

APPENDIX E

Effects of Mainstem Susitna Discharge on Total Wetted and Backwater
Surface Areas at Selected Study Sites

APPENDIX E

TABLE OF CONTENTS

	<u>Page</u>
LIST OF APPENDIX FIGURES	E-ii
LIST OF APPENDIX TABLES	E-iv
LIST OF APPENDIX PLATES	E-v
INTRODUCTION	E-1
METHODS	E-1
RESULTS	E-3
DISCUSSION	E-3
LITERATURE CITED	E-32

APPENDIX E

LIST OF APPENDIX FIGURES

	<u>Page</u>
Appendix Figure E-1	Wetted surface areas at Slough 21 versus mainstem discharge at Gold Creek..... E-8
Appendix Figure E-2	Wetted surface areas at Slough 20 versus mainstem discharge at Gold Creek..... E-9
Appendix Figure E-3	Wetted surface areas at Slough 19 versus mainstem discharge at Gold Creek..... E-10
Appendix Figure E-4	Wetted surface area at Slough 11 versus mainstem discharge at Gold Creek..... E-11
Appendix Figure E-5	Wetted surface areas at Slough 9 versus mainstem discharge at Gold Creek..... E-12
Appendix Figure E-6	Wetted surface areas at Slough 8A versus mainstem discharge at Gold Creek..... E-13
Appendix Figure E-7	Wetted surface areas at Lane Creek/ Slough 8 versus mainstem discharge at Gold Creek..... E-14
Appendix Figure E-8	Wetted surface areas at Slough 6A versus mainstem discharge at Gold Creek..... E-15
Appendix Figure E-9	Wetted surface area at Whiskers Creek versus mainstem discharge at Gold Creek..... E-16
Appendix Figure E-10	Wetted surface area at Birch Creek/Slough versus mainstem discharge at Sunshine..... E-17
Appendix Figure E-11	Wetted surface areas at Sunshine Creek versus mainstem discharge at Sunshine..... E-18

<u>LIST OF APPENDIX FIGURES (Continued)</u>		<u>Page</u>
Appendix Figure E-12	Wetted surface areas at Rabideux Creek/Slough versus mainstem discharge at Sunshine.....	E-19
Appendix Figure E-13	Wetted surface areas at Whitefish Slough versus mainstem discharge at Sunshine.....	E-20
Appendix Figure E-14	Wetted surface areas at Goose Creek/Side Channel versus mainstem discharge at Sunshine.....	E-21
Appendix Figure E-15	Wetted surface area summations for the nine upper Susitna sites versus Susitna River discharge at Gold Creek.....	E-27
Appendix Figure E-16	Wetted surface area summations for the five lower Susitna sites versus Susitna River discharge at Sunshine.....	E-28

APPENDIX E

LIST OF APPENDIX TABLES

	<u>Page</u>
Appendix Table E-1	E-4
<p>Total wetted and aggregate type II (backwater) surface areas of selected regions of Designated Fish Habitat (DFH) sites, and mainstem Susitna River discharges, June through September, 1982.....</p>	
Appendix Table E-2	E-23
<p>Surface areas of morphological pools not regulated by mainstem Susitna River discharge at Designated Fish Habitat (DFH) sites, and mainstem Susitna River discharges, June through September, 1982.....</p>	
Appendix Table E-3	E-25
<p>Total wetted surface areas measured within the boundaries of nine study areas on the upper Susitna River, versus Gold Creek discharge, June through September, 1982.....</p>	
Appendix Table E-4	E-26
<p>Total wetted surface areas measured within the boundaries of five study areas on the lower Susitna River, versus Sunshine discharge, June through September, 1982.....</p>	

APPENDIX E

LIST OF APPENDIX PLATES

	<u>Page</u>
Appendix Plate E-1	August 1980 aerial photograph of Slough 21 (RM 142.0)..... E-33
Appendix Plate E-2	August 1982 aerial photograph of Slough 20 (RM 140.1)..... E-34
Appendix Plate E-3	May 1982 aerial photograph of Slough 19 (RM 140.0)..... E-35
Appendix Plate E-4	August 1980 aerial photograph of Slough 11 (RM 135.3)..... E-36
Appendix Plate E-5	August 1980 aerial photograph of Slough 9 (RM 129.2)..... E-37
Appendix Plate E-6	August 1980 aerial photograph of Slough 8A (RM 125.3)..... E-38
Appendix Plate E-7	August 1982 aerial photograph of Lane Creek mouth and Slough 8 (RM 113.6)..... E-39
Appendix Plate E-8	May 1982 aerial photograph of Slough 6A (RM 112.3)..... E-40
Appendix Plate E-9	May 1982 aerial photograph of Whiskers Creek and Slough (RM 101.2)..... E-41
Appendix Plate E-10	August 1980 aerial photograph of Birch Creek and Slough (RM 88.4)..... E-42
Appendix Plate E-11	August 1980 aerial photograph of Sunshine Creek and Side Channel (RM 85.7)..... E-43
Appendix Plate E-12	August 1982 aerial photograph of Rabideux Creek and Slough (RM 83.1)..... E-44
Appendix Plate E-13	May 1982 aerial photograph of Whitefish Slough (RM 78.7)..... E-45
Appendix Plate E-14	August 1980 aerial photograph of Goose Creek 2 and Side Channel (RM 73.1)..... E-46

INTRODUCTION

Backwater areas are zones of low velocity water which result from hydraulic barriers created by mainstem stage effects. The relationship between backwater surface areas and incremental changes in mainstem Susitna River discharge has been addressed in Volume 4, Part 1 of the Basic Data Report (ADF&G 1983). This appendix provides additional information concerning the response of these backwater surface areas to changes in mainstem discharge and provides information on wetted surface areas. The relationship between the backwater and wetted surface areas, and data on the abundance of pools formed by berms in free flowing stream areas at these study sites is also discussed.

METHODS

Fourteen slough and tributary mouths, between Susitna River miles 73.1 and 142.0, were visited once every two weeks from the beginning of June to the end of September during 1982. Maps of the wetted surfaces present at each site were drawn for each sampling. The total wetted and backwater surface areas represented on the maps were planimetered after ensuring that the study boundaries were identical from trip to trip.

Details of the methodology are described in the Basic Data Report, Volume 4, Part I ADF&G, 1983. A detailed narrative describing each study site is available in Appendix F, Volume 4 of the Basic Data Report.

Aerial photographs of each of the study sites are presented as Appendix Plates E-1 to E-14. The sampling boundaries illustrated in these photographs bracket those reaches of each site where the surface area measurements were taken. The entire wetted surface found within this area during each sampling is termed the "total" wetted surface area although it is a partial total for the slough or tributary as a whole. Inspection of the photographs will show the reader the extent to which the total wetted surface areas reported actually represent the larger physical or hydraulic features of these habitat areas.

