Workshop #5 - Water Quality

I. Introduction

II. Pre-project Susitna River Water Quality

- A. Drainage Basin Morphology
- B. Physical and Chemical Characteristics of the Susitna
- C. Inorganic Entities
- D. Organic Entities
- E. Metals, Pesticides
- F. Miscellaneous
- G. Gas Supersaturation

DISCUSSION

III. Dam Designs and Operations

- A. Watana Dam
  - 1. Basic Design
    - a. Hydraulic Features
    - b. Hydraulic Operations
  - 2. Mid-level Outlet Works
    - a. Detailed Design
    - b. Detailed Operation
- B. Devil Canyon Dam
  - 1. Basic Design
    - a. Hydraulic Features
    - b. Hydraulic Operations
  - 2. Mid-level Outlet Works
    - a. Detailed Design
    - b. Detailed Operations
- C. Avoidance of Gas Supersaturation by Mechanical Designs and Discharge Operations
  - 1. Annual Hydrographs
  - 2. Spilling Discharges

C (continued)

3. Floods - Handled Without Spillways for up to 1 in 50 year flood event

DISCUSSION

IV. Limnological Characteristics of Reservoir

A. Morphological and Hydrological Features of Reservoirs

1. Watana

2. Devil Canyon

B. Reservoir Valley

C. Riverine Inflow

1. Overflow,Underflows and Interflows

2. Photographic Examples

D. Key Limnological Factors Contributing to Reservoir Water Quality

E. Some Estimated Limnological Characteristics and Trophic Status of reservoirs

F. Comparison to Other Glacial Lakes of South Central Alaska

G. Brief Discussion of Potential for Reservoir Fishery

DISCUSSION

Lunch Break - 1 hr. 15 min.

1:30 P.M.

V. Estimated Trends in Downstream Water Quality With-project vs. Pre-project.

A. Estimated Changes in Downstream Nutrients and Primary Productivity

1. Factors Affecting Primary Productivity

2. Summary of Expectations

DISCUSSION

B. Estimated Changes in Total Suspended Sediments and Turbidity

1. Pre - project TSS and Turbidity in Susitna River

2. Eklutna Lake Studies

3. Current Estimates for With - project TSS

4. Future Study Efforts Planned to Refine Estimates of TSS and Turbidity

5. Minerology of TSS in Glacial Lakes

6. Preliminary Estimates of Turbidity vs. TSS Relationships

7. Preliminary Estimates of Turbidity vs. Euphotic Zone Depth

8. Preliminary Estimates of Fisheries vs. Chronic Exposure to Glacial Flour

DISCUSSION

C. Estimated Potential for Project-induced Mercury Bioaccumulation

1. Chemistry

2. Bioaccumulation Mechanism

3. Summary of Expectations for Susitna

4. Future Plans for Study

DISCUSSION

VI. Brief Discussion of Coordination with State and Federal Agencies

1. Permits Required

2. Best Practices Management Manuals

DISCUSSION

VII. "Open Forum": Question and Answer Session on Water Quality Topics

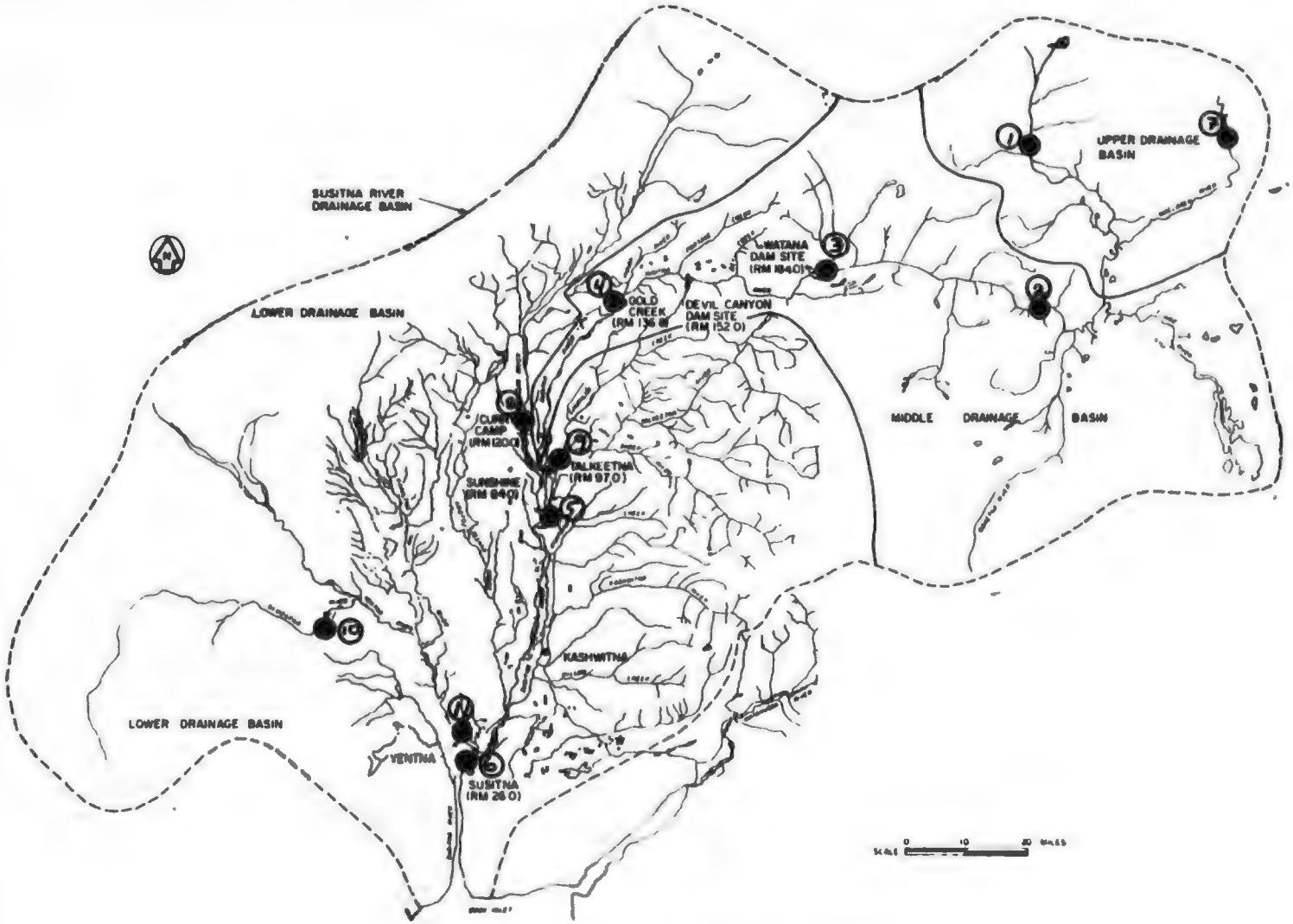
TABLE E.2.2: PERIODS OF RECORD FOR GAGING STATIONS

Station Name	USGS Gage Number	Susitna River Mile	Drainage Area (mi^2)	Periods of Record		Agency
				Streamflow (Continuous)[1]	Water Quality[2]	
Susitna River nr. Denali	15291000	290.8	950	5/57-9/66, 11/68-Present	1957-66, 1968-69, 1974-Present (6/30/82)	USGS
Susitna River nr. Cantwell (Vee Canyon)	15291500	223.1	4,140	5/61-9/72, 5/80-Present	1962-72, 1980-Present(7/27/82)	USGS
Susitna River nr. Cantwell (Vee Canyon)	-	223.1	4,140	-	1980-81	R&M Consult.
Susitna River nr. Watana Damsite	-	182.2[3]	5,180	6/80-Present	10/80-12/81	R&M Consult.
Susitna River at Gold Creek	15292000	136.6	6,160	8/49-Present	1949-58, 1962, 1967-68, 1974-Present (9/16/82)	USGS
Susitna River at Gold Creek	-	136.6	6,160	-	1980-Present(10/14/82)	R&M
Susitna River at Sunshine	15292780	83.9	11,100	5/81-Present	1971, 1975, 1977, 1981-Present (10/13/82)	
Susitna River at Susitna Station	15294350	25.8	19,400	10/74-Present	1955, 1970, 1975-Present(10/5/82)	USGS
Maclaren River nr. Paxson	15291200	259.8[4]	280	6/58-Present	1958-61, 1967-68, 1975	USGS
Chulitna River nr. Talkeetna	15292400	98.0[4]	2,570	2/58-9/72, 5/80-Present	1958-59, 1967-72, 1980-Present (6/3/82)	USGS
Talkeetna River nr. Talkeetna	15291500	97.0[4]	2,006	6/64-Present	1954, 1966-Present(10/14/82)	USGS
Skwentna River nr. Skwentna	15294300	28.0[5]	2,250	10/59-Present	1959, 1961, 1967-68, 1974-75, 1980-81	USGS
Yentna River nr. Susitna Station	15294345	28.0[4]	6,180	10/80-Present	1981-Present (8/11/82)	USGS

Notes:

1. All streamflow gage stations are currently active, however, flow data included in this document is through September 1981.
2. "Present" in periods of record indicates station is active as of January 1983. A date after "Present" indicates the most recent data available.
3. Watana continuous water quality monitor was installed at river mile 183.0.
4. River mile at tributary's confluence with Susitna River.
5. River mile at Yentna-Susitna confluence.

Source: USGS and R&M



SUSITNA RIVER DRAINAGE BASIN

FIGURE 1.1-1

TABLE E,2,16. DETECTION LIMITS AND CRITERIA FOR WATER QUALITY PARAMETERS

Parameters[1]	R&M Detection Limit	USGS Detection Limit[4]	Criteria Levels
Temperature, °C	0.1	--	20,15(M),13(Sp)
Total Suspended Sediments[2]	1	1	no measurable increase
Turbidity (NTU)	0.05	1	25 NTU increase
Dissolved Oxygen	0.1	--	7 and 17
D.O. Percent Saturation	1	--	110
Nitrate Nitrogen	0.1	0.01	10
Total Phosphorus	0.01	0.01	0.01
Ortho-Phosphate	0.01	0.01	--
Total Dissolved Solids[3]	1	1	1,500
Conductivity, umhos/cm @ 25°C	1	--	--
Significant Ions			
Sulfate	1	0.05	200
Chloride	0.2	0.01	200
Ca, Calcium	0.05	0.01	--
Mg, Magnesium	0.05	0.1	--
Na, Sodium	0.05	0.1	--
K, Potassium	0.05	0.1	--
Total Hardness	1	--	--
pH, pH Units	± 0.01	--	6.5 - 9.0
Total Alkalinity, as $CaCO_3$	2	--	20
Free Carbon Dioxide	1	--	--
Chemical Oxygen Demand	1	--	--
Total Organic Carbon	1.0	--	3.0 (S)
True Color, Platinum Cobalt Units	1	1	50
Metals			
Ag, Silver	0.05	0.001	0.05
Al, Aluminum	0.05	0.01	0.073 (S)
As, Arsenic	0.10	0.001	0.440
Au, Gold	0.05	--	--
B, Boron	0.05	0.01	0.043
Be, Berlum	0.05	0.1	1.0
Bi, Bismuth	0.05	--	0.0035 (S)
Cd, Cadmium	0.01	0.001	0.0012, 0.0004
Co, Cobalt	0.05	0.001	--
Cr, Chromium	0.05	0.001	0.1
Cu, Copper	0.05	0.001	0.01
Fe, Iron	0.05	0.01	1.0
Hg, Mercury	0.1	0.0001	0.00005
Mn, Manganese	0.05	0.001	0.05
Mo, Molybdenum	0.05	0.001	0.07
Ni, Nickel	0.05	0.001	0.025
Pb, Lead	0.05	0.001	0.03
Pt, Platinum	0.05	--	--
Sb, Antimony	0.10	0.001	9
Se, Selenium	0.10	0.001	0.01
Si, Silicon	0.05	--	--
Sn, Tin	0.10	0.1	--
Sr, Strontium	0.05	0.01	--
Ti, Titanium	0.05	--	--
W, Tungsten	1.0	--	--
V, Vanadium	0.05	--	0.007 (S)
Zn, Zinc	0.05	0.01	0.03
Zr, Zirconium	0.05	--	--
Organic Chemicals (ug/l)			
- Endrin	0.0002	0.00001	0.004
- Lindane	0.004	0.00001	0.01
- Methoxychlor	0.1	0.00001	0.03
- Toxaphene	0.005	0.001	0.013
- 2, 4-D	0.1	0.00001	100
- 2, 4, 5-TP Silvex	0.01	0.00001	10
Gross Alpha (Picocurie/liter)	3	--	15

TABLE E.2.16 (Cont'd)

Parameters[1]	RM Detection Limit	USGS Detection Limit[4]	Criteria Levels
Others			
Settleable Solids, ml/l	0.1	---	--
Ammonia Nitrogen	0.05	0.01	0.02
Organic Nitrogen	0.1	--	--
Kheldahl Nitrogen	0.1	0.1	--
Nitrite Nitrogen	0.01	0.01	--
Total Nitrogen	0.1	0.01	--
Total Inorganic Carbon	1.0	--	--

(1) All parameters and values are expressed in mg/l unless otherwise noted.

(2) TSS - (nonfilterable) material on a standard fiber filter after filtration of a well-mixed sample.

(3) TDS - (filterable) material that passes through a standard glass fiber filter and remains after evaporation.

(4) USGS detection limits are taken from "1982 Water Quality Laboratory Services Catalog" USGS Open-File Report 81-1016. The limits used are the limits for the most precise test available.

(M) - Migration Routes

(Sp) - Spawning Areas

(S) - Suggested Criteria

Source: USGS and RM

TABLE E.2.17: PARAMETERS EXCEEDING CRITERIA BY STATION AND SEASON

Parameter	Station	Season	Criteria
D.O. % Saturation	G	S	L
Phosphorus, Total (d)	V, G, T, S, SS	S, W, B	E
pH	T	S	L
	V, S	W	
	G, T	B	
Total Organic Carbon	G, SS	S	S
	V, G, SS	W	
	SS	B	
True Color	V, G, T, S	S	L
Aluminum (d)	V, G	S, W	S
Aluminum (t)	G, T, S	S	S
Bismuth (d)	V, G	S	S
	G	W	
Cadmium (d)	G, T, SS	S	E
Cadmium (t)	G, T, S, SS	S	E
	T, SS	W	
Copper (d)	SS	S	A
	T	W	
	T, SS	B	
Copper (t)	G, T, S, SS	S	A
	T, SS	W, B	
Iron (t)	G, T, S, SS	S	E
	T, SS	B	
Lead (t)	G, T, S, SS	S	A
	SS	B	
Manganese (d)	G,	S	E
Manganese (t)	G, T, S, SS	S	E
	T, SS	B	
Mercury (d)	G, T, S, SS	S	E
	T, S	W	
Mercury (t)	G, T, S, SS	S	E
	T, S, SS	W	
	T, SS	B	
Nickel (t)	G, S, SS	S	A
Zinc (d)	S	W	A
	T	B	
Zinc (t)	G, T, S, SS	S	A
	T, SS	W, B	

Notes:

Parameter
(d) dissolved
(t) total recoverable

Stations
D - Denali
V - Vee Canyon
G - Gold Creek
C - Chulitna
T - Talkeetna
S - Sunshine
SS - Susitna Station

Seasons
S - Summer
W - Winter
B - Breakup

Criteria
L - Established by law as per Alaska Water Quality Standards, 1979.
E - Established by law as per EPA Quality Criteria for Water, 1976.
S - Criteria that have been suggested but are not law, or levels which natural waters usually do not exceed.
A - Alternate level to 0.01 of the 96-hour LC_{50} determined through bioassay (EPA 1976).

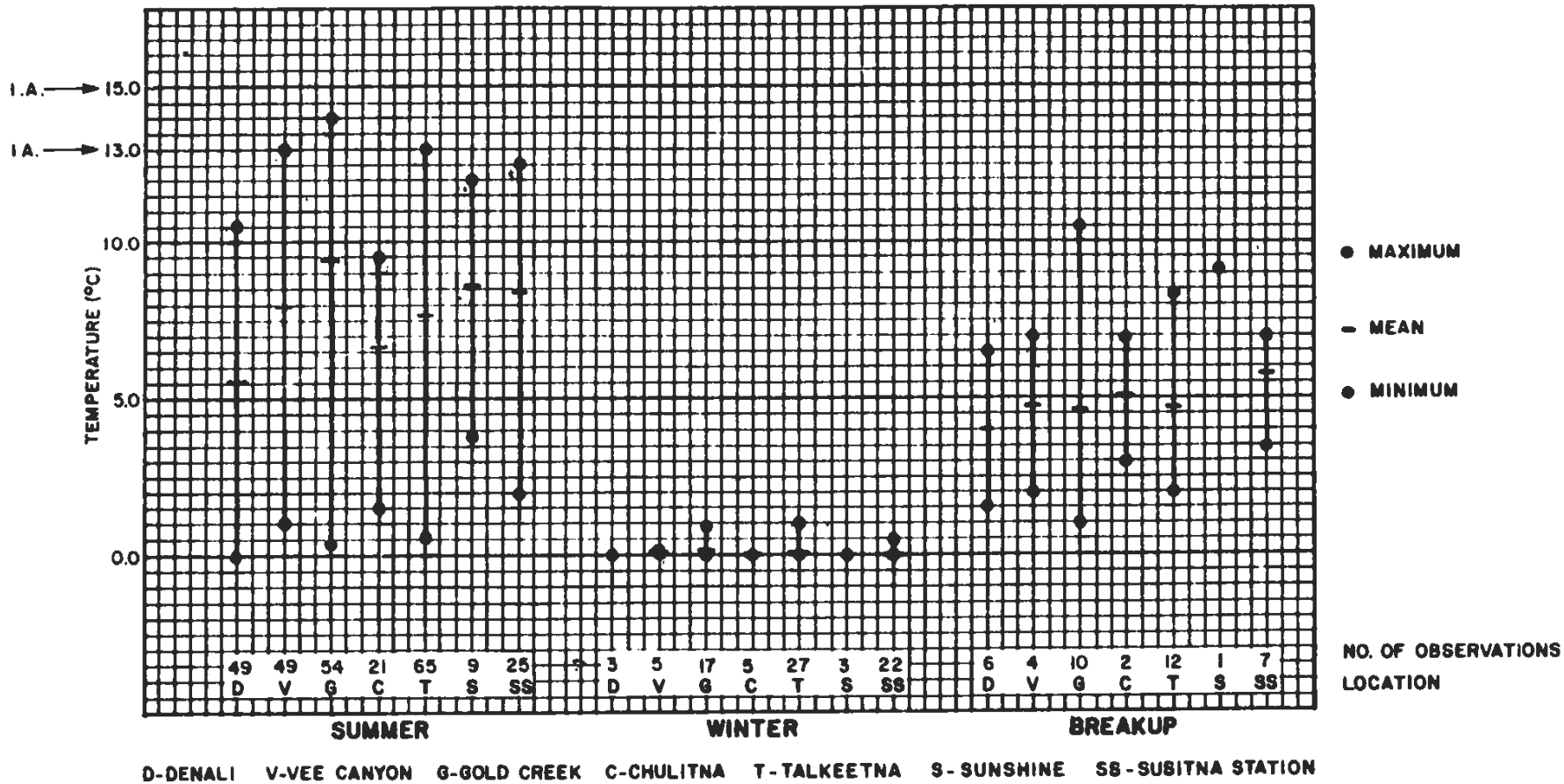
Source: USGS AND R&M

SEASON DEFINITIONS FOR WATER QUALITY SUMMARY

Breakup - from the time ice begins to break up until recession of spring runoff.

Summer - from the end of breakup until the water temperature drops to essentially 0° C in the fall.

Winter - from the end of summer until breakup begins.



NOTES:

I. A. CRITERIA: SHALL NOT EXCEED 20°C AT ANY TIME. THE FOLLOWING MAXIMUM TEMPERATURE SHALL NOT BE EXCEEDED WHERE APPLICABLE: MIGRATION ROUTES AND REARING AREAS--15°C, SPAWNING AREAS AND EGG AND FRY INCUBATION--13°C (ADEC, 1979).

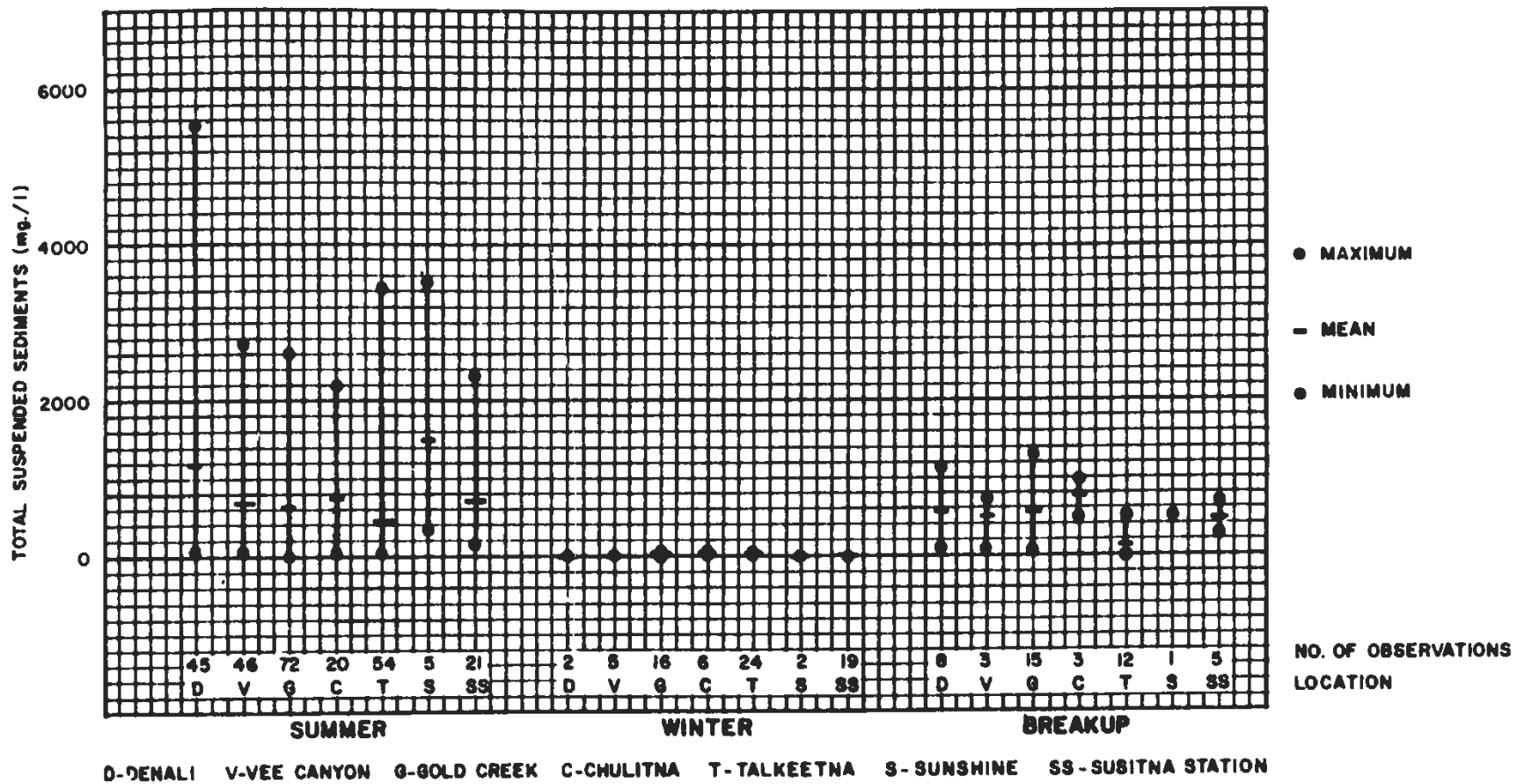
I. B. ESTABLISHED TO PROTECT SENSITIVE IMPORTANT FISH SPECIES, AND FOR THE SUCCESSFUL MIGRATION, SPAWNING, EGG-INCUBATION, FRY-REARING, AND OTHER REPRODUCTIVE FUNCTIONS OF IMPORTANT SPECIES.

2. MAXIMUM VALUES OF 12°C AT DENALI ON JUNE 4 AND 5, 1980; 15.0°C AT GOLD CREEK ON JULY 3 AND 4, 1979; AND 16.5°C AT SUSITNA STATION ON JULY 9, 1976 HAVE BEEN RECORDED BY USGS CONTINUOUS RECORDING EQUIPMENT, HOWEVER THESE WERE NOT INCLUDED IN THE ABOVE COMPILATION. ONLY DISCRETE OBSERVATIONS WERE UTILIZED SINCE CONTINUOUS RECORDERS ARE NOT PRESENT AT EACH STATION THROUGHOUT THE BASIN.

DATA SUMMARY - TEMPERATURE

SOURCE USGS

FIGURE E.2.71



NOTE

1. A. CRITERION: NO MEASURABLE INCREASE ABOVE NATURAL CONDITIONS (ADEC 1979)

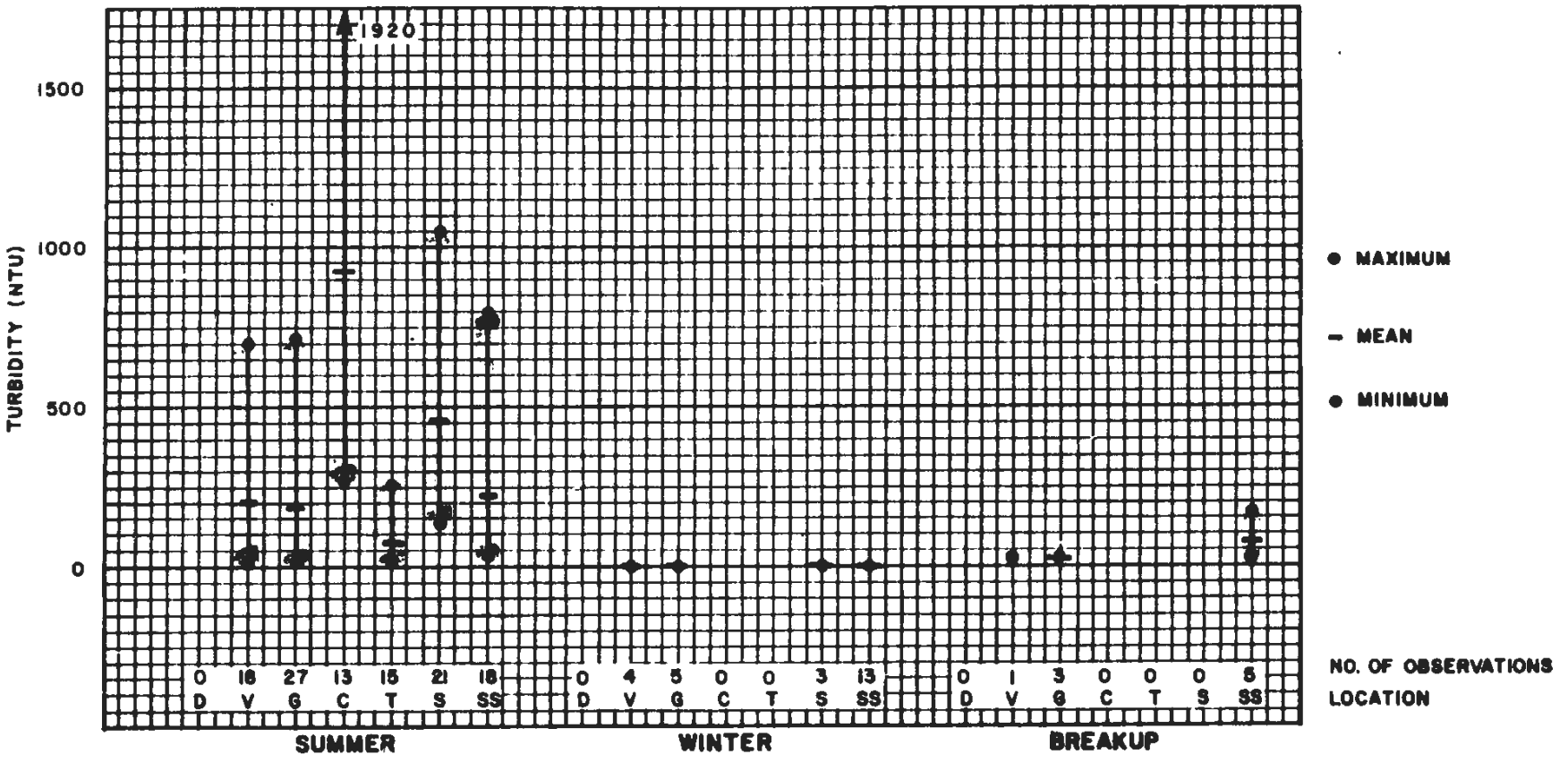
1. B ESTABLISHED TO PREVENT DELETERIOUS EFFECTS ON AQUATIC ANIMAL AND PLANT LIFE, THEIR REPRODUCTION AND HABITAT.

2 AT GOLD CREEK, 2 WINTER OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 1.0 mg./l

DATA SUMMARY-TOTAL SUSPENDED SEDIMENTS

SOURCE. USGS AND R&M

FIGURE E.2.78



NOTES:

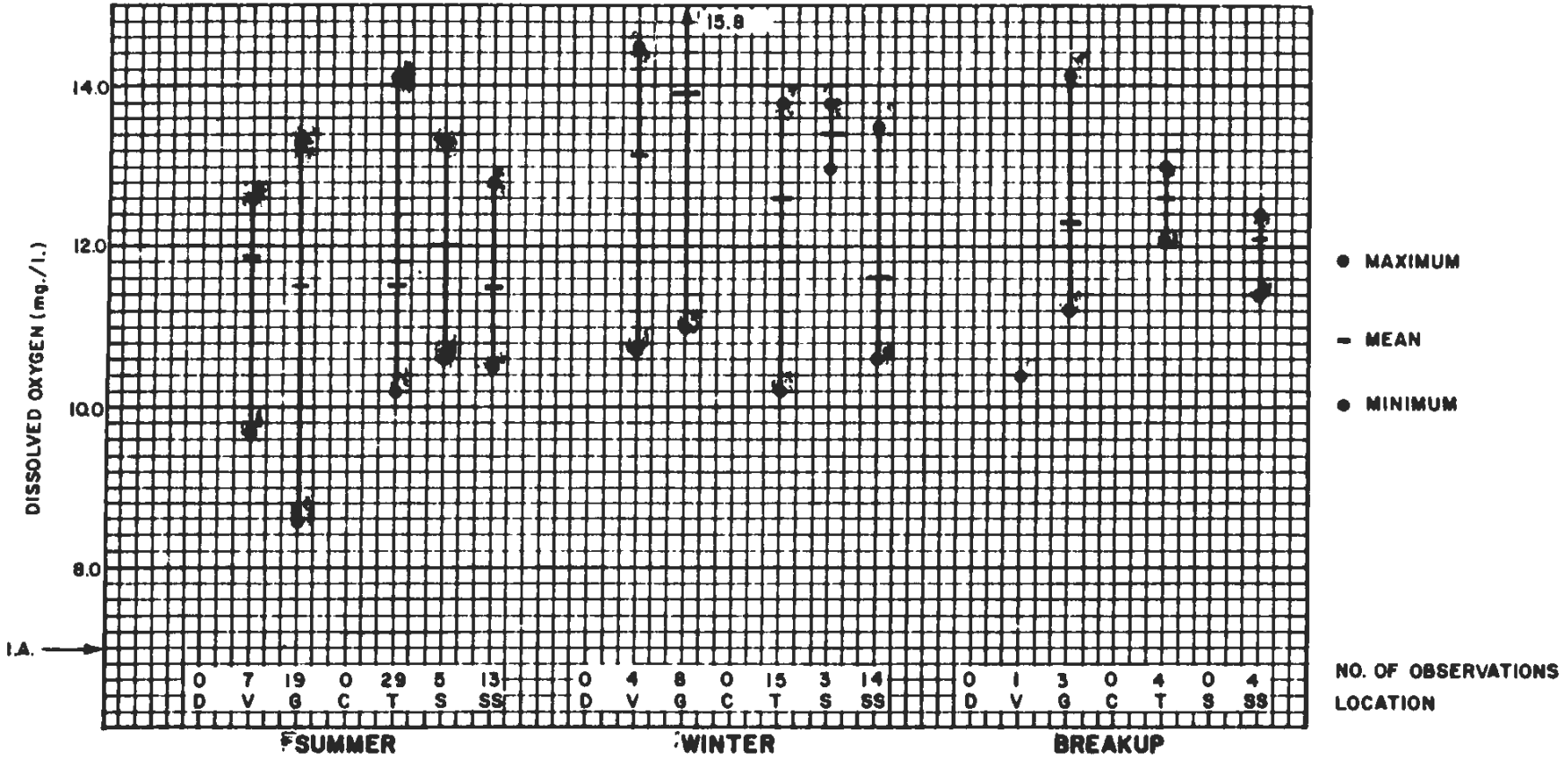
I. A. CRITERION SHALL NOT EXCEED 25 NTU ABOVE NATURAL CONDITIONS (ADEC 1979).

I. B. ESTABLISHED TO PREVENT THE REDUCTION OF THE COMPENSATION POINT FOR PHOTOSYNTHETIC ACTIVITY, WHICH MAY HAVE ADVERSE EFFECTS ON AQUATIC LIFE.

DATA SUMMARY - TURBIDITY

SOURCE: USGS AND R&M

FIGURE E.2.81



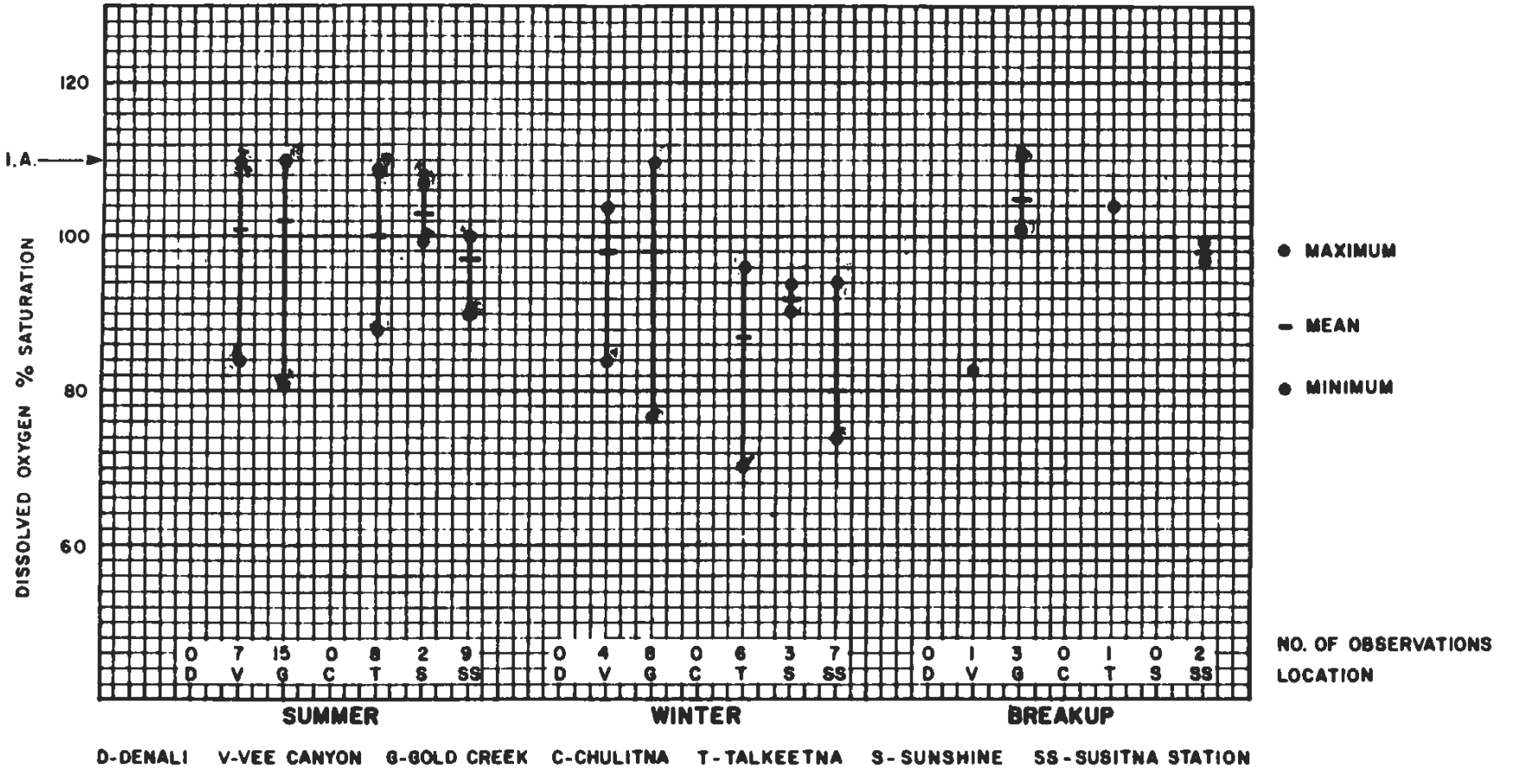
NOTES:

1. A. CRITERIA: GREATER THAN 7mg./l. BUT IN NO CASE SHALL DISSOLVED OXYGEN EXCEED 17 mg /l. (ADEC 1979).
1. B. ESTABLISHED FOR THE PROTECTION OF ANADROMOUS AND RESIDENT FISH.

DATA SUMMARY- DISSOLVED OXYGEN

SOURCE - USGS AND R & M

FIGURE E.2.83



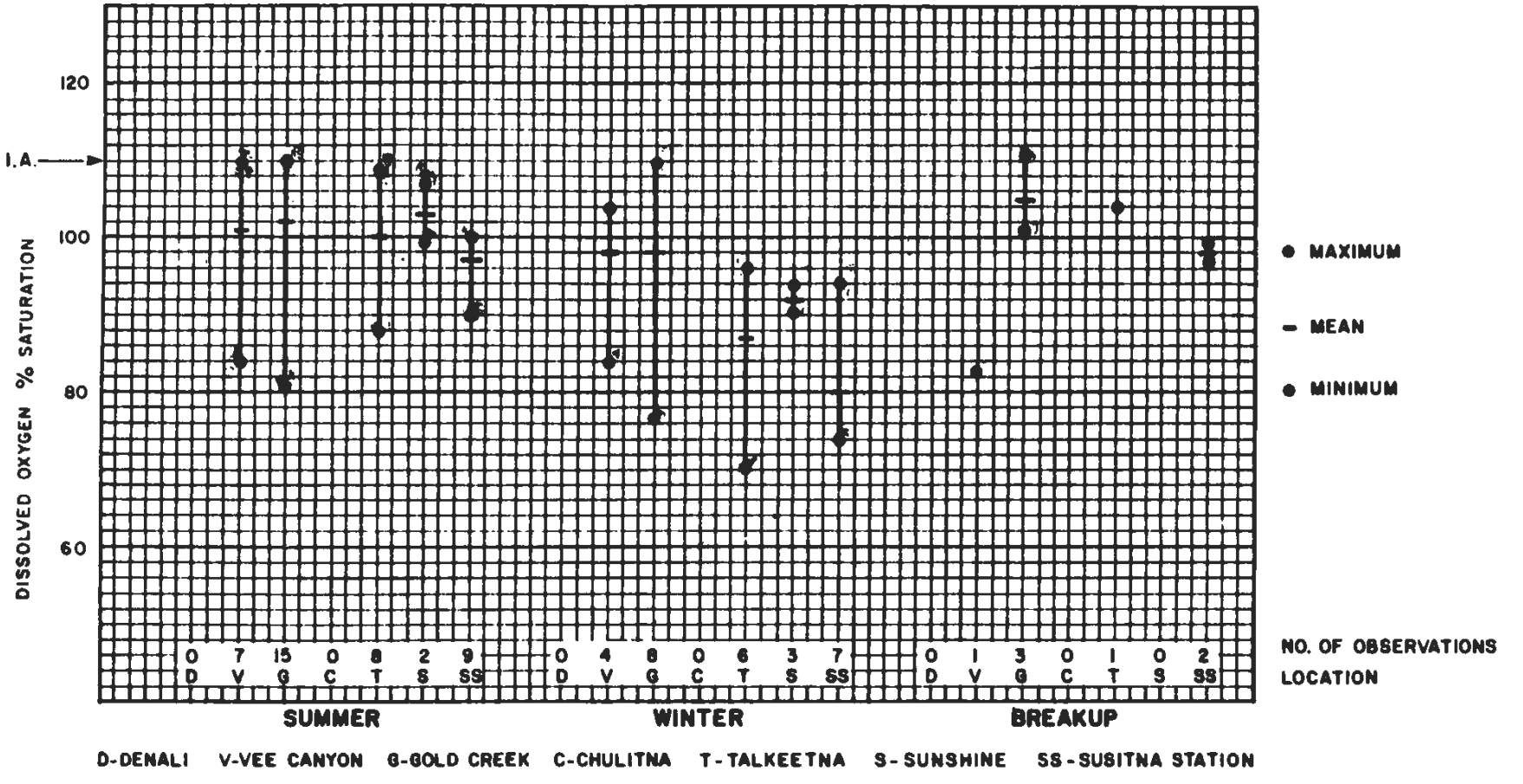
NOTES:

1. A. CRITERION: THE CONCENTRATION OF TOTAL DISSOLVED GAS SHALL NOT EXCEED 110 % SATURATION AT ANY POINT. (ADEC, 1979).
1. B. ESTABLISHED FOR THE PROTECTION OF ANADROMOUS AND RESIDENT FISH.

DATA SUMMARY – DISSOLVED OXYGEN % SATURATION

SOURCE: USGS AND R&M

FIGURE E.2.84



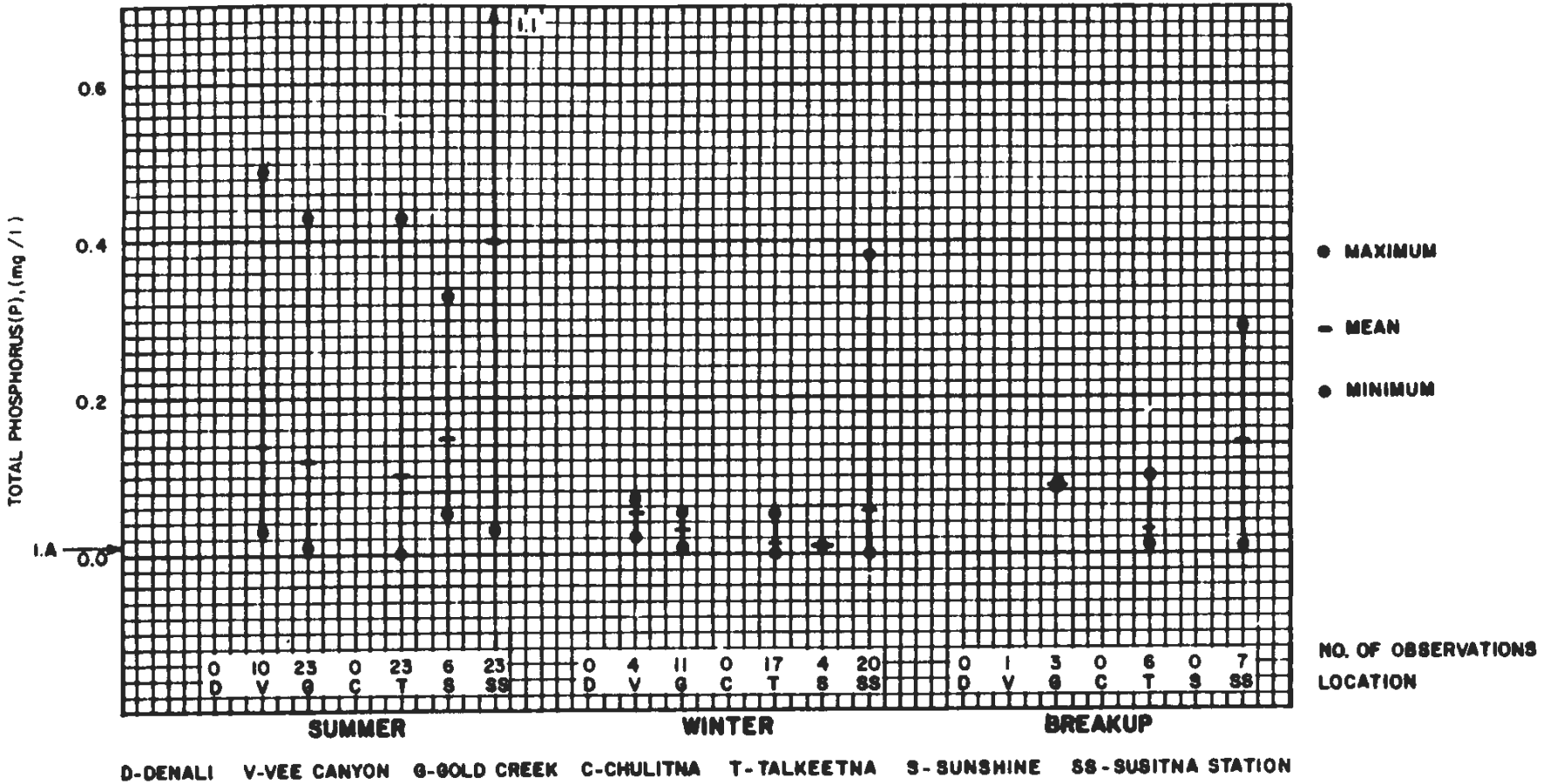
NOTES:

1. A. CRITERION: THE CONCENTRATION OF TOTAL DISSOLVED GAS SHALL NOT EXCEED 110 % SATURATION AT ANY POINT. (ADEC, 1979).
1. B. ESTABLISHED FOR THE PROTECTION OF ANADROMOUS AND RESIDENT FISH.

DATA SUMMARY – DISSOLVED OXYGEN % SATURATION

SOURCE: USGS AND R&M

FIGURE E.2.84



NOTES:

[redacted]

1.B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

2. AT VEE CANYON, 4 SUMMER OBSERVATIONS, 2 WINTER OBSERVATIONS, AND THE I BREAKUP OBSERVATION WERE LESS THAN 0.05 mg./l.

3. AT GOLD CREEK, 6 SUMMER OBSERVATIONS, 3 WINTER OBSERVATIONS, AND I BREAKUP OBSERVATION WERE LESS THAN 0.05 mg./l.

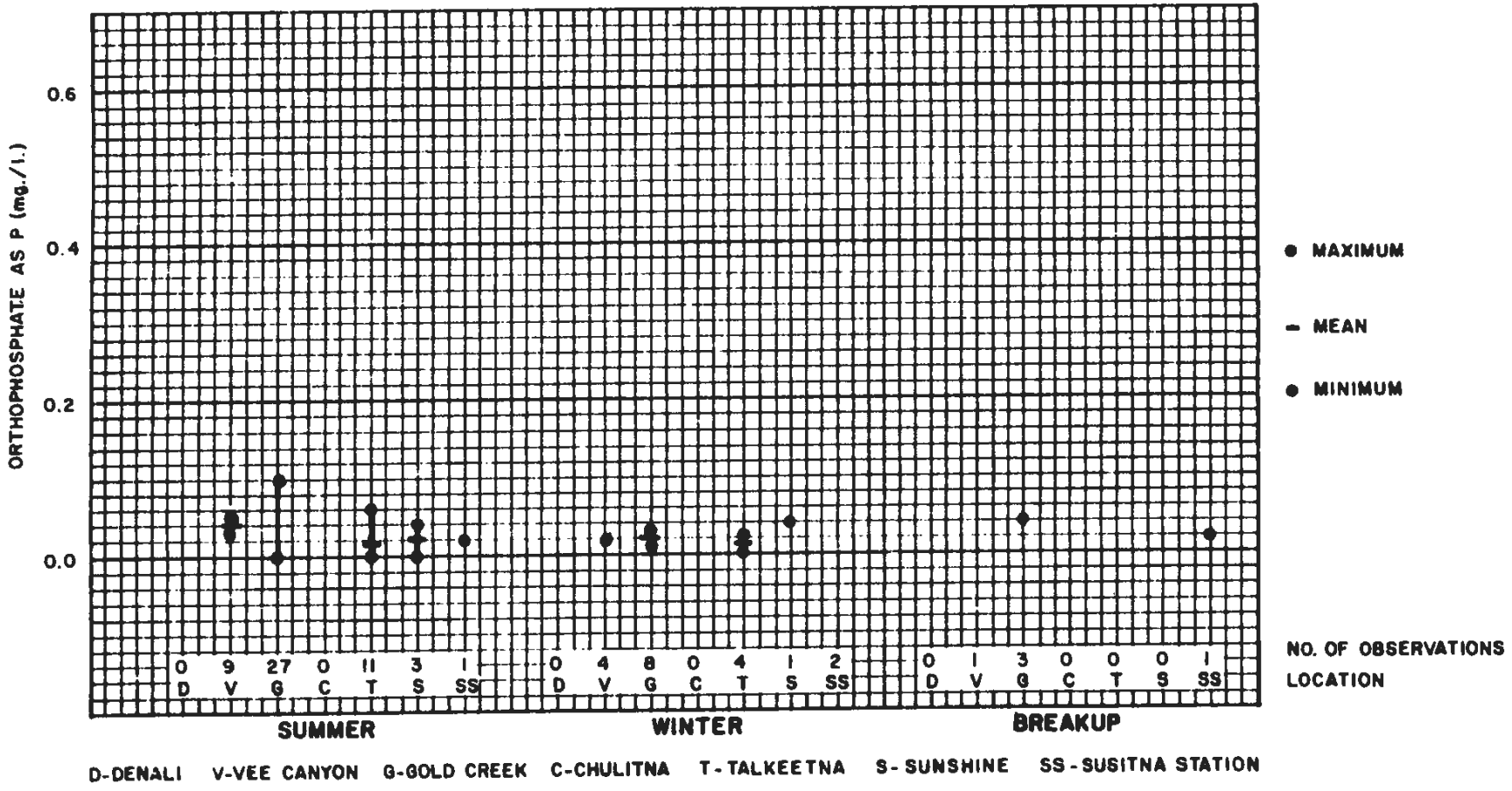
4. AT SUNSHINE, 2 WINTER OBSERVATIONS WERE LESS THAN 0.01 mg./l.

