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UPPER COOK INLET COHO SALMON
HABITAT EVALUATION, 1979-1981

by
Robert C. Lebida

Number 8

Alaska Department of Fish & Game
Division of Fisheries Rehabilitation,
Enhancement and Development

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ABSTRACT

A total of 45 lake systems with potential coho salmon (Oncorhynchus kisutch) rearing habitat in the upper Cook Inlet area was investigated from 1979 to 1981. The objective was to inventory and catalog coho salmon habitat as an aid to the enhancement of coho salmon stocks for recreational fisheries. Juvenile coho salmon were captured in 26 of 34 lake systems sampled for fish. Coho salmon was the third most abundant species collected following threespine stickleback (Gasterosteus aculeatus) and rainbow trout (Salmo gairdneri). Coho salmon spawning occurred in 13 systems. Seven lakes lacked fish access and 25 lakes provided rearing areas for coho salmon which spawned in the main stem of the Little Susitna River. All 45 systems had some degree of fish migration barriers which resulted from beaver activity, debris accumulation, or creek hydrarch succession. Data from limnological parameters were collected and bathymetric maps were drawn for 29 lakes. Recommendations for potential rehabilitation and enhancement work are discussed, including stream clearance activities for the majority of systems investigated, fry stocking programs and other feasibility studies.

KEY WORDS: Habitat inventory, Oncorhynchus kisutch, coho, salmon, limnology, rearing, migration barriers, beaver dams, hydrarch succession, stream clearance, rehabilitation, enhancement.

INTRODUCTION

Within the last decade, major aquaculture programs have been implemented by the State of Alaska to rehabilitate and enhance the State's salmon resources by applying sophisticated techniques of incubation, supplemental rearing and habitat improvement or expansion. The ultimate success of these programs is often primarily dependent upon finding the optimal location of project and facility sites.

As a prerequisite, basic environmental and resource data are required to direct, design, develop and evaluate program plans. To this end, a preliminary inventory of the upper Cook Inlet area was initiated during 1976 to identify and catalog potential hatchery sites (Lebida 1977).

During 1979, another study addressed in this report, was initiated to inventory and catalog the coho salmon, Oncorhynchus kisutch (Walbaum), habitat in the upper Cook Inlet area by 1985, as a basis for the enhancement of coho salmon stocks for recreational fisheries. The objectives of this 6 year project were to locate, determine and document the magnitude, utilization, rearing potential, and basic limnological characteristics of available coho salmon habitat and to identify any rehabilitation or enhancement needs and feasibility in the Matanuska-Susitna Valleys. However, due to lack of funding, the upper Cook Inlet coho salmon habitat evaluation project was terminated 30 June 1981.

This report provides a compendium of basic habitat information about each system gathered during 1979 through 1981 from various sources including on-site investigations. Some of these systems are lacking complete data. All conclusions, remarks and recommendations are subject to revision pending additional data acquisition and analysis.

MATERIALS AND METHODS

Identification and location of coho salmon rearing systems began during May 1979. Initial investigations included a review of topographic maps, aerial photographs, Alaska Department of Fish and Game records and personal communications with area biologists and other knowledgeable individuals. Pertinent data obtained from some system surveys conducted by the Sport Fish Division, ADF&G within the last 10 year period were considered current and only supplemental data were collected from these systems to update information.

Study efforts concentrated on local habitats with known current or historical coho salmon populations. All investigations were focused on selected lentic habitats in the Matanuska and Susitna Valleys. Most of the systems selected were part of a coho salmon producing drainage transected by the road system which had a recreational coho salmon fishery. This selection comprised the drainages of Jim, Cottonwood, Fish and Caswell Creeks and the Little Susitna River. Byers and Larson Lake systems were also incorporated as part of ongoing lake fertilization project sites.

Field surveys were conducted at a minimum of one sampling location in each system to collect biological, physical, chemical and habitat assessment data during the period of July 1979 - March 1981. Methods outlined by Brown et al. (1970), Slack et al. (1973) and Stevens et al. (1971) were followed but with minor modifications in equipment and technique. Map references were from U.S. Geological Survey 1:63,360 Series (Topographic). Motor vehicles, fixed or rotary wing aircraft, and river boats provided transportation to the various sites. Data collections were made from a 4.57-m (15 ft.) Grumman canoe or 3.66-m (12 ft.) Avon inflatable boat, Model S300 with a Johnson 15 horsepower outboard motor.

Fish were collected using gill nets and minnow traps. The gill nets were constructed from monofilament nylon. They had floats on the upper line and were weighted with a lead line. The nets consisted of five panels with one panel each of 1.27-cm (0.5 in.) square, 1.91-cm (0.75 in.) square, 2.54-cm (1.0 in.) square, 3.81-cm (1.5 in.) square and

5.08-cm (2.0 in.) square mesh. Each panel was 7.62 m (25 ft.) long. The overall net was 38.1 m (125 ft.) long and 1.83 m (6 ft.) deep. The fish traps were standard manufacture 0.64-cm (0.25 in.) mesh wire minnow traps.

Gill nets and minnow traps were fished for a minimum of 12 hours in each system which had no record of fish collection. The gill nets were attached to the shore and fished perpendicularly to the shoreline with the largest mesh situated farthest from shore.

One net (floating type) was fished from the surface down and the other (sinking type) from the bottom up. Set locations were normally made from a small peninsula having a moderately sloping lake bottom at it's terminus. A minimum of three minnow traps were fished at irregularly selected locations in approximately 0.5 m of water. The traps were baited with preserved (salted and frozen) salmon roe.

All fish specimens captured were identified and released unharmed except for a few which died. Common and scientific names and abbreviations used for fishes caught during these surveys were according to Bailey (1970).

Water velocities (m/s) were measured with a Price AA or Pygmy type current meter utilizing techniques described by Buchanan and Somers (1969) to determine the discharge (m^3/s) of outlet streams. Water depths in the lakes were recorded with a Raytheon model DE-719B fathometer.

Lake map outlines were drawn from aerial photographs and bathymetric maps were drawn from fathometer recordings for most systems by ADF&G personnel except for Nancy Lake which was previously (1978) mapped by G. McCoy and A. Dvorson (USGS). Outline maps were made of the remaining lakes and depth soundings measured during the field survey were recorded on the maps.

Morphometric features of the lakes (area, volume, mean depth, shoreline length and shoreline development) were calculated from the bathymetric maps according to Lind (1974). Geographic location (latitude and longitude) and elevation were taken from USGS 1:63,360 Series (Topographic) maps. The topographic map reference location for each lake system is listed in Appendix A.

Water temperature (°C) and dissolved oxygen concentrations (mg/L) were measured at 1 m depth intervals with a Yellow Springs Instruments Model 57 Dissolved Oxygen Meter incorporating a YSI 5739 dissolved oxygen probe and a YSI 5795A submersible stirrer.

During 1979, specific conductivity (umhos/cm) was measured *in situ* using a Lab-Line Lectro MHO-Meter Model 11025-MC3. Total hardness and alkalinity (mg/L of $CaCO_3$ and pH were measured with Hach test kit Models HA-4P, AL-AP and 17-N, respectively. In 1980, these parameters were determined from water samples sent to the ADF&G Limnology Laboratory in Soldotna, Alaska.

The accessibility, spawning use, migration barriers, and creek drainage succession stage were evaluated qualitatively by direct observation by a trained observer during foot and aerial surveys conducted at least once for each system. Spawning use was also determined by review of Department files and personal communications with Department fishery biologists. Coho spawning and rearing activity was rated as active, no known occurrent and unknown. Beaver activity i.e., relative numbers of dams located in each outlet creek was classed as none, few (≤ 3) or many (>3). The amount of debris accumulation in the creeks was rated as low (occasional small tangle of sticks, and clumps of vegetation), moderate (frequent brush tangles, occasional logs and large clumps of vegetation), and severe (numerous logs, brush tangles and large clumps of vegetation). A severe classification implied that a possible fish migration barrier existed. Hydrarch succession was recorded according to stage and degree (Oosting 1956). Stages of vegetative succession considered were aquatics (submerged, floating, and emergent plant species) sedge mat, bog shrubs, and bog forest. Degree of succession was observed as early (up to 25% of stream involved), advanced (25 - 75% of stream involved), or complete (more than 75% of stream involved).

RESULTS

A total of 45 potential sites for coho rearing was investigated in the upper Cook Inlet area during 1 July 1979 to 30 June 1981 (Figure 1). Physical features of the lakes studied, including: elevation, surface area, volume, maximum depth, mean depth, shoreline development, and discharge are presented in Table 1. Complete bathymetric maps with associated morphometric data for 29 of these systems and partial maps with incomplete data for the remaining 16 systems are shown in Figures 2 through 46.

Basic chemical parameters reported for the lake systems are the results of a single sample chemical analysis conducted in each of the lakes at various dates during the study period. This information is intended as a data base only.

Values ranged between 3 - 171 mg/L ($CaCO^3$) for alkalinity, 12 - 250 umhos/cm for conductivity and 5.5 - 8.6 for pH (Table 2). Water temperature and dissolved oxygen profile measurements were within normal ranges during ice free and frozen periods for all systems based on data collected.

Coho salmon occurred in 26 of 34 lake systems investigated (Table 3). Other fish identified in these systems are also listed in Table 3. Fish species name abbreviations used are presented in Table 4 with common and scientific names. Coho salmon were the third most frequently collected fish species captured from all lakes (Figure 47). Threespine stickleback and rainbow trout were the first and second most abundant species collected.

Habitat features of the systems examined are summarized in Table 5. These features identified active coho spawning and rearing systems, migration barriers attributable to beaver dams and debris accumulation, creek hydrarch succession by stage and degree plus system access.

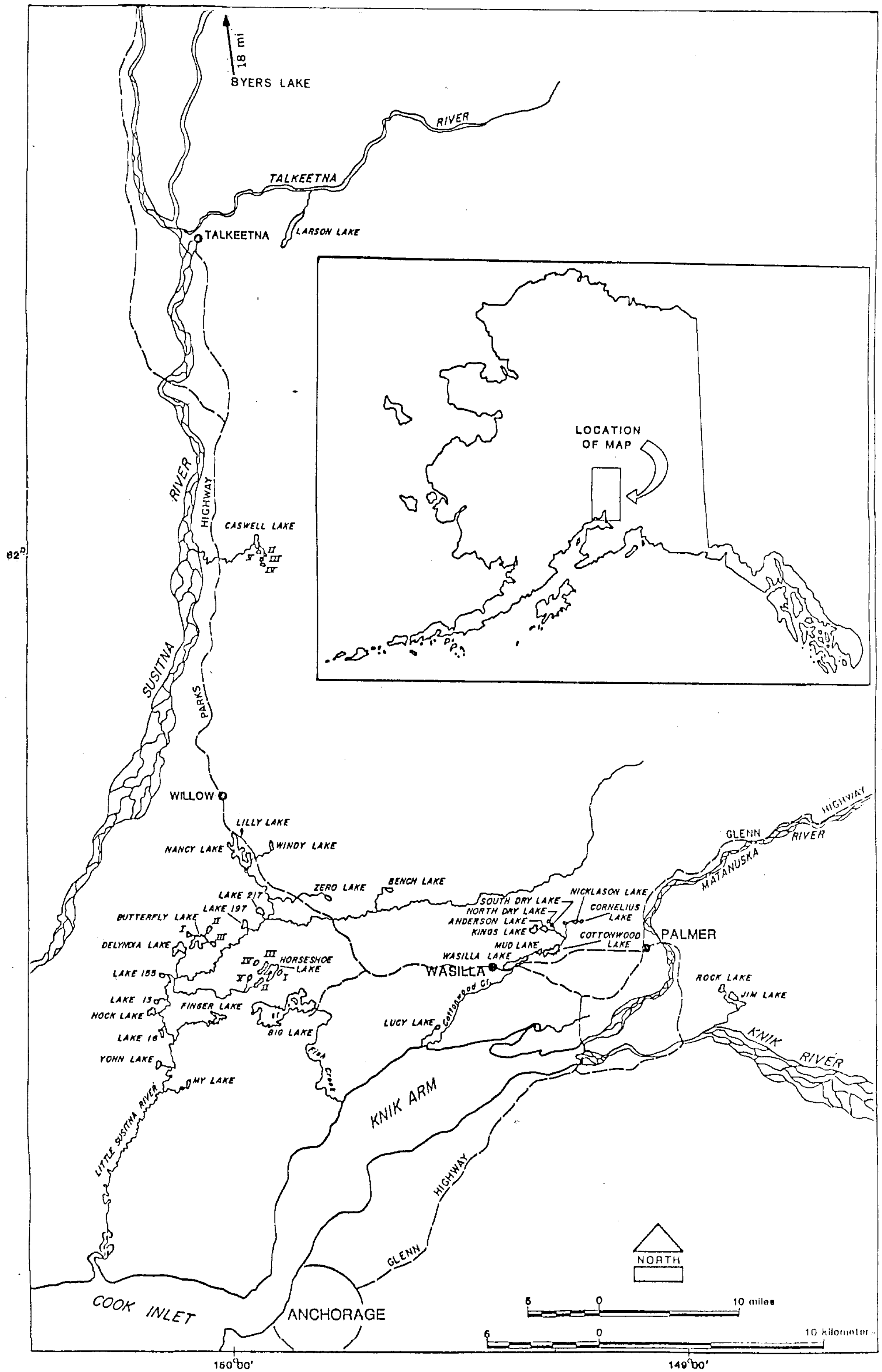

Figure 1. Locations of 45 potential coho salmon habitat systems in the upper Cook Inlet area, Alaska.

Table 1. Physical features of 45 potential coho salmon habitat systems in the upper Cook Inlet area, Alaska, 1979-1981.

Location by drainage	Elevation (m)	Surface area (ha)	Volume $(m^3 \times 10^5)$	Max. depth (m)	Mean depth (m)	Shoreline length (km)	Shoreline development	Discharge-date (m^3/s)
Knik River								
Jim Lake	19.5	68.8	6.9	1.5	1.0	3.1	1.06	0.5 - 7/79
Rock Lake	18.3	20.2	1.0	1.0	0.5	4.1	2.56	0.5 - 7/79
Cottonwood Creek								
Anderson Lake	137.2	54.6	17.3	8.5	3.2	3.6	1.37	4.5 - 7/79
Cornelius Lake	122.0	19.4	13.4	16.5	6.9	2.8	1.80	6.3 - 8/79
Cottonwood Lake	100.3	106.0	35.0	12.0	3.3	6.2	1.71	18.3 - 7/79
Kings Lake	137.2	62.3	14.1	7.0	2.3	6.0	2.15	0.5 - 4/81
Lucy Lake	30.5	10.5	1.2	1.8	1.1	1.3	1.13	0.4 - 3/81
Mud Lake	100.3	22.3	2.2	5.2	1.0	2.3	1.39	21.2 - 8/79
Nicklason Lake	122.0	29.1	14.0	17.3	4.8	2.9	1.49	5.6 - 8/79
North Dry Lake	146.3	8.9	1.4	4.6	1.5	0.8	1.44	1.7 - 7/79
South Dry Lake	137.2	6.2	0.9	2.4	1.5	1.5	0.86	3.6 - 7/79
Wasilla Lake	98.2	151.4	79.1	14.6	5.2	7.1	1.63	17.4 - 3/81
Fish Creek								
Big Lake	43.3	1213.3	1119.2	27.0	9.0	27.0	2.19	32.2 - 3/81

-Continued-

Table 1. (Continued)

Location by drainage	Elevation (m)	Surface area (ha)	Volume ($m^3 x 10^5$)	Max. depth (m)	Mean depth (m)	Shoreline length (km)	Shoreline development	Discharge-date (m^3/s)
<u>Little Susitna River</u>								
Bench Lake	152.4	13.8	7.0	4.0	1.5	1.8	1.27	0.5 - 3/81
Butterfly Lake	61.0	119.4	77.2	22.8	6.5	8.7	2.24	0.5 - 2/81
Butterfly Lake I	61.0	24.3	...	...	...	2.0	1.20	0.1 - 2/81
Butterfly Lake II	61.0	52.6	...	...	...	3.0	1.17	0.1 - 2/81
Butterfly Lake III	61.0	36.4	...	...	...	3.4	1.60	0.1 - 2/81
Delyndia Lake	61.0	116.9	75.9	22.9	6.5	7.5	1.95	0.9 - 2/81
Finger Lake	45.7	101.2	42.2	10.7	4.2	11.3	3.16	0.4 - 2/81
Hock Lake	32.0	52.6	...	...	...	3.2	1.26	...
Horseshoe Lake	52.1	430.0	...	...	...	8.9	1.88	...
Horseshoe Lake I	53.3	24.3	...	...	...	2.6	1.51	...
Horseshoe Lake II	48.2	36.4	...	...	...	4.3	2.03	...
Horseshoe Lake III	53.3	60.1	...	...	...	4.0	1.44	...
Horseshoe Lake IV	53.3	56.7	...	...	...	3.3	1.24	...
Horseshoe Lake V	48.2	16.2	...	...	...	1.8	1.15	...
Lake 13	32.0	12.1	...	...	...	1.4	1.13	...
Lake 16	27.4	24.3	...	...	...	2.7	1.55	...
Lake 155	47.2	12.1	...	...	...	2.5	1.45	...
Lake 197	60.1	40.5	...	...	...	2.4	1.05	...
Lake 217	66.2	40.9	12.3	6.1	3.0	2.7	1.18	0.5 - 7/80
Lilly Lake	122.0	3.0	0.5	4.0	1.7	0.8	1.25	0.7 - 3/81
My Lake	25.9	28.3	...	...	...	2.6	1.35	...
Nancy Lake	66.5	308.1	235.8	19.8	7.7	23.5	3.78	9.9 - 3/81
Windy Lake	122.0	15.8	4.4	6.1	2.8	3.3	2.33	1.0 - 3/81
Yohn Lake	18.3	34.4	...	...	...	2.4	1.14	...
Zero Lake	122.0	30.2	10.6	9.7	3.5	2.2	1.42	1.3 - 3/81

-Continued-

Table 1. (Continued)

Location by drainage	Elevation (m)	Surface area (ha)	Volume $(m^3 x 10^5)$	Max. depth (m)	Mean depth (m)	Shoreline length (km)	Shoreline development	Discharge-date (m^3/s)
Susitna River								
Byers Lake	248.8	131.5	266.9	54.0	20.0	6.4	1.58	64.6 - 10/81
Caswell Lake	91.5	44.5	17.8	8.2	4.0	4.5	1.92	3.3 - 3/81
Caswell Lake II	91.5	8.7	1.5	7.3	1.7	2.4	2.31	0.1 - 3/81
Caswell Lake III	91.5	12.6	6.2	10.1	4.6	2.3	1.70	0.1 - 3/81
Caswell Lake IV	91.5	75.7	2.9	6.7	3.9	1.2	1.18	0.1 - 3/81
Caswell Lake V	91.5	5.8	3.3	9.8	5.8	1.8	1.19	0.0 - 3/81
Larson Lake	186.0	176.9	290.8	42.6	16.4	10.3	2.18	4.7 - 3/81

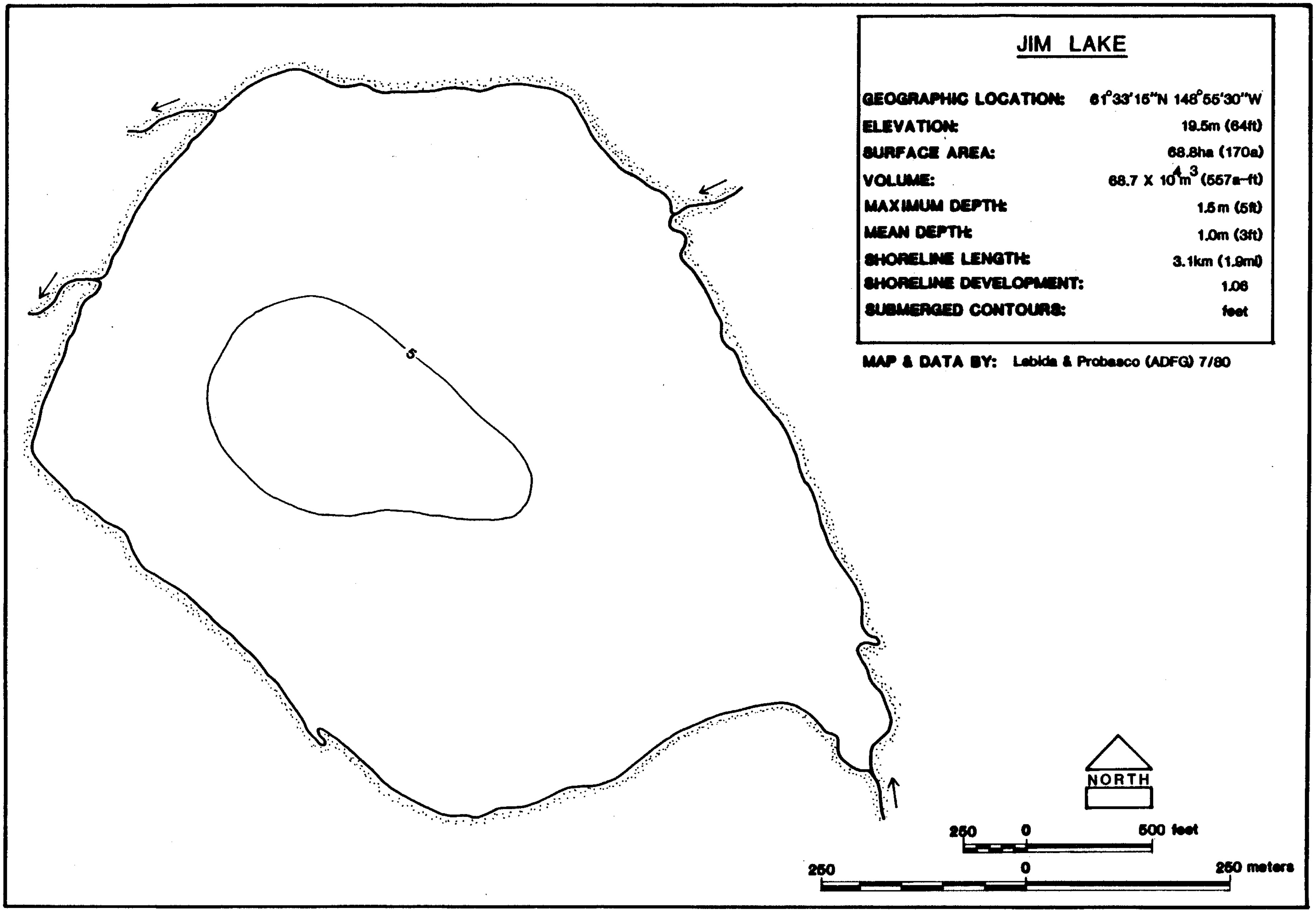

Figure 2. Jim Lake bathymetric map.

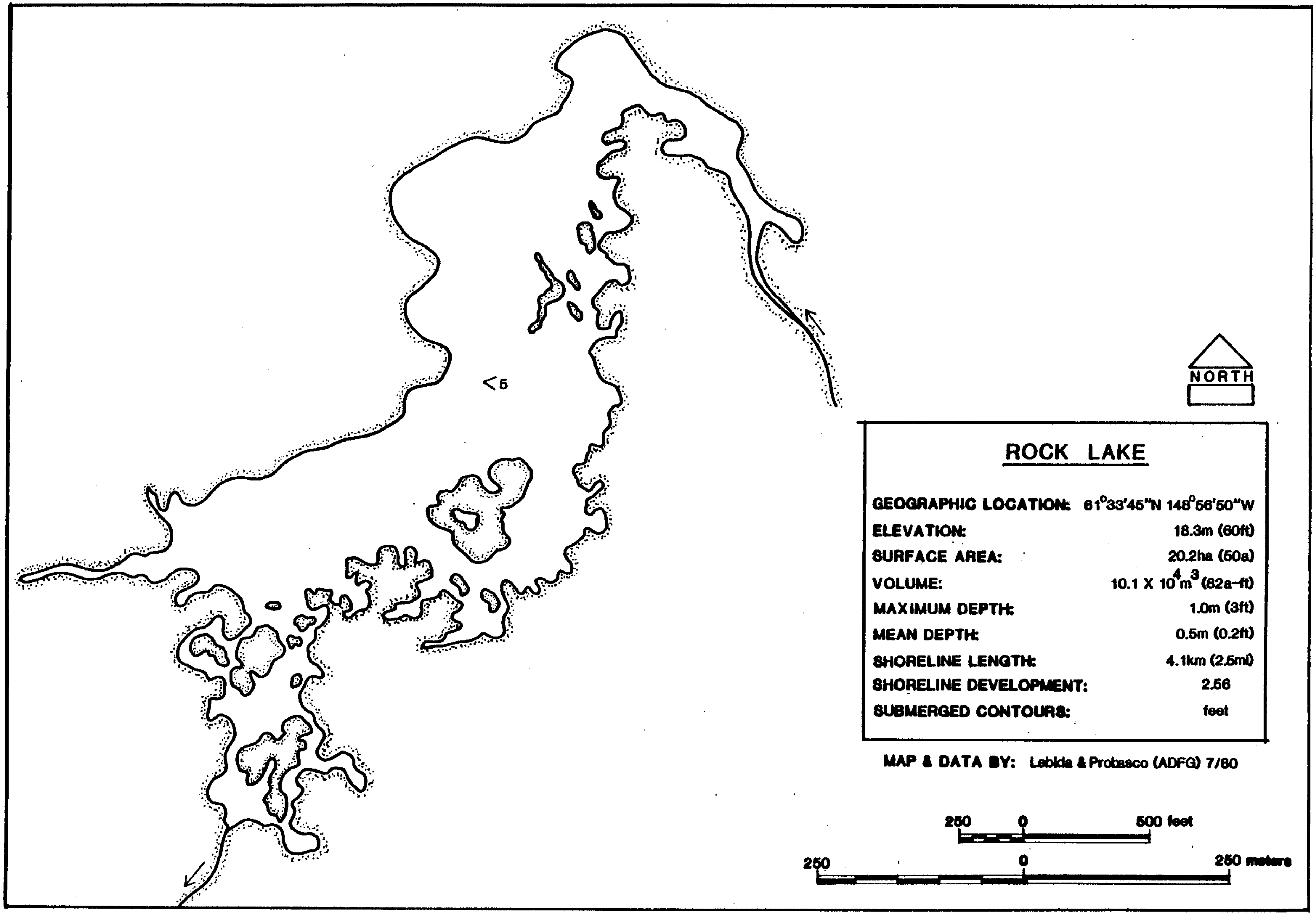

Figure 3. Rock Lake bathymetric map.