Some changes have been made in the definition of "study" boundaries at the Sunshine Creek, Slough 9, Lane and Goose Creek sites from those shown previously in the Basic Data Report. At the Lane and Goose Creek sites, the creek portion of the sites have been omitted because mapping of these areas was not always complete. At the Slough 9 location, maps of the upper half of the study area were not made during low water samplings. Thus, the upper half of the area was not included in the study boundary.

At the Sunshine site, a section of the previously defined study area was also deleted due to inconsistent mapping of the uppermost reaches of the creek. As a result, 15,000 ft² at 60,100 cfs and 24,000 ft² at 82,400 cfs (of the true total) backwater area present during the July samplings was omitted in this study in order to obtain comparable total and backwater area measurements.

In general, the sampling boundaries at each site were chosen to encompass the backwater areas present over the range of flows sampled, and as much additional free flowing slough or tributary water as was necessary for the fish collection aspect of the study.

RESULTS

Appendix Table E-1 displays by two weeks intervals between June and September, 1982, the backwater and total wetted surface areas mapped within the boundaries at Designated Fish Habitat locations. Surface areas are tabulated with the corresponding mean daily discharge reported for the Gold Creek or Sunshine gaging station. Plots of the total wetted surface areas versus mainstem discharge are found as Appendix Figures E-1 to E-14. At most sites, the relationship between total wetted surface area and discharge was plotted by fitting least squares linear regressions to the data. For Whitefish Slough and Slough 21, a hand drawn curve was best fitted to the data. The relationship between backwater surface area and discharge is replotted in the manner developed previously (Volume 4, Part I, Basic Data Report, ADF&G 1982) on a site by site basis.

DISCUSSION

Even though sampling was centered around slough and tributary reaches where mainstem backwater zones were a dominant feature, a very diverse set of hydraulic and physical habitats were sampled. The total wetted surface areas measured decreased with decreasing mainstem discharges.

Appendix Table E-1. Total wetted and aggregate type II (backwater) surface areas of selected regions of Designated Fish Habitat (DFH) sites, and mainstem Susitna River discharges^a, June through September, 1982.

DFH Site	Discharge ^a cfs	Date	Total Wetted Surface Area (Ft ²)	Surface Area Type II (Ft ²)
Slough 21 ^b	31,900	7/25	316,000	72,800
	28,500 ^c	6/19	203,000	16,300
	24,000	7/11	166,000	0
	17,000	8/09	160,000	73,600
	13,800	9/27	89,000	48,200
	12,500	8/20	96,000	47,300
	12,200	9/06	99,000	61,200
Slough 20	33,250 ^c	6/20	139,000	20,600
	26,800	7/24	137,000	0
	23,000	6/04	115,000	0
	16,500	8/07	68,900	0
	14,400	9/04	68,900	500
	14,000	9/26	69,700	--- ^e
	12,500	8/20	55,700	1,800
Slough 19	24,900	7/23	46,000	26,000
	22,000	6/17	30,000	10,000
	22,000	6/05	39,000	16,500
	16,800	8/06	29,000	12,300
	16,600	7/07	25,000	4,800
	15,000	9/25	20,000	0
	14,400	9/04	17,000	0
	13,300	8/19	15,000	4,200
Slough 11	33,250 ^c	6/20	153,000	128,000
	27,300	7/14	135,000	92,800
	23,600	7/29	155,000	124,000
	23,000	6/04	132,000	95,000
	14,400	8/12	69,000	25,600
	12,400	9/29	50,000	19,300
	12,200	9/06	68,000	25,300
	12,200	8/22	53,000	23,700

^aUSGS provisional data at Gold Creek, 1982, 15292000.

^bJune 10, 1982, data for Slough 21 incomplete.

^cAmended mainstem discharge at Gold Creek as determined from ADFG stage discharge curve.

^eNo backwater area mapped. A very small area probably existed.

Appendix Table E-1 (Continued).

DFH Site	Discharge cfs ^a	Date	Total Wetted Surface Area (Ft ²)	Surface Area Type II (Ft ²)
Slough 9	31,500	6/22	269,000	--- ^b
	29,100	7/27	321,000	0
	28,400	7/13	305,000	0
	26,000	6/10	298,000	--- ^b
	19,400	9/23	168,000	118,000
	16,700	8/10	185,000	133,000
	12,200	8/21	134,000	0
	11,700	9/07	172,000	0
	Slough 8A	28,000	6/08	223,000
26,500		7/12	218,000	202,000
26,500 ^c		6/23	223,000	210,000
25,600		7/28	257,000	205,000
17,100		9/24	169,000	143,000
15,400		8/11	220,000	193,000
12,200		8/21	185,000	158,000
11,700		9/07	182,000	155,000
Lane Creek		28,500 ^c	6/19	57,000
	25,000	6/07	61,000	45,000
	22,400	7/22	45,000	14,400
	18,100	7/08	54,000	14,700
	16,600	8/08	37,000	12,700
	15,000	9/25	32,000	8,000
	14,400	9/10	38,000	9,400
	12,500	8/20	36,000	6,100
	Slough 6A	33,250 ^c	6/20	138,000
24,900		7/23	135,000	135,000
23,000		6/06	131,000	131,000
21,500		7/09	134,000	134,000
16,600		8/08	131,000	131,000
14,400		9/10	129,000	129,000
14,000		9/26	131,000	131,000
12,200		8/21	127,000	127,000

^aUSCS provisional data at Gold Creek, 1982, 15292000.

^bJune 10 and June 22 data for Slough 9 incomplete.

^cAmended mainstem discharge at Gold Creek as determined from ADFG stage discharge curve.

Appendix Table E-1 (Continued).

DFH Site	Discharge cfs ^a	Date	Total Wetted Surface Area (Ft ²)	Surface Area Type II (Ft ²)
Whisker Creek and Slough	37,000 ^g	6/21	217,000	76,000 ^b
	31,900	7/25	236,000	56,000 ^b
	25,000	6/03	217,000	160,000 ^c
	23,000	7/10	213,000	83,900
	16,600	8/08	163,000	46,600 ^d
	13,800	5/27	190,000	---
	13,400	9/09	195,000	29,200
	12,200	8/22	150,000	28,500
Birch Creek and Slough	99,300	7/26	458,000	424,000
	61,600	6/23	388,000	354,000
	59,700	6/04	394,000	359,000
	58,400	7/11	422,000	398,000
	52,500	8/09	370,000	157,000
	38,000	8/23	362,000	147,000
	35,900	9/28	376,000	59,500
	33,800	9/11	363,000	81,900
Sunshine Creek and Sidechannel	82,400 ^e	7/27	332,000	218,000 ^f
	70,200	6/09	277,000	121,000
	62,700	6/24	275,000	134,000 ^f
	60,100	7/12	259,000	163,000 ^f
	51,600	8/10	214,000	128,000
	38,700	8/24	180,000	46,300
	35,000	3/12	179,000	12,200
	33,400	9/30	154,000	25,300

^aUSGS provisional data at Gold Creek 15292000 (with Whisker Creek data).

