FY85 DRAFT A/A PROCEDURES MANUEL

FY85 ADULT ANADROMOUS FISHERIES STUDY

PROCEDURES MANUAL - DRAFT

INTRODUCTION

The Susitna River, a major Southcentral Alaska river system, flows into Cook Inlet near the city of Anchorage. The drainage encompasses an area of 19,400 square miles and extends north of Mt. Denali and east almost to the town of Glennallen. The mainstem river and its major tributaries are of glacial origin and carry a heavy silt load during ice-free months. Many of the smaller tributaries are perennially silt-free.

Construction of hydroelectric dams will affect portions of the fish and wildlife resources of the Susitna River Basin. The two dam system proposed would inundate approximately 45,8000 acres of aquatic and terrestrial habitat upstream of Devil Canyon. Historically, the long and short term environmental impacts of hydroelectric dams have adversely altered the sport and commercial fisheries of affected drainages (Keller, 1980; Hagen et al., 1973). Regulation of the mainstem river will substantially alter the natural flow regime downstream. The transmission line corridor, substations, road corridor and construction pad sites will also impact aquatic and terrestrial communities and their habitat.

The proposed hydroelectric development necessitates gaining a substantial knowledge of its chemical, physical and biological parameters prior to final dam design approval and construction authorization.

To insure adequate information is available to determine the impacts of the proposed hydroelectric project and to design proper mitigative strategies, a data collection program has been developed. This manual addresses field sampling procedures to be conducted within the proposed study area in FY85.

I. OBJECTIVES

Adult Salmon

1. Determine the abundance and seasonal timing of the sockeye, pink, chum and coho salmon escapements in the Susitna and Yentna rivers at Flathorn (RM 20), Yentna (TRM 04), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations.

2. Determine the abundance and timing of the chinook salmon escapement in the Susitna River at Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations.

3. Define the age, length, sex composition and migrational characteristics of sockeye, pink, chum and coho salmon in the Susitna and Yentna rivers at Flathorn (RM 20), Yentna (TRM 04), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations. In addition, evaluate the same parameters for chinook salmon at Sunshine, Talkeetna and Curry stations.

4. Define where and when and to what level chinook, sockeye, pink, chum and coho salmon spawn in streams, sloughs, side channels and the main channel of the Susitna River between RM 28 and 161.0.

5. Determine the average stream or spawning life of sockeye and chum salmon in sloughs as necessary to define total escapements into sloughs.

II. TECHNICAL PROCEDURES - Adult Salmon

Main Channel Escapement Monitoring

Operations Dates

Main channel escapement monitoring using side scan sonar (SSS) counters and tag/recapture fishwheels will begin and end on the following dates, by station:

Flathorn Station (RM 20)	July 1 to September 3
Yentna Station (TRM 04)	July 1 to September 5
Sunshine Station (RM 80)	June 4 to September 10
Talkeetna Station (RM 103)	June 7 to September 12
Curry Station (RM 120)	June 10 to September 14

Methods

Sonar and Tag/Recapture

At Yentna Station (TRM 04) two side scan sonar counters will be deployed as shown in Figure 1. Specific methods for substrate deployment, counter set-up and counter operation will be in accordance to procedures outlined in the 1980 Side Scan Sonar Counter Installation and Operation Manual (Appendix 1).

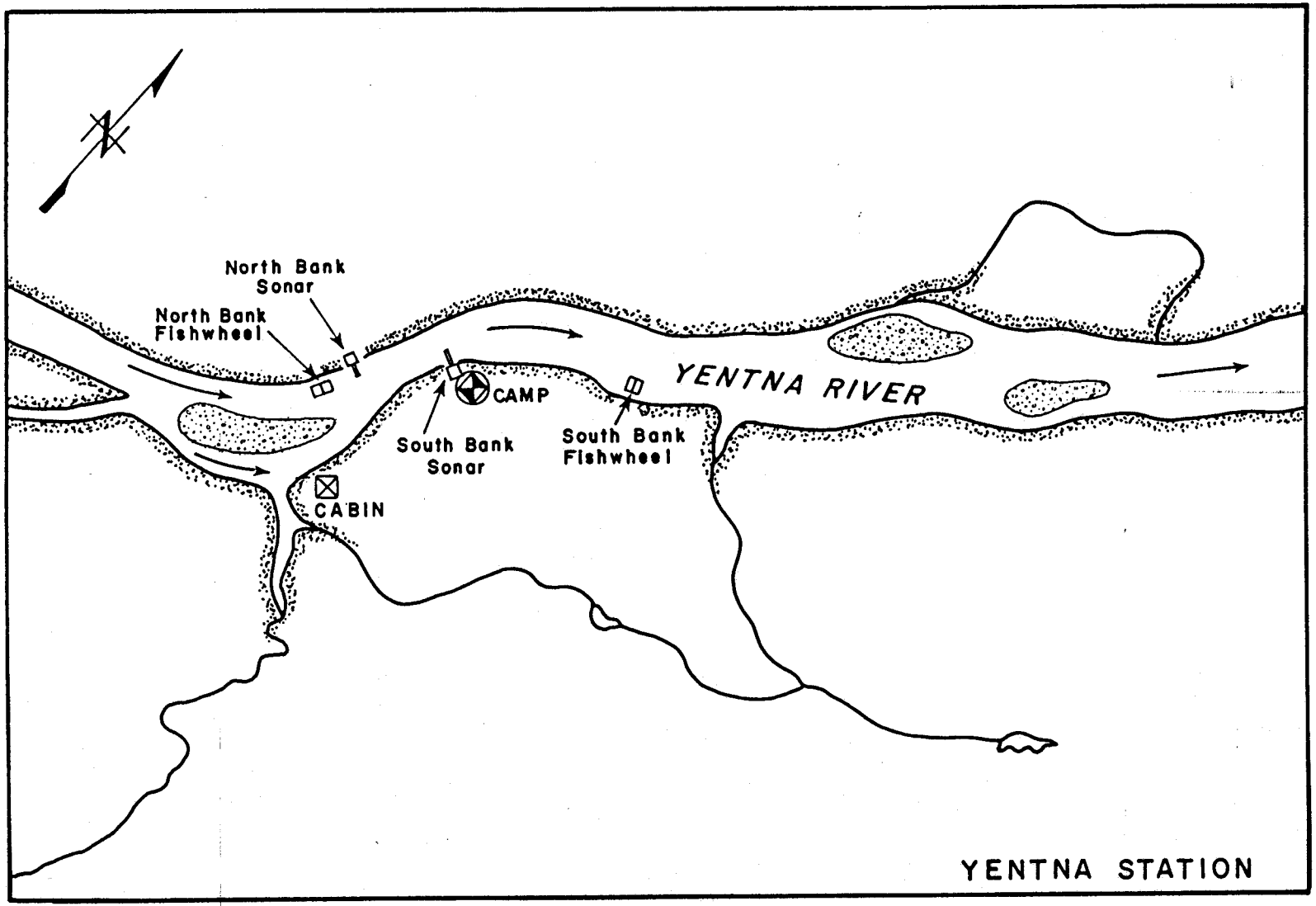
North Bank
Sonar
North Bank
Fishwheel
CAMP
YENTNA RIVER
South Bank
Sonar
South Bank
Fishwheel
CABIN
YENTNA STATION

Figure 1.

To prevent under and over counting adult salmon due to differential fish velocity between species counters will be monitored, at minimum, four times daily. This is accomplished by hand-tallying fish related echos displayed on an oscilloscope and comparing them to SSS counts (Appendix 2). When the ratio of oscilloscope counts to SSS counts deviates from one by greater than 10 percent the fish velocity control will be adjusted as outlined in the above cited operations manual.

Important items concerning SSS operations which may not appear in the operational instructions (Appendix 1) are:

1. When large numbers of pink salmon pass over the substrate it is possible for the counter 'logic' to interpret the counts as debris. On these occasions the debris notation on the counter printout should be ignored.

2. When checking the battery conditions it is preferable to do so when a load, such as the printer, is being applied.

3. A light print problem may be resolved by applying rubbing alcohol to the paper and pulling through the printer rollers.

4. At times the printer may print over the previous hours printout. This problem may be solved by applying a light coat of rubbing alcohol to the paper and attaching a weight to the end of the printer paper.

Two fishwheels will be operated at Yentna Station (TRM 04), one in the immediate vicinity of each SSS counter. Fishwheel catches will provide the necessary species composition data needed to apportion the SSS counts.

At Flathorn (RM 20), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations fishwheels will be operated for tag/recapture purposes at the locations identified in Figures 2, 3 and 4. Two fishwheels will be deployed on each side of the Susitna River at Flathorn, Sunshine and Talkeetna stations. At Curry station, a single fishwheel will be operated offshore of each bank. Fishwheel design is described in the Phase I ADF&G/Su Hydro Adult Anadromous Report (1981) and fishwheel operation in Appendix 3. Fishwheels will be operated 24 hours per day, and sampled for catch and checked for maintenance needs five or more times daily.

All adult salmon caught by fishwheels located at Flathorn (RM 20), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations will be tagged and released except:

1. fish that appear lethargic or stressed.

2. fish which are in post-spawning condition.

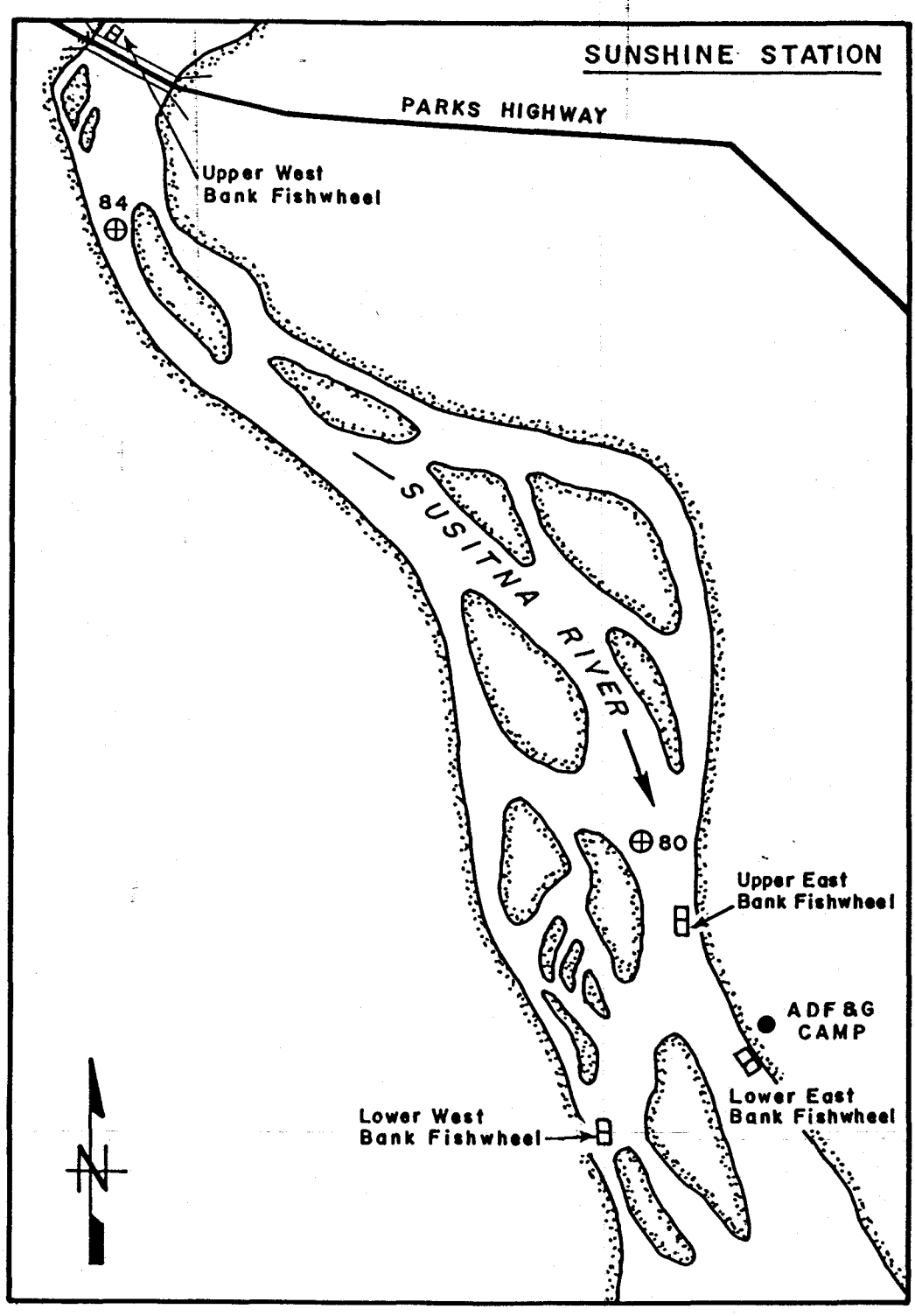
SUNSHINE STATION
PARKS HIGHWAY
Upper West
Bank Fishwheel
84
SUSITNA RIVER
80
Upper East
Bank Fishwheel
ADF&G
CAMP
Lower East
Bank Fishwheel
Lower West
Bank Fishwheel
N

Figure 2.

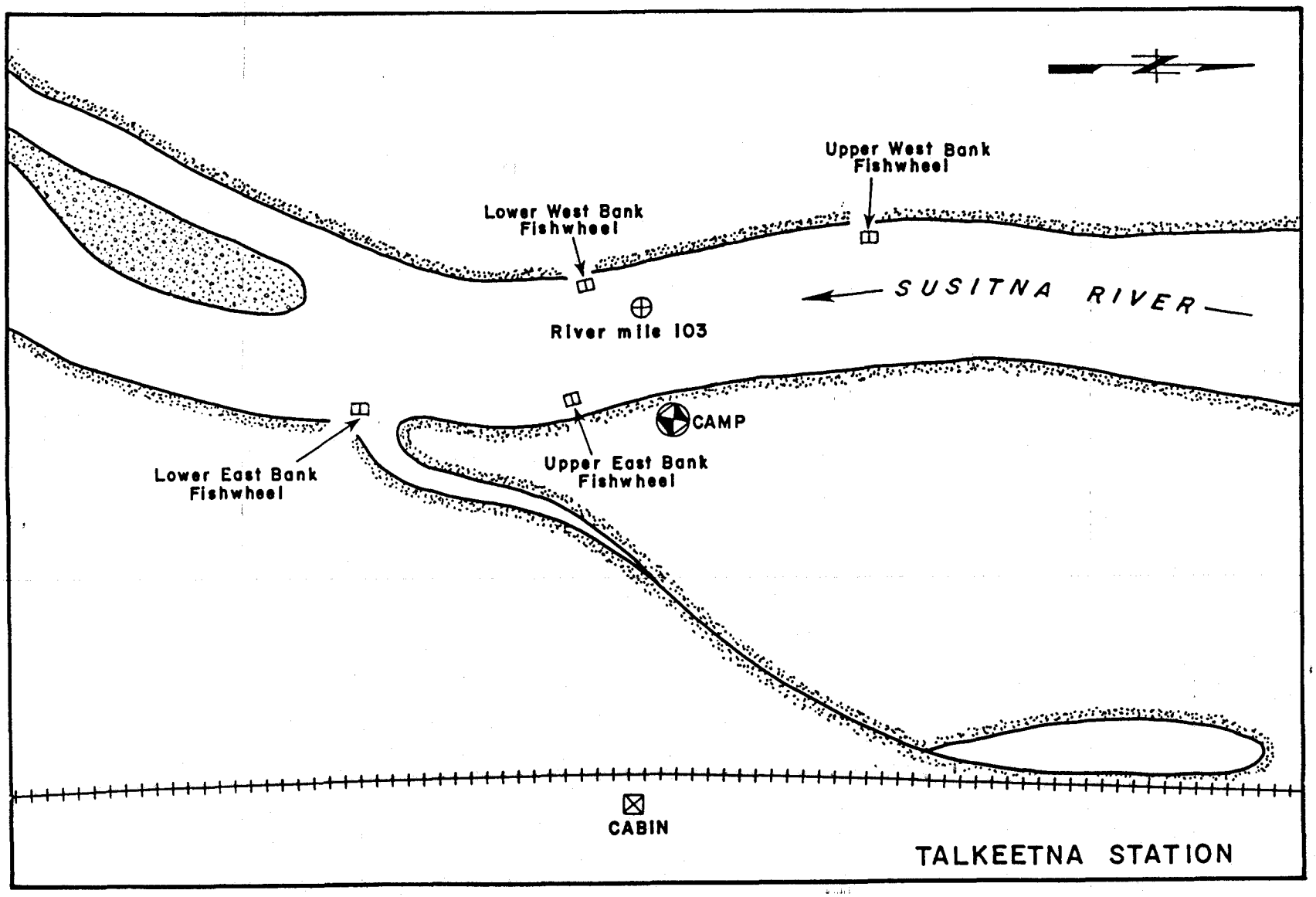
Upper West Bank
Fishwheel
Lower West Bank
Fishwheel
SUSITNA RIVER
River mile 103
CAMP
Upper East Bank
Fishwheel
Lower East Bank
Fishwheel
CABIN
TALKEETNA STATION

Figure 3.

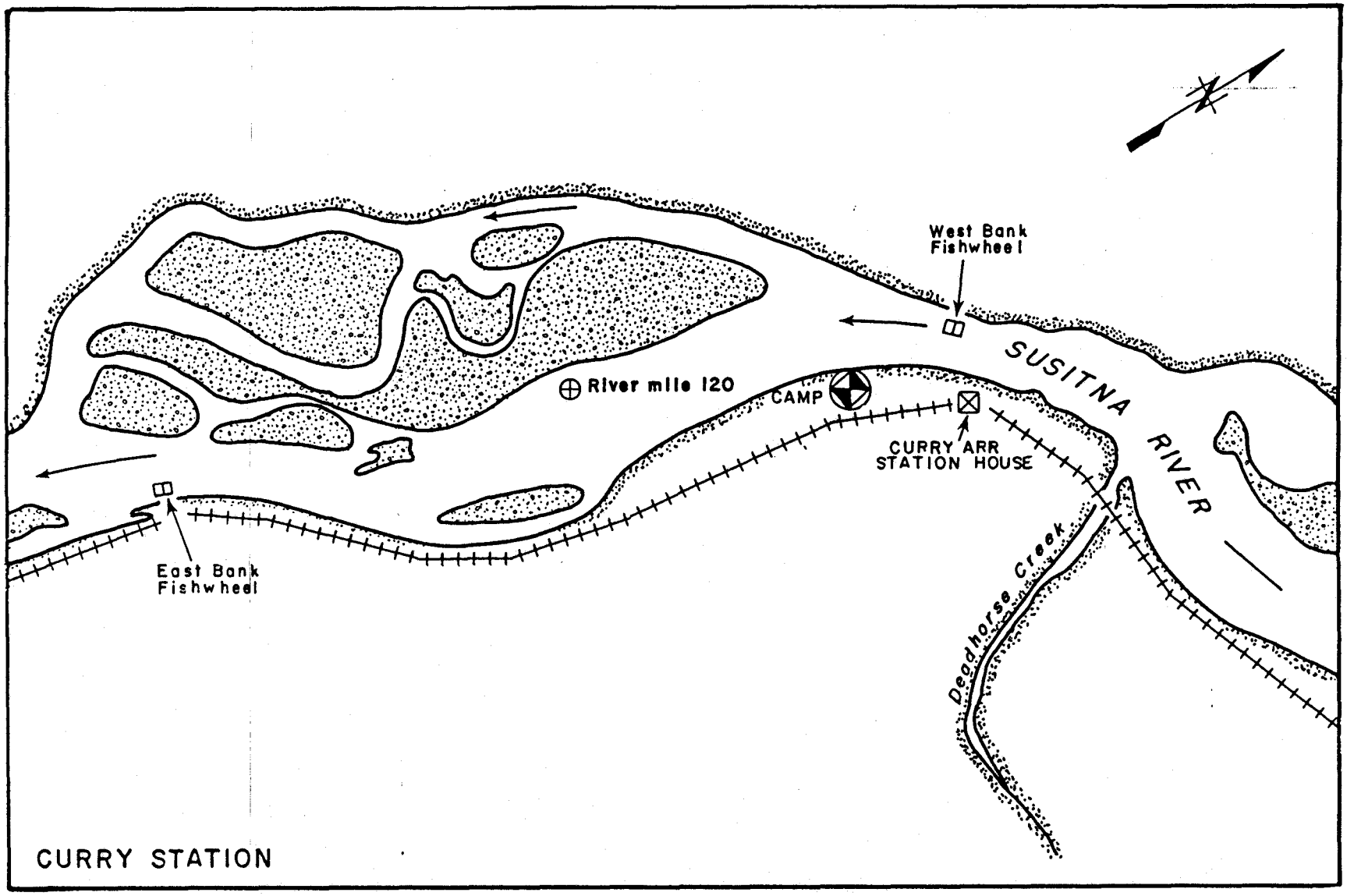
West Bank
Fishwheel
SUSITNA RIVER
River mile 120
CAMP
CURRY ARR
STATION HOUSE
East Bank
Fishwheel
Deadhorse Creek
CURRY STATION

Figure 4.

Table 1.

Station	River Mile	Species	Length	Percent of Catch Tagged	Tag Type	Tag Color
Flathorn	20	Chinook	<351 mm	0	----	-
		Chinook	≥351 mm	0	----	-
		Sockeye	All	100	FT-4 Spaghetti	Green
		Pink	All	10	FT-4 Spaghetti	Green
		Chum	All	100	FT-4 Spaghetti	Green
Sunshine	80	Chinook	<351 mm	0	----	-
		Chinook	≥351 mm	100	1" dia. Peterson Disc	Blue
	(east bank fishwheels)					
		Chinook	<351 mm	0	----	-
		Chinook	≥351 mm	100	1" dia. Petersen Disc	Yellow
	(west bank fishwheels)					
		Sockeye	All	100	FT-4 Spaghetti	Pink
		Pink	All	10	FT-4 Spaghetti	Pink
		Chum	All	100	FT-4 Spaghetti	Pink
		Coho	All	100	FT-4 Spaghetti	Pink
Talkeetna	103	Chinook	<351 mm	0	----	-
		Chinook	≥351 mm	100	1" dia. Petersen Disc	Green
		Sockeye	All	100	FT-4 Spaghetti	Blue
		Pink	All	50	FT-4 Spaghetti	Blue
		Chum	All	100	FT-4 Spaghetti	Blue
		Coho	All	100	FT-4 Spaghetti	Blue
Curry	120	Chinook	<351 mm	0	----	-
		Chinook	≥351 mm	100	1" dia. Petersen Disc	Orange
		Sockeye	All	100	1" dia. Petersen Disc	Orange
		Pink	All	50	1" dia. Petersen Disc	Orange
		Chum	All	100	1" dia. Petersen Disc	Orange
		Coho	All	100	1" dia. Petersen Disc	Orange

3. chinook salmon less than 351 mm in fork length (FL).

4. fish previously tagged at another tagging site.

These fish will be released without being tagged.

Procedures for tagging fish are defined in Appendix 4. The type of tags, colors and percent of each species tagged at Flathorn, Sunshine, Talkeetna and Curry stations are defined in the following table:

Special tagging instructions:

1. Chinook salmon at Sunshine Station will be tagged with two different colored tags; one for the east bank (blue) and one for the west bank (yellow).

2. At Talkeetna Station odd one hundred series (xxxx) tags will be used for fish captured in west bank fishwheels and even one hundred series tags will be used for fish captured in east bank fishwheels. For example, a carcass bearing Talkeetna tag, number 1312 should have been captured in a west bank fishwheel and a carcass bearing Talkeetna tag, number 2613 should have been captured in a east bank fishwheel (note: tags 0-99 are considered even one hundred series).

3. Large numbered Petersen Discs will be deployed at Curry Station. These discs are to be used for sockeye and chum salmon only.

Fish which are recaptured from other tagging locations are to be released with the original tag in place following species identification and recording of tag type, color and number (Section III, DATA PROCEDURES). All non-salmon catches will be identified to species, and if time allows, tagged and released.

Fishwheel catch, sonar and tag deployment and recapture data will be transmitted to the Anchorage office every two weeks from Flathorn (RM

20), Yentna (TRM 04), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations. All data will be edited by the Operations Control Leader and then submitted to the Data Processing Section.

Age, Length and Sex Composition Sampling:

At Flathorn (RM 20), Yentna (TRM 04), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations age, length and sex data (Section III, DATA PROCEDURES) will be collected daily for each species as follows:

Chinook salmon: Age, length and sex samples from 30 consecutively (regardless of size) caught fish.

Except: At Sunshine Station-age, length and sex samples from 30 consecutively (regardless of size) caught fish from east bank fishwheels and 30 consecutively (regardless of size) caught fish from west bank fishwheels.

Sockeye salmon: Age, length and sex samples daily from 30 consecutively (regardless of size) caught fish.

Pink salmon: Length and sex samples daily from 30 consecutively (regardless of size) caught fish.

Chum salmon: Age, length and sex samples daily from 20 consecutively (regardless of sex) caught fish.

Coho salmon: Age, length and sex samples daily from 20 consecutively (regardless of size) caught fish.

Age, length and sex composition data will be forwarded to the Anchorage office every two weeks from Flathorn (RM 20), Yentna (TRM 04), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations.

Stream, Slough, Side Channel and Main Channel Surveys

Lower River

Operation Period and Reach

Streams will be surveyed for salmon escapements weekly from July 21 to October 7. The geographic areas of responsibility for two Lower River survey crews (RM 28.0-98.7) are:

Flathorn Station Survey	RM 28 to Kashwitna River
Sunshine Station Survey	Kashwitna River to Talkeetna

Stream surveys will be in accordance to the schedule defined in Table 2.

Table 2. Lower river salmon escapement survey.

Stream	River Mile	Survey			
		Period	Frequency	Method	Distance
Fish Creek	31.2	7/22-10/7	Weekly	Foot	1/3 mile
Whitsol Creek	35.2	7/22-10/7	Weekly	Foot	1/3 mile
Rolly Creek	39.0	7/22-10/7	Weekly	Foot	1/3 mile
Willow Creek	49.1	7/22-10/7	Weekly	Foot	1/3 mile
Little Willow Cr.	50.5	7/22-10/7	Weekly	Foot	1/3 mile
Grays Creek	59.5	7/22-10/7	Weekly	Foot	1/3 mile
Kashwitna River	61.0	7/22-10/7	Weekly	Foot	1/3 mile
Caswell Creek	64.0	7/22-10/7	Weekly	Foot	1/3 mile
Sheep Creek	66.1	7/22-10/7	Weekly	Foot	1/3 mile
Goose Creek	72.0	7/22-10/7	Weekly	Foot	1/3 mile
Montana Creek	77.0	7/22-10/7	Weekly	Foot	1/3 mile
Rabideux Creek	83.1	7/22-10/7	Weekly	Foot	1/3 mile
Sunshine Creek	85.1	7/22-10/7	Weekly	Foot	1/3 mile
Birch Creek	89.2	7/22-10/7	Weekly	Foot	1/3 mile
Trapper Creek	91.5	7/22-10/7	Weekly	Foot	1/3 mile
Cache Creek	95.5	7/22-10/7	Weekly	Foot	1/3 mile

Additionally, Sunshine Station Survey will survey Birch Creek Slough (RM 88.4), Question Creek (RM 84.1) and Answer Creek (RM 84.1) once between September 15 - 28 for a distance to be field selected.

Sloughs, side channels and main channel habitats between RM 28 and 97.1 will be surveyed for salmon spawning weekly, by helicopter, from August 21 to October 7.

Methods

All spawning ground and tag recovery surveys will be conducted by trained observers. Stream surveys will be conducted on foot for a distance of one third mile from the confluence of the Susitna River except Birch Creek which will be surveyed one third mile from its confluence with Birch Creek Slough. A marker will be established at the upper survey limit on the first survey of each stream to ensure repetitive surveys throughout the season. Surveyors will wear polarized glasses to reduce surface water glare and use hand held tally counters to record live tagged and untagged adult salmon and carcasses. Surveyors will map the distribution of salmon spawning activity and give a brief description of the habitat for any adult salmon found spawning in the stream survey reach. Survey data and maps of salmon spawning distribution will be recorded on the appropriate forms (Section III, DATA PROCEDURES) and transmitted to the Anchorage office once every two weeks. The data forms will be edited by the Operations Control Leader and then forwarded to the Data Processing Section.

Sloughs, side channel and main channel habitats will be surveyed for salmon spawning by helicopter. All suspected spawning areas will be visited by boat and will be defined as true spawning sites if the following criteria are met:

1. Fish exhibits spawning and morphology.

2. Fish expells eggs or milt when slight pressure is exerted on the abdomen.

3. Fish is in vigorous condition, with 25 percent or more of the eggs or milt remaining in the body cavity.

4. Additional fish meeting criteria 1 through 3 are present.

Once a spawning area has been located the appropriate data forms will be filled out (Section III, DATA PROCEDURES) and forwarded to the Anchorage office every two or three weeks.

Middle River

Operation Period and Reach

Salmon stream escapement surveys will be conducted from July 22 to October 7. Chinook salmon escapement surveys will be conducted as outlined in Table 3. Additionally, between July 22 and August 5 specific chinook salmon tag recovery surveys will be conducted as scheduled in Table 4.

Between August 6 and October 7 all streams and sloughs of known and suspected adult salmon use from RM 98.6 to 161.0 will be surveyed as close to weekly as possible. The sloughs will be surveyed in their entirety and streams to a standard index limit or the upper spawning limit as defined in Table 5.

Side channel and main channel habitats will be surveyed for salmon spawning by helicopter a minimum of two times between September 1 and October 7.

Table 3. Chinook salmon escapement survey schedule.

Stream	RM [1]	Survey			
		Period	Frequency [2]	Method	Distance [3]
Chase Creek	106.9	7/22-8/5	Once	Foot	1 Mile
Lane Creek	113.6	7/22-8/5	Twice	Foot	Upper Spawning Limit
Fifth of July Cr.	123.7	7/22-8/5	Twice	Foot	Upper Spawning Limit
Sherman Creek	130.8	7/22-8/5	Twice	Foot	Upper Spawning Limit
Fourth of July Cr.	131.1	7/22-8/5	Twice	Foot	Upper Spawning Limit
Gold Creek	136.7	7/22-8/5	Twice	Foot or Hel.	Upper Spawning Limit
Indian River	138.9	7/22-8/5	Twice	Helicopter	Upper Spawning Limit
Portage Creek	148.9	7/22-8/5	Twice	Helicopter	Upper Spawning Limit
Cheechako Creek	152.4	7/22-8/5	Twice	Helicopter	Upper Spawning Limit
Chinook Creek	157.0	7/22-8/5	Twice	Helicopter	Upper Spawning Limit
Devil Creek	161.0	7/22-8/5	Twice	Helicopter	Upper Spawning Limit

1/ RM = River Mile

2/ Conduct surveys no less than 7 days apart under notation of 'twice.'

3/ Distance either expressed in standard distance to be surveyed from mouth or to upper spawning limit.

Table 4. Specific chinook salmon tag recovery survey schedule.

Stream	RM [1]	Survey			
		Period	Frequency	Method	Distance
Radideux Creek	83.1	7/22-8/5	Once min.	Foot	Field Selected
Prairie Creek	97.1	7/22-8/5	Once min.	Foot	Field Selected
Clear Creek	97.1	7/22-8/5	Once min.	Foot	Field Selected
Troublesome Creek	97.8	7/22-8/5	Once min.	Foot	Field Selected
Byers Creek	97.8	7/22-8/5	Once min.	Foot	Field Selected
Chulitna River	97.8	7/22-8/5	Once min.	Foot	Field Selected
Bunco Creek	97.8	7/22-8/5	Twice	Foot	Field Selected
Indian River	138.9	7/22-8/5	Twice	Foot	Field Selected
Portage Creek	148.9	7/22-8/5	Twice	Foot	Field Selected

1/ RM = River Mile

Table 5. General salmon escapement survey schedule above River Mile 97.1.

Stream	RM 1/	Survey			
		Period	Frequency	Method	Distance
Fish Creek	97.1	8/10-25	Twice	Foot	Field Selected
Larson Creek	97.1	8/11-8/10	Once	Foot	Field Selected
Byers Creek	97.8	8/10-15	Once	Foot	Field Selected
Unnamed Trib.	97.8	8/1-8/10	Once	Foot	Field Selected
Tokositna R. to Troublesome Cr.	97.8	9/5-15	Once	Foot	Field Selected
Swan Lake	97.8	9/5-20	Once	Foot	Field Selected
All Sloughs	98.6-161.0	8/6-10/7	Weekly	Foot	Entire
Whiskers Creek	101.4	8/6-10/7	Weekly	Foot	0.5
Chase Creek	106.4	8/8-10/7	Weekly	Foot	0.75
Slash Creek	106.9	8/8-10/7	Weekly	Foot	0.25
Gash Creek	111.6	8/8-10/7	Weekly	Foot	1.0
Lane Creek	113.6	8/8-10/7	Weekly	Foot	0.5
Lower McKenzie Cr.	116.2	8/8-10/7	Weekly	Foot	0.25
McKenzie Creek	116.7	8/8-10/7	Weekly	Foot	0.25
Little Portage Cr.	117.7	8/8-10/7	Weekly	Foot	0.25
Dead Horse Creek	120.9	8/8-10/7	Weekly	Foot	0.25
Fifth of July Cr.	123.7	8/8-10/7	Weekly	Foot	0.25
Skull Creek	124.7	8/8-10/7	Weekly	Foot	0.25
Sherman Creek	130.8	8/8-10/7	Weekly	Foot	0.25
Fourth of July Cr.	131.1	8/8-10/7	Weekly	Foot	0.25
Gold Creek	136.7	8/8-10/7	Weekly	Foot	0.25
Indian River	138.6	8/8-10/7	Weekly	Foot	1.0
	138.6	8/8-10/7	Weekly	Helicopter	Upper Spawning Limit
Jack Long Creek	144.5	8/8-10-7	Weekly	Foot	0.25
Portage Creek	148.9	8/8-10/7	Weekly	Foot	0.25
	148.9	8/8-10/7	Weekly	Helicopter	Upper Spawning Limit
Cheechako Creek	152.4	8/8-10/7	Weekly	Helicopter	1.0
Chinook Creek	157.0	8/8-10/7	Weekly	Helicopter	1.5
Devil Creek	161.0	8/8-10-7	Weekly	Helicopter	1.0

1/ RM = River Mile

Methods

Sloughs will be surveyed in their entirety and streams for a distance defined in Table 5. Surveyors will wear polarized glasses and use hand held tally counters to enumerate live tagged and untagged salmon and carcasses. Survey data will be recorded on the appropriate forms (Section III, DATA PROCEDURES) and transmitted to the Anchorage office every two weeks. The data forms will be edited by the Operations Control Leader and then forwarded to the Data Processing Section.

Methods addressing main channel and side channel salmon spawning are identical to those reported in the Lower River Survey portion of this procedures manual.

Stream Life

Operation Period and Survey Reach

Investigations will extend from August 16 to freeze-up (approximately October 7) and will be conducted by a crew based at Curry Station (RM 120). Areas surveyed will be sloughs 11, 9, 9A, 8A and Moose.

Methods

Beginning August 16, sloughs 11, 9, 9A, 8A and Moose will be surveyed on foot approximately every third day for sockeye and chum salmon that were tagged at Curry Station (RM 120). Fish will be individually identified

by orange one inch Petersen discs bearing full size identification numbers. Surveyors will wear polaroid glasses and record observations as outlined in Section III, DATA PROCEDURES.

Survey data will be forwarded to the Anchorage office every three weeks. The data forms will be edited by the Operations Control Leader and then forwarded to the Data Processing Section.

III. DATA PROCEDURES

Side Scan Sonar Operations

Daily Procedures

1. PRINTER TAPE STAMP: Each day's printer tape will be stamped (Figure 5) at the beginning and end of the tape as well as anytime during the day that control settings are changed. Each morning the tape is to be removed from the counter, stamped on both ends of the tear and filled in with the same information on each stamp.

2. DAILY LOG FOR SIDE SCAN SONAR COUNTER FORM: This is a summary of changes in controls which will be updated daily (Table 6). The information is necessary when interpreting sonar counts and calibration factor data.

3. SIDE SCANNER COUNTER LOG FORM: Details the mechanics of operation of the counter, substrate and related equipment (Table 7). Any apparent malfunctions should be recorded with description, frequency and consistency noted. Also, changes in sensitivity, spare card changes, raising or moving of substrate, anticipated problems, and needed repairs on equipment. This is the place where suggestions on improving operations, notes on river conditions which might have an effect on the equipment, and general comments should be noted.

Location: _____

Date: _____ Time: _____

Beam Angle: _____

Velocity: _____

Dead Range: _____

Live Range: _____

Observers: _____

Remarks: _____

_____

Figure 5.

Table 6.

AA-84-12

DAILY LOG FOR SIDE SCAN SONAR COUNTER

Station: YENTNA Bank: ______________ S/N: ______________

Date	Time	Fish Velocity	Beam Angle	Dead Range	Counting Range	Command Print Time	Printout Time	Auto Test Time

Table 7.

Page ___ of ___

AA-84-14

Station: YENTNA

SIDE SCAN SONAR COUNTER LOG

Bank: _____

Date	Time	Remarks (i.e., Substrate lifted, any controls reset, etc.)

4. SIDE SCAN SONAR COUNTER FIELD COUNTER CALIBRATION LOG FORM: Calibration of the sonar counter to adjust for differential fish velocities between salmon species will be accomplished by visual monitoring of the counters with an oscilliscope. Counters will be calibrated a minimum of four times daily. All calibration counts are to be recorded on the Side Scan Sonar Counter Field Calibration Log from (Table 8).

5. DAILY SONAR COUNT FORM: Sonar counts from printer tapes will be entered by hour and sector (Table 9). Counts which register debris or are skipped in printing should be noted with a "d" or "s" in the appropriate hour-sector box. When counters are shut off for a portion of one hour, data will be interpolated for the hour as follows:

$$\text{Adj. hourly count} = \frac{60 \text{ minutes}}{\text{minutes operated in hour}} \times \text{counts for minutes operated in hour}$$

For periods when the counter is off more than 50 minutes in one hour that hour will be treated as a debris block. After all blocks have been filled counts should be totalled for all good blocks in each sector and each hour. The grand total is the total of all sectors or all hours (they should be equal). This is known as the "daily raw count". After each days counts are tabulated and reported, printer tapes and SSS count forms are to be placed in notebooks and sent to the main office every two weeks. The Operations Control Leader

Table 8.

AA-84-10

SIDE SCAN SONAR COUNTER FIELD CALIBRATION LOG

Station: YENTNA Bank: ______________ S/N: ______________

Date	Observer	Time		Scope Count (1)	Sonar Count (2)	Percent Agreement (1÷2)100	Beam Width: Alt., 2°, 4°	Fish Velocity (Sec/ft)	Sensitivity	Comments
		Start	Stop							

Table 9.

AA-84-09

Page ___ of ___

Daily Sonar Counts

Bank: _____ Date: ___/___/ 84

Station: YENTNA

Time	Sector 1	2	3	4	5	6	Total	Sector 7	8	9	10	11	12	Total
0100														
0200														
0300														
0400														
0500														
0600														
0700														
0800														
0900														
1000														
1100														
1200														
1300														
1400														
1500														
1600														
1700														
1800														
1900														
2000														
2100														
2200														
2300														
2400														
Total														

_____ (Total raw counts)
\- _____ (Total debris counts)
= _____ (Total good counts)
_____ (debris blocks)

Total good counts _____ x 144 =
Total good blocks _____

Adjusted Raw Count
(Sectors 1-6) _____

_____ (Total raw counts)
\- _____ (Total debris counts)
= _____ (Total good counts)
_____ (debris blocks)

Total good counts _____ x 144 =
Total good blocks _____

Adjusted Raw Count
(Sectors 7-12) _____

TOTAL DAILY ESCAPEMENT (Adjusted raw count sectors 1-6 + 7-12) = _____

COMMENTS ON BACK

will edit the forms and then forward them to the Data Processing Section.

6. All raw daily SSS counts are to be entered in the Epson microcomputer daily (Appendix 10). All data entered onto microcassettes will be "backed up" by microcomputer paper printouts. The microcassettes and printouts will be forwarded to the Anchorage office every two weeks. After editing, the Operations Control Leader will convey the data to the Data Processing Section.

Tag/Recapture Operations

Daily Procedures

1. Daily fishwheel catches will be summarized on the Daily Fishwheel Catch Log form (Table 10, 11 or 12). Each time a fishwheel is checked, the catch will be recorded along with the corresponding time in military hours on the Individual Fishwheel Worksheet (Table 13). All field notebooks will be kept in such a manner that the information is usable upon completion of the field season. Following the last daily check, the catches will be summarized and entered in the appropriate space on the Daily Fishwheel Catch Log form and the 1984 Daily and Cumulative Fishwheel Catch form (Table 14) or entered in the Epson microcomputer following procedures outlined in Appendix 10.

Table 10.

Page ___ of ___

Date __/__/84

Station: _____

AA-84-01A

Geographic Codes

EBU __ __/__ __ __/__ __ __/__ __ __
EBL __ __/__ __ __/__ __ __/__ __ __
WBU __ __/__ __ __/__ __ __/__ __ __
WBL __ __/__ __ __/__ __ __/__ __ __

DAILY FISHWHEEL CATCH LOG

Fishwheel		Salmon					Whitefish			Miscellaneous		
Location	Hours Operated	Chinook	Sockeye	Pink	Chum	Coho	Round	Hump-back	Bering Cisco	Species Code #	No.	Total Catch
Eastbank Upper												
Eastbank Lower												
EASTBANK TOTAL												
Westbank Upper												
Westbank Lower												
WESTBANK TOTAL												
DAILY TOTAL EAST AND WEST BANKS												

COMMENTS:

Table 11.

Page ___ of ___

AA-84-01B

Geographic Codes

Date __ / __ / 84

NB __ __/ __ __ __/ __ __ __/ __ __ __
SB __ __/ __ __ __/ __ __ __/ __ __ __

Station: YENTNA

DAILY FISHWHEEL CATCH LOG

Fishwheel		Salmon					Whitefish			Miscellaneous		Total Catch
Location	Hours Operated	Chinook	Sockeye	Pink	Chum	Coho	Round	Hump-back	Bering Cisco	Species Code 1/	No.	
NORTHBANK												
SOUTHBANK												
DAILY TOTAL NORTH AND SOUTH BANKS												

COMMENTS:

1/
- 511 Eulachon
- 530 Dolly Varden
- 541 Rainbow trout
- 582 Humpback whitefish
- 586 Round whitefish
- 585 Bering cisco
- 590 Burbot
- 610 Arctic grayling
- 640 Longnose sucker

Table 12.

Page ___ of ___

AA-84-01C

Geographic Codes

Date __/__/84

EB __ __/__ __ __/__ __ __/__ __ __
WB __ __/__ __ __/__ __ __/__ __ __

Station: CURRY

DAILY FISHWHEEL CATCH LOG

Fishwheel		Salmon					Whitefish			Miscellaneous		Total Catch
Location	Hours Operated	Chinook	Sockeye	Pink	Chum	Coho	Round	Hump-back	Bering Cisco	Species Code 1/	No.	
EASTBANK												
WESTBANK												
DAILY TOTAL EAST AND WEST BANKS												

COMMENTS:

1/
- 511 Eulachon
- 530 Dolly Varden
- 541 Rainbow trout
- 582 Humpback whitefish
- 586 Round whitefish
- 585 Bering cisco
- 590 Burbot
- 610 Arctic grayling
- 640 Longnose sucker

Table 13.

INDIVIDUAL FISHWHEEL WORKSHEET

Date __/__/84

Station: _____ Fishwheel Location: _____

Time (Military)	Number of Fish Captured					
	Chinook	Sockeye	Pink	Chum	Coho	Other *

Hours Operated: _____

* Identify species and number caught.

Table 14.

Page ___ of ___ AA-84-04

Station ______________________

1984 DAILY AND CUMULATIVE FISHWHEEL CATCH

Date	Chinook		Sockeye		Pink		Chum		Coho	
	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum

2. Fish tagging effort will be recorded on the Tag Deployment Log form (Table 15, 16, or 17) or entered in the Epson microcomputer as detailed in Appendix 10. Information recorded will include: date, project location and tag type, color and number series used.

3. Tag recaptures from other sampling stations will be logged on the Tag Recapture Record form (Table 18) or entered in the Epson microcomputer (Appendix 10). Recorded information shall include: fishwheel locations; tag number, color and type; and species. A summary of recapture data by species shall be entered in the space indicated on the form. Fish recaptured at the sampling stations where they were tagged will be released and <u>will not</u> be recorded on the Fishwheel Data Catch Log form or the Tag Recapture Record form <u>except</u> at Sunshine Station where recaptured <u>chinook</u> salmon previously tagged at Sunshine Station <u>will</u> be recorded on only the Tag Recapture Record Form (Table 18).

Age, Length and Sex Composition Sampling

At Flathorn (RM 20), Yentna (TRM 04), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations age, length and sex data will be collected from adult salmon as defined in Section II, TECHNICAL PROCEDURES. Scales will be mounted on gum cards as illustrated in Figure 6. It is important to note that scales are mounted such that the

Table 15.

Page ___ of ___

EAST BANK ONLY

AA-84-05E

TAG DEPLOYMENT LOG

Project Location (camp): _____

Date: __/__/ 84

LAST Tag Number of day: _____ Tag Color 1/ _____

FIRST Tag Number of day: _____ Tag Type 2/ _____

Number of Missing Tags: _____

Number of Numbered Tags Deployed: _____

Number of Blank Tags Deployed: _____

TOTAL NUMBER OF TAGS DEPLOYED: _____

Summary of Adult Salmon Tagged

Chinook Salmon _____

Sockeye Salmon _____

Pink Salmon _____

Chum Salmon _____

Coho Salmon _____

TOTAL _____

COMMENTS:

1/ Color: Int orange = O
Yellow = Y
Green = G
Pink = P
Blue = B

2/ Type: Floy Spaghetti = S
Petersen Disc = P

Table 16.

WEST BANK ONLY

AA-84-05W

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TAG DEPLOYMENT LOG

Project Location (camp): _____

Date: ___/___/ 84

LAST Tag Number of day: _____ Tag Color 1/ _____

FIRST Tag Number of day: _____ Tag Type 2/ _____

Number of Missing Tags: _____

Number of Numbered Tags Deployed: _____

Number of Blank Tags Deployed: _____

TOTAL NUMBER OF TAGS DEPLOYED: _____

Summary of Adult Salmon Tagged

Chinook Salmon _____

Sockeye Salmon _____

Pink Salmon _____

Chum Salmon _____

Coho Salmon _____

TOTAL _____

COMMENTS:

1/ Color: Int orange = O
Yellow = Y
Green = G
Pink = P
Blue = B

2/ Type: Floy Spaghetti = S
Petersen Disc = P

Table 17.

Page ___ of ___

AA-84-05B

TAG DEPLOYMENT LOG

Project Location (camp): _____

Date: ___/___/ 84

LAST Tag Number of day: _____ Tag Color 1/ _____

FIRST Tag Number of day: _____ Tag Type 2/ _____

Number of Missing Tags: _____

Number of Numbered Tags Deployed: _____

Number of Blank Tags Deployed: _____

TOTAL NUMBER OF TAGS DEPLOYED: _____

Summary of Adult Salmon Tagged

Chinook Salmon _____

Sockeye Salmon _____

Pink Salmon _____

Chum Salmon _____

Coho Salmon _____

TOTAL _____

COMMENTS:

1/ Color: Int orange = O
Yellow = Y
Green = G
Pink = P
Blue = B

2/ Type: Floy Spaghetti = S
Petersen Disc = P

Table 18.

Page ___ of ___

AA-84-19
TAG RECAPTURE RECORD

Project Station: _____

Date	Bank Captured	Species	Tag			Leave Blank (Office Use Only)
			Number	Color 1/	Type 2/	

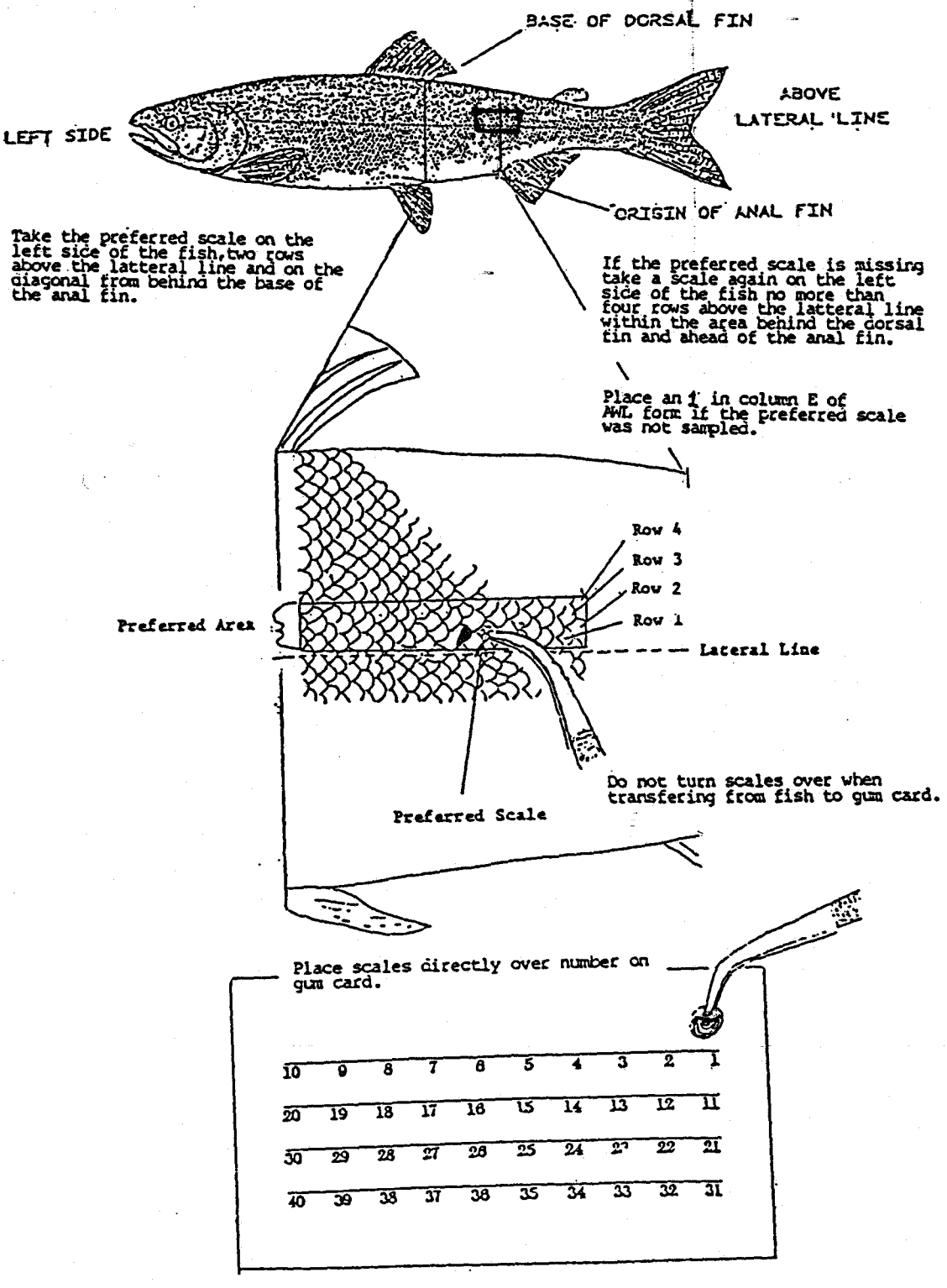
SHEET SUMMARY

	No. Recaptures
Chinook (41)	
Sockeye (42)	
Coho (43)	
Pink (44)	
Chum (45)	
TOTAL	

1/ Color: Int. orange = O
Yellow = Y
Green = G
Pink = P
Blue = B

2/ Type: Floy Spaghetti = S
Petersen Disc = P

Figure 6.


BASE OF DORSAL FIN
ABOVE
LATERAL LINE
LEFT SIDE
ORIGIN OF ANAL FIN
Take the preferred scale on the left side of the fish, two rows above the latteral line and on the diagonal from behind the base of the anal fin.
If the preferred scale is missing take a scale again on the left side of the fish no more than four rows above the latteral line within the area behind the dorsal fin and ahead of the anal fin.
Place an 1 in column E of AWL form if the preferred scale was not sampled.
Row 4
Row 3
Row 2
Row 1
Preferred Area
Lateral Line
Do not turn scales over when transfering from fish to gum card.
Preferred Scale
Place scales directly over number on gum card.
10 9 8 7 6 5 4 3 2 1
20 19 18 17 16 15 14 13 12 11
30 29 28 27 26 25 24 23 22 21
40 39 38 37 36 35 34 33 32 31

ridged surface is facing out and the anterior portion of the scale orientated toward the top of the scale card. All length measurements are taken from mid-eye to fork of tail (FL) and are recorded to the nearest five millimeters.

Length and sex data are recorded on the Age and Length (AL) form (Table 19). Scale cards are numbered to correspond with the proper AL form (i.e. scale card 001 contains scales collected from samples recorded on AL form 001).

Length and sex data along with the corresponding scale cards will be returned to the Operations Control Leader every two weeks.

Stream, Slough, Side Channel and Main Channel Surveys

Lower River

Stream survey results will be recorded on the Stream Survey Log Form (Table 20). Data recorded on each survey will include date, stream, survey conditions, distance surveyed, live and dead fish counted by species and number of live tagged fish by tag type and color. The "comments" column will include names of survey staff and reference to tag loss. Tags on carcasses will be removed as schedules permit and the information recorded on the back side of the Stream Survey Log form.

Adult salmon spawning distribution in the first one-third mile of each stream will be mapped on the Lower River Stream Survey Spawner Distribution Map form (Table 21). In addition, a brief description of the habitat will also be recorded on this form.

Table 19.

AA-84-13

Station: _____ Sample No.: _____

Date: / / 84 Species: _____

Unit of measure: Metric

Type of length measurement: FL

No.	Species	Sex M	Sex F	Length	Age Class	Other Information
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

	M	F
TOTAL EACH SEX		

Table 20.

Page ___ of ___

Date 1/ ___/___/84

Stream _____

AA-84-18
STREAM SURVEY LOG

Area	Survey Conditions 2/	Species Surveyed	No. Live Tagged Fish										Comments 4/
			No. Observed			Petersen Disc				Spaghetti			
			Live 3/	Dead	Total	Blue	Yellow	Green	Int. Orange	Pink	Blue	Green	
Mouth		Chinook											
		Sockeye											
		Pink											
		Chum											
		Coho											
Mouth to Standard Index Point		Chinook											
		Sockeye											
		Pink											
		Chum											
		Coho											
Additional Distance Surveyed (Optional)		Chinook											
		Sockeye											
		Pink											
		Chum											
		Coho											

1/ Month and day.
2/ Poor, fair, good or excellent
3/ Include all live tagged and untagged fish.
4/ Note overall activity of salmon at mouth only and additional distance surveyed.

Table 21.

AA-84-07
Lower River Stream
Survey Spawner
Distribution Map

Stream _____ Observers _____

Date _____

General Habitat Description of Spawning Area(s):

Main channel, slough and side channel spawning will be recorded on the Adult Anadromous Spawning Site Map form (Table 22). Information recorded will include date, river mile, geographic code, a map of the spawning site, number of fish and a general habitat description.

Egg deposition sampling data will be recorded on the Egg Deposition Sampling form (Table 23). Information collected will include: date, location, number of plots sampled, number of live eggs and number of dead eggs.

All survey data will be returned to the Operations Control Leader every three weeks, who will edit the data and forward it to the Data Processing Section.

Middle River

Stream survey, main channel and side channel spawning and egg deposition sampling data procedures are the same as those discussed for the Lower River Surveys.

Escapement surveys of sloughs will be recorded on the Slough Survey Log (Table 24). For each survey a recording by species of the live and dead fish count, tagged and untagged fish numbers and survey conditions and distance surveyed in percentage will be made. Under the comments column include surveyors name(s) and reference to tag loss.

Table 22.

AA-84-05

Adult Anadromous Spawning Site Map

Date: __/__/ 84

Crew: _____

Location: _____ River Mile 1/: _____ GC 2/: _ _ / _ _ _ / _ _ _ / _ _ _ /

Description: _____

1/ Upper river mile

2/ Geographic code for upper river mile

Table 23.

Page ___ of ___

AA-84-07

EGG DEPOSITION LOG

Date ___/___/ 84

Location: River Mile _____ Geographic Code: __ __/ __ __ __/ __ __ __/ __ __ __

Plot Number (Sequential)	Number of Eggs			REMARKS 1/
	Live	Dead	Total	

1/ Include names of survey staff and substrate description.

Table 24.

AA-84-17
SLOUGH SURVEY LOG

Slough No.	Date	Survey 1/		Species Surveyed	No. Observed			No. Live Tagged Fish							Comments 3/
								Petersen Disc				Spaghetti			
		Cond.	Distance		Live 2/	Dead	Total	Blue	Yellow	Green	Int. Orange	Pink	Blue	Green	
				Chinook											
				Sockeye											
				Pink											
				Chum											
				Coho											
				Chinook											
				Sockeye											
				Pink											
				Chum											
				Coho											
				Chinook											
				Sockeye											
				Pink											
				Chum											
				Coho											

1/ Survey conditions: poor, fair, good or excellent.
Survey distance: note by percentage (i.e. 100%)
2/ Include all live tagged and untagged fish.
3/ Note overall activity of salmon at mouth only; survey personnel; tag loss, etc.

All carcasses bearing Talkeetna Station tags will be examined and the number, species, date and location recorded on the back side of the Stream Survey Log form or the Slough Survey Log form. Similar procedures will be followed for carcasses bearing tags from other stations as schedule permits.

All survey forms will be returned to the Operations Control Leader once every three weeks. The data will be edited and forwarded to the Data Processing Section.

Stream Life

The Stream Life Log form will be used to record site observations of sockeye and chum salmon tagged at Curry Station (RM 120) (Table 24).

Data recorded will include site location, date, fish identification number, species and behavior and or condition of fish (i.e., milling, spawning, post-spawning, carcass).

APPENDICES

ADULT ANADROMOUS FISHERIES STUDIES

APPENDIX 1

ADULT ANADROMOUS FISHERIES STUDIES

Sonar Installation and Operation Manual

THE BENDIX CORPORATION

Electrodynamics
Division
North Hollywood
California

INSTALLATION

AND

OPERATION

MANUAL

SIDE SCAN

SALMON COUNTER

(1980 model)

Report No.
SP-78-017
10 March 1980

Prepared for:
The State of Alaska
Department of Fish and Game
Anchorage, Alaska

Revised October 1981 by
Susan L. Ellis
Su Hydro Project

TABLE OF CONTENTS

INDEX

INTRODUCTION

Before attempting to operate or install the Side Scanner, thoroughly read this manual to become familiar with the system operation.

Section I will familiarize you with all the controls and their purpose. It is probably the most important section of this manual.

Section II will show you how to initially set up the unit and test it to determine that it is operating properly. Read this section before applying power to the unit.

Section III will aid you in pinpointing any source of problems and in making any necessary field repairs by replacing printed circuit cards.

Section V will show you how to install the artificial substrate in the river.

I. FUNCTION OF FRONT PANEL CONTROLS

A. PRINTER

1. Printout

The printer prints out 12 lines of data. The number at left designates the river sector, the next column is a letter identifying various conditions such as normal, command print or auto test. These letters are explained on the front panel. If normal, the letter "A" will be printed. This may appear as a dot on the 1978 model. The following four digits are the number of fish counts that have been accumulated in each sector. Each sector represents a length of river, perpendicular to the shore that is equal in length to 1/12 of the "COUNTING RANGE" control setting, with sector 1 being closest to shore. For example, if the "COUNTING RANGE" control is set to 60 feet, then each sector represents 5 feet in distance. A "+" in the third column indicates debris has been detected in the corresponding sector. Anytime PRINTOUT TIME OR AUTOTEST TIME is changed, the time must be reset.

2. Set Time (Printer)

The purpose of this pushbutton is to initially set the printout time and auto test time at any point. The "SAFETY SWITCH" must be off to do this. Set time to print out on the hour.

3. Print Command

The printer may be commanded to print its contents at any time without affecting the timing. The letter "C" is printed when this pushbutton is depressed to permit you to know that this is a command print and not in the normal time sequence. The printout timing is not affected but the counts are erased after printout. Erasure of data on 1978 and '79 models can be avoided by setting the DATA CLEAR TIME switch to the NEVER position until printout is over. On 1980 models the command printout should be added to the next hourly printout.