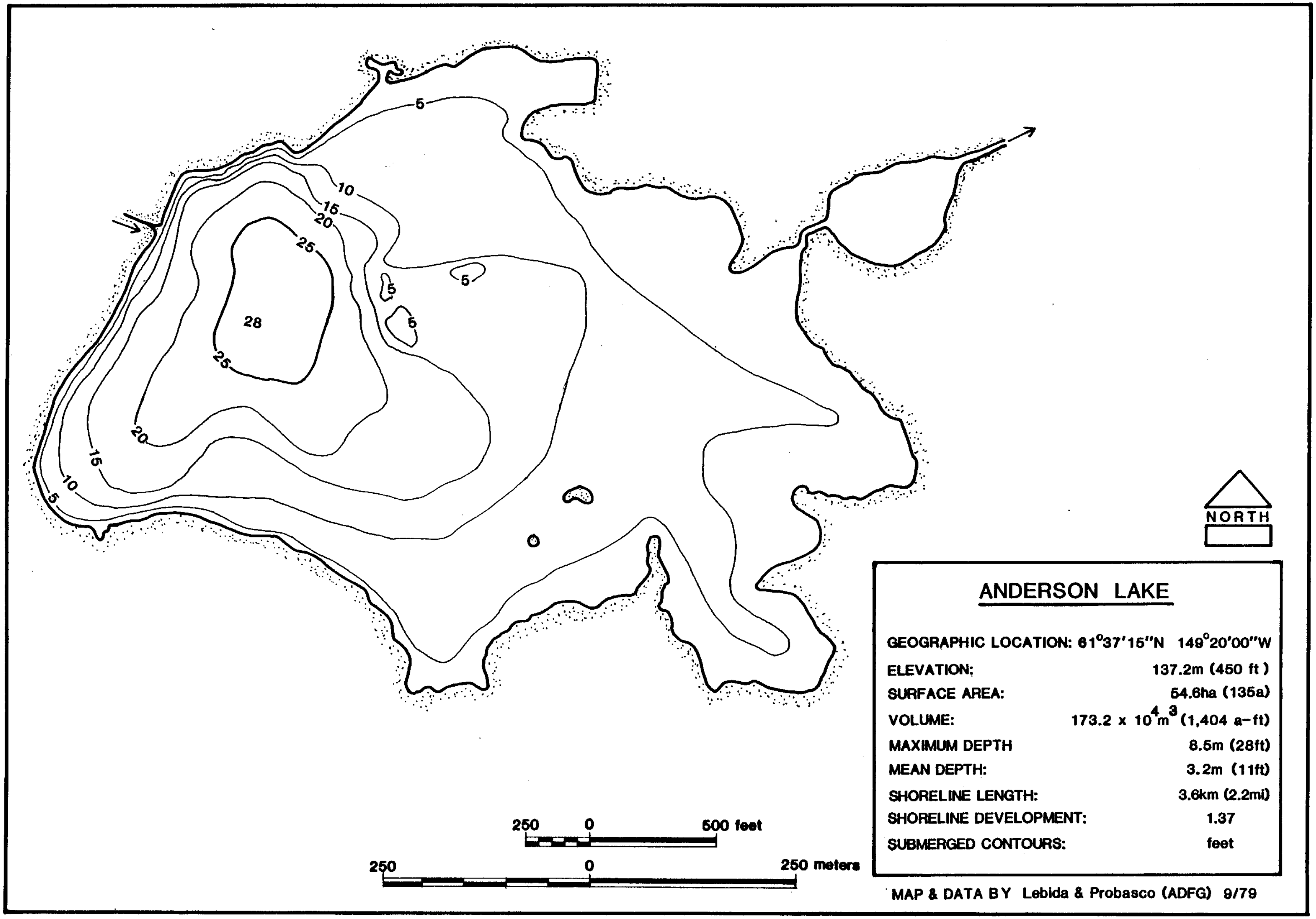

Figure 4. Anderson Lake bathymetric map.

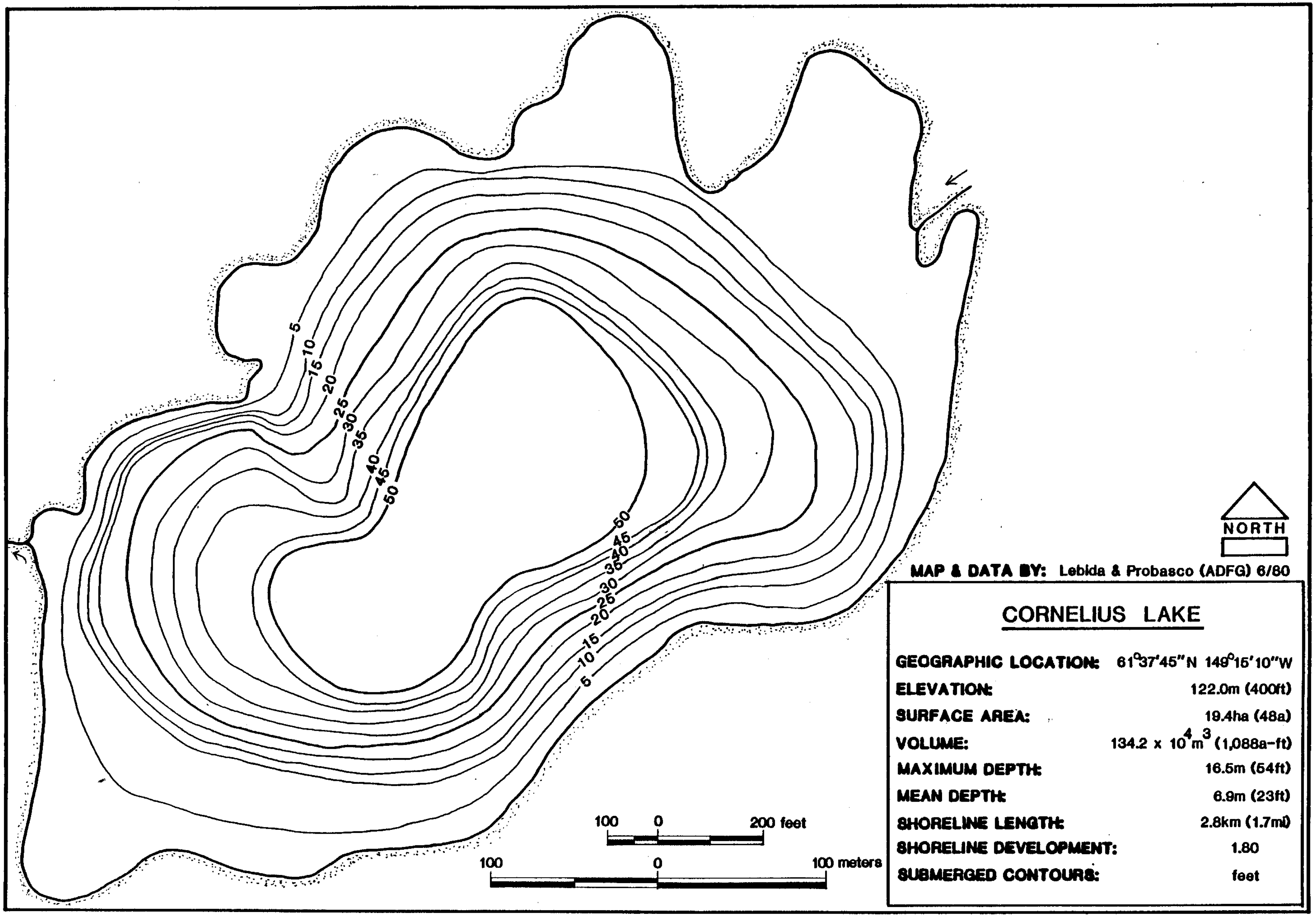

Figure 5. Cornelius Lake bathymetric map.

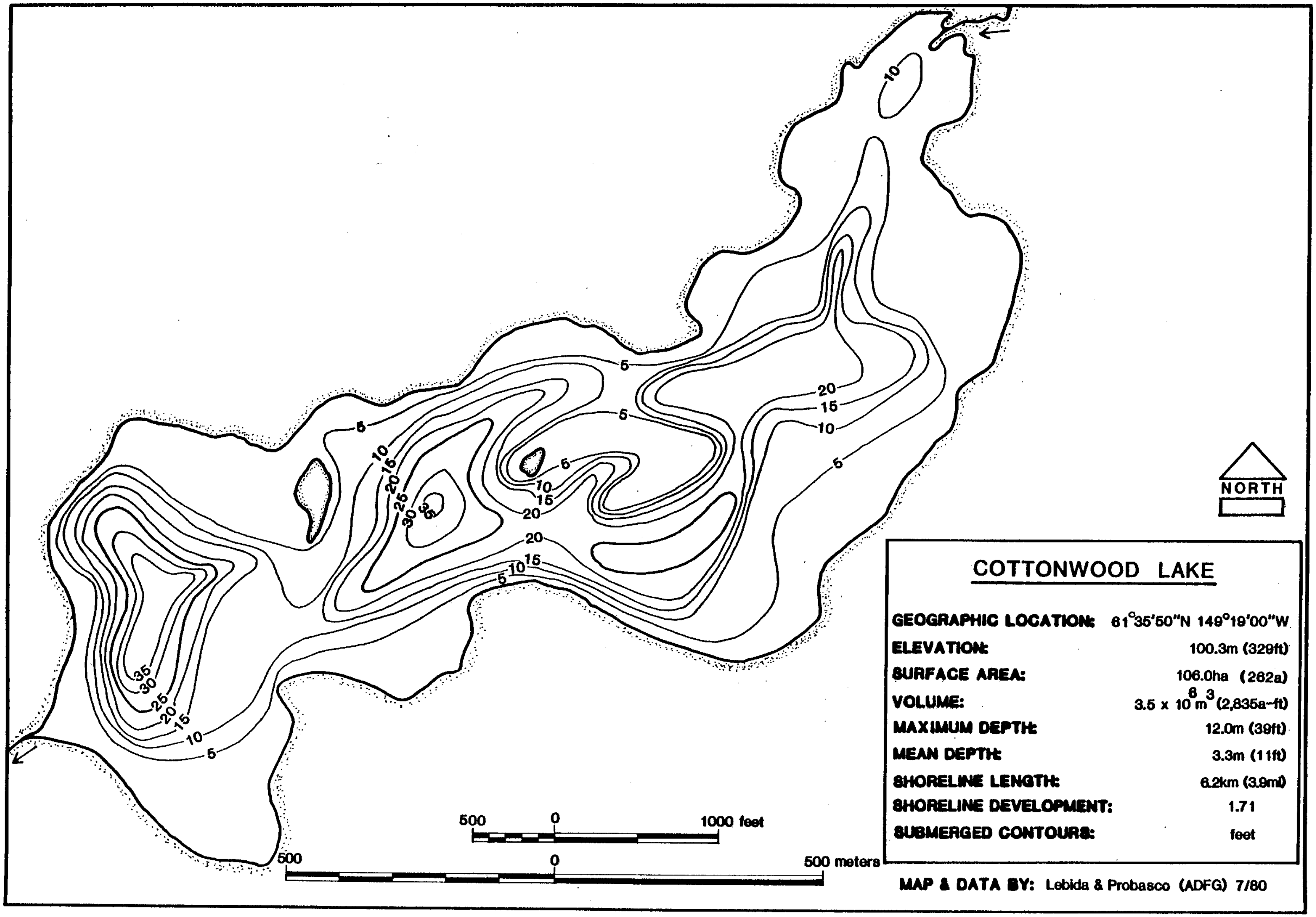

Figure 6. Cottonwood Lake Bathymetric map.

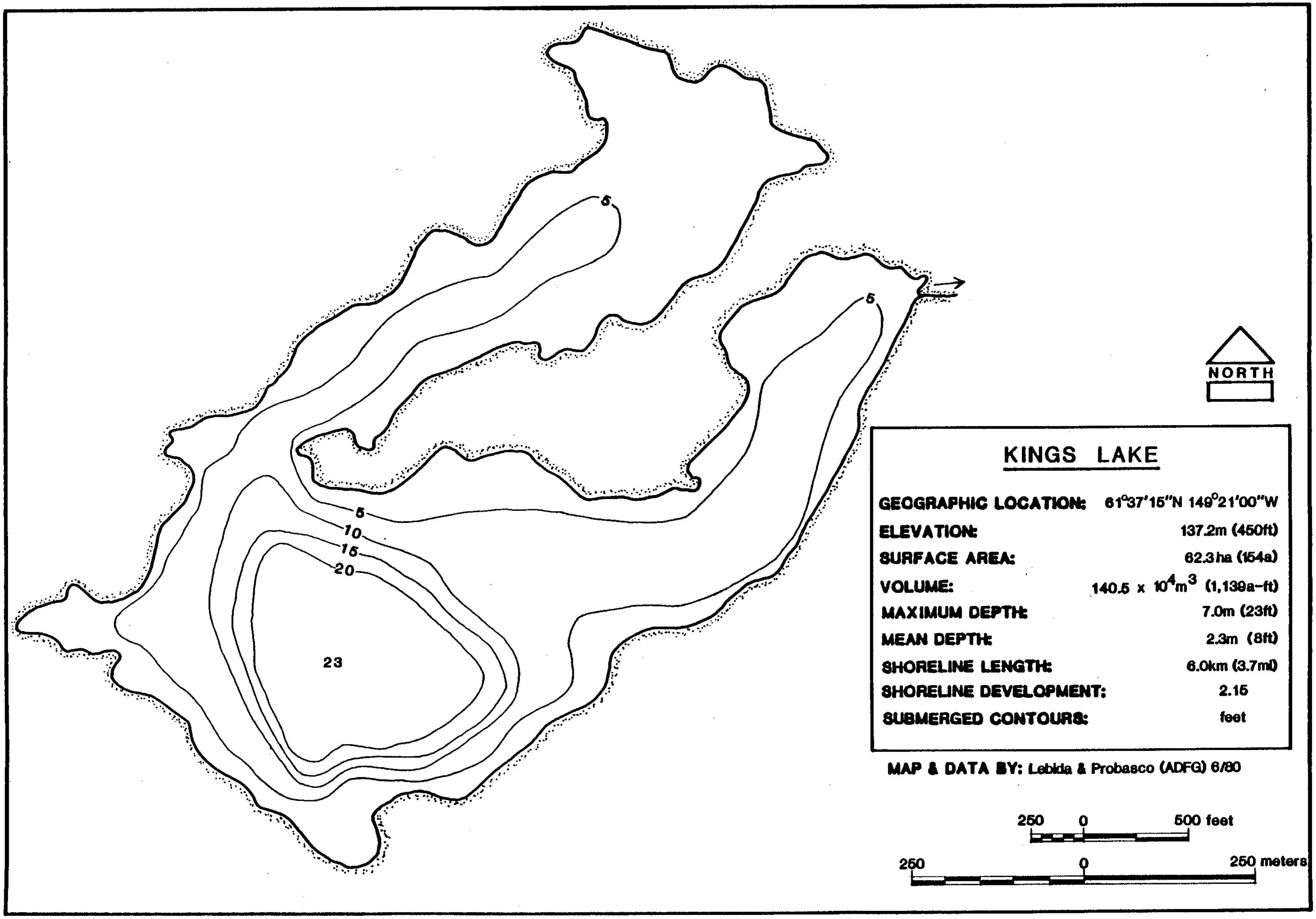

Figure 7. Kings Lake bathymetric map.

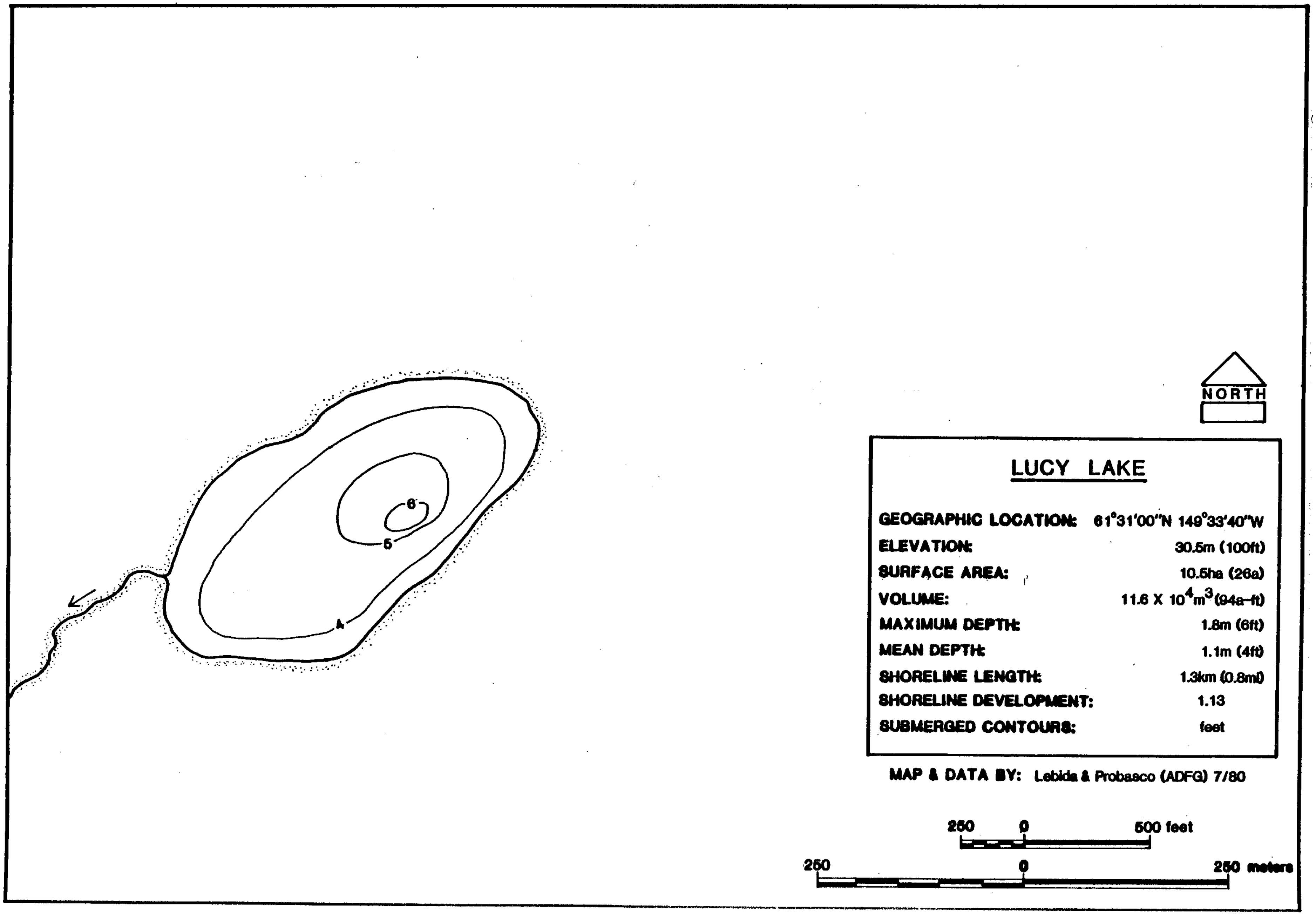

Figure 8. Lucy Lake bathymetric map.

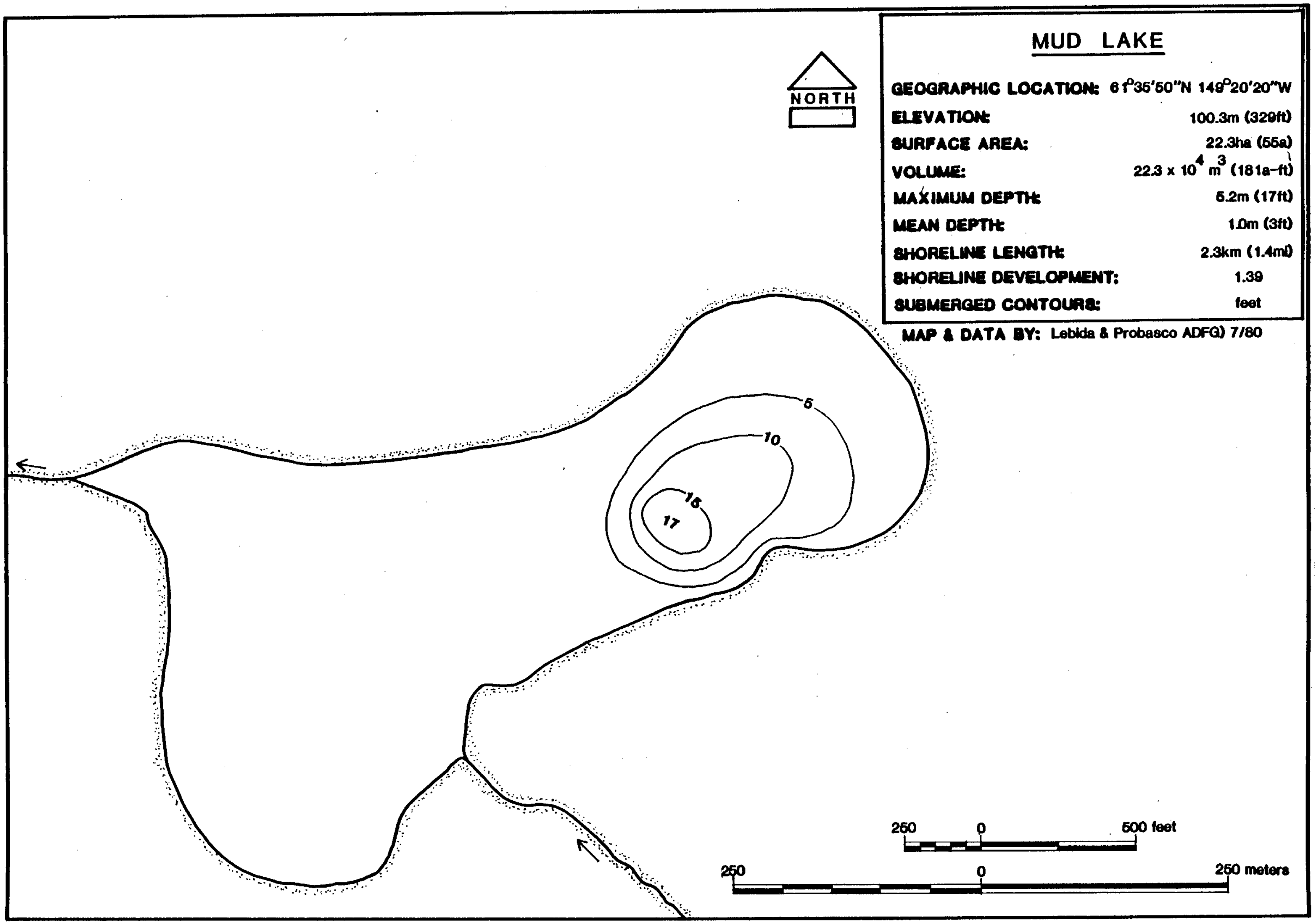

Figure 9. Mud Lake bathymetric map.

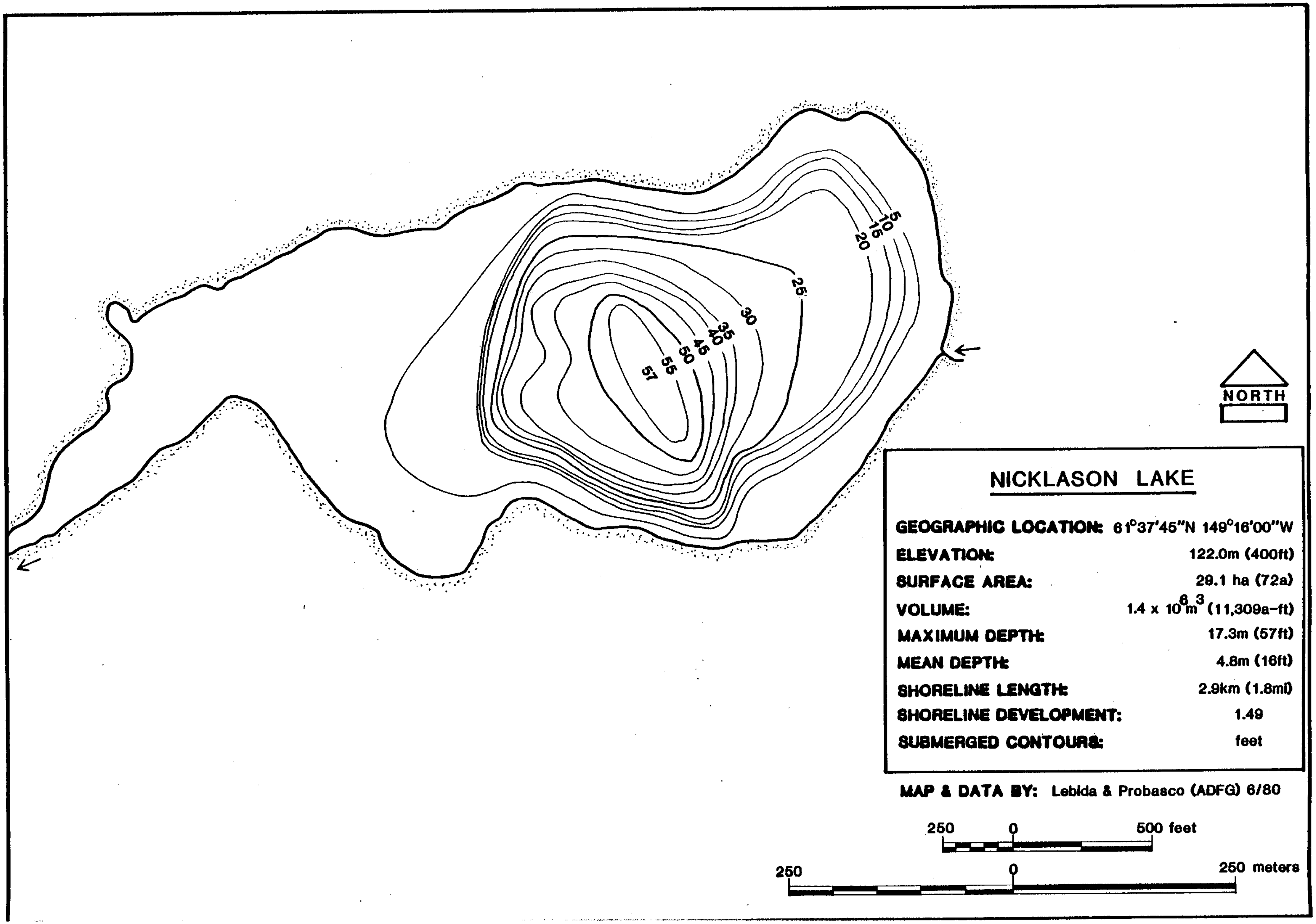

Figure 10. Nicklason Lake bathymetric map.

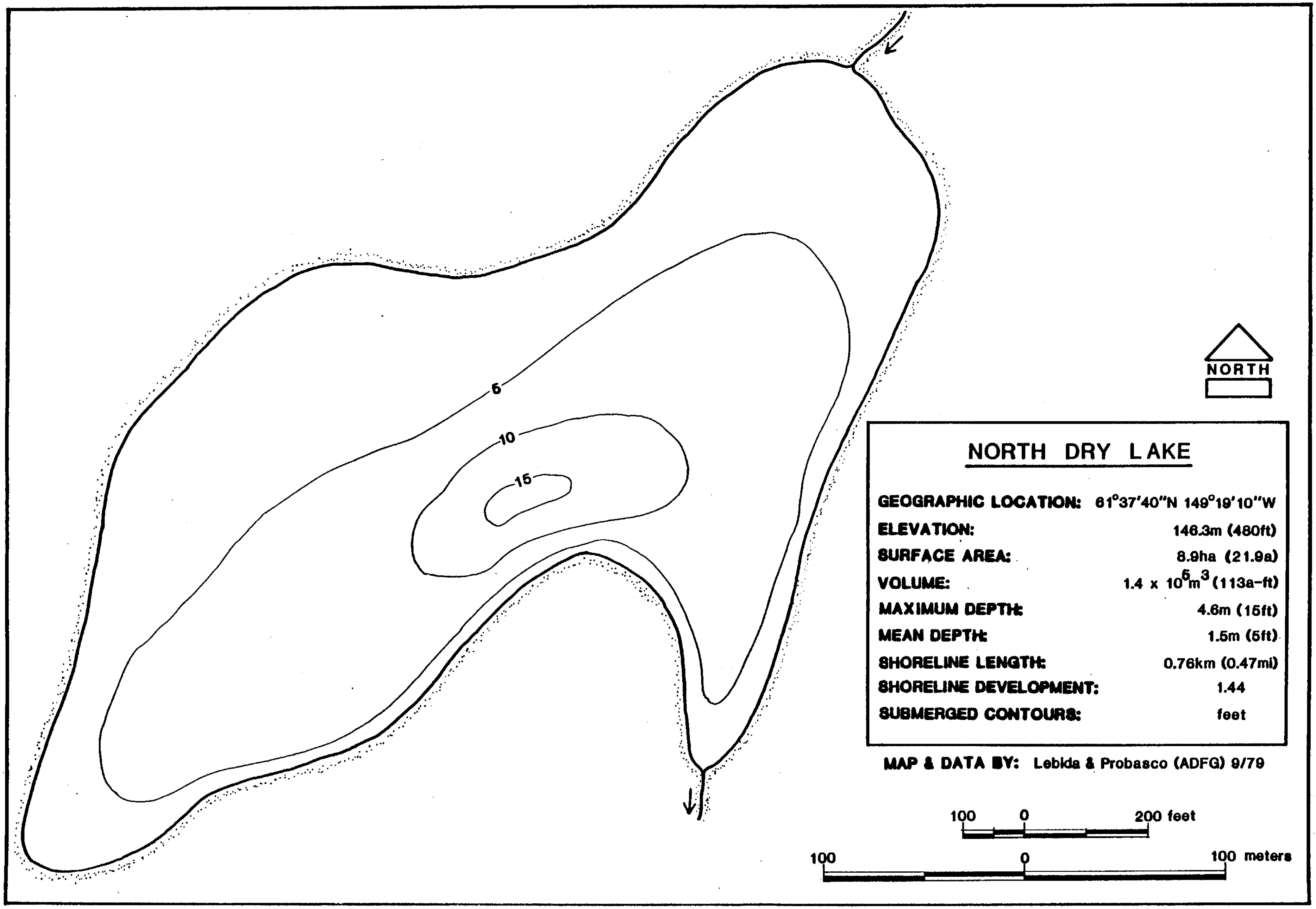

Figure 11. North Dry Lake bathymetric map.