^bSurface area measurements for June 21 and July 25, 1982, are lower limits.

^cSurface area measurement for June 3, 1982 is an upper limit.

^dHigh tributary discharge this date eliminated zone 2 (see ADFG Basic Data Report, 1982).

^eUSGS provisional data at Sunshine 15292780.

^fDiffers from value in ADFG Basic Data Report, 1982 (see text).

^gAmended mainstem discharge at Gold Creek as determined from ADFG stage discharge curve.

Appendix Table E-1 (Continued).

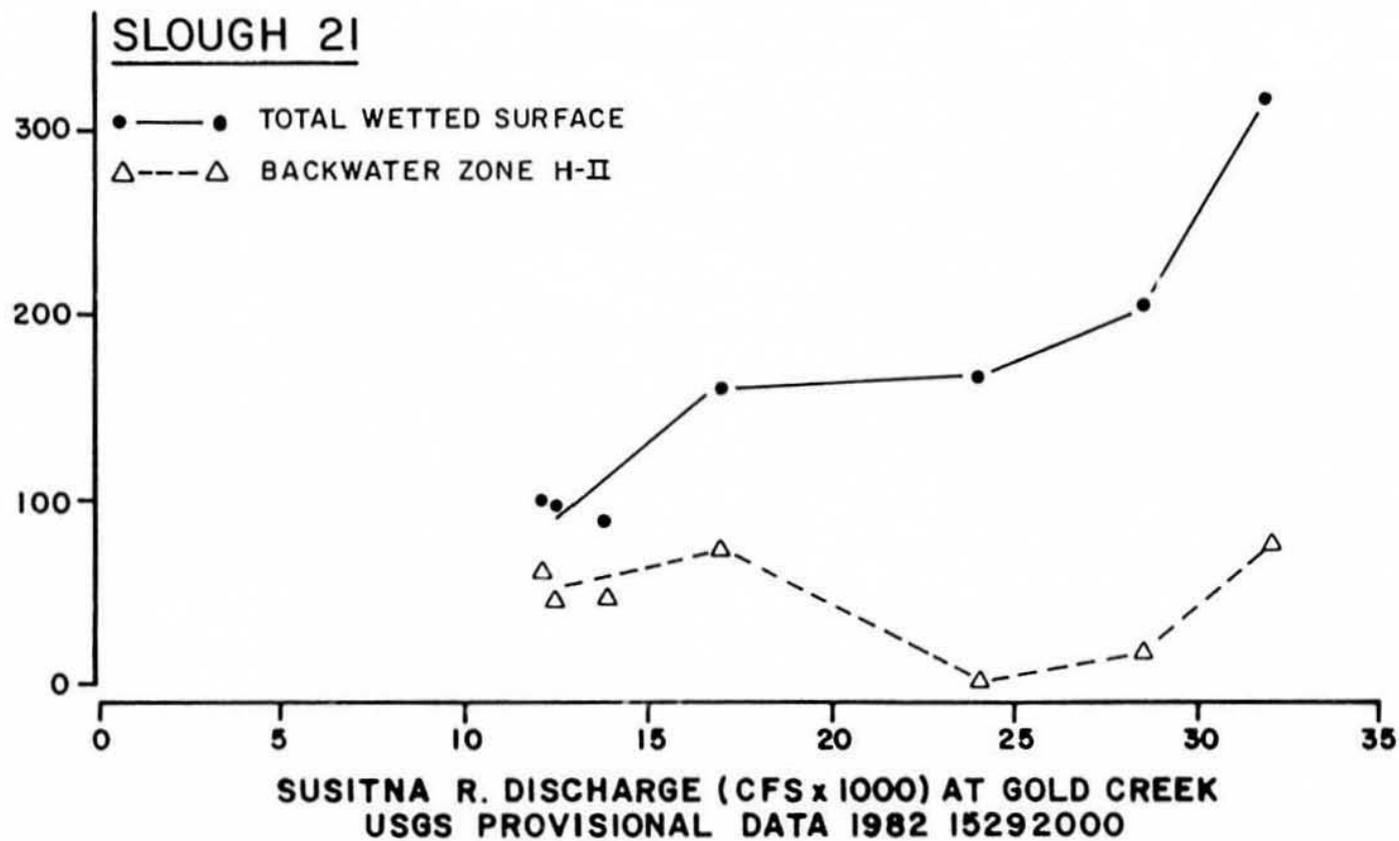
<u>DFH Site</u>	<u>Discharge cfs^a</u>	<u>Date</u>	<u>Total Wetted Surface Area (Ft²)</u>	<u>Surface Area Type II (Ft²)</u>
Rabideux Creek and Slough ^b	71,700	6/26	1,170,000	1,160,000
	67,900	7/29	1,120,000	1,180,000
	53,000	9/14	1,220,000	965,000
	44,000	8/12	1,070,000	876,000
	38,700	8/25	1,080,000	836,000
	33,400	9/30	968,000	344,000
Whitefish Slough ^c	72,000	7/28	85,800	85,800
	65,700	6/25	75,000	75,000
	60,100	7/12	65,800	65,800
	53,000	9/14	71,000	71,000
	47,900	8/11	56,200	56,200
	38,700	8/25	32,200	32,200
Goose Creek and Sidechannel	33,900	9/29	14,200	14,200
	72,000	7/28	166,000	75,000
	66,700	6/25	170,000	83,000
	64,200	6/10	176,000	87,000
	63,000	7/13	158,000	74,400
	47,900	8/11	154,000	113,000
	38,700	8/25	148,000	122,000
	36,400	9/13	137,000	0
33,900	9/29	134,000	0	

^aUSGS provisional data at Sunshine, 1982, 15292780.