5. AT SUSITNA STATION, 2 WINTER OBSERVATIONS WERE LESS THAN 0.01 mg./l.

DATA SUMMARY - TOTAL PHOSPHORUS

SOURCE USGS AND R & M

FIGURE E.2.86



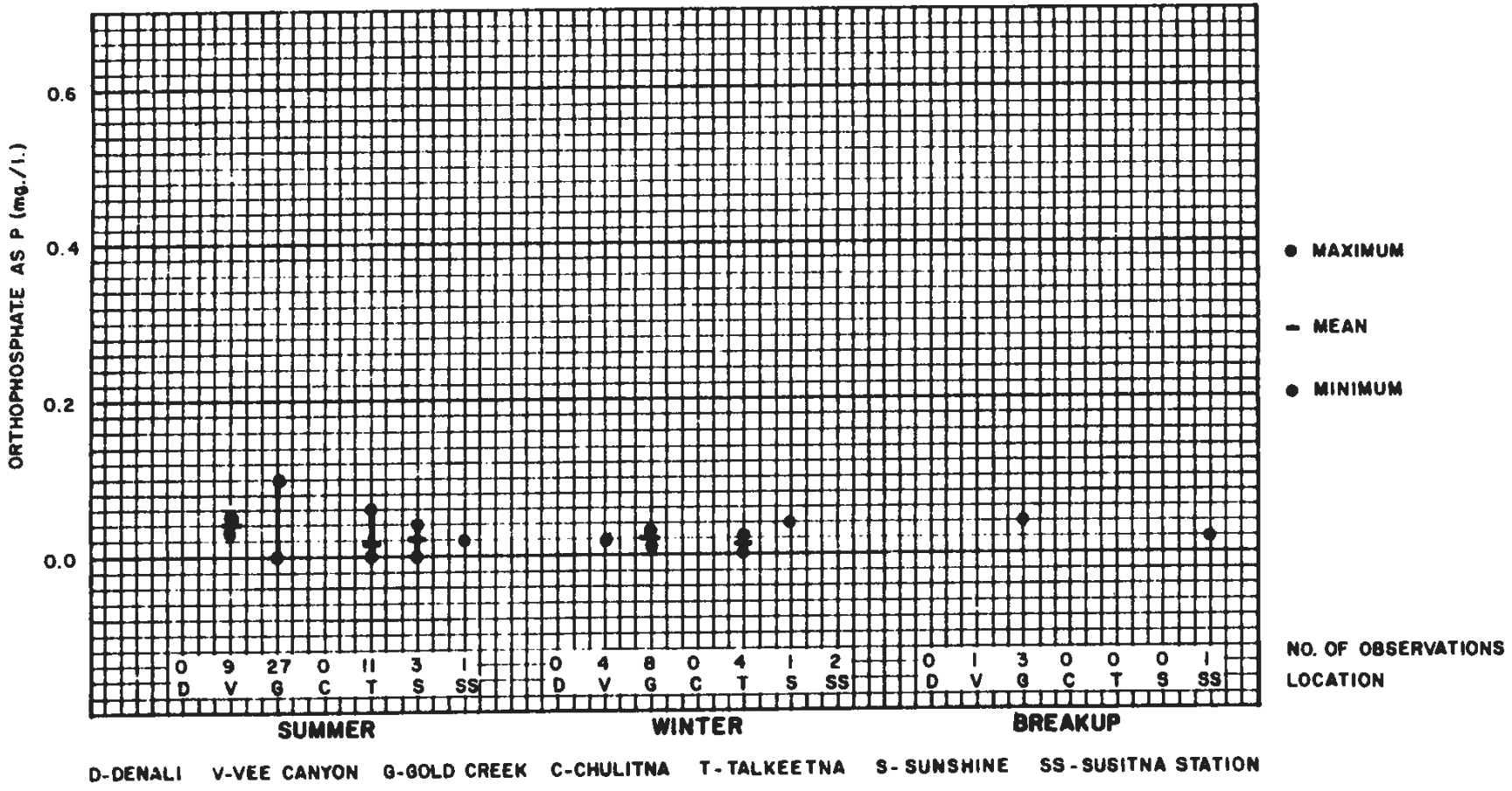
NOTES:

1. NO CRITERION ESTABLISHED.
2. AT VEE CANYON, 7 SUMMER OBSERVATIONS WERE LESS THAN 0.05 mg./l. 2 WINTER OBSERVATIONS AND THE 1 BREAKUP OBSERVATION WERE LESS THAN THE DETECTION LIMIT OF 0.01 mg./l.
3. AT GOLD CREEK, 13 SUMMER OBSERVATIONS WERE LESS THAN 0.02 mg./l. 2 WINTER OBSERVATIONS AND 2 BREAKUP OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 0.01 mg./l.
4. AT SUSITNA STATION, THE 2 WINTER OBSERVATIONS WERE LESS THAN 0.02 mg./l.

DATA SUMMARY-ORTHOPHOSPHATE

SOURCE: USGS AND R&M.

FIGURE E.2.B7



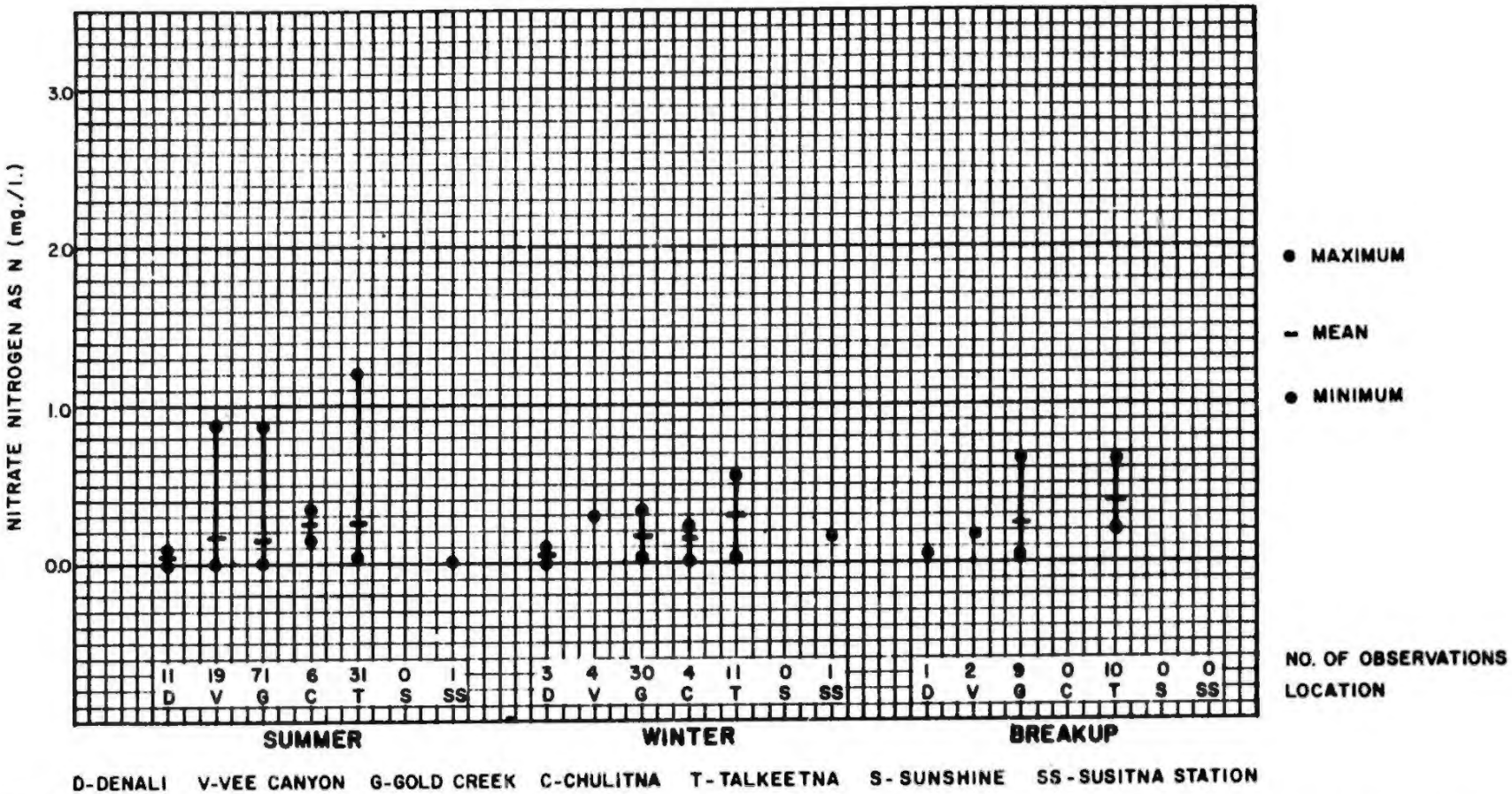
NOTES:

1. NO CRITERION ESTABLISHED.
2. AT VEE CANYON, 7 SUMMER OBSERVATIONS WERE LESS THAN 0.05 mg./l. 2 WINTER OBSERVATIONS AND THE 1 BREAKUP OBSERVATION WERE LESS THAN THE DETECTION LIMIT OF 0.01 mg./l.
3. AT GOLD CREEK, 13 SUMMER OBSERVATIONS WERE LESS THAN 0.02 mg./l. 2 WINTER OBSERVATIONS AND 2 BREAKUP OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 0.01 mg./l.
4. AT SUSITNA STATION, THE 2 WINTER OBSERVATIONS WERE LESS THAN 0.02 mg./l.

DATA SUMMARY-ORTHOPHOSPHATE

FIGURE E.2.B7

SOURCE: USGS AND R&M.



NOTES:

1A. CRITERION: LESS THAN 10mg./l. (EPA 1976).

1B. ESTABLISHED TO PROTECT WATER SUPPLIES.

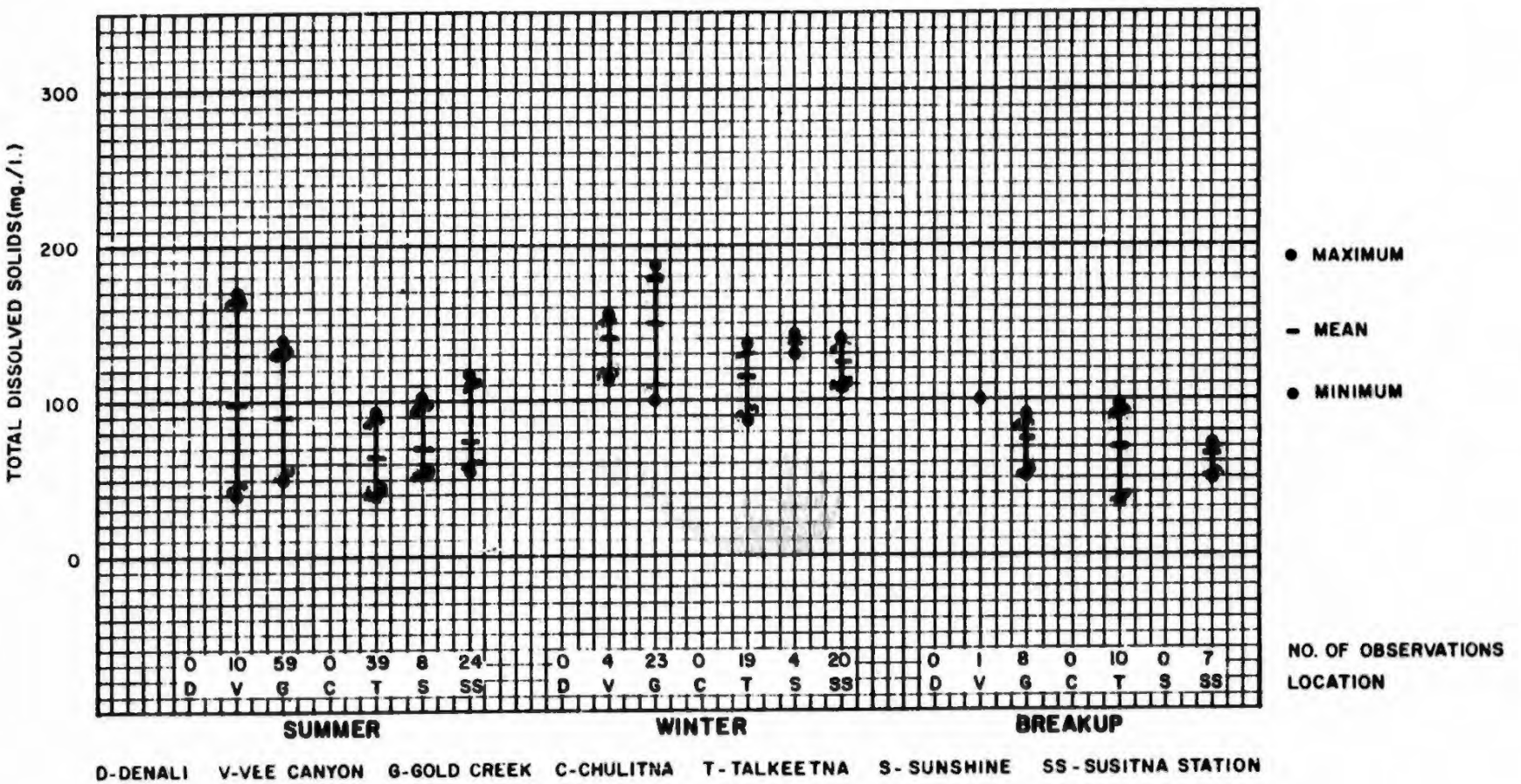
2. AT VEE CANYON, 5 SUMMER OBSERVATIONS, 3 WINTER OBSERVATIONS, AND 1 BREAKUP OBSERVATION WERE LESS THAN THE DETECTION LIMIT OF 0.10 mg./l.

3. AT GOLD CREEK, 6 SUMMER OBSERVATIONS, 2 WINTER OBSERVATIONS AND 2 BREAKUP OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 0.10 mg./l.

DATA SUMMARY - NITRATE NITROGEN

SOURCE: USGS AND R&M

FIGURE E.2.88



NOTES:

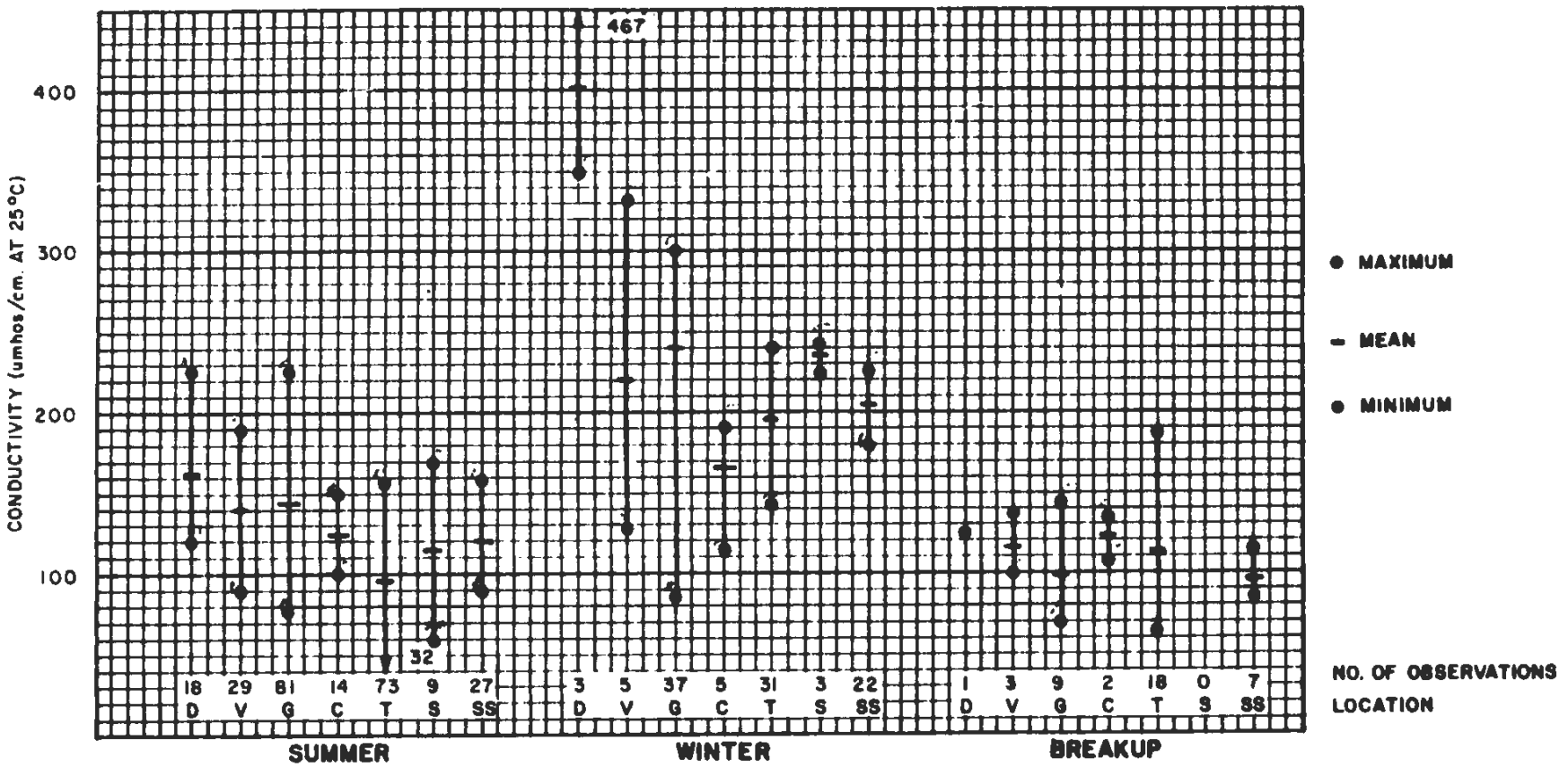
I.A. CRITERION: 1,500 mg./l. (ADEC 1979).

I.B. ESTABLISHED TO PROTECT NATURAL CONDITIONS OF FRESHWATER ECOSYSTEMS (500 mg./l. IS THE CRITERION FOR WATER SUPPLIES).

DATA SUMMARY – TOTAL DISSOLVED SOLIDS

SOURCE: USGS AND R&M

FIGURE E.2.89



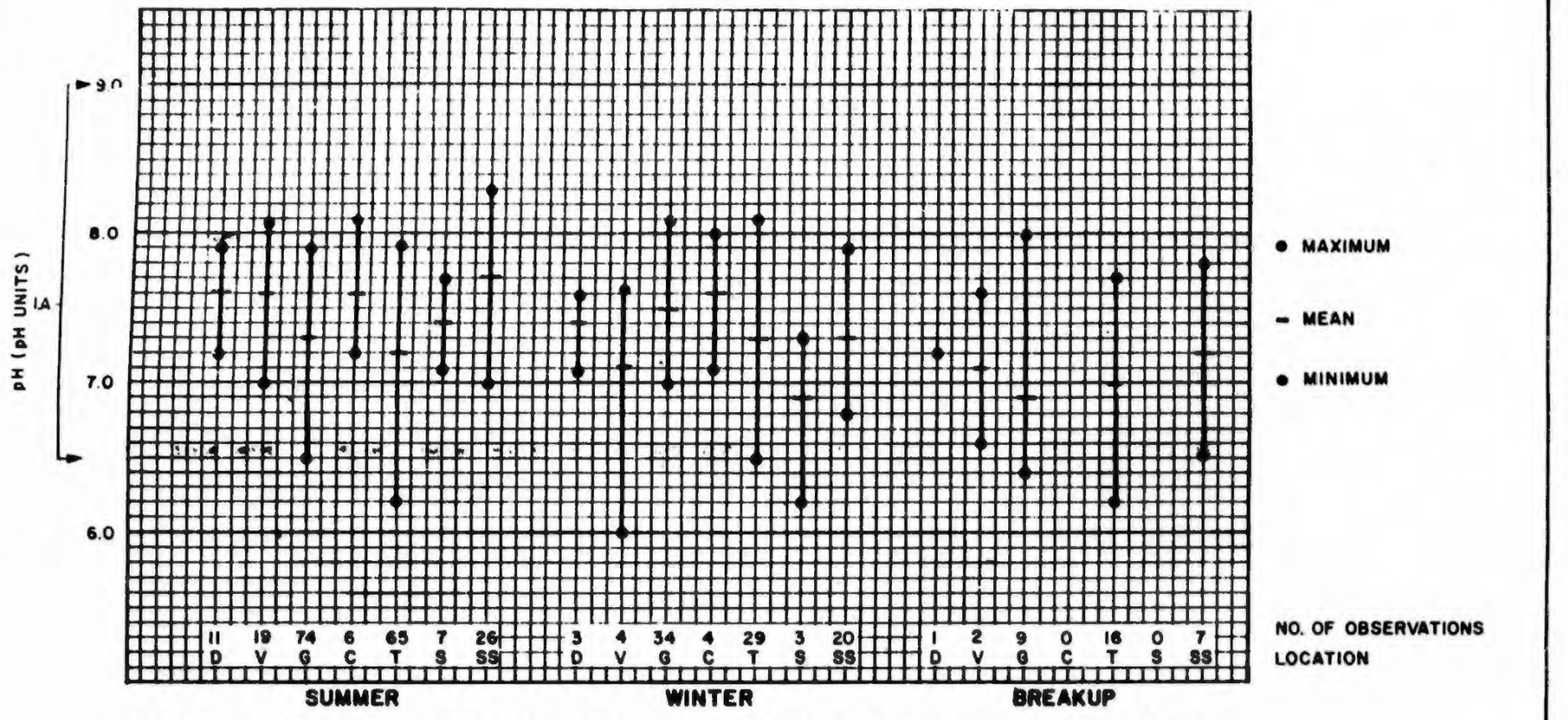
NOTES:

1. NO CRITERION ESTABLISHED.

DATA SUMMARY - CONDUCTIVITY

SOURCE: USGS AND R&M

FIGURE E.2.90



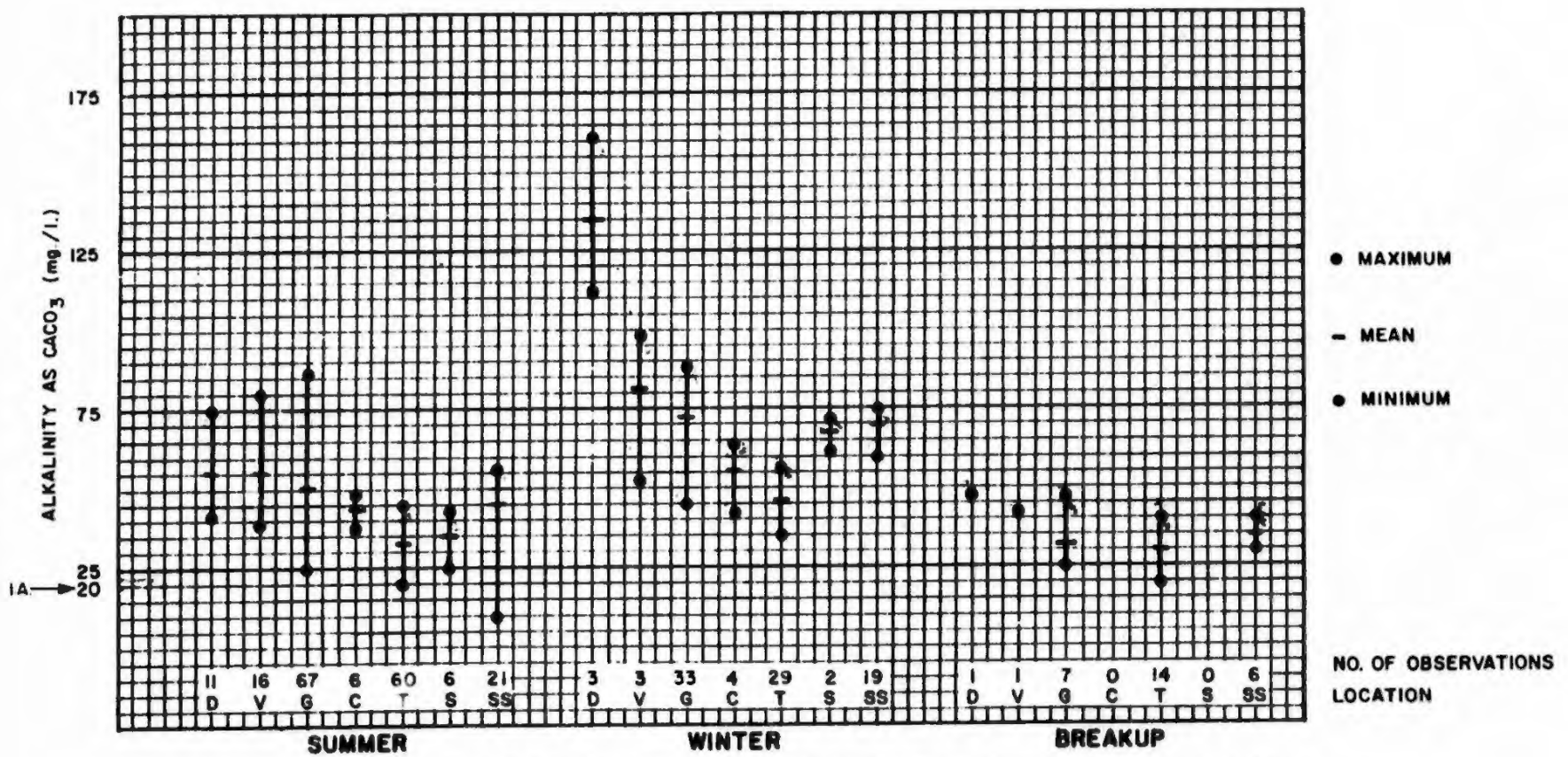
NOTES:

1. A. CRITERIA: NOT LESS THAN 6.5 OR GREATER THAN 9.0 pH UNITS. SHALL NOT VARY MORE THAN 0.5 pH UNITS FROM NATURAL CONDITION (ADEC 1979).
1. B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

DATA SUMMARY - pH

SOURCE: USGS AND R&M

FIGURE E.2.98



NOTES:

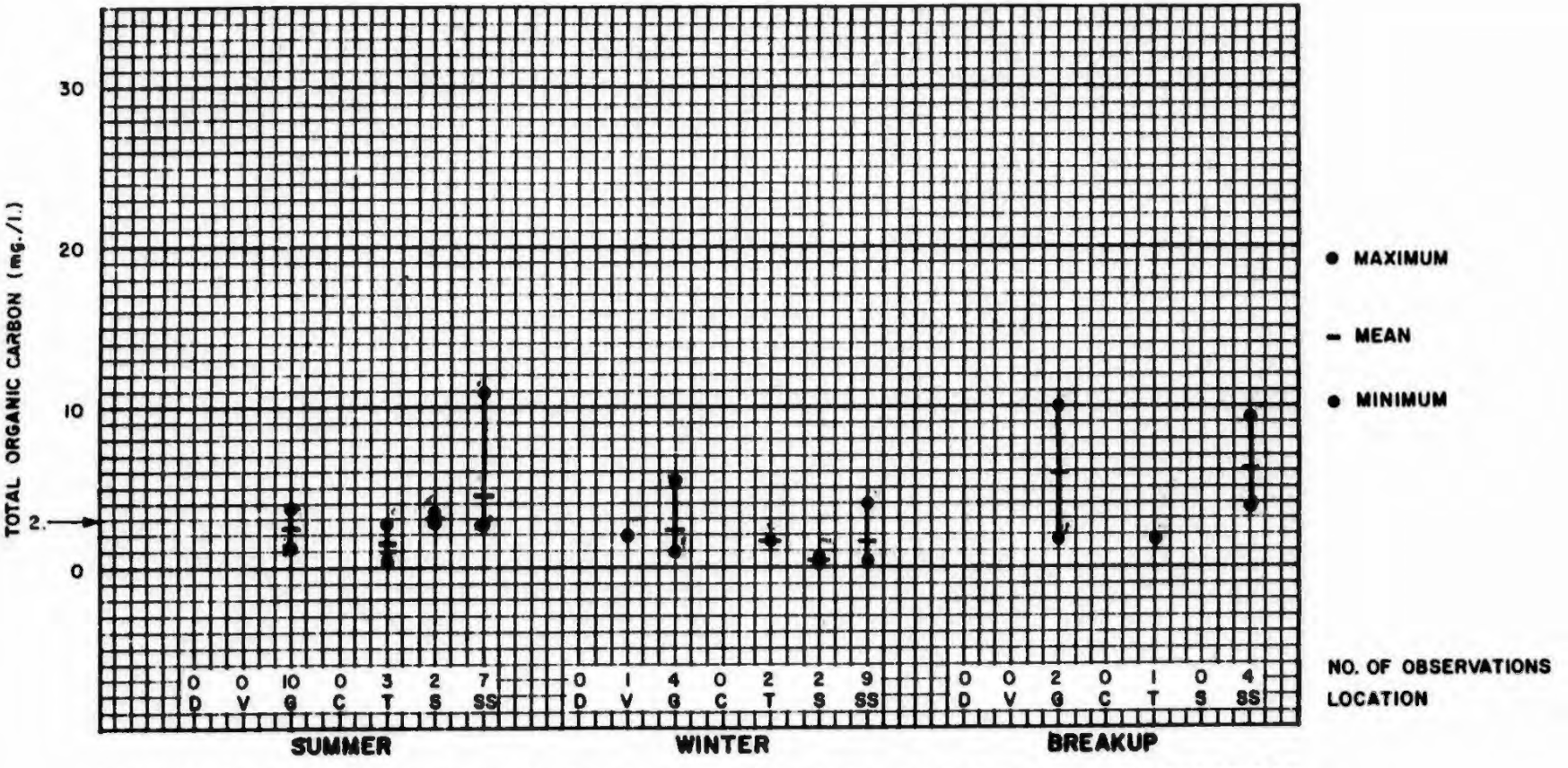
1. A. CRITERION: 20 mg./l. OR MORE EXCEPT WHERE NATURAL CONDITIONS ARE LESS (EPA 1976).

1. B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

DATA SUMMARY - ALKALINITY

SOURCE: USGS AND R&M

FIGURE E.2.99



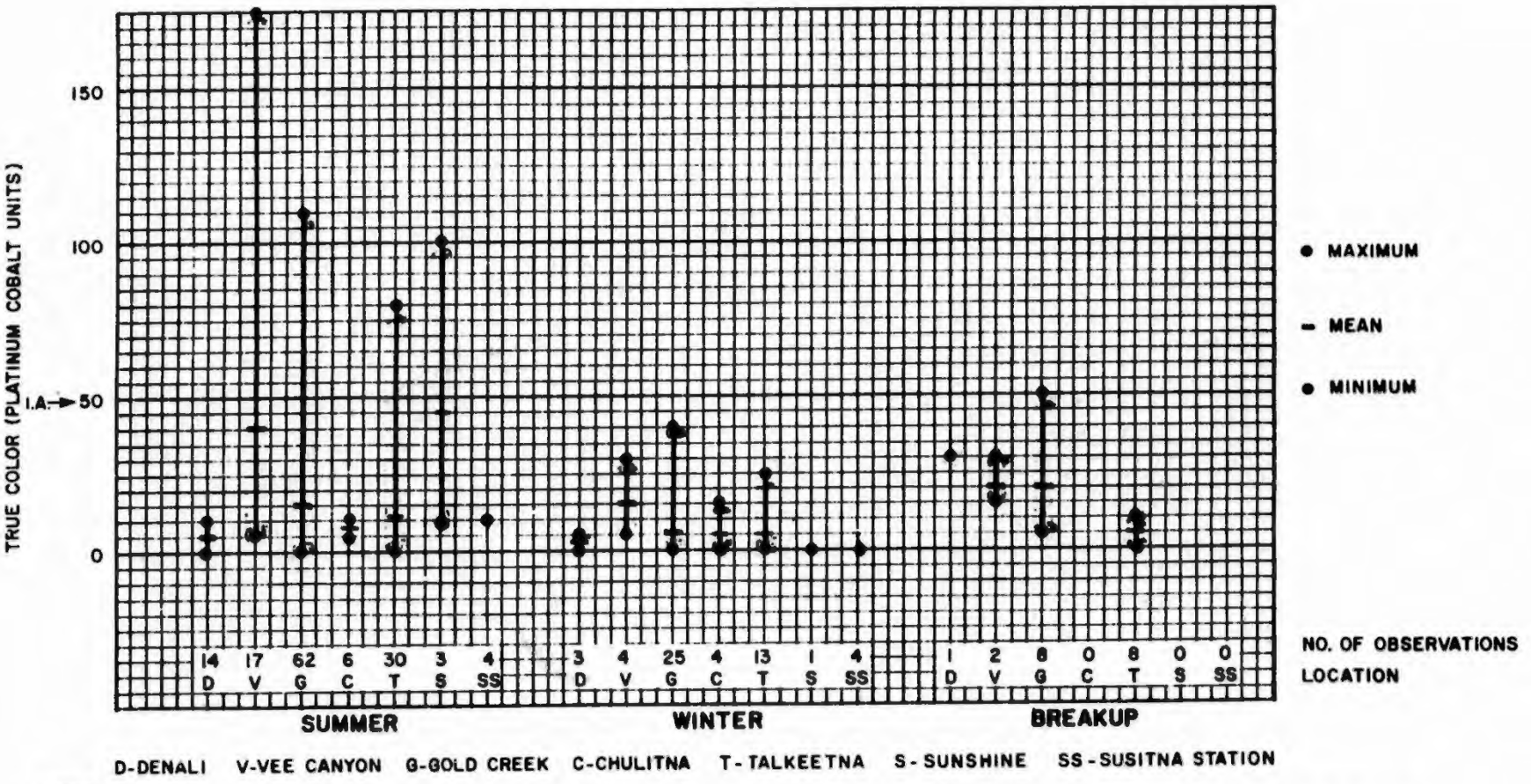
NOTES:

1. NO CRITERION ESTABLISHED.
2. WATERS CONTAINING LESS THAN 3.0 mg./l. HAVE BEEN OBSERVED TO BE RELATIVELY CLEAN (McNEELY et al. 1979).

DATA SUMMARY- TOTAL ORGANIC CARBON

SOURCE: USGS AND R & M

FIGURE E.2.101



NOTES:

I A. CRITERION: SHALL NOT EXCEED 50 UNITS (ADEC 1979).

I.B. ESTABLISHED TO PREVENT THE REDUCTION OF PHOTOSYNTHETIC ACTIVITY WHICH MAY HAVE DELETERIOUS EFFECTS ON AQUATIC LIFE.

2. AT DENALI, I SUMMER OBSERVATION WAS LESS THAN 5 UNITS. ONE SUMMER OBSERVATION WAS GREATER THAN 5 UNITS.

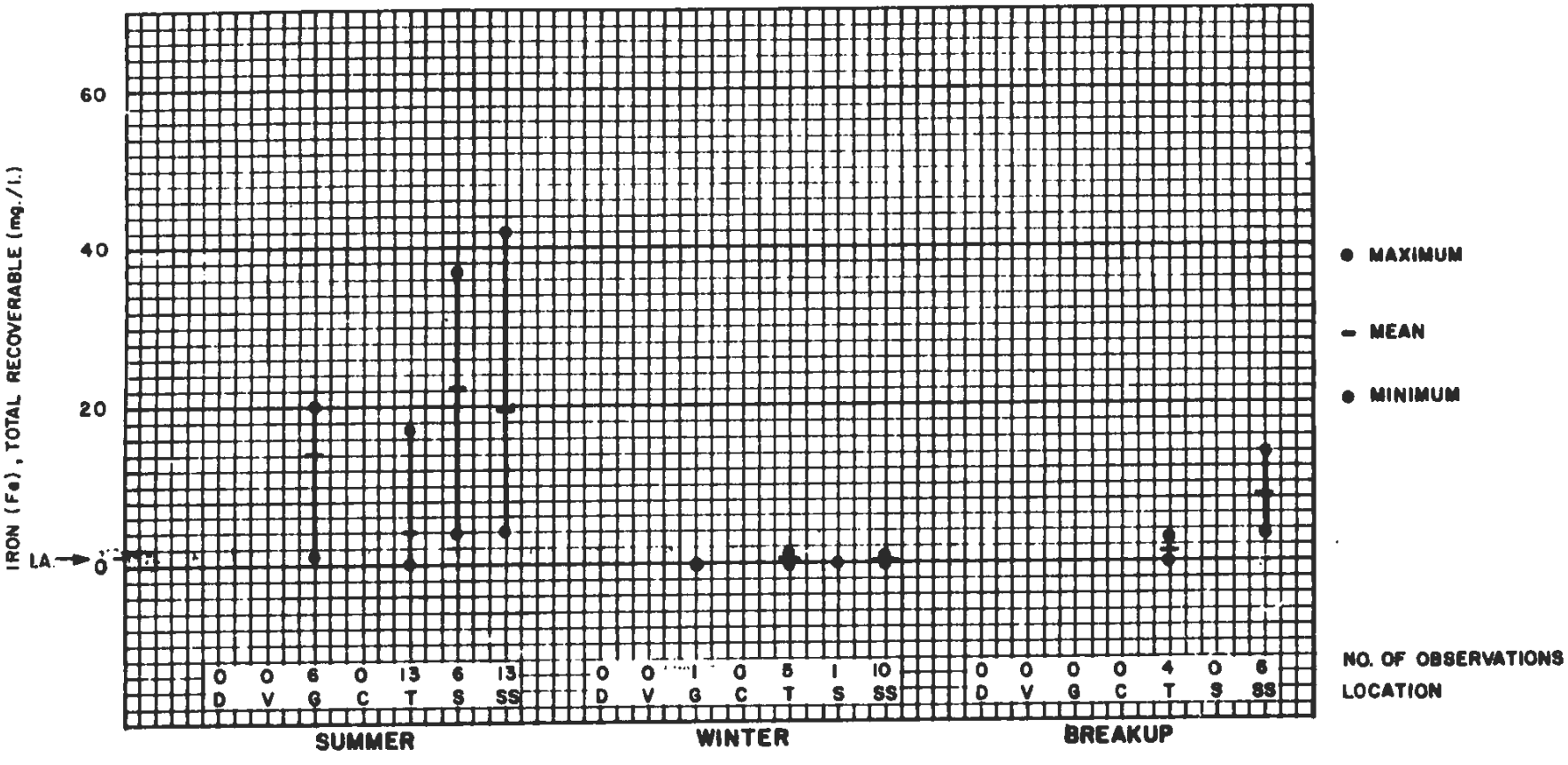
3. AT SUSITNA STATION, 2 SUMMER OBSERVATIONS AND 2 WINTER OBSERVATIONS WERE LESS THAN 5 UNITS.

4. AT TALKEETNA, I WINTER OBSERVATION WAS LESS THAN 5 UNITS.

DATA SUMMARY - TRUE COLOR

SOURCE: USGS AND R&M

FIGURE E.2.103



NOTES:

1.A. CRITERION: LESS THAN 1.0 mg./l. (EPA 1976; SITTIG 1981)

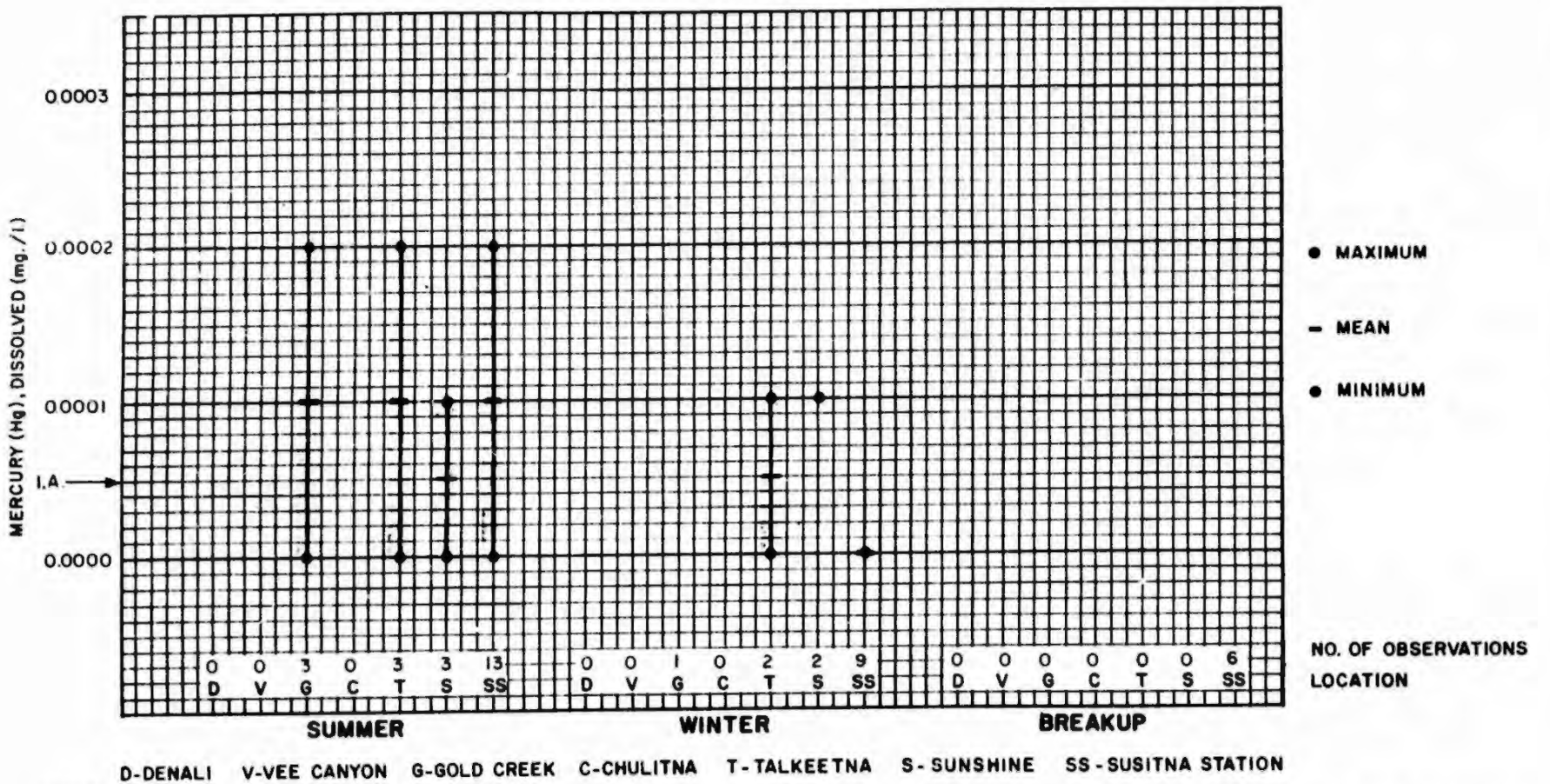
1.B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

2. (t) = TOTAL RECOVERABLE.

DATA SUMMARY - IRON (t)

SOURCE: USGS

FIGURE E.2.III



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

I.A. CRITERION: LESS THAN 0.00005 mg./l. (EPA 1976).

I.B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

2. AT GOLD CREEK, I SUMMER OBSERVATION AND THE I WINTER OBSERVATION WERE LESS THAN 0.001 mg./l.

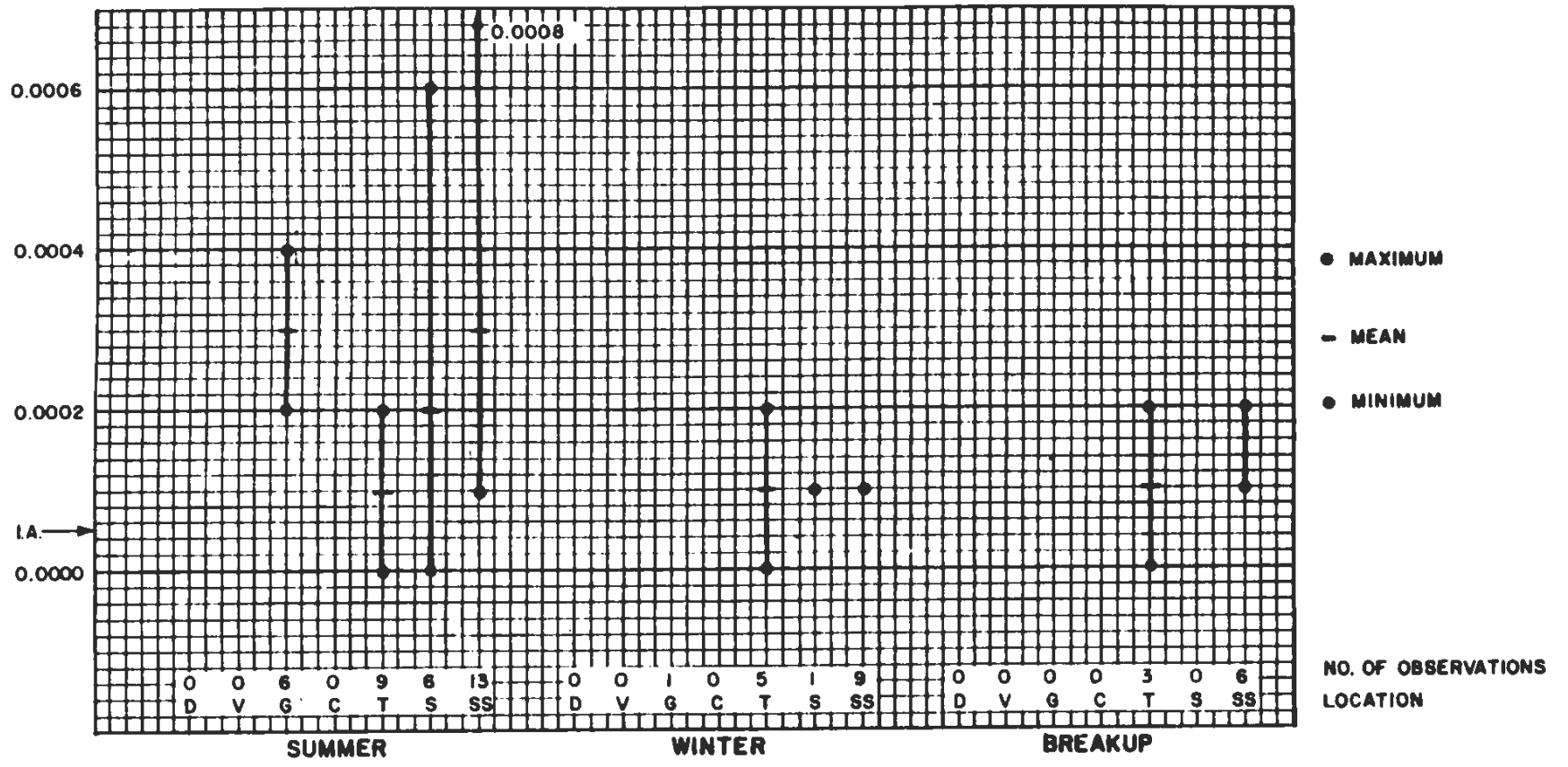
3. AT SUSITNA STATION, 8 SUMMER OBSERVATIONS, 7 WINTER OBSERVATIONS, AND THE 6 BREAKUP OBSERVATIONS WERE LESS THAN 0.0005 mg./l.

4. (d) = DISSOLVED

DATA SUMMARY - MERCURY (d)

SOURCE: USGS

FIGURE E.2.115



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

I.A. CRITERION: LESS THAN 0.00005 mg./l. (EPA 1976).