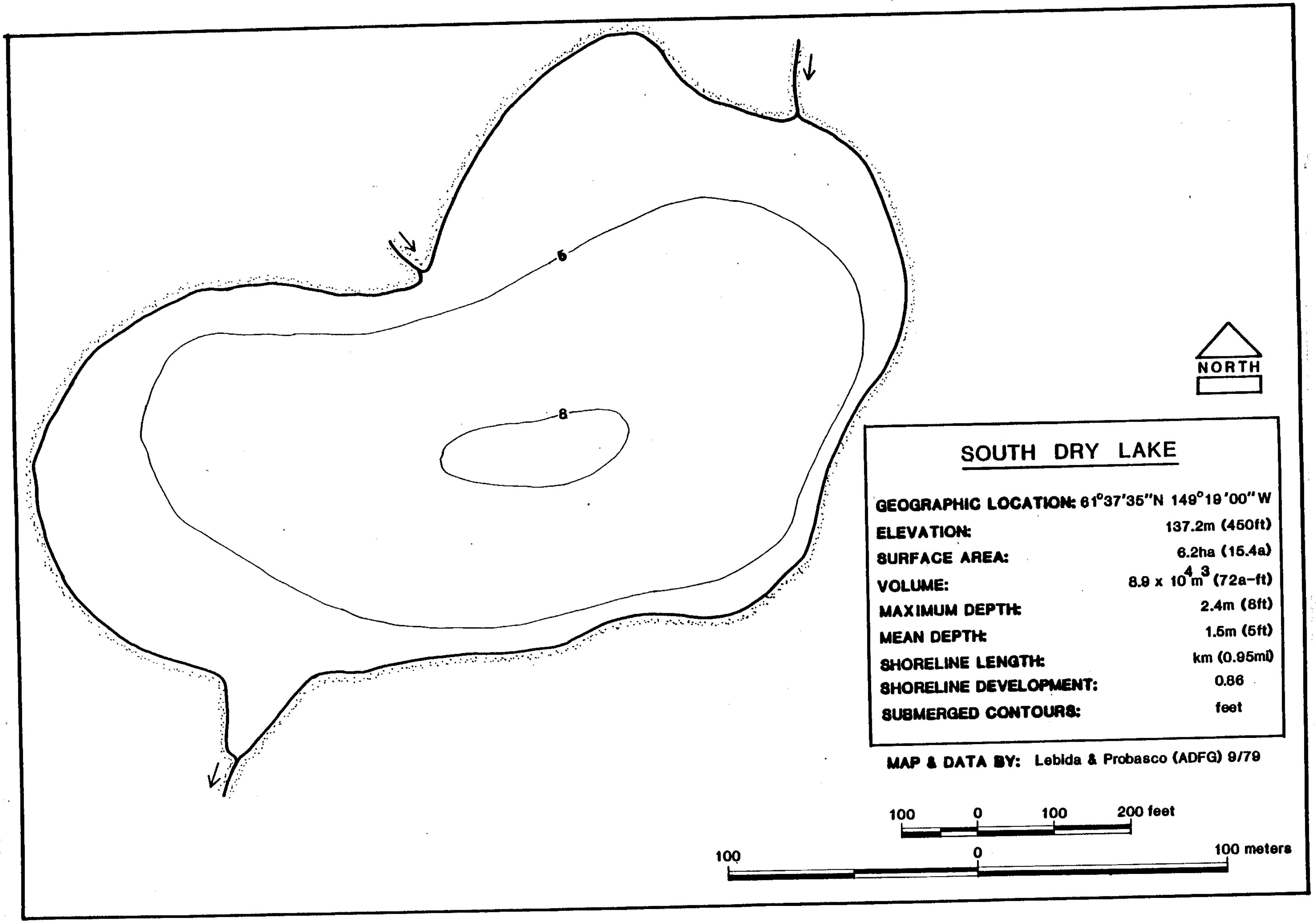

Figure 12. South Dry Lake bathymetric map.

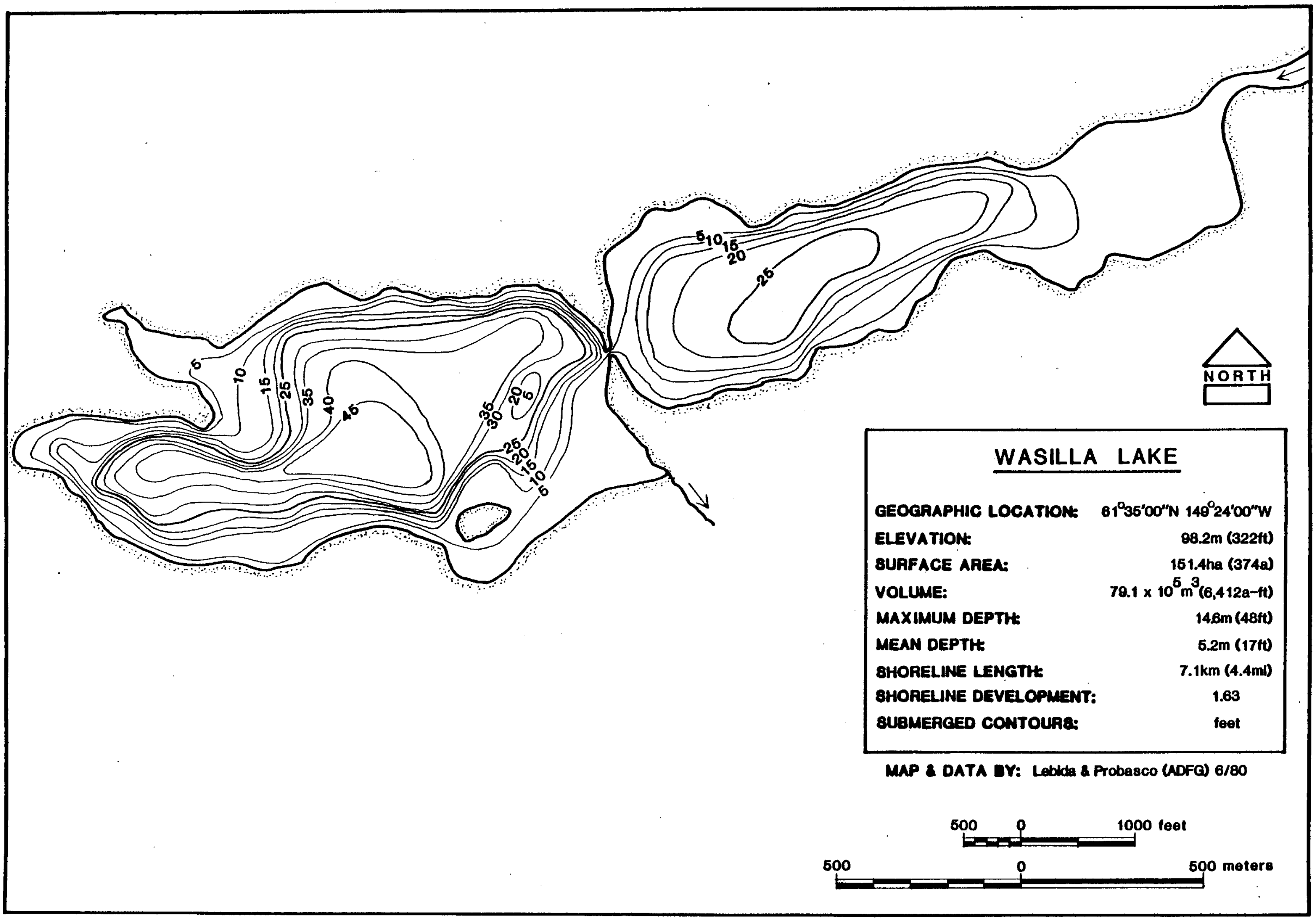

Figure 13. Wasilla Lake bathymetric map.

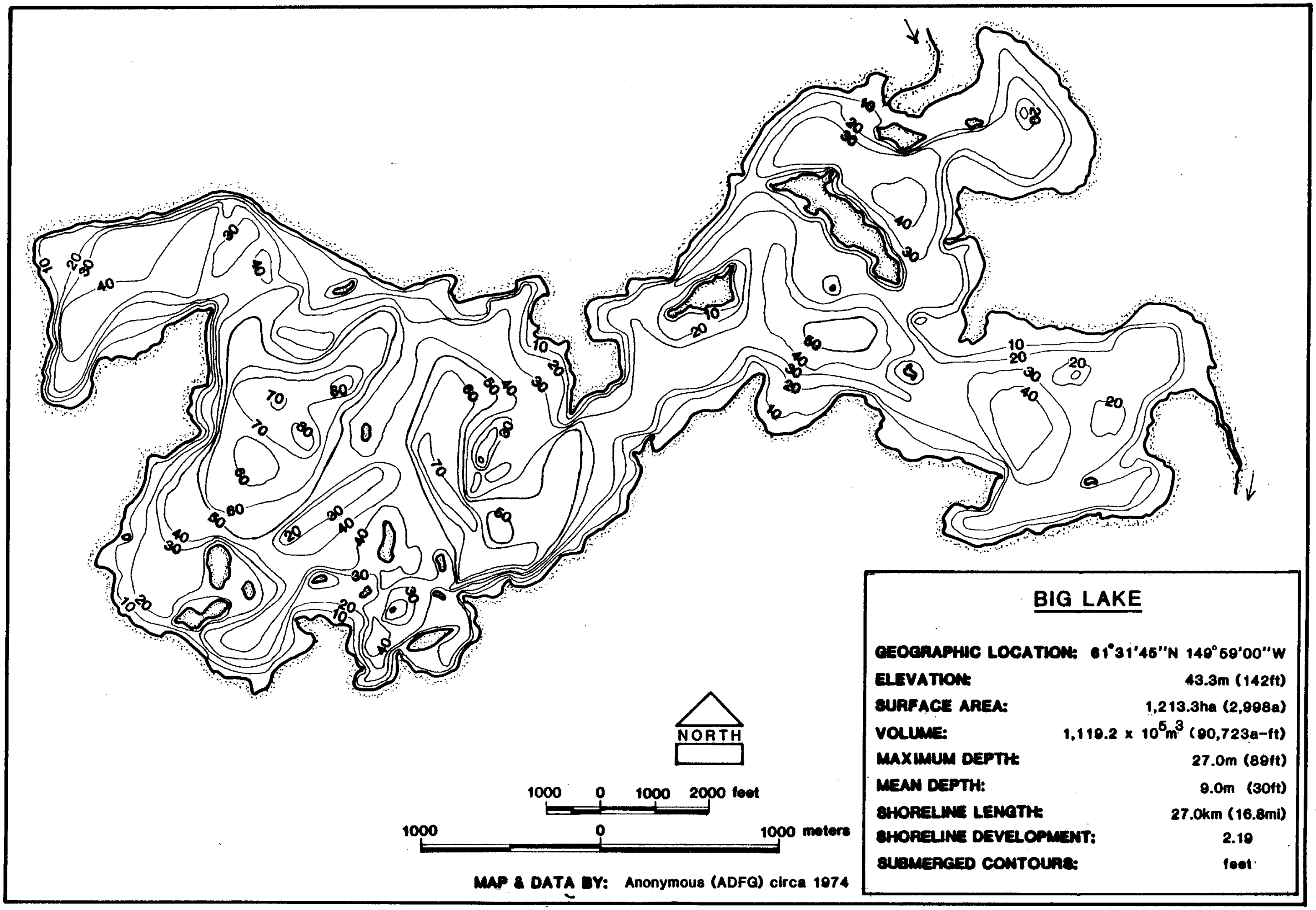

Figure 14. Big Lake bathymetric map.

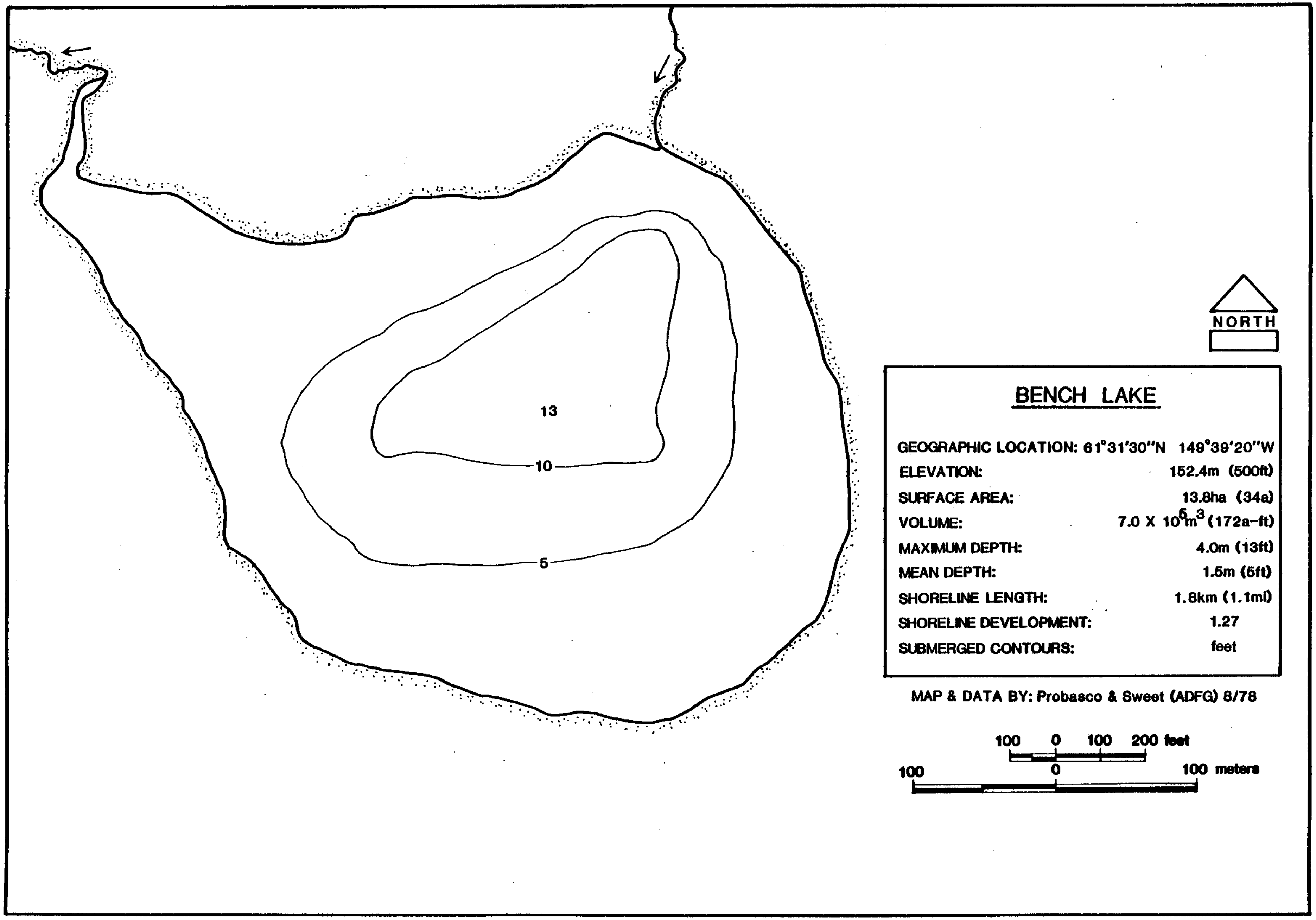

Figure 15. Bench Lake bathymetric map.

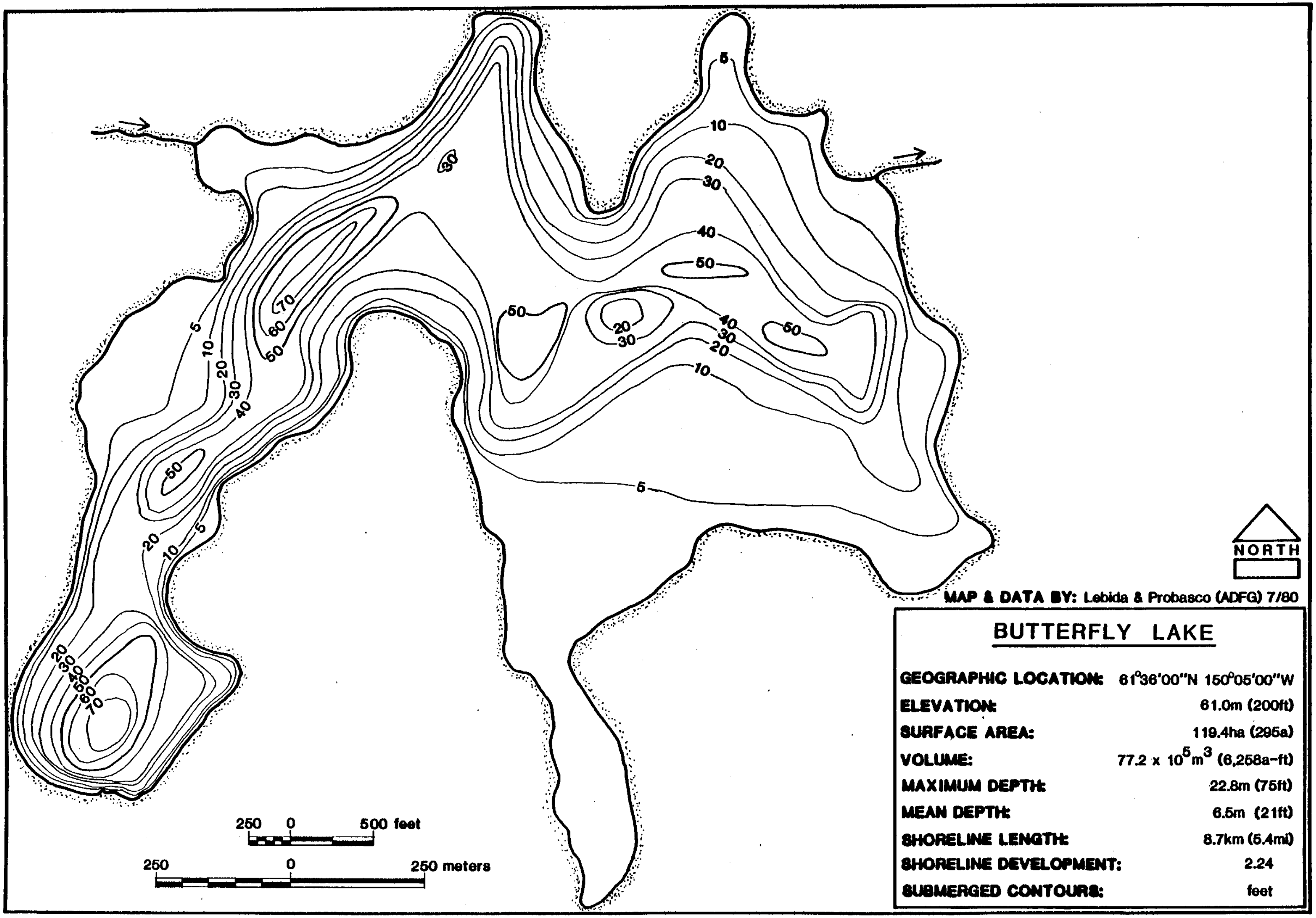

Figure 16. Butterfly Lake bathymetric map.

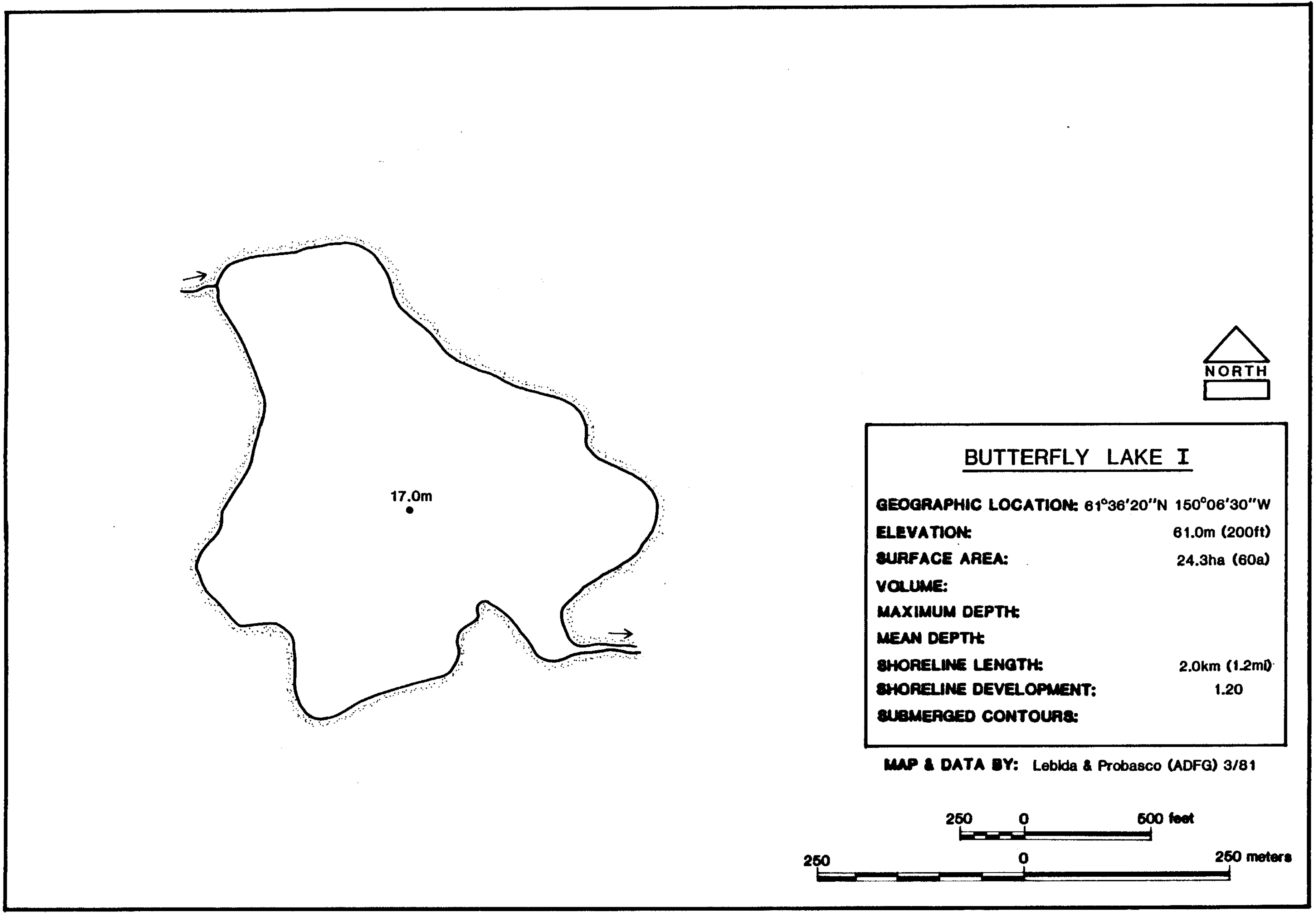

Figure 17. Butterfly Lake I map.

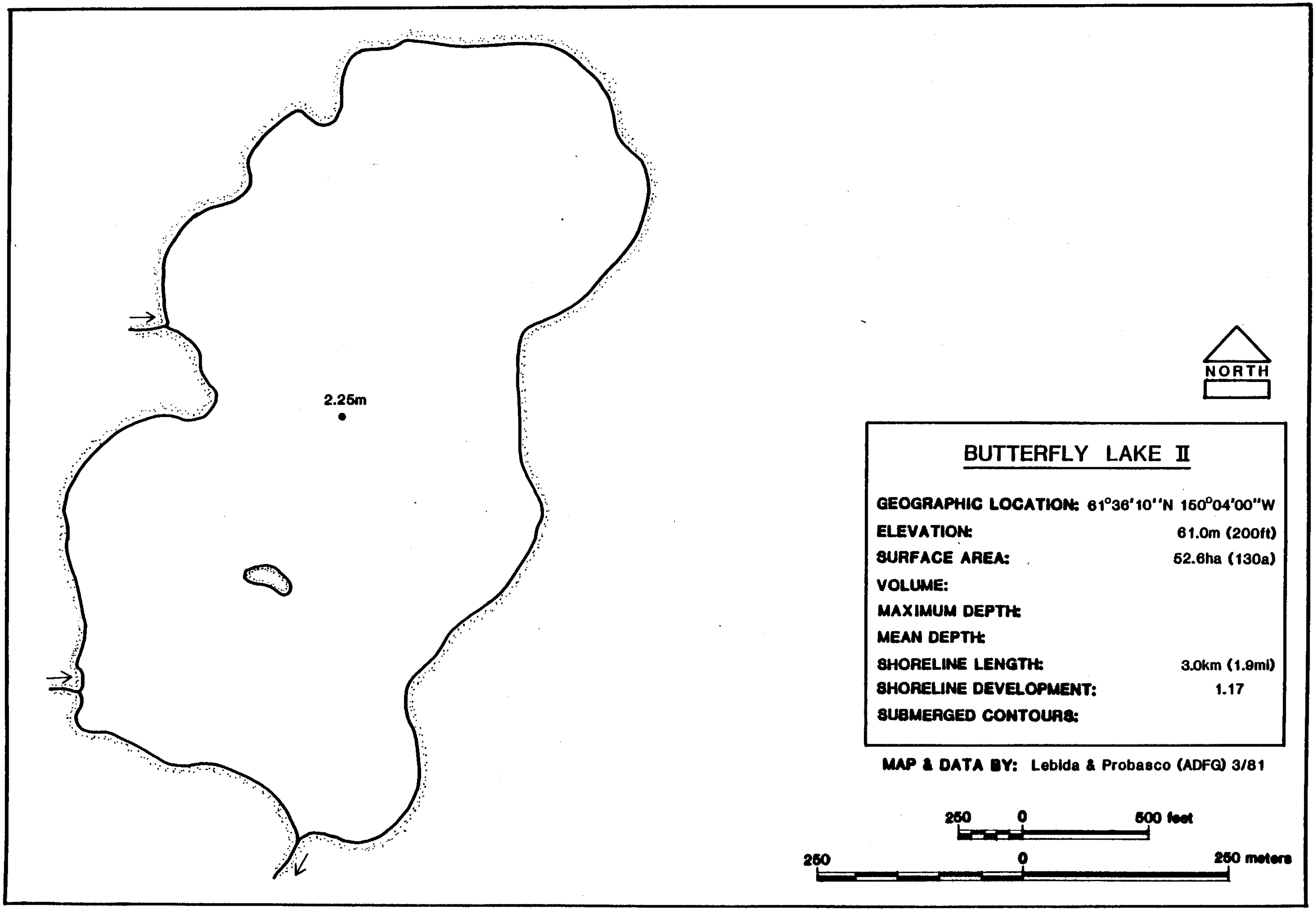

Figure 18. Butterfly Lake II map.

