Canada – Newfoundland
Flood Damage Reduction
Program

GLOVERTOWN FLOOD STUDY

FIELD REPORT

ShawMont Newfoundland Limited

Department of Environment and Lands

Environment Canada

CANADA-NEWFOUNDLAND FLOOD
DAMAGE REDUCTION PROGRAM

GLOVERTOWN FLOOD STUDY

FIELD REPORT

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PART ONE

INTRODUCTION

1.0 INTRODUCTION

1.1 The major purposes of the field program were:

- to obtain an appreciation of site conditions, as these relate to flood problems, and
- to obtain physical measurements for verification and calibration of analytical models.

The scope of work for this program is outlined in this Section. Details of the program and compilation of the results are provided in Section 2.

1.1.1 Site Inspection

A site inspection visit by R. Picco of the Department of Environment and Lands, P.C. Helwig and H.J. Keats, SNL and G. Holder, LHL was carried out on November 14, 1988. The purpose of the visit was to meet municipal authorities, assess site conditions and to select locations for river cross-sections.

1.1.2 Topographic Survey

Eleven cross-sections had previously been surveyed by the Department of Environment and Lands during the summer of 1986. Upon inspection of the site during the walk-over it was decided by the ice specialist that one more section was needed, just upstream of the highway bridge. The site inspection revealed that all visible signs of bench marks used in the original survey were obliterated. To facilitate measuring fall flood water levels it was determined that a new level survey was required to re-establish bench marks at each cross-section.

1.1.3 Interview Survey

During the field program, local officials and residents were approached informally at their residences. They were informed about the purpose of the study and the methods employed. They were also asked to recollect any information on previous floods that would also be a benefit to the study. A house to house interview survey of residents within flood prone areas was carried out to identify high water levels, as well to note resident's observations on the behaviour of the rivers during past flooding events.

1.1.4 Fall Flood Water Level Program

A local resident of each town who had been engaged by the surveyor as rodman was also instructed about recording the maximum water levels of a possible fall flood using spray paint on immovable objects near each cross-section.

1.1.5 Other Information

Documentary information, mostly from the files of the Department of Environment and Lands is compiled in Appendix I. Appendix II contains bridge plans from the Department of Transportation and Communications.

1.2 JOB DIARY

November 18 - Appleton/Glenwood and Glovertown

Weather: Miserable day with heavy rain in the morning and cold northerly winds.

1.2 JOB DIARY (Cont'd)

Work Done: Obtained the remaining historical flood data in both Glenwood and Appleton. Finished up the field program for Glenwood/Appleton and then moved on to Glovertown. Differential level survey to re-establish bench marks was completed from highway bridge up to the old abandoned paper mill.

November 19

Weather: Rain mixed with snow with temperatures +1°.

Work Done: Finished up the bench mark transfer to cross-section 9. Carried out water level survey of all the sections. Completed an extra cross-section on the lower portion of the river (Cross-Section 4.5).

November 20 - Glovertown

Weather: Light snow and light winds and temperatures at -3°.

Work Done: Interviewed residents of flood prone area for historical flood information.

PART TWO

FIELD PROGRAM

2. FIELD PROGRAM

2.1 SETTING UP

The field program for Glovertown was carried out from November 18 to November 20, 1988. A walk-over of the site had previously been done November 14 with G. Holder (LaSalle Hydrologic Laboratory), R. Picco Canada-Newfoundland Flood Damage Reduction Program and P.C. Helwig (ShawMont Newfoundland Limited) in attendance. All sections that were surveyed under the 1986 field survey program, performed by the Department of Environment and Lands, were visited to confirm their location and to search for of bench marks in the vicinity of each cross-section. The location of the sections were easily reestablished with the aid of the project map but all signs of the bench marks had been obliterated (see Figure 2.1).

G. Holder, from LaSalle Hydrologic Laboratory, recommended that an additional section be made in a wide section just upstream of the highway bridge in order to completely describe the river for their modelling program.

2.2 LEVEL SURVEY

A level survey was performed from a geodetic bench mark located on the highway bridge [Monument #76F495] at the mouth of the Terra Nova River, with an elevation of 7.881 m. From there elevations were transferred to bench marks near cross-sections that were surveyed in 1986, and to a new cross-section, cross-section 4.5. A differential levelling loop including all bench marks was completed with a closing error of 0.005 m in a traverse of 2.5 km. Bench mark elevations are summarized in Table 2.1.

2.2 LEVEL SURVEY (Cont'd)

Water levels were measured by differential levelling from cross-section bench marks, on the afternoon of November, 19th, when flow was 45.0 m^3/s, see Table 2.2.

2.3 CONFIRMATION OF PREVIOUS SURVEYS

A check was performed on the survey notes that had been supplied by the Department of Environment for the 1986 survey program. The notes appeared to be carefully done and arithmetic checks applied in accordance with usual practice. As a further check, cross-section 4 was resurveyed. No significant differences between the new and old cross-section were noticed. The sections were then replotted and the new water levels from this field program were superimposed on them (see Tables 2.3 to 2.5 and Figures 2.2 to 2.13).

2.4 INTERVIEW SURVEY

During the field survey some of the residents in the flood prone areas were questioned about past flooding events. They were asked to indicate the best of their recollection, where the flood waters had reached during each of these flooding events. They were also asked if they had any old photographs of past floods. Information on previous water levels obtained in this survey were plotted up on the detailed base mapping (in envelope pocket at end of the report).

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TABLE 2.1
BENCH MARK ELEVATIONS

B.M. #'s	ELEVATION	REMARKS
BM #1	7.881	Geodetic Bench Mark #76F495
TBM #2	3.541	Top of hydrant near Leonard Warfield's house
TBM #2	3.131	Top of Hydrant near Lou Briffit's garage
TBM #3	8.051	Rock at intersection to Mill Road
TBM #4	12.081	Rock near Transmission Line, river side of road
TBM #5	8.071	Brass plug at gauging station
TBM #6	4.526	Rock Near Shore at Cross-Section 9
TBM #7	8.236	Concrete base of round towers - Old Mill
TBM #8	4.676	Top of embedded eye bolt at Cross-Section 7
TBM #9	4.636	Top of bedrock outcrop U/S of old dam structure
TBM #10	1.886	Top of boulder near shore at Cross-Section 5.5
TBM #11	2.861	Rock -20 m from shore near Cross-Section 6
TBM #12	1.146	Painted Rock near House #1
TBM #13	2.631	Base of Forbe Adams House

TABLE 2.2

GLOVERTOWN FLOOD RISK MAPPING

TERRA NOVA RIVER

FLOWS & WATER LEVELS (by section)

SECTION #	WATER ELEVATIONS (m)	FLOWS (m^3/s)
1	0.49	45
2	0.50	45
3	0.51	45
4	0.53	45
4.5	0.57	45
5	0.58	45
5.5	0.72	45
6	1.88	45
6.5	3.08	45
7	3.16	45
8	3.94	45
9	4.10	45

Note:

1. Water levels were measured by differential levelling from cross-section bench marks.

2. Flow was measured fro the Water Survey of Canada gauge on the Terra Nova River near Glovertown (2YS005).

TABLE 2.3

GLOVERTOWN FLOOD RISK MAPPING

SECTION #1

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1985 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
0	93.046	0.927		
10	92.873	0.753		
20	92.292	0.093		0.486
30	91.772	-0.347		0.486
40	92.212	0.093		0.486
50	91.722	-0.387		0.486
60	91.412	-0.707		0.486
70	92.022	-0.097		0.486
74	92.766	0.647		0.486
80	91.552	-0.567		0.486
90	90.938	-1.131		0.486
100	90.628	-1.431		0.486
110	90.588	-1.531		0.486
120	90.278	-1.991		0.486
130	90.188	-2.031		0.486
140	89.988	-2.231		0.486
150	90.038	-2.081		0.486
160	89.638	-2.481		0.486
170	89.389	-2.731		0.486
180	89.388	-2.731		0.486
190	89.598	-2.531		0.486
200	89.988	-2.131		0.486
210	90.588	-1.531		0.486
220	92.212	0.093		0.486
230	91.992	-0.227		0.486
240	92.552	0.433		0.486
250	92.752	0.633		

SECTION #2

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1985 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
2.4	94.181	2.062		
30	93.695	1.566		
50	93.713	1.594		
70	93.820	1.701		
90	93.630	1.511		
96.5	92.760	0.641		
100	91.913	-0.206		0.496
110	91.435	-0.684	-0.489	0.496
120	91.433	-0.686	-0.489	0.496
130	90.630	-1.489	-0.489	0.496
140	90.280	-1.839	-0.489	0.496
150	90.030	-2.089	-0.489	0.496
160	89.830	-2.289	-0.489	0.496
170	89.730	-2.389	-0.489	0.496
180	89.980	-2.139	-0.489	0.496
190	90.080	-2.039	-0.489	0.496
200	90.180	-1.939	-0.489	0.496
210	89.430	-2.689	-0.489	0.496
220	92.033	-0.086	-0.489	0.496
230	93.583	1.464		

SECTION #3

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1985 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
0				
9	93.801	1.682		
13.8	92.157	0.038		
20	92.767	0.648		
25	91.821	-0.298		
30	92.999	0.880		
40	90.201	-1.918		0.506
50	89.951	-2.168		0.506
60	89.001	-3.118		0.506
70	88.401	-3.718		0.506
80	88.301	-3.818		0.506
90	90.501	-1.618		0.506
100	91.767	-0.352		0.506
105	91.850	-0.269		0.506
108	93.370	1.251		
110	92.710	0.591		
120	93.970	1.851		

TABLE 2.4

GLOVERTOWN FLOOD RISK MAPPING

SECTION #4

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1986 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
0		3.000		
10		3.200		
10.7		3.214		
10.7				
14		3.230		
14				
10.7		3.214		
20		3.400		
30		3.500		
40		3.600		
50		3.500		
60		3.000		
70		-0.426	-0.272	0.526
75		-1.272	-0.272	0.526
80		-1.772	-0.272	0.526
85		-1.622	-0.272	0.526
90		-1.772	-0.272	0.526
95		-2.422	-0.272	0.526
100		-2.872	-0.272	0.526
105		-3.172	-0.272	0.526
110		-2.922	-0.272	0.526
115		1.439		
125		2.815		
135		3.648		

POT CULVERT

10.7	-1.222
10.7	1.828
14	1.828
14	-1.222
10.7	-1.222

SECTION #4.5

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1986 SURVEY (WATER ELEVATION)	1989 SURVEY (WATER ELEVATION)
0		2.500		
10		2.600		
20		2.300		
30		2.000		
40		2.000		
50		2.500		
60		2.300		
70		2.000		
80		1.800		
90		1.200		
100		1.000		
110		1.300		
120		2.100		
130		2.000		
140		2.100		
150		0.570		
160		-0.740		0.566
170		-1.180		0.566
180		-1.250		0.566
190		-1.180		0.566
200		-1.350		0.566
210		-1.260		0.566
220		-1.260		0.566
230		-1.260		0.566
240		-1.260		0.566
250		-1.440		0.566
260		-1.350		0.566
270		0.570		
280		1.600		
290		2.600		
300		3.100		
310		3.200		
320		3.400		
330		3.900		
340		4.450		
350		4.950		
360		5.300		
370		5.600		
380		6.000		

SECTION #5

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1986 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
0	91.898	-0.221		
5	92.908	0.789		
10	90.783	-1.336	0.264	0.576
20	90.283	-1.836	0.264	0.576
30	90.433	-1.686	0.264	0.576
40	90.883	-1.236	0.264	0.576
50	90.883	-1.236	0.264	0.576
60	90.083	-2.036	0.264	0.576
69	91.898	-0.221	0.264	0.576
70	93.928	1.809		

TABLE 2.5

GLOVERTOWN FLOOD RISK MAPPING

SECTION #5.5

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1986 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
0	93.329	1.210		
5	92.325	0.206		0.721
10	92.370	0.251		0.721
20	92.550	0.431		0.721
30	90.650	-1.469	0.131	0.721
40	91.350	-0.769	0.131	0.721
50	91.250	-0.869	0.131	0.721
60	89.650	-2.469	0.131	0.721
65	92.250	0.131	0.131	0.721
70	94.010	1.891		

SECTION #6

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1986 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
0	94.065	1.946		
5	93.785	1.666		
10	93.805	1.686		
15	93.610	1.491		
20	94.100	1.981		
25	92.845	0.726	1.462	1.876
30	92.495	0.376	1.462	1.876
35	92.645	0.526	1.462	1.876
40	92.745	0.626	1.462	1.876
45	92.645	0.526	1.462	1.876
50	92.245	0.126	1.462	1.876
55	92.730	0.611	1.462	1.876
60	94.620	2.501		
65	95.550	3.431		
70	94.000	1.881		
72	94.850	2.731		

SECTION #6.5 (DAM)

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1986 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
0	94.820	2.701		
5	95.535	3.416		
10	95.855	3.736		
15	95.582	3.463		
20	96.390	4.271		
25	96.220	4.101		
30	94.900	2.781		3.081
35	95.080	2.961		3.081
40	94.665	2.546	2.696	3.081
45	94.515	2.396	2.696	3.081
50	94.165	2.046	2.696	3.081
55	93.565	1.446	2.696	3.081
60	93.315	1.196	2.696	3.081
65	93.415	1.296	2.696	3.081
70	93.015	0.896	2.696	3.081
75	93.615	1.496	2.696	3.081
80	94.415	2.296	2.696	3.081
85	95.685	3.566		
90	95.910	3.791		

SECTION #7

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1986 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
0	97.707	5.538		
5	96.607	4.499		
10	95.531	3.412		
15	94.189	2.070	2.67	3.159
20	92.839	0.720	2.67	3.159
25	92.289	0.170	2.67	3.159
30	93.389	1.270	2.67	3.159
35	95.097	2.978		3.159
40	95.727	3.608		
45	96.242	4.123		
50	95.436	3.317		
55	95.205	3.086		
60	96.477	4.359		
63	97.257	5.138		

SECTION #8

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1986 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
0				
7	96.622	4.503		
10	95.959	3.840		3.941
15	95.250	3.131	3.381	3.941
20	94.950	2.831	3.381	3.941
25	94.600	2.481	3.381	3.941
30	94.400	2.281	3.381	3.941
35	93.900	1.781	3.381	3.941
40	93.750	1.631	3.381	3.941
45	93.400	1.281	3.381	3.941
50	93.650	1.531	3.381	3.941
55	95.100	2.981	3.381	3.941
60	95.500	3.381	3.381	3.941
65	95.729	3.610		3.941
70	97.419	5.300		

SECTION #9

STA (m)	1986 SURVEY (ASSUMED ELEVATION)	GEODETIC ELEVATION	1986 SURVEY (WATER ELEVATION)	1988 SURVEY (WATER ELEVATION)
0	96.916	4.797		
5	94.978	2.859	3.459	4.096
10	94.878	2.759	3.459	4.096
15	94.928	2.809	3.459	4.096
20	94.628	2.509	3.459	4.096
25	94.828	2.709	3.459	4.096
30	94.628	2.509	3.459	4.096
35	94.078	1.959	3.459	4.096
40	93.728	1.609	3.459	4.096
45	93.778	1.659	3.459	4.096
50	94.078	1.959	3.459	4.096
55	93.978	1.859	3.459	4.096
60	94.228	2.109	3.459	4.096
65	94.828	2.709	3.459	4.096
70	95.328	3.209	3.459	4.096
75	95.762	3.643		4.096
80	96.557	4.438		
85	97.072	4.953		

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Figure 2.6	Section #4.5 - Terra Nova River
Figure 2.7	Section #5 - Terra Nova River
Figure 2.8	Section #5.5 - Terra Nova River
Figure 2.9	Section #6 - Terra Nova River
Figure 2.10	Section #6.5 - Terra Nova River
Figure 2.11	Section #7 - Terra Nova River
Figure 2.12	Section #8 - Terra Nova River
Figure 2.13	Section #9 - Terra Nova River

