banks.

Due to the weather conditions investigators were unable to travel to the site until January 28, 1990. At that time the flood waters had subsided, the blocked ice had been freed from the mouth of the river and normal winter temperatures had returned, thus there was no more run-off from melting snow. However, interviews were conducted with a number of residents. Also, photographs and video tape were able to capture pictures of the damage caused in the area. (See appendix D). The photographs are noted with captions that reflect what the investigating team was told by the residents regarding the severity of the flooding in various areas of the town.

Apparently, this type of flooding is consistent with the beginning of spring in the Trout River area. It should be noted however, that on the weekend of March 16 to the 18, 1990, the region was once again subject to a period of very mild weather and rains. A number of Newfoundland communities that have flooding problems similar to that of the Community of Trout River were once again flooded. However, a telephone call to a resident of the area confirmed that Trout River did not experience flooding.

We will be closely monitoring the region to see if more flooding occurs with seasonal changes in climate.

REGRESSION ANALYSIS RESIDUALS (21 STATIONS)
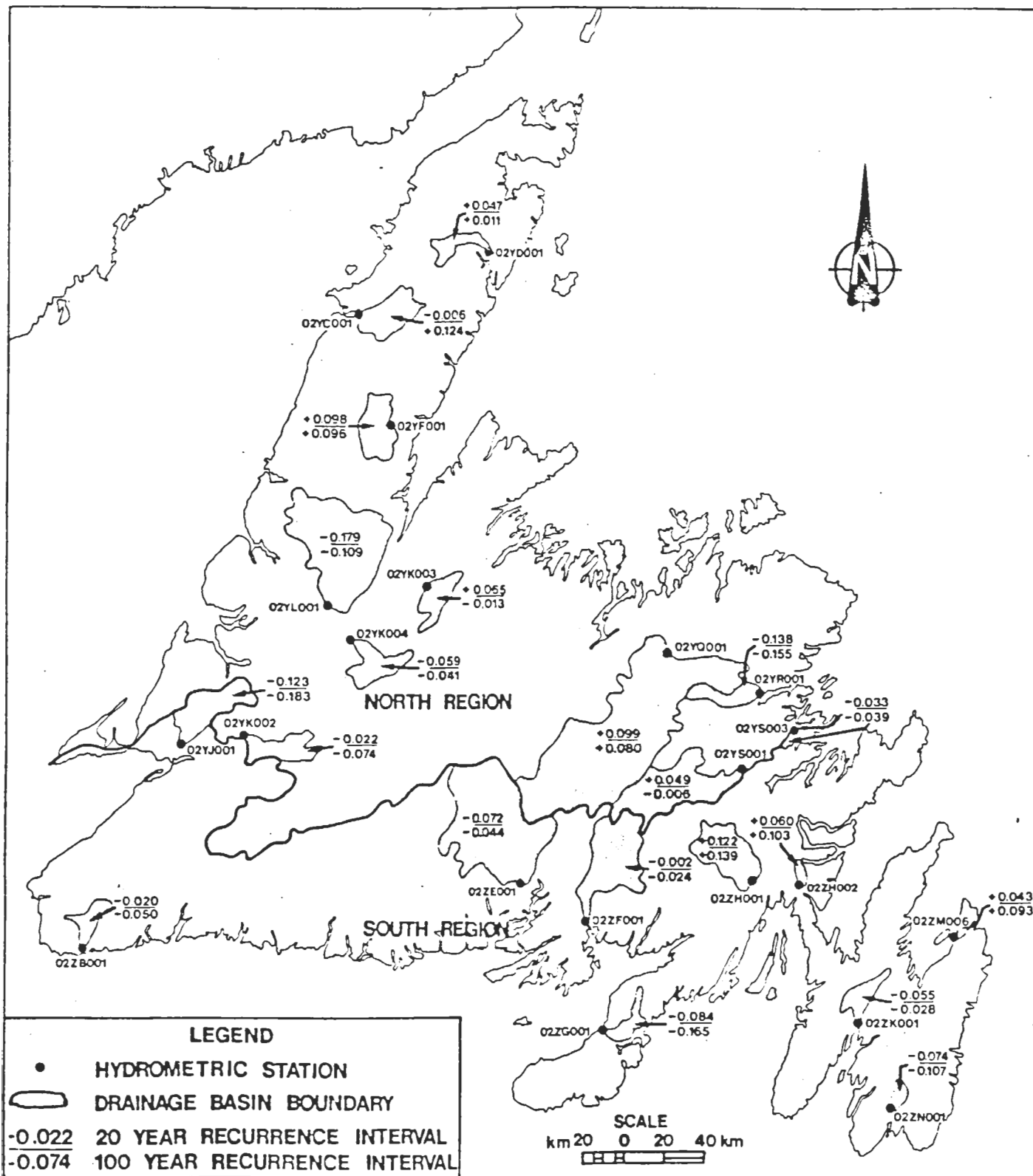
SCALE
km 20   0   20   40 km

LEGEND

•   HYDROMETRIC STATION

⬭   DRAINAGE BASIN BOUNDARY

-0.022   20 YEAR RECURRENCE INTERVAL
-0.074   100 YEAR RECURRENCE INTERVAL

FIGURE 2.2

APPENDIX A : REGRESSION RESULTS

STEPWISE REGRESSION RESULTS FOR $\log_{10} Q^P_2$ ENTIRE ISLAND

$$\log_{10} Q^P_2 = k + a\log_{10}DA + b\log_{10}MAR + c\log_{10}ACLS + d\log_{10}SHAPE$$

REGRESSION PARAMETER COEFFICIENT

Step Number	k	a	b	c	d	SE	Multiple R.
1	0.1424	0.7380	0.0000	0.0000	0.0000	0.26	0.90
2	−6.3102	0.8230	2.0363	0.0000	0.0000	0.14	0.97
3	−2.5295	0.7934	1.6307	−1.2654	0.0000	0.11	0.98
4*	−2.5824	0.8310	1.7260	−1.3269	−0.7894	0.10	0.99

Notes:

1. $F = 4.5$ (the regression constant and coefficients are all significant at the 5 percent level or better)

2. SE = Standard Error of Estimate in log units.

3. * = Accepted step.

STEPWISE REGRESSION RESULTS FOR $\log_{10}Q^P_{10}$ ENTIRE ISLAND

$$\log_{10}Q^P_{10} = k + a\log_{10}DA + b\log_{10}MAR + c\log_{10}ACLS + d\log_{10}SHAPE$$

REGRESSION PARAMETER COEFFICIENT

Step Number	k	a	b	c	d	SE	Multiple R.
1	0.3886	0.7047	0.0000	0.0000	0.0000	0.28	0.87
2	-6.8567	0.8002	2.2865	0.0000	0.0000	0.14	0.97
3	-2.6934	0.7675	1.8398	-1.3934	0.0000	0.11	0.98
4*	-2.7419	0.8020	1.9273	-1.4499	-0.7243	0.09	0.99

Notes:

1. $F = 4.5$ (the regression constant and coefficients are all significant at the 5 percent level or better)

2. SE = Standard Error of Estimate in log units.

3. * = Accepted step.

STEPWISE REGRESSION RESULTS FOR $\log_{10}Q^P_{20}$ ENTIRE ISLAND

$$\log_{10}Q^P_{20} = k + a\log_{10}DA + b\log_{10}MAR + c\log_{10}ACLS + d\log_{10}SHAPE$$

REGRESSION PARAMETER COEFFICIENT

Step Number	k	a	b	c	d	SE	Multiple R.
1	0.4679	0.6916	0.0000	0.0000	0.0000	0.29	0.86
2	−7.0661	0.7909	2.3776	0.0000	0.0000	0.14	0.97
3	−2.8270	0.7576	1.9228	−1.4188	0.0000	0.11	0.99
4*	−2.8741	0.7911	2.0077	−1.4736	−0.7031	0.09	0.99

Notes:

1. $F = 4.5$ (the regression constant and coefficients are all significant at the 5 percent level or better)

2. SE = Standard Error of Estimate in log units.

3. * = Accepted step.