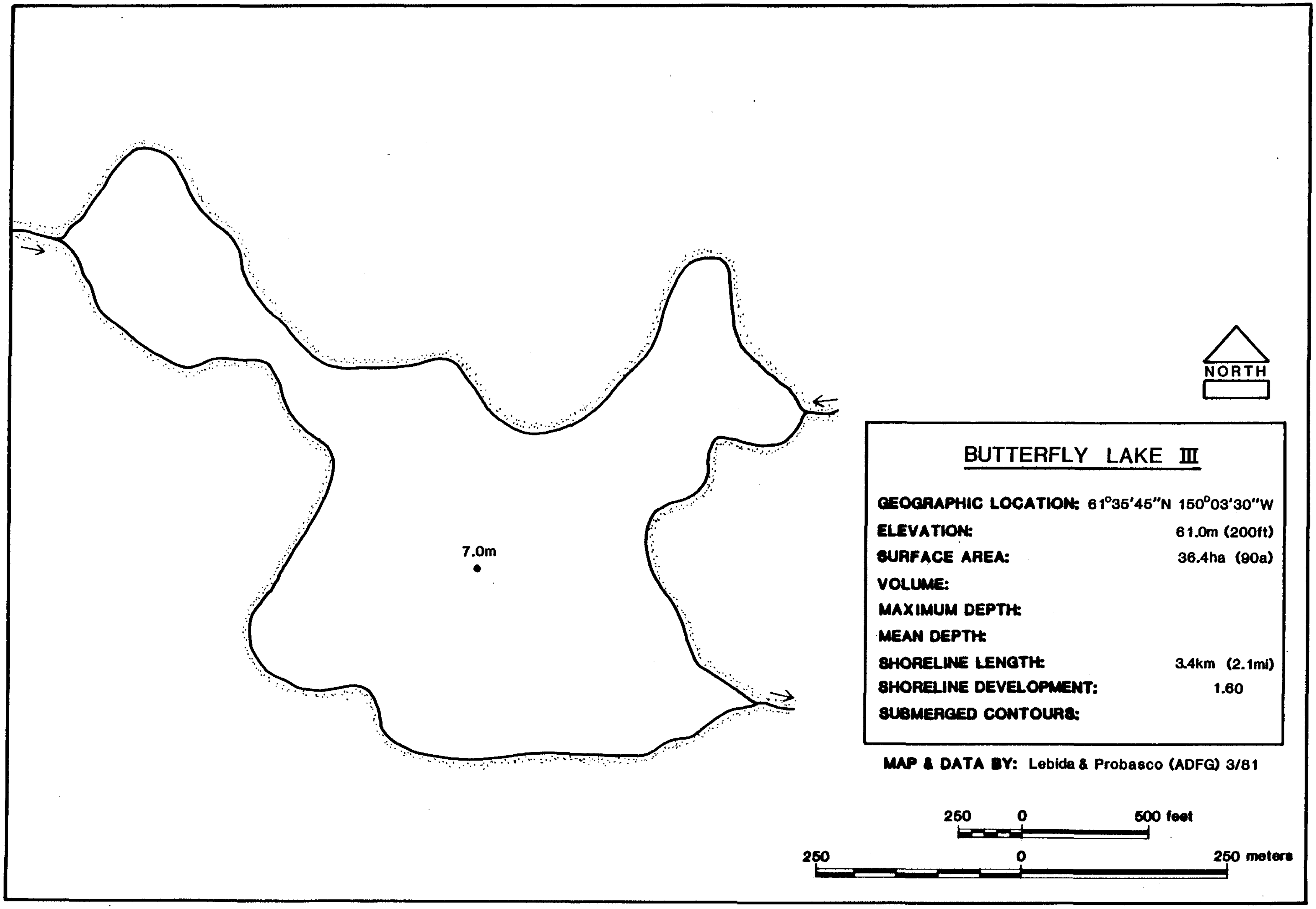

Figure 19. Butterfly Lake III map.

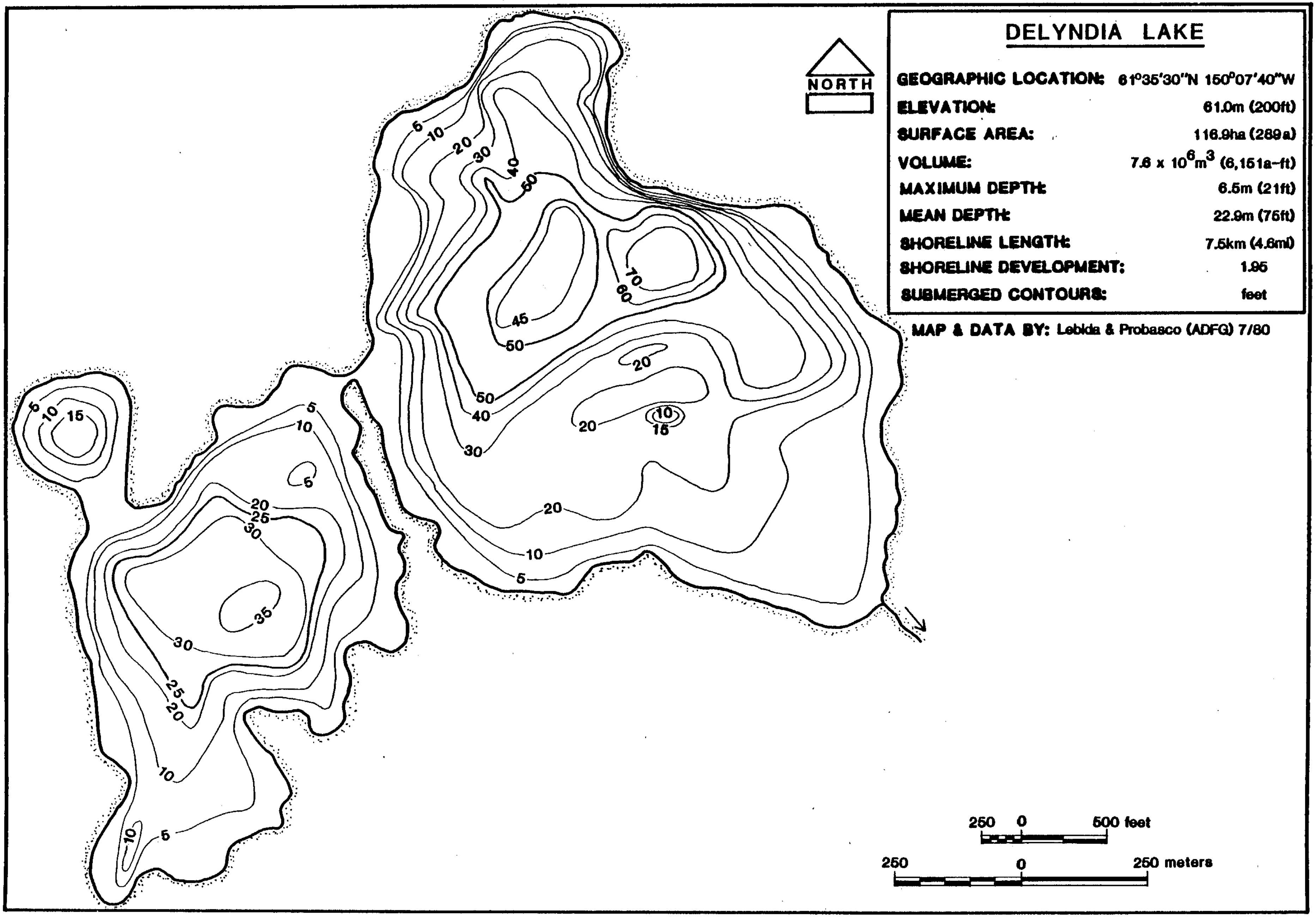

Figure 20. Delyndia Lake bathymetric map.

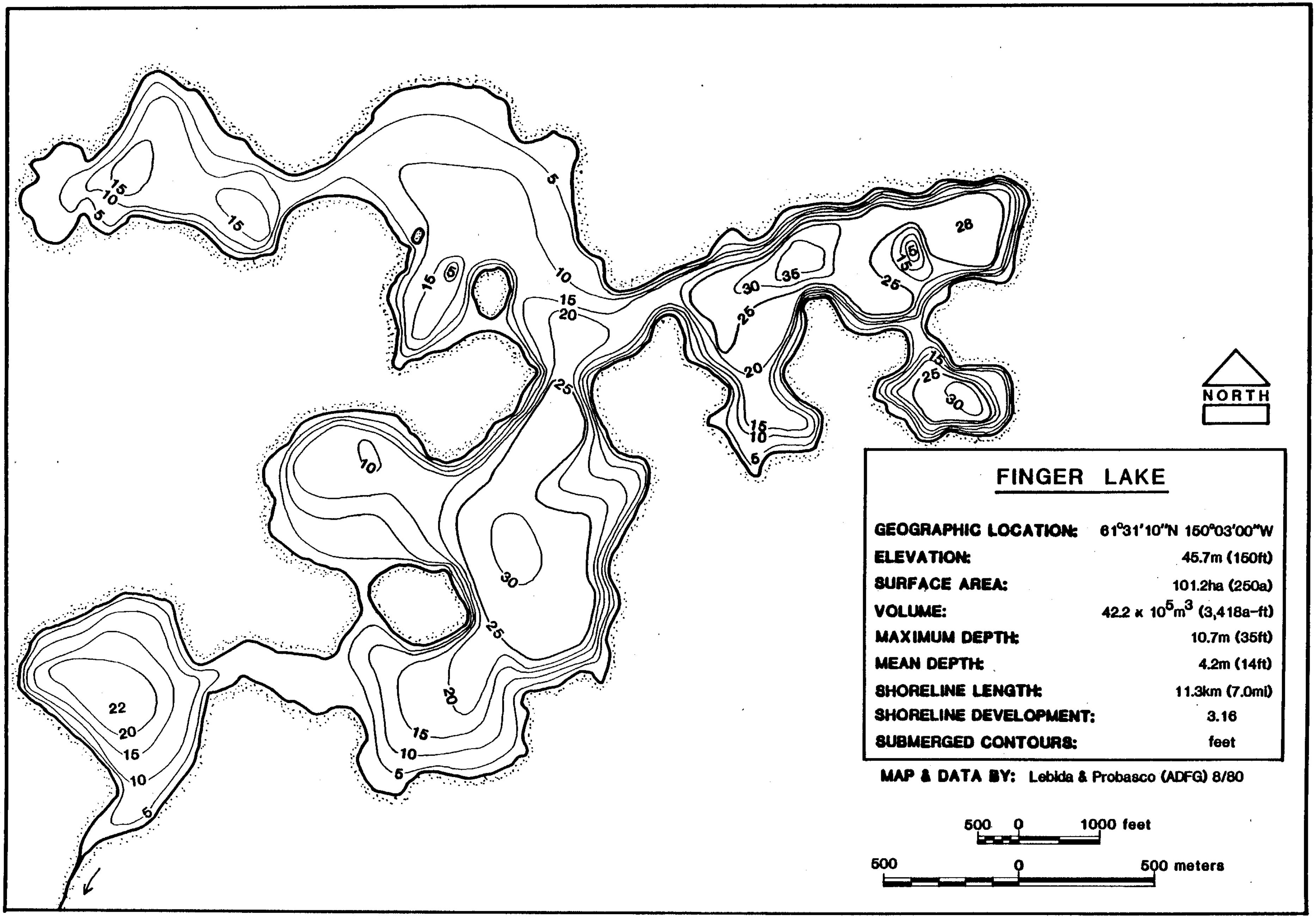

Figure 21. Finger Lake bathymetric map.

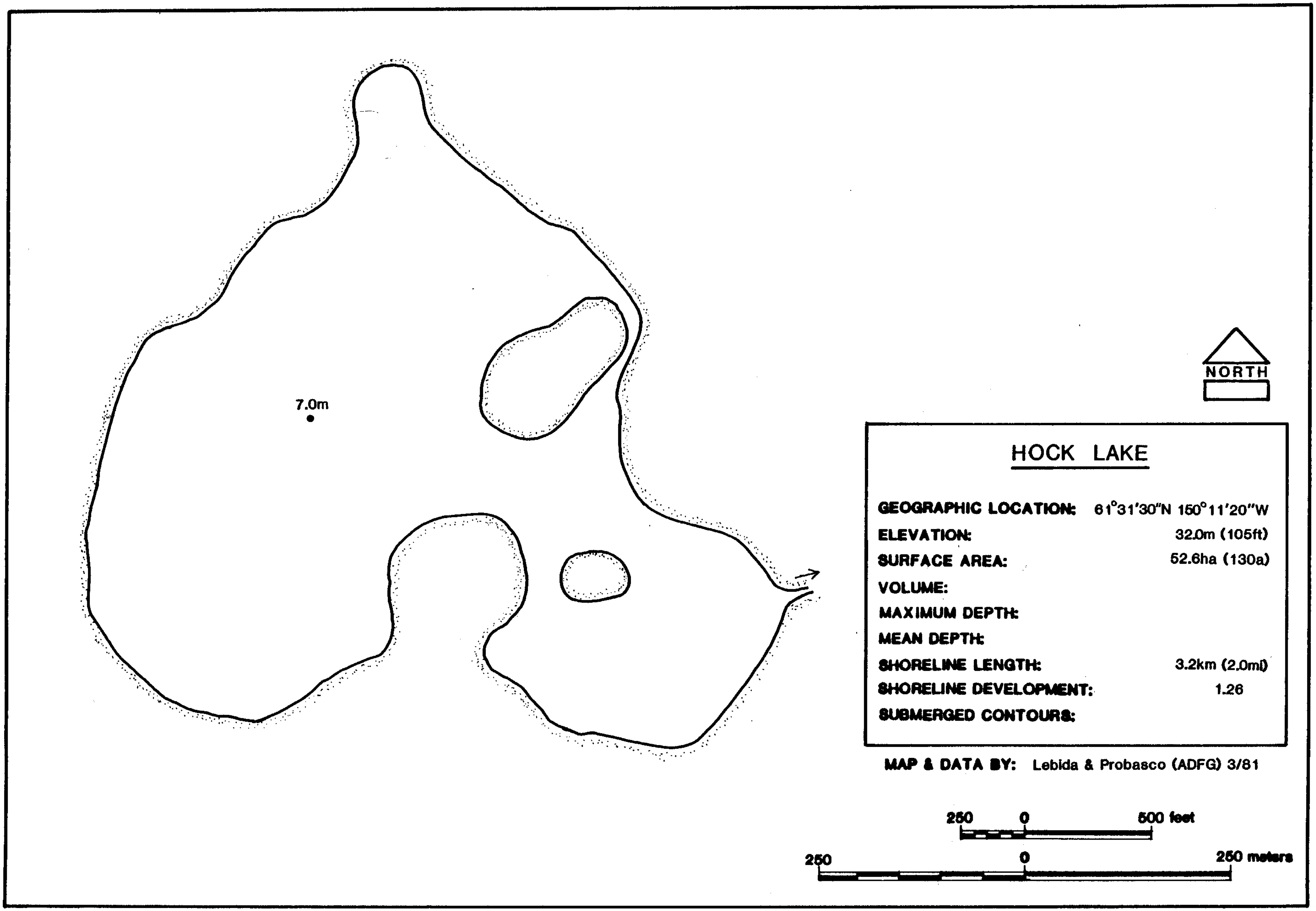

Figure 22. Hock Lake map.

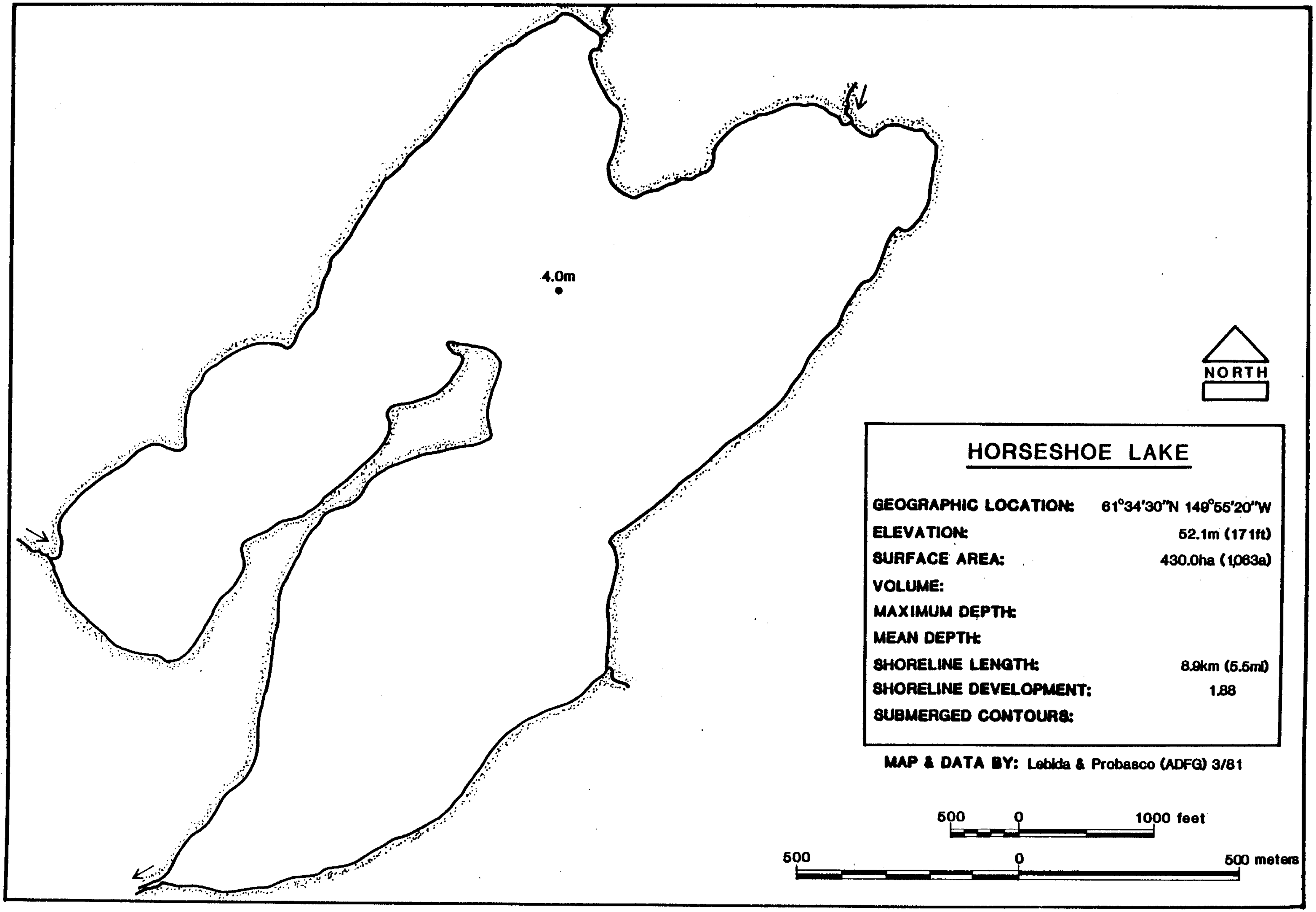

Figure 23. Horseshoe Lake map.

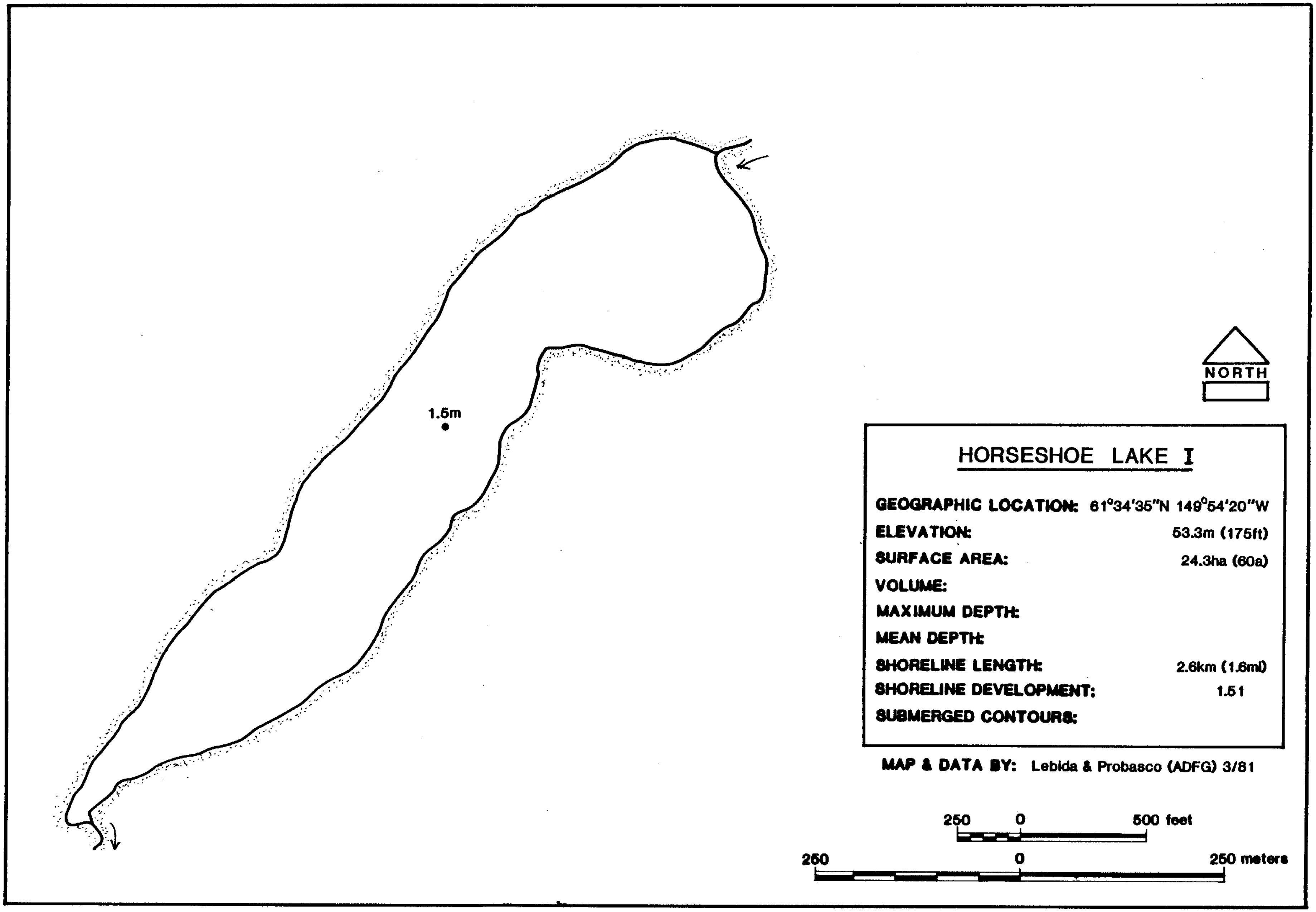

Figure 24. Horseshoe Lake I map.

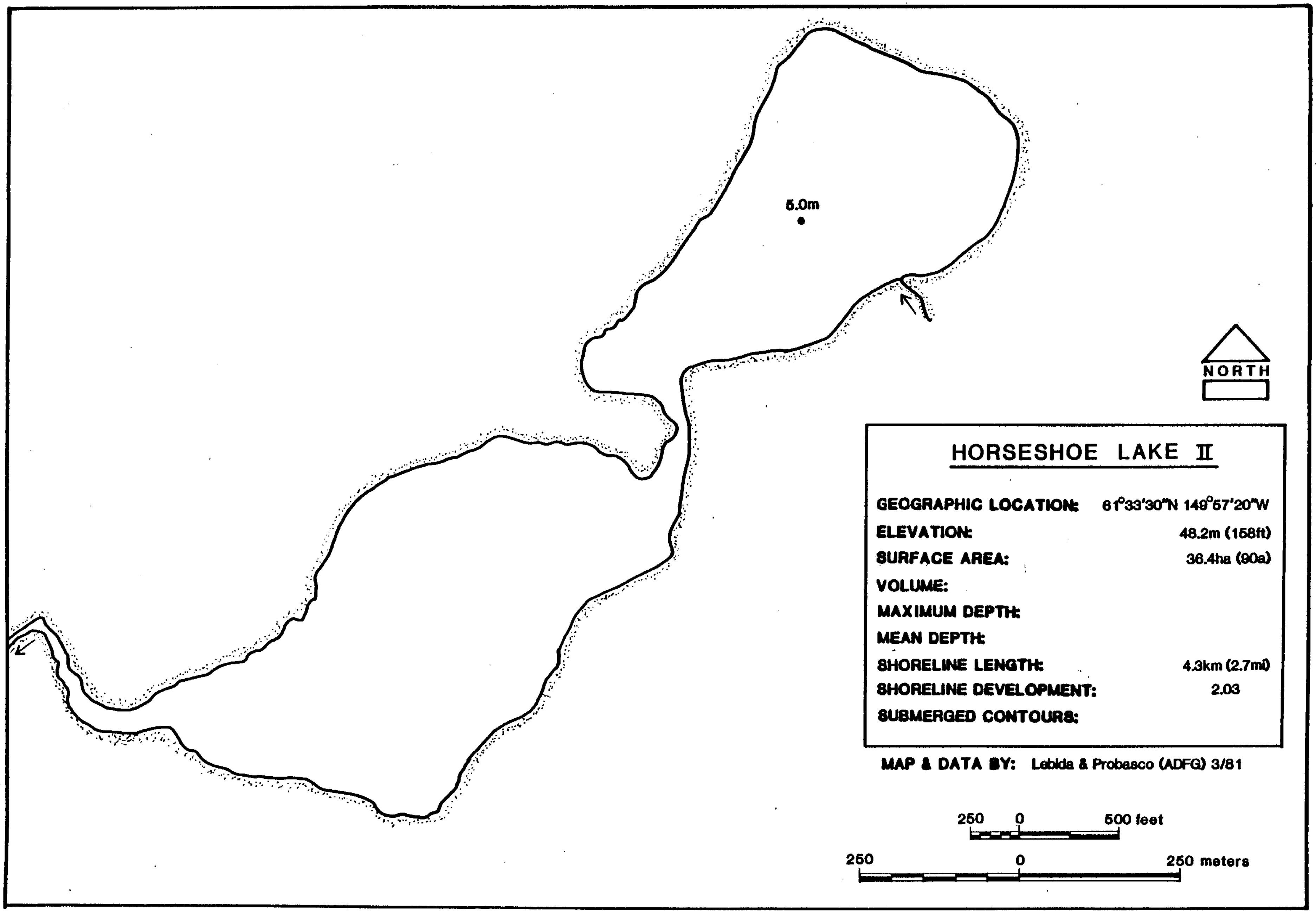

Figure 24. Horseshoe Lake II map.

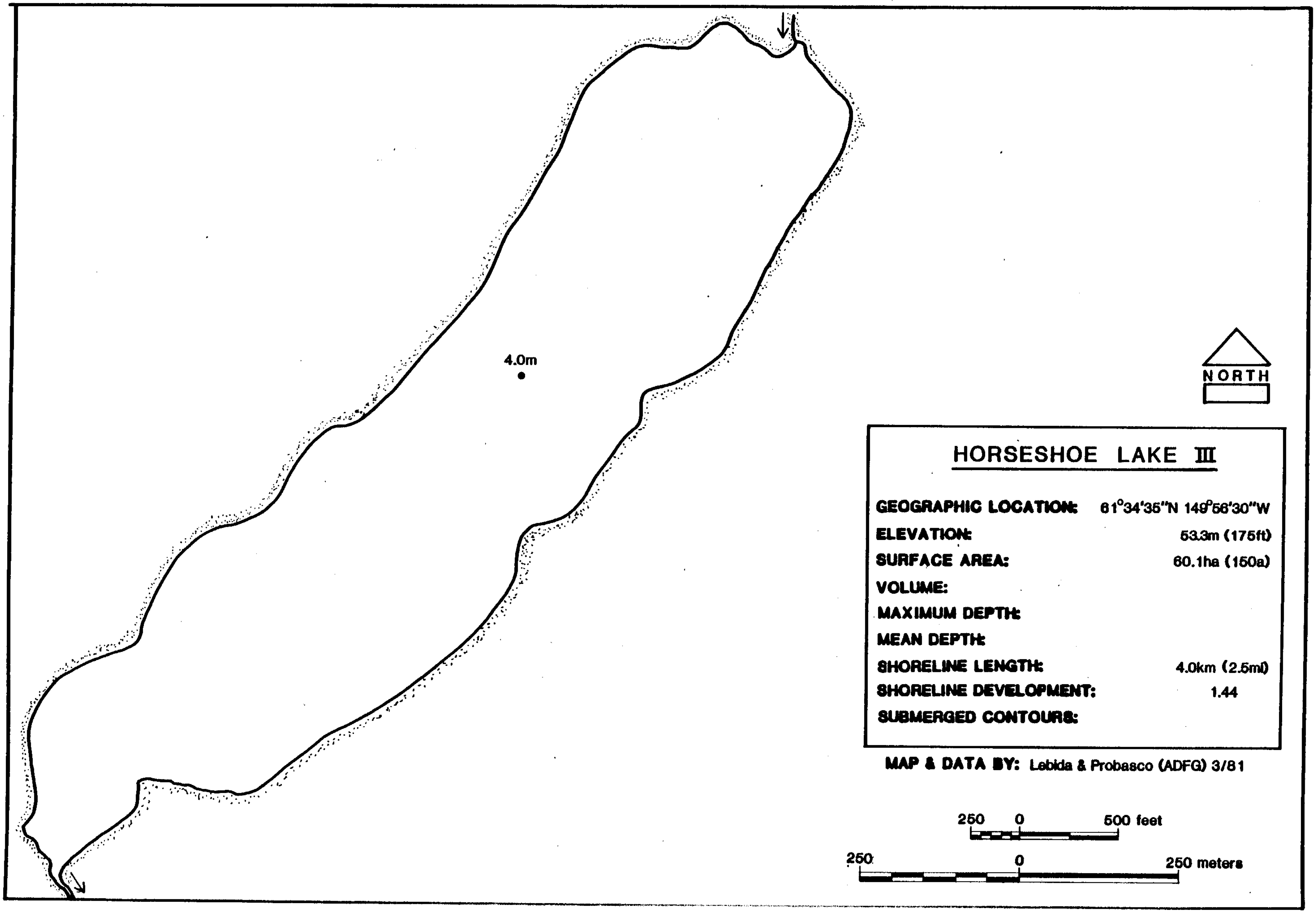

Figure 26. Horseshoe Lake III map.