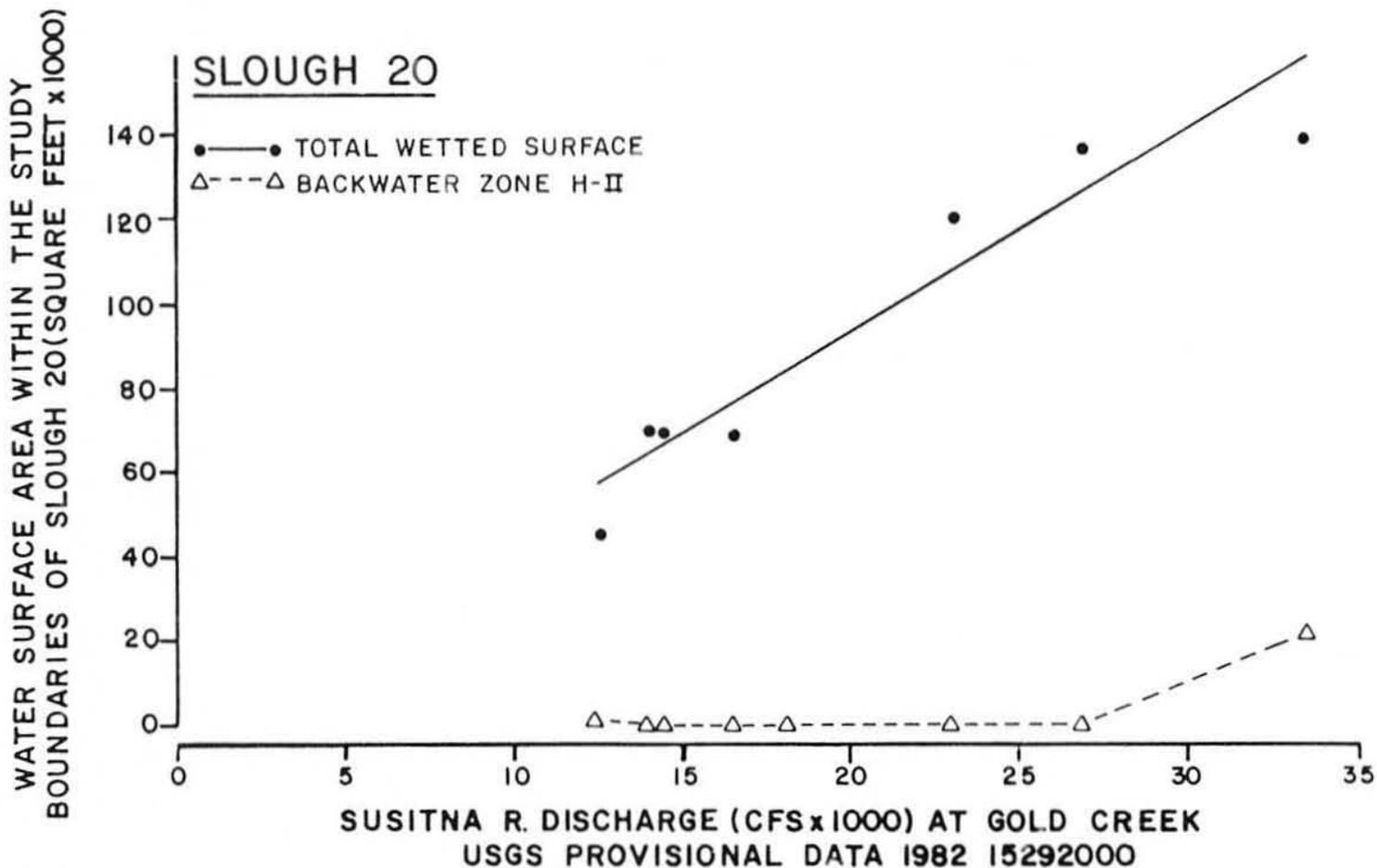
^bNot sampled in early June or in early July.

^cNot sampled in early July.

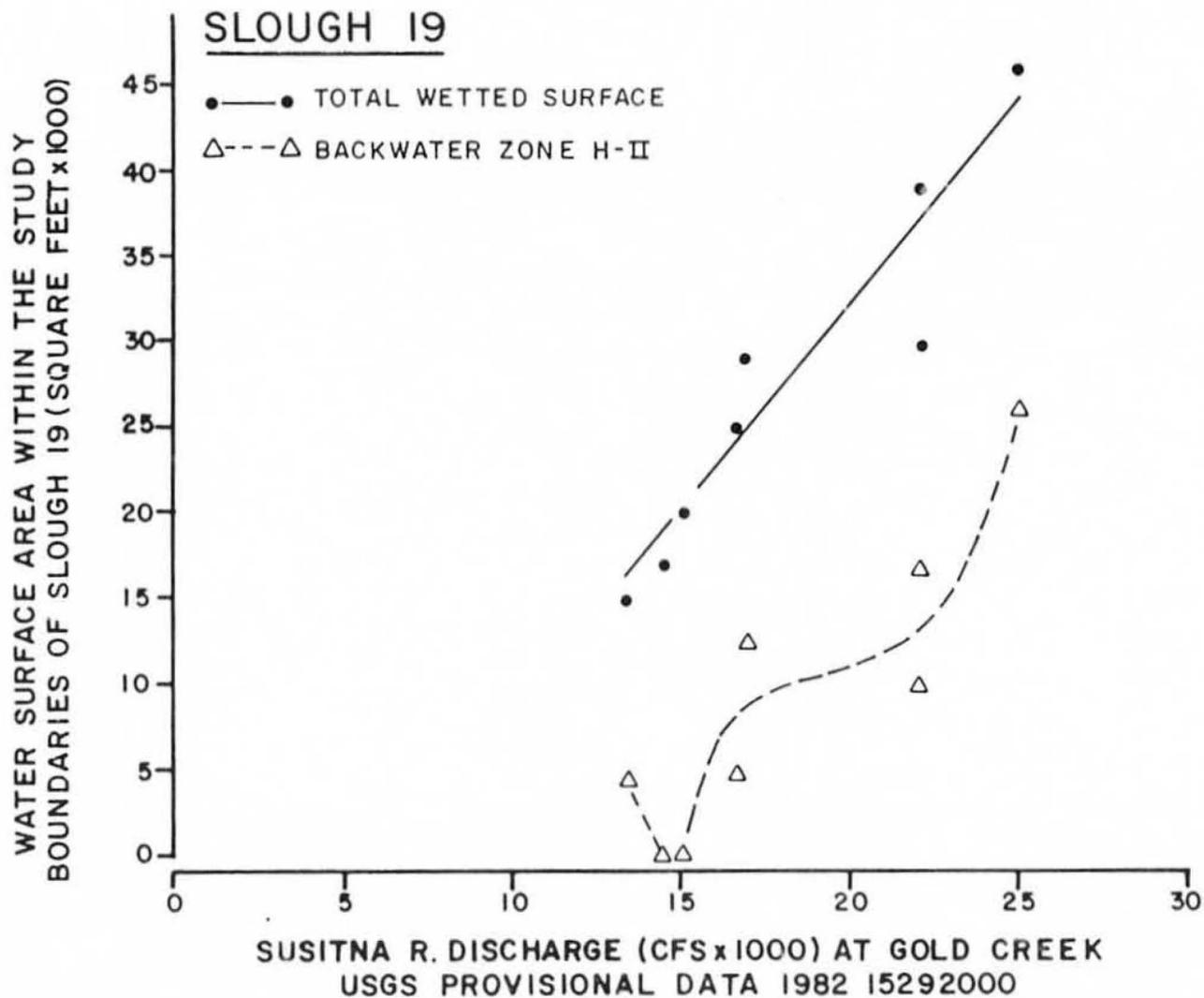
WATER SURFACE AREA WITHIN THE STUDY
BOUNDARIES OF SLOUGH 21 (SQUARE FEET x 1000)