SOURCE: REGIONAL FLOOD FREQUENCY ANALYSIS FOR THE ISLAND OF NEWFOUNDLAND

STEPWISE REGRESSION RESULTS FOR $\log_{10}Q^P{}_{100}$ ENTIRE ISLAND

$$\log_{10}Q^P{}_{100} = k + a\log_{10}DA + b\log_{10}MAR + c\log_{10}ACLS + d\log_{10}SHAPE$$

REGRESSION PARAMETER COEFFICIENT

Step Number	k	a	b	c	d	SE	Multiple R.
1	0.6300	0.6623	0.0000	0.0000	0.0000	0.31	0.84
2	−7.4743	0.7691	2.5576	0.0000	0.0000	0.15	0.97
3	−3.1059	0.7348	2.0889	−1.4621	0.0000	0.11	0.98
4*	−3.1500	0.7662	2.1684	−1.5134	−0.6581	0.10	0.99

Notes:

1. $F = 4.5$ (the regression constant and coefficients are all significant at the 5 percent level or better)

2. SE = Standard Error of Estimate in log units.

3. * = Accepted step.

SOURCE: REGIONAL FLOOD FREQUENCY ANALYSIS FOR THE ISLAND OF NEWFOUNDLAND

STEPWISE REGRESSION RESULTS FOR $\log_{10}Q^{P}_{2}$ NORTH REGION

$$\log_{10}Q^{P}_{2} = k + a\log_{10}DA + b\log_{10}MAR + c\log_{10}LAT + d\log_{10}SHAPE + e\log_{10}BAREA$$

REGRESSION PARAMETER COEFFICIENT

Step Number	k	a	b	c	d	e	SE	Multiple R.
1	−0.3926	0.8987	0.0000	0.0000	0.0000	0.0000	0.23	0.86
2	−6.8128	0.9319	2.5576	0.0000	0.0000	0.0000	0.11	0.97
3*	−28.0689	1.0172	2.0889	13.8620	0.0000	0.0000	0.08	0.99

Notes:

1.　　$F = 5.5$ (the regression constant and coefficients are all significant at the 5 percent level or better)

2.　　SE = Standard Error of Estimate in log units.

3.　　* = Accepted step.

SOURCE: REGIONAL FLOOD FREQUENCY ANALYSIS FOR THE ISLAND OF NEWFOUNDLAND

STEPWISE REGRESSION RESULTS FOR $\log_{10}Q^P_{10}$ NORTH REGION

$$\log_{10}Q^P_{10} = k + a\log_{10}DA + b\log_{10}MAR + c\log_{10}LAT + d\log_{10}SHAPE + e\log_{10}BAREA$$

REGRESSION PARAMETER COEFFICIENT

Step Number	k	a	b	c	d	e	SE	Multiple R.
1	−0.0814	0.8406	0.0000	0.0000	0.0000	0.0000	0.24	0.83
2	−7.1541	0.8772	2.3058	0.0000	0.0000	0.0000	0.10	0.97
3*	−28.7324	0.9638	1.4786	14.0721	0.0000	0.0000	0.07	0.99

Notes:

1. $F = 5.5$ (the regression constant and coefficients are all significant at the 5 percent level or better)

2. SE = Standard Error of Estimate in log units.

3. * = Accepted step.

STEPWISE REGRESSION RESULTS FOR $\log_{10} Q^{P}_{20}$ NORTH REGION

$$\log_{10} Q^{P}_{20} = k + a\log_{10}DA + b\log_{10}MAR + c\log_{10}LAT + d\log_{10}SHAPE + e\log_{10}BAREA$$

REGRESSION PARAMETER COEFFICIENT

Step Number	k	a	b	c	d	e	SE	Multiple R.
1	0.0169	0.8202	0.0000	0.0000	0.0000	0.0000	0.25	0.81
2	−7.3483	0.8583	2.4011	0.0000	0.0000	0.0000	0.10	0.98
3*	−29.1468	0.9458	1.5655	14.2157	0.0000	0.0000	0.06	0.99
4	−34.2758	0.9802	1.6149	16.9861	0.6654	0.0000	0.05	1.00

Notes:

1. $F = 5.5$ (the regression constant and coefficients are all significant at the 5 percent level or better)

2. SE = Standard Error of Estimate in log units.

3. * = Accepted step.

STEPWISE REGRESSION RESULTS FOR $\log_{10}Q^P_{100}$ NORTH REGION

$$\log_{10}Q^P_{100} = k + a\log_{10}DA + b\log_{10}MAR + c\log_{10}LAT + d\log_{10}SHAPE + e\log_{10}BAREA$$

REGRESSION PARAMETER COEFFICIENT

Step Number	k	a	b	c	d	e	SE	Multiple R.
1	0.2187	0.7759	0.0000	0.0000	0.0000	0.0000	0.27	0.77
2	−7.7740	0.8173	2.6057	0.0000	0.0000	0.0000	0.10	0.98
3*	−30.2744	0.9076	1.7432	14.6735	0.0000	0.0000	0.06	0.99
4	−35.2997	0.9413	1.7915	17.3879	0.6520	0.0000	0.04	1.00
5	−36.2564	0.9345	1.4831	18.4648	0.6556	0.0742	0.01	1.00

Notes:

1. $F = 5.5$ (the regression constant and coefficients are all significant at the 5 percent level or better)

2. SE = Standard Error of Estimate in log units.

3. * = Accepted step.

SOURCE: REGIONAL FLOOD FREQUENCY ANALYSIS FOR THE ISLAND OF NEWFOUNDLAND

APPENDIX B : PHOTOGRAPHS

NOTE: These pictures were taken approximatel 35 years ago.

Looking upstream across the river from near the present location of the school.

Looking upstream along the road from the riverside downstream of existing bridge.