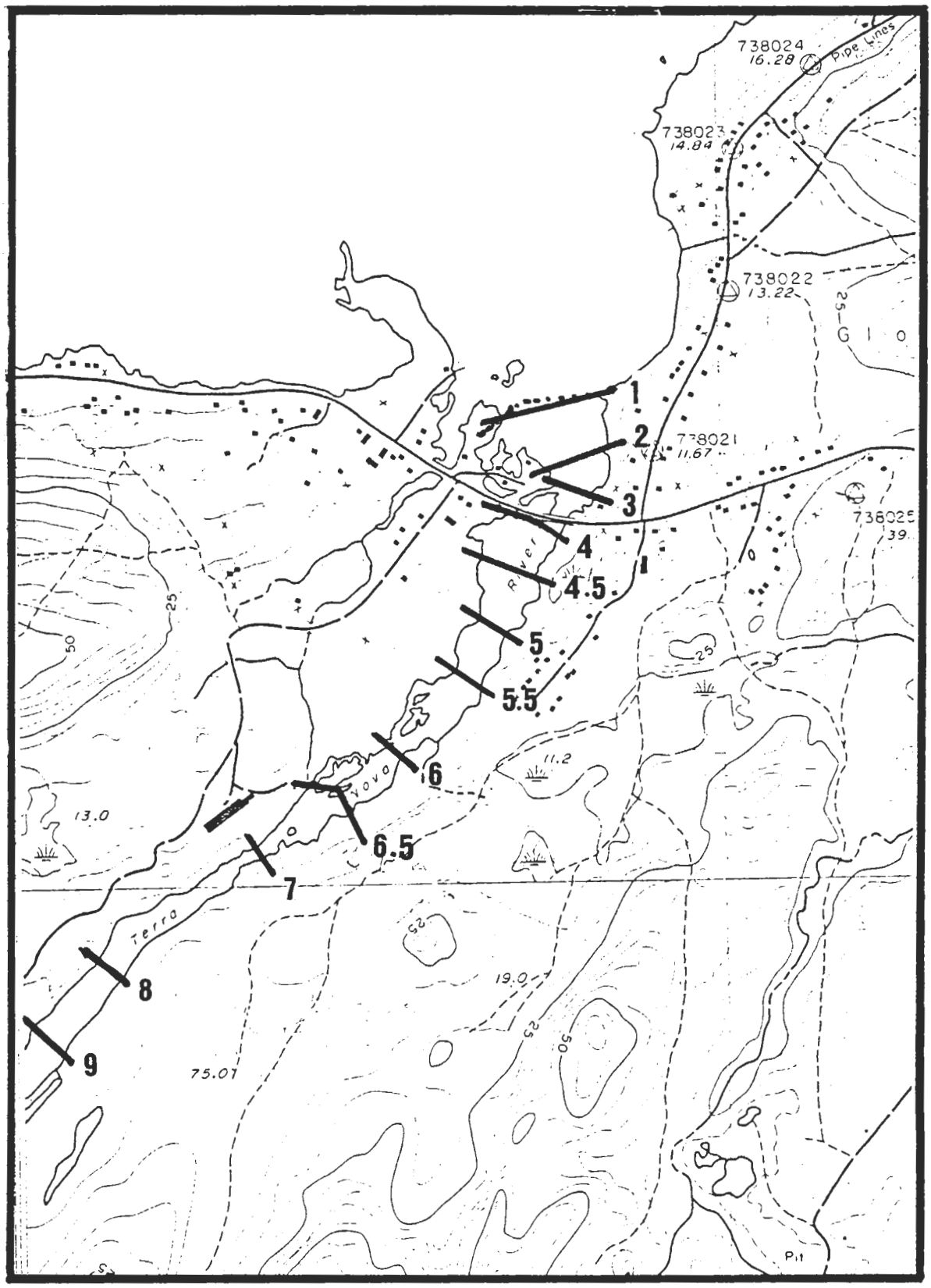
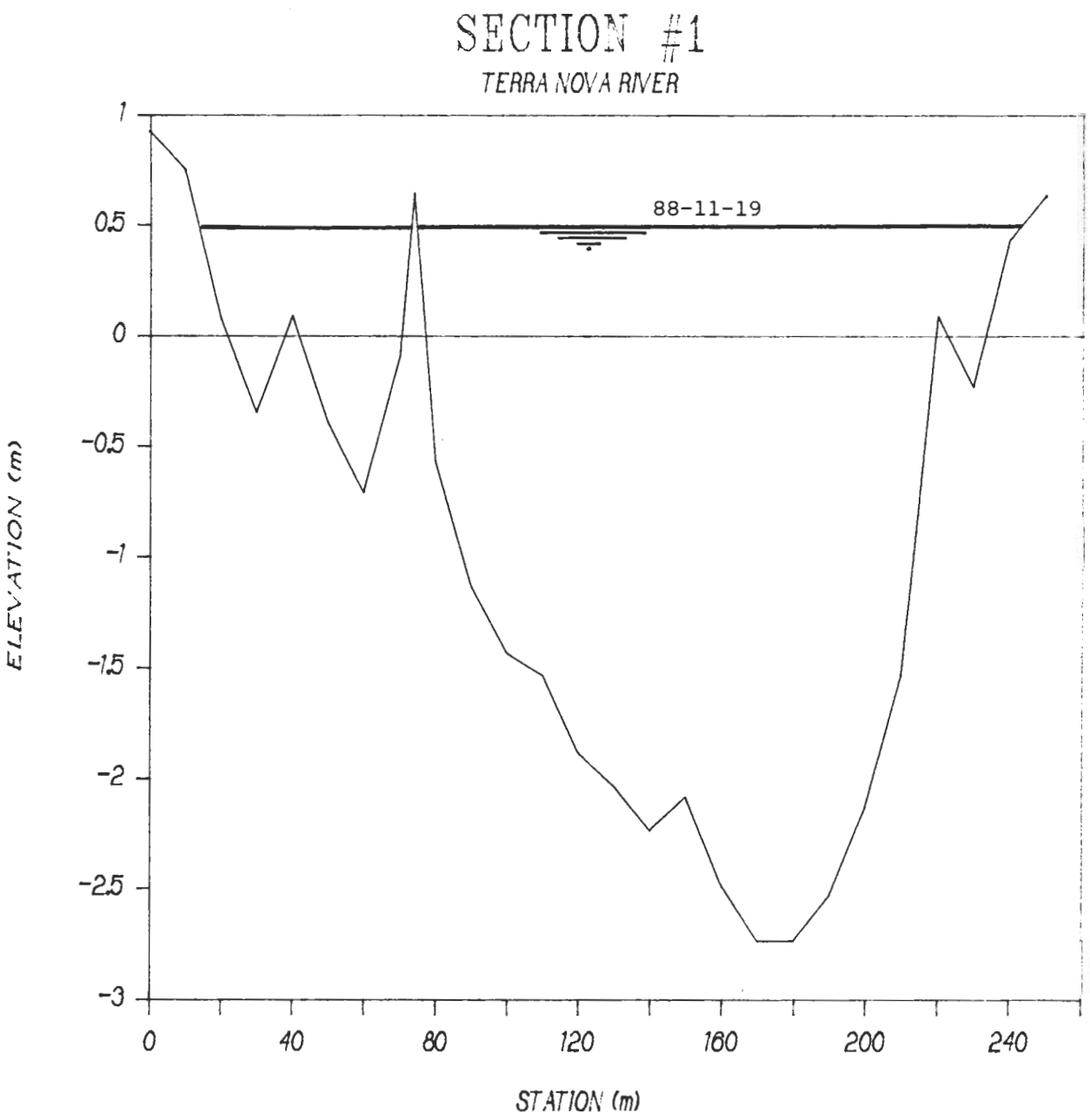


FIGURE 2.1

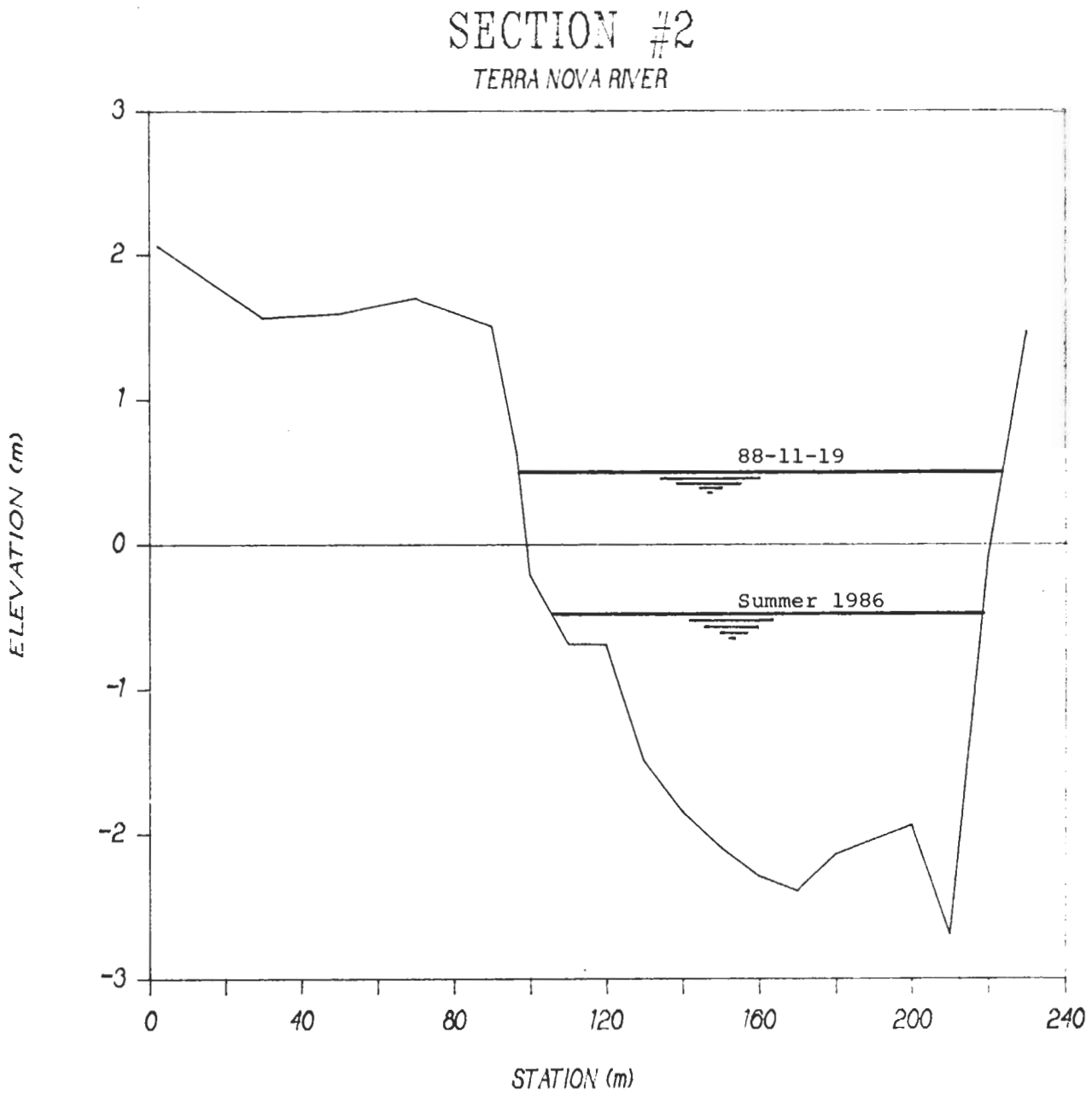
Location of X-Section on Terra Nova River



Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

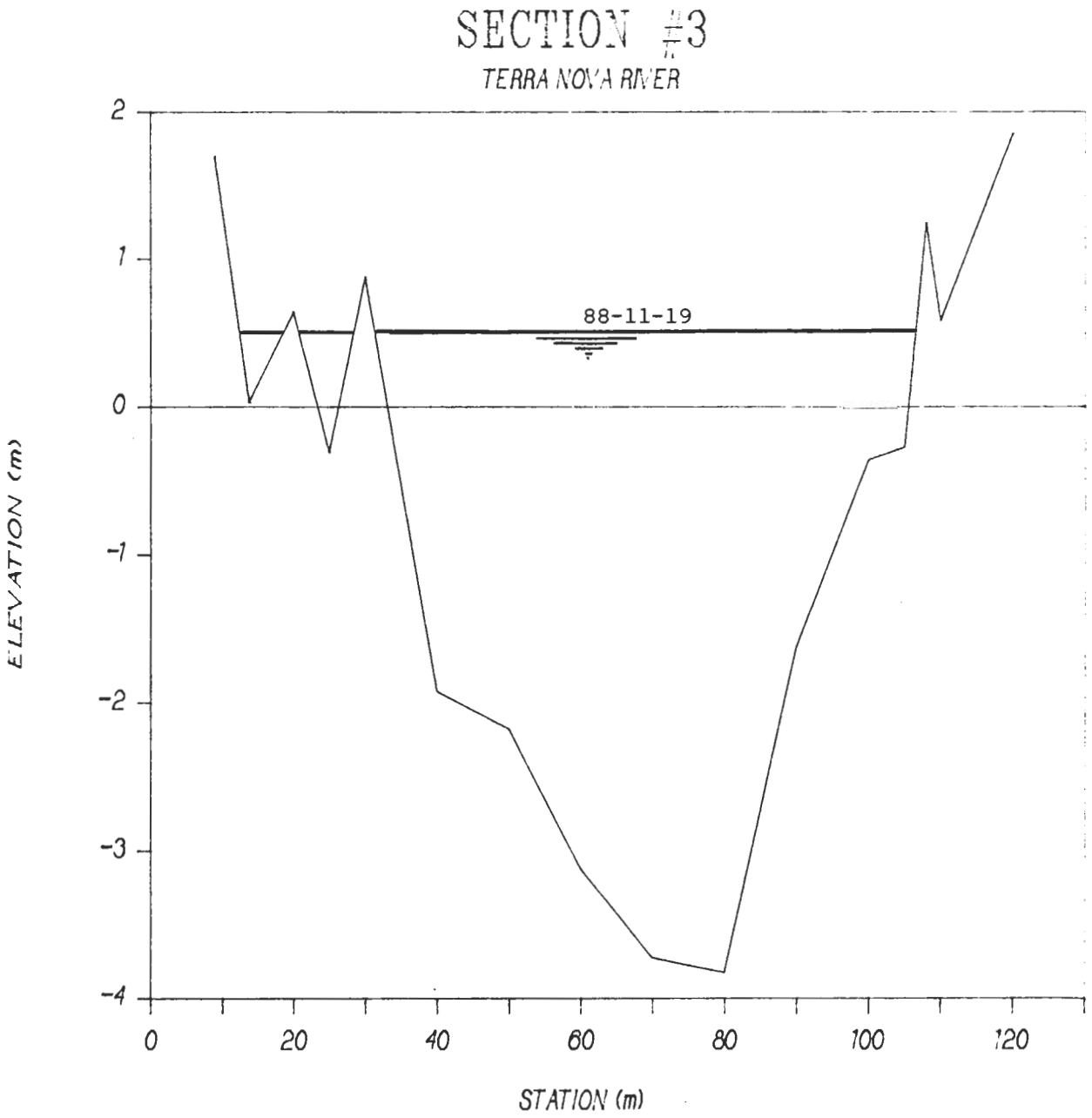
FIGURE 2.2



Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

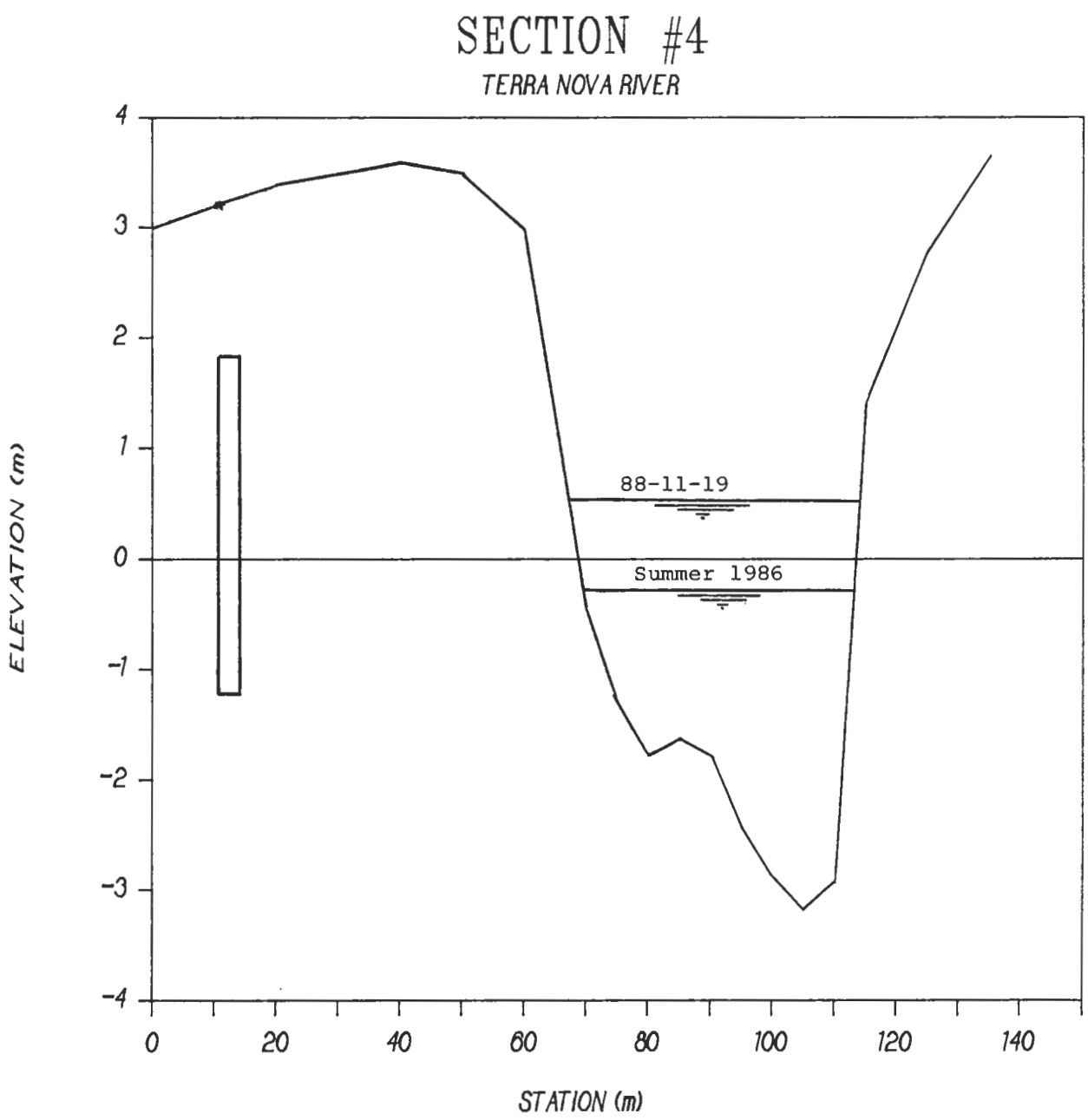
FIGURE 2.3



Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

FIGURE 2.4



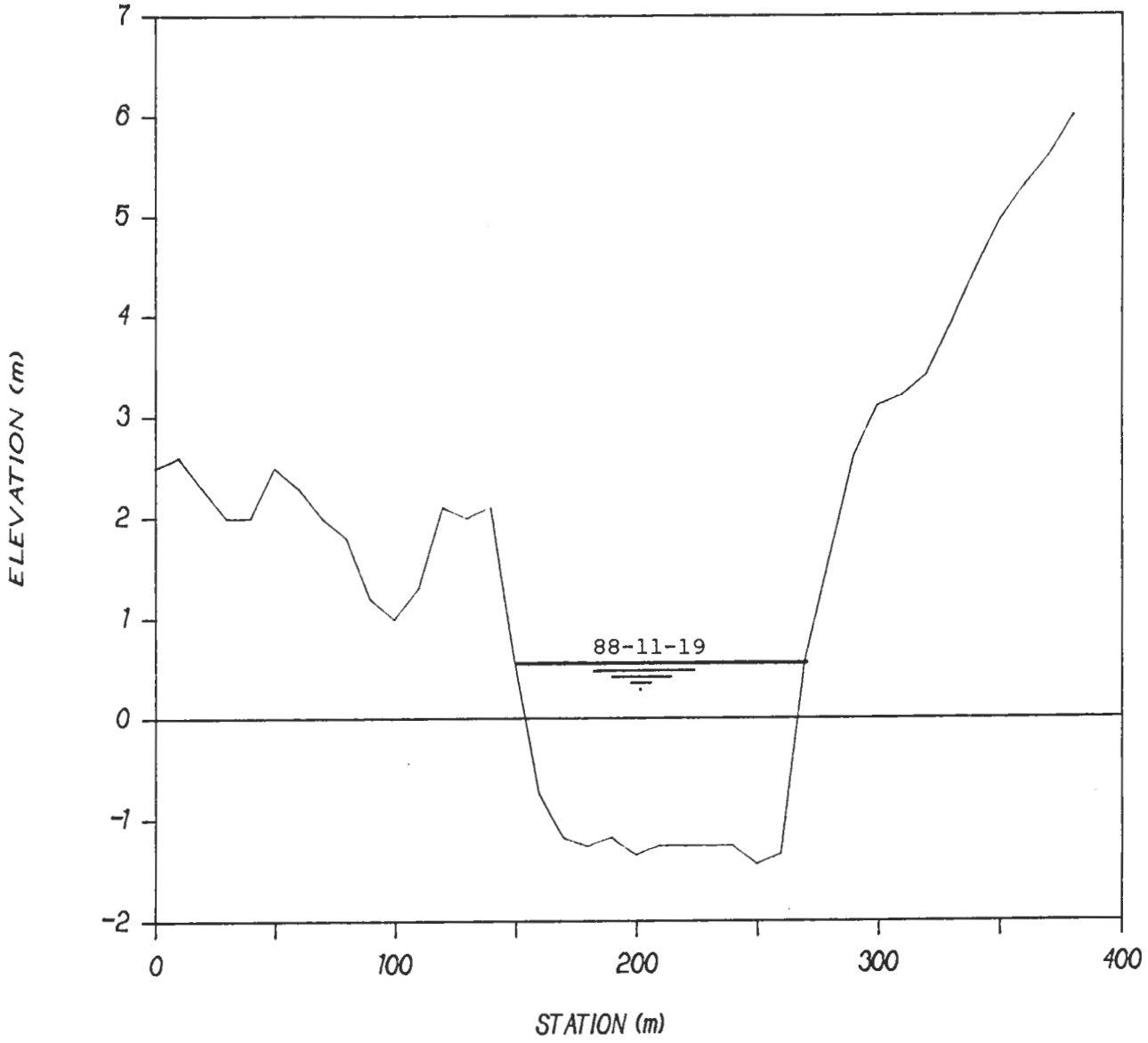
Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