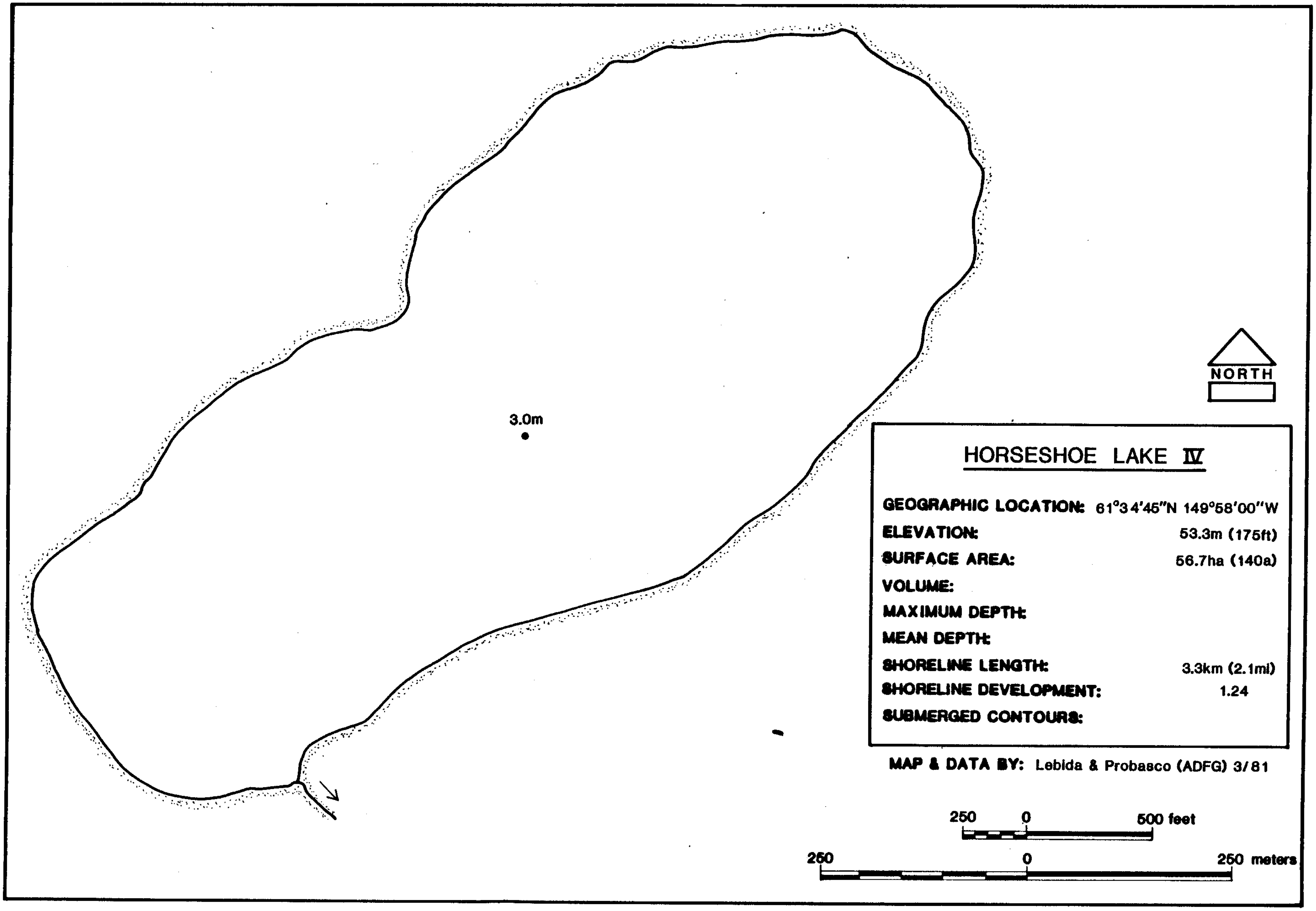

Figure 27. Horseshoe Lake IV map.

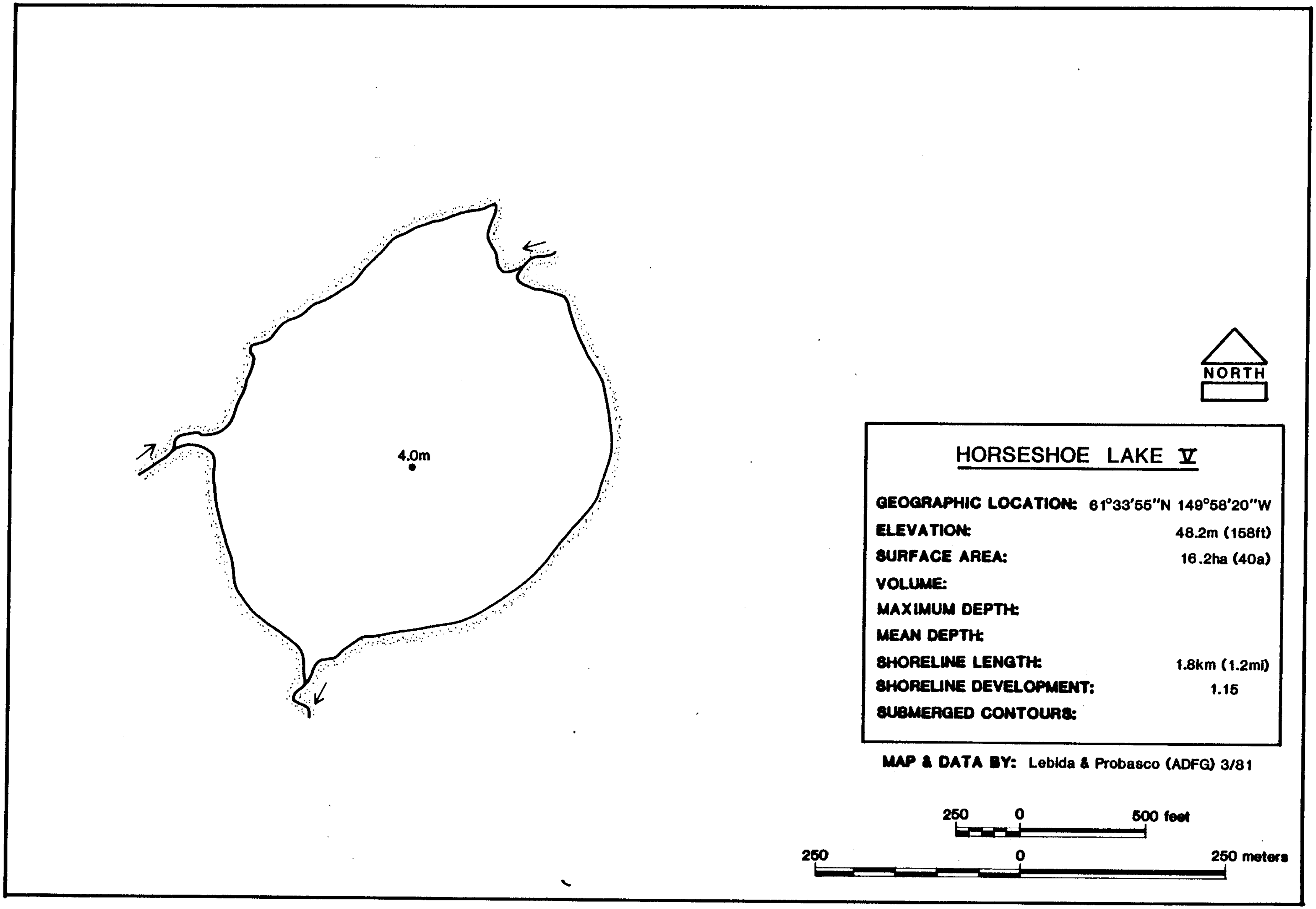

Figure 28. Horseshoe Lake V map.

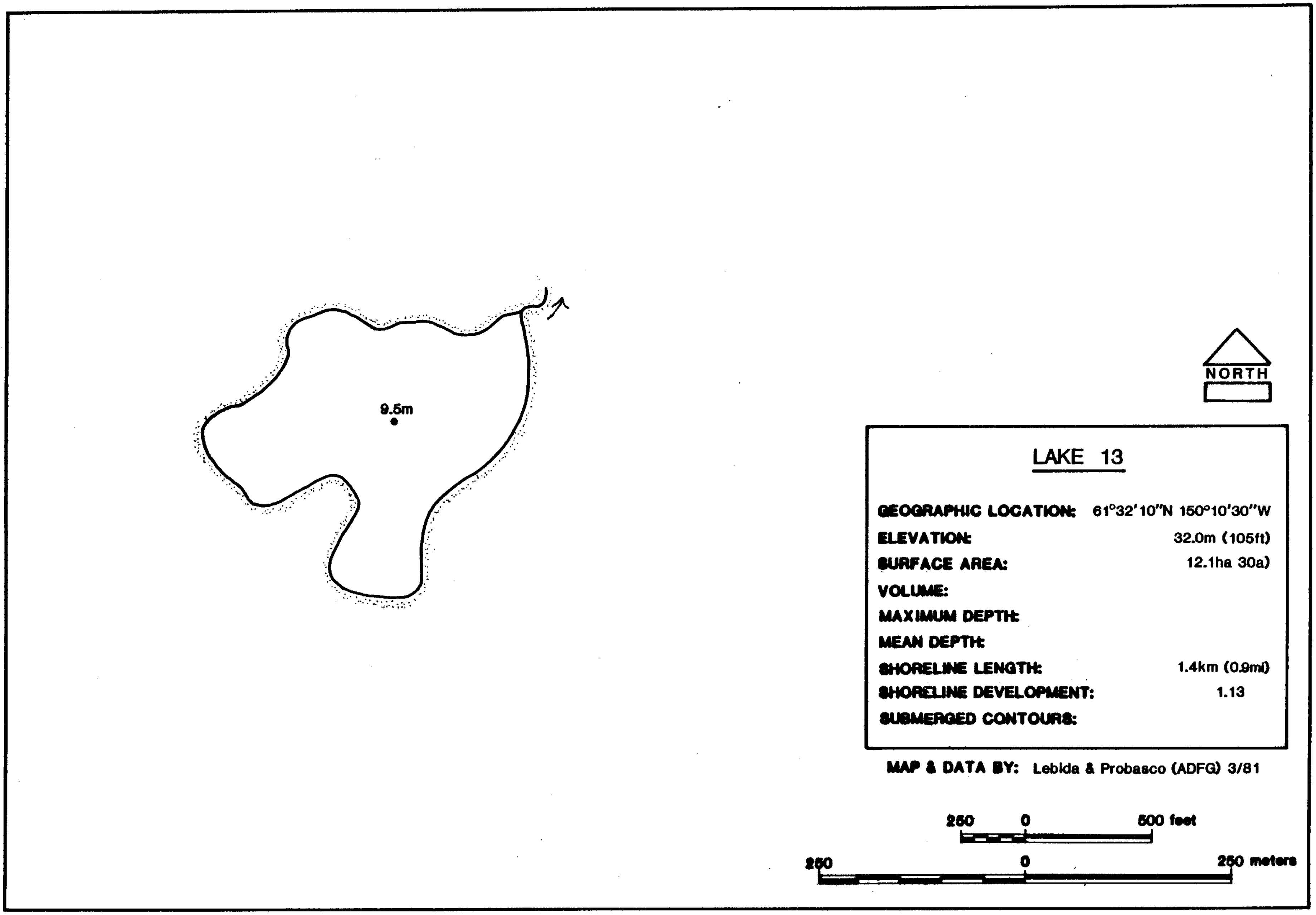

Figure 19. Lake 13 map.

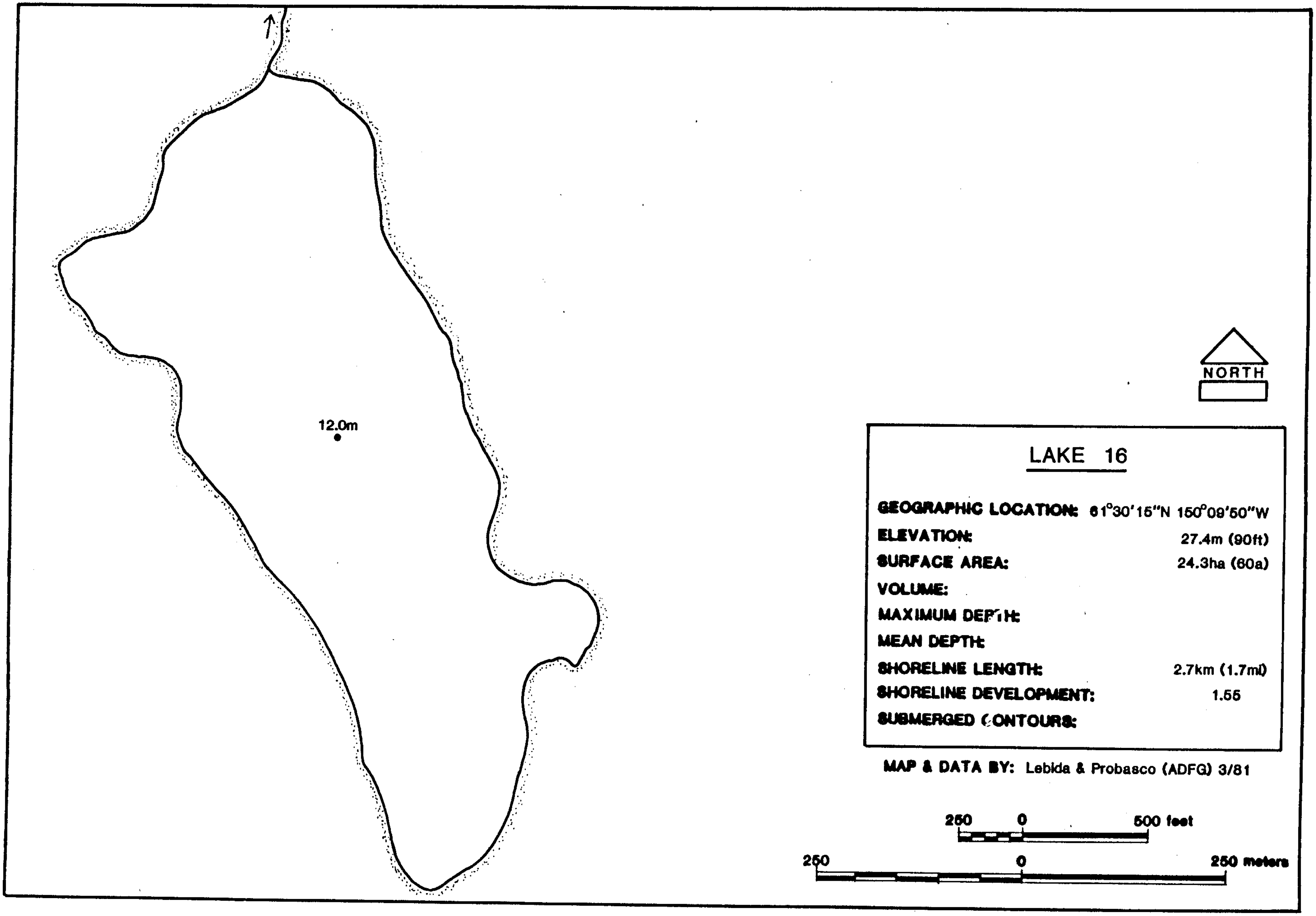

Figure 30. Lake 16 map.

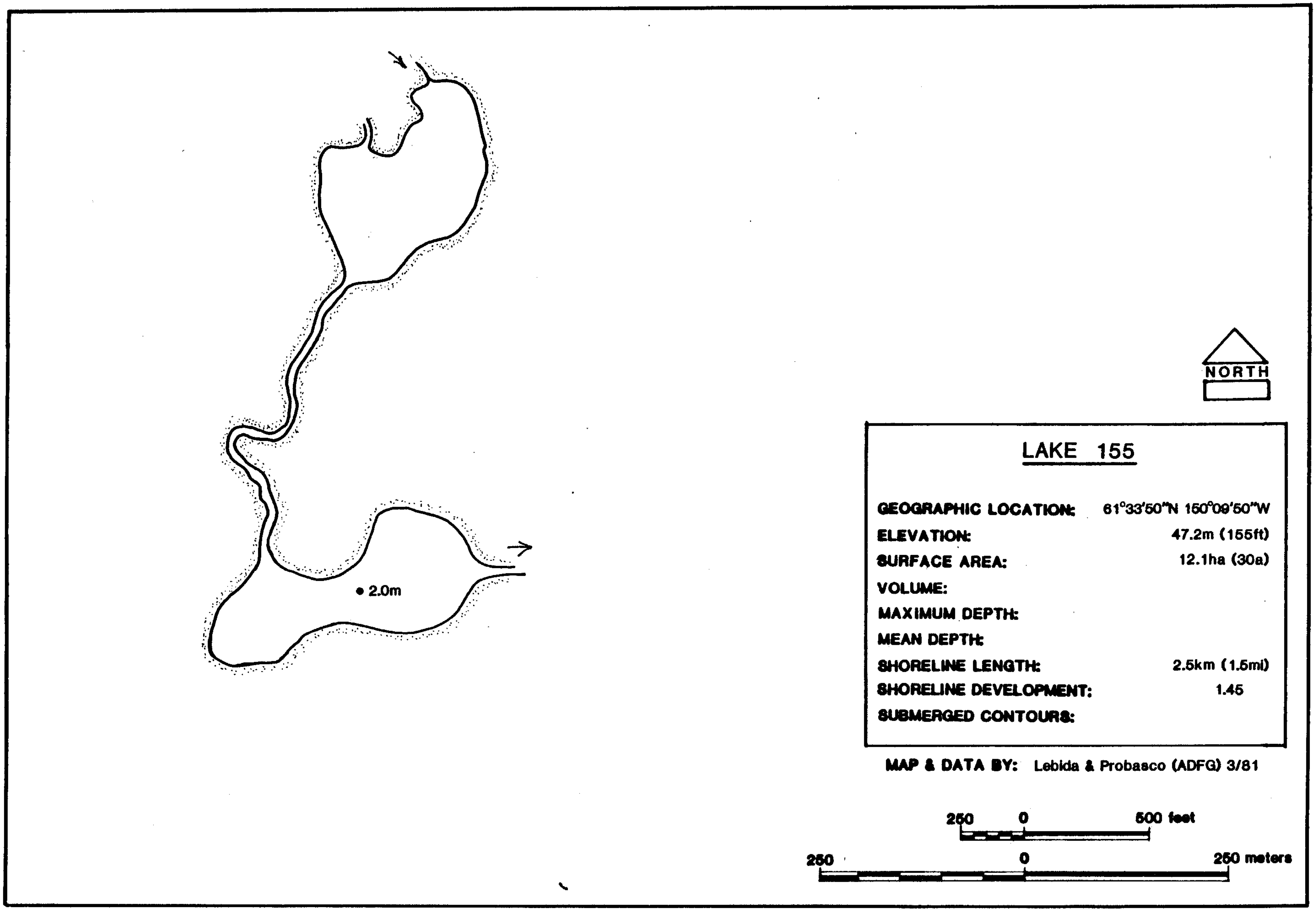

Figure 31. Lake 155 map.

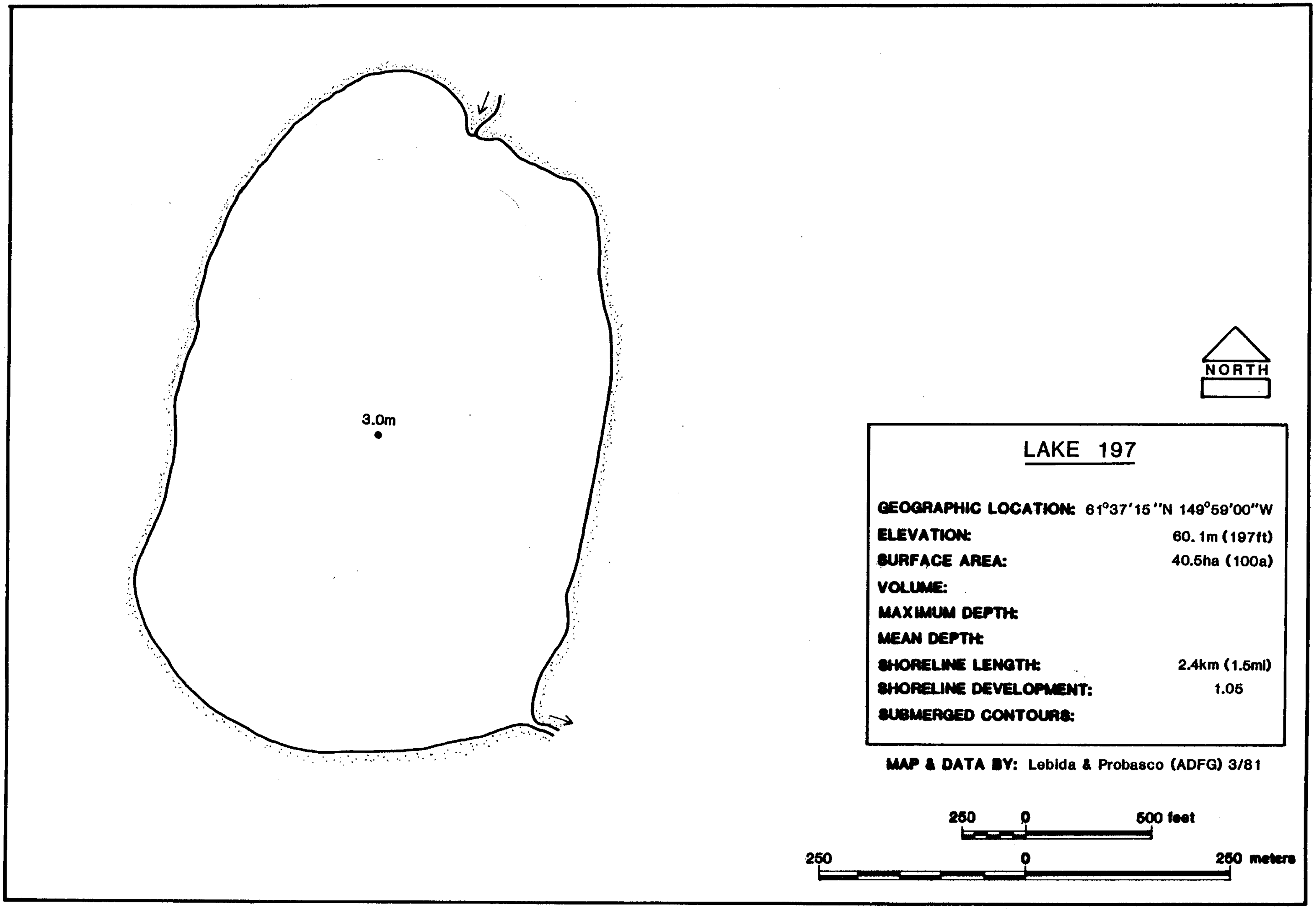

Figure 32. Lake 197 map.

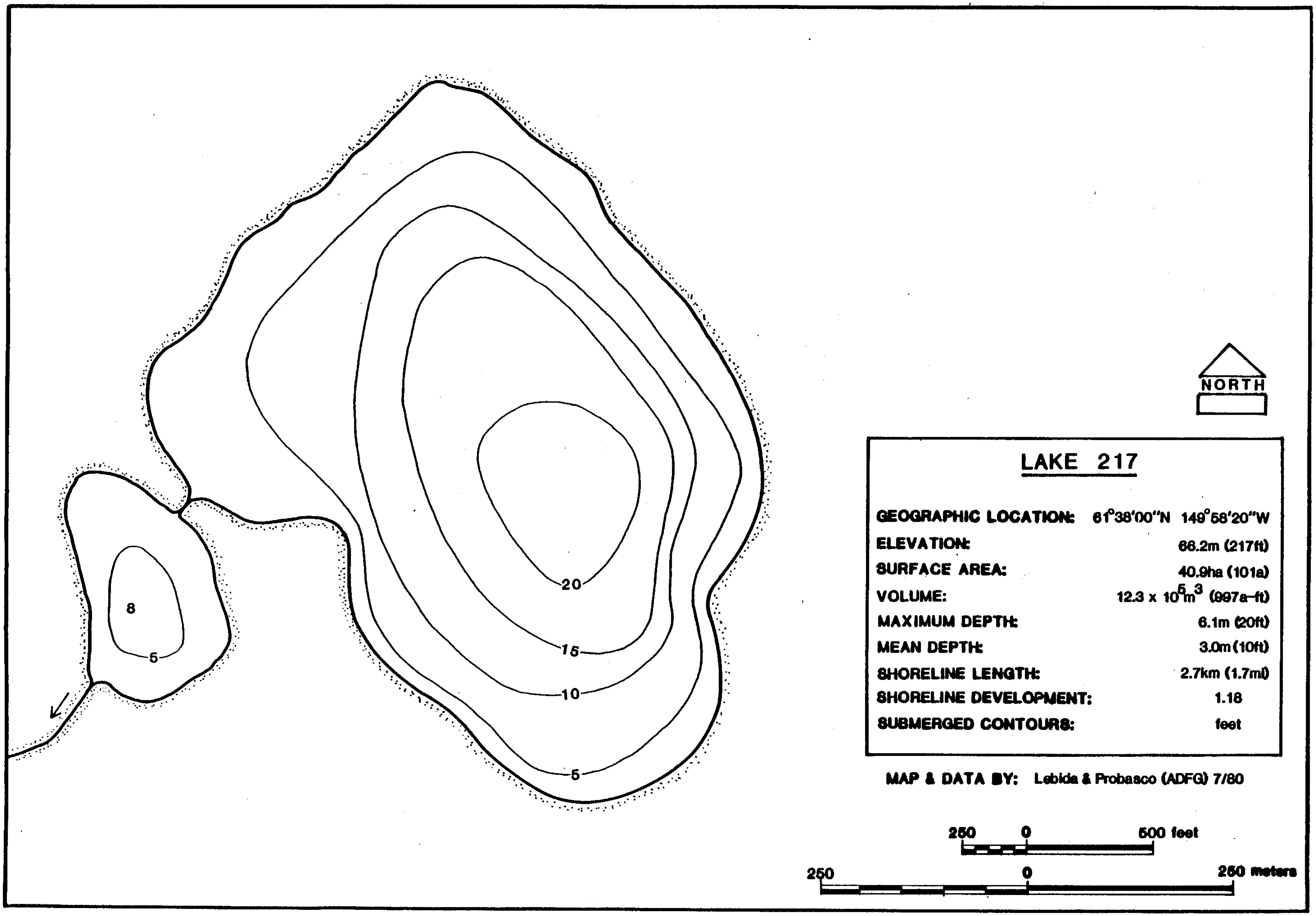

Figure 33. Lake 217 bathymetric map.