Looking downstream along the road.
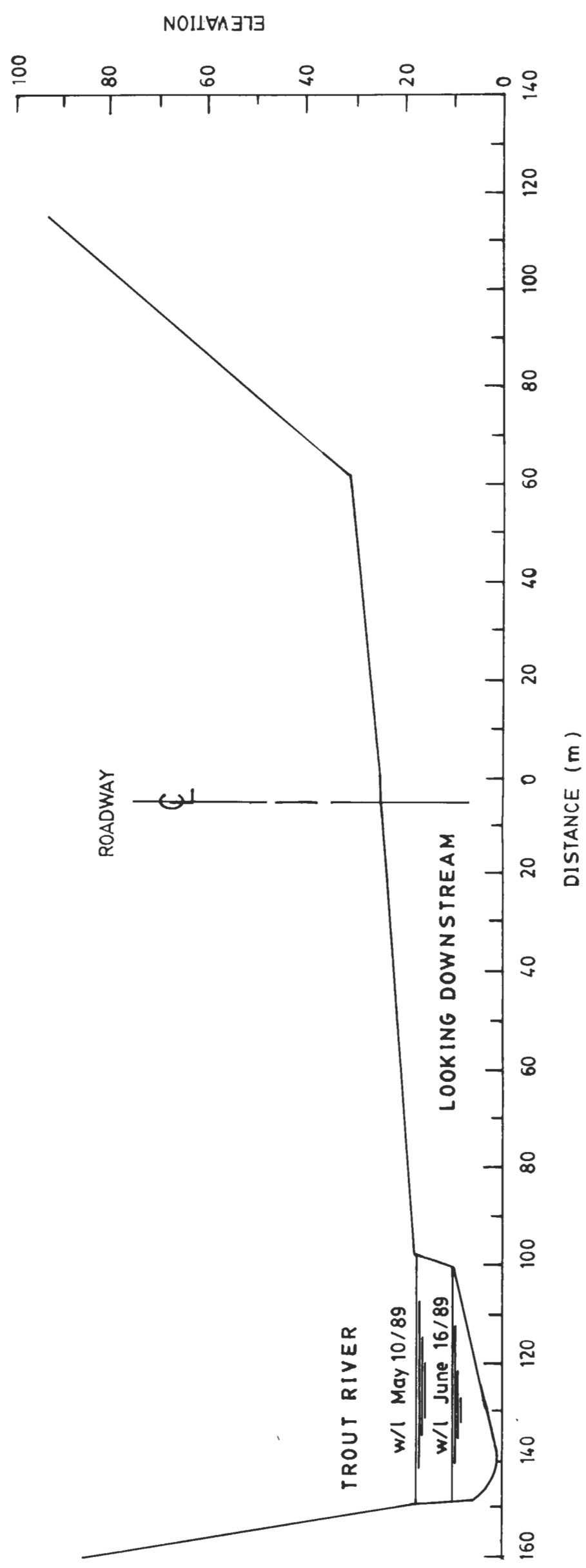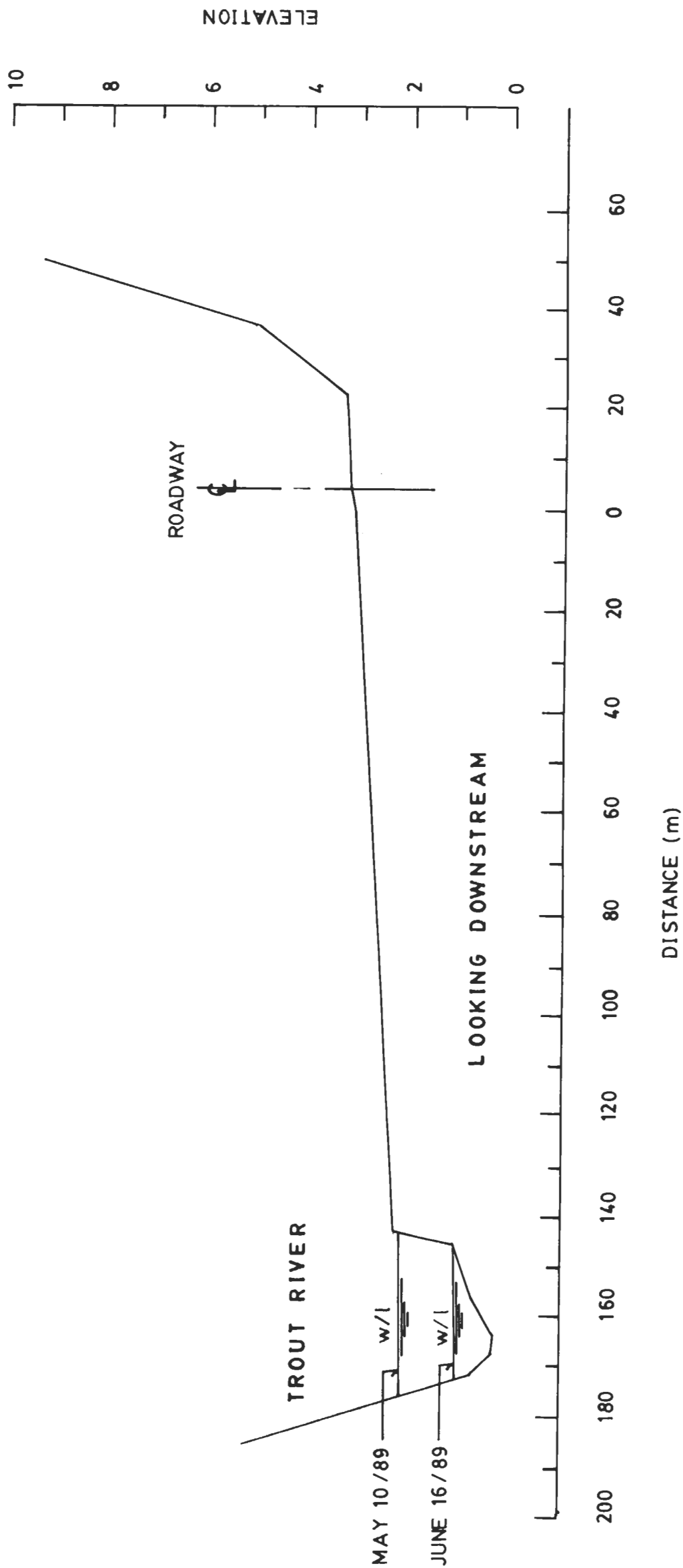
FIGURE 2.1

APPENDIX C : CROSS SECTIONS

existing profile

TROUT RIVER

w/l varies due
to tidal
influence

LOOKING DOWNSTREAM

ELEVATION
GEODETIC METERS

DISTANCE (m)
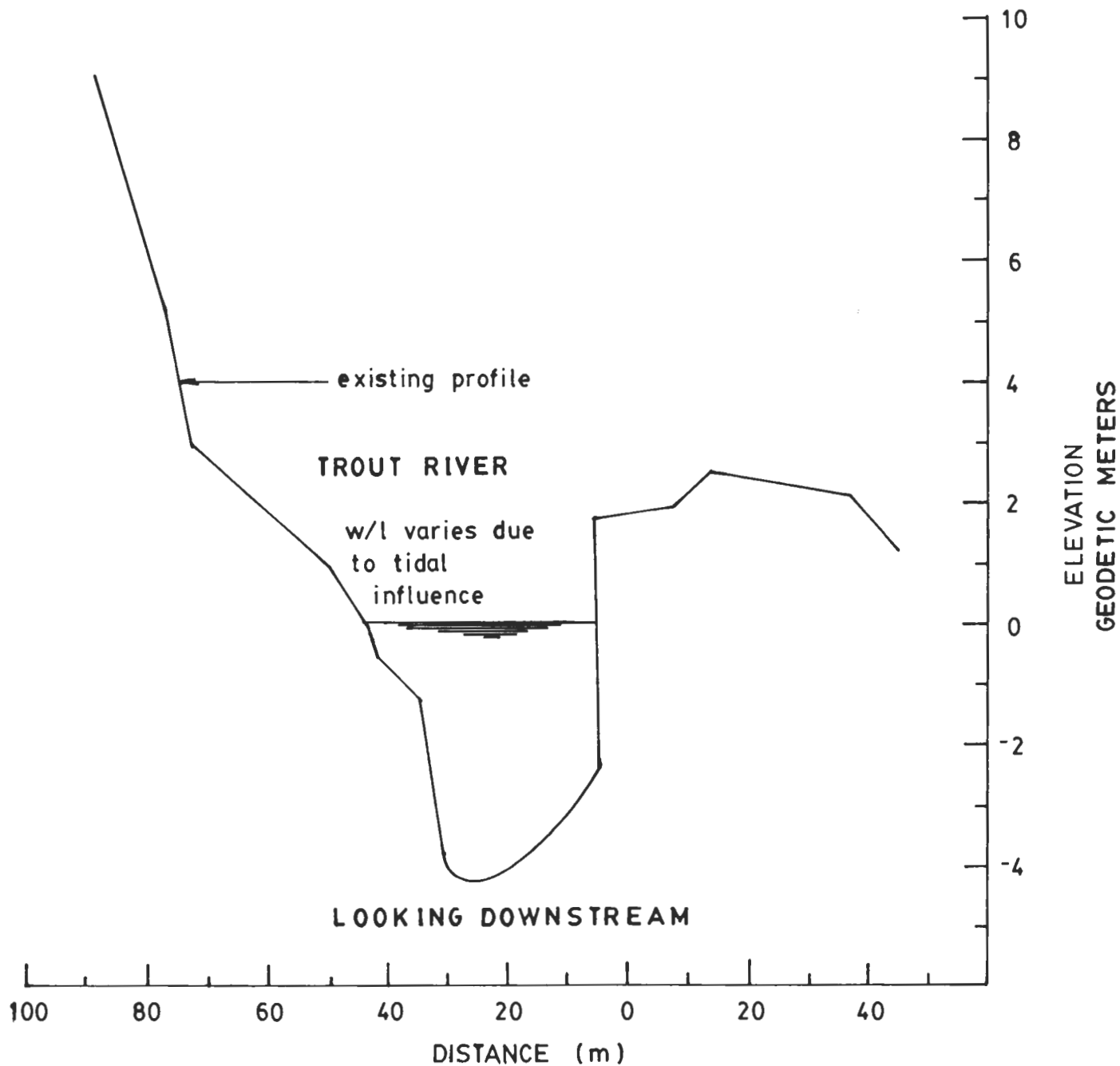
CROSS SECTION 0•045

scale - horiz 1 : 1000
vert 1 : 100

TROUT RIVER

ISLAND

ROADWAY

w/l varies due
to tidal influence

LOOKING DOWNSTREAM

ELEVATION

10 8 6 4 2 0 2

DISTANCE (m)