FIGURE 2.5

SECTION #4.5

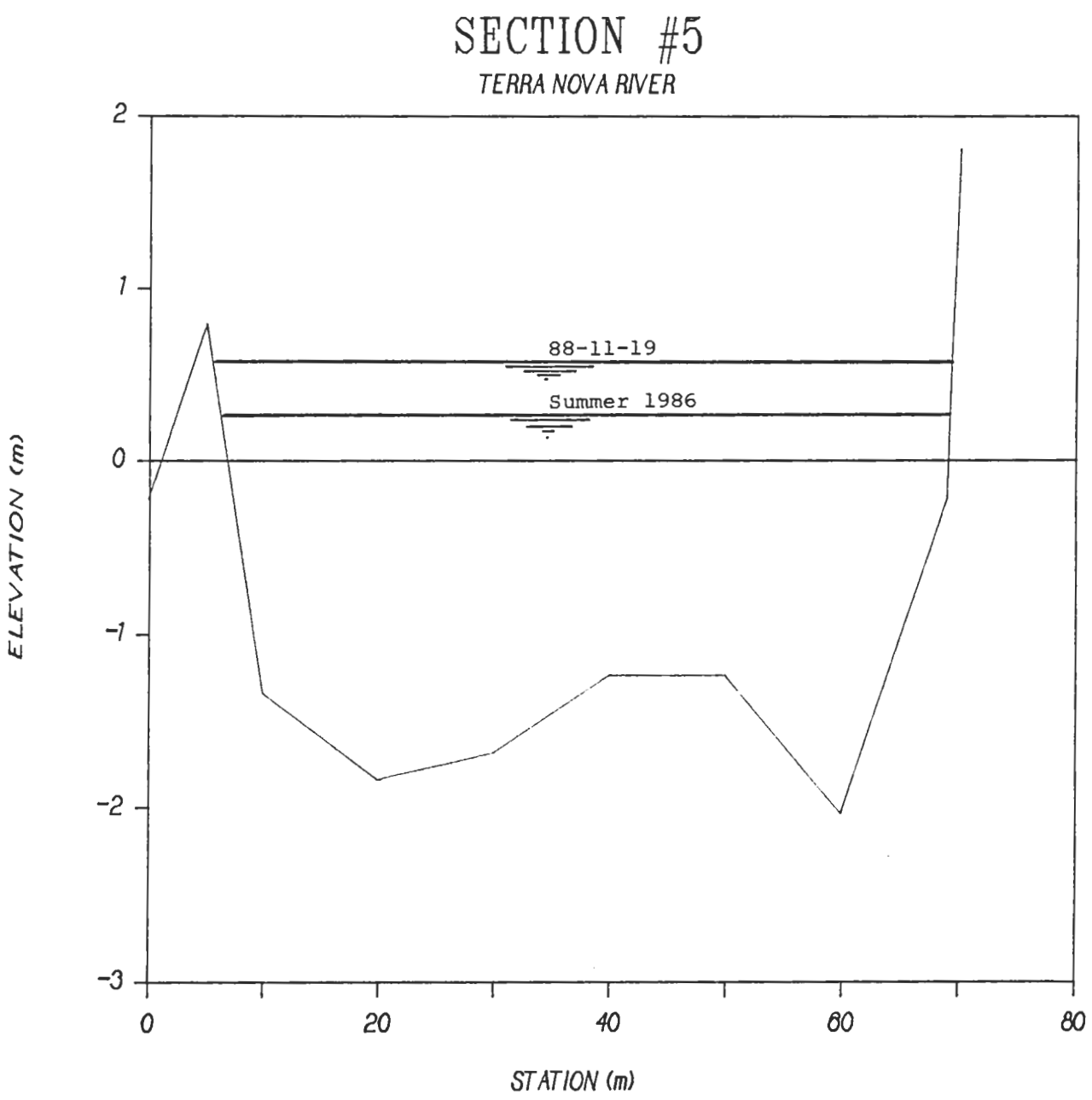
TERRA NOVA RIVER



Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

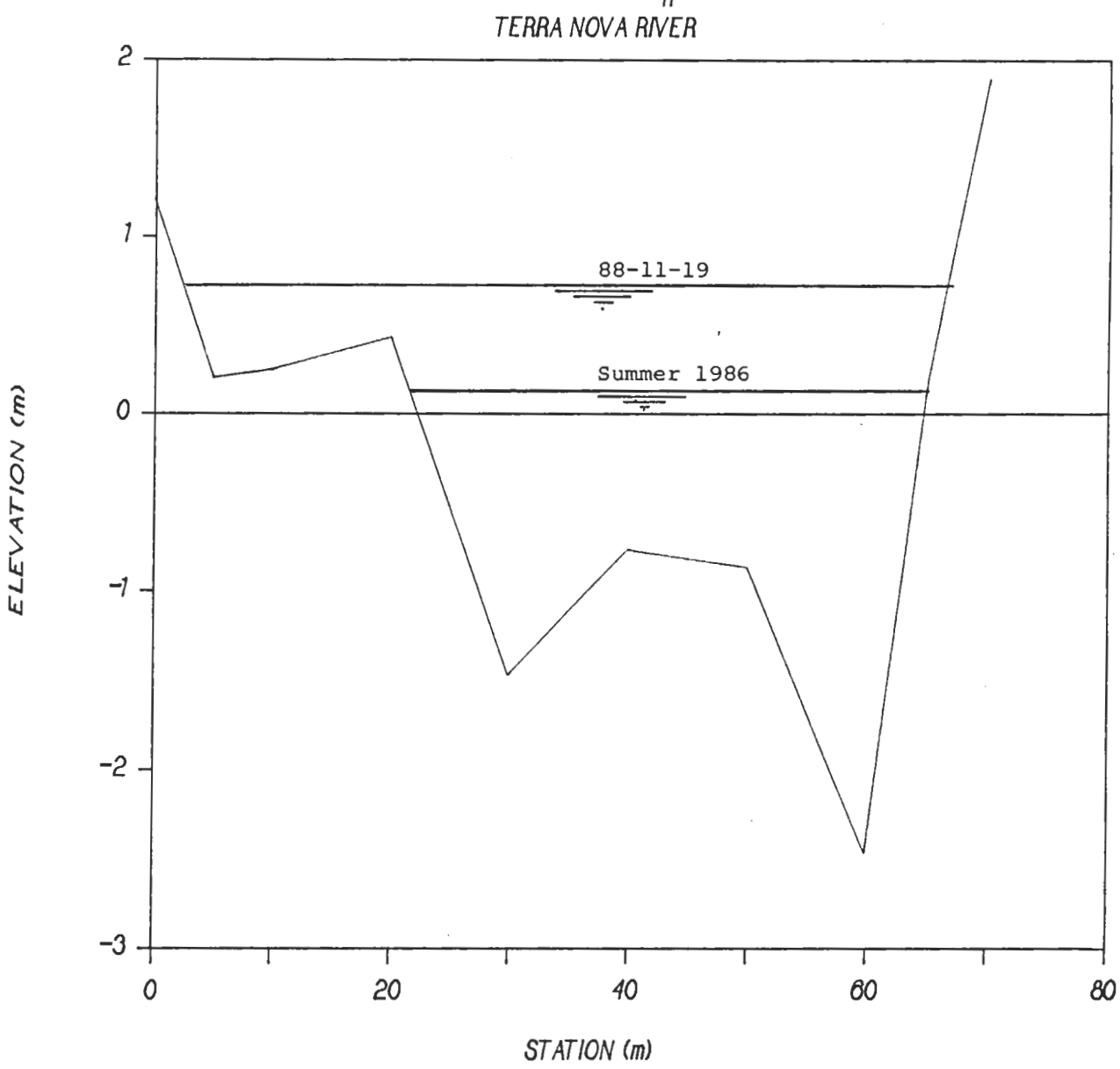
FIGURE 2.6



Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

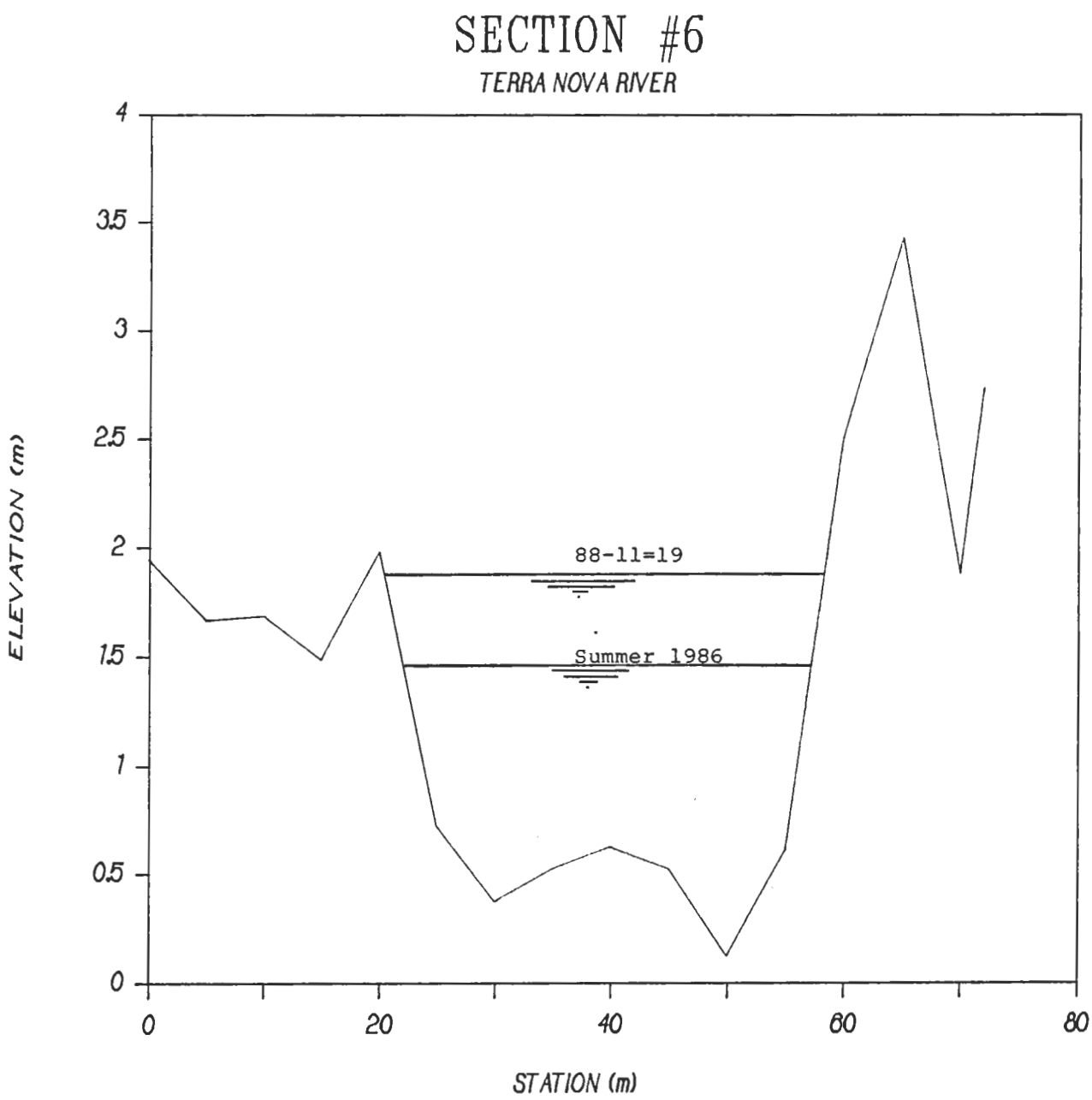
FIGURE 2.7



Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

FIGURE 2.8



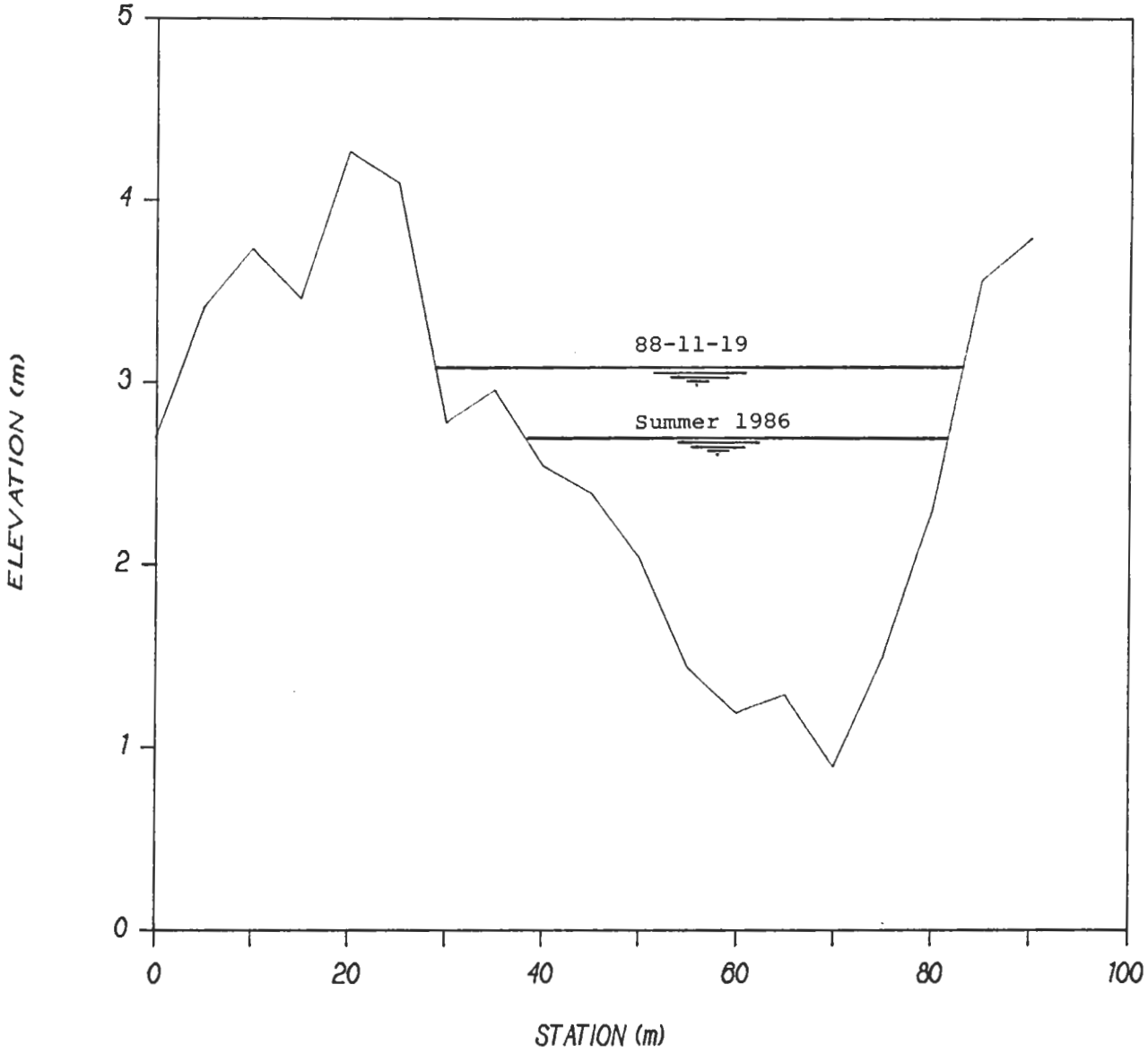
Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

FIGURE 2.9

SECTION #6.5 (DAM)