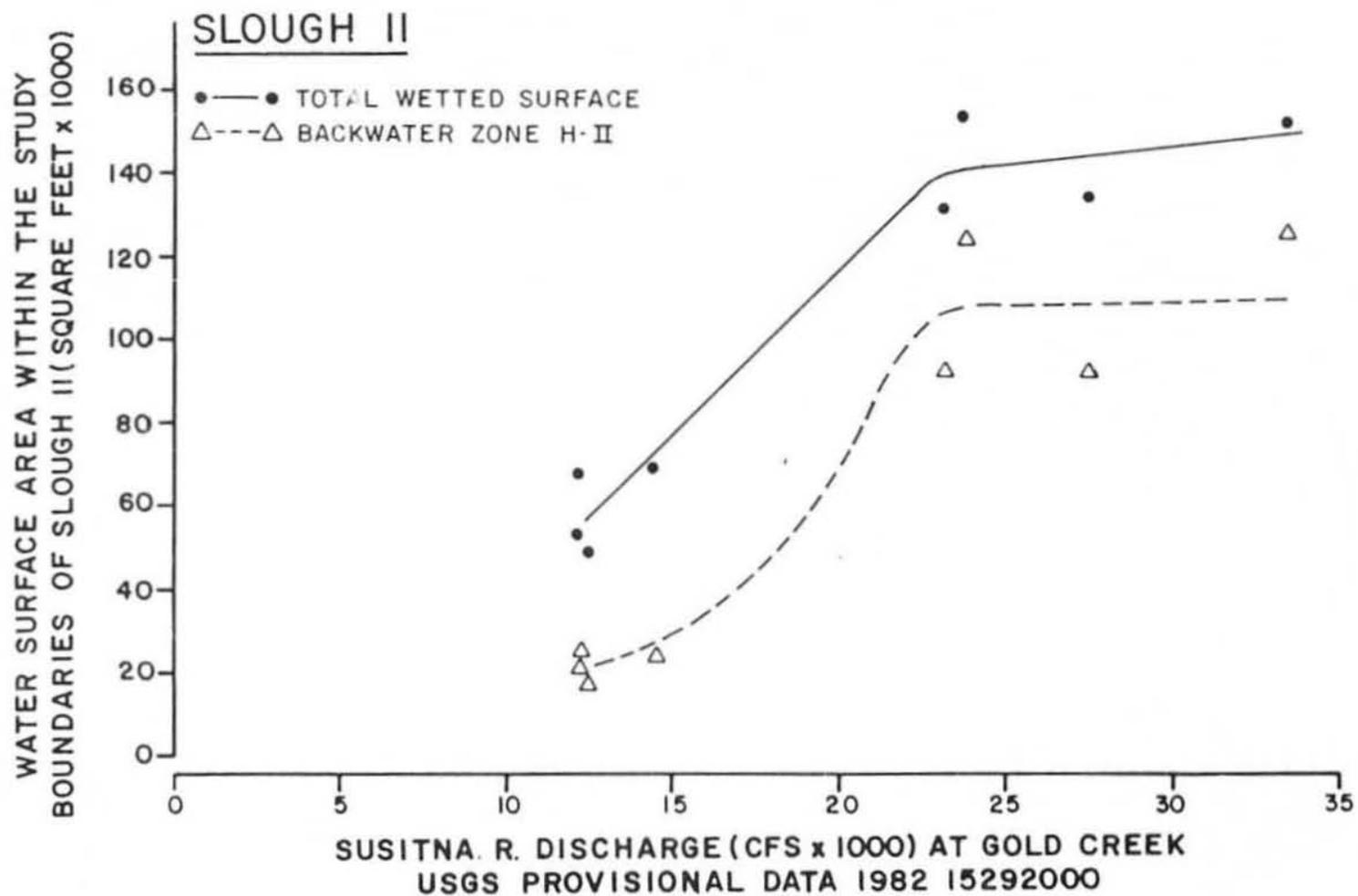
Appendix Figure E-1. Wetted surface area at Slough 21 versus mainstem discharge at Gold Creek. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-1.



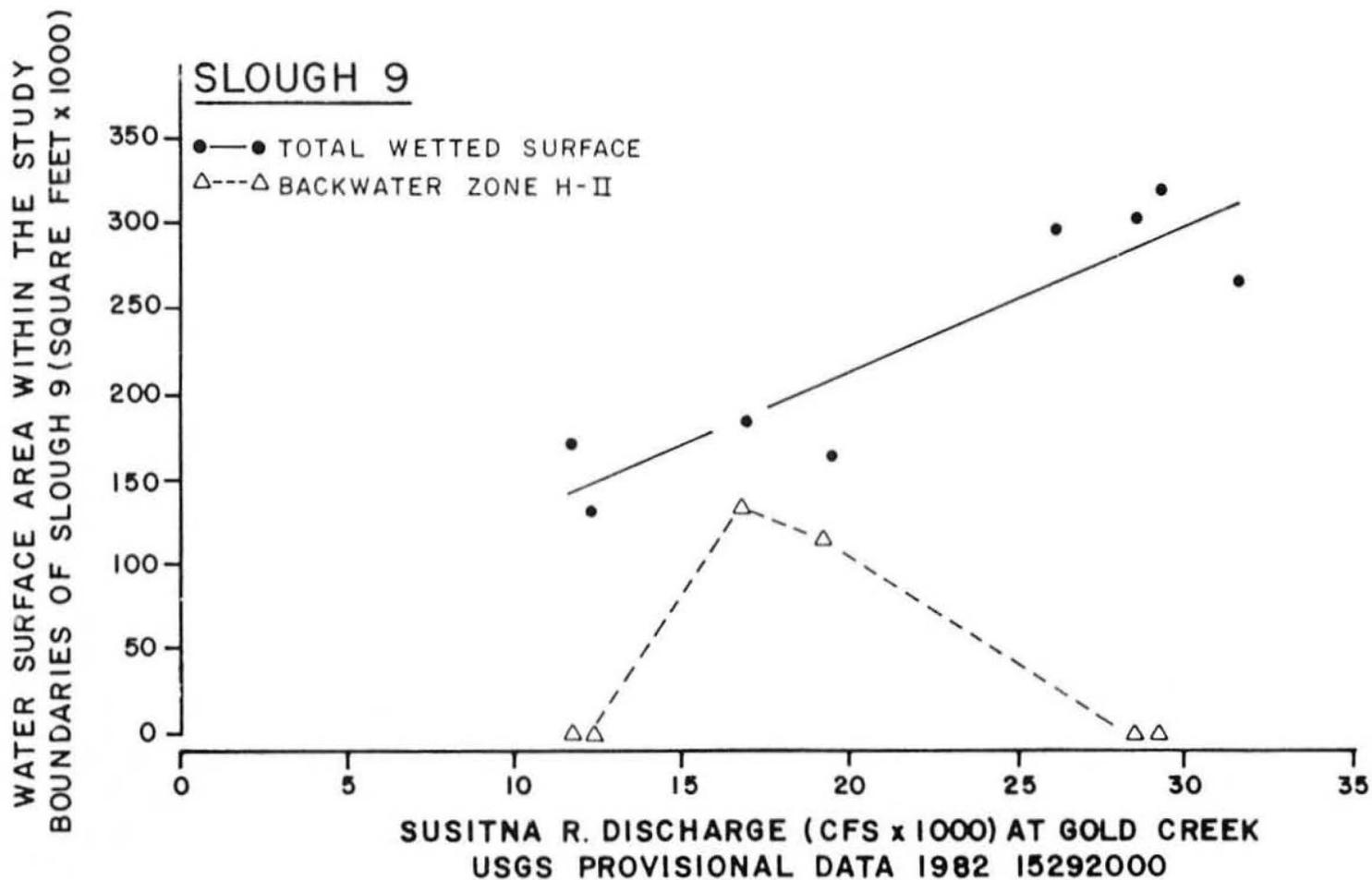
Appendix Figure E-2. Wetted surface area at Slough 20 versus mainstem discharge at Gold Creek. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-2.