4. Printer On-Off Switch

This switch does not affect the timing or data in any way and is merely used to shut off the printer. The sounder will sound to alert you to put the printer ON-OFF switch back on. It normally takes only a minute to change paper so try to plan your paper change between prints or a complete printout may be missed without your knowledge. On models using the "DATEL" printer, be sure to shut off the printer switch when changing printer paper.

5. Replacing Printer Paper

A blue line on the paper alerts you about 1 day in advance of paper depletion. To change paper, shut off the printer switch and unscrew the 2 small silver knurled screws on the printer face. Lay a new pad of paper in the rear tray with the blue lines toward the tray bottom. Feed the paper over the silver roller in front and between the plastic face and rubber roller. Start the paper by revolving the rubber roller with your finger. During operation place a binder clip on the end of the tape as it comes out of the counter. Hanging the clip over the edge of the counter stand will allow tape to move smoothly out of the counter, eliminating printer malfunction. If the printer tape doesn't feed smoothly and hourly printouts are superimposed on each other, clean the black rubber roller thoroughly with alcohol. When the paper runs low the printer may skip printouts, so it is important to avoid letting the paper run too close to the end of the roll. When replacing the printer, push it in while making sure the paper is not pinched between the printer and panel by manually pulling some paper out of the slot. Make sure the printer seats completely flush with the panel since an electrical connector must make contact. Retighten the two knurled screws as tightly as possible with your fingers.1/ If the ink becomes dim after 2 to 4 years of operation, loosen the two black screws on the printer face and pull out the ink pad. A new pad may then be screwed in. Spare pads have been supplied to the State of Alaska and spare printers have been included. Any printers may be interchanged between systems, as they are identical.

B DATA CLEAR TIME

Data is cleared (erased from memory) after each printout. Set for AT PRINT position on 1978 and 1979 models.

C. CLEAR PUSHBUTTON

The red CLEAR pushbutton located on the left side of the panel will clear the data in the memories controlling the printer and 4 digit liquid crystal display. It does not affect the cumulative counter at right. To clear the data, the "SAFETY" switch must be "OFF". The sounder alerts you when this switch is left off.

1/ Screw on printers must be tightened daily as vibrations can cause them to loosen.

D. 4 Digit Display and Manual Sector Selector

The liquid crystal display shows you the number of counts accumulated in any of the 12 sectors that is selected by the black thumbwheel switch above it. It is always on since it uses only 1 microamp of current. Being liquid crystal, it is a reflective display and requires some ambient light to be seen At night a flashlight or match may be necessary to see it.

E. Meter, Meter Switch and Battery

When in the "BATT" position, the meter reads the condition of the GEL- CELL battery. When in the "SOLAR CHARGE" position, the meter reads the output of the solar panel. In full, unobscured sunlight the meter will read at the extreme right indicating the solar panel is supplying 12 times the current that the Side Scanner is using with the excess going to charge the supplied GEL-CELL battery. When the meter is at the point where the red and green meet (such as cloudy weather) the solar panel is supplying twice as much current as the Side Scanner is consuming with the excess going to charge the GEL-CELL battery. This would be enough to indefinitely carry it through the night hours. Although a 12V, 16 amp hour rechargeable GEL- CELL battery is supplied with each system, any 12V battery of equal or greater capacity may be used. The supplied battery, when fully charged, will operate the Side Scanner for approximately 300 hours, or about 2 weeks, day and night, with no solar charging. Internal protection is provided against battery overcharging in the event of constant full sun.

F. Fish Velocity Control

This thumbwheel switch controls the transmit repetition rate of the system. It has been observed that salmon migrate upstream at about 1.75 feet per second (ground speed). Since the switch is labeled in seconds per foot, the reciprocal of 1.75 feet per second is 0.571 seconds per foot so until new fish speed information is obtained, set the control to 0.571. To determine optimum velocity use the following formula after monitoring the oscilloscope for a minimum of 250 cumulative fish spikes:

$$\frac{\text{Fish counts on the SSS counter}}{\text{Fish spikes observed on oscilloscope}} \times \text{existing velocity} = \text{new velocity}$$

e.g., if the SSS count is 200 and the scope count is 250, 200/250 x 0.571 = .457, the new velocity setting. If the ratio of sonar counts to scope counts is within 0.8 and 1.2, do not adjust velocity. The reason behind this is as follows: When the side scan sonar is overcounting the fish are in the beam too long; the pulse repetition rate is too high. The solution is to decrease pulse repetition rate by dialing fish velocity up (remember, the velocity dial is the reciprocal of fish swimming speed). Likewise, when the sonar is undercounting, the fish are

F. Fish Velocity Control Cont.

not in the beam long enough; the pulse repetition rate is too slow and the fish velocity should be dialed down.

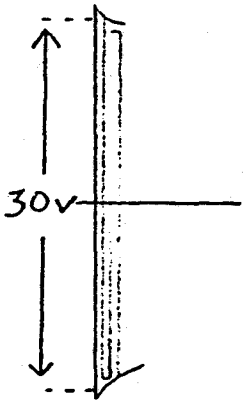
It has been observed that at the lower extreme of the velocity setting (i.e.< .150) the side scan sonar counters tend to function erratically. Such settings should be avoided. If undercounting problems persist at higher settings, the transducer may be misaimed or the sensitivity set too low.

G. Sensitivity Control

This controls the amount of power transmitted to the transducer and is essentially a system sensitivity control.

To adjust it initially requires a fine bladed screwdriver or knife and an oscilloscope. It is adjusted as follows:

(1) Connect the oscilloscope input to the red test point on the panel marked XM2°. Set the vertical sensitivity of the scope to 5V per division and the scope trigger to internal. Set the horizontal scope sweep speed to 50μsec per division. Make sure the transducer is properly connected and in the water.



(2) Set the beamwidth switch to 2°. Adjust the front panel sensitivity control for an average peak to peak (top to bottom) signal of 30V. It will look something like the waveform at left so adjust for an average as shown.

(3) For a quick method to check sensitivity set the volts/div to 5 and time/div to 50μseconds. Turn both red "fine tuning" knobs fully clockwise. Make sure the lever on the for right of the scope face is in the bottom position (EXT TRIG OR HORIZ - DC). Plug the scope trigger lead in the XM2° test point and the vertical input lead in the back of the external trigger lead.

(4) A sensitivity setting of 30 volts is only a starting point and may be adjusted depending on individual situations. If the counter is undercounting, it may help to increase the sensitivity. However, at settings ≥ 60 volts minor bits of debris and water turbulence may cause false counts, so care should be taken not to set the sensitivity too high. Cloudy or muddy rivers usually require a higher sensitivity than clearer rivers.

H. Dead Range Control

This controls the distance from the face of the transducer that the system is "blanked out". That is, any echoes received within

H. Dead Range Control (Cont.)

this preset range will not be accepted for processing. The control may be set from 0 to 10 feet. This control is necessary to blank out transducer "ringing" which occurs for about 2-1/2 feet and would result in false counts. Sometimes a source of air bubbles near shore exists which could false counts. In this case, increase the DEAD RANGE control until the count stops in sector 1 (as evidenced by the #1 fish light blinking). The fish would then have to be weired out to beyond the dead range.

During periods of extreme high water false counts may register in the first one or two sectors possibly due to increased water velocity, increased turbidity or a combination of the two. In this case the dead range may be dialed out to 3 or more feet to avoid overcounting until the river returns to a normal level.

I. Counting Range Control

This controls the total perpendicular distance to which fish counts will be accepted. This preset distance starts immediately after the DEAD RANGE ceases, thus the total range from the face of the transducer is the total of both the "DEAD RANGE" and "COUNTING RANGE" settings.

J. Transducer Aiming

The end of the artificial substrate contains a target, approximately 60 feet from the transducer face. This is necessary for initial aiming of the transducer beam. Prior to submersion the transducer plate should be flushed on all sides with the transducer housing. This can be accomplished by "feel" or using a straight edge.

An oscilloscope should be used in lieu of the #12 FISH LIGHT for more precise aiming. To do so, trigger the oscilloscope from the XM2° panel test point, connect the scope ground to the GND test point and the scope input to the RCVR test point. Set the scope vertical control to 1 V/CM and the horizontal control to 5 millimeters per cm. 1/. The target will be observed on the scope 24 milliseconds from the start of the trace and the transducer may be manipulated for a maximum "spike" at that point. If the transducer is aimed to low, early echoes coming from rough surfaces on the pipe will be seen before 24 milliseconds.2/

The new (1978) artificial substrates have an improved method of transducer adjustment and have transducers modified for the new substrates (see figure on the last sheet.) The transducer plate

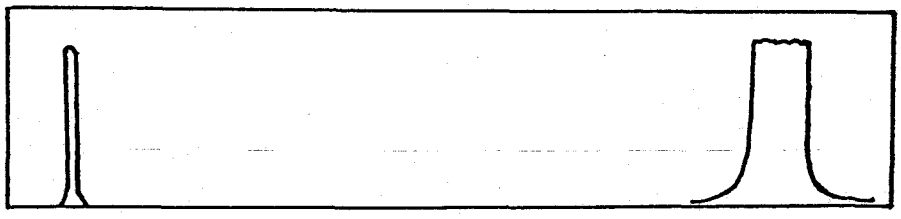
1/ See section titled Oscilloscope Operation for the Side Scanner.

2/ See section titled Typical Side Scanner Oscilloscope Waveforms for various transducer aiming conditions.

J. Transducer Aiming (Cont.)

should be installed in the shroud on the shore end member. The 3 studs attached to the plate will be secured to the plate with the 3/8-16 locknuts. Use lockwashers and tighten with channel lock pliers. About 1 1/2 inches away there will be a 1/2-20 nut followed by a flat washer, a spring and flat washer in that order. The three studs should be pushed through the three corresponding holes in the shroud with the last flat washer against the inside of the shroud. A hand wheel should then be screwed onto the outside of the shroud on each of the portruding studs. Extreme care should be taken when installing or removing the transducer from the housing as the springs tend to fall off and get lost in the river. To avoid this, tape the springs to the studs with a small piece of tape. The transducer and transducer cables should be fed over the top of the transducer and back to shore, securing them with tape to prevent chafing and to provide a little service loop to prevent their being torn off the transducer. The three hand wheels should be tightened with an equal amount of stud protruding through the wheel. The transducer will now be approximately aimed at the target end 60 feet away. (The remaining three hand wheels should be used after final transducer adjustment by running them up the stud and tightening them against the first wheel to lock them in place.)

To aim the transducer with the oscilloscope, set the beamwidth switch to 2° and the counting range to somewhat over 60 feet so that the target is counted (the #12 sector light will constantly blink). The beam should be low enough to just miss counting reflections from the pipe itself. To raise the beam, screw the upper wheel clockwise (to the right) one turn for each 3/4 foot beam movement 60 feet away (or counterclockwise to lower it). The scope trace should appear relatively clean (free of spikes) on 2° and show a few small spikes at the end of the substrate on 4° (see section titled Typical Sice Scanner Oscilloscope Waveforms for schematics of various transducer aiming conditions). A typical schematic of a strong target on 2° beam (expanded horizontally) is shown below:



transducer face target

A good target is broad and flat across the top and not varying in height. Once the target has been adjusted vertically it can be adjusted horizontally. To move the beam to the right, turn the lower right wheel clockwise and the lower left wheel the

same amount counterclockwise at the same time. To move the beam to the left, reverse the procedure. Horizontal movements should involve exactly the same amount of turning on each wheel to avoid "skewing" the beam out and up or down. Each full turn of both wheels together will move the beam horizontally 1 1/2 feet. By turning them together, the vertical aiming remains unchanged. Likewise, adjusting the upper knob does not affect horizontal beam movement.

From the "flushed" position, the transducer should be moved up or down stream as much as necessary to achieve a strong target. In a strong current the pipe tends to bow out so the transducer may need to be aimed a bit upstream to compensate. In cases where fish tend to migrate close to the surface over the substrate, the beam may need to be aimed high and downstream. Frequent monitoring of the oscilloscope and experience with aiming are the surest means of achieving a good target and counting maximum numbers of fish.

It has been observed that when water level rises considerably over a short period of time the target becomes weak or disappears completely. This may be caused by the increased velocity bending the tube, requiring an adjustment of the horizontal position of the beam. If no target can be found when making vertical adjustments of the beam, it may be due to irregularities of the river bottom. If the end of the tube is hanging over a ledge or if the tube is resting on a rock, the target end will be lower than the rest of the tube and may not be locatable by aiming the transducer. In this case the beam should be aimed low enough to just avoid reflecting echoes from the surface of the tube. When no target can be found at all and the printouts are all zeroes, it may be that a large piece of debris is lodged on the transducer, blocking transmission of the beam. This should be checked before adjusting the transducer.

K. Cumulative Counter

This counter maintains a running total of all counts. It is an 8-digit counter and being of the L.E.D. type, consumes a fair amount of power when lit. For this reason a "READ" pushbutton is provided below it to read the total when desired. To clear the cumulative counter, shut off the SAFETY switch and depress the CLEAR pushbutton located below the counter. The alarm will alert you that the SAFETY switch is OFF.

L. Safety Switch

This switch is an interlock provided to prevent accidental clearing of the data or accidental resetting of PRINTER time or

AUTOMATIC TEST time. Whenever it is left in the OFF position the sounder will sound, alerting you to this fact.

M. Sounder

The sounder will alert you whenever any of the following three switches are left in the "wrong" position to prevent walking away from the unit in that condition: (The sounder will "click" whenever a fish is counted).

a. Sounds when "DATA" switch is left OFF.
b. Sounds when "PRINTER" switch is left OFF.
c. Sounds when "SAFETY" switch is left OFF.

Speaker may be covered when working to lessen obnoxious noise. However, the speaker is not a gum repository.

N. Test Pushbutton and Data Switch

The purpose of this test is to verify proper functioning of almost the entire system (except the transmitter). This button, when depressed, electronically simulates fish in the first 11 sectors. When the system is operating properly, the first 11 fish lights will blink, the sounder will sound, the cumulative counter and the 4-digit counter at left will record these counts. If only a partial system test is desired, without interfering with data already present in the memories or the cumulative counter, the DATA switch should be left OFF. This will prevent these "false counts" from being recorded but will permit the FISH lights to blink. When a full system test is desired at the cost of losing the data already present, the DATA switch may be left ON.

O. Fish and Sector Lights

The two red SECTOR L.E.D.'s indicate that the electronics logic card is probably functioning properly. The sector lights must always blink. If a light(s) does not blink, the cause may be merely a burned out light. This can be verified by dialing the large thumbwheel switch to the sector in question and simulating fish by depressing the TEST pushbutton with the DATA switch ON. If data is recorded in that sector, it merely means that either the light is bad or the L.E.D. card in the system is bad, which will not affect proper operation.

To check sector 12, merely increase the RANGE control setting a few feet to "count" the target at the end of the substrate. The FISH lights will blink whenever fish are detected in the corresponding sector and the sounder will sound.

P. Automatic Test

This feature permits automatic self testing of the entire system

including the transducer and its proper aiming. It functions automatically each 12 hours (1978 and 1979 models can be set at 6, 12 or 24 hours. Set at 24 hours) as follows: To start the 12 hour timing sequence at any point in time, press the SET TIMES red pushbutton. This initiates both the printer and auto test times. Precisely 2 seconds after the normal printout 12 hours later, the system will go into an automatic test mode. It will automatically electronically simulate between 2 and 7 fish in each of the first 11 sectors and it will automatically extend its range by 3 feet, thus counting the artificial target 60 feet away and recording these counts in sector 12. It will then print out all these counts and the letter E in the second column to indicate a self start. 1978 and 1979 models will have letter I in the second column. None of these counts will enter the cumulative counter at right, and will be erased right after the print.

Q. Test Points on Panel

The test points have the following purposes:

1. XMALT. This test point is connected to the 4° section of the transducer which shows the transmitted voltage when the unit is transmitting at 4°.

2. The XM2° test point is directly connected to the transducer sector that is selected by the beamwidth switch and permits oscilloscope reading of the transmitted voltage, thus checking the transmitter card in the system. The 4° transmit will always by considerably higher than the 2° transmitted voltage except when the beamwidth switch is set to 2°. When the BEAM WIDTH switch is in the ALT position, the transmitted voltage can be seen to alternately go high and low as the 2° and 4° sectors are automatically selected.

3. RCVR test point. This test point is the receiver output and gives a true "analog picture" on an oscilloscope of what is happening in the water. Any echoes received are amplified and presented at this test point. Any time the echo exceeds 3 volts at this point for the proper pre-programmmed number of "hits" it will result in a count. To use this feature, the scope input is connected to the RCVR test point, the scope ground connected to the GND test point and the scope may be triggered from either the "XM" test point which permits observation of the entire 60 feet or from any one of the "SCOPE - TRIG" test points which starts the scope trace at the beginning of any of the 12 sector "listening times". The scope trigger must be set to - . By doing this and properly expanding the scope sweep speed, any one or more of the 12 sectors may be individually observed.

R. Beamwidth Switch

This switch electronically controls the transducer beamwidth by connecting only the center section of the transducer for a 4° beamwidth or paralleling both the center and outer transducer sections for a 2° beamwidth. Any of the three modes may be selected, but for optimum coverage, the ALT position should be used since this tends to make the lateral coverage more uniform. When in the ALT position, the system alternately transmits on the 2° sector then on the 4° sector and back to the 2° sector, etc. After transmittimg on the 4° sector, only those echoes received during the first half of the active range are accepted (sectors 1 through 6). When transmitting on the 2°sector, only those echoes received during the last half of the active range are accepted (sectors 7 through 12). The system electronically gives more weight to sectors closer to the transducer face since the fish will be in the beam a shorter period of time because of the fact that the closer to the transducer, the narrower the beamwidth. Anumber of samples of each fish are taken, permitting different "aspects" of the fish to be sampled as it crosses the beam. A varying number of valid "hits" are required before the system "decides" the target is a fish and enters it into permanent memory. The number of valid hits required for detection is a function of which of the 12 sectors the fish was detected. For example, although a fish travelling at 1.75 feet/sec is sampled 9 times, if it is detected in sector 9, only 5 valid "hits" are required to count, so if 5,6,7,8 or 9 hits are made during the passage of the fish only 1 count will result.

This feature essentially eliminates downstream passing debris which typically is travelling at the river velocity which is usually much faster than 1.75 ft/sec and which would not be in the beam long enough to count. To prevent single debris counts occurring over a period of time from adding up to the number required for a valid fish count, the temporary fish decision memories are automatically cleared 4 transmissions after receipt of any single echo.

S. Debris Alerting

Any time 24 counts are made in any one of the 12 sectors in a 35 second period (starting from the first count), the system assumes that this cannot be fish and is probably a piece of debris hung up on the artificial substrate. When the next printout occurs, the corresponding sector column will contain the symbol " + " in the third column next to the sector identification number. After printout, the debris detector is cleared and starts out "fresh" again. If the debris is still present, the system will again accept up to 24 counts in 35 seconds and indicate " + " again. If the debris has washed away, it will resume normal operation.

NOTE: Some of the front panel switches are of the PULL TO CHANGE types. This is to prevent inadvertent changing of the switch positions. The switch handle must be pulled away from the panel and then changed. Make sure that the switch is firmly seated in the desired position.

II. INITIAL SET UP AND SYSTEM TEST

To verify proper system operation when first turned on or anytime desired, do the following:

Before the battery is plugged in, which turns on the system, place the following switches in the noted positions:

(1) PRINTER OFF.

(2) TRANSDUCER NOT PLUGGED IN.

(3) SAFETY SWITCH OFF.

(4) METER SWITCH IN BATT POSITION.

(5) FISH VELOCITY to 0.571.

(6) DATA ON.

(7) ACTIVE RANGE to about 50 feet.

The remainder of the controls may be left in any position.

Next, plug in the battery and then press the SET TIMES pushbutton (this synchronizes the system). Some of the FISH lights may remain on. To clear the system, press and hold the red TEST pushbutton, noting that each of the FISH lights blink in sectors 1 through 11. The system is now cleared and ready for operation. At this time, the SECTOR lights should be blinking and the BATTERY CONDITION METER should be in the green. Press the two red CLEAR pushbuttons to erase any counts from the memories. Press and hold the red TEST pushbutton. This will simulate counts on sectors 1 through 11. Hold it in until a few hundred counts appear on the CUMUL counter. (You have to press the black READ pushbutton to see this.)

The next step will be to verify that counts have been registered on each section of the 4-digit liquid crystal display and that the printer is functioning, and that all counts agree. To do this, turn on the PRINTER switch and momentarily press the black PRINT COMM pushbutton. The printer should now print out 12 lines of data. The column at left will be the sector identification number and should sequentially read 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2. The next column should have

printed the letter "C". Dial the large black thumbwheel switch through its 12 positions and compare the numbers in the 4-digit numerical display with the corresponding blue printed columns. They should agree.

Next, add up the column of figures. The total should agree with the total CUMUL count within one or two digits.

Solar Panel

The purpose of the solar panel is to charge the 16AH GEL-CELL battery supplied with the system.

Mount the solar panel such that it will receive a maximum average amount of light throughout the day. Plug it into the side connector marked SOLAR PANEL, observing polarity (this means red to red and black to black). If the solar panel is connected backward, no damage will result, but the meter will read no solar charge when exposed to light. Put the METER switch in the SOLAR CHARGE position. If full sunlight is falling directly on the solar panel, the meter will be at the extreme right. In very cloudy weather the meter will probably be in the red. When it is at the red/green crossover point, the solar panel is supplying twice as much current as the system is consuming, with the excess going to the battery. This condition will be adequate to indefinitely carry the system through the night hours. Make sure no part of the solar panel is shaded because shading one cell is the same as shading the entire panel.

III. TROUBLESHOOTING

Many complete sets of printed circuit card spares have been supplied to Alaska Department of Fish and Game. They contain pre-tested cards of every type used in the Side Scanner System. They are identified by a function name etched on the component side of the cards at the upper left corner of the card. The following table lists the P.C. card names and their functions to aid in troubleshooting.

Printed Circuit Card Name & Location in P.C. Card File	Card Function
MEMORIES (Slot 1 & Slot 2) These 2 cards are identical.	The memory cards store valid fish counts after the electronic decision has been made if debris or fish. They drive the 4 digit liquid crystal display and the printer. They have nothing to do with the cumulative counter display. The 2 cards are identical and interchangeable. The memory card in slot 1 controls the two most significant digits of the display and printer fish counts, i.e., the two digits on the left. The memory card in slot 3 controls the 2 least significant digits of the display and printer fish counts, i.e., the two digits on the right.

Printed Circuit Card Name & Location in P.C. Card File	Card Function
LOGIC (Slot 5)	The logic card controls the system repetition rate (or "ping" rate). It controls the duration of the transmit signal, the 11 simulated fish counts for test, the automatic range extension during auto test, the counting range, the dead range, the smolt vs. fish function, the power to receiver, all the L.E.D. functions, the 12 sector scan, the cumulative counter, the sounder duration when fish are detected and the temporary memories which decide whether the echo detected is fish or debris. If debris, it is erased; if fish it is routed to the previously mentioned permanent memories cards for storage and then erased from this card. This card also controls the 2°, 4° and ALT beam routing in conjunction with the beam-width switch.
PRINTER (Slot 7)	The printer card controls the printer time clock the printer command, the 12 print sequencing, the printer sector I.D. number printed on the left of the printed paper, the letters printed next to the left on the printed paper, the automatic self test timing, the erasure or automatic clearing of the data after print, the tape recorder automatic power turn-on for 3.6 minutes after each print, and makes the decision whether a very high rate of counts is fish or debris and if debris it tells the printer to print the symbol "+".
RECEIVER (Slot 11) CAUTION: If this card is changed, it will be necessary to readjust the sensitivity screwdriver control on the front panel as discussed earlier in this manual.	The receiver card contains the receiver which takes the minute fish echoes, amplifies them 23,000 times and if the echo exceed a predetermined threshold it triggers a device which sends a signal to the temporary memory card for subsequent decision as to whether it was fish or debris. This card also contains a 9V regulator to power the entire system. It also controls the battery and solar charge meter and provides T.V.G. which means time variable gain which causes fish echoes detected far away to be amplified at a greater factor than fish close by since the echo decreases with distance in a log manner. This card also contains the transmitter which transmits a 515 kHz signal to the transducer. The card also contains part of the circuitry to electronically simulate fish in the first 11 sectors for automatic and manual test. The tape recorder power regulator is located on this card also.

Printed Circuit Card Name & Location in P.C. Card File	Card Function
LIQUID CRYSTAL DISPLAY CARD Located on front panel.	This card contains a 4-digit liquid crystal display on the front panel. If it becomes defective it may be removed from the inside by removing the two retaining 6-32 nuts and replacing it with a spare display card. If this is done, be sure the two flat plugs that are inserted in its connector are firmly inserted in the new card in identical orientation. The display has an average life of about 7 years. It will be noticed that in cold weather the display takes longer to change its numbers. This is a normal characteristic of liquid crystal displays.

Most of the card functions are self-explanatory so that in the event of trouble, a card may be replaced. Since many of the card functions are inter-related, a problem may sometimes not be definitely localized to a specific card and more than one card may have to be interchanged to cure the problem (one at a time).

To change a printed circuit card, disconnect the battery and solar panel. Remove the 6 screws holding the front panel and carefully lift the front panel straight up. It may then be turned and laid down next to the electronics.

CAUTION: The electronic components on the cards are susceptible to immediate destruction by static electricity. They should never be handled in an office where carpets generate static electricity.

Replace the suspect card with a new one and retest. The system can be operated in the open position so it will not be necessary to close the system to test it, but be very careful not to short anything.

To remove a card, pull up on the two card ejectors. To replace a card, press the card firmly down and hook the combination black card ejector/inserter under the ridge of the card file and push the two black inserters down. These will force the card into its sockets and may have to alternately be "rocked" until the card is firmly seated in its socket.

CAUTION: NEVER remove or replace a card with power from the battery or solar panel connected.

To replace the panel, reverse the removal procedure being careful not to

pinch any cables between the panel and the case. The 6 nuts are on sliding plates and may have to be repositioned with a knife blade if they were moved.

Some problems with the counter can be solved without changing cards. If the printer is malfunctioning, check to see that it is flush with the counter and the screws are fully tightened. Also make sure the tape is feeding out smoothly. If it is pulled out crookedly, the paper will become jammed. If the printer begins skipping hours and changing cards does not help, there is plenty of paper, the roller is clean and the battery is tightly plugged in, the problem may be a faulty power inverter. This requires repair by Bendix.

IV. SIDE SCAN ARTIFICIAL SUBSTRATE

General Description

The array (Figure 1A, 1B and 3) is made up of three 18½ foot long sections of tubes that plug together with an 18 inch overlap forming a single tube. Offshore and onshore sections terminate the assembly ends. A ¼ inch diameter wire rope runs through the assembly and is pinned to the offshore cap. The onshore cap has a threaded shaft and handwheel which is used to provide tension holding the array sections together by tensioning the cable. Cable should be threaded on the downstream side of bolts which hold sections together. Alignment of the vortex shedding fins on each section is required in order to prevent oscillation or vibration of the array in fast currents. Install and tighten the ¼" bolts on the welded brackets. These will squeeze the slots together thus securing the pipes together. On 1978 and 1979 arrays tighten bolts to 45 ft/lbs (second bolt from target end - tighten to 20 ft/lbs only). If too loose, the array will bend excessively, allowing fish to escape under the beam. If tightened to greater than 60 ft/lbs the bolts will break or the tube deform.

NOTE: The bolts should be tightened with the pipe upside down from the way it will lie on the river bottom. This will help straighten the pipe.

The offshore cap provides the wire rope termination, has a water check valve used for blowing out and floating the array, mounts the offshore cable attachment point and has a target attached for acoustic signal alignment. The onshore cap has a 2 inch diameter hole in the end which is used to stake the array in position on the shore. A second 2 inch hole may be used to tie off the array for safety. A mount for the transducer is provided on the cap. Both vertical and horizontal adjustment of the transducer is possible. A ½ inch diameter x 2 ft. long bar is provided to use as a lever for aligning the transducer on the 1976 systems. The new systems have adjustment handwheels. Mount the transducer in the upper 3 holes of its housing. A traveler, attached to the cable swivel, rides on a bar preventing rotation of the cable when tightening.

NOTE: The cable must be as tight as possible to prevent array breakup in fast river. Hand tighten only.

A ½ inch threaded plug is provided for an air hose to blow out and float the array prior to removal from the river bed. Netting is tied to the lower vortex fin. 1/8 inch diameter holes spaced at 1½ inch intervals provide net tie points. Holes are provided on both top and bottom fins as installation on the opposite shore requires turning the array end for end and rotating 180°.

NOTE: It has been found by A.D.F.& G. that if no air is available, the array may be raised by allowing the pipe to tilt down inthe direction of the water flow. The fairings act as ailerons and will raise the pipe to the surface. Conversely, when sinking the array, the stake on the shore end should be attached via a "come-along" to a tree and should be tilted upstream a few degrees to help sink the array and hold it firmly on the river bottom.

Assembly Procedure for 60 Foot Array

1. Lay out the following parts on a reasonably level surface parallel to the river bed in the order listed. Leave 1 foot of space between parts.

   1 each Offshore Cap.

   2 each 18½ foot section with couplers attached.

   1 each 18½ foot section without coupler.

   1 each Onshore Cap (screw in tension screw handwheel all the way).

2. Attach swivel end of ¼ inch cable to eye on threaded tension screw.

3. Feed opposite end of cable (with eye) through the 18½ foot tube sections. Cable must pass through center hole in bulkheads (two places), and on downstream side of 3/8 inch bolts.

4. With the onshore cap transducer housing straight up, slip the first 18½ foot section onto the shore cap (male), reduced diameter, align the bolt holes and install ¼ inch diameter bolts. Fitting coupler sections into 18½ foot sections is made much easier by spreading the welded brackets apart with 2 or 3 disc brake pad spreaders. Before fitting sections together, coat the outside of coupler sections with clear silicone to prevent air leaks. Also coat both ends of bolts, cable anchor bolt, endplate and offshore cap. Be sure 18½ foot sections face in the right direction. Fins go downstream.

5. Install second and third section in similar manner. If couplings hang up and do not seat, the cable and tension screw can be used to pull the couplings together. However, care must be taken to align the fins during coupling insertion as turning the sections after complete assembly may be difficult.

6. Insert cable eye through the offshore cap and install cap on last section. Insert bolt. Target (curved projection) should be up.

7. Install end plate (with slot for pin) onto offshore cap. Cable should project through cap center hole and extend out about 12 inches if all couplings are seated.

8. Start to tighten the handwheel inside onshore cap until cable eye is aligned with slot in end plate.

9. Install pin through eye and seat in slot of end plate.

10. Tighten cable hand tight, using handwheel. All couplings should now be fully seated. When tightening, insert a long screwdriver in the far end of the swivel assembly to keep the traveler bar from twisting as the cable is tightened. The cable tightens by turning the knob counterclockwise and loosens by turning it clockwise. Two nuts should be screwed on both in front of and behind the handwheel to allow the shaft to turn as the knob is turned.

11. Install coupling bolts and cap nuts not previously installed. Tighten to 20 ft/lbs only, apply silicone.

12. Install end cap onto end plate covering cable.

13. All seams must be sealed to prevent air leaks when raising the tube. Apply silicone generously to each joint and wrap with insulation tape (such as 3M Scotchfill Insulation Putty Tape). Cover this tightly with gray 2" PVC tape, overlapping the seam 2 inches on each side. Place 2 connected 8 inch hose clamps on each side of the seam and over tape. Tighten clamps, being careful to keep clamp nuts to the downstream side of the tube and out of the beam path.

14. The array is now ready for placing into the river.

Array Installation Procedure

1. Before placing the array in the river, the chain anchoring the net should be tied up to prevent it from snagging on debris during deployment. It is easiest to thread a line through the links and tie it to the holes in the fins. This can be readily cut when releasing the net. Make sure the ½ inch plug on top and 3 inch floodcap on the side are in before putting the array in the water.

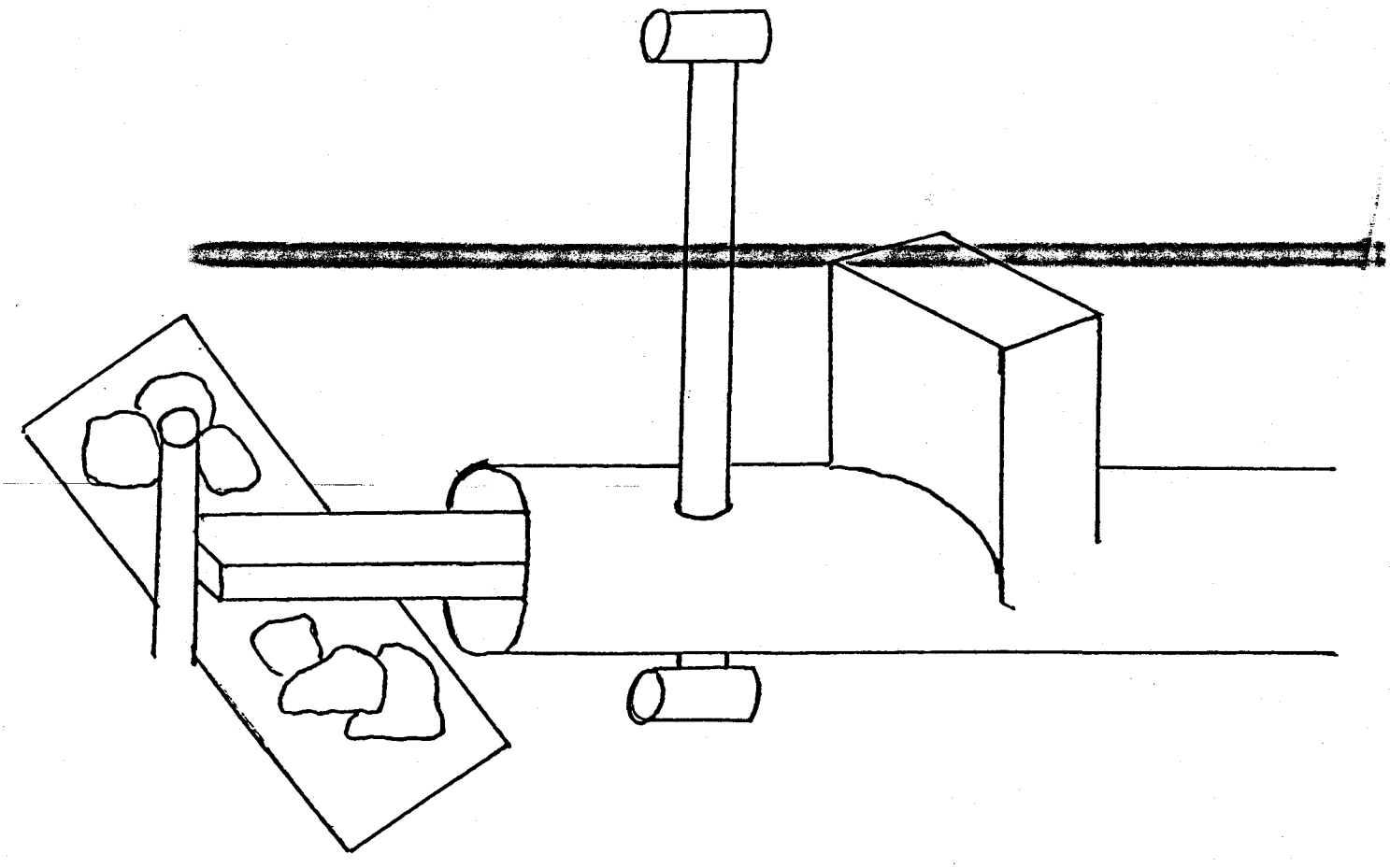
2. Attach an appropriate shore cable ¼ inch minimum diameter to upstream end of collar provided on offshore cap. The longer the cable, the easier it will be to move the array in and out. Attach the other end of the cable to a stake, tree or other available attachment point. CAUTION: In 7 foot per second currents cable tension of floating array will be as high as 850 pounds.

3. Attach another cable to the 2 inch hole on the upstream side of the inshore end of the array. The other end of the cable should be attached to a tree or stake onshore. Moving the array out will be much easier if the cable runs as closely to parallel with the bank as possible.

4. Once both cables are attached, the offshore end should be gradually let out, allowing the array to swing out into the current until it is perpendicualr to the bank. In fast rivers the current may tend to push the tube out parallel to the bank as the offshore cable is being let out. As a safety precaution against this, it is a good idea to tie a short rope from the standpipe to a stake or tree onshore. (The standpipe is a 4 foot x 2 inch O.D. steel pipe inserted in the 2 inch holes behind the transducer housing with T-caps screwed onto both ends. This allows easier movement of the array and is a handle by which you can "aileron" the array).

5. Someone on the onshore end should be ready to place a boom log in the end of the pipe to hold the array out far enough so that about 6 inches of water covers the top of the transducer housing. The boom log can be held in place by weights or stakes (see drawing below).

6. When in place, cut the line holding the chain up and remove the ½ inch plug on top and the 3 inch floodcap on the side to allow the pipe to sink.



Array Removal Procedure

1. Blow out water in the array through the check valve located in the shore cap. This is done by removing the ½ inch pipe plug located in the shore cap and replacing with an air hose. Air pressure applied here (as from an air compressor) will force water out the check valve, floating the array.

   If no air is available, the alternate raising method described earlier may be used, i.e., allow the shore end stake to tilt forward (downstream) which will raise the array by the aileron action of the fins.

2. The floating array can now be hauled ashore either by pulling straight out or by pulling in the offshore cable.

Array Disassembly Procedure, See Figures 1A, 1B and 3

1. With the array on a reasonably level area, remove the end cap.

2. Untighten (screw in) the handwheel inside the onshore cap. This will loosen the tension cable and allow removal of the pin on the offshore end plate.

3. Remove the end plate.

4. Drive a stake through the 2 inch shore cap hole into the ground. Also drive a second stake into the ground about 10 feet from the opposite end of the array.

5. Attach the "Y" cable to the offshore cap, see Figure 3. Install come-along between stake and "Y" cable.

6. Remove through bolt of first section to be disassembled (any order is OK).

7. Pull apart with come-along.

8. Install 2 eye short cable between sections pulled apart. See Figure 3.

9. Remove next through bolt and pull apart next section.

10. Continue process until all sections are pulled apart.

General Caution Notes

1. Before placing array in water inspect check valve operation.

2. Cable must be tensioned before array deployment.

3. Do not turn array vortex fins into current in currents over 4 feet per second. Excessive load may damage array.

4. Installation of a cable around the onshore cap to a stake upstream on shore may be useful in a fast current river.

5. If corrosion prevents loosening of cable tension wheel on assembled array, the offshore cap pin may be driven out, after removal of the cap, thus releasing cable tension.

6. Handle exposed section ends with reasonable care to avoid nicks or tube distortion.

7. Be sure ½ inch diameter carriage bolt in coupling sections are tightened to 45 ft/lbs in order to eliminate coupling to tube clearance thus preventing array sag. Never exceed 50 ft/lbs.

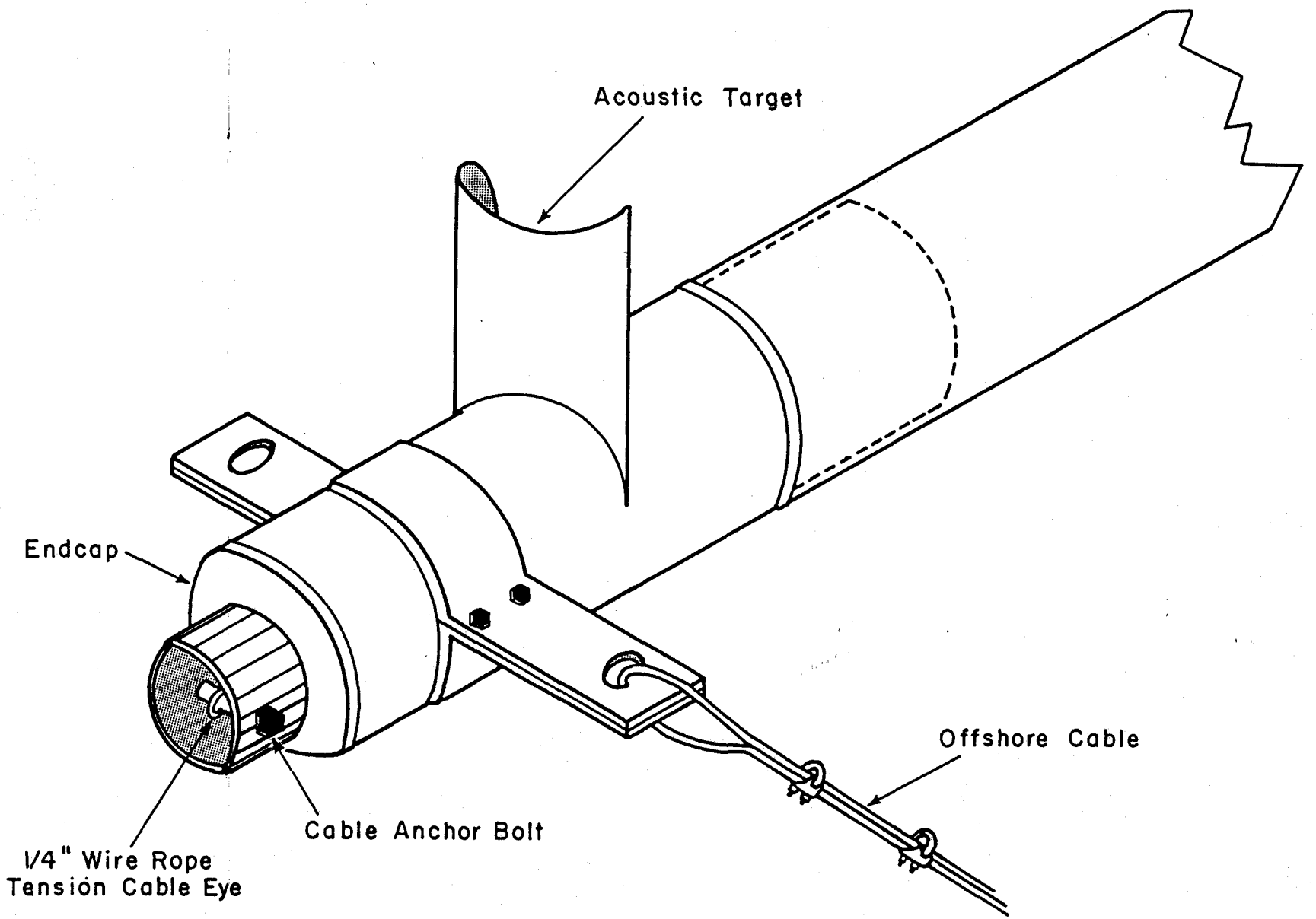
8. Transducer. The transducer, although reasonably rugged would be destroyed if dropped on a rock. Before use, the radiating polyurethane face should be washed with a detergent, preferably liquid detergent with the liquid left on the face. This cleans off finger oils. Any oil or grease will completely block the high frequency output and make the transducer inoperative. In some rivers, a buildup of various forms of "crud" may develop on the transducer face after a week or two, so a quantity of liquid detergent should be placed in the hand and the hand quickly put under water to rub the face of the transducer. This should be done whenever too much buildup of "crud" is felt or seen on the transducer face. A moderate amount of detritus will not affect normal operation.

Shortened Arrays

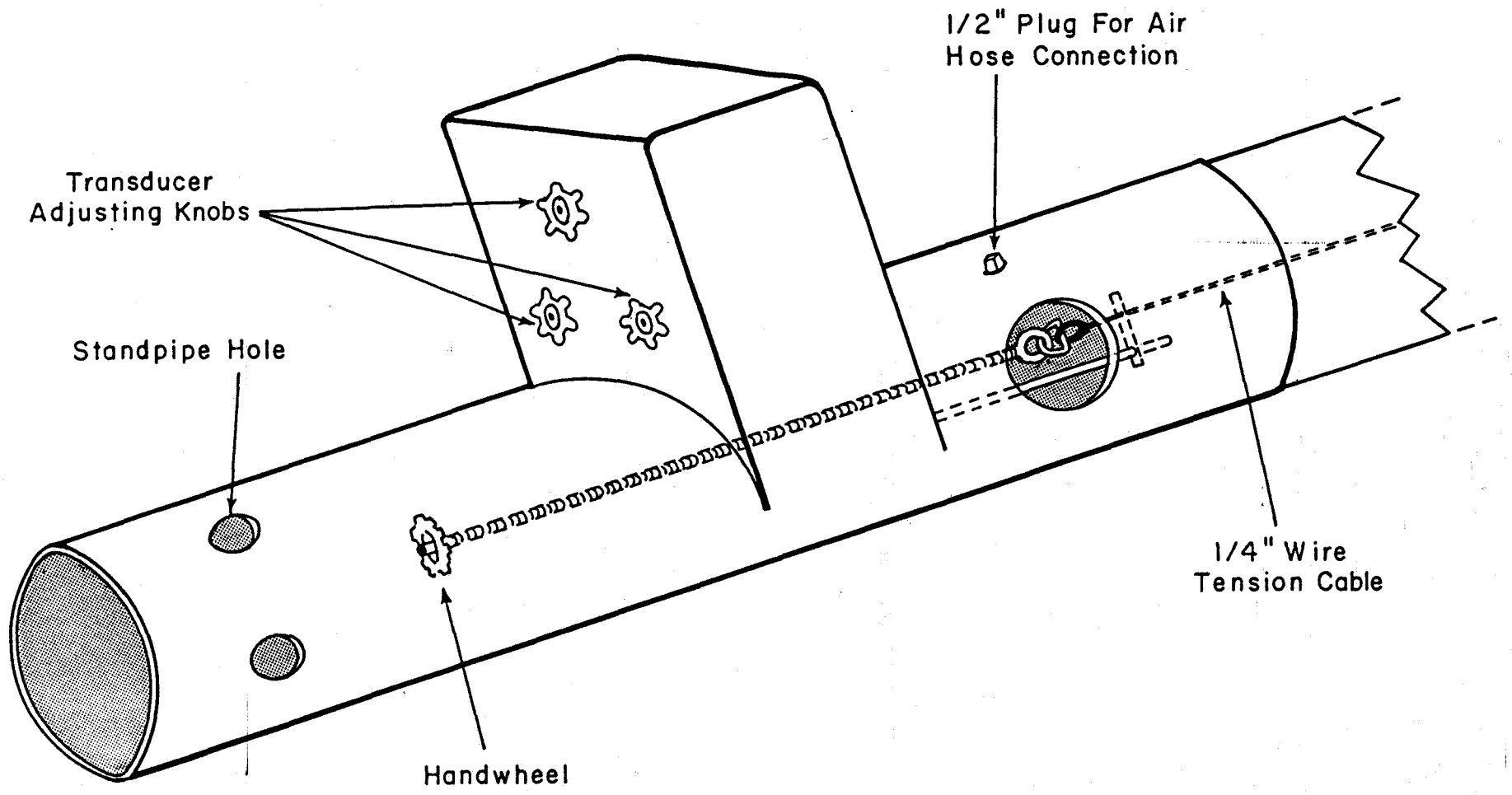
In situations where the current is swift or the fish hug the bank tightly it may be desirable to use only one or two of the 18½ foot sections to assemble a 20 or 40 foot array. Assembly procedures are the same as for a full size 60 foot array except that the inner cable must be shortened.

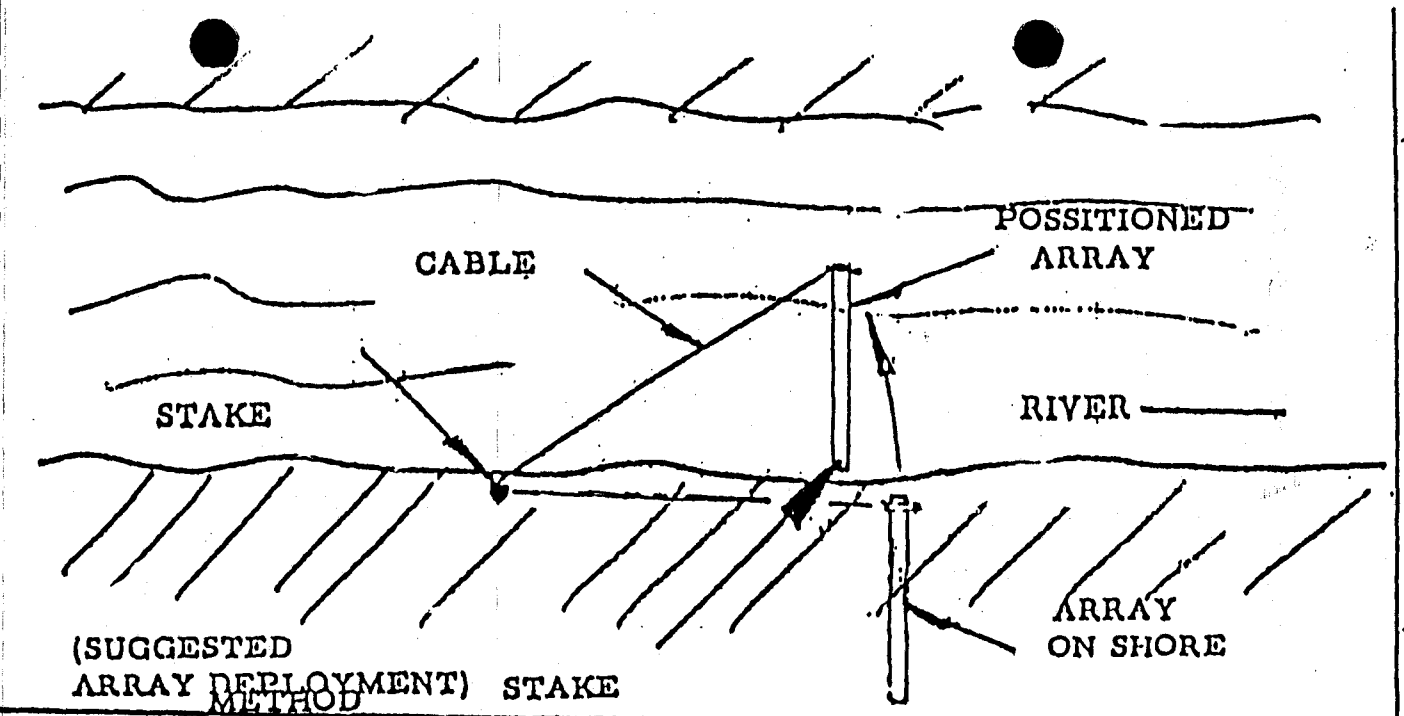
When using a 40 foot tube the beamwidth switch should be set to ALT and the counting range to a distance of about 38 feet. Beamwidth for a 20 foot array should be set on XM2° and counting range to about 18 feet.

SIDE SCAN SONAR OFFSHORE CAP

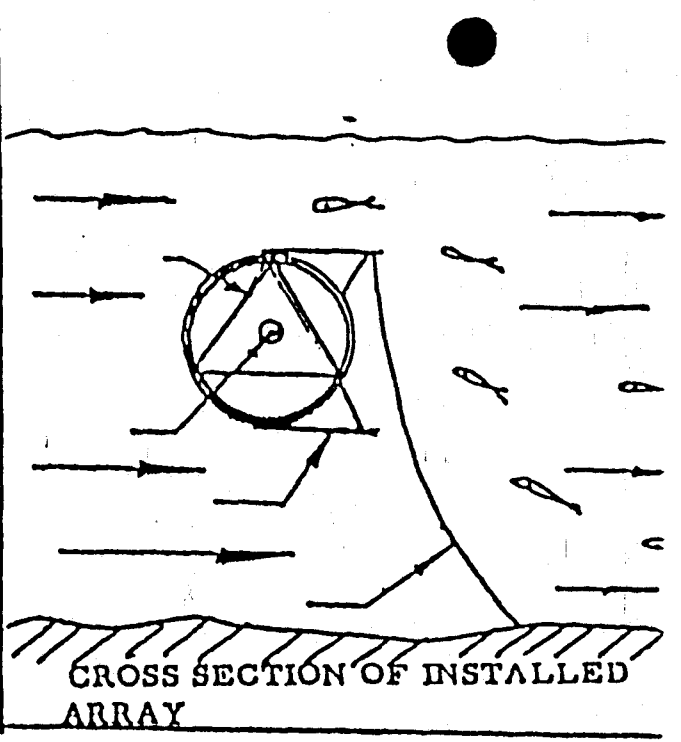


SIDE SCAN SONAR ONSHORE CAP

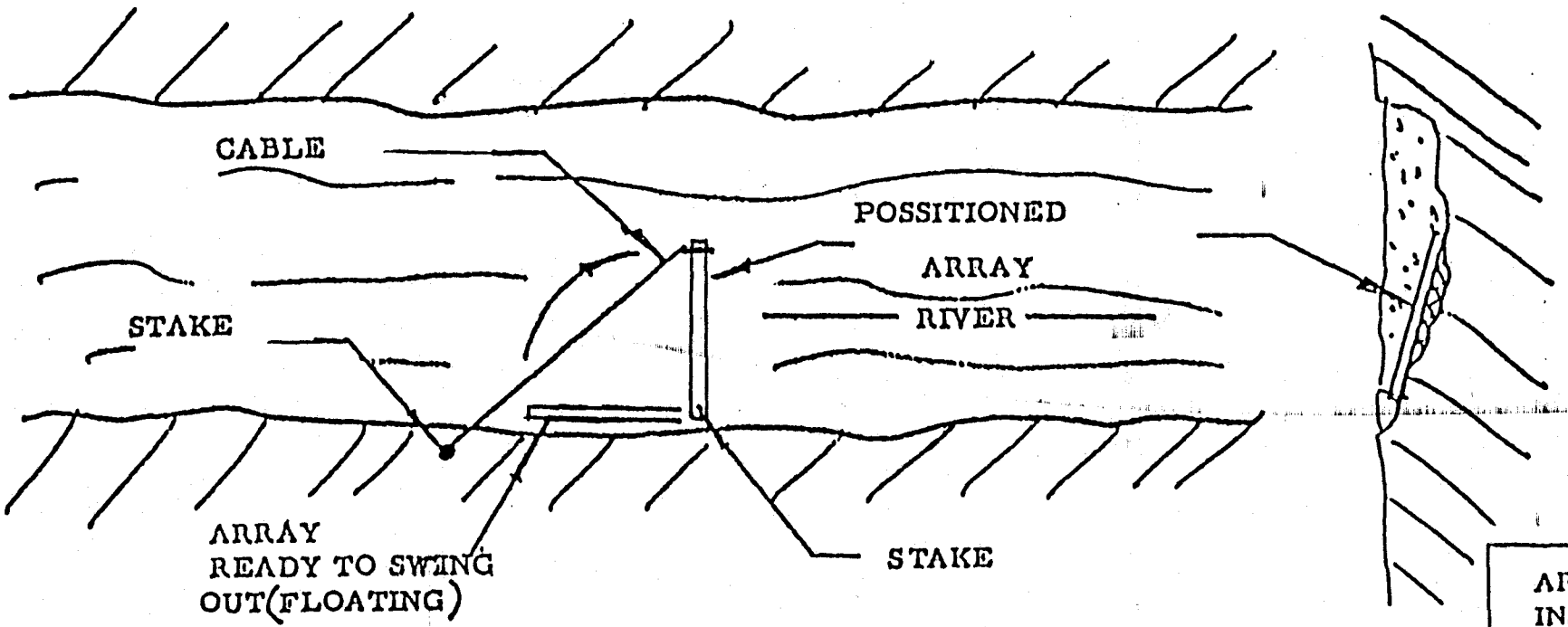




(SUGGESTED ARRAY DEPLOYMENT) METHOD

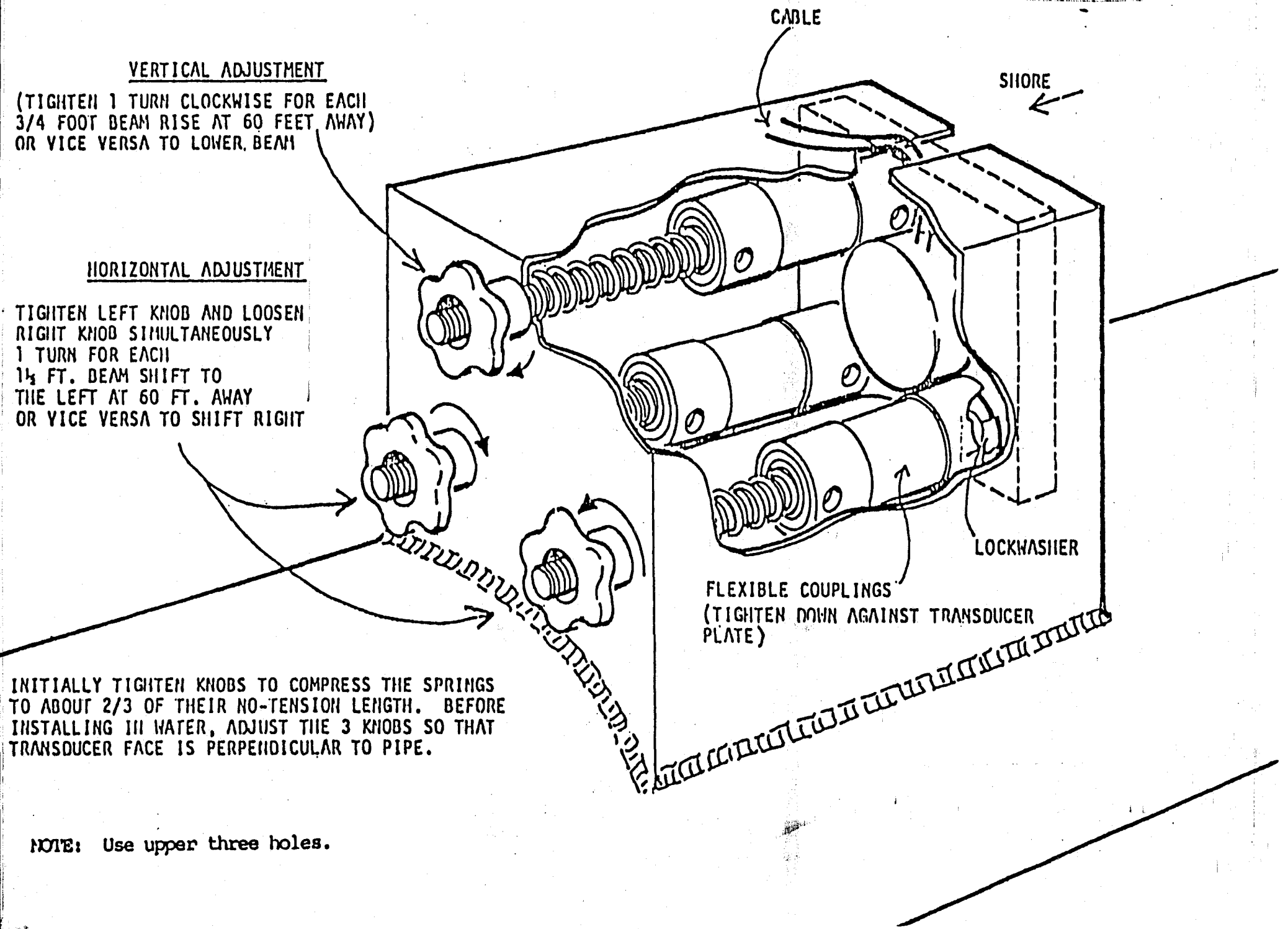


CROSS SECTION OF INSTALLED ARRAY

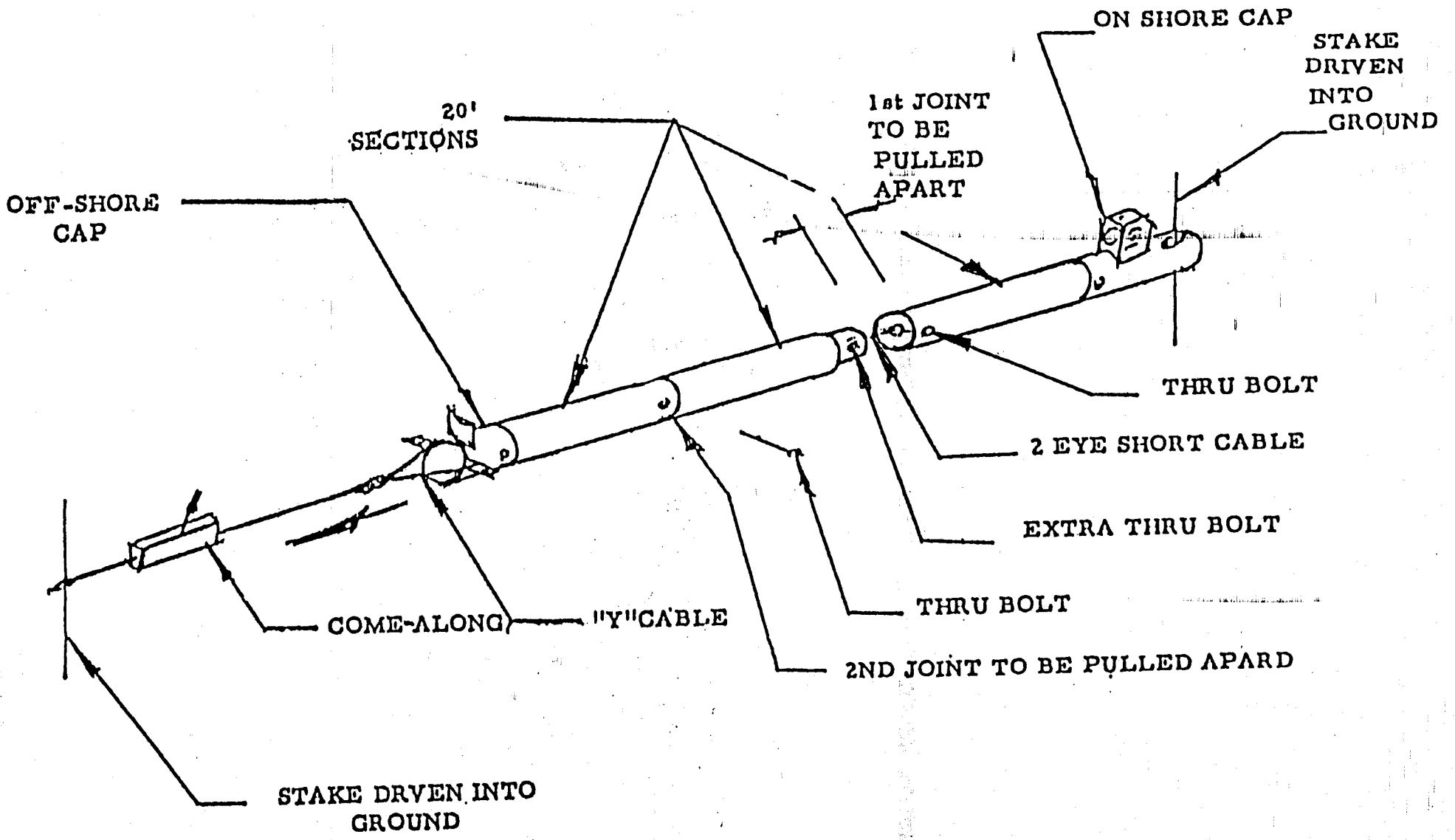


ARRAY INSTALLED IN RIVER

ALTERNATE ARRAY DEPLOYMENT METHOD
(SLOW CURRENT STREAMS)



NOTE: Use upper three holes.