I.B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

2. AT TALKEETNA, 1 SUMMER OBSERVATION WAS LESS THAN 0.0005 mg./l.

3. AT SUSITNA STATION, 7 SUMMER OBSERVATIONS, 7 WINTER OBSERVATIONS AND 4 BREAKUP OBSERVATIONS WERE LESS THAN 0.0005 mg./l.

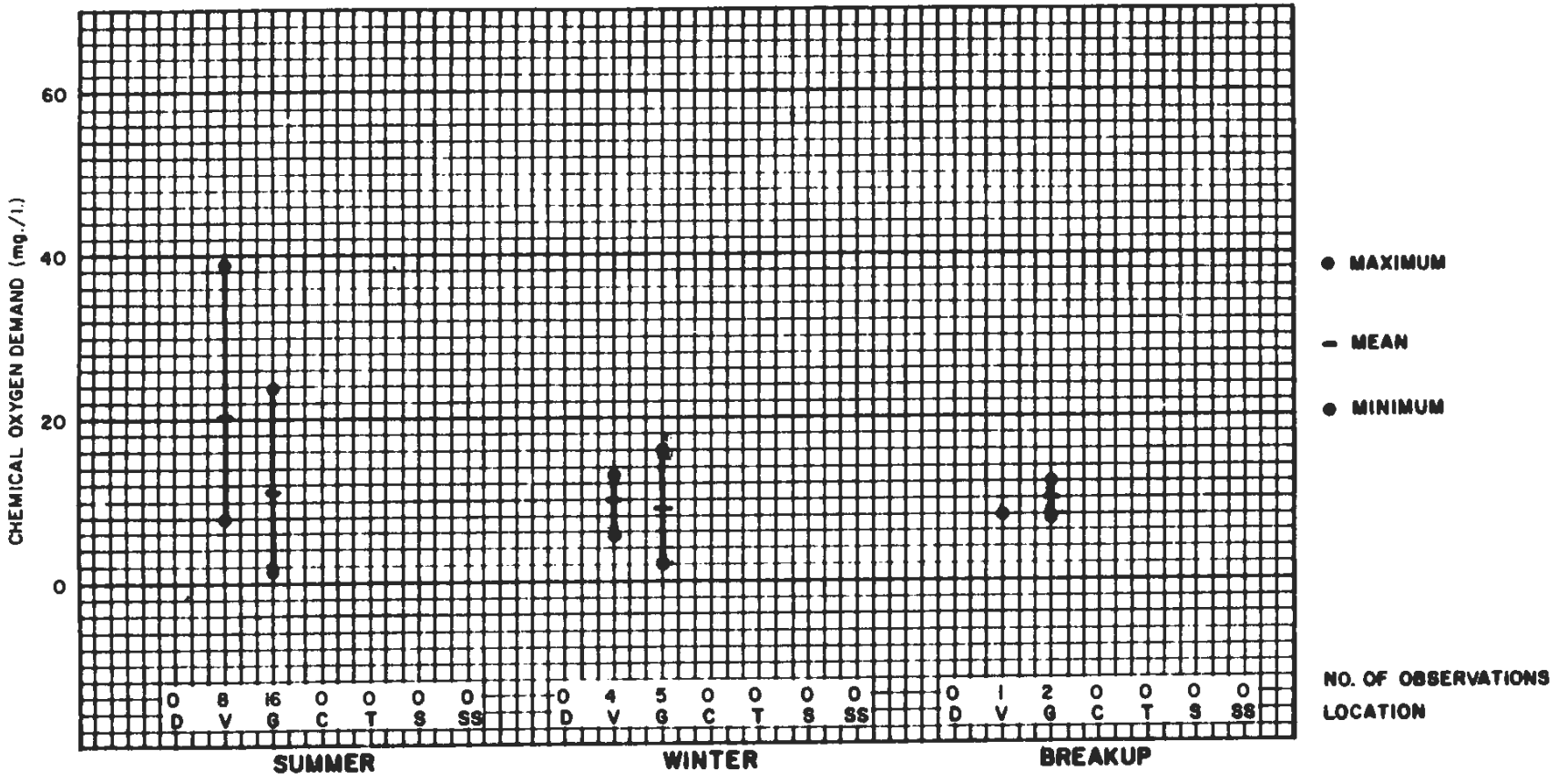
4. AT GOLD CREEK, THE 1 WINTER OBSERVATION WAS LESS THAN 0.0005 mg./l.

5. (t) = TOTAL RECOVERABLE.

DATA SUMMARY - MERCURY (t)

SOURCE USGS

FIGURE E.2.116



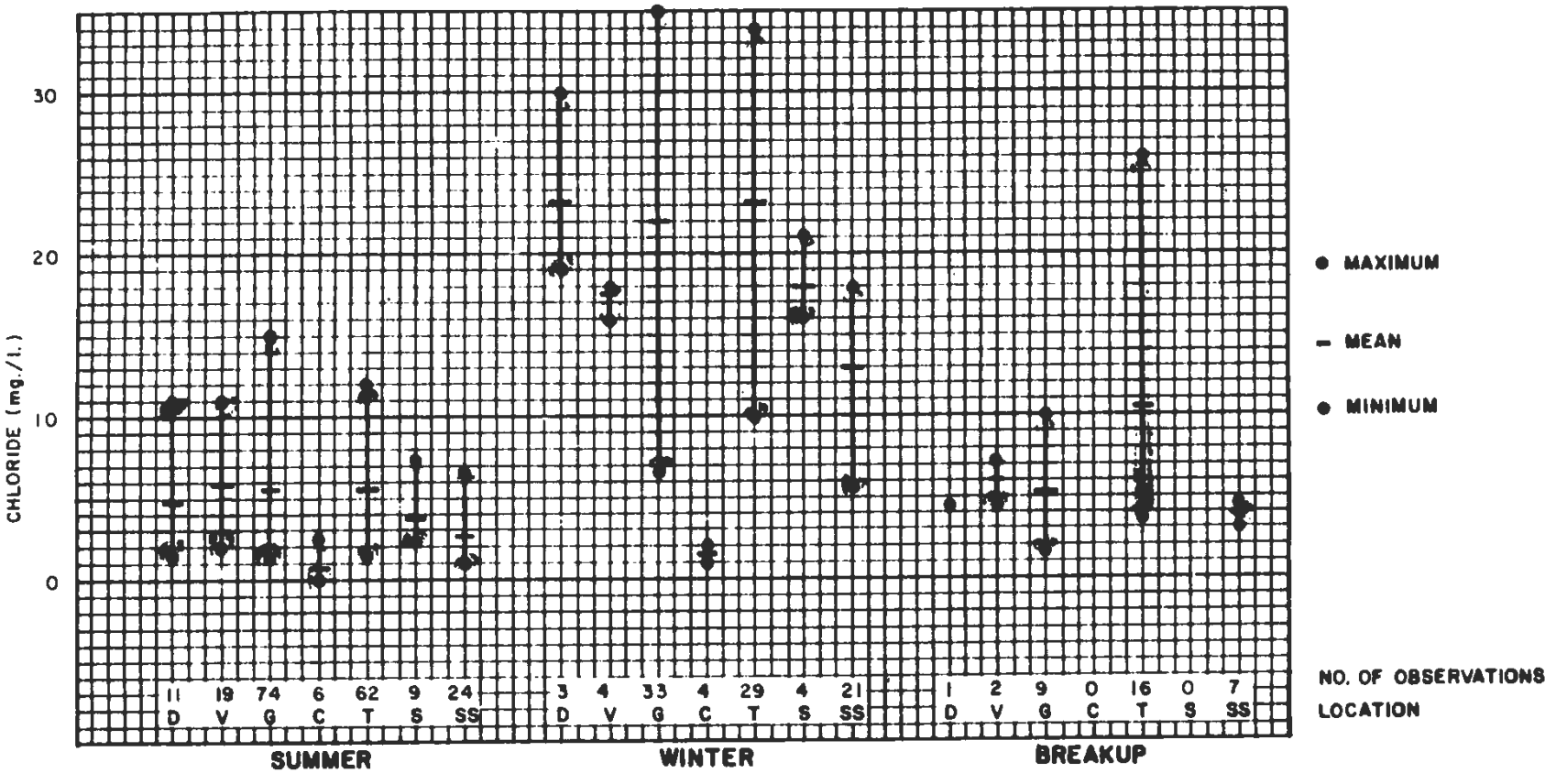
NOTES:

1. NO CRITERION ESTABLISHED.
2. AT GOLD CREEK, 2 SUMMER OBSERVATIONS WERE LESS THAN 1.0 mg./l.

DATA SUMMARY - CHEMICAL OXYGEN DEMAND

SOURCE R & M

FIGURE E.2 102



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES.

1 A CRITERION: LESS THAN 200 mg/l (ADEC 1979).

1 B ESTABLISHED TO PROTECT WATER SUPPLIES

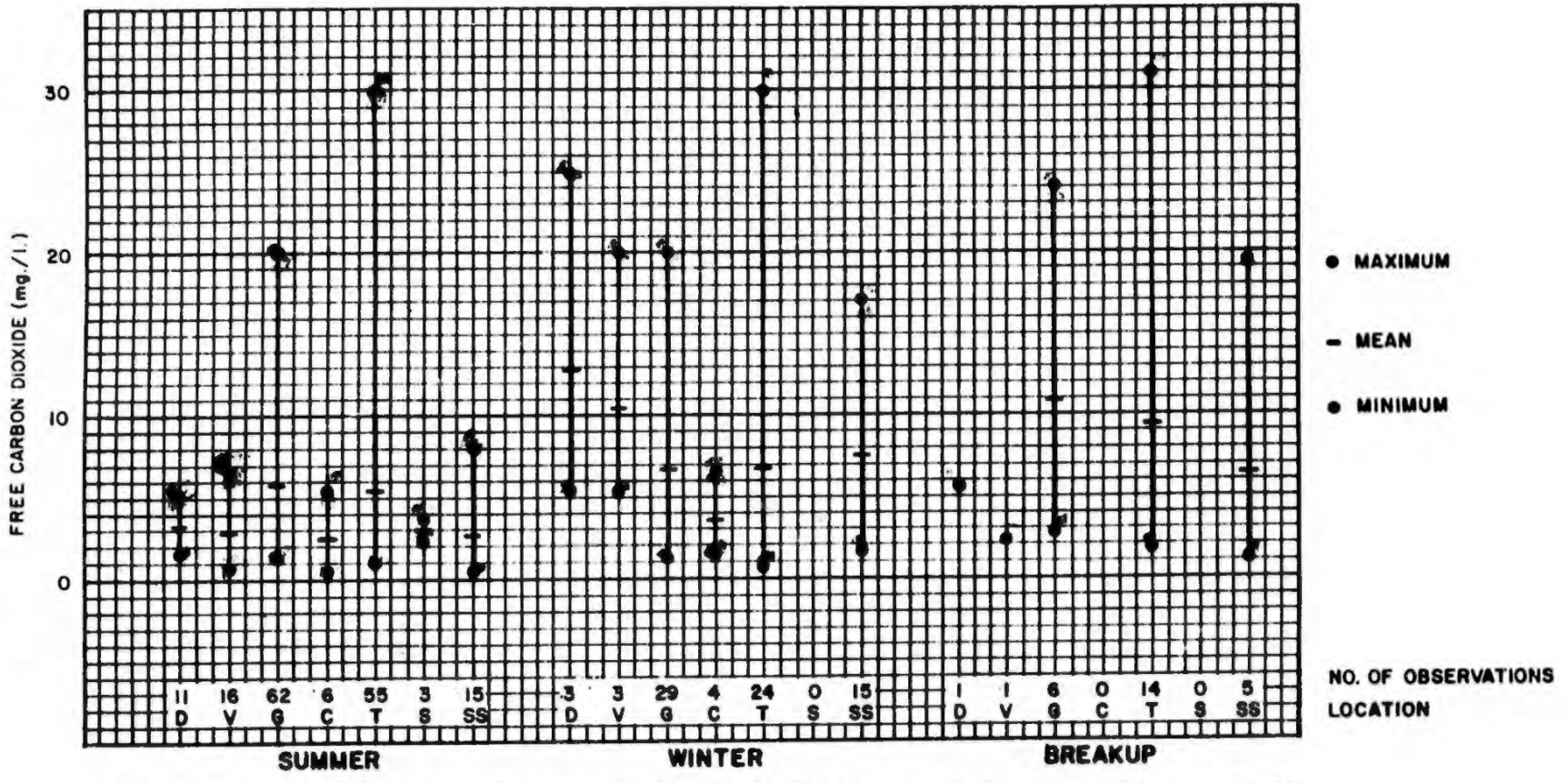
2 AT VEE CANYON, 3 SUMMER OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 10 mg/l

3 AT GOLD CREEK, 2 SUMMER OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 10 mg/l.

DATA SUMMARY – CHLORIDE

SOURCE USGS AND R&M

FIGURE E.2.92



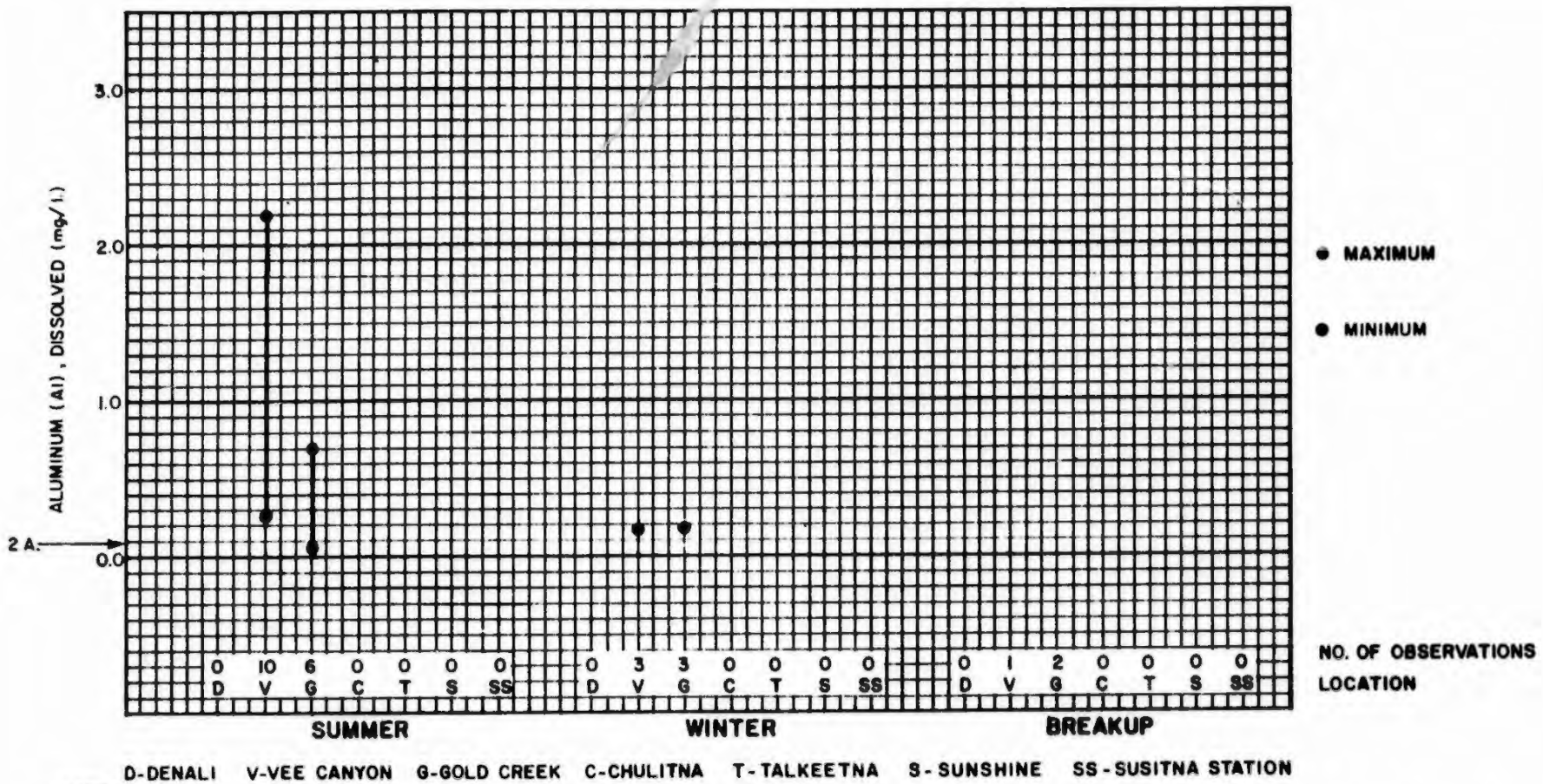
NOTE:

1. NO CRITERION ESTABLISHED.

DATA SUMMARY - FREE CARBON DIOXIDE

SOURCE: USGS AND R&M

FIGURE E.2.100



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

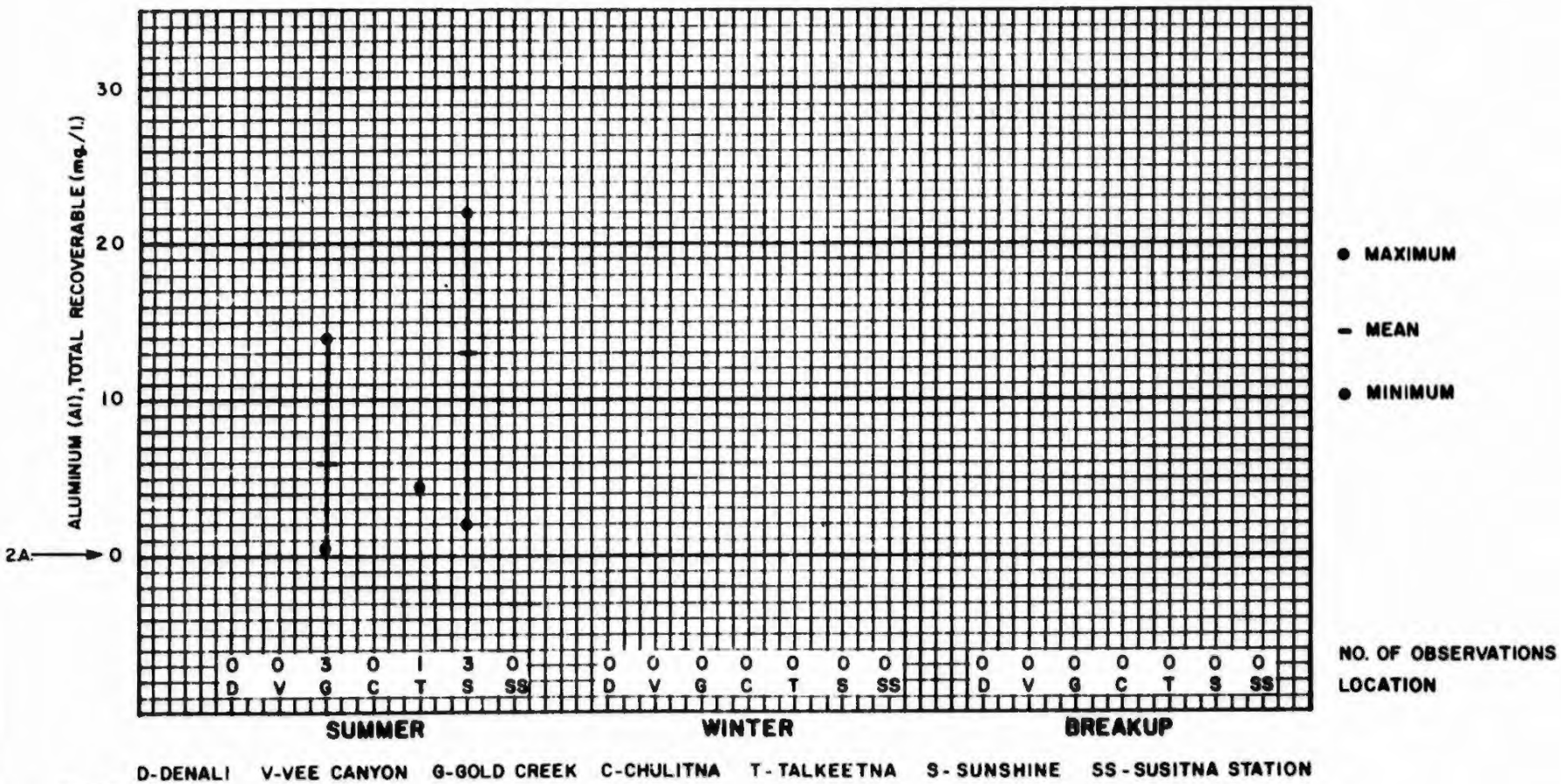
NOTES.

1. NO CRITERION ESTABLISHED.
2 A. A LIMIT OF 0.073 mg/l HAS BEEN SUGGESTED BY EPA (SITTIG 1981).
2.B. THIS SUGGESTED LIMIT IS BASED ON THE EFFECTS OF ALUMINUM ON HUMAN HEALTH.
3. AT VEE CANYON, 7 SUMMER OBSERVATIONS WERE LESS THAN 0.10 mg/l TWO WINTER OBSERVATIONS AND THE ONE SUMMER OBSERVATION WERE LESS THAN THE DETECTION LIMIT OF 0.05 mg/l.
4. AT GOLD CREEK, 4 SUMMER OBSERVATIONS, 2 WINTER OBSERVATIONS AND THE 2 BREAKUP OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 0.05 mg/l.
5. (d) = DISSOLVED.

SOURCE: R&M

DATA SUMMARY - ALUMINUM (d)

FIGURE E.2.104



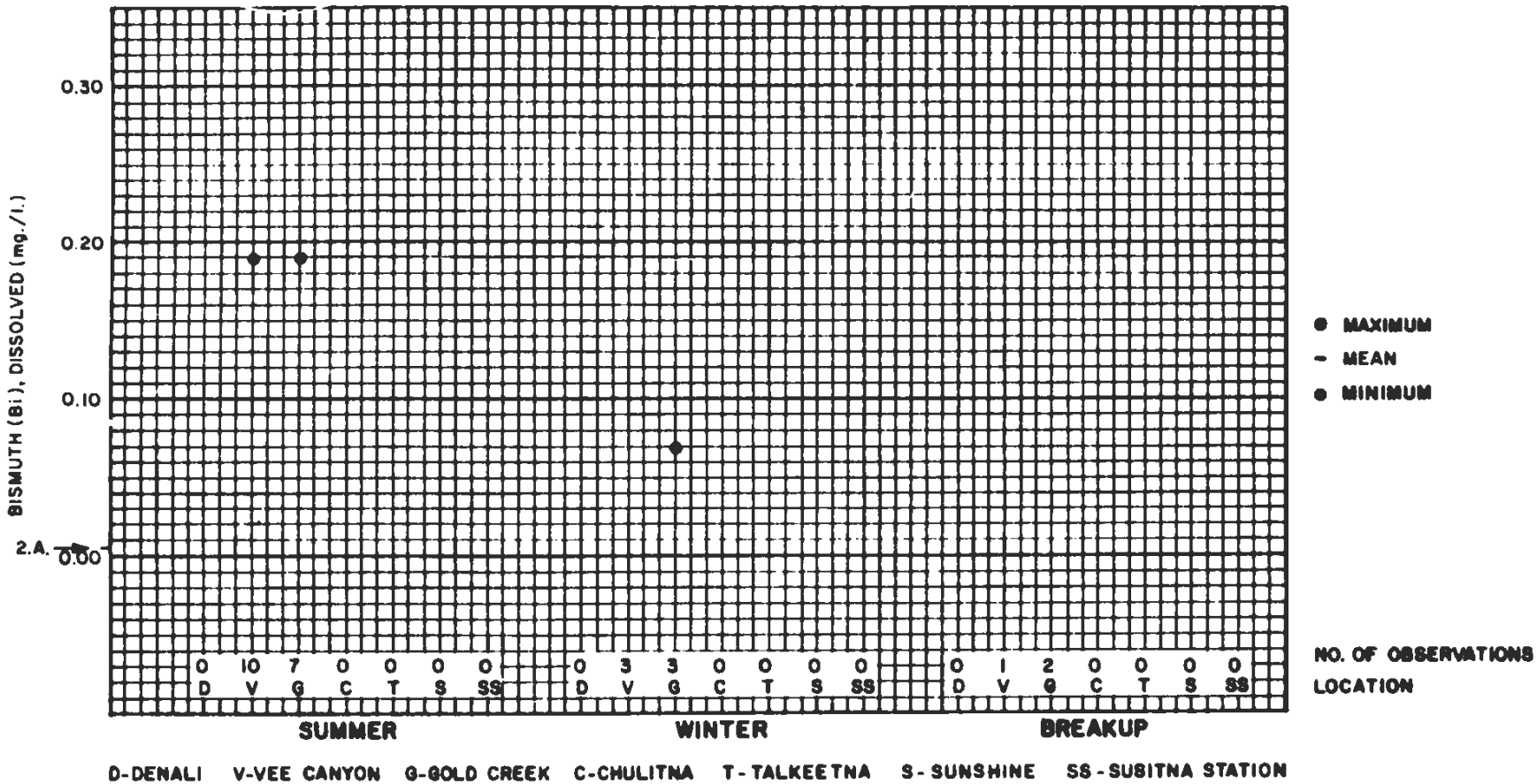
NOTES:

1. NO CRITERION ESTABLISHED.
2. A. A LIMIT OF 0.073 mg./l. HAS BEEN SUGGESTED BY EPA (SITTIG 1981).
   B. THIS SUGGESTED LIMIT IS BASED ON THE EFFECTS OF ALUMINUM ON HUMAN HEALTH.
3. (t) = TOTAL RECOVERABLE.

DATA SUMMARY - ALUMINUM (t)

SOURCE: USGS

FIGURE E.2.105



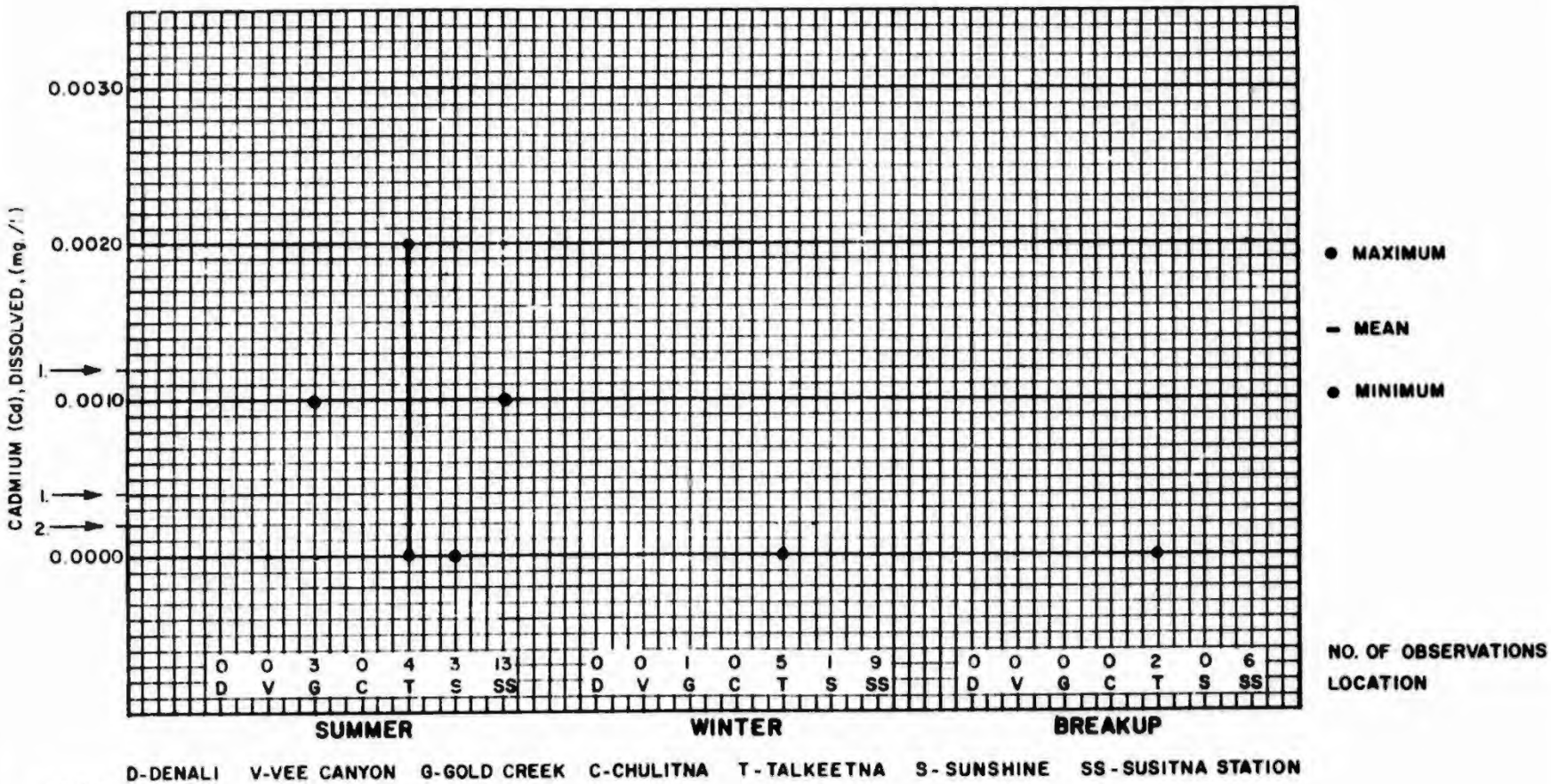
NOTES:

1. NO CRITERION ESTABLISHED.
2. A. EPA HAS SUGGESTED AN AMBIENT LIMIT OF 0.0035 mg./l. (SITTIG 1981).
2. B. THIS SUGGESTED LIMIT FOR BISMUTH IS BASED ON HUMAN HEALTH EFFECTS.
3. AT VEE CANYON, 9 SUMMER OBSERVATIONS, THE 3 WINTER OBSERVATIONS, AND THE 1 BREAKUP OBSERVATION WERE LESS THAN 0.05 mg./l.
4. AT GOLD CREEK, 6 SUMMER OBSERVATIONS, 2 WINTER OBSERVATIONS, AND THE 2 BREAKUP OBSERVATIONS WERE LESS THAN 0.05 mg./l.
5. (d) = DISSOLVED.

SOURCE: R&M

DATA SUMMARY-BISMUTH (d)

FIGURE E.2.106



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

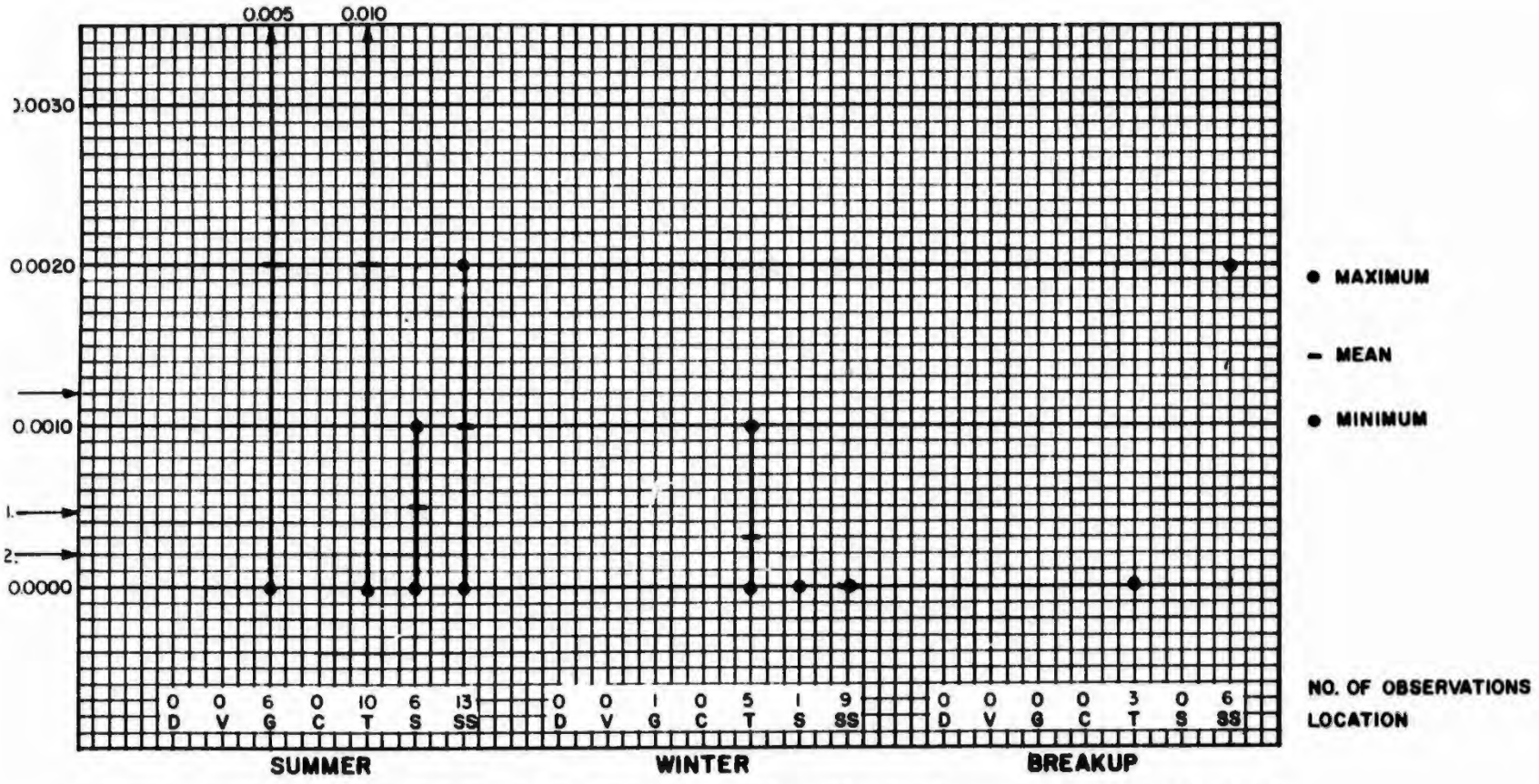
NOTES:

1. CRITERIA: 0.0012 mg/l IN HARD WATER AND 0.0004 SOFT WATER (EPA 1976).
2. CRITERION LESS THAN 0.0002 mg./l. (McNEELY et al. 1979).
3. THE ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT GOLD CREEK, I SUMMER OBSERVATION WAS LESS THAN 0.001 mg./l. THE I WINTER OBSERVATION WAS LESS THAN 0.003 mg/l.
5. AT TALKEETNA, 2 SUMMER OBSERVATIONS AND 2 WINTER OBSERVATIONS WERE LESS THAN 0.001 mg./l.
6. AT SUNSHINE, 2 SUMMER OBSERVATIONS AND THE I WINTER OBSERVATION WERE LESS THAN 0.001 mg./l.
7. AT SUSITNA STATION, 12 SUMMER OBSERVATIONS WERE LESS THAN 0.002 mg./l. THE 9 WINTER OBSERVATIONS AND THE 6 BREAKUP OBSERVATIONS WERE LESS THAN 0.003 mg/l.
8. (d) = DISSOLVED

DATA SUMMARY - CADMIUM (d)

SOURCE: USGS

FIGURE E.2.107



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

TES

CRITERIA 0.0012 IN HARD WATER AND 0.0004 mg/l IN SOFT WATER (EPA 1976).

CRITERION LESS THAN 0.0002 mg./l. (McNEELY et al. 1979).

ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

AT GOLD CREEK, 3 SUMMER OBSERVATIONS WERE LESS THAN 0.010 mg/l. THE 1 WINTER OBSERVATION WAS LESS THAN 0.001 mg./l.

5 AT TALKEETNA, 5 SUMMER OBSERVATIONS, 1 WINTER OBSERVATION AND 2 BREAKUP OBSERVATIONS WERE LESS THAN 0.010 mg./l.

6 AT SUNSHINE, 4 SUMMER OBSERVATIONS WERE LESS THAN 0.010 mg/l

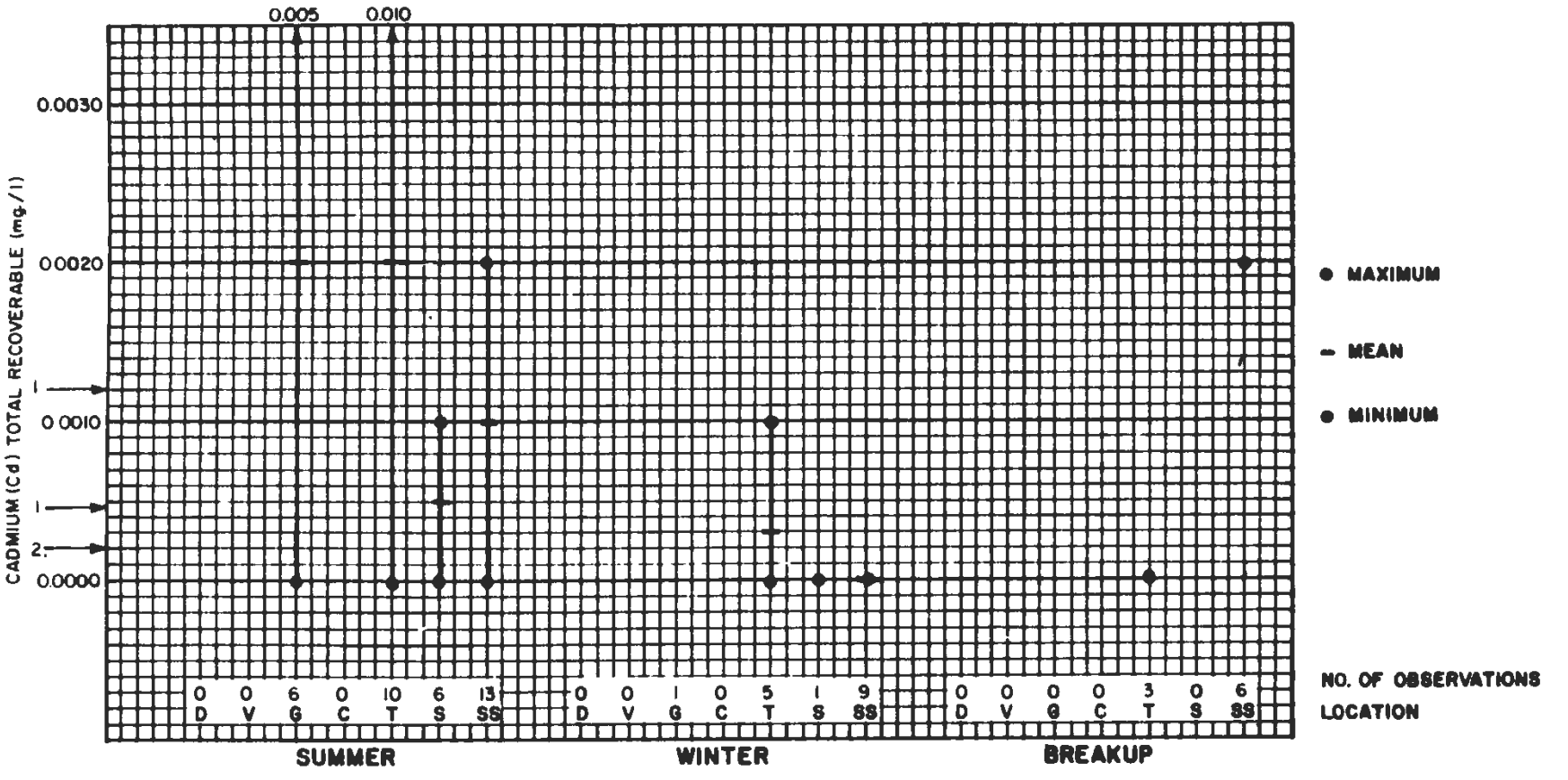
7 AT SUSITNA STATION, 7 SUMMER OBSERVATIONS, 7 WINTER OBSERVATIONS AND 5 BREAKUP OBSERVATIONS WERE LESS THAN 0.020 mg/l

8 (t) = TOTAL RECOVERABLE

DATA SUMMARY - CADMIUM (t)

USGS

FIGURE E.2.108



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES

1 CRITERIA 0.0012 IN HARD WATER AND 0.0004 mg/l IN SOFT WATER (EPA 1976).

2 CRITERION LESS THAN 0.0002 mg./l. (McNEELY et al. 1979).

3 ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

4 AT GOLD CREEK, 3 SUMMER OBSERVATIONS WERE LESS THAN 0.010 mg/l. THE 1 WINTER OBSERVATION WAS LESS THAN 0.001 mg./l.

5 AT TALKEETNA, 5 SUMMER OBSERVATIONS, 1 WINTER OBSERVATION AND 2 BREAKUP OBSERVATIONS WERE LESS THAN 0.010 mg /l.

6 AT SUNSHINE, 4 SUMMER OBSERVATIONS WERE LESS THAN 0.010 mg./l

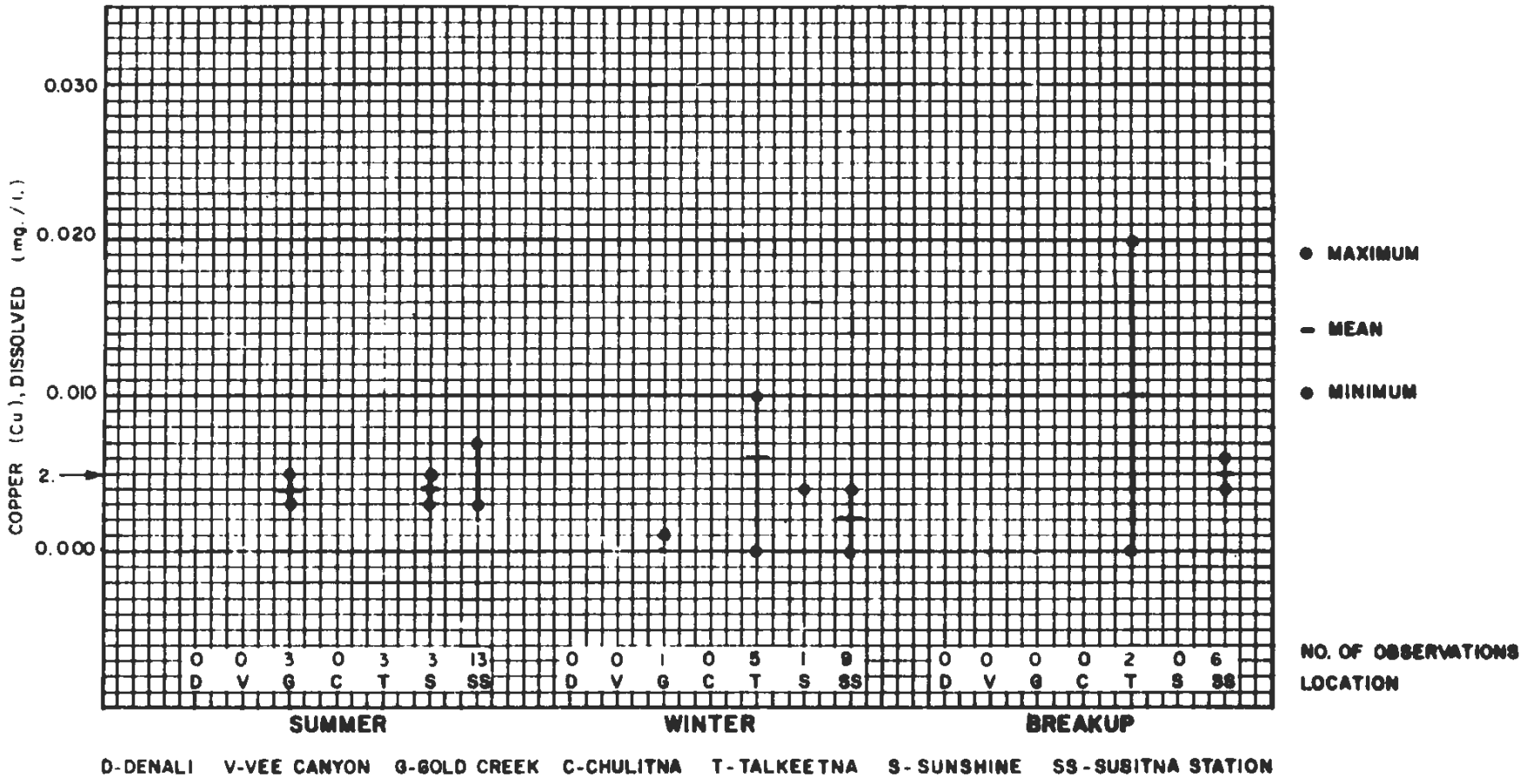
7 AT SUSITNA STATION, 7 SUMMER OBSERVATIONS, 7 WINTER OBSERVATIONS AND 5 BREAKUP OBSERVATIONS WERE LESS THAN 0.020 mg/l

8 (t): TOTAL RECOVERABLE

DATA SUMMARY - CADMIUM (t)

SOURCE USGS

FIGURE E.2.108



NOTES

1 CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED THROUGH BIOASSAY (EPA 1976).

2 CRITERION 0.005 mg/l (McNEELY et al. 1979).

3 THE ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS

4 AT TALKEETNA, THE 3 SUMMER OBSERVATIONS WERE LESS THAN 0.010 mg/l.

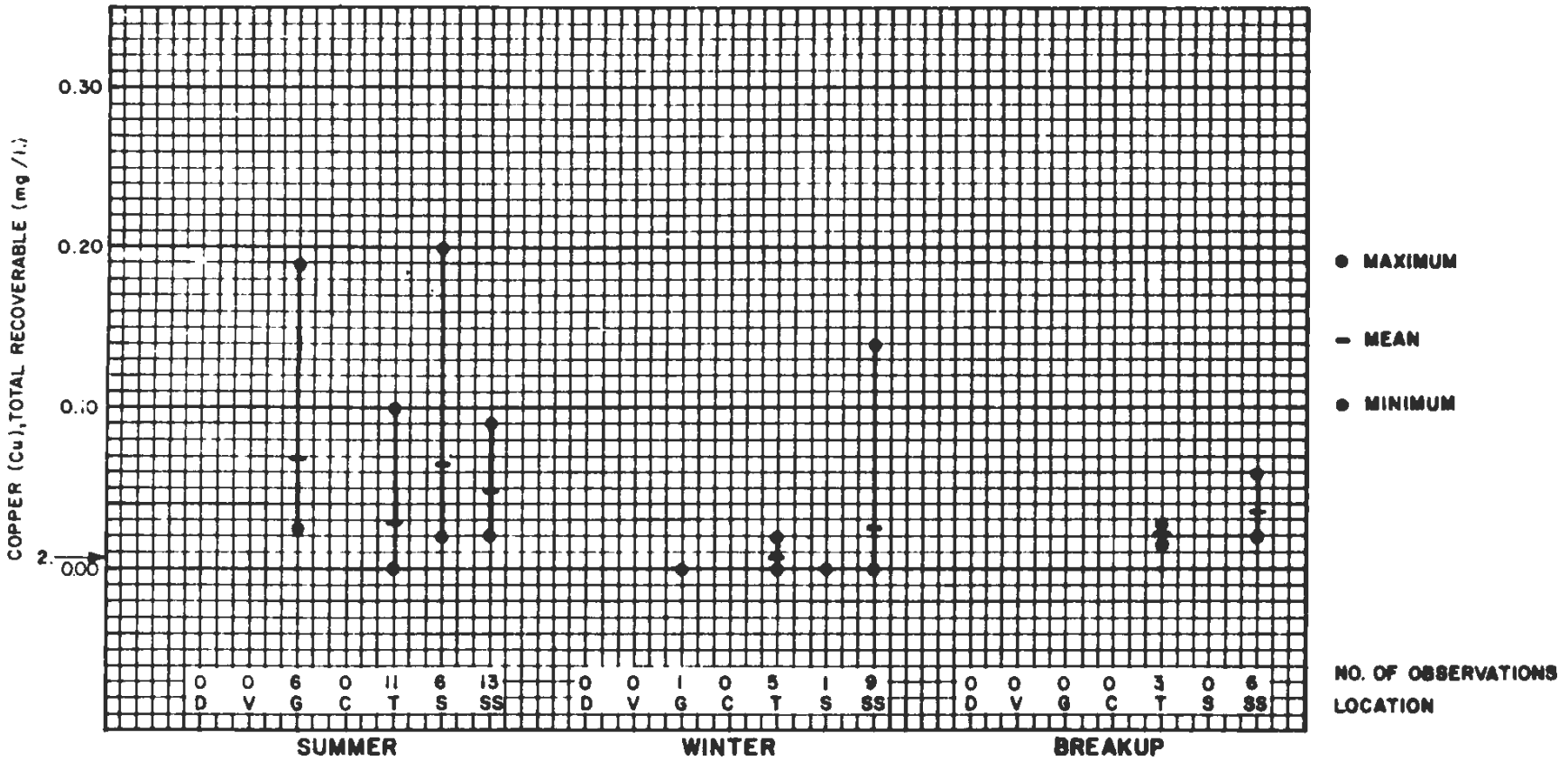
5 AT SUSITNA STATION, 6 SUMMER OBSERVATIONS, 2 WINTER OBSERVATIONS AND 2 BREAKUP OBSERVATIONS WERE LESS THAN 0.002 mg/l.