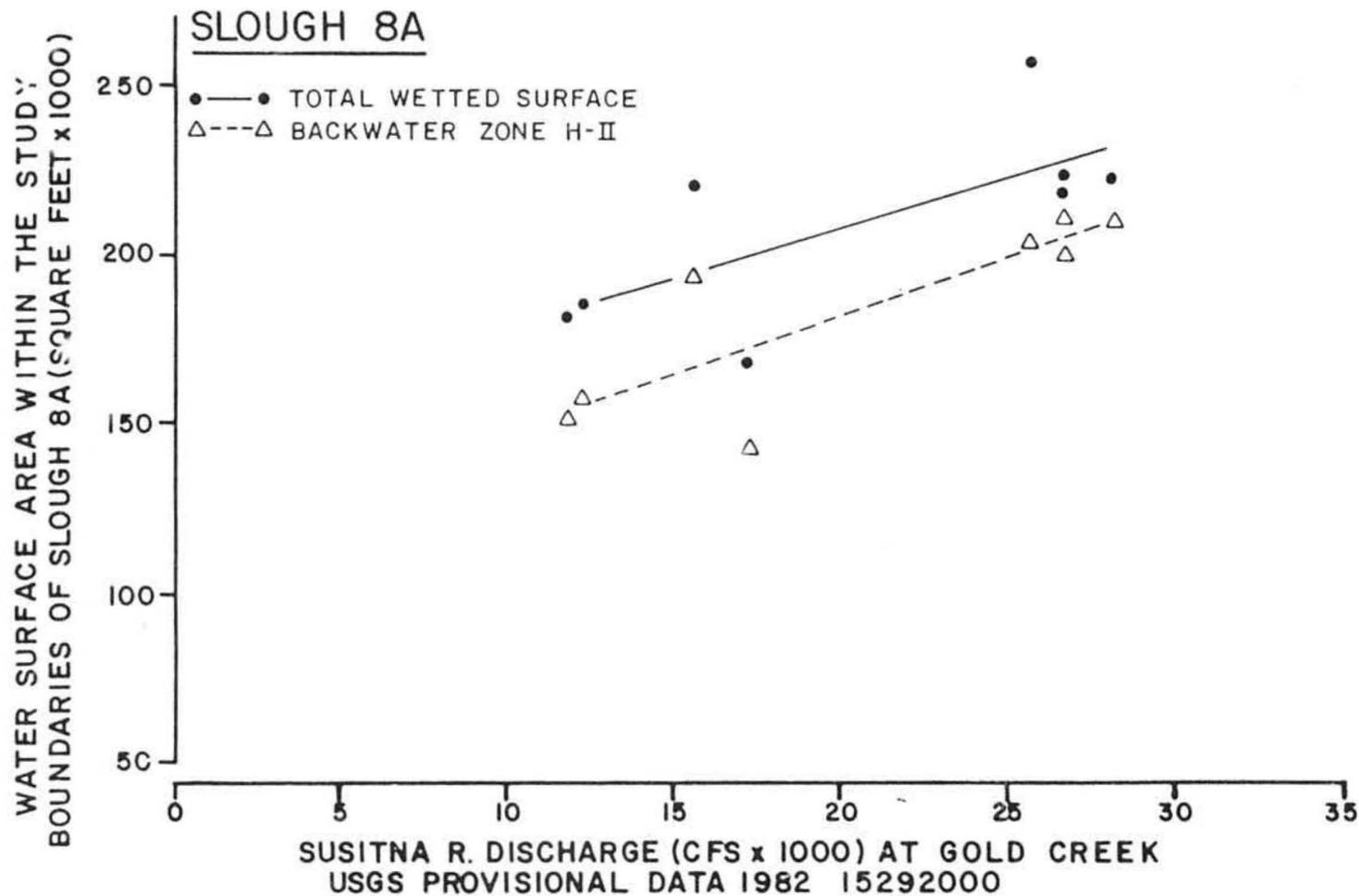
Appendix Figure E-3. Wetted surface area at Slough 19 versus mainstem discharge at Gold Creek. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-3.



Appendix Figure E-4. Wetted surface area at Slough II versus mainstem discharge at Gold Creek. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-4.