ARRAY DISASSEMBLY

APPENDIX 2

ADULT ANADROMOUS FISHERIES STUDIES

Oscilloscope Operation

July 16, 1979

A. Menin

OSCILLOSCOPE OPERATION

for the

SIDE SCANNER

This manual describes how to use the oscilloscope in conjunction with the side scanner. Although it is specificially written around the Tektronix model 323 "scope", the same basic rules apply to virtually any model scope except for the location of controls.

THEORY OF SCOPE OPERATION

The scope is basically a time variable voltmeter. A bright dot moves across the screen at a constant rate from left to right. The speed at which it moves is determined by the TIME/DIV control setting on the scope. At most settings, the dot moves so quickly that it looks like a continuous horizontal line to the human eye.

The VERTICAL INPUT of the scope (on the left side of scope) is the same as the + & - input leads on a voltmeter except that a voltage connected to VERTICAL INPUT scope connector will cause an upward vertical deflection of the moving dot of light proportional to the amount of voltage at the input at the point in time that the moving dot happens to be when that voltage is connected. For example, if there is no voltage on the scope input for the first half of the trace, you will see a straight line. If a + voltage is then applied during the middle of the trace (or sweep as it is usually called), the bright dot will go vertically up to the corresponding place on the scope's face as determined by the VOLTS/DIV setting of the scope. Example: With a 2V/DIV setting, the dot would rise three divisions at the precise instant in time that you connected the + of a 6V battery to the scope's VERTICAL INPUT with the - of the battery connected to the scope ground.

TRIGGERING

The bright dot on the screen requires an electrical voltage on the TRIGGER INPUT of the scope (on the left side of scope) to start the dot moving at the

rate (or speed) set by the TIME/DIV control on the scope's front panel. This trigger is required for each "sweep" of the dot. At the instant in time that a voltage is applied to the TRIGGER INPUT of the scope, the dot will start moving from left to right. This provides synchronization of what you see on the screen with the side scanner. In the case of the side scanner, the TRIGGER INPUT will be connected to either XM2°, XM4° (or XM ALT. in the latest version of the side scanner). Each time the side scanner transmits a "burst of sound", the transmitted voltage momentarily appears on the XM pin connector of the side scanner. At this instant in time, this voltage causes the dot to start moving from left to right. Since you will have the TIME/DIV set to 2 ms (MILLISECONDS) for proper operation with the side scanner, this dot is now moving across the screen at the rate of 2 milliseconds (2 thousanths of a second) per division. This of course is too fast for the human eye to follow so it looks like a straight line to the eye. Since sound travels (in water) at about 5000 feet per second which equals 5 feet per milliseconds (1 thousanth of a second), when the scope's VERTICAL INPUT is connected to the RCVR (receiver) pin connector of the side scanner, an echo (a vertical line) from a fish (or other object) 25 feet away from the transducer would be seen as a vertical line at 5 divisions from the left of the start of the sweep of the bright dot. This is because it took 5 milliseconds for the sound to travel the 25 feet to the "fish" and another 5 milliseconds for the "echo" from the fish to return to the transducer for a total of 10 milliseconds round trip travel time. Since the scope is set to 2 milliseconds per division, 10 milliseconds would be 5 divisions.

To see the metal target at the end of the pipe which is about 59 feet away from the transducer, you should expect to see this target 23.6 milliseconds from the face of the transducer (the start of the sweep) because at 5 feet per

millisecond travel time, it will take 11.8 milliseconds for the sound to hit the metal target and another 11.8 milliseconds for the "echo" to return to the transducer or a round trip travel time of 11.8 + 11.8 = 23.6 milliseconds. Since the TIME/DIVISION of the scope is set to 2 Msec/DIVISION, that would be just beyond the 10 divisions on the scope screen and would not be seen, so a fine variable adjustment knob located in the center of the TIME/DIV coarse control should be rotated a little counter clockwise so that the echo from the metal target can be seen on the scope's face. Rotating this small control counterclockwise increases the time per division to some amount greater than the 2 milliseconds per division that the coarse control was set to.

SCOPE CONTROLS AND THEIR FUNCTIONS

1. POWER SWITCH-ON (see fig. 1) - CAUTION: Be sure to shut off power when scope is not being used since it draws much more power than the side scanner and would rapidly discharge the battery.

2. POWER SOURCE SELECT SWITCH (see fig. 2) - This is a small slide switch on the rear of the scope and should be pushed down to the EXT DC position which means that the scope is being powered by an external 12V from the side scanner.

3. VOLTS/DIV. ROTARY CONTROL (see fig. 1) - This switch may be set as desired for viewing the side scanner RCVR output. It should be set to either 1V or 2V. If it is set to 1V per division you may want to rotate the small "fine control" center knob inside the coarse control VOLTS/DIV to reduce the height of the vertical lines or fish echos to about 1 inch.

4. POSITION CONTROLS (see fig. 1) - These 2 controls merely affect the horizontal and vertical position of the scope display. You may want to set the vertical position control so that the horizontal trace of the scope is a little above the bottom of the screen and the first vertical line on the left

is about 1/4 inch inside of the screen. (This corresponds to the transmitted burst of sound or the transducer position).

5. INPUT LEVER SWITCH (see fig. 1) - This should be down (in the DC position).

6. TRIGGER LEVER SWITCH (see fig. 1) - This important switch should be in one of the 2 bottom external trigger positions, either AC or DC. This switch is located on the right side of the model 323 scope.

7. TRIGGER KNOB (see fig. 1) - This is probably the most important (and most often mis-set control). Its function is to assure that the start of the sweep of the scope picture exactly coincides with the instant the side scanner transmits its burst of sound. This will cause the transmit burst vertical line to be at the start of the sweep (the extreme left side of the trace). If this knob is rotated completely clockwise or completely counterclockwise, the scope trace will "free run", that is to say, it will never be synchronized with the transmit burst and therefore the transmit burst vertical line on the scope's face may occur anywhere along the scope sweep.

8. TIME/DIV. ROTARY CONTROL (see fig. 1) - This controls the speed at which the bright dot crosses the screen. For use with the side scanner, it should be set to the 2 Ms (MILLISECONDS) position.

9. ATTEN. SLIDE SWITCH (see fig. 1) - This switch is located on the left side of the scope. Although it can be operated in either position, stable triggering is a little easier to adjust if this slide switch is in the 10X position.

10. FOCUS AND INTENSITY (see fig. 1) - These two controls are located on top of the scope.

The intensity control should be rotated fully clockwise for maximum brightness of the trace. After adjusting the brightness, rotate the focus control for the sharpest vertical lines.

At night you may want to decrease the brightness. If you do, refocus the FOCUS control.

OSCILLOSCOPE CONNECTIONS TO SIDE SCANNER

1. EXT. D.C. POWER (see fig. 2) - This twin connection is located on the right side of scope. This should be connected to the mating connector labeled "SCOPE" on the right side of the side scanner. CAUTION: This is the 12 volt power connection to the scope and does not have reverse polarity protection. If these leads are reversed, the scope will burn out instantly.

2. EXT TRIG. (see fig. 1) - This connector is located on the left side of scope. It should be connected to either the 2° or 4° (or ALT. in 1980 model side scanner). This is to provide triggering of the scope from the side scanner. Use either one of the supplied connector cables. The black pin on the connector cable is ground and may be connected to the gnd. pin of the side scanner or left disconnected if you like, since the scope will be grounded anyway through the power connector.

3. VERT. INPUT (see fig. 1) - This connector is also located on the left side of the scope. It should be connected to the RCVR connector on the face of the side scanner using the supplied connector cord which is identical to the ext. trig. cord. The black pin is ground and need not be connected to the side scanner ground since the scope is already grounded through the 12V power cord.

This is the vertical input to the scope and causes the bright moving dot of the scope to go up vertically when a voltage is present on the RCVR output of the side scanner as it would be when a fish echo is present.

OSCILLOSCOPE ADJUSTMENTS

1. After all three connectors are in place (trigger, vertical input and external 12V power) turn on the scope power.

2. Turn the brightness control fully clockwise.

3. Place the rear slide switch in the down (ext DC) position (Fig. 2).

4. Place the ext. trig. switch on the left side of scope to the 10X position.

5. Place the inout lever switch on the scope face to the DC position (down).

6. Place the trigger lever switch (on the right side of scope face) down. to the EXT TRIG DC position.

7. Set the TIME/DIV rotary switch to 2 ms.

8. Rotate the small center knob inside the TIME/DIV switch about 1/3 of a revolution counterclockwise from its fully clockwise (detent) position.

9. Set the VOLTS/DIV rotary switch to 1 volt.

10. Rotate the small center knob inside the VOLTS/DIV switch about 1/3 of a revolution counterclockwise from its fully clockwise (detent) position.

11. Push in the 2 POSITION controls located on the bottom center of the scope face. These 2 rotary controls are also push-pull switches and should always be pushed in.

12. Rotate the trigger knob on the lower right side of scope face fully counterclockwise to its detent position. This will cause the scope to operate even without an external trigger so that you can adjust the two position controls.

13. Rotate the vertical position knob on the bottom center of the scope until the trace on the screen is about 1 division from the bottom of the screen.

14. Rotate the horizontal position control on the lower center of the scope face until the trace starts about one division from the left side of the scope screen.

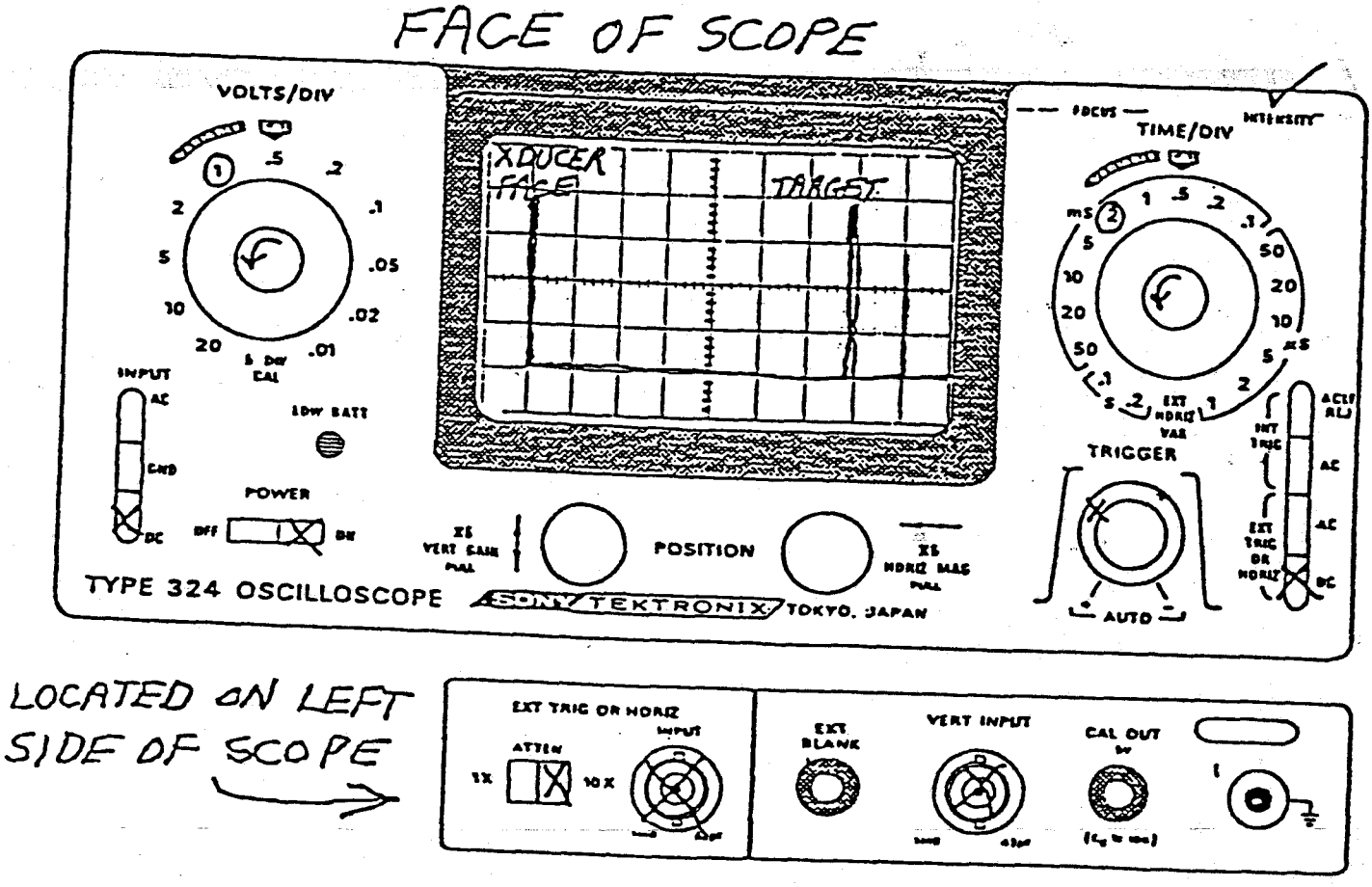
The scope is now ready for final trigger adjustments.

15. Put the side scanner beamwidth switch in the 2° position and connect the EXT TRIG. cable to the XM2° pin connector on the face of the scope.

Rotate the TRIGGER knob on the right side of scope face to about the 10 o'clock position. Somewhere near this point, the scope should be triggering properly as evidenced by a stable vertical "spike" being seen on the extreme left (the beginning) of the scope trace. Now place the beamwidth switch on the side scanner to the Alternate position. The scope trace should look the same as it did in the 2° position meaning that you are still triggering only on 2°. If it looks different or seems to speed up or get brighter that means you are slightly misadjusted. If so, rotate the TRIGGER knob a bit until the scope picture does not change as you switch between the 2° to the ALT positions on the side scanners beamwidth switch.

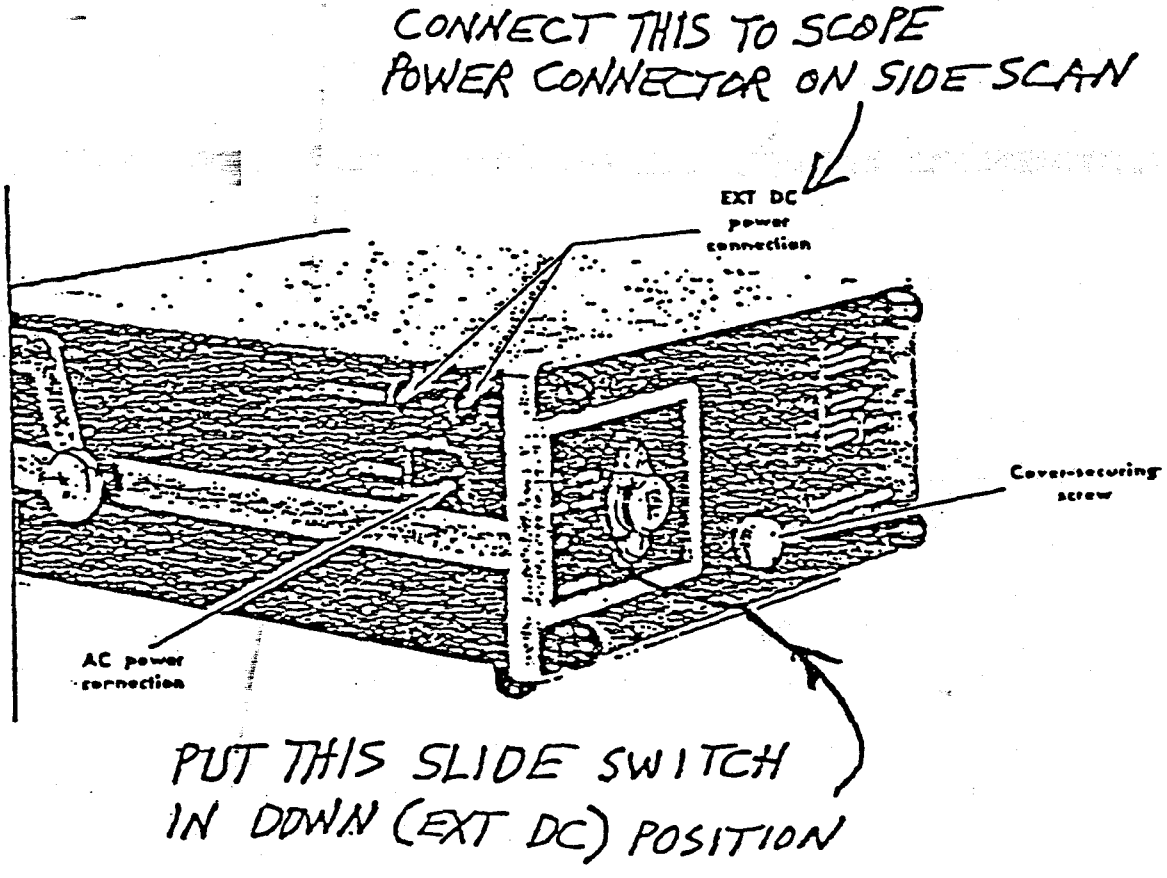
Now put the EXT TRIG connector cord in the XM4° connector (or the XM ALT. on the 1980 model) When the side scanner beamwidth switch is in the ALT position the trace on the scope should now be triggering twice as fast (brighter) as in the 2° position since now you are alternately triggering the scope twice as fast as you were. You are causing the scope to alternately trigger on 2°, 4°, 2°, 4° etc. If you now move the EXT TRIG. cable connector back to the XM2° connector you will see a change in the trace since it will only be triggering on the 2° beam (half as often).

You should now see a stable vertical spike, about 1 inch high on the left side of the trace and you should see the metal target echo (about 1 inch high) near the right side of the trace if you increase the COUNTING RANGE control on the side scanner to beyond 60 feet. To operate the side scanner normally, you should now reduce the COUNTING RANGE control slowly until it just ceases to count the target (on sector 12) and then reduce it about one foot more for safety.



Oscilloscope controls. Sony Tektronix type 324 oscilloscope.

FIG, 1



Oscilloscope adjustments. Sony Tektronix type 324 oscilloscope.

Table II-1. TYPICAL SIDE SCANNER OSCILLOSCOPE WAVEFORMS FOR VARIOUS TRANSDUCER AIMING CONDITIONS

FIGURE #	CONDITION
II-3.	PROPER VERTICAL AIMING. 2°
II-4.	PROPER VERTICAL AIMING. ALT. BUT SCOPE TRIG. ON 4°
II-5.	PROPER VERTICAL AIMING. ALT. BUT SCOPE TRIG. ON 2°
II-6.	IMPROPER VERTICAL AIMING. (AIMED TOO LOW)
II-7.	IMPROPER VERTICAL AIMING. (AIMED TOO HIGH). 2°
II-8.	IMPROPER VERTICAL AIMING. (AIMED TOO HIGH). 4°
II-9.	IMPROPER HORIZONTAL AIMING. (AIMED TOO FAR DOWNSTREAM)
II-10.	PROPER HORIZONTAL AIMING.
II-11.	IMPROPER VERTICAL AIMING. (TOO LOW AND BOUNCING OFF SUBSTRATE)
II-12.	ECHOS FROM BOAT WAKE
II-13.	IMPROPER VERTICAL AIMING IN SHALLOW WATER

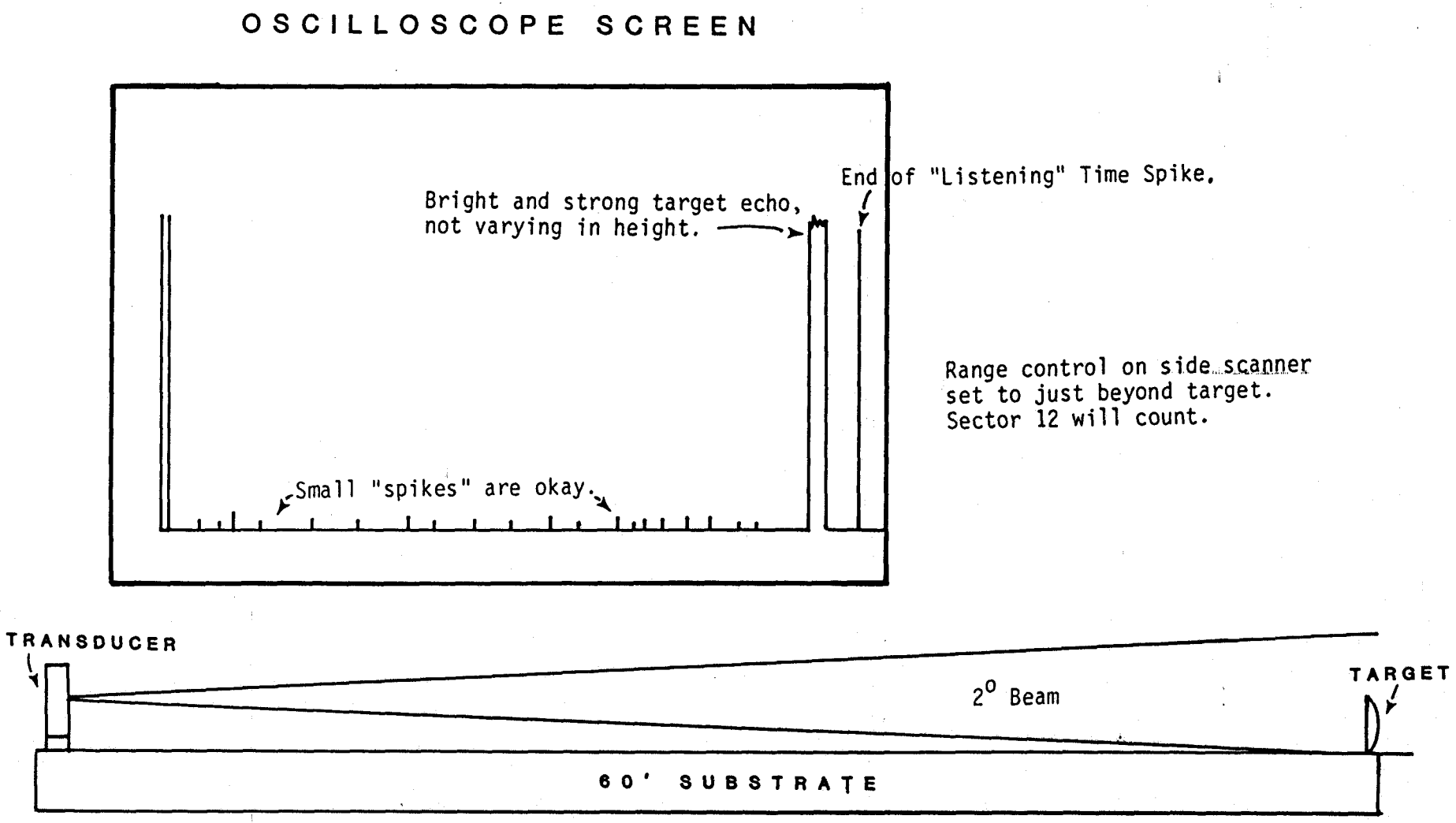


Figure 1. PROPERLY aimed transducer when beamwidth switch is set to 2^{o} and scope triggered from XM 2^{o}.

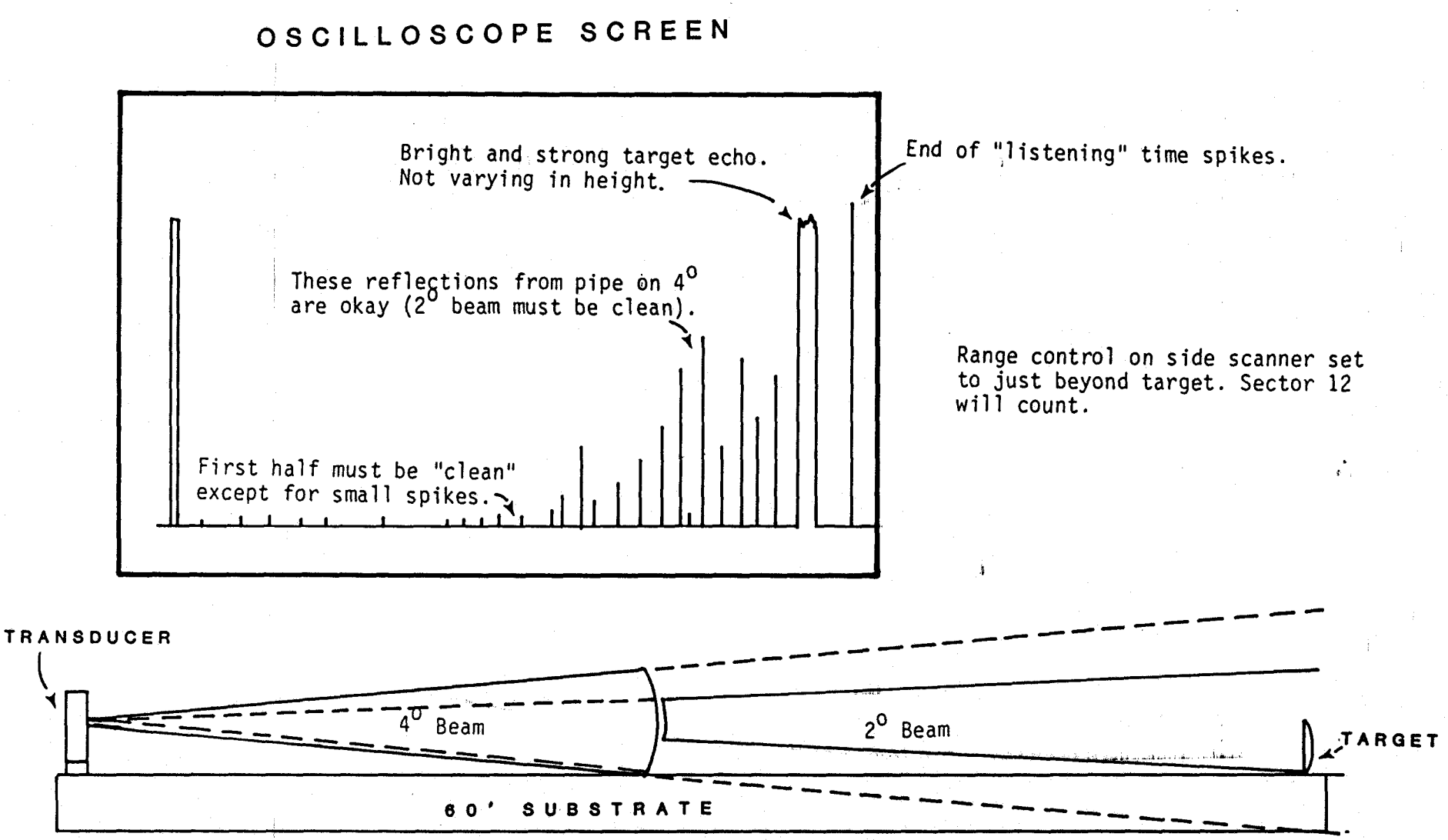


Figure 2. PROPERLY aimed transducer when beamwidth switch is set to alternate and scope is triggered from XM 4°. Note 4° beam is skimming surface of substrate beyond the 50% point on substrate thus causing reflections from imperfections on the substrate surface. This is okay since the 4° beam will not count any echos beyond the 50% point.

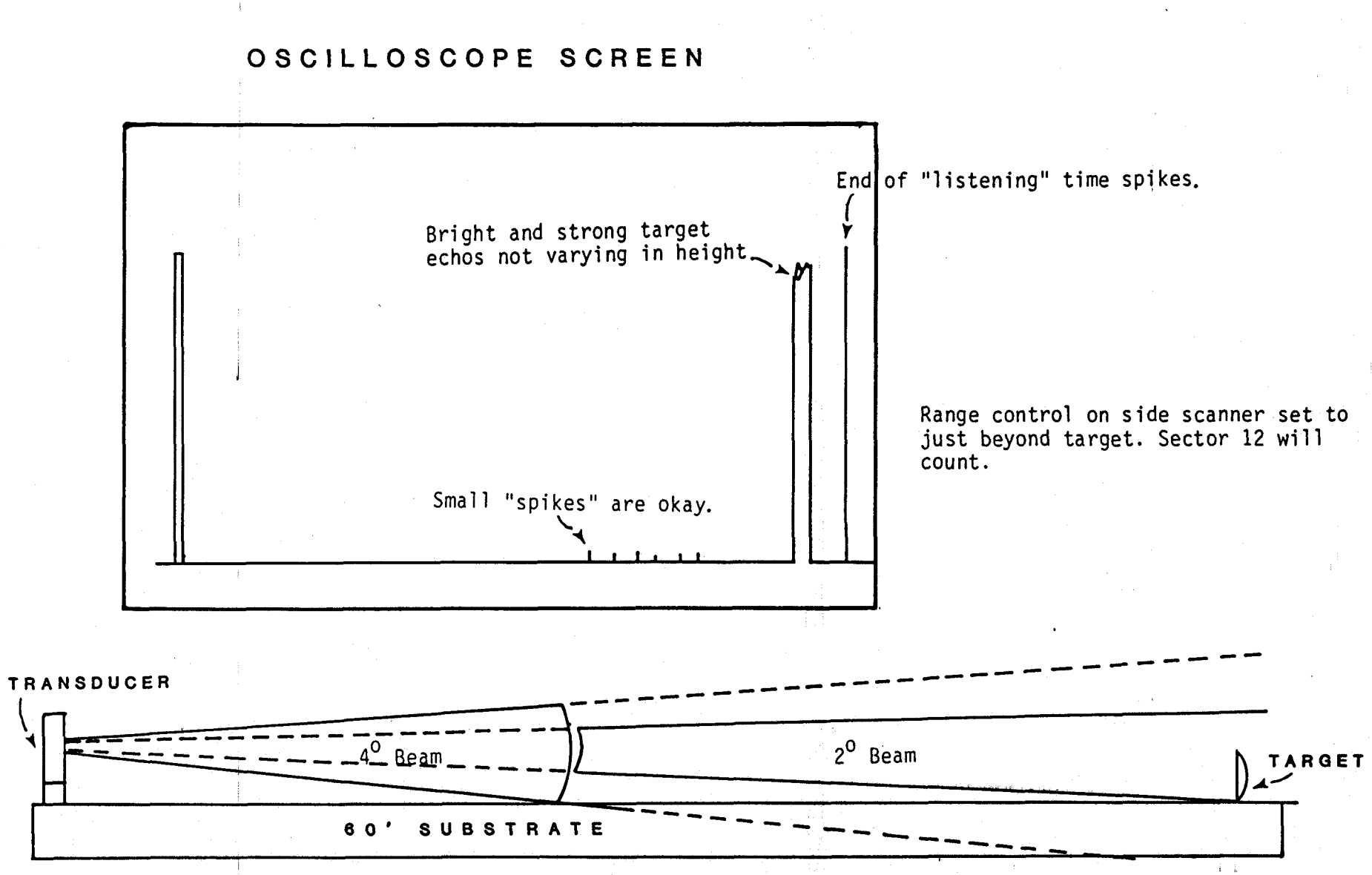


Figure 3. PROPERLY aimed transducer when beamwidth is set to alternate but scope is triggered from XM 2^{o}.

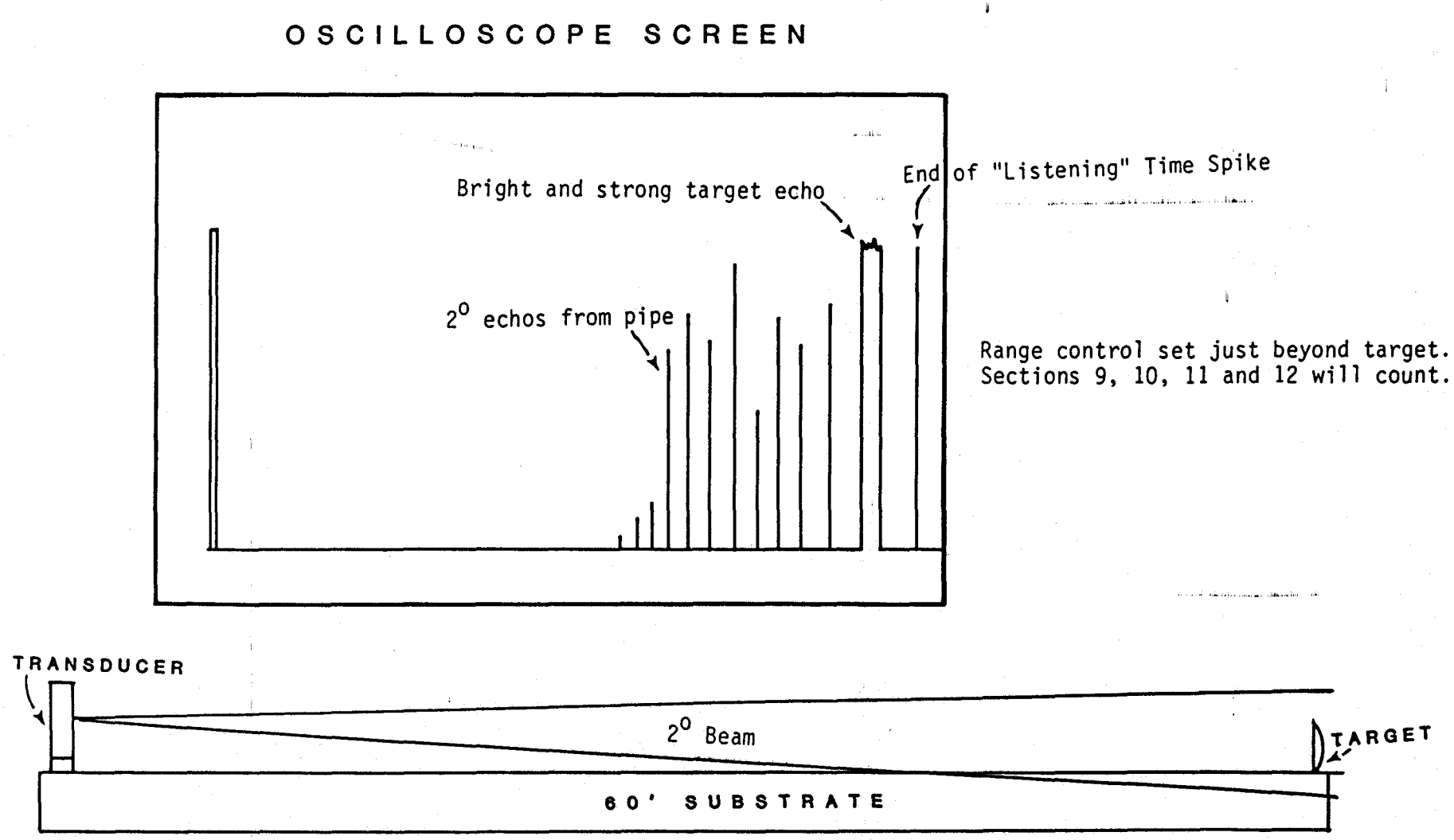


Figure 4. IMPROPERLY aimed transducer when beamwidth switch is set to 2^{o} and scope is triggered from XM 2^{o}. Note that beam is aimed too low, causing echos to be returned from last Y_3 of substrate imperfections even though target echo is strong and doesn't vary in height.

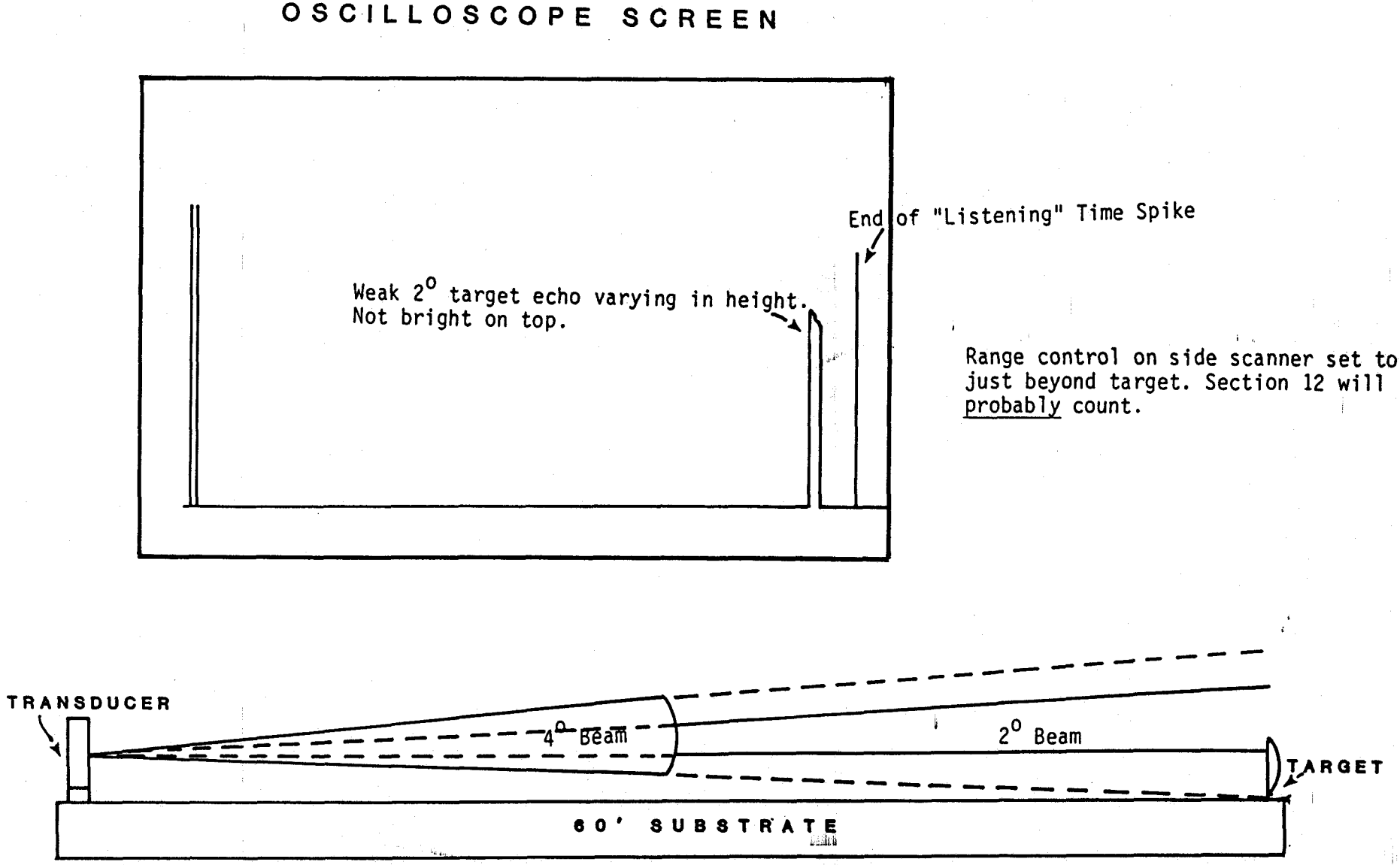
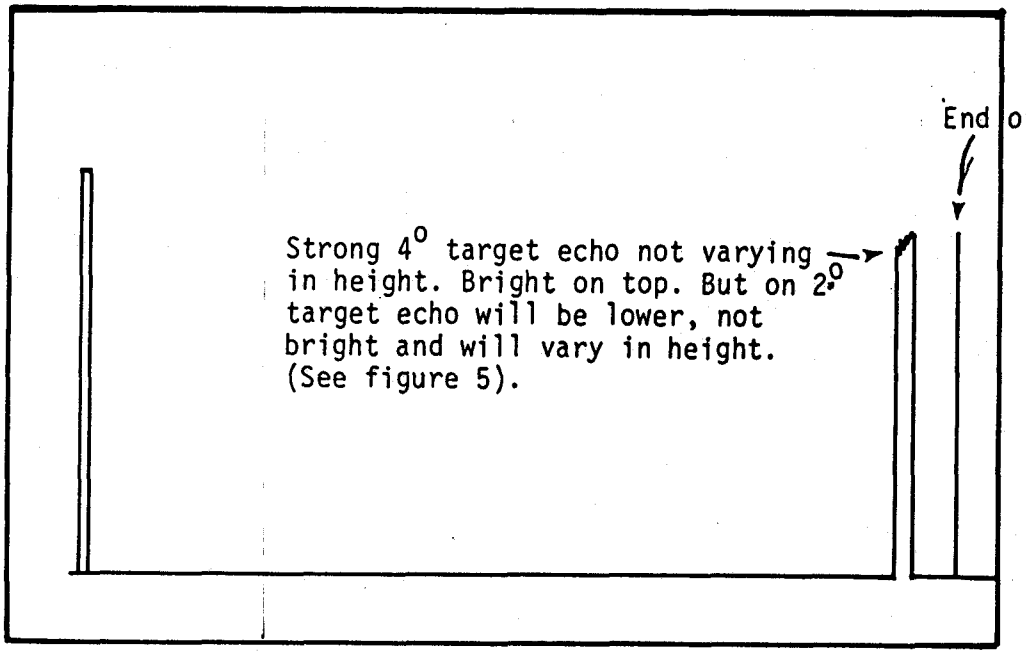


Figure 5. IMPROPERLY aimed transducer. Beamwidth switch is set to 4° and scope is triggered from XM 2°. Note that beam is aimed too high and is just catching target in 2° beam although 4° beam does hit target. See figure 6. Low passing fish may be missed.

OSCILLOSCOPE SCREEN



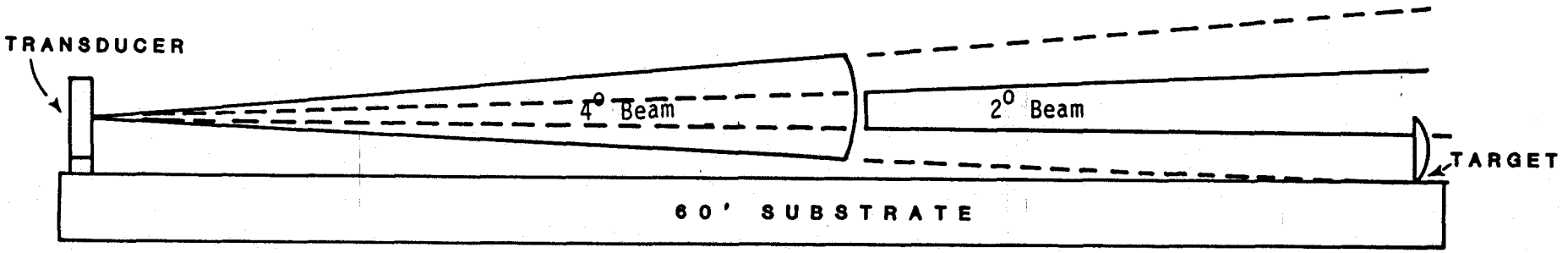


Figure 6. IMPROPERLY aimed transducer. Beamwidth switch is set to Alt. (or 4°). Scope is triggered from XM 4°, Note that beam is aimed too high, although the 4° beam solidly hits the target, the 2° beam just barely hits the target (see figure 5 for 2° scope waveform.) Fish may be missed.

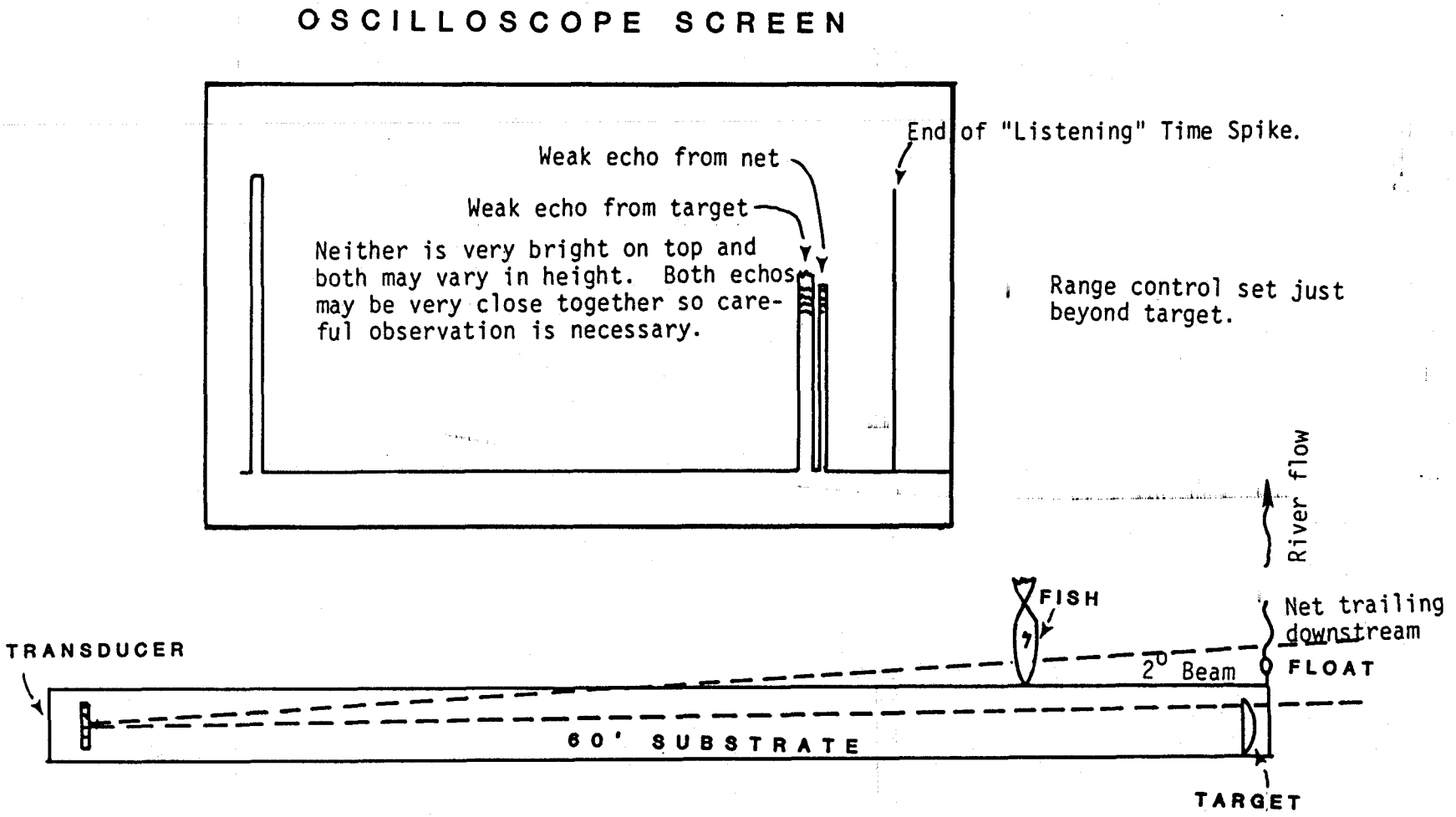


Figure 7. IMPROPERLY aimed transducer. Beamwidth switch is set to 2° and scope is triggered from XM 2°. Transducer is aimed too far downstream, just barely hitting target. This will cause an overcount on salmon in the last half of substrate because salmon tend to linger downstream of pipe before crossing. If salmon tend to overcount near end of substrate, this may be the problem. Reaiming the transducer more upstream will cure the problem.

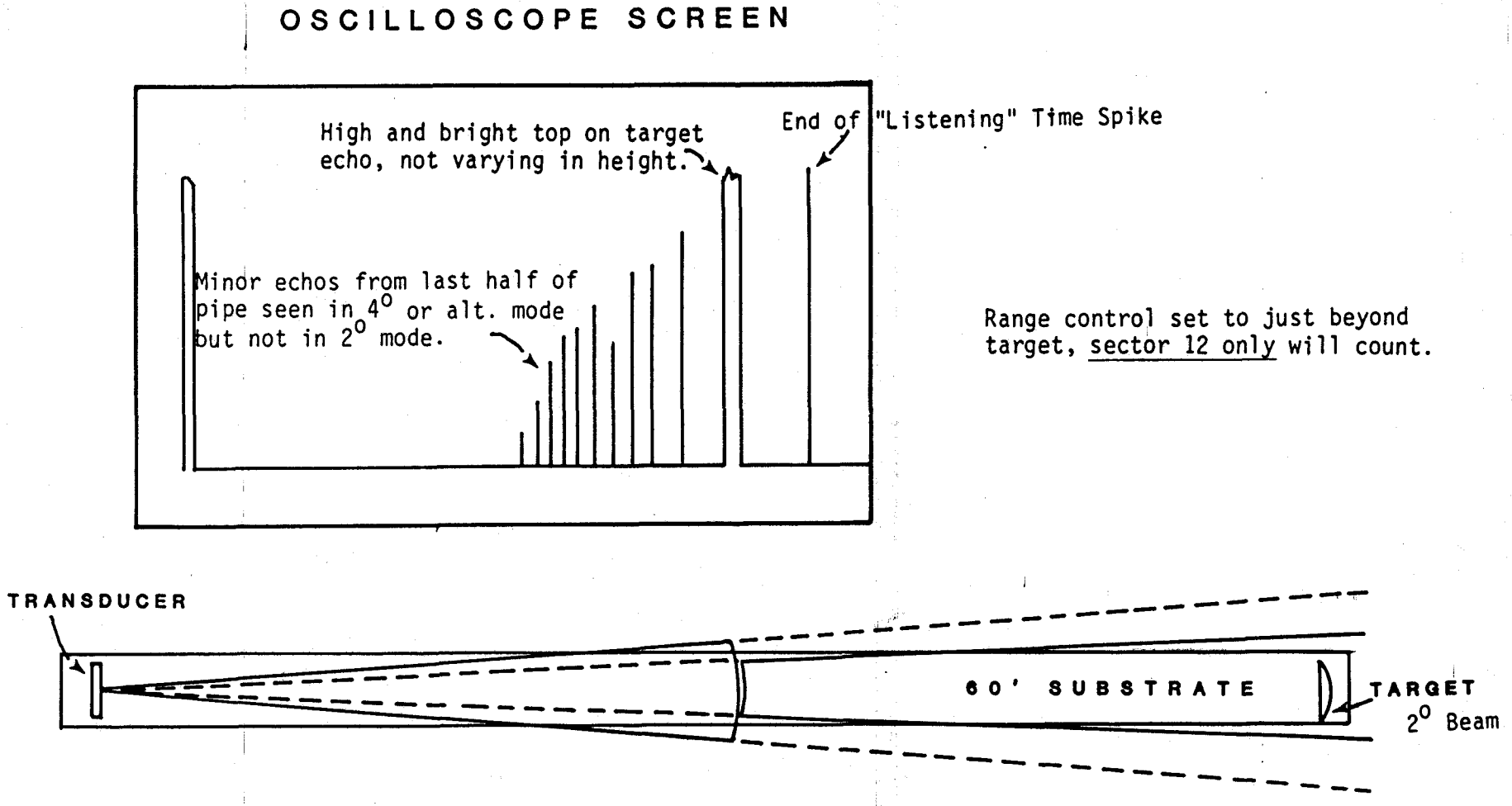


Figure 8. PROPERLY aimed transducer. Transducer beamwidth switch is set to alternate and scope is triggered from XM 4°. This assumes vertical aiming of transducer is correct.

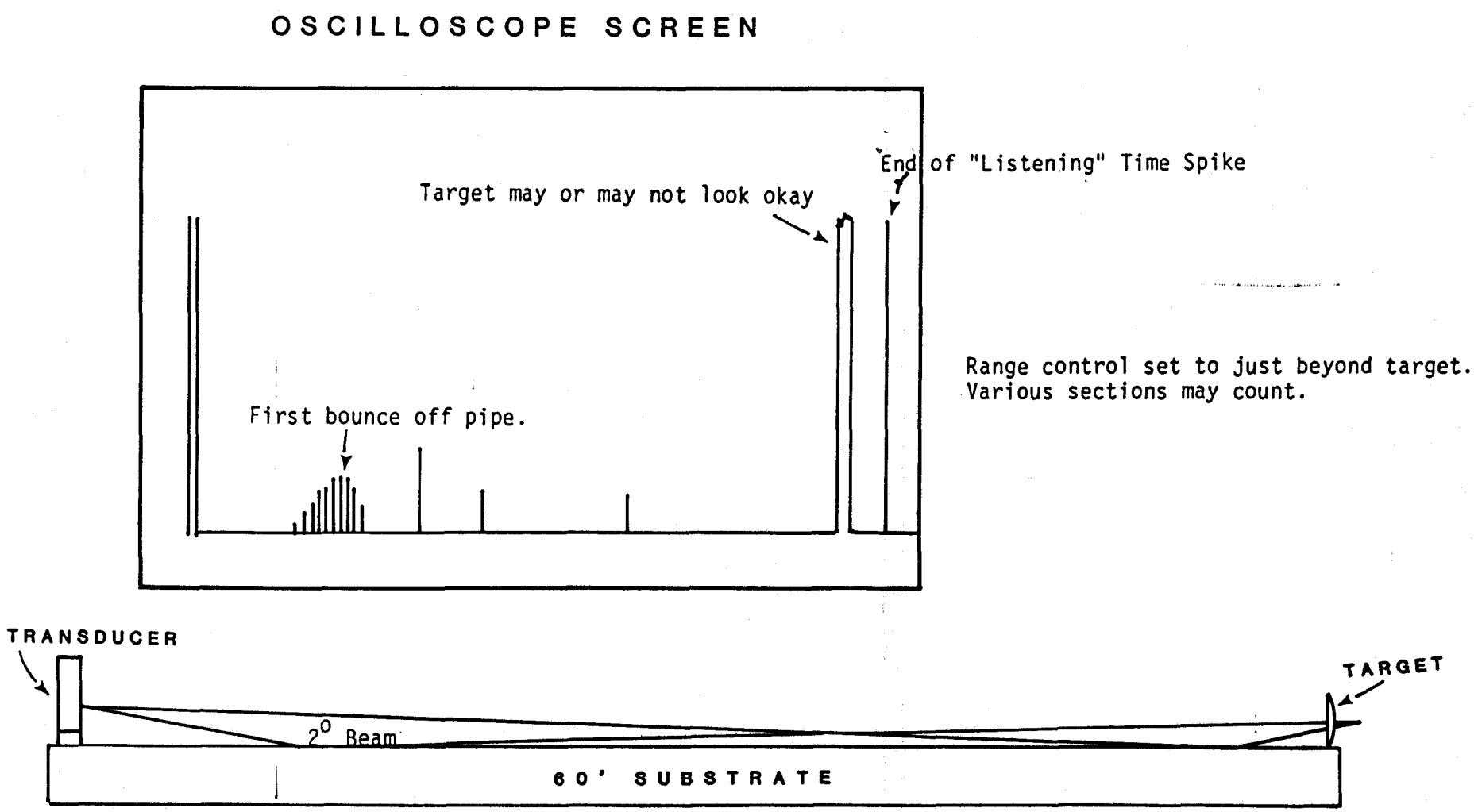


Figure 9. IMPROPER transducer aiming. Beamwidth switch set to 2^{o} and scope trigger to XM 2^{o}. Transducer is aimed much too low and beam is bouncing off pipe near transducer, then hits target and returns by same path.

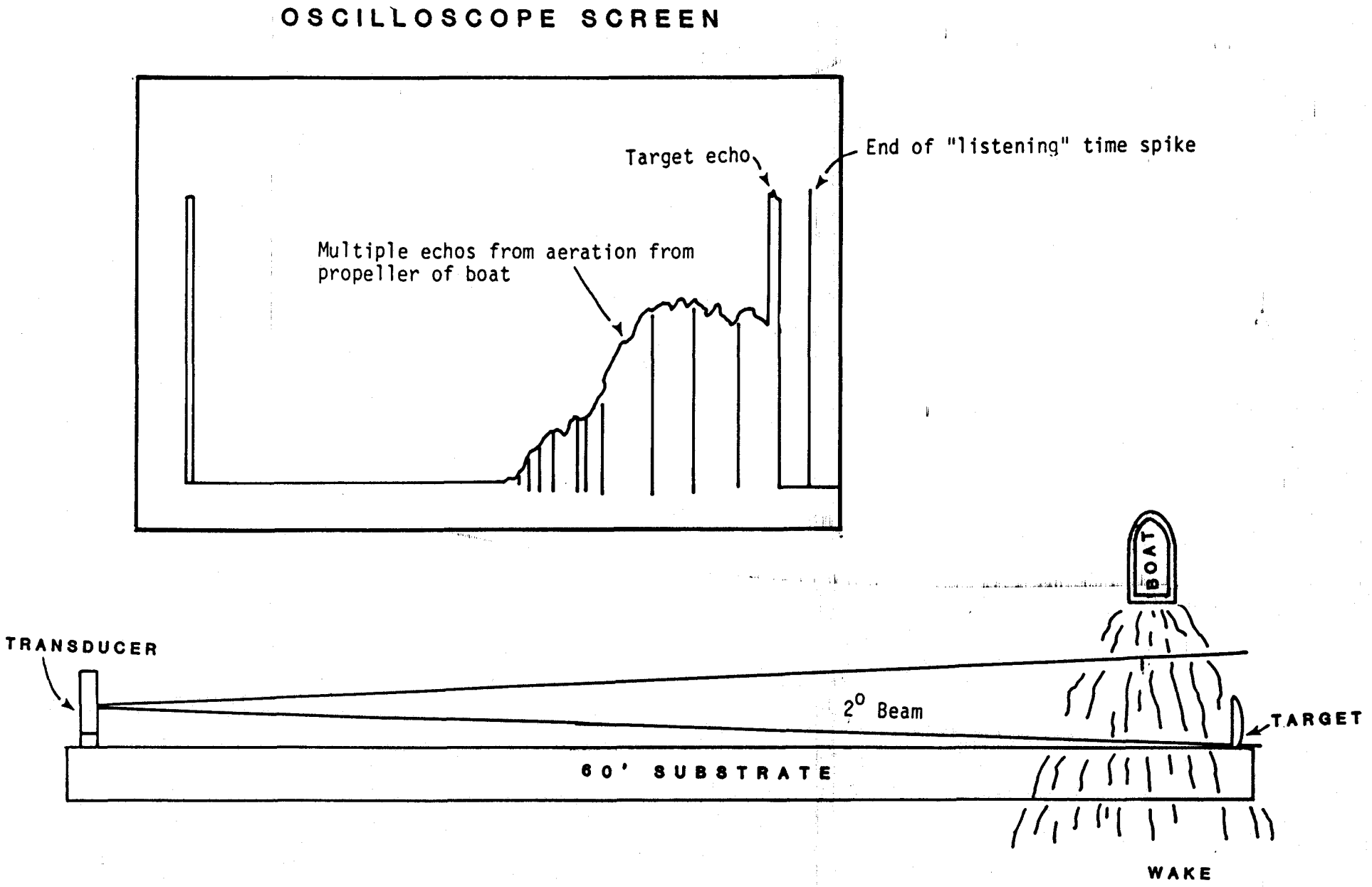


Figure 10. Properly aimed transducer but multiple echos from wake of boat. This will cause many counts, usually in outer sectors, and will probably trigger the debris indicator.