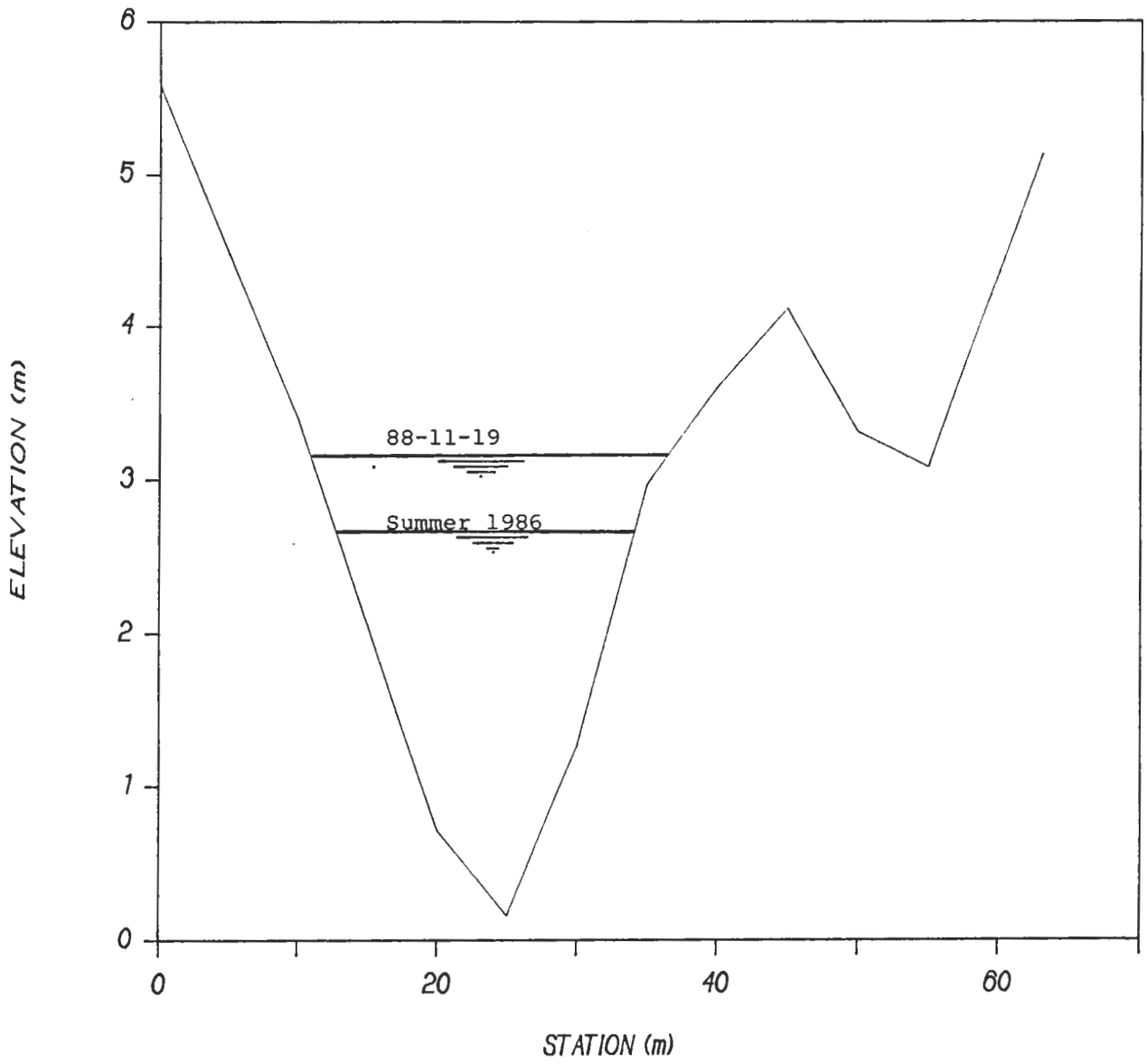
TERRA NOVA RIVER



Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

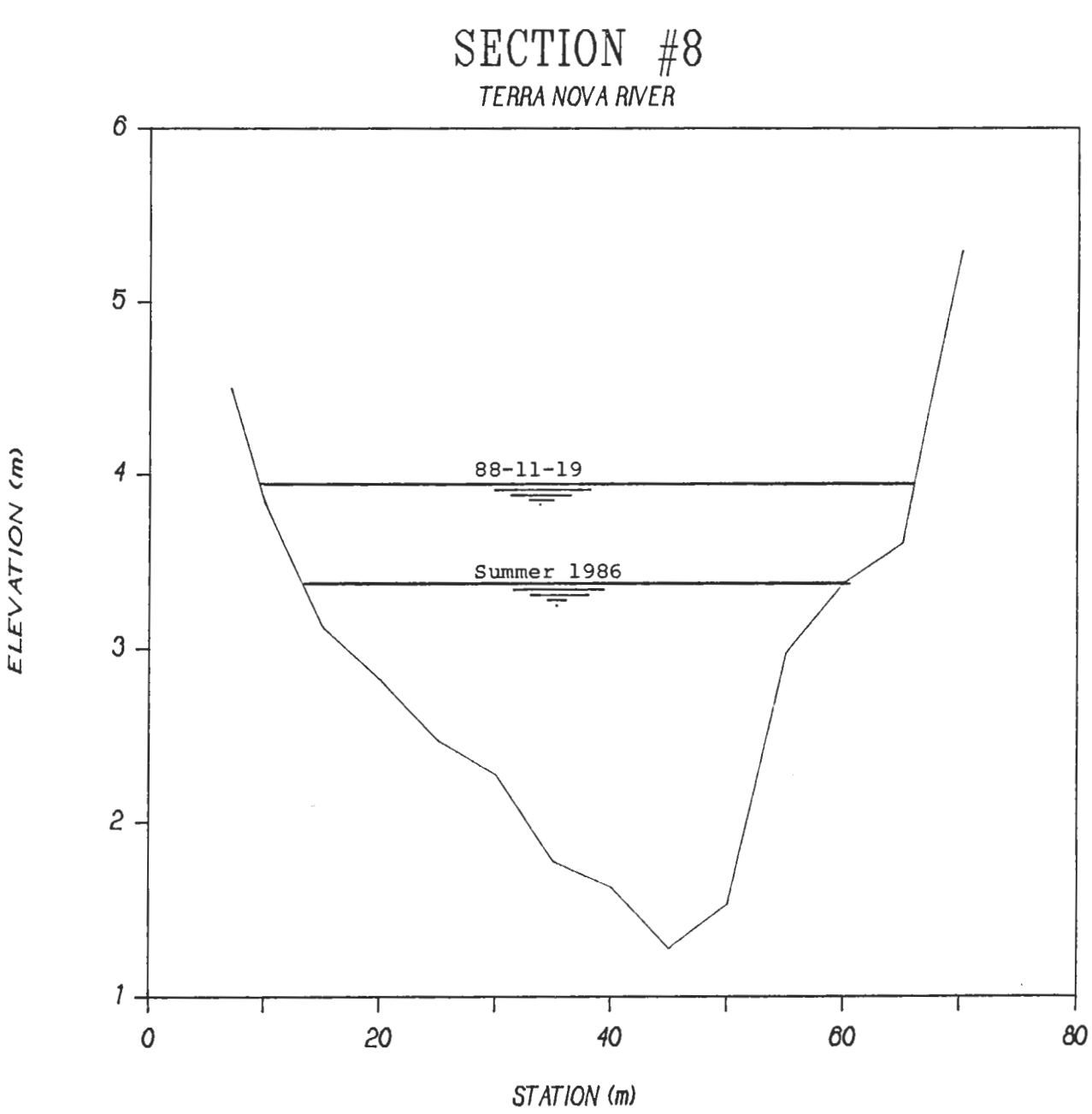
FIGURE 2.10



Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

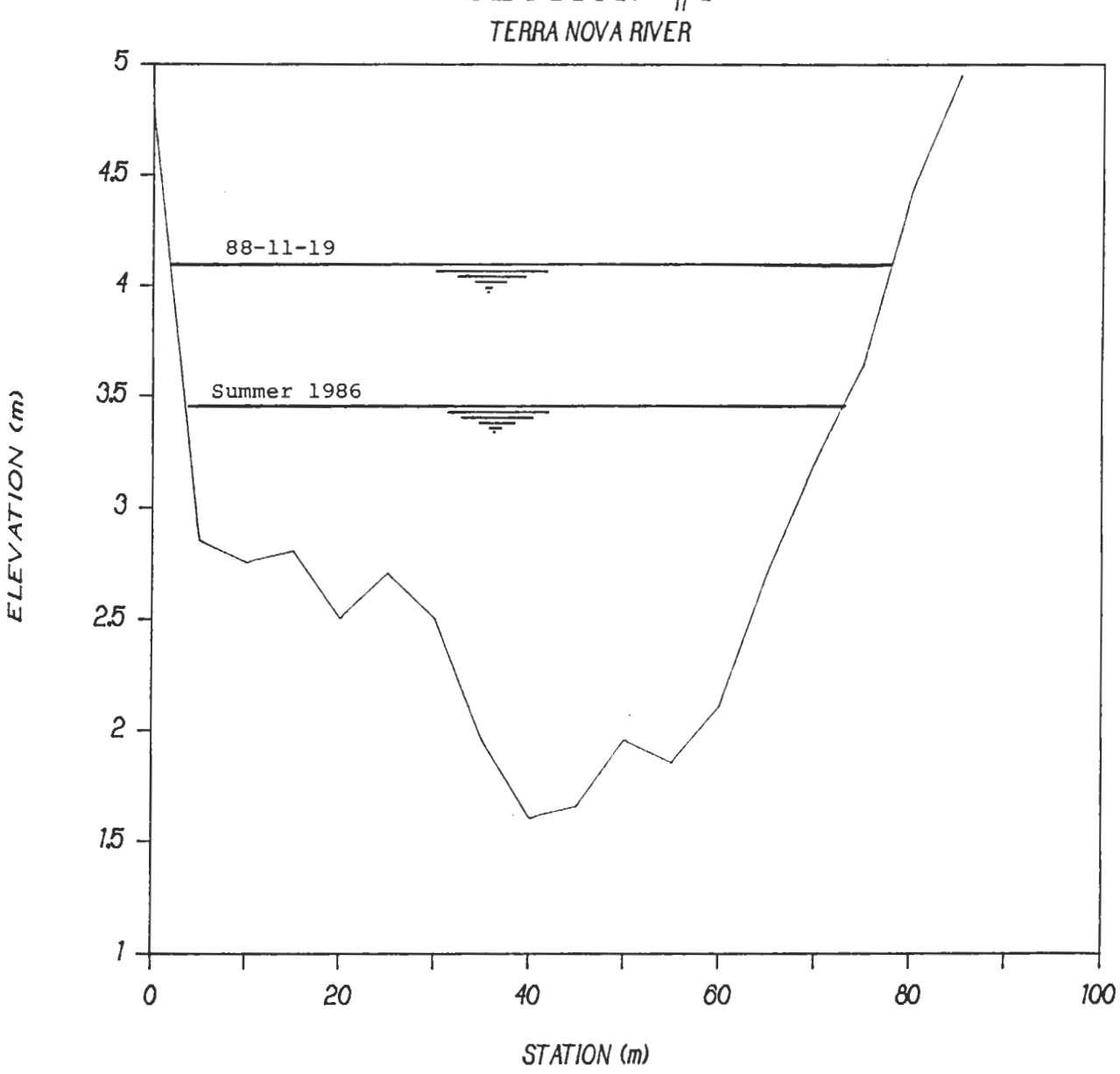
FIGURE 2.11



Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

FIGURE 2.12



Notes:

1. Elevations are geodetic
2. Cross-sections are plotted looking downstream

FIGURE 2.13

APPENDIX I

NOTES ON 1984 FLOOD

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF ENVIRONMENT
P.O. Box 4750
St. John's, Newfoundland
A1C 5T7

In Reply Please Quote
File Ref. No.
525

1984 07 17

Glovertown South,
Terra Nova River Ice Jam Monitoring.

1. Background Site Data

A data report should be prepared summarizing historical hydrological and meteorological data. Most of the information should be available from AES and Water Survey of Canada Records. Local observations should be used to supplement the information. The following would be a sufficient starting point.

1.1 Historical Data

Site inventory - location of all nearby met. and hydrological stations shown on a large scale map (Gander, Terra Nova Park, Comfort Cove, etc.)

List of all available data at the above stations

Summaries of data using tables, charts

- daily temperature - min-max.
- monthly summaries
- daily precipitation - rainfall intensity
- snow accumulation
- flows at upstream location
- analysis of peak instantaneous runoff
- table of previous ice jams, i.e., 1984 and 2 previous occasions

. . ./2

- obtain general topographic information i.e., basin characteristics
- obtain plans and profiles of bridge across river (D.O.T.)

1.2 1984 Flood

Obtain data leading up to 1984 flood. This is a summary of the above (1.1) specifically referring to the period preceding the ice jam to the clearing of the river.

Include - air temperatures, degree days
- precipitation
- statement of conditions

Obtain survey data to tie in water surface data from flood with general river elevations.

Summarize ice clearing events and blasting procedure used in 1984.

1.3 Hydraulic Data

Obtain by surveys and from 1:2500 scale maps and air photos

- cross sections
- profiles
- manning's n values
- observed flow rates & velocities
- tie in with benchmark at bridge and survey in a location for a crest gauge (see map).

2. Ice Break-Up Observation

In the event that a professional observer is at Glovertown during spring break-up or during a flood a prepared list of possible observations should be in hand. This will help to prevent missing important observations. Also topo maps, aerial photos and reports should be available at the site.

2.1 Normal Spring Break-up

- background data from local observers regarding type of ice, weather, extent of break-up
- at time of observation - type of ice, water surface elevations, where ice goes into the Bay, extent of ice upstream if any

. . ./3

2.2 Flooding Event

- If there is flooding in addition to the above survey and/or mark flood lines on properties and buildings, take photos
- Prepare a summary of damage and affected utilities i.e., flooded roads
- Contact responsible persons in area (Have a list prepared and check off).
  - RCMP
  - Town Council - Mayor
  - Dept. of Transportation for equipment on standby
  - Ice monitor if there is one designated.
- Assess and recommend immediate remedial measures using emergency procedure plans. i.e., construction of cofferdams, clearing of ice, diverting flows

3. Ice Monitoring Program

Prepare a plan for regular ice monitoring for use in

- emergencies
- establishing preventative measures
- general knowledge enhancement

3.1 Staff or Crest Gauges

2 locations - 1 at bridge
1 upstream but below rapids
1 possibly above rapids

- initiate daily observations during events but weekly otherwise
- explore possibility of having a recording gauge at one site

3.2 Freeze-up

- Have a paid or volunteer observe formation of ice.

  To include - harbour area
  - upstream of bridge
  - upstream of gravel pit
  - at highway TCH

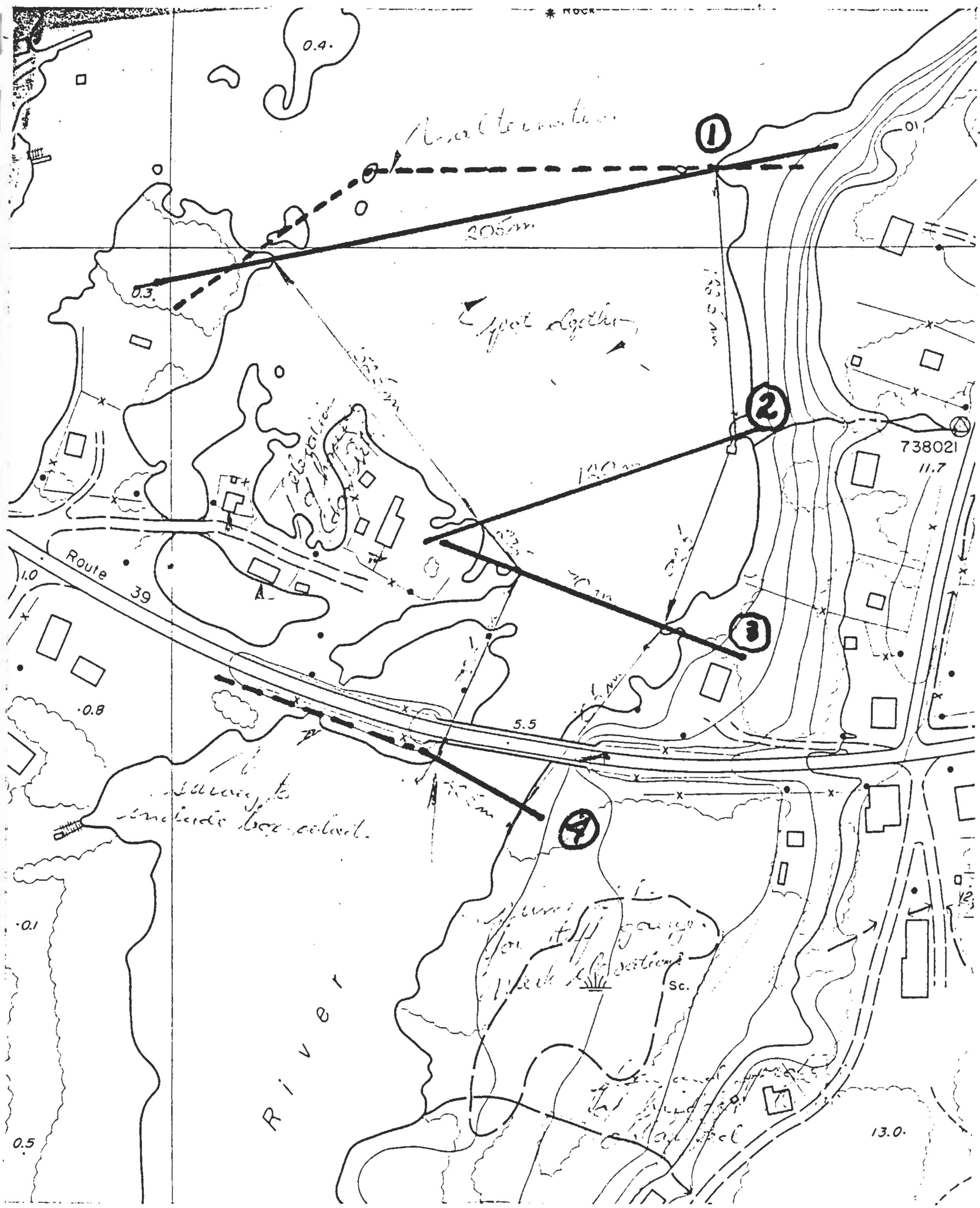
- record extent of ice cover at all locations
- record flows, temperatures, precipitation
- note any ice movement ie., pan ice or frazil

3.3 Mid Winter

- obtain ice thickness weekly at above 4 sites
  get 2 x weekly prior to break-up if safe
- visual