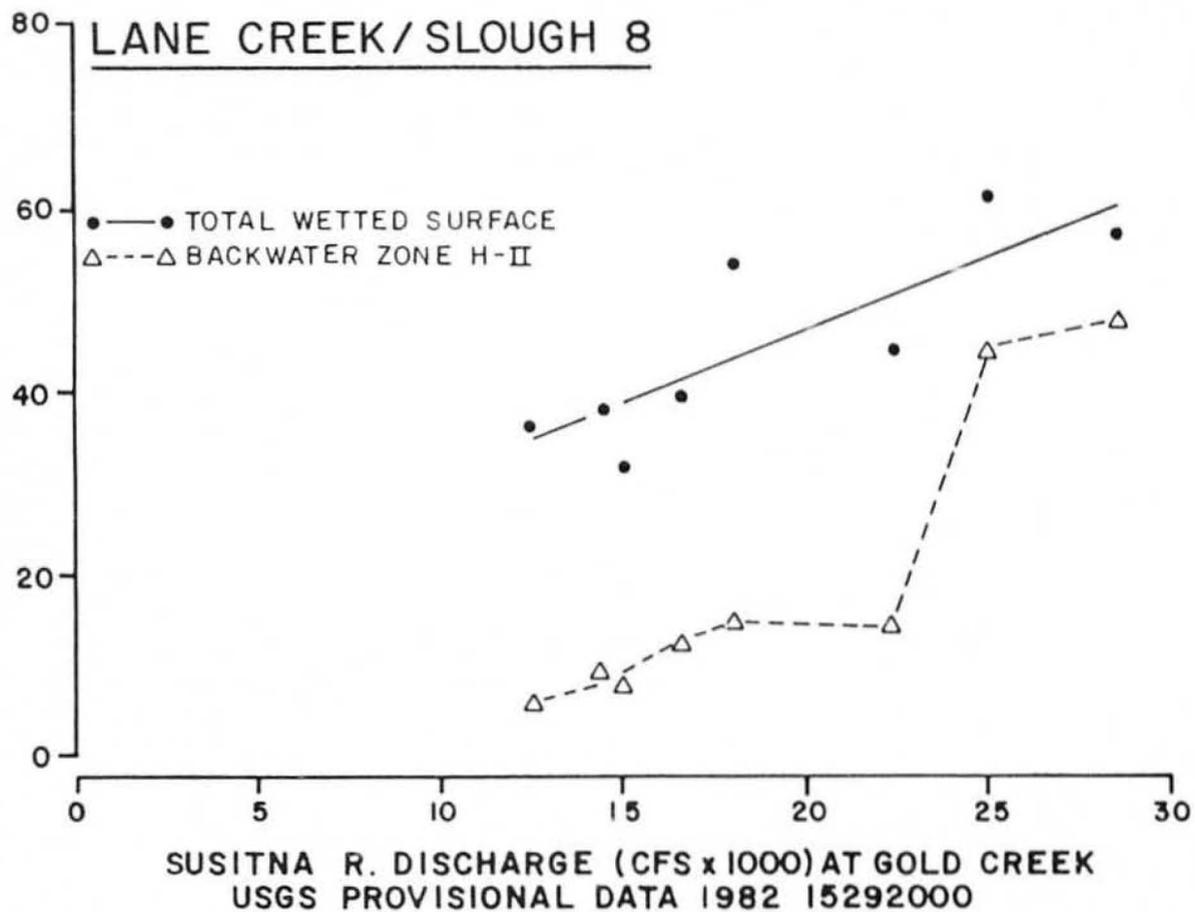


Appendix Figure E-5. Wetted surface area at Slough 9 versus mainstem discharge at Gold Creek. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-5.

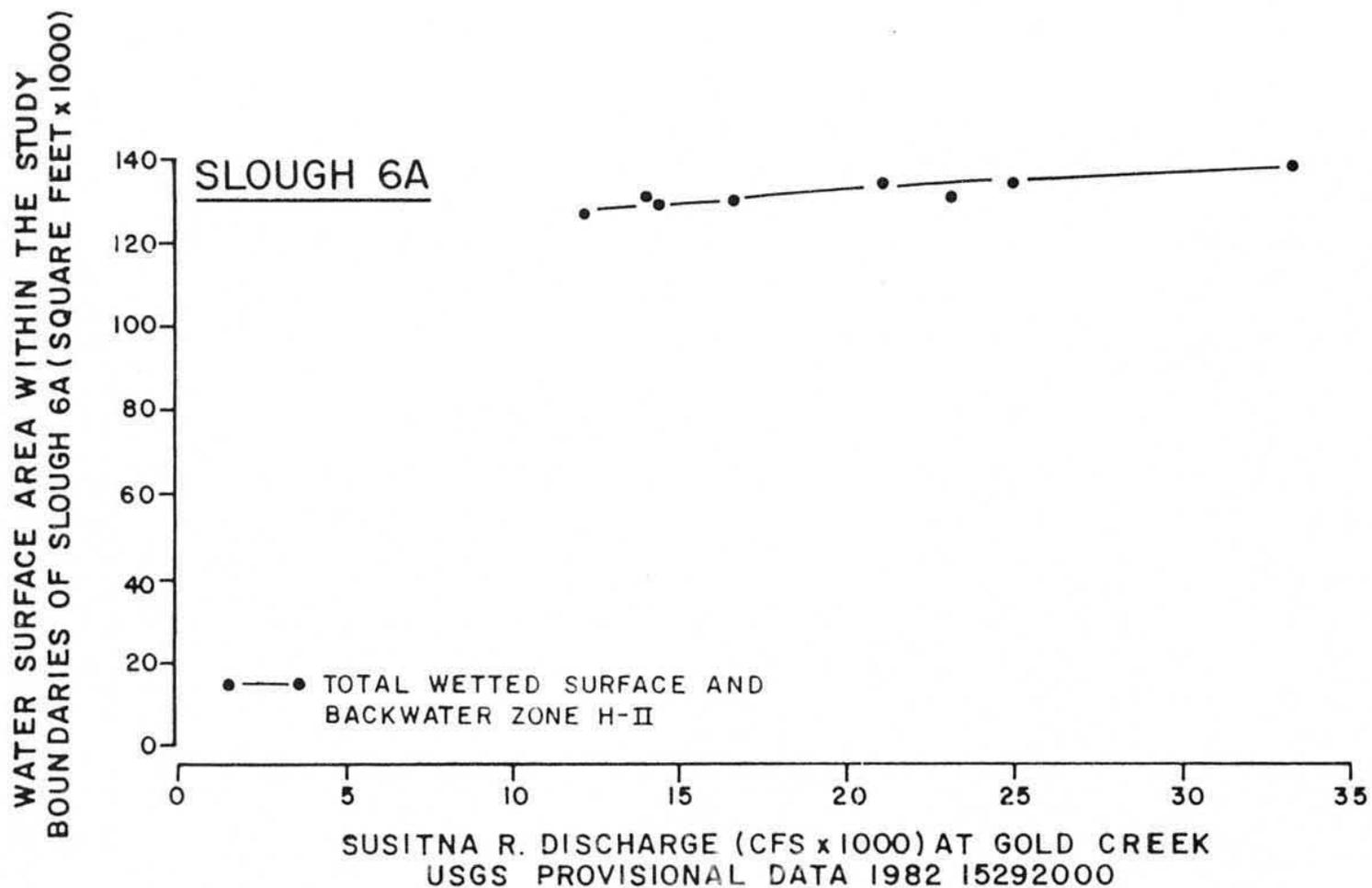


Appendix Figure E-6. Wetted surface area at Slough 8A versus mainstem discharge at Gold Creek. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-6.