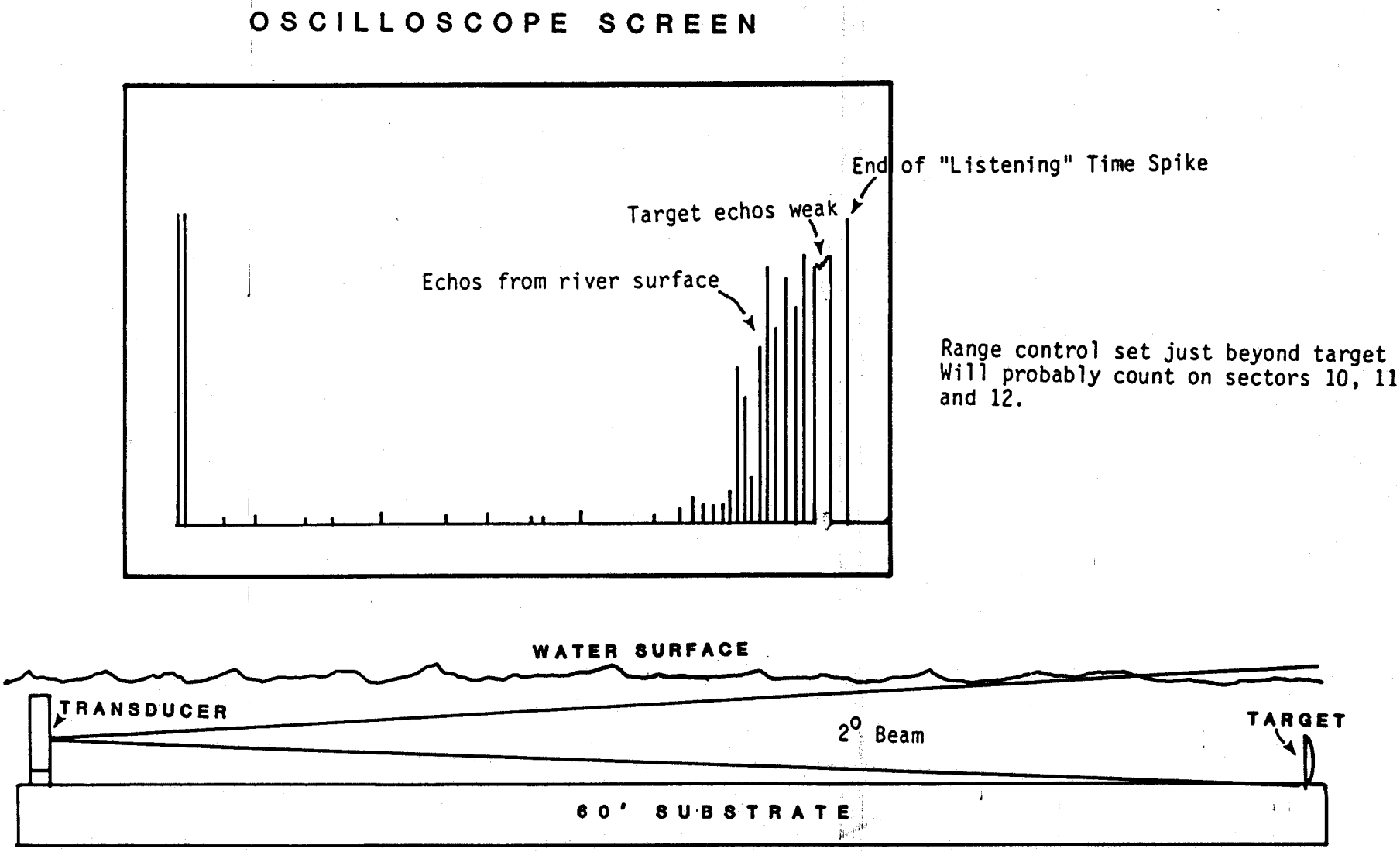


Figure 11. Improperly aimed transducer. Beamwidth switch set to 2^{o} and scope triggered from 2^{o}. Note water is too shallow even for 2^{o} beam which is boxed in. Counting range on side scanner would have to be reduced to about 50' to prevent surface echos from counting. Target will be obscured by surface echos.

APPENDIX 3

ADULT ANADROMOUS FISHERIES STUDIES

Fishwheel Operation

APPENDIX 3

A. ADULT ANADROMOUS FISHERIES STUDIES

Fishwheel Operation

Design

The fishwheels used at Flathorn, Yentna, Sunshine, Talkeetna and Curry stations are of identical design with two baskets and two paddles each. Flotation is provided by styrofoam logs covered with a plywood frame or urethane sealed floats. The baskets are constructed of native spruce and have an average length, width and depth of 7.5 feet, 6.0 feet and 30 inches respectively. The paddles, also constructed of native spruce poles, have the same width and length as the baskets. The baskets are netted with 2.5 inch square creosote coated netting. The axle is an eight inch squared spruce log capped at each end with a steel collar fitted with a 1.25 inch steel shaft. The side assembly rotates on self adjusting bearings which bolt to an adjustable wood frame on each float that permits the axle to be raised or lowered at 6 inch steps. A live box is attached to the inshore side of each fishwheel. The fishwheel is held stationary by a cable bridle anchored to an onshore deadman located upsteam of the fishwheel. The fishwheel is kept offshore by an inshore mounted boom log lodged between the bank and the inshore float.

Lead Weir

A lead weir is a critical component of a successfully operating fishwheel. The purpose of a lead weir is to direct inshore migrant fish into the fishing area of the wheel. The weir is constructed out of a series of framed panels averaging five feet long and covered with 2.5 inch mesh fencing fabric. The panels are built to contour the river bottom and are held in place by a boom log extending perpendicular to the river flow from the downstream end of the live box to the river bank.

Operation

Fishwheels are designed to rotate at a speed ranging from 2.0 to 3.5 rpm. Maximum catch efficiency normally occurs at 2.5 rpm. At fishwheel locations where velocity causes a wheel to turn at a speed greater than 3.5 rpm an experimental brake system will be used that creates a negative lifting force to slow the wheel. The brake will consist of two water releasing boxes referred to as "bird boxes" that attach to the paddles.

Properly sited and adjusted, fishwheel baskets should reach within six inches or less of the bottom. If the baskets do not reach within six or less inches of the bottom, fish will pass underneath the baskets without being subject to capture.

Maintenance

Fishing depth of the baskets must be checked twice daily and appropriate adjustments made. Lead weirs should also be inspected twice daily to insure that they are properly functioning. Additionally, once a day each

wheel should be rigorously inspected for wear, damaged components, loose rigging and protuding nails or rough surfaces which can inflict injuries to captured fish. Appropriate repairs must be effected at the first indication of a problem.

APPENDIX 4

ADULT ANADROMOUS FISHERIES STUDIES

Fish Tagging

A. ADULT ANADROMOUS FISHERIES STUDIES

Fish Tagging (ADF&G, 1976)

Development of Marking of Fish

A mark can be defined as a brand, label, seal or tag which identifies an object to show the marker or owner. Early tagging of fish was begun by land owners along streams who were interested in conserving salmon and trout runs. Charles Atking tagged Atlantic salmon in 1873 in Maine's Penobscot River and several recoveries were noted in following years. T.W. Fulton of Scotland (1893) and C.G.J. Petersen of Denmark (1884) both used numbered buttons or disks on plaice (flatfish) and other fish species in the Atlantic Ocean. The Petersen disc has been one of the most successful types of tags and most widely used over the years.

Exact figures on the rate of development of tagging are hard to accumulate, but there are estimates that by 1910 about 100,000 fish had been marked with tags. By 1936, the total was around 600,000 marked fish. Presently many millions of fish (also molluscs, crustacea and sea mammals) are being tagged every year for the purpose of studying population dynamics and migrations.

Idea Fish Marks

Information on what constitutes an ideal fish mark, the types of marks, purposes of tagging and methods of tagging and recovery are spread through the fisheries literature.

Arnold (1966) suggested the following criteria for an ideal fish mark.

1. It should be retained essentially unaltered for life of fish regardless of the age at which applied.

2. It should have absolutely no effect of fish's behavior, reproductions, life-span, growth, feeding, movement, vulnerability to predation, angling or other external factors.

3. It should not tangle in vegetation or nets of any kind.

4. It should be inexpensive and easily manufactured.

5. It should be usable on any size fish without significant alternation.

6. It should not be found in nature nor should it be possible to confuse it with any other mark, natural or artificial.

7. It should be easily applied to fish in the field without the need for an anesthetic.

8. It should be easily detected in the field by untrained personnel or the public.

9. If the marked fish is preserved as a scientific specimen, or for later examination, the mark would not be affected by the preservation.

10. There should be enough possible variations of the mark so that many individuals or many small groups can be identified separately.

11. The marking substance should not present any health or safety hazard to the biologist, fish, or the public.

12. The mark should not cause adverse public relations by spoiling edible parts of the fish.

Obviously, no one mark satisfies all the above listed requirements and it generally only satisfies a few of them. One of the critical problems of a research project is to decide on the best mark for the particular circumstances.

Both Floy and Petersen disc tags have been utilized in the Susitna River drainage in the past and will be used to tag fish at Flathorn, Sunshine, Talkeetna and Curry stations.

Petersen Disc Tags

One (1) inch diameter, sequentially numbered or blank Petersen disc tags will be utilized on adult salmon at Curry Station, and at Sunshine and Talkeetna stations on chinook salmon. The color code will be international orange at Curry Station and yellow or blue at Sunshine Station and green at Talkeetna Station.

Tagging procedures will be reviewed in the field as it is difficult to explain without having tags and a fish in hand. Generally, the following steps are as followed:

1. Hold prepared tag (pin, buffer pad, and numbered tag) with needle nosed pliers and insert through the cartilage immediately under the dorsal fin.

2. Place a blank tag on the pin and cut off all but 3/8 inch of the pin with a cutting pliers.

3. Twist remaining pin in a inward and rolling motion so that the pin lies flat against the disc and forms a loop.

Here are a couple suggestions that will help:

1. Use a sharpening stone to make a sharp point on the tagging pins. This can be done ahead of time and will make penetration easier.

2. Prepare tags prior to making fishwheel checks. Assemble tags in sequential order and stick them in a piece of styrofoam: pin, clear buffer disc, tag.

Floy Tags

Sequentially numbered FT-4 Floy tags will be utilized on sockeye, pink, chum and coho salmon at the Flathorn, Sunshine and Talkeetna stations. Color codes will be: green at Flathorn, pink at Sunshine and blue at Talkeetna.

Tagging procedures will be demonstrated in the field; generally the following steps are followed:

1. Slide one end of the tag into the hollow end of the tagging needle. Insert the needle completely through the fish in the cartilage immediately under the dorsal fin.

2. Slide the tag off the needle and tie the tag firmly against the posterior end of the dorsal fin with an overhand knot making sure that the tag does not override or vertically compress the dorsal fin.

Several suggestions are:

1. Keep two (2) or three (3) tagging needles available in the event of a loss.

2. Use a sharpening stone to maintain a sharp point on the tagging needle. This can be done ahead of time, making the tagging easier.

3. Prepare tags prior to making fishwheel checks. Assemble tags in sequential order on a board and tape them in place, thus allowing them to be easily withdrawn.

APPENDIX 5

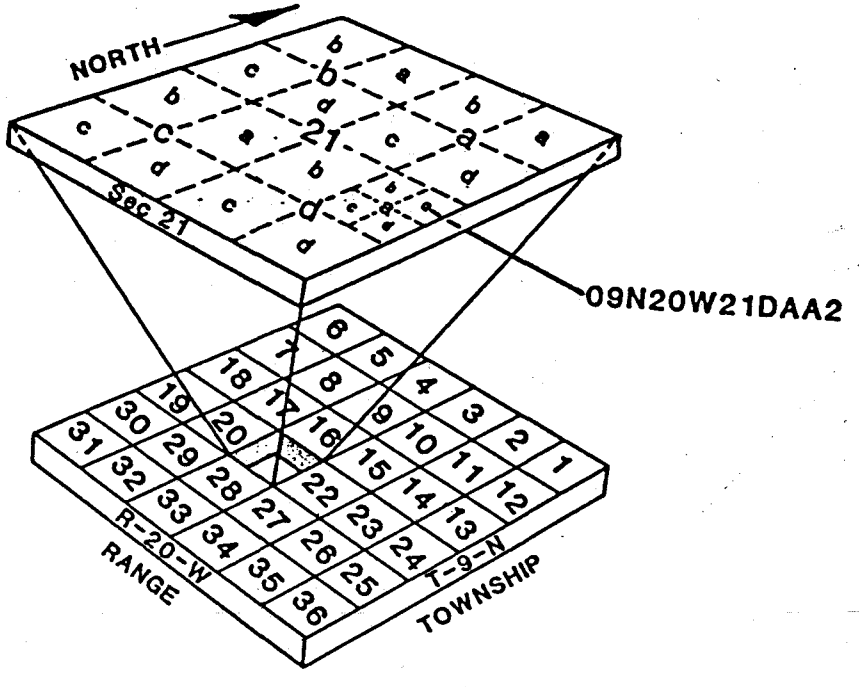
ADULT ANADROMOUS FISHERIES STUDIES

Geographic Location Code and General Maps

System of Specifying Geographic Locations

For conciseness and for use in the computer processing, it is convenient to use a modification of the General Land Office method of specifying locations as developed by federal and state agencies in Montana (MDFWP, 1979).

In this report, locations of features such as sampling points are specified by using 12 characters. The first three characters of the location give the township, the next three characters the range. The next two give the section number within the township, and the next tract, the quarter-quarter section (40-acre tract), and the quarter-quarter-quarter section (10-acre tract). These subdivisions of the 640-acre section in the northeast quadrant. If there is more than one feature in a 10-acre tract, consecutive digits beginning with 2 are added to the number. For example, if a sample was collected in Section 21, Township 9 North, Range 20 West, it would be numbered 09N20E21DAA2. The letters DAA indicate that the site is in the N1/4 of the N1/4 of the SE1/4, and the number 2 following the letters DAA indicates there are at least two sampling locations in this 10-acre tract.



System used by ADF&G in this study to specify geographic locations.

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

ATTACHMENT D: SUSITNA RIVER MILE INDEX MOUTH TO SUSITNA GLACIER

DECEMBER 1981

Prepared by:

R&M CONSULTANTS, INC.
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Prepared for:

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ATTACHMENT D

SUSITNA RIVER MILE INDEX

SUSITNA RIVER MILE INDEX
LIST OF FIGURES

SOURCES OF INFORMATION

River Miles were established by means of measurement along the principal channel thalweg, as identified on maps and photographs of varying scales as follows:

- River Mile 1-96. 1" = 1000' blueline copies of reproducible photographs, Sheets 18/37 through 37/37, by North Pacific Aerial Surveys for R&M Consultants and Acres American.

- River Mile 96-152. 1" = 500' blueline copies of reproducible photographs, Sheets 1/37 through 17/37 by North Pacific Aerial Surveys for R&M Consultants and Acres American.

- River Mile 152-182 and 188-248. 1" = 2000' blueline copies of topographic maps, Sheets A-G, by R&M Consultants and Acres American for Alaska Power Authority.

- River Mile 182-188. 1" = 1000' blueline copies of photogrammetric topographic maps, Sheets 2/19 and 4/19, by North Pacific Aerial Surveys, from photography dated 7:19:80.

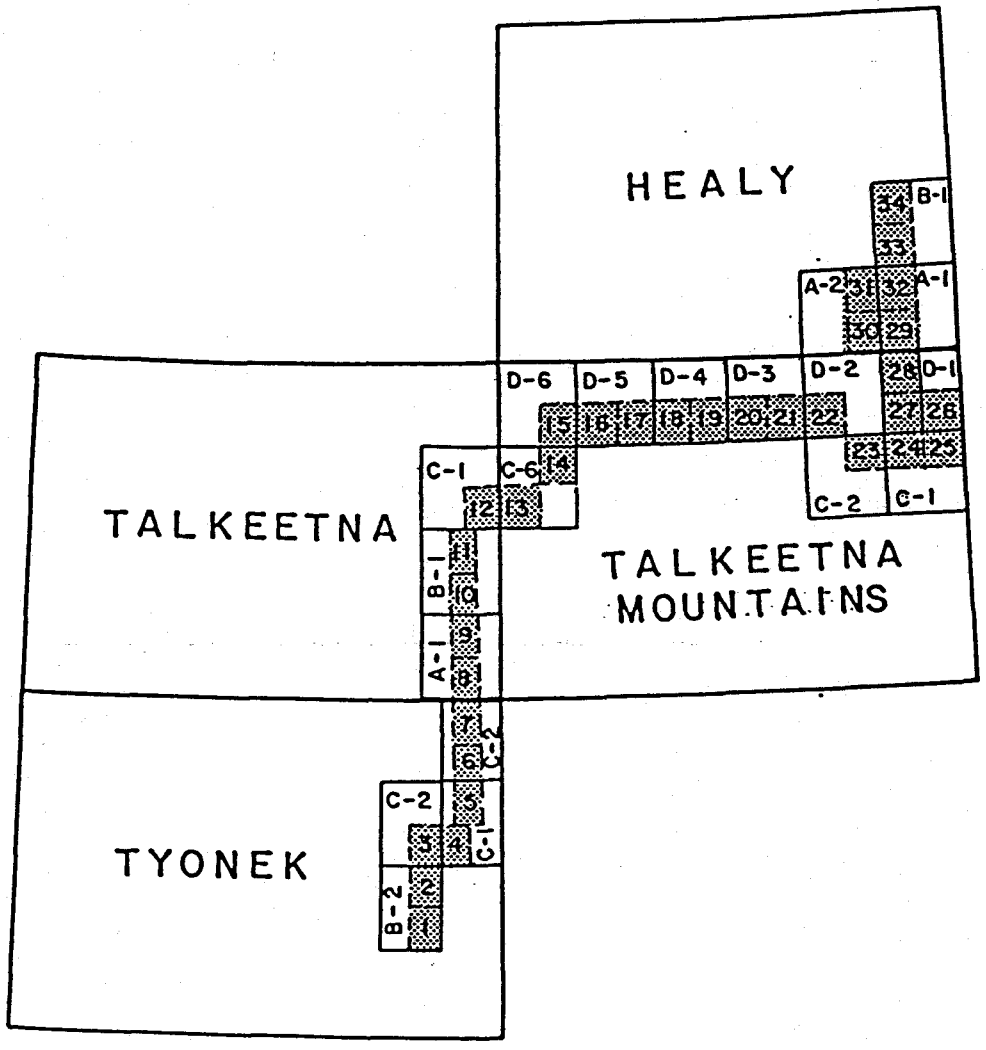
- River Mile 248-320. 1:63,360 photocopies of 15' quadrangle maps from the U.S. Geological Survey, as included herein.

LEGEND

HEALY — 1:250,000 QUADRANGLE NAME

C-2 — 1:63,360 QUADRANGLE NAME

16 — FIGURE NUMBER OF THIS INDEX



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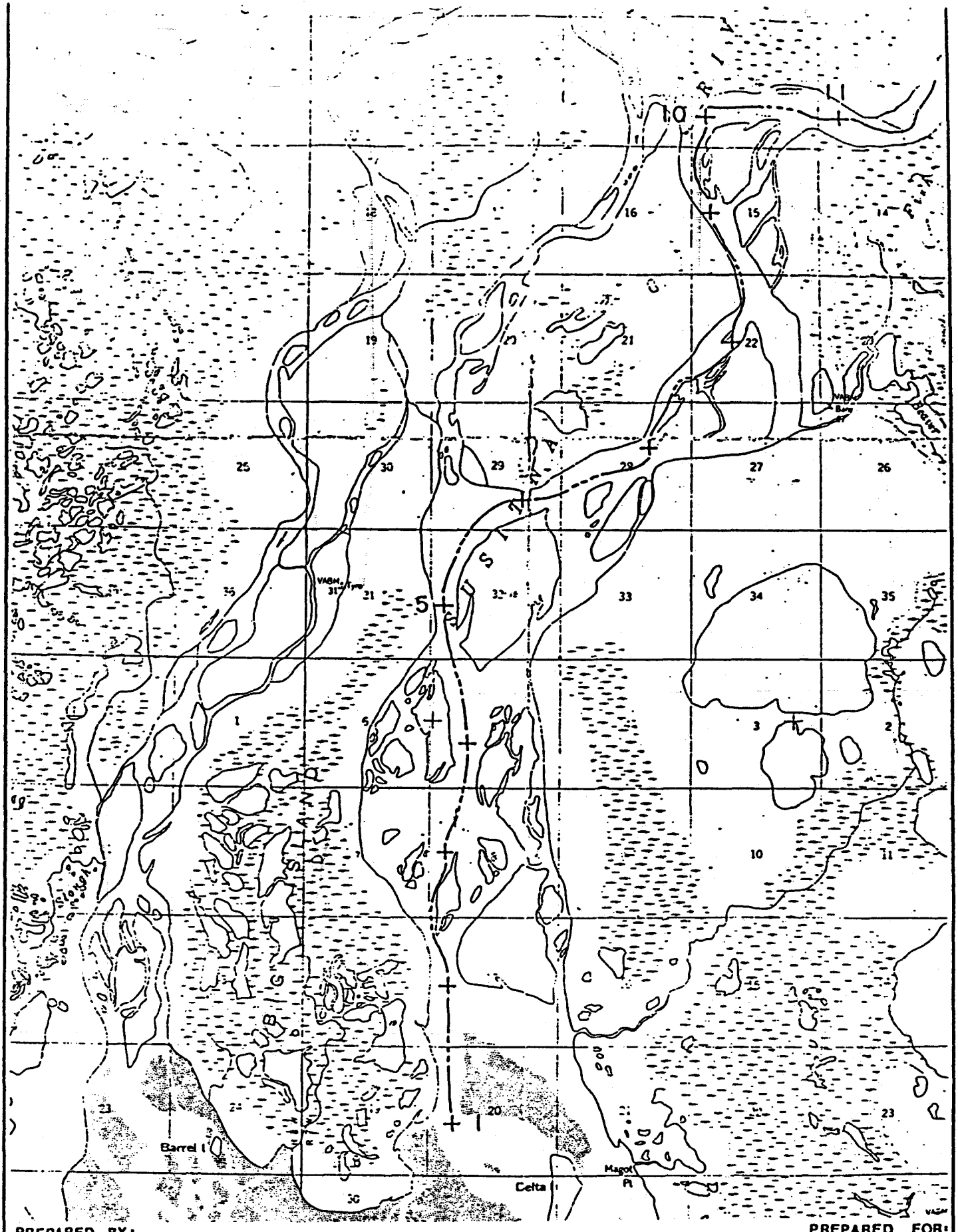
SUSITNA RIVER MILE INDEX

INDEX MAP

FIGURE 0



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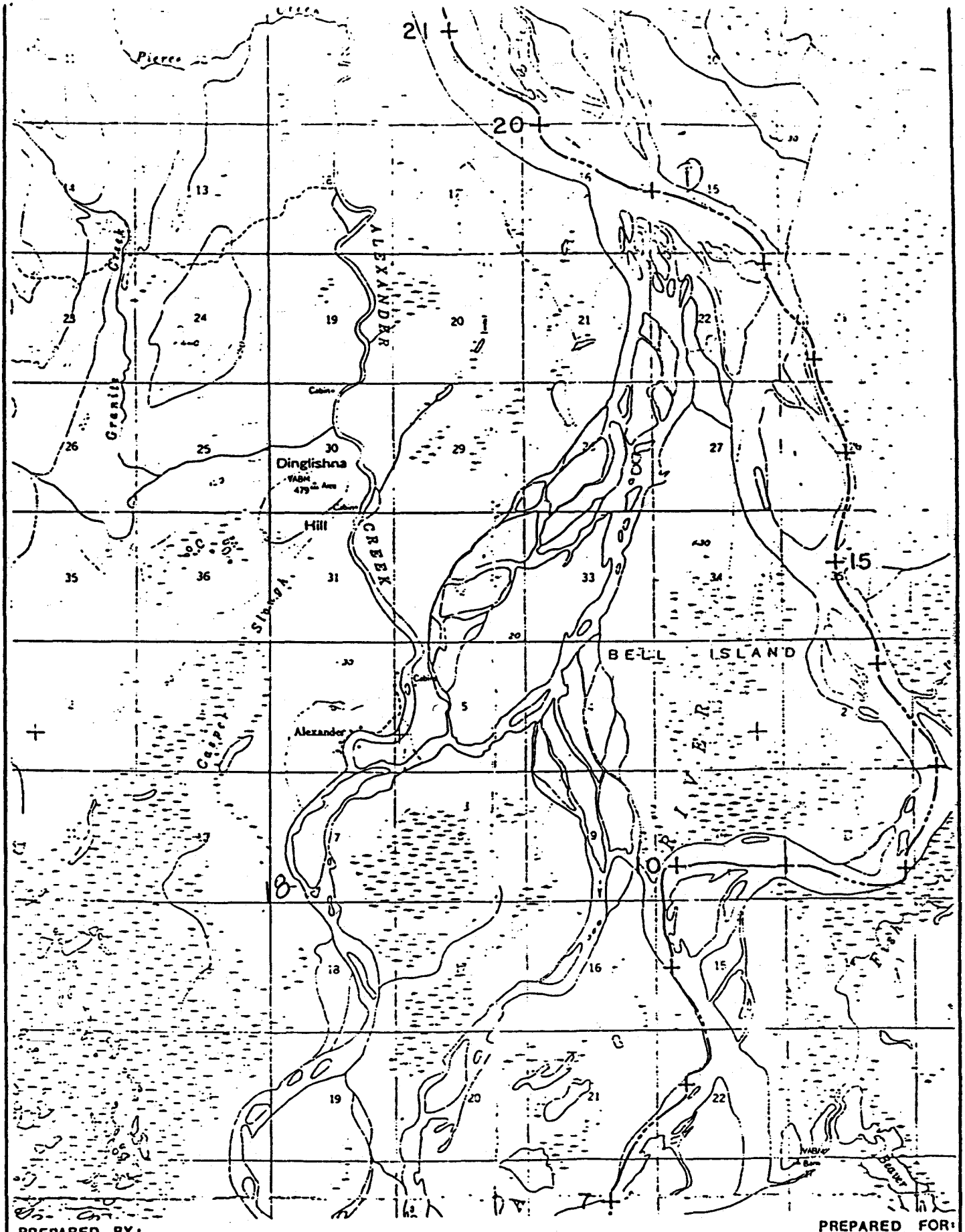
SUSITNA RIVER MILE INDEX

MILES 1 TO 11

(FROM U.S.G.S. TYONEK B-2)

FIGURE 1



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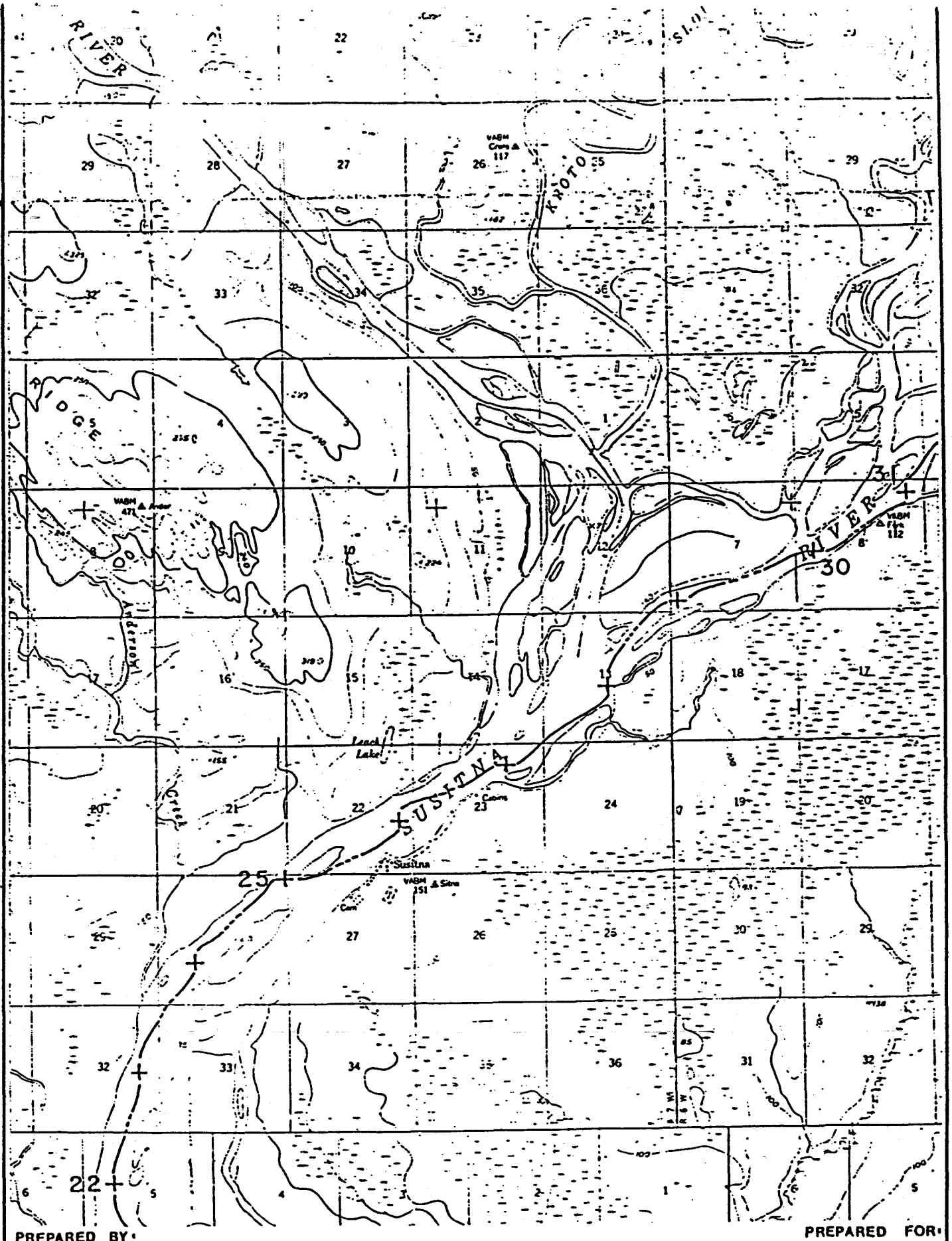
SUSITNA RIVER MILE INDEX
MILES 7 TO 21

(FROM U.S.G.S. TYONEK B-2)

FIGURE 2



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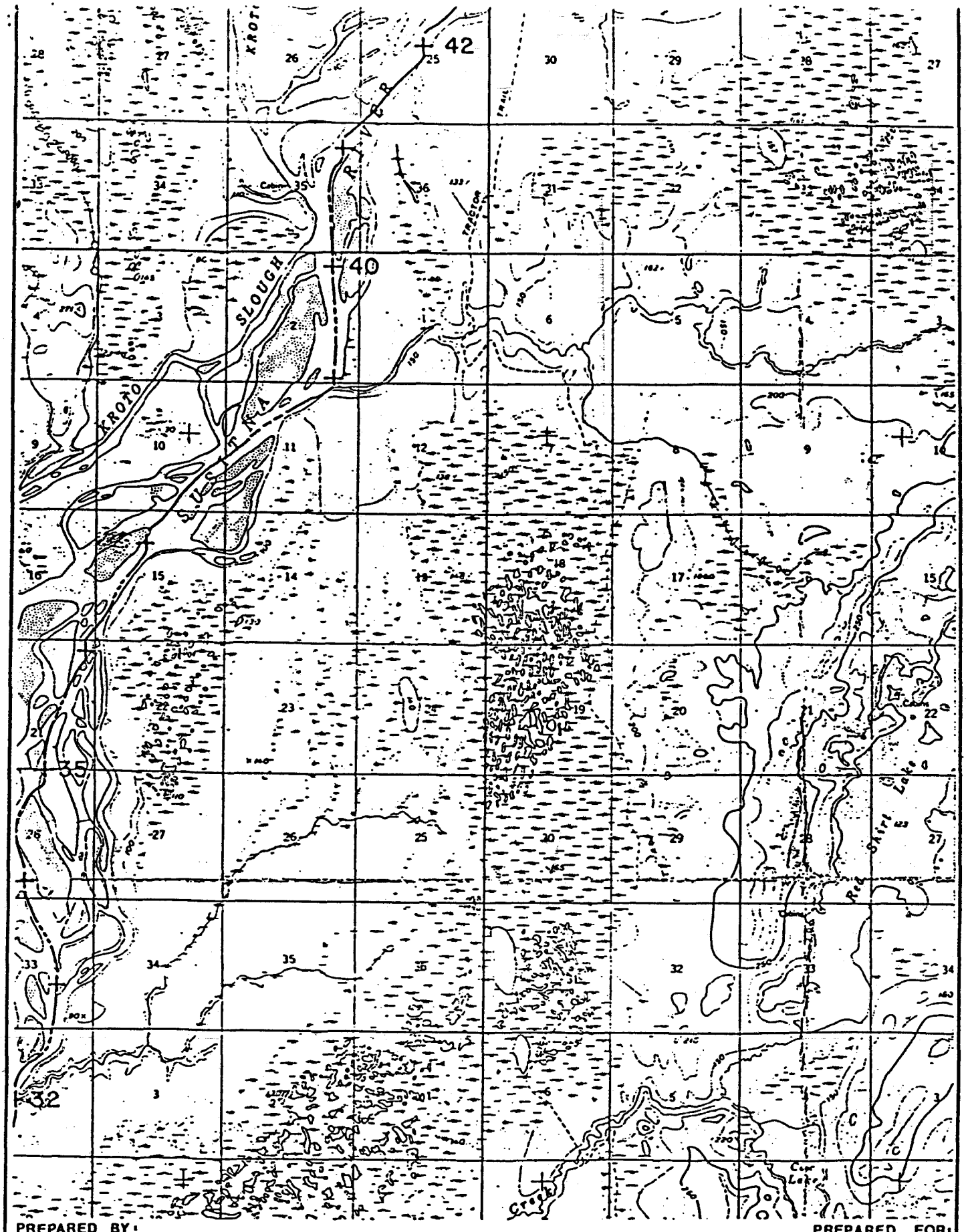
SUSITNA RIVER MILE INDEX

MILES 22 TO 31

(FROM U.S.G.S. TYONEK C-2)

FIGURE 3



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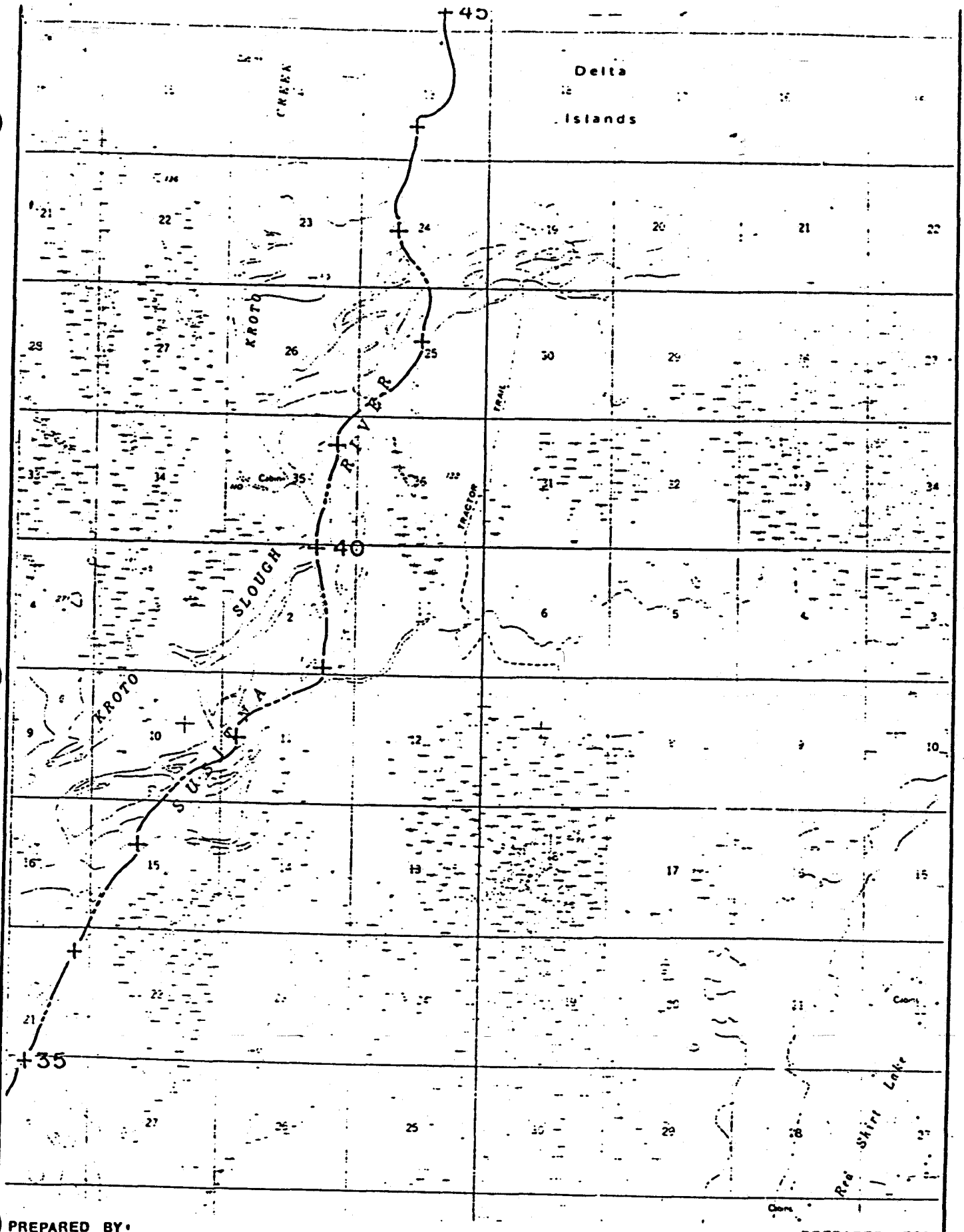
SUSITNA RIVER MILE INDEX
MILES 32 TO 42

(FROM U.S.G.S. TYONEK C-1)

FIGURE 4



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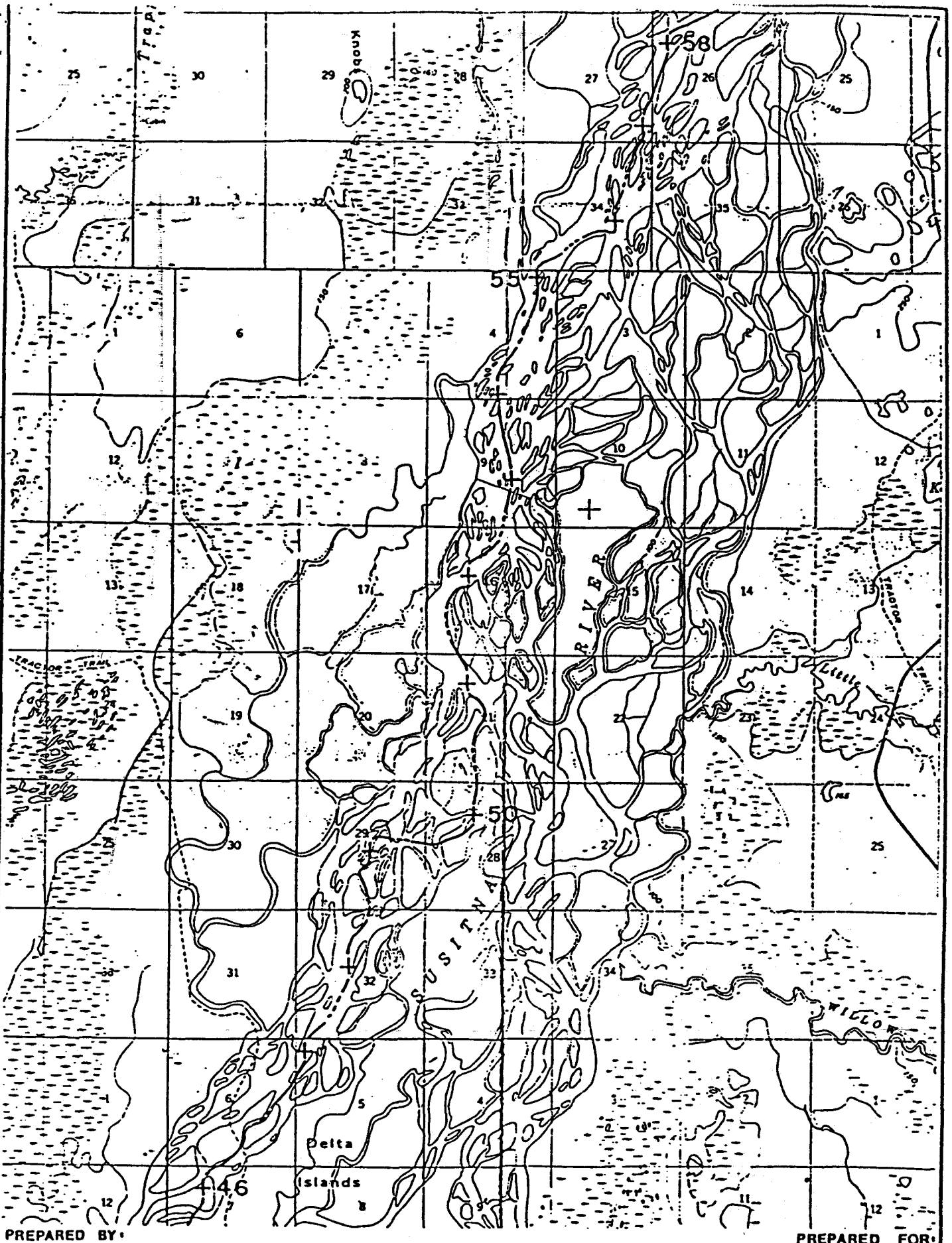
SUSITNA RIVER MILE INDEX
MILES 35 TO 45 MILES

(FROM U.S.G.S. TYONEK C-1)

FIGURE 5



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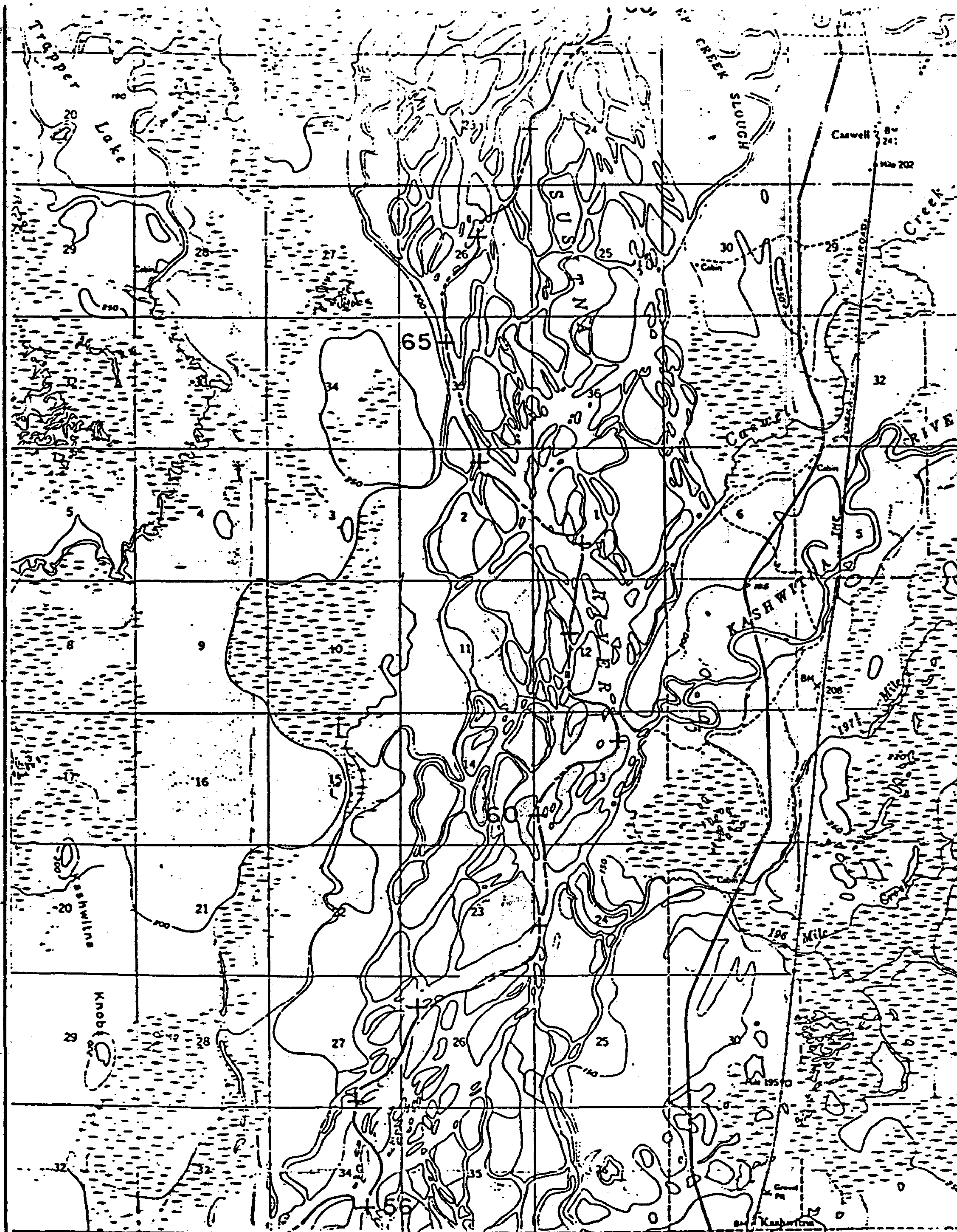
SUSITNA RIVER MILE INDEX
MILES 46 TO 58

(FROM U.S.G.S. TYONEK D-1)

FIGURE 6



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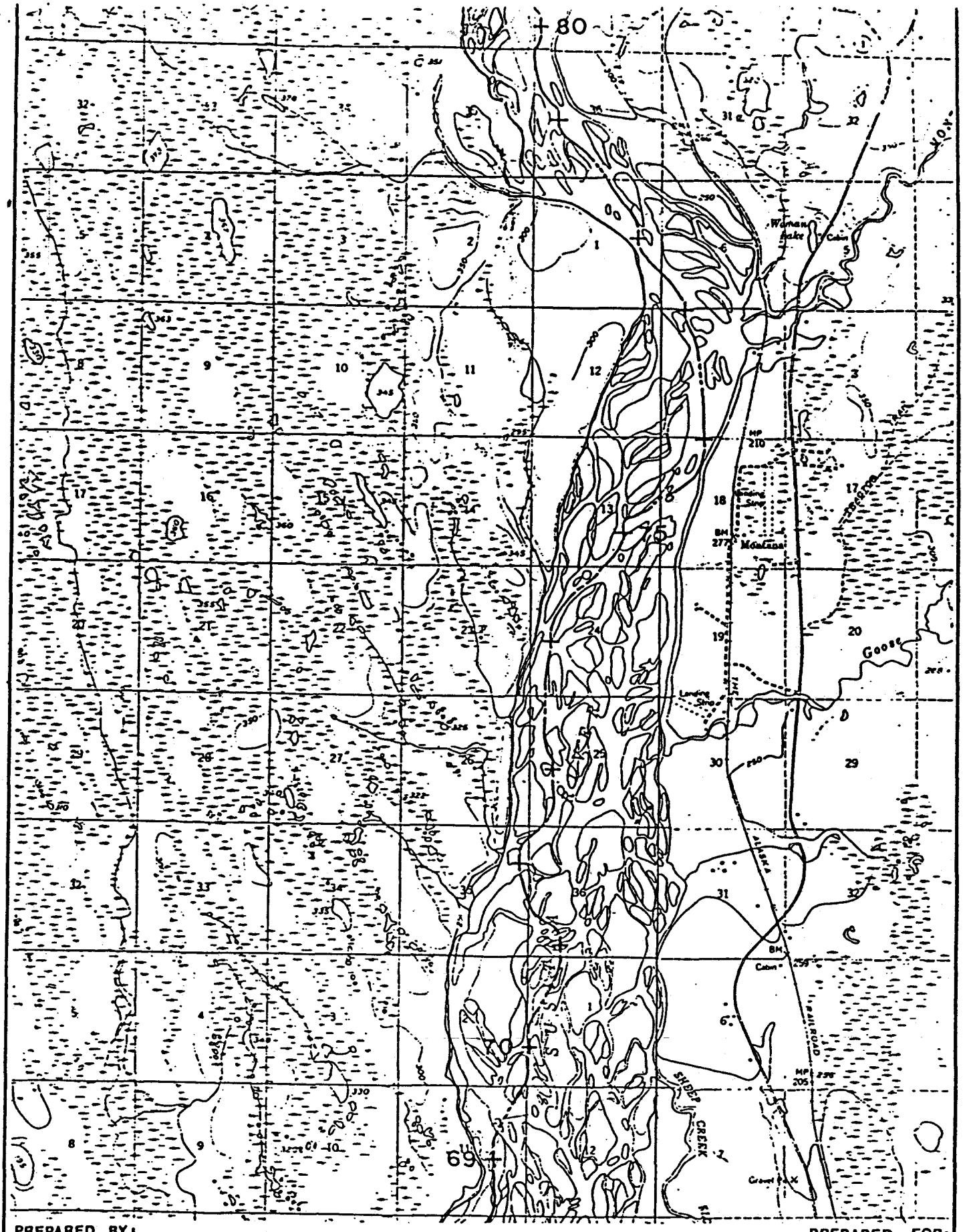
SUSITNA RIVER MILE INDEX

MILES 56 TO 68

(FROM U.S.G.S. TYONEK D-1)

FIGURE 7



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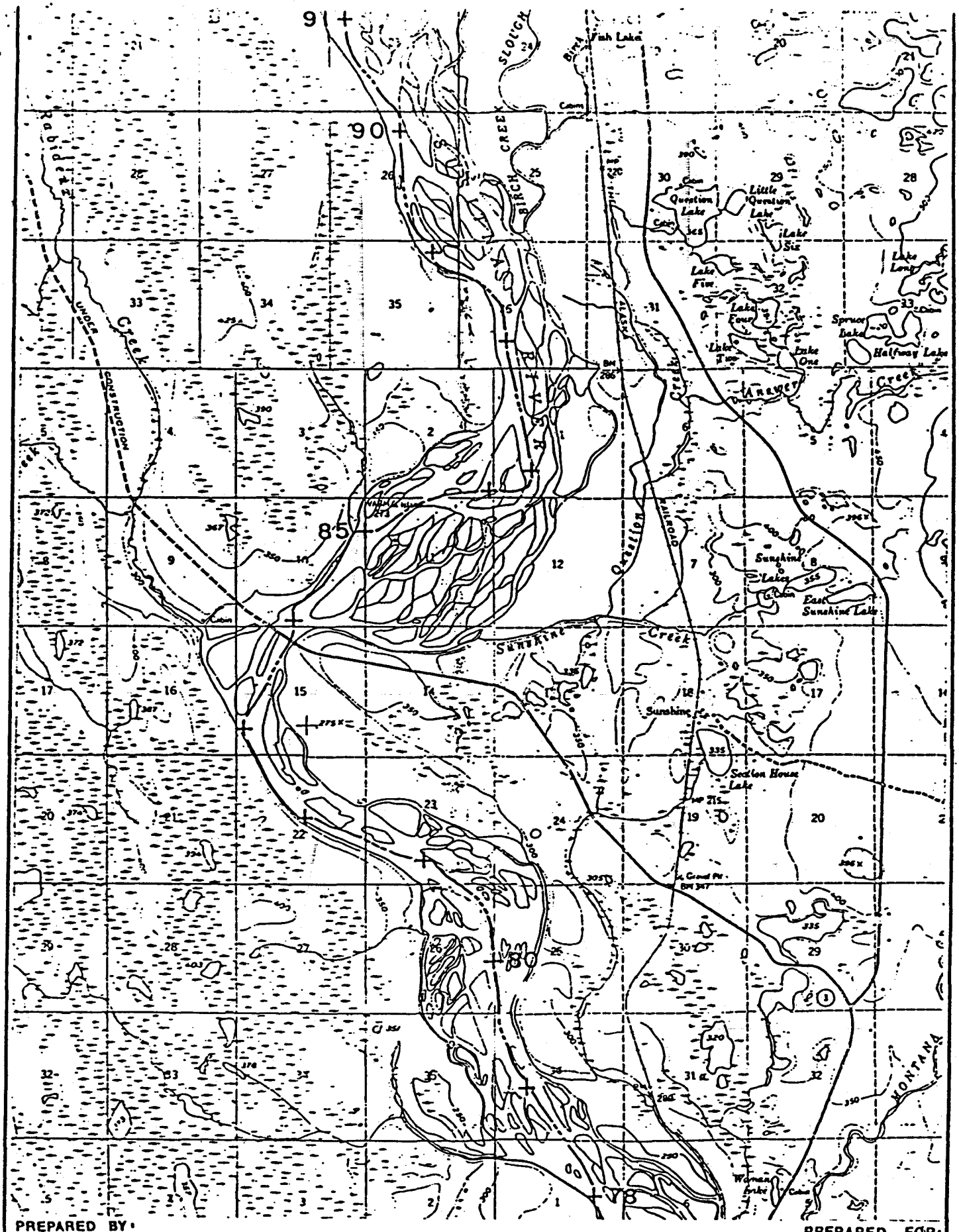
SUSITNA RIVER MILE INDEX
MILES 69 TO 80

(FROM U.S.G.S. TALKEETNA A-1)

FIGURE 8

ACRES



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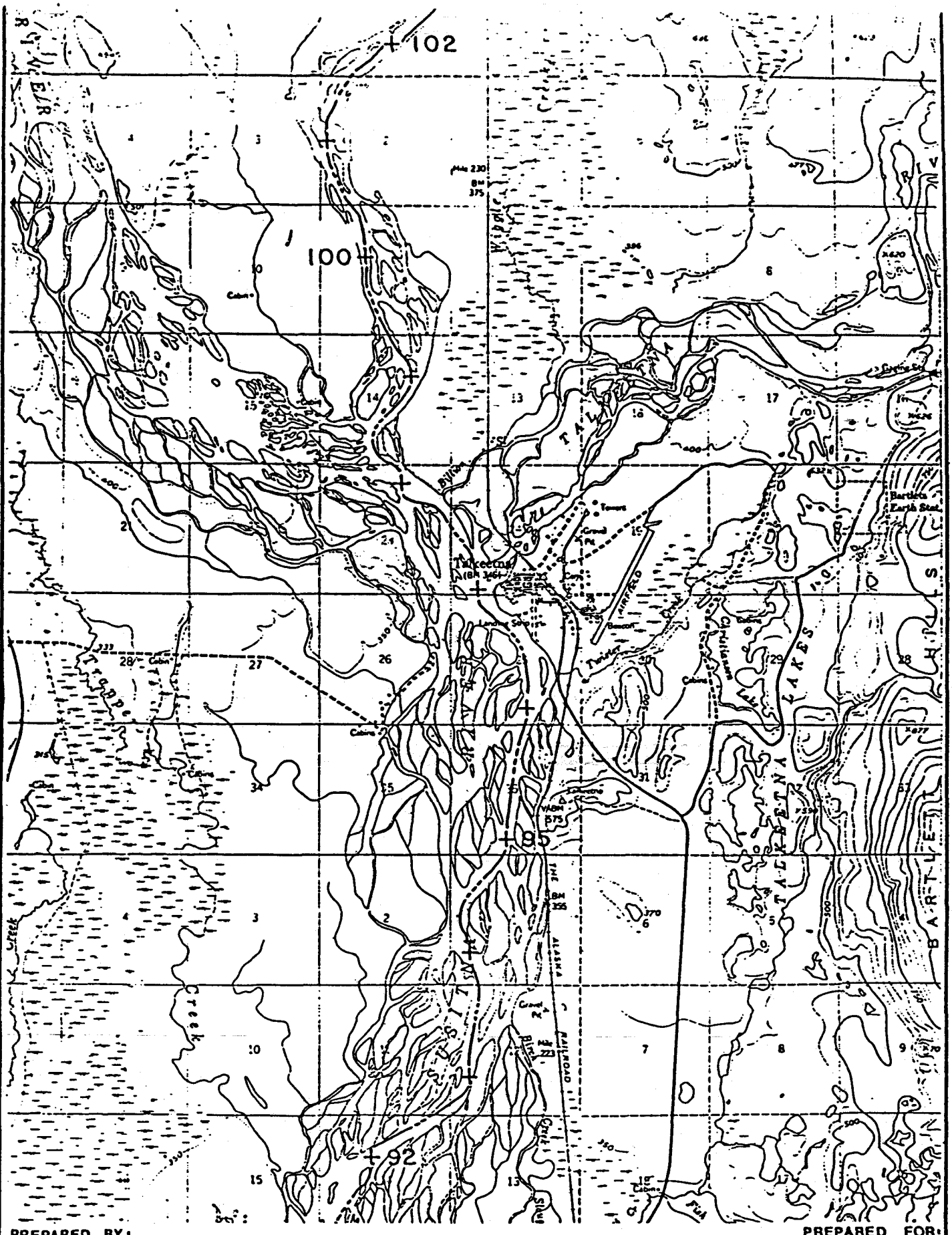
SUSITNA RIVER MILE INDEX
MILES 78 TO 91

(FROM U.S.G.S. TALKEETNA A-1)

FIGURE 9



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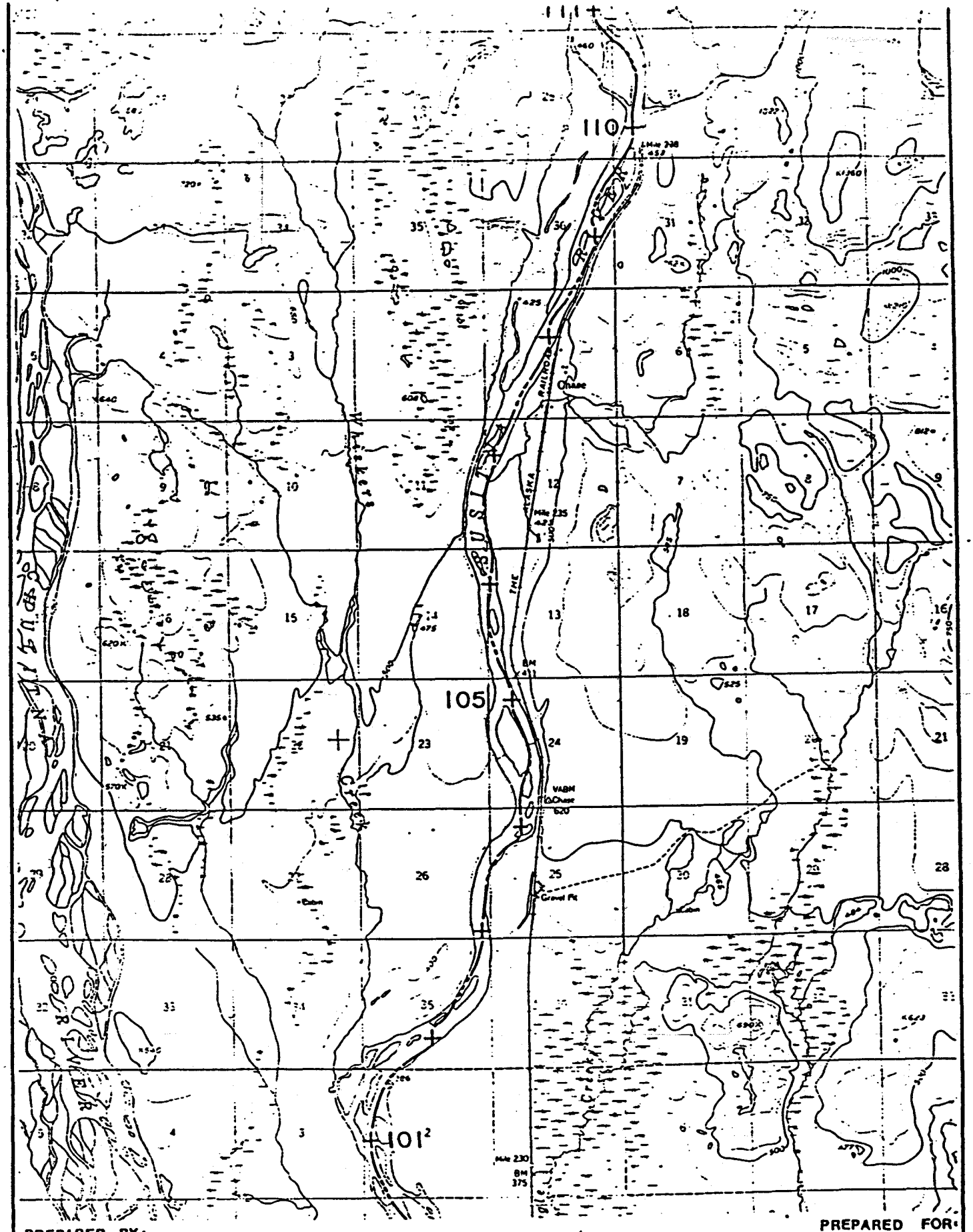
SUSITNA RIVER MILE INDEX MILES 92 TO 102