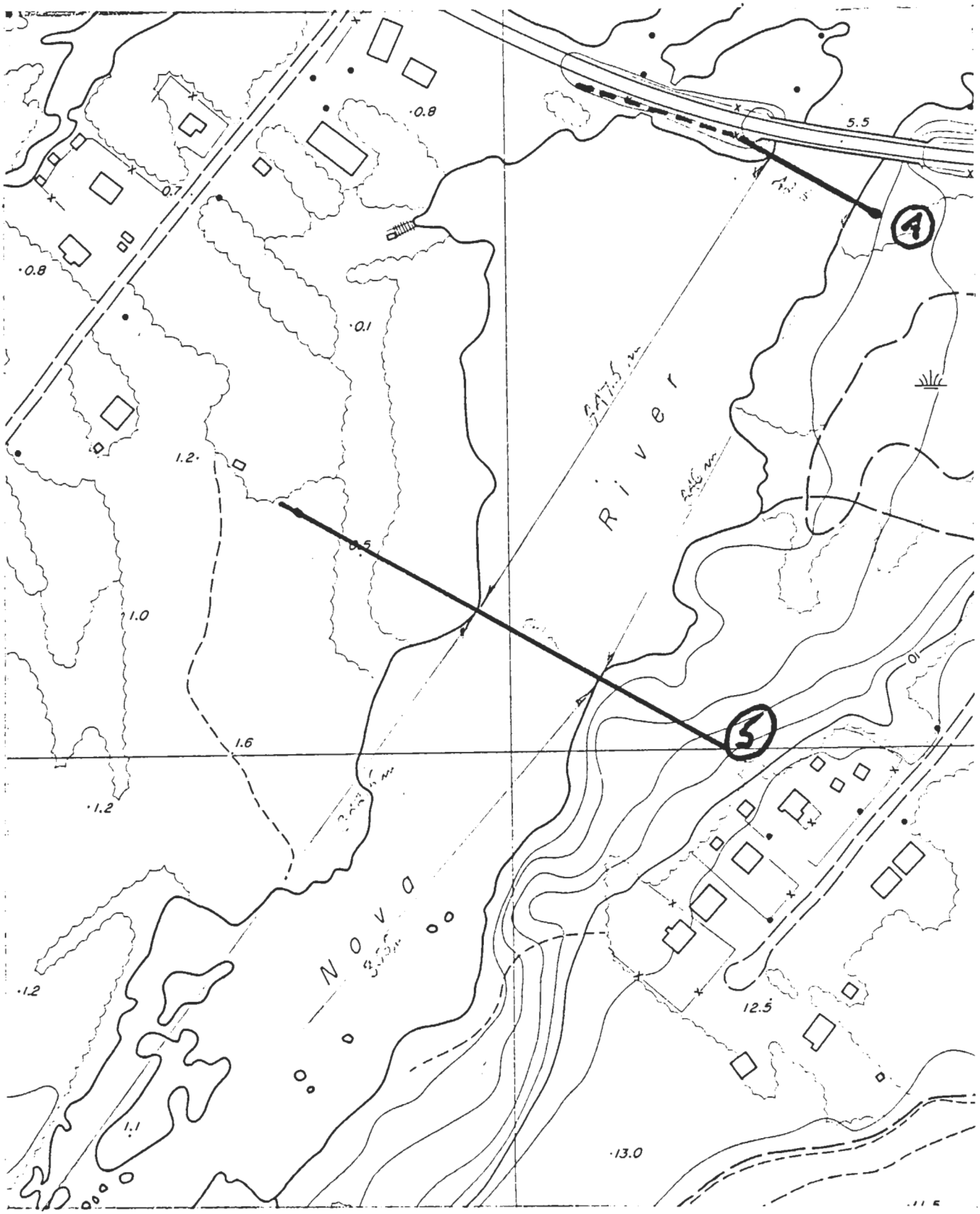
3.4 Spring Break-up

- See Section 2



(1)

Details


5.5
0.8
0.7
0.8
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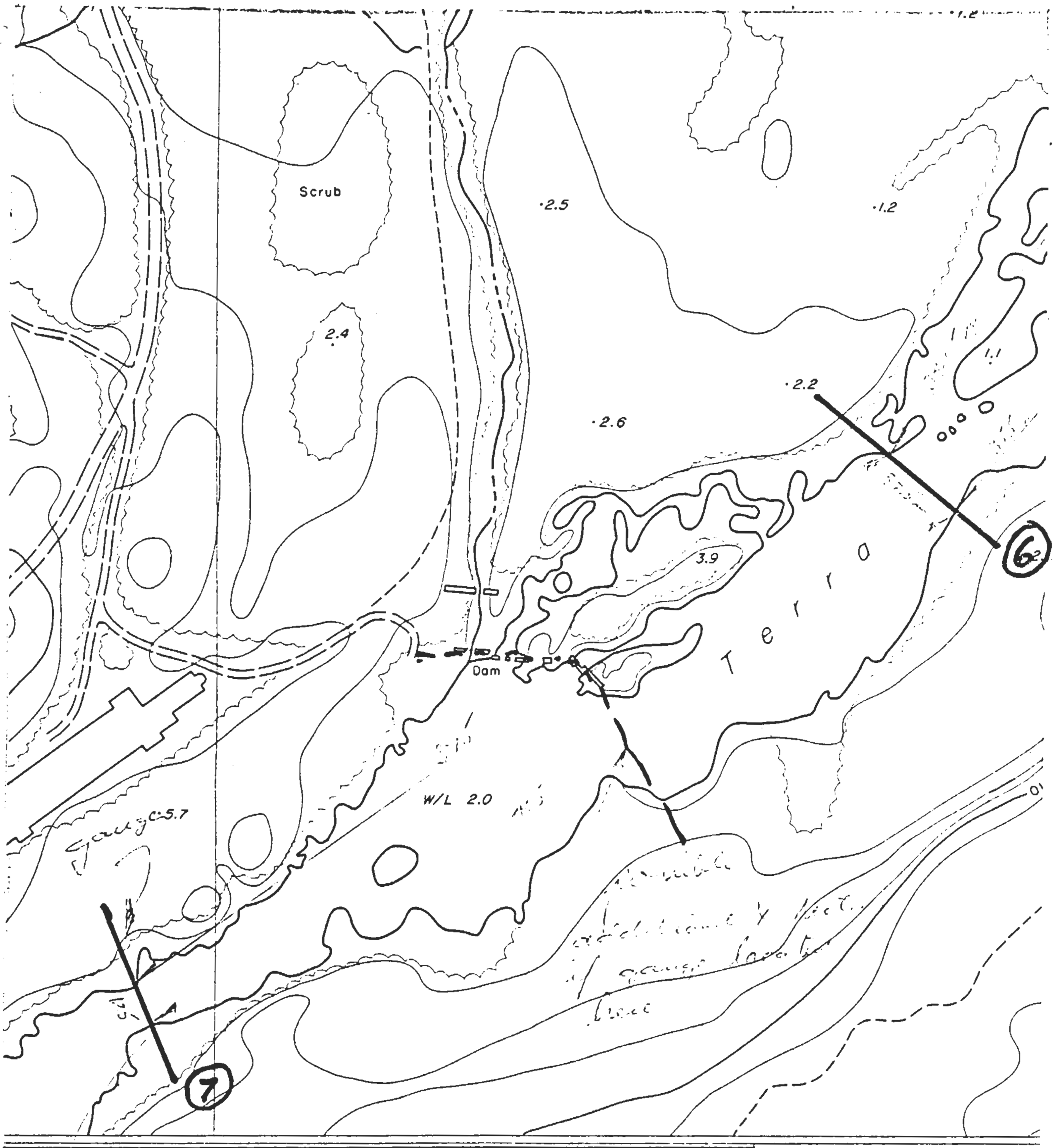
River
A
S



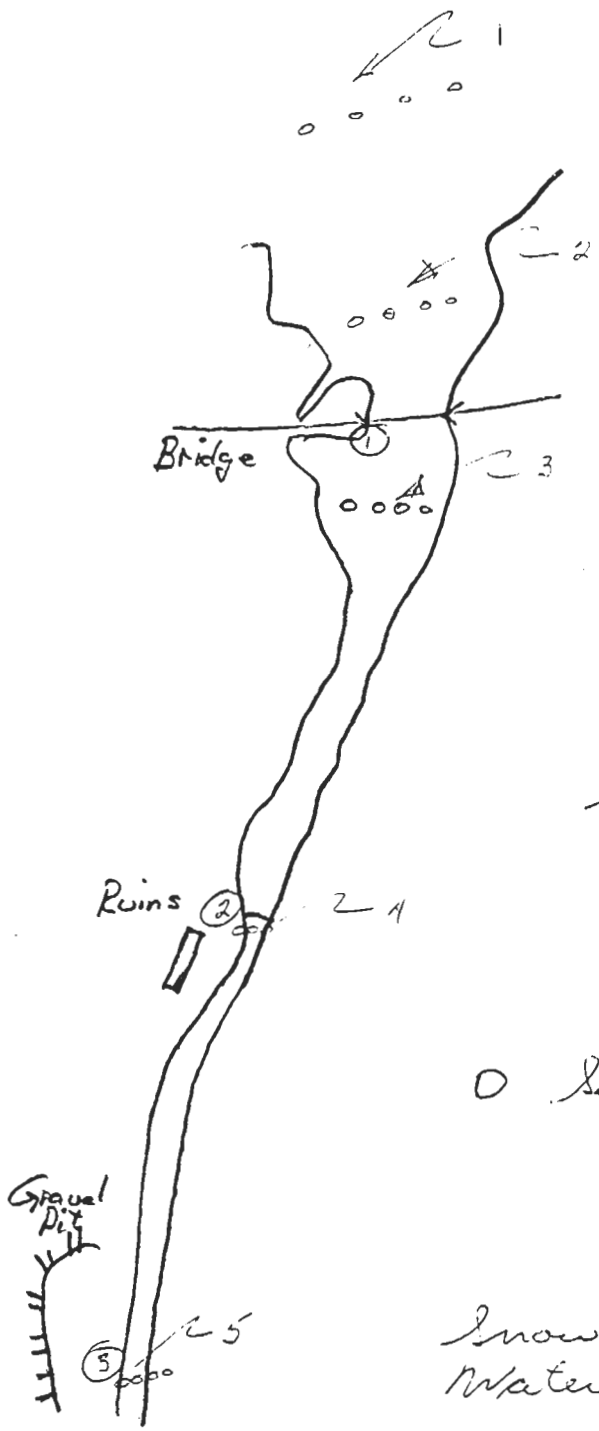
230,300 M
755,577.43

2 additional X-sections upstream - access from [illegible] - possible gauge location

(3)

Glovertown South
Terra Nova River Ice Monitoring

Observer: ..... Date: ....



Indicate on Map Ice Conditions

O - Open Water
M - Moving Ice
- s - Slush
- p - Pancakes
- l - Large Sheets
- f - Floes

F - Frazil Ice
S - Stationary Ice
- p - Pancake
- l - Large Sheets
- b - Blocks
- j - Jam

ie Sl - sheet ice, stationary
Mp - moving (pancake ice)

Ice Thicknesses and Type/Quality

site 1 .....
2 .....
3 .....
4 .....
5 .....

O Staff Gauge Reading
1
2
3

Snow Cover
Water Temperature

other notes - indicate important changes since last observation, water on ice, overbank flow, presence of ice walls and miscellaneous

Reviewed by Dr Bell

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF ENVIRONMENT
P.O. Box 4750
St. John's, Newfoundland
A1C 5T7

In Reply Please Quote
File Ref. No.
525

1984 07 17

Glovertown South,
Terra Nova River Ice Jam Monitoring.

1. Background Site Data

A data report should be prepared summarizing historical hydrological and meteorological data. Most of the information should be available from AES and Water Survey of Canada Records. Local observations should be used to supplement the information. The following would be a sufficient starting point.

1.1 Historical Data

Site inventory - location of all nearby met. and hydrological stations shown on a large scale map (Gander, Terra Nova Park, Comfort Cove, etc.) ✓

List of all available data at the above stations ✓

Summaries of data using tables, charts ✓

- daily temperature - min-max. ✓
- monthly summaries ✓
- daily precipitation - rainfall intensity ✓
- snow accumulation ✓
- flows at upstream location ✓
- analysis of peak instantaneous runoff ✓ Excel
- table of previous ice jams, i.e., 1984 and 2 previous occasions
- indicate normal conditions at breakups

. . ./2

- obtain general topographic information i.e., basin characteristics
- obtain plans and profiles of bridge across river (D.O.T.)

check purpose of culvert (if possible) with D.O.T.
check historical infor. on dams u/s. when built/when removed / mode & purpose of operation

1.2 1984 Flood

Obtain data leading up to 1984 flood. This is a summary of the above (1.1) specifically referring to the period preceding the ice jam to the clearing of the river.

Include - air temperatures, degree days
- precipitation
- statement of conditions
- discharge if possible/ever. est'd.

Obtain survey data to tie in water surface data from flood with general river elevations. ✓

Summarize ice clearing events and blasting procedure used in 1984. ✓

1.3 Hydraulic Data

Obtain by surveys and from 1:2500 scale maps and air photos

- cross sections
- profiles
- manning's n values
- observed flow rates & velocities
- tie-in with benchmark at bridge and survey in a location for a crest gauge (see map).

2. Ice Break-Up Observation

In the event that a professional observer is at Glovertown during spring break-up or during a flood a prepared list of possible observations should be in hand. This will help to prevent missing important observations. Also topo maps, aerial photos and reports should be available at the site.

2.1 Normal Spring Break-up

- background data from local observers regarding type of ice, weather, extent of break-up ✓
- at time of observation - (type of ice) water surface elevations, where ice goes into the Bay, extent of ice upstream if any ✓

(& thickness) of blocks if accessible

2.2 Flooding Event

- If there is flooding in addition to the above survey and/or mark flood lines on properties and buildings, take photos
- Prepare a summary of damage and affected utilities i.e., flooded roads
- Contact responsible persons in area (Have a list prepared and check off).
  - RCMP
  - Town Council - Mayor
  - Dept. of Transportation for equipment on standby
  - Ice monitor if there is one designated.
- Assess and recommend immediate remedial measures using emergency procedure plans. i.e., construction of cofferdams, clearing of ice, diverting flows

- try to obtain aerial views of river, if aircraft rental feasible
- photos for W.L. profiles, @ XS's or staff gges

3. Ice Monitoring Program

Prepare a plan for regular ice monitoring for use in

- emergencies
- establishing preventative measures
- general knowledge enhancement

3.1 Staff or Crest Gauges

2 locations - 1 at bridge
1 upstream but below rapids
1 possibly above rapids
or more frequent

- initiate daily observations during events but weekly otherwise
- explore possibility of having a recording gauge at one site

3.2 Freeze-up

- Have a paid or volunteer observe formation of ice.

To include - harbour area ✓
- upstream of bridge ✓
- upstream of gravel pit ✓
- at highway TCH ✓

- record extent of ice cover at all locations
- record flows, temperatures, precipitation
- note any ice movement ie., pan ice or frazil

- read staff gges w/ possible

3.3 Mid Winter

- obtain ice thickness weekly at above 4 sites
  get 2 x weekly prior to break-up if safe
- visual

3.4 Spring Break-up

- See Section 2

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF ENVIRONMENT
P.O. Box 4750
St. John's, Newfoundland
A1C 5T7

In Reply Please Quote
File Ref. No.

1984 02 20

MEMO TO: Dr. W. Ullah, Director, Water Resources Division

FROM: Martin Goebel, P. Eng., Water Investigations Branch

RE: Flooding of Terra Nova River at Glovertown, NF

Department of Environment officials (Mr. M. Goebel and Mr. D. Hansen) arrived in Glovertown on Wednesday, February 8, 1984 at 2:30 p.m. Mr. J. Greer was contacted at the R.C.M.P. station in Glovertown and an immediate inspection of the site was carried out.

Cause of Flooding

Heavy rainfall which occurred on the weekend prior to the flooding, resulted in the rising of water levels in the Terra Nova River. It is estimated that approximately 1.5 km of ice broke loose. This ice jammed at the outlet of the river where the depth of the channel is reduced and where the presence of sea ice further restricted flow. The production of frazil ice and additional floes of surface ice were contributing to increase the density of the jam. The situation at that time was as shown in Figure 1.

The increased water level in the Terra Nova River was causing water to spill over the banks at several places. The worst was at a 20' wide box culvert (A) where evidently the normal side channel was completely inundated and water was diverted overland (B) and was flooding the houses at (C). The church (D) as well as some municipal buildings were in danger of being flooded from water flowing over the banks at (E). Approximately 2" of water was crossing the highway at (F).

.../2

Decision to Proceed with Blasting

The decision to give environmental approval to proceed with blasting was made by Mr. M. Goebel. The plan for blasting was to create a channel through the middle of the jam starting at the downstream end. It was anticipated that there was sufficient open water to contain the ice and that there was sufficient hydraulic head to take some of the ice under the sea ice sheet. The actual blasting would not take place until the following day (Feb. 9). It was intended that the blasting operation would involve the use of a helicopter and that the charges were to be placed on the ice surface.

Further Investigation (see photos)

Further details were investigated by walking along the shore of the ice jam area north of the bridge and by travelling upstream to the point along the Terra Nova River where the ice cover started. By approximately 5:00 p.m. there was little change in depth of water in the vicinity of the flooded houses. Another conversation took place with Mr. Greer and the decision to carry out blasting was confirmed. It was stressed that any changes in the planned operation were to be communicated to the Department.

Blasting Operations - February 9

Department of Environment officials (Mr. M. Goebel and Mr. R. Picco) arrived in Glovertown by 9:15 a.m. It appeared that overnight the water had risen between one and two inches and water was now crossing the road at point (E).

The blasting began at 10:00 a.m. The procedure was to transport four 25-pound bags of explosives to the ice. These were detonated by lighting six min. fuses at approximately 30 sec. intervals. The explosives were laid on the ice surface. The charges were not entirely effective because there were no boosters. Also, some of the charges failed to explode. Unexploded charges were detonated in the next round by placing a new charge on top of the old charge.

A break in the blasting operations took place at lunch time to allow school children to go outside. A visible channel had been cut by this time.

Blasting again commenced at 1:30 p.m. Boosters had arrived by this time and the charges were significantly more effective. By 3:30 p.m. all but a few blasting caps had been used up. Blasting operations ceased and Mr. M. Goebel flew over the jam to observe the progress. A significant channel had been created but more important, a small fracture about four inches wide and running at right angles to the flow

.../3

direction was observed in what was previously competent sheet ice (see Figure 2).

The ice jam broke at approximately 4:00 p.m. The ice was now displaced into what was previously the open water area. Water levels dropped approximately 12-18 inches. The flow of water around the flooded homes had changed direction and the highway was completely free of water. The situation at this time was as shown in Figure 3.

Subsequent Water Level Changes

The water levels increased approximately three inches by 10:30 p.m. By 7:00 a.m. the following morning (February 10) there was a further increase in depth of approximately one inch. The cold temperatures overnight had frozen ice along the shores of the inundated areas. It appeared that there was more ice in the jam area then there was previously.

Fly-over at 9:30 a.m. - February 10

The Honourable Hal Andrews arrived by helicopter and was briefed about the situation at that time. A fly-over of the area confirmed that an additional ice sheet had broken loose upstream and was piled up against the jam. Water flowing through the box culvert was still flooding the area around the two houses. A site was identified where further blasting could be effective if necessary.

By about 11:00 a.m. it was evident that the water levels were no longer rising. The R.C.M.P. were advised to monitor the water levels closely as there was a possibility that if more ice broke loose from upstream it could cause more flooding. However, the cold temperature and lack of precipitation was contributing to a decrease in flow in the river and water levels were expected to gradually go down.

Department of Environment officials left the area shortly before noon.