6 (d) : DISSOLVED

DATA SUMMARY COPPER (d)

SOURCE - USGS

FIGURE E.2.109



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

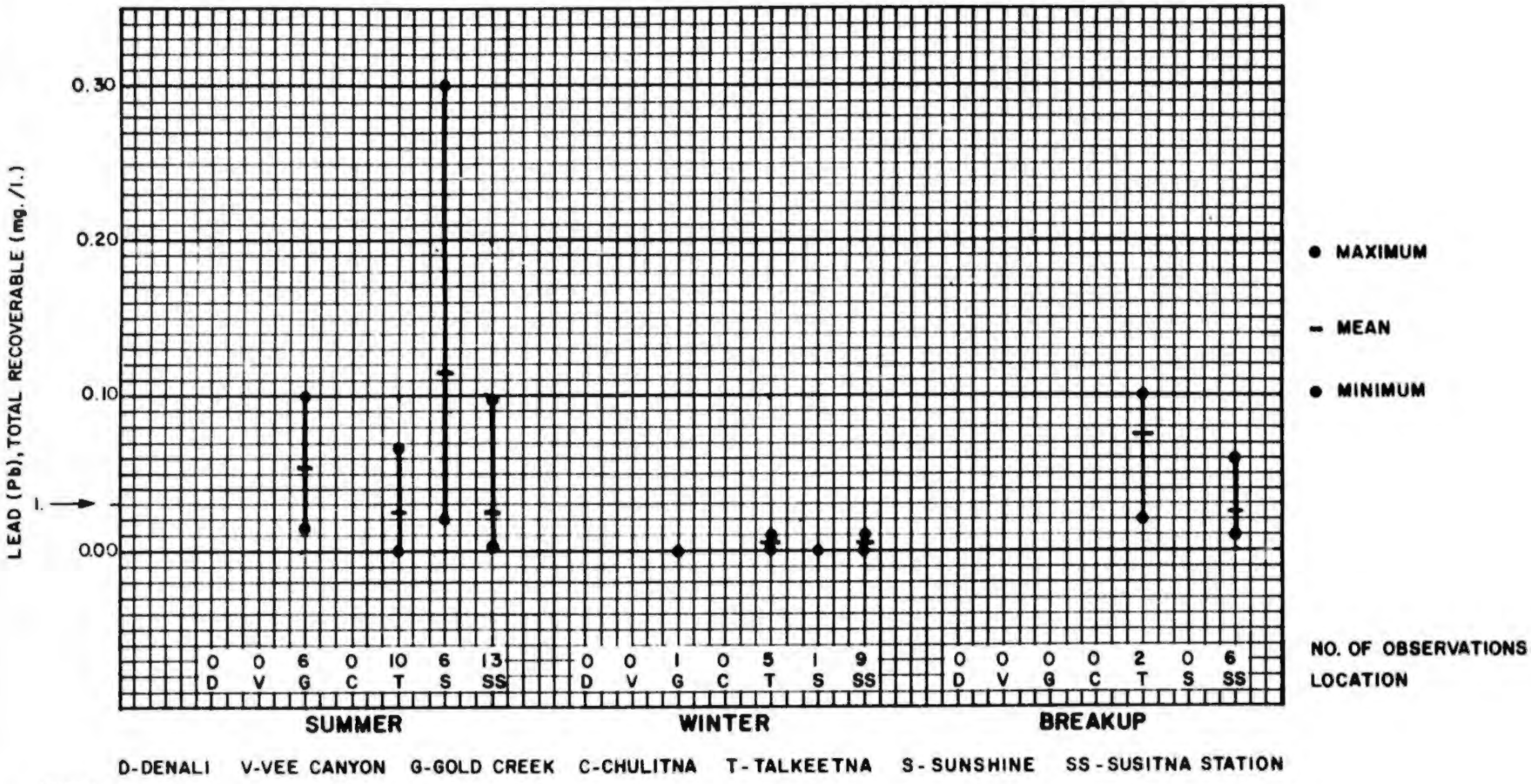
NOTES:

1. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED THROUGH BIOASSAY (EPA 1976)
2. CRITERION: 0.005 mg/l (McNEELY et al 1979).
3. THE ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS
4. AT GOLD CREEK, 1 SUMMER OBSERVATION WAS LESS THAN 0.010 mg/l.
5. AT SUSITNA STATION, 1 SUMMER OBSERVATION AND 2 WINTER OBSERVATIONS WERE LESS THAN 0.020 mg./l.
6. AT TALKEETNA, 1 BREAKUP OBSERVATION WAS LESS THAN 0.020 mg./l.
7. (t) = TOTAL RECOVERABLE.

SOURCE USGS

DATA SUMMARY-COPPER (t)

FIGURE E 2.110



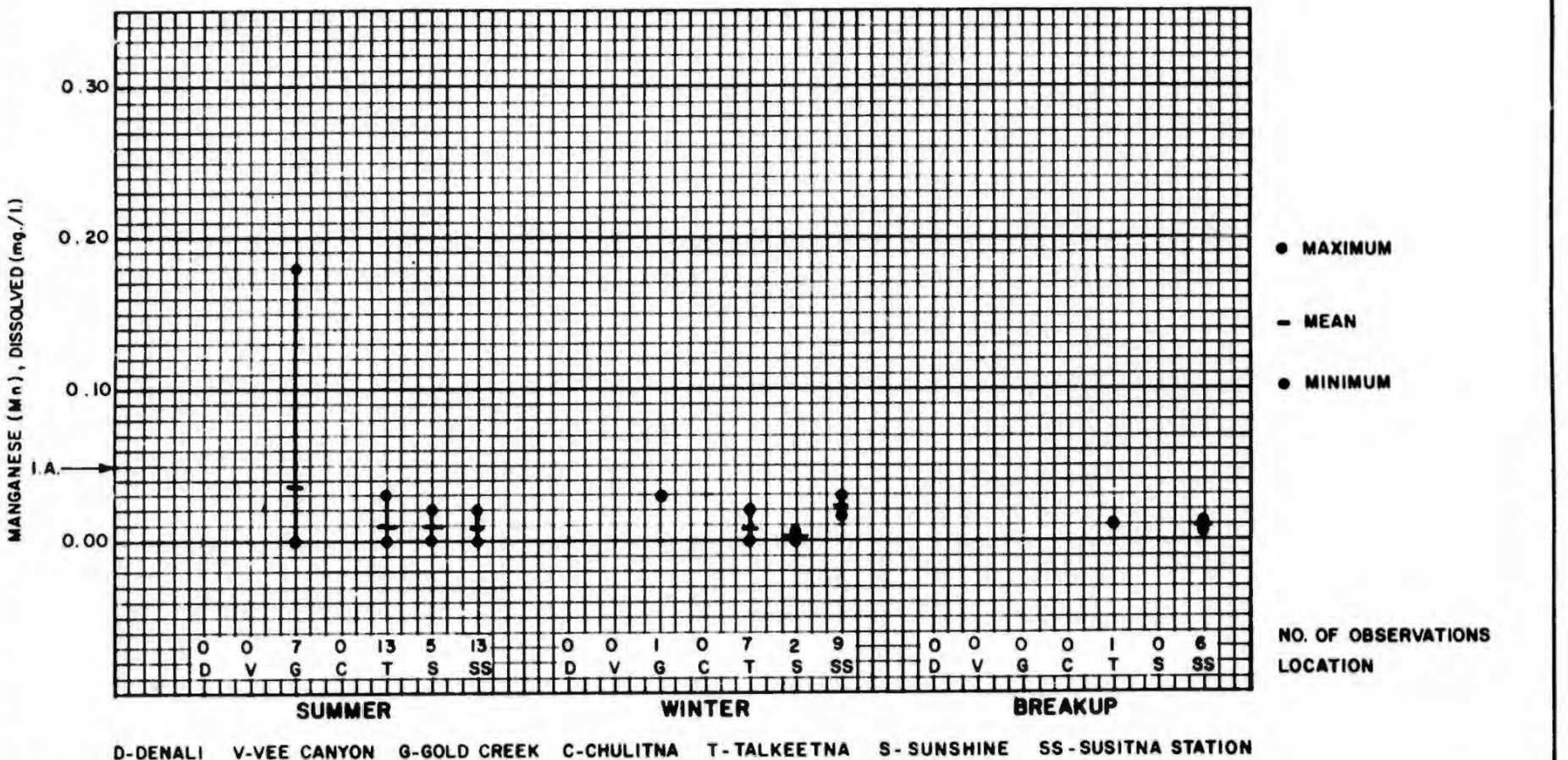
NOTES

1. CRITERION: LESS THAN 0.03 mg./l. (McNEELY et al. 1979).
2. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED BY BIOASSAY (EPA 1976).
3. ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT GOLD CREEK, 3 SUMMER OBSERVATIONS WERE LESS THAN 0.100 mg./l.
5. AT TALKEETNA, 6 SUMMER OBSERVATIONS AND 1 WINTER OBSERVATION WERE LESS THAN 0.100 mg./l.
6. AT SUNSHINE, 2 SUMMER OBSERVATIONS WERE LESS THAN 0.100 mg./l.
7. AT SUSITNA STATION, 5 SUMMER OBSERVATIONS, 3 WINTER OBSERVATIONS, AND 2 BREAKUP OBSERVATIONS WERE LESS THAN 0.200 mg./l.
8. (t) = TOTAL RECOVERABLE.

SOURCE USGS

DATA SUMMARY - LEAD (t)

FIGURE E.2.112



NOTES:

I.A CRITERION: LESS THAN 0.05 mg./l. (EPA 1976)

I.B. ESTABLISHED TO PROTECT WATER SUPPLIES.

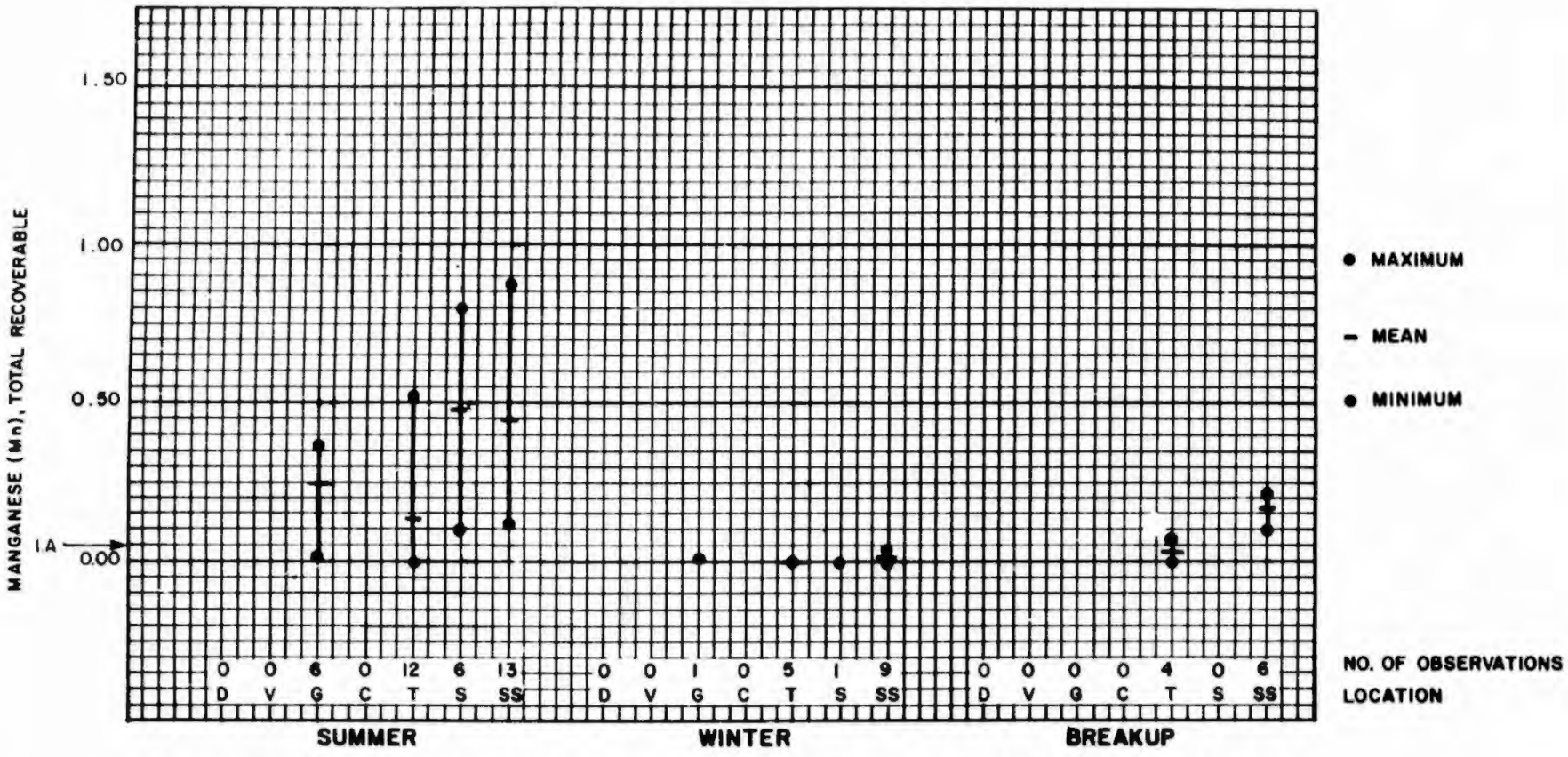
2. AT SUSITNA STATION, 6 SUMMER OBSERVATIONS, 1 WINTER OBSERVATION AND 6 BREAKUP OBSERVATIONS WERE LESS THAN 0.010 mg./l.

3. (d) = DISSOLVED

DATA SUMMARY - MANGANESE (d)

SOURCE: USGS

FIGURE E.2.113



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

1.A. CRITERION: LESS THAN 0.05 mg./l. (EPA 1976).

1.B. ESTABLISHED TO PROTECT WATER SUPPLIES.

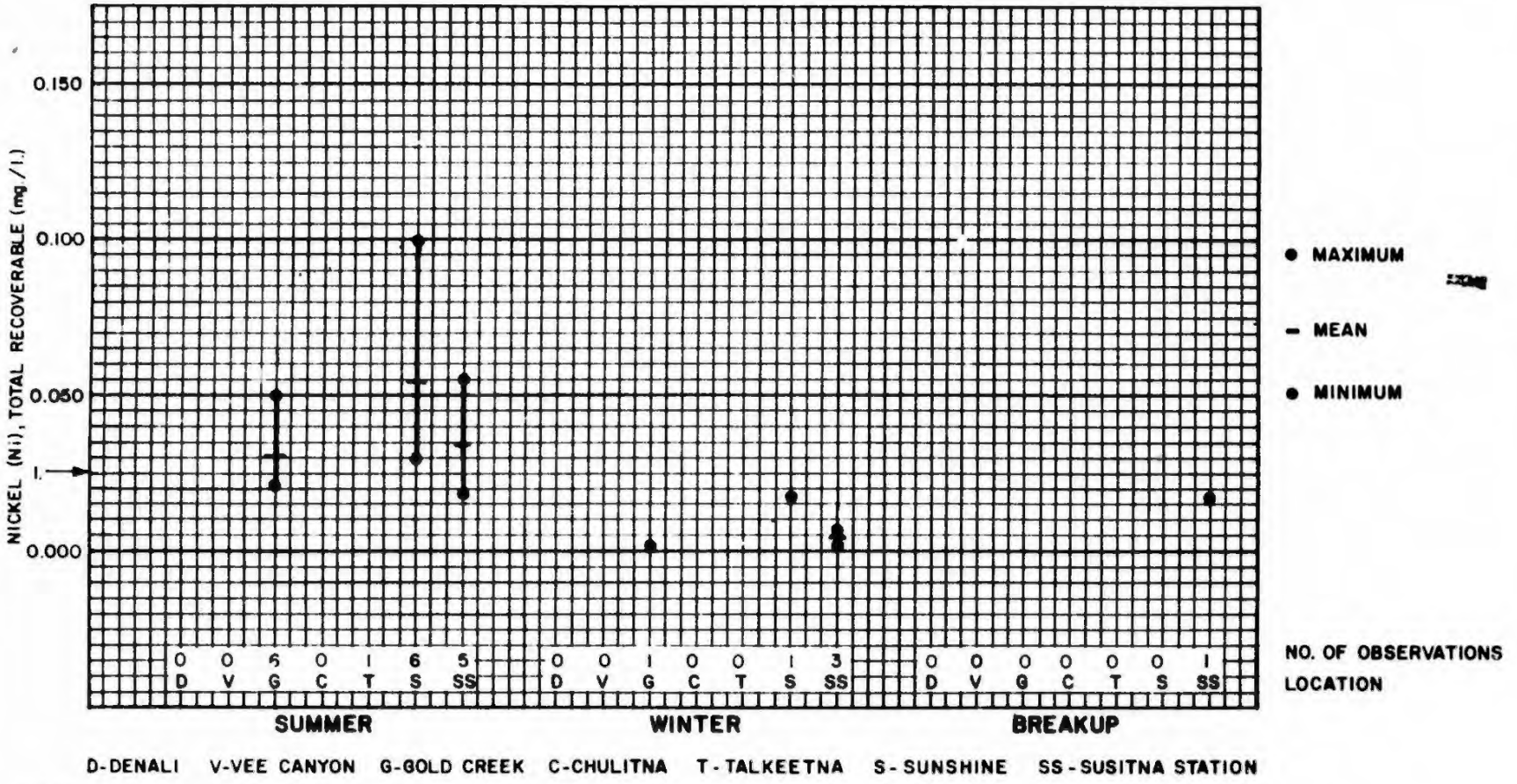
2. AT SUSITNA STATION, 1 BREAKUP OBSERVATION WAS LESS THAN 0.01 mg./l.

3. (t) = TOTAL RECOVERABLE.

DATA SUMMARY - MANGANESE (t)

SOURCE: USGS

FIGURE E.2.114



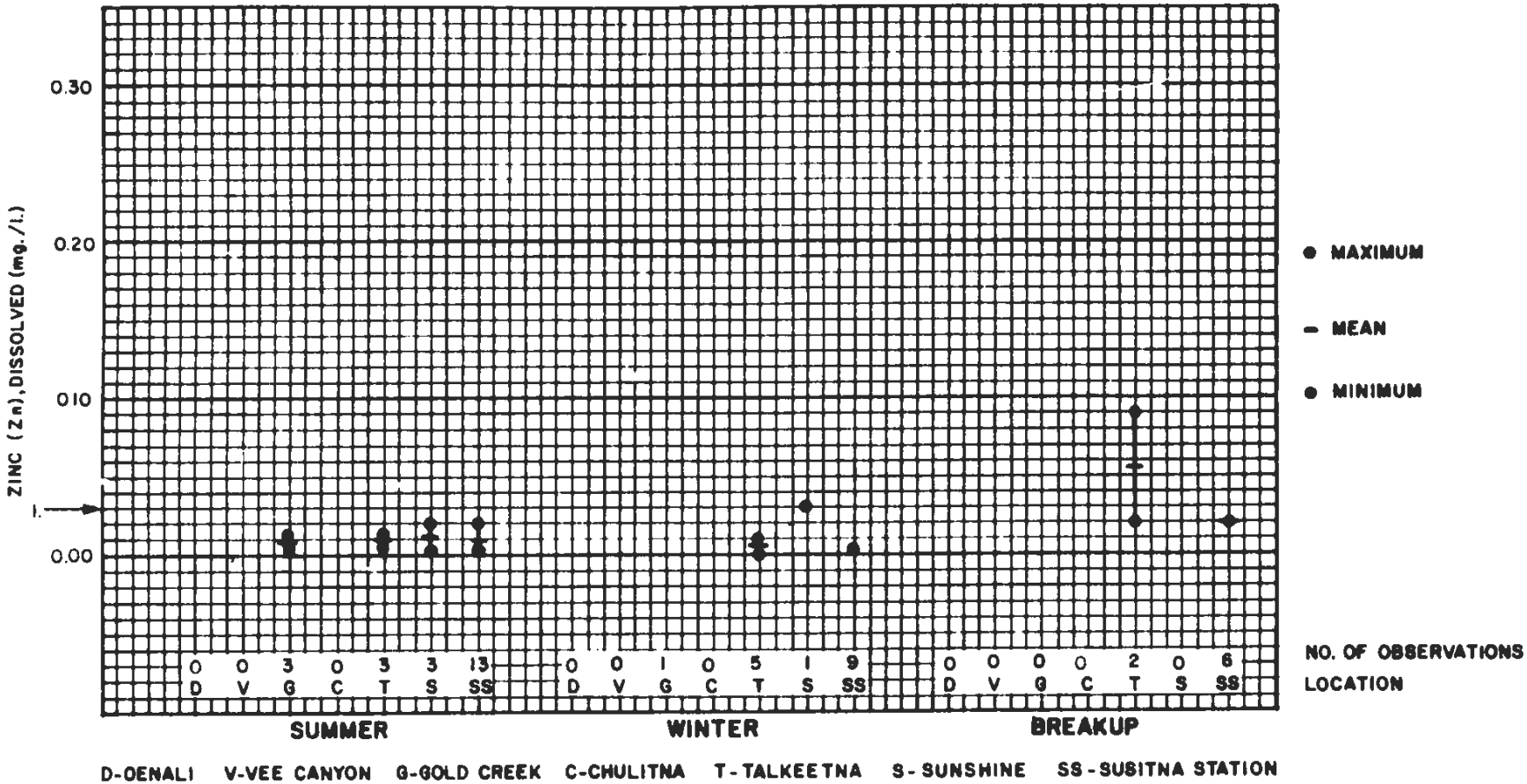
NOTES:

1. CRITERION: LESS THAN 0.025 mg./l. (McNEELY et al. 1979).
2. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED THROUGH BIOASSAY (EPA 1976).
3. THE ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT GOLD CREEK, 2 SUMMER OBSERVATIONS WERE LESS THAN 0.05 mg./l.
5. AT TALKEETNA, THE 1 SUMMER OBSERVATION WAS LESS THAN 0.05 mg./l.
6. AT SUNSHINE, 2 SUMMER OBSERVATIONS WERE LESS THAN 0.05 mg./l.
7. (t) = TOTAL RECOVERABLE.

SOURCE: USGS

DATA SUMMARY- NICKEL (t)

FIGURE E.2.117



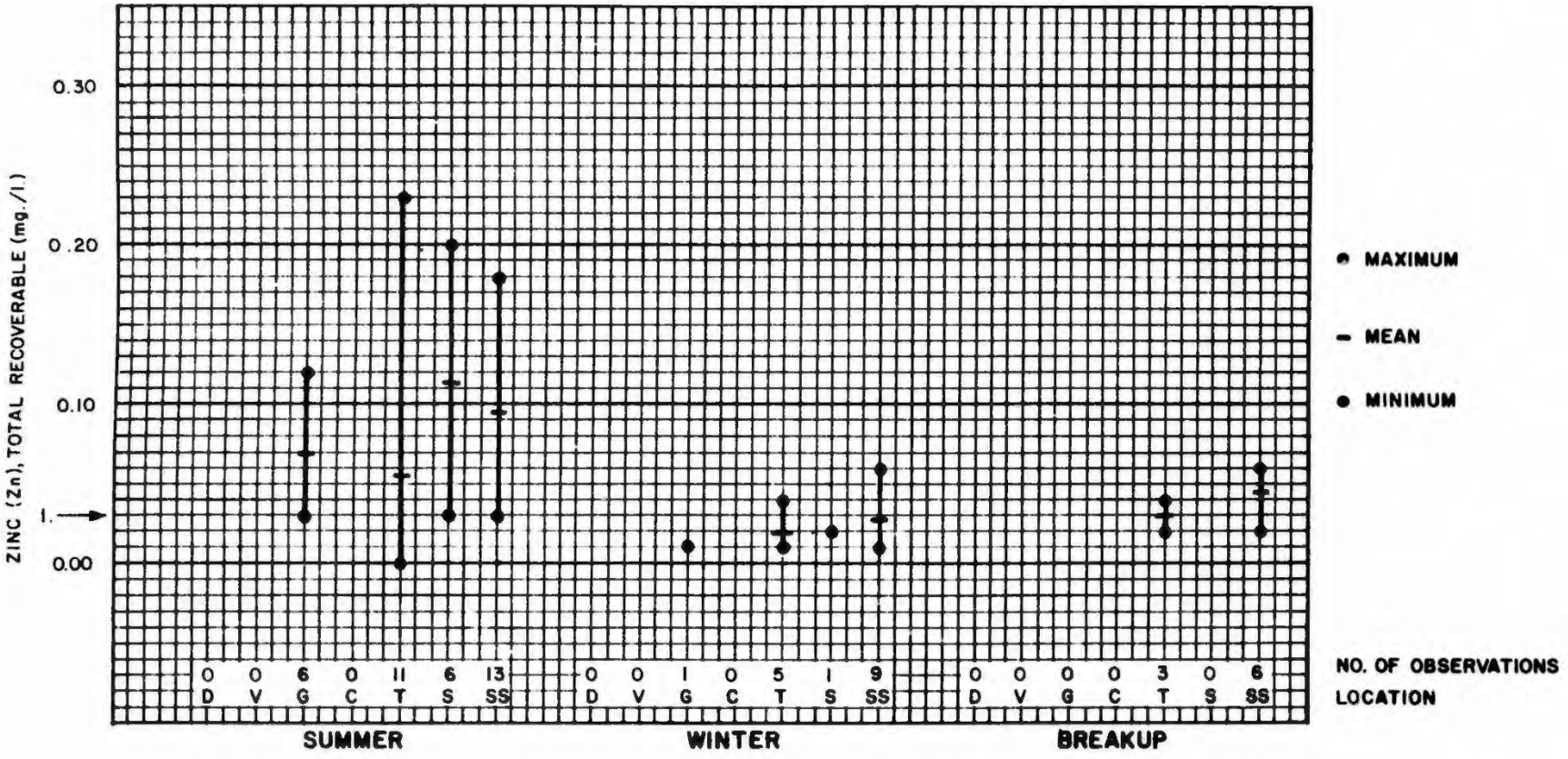
NOTES:

1. CRITERION: LESS THAN 0.03 mg./l. (McNEELY et al. 1979).
2. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED THROUGH BIOASSY (EPA 1976).
3. THE ABOVE CRITERIA BASED ON HUMAN HEALTH EFFECTS.
4. AT SUSITNA STATION, 8 SUMMER OBSERVATIONS, 8 WINTER OBSERVATIONS AND 4 BREAKUP OBSERVATIONS WERE LESS THAN 0.020 mg./l.
5. AT GOLD CREEK THE 1 WINTER OBSERVATION WAS LESS THAN 0.012 mg./l.
6. (d)= DISSOLVED

SOURCE USGS

DATA SUMMARY - ZINC (d)

FIGURE E.2.118



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

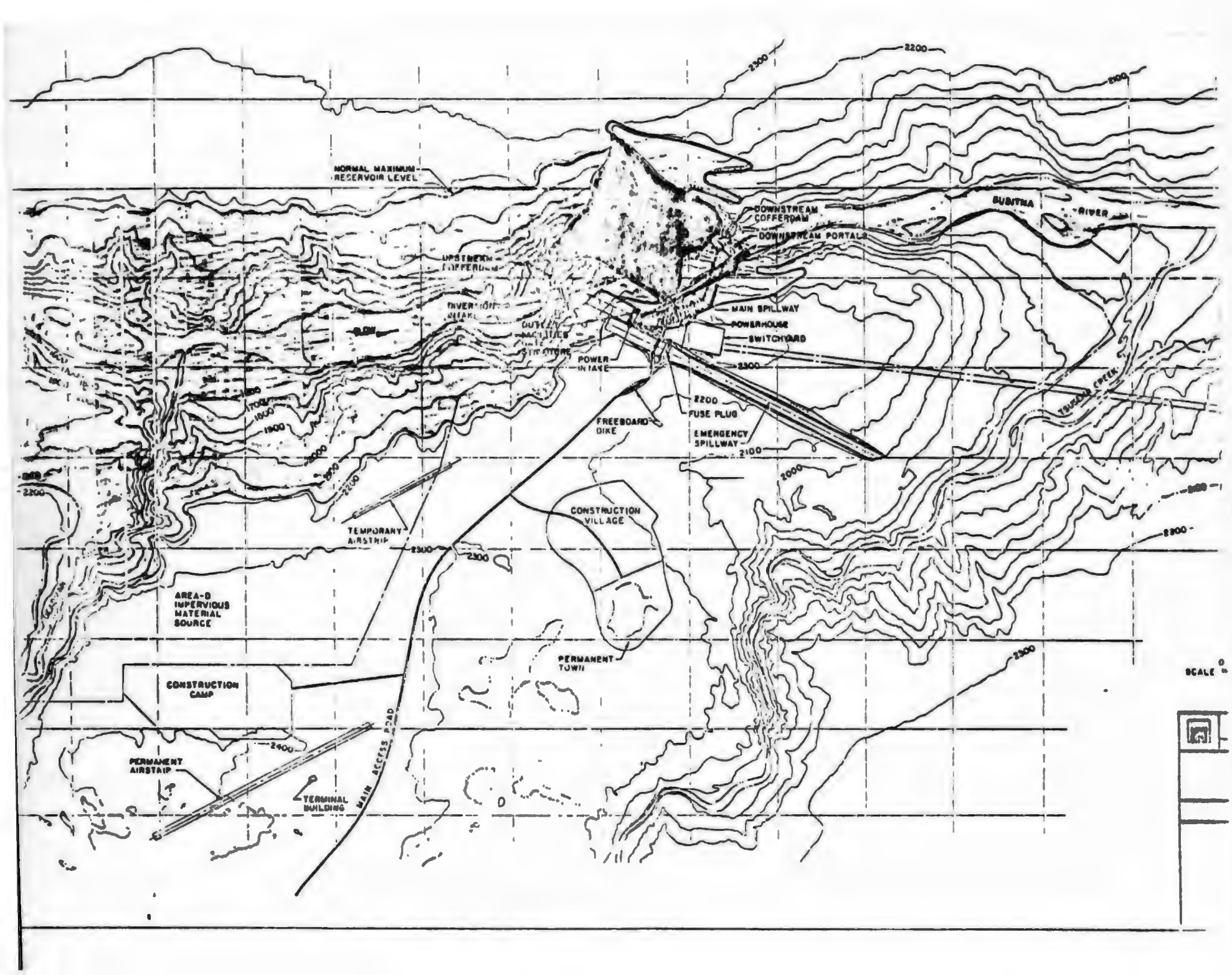
NOTES:

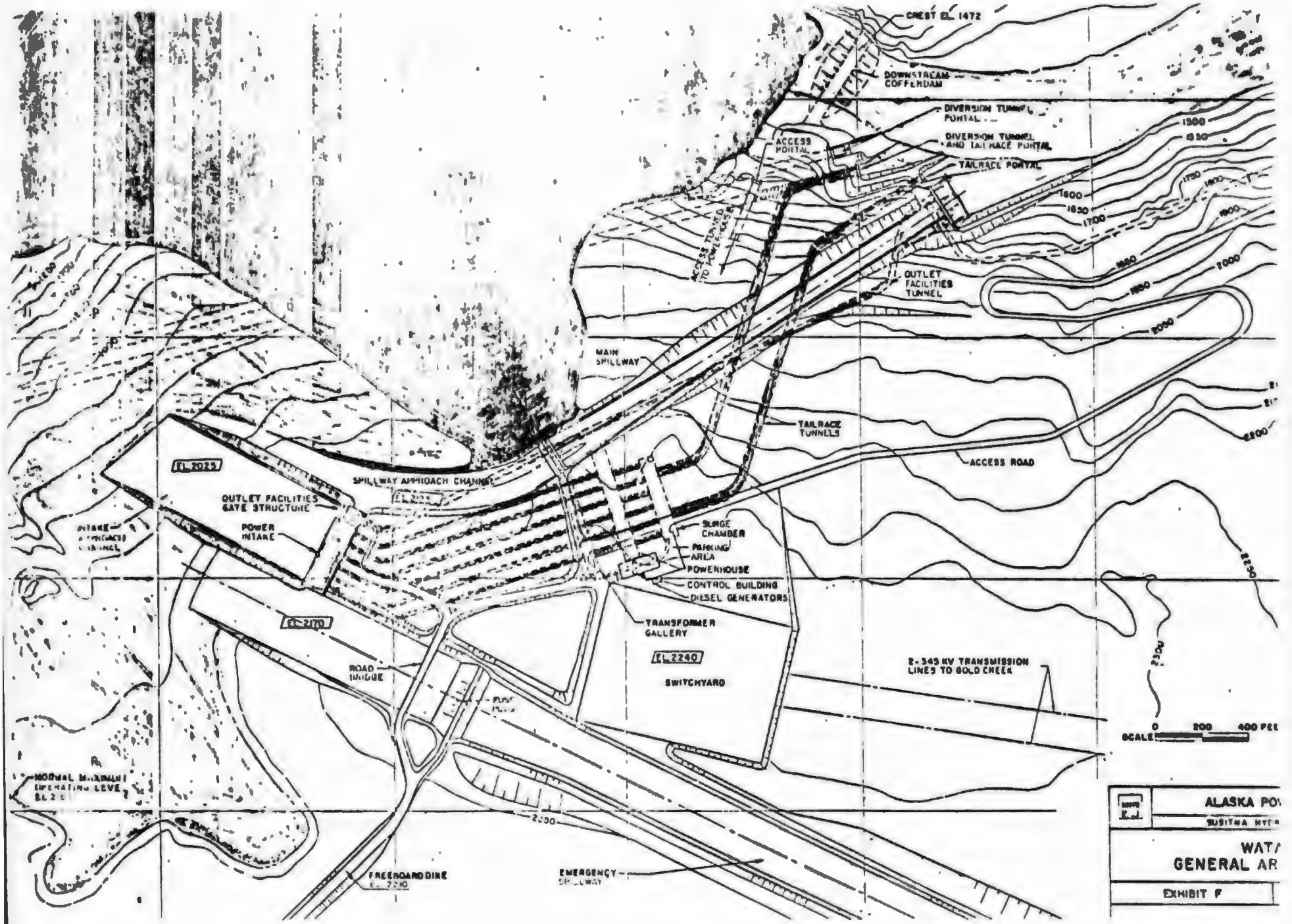
1. CRITERION: LESS THAN 0.03 mg./l. (McNEELY et al. 1979).
2. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED THROUGH BIOASSAY (EPA 1976).
3. THE ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT SUSITNA STATION, 1 SUMMER OBSERVATION AND 2 WINTER OBSERVATIONS WERE LESS THAN 0.020 mg./l.
5. (t) = TOTAL RECOVERABLE.

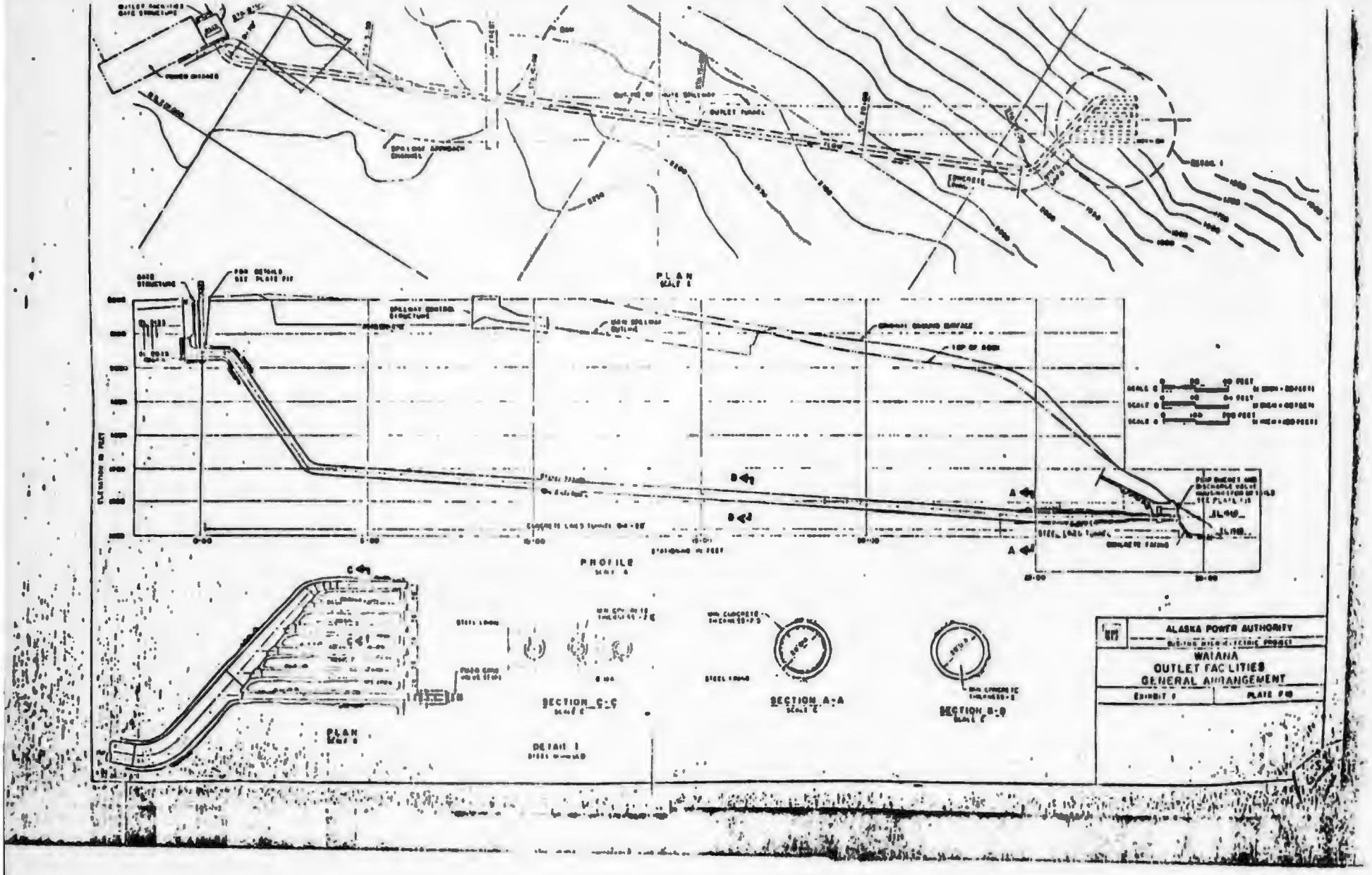
DATA SUMMARY- ZINC (t)

SOURCE: USGS

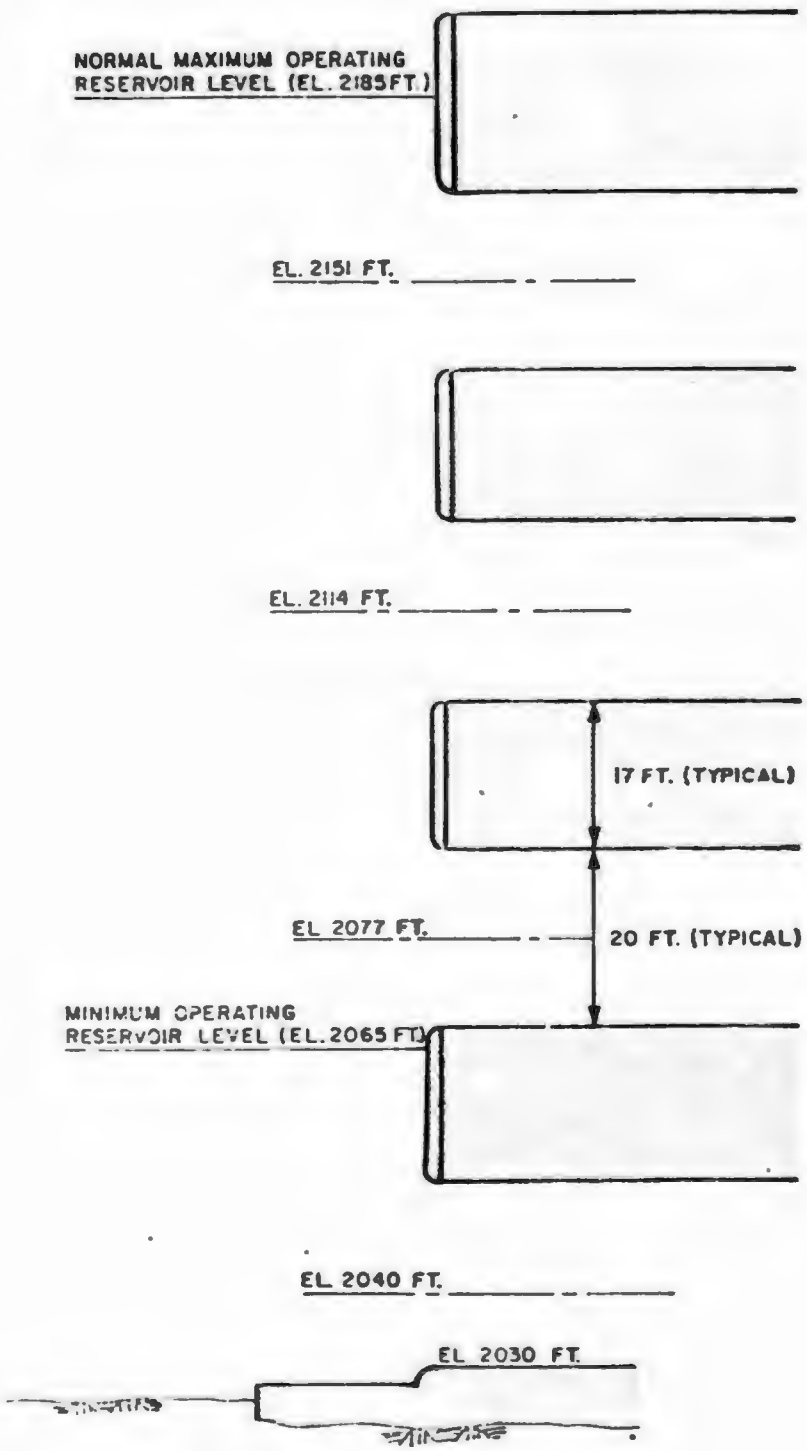
FIGURE E.2.119


NORMAL MAXIMUM RESERVOIR LEVEL
DOWNSTREAM COFFERDAM
DOWNSTREAM PORTALS
SUSITNA
RIVER
MAIN SPILLWAY
POWERHOUSE
SWITCHYARD
POWER INTAKE
FUSE PLUG
FREEBOARD DIKE
EMERGENCY SPILLWAY
TSUSENA CREEK
CONSTRUCTION VILLAGE
TEMPORARY AIRSTRIP
AREA-D IMPERVIOUS MATERIAL SOURCE
PERMANENT TOWN
CONSTRUCTION CAMP
PERMANENT AIRSTRIP
TERMINAL BUILDING
MAIN ACCESS ROAD
2200
2300
2400
2100
2000
1900
1800
1700
1600
SCALE


CREST EL. 1472
DOWNSTREAM COFFERDAM
DIVERSION TUNNEL PORTAL
ACCESS PORTAL
DIVERSION TUNNEL AND TAILRACE PORTAL
TAILRACE PORTAL
ACCESS TUNNEL TO POWERHOUSE
OUTLET FACILITIES TUNNEL
MAIN SPILLWAY
TAILRACE TUNNELS
ACCESS ROAD
EL. 2025
SPILLWAY APPROACH CHANNEL
OUTLET FACILITIES GATE STRUCTURE
POWER INTAKE
SURGE CHAMBER
PARKING AREA
POWERHOUSE
CONTROL BUILDING
DIESEL GENERATORS
EL. 2170
TRANSFORMER GALLERY
EL. 2240
SWITCHYARD
ROAD BRIDGE
2-345 KV TRANSMISSION LINES TO GOLD CREEK
NORMAL MAXIMUM OPERATING LEVEL EL. 2
FREEBOARD DIKE EL. 2210
EMERGENCY SPILLWAY
SCALE
ALASKA PO
SUSITNA HYD
WAT
GENERAL AR
EXHIBIT F

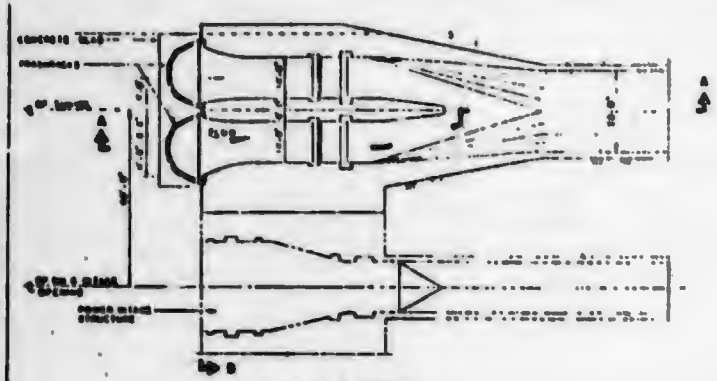

PLAN
PROFILE
SECTION C-C
SECTION A-A
SECTION B-B
PLAN
DETAIL 1
ALASKA POWER AUTHORITY
WAIANA
OUTLET FACILITIES
GENERAL ARRANGEMENT

[redacted]