(FROM U.S.G.S. TALKEETNA B-1)

FIGURE 10



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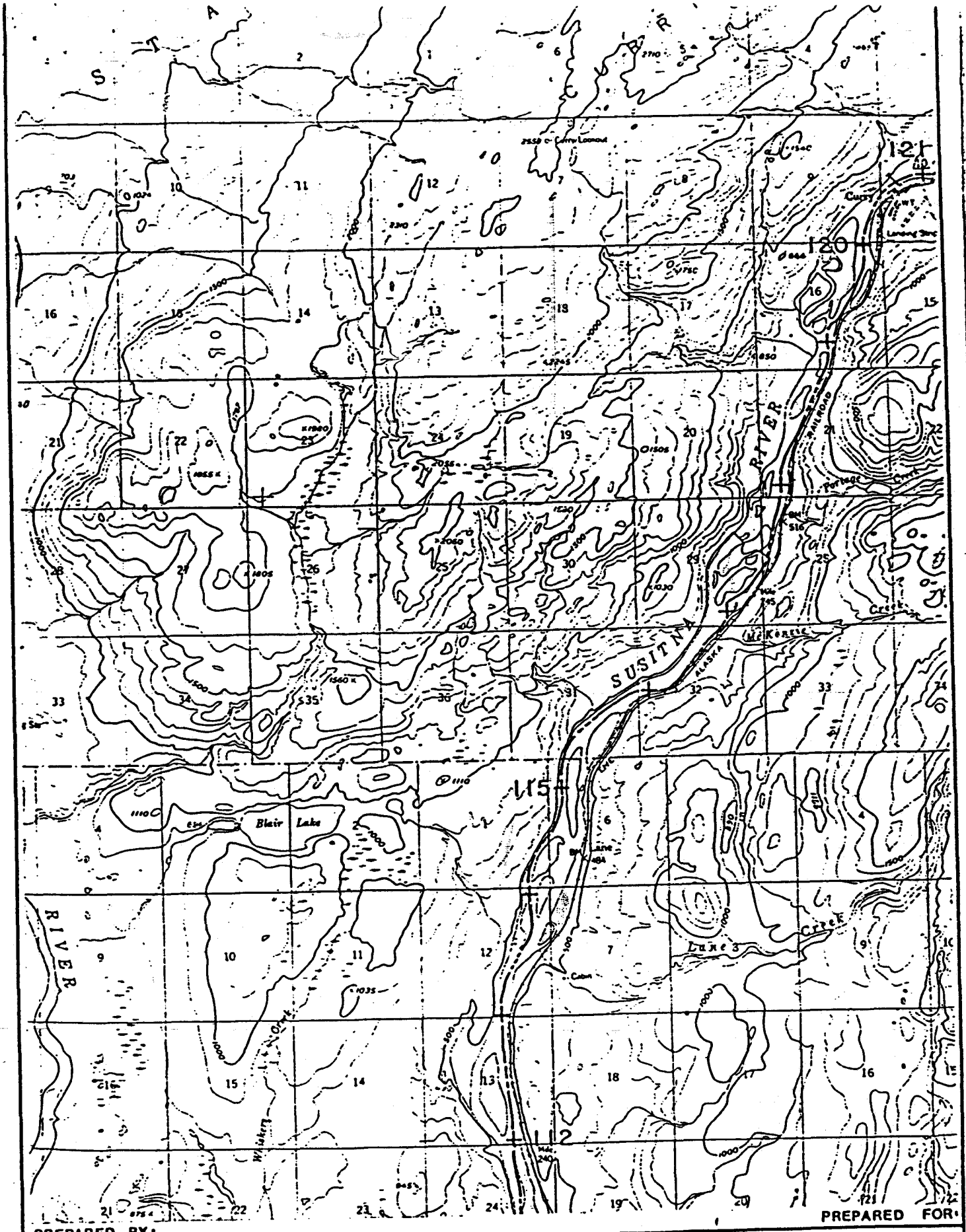
SUSITNA RIVER MILE INDEX
MILES 101 TO 111

(FROM U.S.G.S. TALKEETNA B-1)

FIGURE 11

ACRES



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SUSITNA RIVER MILE INDEX
MILES 112 TO 121

(FROM U.S.G.S. TALKEETNA C-1)

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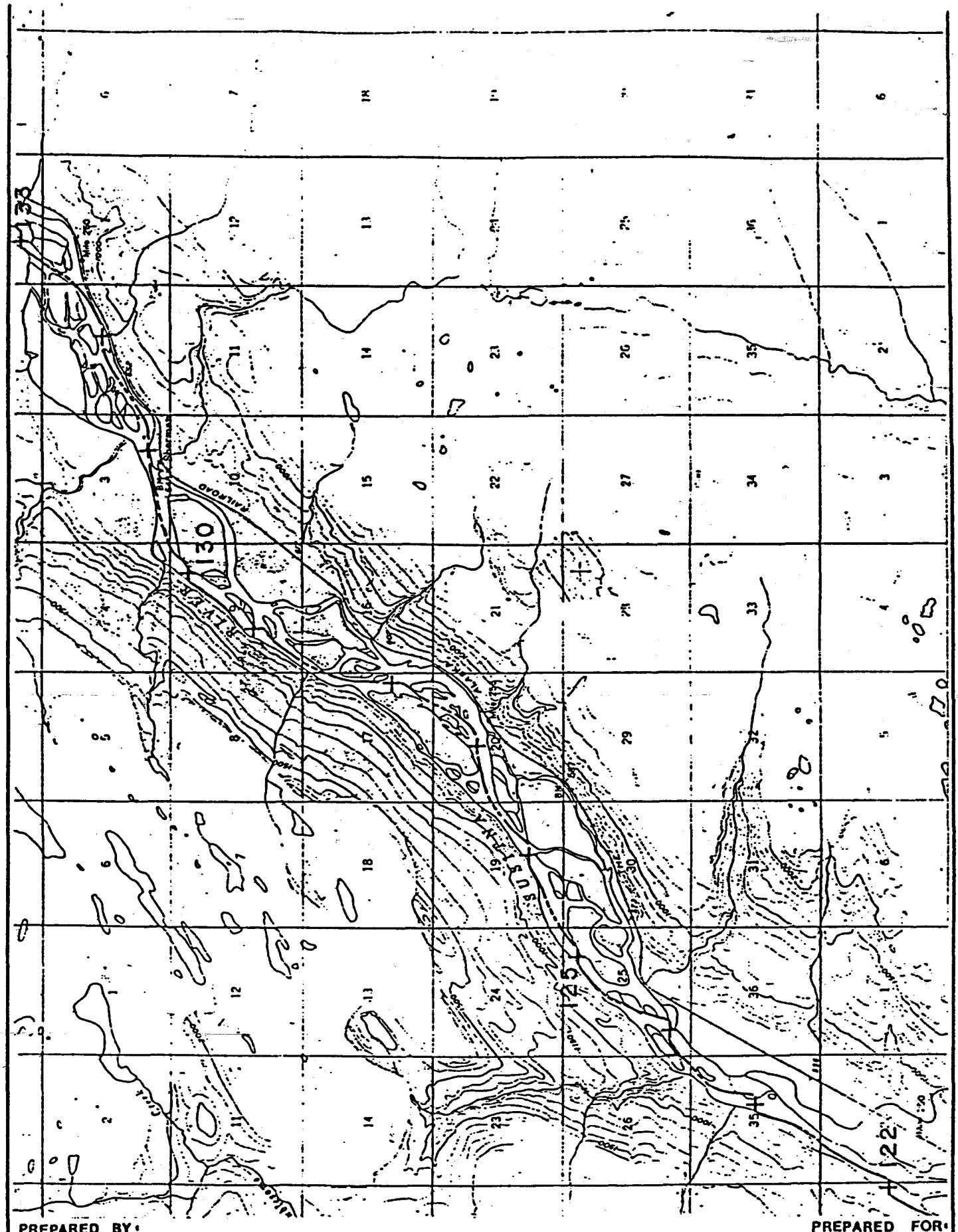
FIGURE 12



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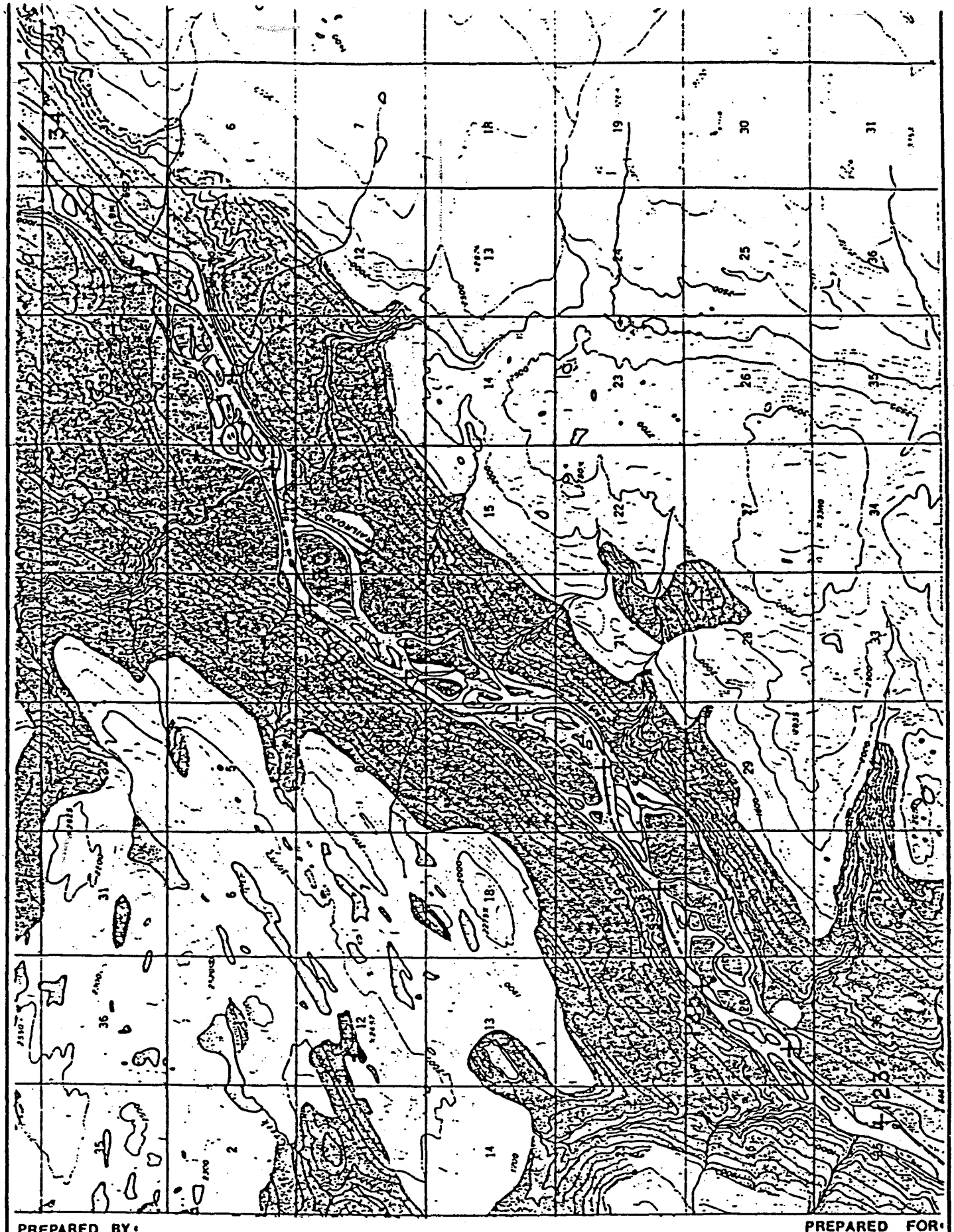
SUSITNA RIVER MILE INDEX
MILES 122 TO 133

(FROM U.S.G.S. TALKEETNA MNTS. C-6)

FIGURE 13

ACRES



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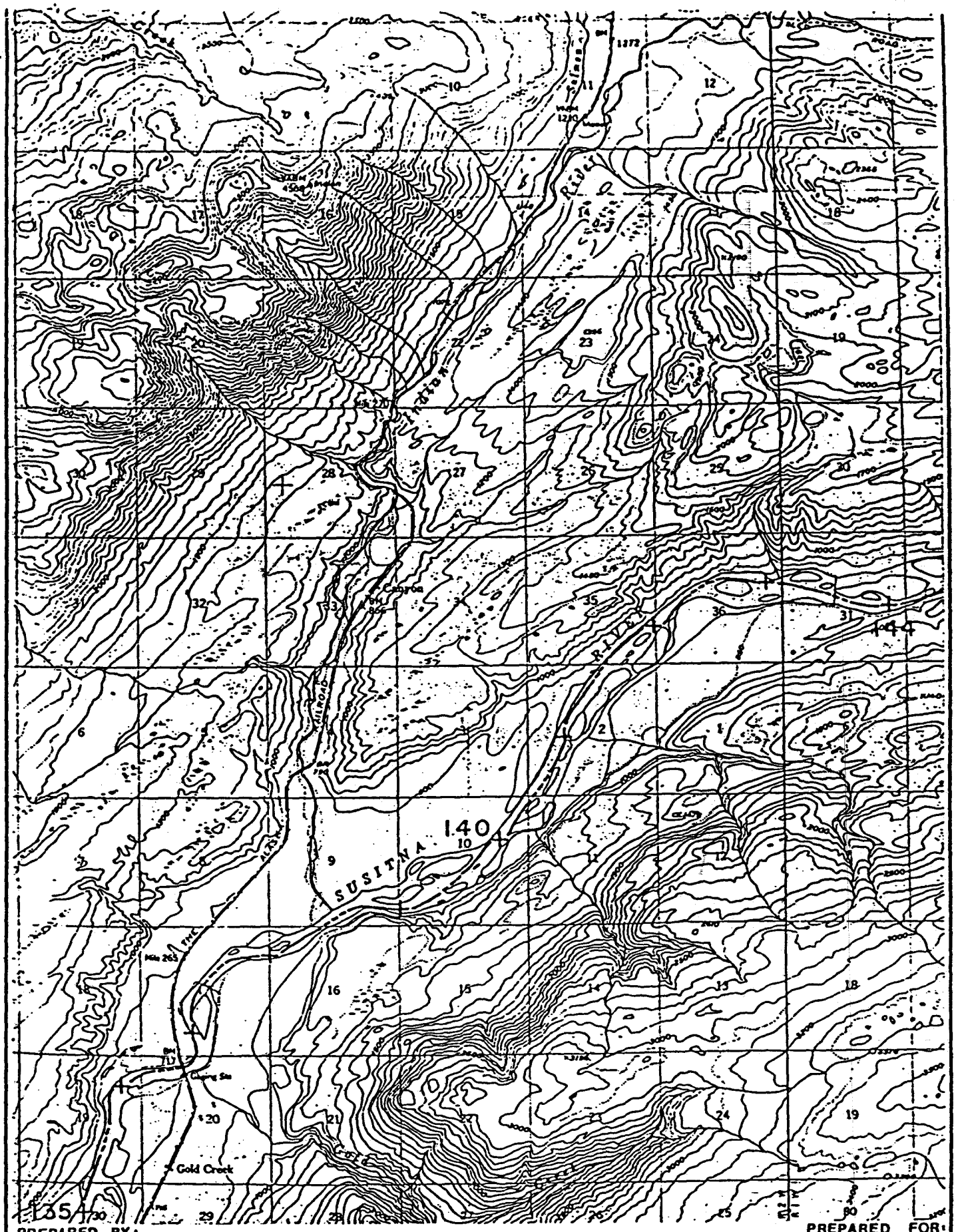
SUSITNA RIVER MILE INDEX
MILES 123 TO 134

(FROM U.S.G.S. TALKEETNA MNTS. C-6)

FIGURE 14



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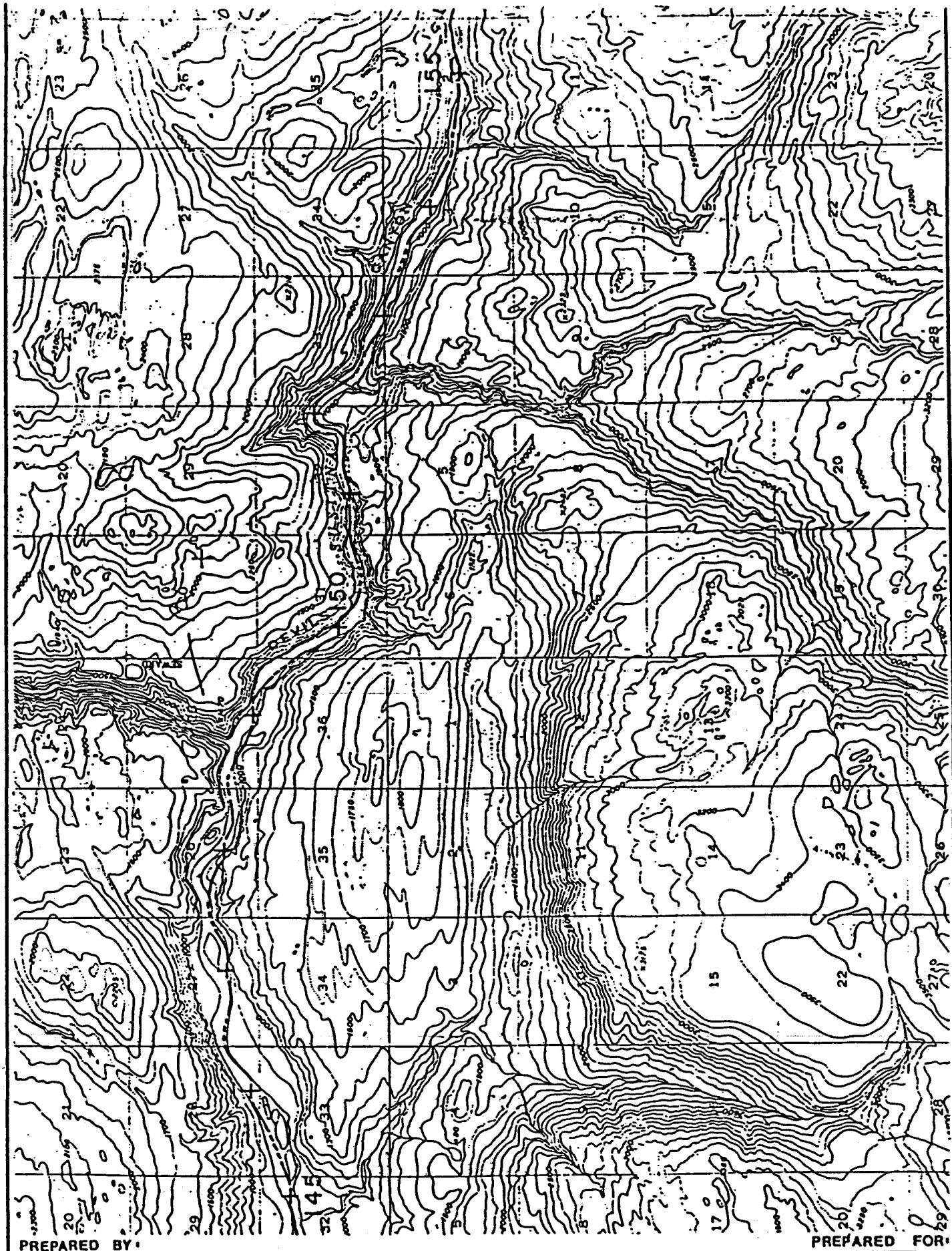
SUSITNA RIVER MILE INDEX

MILES 135 TO 144

(FROM U.S.G.S. TALKEETNA MNTS. D-6)

FIGURE 16

ACRES



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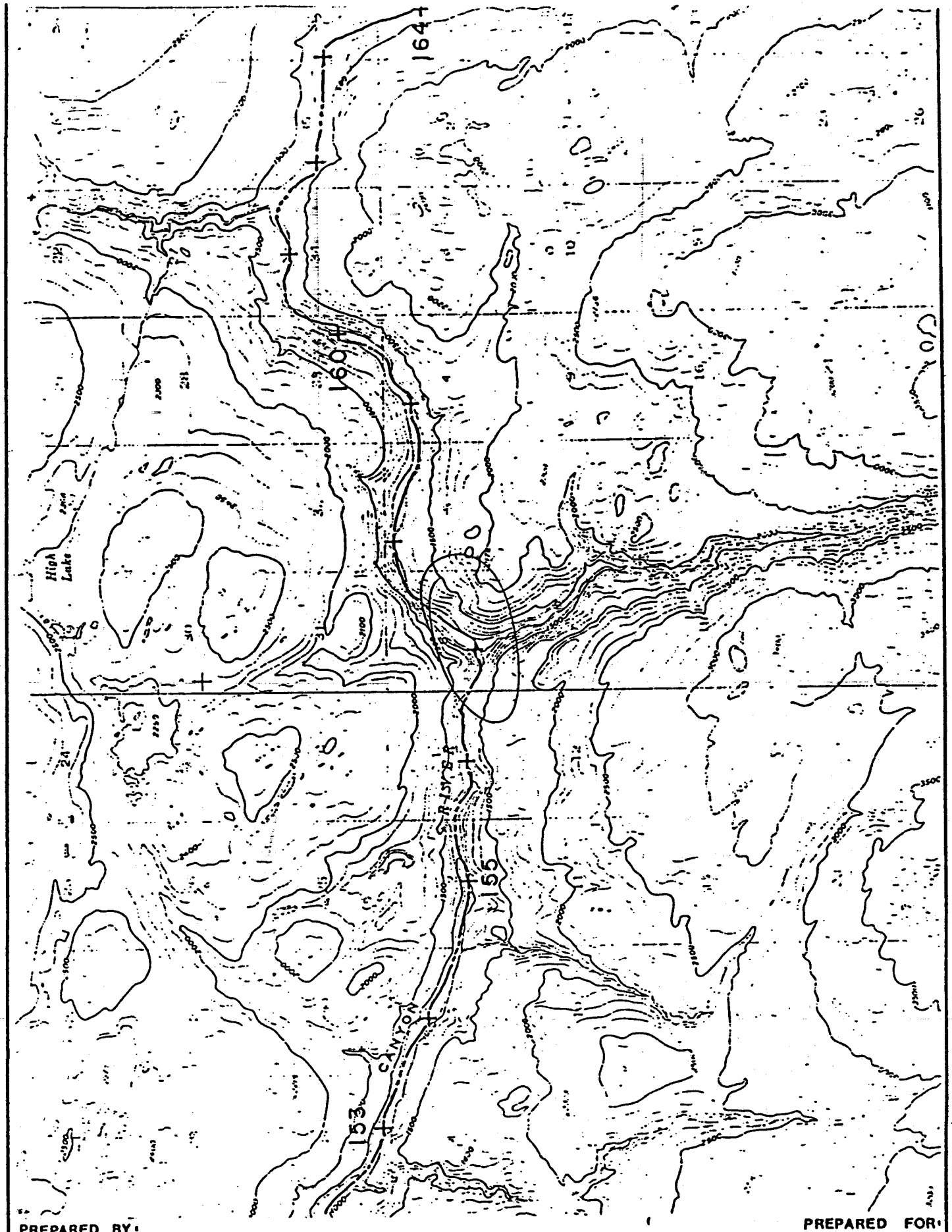
SUSITNA RIVER MILE INDEX

MILES 145 TO 155

(FROM U.S.G.S. TALKEETNA MNTS. D-6)

FIGURE 16



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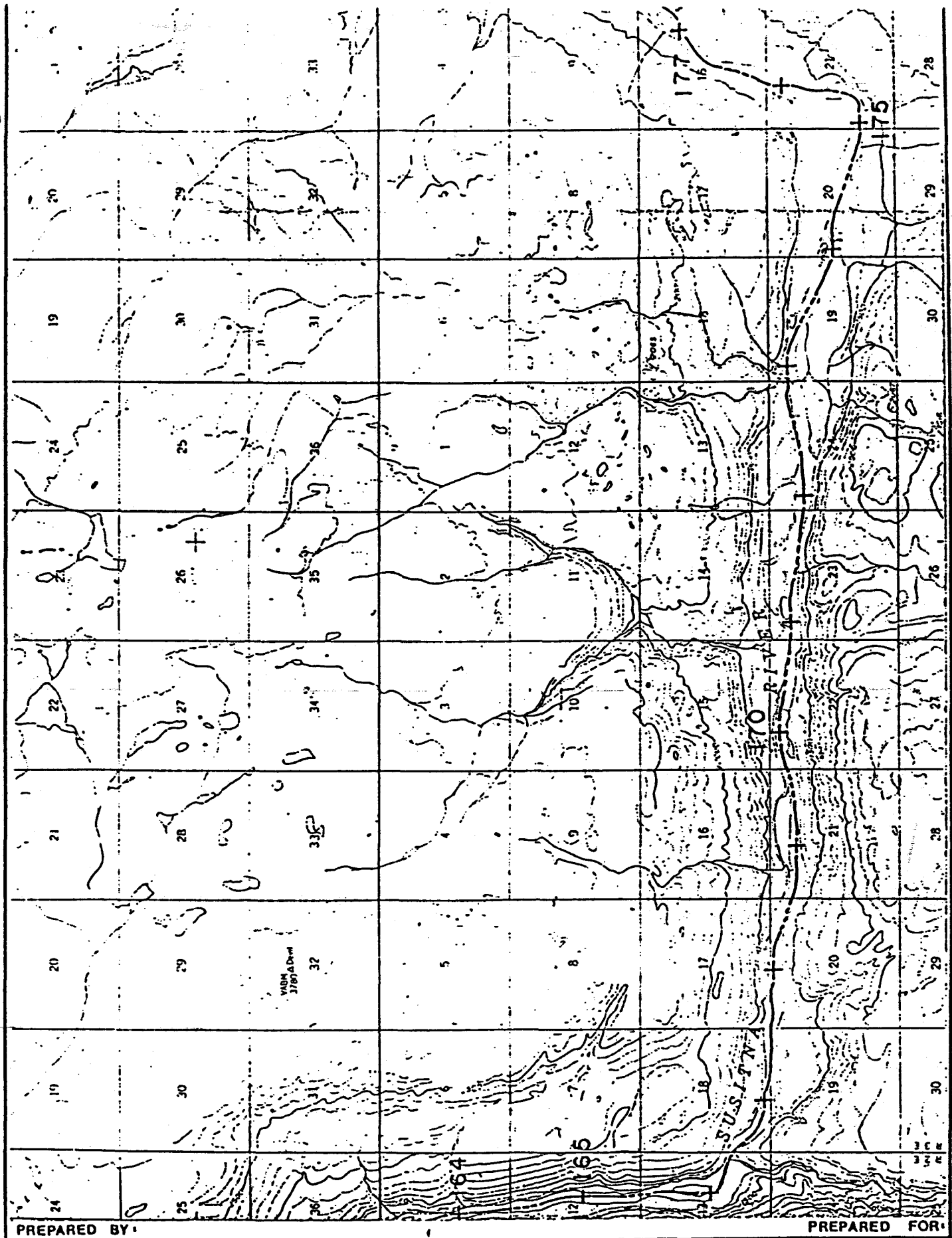
SUSITNA RIVER MILE INDEX

MILES 153 TO 164

(FROM U.S.G.S. TALKEETNA MNTS. D-6)

FIGURE 17



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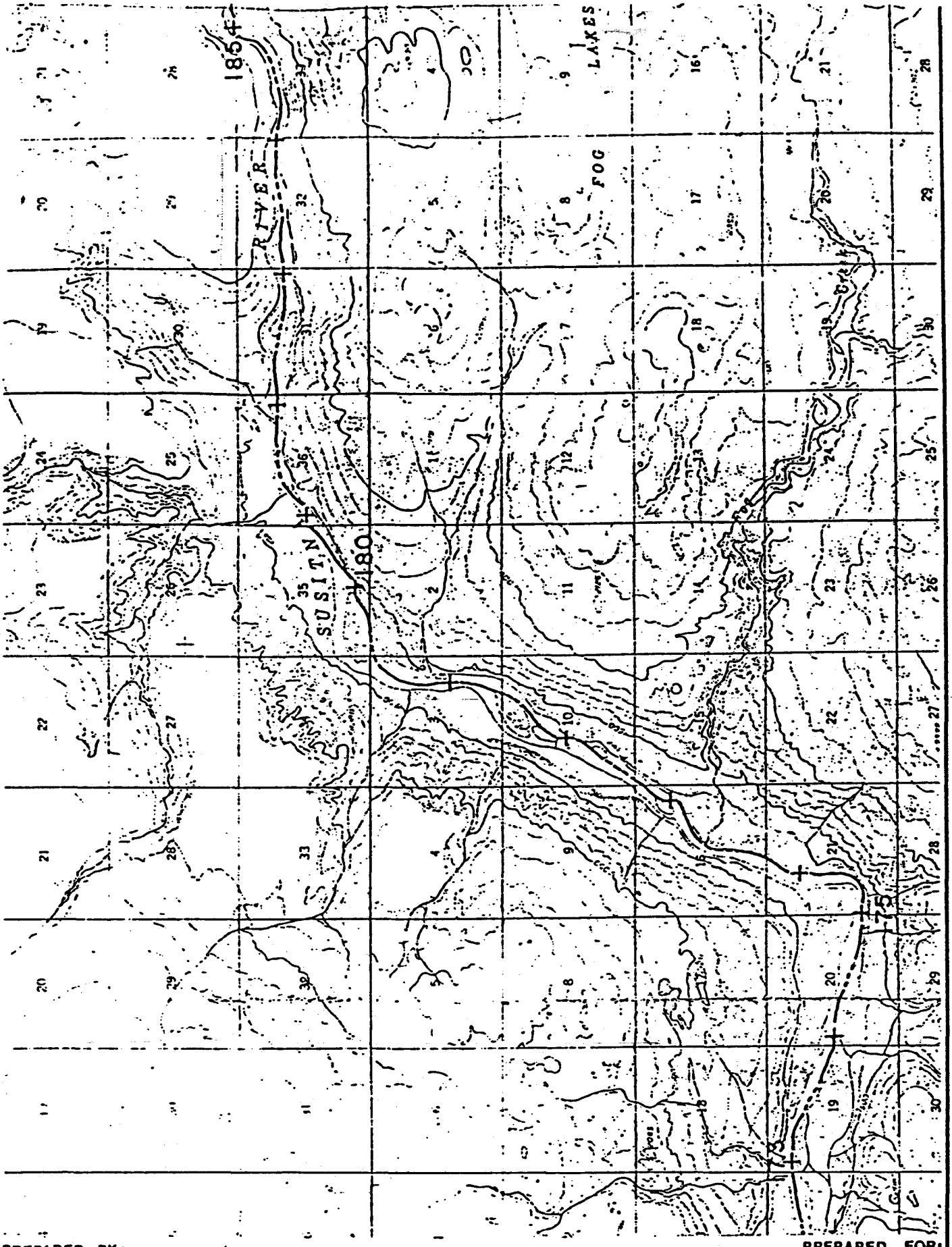
SUSITNA RIVER MILE INDEX
MILES 164 TO 177

(FROM U.S.G.S. TALKEETNA MNTS. D-4)

FIGURE 18



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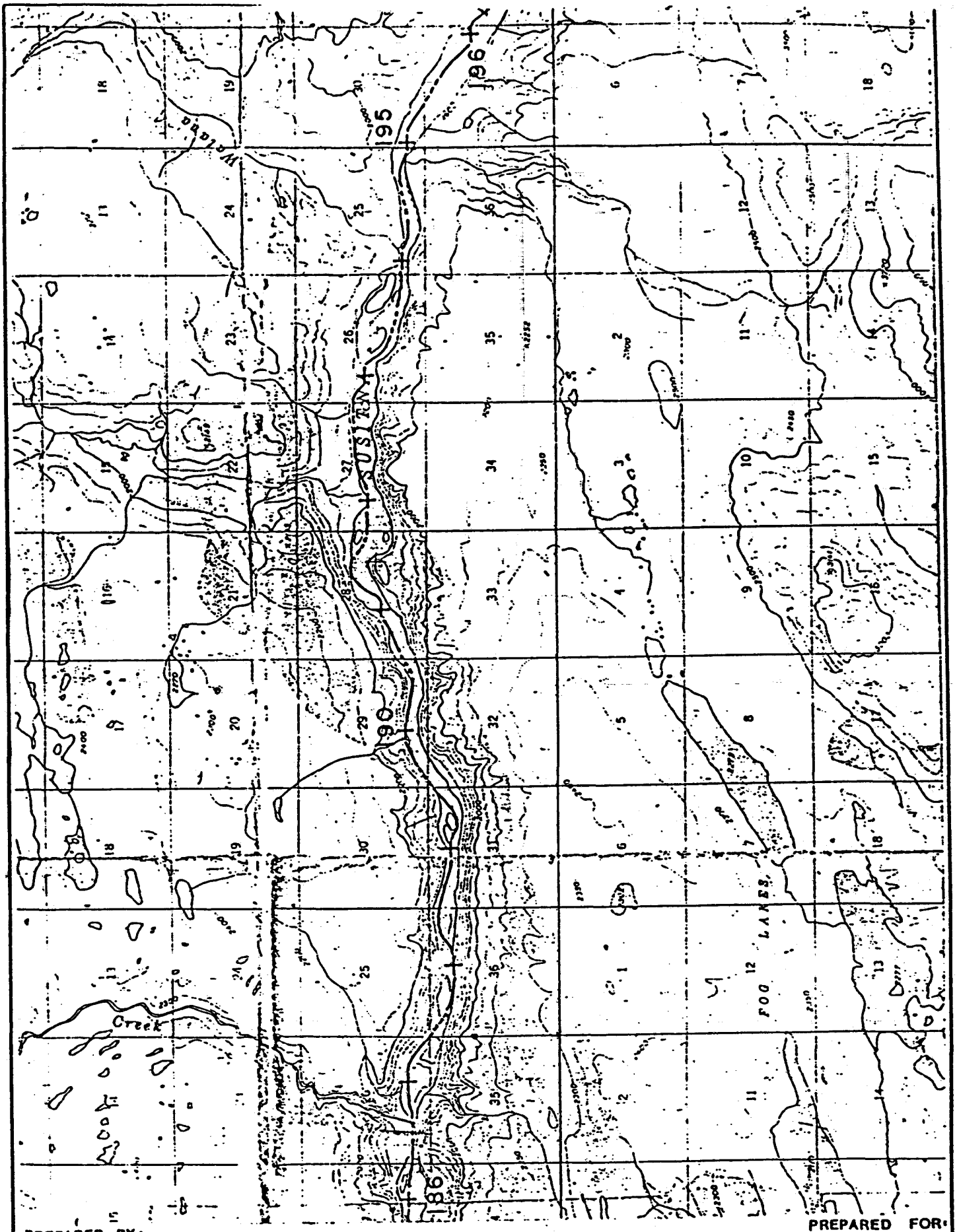
SUSITNA RIVER MILE INDEX

MILES 173 TO 185

(FROM U.S.G.S. TALKEETNA MNTS. D-4)

FIGURE 19



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SUSITNA RIVER MILE INDEX

MILES 186 TO 196

(FROM U.S.G.S. TALKEETNA MNTS. D-3)

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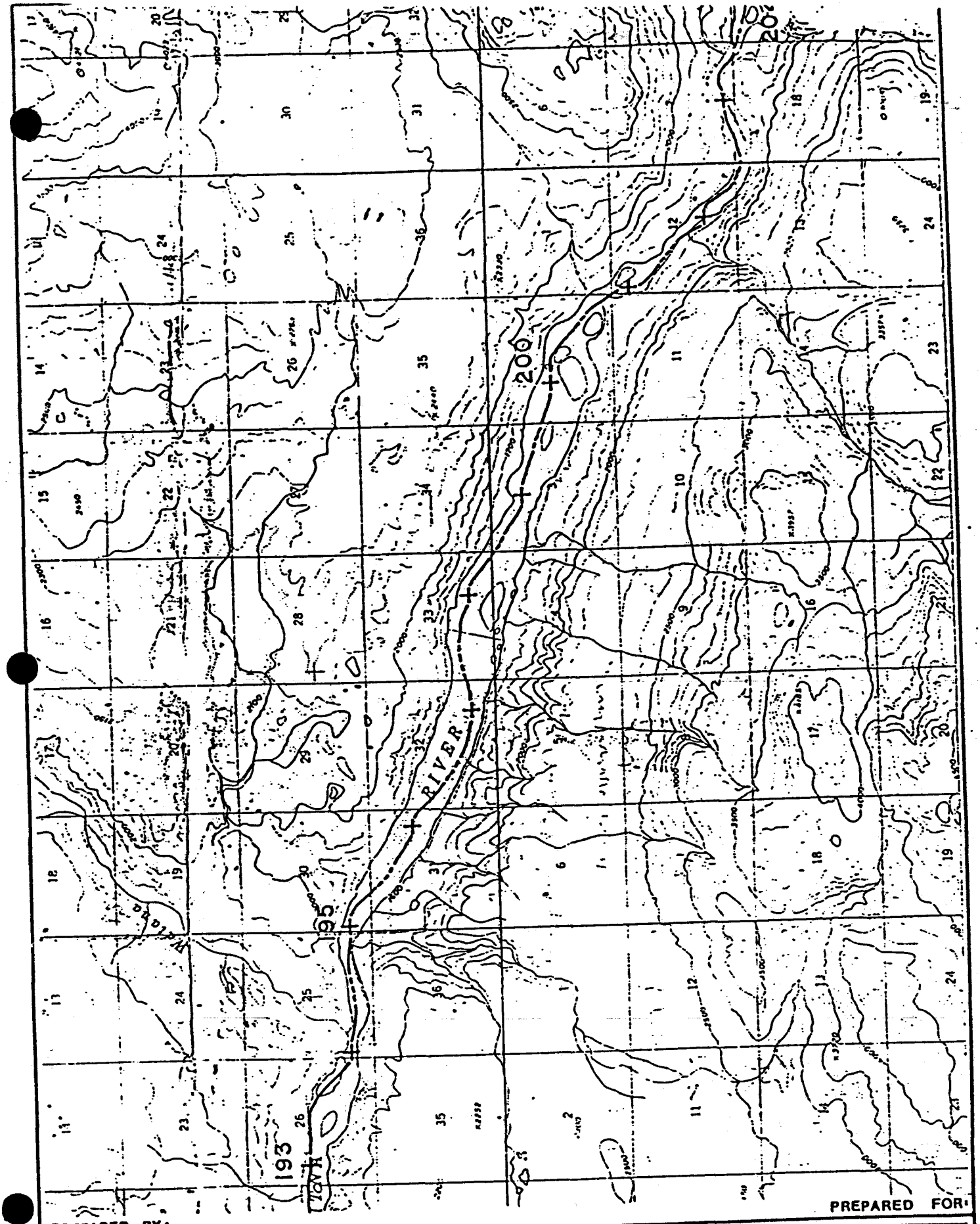
FIGURE 20



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SUSITNA RIVER MILE INDEX
MILES 193 TO 204

(FROM U.S.G.S TALKEETNA MNTS, D-3)

FIGURE 21

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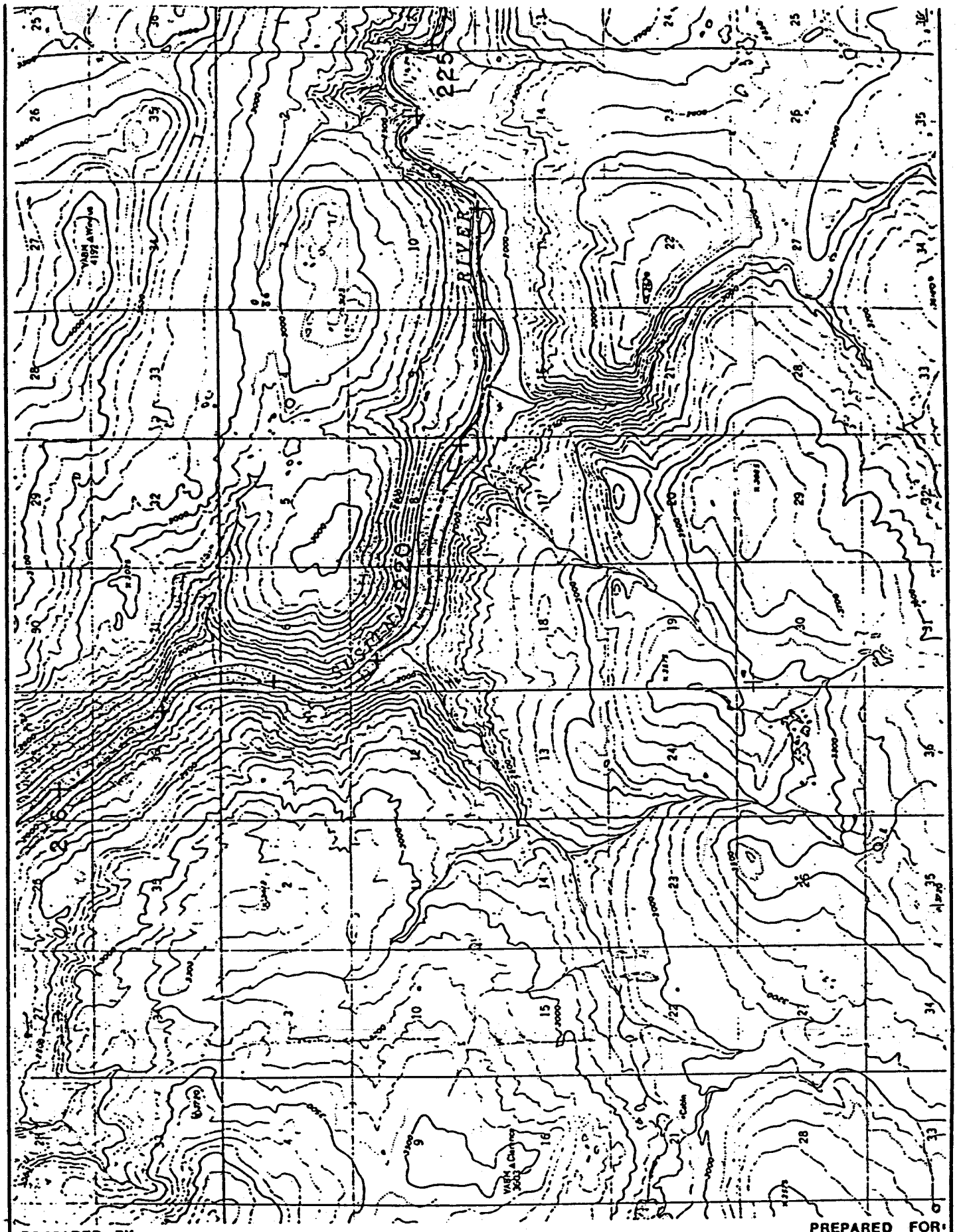
SUSITNA RIVER MILE INDEX

MILES 205 TO 215

(FROM U.S.G.S. TALKEETNA MNTS, D-2)

FIGURE 22



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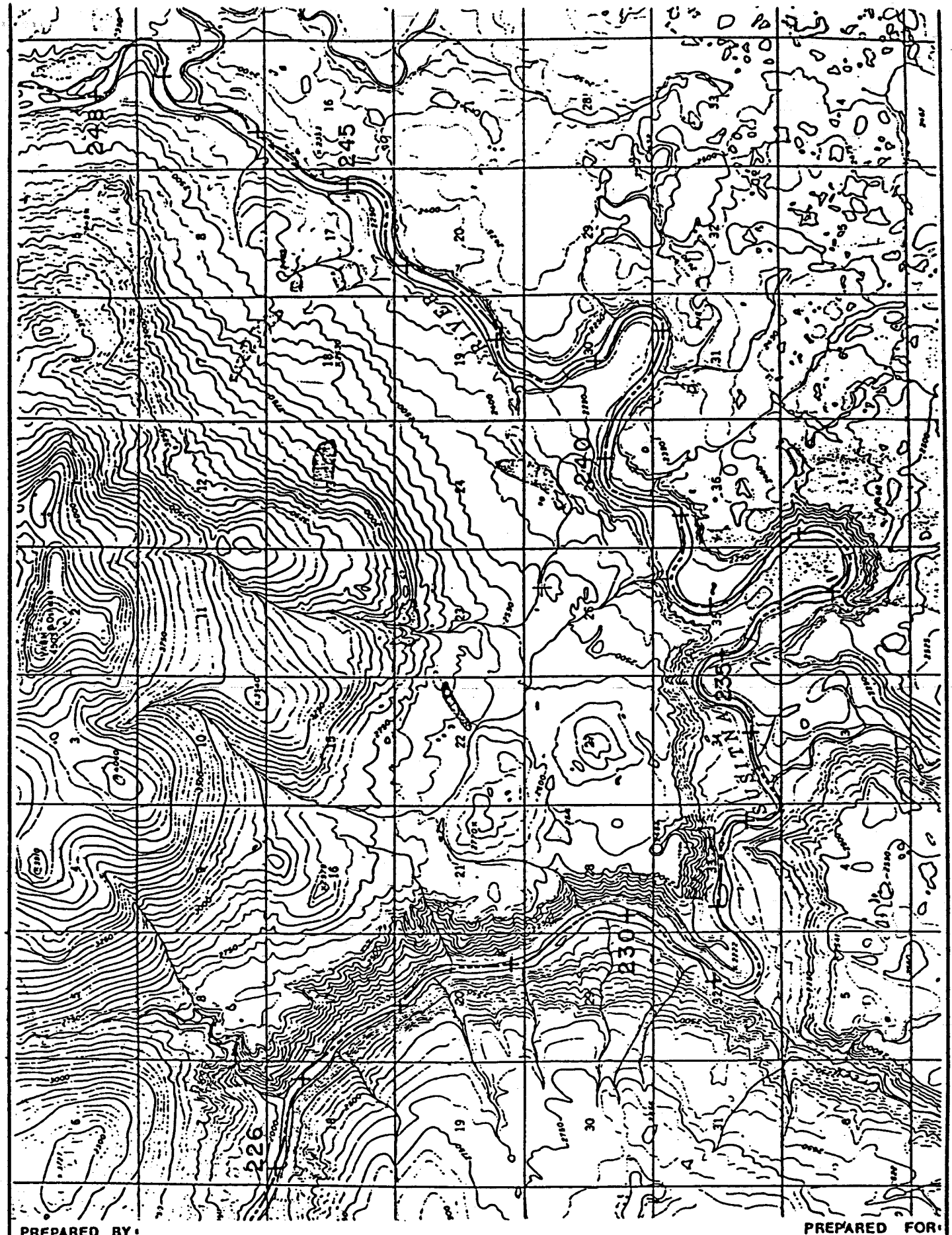
SUSITNA RIVER MILE INDEX

MILES 216 TO 225

(FROM U.S.G.S. TALKEETNA MNTS. C-2)

FIGURE 23



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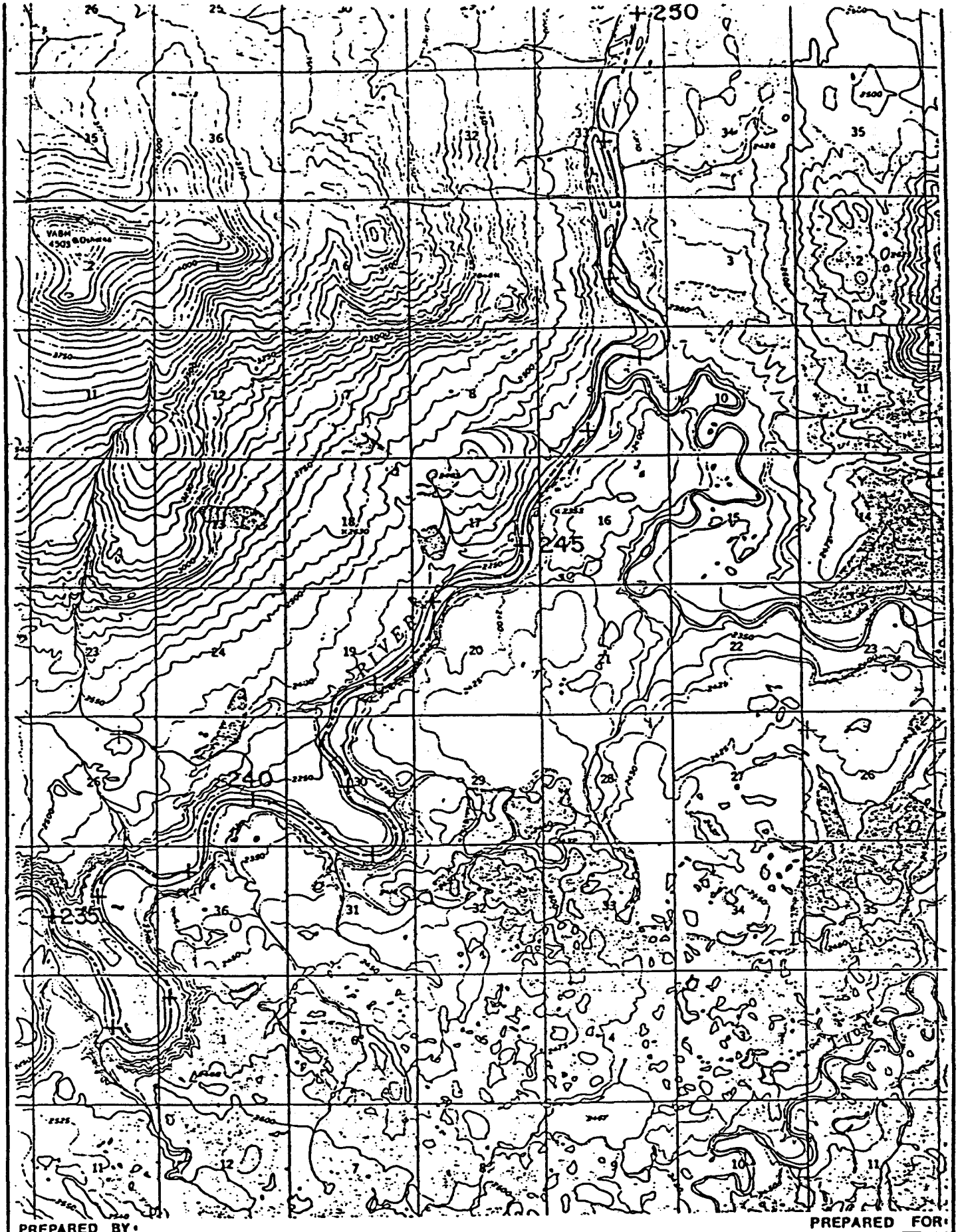
SUSITNA RIVER MILE INDEX
MILES 226 TO 248

(FROM U.S.G.S. TALKEETNA MNTS. C-1)

FIGURE 24



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SUSITNA RIVER MILE INDEX
MILES 235 TO 250

(FROM U.S.G.S. TALKEETNA MNTS, C-1)

FIGURE 26

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SUSITNA RIVER MILE INDEX
MILES 251 TO 264

(FROM U.S.G.S., TALKEETNA MNTS. D-1)

FIGURE 26

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SUSITNA RIVER MILE INDEX
MILES 260 TO 273

(FROM U.S.G.S. TALKEETNA MNTS. D-1)

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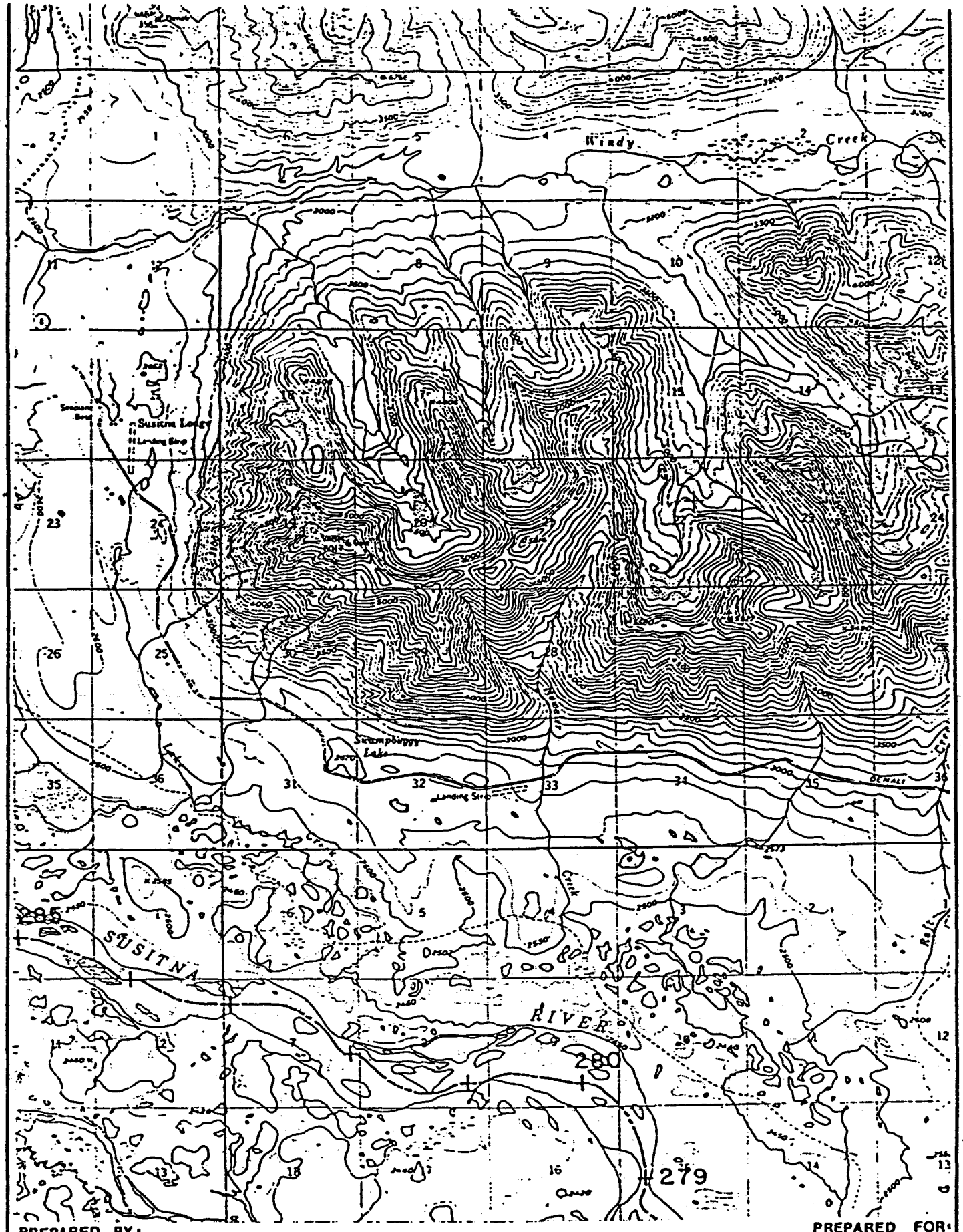
SUSITNA RIVER MILE INDEX

MILES 273 TO 278

(FROM U.S.G.S. TALKEETNA MNTS. D-1)

FIGURE 28



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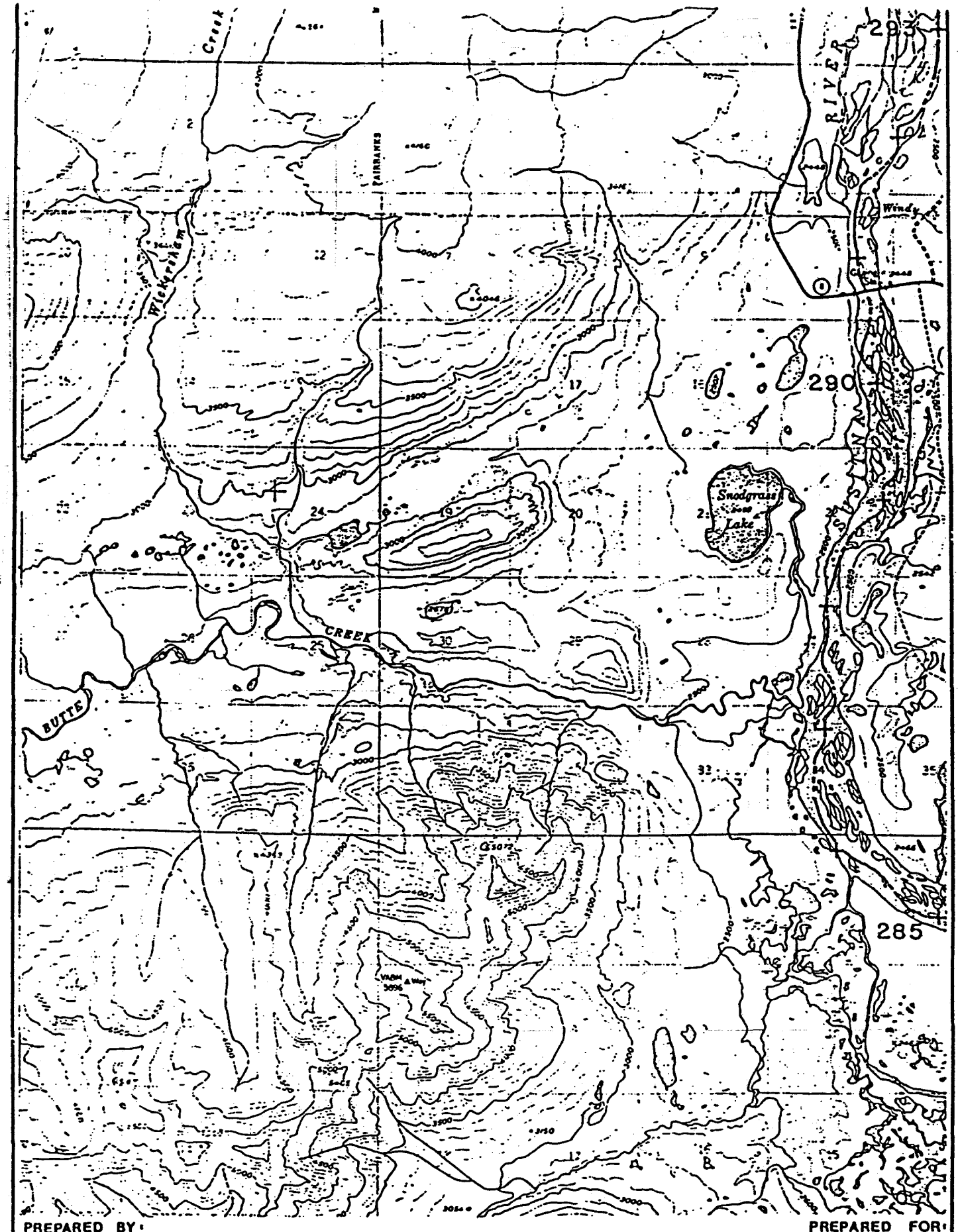
SUSITNA RIVER MILE INDEX