Martin Goebel, P. Eng.

pt
Attachments

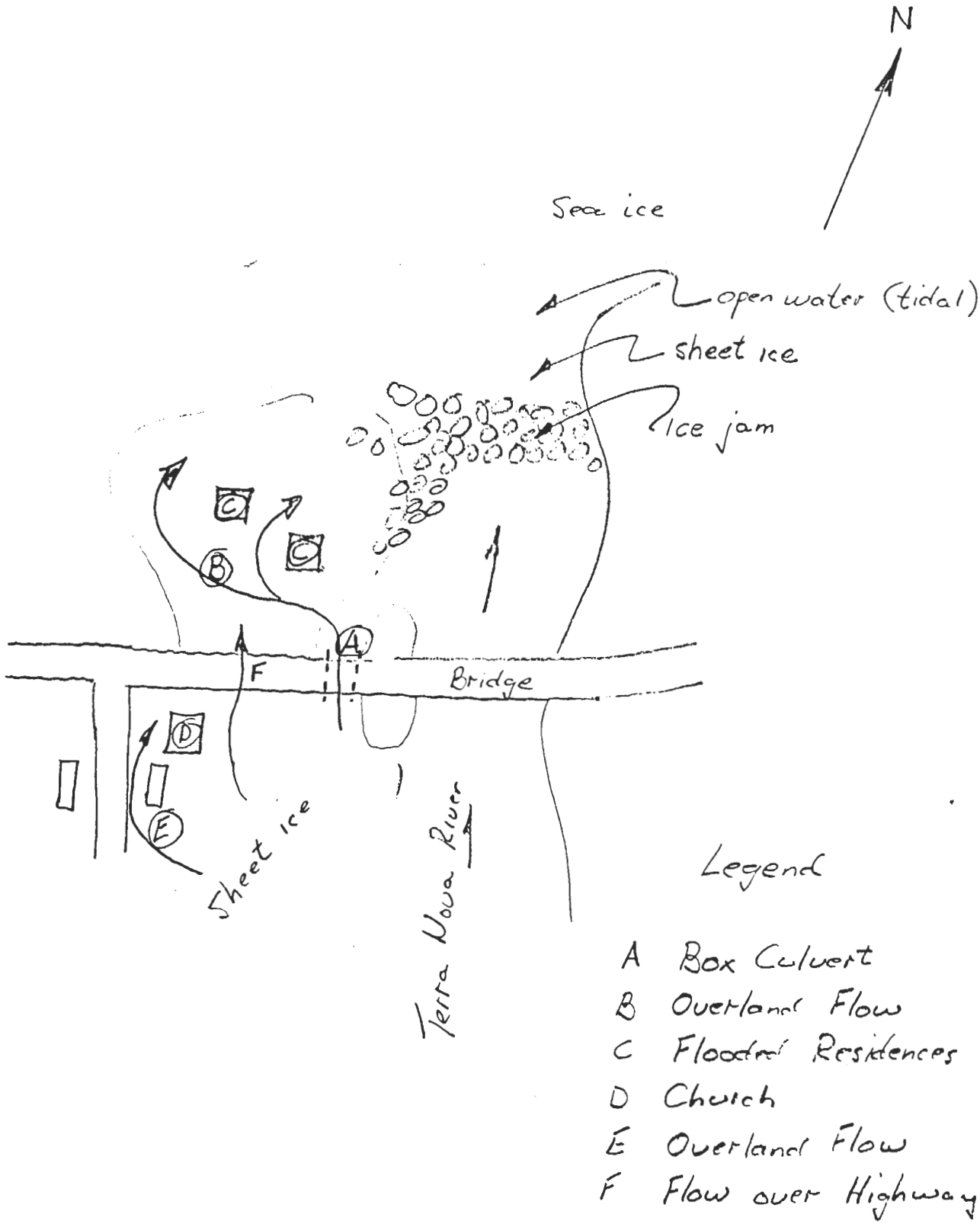


Fig 1. Site Plan at Gloverton

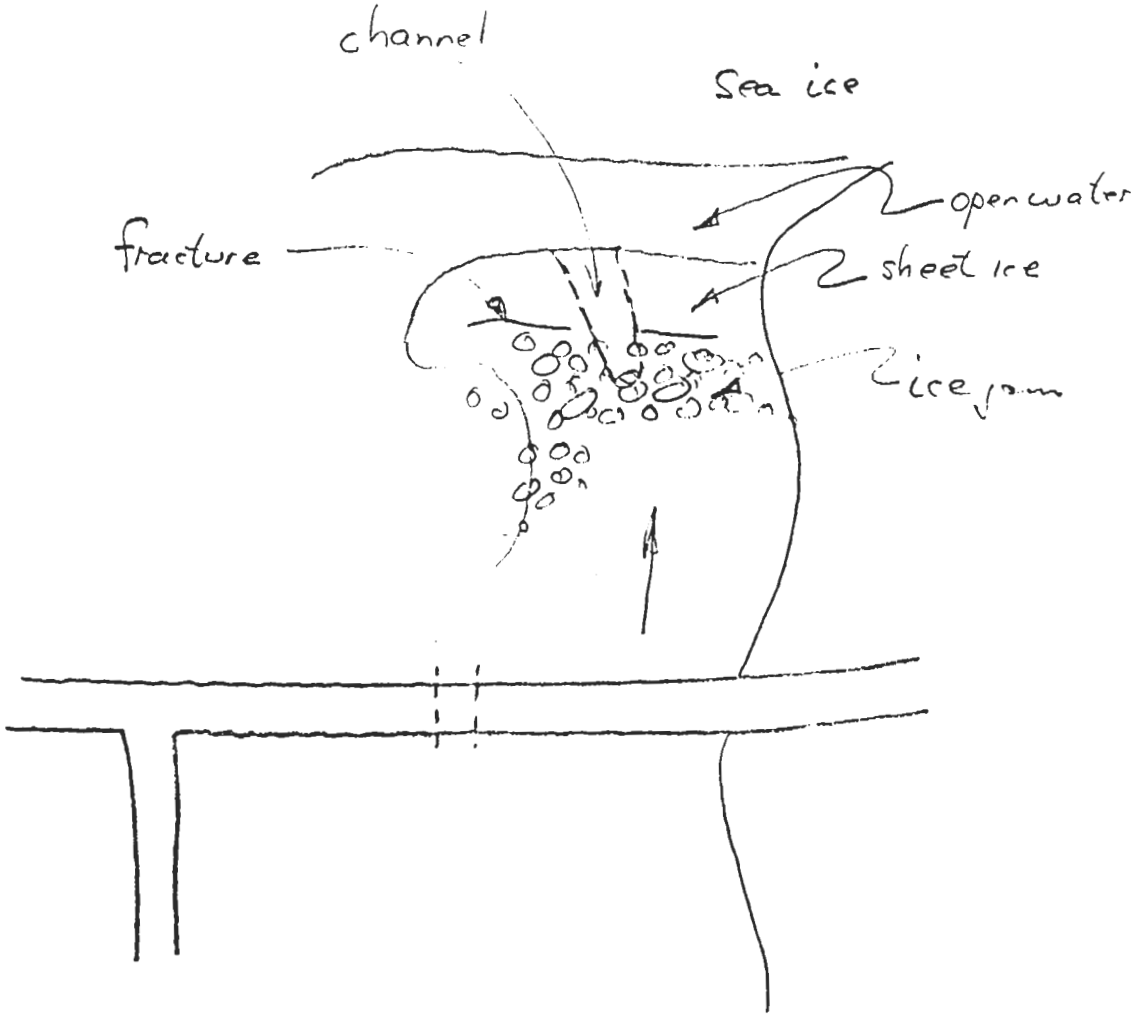


Fig 2. Ice Jam Prior to Break

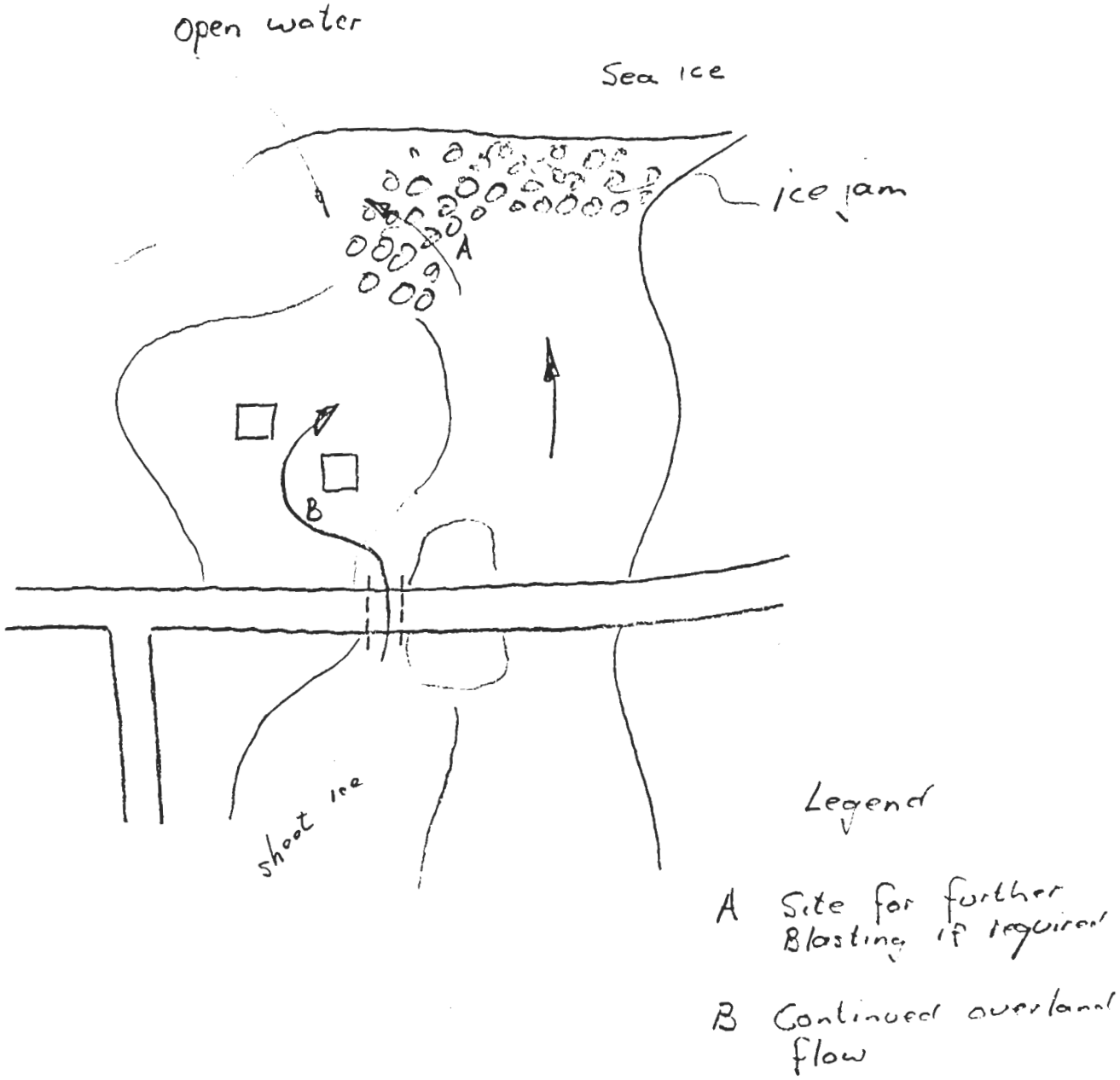
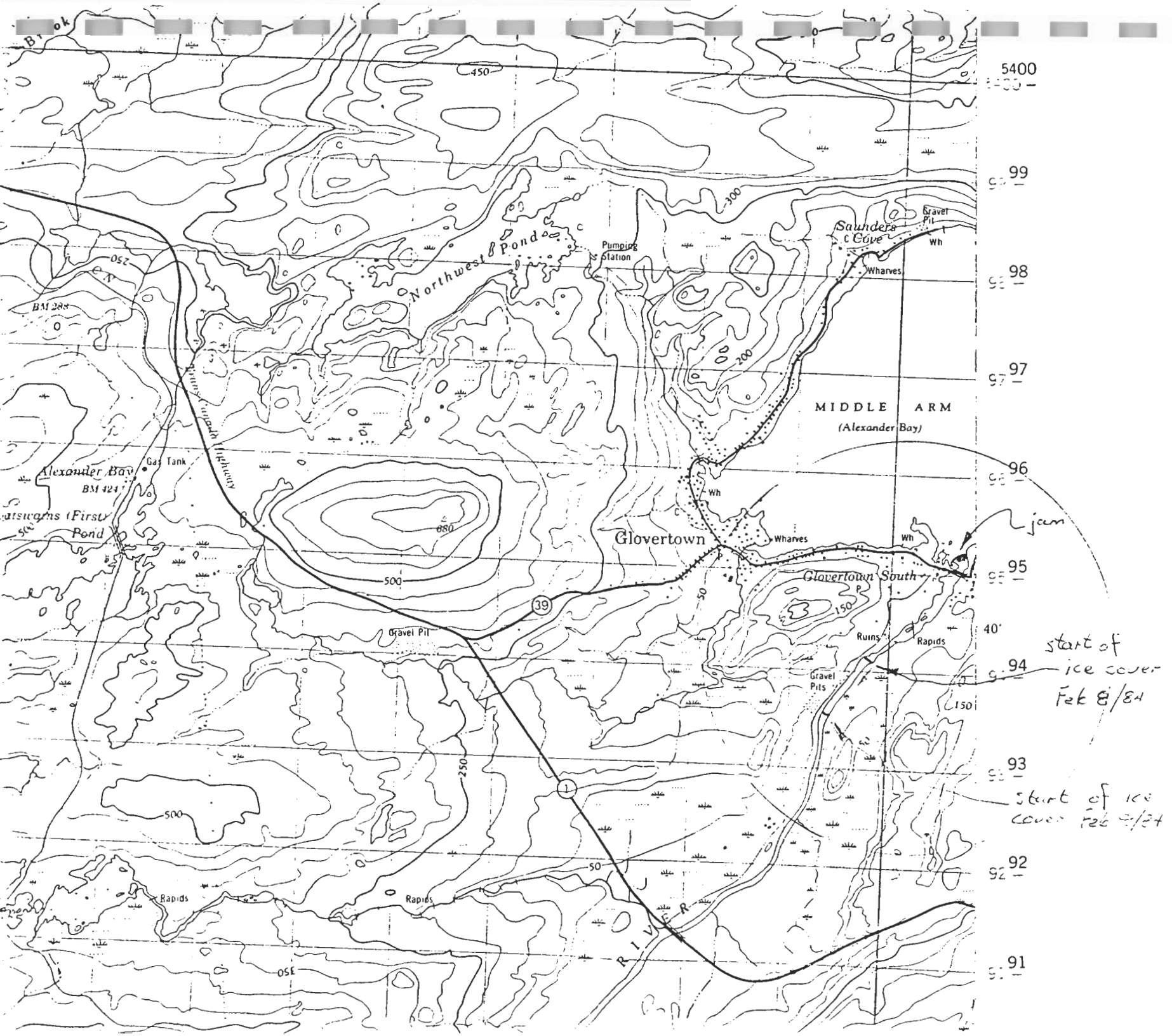


Fig 3 Site Plan after breaking the ice jam


5400
99
98
97
96
95
40'
94
93
92
91
Northwest Pond
Pumping Station
Saunders Cove
Gravel Pit
Wharves
Wh
MIDDLE ARM
(Alexander Bay)
Alexander Bay
Gas Tank
BM 424
BM 288
Glovertown
Glovertown South
Ruins
Rapids
Gravel Pits
Gravel Pit
Trans-Canada Highway
39
1
RIVER
jam
start of ice cover Feb 8/84
start of ice cover Feb 9/84
CONVERSION SCALE FOR ELEVATIONS
Metres
Feet

Thurs. Feb 9/84
Evening Telegram

Glovertown buildings threatened

Emergency declared in face of flooding

A state of emergency was declared in Glovertown this morning as the ice-blocked Terra Nova River shifted from its regular course, threatening homes and businesses.

Mayor Caleb Ackerman told The Evening Telegram that he called a meeting of the town council at 7:30 this morning and after extensive discussion a resolution was passed declaring a state of emergency, which went into effect at 8:15 a.m.

Ackerman said the ice blockage, just below the bridge joining the southern part of Glovertown with the rest of the community, has been building up for several days.

He said that early this morning the river was beginning to change course — from the mouth of the river, in the harbor at Clovertown, toward a road known locally as Hangabrook Road.

Ackerman said the water from the river had already flooded the basements of two homes and the Salvation Army Citadel and was threatening 15 other homes and a number of businesses.

The two homeowners, Richard Moss and Norman Smith and their families, had moved out of their homes Monday in the face of the flood threat and since then they have been trying to pump out their basements.

Ackerman said a three-man demolition team from Badger, under John Greer, director of emergency measures, was to blast the ice in the river harbor, and then the river mouth this morning, with the aid of helicopters.

Ackerman said the Terra Nova River is the third largest in Newfoundland and the flow is very powerful.

RCMP officials were standing by to ensure residents keep well clear of the blasting areas, he said.

"We can only pray and hope the blasting will relieve the pressure, if not, I don't know where we're going."

A transportation department official in Grand Falls said Wednesday night that three of four roads in the Bay d'Espoir area, closed during the past five days due to torrential rains, had been reopened.

The official said the Conne River, Hermitage and Harbour Breton roads were reopened Wednesday but the road to Pool's Cove is still impassable.

He said more than 150 millimetres of rain fell on the area the last few days, and combined with melting snow, washed out many roads in the area.

He said motorists were urged to use caution when driving in the area because of soft highway shoulders and roadbed damage.

Friday Feb 10/84 - Evening Telegram

Water recedes in Glovertown

The flood-threatening waters of the ice-jammed Terra Nova River in Glovertown have receded considerably and a potential crisis has been avoided although there are still a couple of trouble spots, Mayor Caleb Ackerman said this morning.

A state of emergency, declared by the town council early Thursday morning, as the river's water level rose eight to 10 feet above normal, flooding two or three buildings and threatening some 15 others, was lifted by the mayor at 6 p.m.

The river had begun to change its direction because of the ice blockage but Ackerman said this morning the main flow is back on course as a result of dynamite blasting of the ice Thursday by an Emergency Measures demolition team under the direction of John Greer, director of Emergency Measures.

Two houses are still being threatened with flooding, however, and Ackerman said Greer feels further blasting is needed if some of the ice blocking the rivermouth in the harbor at Glovertown.

That situation has given rise to another problem, said the mayor, as he noted that he was extremely busy this morning taking phone calls from residents of the community complaining that the two or three blasts set off Thursday caused dishes to fall off shelves and windows to pop out. He said the people want the blasting to stop.

However, he said Greer feels that at least two more holes need to be blasted in the ice in order to have the pressure completely relieved and any flood threat dissapated.

Ackerman said a final decision on whether there will be any further blasting will be made later today.

In the meantime, the mayor said, while people are suggesting council is responsible for any damage caused to or in their homes, the responsibility lies fully with the Emergency Measures division of the justice department.

Ackerman said Greer is doing everything in his power to avoid causing any damage by the blasting but "it appears to be beyond his control."

He said while council is not responsible for the damage it has voluntarily boarded up some of the broken out windows with plywood.

Sat. Feb 11/84 Evening Telegram

Crews in Black Duck to work on flood problem

An Emergency Measures team and officials of the Environment Department arrived in the west coast community of Black Duck Friday night to determine if it is necessary to blast ice in Harry's River.