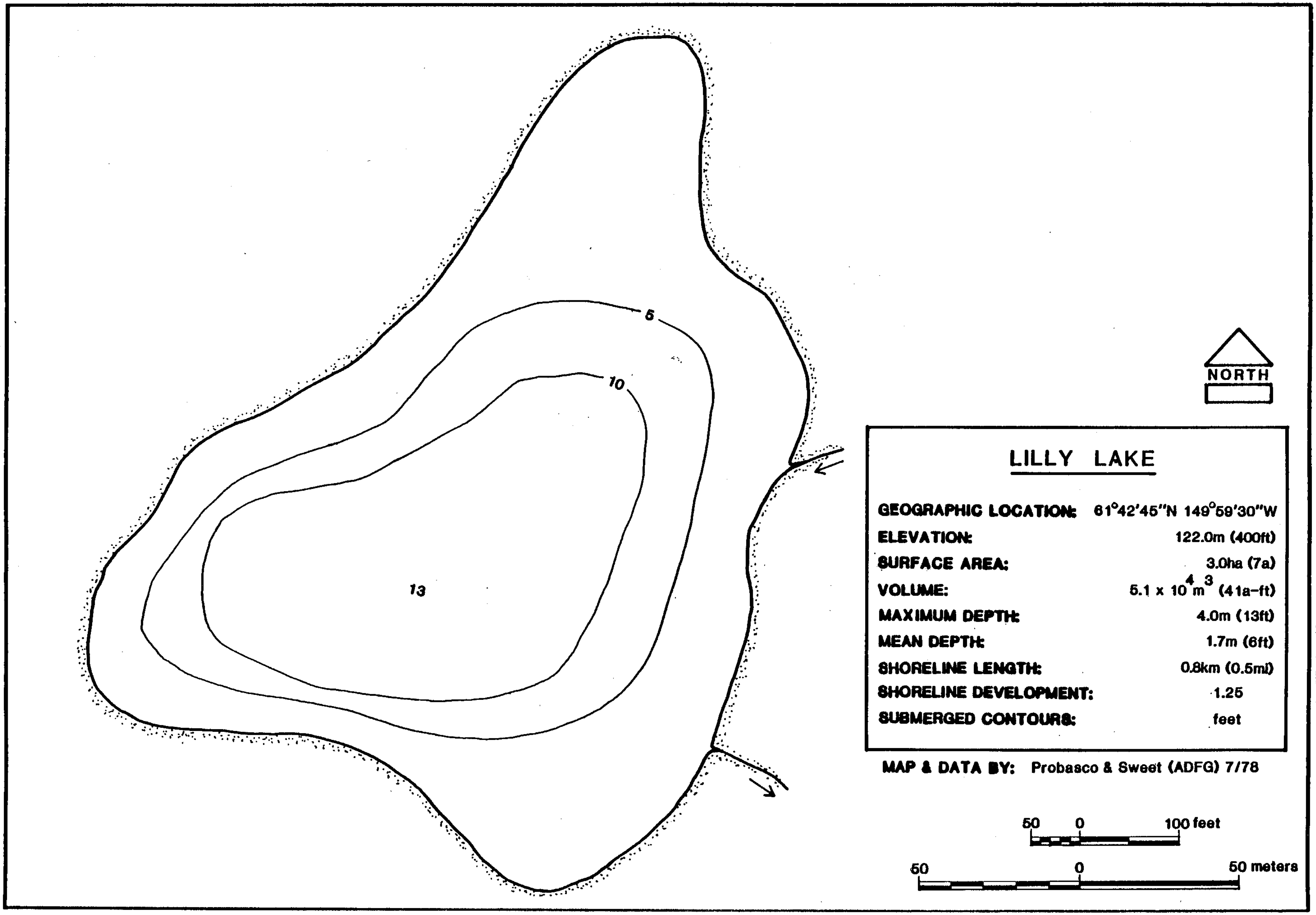

Figure 34. Lilly Lake bathymetric map.

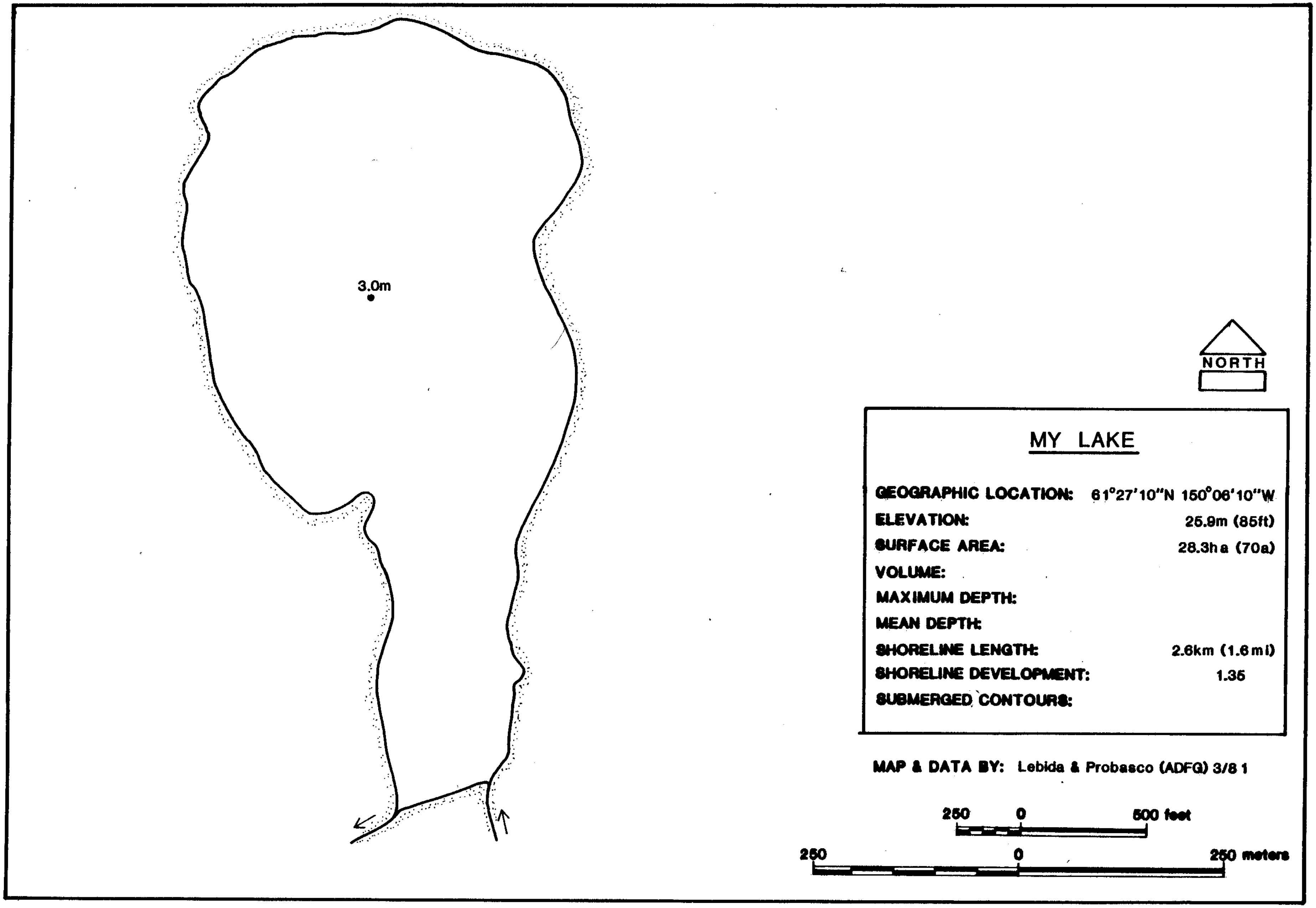

Figure 35. My Lake map.

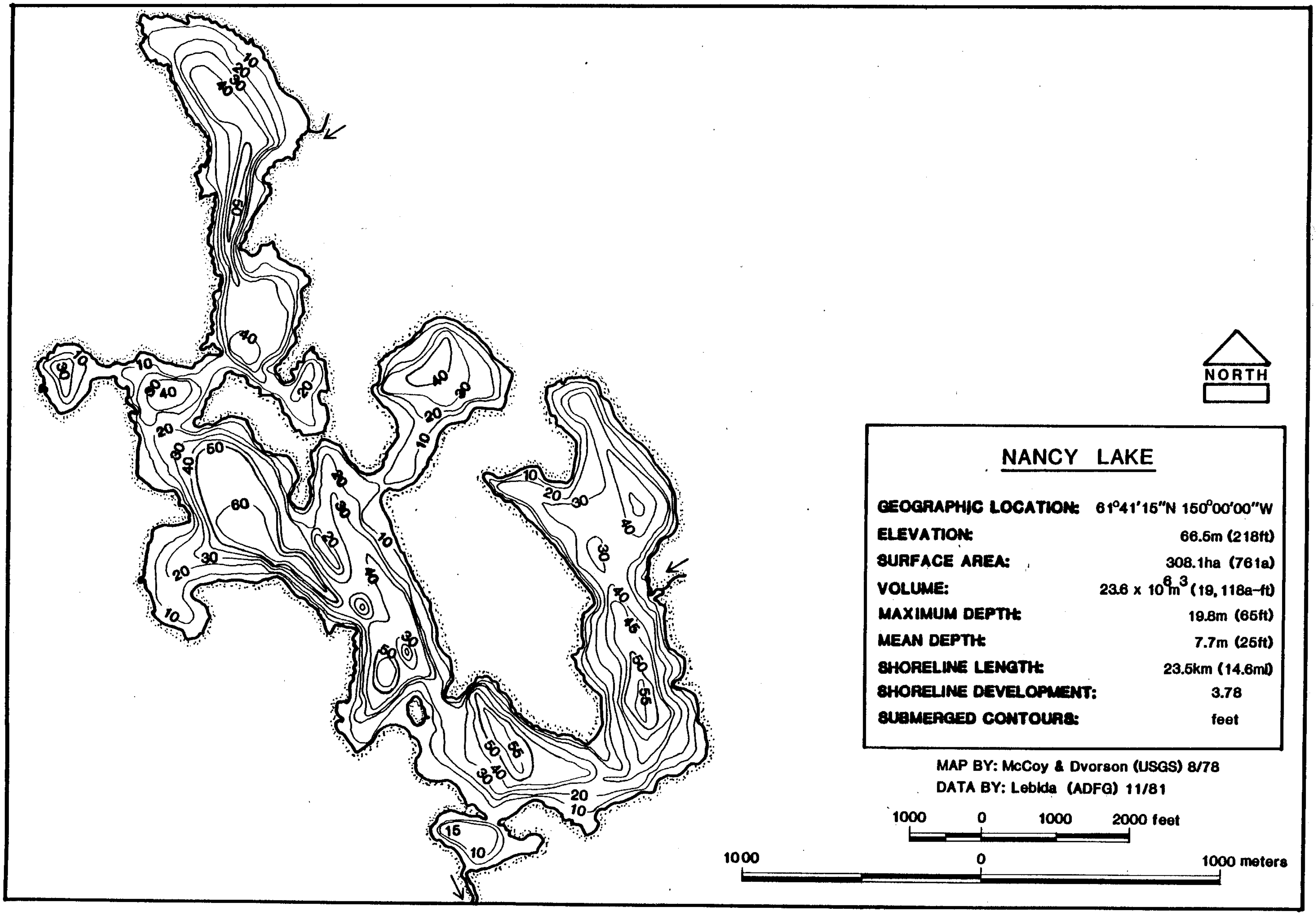

Figure 36. Nancy Lake bathymetric map.

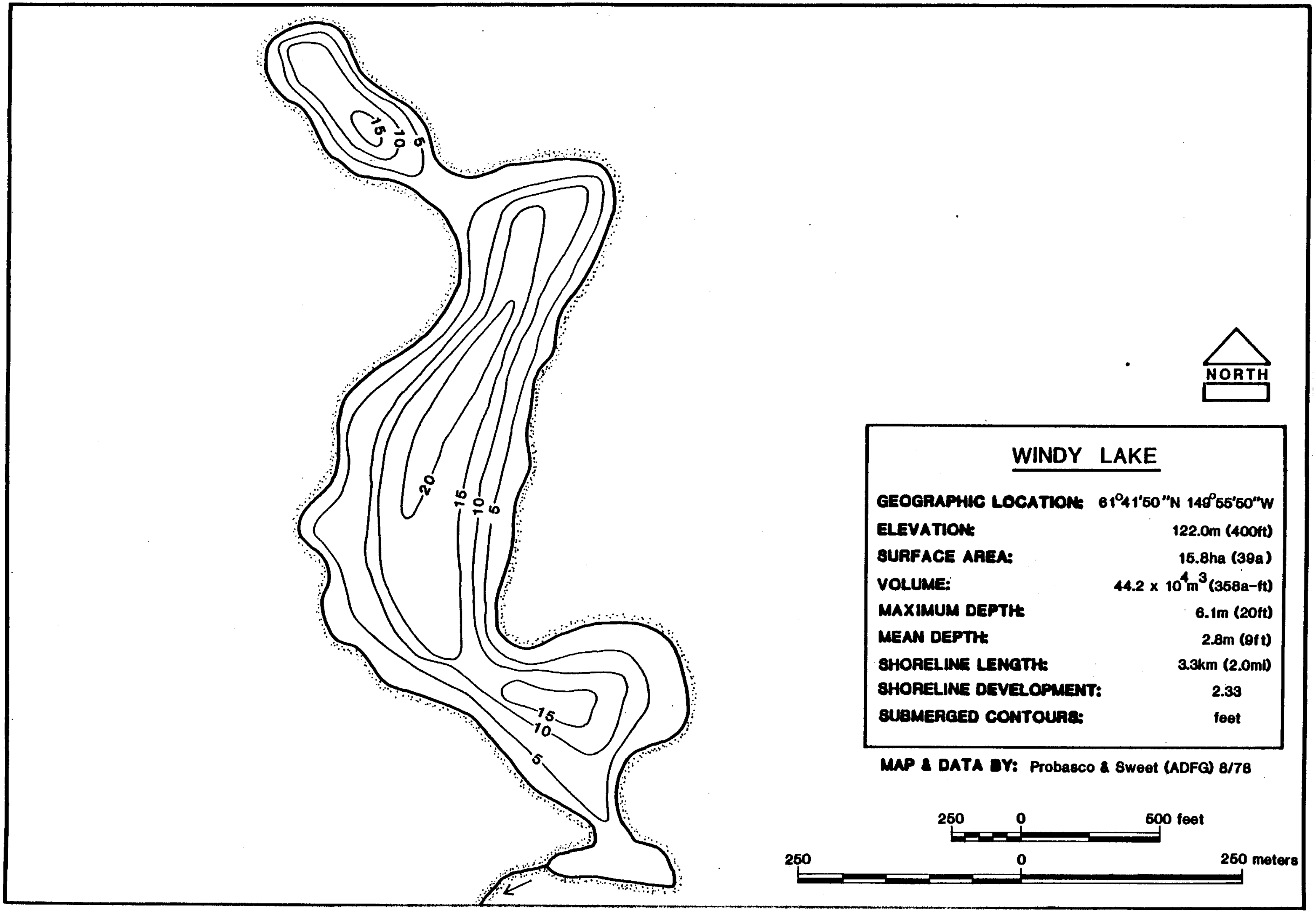

Figure 37. Windy Lake bathymetric map.

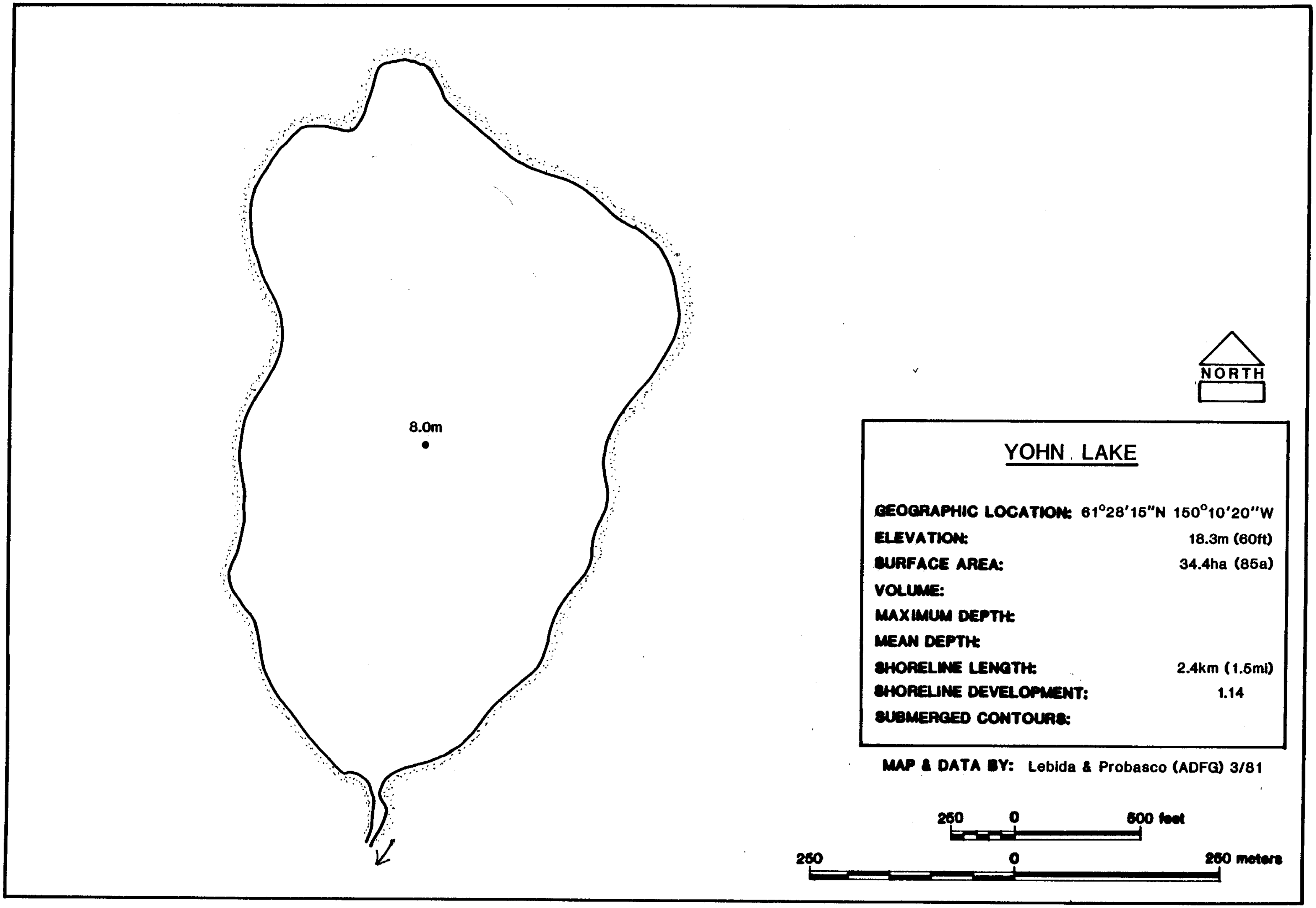

Figure 38. Yohn Lake map.

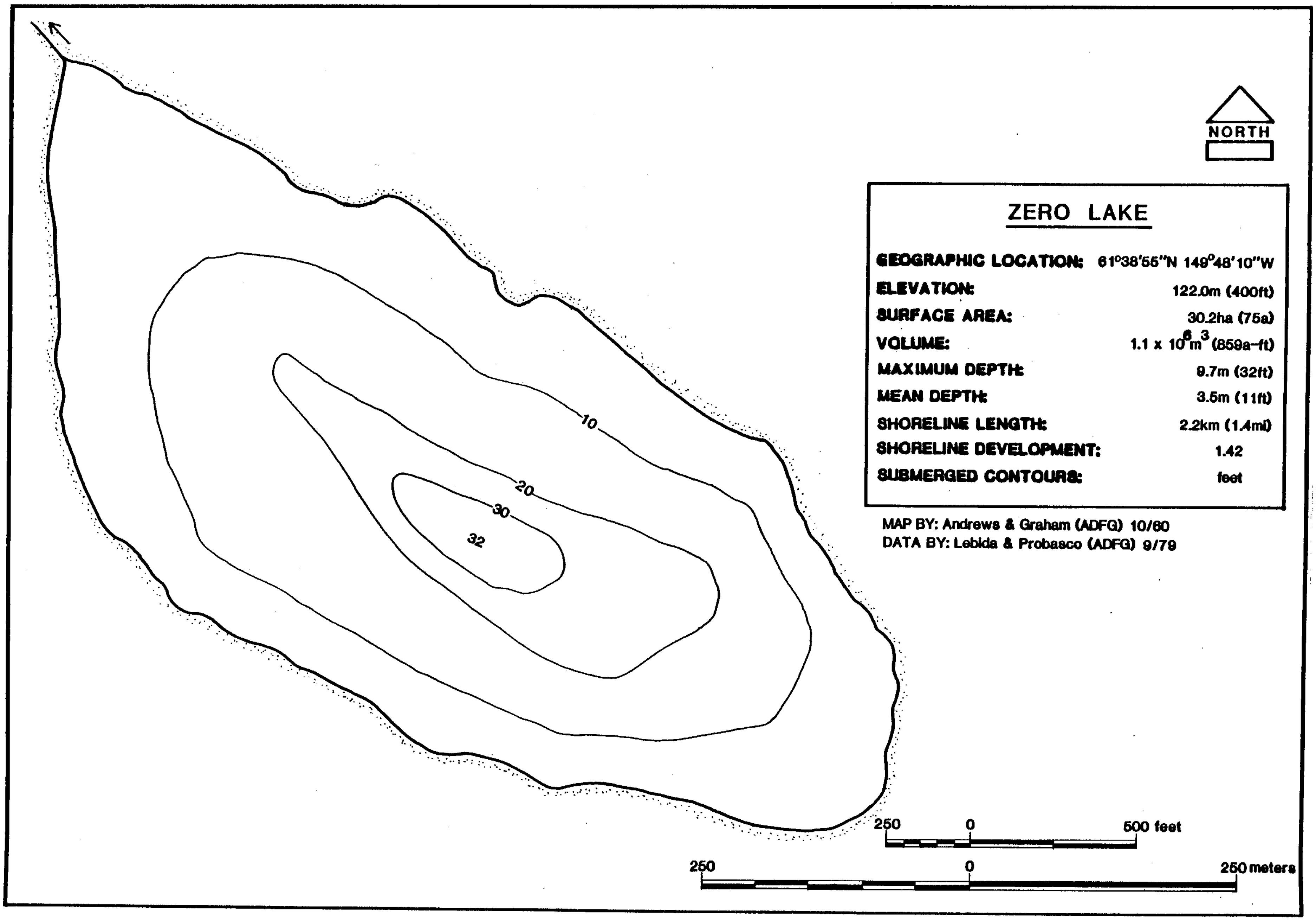

Figure 39. Zero Lake bathymetric map.

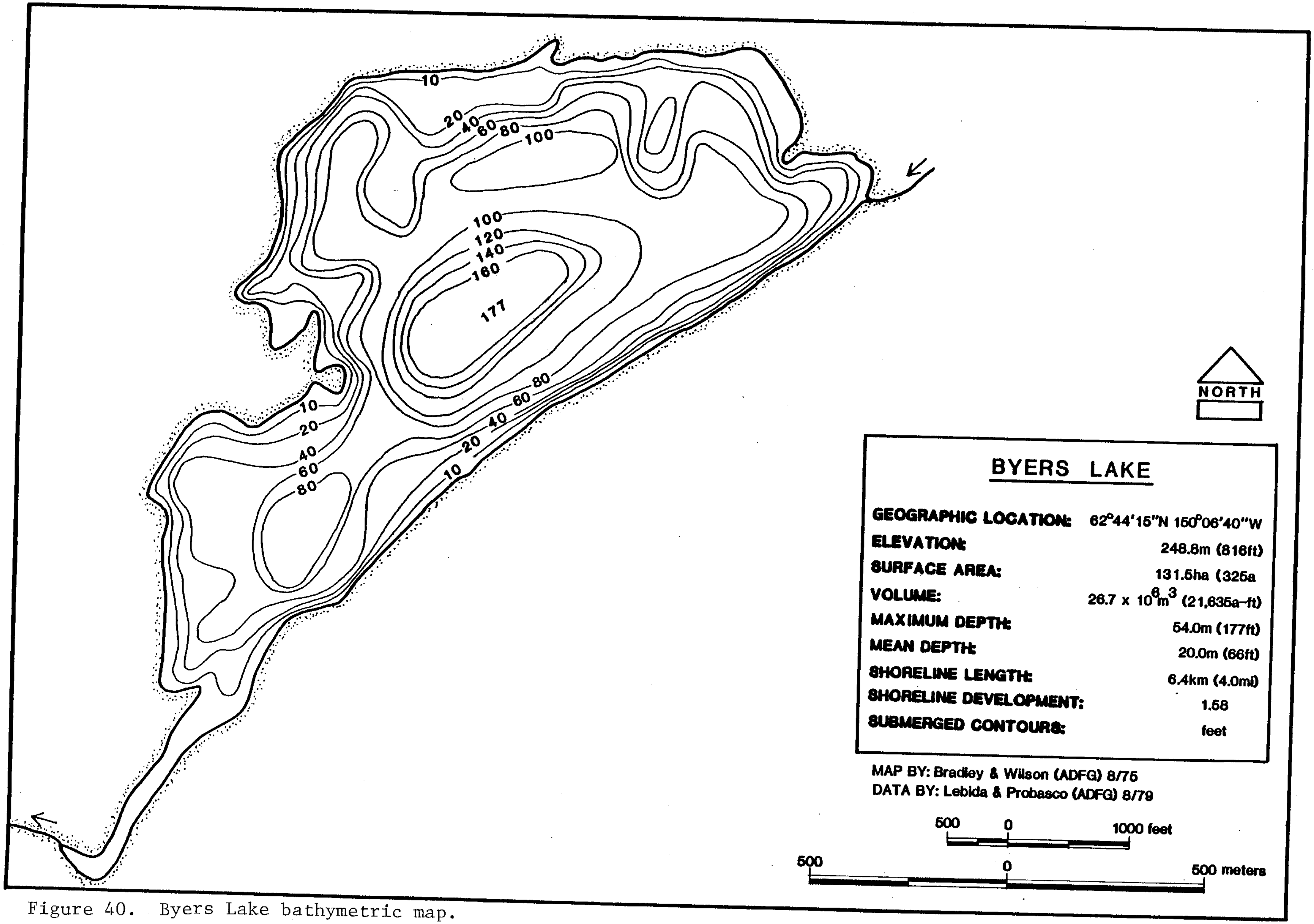

Figure 40. Byers Lake bathymetric map.