MILES 279 TO 285

(FROM U.S.G.S. HEALY A-1)

FIGURE 29



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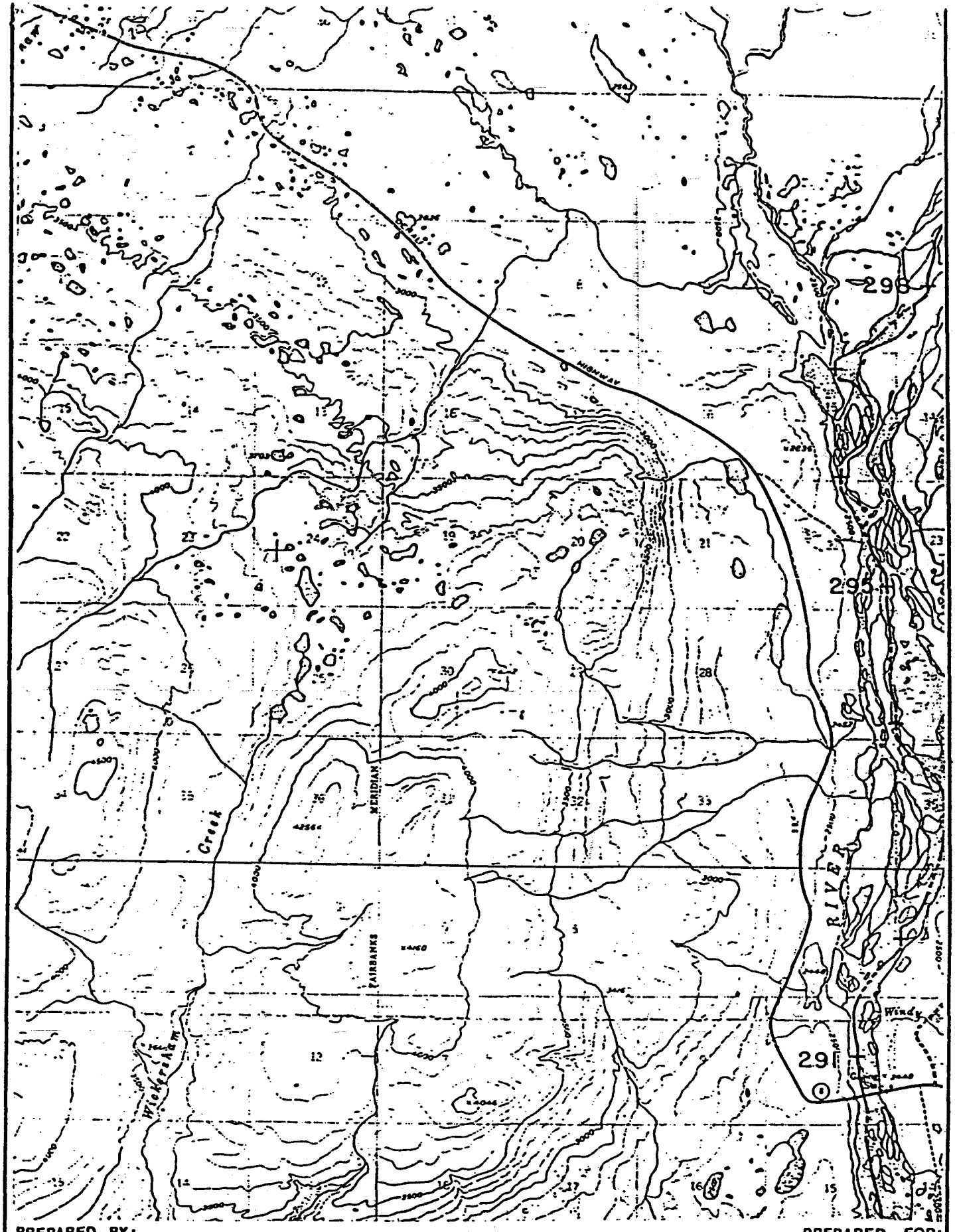
SUSITNA RIVER MILE INDEX
MILES 285 TO 293

(FROM U.S.G.S. HEALY A-2)

FIGURE 30



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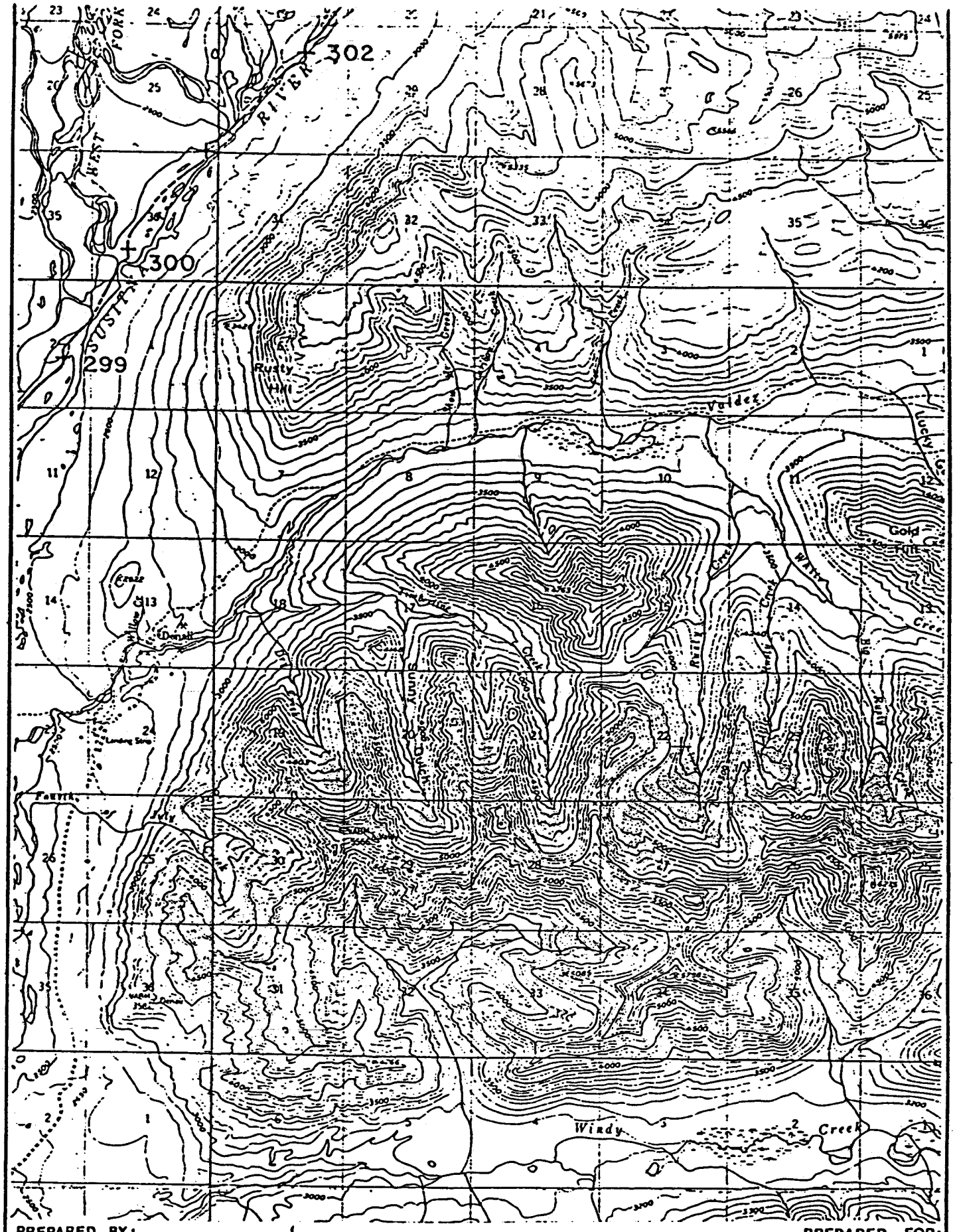
SUSITNA RIVER MILE INDEX
MILES 291 TO 298

(FROM U.S.G.S. HEALY A-2)

FIGURE 31



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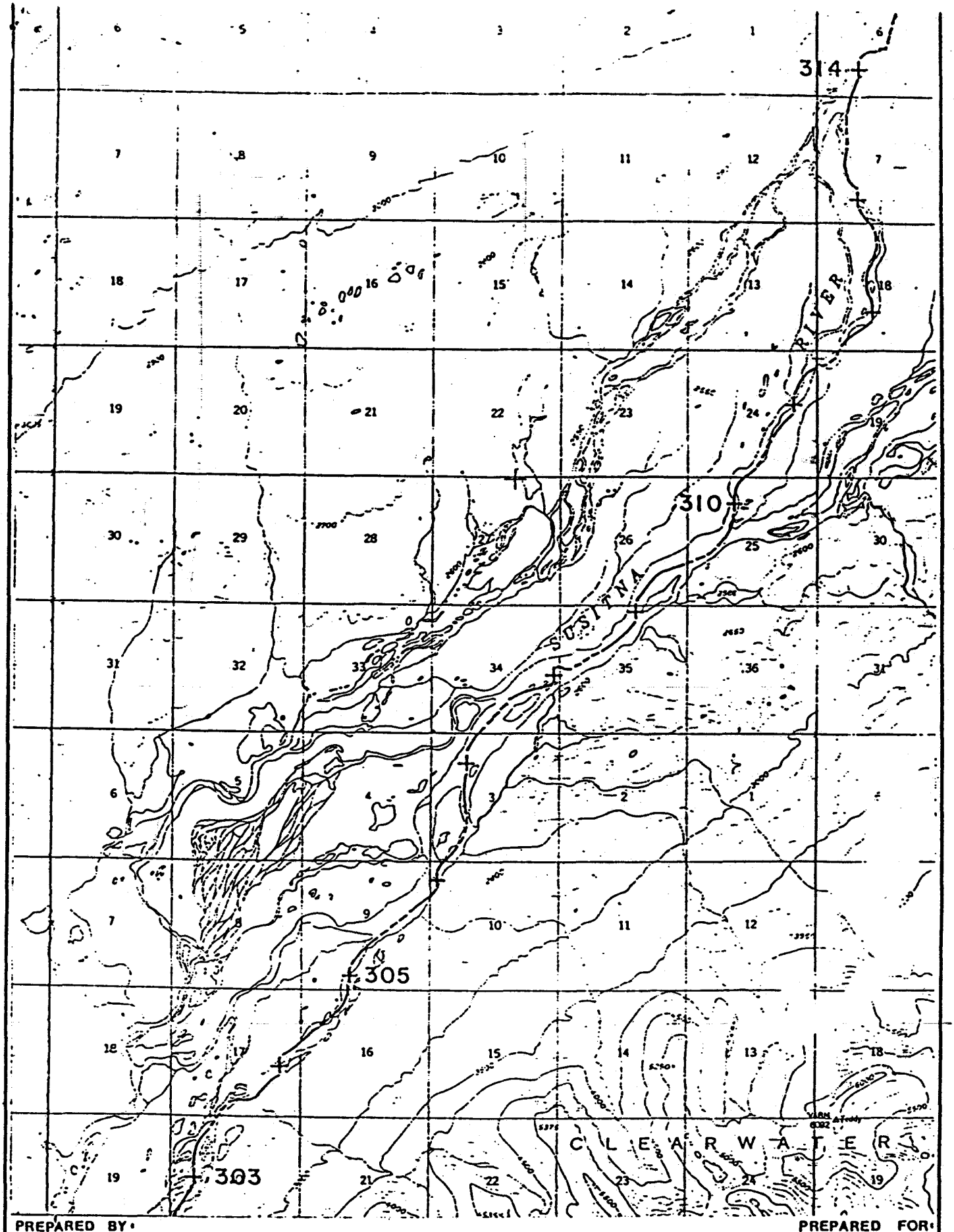
SUSITNA RIVER MILE INDEX
MILES 299 TO 302

(FROM U.S.G.S. HEALY A-1)

FIGURE 32



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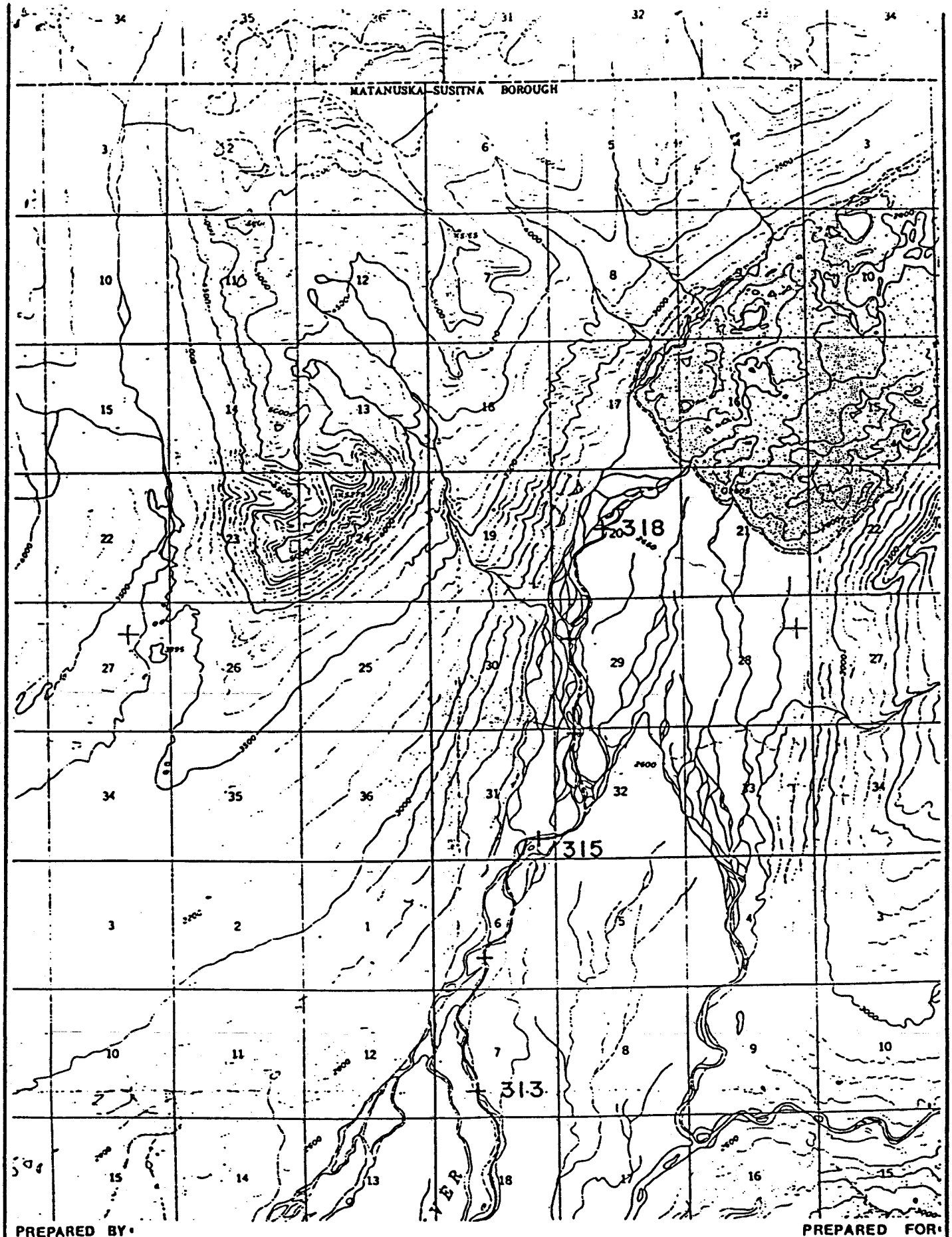
SUSITNA RIVER MILE INDEX
MILES 303 TO 314

(FROM U.S.G.S. HEALY B-1)

FIGURE 33



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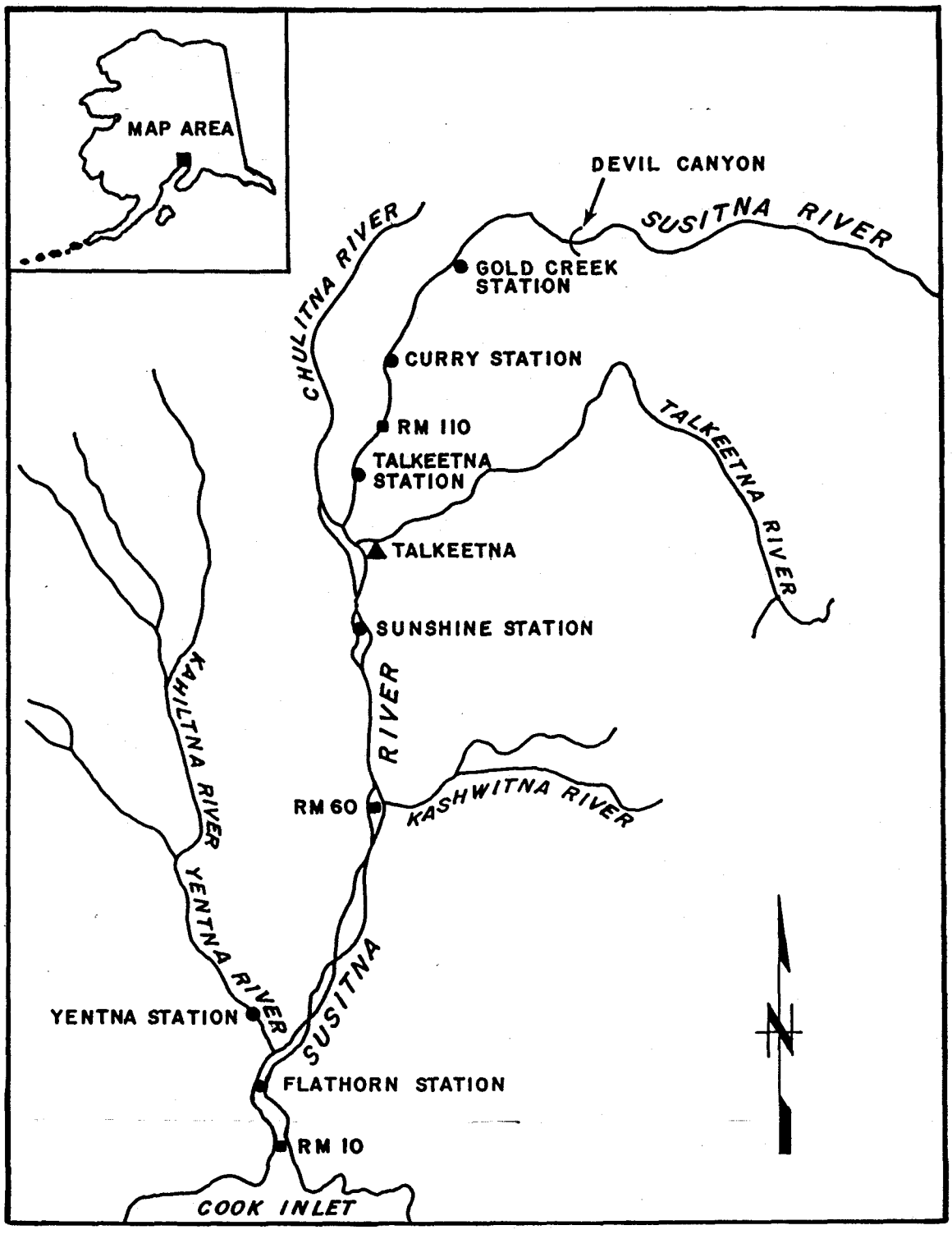
SUSITNA RIVER MILE INDEX

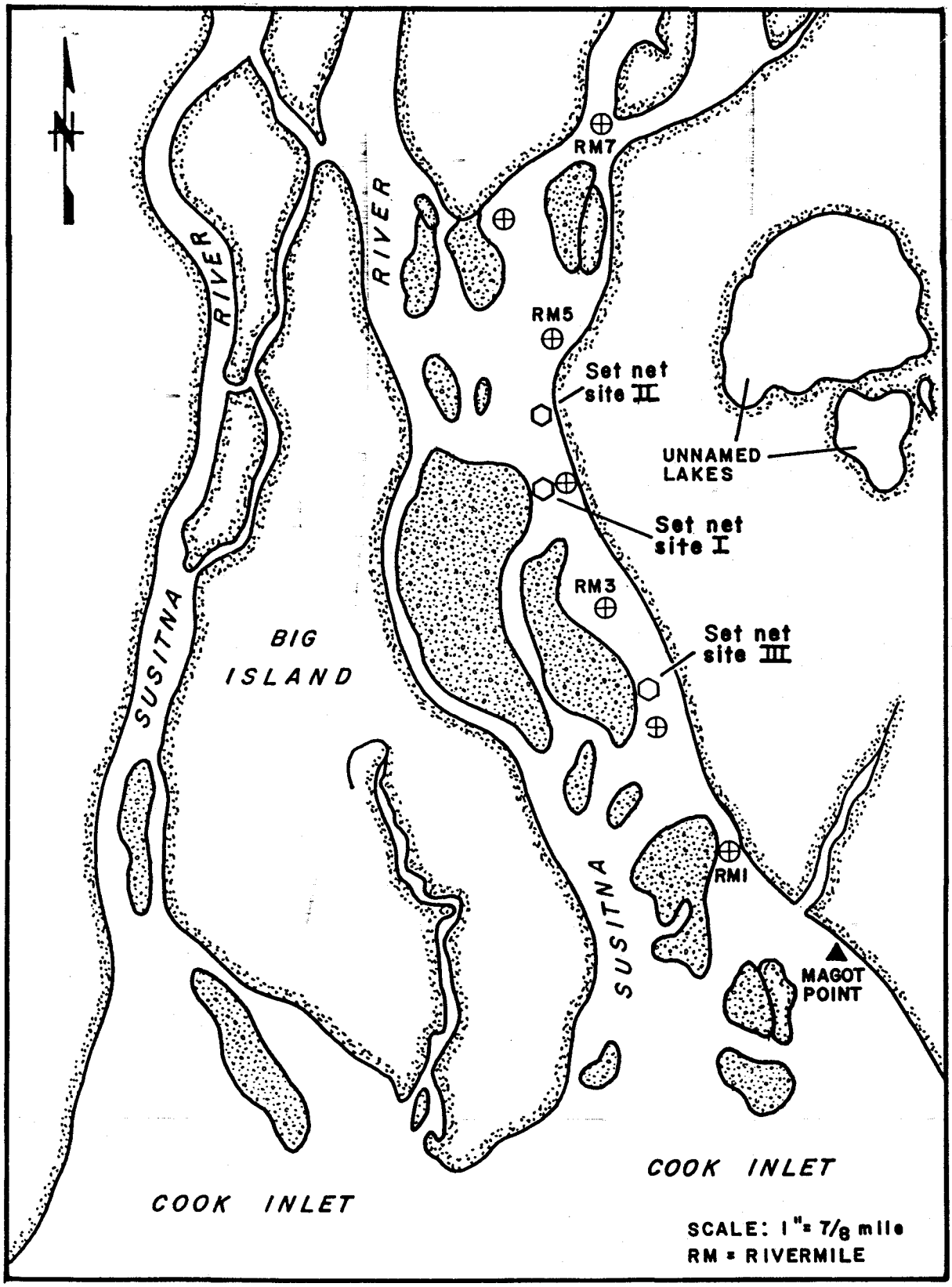
MILES 313 TO 318

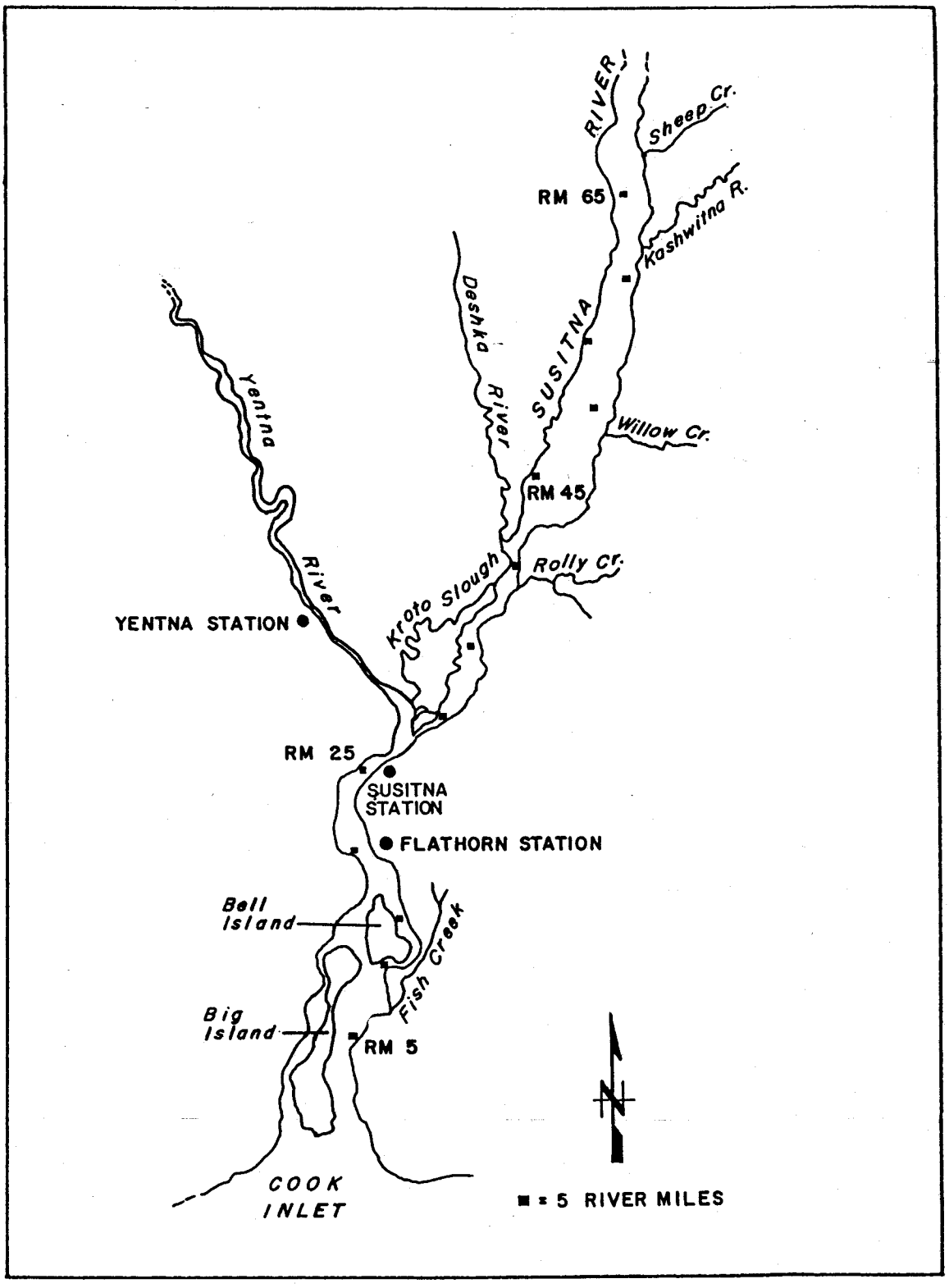
(FROM U.S.G.S. HEALY B-1)

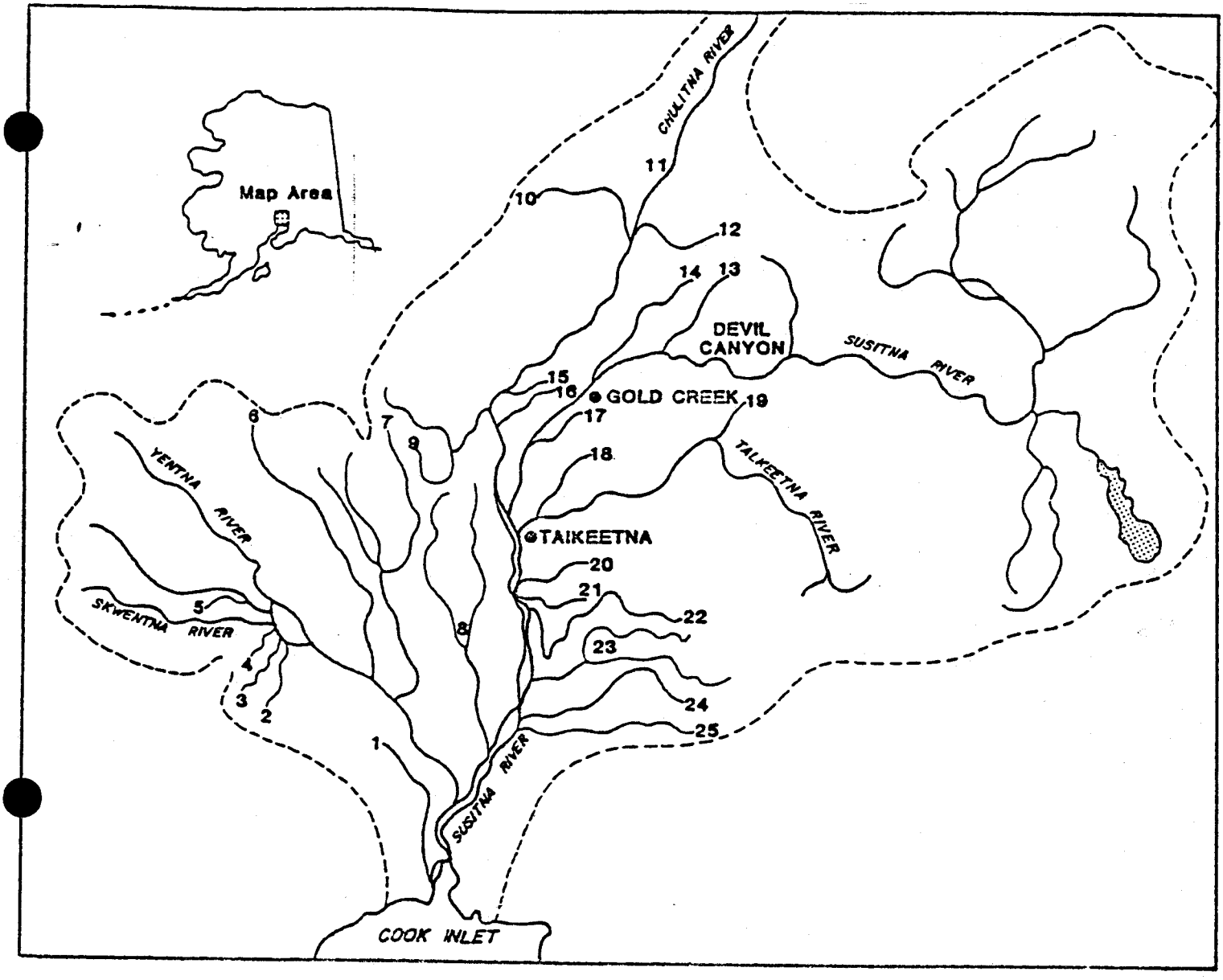
FIGURE 34

ACRES


MAP AREA
DEVIL CANYON
SUSITNA RIVER
CHULITNA RIVER
GOLD CREEK STATION
CURRY STATION
RM 110
TALKEETNA STATION
TALKEETNA
TALKEETNA RIVER
SUNSHINE STATION
SUSITNA RIVER
KAHILTNA RIVER
RM 60
KASHWITNA RIVER
YENTNA RIVER
YENTNA STATION
SUSITNA
FLATHORN STATION
RM 10
COOK INLET

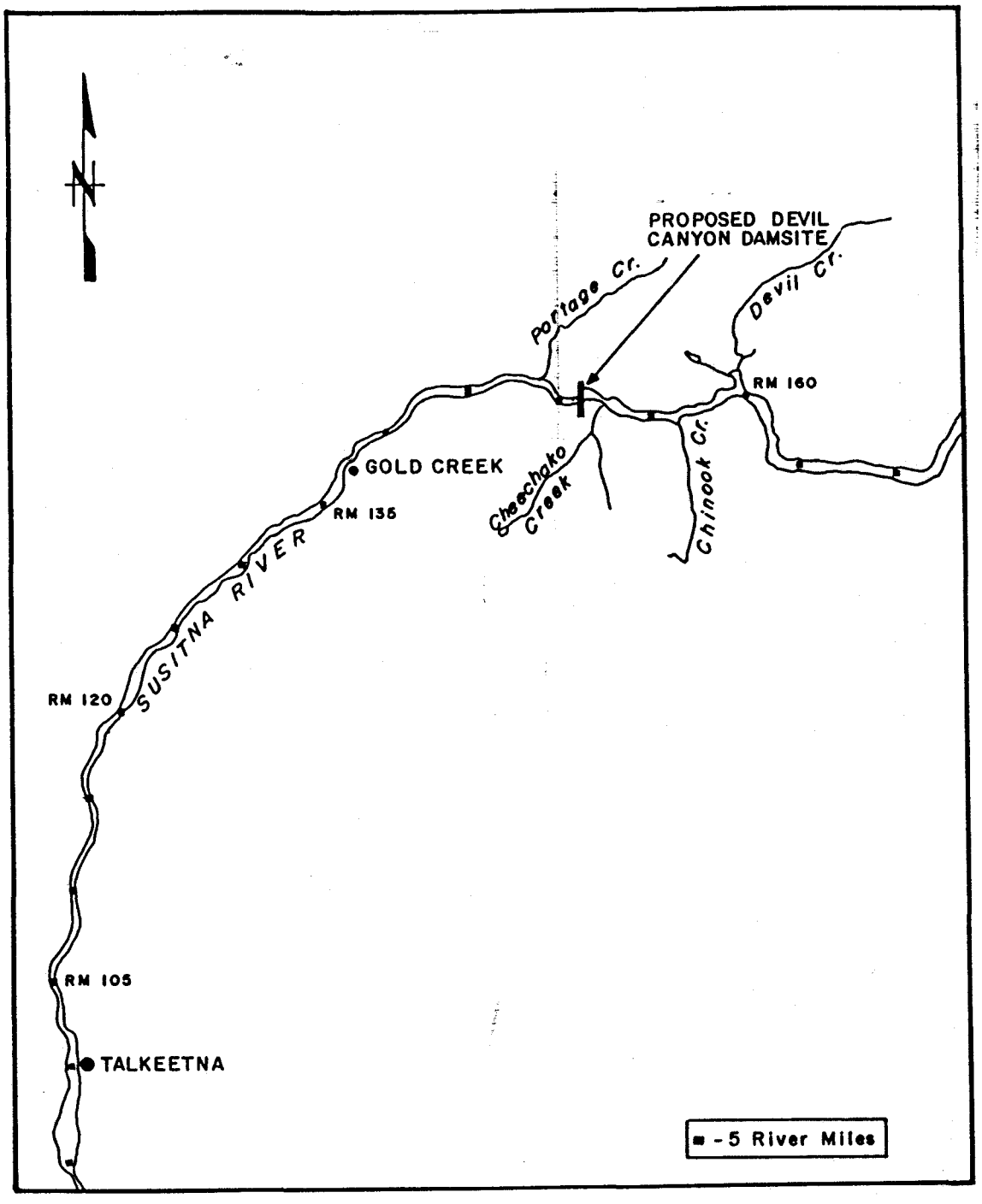

N
RM7
RM5
RM3
RM1
Set net site II
Set net site I
Set net site III
UNNAMED LAKES
MAGOT POINT
BIG ISLAND
SUSITNA RIVER
SUSITNA RIVER
SUSITNA
COOK INLET
COOK INLET
SCALE: 1" = 7/8 mile
RM = RIVERMILE

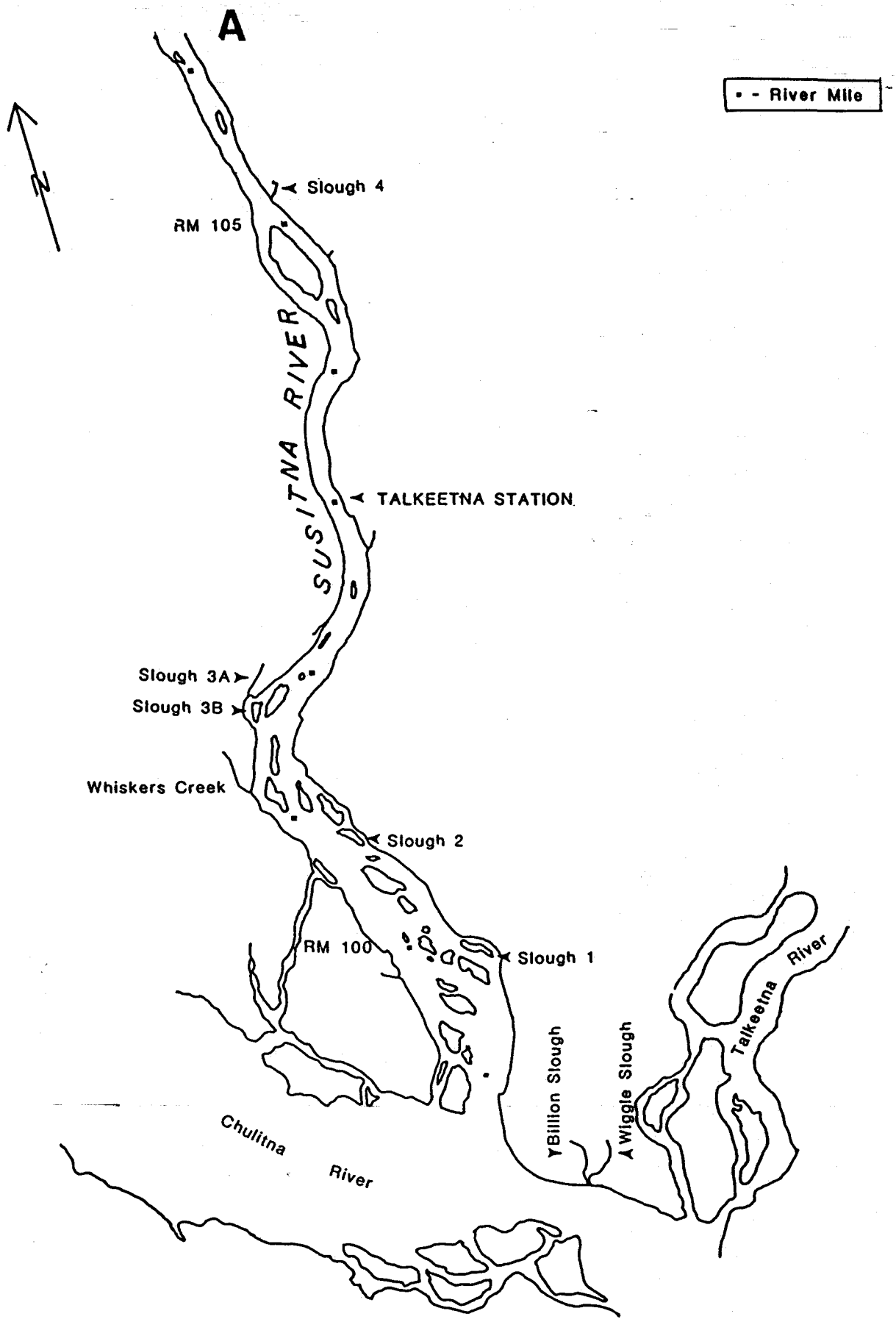

RIVER
Sheep Cr.
RM 65
Kashwitna R.
Deshka River
SUSITNA
Willow Cr.
RM 45
Yentna
River
Rolly Cr.
Kroto Slough
YENTNA STATION
RM 25
SUSITNA STATION
FLATHORN STATION
Bell Island
Fish Creek
Big Island
RM 5
COOK INLET
■ = 5 RIVER MILES

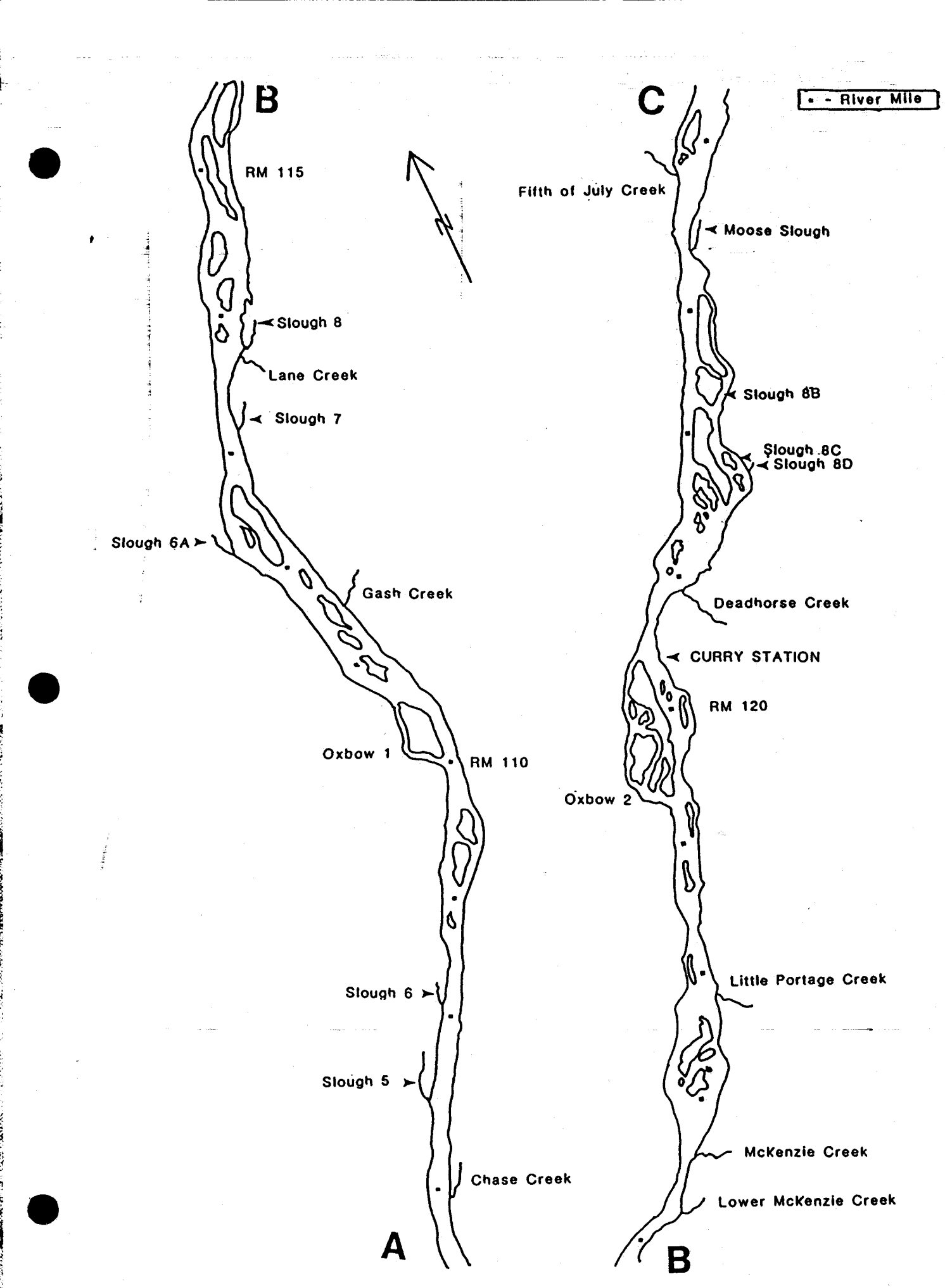


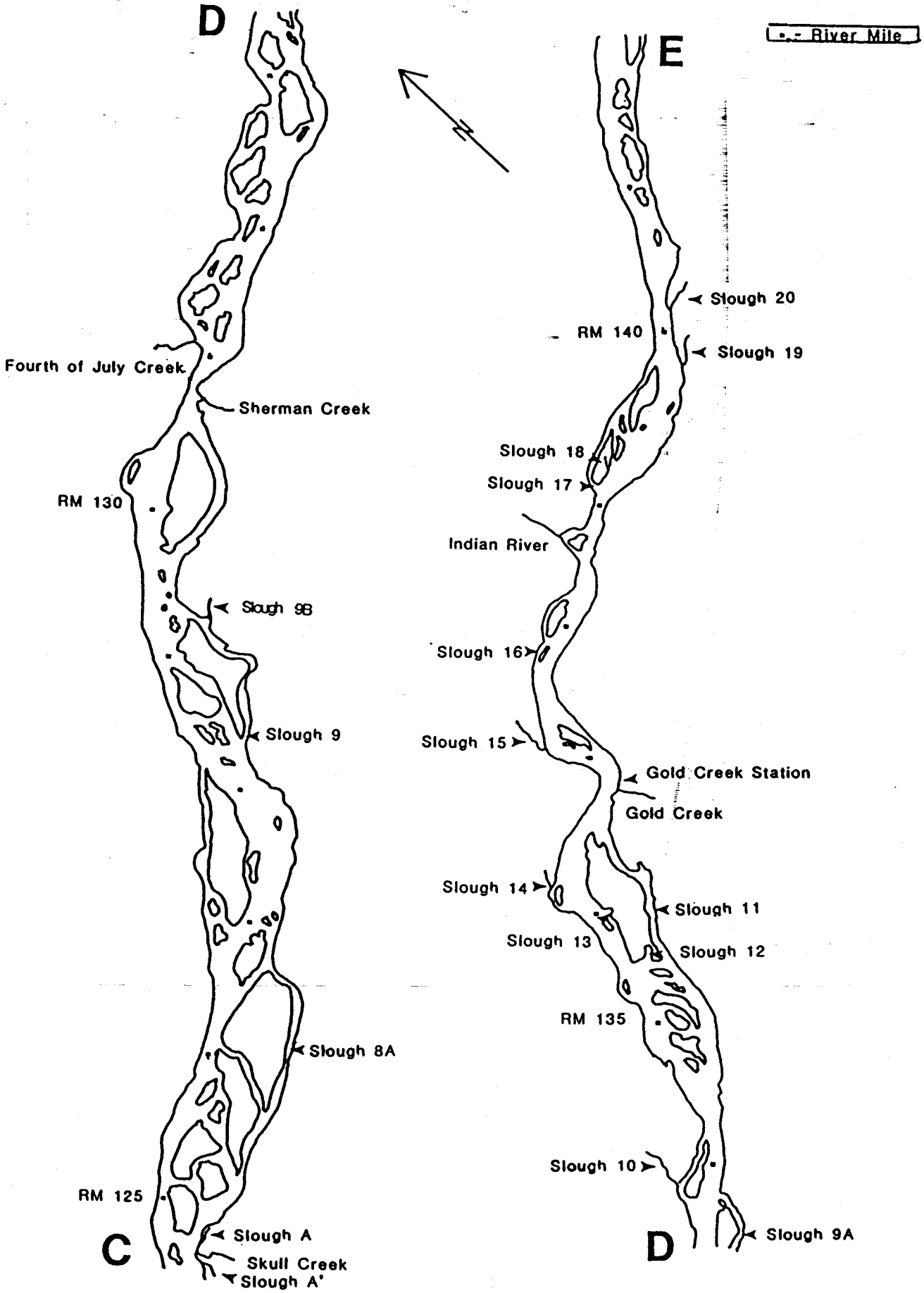
1. ALEXANDER CREEK
2. TALACHULITNA
3. QUARTZ CREEK
4. CANYON CREEK
5. RED CREEK
6. LAKE CREEK
7. PETERS CREEK
8. DESHKA RIVER
9. BUNCO CREEK
10. CHULITNA WEST FORK
11. CHULITNA MIDDLE FORK
12. HONOLULU CREEK
13. PORTAGE CREEK
14. INDIAN CREEK
15. BYERS CREEK
16. TROUBLESOME CREEK
17. LANE CREEK
18. CLEAR CREEK
19. PRAIRIE CREEK
20. MONTANA CREEK
21. GOOSE CREEK
22. SHEEP CREEK
23. KASHWITNA RIVER NORTH FORK
24. LITTLE WILLOW CREEK
25. WILLOW CREEK

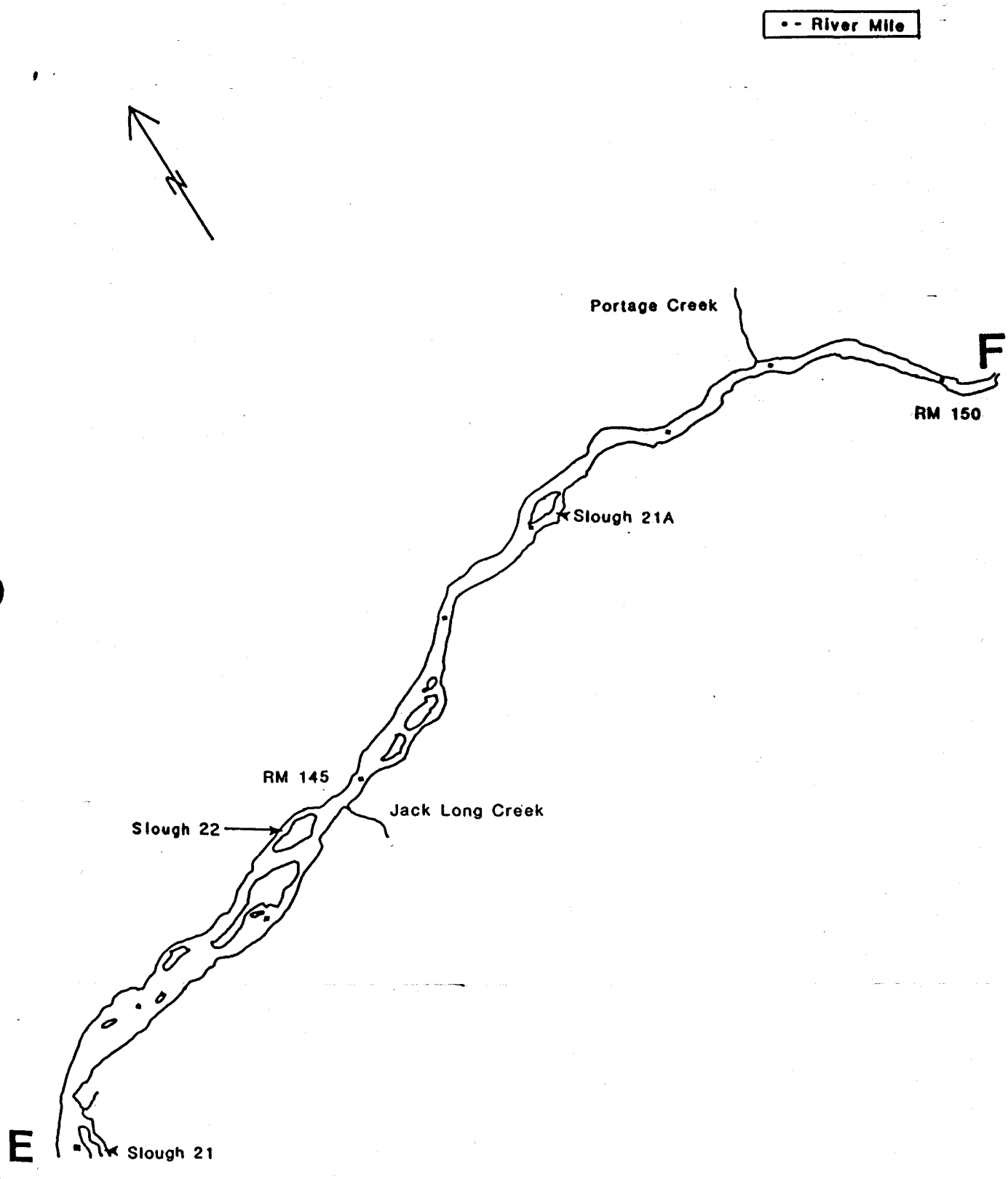
Susitna basin map showing chinook salmon survey streams

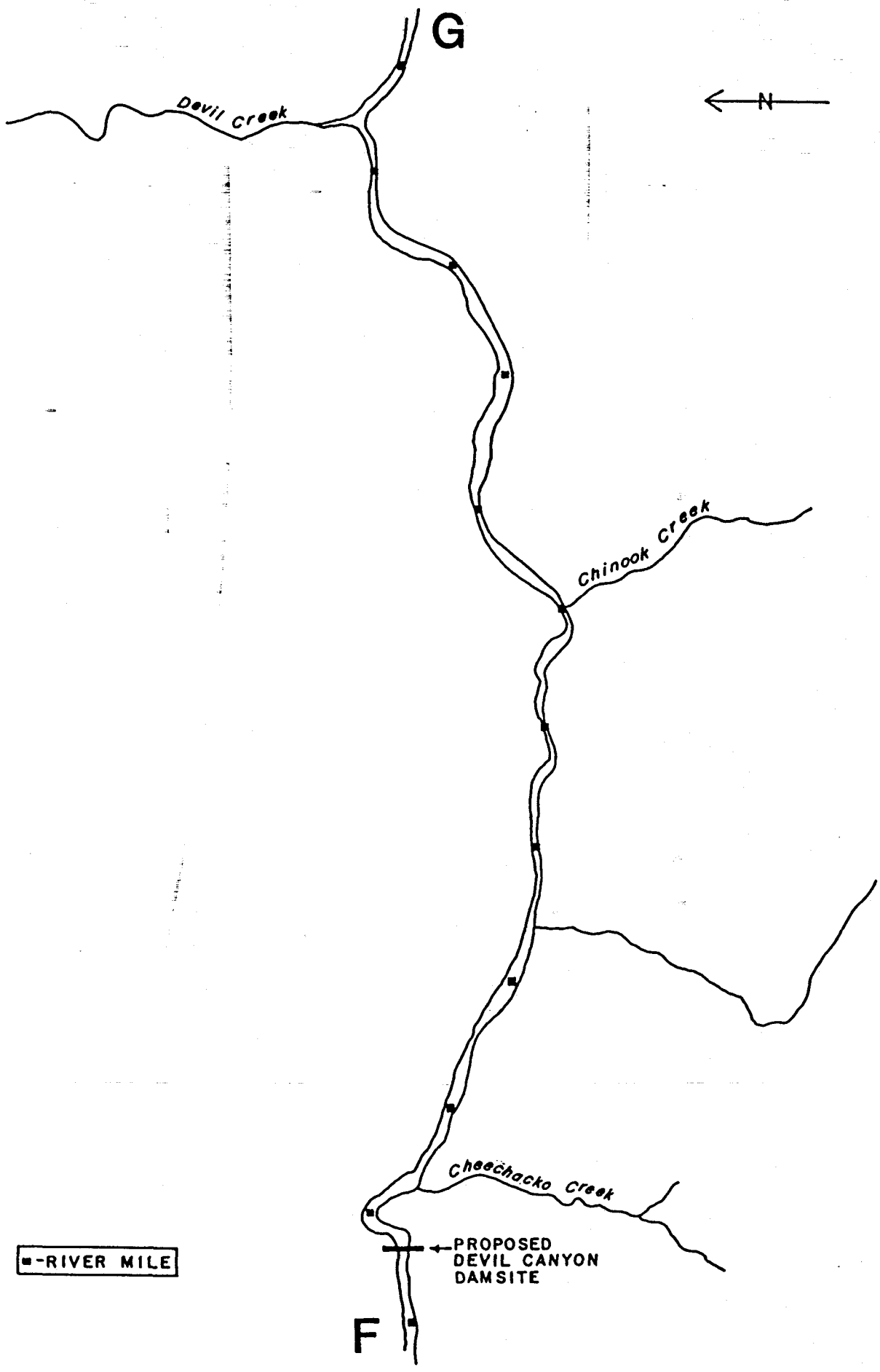

PROPOSED DEVIL CANYON DAMSITE
Portage Cr.
Devil Cr.
RM 160
Chinook Cr.
GOLD CREEK
Chacchako Creek
RM 135
SUSITNA RIVER
RM 120
RM 105
TALKEETNA
= - 5 River Miles

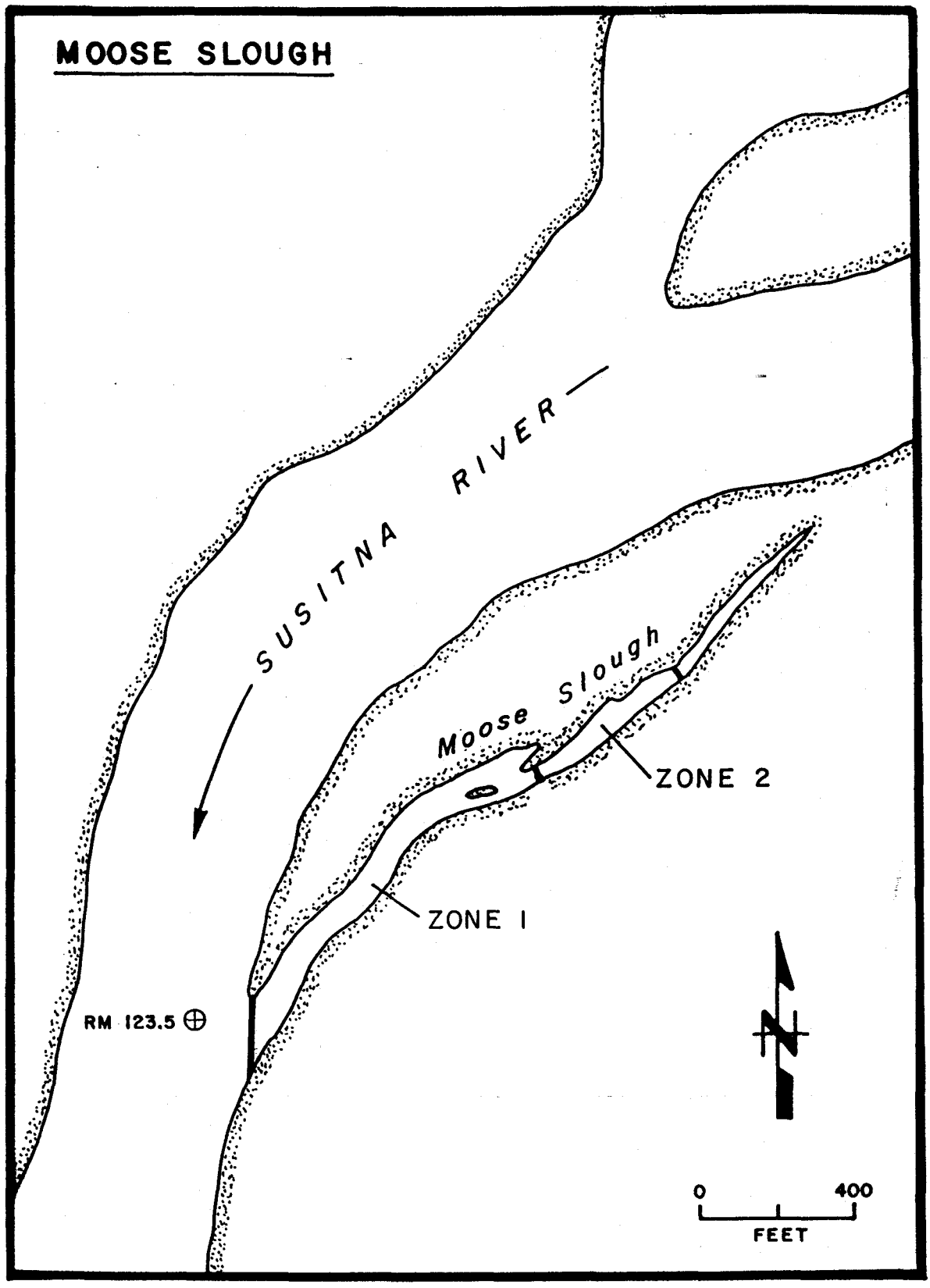

A
• - River Mile
N
Slough 4
RM 105
SUSITNA RIVER
TALKEETNA STATION
Slough 3A
Slough 3B
Whiskers Creek
Slough 2
RM 100
Slough 1
Billion Slough
Wiggle Slough
Talkeetna River
Chulitna River