80 60 40 20 0 20 40 60 80 100 120 140 160 180
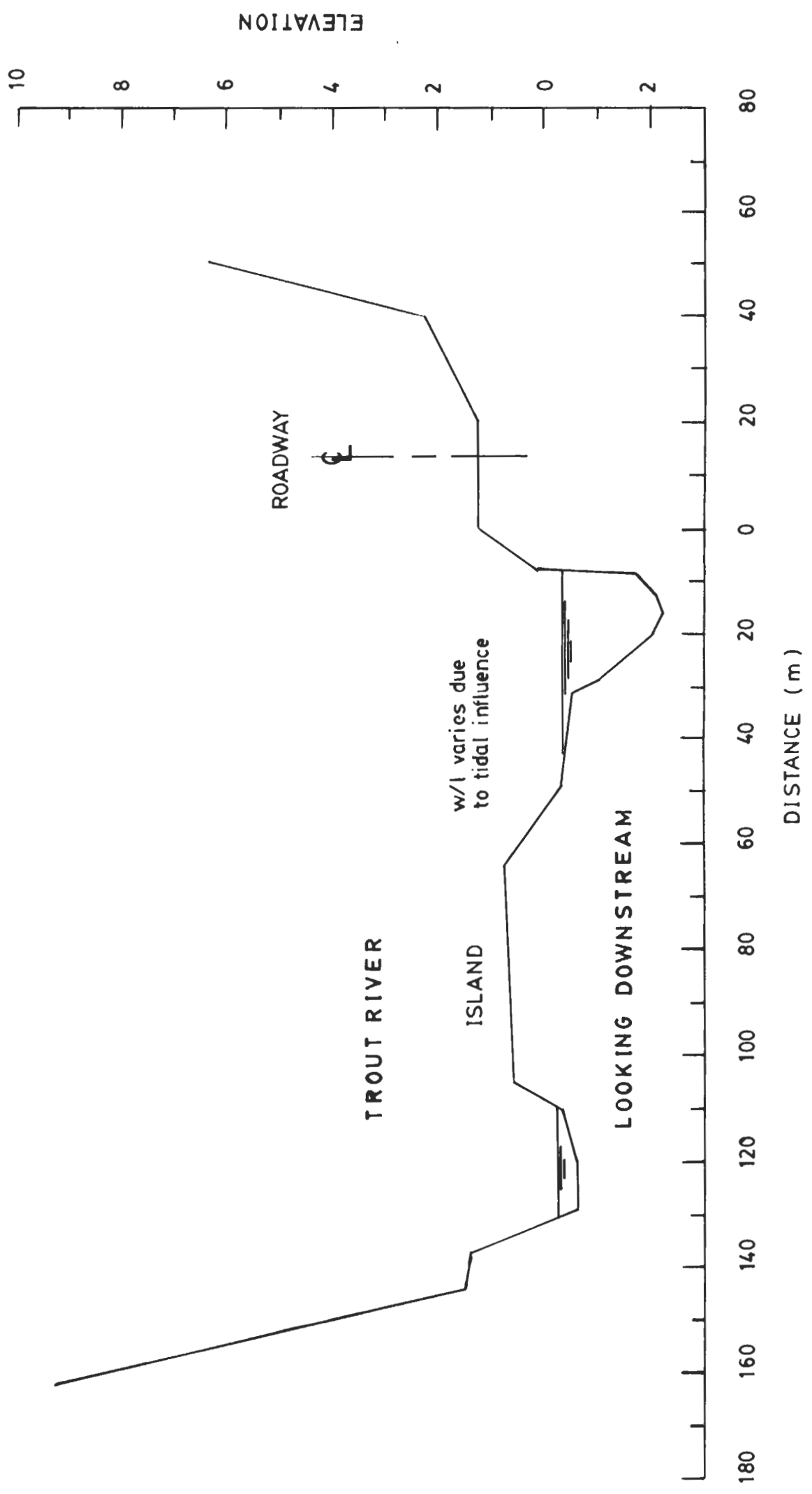
CROSS SECTION 0+300

scale - horiz 1 : 1000
        vert   1 : 100

ELEVATION

DISTANCE (m)

TROUT RIVER

w/l May 10/89

w/l June 16/89

LOOKING DOWNSTREAM

ROADWAY

₵

CROSS SECTION 0·810

scale - horiz   1 : 1000
       vert   1 : 100

ELEVATION

DISTANCE (m)

CROSS SECTION 1+035

scale - horiz   1 : 1000
         vert   1 : 100

ROADWAY

LOOKING DOWNSTREAM

TROUT RIVER

MAY 10/89

JUNE 16/89

w/l

ELEVATION

ROADWAY

TROUT RIVER

LOOKING DOWNSTREAM

w/l May 10/89

w/l June 16/89

DISTANCE (m)
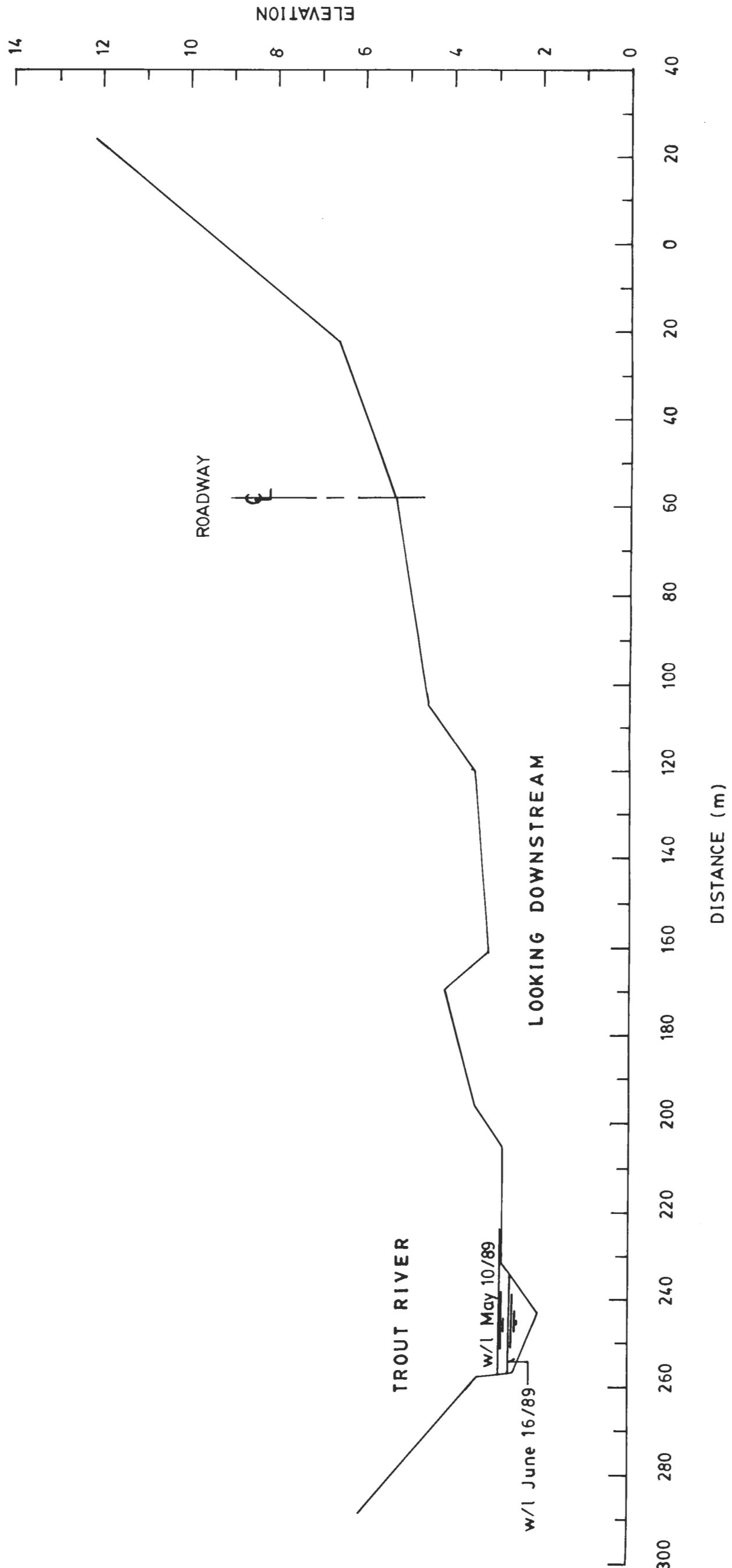
CROSS SECTION 1+290
scale - horiz   1 : 1000
       vert   1 : 100