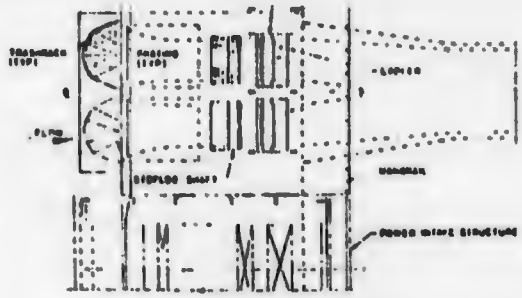


WATANA MULTILEVEL INTAKE

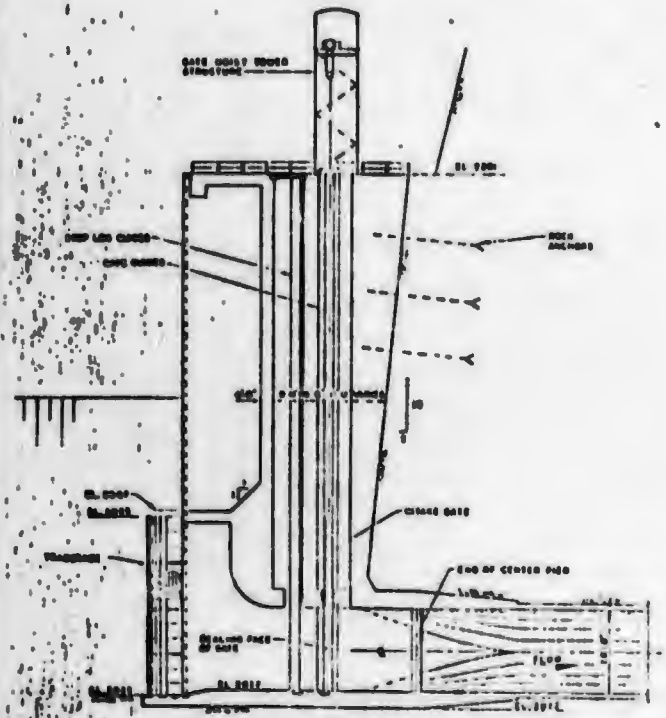
FIGURE E 2.169



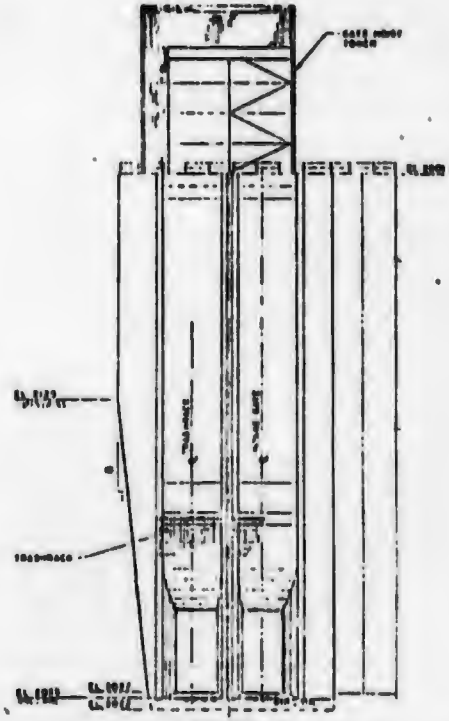
PLAN AT E TUNNEL



PLAN AT EL. 2300



SECTION A-A

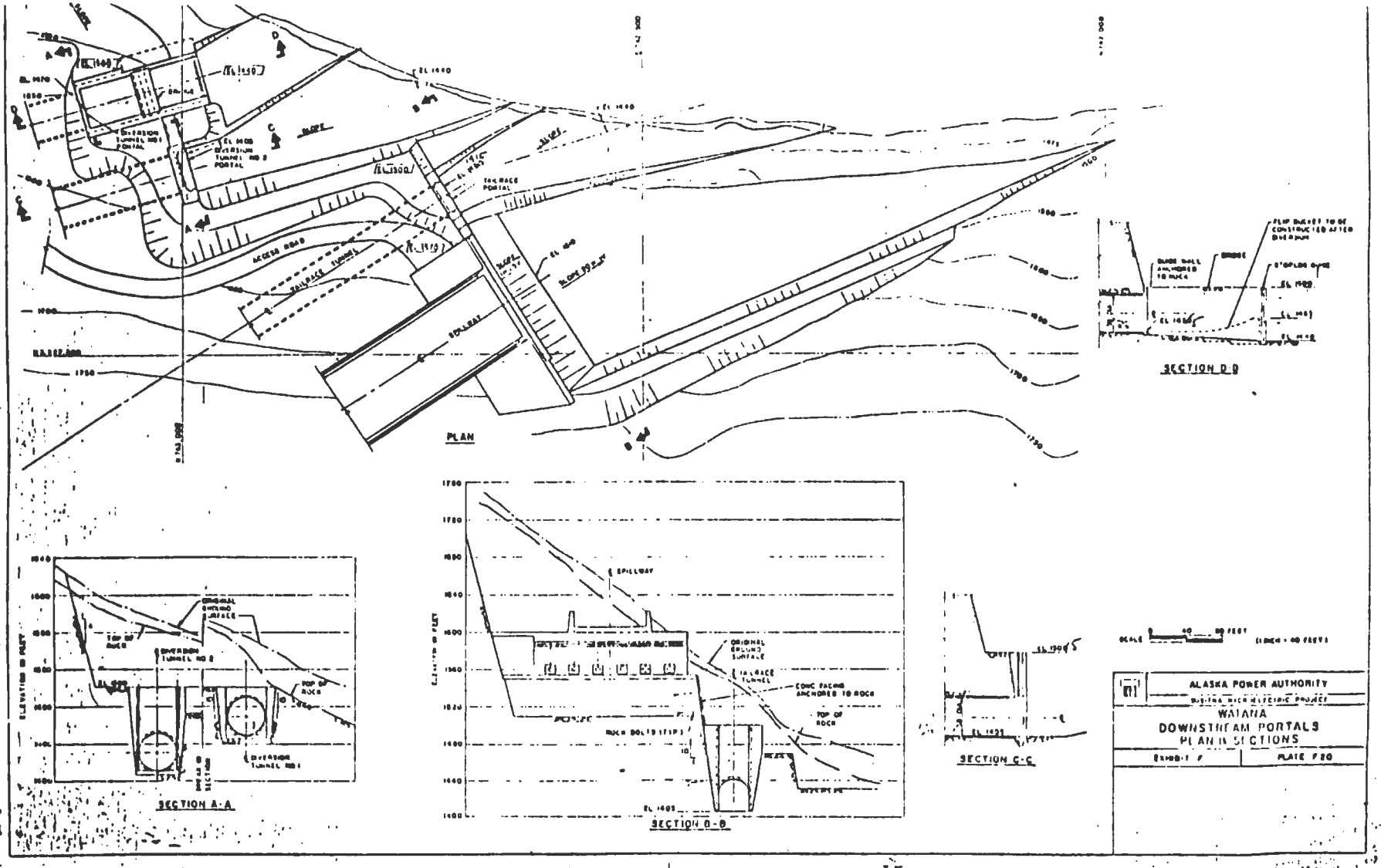


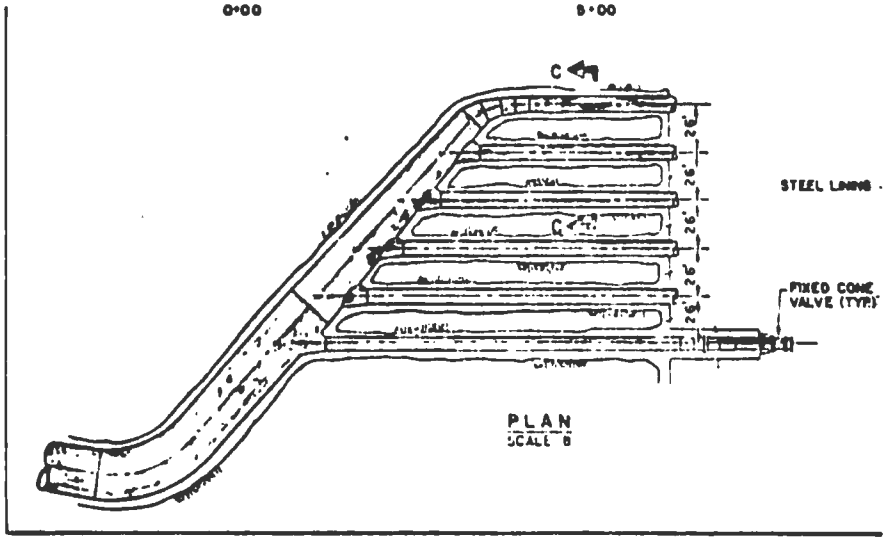
SECTION B-B

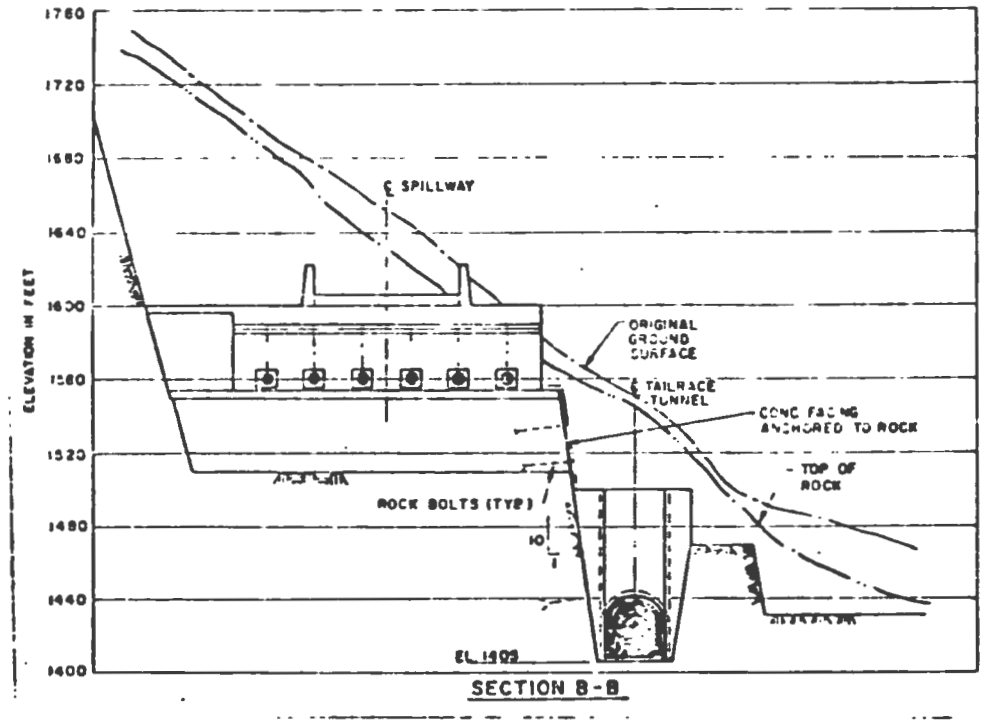
ALASKA POWER AUTHORITY

WATANA
OUTLET FACILITIES
GATE STRUCTURE

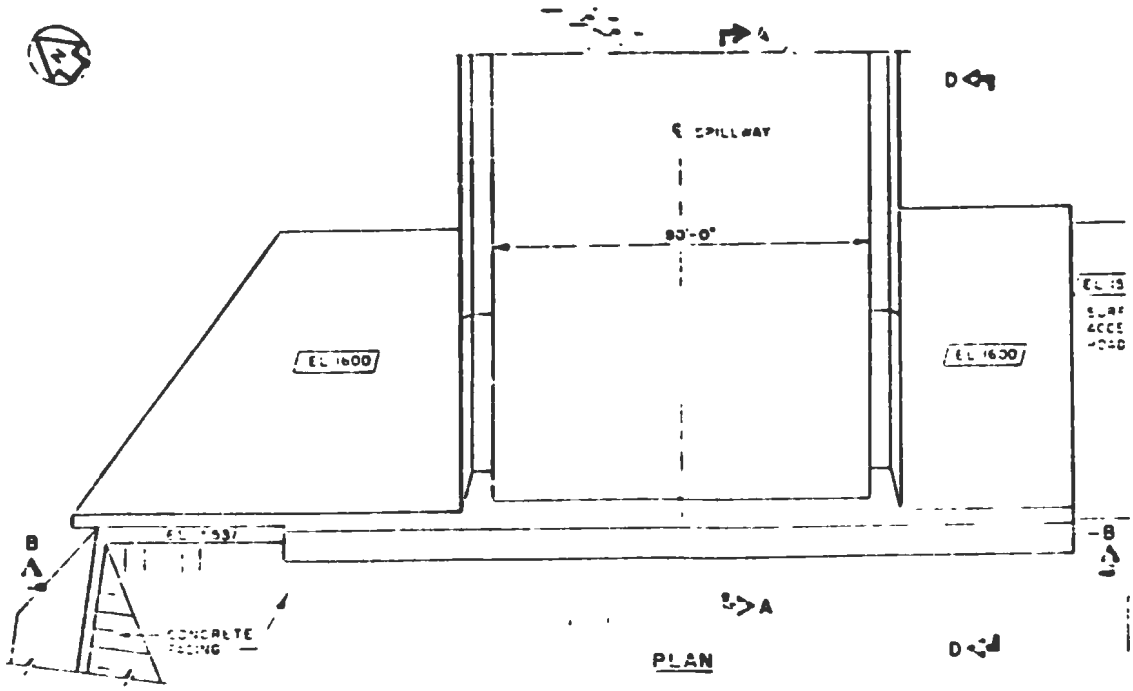
EXHIBIT F | PLATE F17


PLAN
SECTION D-D
SECTION A-A
SECTION B-B
SECTION C-C
ALASKA POWER AUTHORITY
WATANA
DOWNSTREAM PORTALS
PLAN & SECTIONS
EXHIBIT F
PLATE F20

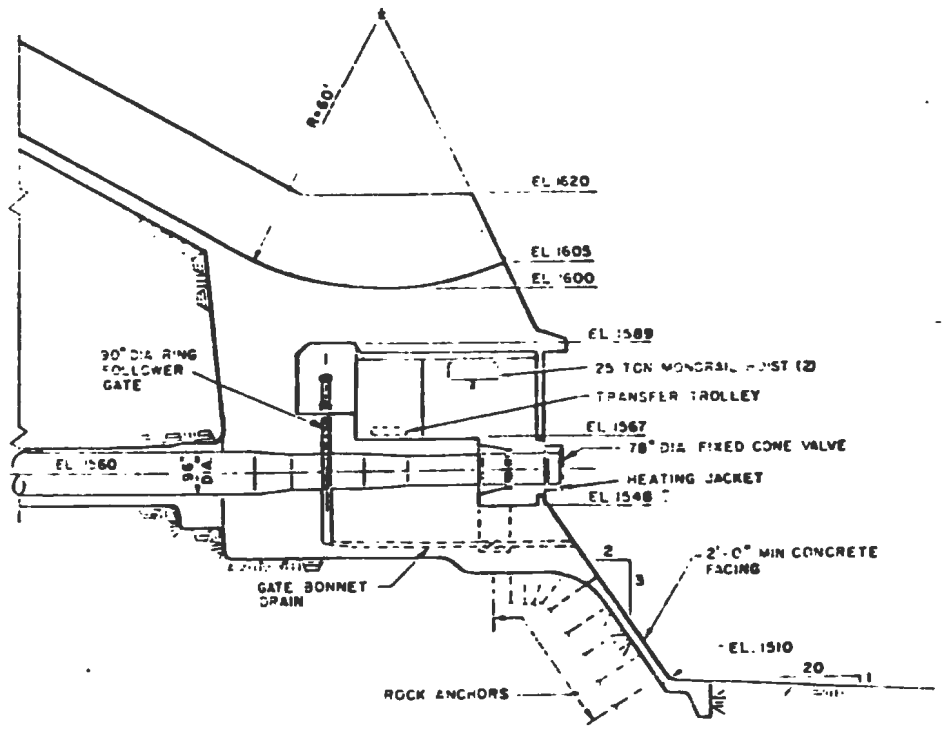

0+00
9+00
C
STEEL LINING
FIXED CONE VALVE (TYP.)
PLAN
SCALE 0


1760
1720
1680
1640
1600
1560
1520
1480
1440
1400
ELEVATION IN FEET
℄ SPILLWAY
ORIGINAL GROUND SURFACE
℄ TAILRACE TUNNEL
CONC FACING ANCHORED TO ROCK
TOP OF ROCK
ROCK BOLTS (TYP)
10'
EL 1402

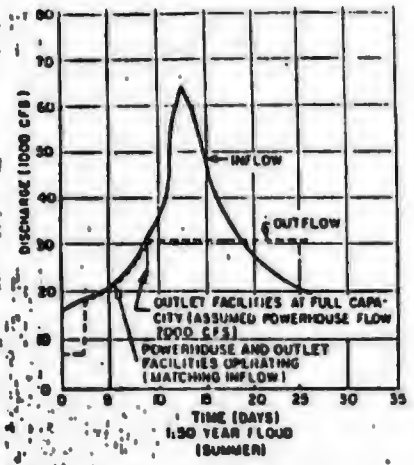
SECTION B-B

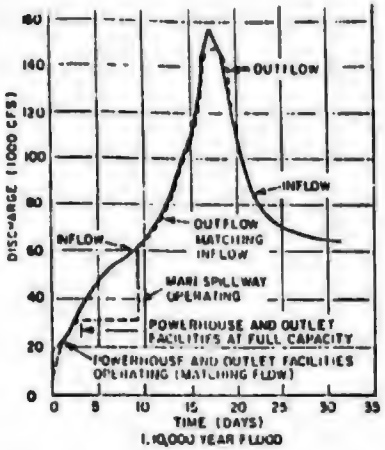


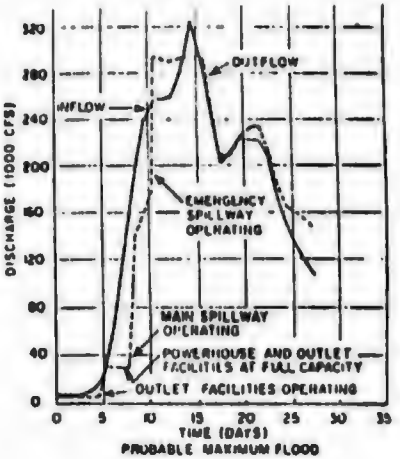
PLAN

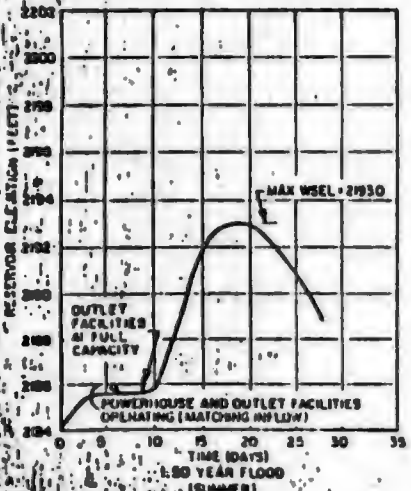


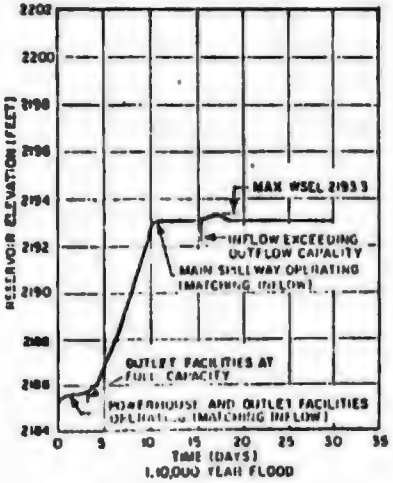
SECTION A-A (TYPICAL)

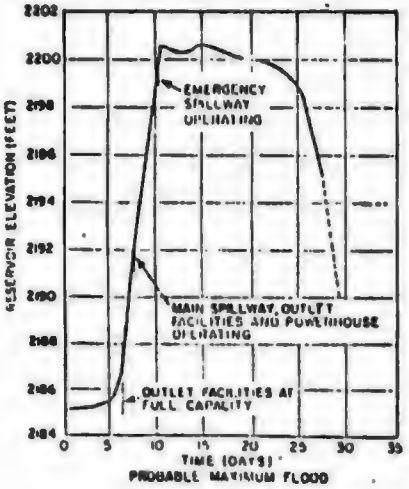






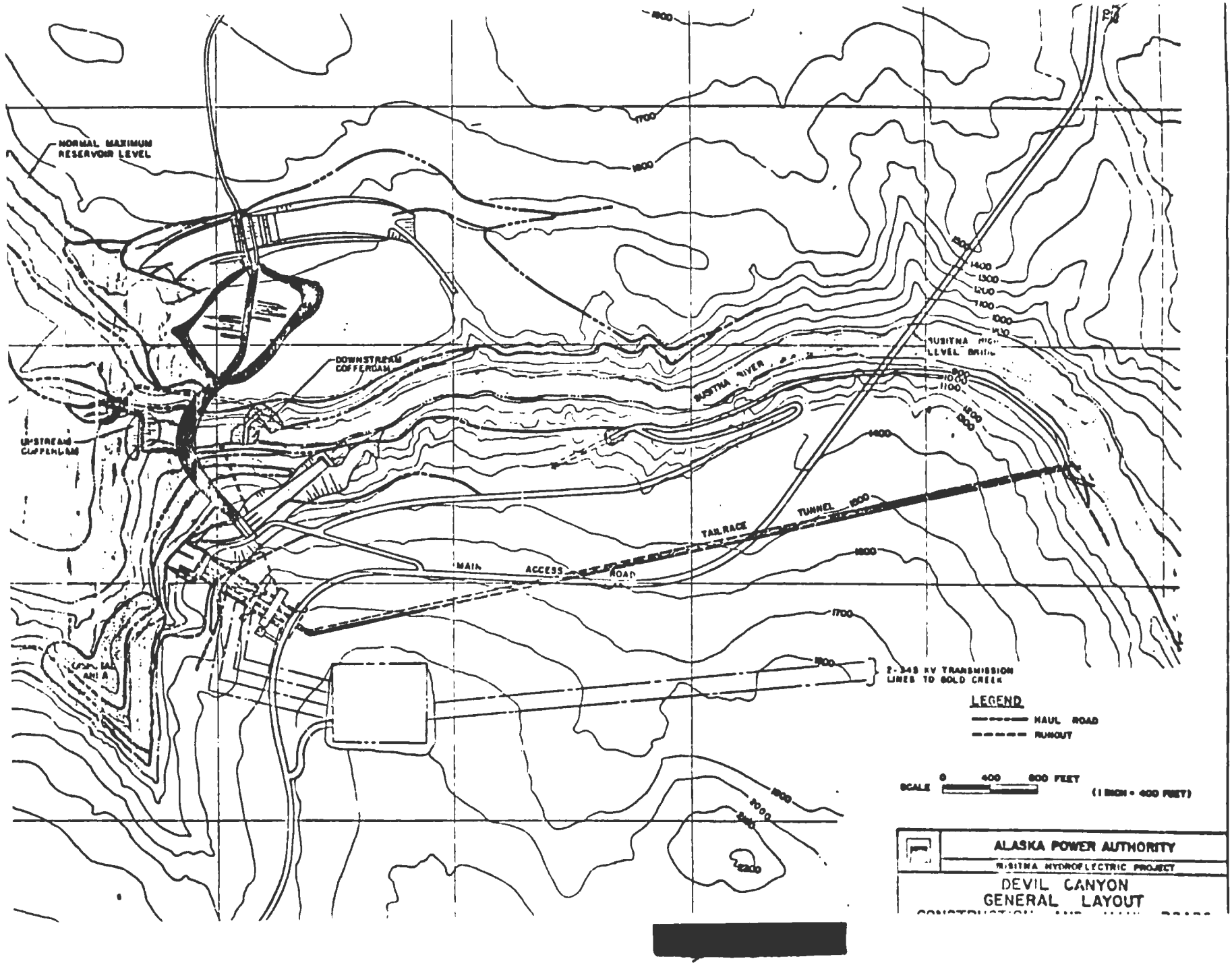


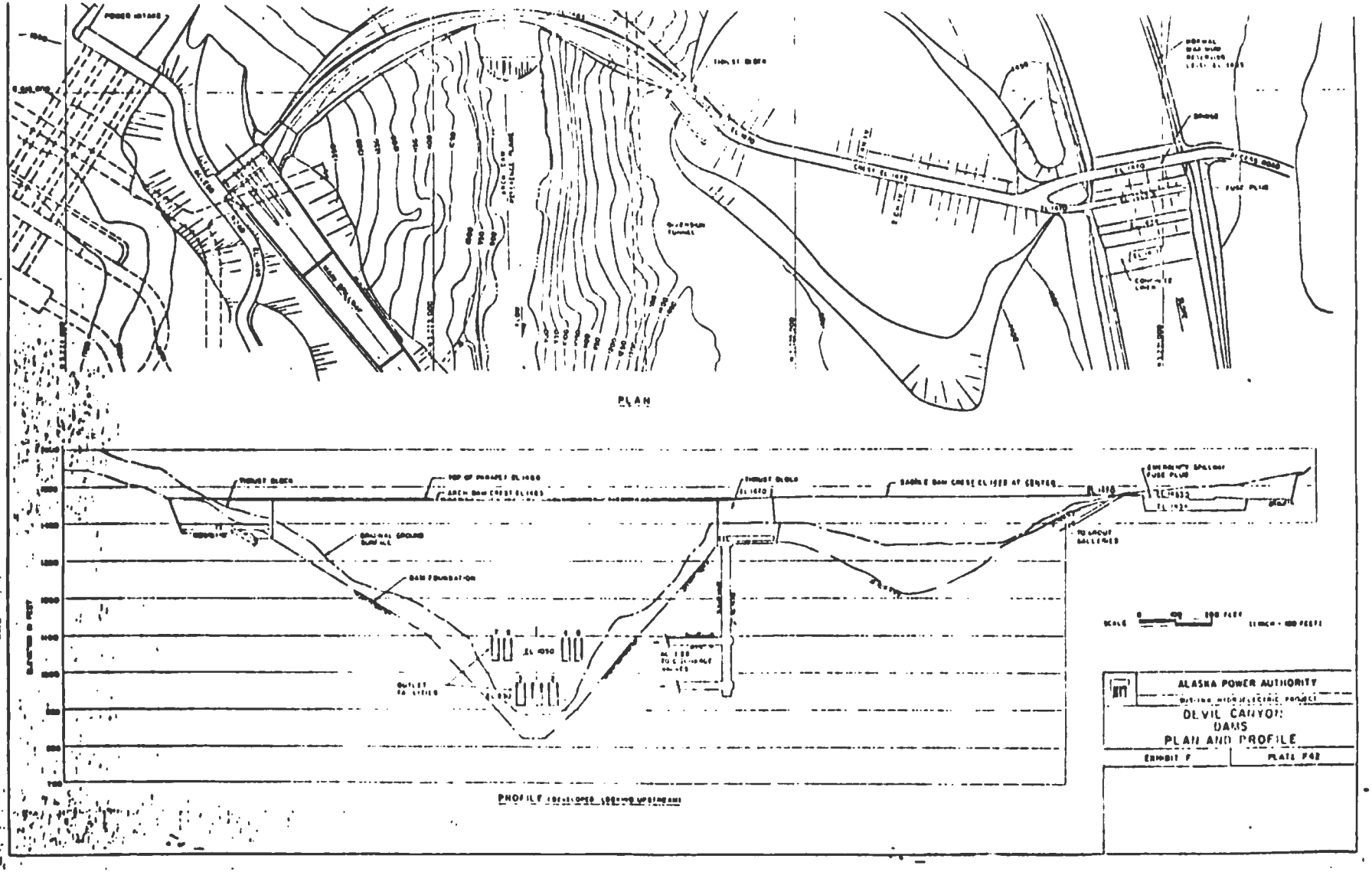




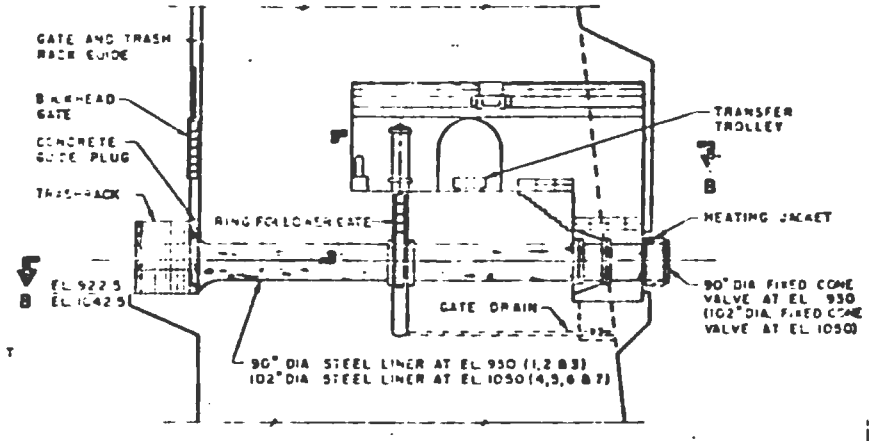
WATANA
FLOOD DISCHARGES AND RESERVOIR SURFACE ELEVATIONS

FIGURE E-61-134

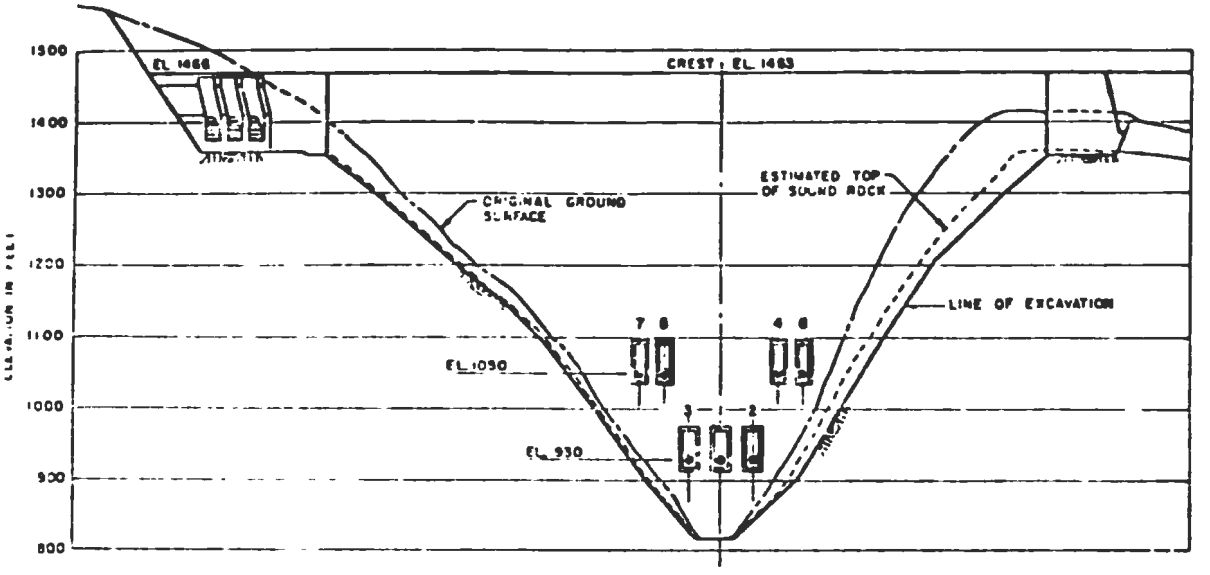

NORMAL MAXIMUM RESERVOIR LEVEL
DOWNSTREAM COFFERDAM
UPSTREAM COFFERDAM
SUSITNA RIVER
TAILRACE
TUNNEL
MAIN ACCESS ROAD
2-345 KV TRANSMISSION LINES TO GOLD CREEK
LEGEND
HAUL ROAD
RUNOUT
SCALE 0 400 800 FEET
(1 INCH = 400 FEET)
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
DEVIL CANYON
GENERAL LAYOUT


PLAN
PROFILE
ALASKA POWER AUTHORITY
DEVIL CANYON
DAMS
PLAN AND PROFILE
EXHIBIT F
PLATE F42

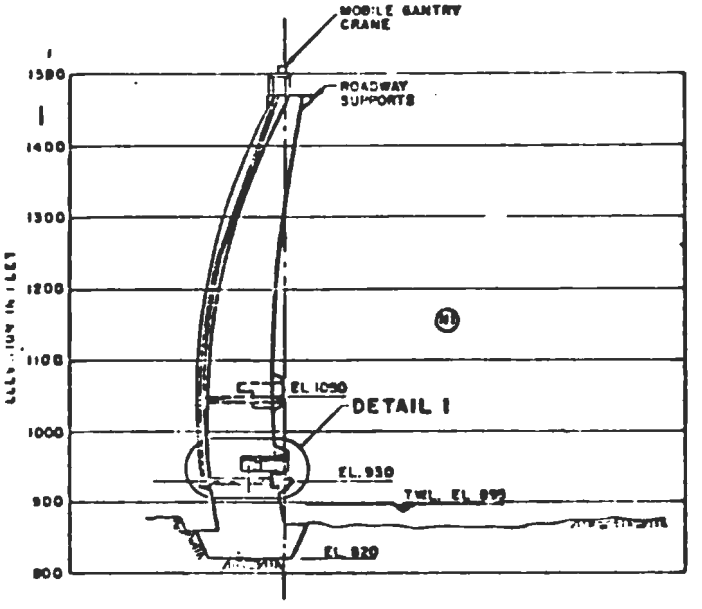
[redacted]



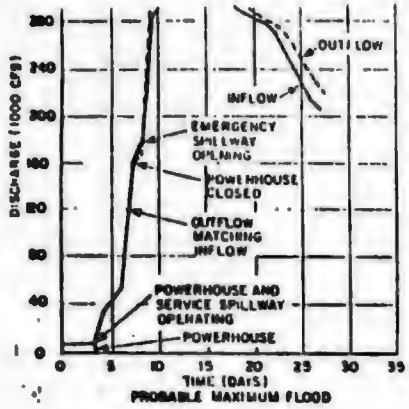
DETAIL I
SCALE 8

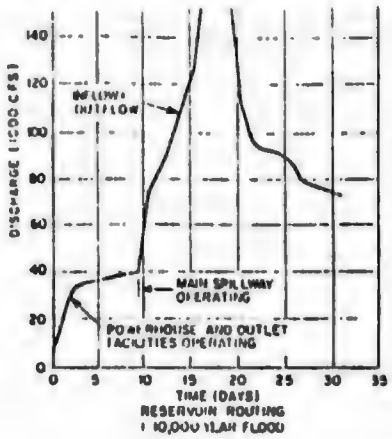


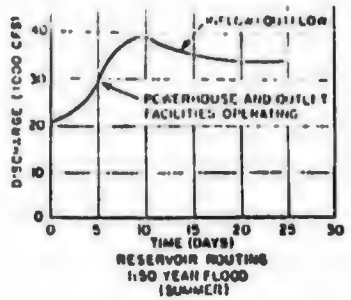
DAM PROFILE (PROJECT ON-LOOKING UPSTREAM)
SCALE A

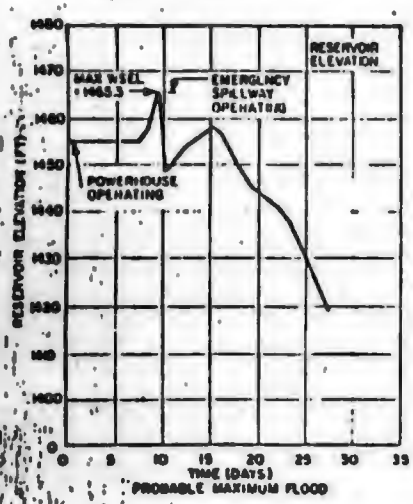


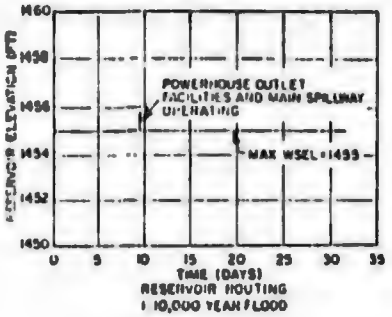
SECTION A-A(TYPICAL)
SCALE A

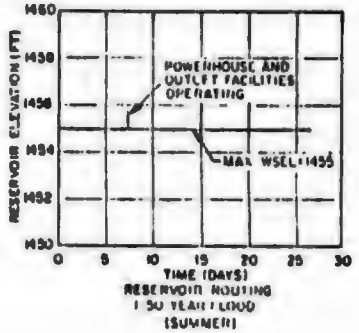








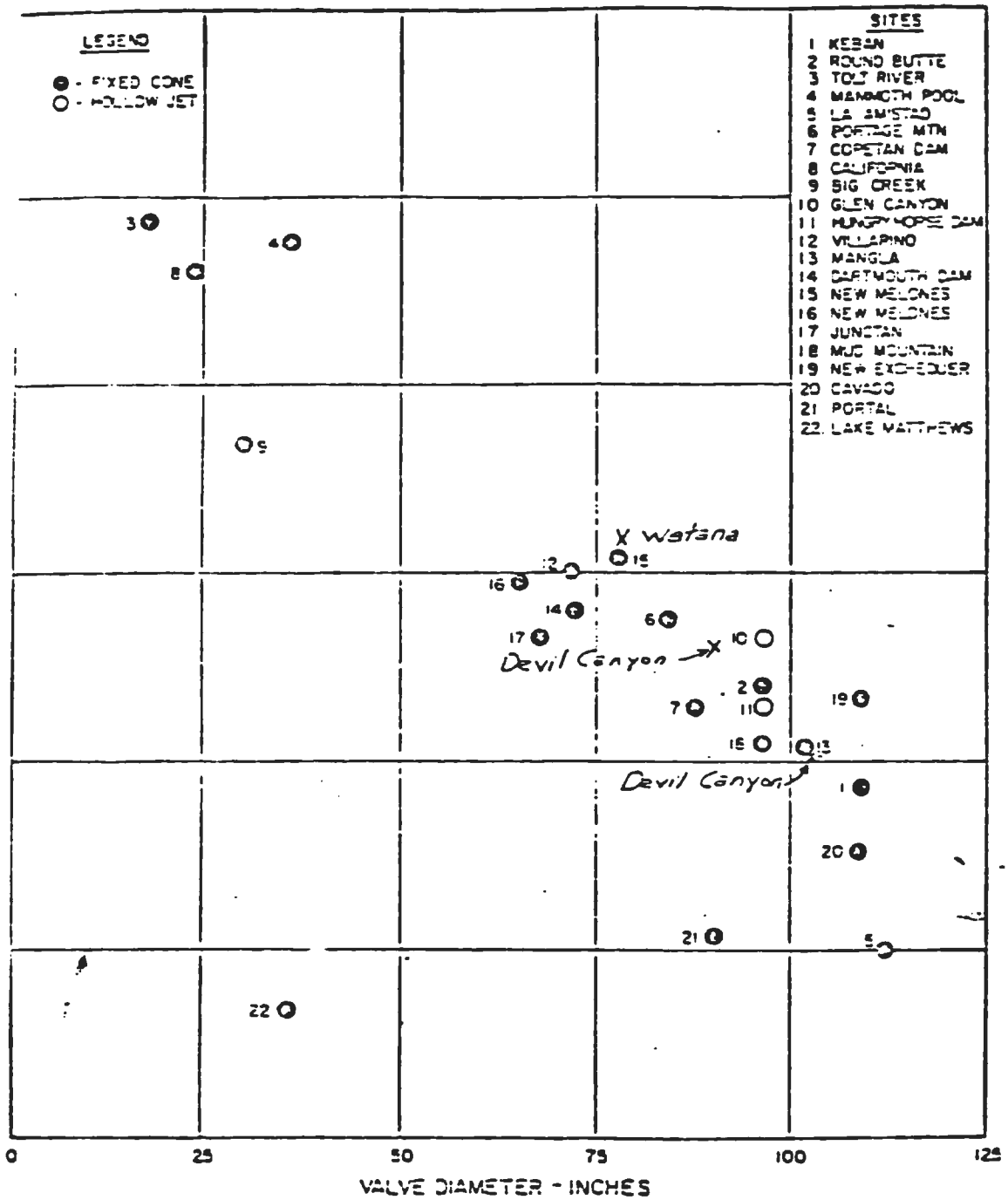




DEVIL CANYON
FLOOD DISCHARGES AND RESERVOIR
SURFACE ELEVATIONS

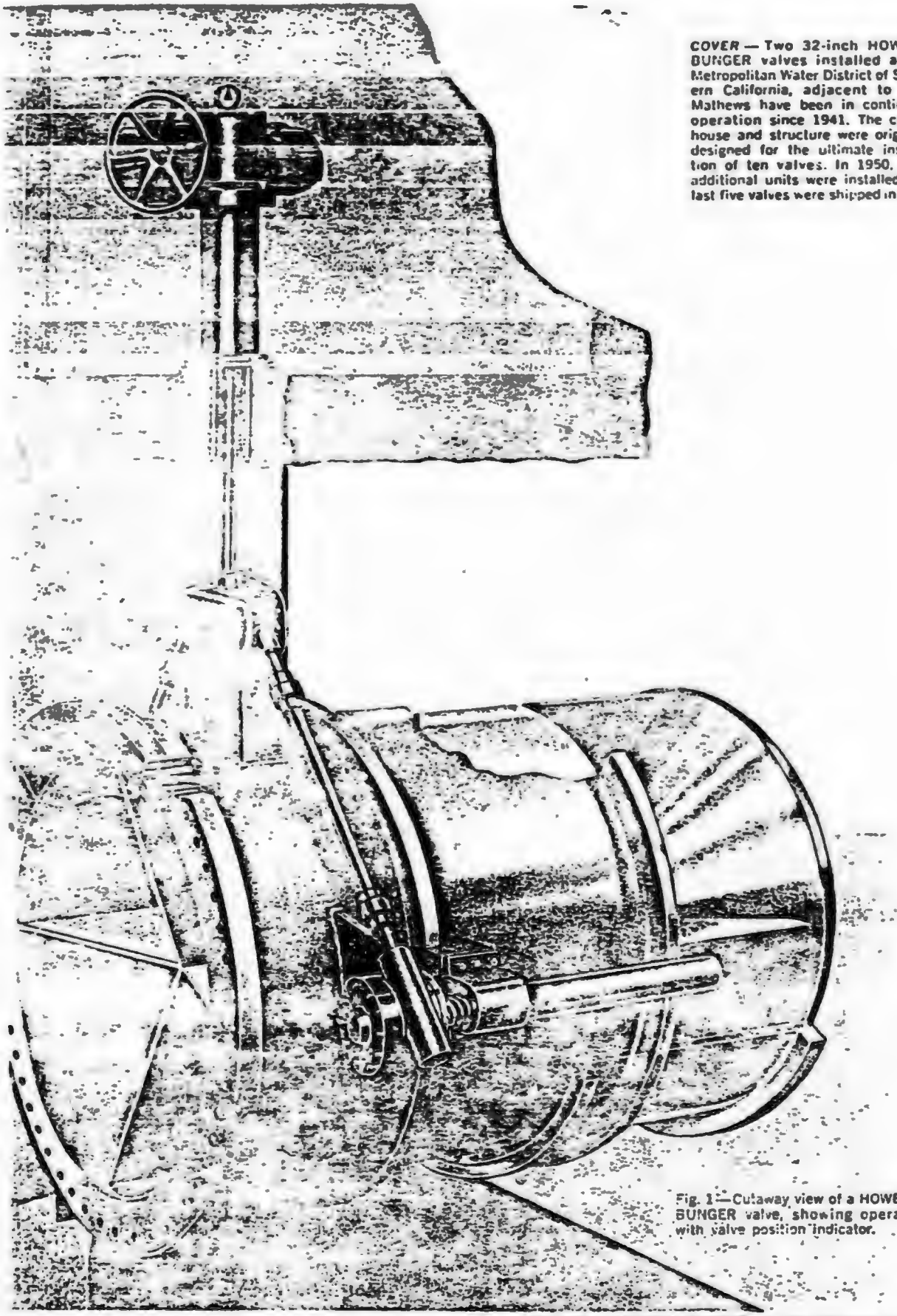
FIGURE E-0.100

Figure B.34.1



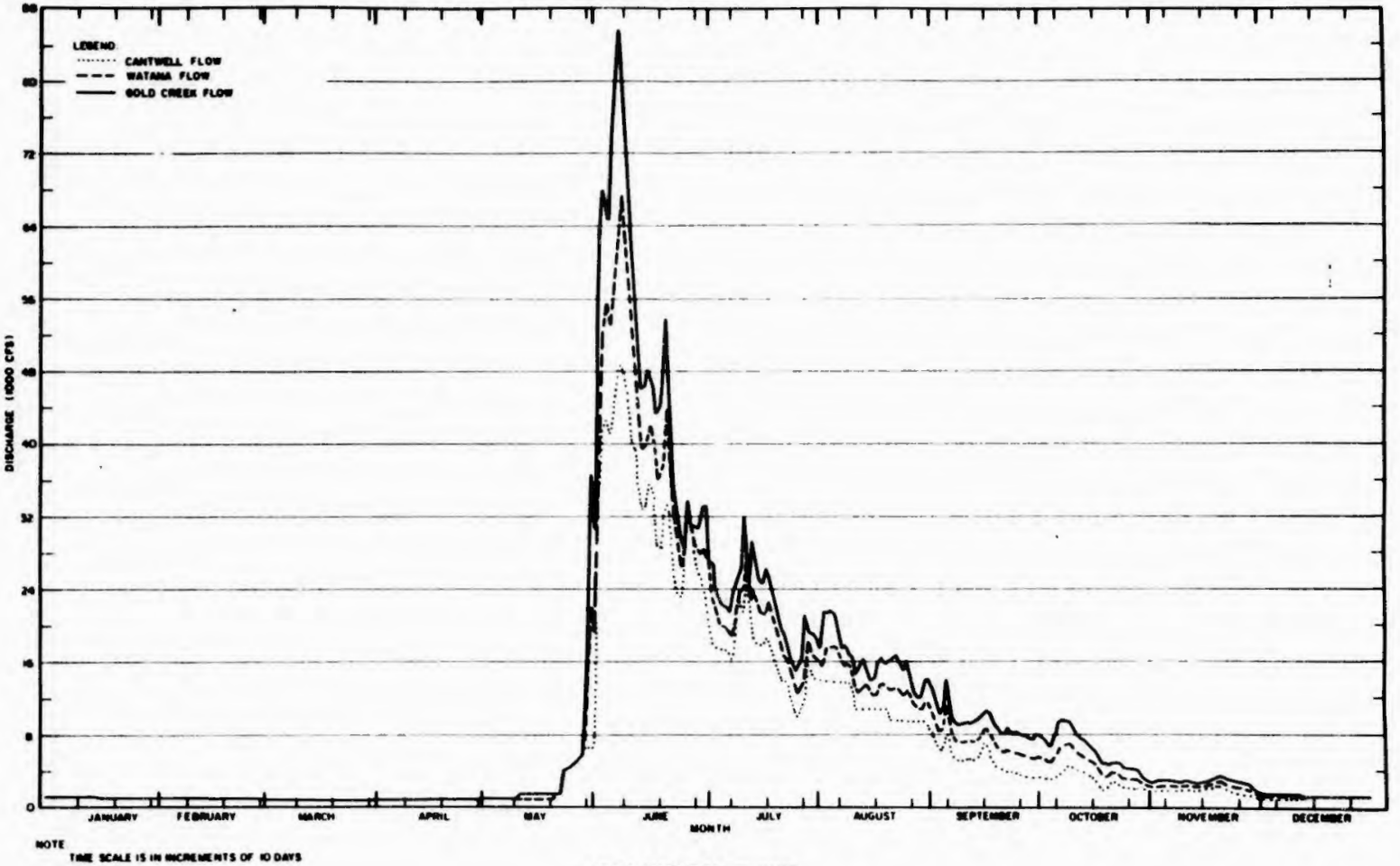
FREE DISCHARGE VALVE
EXPERIENCE PLOT

FIGURE I



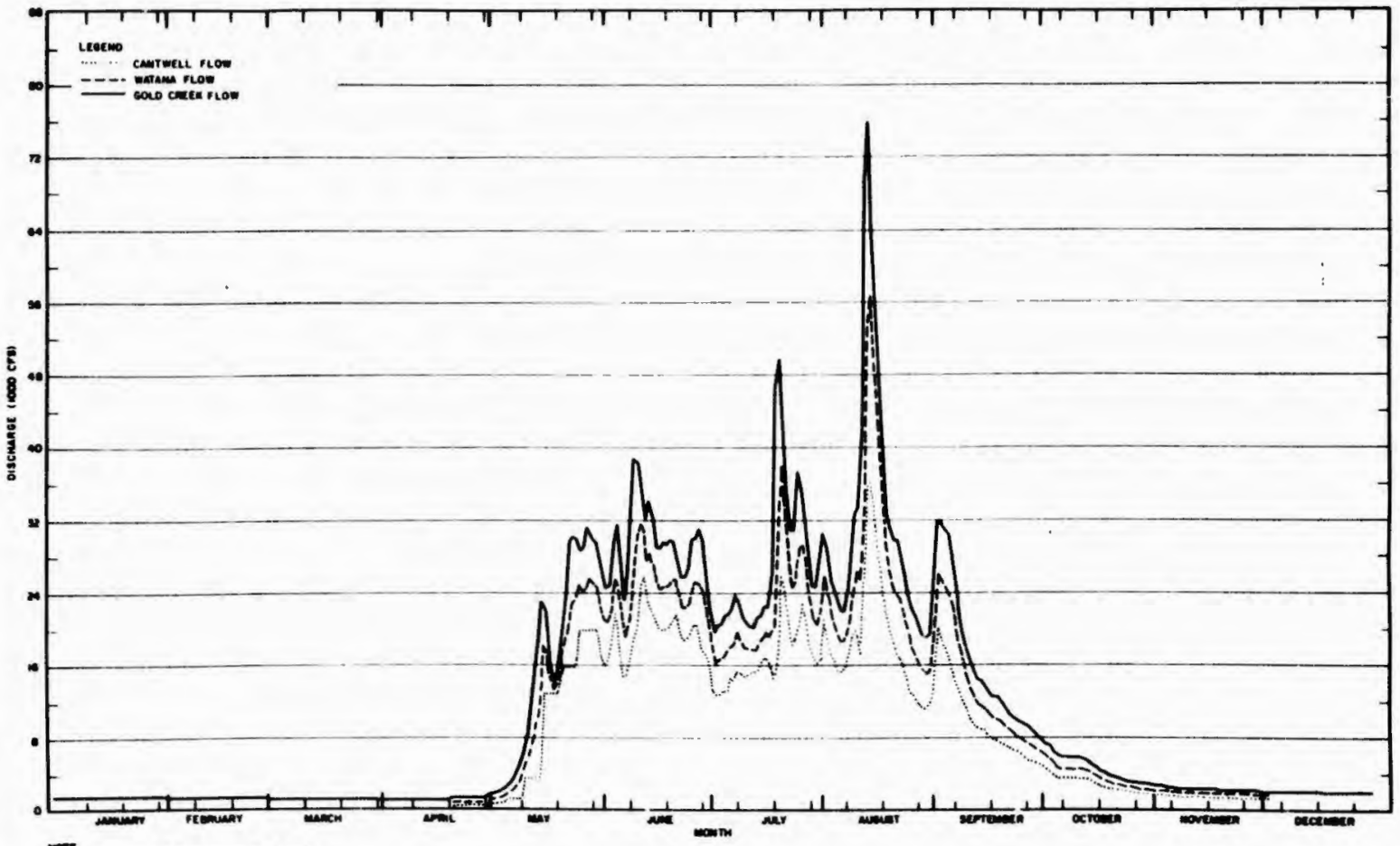
COVER — Two 32-inch HOWELL-BUNGER valves installed at the Metropolitan Water District of Southern California, adjacent to Lake Mathews have been in continuous operation since 1941. The control house and structure were originally designed for the ultimate installation of ten valves. In 1950, three additional units were installed. The last five valves were shipped in 1955.