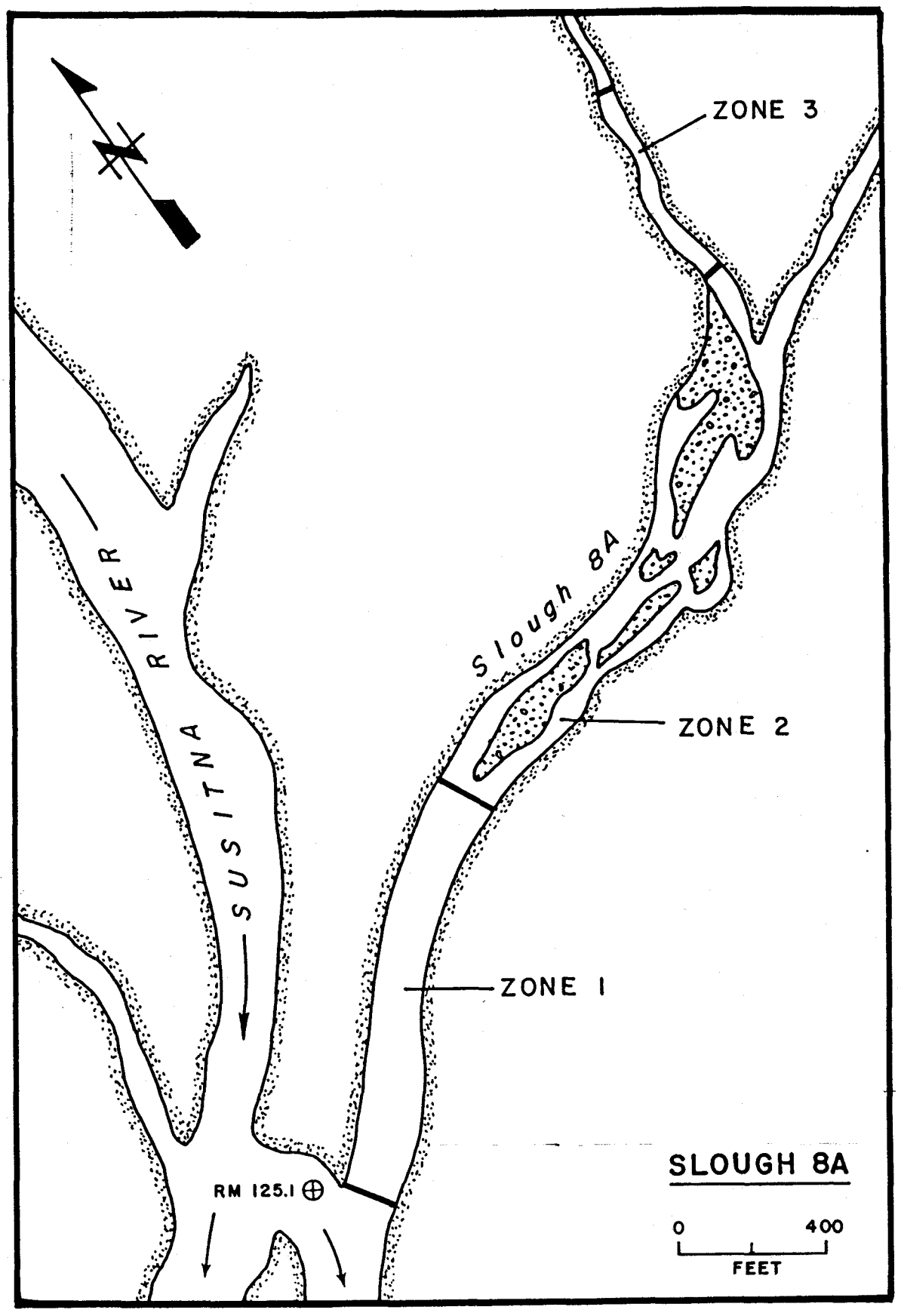

B
RM 115
Slough 8
Lane Creek
Slough 7
Slough 6A
Gash Creek
Oxbow 1
RM 110
Slough 6
Slough 5
Chase Creek
A
C
• - River Mile
Fifth of July Creek
Moose Slough
Slough 8B
Slough 8C
Slough 8D
Deadhorse Creek
CURRY STATION
RM 120
Oxbow 2
Little Portage Creek
McKenzie Creek
Lower McKenzie Creek
B

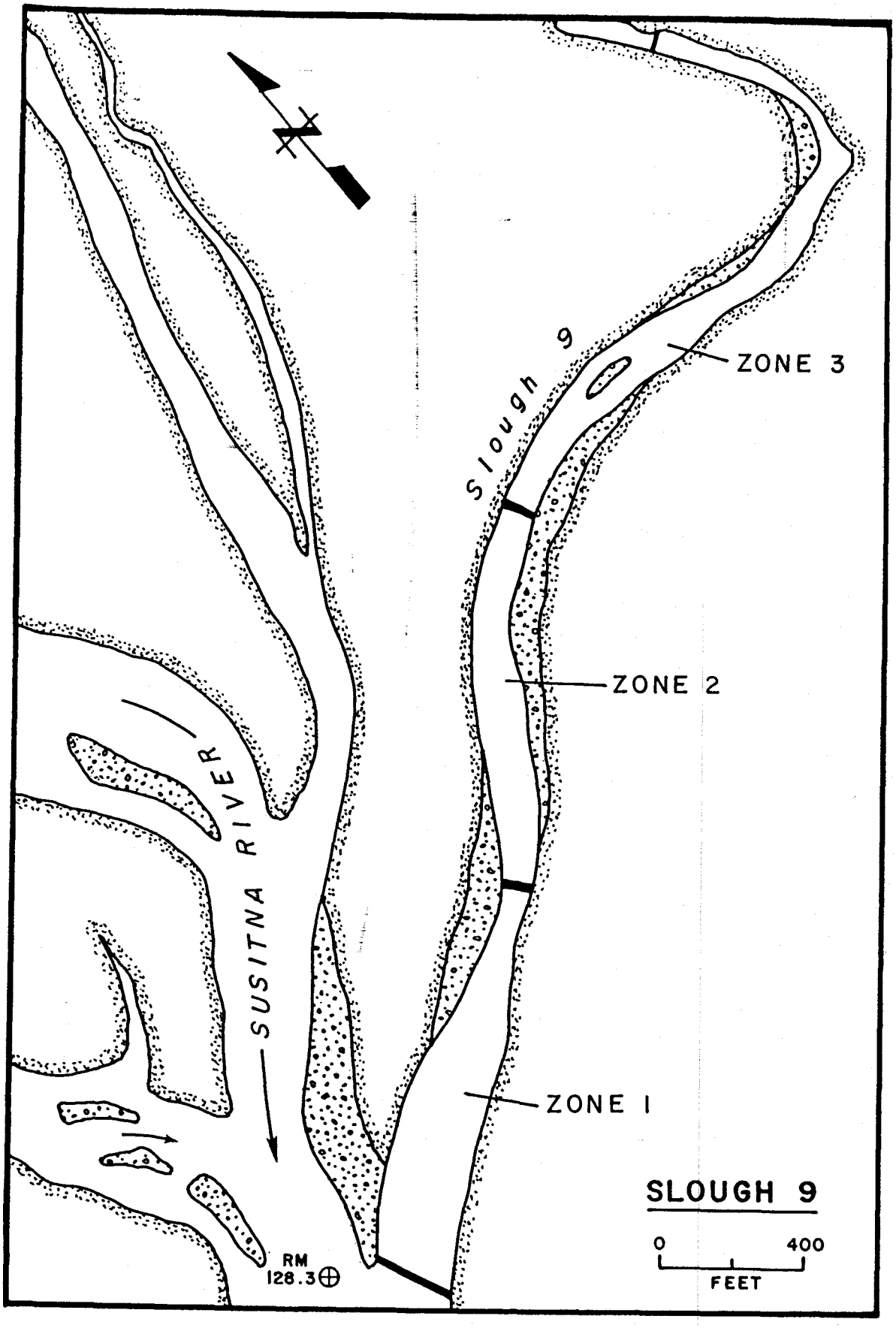

D
E
•.- River Mile
Slough 20
RM 140
Slough 19
Fourth of July Creek
Sherman Creek
Slough 18
Slough 17
RM 130
Indian River
Slough 9B
Slough 16
Slough 9
Slough 15
Gold Creek Station
Gold Creek
Slough 14
Slough 11
Slough 13
Slough 12
RM 135
Slough 8A
Slough 10
RM 125
Slough A
Skull Creek
Slough A'
Slough 9A
C
D

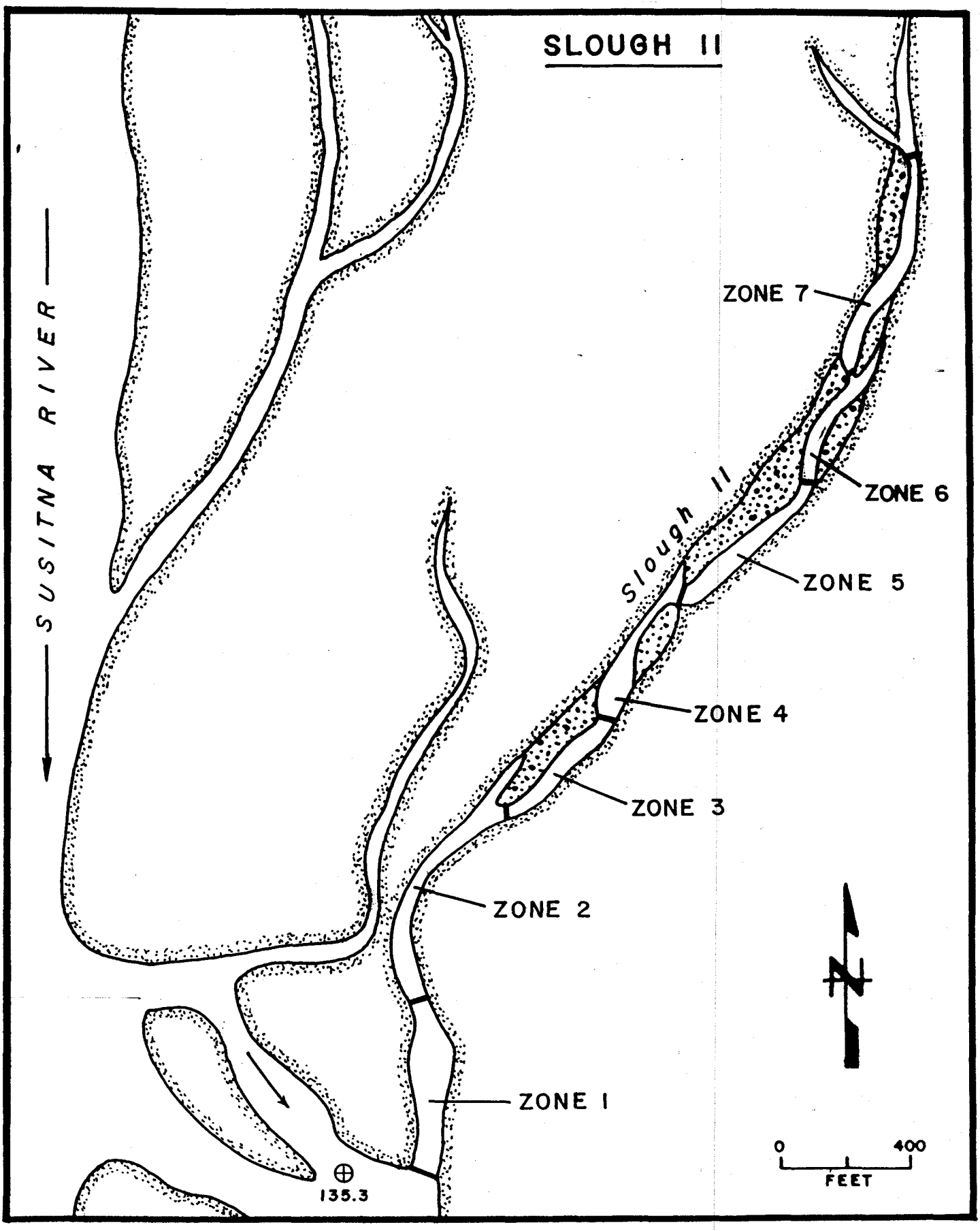

• - River Mile
N
Portage Creek
F
RM 150
Slough 21A
RM 145
Jack Long Creek
Slough 22
E
Slough 21


G
Devil Creek
N
Chinook Creek
Cheechacko Creek
PROPOSED
DEVIL CANYON
DAMSITE
■-RIVER MILE
F


MOOSE SLOUGH
SUSITNA RIVER
Moose Slough
ZONE 2
ZONE 1
RM 123.5
N
0
400
FEET


ZONE 3
Slough 8A
ZONE 2
SUSITNA RIVER
ZONE 1
RM 125.1
SLOUGH 8A
0
400
FEET


Slough 9
ZONE 3
ZONE 2
ZONE 1
SUSITNA RIVER
RM
128.3
SLOUGH 9
0
400
FEET


SLOUGH 11
SUSITNA RIVER
ZONE 7
ZONE 6
Slough 11
ZONE 5
ZONE 4
ZONE 3
ZONE 2
ZONE 1
135.3
N
0
400
FEET

APPENDIX 6

ADULT ANADROMOUS FISHERIES STUDIES

General Equipment, Camp Maintenance and Camp Policy

GENERAL EQUIPMENT AND CAMP MAINTENANCE, AND CAMP POLICY

Camp Maintenance

Maintaining a clean and efficient camp site is required. A few of the things to check are:

1. Maintenance of tent camp and other installations will be performed as necessary. All materials necessary will be provided.

2. Grounds will be kept free of liter. All garbage will be bagged up and at minimum disposed of at the nearest sanitary landfill once a week. Special precautions should be observed to insure that garbage does not attract bears and other scavenger species.

3. Upon completion of the summer season, all camp equipment will be cleaned preparatory to winter storage.

4. All sampling nets, tents and tarps must be dry before being stored.

5. A complete camp inventory will be taken by the crew leader at the close of the field season.

6. All equipment will be brought in when the field station is disbanded in the fall.

Camp Policy

1. No alcoholic beverages are to be stored in areas open to public view including cook tents. If alcohol is consumed at a camp an employee must be off-duty and under no circumstances shall he or she engage in the operation of any state equipment, including boats and motors nor shall he or she return to duty status under the influence of alcohol.

2. The crew leader of each sampling station shall establish a policy on living standards and personnel behavior in accordance with normal guidelines.

3. All sampling stations will operate seven days a week, 24 hours a day. No crew leader shall be off location for more than 24 hours unless specifically authorized by the A/A Project Leader or one of his assistants. Time-off for individual crew members shall be scheduled by the crew leader and it shall be his option as to whether sampling duties allow time-off from the location.

4. All A/A employees will be required to act in a professional manner at all times and shall be especially courteous to the public.

5. It will be the responsibility of the crew leader to report any equipment abuse to the A/A Project Leader or one of his assistants and to insure that no abuse does occur. Additionally, the crew leader must also report within 24 hours to the above cited authority, any Line 500 equipment loss which occurs.

Equipment Maintenance

Equipment maintenance is perhaps one of the most important operations you will perform during the field season. The outboard motors and generators must be kept in good operating condition or the whole program will suffer.

It will be the crew leader's responsibility to assign the most knowledgeable member of the crew to the job of maintaining and servicing the equipment. It will be this persons responsibility to see that all equipment is kept in operating condition.

Outboard Motors

Your outboard motor will perform longer and give less trouble if these suggestions are followed:

1. The correct outboard fuel mixture is 50:1. Always pour the oil into the tank first, then add 2 or 3 gallons of gas and mix thoroughly, then fill tank to capacity always using a large funnel and chamois filter.
2. Chainsaws have a fuel mixture of 25:1. Chainsaw gas should be mixed in a 5 gallon can and clearly marked that it is chainsaw fuel.
3. When mixing gasoline or filling the tanks of the generator, stove or lantern, keep the following in mind:
    a. Always mix fuel tanks or equipment under cover to prevent water contamination. Always use a funnel and filter.
    b. Fill camp stoves and lanterns outside as the danger of fire is very real.
    c. A little extra effort toward cleanliness will pay in hours of trouble free operation.
4. Always place outboard in neutral when starting.
5. Check daily the clamp screws that hold the outboard to the transom. Also routinely check the motor for loose screws and bolts, cracks, and break, especially in the area of the lower unit.
6. Never start or run an outboard in the tilted position.
7. In the normal operation of a water pump, a "tell-tale" stream of water is discharged from a hole in the bottom edge of the cowling or from the back of the shaft. If this stream of water stops, the water pump is not working and the motor should be shut off. The side plate over the water intake can be removed for temporary relief as it may be plugged. If the pump continues not to function, the outboard should not be run, and a report to base camp should be made.
8. Check the grease in the lower unit of prop outboards once a week, and drain and replace grease every three weeks. Jet units must be greased daily. This is crucial. Special grease guns will be provided.
9. If the skeg or jet unit hits bottom, check the screws for tightness and housing damage.
10. If your outboard will not start, check the following:
    a. Check to see if the fuel line is connected to the motor and the tank and not pinched or kinked.
    b. Check to see if there is water in the gasoline.
    c. Check to see that the engine is not flooded.

d. Check the spark plugs as they may be fouled or defective (replace if needed).

11. All outboards are to be tilted in the up position when moored at mainstem stations to preclude silt accumulation in the jet unit or water pump and skeg or housing damage.

Lastly, it should be emphasized that the salmon enumeration counts and sampling must continue, as they are very important to the program. All stations will be provided with a spare outboard and Anchorage will replace all inoperative outboards as soon as possible.

Boats

1. Boats are to be kept clean and free of loose tools and debris, and moored at locations where they are not subject to damage by wave action or through contact with the river bottom in rock laden areas.

2. Each crew leader will be responsible for maintaining mooring stakes on the river bank sufficient for the boats assigned to his subproject plus one transient craft. Further responsibility includes maintaining a skookum bow line on each assigned craft and insuring that each boat is properly moored at the end of each work day to preclude possible loss or damage.

Generators

Portable generators will be supplied to all field camps. Their maintenance follows the same line as for the outboards. Since the generators have 4-cycle engines, mixed gas must not be used. The crankcase oil reservoir should be checked daily and maintained at the full level. After 25 hours of operation the oil should be changed. Spark plugs should be checked after every five (5) hours of operation.

Food Orders

Grocery orders will be placed with the Anchorage office once a week. A grocery request list will be supplied to each camp. Please order all food by corresponding numbers. This saves a lot of time on the radio and/or telephone and also lessens the changes of mix-ups of orders.

CANNED MEALS

1. baked beans
2. chili
3. kidney beans
4. pork and beans
5. chow mein
6. hash
7. sloppy joes
8. stew, "Dinty Moore"

BEVERAGES

9. canned soda
10. canned soda, diet
11. coffee, instant
12. coffee, regular grind
13. tea, bags
14. tea, instant
15. Swiss Miss

BREAD AND CRACKERS

16. pretzels
17. hot dog buns
18. hamburger buns
19. triscuits
20. pilot bread
21. ritz crackers
22. soda crackers
23. white, loaf
24. wheat, loaf
25. assorted crackers

CAKE AND MUFFIN MIXES

26. blueberry muffins
27. brownie mix
28. chocolate cake
29. white cake
30. yellow cake
31. other cake
32. corn bread muffins
33. snack-n-cake

CEREALS

34. Frosted Flakes
35. cream of rice
36. cream of wheat
37. quick rolled oats
38. variety pack
39. wheaties
40. grape nuts
41. instant oatmeal
42. regular oatmeal
43. grits

CONDIMENTS

44. molasses
45. cucumber pickles
46. dill pickles
47. sweet pickles
48. honey
49. horseradish
50. ketchup
51. mustard
52. relish
53. mayonaise
54. mixed nuts
55. olives
56. syrup
57. vinegar
58. tarter suace

DAIRY

59. "Coffeemate"
60. canned milk
61. Milkman

DESSERTS (cookies, jello, candy, gum)

62. chocolate chips
63. candy bars
64. chocolate chip cookies
65. Oreo cookies
66. fig newtons
67. gum, assorted
68. Jello gelatin
69. Lifesavers
70. chocolate puddings
71. vanilla puddings
72. butterscotch puddings
73. marshmallows
74. oatmeal cookies
75. Chocolate mint cookies

DETERGENTS AND CLEANSERS

76. Ajax
77. bar soap
78. bleach
79. Borax
80. cold water "All"
81. liquid dishwashing soap
82. scouring pads (Brillo & S.O.S)
83. sponges

CHEESE

84. Parmesan (canned)
85. mozzarella
86. monterey jack
87. swiss
88. mild cheddar
89. sharp cheddar
90. mozzarella

FROSTING MIX

91. chocolate
92. white
93. other

FRESH FRUIT

94. apples
95. bananas
96. grapes
97. melons
98. oranges
99. peaches
100. pears
101. grapefruits
102. other, in season

CANNED FRUIT

103. applesauce
104. apricots
105. fruit cocktail
106. grapefruit slices
107. mandarin oranges
108. peaches
109. pears
110. pineapple
111. raisins

GRAIN PRODUCTS

112. egg noodles
113. elbow macaroni
114. spaghetti
115. lasagna noodles

FLOUR

116. bisquick
117. krusteaz
118. white
119. whole wheat

NON EDIBLE

120. wax paper
121. saran wrap
122. plastic bags, small
123. garbage bags
124. aluminum foil
125. "Cutters"
126. matches
127. paper towels
128. napkins
129. mosquito coils
130. toilet paper
131. toothpicks

OIL AND BUTTER

132. butter, canned
133. margarine
134. olive oil
135. shortening, canned
136. "Wesson" oil
137. creamy peanut butter
138. chunky peanut butter

POULTRY

139. chicken, fresh
140. chicken, canned
141. eggs, 1 dozen

PRESERVES

142. apple butter
143. apricot
144. blackberry
145. boysenberry
146. grape
147. raspberry
148. strawberry
149. Peach

JUICE

150. apple
151. cranapple
152. cranberry
153. V-8
154. grape
155. grapefruit
156. lemon
157. orange
158. pineapple
159. tang

MEATS

160. bacon
161. ham
162. hamburger
163. hot dogs
164. pork chops
165. pot roast
166. sandwich meats
167. sausage
168. steak
169. veal cutlet

MIXES (packaged)

170. dream whip
171. frying mix
172. pie crust
173. sour cream
174. spaghetti sauce
175. taco mix

SPICES

176. allspice
177. baking powder
178. baking soda
179. basil, sweet
180. bay leaves
181. chili powder
182. cinnamon
183. garlic salt
184. garlic powder
185. onion salt
186. oregono
187. paprika
188. pepper, black
189. salt
190. vanilla

RICE

191. brown
192. minute
193. Rice-A-Roni

SAUCES

194. A-1
195. barbeque
196. soy
197. tobasco
198. Worchestershire

SOUP

199. tomato
200. bean with bacon
201. bullion cubes, beef
202. bullion cubes, chicken
203. clam chowder
204. chicken noodle
205. cream of mushroom
206. minestrone
207. onion
208. package mixes, dehydrated
209. vegetable

SUGAR

210. brown
211. granulated
212. powdered

VEGETABLES, CANNED

213. asparagus
214. beets
215. carrots
216. cream style corn
217. whole kernal corn
218. corn on the cob
219. french style green beans
220. cut green beans
221. mushrooms
222. peas
223. sauerkraut
224. spinach
225. tomatoes, stewed
226. tomatoes, solid pack
227. tomato sauce
228. tomato paste

VEGETABLES, FRESH

229. lettuce
230. mushrooms
231. onions
232. potatoes, 10 lb. sac
233. radishes
234. tomatoes
235. cabbage
236. zucchini
237. cucumbers
238. misc., in season

APPENDIX 7

ADULT ANADROMOUS FISHERIES STUDIES

Fish Identification

THE FRESHWATER FISHES

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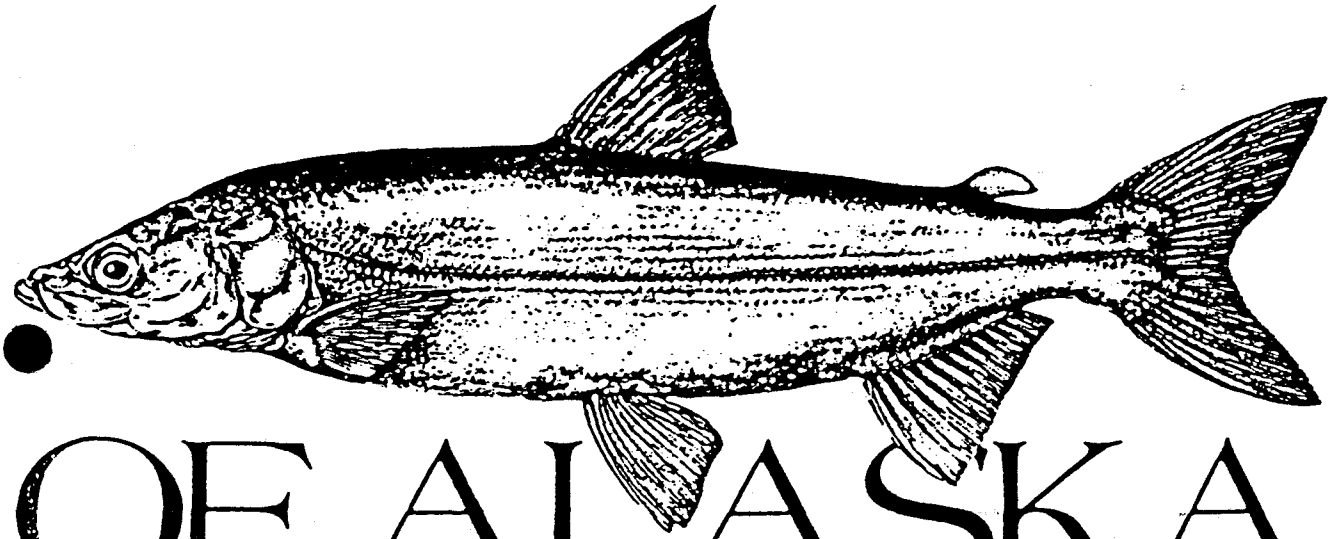

OF ALASKA

JAMES E. MORROW

ILLUSTRATIONS BY
MARION J. DALEN

ALASKA
NORTHWEST
PUBLISHING
COMPANY
Anchorage, Alaska

and Crossman, 1973), Cohen (1954) found that the anadromous fish at Point Barrow grew slower and were thinner than a nonmigratory population in Ikroavik Lake. To further confound the situation, a second population in Ikroavik Lake was slower-growing and shorter-lived than the first two.

Kepler's (1973) data on various numbers of spawning females from the Chatanika River yield the following average fork lengths at ages from 2+ to 8+: 2+, 31.1 cm (2 fish); 3+, 31.6 cm (4); 4+, 33.3 cm (15); 5+, 37 cm (12); 6+, 38.3 cm (5); 7+, 41.3 cm (1); 8+, 40.5 cm (2). Alt (1971a), on the basis of back-calculating from scales, gave the following fork lengths at the end of each year of life for Chatanika River fish: 1, 12 cm; 2, 20.8 cm; 3, 26.1 cm; 4, 30.4 cm; 5, 33.7 cm; 6, 36.4 cm; 7, 38.7 cm; and 8, 41 cm.

Although lake-dwelling populations appear to be nonmigratory, those least ciscoes living in streams or reaching brackish water go to considerable effort to reach or leave their spawning grounds. As already noted, young-of-the-year move off the spawning grounds shortly after spring breakup. The upstream spawning migration of adults begins in early July in the Chatanika River and is completed by late September.

Least ciscoes feed primarily on various types of zooplankton, including various small copepods, cladocerans, mysids and the adults and larvae of a variety of insects. They may also eat plant material. The ciscoes normally do not feed during the spawning run (Nikolskii, 1961; Furniss, 1974; Morrow et al., 1977).

The least cisco is sought by many predators including the eagle, hawk, kingfisher, pike, inconnu, lake trout, burbot, man and, no doubt, any others capable of catching it. The eggs may be eaten by grayling and Alaska whitefish during spawning (Morrow et al., 1977).

IMPORTANCE TO MAN

In North America the least cisco is relatively unimportant. It is taken by subsistence fisheries in Alaska and northern Canada, usually as an incidental in nets set primarily for other whitefishes or for pike or grayling. Spearfishing for least cisco has developed as a sport of small proportions in the Chatanika River in interior Alaska. The least cisco is an important commercial fish in Siberia. Annual landings in the late 1930s were in excess of 1 million kg (Nikolskii, 1961).

As a food fish, the least cisco is generally considered somewhat inferior to the humpback whitefishes. Nevertheless, it is a very good fish for eating, with firm, tasty meat.

BERING CISCO

Coregonus laurettae Bean

DISTINCTIVE CHARACTERS

The pale, almost colorless pelvic and pectoral fins distinguish the Bering cisco from the least cisco, and the smaller number of gill rakers (18 to 25) on the lower portion of the first gill arch distinguish it from the arctic cisco, which has 26 to 31 gill rakers (Figure 14).

DESCRIPTION

Body rather elongate, slightly compressed; depth about 20% of total length. Head moderate, 22% to 25% of total length. Snout 20% to 25% of head length. Eye about equal to snout, round. Two nostrils on each side of head with a double flap between openings of each pair. Mouth moderate, terminal; upper and lower jaws equal. Maxilla reaches backward to middle of eye. Usually no teeth on jaws, but weak teeth are present on maxilla in young and in rare cases a few small teeth are present on lower jaw of adults. Small patch of teeth present on tongue. From 18 to 25 gill rakers on lower portion of first gill arch; total gill rakers on first arch: 35 to 39. Branchiostegals: 8 to 9. Lateral line has 76 to 95 pored scales. Pyloric caeca: 71 to 123. Vertebrae: 62 to 65.

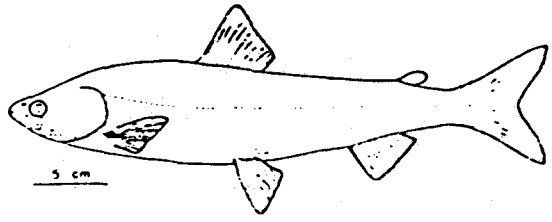

FIGURE 14. Bering cisco, *Coregonus laurettae*. The arctic cisco, *Coregonus autumnalis*, appears identical with this species but has more gill rakers.

FINS: Dorsal, which is rather high and falcate, has 11 to 13 rays. Adipose fin present. Anal has 12 to 14 rays; pectorals, 14 to 17; pelvics, 10 to 12, axillary process present. Caudal forked.

SCALES. Cycloid, fairly large.

COLOR. Generally brownish to dark green on back; silvery on lower sides and belly. Anal, pelvic and pectoral fins pale; caudal and dorsal fins dusky (photographs, page 85; Plate 22, page 133).

SIZE: The largest known Bering cisco, recorded by Alt (1973), was a female of 48 cm fork length from the lower 500 m of Hess Creek, Alaska. The average size of adults is about 30 cm.

RANGE AND ABUNDANCE

The Bering cisco is found from Bristol Bay north and east to Oliktok Point on the arctic coast of

Alaska. It is present in the Yukon River as far upstream as Fort Yukon, and also in the Porcupine River. It has been found at the mouth of Ship Creek, Knik Arm, at Anchorage (SUFC #41858, now in the Ichthyological Collection of the California Academy of Sciences) (McPhail, 1966), in Tolugak Lake in Anaktuvuk Pass in the Brooks Range (UAFC #617, #618), and was found in 1972 in the Kenai River on the Kenai Peninsula.*

Throughout its range the Bering cisco is fairly abundant, at least seasonally; Alt (1973c) reported up to 18 a day taken in a fish wheel at Rampart, on the Yukon River, in September, 1972.

HABITS

Very little is known of the biology of the Bering cisco. Most of the following is derived from Alt (1973c).

Spawning runs begin in the spring. Most Bering ciscoes apparently winter in salt or brackish water near river mouths, but the presence of potential spawners well up the Yukon and Kuskokwim rivers suggests that some populations may spend the winter in fresh water, far from the sea. Bering cisco were first observed well inland in 1968 and 1969, when one (UAFC #2176) was taken in the Chatanika River near Fairbanks and seven (UAFC #632) at Rampart, on the Yukon River. Two more specimens (UAFC #617, #618) are from Tolugak Lake in Anaktuvuk Pass. Subsequently, Alt (1973c) found Bering cisco in the Yukon River at Fort Yukon; in the Porcupine River, 1,400 km from the mouth of the Yukon; and in the South Fork of the Kuskokwim River, 840 km from the ocean.

Spawning probably takes place in the fall, but spawning behavior and the location of the spawning grounds are unknown.* From the distribution of the fish in June it may be presumed that the spawning grounds are in clear-water streams tributary to major rivers. Dymond (1943) mentioned hybrids between *C. laurettae* and *Stenodus leucichthys*, but the location from which the specimens came, the Mackenzie River Delta, strongly suggests that they were actually hybrids between the arctic cisco, *C. autumnalis*, and the inconnu.

Alt (1973) stated that the majority of his specimens from Hess Creek were 4+ to 6+ and were mature. His fish from Port Clarence and Grantley Harbor were mostly 2+ and 3+ immatures, but included a few adults. These adults showed slower growth than the Hess Creek fish, possibly because of a shorter growing season. Mean fork lengths at age, were for the Hess Creek fish: 4+, 34.4 cm; 5+, 35.4 cm; 6+ 37.3 cm; 7+, 40.5 cm; 8+, 44.6; and for the Port Clarence-Grantley Harbor fish: 3+, 24.1 cm; 4+, 26.3 cm; 5+, 28.5 cm; 6+, 31.3 cm; 7+, 35 cm.

As noted above, Bering cisco undertake extensive spawning migrations. Presumably they move downstream after spawning. However, the precise extent of the migrations is unknown.

The Bering cisco, like other ciscoes, apparently does not feed during its spawning runs. All the fish examined from the Yukon and Kuskokwim rivers in June through September had empty stomachs. By contrast, fish taken at Port Clarence-Grantley Harbor had fed on invertebrates and small cottids (Alt, 1973). McPhail and Lindsey (1970) listed amphipods as food of the Bering cisco.

IMPORTANCE TO MAN

The Bering cisco is little used. Small numbers are taken for subsistence use by gill net and by fish wheel in the Yukon and Kuskokwim rivers. Similar use probably exists wherever subsistence fishing and the Bering cisco coincide.

*K.T. Alt: personal communication.

ARCTIC CISCO

Coregonus autumnalis (Pallas)

DISTINCTIVE CHARACTERS

Pale or colorless pelvic fins, a terminal mouth and the presence of 41 to 48 gill rakers on the first gill arch serve to distinguish the arctic cisco (Figure 14, page 29).

DESCRIPTION

Body elongate, slightly compressed. Depth 20% to 23% of total length. Head moderate, somewhat less than 25% of total length. Snout about 25% of head, a little longer than eye diameter. Eye round, 20% to 24% of head. Nostrils have a double flap between the openings. Mouth moderate, jaws toothless in adults (a few weak teeth may be present in very small young), a patch of teeth on tongue. Maxilla extends backward to about middle of eye. Gill rakers: 41 to 48 on first arch. Branchiostegals: 8 to 9. Lateral line has 82 to 110 pored scales. Pyloric caeca: 113 to 183. Vertebrae: 64 to 67.

FINS. Dorsal, which is fairly high and slightly falcate, has 10 to 12 rays. Adipose fin present. Anal has 12 to 14 rays; pectorals, 14 to 17; pelvics, 11 to 12, axillary process present. Caudal forked.

SCALES. Moderately large, cycloid; 82 to 110 pored scales in lateral line.

COLOR. Brown to dark greenish above fading to silvery on sides and belly. Fins pale.

SIZE. Specimens up to 64 cm in total length and up to 2.68 kg in weight have been reported from the Lena River in Siberia (Berg, 1948). However, North American specimens generally are much smaller, averaging somewhere in the neighborhood of 35 to 40 cm long (Roguski and Komarek, 1971) and perhaps 1 kg in weight.

systems in Washington, Montana, British Columbia and the Yukon Territory; and from the Chignik, Naknek and Wood river systems in southwestern Alaska. It is not known outside of North America. Wherever it is found, it seems to be quite abundant.

HABITS

Details of breeding behavior of the pygmy whitefish are unknown. Spawning takes place at night in late fall and early winter (November to January) at water temperatures of about 4°C or colder. Spawning grounds appear to be on gravel in lake shallows and in streams. Presumably the eggs are broadcast; then they settle into interstices in the gravel and hatch the following spring. In the Bristol Bay region, the eggs are about .24 cm in diameter (Heard and Hartman, 1966), somewhat larger than the .2 cm reported for Lake Superior fish (Eschmeyer and Bailey, 1955). Egg number varies between 103 and 1,153 per female in Bristol Bay fish, a greater average number than in Lake Superior fish. Males may become sexually mature at as early an age as a year; females, a year later (Weisel et al., 1973).

Growth of the pygmy whitefish is very slow and shows considerable variation from one population to another. In general, females grow faster than males, although in some populations the males grow faster than females during the first year (Eschmeyer and Bailey, 1955). In Brooks Lake, Alaska, the average 3-year-old fish was about 7 cm in fork length, while in South Bay, Naknek Lake, fish of the same age averaged about 11.6 cm. The maximum age recorded for fish in the Naknek system was 5+ (Heard and Hartman, 1966), but ages up to 9+ have been noted in Maclure Lake, British Columbia (McCart, 1965).

The pygmy whitefish does not make extended migrations. However, it does move on to the spawning areas in the early winter and presumably back into deeper water after spawning.

Food of the pygmy whitefish includes a rather wide variety of items. Listed as most important in the Naknek system were cladocerans, dipteran (chiefly Chironomidae) larvae and pupae, adult Diptera and nymphs of Plecoptera. Other food included diatoms and other algae, pelecypods, nematodes, arachnids and fish eggs (Kendall, 1921; Heard and Hartman, 1966). In Lake Superior, ostracods and amphipods were the principal foods (Eschmeyer and Bailey, 1955). The pygmy whitefish feeds almost exclusively during daylight hours, making "short distinct jabs or darts, apparently at specific food items, such as insect larvae, when picking up mouthfuls of bottom material." They may also rise off the bottom and take specific items from the current (Heard and Hartman, 1966).

There is a distinct positive correlation between the diet and the average size of individuals in a population. Fish belonging to groups in which insects are the dietary mainstay are, on the average, much larger than those in which zooplankton is the chief food (Heard and Hartman, 1966). McCart (1970) found forms with high and low gill raker counts in Aleknagik, Naknek and Chignik lakes in Alaska and suggested that these represented sibling species. The high-count form, which was found almost exclusively in deep water, fed on plankton and grew more slowly. By contrast, the low-count form was found in both shallow and deep water, ate mostly insects and grew faster. However, the difference in growth rates through age IV in Chignik Lake does not appear to be significant. More careful analyses of larger samples are needed.

As noted above, the pygmy whitefish is found in both deep and shallow water. In Lake Superior, it was reported as most abundant at depths of 46 to 71 m (Eschmeyer and Bailey, 1955; Dryer, 1966). In the Naknek system, the species was found at depths to 168 m but was also abundant in the shallows (Heard and Hartman, 1966). McCart (1970) found that in Chignik Lake beach seine samples were composed entirely of the form with the low gill raker count, while in gill nets set at 30 m or deeper, the high-count form accounted for 36.2% of the fish taken.

IMPORTANCE TO MAN

The pygmy whitefish is of no direct importance to man. It is too small and scarce and of too limited distribution to be profitable for any kind of fishery. However, it is undoubtedly fed upon by predatory fishes such as charr, pike and burbot and may contribute to the overall scheme of competition for food. In this respect, it is interesting to note that the pygmy whitefish attains its greatest size in waters where there is no competition from other coregonids (McCart, 1965).

ROUND WHITEFISH

Prosopium cylindraceum (Pallas)

DISTINCTIVE CHARACTERS

The narrow, rather pointed snout, the 74 or more pored scales in the lateral line, and the 50 or more pyloric caeca distinguish the round whitefish (Figure 16).

DESCRIPTION

Body elongate, cylindrical, slender; depth 15% to 20% of fork length. Head relatively short, its length averaging 20% of fork length. Snout short, about 22% of head, pointed when seen from above. Eye

round, diameter equal to or less than snout length; notch present in membrane below posterior edge of pupil. Nostrils have a single flap separating the openings on each side. Mouth small, upper jaw overhanging lower; maxilla reaches about to anterior margin of eye in adults, a little farther back in young. Teeth restricted to a small patch of embedded teeth on tongue; also present on bases of gill rakers. Gill rakers, which are short: 14 to 21. Branchiostegals: 6 to 9. Lateral line has 74 to 108 pored scales. Pyloric caeca: 50 to 130. Vertebrae: 58 to 65.

FINS. Dorsal has 11 to 15 rays. Adipose fin present. Anal has 10 to 13 rays; pectorals, 14 to 17; pelvics, 9 to 11, axillary process present. Caudal forked.

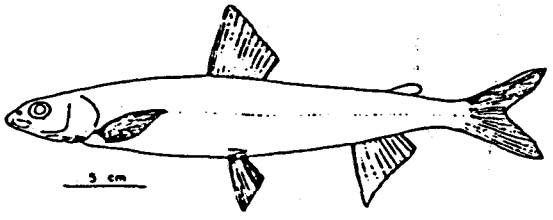

FIGURE 16. Round whitefish, *Prosopium cylindraceum*.

SCALES. Cycloid, fairly large; nuptial tubercles prominent on lateral scales of breeding males, but only feebly developed in females.

COLOR. Bronze on back, sometimes with a greenish tinge. Sides silvery, belly silvery white. Fins of most Alaskan specimens are more or less colorless or slightly dusky. Scott and Crossman (1973) reported the pectoral, pelvic and anal fins to be an amber color, becoming orange at spawning time. The young are marked with 3 rows of fairly well-defined parr marks, the first row lying along the lateral line, a second row (sometimes not well defined) just above the first, and a third row just below the midline of the back. The spots of this third row often coalesce across the middorsal line (photographs, page 86 and 87).

SIZE. The largest round whitefish on record was a specimen of 56.1 cm total length from Great Slave Lake (Scott and Crossman, 1973). The round whitefish is known to reach a weight of 2 kg (Keleher, 1961) and has been reported as reaching "about 5 pounds" (2.27 kg) in Lake Superior (Koelz, 1929).

RANGE AND ABUNDANCE

The round whitefish is found throughout mainland Alaska from the Taku River, near Juneau, north to the arctic coast. It ranges eastward across Canada to the western shores of Hudson Bay. A discontinuity in range exists in Manitoba and northern Ontario, and the species is again present in the Great Lakes (except Lake Erie), eastward to New Hampshire and Maine, south to Connecticut and north to Labrador's arctic coast. In Asia the round whitefish ranges west to the Yenisei River and south to Kamchatka.

The round whitefish is fairly abundant wherever it is present, although it usually does not occur in such large numbers as some of its relatives.

HABITS

Spawning occurs in late September through October in interior Alaska, but not until November or December in more southern parts of the range. Spawning appears to be an annual affair, with many fish breeding in successive years, even in the Arctic (McCart et al., 1972). Spawning beds are located on gravelly shallows of rivers and the inshore areas of lakes. Inshore and upstream migrations have been observed (Harper, 1948; Normandeau, 1969) at spawning time and are probably characteristic. However, fish in interior Alaska do not seem to show the concentrated migrations characteristic of ciscoes and humpback whitefish. According to Normandeau (1969), the fish swim in pairs during spawning, a single male with each female. Details of spawning behavior have not been described, but probably resemble those of the mountain whitefish, *Prosopium williamsoni*. In that species, the fish contact each other and rest on the bottom for 2 to 4 seconds, emitting eggs and milt, then separate (Brown, 1952). The eggs of the round whitefish are known to be broadcast and to receive no parental care. Females produce between 1,000 and 12,000 eggs, with the average between 5,000 and 6,000 (Bailey, 1963; Normandeau, 1969; Furniss, 1974). The size of ovarian eggs varies with locality. In New Hampshire unfertilized eggs averaged .27 cm, in diameter (Normandeau, 1969), but Furniss (1974) found ovarian eggs of Alaskan fish to be only .1 to .18 cm in diameter. The eggs absorb water after fertilization and may reach diameters of .3 cm to almost .5 cm in a few hours. The eggs, which are yellow to orange and demersal but not sticky, settle into crevices in the rocks and gravel of the bottom. Time of development has been reported as about 140 days at 2.2°C in New Hampshire (Normandeau, 1969) and presumably is not much different in Alaska. The young hatch out as sac fry. In two to three weeks, the yolk has been absorbed and the young have left the spawning grounds.

Growth rates vary from one locality to another. Lake Michigan fish grow very rapidly, reaching a total length of about 50 cm in 7 years (Mraz, 1964a). By contrast, in Elusive Lake, in the Brooks Range of Alaska, this length is not achieved until age 12. The oldest known round whitefish is one of 16+ from Shainin Lake, Alaska (Furniss, 1974). Sexual matur-

ity is reached in about 5 years in the southern parts of the range, but not until age 7 in the Brooks Range of Alaska (Furniss, 1974).

Except for the spawning movements already mentioned, the round whitefish apparently does not migrate.

Food of the round whitefish is primarily the immature stages of various insects, especially Diptera and Trichoptera. Adult Trichoptera are also important, as well as gastropods, *Daphnia* and fish eggs (Martin, 1957; Loftus, 1958; Normandeau, 1969; Furniss, 1974). In some areas the round whitefish is considerd a serious predator on the eggs of lake trout (Martin, 1957; Loftus, 1958).

IMPORTANCE TO MAN

The round whitefish was formerly taken in considerable quantities in the Great Lakes. In the late 1920s annual catches from northern Lake Michigan were on the order of 90,900 to 163,200 kg (Mraz, 1964a), but present-day catches are much smaller, primarily because of the relatively small size of the fish and an uncertain supply. In Alaska the round whitefish is of some importance in freshwater subsistence fisheries. It is occasionally smoked in strips and sold as "squaw candy."

BROAD WHITEFISH

Coregonus nasus (Pallas)

DISTINCTIVE CHARACTERS

The broad whitefish is set off by its short gill rakers, which are less than one-fifth as long as the interorbital width, and the rounded to flat profile of the head (Figure 17).

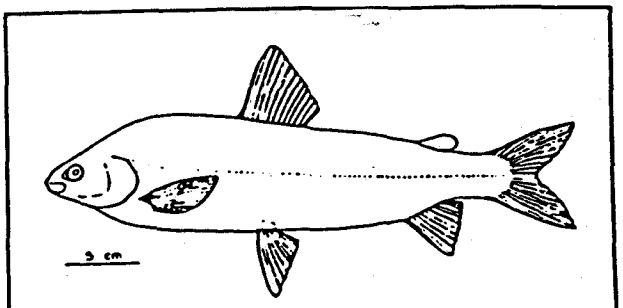

FIGURE 17. Broad whitefish, *Coregonus nasus*.

DESCRIPTION

Body elongate and compressed, especially in large specimens; sides a bit flatter than in most other whitefishes. Depth of body 23% to 31% of fork length in adults, less in young. Head short, 15% to 20% of fork length. Dorsal profile rounded to flat (may be slightly concave in large specimens). Snout blunt, short, rounded, sheep-nosed in profile, its length equal to or less than diameter of eye. Eye small, 12% to 16% of head length. No notch in adipose lid. Nostrils have a double flap between openings. Mouth small, upper jaw overhanging lower, maxilla reaching rearward approximately to below anterior edge of eye. No teeth except for a small patch of weak teeth on base of tongue. The 18 to 25 gill rakers are blunt and short, longest 13% to 19% of interorbital width. Branchiostegals: 8 or 9. Lateral line has 84 to 102 pored scales. Pyloric caeca: about 140 to more than 150. Vertebrae: 60 to 65.

FINS. Dorsal has 10 to 13 rays. Adipose fin present and fairly large. Anal, 11 to 14 rays; pectorals, 16 to 17; pelvics, 11 to 12, axillary process present. Caudal forked.

SCALES. Large, cycloid. Males develop prominent breeding tubercles on lateral scales at spawning time, but these are only weakly developed in females.

COLOR. Olive-brown to nearly black on back; sides silvery, often with a gray cast; belly white to yellowish. Fins usually rather gray in adults, pale in young (photograph, page 87).

SIZE. This species is the largest of the Alaskan whitefishes. It is reported to reach weights up to 16 kg in the Kolyma River of Siberia (Berg, 1948), but most mature fish run around 2 to 5 kg. One of 71.5 cm weighing 5.7 kg from the Yenisei River is mentioned by Berg (1948). The largest Alaskan specimen known was a fish of 67 cm fork length from the Colville River at Umiat (Alt and Kogl, 1973).

RANGE AND ABUNDANCE

The broad whitefish is found throughout Alaska from the Kuskokwim River north to the arctic coast. It is present in the Yukon River from the mouth to the headwaters. In the Tanana River drainage it is known from Minto Flats and the Tolovana, Chatanika and Chena rivers and probably occurs farther upstream as well. It is present in most, if not all, of the rivers draining into the Bering, Chukchi and Beaufort seas. The range extends eastward to the Perry River, Northwest Territories, westward across Siberia to the Pechora River, south to the Bay of Korf and to the Penzhina River on the Sea of Okhotsk. It is fairly abundant seasonally, though apparently not in as large numbers as some of its relatives.

HABITS

Little is known of the biology of the broad whitefish. Although the adults are more or less anadromous, those reaching the sea apparently do not venture far from brackish water. Upstream spawning runs begin as early as June and may extend into September or even later (Kogl, 1971; Alt and

Kogl, 1973; Kepler, 1973; Townsend and Kepler, 1974). Spawning actually takes place from September through October, possibly even into November. Wynne-Edwards's (1952) statement that "The broad whitefish spawns in the rivers in August . . ." is probably based on a misinterpretation of the timing of the spawning runs. Except for our knowledge that spawning takes place in streams with gravel bottoms, nothing is known of the breeding habits. Presumably they are similar to those of other coregonids. The ovarian eggs are pale yellow to milky white in color and up to .4 cm in diameter (Berg, 1948; Nikolskii, 1961). Young hatch in the spring and move downstream. Adults apparently move downstream after spawning and overwinter in deep parts of the rivers or in estuaries.

Growth is relatively slow, especially in the arctic. Berg (1948) mentioned lengths of 50 to 53 cm at 8+ for fish from the Kara and Kolyma regions of Russia, but in the Colville River, Alaska, the average length of 8+ fish was under 40 cm (Kogl, 1971). Broad whitefish from the Minto Flats area grow at about the same rate as the Siberian fish (Alt and Kogl, 1973). Maximum age recorded is 15 years (Alt and Kogl, 1973), although Nikolskii (1961) stated that "The age limit of this fish exceeds 15 years."

The broad whitefish appears to be mainly a bottom feeder. It is known to eat chironomids, snails, bivalve mollusks (Kogl, 1971), mosquito larvae (Berg, 1948) and crustaceans (Scott and Crossman, 1973).

IMPORTANCE TO MAN

The broad whitefish is taken commercially in Siberia, but it is not of great importance. Pre-World War II catches in Siberia averaged 40,000 kg per year. In North America the broad whitefish is used almost exclusively in subsistence fisheries, although a commercial fishery in the Colville River Delta takes about 7,000 kg per year. Despite its lack of popularity the broad whitefish is an excellent food fish.

THE HUMPBACK WHITEFISHES
Coregonus clupeaformis complex

This group of three closely related species forms a most confusing assemblage because almost the only means by which they can be distinguished from one another seems to be the modal number of gill rakers in large samples (the mode is the most frequent number to appear in a count). The form here called *Coregonus pidschian* has average gill raker counts of 21 to 23, with a range from about 17 to 24 or 25 in individual specimens. *Coregonus nelsoni* averages 24 or 25 (the mode is usually 25) with a range of 22 to 27, while *Coregonus clupeaformis* has modal counts of 26 or more, with individual counts ranging from 24 to 33. *C. pidschian* appears to have lower average vertebral counts than do *C. nelsoni* and *C. clupeaformis*. Fisheries biologists in Alaska have applied one or another of these names to humpback whitefish throughout the state, all too often without adequate samples for proper identification. Hence, distributional records are often of little value.

There appear to be some differences in ecological relationships among the three species. *C. clupeaformis* is primarily a lake-dwelling form. *C. nelsoni* is mostly a stream dweller, only rarely being encountered in lakes. It seems to be intolerant of salt water. *C. pidschian* apparently is truly anadromous, at least in some areas, and may winter in the sea near river mouths.

ALASKA WHITEFISH
Coregonus nelsoni

DISTINCTIVE CHARACTERS

The distinctive marks of the Alaska whitefish are gill rakers that are longer than 20% of the interorbital width, a total of 22 to 27 gill rakers on first arch (with modal counts of 24 or 25) and a pronounced hump behind the head in adults (Figure 18).

DESCRIPTION

Body moderately compressed, sides rather flat. Depth of body 25% to 33% of fork length in adults, the percentage increasing in larger fish. Head short, less than 25% of fork length. Dorsal profile of head distinctly concave behind eyes in adults due to the prominent nuchal hump. Snout 27% to 35% of head length. Eye small, its diameter 20% to 25% of head length; no notch present in lower posterior part of membrane. Nostrils have a double flap between openings. Mouth rather small with upper jaw over-

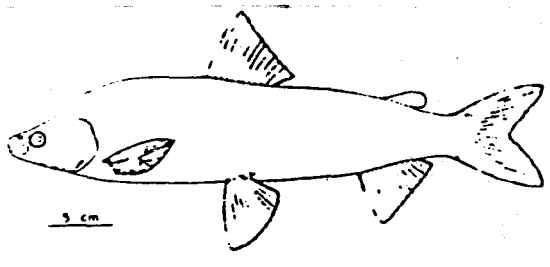

FIGURE 18. Alaska whitefish, *Coregonus nelsoni*. The humpback and lake whitefishes closely resemble this species but differ in number of gill rakers.

hanging lower and maxilla reaching backward to below front third of eye. A few weak teeth present on premaxilla in young, no teeth on jaws in adults. A few small teeth present on tongue. Gill rakers: 22 to 27, with total counts averaging around 24 or 25. Longest raker longer than 20% of interorbital space. Branchiostegals: 8 to 10. Lateral line has 77 to 95 pored scales. Vertebrae: 60 to 63.

FINS. Dorsal has 11 to 13 rays. Adipose fin well developed, often larger in males than in females. Anal has 10 to 14 rays; pectorals, 15 to 17; pelvics, 11 to 12, axillary process present. Caudal forked.

SCALES. Cycloid, fairly large. Well-developed nuptial tubercles on lateral scales of males, less developed in females.

COLOR. Dark brown to midnight blue above fading to silver on sides and white beneath. No parr marks in young (photograph, page 88).

SIZE. Up to at least 53.2 cm fork length in the Chatanika River (Alt, 1971a).

RANGE AND ABUNDANCE

The precise distribution of Alaska whitefish is uncertain, primarily because of the difficulty of identifying the three species of humpbacked coregonids which occur in Alaska. However, as far as can be determined, the Alaska whitefish seems to be pretty well confined to the Yukon and its tributary drainages, where it is to be found all the way from Nulato to the Canadian border. It is present in the Tanana River and the Koyukuk River and their tributaries and in Lake Minchumina. Specimens that may be of this species have been reported from the Unalakleet and Wulik rivers. Possible *C. nelsoni* are known from the Alsek, Copper and Susitna systems, the upper parts of the Yukon River in Canada, the lower reaches of the Mackenzie River and several lakes in western Canada (Lindsey, 1963a, b; Lindsey et al., 1970; McPhail and Lindsey, 1970).

The Alaska whitefish is locally and seasonally abundant during the summer and fall. Throughout the rest of the year the fish apparently disperse widely.

HABITS

The Alaska whitefish spawns from late September through October in interior Alaska. Spawning areas are in clear, moderately swift streams with fairly clean gravel bottoms. In the Chatanika River, these areas are from 100 to 800 m long, 15 to 22 m wide, and 1.3 to 2.6 m deep, with water velocities of about 0.5 m per second. Water temperatures at spawning are between 0° and 3°C (Kepler, 1973). Average fecundity of 20 mature females 5 to 10 years old and 39.5 to 52 cm fork length was about 50,000 eggs. Fecundity was not closely related to age or size of the fish (Townsend and Kepler, 1974).

The spawning act is similar to that of the least cisco. A female begins to swim vertically toward the surface, belly upstream. She is joined by a male (sometimes two, rarely three). Eggs and milt are extruded as the fish approach the surface of the water. The fish break the surface, fall away from each other and return to the bottom of the pool. In contrast to the least cisco, the Alaska whitefish spawns actively both at night and in the daytime. The yellow to orange eggs, with an average diameter of .21 to .23 cm, drift down to the bottom where they lodge in crevices in the gravel. The exact time of incubation is unknown. However, young-of-the-year have been taken in June and July, so presumably the young fish hatch in late winter or early spring.

The Alaska whitefish of the Chatanika River grow rapidly during their early years. A year-old fish averages about 12 cm fork length. By the age of 5, the fish average between 35 and 40 cm fork length, and at 10 years about 48.5 cm. The oldest so far recorded was a 12+ of 53.2 cm fork length. Sexual maturity is reached between 3 and 5 years (Alt, 1971a; Townsend and Kepler, 1974).

The Alaska whitefish of the interior undertakes fairly extensive upstream and downstream movements. Upstream migration, apparently the beginning of the spawning run, may start as early as late June. The migration seems to be rather indefinite at first but it becomes marked as the season progresses and more and more fish approach breeding condition. By September schools of up to several hundred fish are on or close to the spawning areas. Following the completion of spawning, the majority of the fish move downstream but a few may winter in deep pools near the spawning grounds. The young-of-the-year move downstream in their first year and as a rule do not return to the spawning areas until they are sexually mature.

Alaska whitefish generally return to the same spawning grounds year after year. Townsend and Kepler (1974) found that five fish tagged in 1972 were present on the same grounds in 1973. On the other hand, these same investigators noted far fewer tag returns than were expected and suggested that this might indicate either increased mortality of tagged fish or nonconsecutive (nonannual) spawning. The October, 1975, recovery at Nenana of an Alaska whitefish tagged in the Chatanika River in 1974* suggests that some fish may wander far from their natal streams. Apparently not all fish return each year to the same spawning areas.

Hybrids of Alaska whitefish and inconnu are known to exist (Alt, 1971c). The two species spawn at

*A.H. Townsend: personal communication.

the same time and in the same places. Because of the differences in breeding behavior, hybridization is probably not the result of pairing between genera but due rather to simultaneous broadcasting of reproductive products in the same area. Occasional hybridization occurs also between the Alaska whitefish and the least cisco (UAFC #2173).

Alaska whitefish feed primarily on immature stages of insects, notably Diptera and Trichoptera. Although they generally do not feed during the latter part of the spawning run, this is not always so. On occasion they will feed heavily on eggs of the least cisco (Morrow et al., 1977).

IMPORTANCE TO MAN

The Alaska whitefish is an excellent food fish but is virtually never eaten. Its major importance is in the subsistence fisheries, but even here it falls far behind the various salmons. Spearfishing for sport has resulted in a small fishery in the Chatanika River; this fishery, which takes place at night, is estimated to take up to 500 fish yearly (Kepler, 1973) and similar spear fisheries, also small, exist at other locations in Alaska. Commercial fisheries have operated in some of the lakes of the Copper River drainage, but the take has not been large (Williams, 1968, 1969). The young are consumed by predatory fishes such as pike and burbot (Alt, 1968) and by other predators such as kingfishers, mink and otter.

HUMPBACK WHITEFISH

Coregonus pidschian

DISTINCTIVE CHARACTERS

The humpback whitefish is distinguished by gill rakers that are longer than 20% of the interorbital width, 19 to 25 gill rakers (with modal counts of 22 or 23), and a pronounced hump behind the head in adults.

DESCRIPTION

See description of *C. nelsoni* (page 35). Except for the gill raker counts, there are no known morphological differences of any significance. It is my impression, as well as that of several fisheries biologists in the Fairbanks office of the Alaska Department of Fish & Game, that pearl organs are far fewer in number and are less well developed in *C. pidschian* than in *C. nelsoni*. Specimens from the Kobuk River that I have seen myself, and specimens from Highpower Creek and the Kalitna River in the Kuskokwim system,* all taken in early October, had few pearl organs. Vertebrae (in Siberian fish): 58 to 63.

*K.T. Alt: personal communication.

RANGE AND ABUNDANCE

The humpback whitefish is to be found in most of the Alaskan rivers that empty into the Bering, Chukchi and Beaufort seas. It ranges throughout the Kuskokwim River drainage and well above Umiat in the Colville. Alt and Kogl (1973) found it at Umiat in July; thus it is presumed that the spawning grounds in the Colville must be much farther upstream. In the Yukon, on the other hand, it apparently is confined to the lower reaches, where it has been recorded from Marshall. Its range extends eastward along the arctic coast at least to the Sagavanirktok River, Alaska, westward across Siberia to the Kara Sea. Throughout its range it is quite abundant during the spawning concentrations, but the fish apparently disperse at other times of the year.