ELEVATION

DISTANCE (m)

ROADWAY

LOOKING DOWNSTREAM

TROUT RIVER

w/l June 16/89
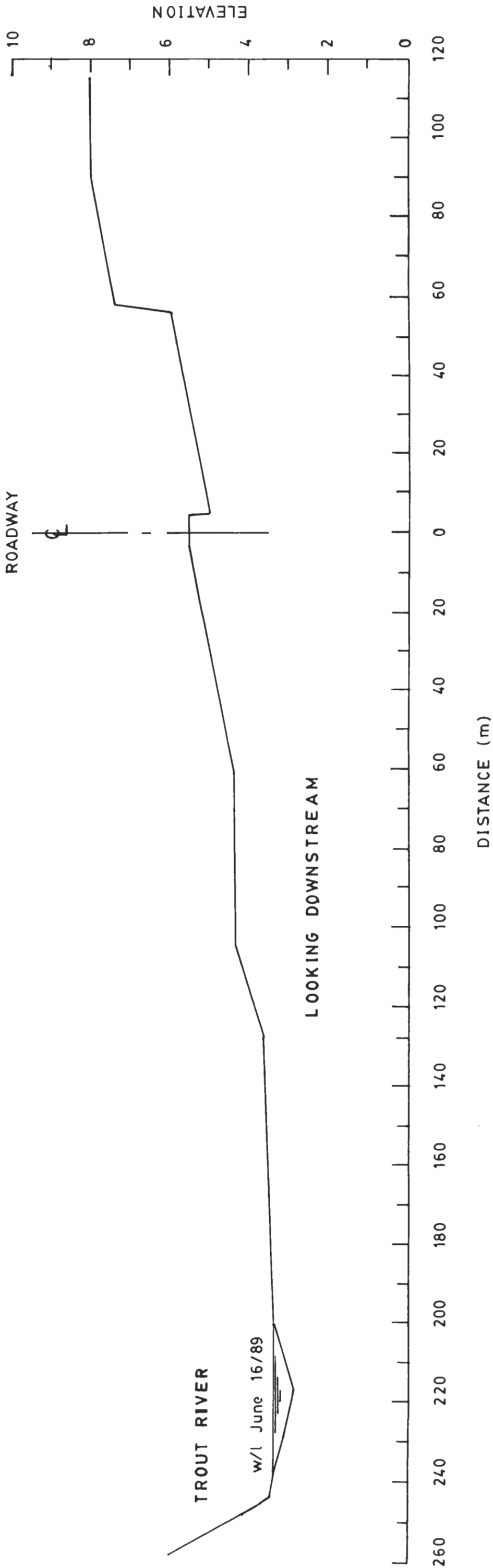
CROSS SECTION 1+400

scale - horiz 1 : 1000
       vert   1 : 100

TROUT RIVER
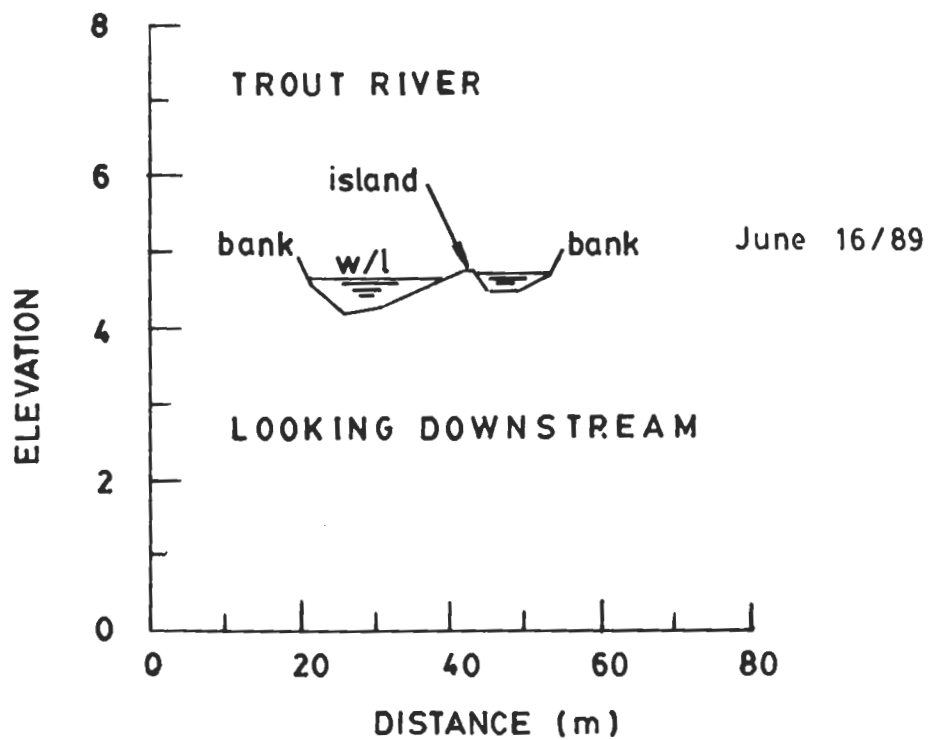
CROSS   SECTION   1+635

scale - horiz   1 : 1000
vert   1 : 100

TROUT RIVER

bank

island

w/l

bank

June 16/89

LOOKING DOWNSTREAM

ELEVATION

8

6

4

2

0

0　　20　　40　　60　　80

DISTANCE (m)
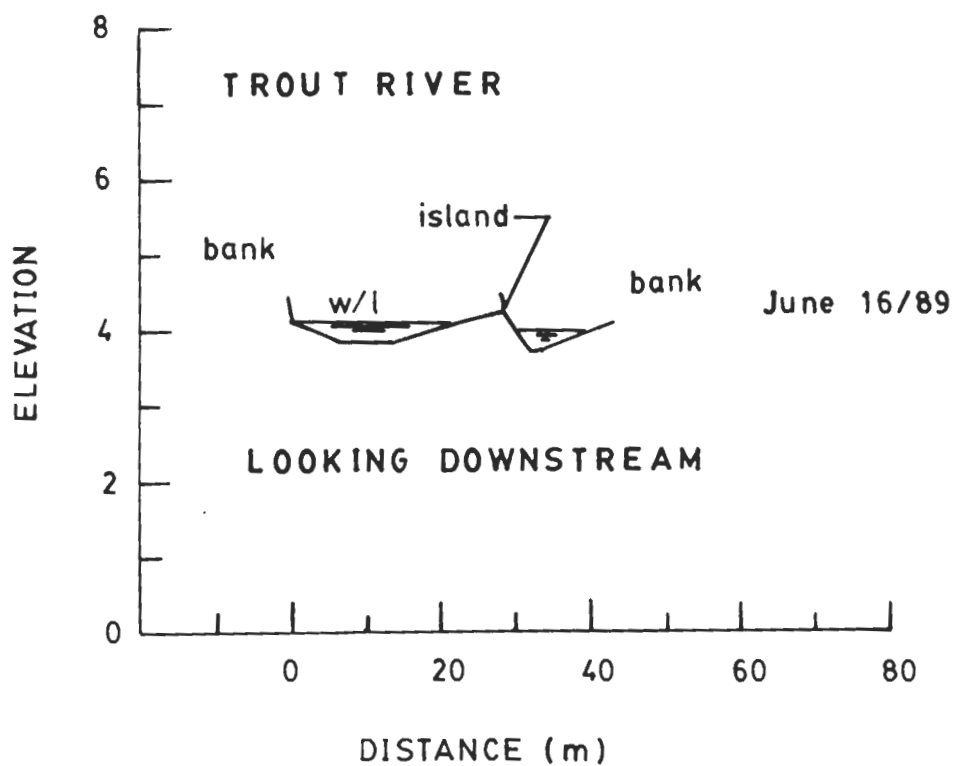
CROSS SECTION 1+805

scale - horiz　1 : 1000
vert　.1 : 100

TROUT RIVER

ROADWAY

w/l May 10/89

w/l June 16/89

LOOKING DOWNSTREAM

ELEVATION

DISTANCE (m)
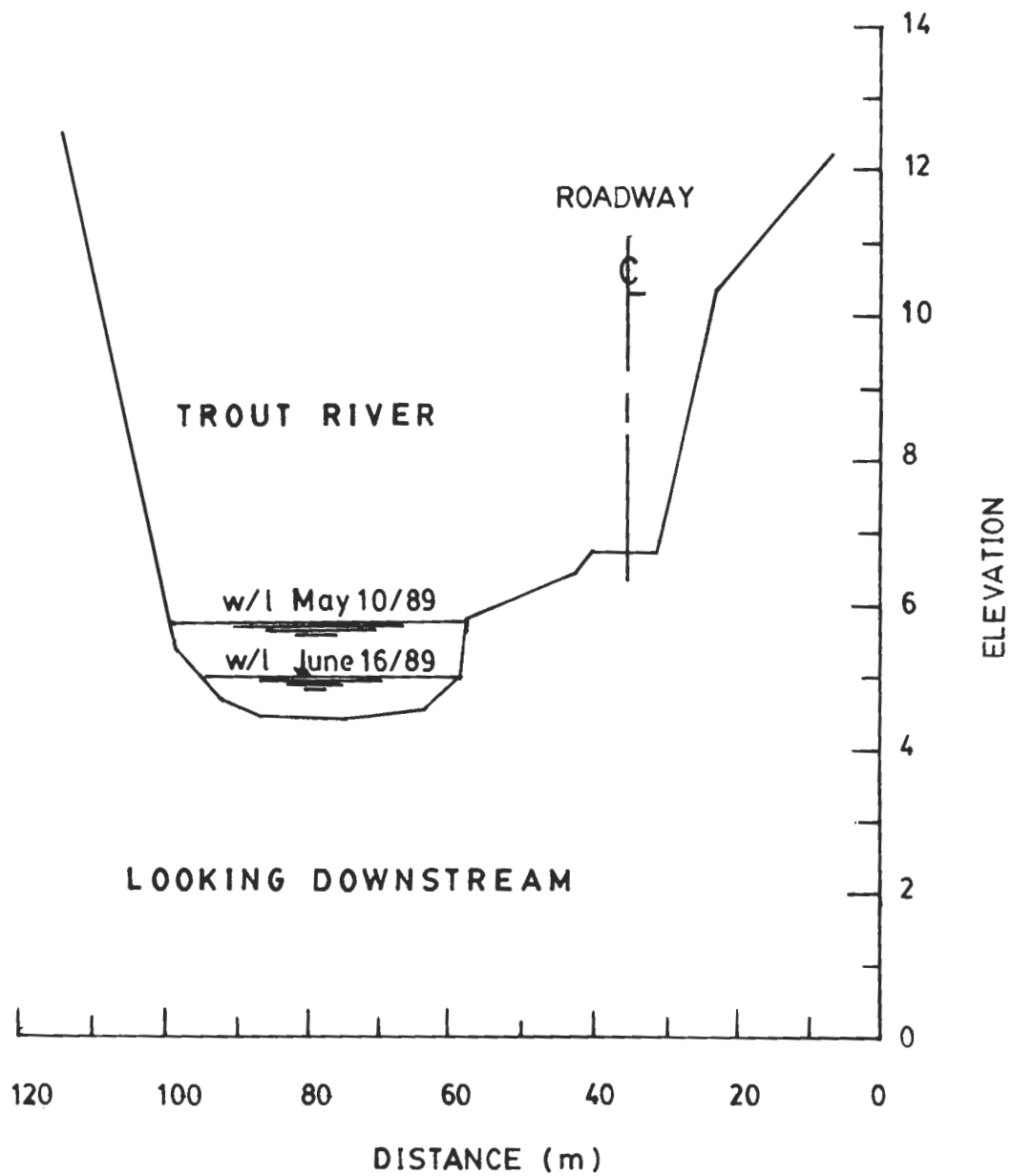
CROSS SECTION 2+085