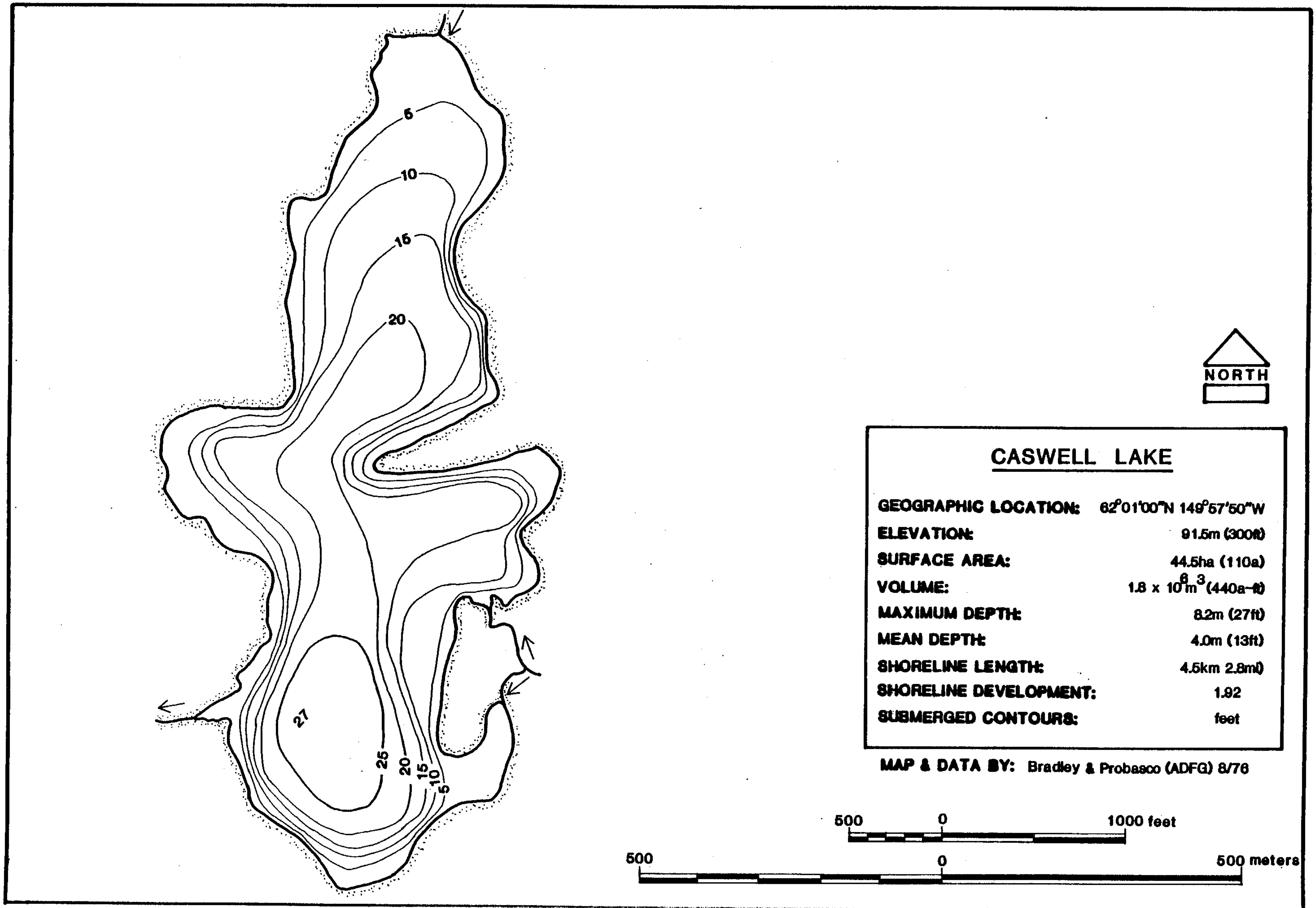

Figure 41. Caswell Lake bathymetric map.

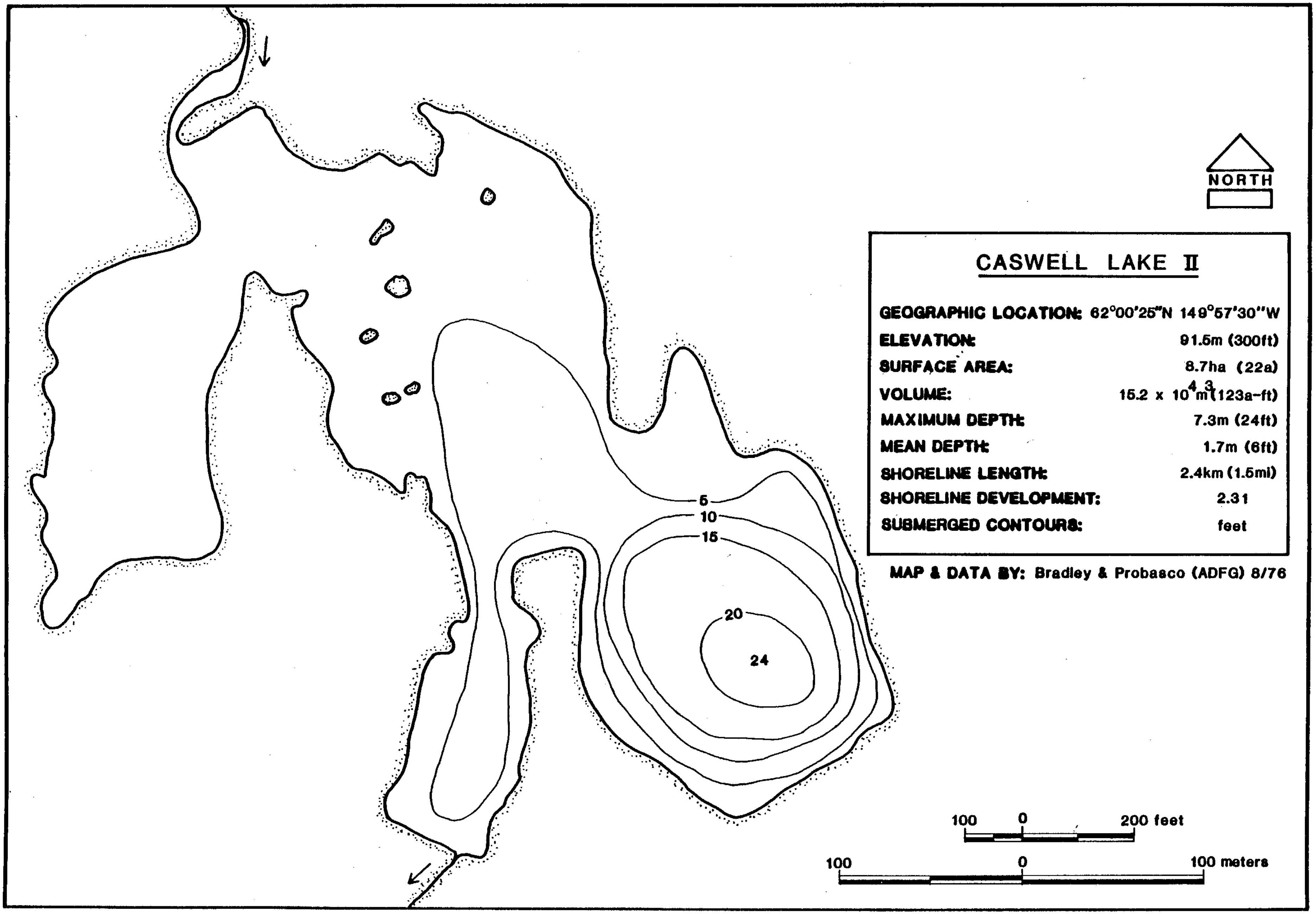

Figure 42. Caswell Lake II bathymetric map.

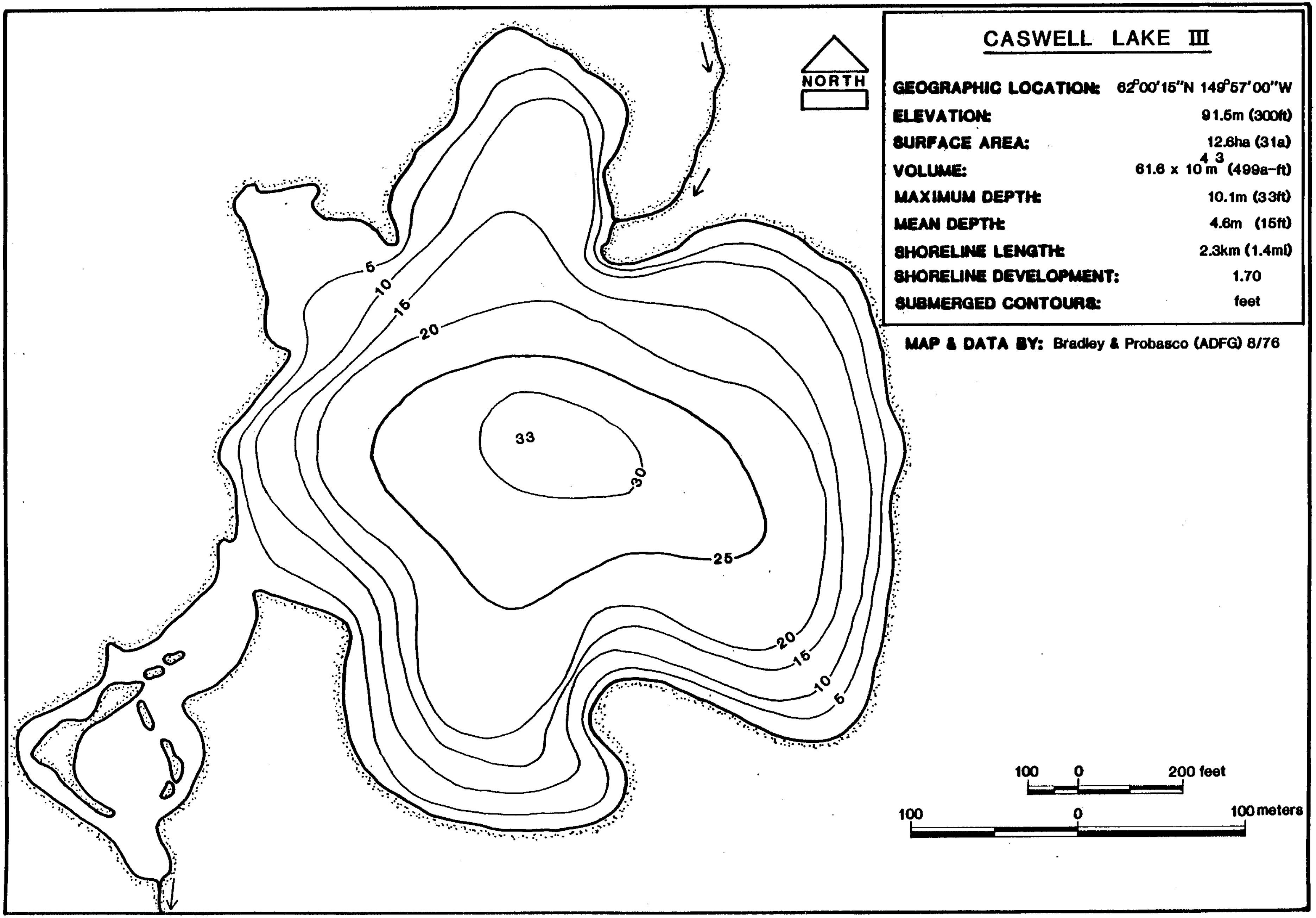

Figure 43. Caswell Lake III bathymetric map.

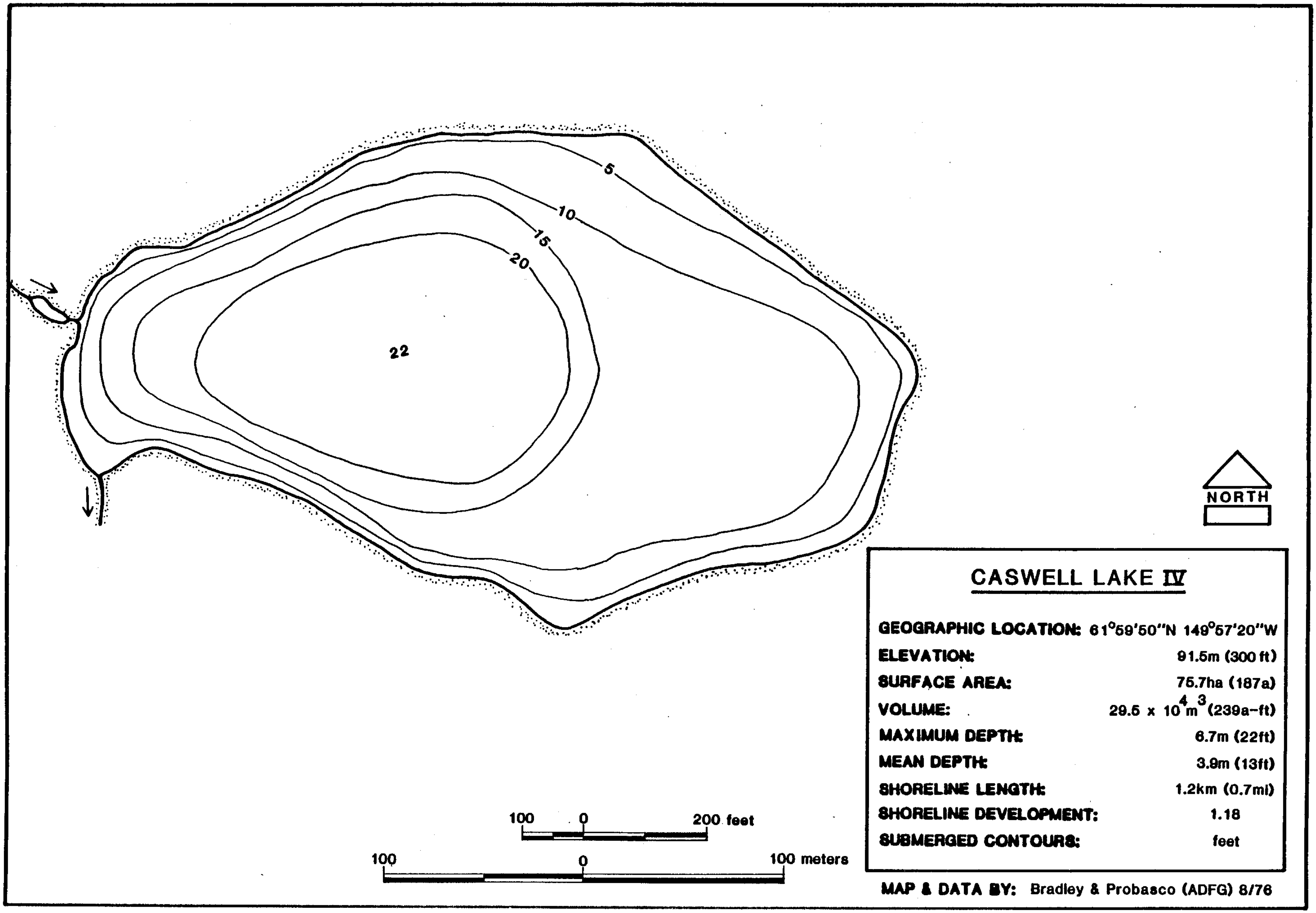

Figure 44. Caswell Lake IV bathymetric map.

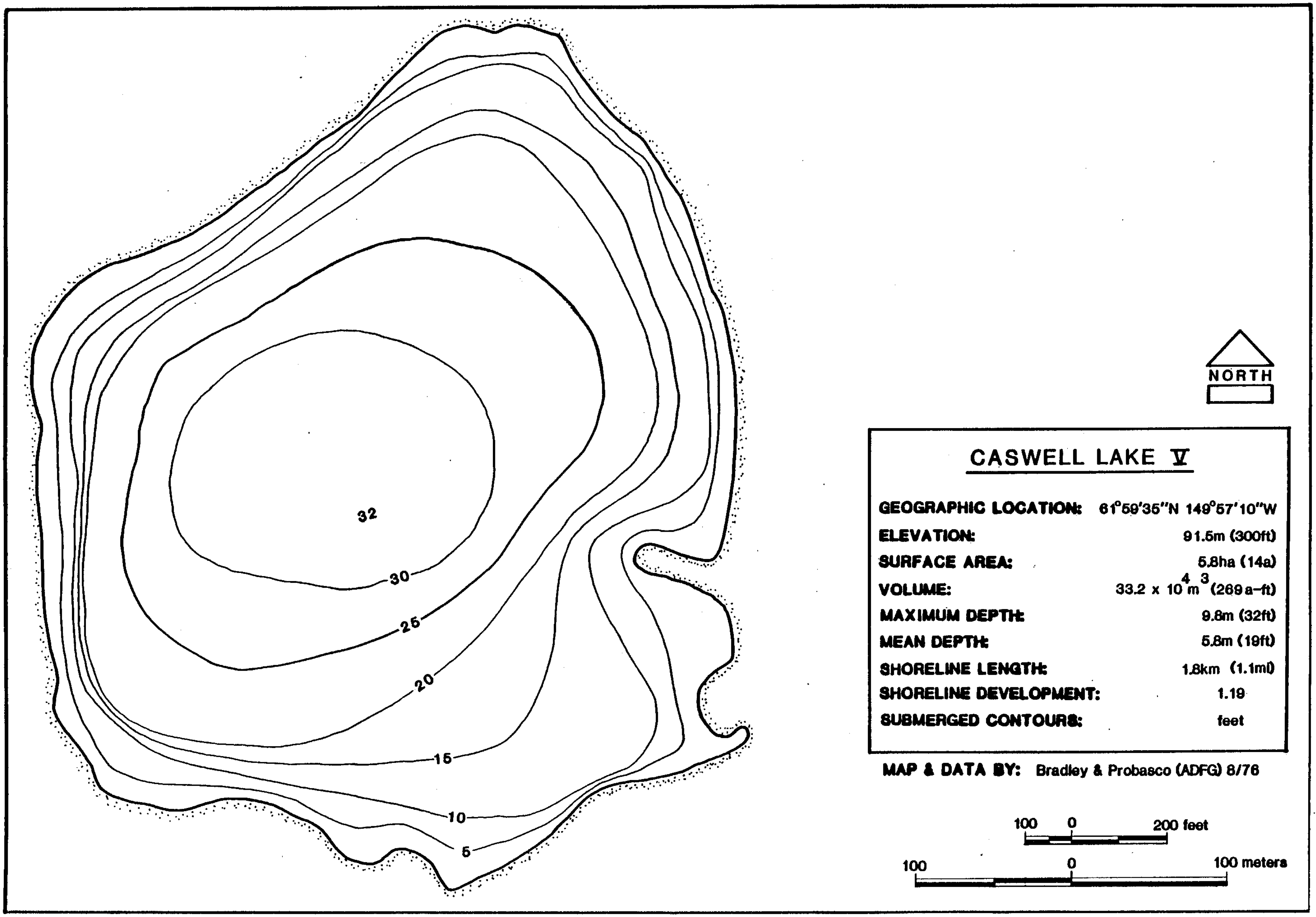

Figure 45. Caswell Lake V bathymetric map.

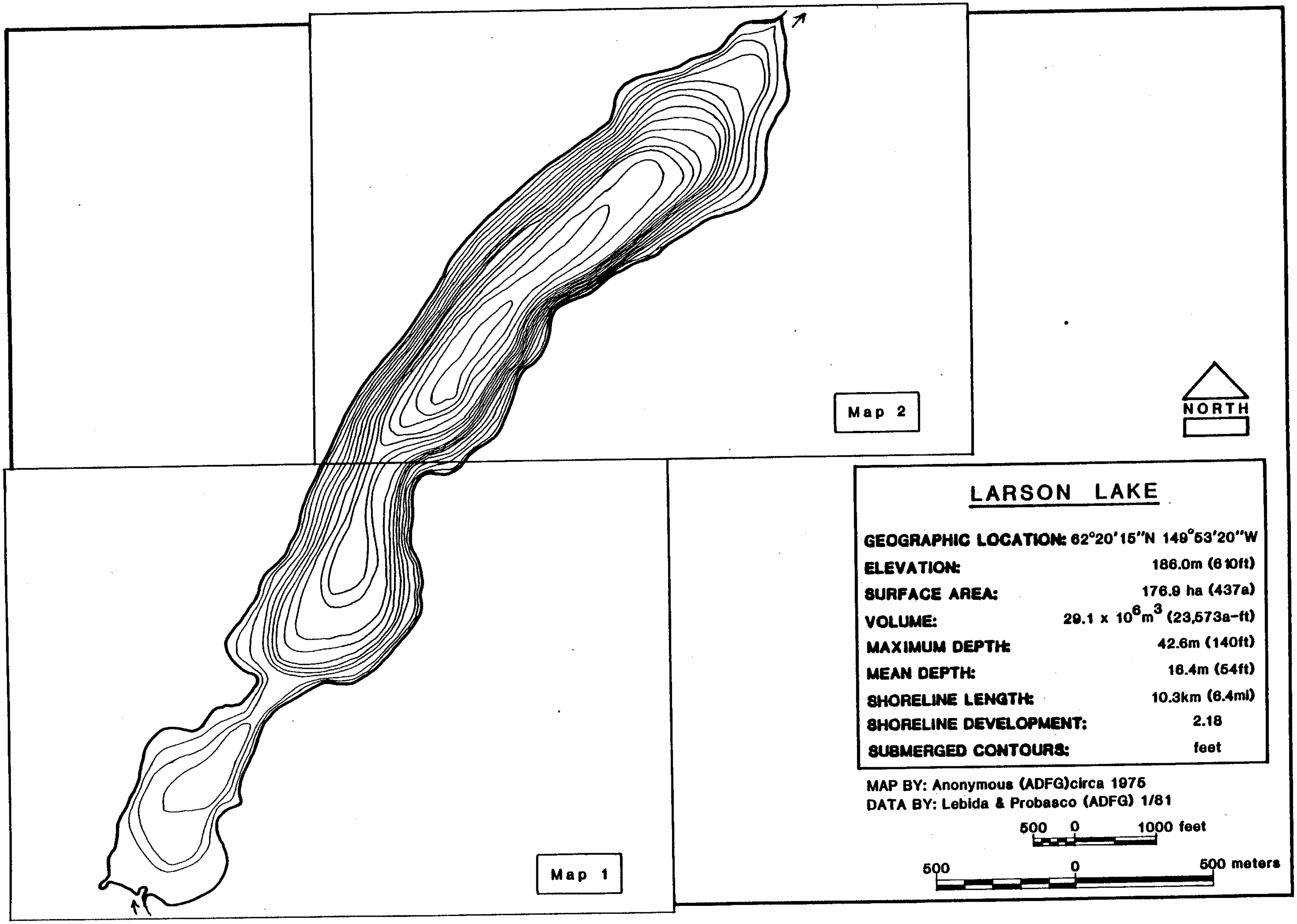

Figure 46. Larson Lake bathymetric map.

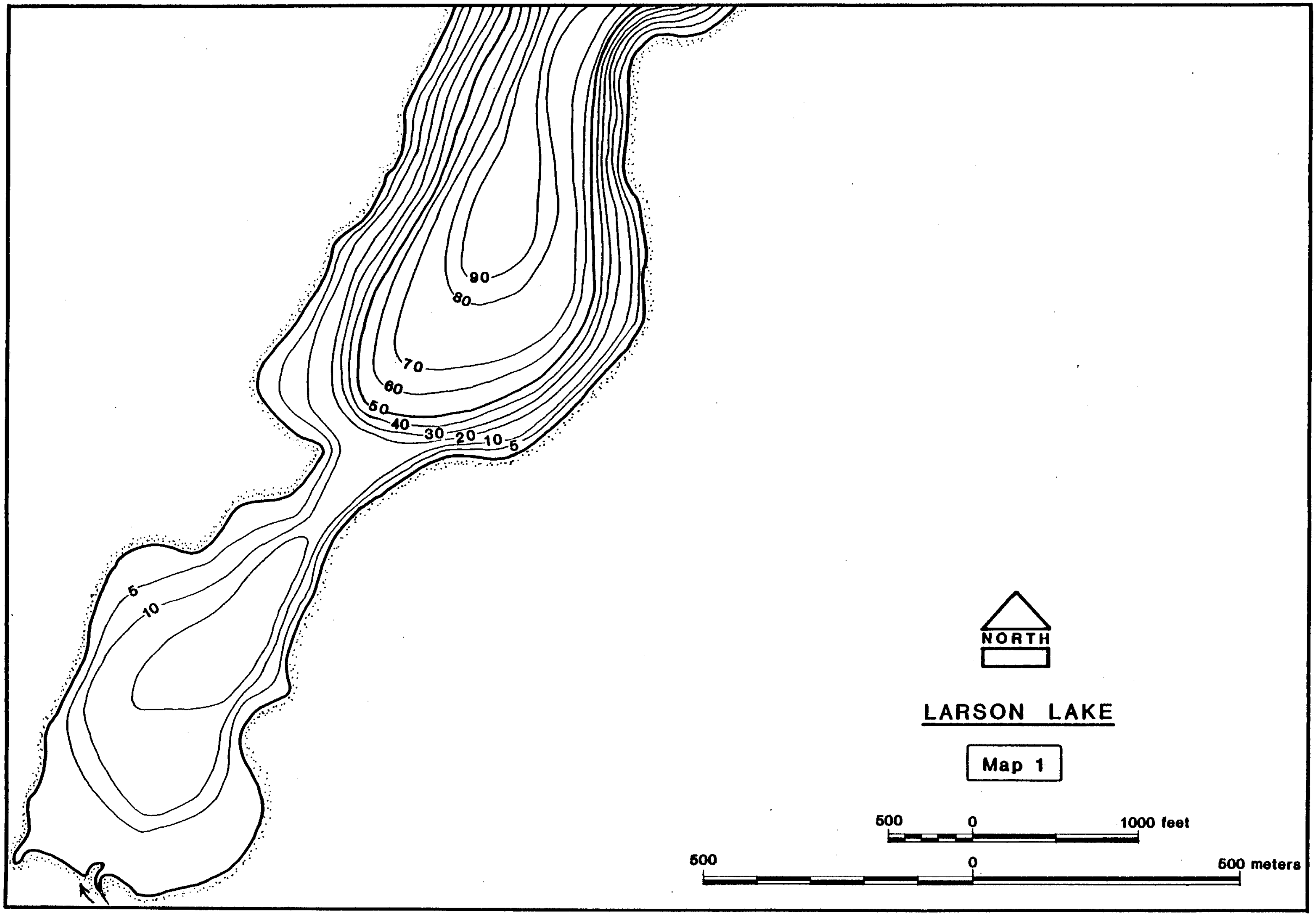

Figure 46(a). Map 1 - Larson Lake map.

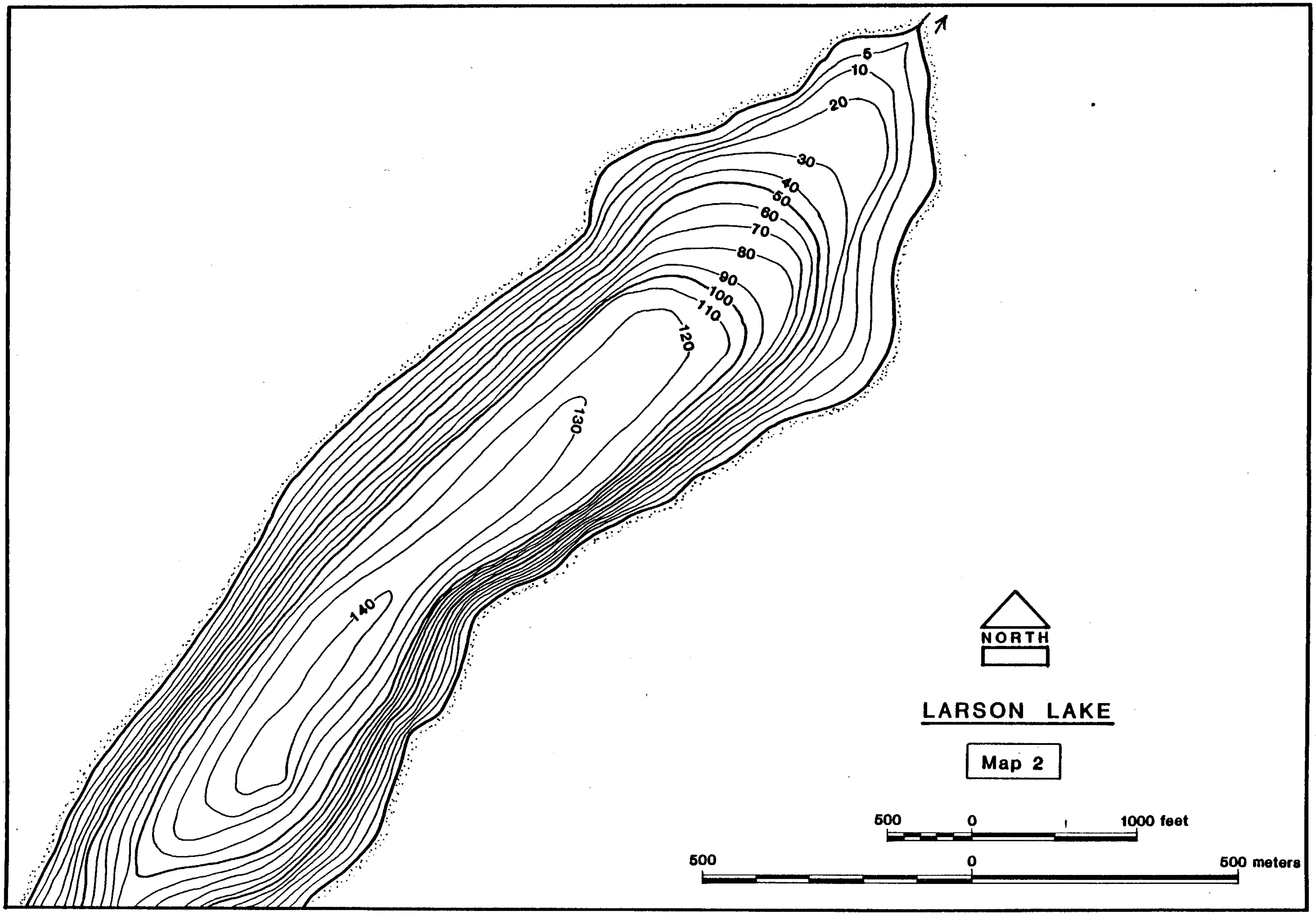

Figure 46(b). Map 2 - Larson Lake map.