Fig. 1—Cutaway view of a HOWELL-BUNGER valve, showing operator with valve position indicator.



1964 NATURAL FLOWS
CANTWELL, WATANA AND GOLD CREEK

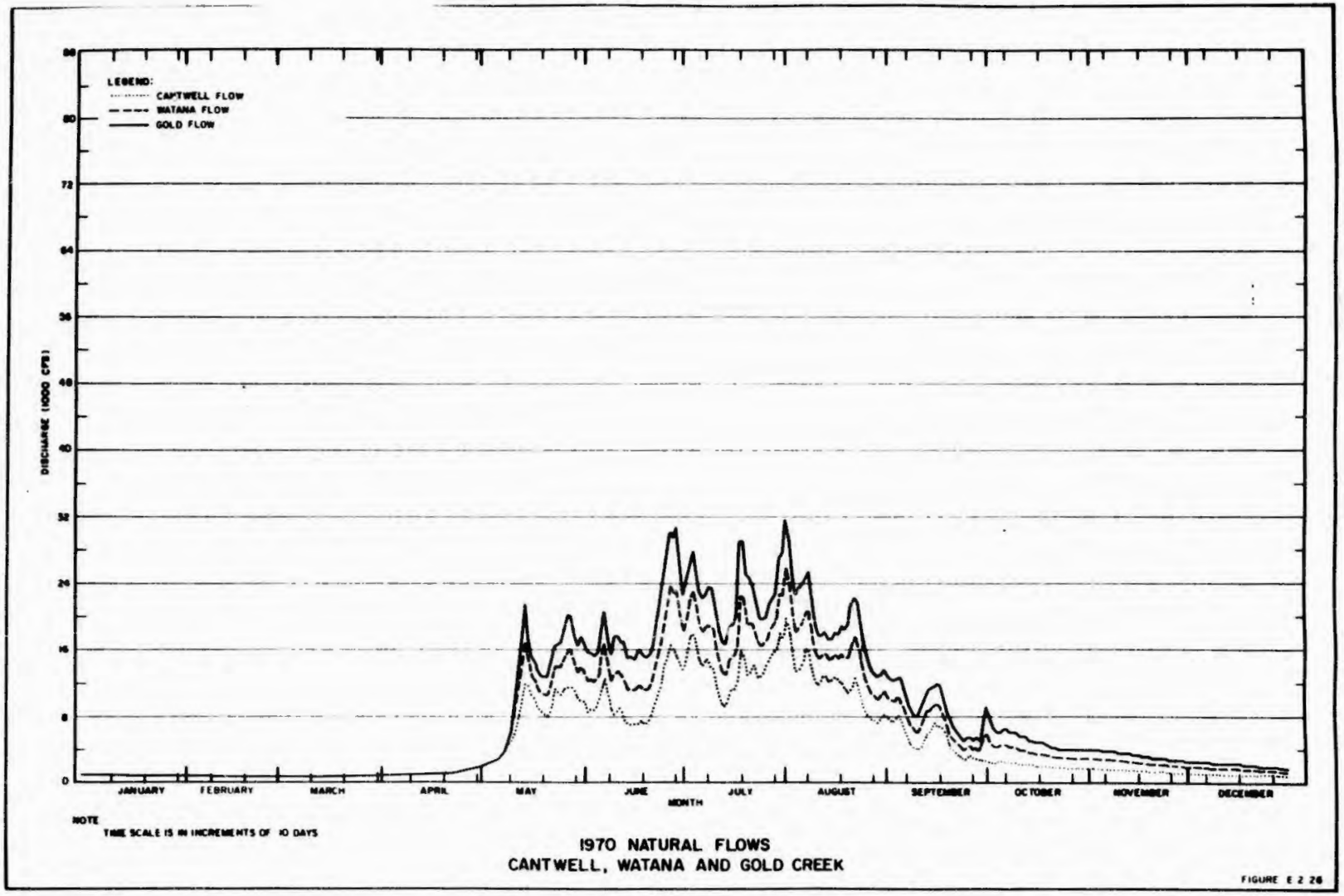
FIGURE E 2.24



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS

1967 NATURAL FLOWS
CANTWELL, WATANA AND GOLD CREEK

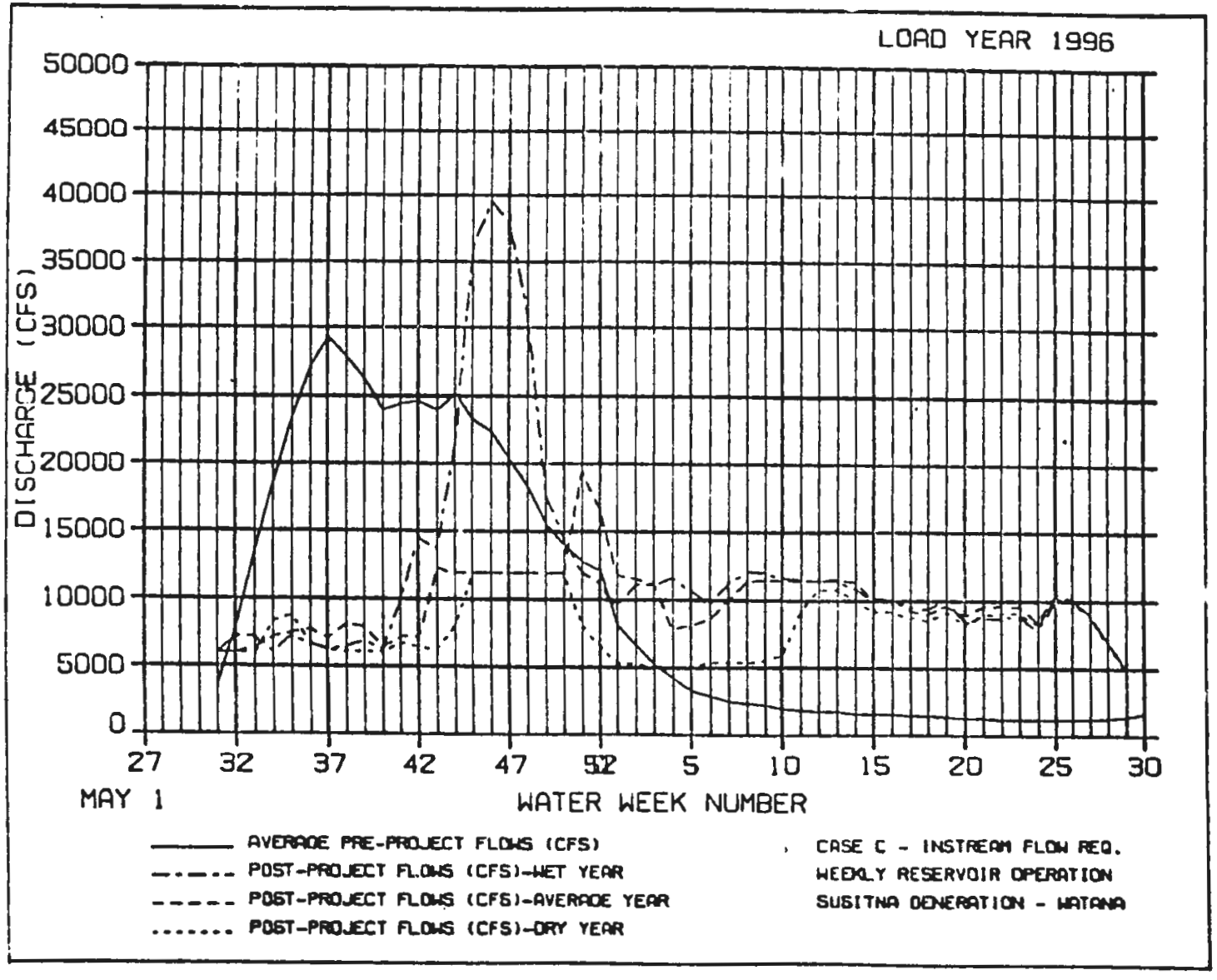
FIGURE E 2.25



1970 NATURAL FLOWS
CANTWELL, WATANA AND GOLD CREEK

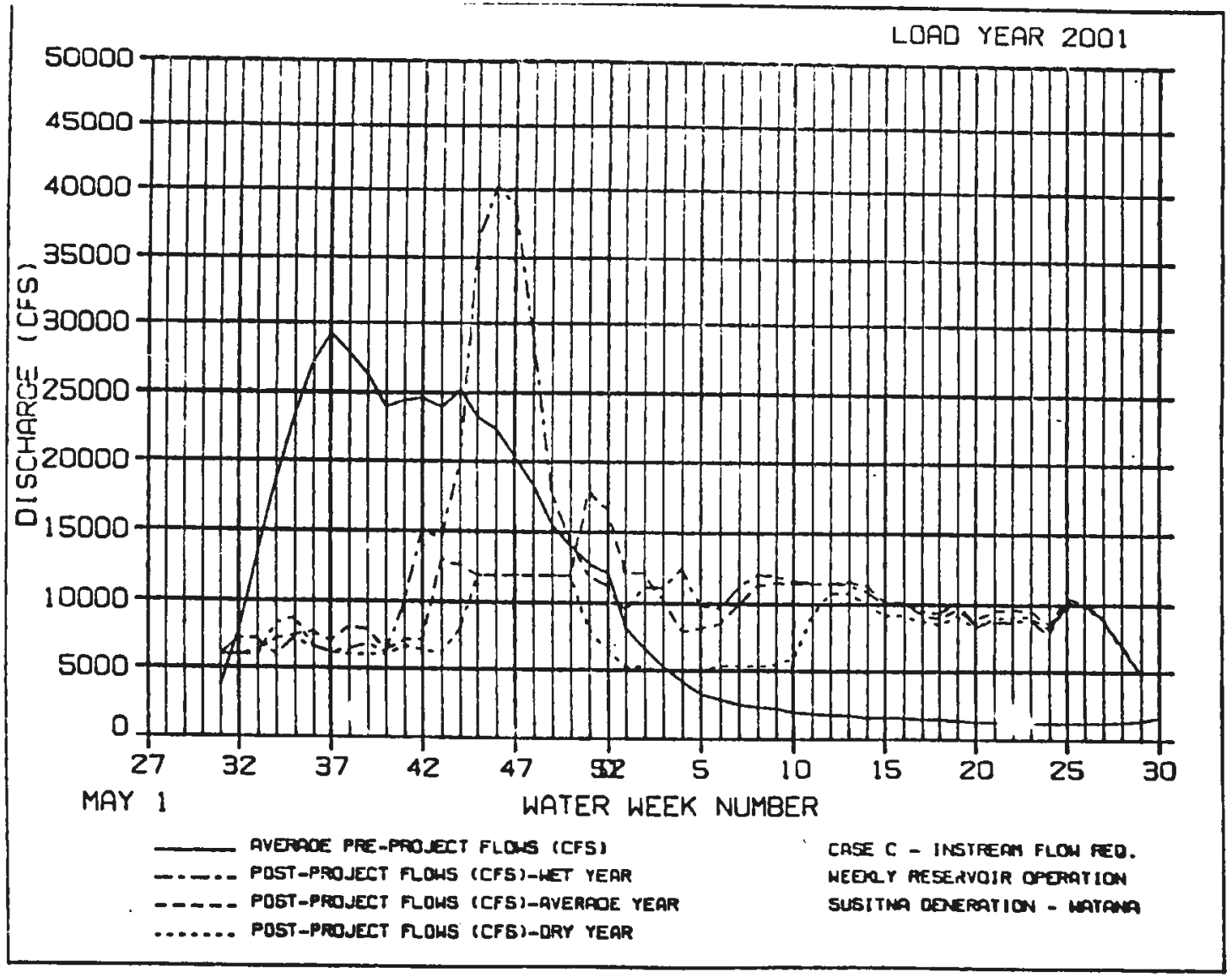
FIGURE E 2 26

[redacted]



WEEKLY PRE--PROJECT AND WITH--PROJECT FLOWS AT GOLD CREEK - LOAD YEAR 1996

EXHIBIT 1



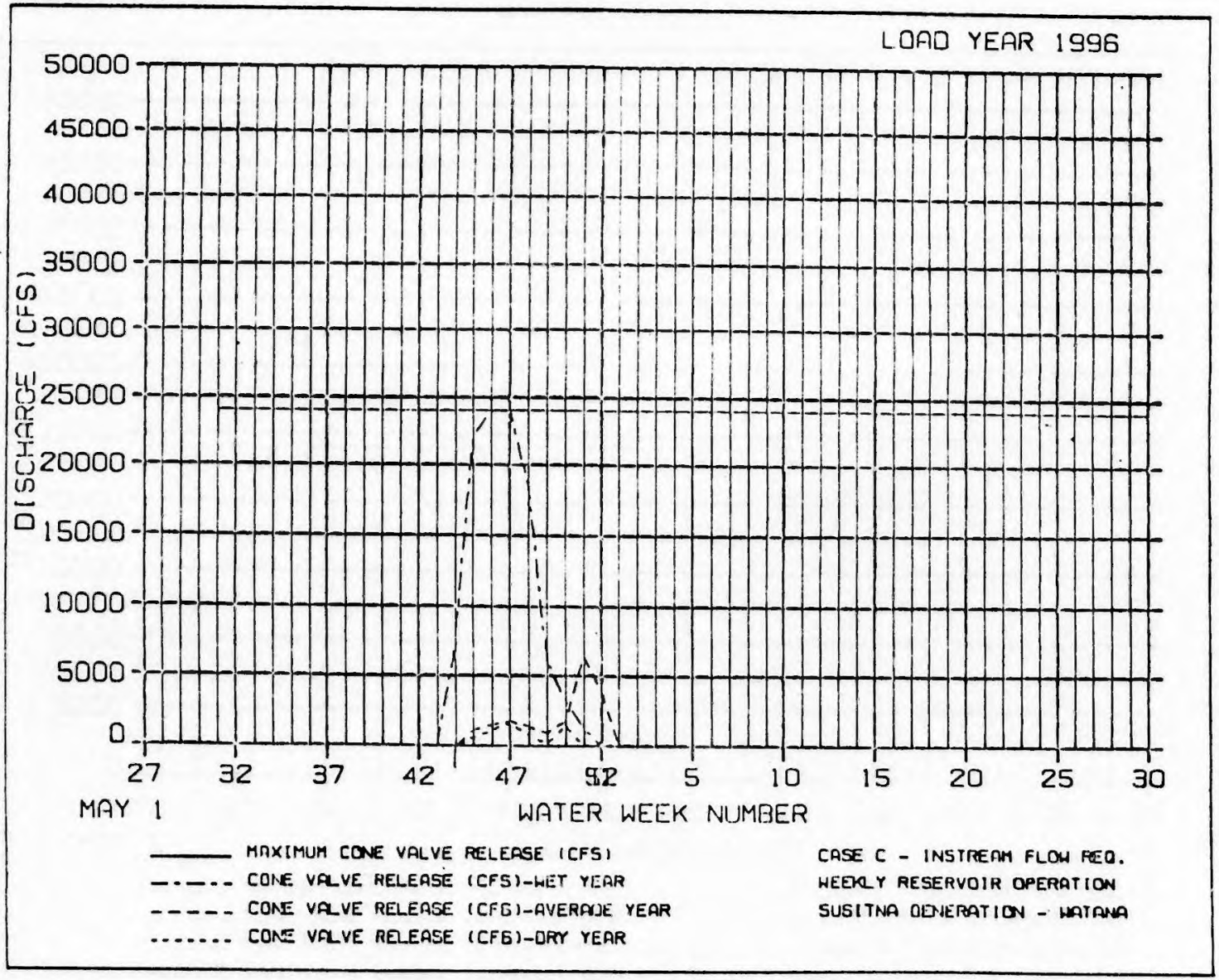
WEEKLY PRE-PROJECT AND WITH-PROJECT FLOWS AT GOLD CREEK - LOAD YEAR 2001

EXHIBIT 2

Table 1

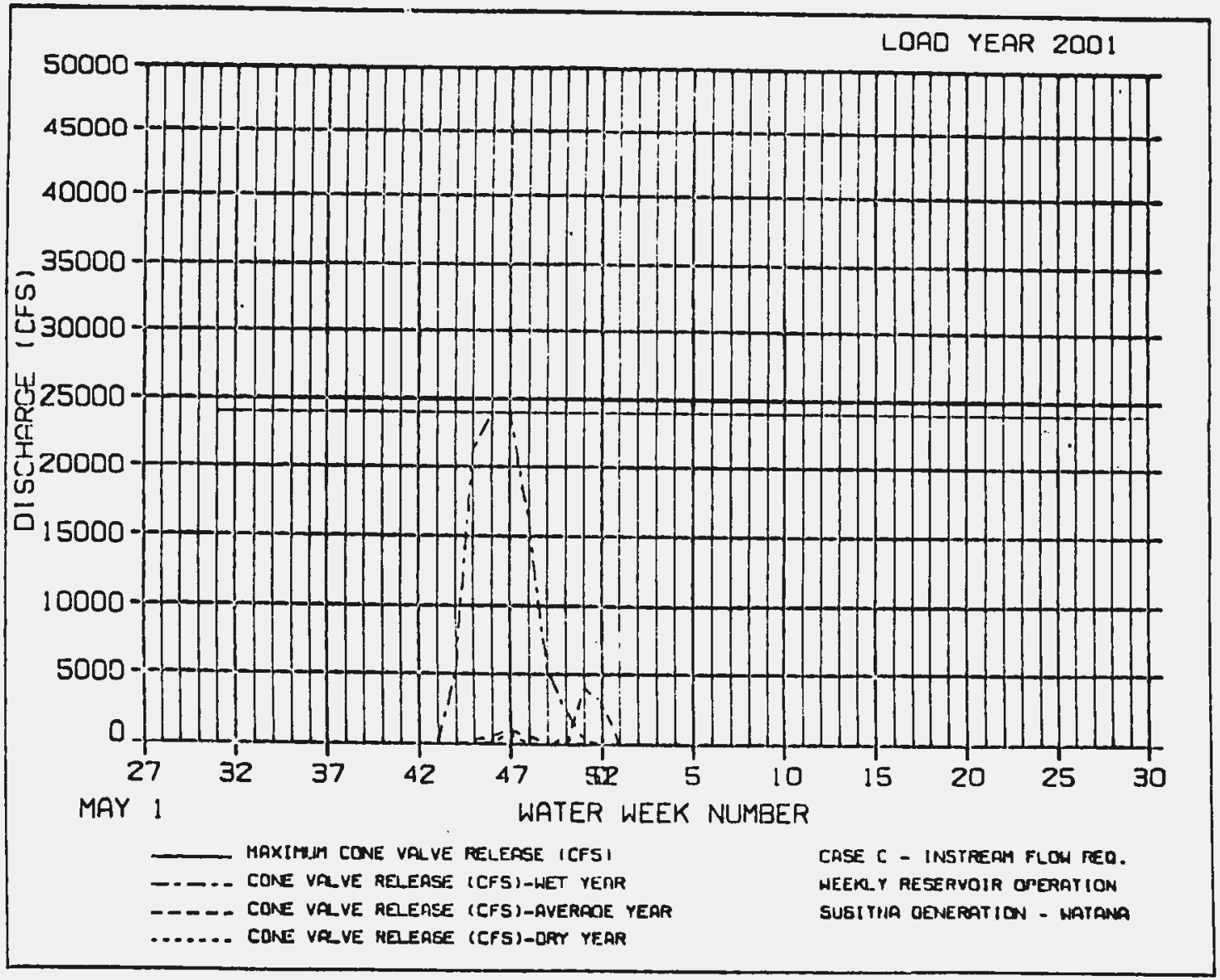
WATANA FIXED CONE VALVE OPERATION

1996 Simulation					2001 Simulation				
Simulated Water Year	Week of First Release	Week of Maximum Release	Maximum Release (cfs)	Powerhouse Flow (cfs)	Simulated Water Year	Week of First Release	Week of Maximum Release	Maximum Release (cfs)	Powerhouse Flow (cfs)
1950	Oct 1-7	Sept 3-9	1493	9033	1950	Aug 20-26	Aug 27-Sept 2	652	9253
1951	Aug 6-12	Sept 3-9	9129	8947	1951	Aug 6-12	Sept 3-9	8270	9805
1952	Aug 13-19	Sept 3-9	6956	8925	1952	Aug 20-26	Sept 3-9	6100	9781
1953	Aug 6-12	Sept 3-9	6872	8925	1953	Aug 13-19	Sept 3-9	6016	9781
1954	Aug 13-19	Aug 20-26	11981	8201	1954	Aug 13-19	Aug 20-26	11194	8988
1955	Aug 6-12	Aug 27-Sept 2	22931	8387	1955	Aug 20-26	Aug 27-Sept 2	22126	9192
1956	July 29-Aug 5	Aug 6-12	15982	8212	1956	July 29-Aug 5	Aug 6-12	15195	9000
1957	Aug 27-Sept 2	Sept 10-16	8430	8929	1957	Aug 27-Sept 2	Sept 10-16	7573	9786
1958	Aug 13-19	Aug 20-26	5750	8185	1958	Aug 13-19	Aug 20-26	4965	8970
1959	Aug 6-12	Aug 27-Sept 2	24000	8395	1959	Aug 20-26	Aug 27-Sept 2	24000	9201
1960	Aug 13-19	Sept 10-16	15389	8949	1960	Sept 3-9	Sept 10-16	14530	9808
1961	Oct 1-7	Aug 20-26	9524	8195	1961	Aug 13-19	Aug 20-26	8738	8981
1962	July 29-Aug 5	July 29-Aug 5	13600	8101	1962	July 29-Aug 5	Aug 27-Sept 2	10542	9160
1963	July 29-Aug 5	Aug 6-12	12939	8204	1963	July 29-Aug 5	Aug 6-12	12152	8991
1964	Aug 6-12	Aug 27-Sept 2	3100	8336	1964	Aug 13-19	Sept 10-16	740	9788
1965	Aug 6-12	Sept 24-30	10910	10149	1965	Aug 20-26	Sept 24-30	9936	11123
1966	Oct 1-7	Sept 3-9	7043	8911	1966	Oct 1-7	Aug 27-Sept 2	6242	9147
1967	Aug 6-12	Aug 13-19	24000	8252	1967	Aug 6-12	Aug 13-19	24000	9044
1968	Aug 6-12	Aug 27-Sept 2	2957	8336	1968	Aug 13-19	Aug 27-Sept 2	711	9152
1969	Aug 6-12	Aug 20-26	2401	8645	1969	Aug 6-12	Aug 20-26	1409	9475
1970	Aug 13-19	Aug 10-16	1189	9305	1970	Aug 27-Sept 2	Sept 10-16	296	10198
1971	Aug 13-19	Aug 13-19	21425	8234	1971	Aug 13-19	Aug 13-19	19839	9023
1972	Aug 6-12	Aug 20-26	9129	8194	1972	Aug 20-26	Aug 20-26	7564	8979
1973	Aug 6-12	Sept 10-16	1557	9020	1973	Aug 13-19	Sept 10-16	692	9785
1974	Aug 6-12	Aug 20-26	1612	8376	1974	Aug 13-19	Aug 20-26	809	9179
1975	Aug 6-12	Sept 10-16	7538	8927	1975	Aug 13-19	Sept 10-16	6681	9784
1976	Aug 13-19	Sept 10-16	1978	9015	1976	Aug 20-26	Sept 10-16	1114	9880
1977	Aug 6-12	Aug 20-26	6293	8191	1977	Aug 27-Sept 2	Sept 17-23	2000	9769
1978	Aug 6-12	Aug 27-Sept 2	1280	8521	1978	Aug 20-26	Aug 27-Sept 2	962	9338
1979	Aug 13-19	Aug 13-19	6944	8192	1979	Aug 13-19	Aug 20-26	5372	8971
1980	July 29-Aug 5	Aug 6-12	11310	8200	1980	Aug 6-12	Aug 13-19	9457	8983
1981	July 29-Aug 5	Aug 13-19	24000	8242	1981	July 29-Aug 5	Aug 13-19	24000	9032
1982	Aug 6-12	Sept 17-23	6426	8939	1982	Aug 6-12	Sept 17-23	4008	9795
1983	Aug 20-26	Aug 27 Sept 2	14063	8365	1983	Aug 20-26	Aug 27-Sept 2	13261	9167



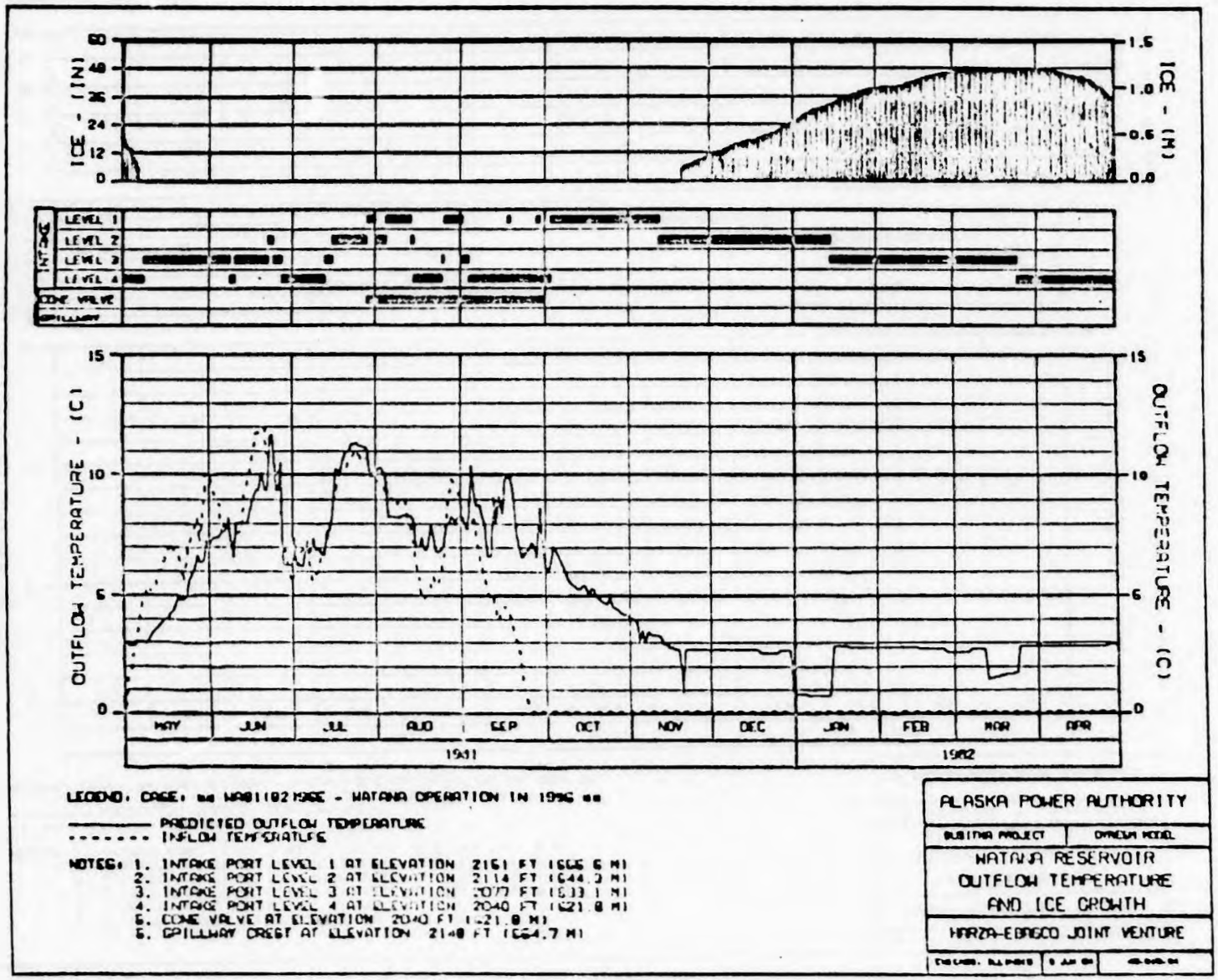
WEEKLY CONE VALVE OPERATION - LOAD YEAR 1996

EXHIBIT 15



WEEKLY CONE VALVE OPERATION - LOAD YEAR 2001

EXHIBIT 16



LEGEND: CASE: ** WAB1102MSE - WATANA OPERATION IN 1996 **

——— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

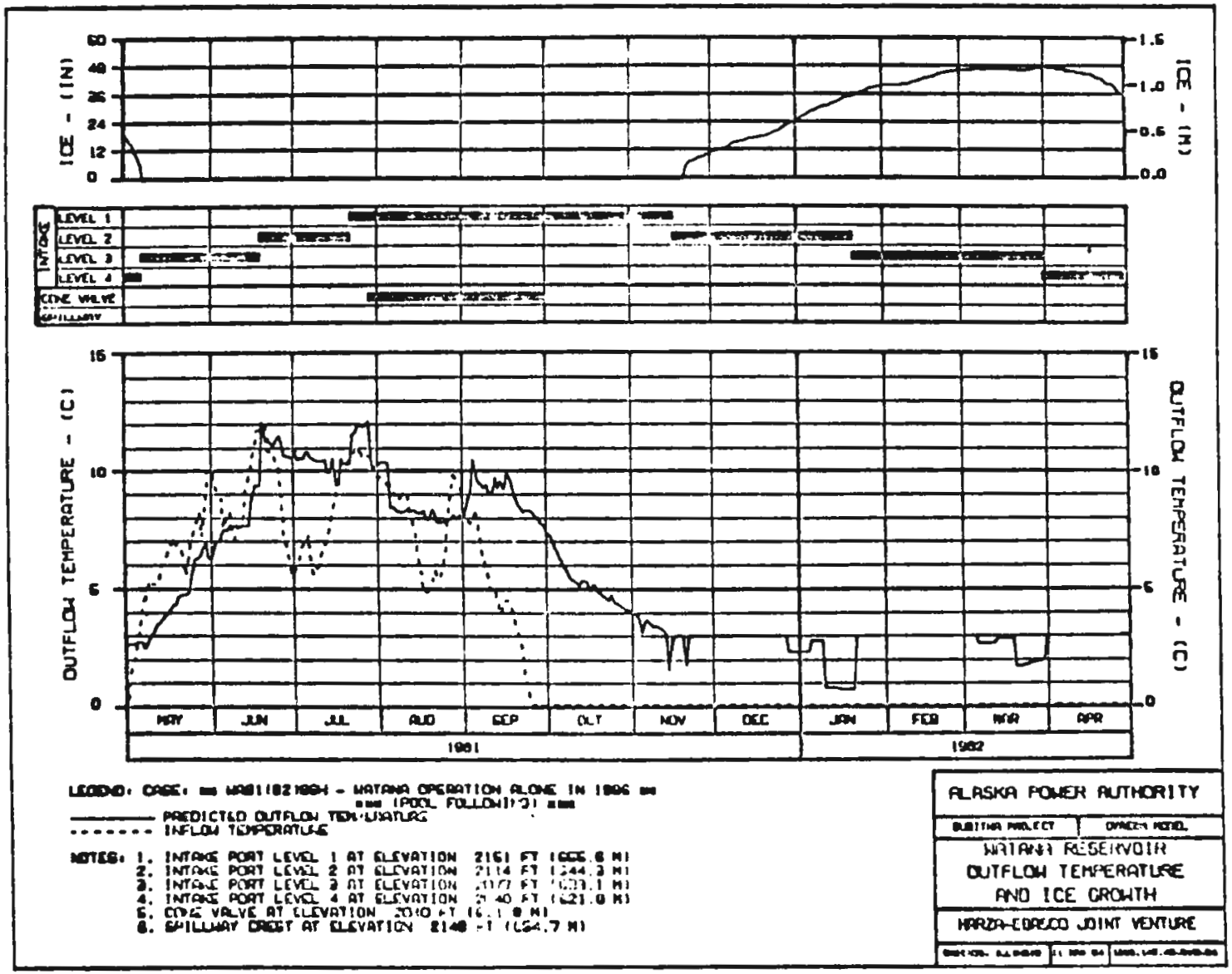
NOTES: 1. INTAKE PORT LEVEL 1 AT ELEVATION 2161 FT (665.6 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 2114 FT (644.3 M)
3. INTAKE PORT LEVEL 3 AT ELEVATION 2077 FT (633.1 M)
4. INTAKE PORT LEVEL 4 AT ELEVATION 2040 FT (621.8 M)
5. CONE VALVE AT ELEVATION 2040 FT (621.8 M)
6. SPILLWAY CREST AT ELEVATION 2148 FT (654.7 M)

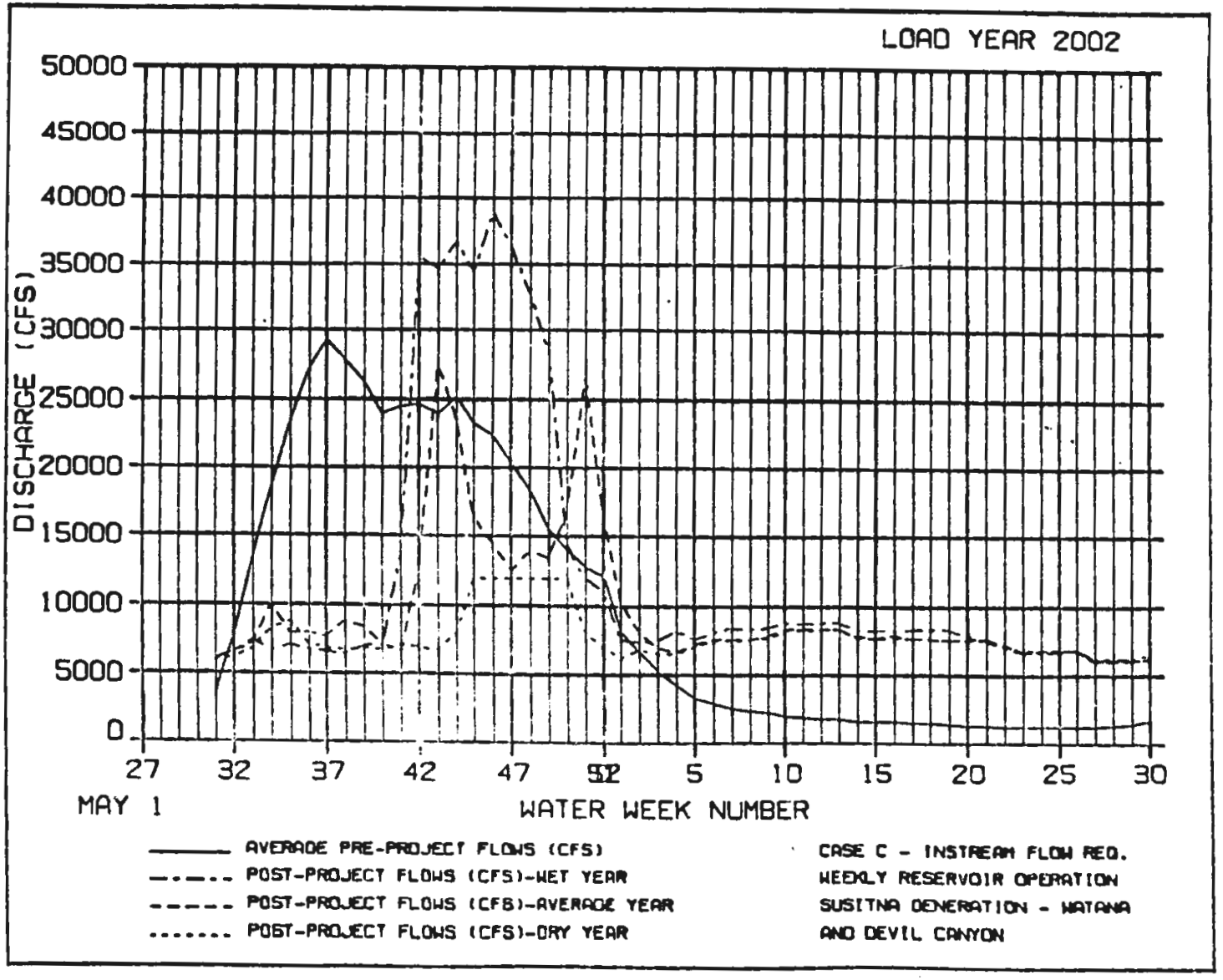
ALASKA POWER AUTHORITY

SUSITNA PROJECT | DYNESIM MODEL

WATANA RESERVOIR
OUTFLOW TEMPERATURE
AND ICE GROWTH

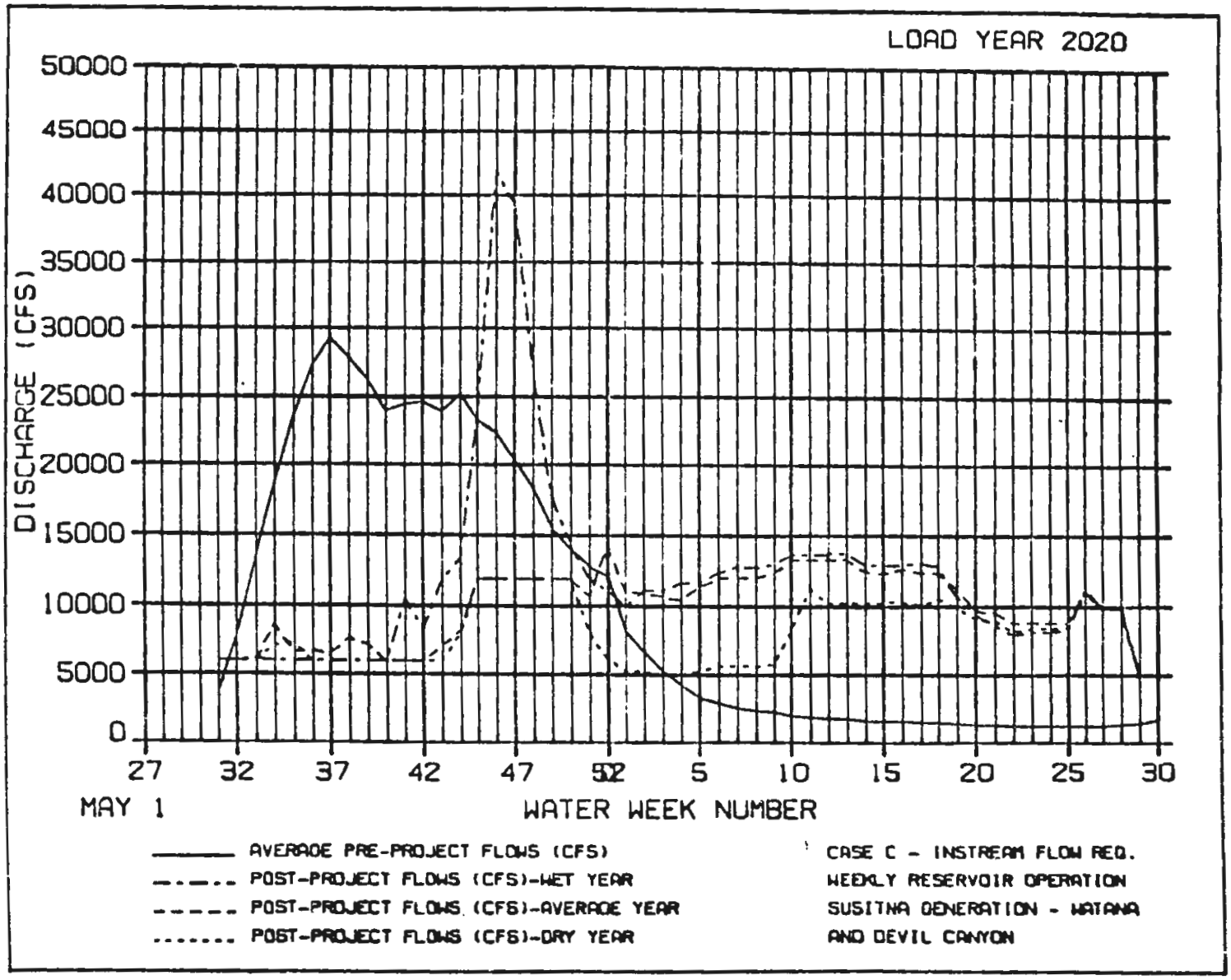
HARZA-EBASCO JOINT VENTURE


ICE - (IN)
60
48
36
24
12
0
1.5
1.0
0.5
0.0
ICE - (M)
INTAKE
LEVEL 1
LEVEL 2
LEVEL 3
LEVEL 4
CONE VALVE
SPILLWAY
OUTFLOW TEMPERATURE - (C)
15
10
5
0
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
1981
1982
LEGEND: CASE: MAB1182 1994 - WATANA OPERATION ALONE IN 1996
(POOL FOLLOWING)
PREDICTED OUTFLOW TEMPERATURE
INFLOW TEMPERATURE
NOTES: 1. INTAKE PORT LEVEL 1 AT ELEVATION 2161 FT (655.6 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 2114 FT (644.3 M)
3. INTAKE PORT LEVEL 3 AT ELEVATION 2077 FT (633.1 M)
4. INTAKE PORT LEVEL 4 AT ELEVATION 2040 FT (621.8 M)
5. CONE VALVE AT ELEVATION 2040 FT (621.8 M)
6. SPILLWAY CREST AT ELEVATION 2148 FT (654.7 M)
ALASKA POWER AUTHORITY
SUSITNA PROJECT
WATANA RESERVOIR
OUTFLOW TEMPERATURE
AND ICE GROWTH
HARZA-EBASCO JOINT VENTURE



WEEKLY PRE--PROJECT AND WITH--PROJECT FLOWS AT GOLD CREEK - LOAD YEAR 2002

EXHIBIT 3

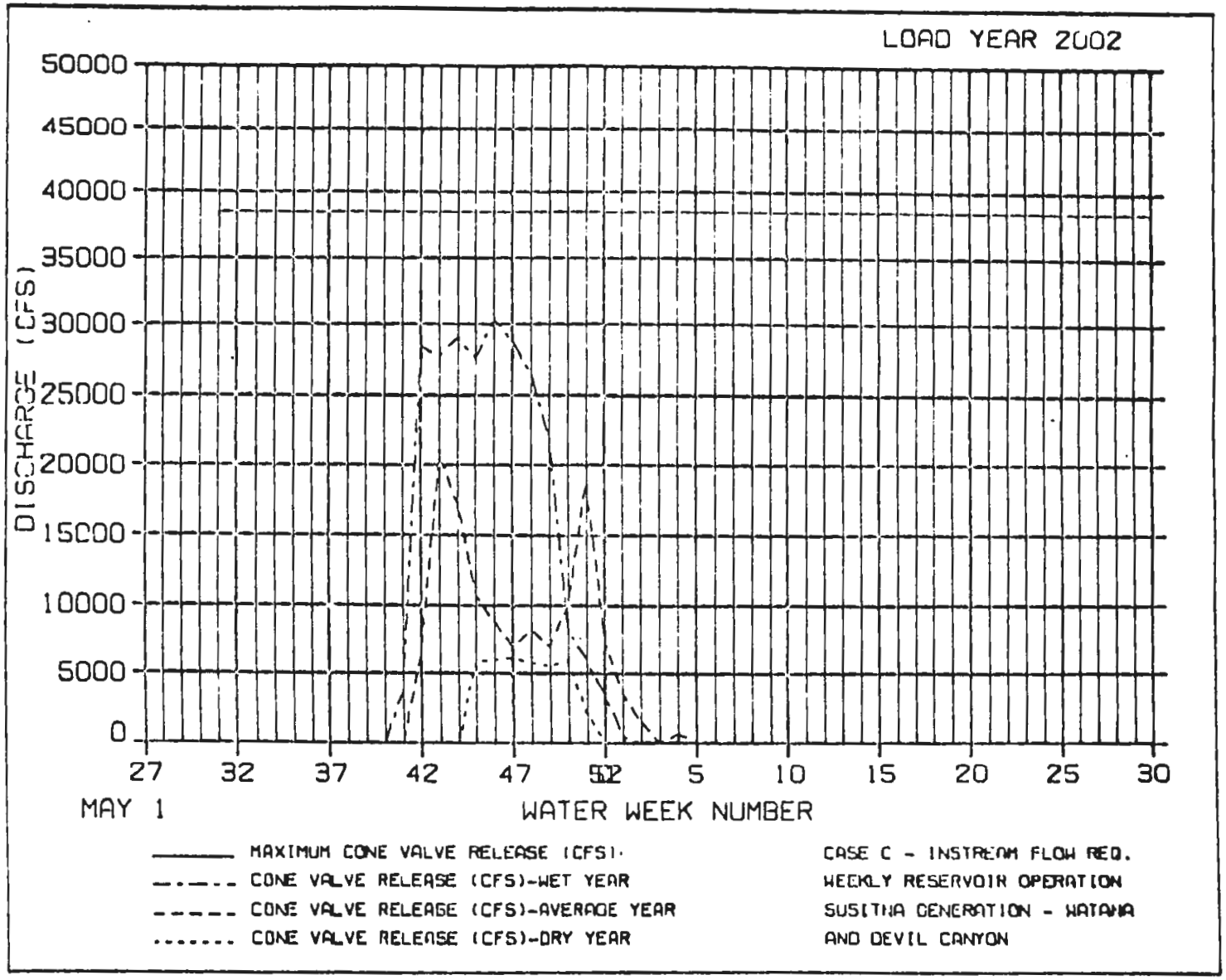


WEEKLY PRE-PROJECT AND WITH-PROJECT FLOWS AT GOLD CREEK - LOAD YEAR 2020

EXHIBIT 4

DEVIL CANYON FIXED CONE VALVE OPERATION

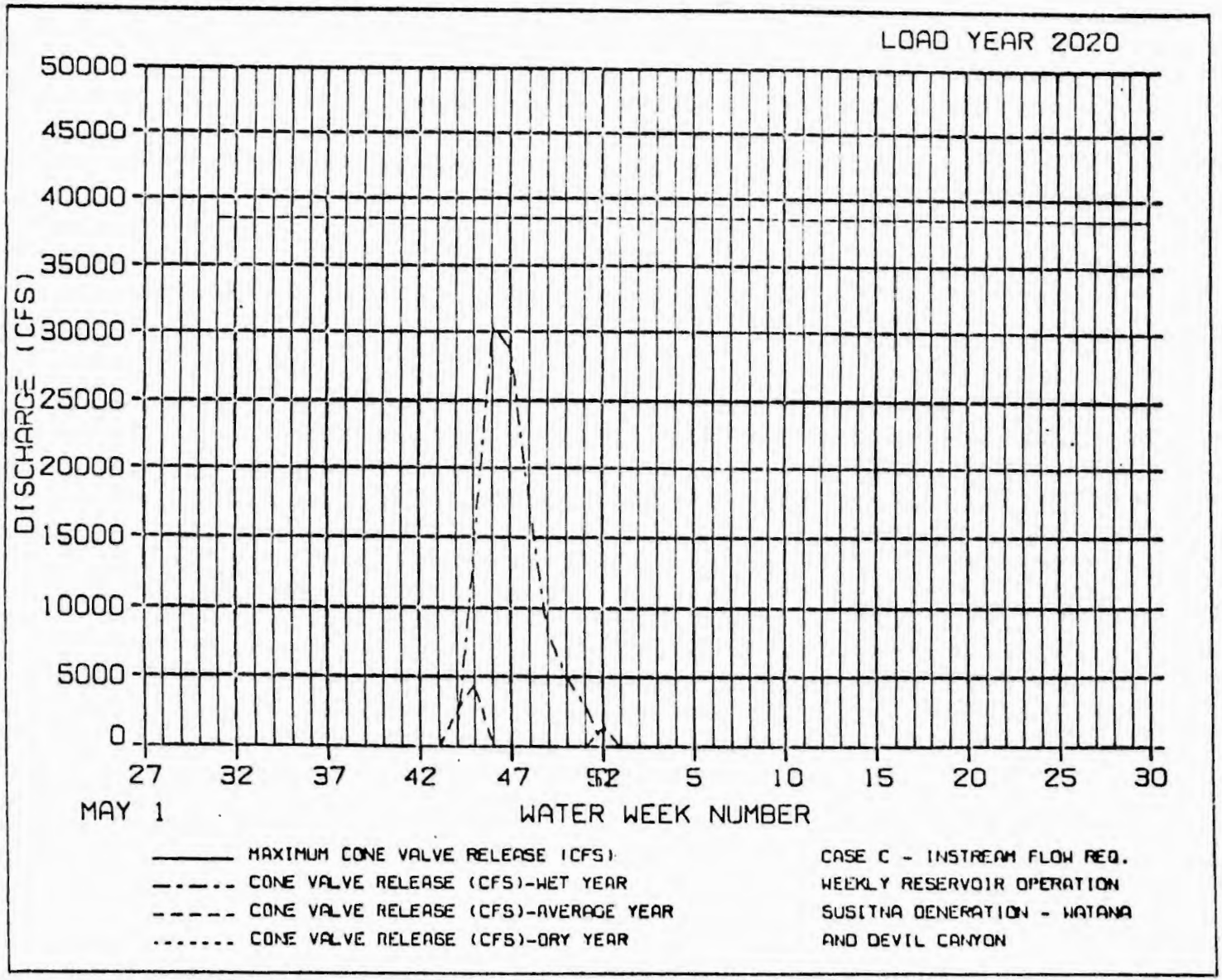
Simulated Water Year	2002 Simulation: Week of First Release	Week of Maximum Release	Maximum Release (cfs)	Powerhouse Flow (cfs)	2020 Simulation: Week of First Release	Week of Maximum Release	Maximum Release (cfs)	Powerhouse Flow (cfs)
1950	Oct 1-7	Aug 13-19	11502	5018	Oct 1-7	Aug 6-12	4381	6305
1951	Aug 6-12	Sept 3-9	22874	5476	July 29-Aug 5	Sept 24-30	6757	9829
1952	Oct 1-7	July 29-Aug 5	27827	4972	July 29-Aug 5	Aug 6-12	4432	6144
1953	Oct 1-7	July 29-Aug 5	19212	4954	July 29-Aug 5	Sept 17-23	4815	8646
1954	Oct 1-7	July 29-Aug 5	24412	4962	July 29-Aug 5	Sept 3-9	6708	8653
1955	July 15-21	Aug 27-Sept 2	27828	5133	July 29-Aug 5	Aug 27-Sept 2	25157	8152
1956	Oct 1-7	July 15-21	25380	4802	July 29-Aug 5	Aug 6-12	19167	7970
1957	Oct 1-7	July 22-28	19675	4794	July 29-Aug 5	Sept 24-30	10937	9840
1958	Oct 1-7	July 29-Aug 5	27974	4974	July 29-Aug 5	July 29-Aug 5	3938	3734
1959	July 22-28	Aug 20-26	28535	5044	July 29-Aug 5	Aug 27-Sept 2	28442	8156
1960	Oct 1-7	Sept 10-16	21825	5474	July 29-Aug 5	Sept 24-30	5535	9825
1961	Oct 1-7	July 22-28	19635	4794	Oct 1-7	Aug 20-26	8909	7960
1962	Oct 1-7	July 1-7	20847	4796	July 29-Aug 5	Aug 27-Sept 2	13988	8110
1963	Oct 1-7	July 8-14	28135	4814	Aug 6-12	Aug 6-12	13830	7958
1964	Oct 1-7	July 8-14	19864	4794	Aug 27-Sept 2	Aug 27-Sept 2	3003	8225
1965	Oct 1-7	Aug 13-19	23634	5026	Aug 20-26	Sept 24-30	13772	9849
1966	Oct 1-7	July 29-Aug 5	21465	4958	Oct 1-7	Aug 6-12	4433	6266
1967	July 15-21	Aug 13-19	29628	5056	Aug 13-19	Aug 13-19	29636	8026
1968	July 1-7	July 8-14	20469	4795	Aug 27-Sept 2	Aug 27-Sept 2	3003	8234
1969	July 29-Aug 5	Aug 20-26	6506	5154	-	-	-	-
1970	Aug 6-12	Aug 27-Sept 2	5926	5291	July 29-Aug 5	Aug 6-12	4327	6374
1971	Aug 6-12	Aug 20-26	18118	5017	July 29-Aug 5	Aug 20-26	15175	7960
1972	Oct 1-7	June 24-30	19313	4954	Aug 13-19	Aug 20-26	11109	7951
1973	Aug 6-12	Aug 27-Sept 2	16744	5111	-	-	-	-
1974	Aug 6-12	Aug 20-26	6198	5084	-	-	-	-
1975	July 8-14	July 15-21	21936	4797	Aug 20-26	Sept 17-23	8912	8659
1976	Oct 1-7	Aug 6-12	18182	5023	July 29-Aug 5	Aug 6-12	4259	6167
1977	July 1-7	July 15-21	19272	4793	Aug 20-26	Aug 27-Sept 2	3129	8161
1978	Oct 1-7	Aug 6-12	13020	5009	July 29-Aug 5	Aug 6-12	4255	6660
1979	July 15-21	July 22-28	25011	4803	Aug 20-26	Aug 27-Sept 2	3770	8095
1980	Oct 1-7	July 15-21	26847	4805	Aug 13-19	Aug 20-26	10807	7949
1981	Oct 1-7	Aug 13-19	30428	5058	Aug 6-12	Aug 13-19	30439	8005
1982	Oct 1-7	July 22-28	20883	4795	July 29-Aug 5	Aug 6-12	4494	6693
1983	Oct 1-7	Aug 6-12	20056	5020	July 29-Aug 5	Sept 3-9	7828	8664