scale - horiz   1 : 1000
         vert   1 : 100

TROUT
RIVER

w/l May 10/89

w/l June 16/89

LOOKING DOWNSTREAM

ELEVATION

DISTANCE (m)
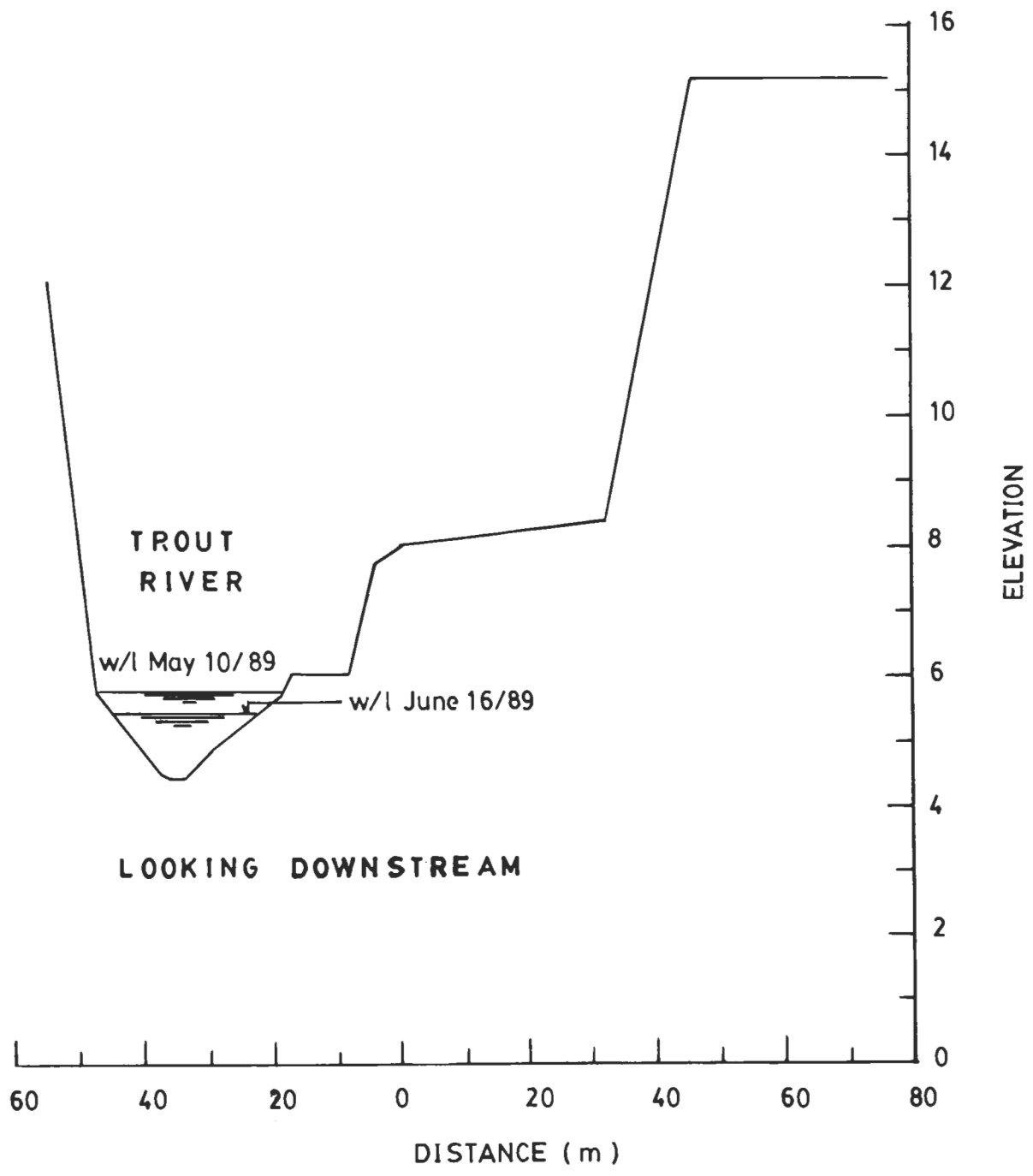
CROSS SECTION 2+300

scale - horiz 1 : 1000
        vert 1 : 100

scale not suitable to represent
water level of Feeder Brook

**FEEDER
BROOK**

bank

bank

LOOKING UPSTREAM

ELEVATION

12

10

8

6

4

2

0

0   20   40   60   80   100

DISTANCE (m)
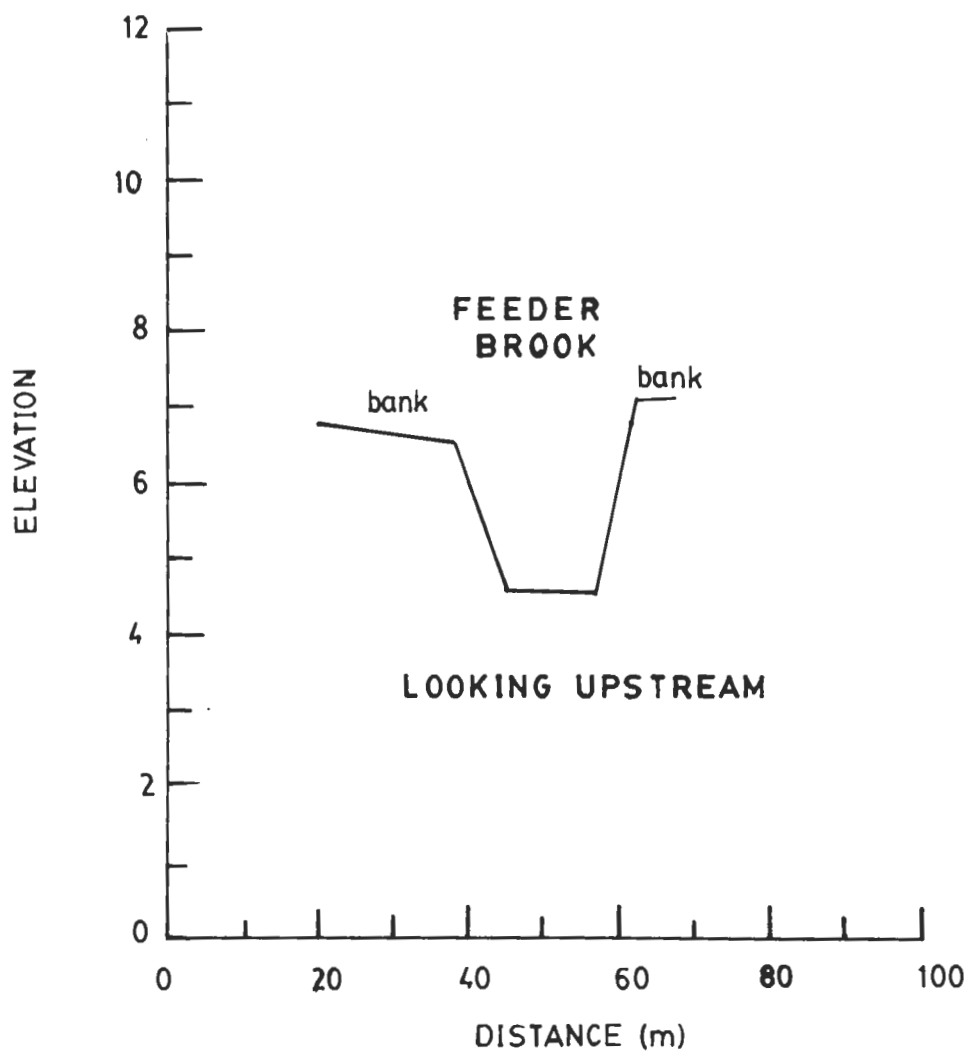
CROSS SECTION 7+230

scale - horiz   1 : 1000
        vert   1 : 100

scale not suitable to represent
water level of **Feeder Brook**

**FEEDER
BROOK**

bank

bank

LOOKING UPSTREAM

ELEVATION

14

12

10

8

6

4

2

0