HABITS

Humpback whitefish appear to be truly anadromous, but it is not known how far the wintering fish move from the river mouths. They have been taken in the Beaufort Sea several miles offshore of the Colville and Sagavanirktok rivers as well as in Kotzebue Sound, off Nome, and around the mouths of the Yukon and Kuskokwim rivers. In the Kara Sea of western Siberia they have been taken well out in the northern parts "which are characterized by high salinities" (Berg, 1948). Upstream spawning migrations may be extensive. Fish tagged in the Kuskokwim River below Bethel have been recovered on the North Fork at Medfra and Telida, the latter representing a migration of not less than 1,280 km. Possible *C. pidschian* have been found in the Yukon River at Fort Yukon and in the Porcupine River,* but their origin remains unknown. Other populations seldom venture far upstream and still others may never go to sea at all (Berg, 1948).

The spawning run generally begins in June and spawning usually occurs in October. However, humpback whitefish have been found spawning under the ice in the Kuskokwim River near Bethel as late as November 15* and similar phenomena have been recorded in Siberia (Berg, 1948). Spawning behavior has not been described, but presumably is similar to that of the Alaska whitefish. Sexual maturity is attained at 4 to 6 years. Ovarian eggs are reported as .12 cm in diameter in Siberian fish (Nikolskii, 1961). Fecundity of females varies from one population to another and with the size of the fish. The general range is from about 8,000 to nearly 50,000 eggs per female. It is assumed that the young hatch in the late winter and spring, subsequently moving downstream, to return as mature adults 4 to 6 years later.

The young feed mainly on zooplankton, but adults feed mostly on mollusks, crustaceans and chironomid larvae (Nikolskii, 1961).

Growth rates vary greatly from place to place and even in different sections of the same river (Nikolskii, 1961). In Alaska, fish in arctic rivers such as the Colville, Kobuk and Agiakpuk grow much more slowly than do those in the Kuskokwim and lower Yukon drainages. Humpback whitefish from the first three rivers average about 26.7 cm fork length at 5+ and 40.5 cm at 10+ while those from the latter areas average 34.7 cm and 44.5 cm at the same ages (Alt, 1973b).

IMPORTANCE TO MAN

The humpback whitefish of Alaska is of little direct importance except in local subsistence fisheries. A commercial operation on the Colville River Delta takes about 1,000 fish annually (Alt and Kogl, 1973). However, this fish is an important commercial species in Siberia (Berg, 1948; Nikolskii, 1961).

LAKE WHITEFISH

Coregonus clupeaformis (Mitchill)

DISTINCTIVE CHARACTERS

The lake whitefish is differentiated from the other two humpback whitefishes of Alaska by its higher gill raker count, which ranges from 26 to 33.

DESCRIPTION

See description of *C. nelsoni* (page 35). Except for the gill raker counts, there are no known differences in appearance of any significance. Pyloric caeca: 140 to 222. Vertebrae: 55 to 64.

RANGE AND ABUNDANCE

The lake whitefish is widely distributed across Canada and the northern United States, from the upper Yukon and Northwest Territories south to Montana, Minnesota and the Great Lakes, and east to New England, Quebec and Labrador. Records of its distribution in Alaska are not completely reliable due to the confusion with closely related species. However, the lake whitefish has been recorded with reasonable certainty from Paxson and Crosswind lakes in the Copper River drainage and from Lake Louise and the Tyone Lakes in the Susitna drainage (Williams, 1968; Van Wyhe and Peck, 1969). Lindsey et al., (1970) show a possible record of lake whitefish from Old John Lake at the head of the Sheenjek River, but the record is based on only two specimens.* Wherever it is found, the lake whitefish is quite abundant, especially when schooled up for spawning.

HABITS

Breeding behavior of the lake whitefish is similar to that of the Alaska whitefish except that spawning generally takes place in the inshore regions of lakes. Stream populations, of course, use the rivers and creeks. Spawning takes place over rocky or gravelly bottom in depths of 1 to 3 m. A female and one or more males rise to the surface, extrude eggs and milt, then descend separately toward the bottom. Spawning occurs at night (Bean, 1903; Hart, 1930; Everhart, 1958). Adults breed annually in the southern parts of the range, but apparently only every other year or even every third year in the arctic and sub-arctic (Kennedy, 1953).

Fecundity varies greatly from one population to another, averaging around 50,000 eggs per female, with a reported range of less than 6,000 to more than 150,000. Spawning occurs from October to December, depending on locality, and seems to be associated with water temperatures of about 6°C or less. Hatching normally occurs in late April. Development of the eggs takes 140 days at .5°C, which seems to be the optimum temperature for the eggs. In laboratory studies, no eggs survived at 0° or at 12°C. Mortalities through hatching increased from 27% at .5° to 41% or 42% at 2° to 6°, 81% at 8° and 99% at 10°C. Abnormalities also increased from none at .5° to 2°C to 50% at 10°C (Price, 1940).

The larvae are 1.1 to 1.4 cm long at hatching and grow rapidly during the summer. In Lake Huron the larvae are close inshore from soon after breakup to the end of the summer (Faber, 1970), their location often being associated with emergent vegetation. They stay at or near areas with temperatures of 17°C (Reckahn, 1970), descending with it to the metalimnion. Van Wyhe and Peck (1969) found similar movements of young-of-the-year that were believed to be lake whitefish in Paxson Lake, Alaska.

Growth slows abruptly in September so that by the end of October the larvae are about 12 cm long. This slowing of growth is associated with descent into the colder water of the hypolimnion.

Growth rates vary with locality and population. Average total lengths at age, covering a wide variety of localities in the U.S. and southern Canada, are: 1+, 13 cm; 2+, 21.6 cm; 5+, 38.6 cm; 10+, 51.1 cm; 15+, 62.7 cm (Carlander, 1969). By contrast, lake whitefish in Paxson Lake, Alaska, had the following age-length relationships: 1+, 4 cm; 2+,

*C. Lindsey: personal communication.

7.7 cm; 5+, 20.2 cm; 10+, 37.3 cm; 15+, 46 cm (Van Wyhe and Peck, 1969). Maximum age reported was that of a fish of 28 years from Great Slave Lake (Kennedy, 1953), while the largest size was of a fish of 19 kg taken in Lake Superior in 1918 (Van Oosten, 1946). If the length-weight relationship given by Dryer (1963) for Lake Superior whitefish can be applied to this second specimen, then the fish must have been on the order of 135 cm total length. The next largest known weighed just over half as much, 10.9 kg (Keleher, 1961).

The lake whitefish appears to be a rather sedentary fish, at least in the Great Lakes. Tagging studies (Budd, 1957; Dryer, 1964) indicate that the majority of fish stay within 16 km of their spawning ground, although one fish in Lake Huron was recaptured 240 km from the point of release. There seems also to be a tendency toward movement in definite directions, although no well-defined routes have been determined (Budd, 1957). In general, movement of lake whitefish in large lakes consists of four stages: travel from deep to shallow water in the spring; movement back into deep water during the summer as the shoal water warms; migration back to the shallow-water spawning areas in the fall and early winter; and post-spawning movement back to deeper water.

Within each of the Great Lakes, and probably in most large lakes, the lake whitefish form more or less separate populations. These are usually characterized by different growth rates rather than by morphological differences (Budd, 1957; Roelofs, 1958; Dryer, 1963, 1964; Mraz, 1964b). It is not known whether these populations are genetically distinct or are produced by environmental factors. In any case, the lack of migratory habits probably tends to keep them separate.

Food of the lake whitefish varies with size and age of the fish, location, and the type of food available. The initial food of the young consists of copepods, later on of cladocerans. By early summer they begin to feed on bottom organisms, but Cladocera, especially *Bosmina*, remain a dominant food item for some time (Reckahn, 1970). Adults feed mainly on benthic organisms, but pelagic and semipelagic forms also are important. Kliewer (1970) found a significant negative correlation between gill raker length and the proportion of benthic food, and a strong positive correlation between the number of gill rakers and the amount of benthic food. He listed the following food items for lake whitefish from the Cranberry Portage area in northern Manitoba: Pelecypods, gastropods, amphipods, Diptera (tendepedid larvae and pupae, culicid and ceratopogonid larvae), Ephemeroptera, Trichoptera, Megaloptera, plant material, fish eggs, Hirudinea, Cladocera, Copepoda, mysids, Hemiptera (*Corixidae*), Hymenoptera and fishes. In Paxson Lake, Alaska, adult whitefish were seen to prey upon young sockeye salmon until the fry grew too big for the whitefish (Van Wyhe and Peck, 1969).

Although extensive hatchery programs for the propagation of lake whitefish have been carried on for years on the Great Lakes and other places, there is no evidence to show that these programs have ever influenced the strength of year classes (Koelz, 1929; Christie, 1963). Weather seems to be the most important factor. Cold water temperatures at spawning time—below 6°C—followed by a steady nonfluctuating decrease to .5°C and by warm temperatures at hatching time, produce the strongest year classes (Christie, 1963; Lawler, 1965a).

IMPORTANCE TO MAN

The lake whitefish has long been one of the most valuable freshwater species in North America. Deterioration of its environment, depletion of the stocks and other factors led to a decline in yield from the 5.5 million kg per year of the 1880s to the 700,000 kg per year of the 1920s (Koelz, 1929), but in the late 1960s the catch was increasing. In 1970 the U.S. and Canadian landings from the Great Lakes and the International Lakes between Minnesota and Ontario amounted to about 1.69 million kg (Anonymous, 1973). In addition, there are considerable Canadian fisheries in the northern lakes such as Lake Winnipeg and Great Slave Lake. In Alaska, however, the lake whitefish is virtually unused. Attempts at commercial fishing for lake whitefish have been made in Crosswind Lake in the upper Copper River drainage and in Lake Louise and Tyone Lake in the upper Susitna. These have not, however, been especially successful (Williams, 1968, 1969).

APPENDIX 8

ADULT ANADROMOUS FISHERIES STUDIES

Side Band Radio

TRIDENT

HF-RADIO TELEPHONE COMMUNICATIONS

●

HOW TO USE A SINGLE SIDE BAND RADIO

PRODUCED FOR OUR CUSTOMERS

by

Jack and Virginia Reed
and the Trident Staff

P.O. BOX 10-1158 • ANCHORAGE, ALASKA 99511

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HOW THE RADIO WORKS AND WHY IT DOESN'T SOMETIMES.

Radio is a means of communication that uses electro-magnetic waves sent through the atmosphere at approximately the speed of light. It works by changing sounds or other signals into these waves that carry the desired information. These are called "Radio Waves". These radio waves travel through the atmosphere and through space, and through some solid objects such as walls of buildings. Radio waves will not, however, pass through metals, like lead, and sometimes large land masses such as mountains can inhibit them. The waves used are similar to light waves, but are lower in frequency.

"Frequency" is the word used to designate the number of vibrations per second that the radio waves contain. Many different frequencies are used so that many different messages can be transmitted at the same time without causing interference of being just a mumbo-jumble that no one can understand.

Sending and receiving radio communications involve four basic steps. They are:

1. Converting the communication into "Radio Waves". This is done in several steps. First your voice (or any sound) is converted into electrical energy by the microphone. It is then impressed onto a radio wave by the "modulator", and then amplified by the "amplifier". This all happens inside the radio.

2. "Transmitting" or sending the radio waves up and out into space. This is done through the antenna, which sends or launches the radio wave out and up into space in all directions.

3. "Receiving" or catching the radio waves. This happens when the transmitted waves passes your antenna, and causes a current to flow through it and on into your radio.

4. Changing the "received" waves back into the original form of communication sent, so it is understandable. This is done the same way that the original communication was converted into radio waves, but in reverse. In other words, first it is amplified, then converted by the demodulator, then sent to the loudspeaker or through the earphones so you can hear it.

The sounds or signals transmitted by the radio transmitter are carried on a "Carrier Wave". The carrier wave is varied by the electrical signal, or the frequency, used to produce it. The wave is fed into a "Transmitter" or "Transmitting Antenna" which sends the waves either up into the atmosphere or along the ground. The waves that go up into the atmosphere are called "Sky Waves" and the waves that go along the ground are called "Ground Waves".

Sky waves are usually applied to long distance communications and are what we use to transmit on single side band radios. These waves go out into space till they reach the layer known as the "Ionosphere", then are bounced back to earth by the ionsphere if the conditions are correct. What I mean by this is that the waves must be properly transmitted, and on a correct frequency that does not exceed the "Critical Frequency". Communications that are transmitted above the critical frequency are not bounced back, but go through the ionosphere and are lost. This is one of the reasons why there is so much flap about being on frequency. The other reason is that by being off frequency you can

interfere with other peoples signals and impair their communications.

The condition and location or height of the ionosphere has a great deal to do with the quality of communications on any given day, or at different times of the day. The ionosphere is usually higher in the evening and early morning. In the early afternoon through mid-afternoon it lowers slightly, and during the night it goes back up. As the height of the ionosphere changes the frequencies that work best change also. As the ionosphere moves up, the frequency moves down. 3201 usually doesn't work as well during the day when the ionosphere is lower, and 8070 is usually better during the day than at night. The reason for this is that the angle in which the radio wave strikes the ionosphere determines the place where it will come down to some degree, and as the ionosphere changes some communications come down where they shouldn't be. This will sometimes explain the noise and foreign language transmission that goes on at certain times of the day over the air.

A small portion of the carrier wave you send is captured by an antenna that is tuned, or made sensitive to the frequency that is being used. The wave is then sent to a receiver which separates the signal from the radio wave and converts the signal into understandable communication, as we discussed previously.

Radio-waves are invisible, and need no wires to send them from one place to another, and since the inception of transistors and printed circuits radios have become highly portable. This is why radio has become such a desirable means of communication to people that are in remote areas where the local power company or telephones just do not exist.

There are many reasons why radio waves don't "connect". We discussed being off frequency and the frequencies that are best to use at different times of the day in the previous paragraphs. Another common problem is that the radio has been connected to the power supply backwards. Not only will the radio not work, but it will blow fuses, or it could blow up transistors and become a very expensive mistake. Be careful!!! Not having the antenna set up correctly is another common problem. We will cover how to set up your antenna in the next chapter. Weak power supplies also will cause you problems. All of these are human error, and if you are experiencing a problem check these areas first.

Another common error we run into is that the operator has not allowed the radio to warm up before trying to transmit. This can result in garbled communications because a radio that has not been allowed to warm up is not transmitting on the proper frequency. Allow the radio to warm up for at least 15 minuted before trying to transmit. It will work much better and you won't get nasty letters from the FCC about broadcasting off frequency.

Since radio waves are an electro-magnetic wave any electrical or magnetic disturbance in the atmosphere can really louse up communications. Sun spots or solar flares, meteors, electrical storms, northern lights activity, comets, all of these things can foul up radio transmission, and sometimes for days. Our operators swear that cloud covers sometimes help communications, although it isn't supposed to make a difference.

Normally when you are experiencing difficulty in transmission you will not hear other transmissions taking place over the air, or if you do, they are obviously not

successful. In other words, if communications are down, they are down for everybody. If you do hear communications taking place and you are not able to get through, check your antenna location and attachment, power supply strength and attachment, your microphone attachment, and your fuses, and if all is well there, you could have a radio problem. This happens infrequently, but if it does you have to get the thing in for repairs. We cover that in the last chapter.

This doesn't cover all the contingencies, but from our experience these are the problems that we run into most often, I hope this chapter answers some of your questions, and gives some insight into how the radio works, and how to handle problems that might come up.

HOW TO SET YOUR RADIO AND ANTENNA UP FOR USE

We discussed allowing your radio to warm up in the last chapter. Don't forget.... at least 15 minutes. The best possible set up is never to turn off the radio at all, but this is not usually possible when you are out in the bush.

You do need a CONSTANT SOURCE OF POWER. A gasoline or diesel generator is not the best source of power to connect directly to the radio because they tend to be off frequency and create power surges. These power surges will blow your fuses, or worse yet the transistors, and the radio won't work. The best and most efficient arrangement is to hook up a 6 amp minimum, automatic battery charger to the generator, attach a designated type of battery or batteries to the charger, and the radio to the batteries. This will give you the constant power you need. The second best, and more temporary and portable solution is just to use alkaline or lead acid batteries only, depending on the make, model and type of radio you are using. The technician that delivers the radio to you should tell you which type of power source the radio needs.

Another very important point is to make sure you know which terminal is positive and which is negative on your radio. This may sound like a simple thing to ask about, but these are not always marked clearly, and hooking up a radio backwards can really put it out of commission quickly and permanently. We fix at least a dozen radios that have been hooked up backward every season. This is a common mistake, and a very inconvenient and expensive one. Pay Attention!!!!!

Your antenna should be set up as per the illustration on the page following this chapter. The ideal height is 50

feet, but when you are out in the bush you can't always find 50 foot trees. The minimum height you should use is 20 feet. 30 feet is better, 40 feet better yet, and 50 is the best, but 20 will work. Do the best you can. The antenna should be set up in a straight a line as possible..... or as straight a line as you can create under bush conditions. The rule is that the antenna should be at 90 degree angles, or crosswise from the direction that you wish to transmit toward, however this is only really important at heights that are greater than the ones we are talking about here. It still will help a little, but isn't as critical. Get it as high as you can, up to 50 feet, and in as straight a line as possible, and it will work. More important than the direction of broadcast is to set up the antenna at right angles to any power lines in the area to reduce the electric noise coupled into the antenna.

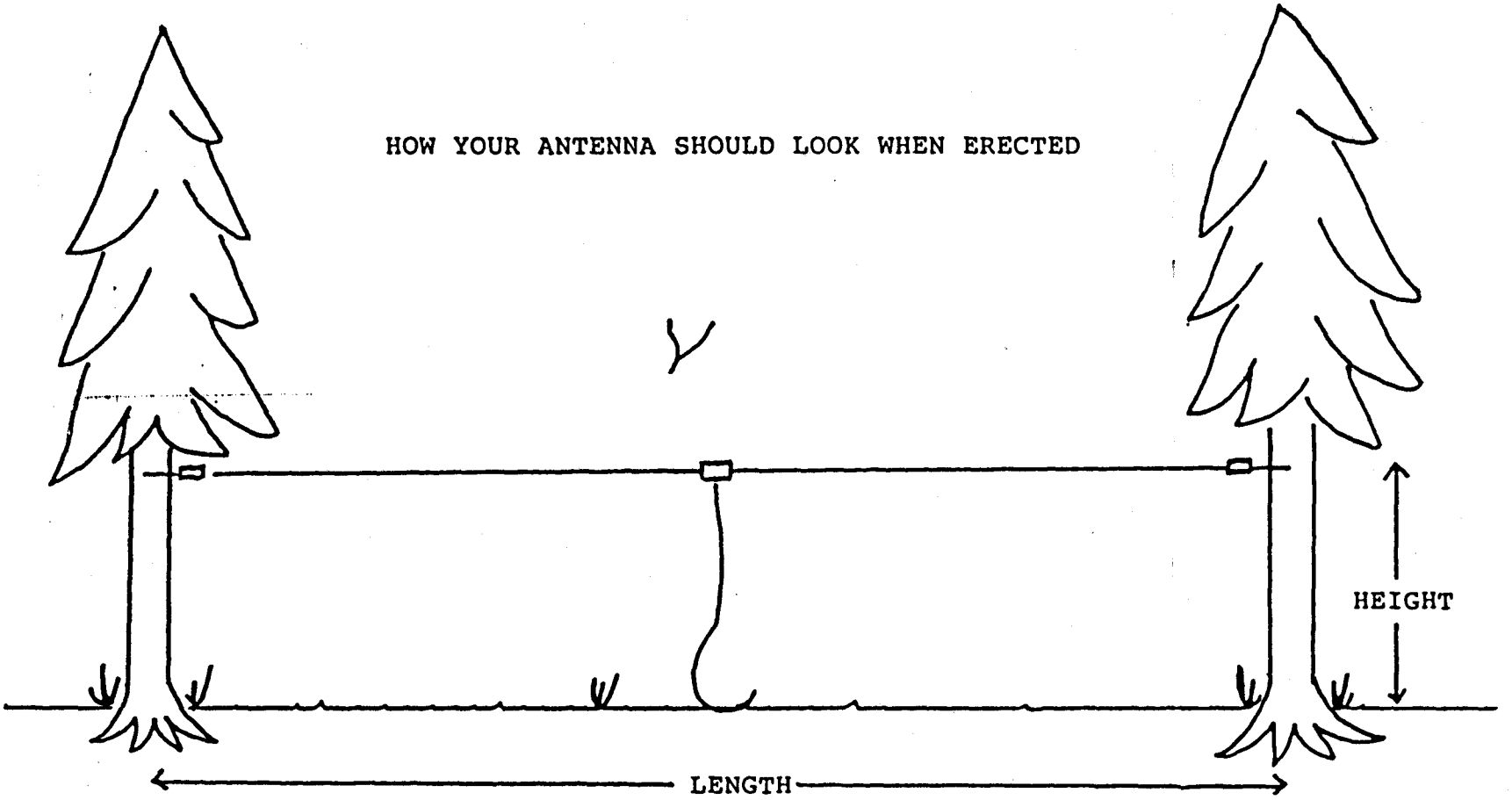
The length of the antenna varies with the frequency or frequencies that the antenna is built to utilize. Our three frequency antennas for 3201, 5167.5 and 8070 are 110 feet long. A single frequency antenna or antennas that operate on other than these frequencies can range from about 60 feet to 190 feet long. If you are out in the bush, you usually will use trees to mount your antenna on, so the length isn't that important, but before you build a permanent structure to use as a mount, be sure to check the length of the antenna that you will be using.

We will be discussing our frequencies which are used by Trident only in a later chapter. These are 5134.5/5370 and 3362/3238. Our standard 110 foot antenna will work for these frequencies as well as the Alaska Public Fixed Frequencies which are 3201, 5167.5 and 8070. However....if you have the aeronautical enroute frequency, (which is 3449),

or one of the marine frequencies on your radio, you will need separate antennas for them.

Just as an after thought, REMEMBER TO TURN THE RADIO OFF BEFORE CONNECTING OR DISCONNECTING ANY POWER SOURCES!!!

HOW YOUR ANTENNA SHOULD LOOK WHEN ERECTED



HOW TO USE THE RADIO CONTROLS PROPERLY

Now that you have wrestled with the antenna, set up your power source, and allowed the radio to warm up, you are ready to transmit. You must "KEY" the microphone, ("mike") to talk, that is, push the button on it IN to talk, and let it OUT to listen. Hold the mike about 4 inches from the lips and speak in a clear, normal voice. Do not shout into the mike, as this will result in a garbled communication and loss of clarity. (Not to speak of what it does to the ears of the poor person on the other end.)

All radios have some or all of the following controls on the face plate. The technician or salesperson that delivers your radio to you should go over your particular model with you, but the following will give you an idea of what the different types of dials or buttons are and what they do.

The ON/OFF or POWER switch or button has an obivious function. Some radios combine this switch with another dial or switch such as VOLUME or CHANNEL SELECTOR. Your salesperson will point this out.

The CHANNEL SELECTOR switch selects which channel you want to be on. Different radios have different channel capacities that range anywhere from one to twenty or more. Each frequency is assigned to a specific channel, and should be marked on a channel selector plaquet on the front of the radio. Again your technician or salesperson will help you.

VOLUME or LOUDNESS control is another one with a pretty obvious function.

SQUELCH modifiys the noise coming in over the air. Too much SQUELCH interferes with communication and as a general rule should be left OFF.

CLARITY or CLARIFIER is the control that will help when a communication sounds distorted or garbled.

Some radios have a SPEAKER/PHONE switch. This switch causes the noise the radio makes to be channeled either to the loudspeaker or to the headphones, depending on the position the switch is in.

The "VOLUME CONTROL" should be left at mid-range and the "SQUELCH" button or dial should be left OFF, since loud volume decreases clarity and the Squelch can interfere with your hearing any weak communications that are directed at you. The "CLARIFIER" control will help you out if the person that is transmitting to you sounds like Mickey Mouse, or Donald Duck.

I may have missed some of the controls on your particular radio, but these are the important ones that you will use. Once again, when you pick up your particular radio, the technician or salesperson should go over all the features of your specific make and model with you. This list should help you to remember the most important ones, and what to use them for.

SOME NOTES ON GOOD RADIO MANNERS

The two biggest complaints we seem to hear from people who use radios all the time are about people who spend an inordinate amount of time gabbing about nothing over the air, and people who continually "walk on", or interrupt other transmissions that are taking place.

First we'll cover the amount of time spent on the air. There is an FCC regulation that states that the radio is not to be used for "superfluous or frivilous conversation", and it (the regulation) also limits the amount of time spent on each call, and the number of calls allowed each call sign within a 24 hour period. This rule is not often enforced, unless the station REALLY abuses the privilege, and infringes on the rights of other users. We here at Trident try to limit calls to six minutes or less, and try to discourage people from calling thier wives, sweethearts, mothers, husbands and friends just to gab and pass the time of day. Aside from the fact that you are preventing people from using the frequency who might need to make important calls, you are being listened to by hundreds of people who really aren't interested in Old Charlie's lumbago, and/or Nina's sweet/ugly new baby/boyfriend or affair with the postman. Try to keep your calls as businesslike as possible, and again, under six minutes. If you have a grocery list or parts order that you know will take longer than the alloted time, make two calls, or wait till after hours when the radio is not so busy, such as after 9 at night. You can often give lists like these to a friend, and have them relay the order, or reservations or whatever to the necessary people involved. This usually saves difficulty anyway, as most clerks that answer phones don't really know what is

going on when they receive a radio phone patch.

The second most common breach of etiquitte is "walking on", or interrupting another transmission. If you are aware of another communication going on, do not interrupt unless it is s bona-fied emergency, and then only with the correct "buzz words". We will cover what is a bona-fied emergency and what these words are in a later chapter. Wait till the air is cleared, which will be signaled by both parties saying "Call sign, Clear", (like, ABC 21, Clear, followed by BCB 21, Clear). Then you race like mad to get your call in before someone else gets on the air. Sometimes a person does interrupt a transmission because they couldn't hear the traffic going on. If you accidentally do interrupt someone, they will usually tell you to "Stand By for Traffic", which loosely translated means to shut up and wait till it's your turn.

Once again let me remind you that people are listening to the conversations that go on over the air. This is a point that you should try never to forget. Don't discuss things of a delicate or personal nature, don't discuss bank accounts, credit card numbers, dollar figures, and so on. If you want your business public that's OK with us, but be warned that it <u>will</u> be public if you broadcast it over the air, and we are not take responsiblility for charges made to credit cards, etc., whose numbers have been broadcasted. If you want to guarantee payments to a credit card number, call on a land line and give the operator the credit card number and the OK to use it, and she will give the party that should have it the information after you have cleared the air. Our operators are bondable, and your information is secure with us.

On the subject of confidential information, we will not give out any information about you, neither will we give you information on anyone else. Please do not discuss other customers affairs on the air with our operators, and don't gossip. As I said before, hundreds of other people are out there listening.

Most good manners are just common sense and consideration of the rights and feelings of others. Follow a few simple guidelines, and you will remain on good terms with your neighbors and our operators.

CORRECT TERMINOLOGY TO USE WHILE ON THE AIR

This is a brief glossary of terms you'll use over the air. Remember NEVER to use CB jargon, such as 10-4, Breaker, and so on.

"ROGER" means yes, or OK.

"AFFIRMATIVE" means yes, or OK.

"NEGATIVE", or "THAT'S A NEGATIVE" means no.

"DO YOU COPY" or "HOW DO YOU COPY" means how can you hear me, or how well can you hear me.

"TRAFFIC" is a term used to describe the transmissions going on at the time, or, Is there much traffic today?" would mean has there been broadcasting going on, or not.

"STAND BY" means hold on, or wait till you are called BY YOUR CALL SIGN for a resumption of transmission. Other stations are permitted to transmit while a station is on stand by. This means that you are not finished with your transmission, but are temporarily off the air. This is used when you have to get paper, numbers, and so forth.

"SAY AGAIN" means to repeat what you just said.

"OVER" should be said at the end of a transmitted phrase to signal the operator and the other party that you are finished speaking and are waiting for a response. Not all radio operators use this phrase, but it is good practice.

"GO AHEAD" is sometimes used instead of over.

"CLEAR", preceeded by your call letters, such as ABC 21, Clear, means that you are finished with your transmission, and are clearing the air for others use.

"1 BY 1, 2 BY 2, 3 BY 3, 4 BY 4, and 5 BY 5" or any combination of the preceeding numbers is the way to communicate the quality of the transmission you are receiving or sending. One (1) is the worst, or totally unreadable, and five (5) is the best, or very clear. The first number given represents the loudness of the communication, the second number represents the clarity. For instance, if a communication is loud, but garbled, it should be classified as a 5 by 3. When someone asks you "How do you copy", or "How do you read me", you should answer with the numbers that give the caller the best indication as to how they are transmitting. This is also the way our operators will communicate to you how you are transmitting when you call for radio checks, or if you are having trouble with a transmission. In cases of 1 X 1 or 2 X 2 transmission, you usually should try again later.

"SIGNALS ARE DOWN" means that for some or all of the reasons described in the first chapter, that radio transmission is lousy that day, forget about being understood.

PROCEEDURES FOR RADIO TRANSMISSION,OR HOW TO MAKE A RADIO CALL

The correct form for calling another station is "Call sign, this is Call Sign. (Such as, ABC 21 this is BCB 23.) This can be repeated three times over the air at 10 second intervals, and at that point, if you havn't received an answer, you must clear the air. You do this by saying, "Negative Contact, Call Sign Clear, or just Call Sign, Clear, (such as, Negative Contact, ABC 21, Clear, or ABC 21, Clear.)

If the station you are calling is monitering the radio, and wants to talk to you, they will answer you by saying Call sign, this is Call Sign, Go Ahead Please, (such as ABC 21, this is BCB 23, Go Ahead Please). At this point you can go on with your communication, say what you have to say, and clear the air.

You clear the air by saying Call Sign, Clear, (or ABC 21, Clear,) and are answered by the other call sign saying Their Call sign, Clear, (or BCB 23, Clear.) Always remember to use YOUR ENTIRE CALL SIGN, AND NOT JUST A PORTION OF IT. Using just your letters, as some people have been known to do will get you a violation letter from the FCC really fast.

If you need to interrupt a communication that is in progress for some reason, such as to find a number or get something you need, do so by saying Called Call Sign, Stand By. (For instance, if your call sign is ABC 21, and you were talking to BCB 23, you should say BCB 23, Stand By, and BCB 23 should answer by saying BCB 23, Standing By). After a stand by, you must re-call the station you were talking to in the same manner that you would use to call a new station.

Remember to use both of the call signs in thier entirity.

Other stations are allowed to broadcast while a station is on stand by, so if you return and find the air waves in use, just wait till the station transmitting has cleared, then continue your transmission.

WHAT IS AN EMERGENCY, AND WHAT TO DO

This is a difficult chapter to write, because in most emergency cases your own judgement is what determines the action to take. I'll try to define a true emergency, and to explain what the normal procedures are. You have to take it from there.

According to the FCC, a true emergency is "a situation that imminently endangers the safety of life and/or property". This rather broad definition covers aircraft that are lost, missing, crashed or in trouble, boats lost, missing or in trouble, lost or missing persons, crimes, or medical emergencies such as heart attack, burns, excessive bleeding, appendicitus, broken bones, athasma attacks, and so on.

A person that is already dead is not an emergency. They feel, and rightly so, that there is nothing more that can be done for them.

The FCC frowns on people that use an "emergency" signal to get through when it is not really a bona-fied emergengy. A wife, husband or girl friend that is not home at 11 o'clock when someone trys to reach him or her is <u>not</u> an emergency. Neither is a hunter or fisherman that is weathered in out in the bush and needs to call his office and cancel a business meeting on Monday morning.

A crime is defined as some nut shooting up the streets of Kotzebue, or someone holding hostages, or things of that type.

There are some terms to use on the air when an emergency situation is taking place. The use of these terms will cease

any radio transmission that is going on at the moment, so that the emergency can be broadcasted, and resolved. These terms are as follows:

Distress Signal MAYDAY

MAYDAY is the most familliar emergency term to us all because of all those 1940's war movies. The FCC definition of a MAYDAY communication is that it is to be used only in cases where there is immediate danger of loss of life and/or property. MAYDAY takes priority over all other communications.

Urgency Signal PAN

PAN is used when the safety of life and /or property is in jeopardy. PAN takes priority over all communications except MAYDAY.

Safety Signal SECURITY

SECURITY is used mainly by the coast guard for messages concerning the safety of navigation or giving metorological bulletins and warnings.

The proceedure to follow is to clear the air, and stay off, unless you can provide additional and helpful information, or if you can pass along an unclear transmission. This includes things such as sightings of the plane or boat in question and the location, or as I said, relaying an unclear transmission. If you can't help, keep quiet.

When the emergency has been resolved, that is, some action taken, communications will begin again.

The people that will help you in emergency situations are the Search and Rescue People, The State Police, Flight Service, and in some cases the Coast Guard. You should try to have the numbers of these agencies posted near your radio in case of a problem. All of the Agencies work closely together in emergency situations and if you should call the wrong one to help you with your problem they will set you aright very quickly. They are very efficient, and have solved alot of problems in the past with remarkable speed and dexterity. These people know what they are doing. Give them all the information you have, and let them do thier work. If there is anything that can possibly be done they will do it.

Once again, DO NOT USE "EMERGENCY" FOR ANYTHING BUT A BONA-FIED EMERGENCY AND ABOVE ALL.....

DON'T PANIC !!!!!

SOME FCC RULES AND REGULATIONS

Here is a VERY brief summary of the things you need to know to prevent getting in trouble with the FCC. They DO moniter the airwaves, and the DO send out notices of violations and fines. PAY ATTENTION !!!

There are several frequencies available for use in Alaska. The most common are 3201, 5167.5, 8070, 3449, 5472, and a bunch of them for boats. Our OWN frequency is 5134.5/5370. All of these have special licensing and useage rules applicable, and to cover it all would (DOES) fill a LARGE book. I'll cover the most important ones here. 3201, 5167.5 and 8070 are the frequencies used for public communication. They are open to everyone, and the restrictions (briefly) are as follows:

1. 3201 may be used at any time, and at any distance.

2. 5167.5 may only be used between the hours of 6:00AM and 9:00PM (2100 hours), and only with distances of 50 miles between transmitter and receiver.

3. 8070 is only useable for the same hours, and only at distances of 200 Miles between users.

4. Calls should be kept to 6 minutes, and not more than 5 a day. This is not a commonly enforced rule, but if someone abuses the air, we will all have problems.

5. "Superflouos and Frivilous" conversation is not allowed.

6. Obscene Language is not permitted.

7. You may NOT speak to boats or planes on the above noted frequencies unless there is an emergency

8. During Daylight Savings Time Months the hours of useage change to 7:00 AM to 10:00 PM.

3449 and 5472 are the aeronautical enroute frequencies. These are used to talk to planes, but only from the ground. You may not talk from plane to plane on these frequencies. You also may not talk from one station to another on the ground on these frequencies.

The marine frequencies are too numerous to mention. You may not talk to boats at all over any of the above mentioned frequencies. If you need to talk to a boat, you have to patch a phone call to a marine operator, and let her handle it.

Most Alaska call signs have three letters and two numbers. Some Government issued call signs have three letters and three numbers, but there aren't too many of these. Planes have some numbers (no specific format) and 1 letter, preceeded by "N". Planes use the number on the tail as a call sign. Boats are not uniform, but usually have three letters and four numbers. This as sometimes how you can tell who you are talking to and who NOT to talk to. I know this is rather vague, but it's the best we can do.

Our frequency is 5134.5/5370, and according to the FCC it is now illegal to make phone patches on 5167 or the others. This is why we have our own. This will be for phone calls only.

The FCC really yells if your radio is not operating on frequency. Be sure to have your radio checked once a year for this.

You are supposed to keep a log of all calls including the

Time, Date, Frequency Used, Your Call Sign , Thier Call Sign, and approximate content of the conversation. You also need to have a FCC license (personal), which we can give you a form for, and station license, which should be posted near the radio at all times.

If you should get a violation from the FCC, it usually needs answering in writing within 10 days. Failure to do so results in losses of license, fines and thunderbolts.

As I said before, this is VERY brief, but I think you get the idea. If you have any problems, call us and we'll help you straighten it out if we can.

According to the FCC. you should also have a copy of the FCC Rules and Regulations, Part 81, near the radio, and a copy of FCC Form 1079 attached to your lisence. You can obtain the FCC part 81 from the FCC, Form 1079 you can get from us if you need one.

HOW TO CONTACT US VIA PHONE OR RADIO, HELPFUL HINTS AND ASSOCIATED SERVICES WE OFFER, AND HOURS OF OPERATION

Trident has two telephone lines into the radio room. One is a message line only, the other is the phone patch line. The message line is for the times that people may want a call sign to get a message, but do not need to talk to anyone at the call sign directly. The operator will take the message and deliver it to the call sign as soon as contact with the call sign is made. The other line is the phone patch line, and should be called when someone desires to contact a call sign directly. Our customers should try to make sure that all the people that will be trying to contact them at thier call signs have the correct call sign, and the name of the camp, such as ABC 21, Lake Lovely. This will expidite service and make everyone involved more popular with our operators. Our customers should also try to make the people who might be calling them aware that the radio is not the same as a telephone, and if the call sign at camp is not monitoring the frequency, they can't be reached, and the operator can do nothing except take a message. This is difficult for many people to understand, especially if they have never heard of a Single Side Band Radio.

Our two telephone numbers are as follows:

Message Phone 907-345-1140
Patch Phone 907-345-1160

We also have a business office phone. It is in a different building and cannot be used for messages or phone patches. This is the place to call for information, prices, repairs,

and questions about your bills and/or service. This number is as follows:

Business Office 907-345-1170

The way to call TRIDENT over the air is WKD 22, Anchorage. This is our call sign. Just follow the instructions on manual pages 17 & 18, using this call sign and your own, and we will answer you!

SOME HELPFUL HINTS ON GETTING ALONG WITH OUR OPERATORS

I'll try to give you some helpful tips on protocol within our organization and how to save yourself and your callers some time and money. Most of this information is meant to be directed at people calling on the phone, and we encourage our customers to pass it along to the people who will be calling them. Try to remember that our operators are trained to give the radio first priority over the phones. If someone calls and there is a radio transmission taking place, they will be asked to hold. Often they will be left holding while the operator takes information from several different call signs on the air. He or she is not picking on the caller - they are following instructions. Please explain this to your callers.

Our operators are instructed to inquire if the caller is calling long distance. Unfortunately they sometimes forget, and if you could spend an hour or so in the radio room on a busy day you would understand why. If someone is calling long distance I suggest that you tell them to inform the operator of that fact quickly, and then to tell him or her which call sign they are trying to contact, and leave a

number where they can be reached so that he or she can get back to them when their turn comes up. This is much cheaper and less frustrating than holding on a long distance line.

Another thing to remember is that you share air space with the entire State of Alaska. Only one communication can take place at a time on any frequency....sort of like your phone....when it's busy nobody else can get through. The problem is that there aren't nearly as many available frequencies as phone lines, so while several thousand people can call into Anchorage at the same time by phone, only a few can use the radio frequencies that exsist. There is often a wait during the summer months for communications to go through. Not only does the operator have to answer the radio calls and telephone calls, he or she has to take messages, deliver messages, make phone calls, keep a log and keep it all straight besides. While the operators are doing this juggling act, they are often keeping track of 10 or 15 calls waiting ahead of yours, so try to be patient and tell your callers to do the same. A 45 minute wait for communications is not uncommon during the summer months. Just keep cool.

Another thing that is helpful to our operators is for the people calling in on the radio to have the phone numbers that they wish to call. The operators have thier hands full with the phones and the radio....they will look up a number for you, or assist you in any way they can, but try to be considerate of their time.

We get a lot of good feedback and compliments on most of our operators most of the time. We feel that they all do a good and necessary job, but even they have bad days and

once in a while they make a mistake. If you have a complaint or problem we can't help you if we don't know about it. Please let us know immediately if you encounter any difficulties with our service. On thing we DO ask is that you make your complaints known to Jack or Virginia by land line or by mail....not on the air, and please discuss complaints with us and not our operators. This saves lots of confusion. I assure you that we will do whatever we can to solve any difficulties that come up. Virginia hand opens all the mail... all you have to do is jot a note on your monthly statement and when we get your payment, she will see it, and reply.

Speaking of billing, we bill on the 15th of the previous month for our monthly services. In other words, you will be billed on the 15th of July for August's phone patch service, and we bill twice a month, on the 1st and 15th for any repairs done to your radio during that period. All of our billing is due within 30 days. Following this chapter is a short, rough summary on our charges, and what they mean. We also ask that you supply us with a credit card number or a third party billing number so we can charge any long distance charges to it. In the event that there is a mistake made and a long distance call is charged to our phone, it will be passed on to you on your monthly statement labeled LD CHGS.

We hold the customer responsible for informing us when they wish to interrupt their service, and will continue to charge our monthly service charges as agreed upon until we are notified differently.

Associated Services

Trident offers a complete line of communications materials

and services. We sell, service, install and in some cases manufacture, as well as offer consulting and engineering services. If you have any communications problems or questions, call us. If we can't help you solve it ourselves, we probably will know who else will be able to help.

HOURS OF OPERATION

Our hours of operation are as follows:

6 AM through 12 Midnight, Seven Days A Week

Thanksgiving and Christmas day are the only days of the year that we are closed completely so that our employees may spend these holidays with their families. On these two days we close at 9 PM the night before, and re-open at 7 AM the day after.

I hope we have covered most of the questions that you have, and most of the information that you need to operate a radio in the bush. If there is anything we forgot or failed to cover, or any additional questions that you may have, please don't hesitate to contact us here at Trident. It is our wish that you enjoy the best communications services possible and we try to ensure that for all our customers.

APPENDIX 9

ADULT ANADROMOUS FISHERIES STUDIES

First Aid
and
Safety

In Alaska. . .

Think before you drink

It's called 'backpacker's disease,' 'beaver fever,' or giardiasis, and each year an increasing number of wilderness travelers suffer from its unpleasant symptoms. Before you quench your thirst from a clear Alaska stream, consider the following information about the *Giardia lamblia* parasite -- and how to avoid it.

What is giardiasis?

Giardia lamblia is found worldwide and is the most commonly reported human intestinal parasite in the United States. Although the cyst can be transmitted on food and from person to person, its most frequent transmission is through surface water that is either untreated or inadequately treated. In treated water, either inadequate chlorination or defective filters or both have been responsible for large outbreaks of the disease nationwide.

What are the symptoms?

Abdominal bloating, cramps, excessive gas, diarrhea and a vague feeling of physical discomfort are typical. The incubation period after ingesting the cysts is one to four weeks with an average of 10 to 14 days.

If you have any combination of the above symptoms, especially if they continue longer than seven days, you should consult your physician and mention the possibility of giardiasis so that appropriate tests can be done. Diagnosis is confirmed by stool examination.

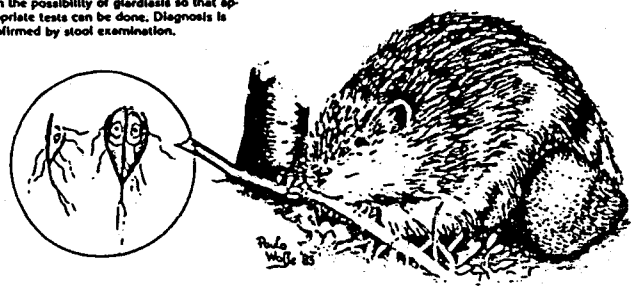
How do you contract the disease?

Follow-up on many cases in southcentral Alaska revealed that the victims had consumed untreated surface water, usually on camping or fishing trips.

The parasite is carried by all mammals, including humans and wild and domestic animals. Beavers seem particularly susceptible to *Giardia* infections and carry large numbers of cysts in their intestines. The feces of carrier animals contain cysts which live outside the host. The cysts reach water drainage systems either by direct deposits into water, as in the case with beavers, or indirectly by rain and runoff.

Giardiasis is usually passed between humans as a result of poor sanitary practices. Young children who become infected may reinfect themselves or others. Typically a child may neglect to wash their hands after a bowel movement. Later their fingers reach their mouths while eating or playing, reintroducing the cysts into their intestines.

Those who handle babies and change diapers, such as day care workers, must also be cautious about washing their hands to avoid passing cysts to others.



Treatment

Treatment for humans involves use of properly prescribed drugs for seven to ten days. The drugs may produce side effects, and care must be observed in their use by pregnant women and possibly others. Treatment should be prescribed by a doctor.

There is a catch to the treatment of this unpleasant disease. From 85% to 90% of patients are cured with one course of medication. The 10% to 15% who are not must take a second course of treatment.

Whenever possible, people in the out-of-doors should carry drinking water of known purity with them. When this is not practical, and water from streams, lakes, ponds, and other outdoor sources must be used, time should be taken to disinfect the water before drinking it.

Boiling

Except for municipal water treatment methods that include adequate filtration, boiling is the only technique that can be recommended with complete confidence for eliminating *Giardia* in water. Boiling for one minute is adequate to kill *Giardia*. If other upstream contamination is suspected (from places of human habitation, sewage outfalls, etc.), the water should be boiled for 20 minutes.

Chlorine or Iodine disinfection

Although boiling is the most reliable method of disinfection, it is recognized that boiling drinking water is not practical under many circumstances. Therefore, when one cannot boil water, chemical disinfectants such as iodine or chlorine should be used. This will provide a large degree of protection against *Giardia* and will destroy most bacteria and viruses that cause illness.

The effectiveness of chlorine and iodine against *Giardia* has been studied by researchers at the University of Oregon. They have shown that chlorine and iodine can be effective against *Giardia* cysts under certain circumstances. The effectiveness decreases as water gets colder. Cloudy or turbid water also decreases the effectiveness of chlorine and iodine. To counteract these effects, the contact time (holding time) after the disinfectant is added should be increased.

Below are instructions for disinfecting water using household tincture of iodine or chlorine bleach. If water is visibly dirty, it should first be strained through a clean cloth into a container to remove any sediment or floating matter. Then the water should be treated as follows:

Chlorine

Household liquid chlorine bleach (Clorox, Purex, etc.) usually has 4% to 5% available chlorine. Read the label to find the percentage of chlorine in the solution. Chlorine tablets (Halazone) are also available at many drug stores.

Mix thoroughly by stirring or shaking water in container and let stand for 30 minutes. For chlorine tablets, contact time begins after tablets have dissolved. Be sure screw cap threads of your water container receive disinfected water for the appropriate contact time. The water should have a slight chlorine odor after standing. If not, repeat the doseage and let stand for an additional 30 minutes before using.

% Chlorine	Amount per quart (1 drop = 0.05 ml)	Contact Time
1	20 drops	30 min.
4-6 (Household bleach)	4 drops	
7-10	2 drops	
Unknown	20 drops	
Halazone	5 tablets	

Note: Very cold or turbid water will require prolonged contact time. Let it stand up to several hours or even overnight.

Iodine

Tincture of iodine from the medicine chest or first aid kit can be used to treat water. Iodine disinfecting tablets are also available. Mix thoroughly by stirring or shaking water in container and let stand for 30 minutes. For iodine tablets, contact time begins after tablets have dissolved. Be sure screw cap threads of your water container receive disinfected water for the appropriate contact time.

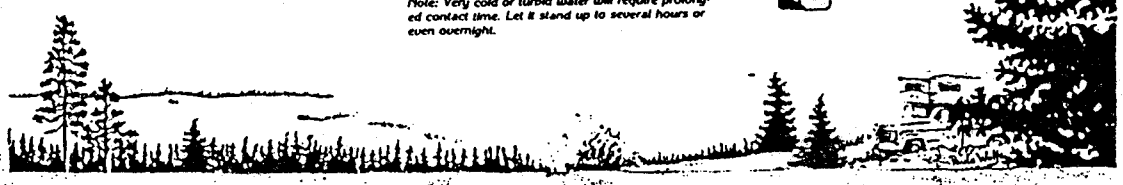
	Amount per quart (1 drop = 0.05 ml)	Contact Time
Tincture of iodine (2%)	10 drops	30 min.
Iodine tablets (Globaline, Potable aqua, Coughlans, etc.)	2 tablets	

Note: Very cold or turbid water will require prolonged contact time. Let stand up to several hours or overnight.

Water filters

Portable filtration devices which are effective against *Giardia* are those with pore sizes less than five micrometers (one micrometer is one millionth of a meter). Water pressure will be required to use filters with pore openings of this size. Water filters containing resins or activated carbon granules without microfilters with pore sizes less than five micrometers will probably not filter out *Giardia* cysts.

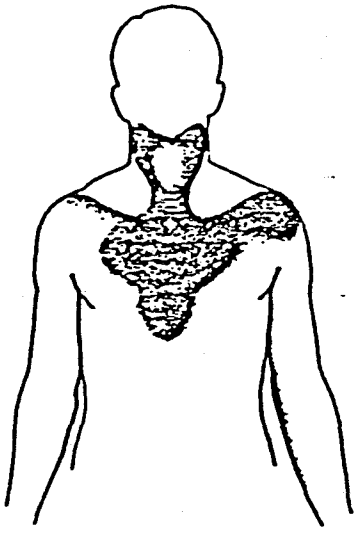
Alaska Department of Environmental Conservation
Pouch O,
Juneau, Alaska 99811



CPR

In Basic Life Support

For Cardiac Arrest



The most common signal of a heart attack is:

- uncomfortable pressure, squeezing, fullness or pain in the center of the chest behind the breastbone.

Other signals may be:

- sweating
- nausea
- shortness of breath, or
- a feeling of weakness

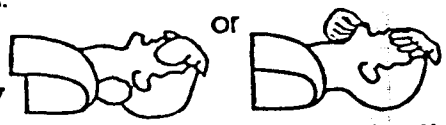
Sometimes these signals subside and return.

After you have completed the training course in cardiopulmonary resuscitation (CPR), you will want to keep this leaflet as a review of what you have learned until you take your next refresher course.

There are many causes of sudden death: poisoning, drowning, suffocation, choking, electrocution and smoke inhalation. But the most common cause is heart attack. Everyone should know the usual early signals of heart attack and have an emergency plan of action.

Basic CPR is a simple procedure, as simple as A-B-C, Airway, Breathing and Circulation.

Airway



If you find a collapsed person, determine if victim is conscious by shaking the shoulder and shouting "Are you all right?" If no response, shout for help. Then open the airway. If victim is not lying flat on his back, roll victim over, moving the entire body at one time as a total unit.

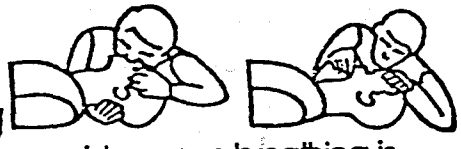
To open the victim's airway, lift up the neck (or chin) gently with one hand while pushing down on the forehead with the other to tilt head back. Once the airway is open, place your ear close to the victim's mouth:

- Look—at the chest and stomach for movement.
- Listen—for sounds of breathing.
- Feel—for breath on your cheek.

If none of these signs is present, victim is not breathing.

If opening the airway does not cause the victim to begin to breathe spontaneously, you must provide rescue breathing.

Breathing



The best way to provide rescue breathing is by using the mouth-to-mouth technique. Take your hand that is on the victim's forehead and turn it so that you can pinch the victim's nose shut while keeping the heel of the hand in place to maintain head tilt. Your other hand should remain under the victim's neck (or chin), lifting up.

Immediately give four quick, full breaths in rapid succession using the mouth-to-mouth method.

Check Pulse

After giving the four quick breaths, locate the victim's carotid pulse to see if the heart is beating. To find the carotid artery, take your hand that is under the victim's neck and locate the voice box. Slide the tips of your index and middle fingers into the groove beside the voice box. Feel for the pulse. Cardiac arrest can be recognized by absent breathing and an absent pulse in the carotid artery in the neck.

If you cannot find the pulse, you must provide artificial circulation in addition to rescue breathing.

Activate The Emergency Medical Services System (EMSS) Send someone to call 911 or Your Local Emergency Number

Cardiac Compression

Artificial circulation is provided by external cardiac compression. In effect, when you apply rhythmic pressure on the lower half of the victim's breastbone, you are forcing his heart to pump blood. To perform external cardiac compression properly, kneel at the victim's side near his chest. Locate the notch at the lowest portion of the sternum. Place the heel of one hand on the sternum 1½ to 2 inches above the notch. Place your other hand on top of the one that is in position. Be sure to keep your fingers off the chest wall. You may find it easier to do this if you interlock your fingers.

Bring your shoulders directly over the victim's sternum as you compress downward, keeping your arms straight. Depress the sternum about 1½ to 2 inches for an adult victim. Then relax pressure on the sternum completely. However, do not remove your hands from the victim's sternum, but do allow the chest to return to its normal position between compressions. Relaxation and compression should be of equal duration.

If you are the only rescuer, you must provide both rescue breathing and cardiac compression. The proper ratio is 15 chest compressions to 2 quick breaths. You must compress at the rate of 80 times per minute when you are working alone since you will stop compressions when you take time to breathe.

When there is another rescuer to help you, position yourselves on opposite sides of the victim if possible. One of you should be responsible for interposing a breath during the relaxation after each fifth compression. The other rescuer, who compresses the chest, should use a rate of 60 compressions per minute.

RESCUERS	RATIO OF COMPRESSIONS TO BREATHS	RATE OF COMPRESSIONS
ONE	15:2	80 times/min.
TWO	5:1	60 times/min.

For Infants and Small Children

Basic life support for infants and small children is similar to that for adults. A few important differences to remember are given below.

Airway

Be careful when handling an infant that you do not exaggerate the backward position of the head tilt. An infant's neck is so pliable that forceful backward tilting might block breathing passages instead of opening them.

Breathing

Don't try to pinch off the nose. Cover both the mouth and nose of an infant or small child who is not breathing. Use small breaths with less volume to inflate the lungs. Give one small breath every three seconds.

Check Pulse

The absence of a pulse may be more easily determined by feeling over the left nipple.

Circulation

The technique for cardiac compression is different for infants and small children. In both cases, only one hand is used for compression. The other hand may be slipped under the child to provide a firm support for his back.

For infants, use only the **tips** of the index and middle fingers to compress the chest at mid-sternum. Depress the sternum between ½ to ¾ inch at a fast rate of 80 to 100 times a minute.

For small children, use only the **heel** of one hand to compress the chest. Depress the sternum between ¾ and 1½ inches, depending upon the size of the child. The rate should be 80 to 100 times per minute.

In the case of both infants and small children, breaths should be administered during the relaxation after every fifth chest compression.

	Part of Hand	Hand Position	Depress Sternum	Rate of Compression
INFANTS	tips of index and middle fingers	mid-sternum	½ to ¾ inch	80 to 100 per minute
CHILDREN	heel of hand	mid-sternum	¾ to 1½ inches	80 to 100 per minute

Neck Injury

If you suspect the victim has suffered a neck injury, you must not open the airway in the usual manner. If the victim is injured in a diving or automobile accident, you should consider the possibility of such a neck injury. In these cases, the airway should be opened by using a modified jaw thrust, keeping the victim's head in a fixed, neutral position.

Choking

The urgency of choking cannot be over-emphasized. Immediate recognition and proper action are essential. If the victim has good air exchange, or only partial obstruction, and is still able to speak or cough effectively, do not interfere with his attempts to expel a foreign body.

When you recognize complete airway obstruction by observing the conscious victim's inability to speak, breathe or cough, the following sequence should be performed quickly on the victim in the sitting, standing or lying position:

a. 4 Back blows
b. 4 Manual thrusts (abdominal or chest)
c. Alternate back blows and manual thrusts until effective, or the person becomes unconscious

If the victim becomes unconscious, shout for help. Place him on his back, face up. Open the airway and attempt to ventilate. If unsuccessful, deliver 4 back blows, 4 manual thrusts, probe the mouth with the finger and attempt to ventilate. It may be necessary to repeat these steps. BE PERSISTENT.

Infants and Small Children

To dislodge an object in the airway of a child, turn him upside down over one arm and deliver blows between his shoulder blades.

Other Causes of Airway Obstruction

An adequate open airway must be maintained at all times in all unconscious patients.

Other conditions which may cause unconsciousness and airway obstruction include: stroke, epilepsy, head injury, alcoholic intoxication, drug overdose, diabetes.

REMEMBER

1. Is the victim unconscious?
2. If so, shout for help, open the airway, and check for breathing
3. If no breathing, give 4 quick breaths
4. Check carotid pulse
5. Activate the EMSS: Send someone to call "911" or your local emergency number
6. If no pulse, begin external cardiac compression by depressing lower half of the sternum 1½ to 2 inches
7. Continue uninterrupted CPR until advanced life support is available

CPR for ONE RESCUER:	15:2 compressions to breaths at a rate of 80 compressions a minute (4 cycles per minute)
CPR for TWO RESCUERS:	5:1 compressions to breaths at a rate of 60 compressions a minute

Periodic practice in CPR is essential to insure satisfactory level of proficiency. A life may depend upon how well you have remembered the proper steps of CPR and how to apply them. You should be sure to have tested both your skill and knowledge of CPR at least once a year. It could mean someone's life.

Emergency Medical Services System (EMSS)

Any victim on whom you begin resuscitation must be considered to need advanced life support. He or she will have the best chance of surviving if your community has a total emergency medical services system. This includes an efficient communications alert system, such as 911, with public awareness of how or where to call; well trained rescue personnel who can respond rapidly; vehicles that are properly equipped; an emergency facility that is open 24 hours a day to provide advanced life support; and an intensive care section in the hospital for the victims. You should work with all interested agencies to achieve such a system.

Signals and Actions For Survival

Know the signals: an uncomfortable pressure, squeezing, fullness or pain in the center of the chest, behind the breastbone, which may spread to the shoulder, neck or arms (the pain may not be severe); other signals may include sweating, nausea, shortness of breath and a feeling of weakness.

1. Recognize the "signals",
2. Stop activity and sit or lie down,
3. If signals persist, call your local EMSS number, or if not available, go to the nearest hospital emergency room which provides emergency cardiac care.

To activate your EMSS, call _____.

Nearest Emergency Department:

_____

American Heart Association
National Center • 7320 Greenville Avenue • Dallas, Texas 75231
70-023C
11-77-WM

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF FISH AND GAME

Su Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

June 9, 1982

Lt. Col. Jack G. Sautter
Commanding Officer
AAC/RCC Elmendorf Airforce Base
Anchorage, Alaska 99506

Sir:

Several weeks ago I contacted members of your command regarding assistance and information that we may provide in the event personnel deployed along the Susitna River by the Alaska Department of Fish and Game Aquatic Study Team would need your rescue services. Your subordinates suggested we provide your team with detailed maps showing the locations of our camps and the possible helicopter landing sites along with other information such as radio frequencies and the names and telephone numbers of Anchorage based persons that could act as guides on short notice.

The maps which accompany this letter indicate the locations of camps and nearby potential helicopter landing sites. Radio frequencies monitored through "Trident Communications", a commercial company, are 5167.5 and 3201 mHz. Communication through the Fish and Game reserved frequency of 3230 mHz is also possible. Each camp is equipped with a single sideband radio.

Anchorage based persons that could act as guides are:

Tom Trent	344-6187
Bruce Barrett	349-7138
Susan Wick	276-4508

Each of our camps are equipped with aerial flares to guide pilots to landing sites in darkness or marginal light conditions.

If you office could provide us with a reference number to draw attention to these maps it may save time in the event of emergency.

I am hopeful that we will not require your services but want to be prepared in the event we do.

Sincerely,

Larry Bartlett

Larry Bartlett
Assistant Aquatic Studies Coordinator

cc: T. Trent
S. Wick

MEMORANDUM State of Alaska

TO: All AH Crew Leaders

DATE: July 26, 1982

FILE NO: 03-82-7.10-3.0

TELEPHONE NO: 274-7583

FROM: Christopher Estes
Aquatic Habitat and Instream Flow
Project Leader

SUBJECT: Health and Welfare of Crew Members

It is your responsibility to insure that your crew members are fully aware of health and safety practices (e.g. boiling water to prevent dysentary and kill giardia, what to do in a emergency, where first aid kits and fire extinguishers etc. are located, washing hands before preparing meals, etc.). More often than not, these obvious practices are ignored. With camps as large as they are, neglect of health practices can have serious ramifications if several employees were to become ill at the same time.

On the same topic, you are all required to maintain a current copy of the Su Hydro Staff Telephone numbers at your home, including the radio call numbers for each field camp. Additionally, a copy of staff and other emergency telephone numbers should be posted next to the Trident Radio at each camp.

There can be no excuse for neglecting to implement these practices.

cc: T. Trent
L. Bartlett

USAF Rescue Coordination Center

Emergency numbers: 752-3437
277-2131
552-2426

LT. Col. Sautter said on 7-29-82:

"There is no file or identifing number assigned to the ADF&G file. However, all personnel have been made aware of it and will know who you are and where to find it should ADF&G/SuHydro people call for Rescue services."