WEEKLY CONE VALVE OPERATION - LOAD YEAR 2002

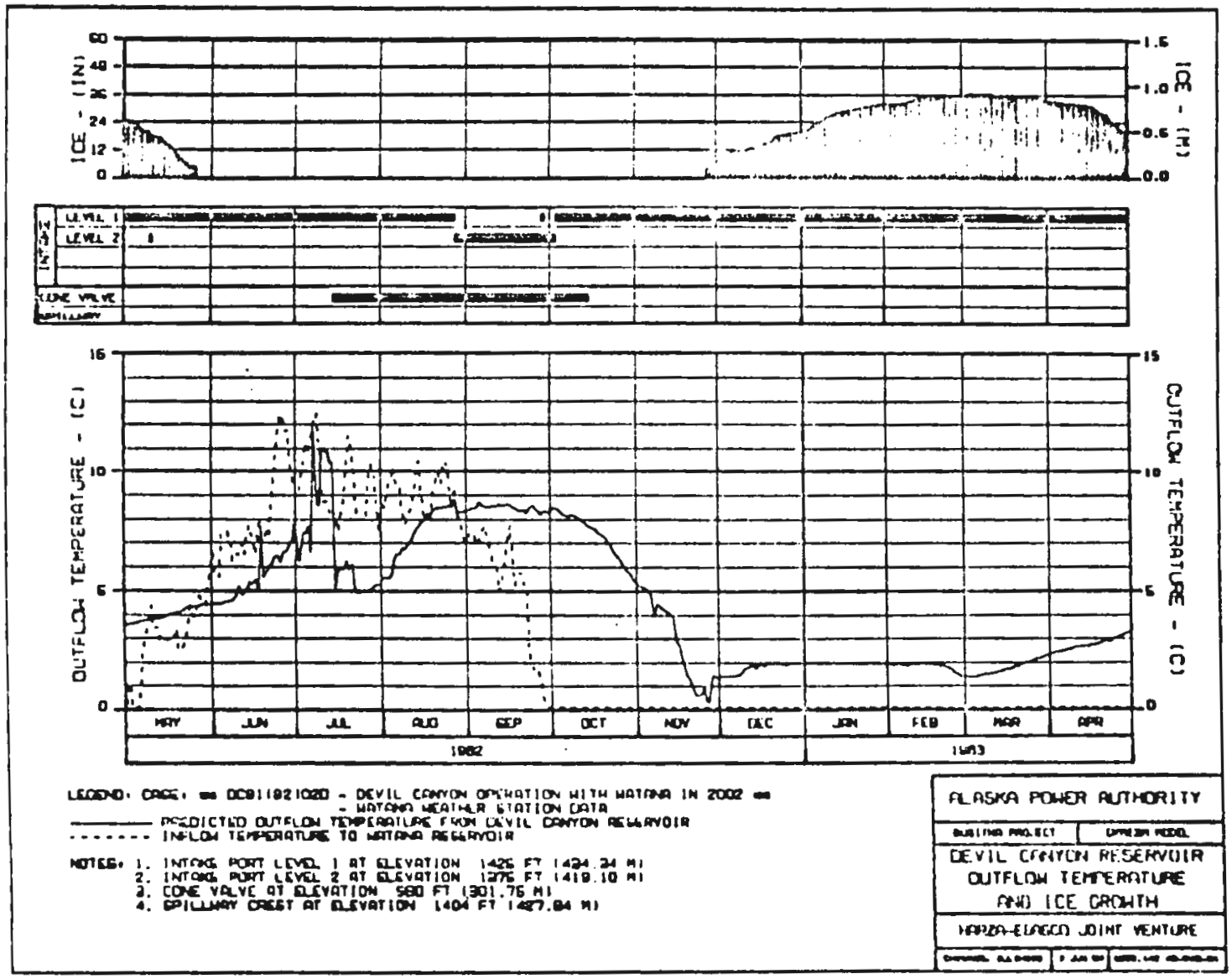
[redacted]

EXHIBIT 17



WEEKLY CONE VALVE OPERATION - LOAD YEAR 2020

EXHIBIT 18


ICE - (IN)
ICE - (M)
OUTFLOW TEMPERATURE - (C)
OUTFLOW TEMPERATURE - (C)
LEVEL 1
LEVEL 2
CONE VALVE
SPILLWAY
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
1992
1993
LEGEND: CASE: DC91192102D - DEVIL CANYON OPERATION WITH WATANA IN 2002
- WATANA WEATHER STATION DATA
PREDICTED OUTFLOW TEMPERATURE FROM DEVIL CANYON RESERVOIR
INFLOW TEMPERATURE TO WATANA RESERVOIR
NOTES: 1. INTAKE PORT LEVEL 1 AT ELEVATION 1425 FT (434.34 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 1275 FT (419.10 M)
3. CONE VALVE AT ELEVATION 980 FT (301.75 M)
4. SPILLWAY CREST AT ELEVATION 1404 FT (427.84 M)
ALASKA POWER AUTHORITY
DEVIL CANYON RESERVOIR
OUTFLOW TEMPERATURE
AND ICE GROWTH
HARZA-EBASCO JOINT VENTURE

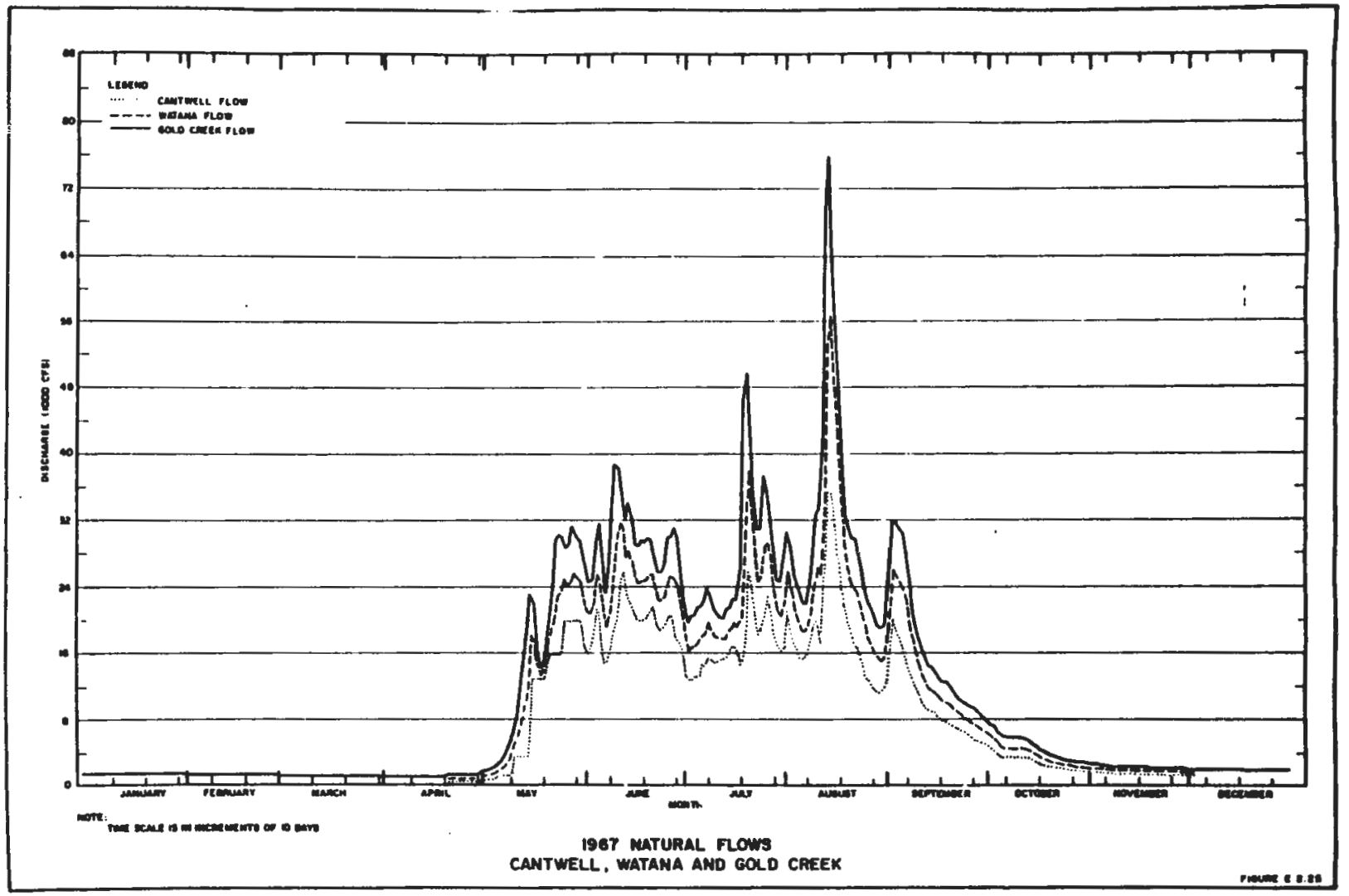
[redacted]

Morphological and Hydrological Features - Watana Reservoir

Elevation (maximum surcharge level)	2201 MSL (671 m)
(normal maximum level)	2185 MSL (666 m)
(minimum operating level)	2065 MSL (630 m)
Normal Drawdown	120 feet (36.6 m)
Live Storage	3.7×10^6 acre-ft. (4.6×10^9 m^3)
Maximum Surface Area	38,000 acres (60 mi^2)
Maximum Length	approx. 48 miles (77 km)
Maximum Depth	735 ft. (223 m)
Mean Depth	250 ft. (76 m)
Gross Storage (total volume)	9.5×10^6 acre-ft. (11.7×10^9 m^3)
Shoreline Length	183 miles (295 km)
Mean Hydraulic Residence Time	1.65 years
Drainage Basin	5,180 $mi.^2$ (13,416 km^2)
Mean River Inflow	7,990 CFS (226 m^3s^{-1})
Peak Flood Inflows	
PMF	326,000 CFS (9,226 m^3s^{-1})
10,000 yr.	156,000 CFS (4,415 m^3s^{-1})
50 yr.	87,000 CFS (2,462 m^3s^{-1})
25 yr.	76,000 CFS (2,151 m^3s^{-1})
Tailwater Elevation	1455 ft. MSL (443.5 m)

Morphological and Hydrological Features - Devil Canyon Reservoir

Elevation (maximum surcharge level) (normal maximum level) (minimum operating level)	1466 MSL (446.8 m) 1455 MSL (443.5 m) 1405 MSL (428.2 m)
Normal Drawdown	50 ft. (15.2 m)
Live Storage	350,000 acre-ft. (432 X $10^6 m^3$)
Maximum Surface Area	7,800 acres (12 $mi.^2$)
Maximum Length	26 mi. (42 km)
Maximum Depth	565 ft. (171 m)
Mean Depth	140 ft. (42 m)
Gross Storage (total volume)	1.1 X 10^6 acre-ft. (1.4 X $10^9 m^3$)
Shoreline Length	76 mi. (123 km)
Mean Hydraulic Residence Time	approx. 60 days
Drainage Basin	5,810 $mi.^2$ (15,048 km^2)
Mean River Inflow	9,080 CFS (256 $m^3 s^{-1}$)
Peak Flood Inflows	
PMF	345,000 CFS (w/Watana)
10,000 yr.	165,000 CFS (w/Watana)
50 yr.	39,000 CFS (w/Watana)
25 yr.	37,800 CFS (w/Watana)
Tailwater Elevation	850 ft. MSL



1967 NATURAL FLOWS
CANTWELL, WATANA AND GOLD CREEK

FIGURE E 2.25

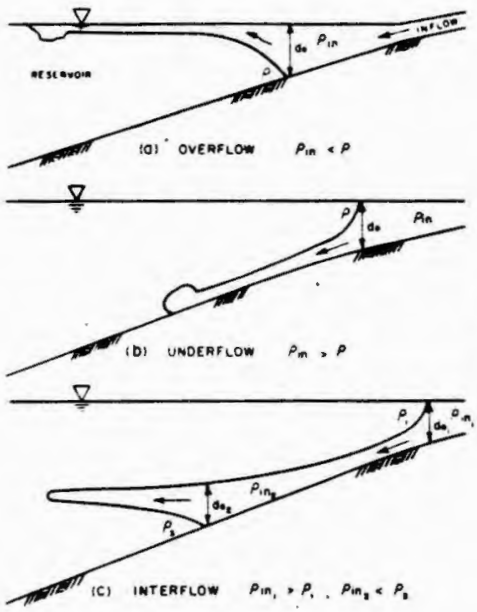


Figure 7–18 Types of inflow into lakes and reservoirs. (From Wunderlich, W. O.: The dynamics of density-stratified reservoirs. *In* Hall, G. E., ed., Reservoir Fisheries and Limnology. Washington, D.C., American Fisheries Society, 1971.)

Table

SUSITNA HYDROELECTRIC PROJECT

Key Limnological Limitations for Water Quality

Temperature

Turbidity

Depth

Large Volume vs. Small Surface Area

Large Volume for Dilution of Leachates

Short Average Hydraulic Residence Time

Surface Withdrawal of Water (Predominately)

Long and Narrow with Small Surface for Wind Circulation - better sedimentation of particulates

Sediment "Blanket" Effect

Very Small Littoral Zone

Little or no Human Induced Nutrient Additions

Table

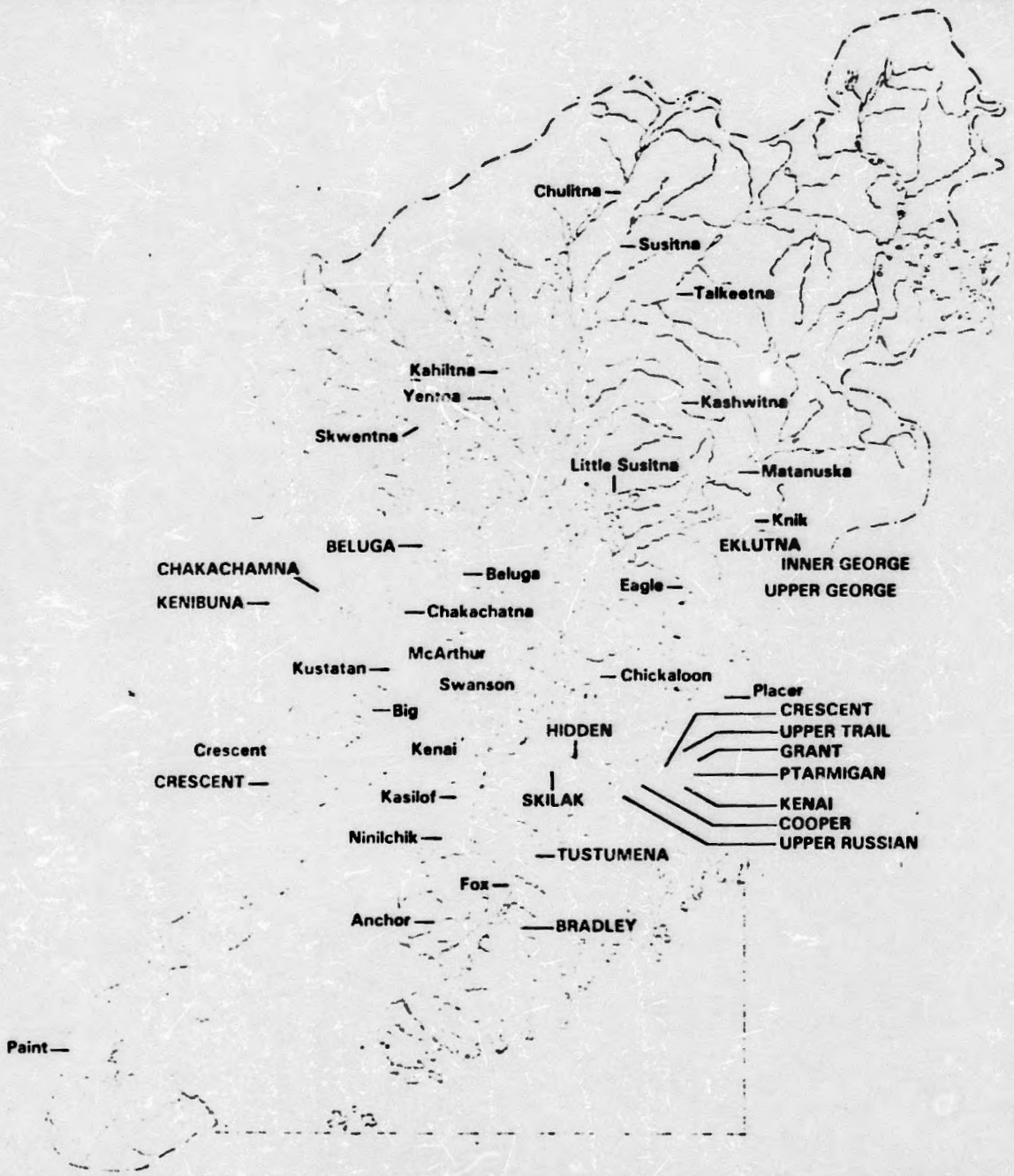
SUSITNA HYDROELECTRIC PROJECT

Estimated Water Quality Characteristics of Susitna Hydroelectric Project Reservoirs

Trophic Status	Ultraoligotrophic-to-Oligotrophic (slight upsurge for @ 10 yrs.)	10-200mgC m^{-2} day^{-1}
Phytoplankton Standing Crop	<1.0mg m^{-3}	
Phytoplankton Density	<1.0 cm^3 m^{-3}	
Chlorophyll a	<0.25mg m^{-3}	
Dominant Phytoplankton	Bacillariophyceae, Chrysophyceae, Dinophyceae	
Euphotic Zone (1% PAR)	0.1m ---> 4.0m	
Total Organic Carbon	Slight Increase (5-10 yrs) --->then Decrease	
Total Biologically Available P	<20 ugl^{-1}	
Total Nitrate Nitrogen	<250 ugl^{-1}	
Total Suspended Solids	0-300 mgl^{-1} (at present estimate)	
pH	7.0+	
Alkalinity	65 mg $CaCO_3$	
Conductivity	150 umhos cm^{-2}	
Dissolved Oxygen	8.0+ ; 50-100% saturation	

SURFACE WATERS

EXHIBIT-E



Table

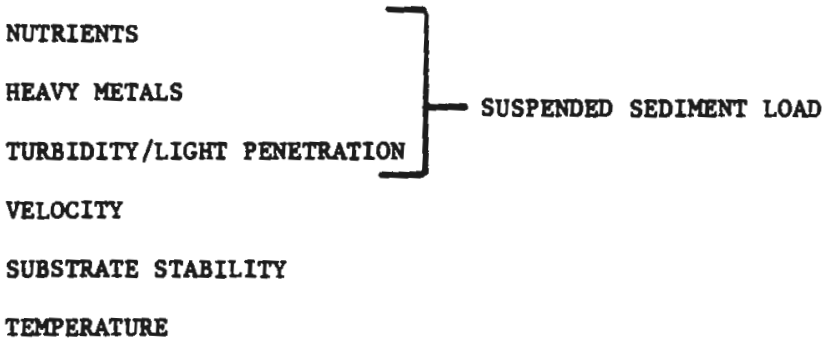
SUSITNA HYDROELECTRIC PROJECT

Some Estimated Downstream Water Quality Trends: With - Project vs. Natural

	Summer May - September	Winter October - April
Settleable Solids	Much Less	More
TSS	Much lower	Much Higher
Turbidity	Lower	Much Higher
Nutrients:		
1. Phosphorus		
Total	Much Less	Much More
BAP-Organic	More	More
BAP-Inorg.	Little Change	Little Change
2. Organic Carbon	Less	Higher
Labile	More	More
Refractory	Less	More
3. Oxygen	Little Change	Little Change
4. Nitrogen	Less	More
Most Metals	Much Less	More
Conductivity	Higher	Lower

Total Dissolved Solids (slight increase during trophic upsurge, then more seasonally stabilized)

FACTORS AFFECTING PRIMARY PRODUCTION



CONCLUSIONS

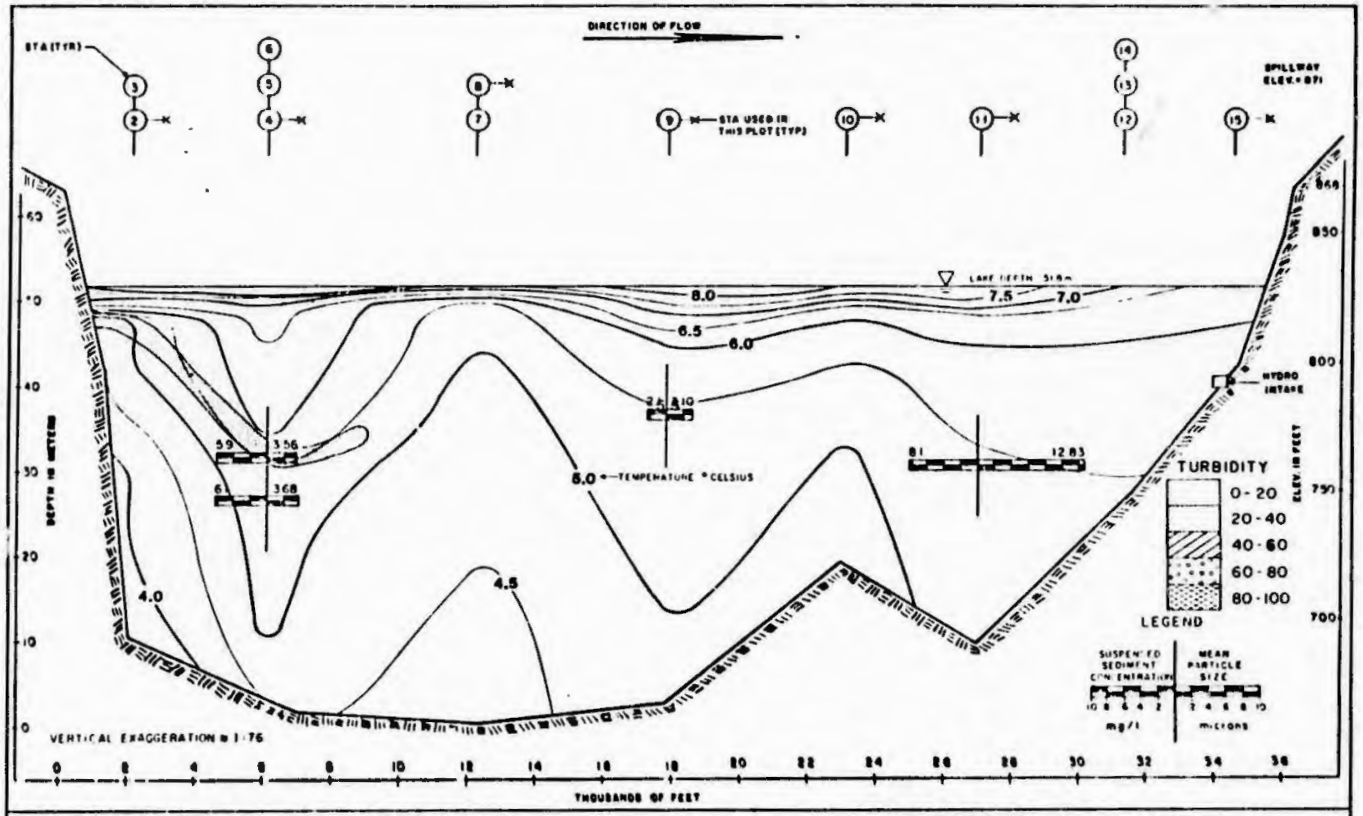
NUTRIENTS WILL REMAIN ABUNDANT

PRIMARY PRODUCTION IS PRESENTLY LIMITED BY LIGHT AND VELOCITY

PRIMARY PRODUCTION MAY INCREASE UNDER POST-PROJECT CONDITIONS BECAUSE OF LOWER, MORE STABLE FLOWS AND DECREASED TURBIDITIES

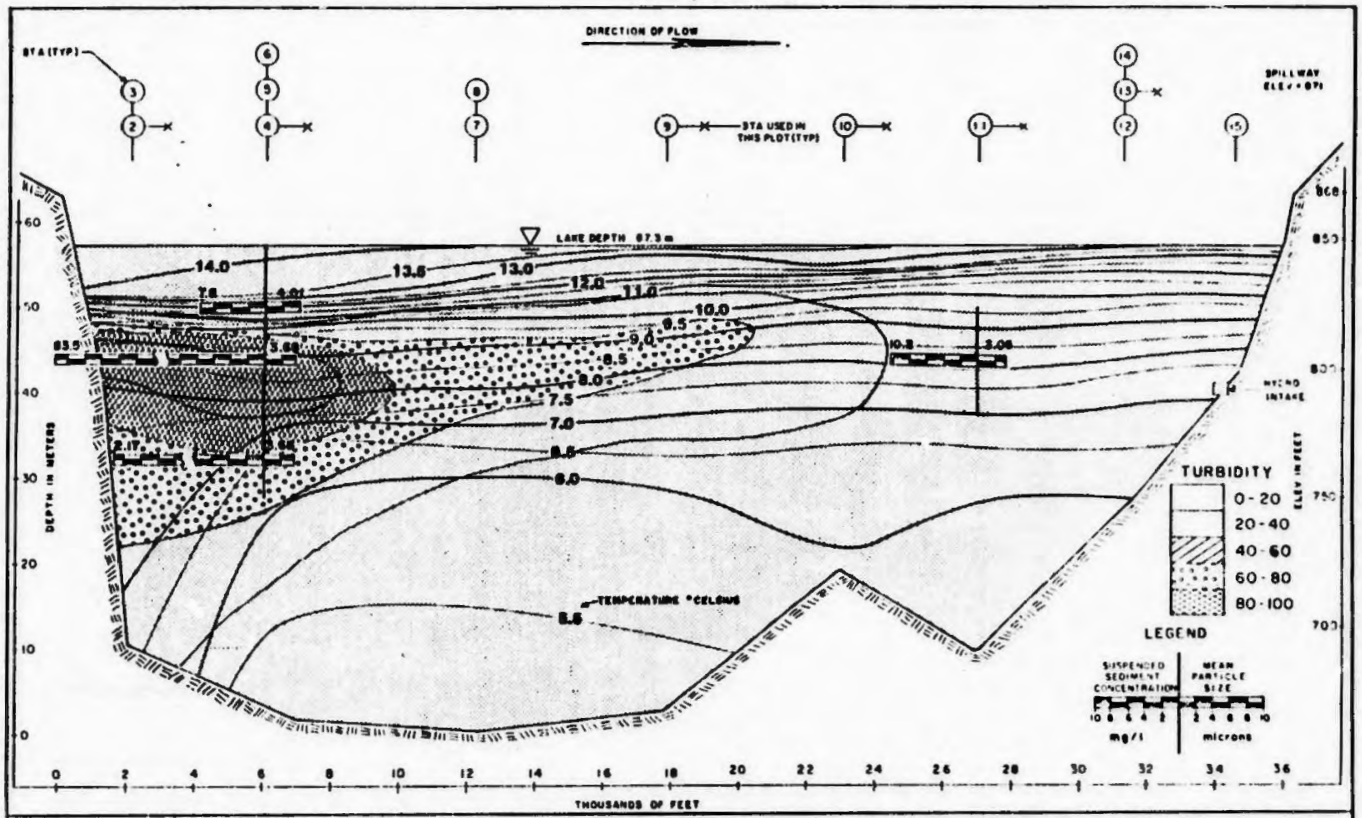
TABLE 1.1

	Watana Reservoir	Eklutna Lake
Surface Area	37,800 acres	3427 acres
Maximum Depth	860 feet	208 feet
Drainage Area	5,180 sq. mi.	111 sq. mi.
Average Annual Inflow	5,880,000 acre-ft	234,300 acre-ft
Average Residence Time	1.65 years	1.77 years
% Glaciated Drainage Area	5.9%	5.2%



EKLUTNA LAKE PROFILE **FIGURE 4**

SUSPENDED SEDIMENT 18 JUNE 82 **SOURCE: R&M CONSULTANTS, INC. (1982b)**

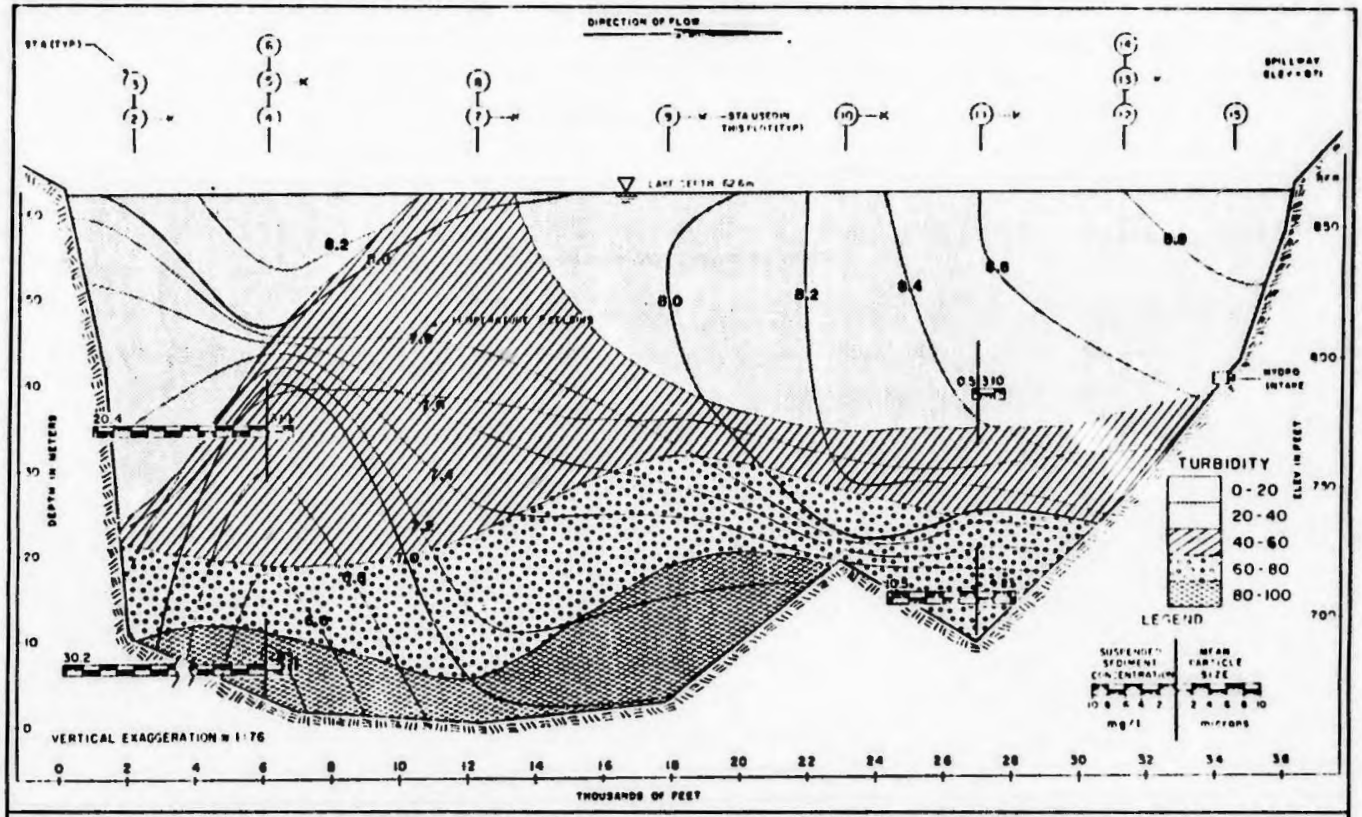


EKLUTNA LAKE PROFILE

SUSPENDED SEDIMENT 28 JULY 82

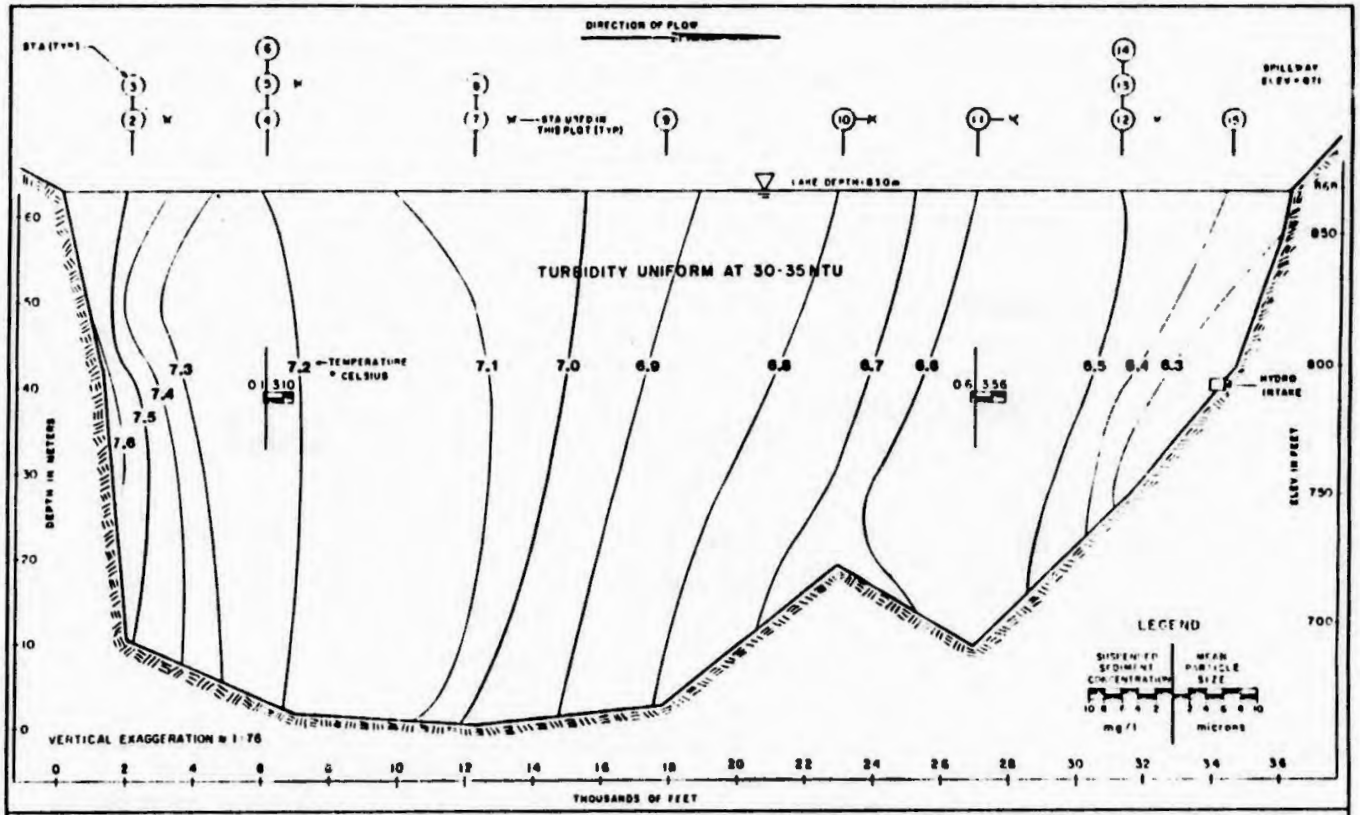
FIGURE 5

SOURCE: R&M CONSULTANTS, INC. (1982b)



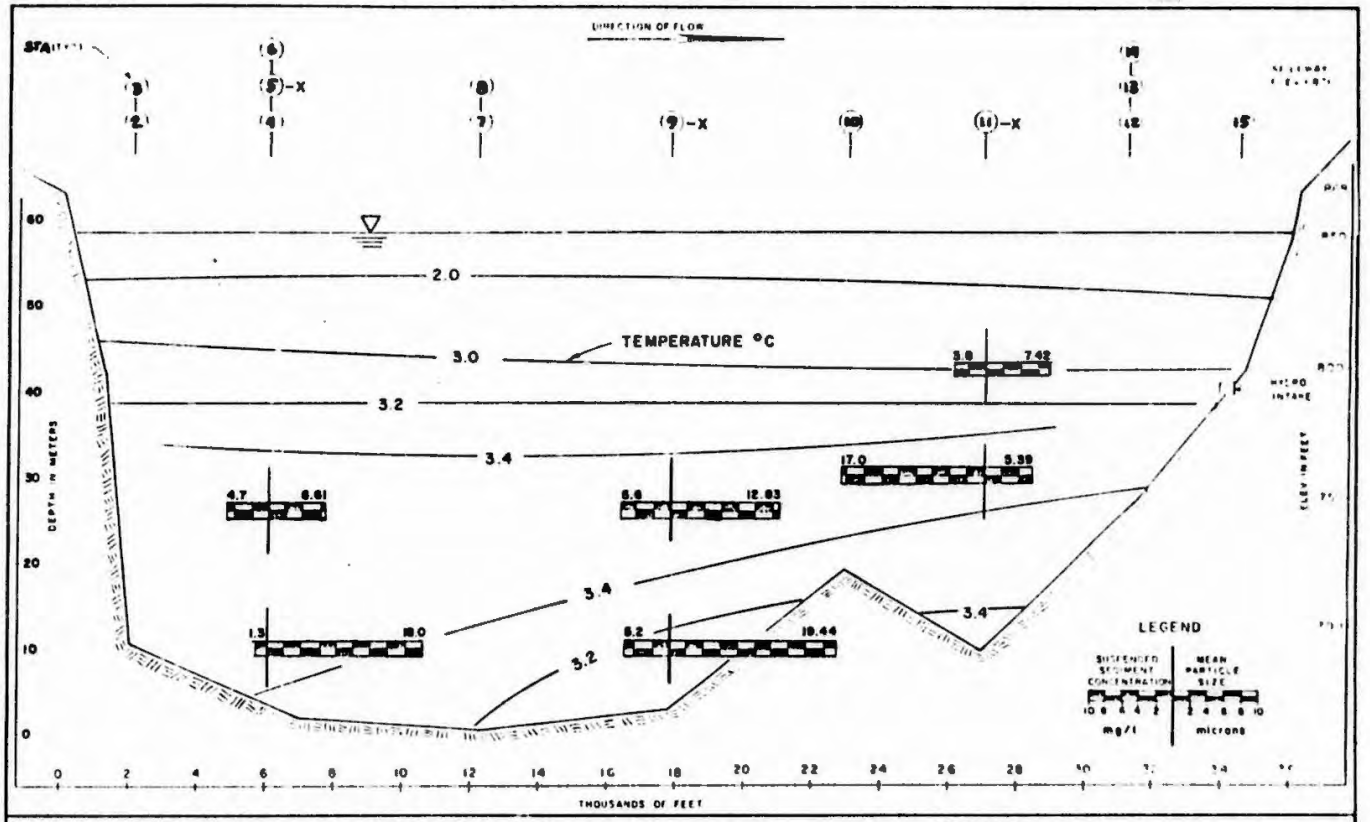
EKLUTNA LAKE PROFILE **FIGURE 7**

SUSPENDED SEDIMENT 22 SEPT 82 **SOURCE: R&M CONSULTANTS, INC. (1982b)**



EKLUTNA LAKE PROFILE **FIGURE 8**

SUSPENDED SEDIMENT 14 OCT 82 **SOURCE: R&M CONSULTANTS, INC. (1982b)**



EKLUTNA LAKE PROFILE **FIGURE 9**

SUSPENDED SEDIMENT 11 JAN 83 **SOURCE: R&M CONSULTANTS, INC. (1982b)**

TABLE 4.2
PETROGRAPHIC ANALYSIS

Mineral Species	% of Total Sediment: Susitna River at Gold Greek	% of Total Sediment: Eklutna Lake Composite
Augite	5 - 10	5
Quartz	15 - 20	15 - 20
Diatoms	5	1 - 2
Muscovite	19 - 20	15 - 20
Mixed Feldspars	25 - 30	30 - 35
Iron Oxides	10 - 15	4 - 8
Illmenite	5	3
Calcite	1 - 2	2 - 3
Zircon	1	---
Pyrite	3 - 5	1

Table 1

AVERAGE TOTAL SUSPENDED SOLIDS AND TURBIDITY VALUES
SETTLING COLUMN TESTS

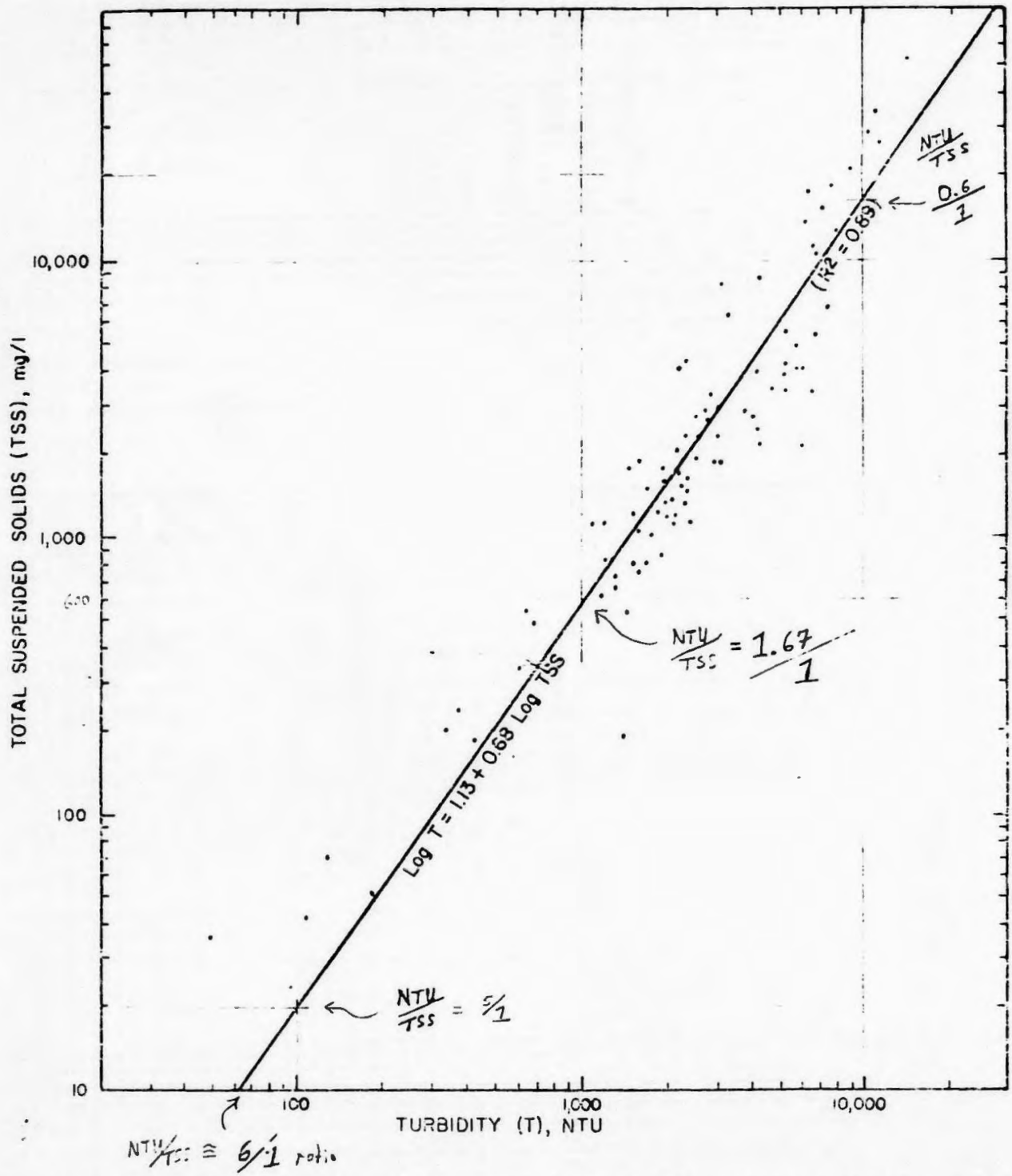
MINE SITE	0 HOUR TSS mg/l	0 HOUR Turb NTU	0 HOUR NTU/TSS	6 HOUR TSS mg/l	6 HOUR Turb NTU	6 HOUR NTU/TSS	12 HOUR TSS mg/l	12 HOUR Turb NTU	24 HOUR TSS mg/l	24 HOUR Turb NTU	48 HOUR TSS mg/l	48 HOUR Turb NTU	72 HOUR TSS mg/l	72 HOUR Turb NTU	72 HOUR NTU/TSS
1	6,280	3,200	.51	2,310	2,900	1.25	2,060	2,200	1,260	1,900	1,240	1,500	780	1,500	1.94
2	53,800	14,200	.26	15,300	7,100	0.46	4,100	5,400	1,800	2,900	800	1,700	620	1,200	1.94
3	11,200	6,700	.60	3,410	6,500	1.9	4,080	5,300	3,600	5,200	3,400	4,700	2,800	3,700	1.32
4	33,500	10,700	.32	5,310	6,800	1.28	2,690	4,000	1,430	2,300	540	1,300	190	1,400	7.37
5	5,480	5,300	.97	3,990	4,200	1.05	3,260	2,900	1,840	2,900	1,280	2,300	1,000	1,700	1.70
6	8,100	3,100	.38	4,250	2,300	0.54	1,850	1,600	1,410	1,300	1,130	1,100	810	1,200	1.48
7	17,200	6,300	.37	2,760	2,800	1.01	1,730	2,200	1,320	2,000	1,030	1,600	1,160	1,980	1.71
8	13,700	6,100	.45	2,900	3,600	1.24	2,290	2,500	1,850	2,500	1,590	1,900	1,130	1,200	1.06
9	12,700	7,900	.62	2,710	4,800	1.77	1,130	2,100	700	1,280	330	600	180	420	2.33
10	18,100	7,400	.41	4,950	5,600	1.13	3,770	5,100	3,480	5,100	2,430	3,600	2,290	3,000	1.31
11	3,030	2,700	.89	1,780	2,400	1.35	1,470	1,700	1,280	2,000	1,350	2,600	1,170	2,000	1.71
12	20,700	8,500	.41	6,550	6,800	1.04	4,180	5,300	2,180	4,300	1,840	3,100	1,110	2,400	2.16
13	27,900	10,200	.37	1,470	1,800	1.22	490	680	200	330	52.3	180	42.9	110	2.56
14	25,600	11,100	.43	10,400	6,800	0.65	534	630	232	370	68.8	130	35.2	45	1.28
Porcupine	8,610	4,300	.50	2,830	2,800	0.99	1,630	2,300	873	1,500	740	1,400	651	1,300	2.0

n=15 $\bar{x}$ = .50 | $\bar{x}$ = 1.13 | $\bar{x}$ = 1.26 | $\bar{x}$ = 1.55 | $\bar{x}$ = 1.78 | n=15 $\bar{x}$ = 2.1

Note: The values listed above are average values of the column parts sampled. Average values for Porcupine Creek listed under 6 hour and 12 hour were sampled at 4 and 7 hours, respectively. Total Suspended Solids and Turbidity values for Porcupine Creek after 528 hours (22 days) are 120 mg/l and 390 NTU, respectively. NTU/TSS = 3.25

R&M

R&M CONSULTANTS, INC.