0   20   40   60   80   100   120   140   160

DISTANCE (m)
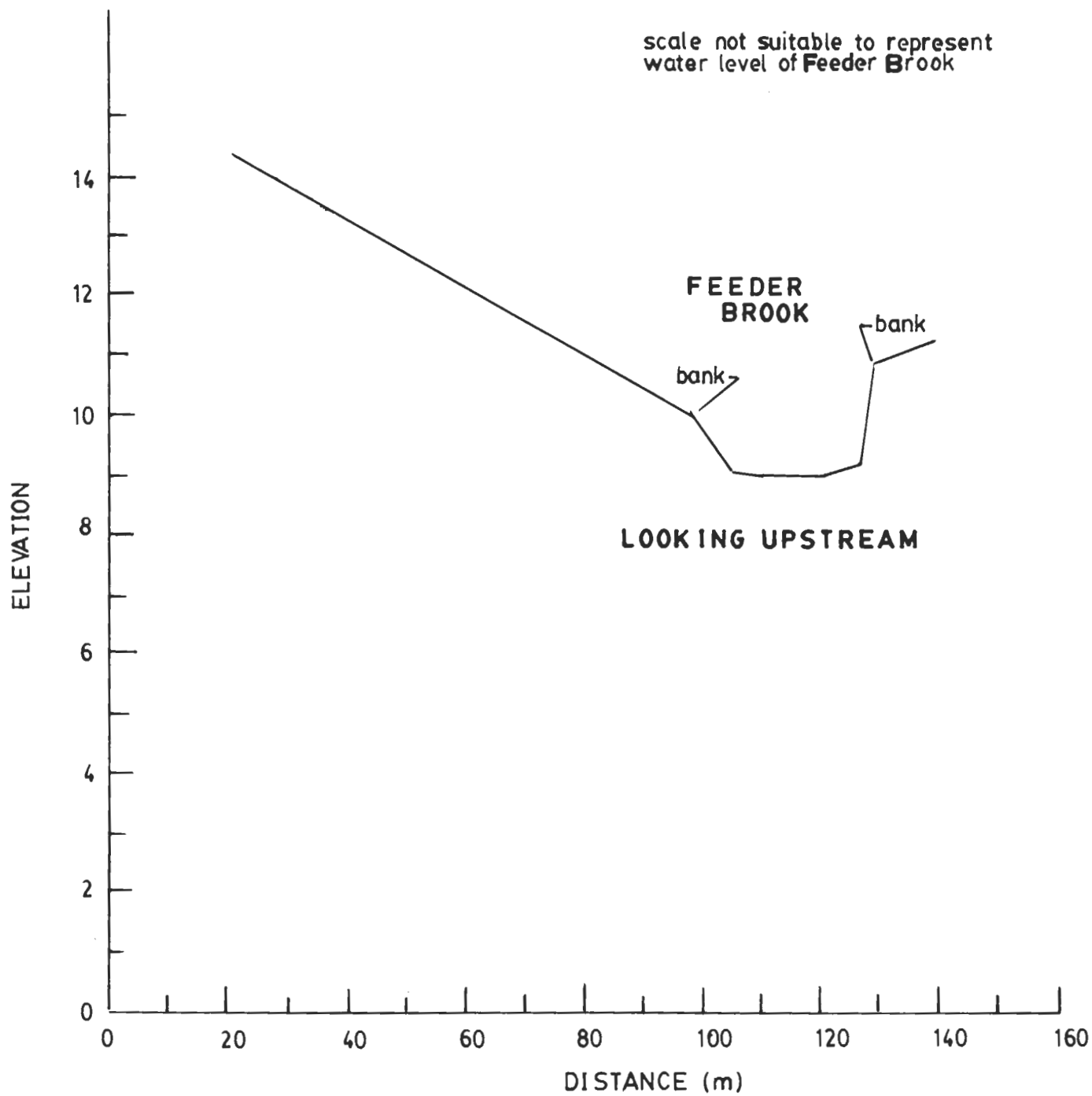
CROSS SECTION **7·530**

scale - horiz   1 : 1000
        vert   1 : 100

APPENDIX D : ICE STUDY PHOTOGRAPHS

NOTE: PHOTOGRAPHS IN THIS SECTION START AT NUMBER 11. NUMBERS 1 TO 10 HAVE BEEN INCLUDED BY CUMMINGS AND COCKBURN LTD. IN THEIR PORTION OF THE REPORT.

ALL PHOTOGRAPHS IN THIS SECTION WERE TAKEN ON MONDAY, JANUARY 29, 1990 TWO DAY AFTER THE FLOOD ON JANUARY 27, 1990.

PHOTO NO. 11 shows the main area of town. There was 450 mm of water
flowing on this section the night of Jan. 27, 1990.

PHOTO NO. 12 shows an outlet off the main road where the flood water
eventually broke free into river.