Residents of the community, about 12 miles west of Stephenville, have been plagued by flooding since last Sunday when the river became blocked with ice and backed up over 55 acres of farmland, forcing three families to leave their homes.

Tom Hickey, whose farm sustained the worst flooding, said Friday the water had again reached the level it was five days before and was still rising.

He said 11 of his 35 calves were trapped in a barn surrounded by water and ice and there was about a foot of water inside the building.

He had contacted Emergency Measures and the RCMP to request assistance.

He said he was given the impression by the officials that they may use dynamite to blast the river ice this morning.

An Environment Department spokesman in St. John's said a decision on blasting will be made after the flooding is assessed.

Meanwhile, Department of Transportation equipment was used Friday afternoon to prevent two homes in Glovertown from being flooded by the ice-jammed Terra Nova River.

Mayor Caleb Ackerman said the situation was stable and residents were hoping the river will level off in a day or two.

He said there was no blasting carried out Friday because John Greer, director of Emergency Measures, was called to Black Duck.

The town council declared a state of emergency Thursday morning when the river's water level rose about three metres above normal, flooding two or three buildings and threatening about 15 others. The state of emergency was lifted Thursday night.

The river began to change its direction because of the ice blockage but the main flow was brought back on course when an Emergency Measures demolition team used dynamite to blast the ice.

The blasting caused another problem as people complained of dishes falling off shelves and windows popping out.

Ackerman said the responsibility for the damage lies with the Emergency Measures Division of the Department of Justice.

Feb 17/84

MHA awaiting claims for flood damage

Glenn Greening, MHA, Terra Nova, said Thursday, he is waiting for claims from residents of Glovertown on damage to their homes caused, he said by flooding of the Terra Nova river and the blasting carried out to break up the ice on the river, by Emergency Measures, under the direction of John Greer.

Greening said he has had co-operation from at least two government departments, Justice and Municipal Affairs. In acknowledging the claims and having them processed. He said the Department of Transportation may also become involved because of a crack in the footings of the Terra Nova River bridge.

Greening said he has had meetings with Mayor Caleb Ackerman of Glovertown and agreement was reached with the Municipal Affairs department to have an inspector from the Gander office of Newfoundland and Labrador Housing evaluate damage to about 10 to 15 homes on the south side of Glovertown. Greening said basement walls have been cracked and Gus Briffet's grocery store also received damage. He said shelf stock was knocked to the floor with the blast.

Greening said it appears the blast was set off at the mouth of the river where the water is very shallow, causing tremors through the ground

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF ENVIRONMENT

ST. JOHN'S

In Reply Please Quote
File Ref. No.

1984 02 13

MEMO TO: Martin Goebel,
Water Resources Engineer.

FROM: David Hansen,
Project Engineer.

RE: Glovertown Flooding.

Please find attached a short report on the flooding in Glovertown. The report is based only on the observations we made of the situation on the afternoon of February 8th, 1984, when we were both at the site. Some background weather information is also included.

I hope you find the report satisfactory.

Yours truly,

David Hansen

David Hansen,
Project Engineer.

DH/sjd.

Attachment (1).

Glovertown Flooding, February 6-9, 1984

(1) Weather Conditions Preceding Flooding

During January 1984 the average temperature was 9.4°C, which was 3.2°C below normal. These low temperatures caused the build-up of Terra Nova River flows into Alexander Bay at the community of Glovertown South. On Saturday, February 4th at about 0800 hours the temperature rose above 0°C and stayed that way until approximately 2000 hours on Sunday, February 5th. In this period 52.0 mm of rain was record by the Gander weather office, including a six hour burst of 38.0 mm between 0800 hours and 1400 hours on Sunday February 5th. (See graph attached).

(2) Site Conditions, Wednesday, February 8th

Martin Goebel and David Hansen arrived at the site at 1430 hours. We observed that the ice jam which was causing the problem had formed in the mouth of the river and that it began about 70 m downstream of the Terra Nova Road bridge over the river (See sketch of flood damaged area).

The ice jam was causing water to flow to the west after passing under the bridge and was flowing around the residences of Mr. R. Moss and Mr. N. Smith (the yellow house and the white house labelled in the sketch, see also photograph A). A box culvert located about 25 m from the bridge was flowing full and was also contributing to the flooding around these two houses.

Water was also seen flowing to a depth of about 6 cm and a width of about 20 m over Terra Nova Road in front of the Salvation Army citadel (see photograph B). Boards had been placed against the basement windows of the church because of the water on the east side of the building. The captain's residence nearby also had some water around it.

After noting the height of the water on the yellow house (see sketch) we traversed a reach of the east bank about 200 m upstream of Garden Point. The ice within 20 m of this bank was smooth, with the water flowing

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both under and over the ice. In some places water spurted up through breaks and openings in the ice. Beyond the zone of 20 m of smooth ice the ice was broken and irregular. The pieces of irregular ice were up to 3 m in diameter and were about 30 cm thick. Photograph C was taken from near Garden Point, looking toward the bridge. Photograph D shows the ice jam as seen from the bridge.

We then travelled south on Hangabrook Road. Not far from the intersection of Hangabrook Road and Terra Nova Road we noted a flooded storage yard owned by Nfld. Light and Power and an inundated playground. Both of these areas were between Hangabrook Road and the river. The forest floor behind these two areas was partially inundated. This inundation seemed to extend from behind the Salvation Army church to just downstream of the old mill. (See map attached).

About two kilometers upstream of the Terra Nova Road bridge the river was ice covered, but we could not get to the normal shoreline to look at the condition of the ice. The river appeared to be one to two metres above its normal stage, judging from submergence of tree trunks. The tree trunks were submerged on the bank to a distance of about 10 m in from the "normal" shoreline.

Further downstream, next to the old mill we noted that the river was open. There were dramatic rapids both upstream and downstream of this location. There were also roughly one dozen vertical concrete piers in the river which were at one time associated with the mill. It was evident that if ice did come from the iced-over areas further upstream, it would be well broken up by the two sets of rapids and the concrete piers in the river.

(3) Assessment of the Situation

It was obvious that the warm temperatures and the swelling river had caused ice upstream of Glovertown South to break up in the Terra Nova River on Monday and Tuesday (February 6 and 7th) and move downstream and under the Terra Nova Road bridge, where it had jammed. Besides diverting water to the residences of Mr. R. Moss and Mr. N. Smith, the ice jam had caused a backwater effect which resulted in the river overtopping its west bank upstream of the bridge for a distance of about 600 m. This overtopping was not dramatic but was

causing some inundation of land and property, as well as being the source of the water which was flowing over Terra Nova Road in from and of the Salvation Army church.

At 1630 hours we checked the water level again at the yellow house, but no change in level was evident. The situation appeared stable. The weather forecast predicted no rain and more of the same temperatures ($\sim -5^{o}C$) for the next couple of days. In the short term, therefore, there did not appear to be danger of outright property loss, only some water damage to three to four buildings.

(4) Action Proposed by E.M.O.

Mr. John Greer of the Emergency Measures Organization told us his plan upon our arrival. He intended to set two experimental blasts on the ice at the lower end of the ice jam, at the level of the ice in Alexander Bay. These test blasts would show the areal extent of flying ice and would give an idea on whether ice would be carried away once a hole was created. Based on the second test blast, Mr. Greer would judge the spacing of the next six blasts, which were to be placed in the very irregular ice above the location of the main channel. Mr. Greer believed that many of the large pieces of ice were wedged into the channel bed. The blasting area would follow a path between the areas of open water and the bridge (see sketch attached). Charges were to be 50 lb of ammonium nitrate and diesel fuel.

(5) Conclusions

Although the combination of ammonium nitrate and diesel fuel is not environmentally neutral, and although blasting is harmful to fish and dangerous for the people involved, we also consented to Mr. Greer's proposed plans. The reason for our approval was not so much because of the water surrounding the two houses or flowing over the short stretch of the road. The situation appeared stable and there was no rain or warm temperatures in the forecast for the next couple of days. Rather, blasting seemed the best way of insuring that if another thaw and rain event did occur, the ice which was about 2 km upstream would not double the size of the existing ice jam, when and if the ice came downstream. If this were to happen, buildings on the road on the west side of the river would probably be damaged, in addition to the Moss's

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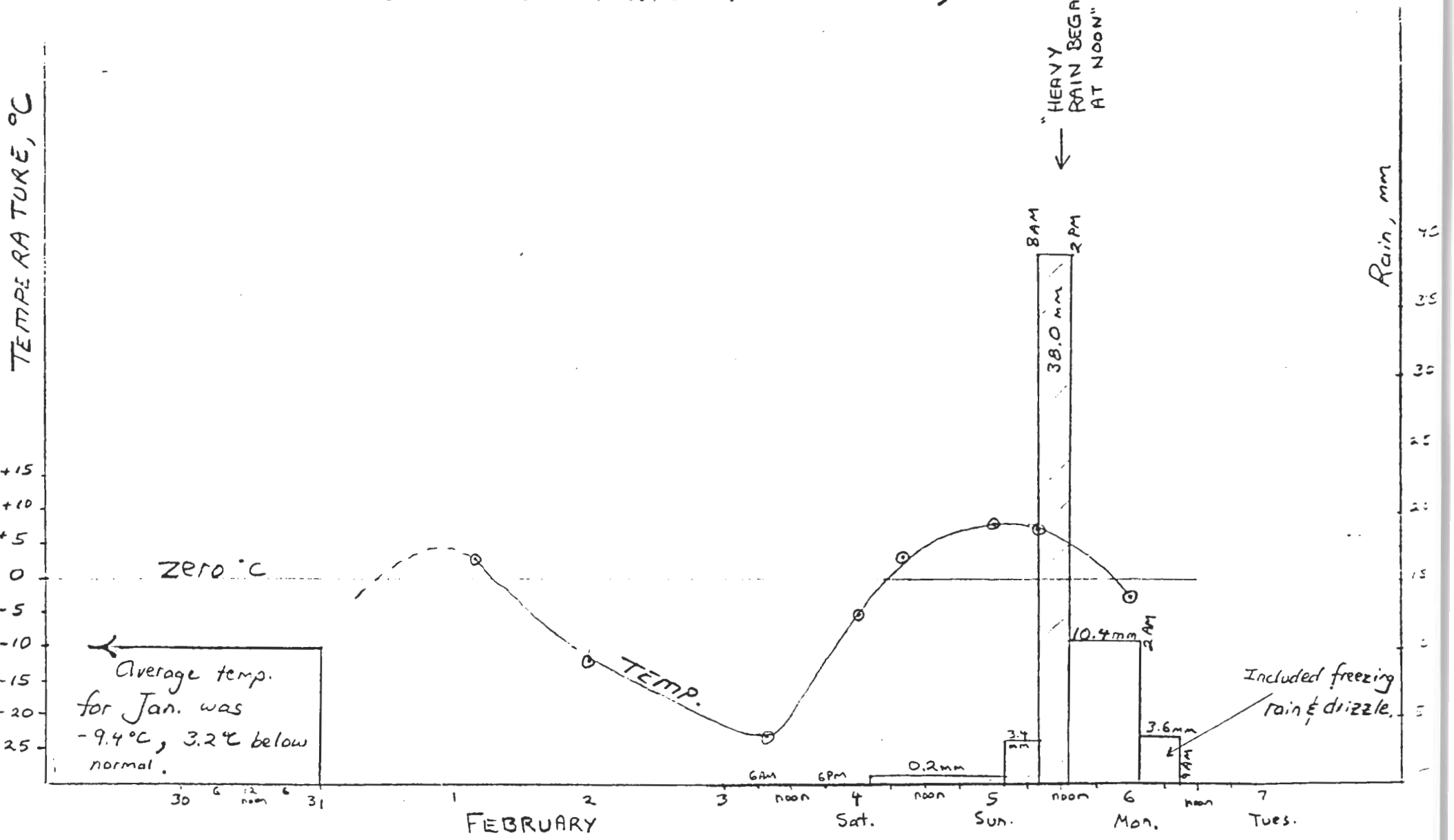
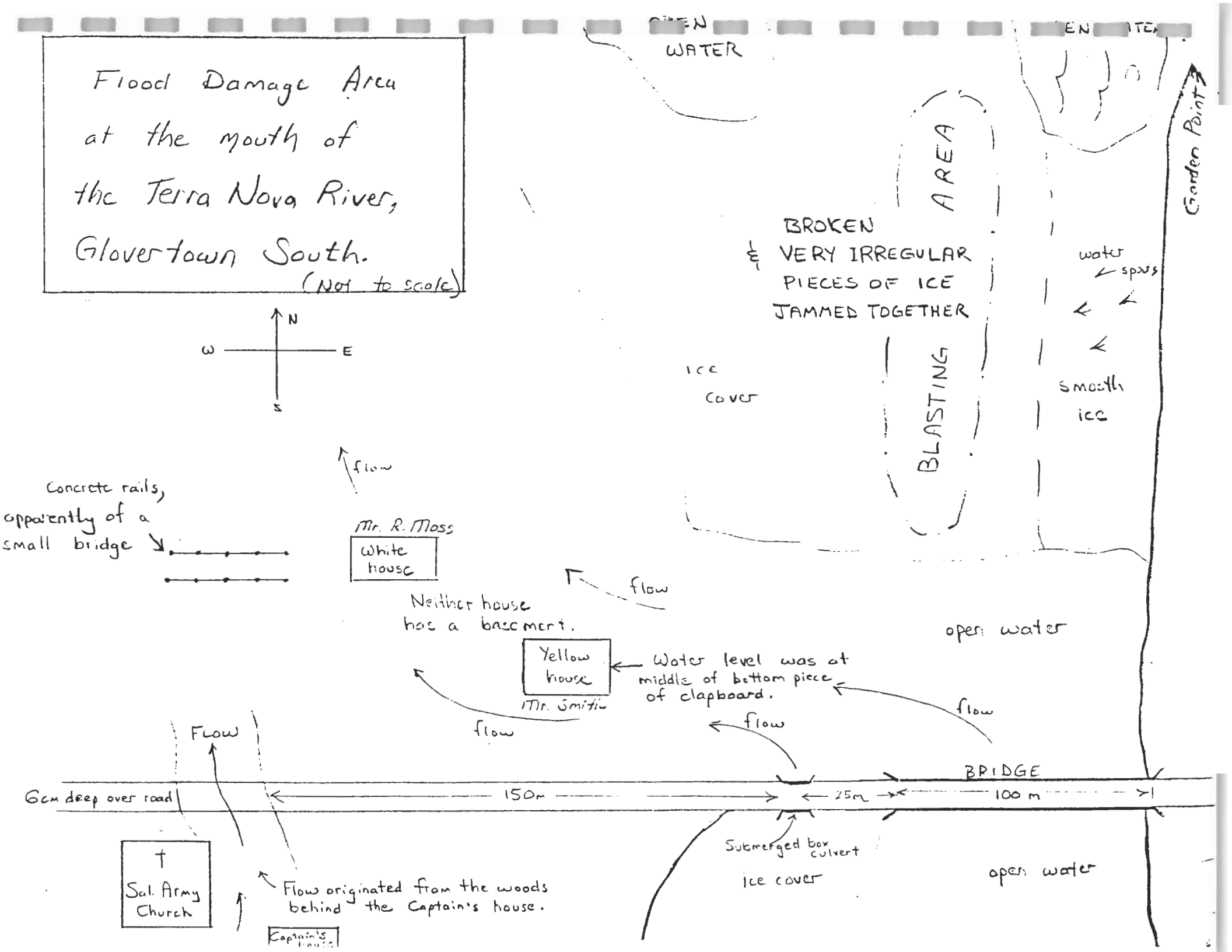
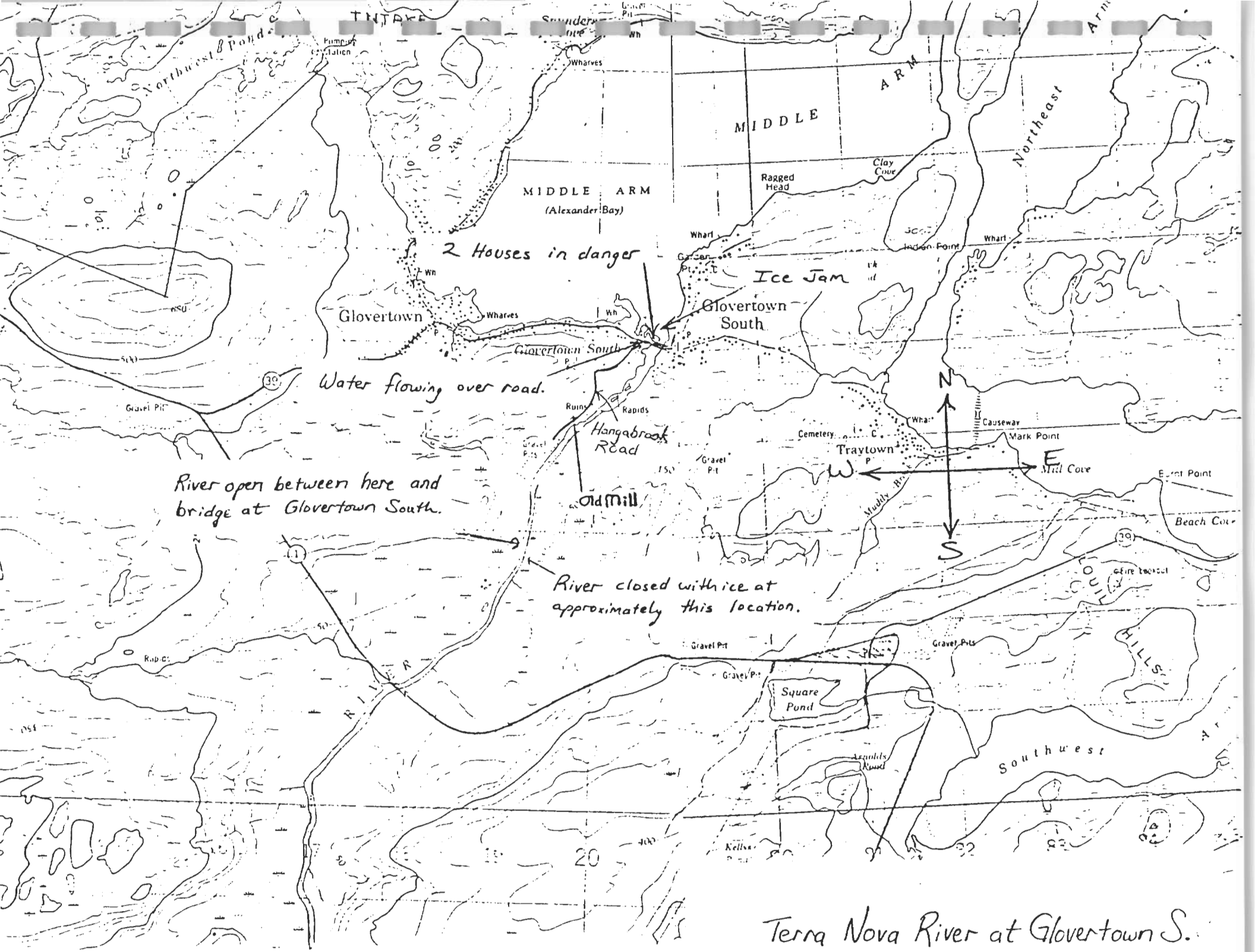
residence, Smith residence, the Salvation Army church and the captain's residence.