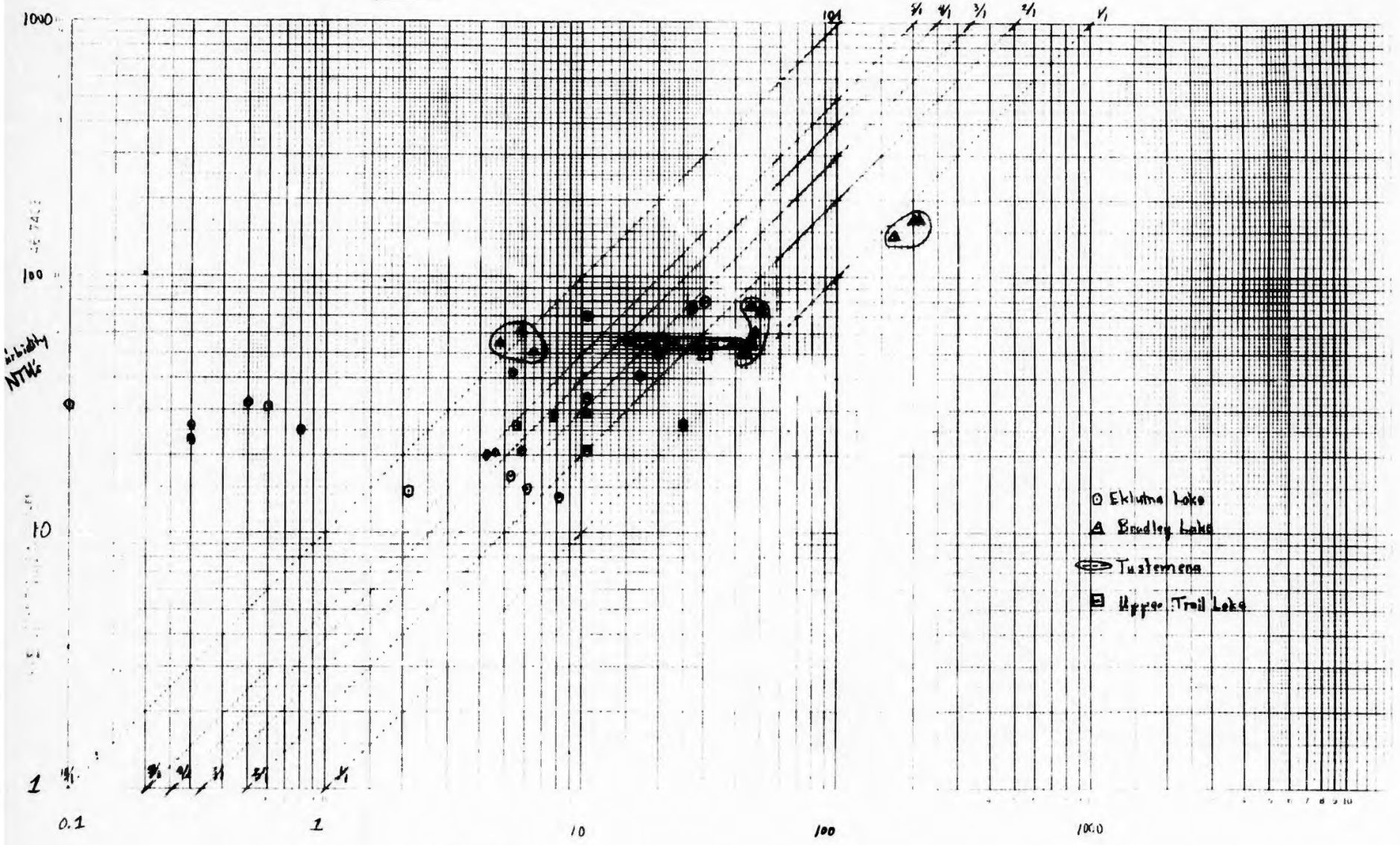


RELATIONSHIP BETWEEN TURBIDITY AND TOTAL SUSPENDID SOLIDS

SETTLING POND DEMONSTRATION PROJECT

DATE	SCALE	DRAWN BY	CHECKED BY	PROJECT NO.	DRAWING NO.
6-6-62	AS SHOWN	LDS	JHW	013104	5

Glacial Lake Data



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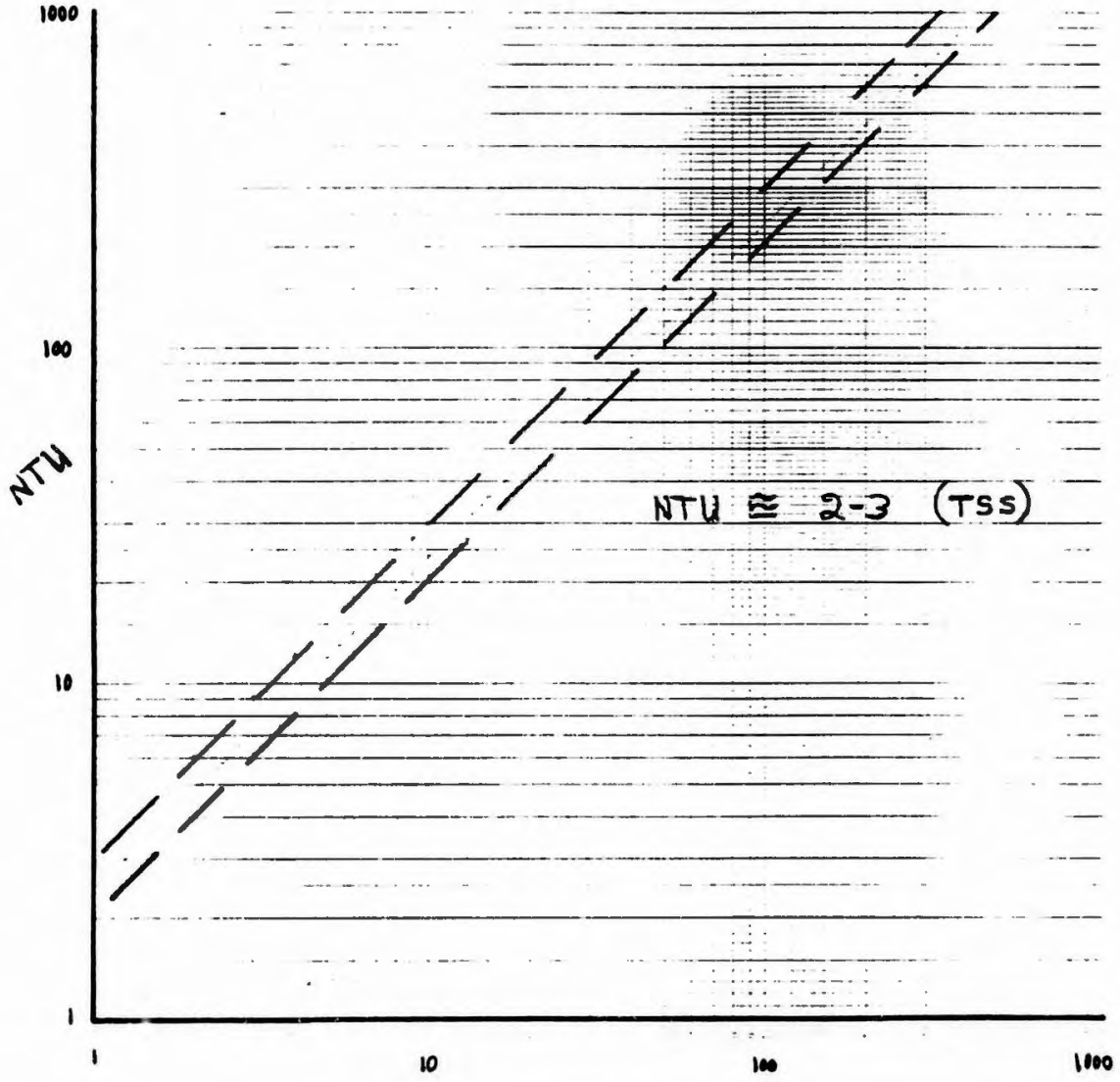
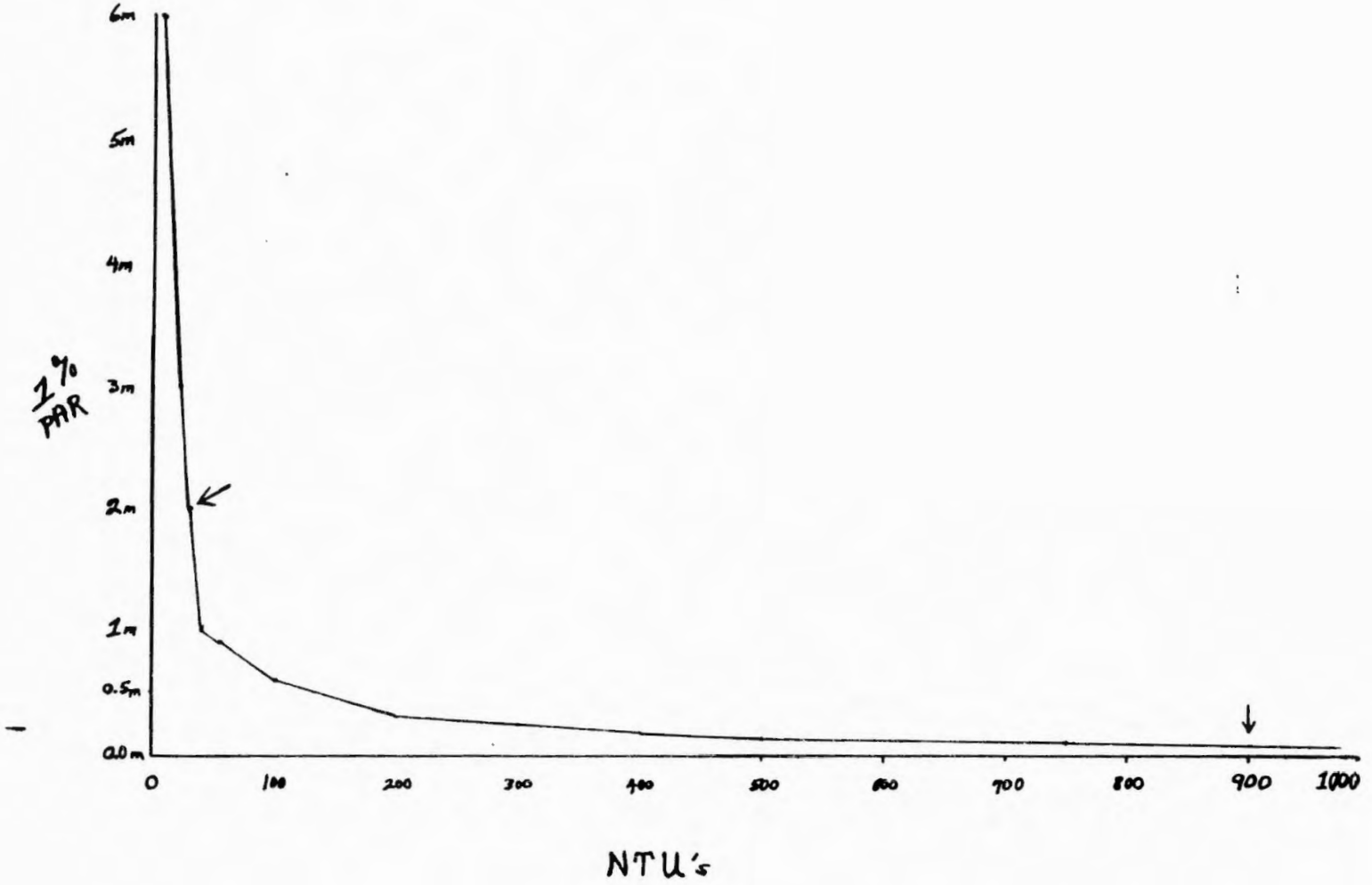

1000
100
10
1
NTU
NTU ≅ 2-3 (TSS)
1
10
100
1000
Total Suspended Solids


6m
5m
4m
3m
2m
1m
0.5m
0.0m
1% PAR
0
100
200
300
400
500
600
700
800
900
1000
NTU's

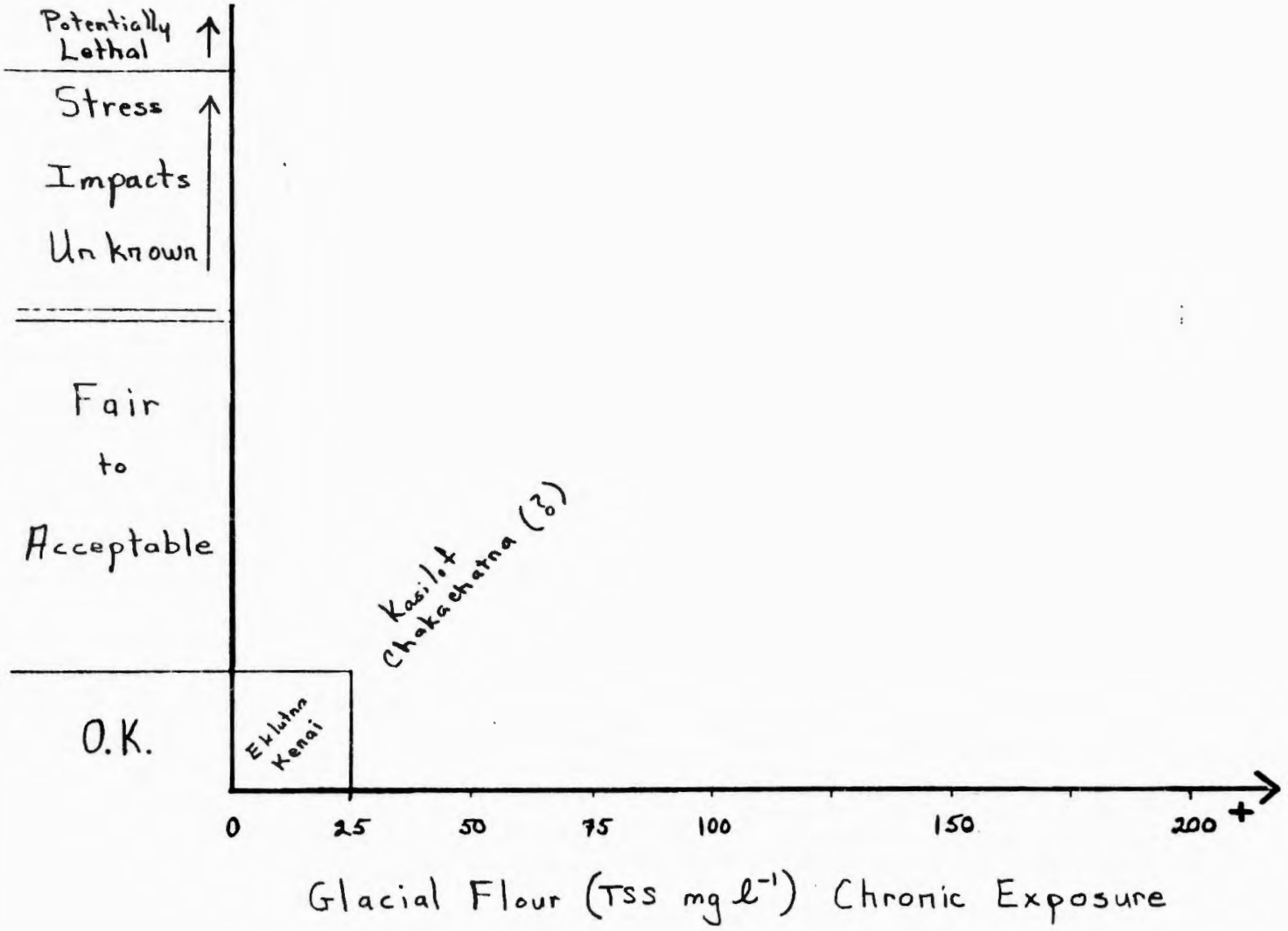

Potentially Lethal
Stress Impacts Unknown
Fair to Acceptable
O.K.
Kasilof
Chakachatna (?)
Eklutna
Kenai
0
25
50
75
100
150
200
+
Glacial Flour (TSS mg ℓ^{-1}) Chronic Exposure

Table 1

Mercury Physical and Chemical Characteristics

Item	
Atomic weight	200.59
Melting point	-38.87° C
Boiling point	356-358° C
Solubility in water	practically insoluble, 25 ppb as Hg
Specific gravity @ 20° C	13.546
Vapor pressure @ 20° C	0.0012 mm Hg
Oxidation states	H°, Hg^{+}, Hg^{++}

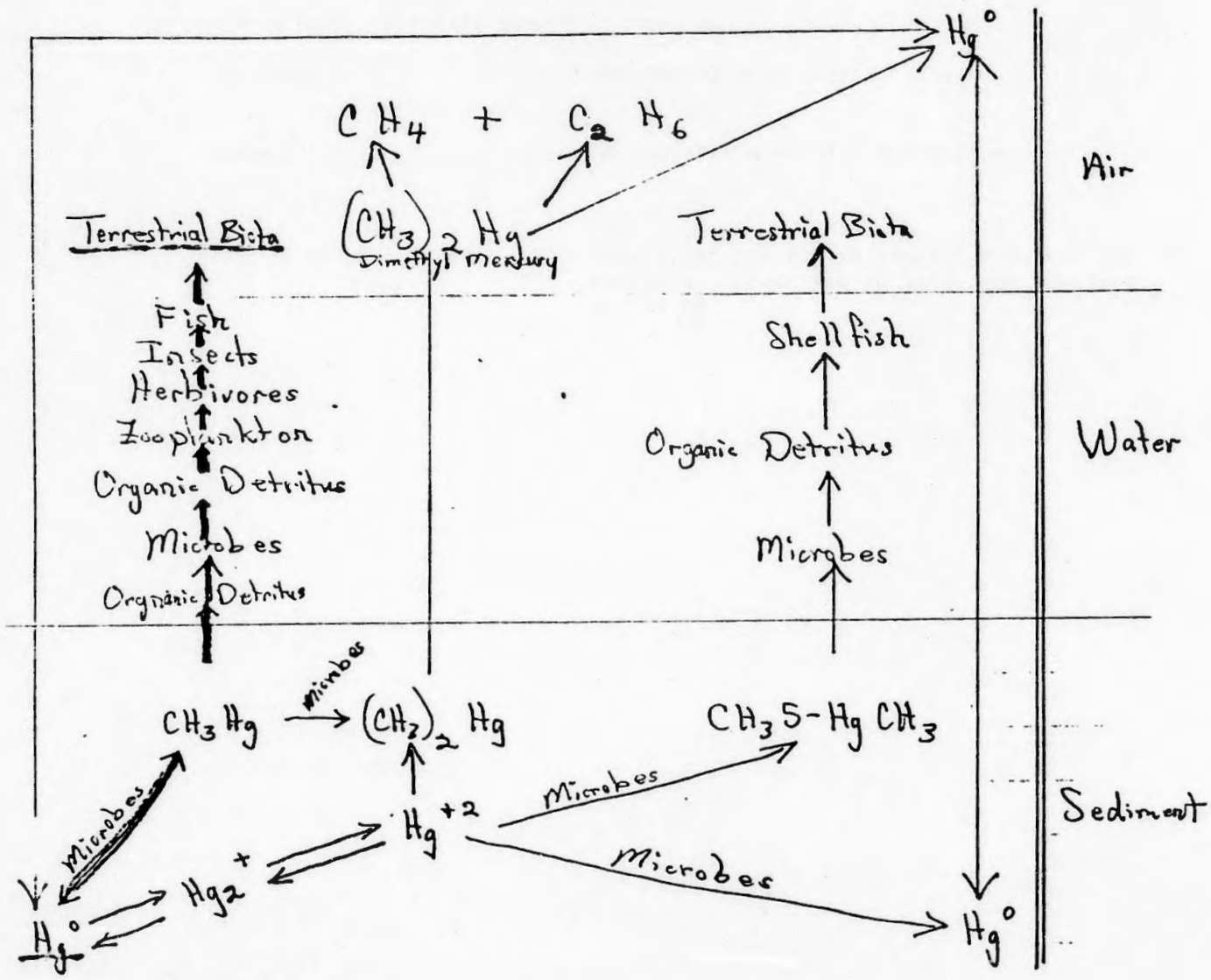


Figure 1.

A simplified representation of the mercury cycle demonstrating the flow of mercury and its bioaccumulation through the aquatic food chains.

Selected Thoughts about Possible Limited Potential for Susitna Induced Mercury Bioccumulation

1. Limited Fishery in Reservoirs

2. Limited primarily to resident fish - Downstream

3. Other "problem" reservoirs are:

Shallower	- Inundating much organic debris
Warmer	- Accelerates microbial metabolism
Richer Trophic Status	- More light and labile organic material for microbial metabolism to cycle and possibly for CH_3Hg

SUSITNA HYDROELECTRIC PROJECT

Status of Construction Permits
Water Quality Protection
July 30, 1984

Applications Submitted

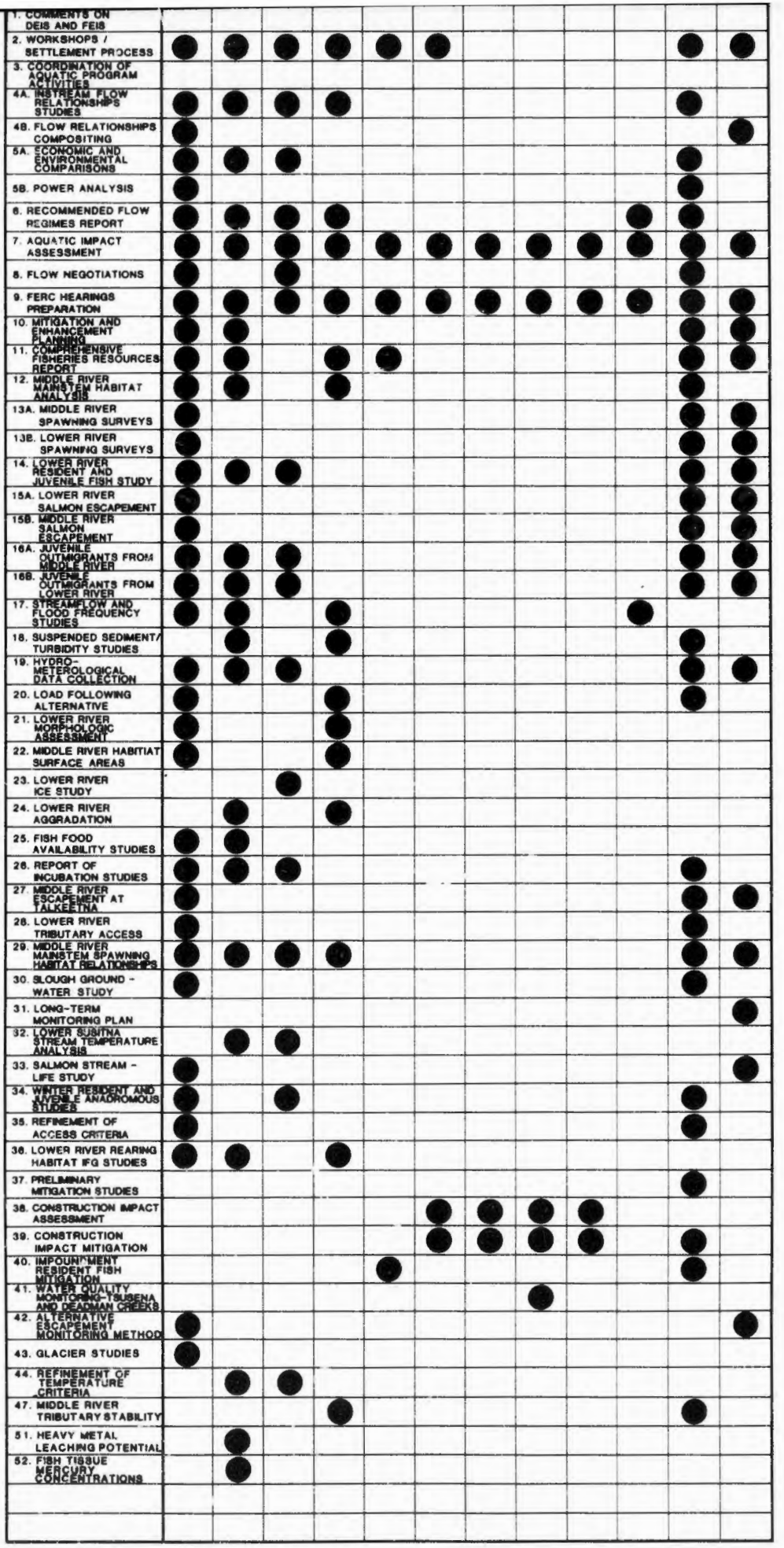
Hydroelectric License	FERC
NPDES	EPA
Determination of Consistency w/Coastal Mgt. Program	OMB-DGC
Section 401, Cert. of Reas. Assurance w/Water Quality	ADEC

Applications Pending

Section 10, Rivers & Harbor Act	COE
Section 404, Clean Water Act	COE
Solid Waste Management	ADEC
	MSB
	EPA
Wastewater Disposal	ADEC
	MSB
	EPA
AS 16.10.010, Work in Anad. Streams	ADEC
AS 16.10.020, " " "	ADHSS
AS 16.05.870, " " "	ADF&G
Approval to Construct/Operate (Potable Water)	ADEC
Toxic & Hazardous Waste Mgt., incl. Contingency Planning	EPA
	ADEC
Material Acquisition	BLM
	ADNR
	CIRI

RELATIONSHIP BETWEEN FY 85 AQUATIC PROGRAM WORK PLAN AND ISSUES

TASKS	F-1 SIGNIFICANCE OF ALTERED FLOWS ON FISH	F-2 SIGNIFICANCE OF WATER QUALITY CHANGES	F-3 SIGNIFICANCE OF ALTERED ICE PROCESSES	F-4 SIGNIFICANCE OF CHANGES TO STREAM MORPHOLOGY	F-5 SIGNIFICANCE OF IMPOUNDMENT EFFECTS ON FISH	F-6 SIGNIFICANCE OF ACCESS CORRIDOR EFFECTS ON FISH	F-7 SIGNIFICANCE OF TRANSMISSION LINE EFFECTS ON FISH	F-8 SIGNIFICANCE OF WATER QUALITY EFFECTS DUE TO CAMP AND VILLAGE	F-9 SIGNIFICANCE OF WATER QUALITY EFFECTS IN BORROW AND SPOIL AREAS	F-10 SIGNIFICANCE OF INSTREAM ACTIVITIES ON FISH	F-11 FEASIBILITY OF MITIGATION OPTIONS	F-12 FORMULATION OF LONG-TERM MONITORING PLAN
1. COMMENTS ON DEIS AND FEIS												
2. WORKSHOPS / SETTLEMENT PROCESS	●	●	●	●	●	●					●	●
3. COORDINATION OF AQUATIC PROGRAM ACTIVITIES												
4A. INSTREAM FLOW RELATIONSHIPS STUDIES	●	●	●	●							●	
4B. FLOW RELATIONSHIPS COMPOSITING	●											●
5A. ECONOMIC AND ENVIRONMENTAL COMPARISONS	●	●	●								●	
5B. POWER ANALYSIS	●										●	
6. RECOMMENDED FLOW REGIMES REPORT	●	●	●	●						●	●	
7. AQUATIC IMPACT ASSESSMENT	●	●	●	●	●	●	●	●	●	●	●	●
8. FLOW NEGOTIATIONS	●		●								●	
9. FERC HEARINGS PREPARATION	●	●	●	●	●	●	●	●	●	●	●	●
10. MITIGATION AND ENHANCEMENT PLANNING	●	●									●	●
11. COMPREHENSIVE FISHERIES RESOURCES REPORT	●	●		●	●						●	●
12. MIDDLE RIVER MAINSTEM HABITAT ANALYSIS	●	●		●							●	
13A. MIDDLE RIVER SPAWNING SURVEYS	●										●	●
13B. LOWER RIVER SPAWNING SURVEYS	●										●	●
14. LOWER RIVER RESIDENT AND JUVENILE FISH STUDY	●	●	●								●	●
15A. LOWER RIVER SALMON ESCAPEMENT	●										●	●
15B. MIDDLE RIVER SALMON ESCAPEMENT	●										●	●
16A. JUVENILE OUTMIGRANTS FROM MIDDLE RIVER	●	●	●								●	●
16B. JUVENILE OUTMIGRANTS FROM LOWER RIVER	●	●	●								●	●
17. STREAMFLOW AND FLOOD FREQUENCY STUDIES	●	●		●						●		
18. SUSPENDED SEDIMENT/ TURBIDITY STUDIES		●		●							●	
19. HYDRO-METEROLOGICAL DATA COLLECTION	●	●	●								●	●
20. LOAD FOLLOWING ALTERNATIVE	●			●							●	
21. LOWER RIVER MORPHOLOGIC ASSESSMENT	●			●								
22. MIDDLE RIVER HABITAT	●			●								


1. COMMENTS ON DEIS AND FEIS
2. WORKSHOPS / SETTLEMENT PROCESS
3. COORDINATION OF AQUATIC PROGRAM ACTIVITIES
4A. INSTREAM FLOW RELATIONSHIPS STUDIES
4B. FLOW RELATIONSHIPS COMPOSITING
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5B. POWER ANALYSIS
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19. HYDRO-METEROLOGICAL DATA COLLECTION
20. LOAD FOLLOWING ALTERNATIVE
21. LOWER RIVER MORPHOLOGIC ASSESSMENT
22. MIDDLE RIVER HABITIAT SURFACE AREAS
23. LOWER RIVER ICE STUDY
24. LOWER RIVER AGGRADATION
25. FISH FOOD AVAILABILITY STUDIES
26. REPORT OF INCUBATION STUDIES
27. MIDDLE RIVER ESCAPEMENT AT TALKEETNA
28. LOWER RIVER TRIBUTARY ACCESS
29. MIDDLE RIVER MAINSTEM SPAWNING HABITAT RELATIONSHIPS
30. SLOUGH GROUND - WATER STUDY
31. LONG-TERM MONITORING PLAN
32. LOWER SUSITNA STREAM TEMPERATURE ANALYSIS
33. SALMON STREAM - LIFE STUDY
34. WINTER RESIDENT AND JUVENILE ANADROMOUS STUDIES
35. REFINEMENT OF ACCESS CRITERIA
36. LOWER RIVER REARING HABITAT IFG STUDIES
37. PRELIMINARY MITIGATION STUDIES
38. CONSTRUCTION IMPACT ASSESSMENT
39. CONSTRUCTION IMPACT MITIGATION
40. IMPOUNDMENT RESIDENT FISH MITIGATION
41. WATER QUALITY MONITORING-TSUSENA AND DEADMAN CREEKS
42. ALTERNATIVE ESCAPEMENT MONITORING METHOD
43. GLACIER STUDIES
44. REFINEMENT OF TEMPERATURE CRITERIA
47. MIDDLE RIVER TRIBUTARY STABILITY
51. HEAVY METAL LEACHING POTENTIAL
52. FISH TISSUE MERCURY CONCENTRATIONS

SUSITNA HYDRO AQUATIC STUDIES
PHASE II BASIC DATA REPORT

Volume 4: Aquatic Habitat and Instream Flow Studies, 1982.

Parts I and II

-by-

ALASKA DEPARTMENT OF FISH AND GAME
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503
1983

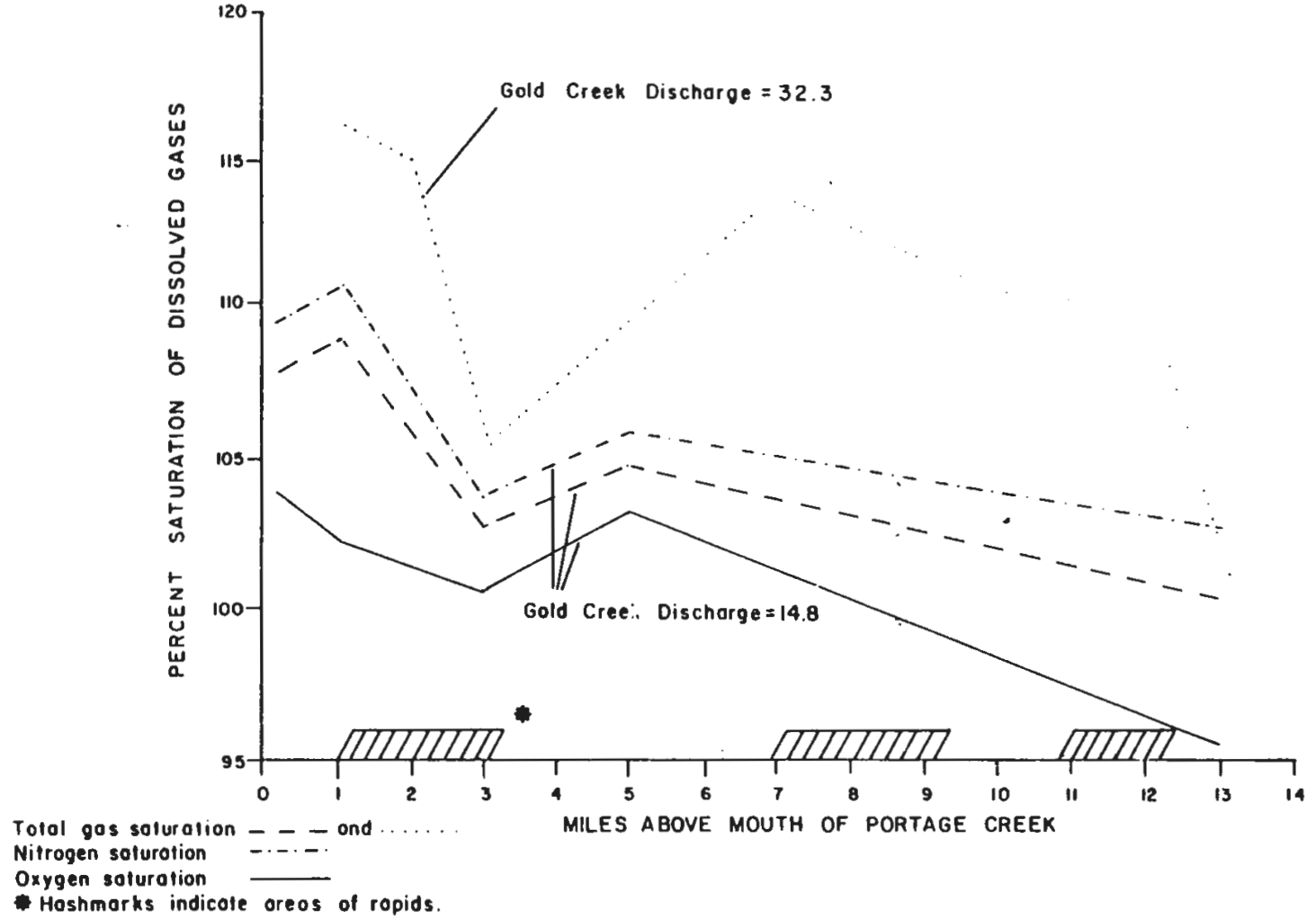


Figure 4I-3-55. Concentrations of dissolved gases in Devil Canyon rapids complex.

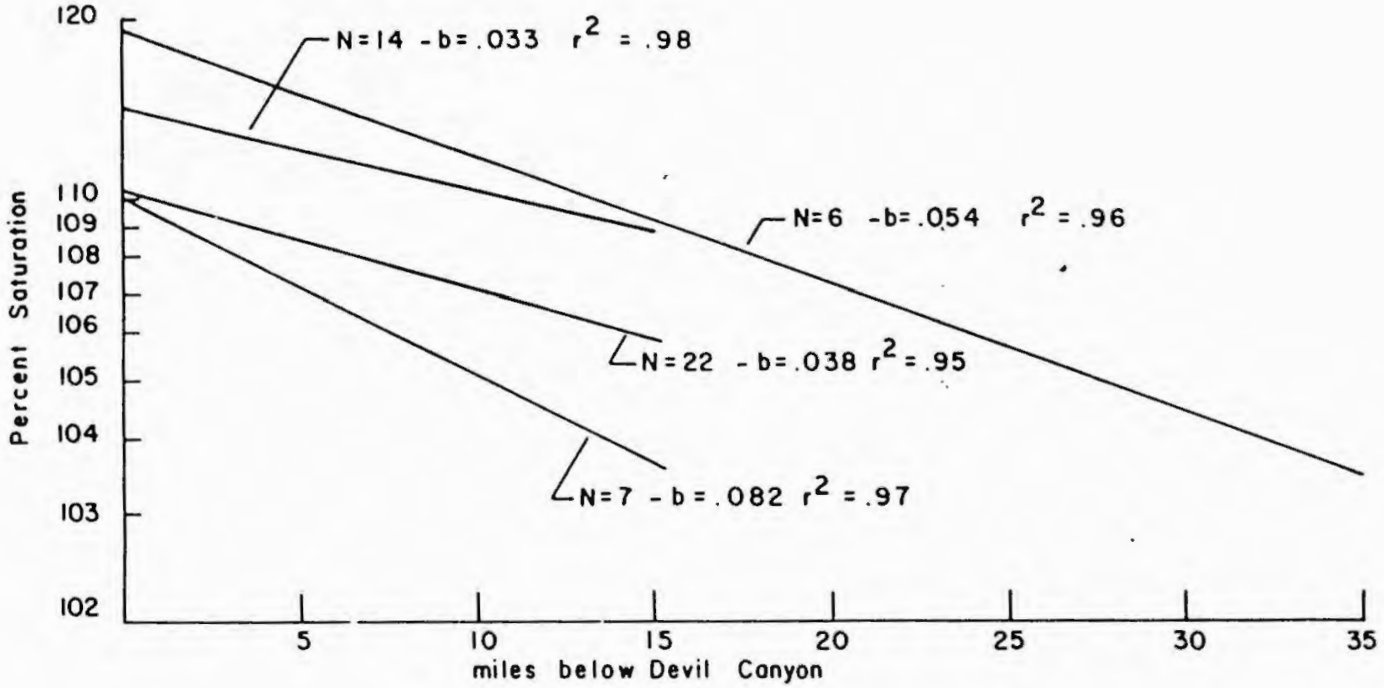


Figure 4I-3-54. Percent concentration of total dissolved gas versus distance below the Devil Canyon proposed dam site.

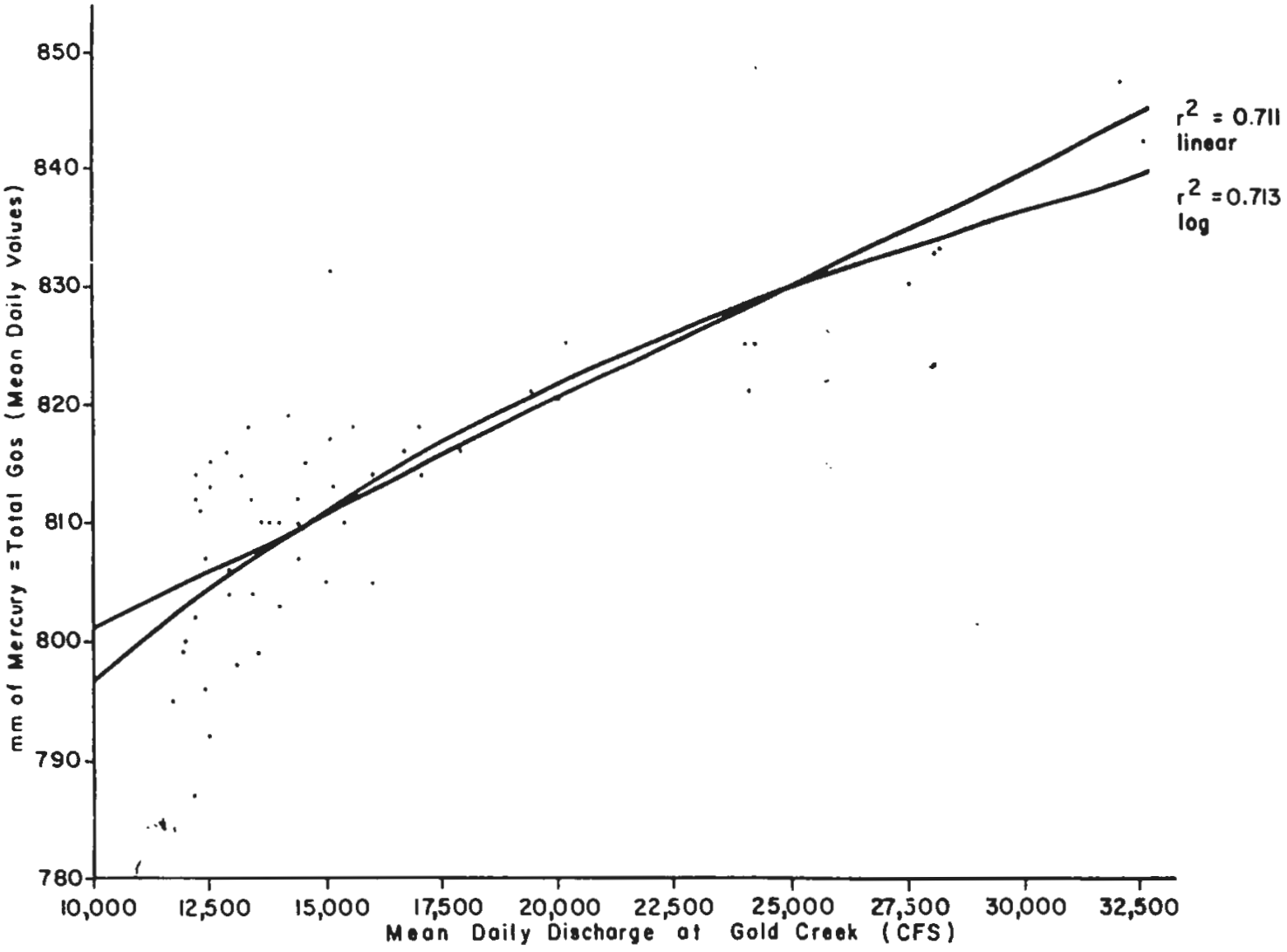
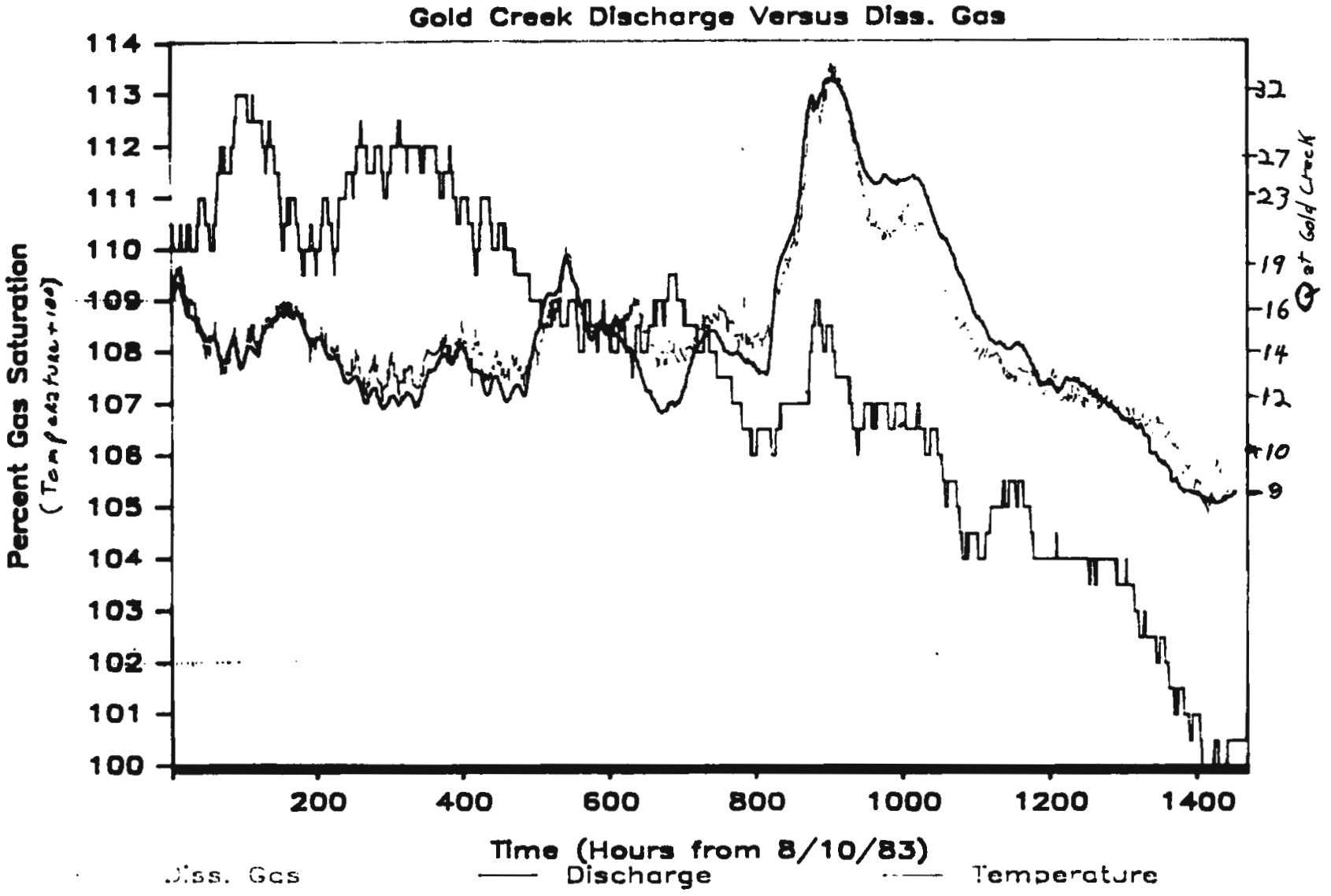


Figure 41-3-56. Mean daily discharge versus saturometer readings below Devil Canyon.

Dissolved Gas below Devil Canyon



Dissolved Gas near Gold Creek