PHOTO NO. 13 shows another outlet off the main road where the flood waters escaped into Trout River.

PHOTO NO. 14 shows Trout River as it flows through the main community. Note the high water mark.

PHOTO NO. 15 shows the lower section of Trout River just above the fish plant, on January 29, 1990.

PHOTO NO. 16 shows the opposite of Trout River just below the bridge. Note this area was totally underwater the night of January 27, 1990.

PHOTO NO. 17 shows the bridge across Trout River.

PHOTO NO. 18 shows a house just above the school. Water ran into the basement windows.

PHOTO NO. 19 shows a barn just below Feeder Brook. The water was 450 mm up the wall of the building.

PHOTO NO. 20 shows the main road that had to be breached by heavy equipment to release the flood waters.

PHOTO NO. 21 shows the four emergency overflow culverts that were plugged up by ice. This was the greatest cause of the flood water backing up.

PHOTO NO. 22 shows the ice pile at the junction of Feeder Brook and Trout River.

PHOTO NO. 23 shows the bridge at the Trout River Pond outlet. Since there are no scour marks on the snow, it appears that there may not have been any flooding in this area.

PHOTO NO. 24 shows the area of Trout River just below the bridge at the pond. Again, note there are no scour marks in the snow.

PHOTO NO. 25 shows the Bailey Bridge at Feeder Brook on January 29, 1990.

PHOTO NO. 26 shows the upper section of Feeder Brook on Jan. 29, 1990.
This was all underwater the night of Jan. 27, 1990.

PHOTO NO. 27 shows the downstream section of Feeder Brook on Jan. 29,1990.
The shed on the keft was in about 300 mm of water the night of Jan. 27, 1990.

TROUT RIVER

ROADWAY
Ȼ

w/l May 10/89

ISLAND

w/l June 16/89

w/l June 16/89

LOOKING DOWNSTREAM

ELEVATION

10

8

6

4

2

0

| 280 | 260 | 240 | 220 | 200 | 180 | 160 | 140 | 120 | 100 | 80 | 60 | 40 | 20 | 0 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 |

DISTANCE (m)
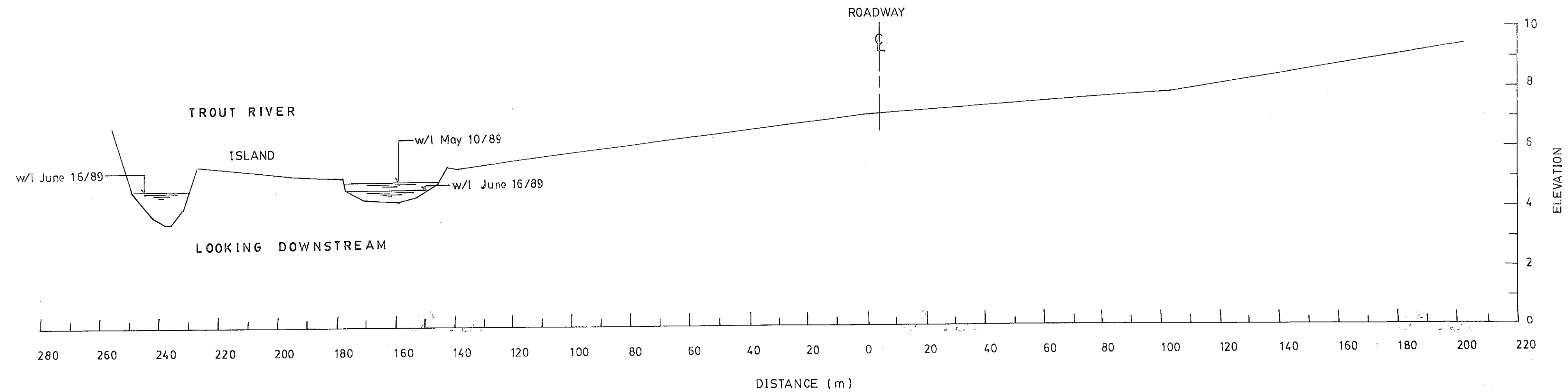
CROSS SECTION 1·700
scale - horiz   1 : 1000
        vert   1 : 100

LOWER TROUT RIVER POND
BRIDGE

ROAD

w/l May 10/89

w/l May 30/89

LOOKING DOWNSTREAM

ELEVATION

14

12

10

8

6

4

2

0

DISTANCE (m)

140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260
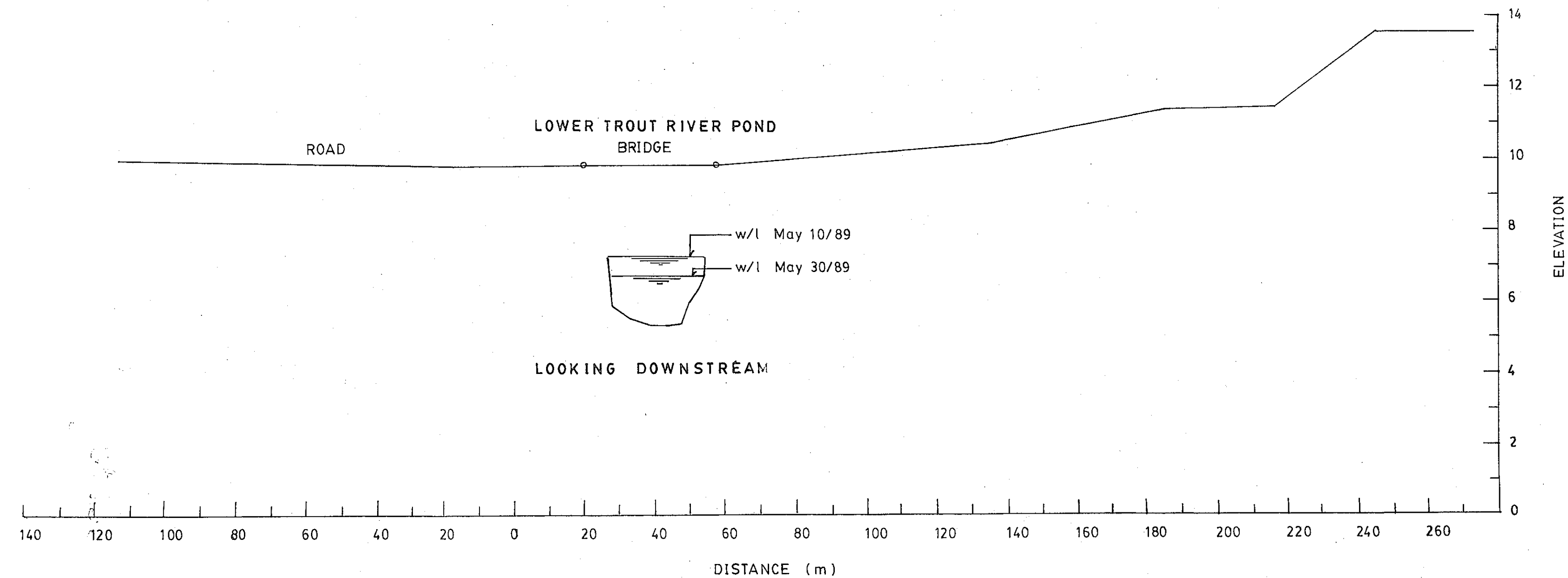
CROSS SECTION 2+620

scale – horiz   1 : 1000
         vert   1 : 100

ISLAND ENGINEERING CO. LTD.
CORNER BROOK
NEWFOUNDLAND

7+530

7+230

1+280
1+400
1+600
1+635
1+700
1+805

2+095
2+300
2+620

LIMIT OF FLOOD
RISK MAPPING

GENERAL INFORMATION

FLOOD LINES

FLOOD RISK MAP

SCALE 1:2000 METRES

LIMIT OF FLOOD RISK MAPPING

TROUT RIVER

0+045

0+300

0+575

0+810

1+035

0+000
0+057
0+082
0+104
0+172
0+197

Former Brook Route

GENERAL INFORMATION

LEGEND-LEGENDE

FLOOD RISK MAP
TROUT RIVER, NEWFOUNDLAND
CARTE DU RISQUE D'INONDATION
TROUT RIVER, TERRE-NEUVE

SCALE 1:2500 ECHELLE

LEGEND-LEGENDE