Selected Rain & Temperature Data from Gander weather office.

(Gander is about 50 km NW of Glovertown)




Flood Damage Area at the mouth of the Terra Nova River, Glovertown South.
(Not to scale)
OPEN WATER
Garden Point
AREA
BROKEN & VERY IRREGULAR PIECES OF ICE JAMMED TOGETHER
BLASTING
water sprays
ICE Cover
smooth ice
N
W
E
S
flow
Concrete rails, apparently of a small bridge
Mr. R. Moss
White house
flow
Neither house has a basement.
open water
Yellow house
Mr. Smith
Water level was at middle of bottom piece of clapboard.
flow
flow
flow
Flow
BRIDGE
6cm deep over road
150m
25m
100 m
Submerged box culvert
ice cover
open water
Sal. Army Church
Flow originated from the woods behind the Captain's house.
Captain's house



Terra Nova River at Glovertown S.

Photographs

A - houses flooded

C - ice jam, looking d/s from near the sea

D - ice jam, looking d/s from bridge

B - road flooded

Diagrams

- plan view (not to scale)

Maps 2D-9 2C-12

D R A F T

INTRODUCTION

Between 0200 hrs on Sunday, February 5 and 0900 hrs Monday, February 6 the Gander weather office recorded 55.4 mm of rain. This included a six-hour burst of rain of 38.0 mm between 8:00 A.M. and 2:00 P.M. on Sunday, February 5. Unseasonably warm temperatures reached a high of 8^{o}C after midnight, early Sunday morning (see the attached graph of temperature and rainfall). The warm temperatures and the swelling river caused ice upstream of the Glovertown South bridge to break up in the Terra Nova River. This ice moved downstream, under the bridge and formed an ice jam about 60 m downstream of the bridge. This caused water to be diverted toward the residences of Mr. R. Moss and Mr. N. Smith (see photograph A and the sketch attached). It also caused a backwater effect which resulted in the river overtopping its west bank upstream of the bridge for a distance of about 600 m. This overtopping was not dramatic but did cause the forest floor to be submerged. Water from the woods came out in the vicinity of the residence of the Salvation Army captain and was flowing over the road to a depth of about 60 cm (see photograph B and sketch of area). The width of this flow was about 20 m.

SITE INSPECTION & DISCUSSIONS WITH E.M.O.

Martin Goebel and David Hansen arrived at the site at 1430 hrs, Wednesday, February 8. At the Glovertown RCMP detachment, we spoke with John Greer of the Emergency Measures Organization. He briefly described the situation and told us that he had received permission to proceed with his plans from the director of the Water Resources Division.

Mr. Greer took us to the bridge over the Terra Nova River

At 1630 hrs we again checked the water level at the yellow house, but no change was evident. At 1700 hrs we checked in at the RCMP detachment office and spoke with John Greer. He informed us that he would get an aerial view of the area before dark to aid in evacuation proceedings. Mr. Greer agreed to inform us of the outcome of the blasting planned for the next morning.

Not far from the intersection of Hangabrook Rd. and Terra Nova Rd we noted a partially flooded storage yard owned by NFld Light and Power and an inundated playground, both of these were being between Hangabrook Rd and the river. ~~We also no~~ The forest floor behind these two areas was partially inundated. This inundation extended from apparently

Lorne Sparkes, Town Manager, disagreed with councillors on digging out ice by the bridge.

Mr Lush's damages (Smith's)

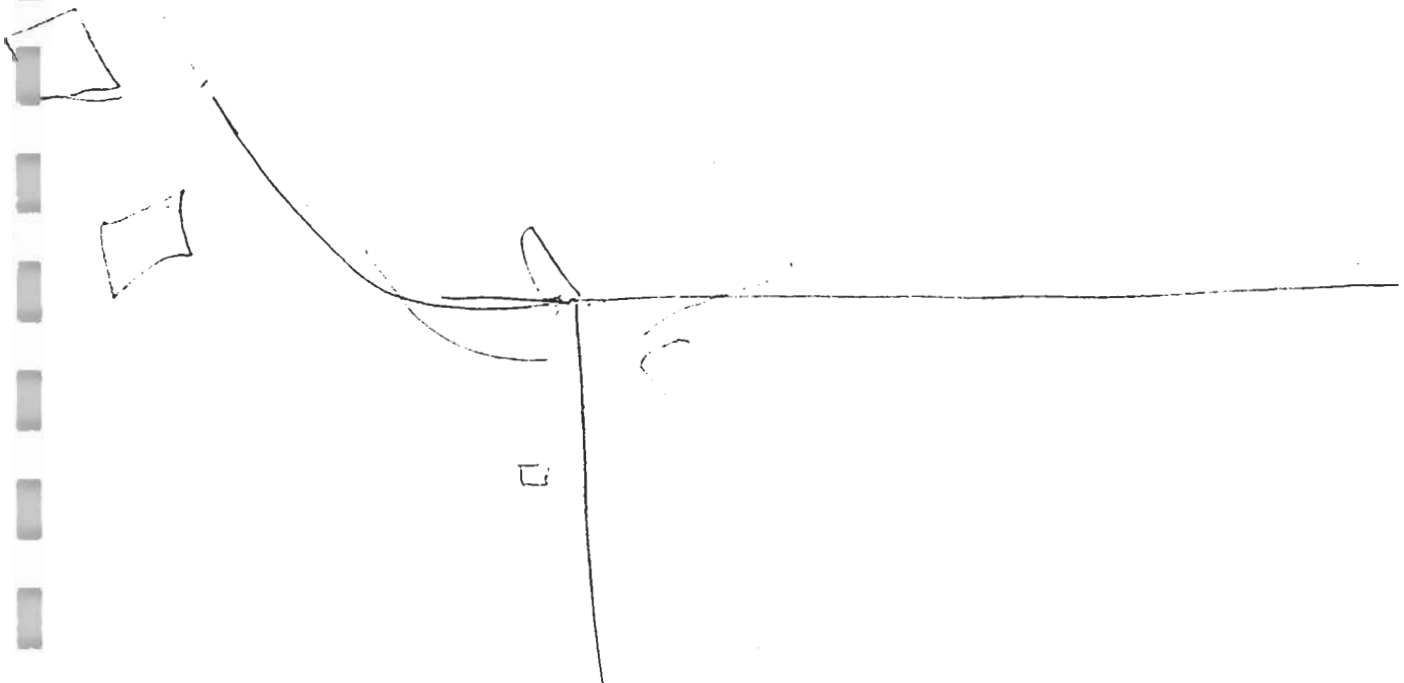
- twin pane window broke its seal. Condensation on side.

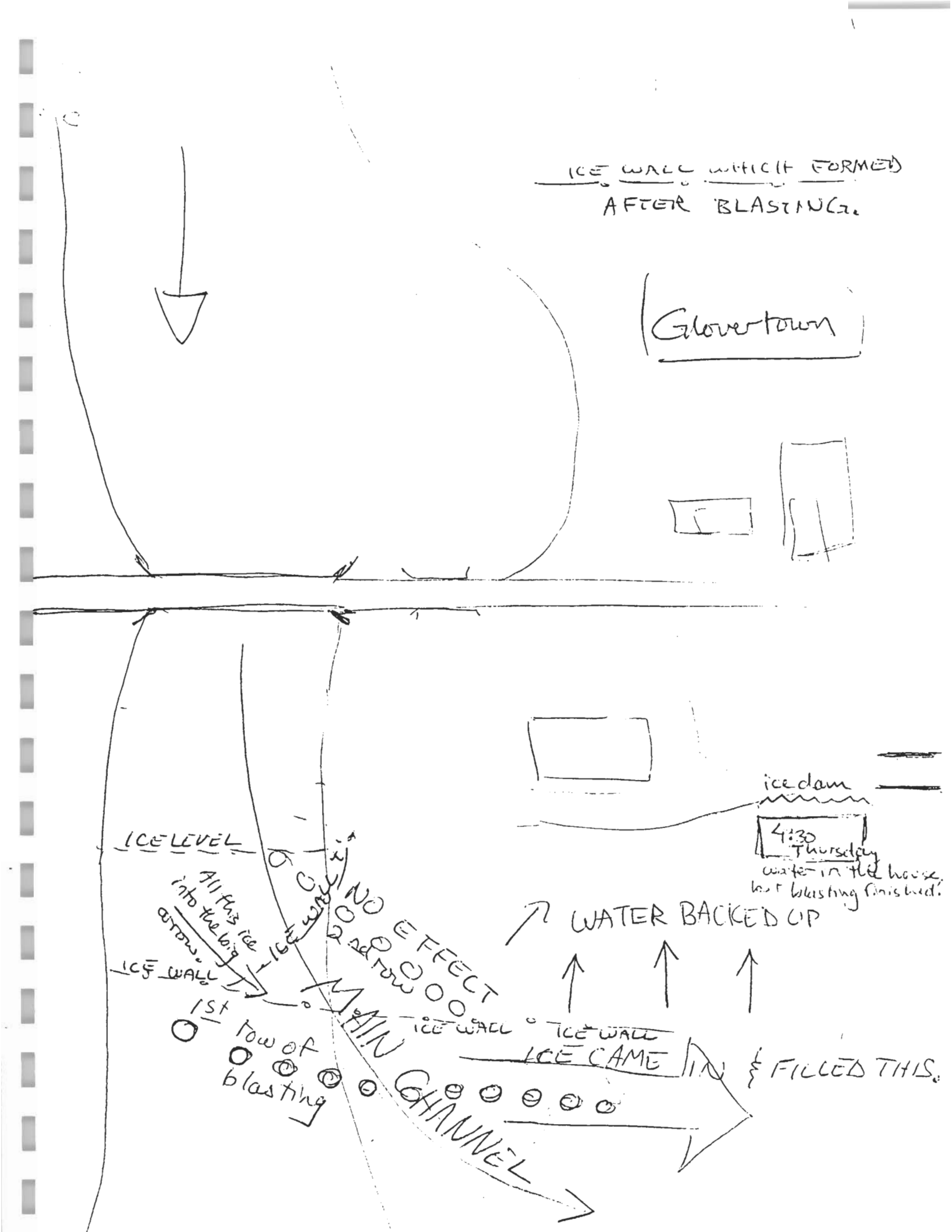
- about 35 to 40 blasts. Ended 3:40 PM.
- broken globe in chandelier

(Norman) Mr. Lush - 533 2399

Salvation Army Church

(basement) 10 paces X 15 paces carpet wetted. Mildew.




ICE WALL WHICH FORMED AFTER BLASTING.
Glovertown
ice dam
4:30 Thursday
water in the house, but blasting finished.
ICE LEVEL
ICE WALL
All this ice into the bay
ICE WALL
1st row of blasting
NO EFFECT
WATER BACKED UP
ICE WALL
ICE WALL
ICE CAME IN & FILLED THIS.
MAIN CHANNEL

Glovertown

- Bowaters dam 18 or 20 miles up broke last winter. No more regulation

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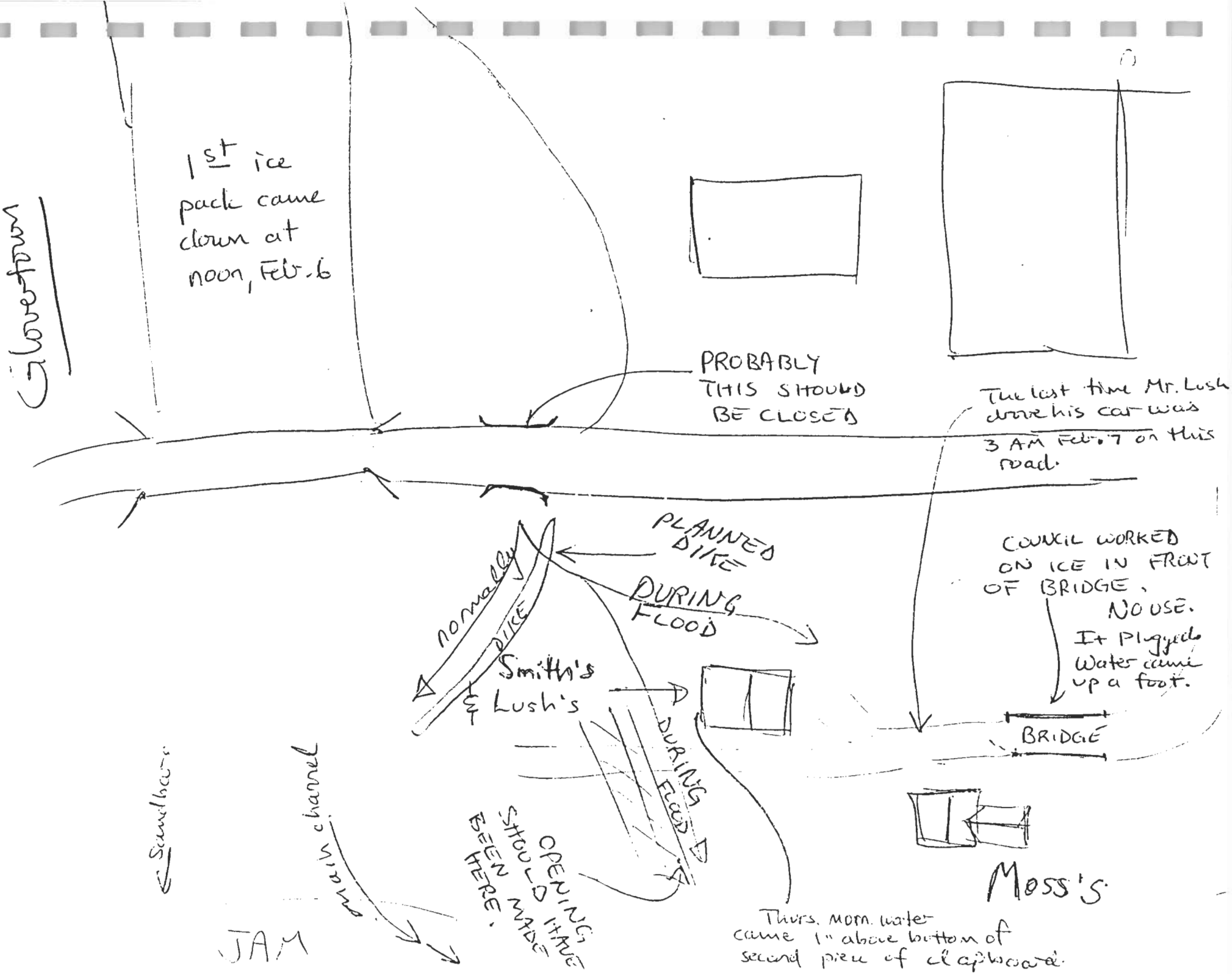
Mr. Richard Moss 533-2411

- all flooring ruined approx. house value $30,000
- back 10' of the house sank down.
- 4¼" water in house, behind furnace.
- mold smell. Mold on walls. Mildew.
- doors won't close.
- 2 sheds full of ice. (sleeping bags bed clothes)
- house sits (sat) on poured concrete footings and concrete blocks.


Glenerin
1st ice pack came down at noon, Feb. 6
PROBABLY THIS SHOULD BE CLOSED
The last time Mr. Lush drove his car was 3 AM Feb. 7 on this road.
PLANNED DIKE
normally
DIKE
DURING FLOOD
Smith's & Lush's
COUNCIL WORKED ON ICE IN FRONT OF BRIDGE. NO USE. It Plugged. Water came up a foot.
BRIDGE
DURING FLOOD
Sandbar
main channel
OPENING SHOULD HAVE BEEN MADE HERE.
JAM
Moss's
Thurs. morn. water came 1" above bottom of second piece of clapboard.

C

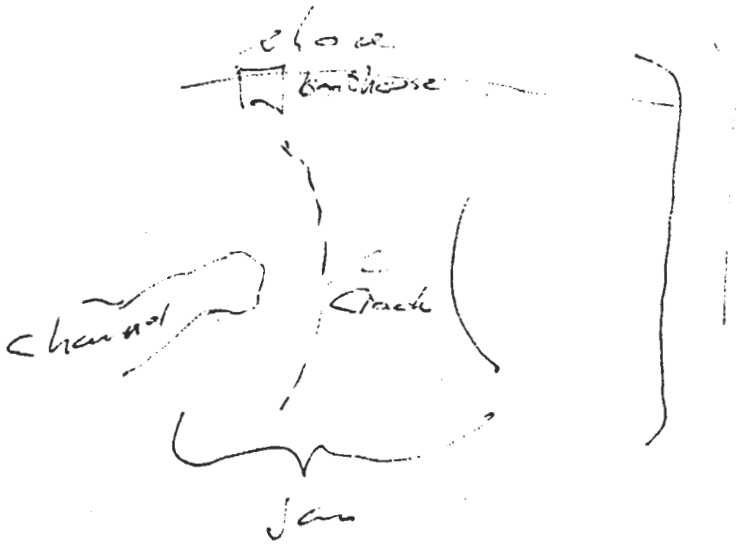
Wed Feb 8/84

- Reach Glaciation by 2:30
- Observe flooding
- Recommend blasting to John Greer
- Inspected downstream Town Dam (photos)
- Inspected upstream - extent of ice cover
  - observed at pit
- speak with John Greer - final ok
  - leave site @ 4:45

- Speak to R Price at 9:30
- Speak to Dr Ulrich at 10:10
- pick up maps & flow summary

Thursday Feb 9/84

- Reach agreement by 7:15
- Shovel stone approx 1-½" size
- Blasting begins @ 10:00 - Progress is slow
  - some days don't detonate
- Break for lunch because of school children
- Blasting continues @ 1:30
  - send Robert to numbers
  - all caps used up by approx 3:30
  - in pack by chafer
    - observe



- break in jaw reported approx 4:00
- go to site - jaw broken
  - water levels down
- called DA Villa

C

R: Fiscal Reports
Lumsden going down in flood

Discuss plans with officer - no commitment

- Called Tom Hickey - flooding issues
-
- Called Hal Andrews

APPENDIX II

BRIDGE PLANS

1. Glovertown - Traytown Highway
   Sta 199+00 to Sta. 211+00
   through Glovertown

2. Terra Nova River Bridge

3. Terra Nova River Bridge:
   Culvert Layout & Reinforcement