Table 2. Chemical features of 45 potential coho salmon habitat systems in the upper Cook Inlet area, Alaska, 1979-1981.

Location by drainage	Total hardness (mg/L)	Alkalinity (mg/L)	Conductivity (umhos/cm)	pH
Knik River				
Jim Lake	138	115	250	7.2
Rock Lake	98	66	172	7.0
Cottonwood Creek				
Anderson Lake	41	45	89	8.3
Cornelius Lake	171	137	170	8.0
Cottonwood Lake	137	120	150	8.5
Kings Lake	50	49	93	8.6
Lucy Lake	137	120	90	8.5
Mud Lake	154	120	150	8.5
Nicklason Lake	171	120	195	8.0
North Dry Lake	83	74	145	6.8
South Dry Lake	73	60	122	7.1
Wasilla Lake	77	93	170	8.3
Fish Creek				
Big Lake	86	86	75	8.0
Little Susitna River				
Bench Lake	34	68	50	7.3
Butterfly Lake	14	13	34	7.1
Butterfly Lake I	10	13	28	7.0
Butterfly Lake II	12	10	24	6.6
Butterfly Lake III	18	16	39	7.0
Delyndia Lake	22	19	50	7.5
Finger Lake	28	29	57	7.7
Hock Lake	35	32	98	7.6
Horseshoe Lake	24	28	54	7.4
Horseshoe Lake I	19	20	42	7.2
Horseshoe Lake II	24	29	55	7.4
Horseshoe Lake III	18	19	40	7.1
Horseshoe Lake IV	13	11	28	6.9
Horseshoe Lake V	16	12	27	6.8
Lake 13	33	31	66	7.4
Lake 16	25	26	54	6.9
Lake 155	3	6	17	5.6
Lake 197	19	22	43	6.8
Lake 217	14	12	28	7.1
Lilly Lake	63	44	90	6.7
My Lake	43	44	99	7.9
Nancy Lake	20	60	88	7.0

-Continued-

Table 2. (Continued)

Location by drainage	Total hardness (mg/L)	Alkalinity (mg/L)	Conductivity (umhos/cm)	pH
Windy Lake	41	23	51	6.8
Yohn Lake	25	18	72	7.0
Zero Lake	15	13	30	6.6
Susitna River				
Byers Lake	17	51	12	7.5
Caswell Lake	10	30	40	7.1
Caswell Lake II	51	68	29	5.5
Caswell Lake III	68	51	27	5.5
Caswell Lake IV	51	51	27	5.5
Caswell Lake V	86	68	15	7.5
Larson Lake	34	14	130	7.5

Table 3. Fish species observed in 34 potential coho salmon habitat systems[1/] examined in the upper Cook Inlet area, Alaska, 1979-1981.

Location by drainage	Species[2/]												
	SS	RS	KS	PS	DV	RT	LT	HWF	RWF	SSC	TST	LNS	BB
Knik River													
Jim Lake	*				*	*		*	*		*		
Rock Lake	*				*	*		*	*		*		
Cottonwood Creek													
Anderson Lake	*	*			*	*				*	*	*	
Cornelius Lake	*	*			*	*					*	*	
Cottonwood Lake	*	*			*	*				*	*	*	
Kings lake	*	*			*	*			*		*	*	
Lucy Lake					*						*		
Mud Lake	*	*			*	*				*	*	*	
Nicklason Lake	*	*			*	*					*	*	
North Dry Lake											*	*	
South Dry Lake	*					*				*	*	*	
Wasilla Lake	*	*			*	*					*	*	
Fish Creek													
Big Lake	*	*	*		*	*			*	*	*	*	*
Little Susitna River													
Bench Lake	*				*	*					*		
Butterfly Lake	*					*		*	*		*	*	
Butterfly Lake I	*					*					*	*	
Butterfly Lake II	*					*					*	*	
Butterfly Lake III	*					*					*	*	
Delyndia Lake	*					*					*	*	
Finger Lake	*					*					*	*	
Horseshoe Lake	*	*			*	*					*	*	
Horseshoe Lake II	*					*					*	*	
Lake 217											*		
Lilly Lake	*				*	*				*	*		
Nancy Lake	*	*			*	*			*		*		
Windy Lake	*				*	*					*		
Zero Lake											*		
Susitna River													
Byers Lake	*	*	*			*	*				*	*	*
Caswell Lake	*					*			*		*	*	
Caswell Lake II						*					*	*	
Caswell Lake III						*					*	*	
Caswell Lake IV									*		*	*	
Caswell Lake V	None captured												
Larson Lake	*	*		*	*	*	*		*		*	*	*

1/ Only those systems where fish collecting activities were conducted are listed.
2/ Species abbreviations according to Table 4.

Table 4. List of common names, scientific names and abbreviations of fish species observed in 34 potential coho salmon habitat systems in the upper Cook Inlet area, Alaska, 1979-1981.

Common Name	Scientific Name and Author	Abbreviation
Coho Salmon	*Oncorhynchus kisutch* (Walbaum)	SS
Sockeye Salmon	*Oncorhynchus nerka* (Walbaum)	RS
King Salmon	*Oncorhynchus tshawytscha* (Walbaum)	KS
Pink Salmon	*Oncorhynchus gorbuscha* (Walbaum)	PS
Dolly Varden	*Salvelinus malma* (Walbaum)	DV
Rainbow Trout	*Salmo gairdneri* (Richardson)	RT
Lake Trout	*Salvelinus namaycush* (Walbaum)	LT
Humpback Whitefish	*Coregonus pidschian* (Gmelin)	HWF
Round Whitefish	*Prosopium cylindraceum* (Pallas)	RWF
Slimy Sculpin	*Cottus cognatus* (Richardson)	SSC
Threespine Stickleback	*Gasterosteus aculeatus* (Linnaeus)	TST
Longnose Sucker	*Catostomus catostomus* (Forester)	LNS
Burbot	*Lota lota* (Linnaeus)	BB

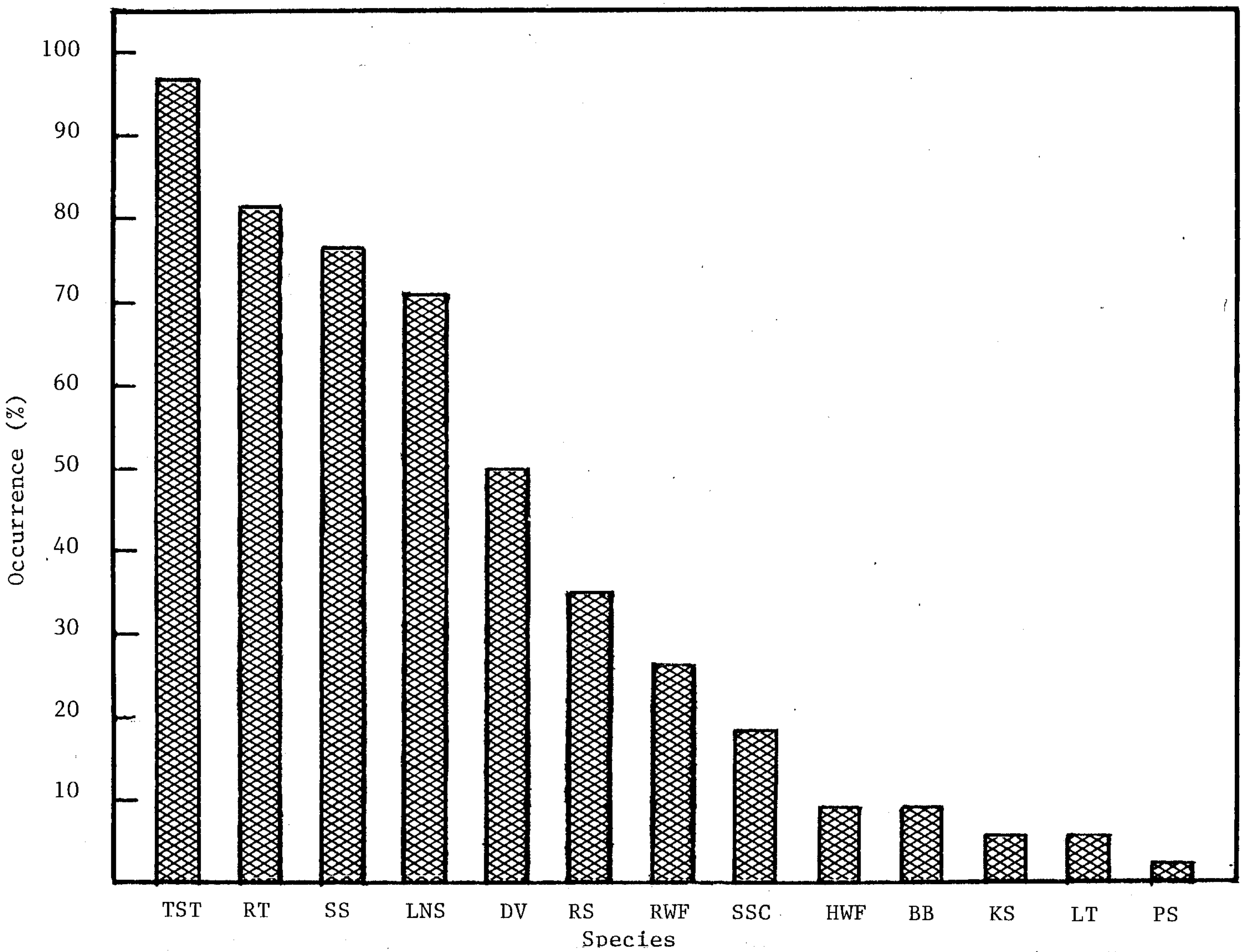

Figure 47. Frequency occurrence of fish species observed in 34 lake systems in the upper Cook Inlet area, Alaska, 1979-1981. (Species abbreviations according to Table 4.)

Table 5. Habitat features of 45 potential coho salmon systems in the upper Cook Inlet area, Alaska, 1979-1981.

Location by drainage	Active coho spawning system 1/	Active coho rearing area 2/	Migration barriers		Creek hydrarch succession		Access
			Beaver dams 3/	Debris accumulation 4/	Stage 5/	Degree	
Knik River							
Jim Lake	X	X	N	L	1	A	Trail, boat
Rock Lake	X	X	N	L	1	A	Trail, boat
Cottonwood Creek							
Anderson Lake	X	X	N	L	1	A	Primary road
Cornelius Lake	X	X	N	L	1	E	Primary road
Cottonwood Lake	X	X	N	M	1	E	Primary road
Kings Lake	-	X	N	L	1	E	Primary road
Lucy Lake	-	-	N	M	1	E	Primary road
Mud Lake	X	X	N	L	1	A	Primary road
Nicklason Lake	X	X	N	L	1	E	Primary road
North Dry Lake	-	-	N	M	1	E	Foot trail
South Dry Lake	X	X	N	M	1	E	Foot trail
Wasilla Lake	X	X	N	M	1	E	Primary road
Fish Creek							
Big Lake	X	X	F	M	1	E	Primary road
Little Susitna River 6/							
Bench Lake	-	X	F	M	1	A	Trail, Air
Butterfly Lake	-	X	M	M	3	A	Trail, Air
Butterfly Lake I	-	X	F	L	2	A	Trail, Air
Butterfly Lake II	-	X	N	L	2	A	Trail, Air
Butterfly Lake III	-	X	N	L	2	A	Trail, Air
Delyndia Lake	-	X	F	M	3	A	Trail, Air
Finger Lake	-	X	F	M	2	C	Secondary road
Hock Lake	-	U	N	L	1	E	Air

-Continued-

Table 5. (Continued)

Location by drainage	Active coho spawning system 1/	Active coho rearing area 2/	Migration barriers: Beaver dams 3/	Migration barriers: Debris accumulation 4/	Creek hydrach succession: stage 5/	Creek hydrach succession: degree	Access
Horseshoe Lake	-	X	N	L	2	A	Secondary road
Horseshoe Lake I	-	U	N	M	2	A	Foot, Air
Horseshoe Lake II	-	X	F	M	2	A	Secondary road
Horseshoe Lake III	-	U	N	M	2	A	Secondary road
Horseshoe Lake IV	-	U	N	M	2	C	Foot, Air
Horseshoe Lake V	-	U	F	M	2	C	Secondary road
Lake 13	-	U	N	S	4	C	Air
Lake 16	-	U	F	M	2	C	Air
Lake 155	-	U	F	M	1	E	Air
Lake 197	-	U	F	S	2	C	Air
Lake 217	-	-	F	S	4	C	Air
Lilly Lake	-	X	N	M	1	A	Primary road
My Lake	-	U	M	M	1	E	Air
Nancy Lake	-	X	F	L	1	A	Primary road
Windy Lake	-	X	F	M	2	A	Air
Yohn Lake	-	U	F	M	2	A	Air
Zero Lake	-	-	N	S	4	C	Trail
Susitna River							
Byers Lake	X	X	N	L	1	E	Primary road
Caswell Lake	X	X	M	S	1	E	Secondary road
Caswell Lake II	-	-	N	M	1	E	Secondary road
Caswell Lake III	-	-	N	M	1	E	Secondary road
Caswell Lake IV	-	-	N	M	1	E	Secondary road
Caswell Lake V	-	-	N	M	No outlet		Foot trail
Larson Lake	X	X	N	L	1	E	Air

-Continued-

Table 5. (Continued)

1/ X = spawning in Outlet Creek
- = no known spawning

2/ X = coho juveniles presently rearing in system
U = unknown, appears to be useable system, confirming data not presently available

3/ N = none; F = few; M = many

4/ L = low; M = moderate; S = severe

5/ 1 = aquatics; 2 = sedge mat; 3 = bog shrubs; 4 = bog forest
E = early; A = advanced; C = complete

6/ Only known coho salmon spawning in the Little Susitna River drainage occurs in the river.

Active coho salmon spawning in lake outlet creeks was found to occur in 13 of the 45 systems. Of the 32 remaining systems with no spawning noted, seven systems lacked suitable spawning areas or physical barriers prevented fish access and 25 systems were part of the Little Susitna River drainage in which coho salmon are primarily main stem spawners.

Juvenile coho salmon were collected in 26 of the systems. Rearing coho salmon were not captured in 8 lakes and 11 systems were not sampled for fish.

Beaver activity was observed in 17 lake outlet creeks. Only three of these creeks, however, contained beaver dams which were considered obstacles to fish movement.

Debris accumulation was prevalent in most systems. Five systems had severe deposits of brush, trees and vegetation throughout a significant portion of their drainage. Fish movements through these areas would be difficult. Another 25 lake outlet creeks had moderate accumulations of debris which would not significantly hamper fish movements. The remaining 15 systems contained little debris.

The outlet creeks of 18 of the systems were in hydrarch aquatics-early succession stage. Seven others were classified as aquatics-advanced. Nine creeks were in sedge mat-advanced succession stage and five were in the sedge mat-complete stage. Almost totally obscured outlet creeks were found in five systems; two of these were classified as bog shrubs-advanced, and three as bog forest-complete. One system lacked an outlet creek.

Thirty lakes were accessible by road. Primary roads were directly adjacent to 12 lakes. Secondary roads passed by another nine lakes. Trails requiring four-wheel drive vehicles reached an additional nine lakes. Foot travel of over 1 mile was required to reach three systems. Access by air was the most direct means to the remaining 12 systems.

DISCUSSION

Since this 6 year project was terminated after only 2 years of study, a significant amount of the pertinent limnological and biological data required to determine the overall magnitude of the utilization, rearing potential and basic limnological characteristics of available coho salmon rearing habitat plus rehabilitation or enhancement needs and feasibility in the upper Cook Inlet area will not be available. The data, however, indicate a slow, progressive loss of coho salmon rearing habitat is occurring primarily because of natural environmental changes which limit or prevent juvenile coho salmon movements in and out of rearing areas.

To meet the criteria for coho salmon rearing habitat, a minimum of three prime ingredients are required. These are: 1) suitable water quality and quantity; 2) an adequate food supply, and 3) unrestricted migration routes. Loss of any one of these factors would severely limit the usefullness of any system to produce coho salmon. Usually the first factor lost in the Matanuska-Susitna Valleys is restriction and decrement of fish migration routes.

The chemical features in all the lakes systems (Table 2) exceeded the threshold of acceptable limits for aquaculture purposes such as rearing (Baker et al. 1977). These limits are: an alkalinity of at least 20 mg/L as $CaCo_3$, dissolved oxygen of 8.0 mg/L, pH of 6.5 - 8.0, temperature range of 0-15°C and total dissolved solids <400 mg/L. Although T.D.S. values were not measured during this study, the conductivity was measured and T.D.S. values can be estimated by multiplying the conductivity (umhos/cm) by an empirical factor which may vary from 0.55 to 0.9 (A.P.H.A. 1976). If the largest conversion factor is applied to the conductivity values collected, the estimated T.D.S. values range from 10.8 to 225 mg/L.

For the 29 lakes for which complete morphometric data were collected, nearly all systems appeared to have adequate rearing conditions (Table 1). The shallowest lakes, which had potentially marginal winter conditions for fish, however, also contained populations of rearing juvenile coho salmon.

At least 26 of the lakes surveyed were coho salmon rearing systems, but no coho salmon were caught in eight lakes (Tables 3 & 5). Most likely, in these systems, physical barriers prevented juvenile fish ascent into the rearing areas. The lakes found barren of coho were Lucy, North Dry, Lake 217, Zero, Caswell II, Caswell III, Caswell IV and Caswell V. The total surface area of these eight lakes comprised 193.3 ha. Based on a coho salmon fry density of 1,250 fish/surface ha as applied to Bear Lake (McHenry 1981), an additional 242,000 coho salmon could be reared in this unutilized environment. Applying a standard 2% assumption of coho salmon survival (ADF&G 1978) from fingerlings to adult, 4,840 coho salmon adults could be added to the fisheries.

Although some small beaver dams are present in the Lucy Lake system, they are not entirely responsible for the absence of rearing coho salmon since these barriers do not completely block passage of fish into the lake (Table 3). The system contains minimal spawning area and the small creek flows directly into tidewater. In effect, fingerling coho salmon are not likely to be available to ascend into the lake. However, the rearing potential of this system could be realized by a coho salmon stocking program but more comprehensive physical and chemical data would be required to determine feasibility. Assuming a stocking density of 1,250 fish/ha, this system (10.5 ha) would be capable of rearing 13,125 coho salmon juveniles with a potential of producing 263 adults. These returning adults would be expected to enter the sport fishery at the mouth of Cottonwood Creek.

North Dry Lake flows directly into South Dry Lake which contains a rearing population of coho salmon (Table 5). The outlet from North Dry Lake is a small creek approximately 0.6 m wide x 0.3 m deep and 30 m long. It has a steep 1.2 m high falls at mid length which restricts fish access into the lake. The system is a viable rearing area since it supports self sustaining populations of sticklebacks and longnose suckers. Providing a fish pass into this small system (8.9 ha) would not be economically feasible based on an annual projected production of 2,225 smolts resulting in 222 adults. However, a stocking program involving backpacking 12,000 coho salmon fry ½ mile into the lake would be a feasible alternative to additional enhancement of the Cottonwood Creek system.

The waters of Lake 217 and Zero Lake flow into the Little Susitna River, a prime coho salmon producer (Figure 1, Table 5). Escapement for this system totaled 11,975 adult coho salmon during 1981 (Bentz 1982). Lake 217 and Zero Lake contributed no coho salmon to this system. However, since the outlets of both lakes are in advanced stages of vegetative succession, there is no access to these potential rearing areas by juvenile coho salmon produced in the Little Susitna River. Water from Lake 217 flows around tree roots and debris prior to being filtered by dense masses of sedge mat before entering the main river. Zero Lake water, on its way to the Little Susitna River via Lake Creek, must first pass through dense sedge mats, then trickle around tree roots, boulders and debris. In certain areas, the creek flows entirely underground for considerable distances. Based on the lack of evidence of other barriers (Table 5) and the presence of sticklebacks (Table 3), it is felt that in the past these two lakes provided a rearing opportunity for coho salmon.

If the outlet stream from Lake 217 were cleared, this 40.9 ha lake would be accessible to juvenile coho salmon from the Little Susitna River and, potentially, approximately 1,022 additional adults could be produced. Zero Lake outlet creek, however, is beyond normal rehabilitation and would require considerable expense and work to recover the creek. A lake stocking program here would be futile as the innumerable barriers would block smolt emigration.

Caswell Lakes II, III, IV and V lacked rearing coho salmon populations (Tables 3 & 5). Caswell Lake V has no visible outlet and appears to be fed by seepage water from surrounding marshes. Caswell Lakes II, III and IV all have outlets which are transected by subdivision roads. During 1968, culverts were installed under these roads to raise the water level in the lakes (Watsjold 1977). This created a physical barrier for fingerling coho salmon attempting to reach the lakes, as the discharge ends of the culverts were raised above the original creek level and the juvenile fish were unable to jump up and into the culverts. As a result, 97.0 surface ha, capable of supporting 121,250 juvenile (2,425 adult potential) coho salmon, are not available for production.

The Caswell Creek systems should lend themselves to a stocking enhancement program. However, Caswell Creek, which provides drainage for all of the Caswell Lakes contains many beaver dams and severe debris accumulation (Table 5). This creek would have to be cleared to accommodate fish passage. An additional benefit to be realized through enhancement of this system is the establishment of a potential brood source. The creek has a favorable site for capturing adult salmon and obtaining eggs.

To maintain the coho salmon rearing habitat presently available in the Matanuska-Susitna Valleys, a habitat improvement program should be initiated. This program would be based on an initial intensive stream clearance of candidate systems and periodic maintenance at approximately 10 year intervals, depending on the results of regular inspections. Selection of candidate systems would be based on this study and any additional information. Future studies, however, should include a more accurate assessment of outlet creek lengths, general mapping of the creeks, and any problem areas where remedial work is required.

In general, there is little information to correlate the effects of stream clearance with natural juvenile coho salmon movements and associated rearing lake production. Consequently, it would be paramount to conduct a study to evaluate and document results of such efforts on a representative system such as Lake 217. Basically, the project would involve sampling the lake with minnow traps to confirm that coho salmon are not present, and clearance of migration obstructions with continued trapping to evaluate changes in the fish population.

There is already some evidence to demonstrate that this type of rehabilitation work can affect fish populations. During a pilot study in 1979, a ½ mi portion of Cottonwood Creek between South Dry Lake and Anderson Lake was cleared of accumulated debris which formed a total barrier to fish movements into the lake. In October of that year, three adult coho salmon were observed entering the lake system. According to local riparian residents, the lake had been devoid of salmon for many years. Data contained in ADF&G files documented the system as a historical producer of coho and sockeye salmon. A minimum of five adult coho salmon were observed entering the lake in 1980 and later spawning in the outlet. During 1981, a total of eight adult coho and five sockeye salmon were observed in the system. Although documentation of the numbers of adult fish utilizing Anderson Lake is based on casual observations, it does indicate the effectiveness of stream clearance and natural salmon repopulation ability. To augment these efforts and aid the Cottonwood Creek coho salmon production, however, 50,797 coho salmon fry were released into Anderson Lake during 1980. The following year, 52,097 and 46,832 coho salmon fry were released in Anderson and Kings Lakes respectively. These two lakes are separated by a narrow road but are joined by a culvert. Replacement of this culvert may be required since it is collapsing on each end and during dry periods water ceases to flow from Kings Lake into Anderson Lake.

There is clearly an opportunity for coho salmon enhancement in the Matanuska-Susitna Valleys. Results of this study focused attention on the underutilization of much available rearing habitat due to blockage of juvenile fish movements in drainage streams by barriers created by beaver dams, debris accumulation or plant succession. To remove these barriers, a stream clearance program must be initiated. Additional enhancement to aid in the reestablishment of coho salmon populations would require some supplemental stocking. Accomplishment of this stream clearance work would insure the coho salmon systems to be self perpetuating and increase available habitat for future stocks.

RECOMMENDATIONS

1. Stream clearance activities should be accomplished in the following systems listed in order of priority: 1) the Caswell Lakes; 2) the Butterfly Lakes; 3) Delyndia Lake; 4) Finger Lake; 5) the Horseshoe Lakes; 6) Lake 217; 7) Bench Lake; and, 8) the remaining lakes of the Little Susitna River drainage (My Lake, Lake 16, Lake 13, Lake 197, Lake 155, Windy Lake, Yohn Lake and Hock Lake).

2. Initiate a fry stocking program for the Caswell Lakes following stream clearance activities. In conjunction, investigate the development of the Caswell Creek coho salmon stock as a potential brood source.

3. Determine the feasibility of providing wild coho salmon juveniles access into Caswell Lakes II, III and IV.

4. Fry stocking programs should be considered for Lake 217 and any other lakes found to be devoid of rearing coho salmon following any stream clearance activities. Fry stocking may not be necessary in established coho salmon drainages since naturally produced juveniles are expected to migrate into available rearing systems. However, stocking would utilize the systems' production potential more rapidly.

5. Assess natural coho salmon utilization of rearing areas following stream clearance.

6. Regularly inspect and maintain all systems at least once every 10 years, or more frequently as required, depending on beaver activities or other changes which may block fish passage.

7. Continue coho salmon fry stocking program in the Cottonwood Creek system lakes (Anderson, Cornelius, Cottonwood, Kings, Mud, Nicklason, and Wasilla Lakes).

8. Increase the fry stocking program into North Dry Lake and other potential systems.

9. Determine feasibility of coho salmon rearing in Lucy Lake for stocking juveniles.

10. Complete the investigation of all Little Susitna River lake drainage systems to identify coho salmon utilization, rearing potential, and rehabilitation or enhancement needs. These systems are collectively essential to maintain the Little Susitna coho salmon stock at present or even greater production levels.

11. Continue this study to inventory and catalog the coho salmon habitat in the upper Cook Inlet area.

12. No action is recommended for the following lakes:

a. Jim and Rock Lakes - Fish access unimpeded, coho salmon stock appears to be building. May be potential brood source but needs to be screened for disease, run strength, and availability for capture. Recreational summer and winter coho salmon fishing pressure increasing.

b. Zero Lake - Substantial portions of outlet stream in bog forest stage of succession with stretches completely flowing underground. Economically not feasible to conduct stream clearance activities. Stocking program not suitable due to outlet obstructions.

c. Caswell Lake V - No outlet, completely landlocked.

d. Byers and Larson Lakes - Primarily producers of sockeye salmon. Small runs of coho salmon exist. Production limited by available spawning area. Lakes lack sufficient littoral area to support many rearing coho salmon juveniles.

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Appendix A: Map reference [USGS 1:63,360 Series (Topographic) Seward Meridian] location of lake systems surveyed in upper Cook Inlet, Alaska coho habitat systems evaluation, 1979-1981.

ANCHORAGE (C-6), ALASKA

Jim Lake
Rock Lake

ANCHORAGE (C-7), ALASKA

Anderson Lake
Cornelius Lake
Cottonwood Lake
Kings Lake
Lucy Lake
Mud Lake
Nicklason Lake
North Dry Lake
South Dry Lake
Wasilla Lake

ANCHORAGE (C-8), ALASKA

Big Lake
Bench Lake
Horseshoe Lake
Horseshoe Lake I
Horseshoe Lake II
Horsehsoe Lake III
Horseshoe Lake IV
Horseshoe Lake V
Lake 197
Lake 217
Lilly Lake
Windy Lake
Zero Lake

ANCHORAGE (D-8), ALASKA

Caswell Lake IV
Caswell Lake V

TALKEETNA (C-1), ALASKA

Byers Lake

TALKEETNA MOUNTAINS (A-6), ALASKA

Caswell Lake
Caswell Lake II
Caswell Lake III

TALKEETNA MOUNTAINS (B-6), ALASKA

Larson Lake

TYONEK (B-1), ALASKA

My Lake
Yohn Lake

TYONEK (C-1), ALASKA

Butterfly Lake
Delyndia Lake