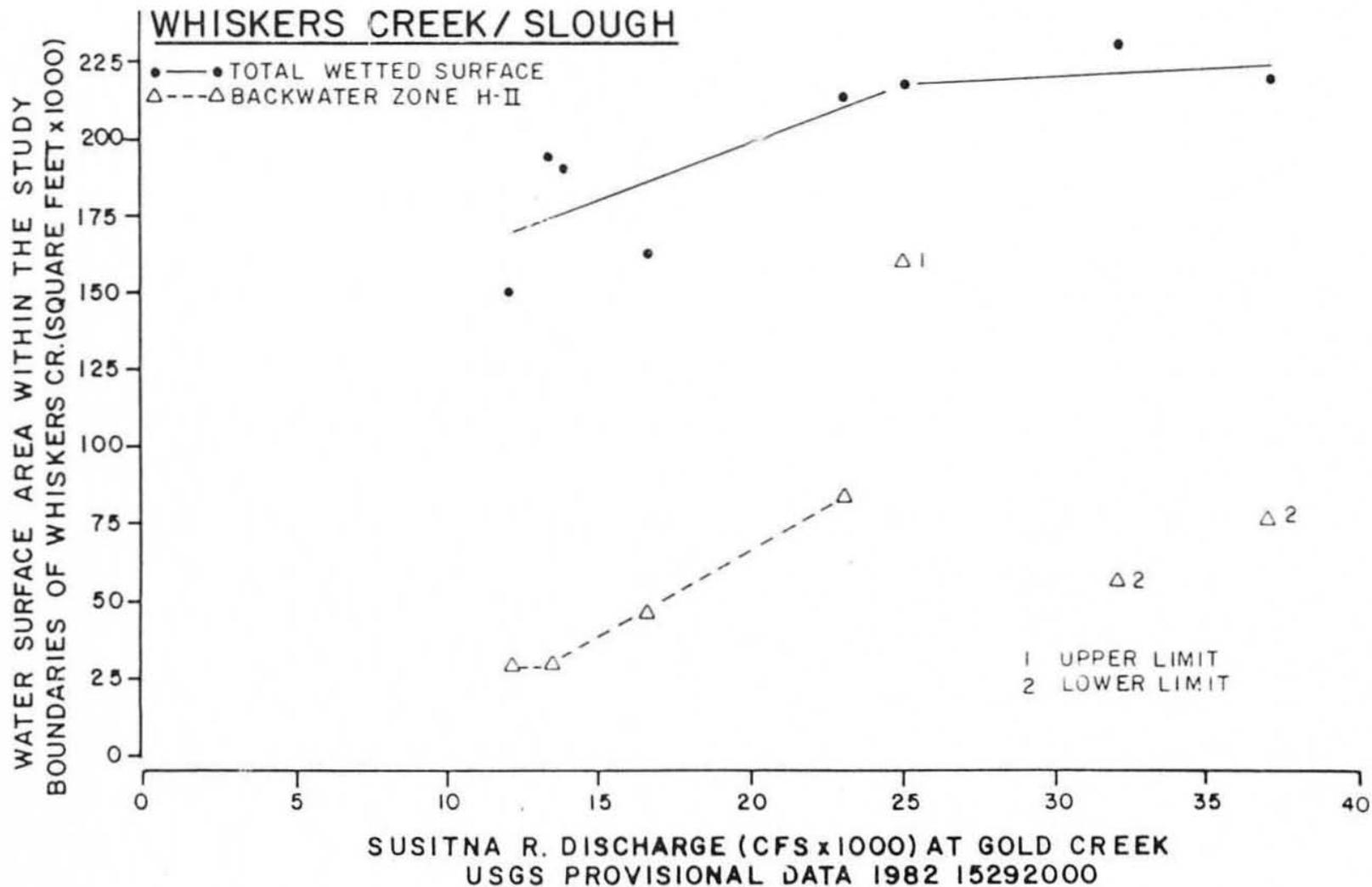
WATER SURFACE AREA WITHIN THE STUDY
BOUNDARIES OF LANE CR./SLOUGH 8 (SQUARE FEET x 1000)



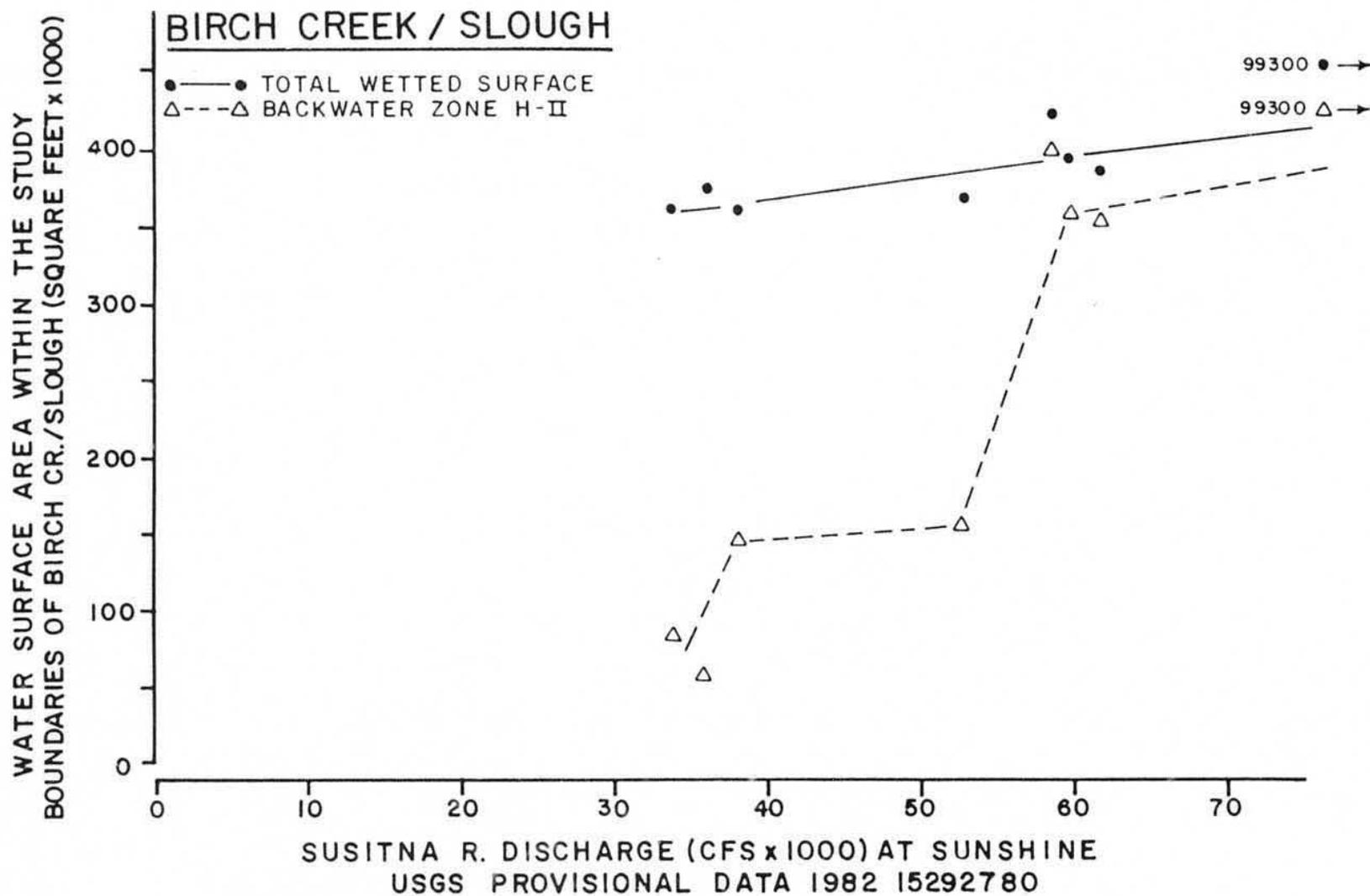
Appendix Figure E-7. Wetted surface area at Slough 8 / Lane Creek versus mainstem discharge at Gold Creek. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-7.



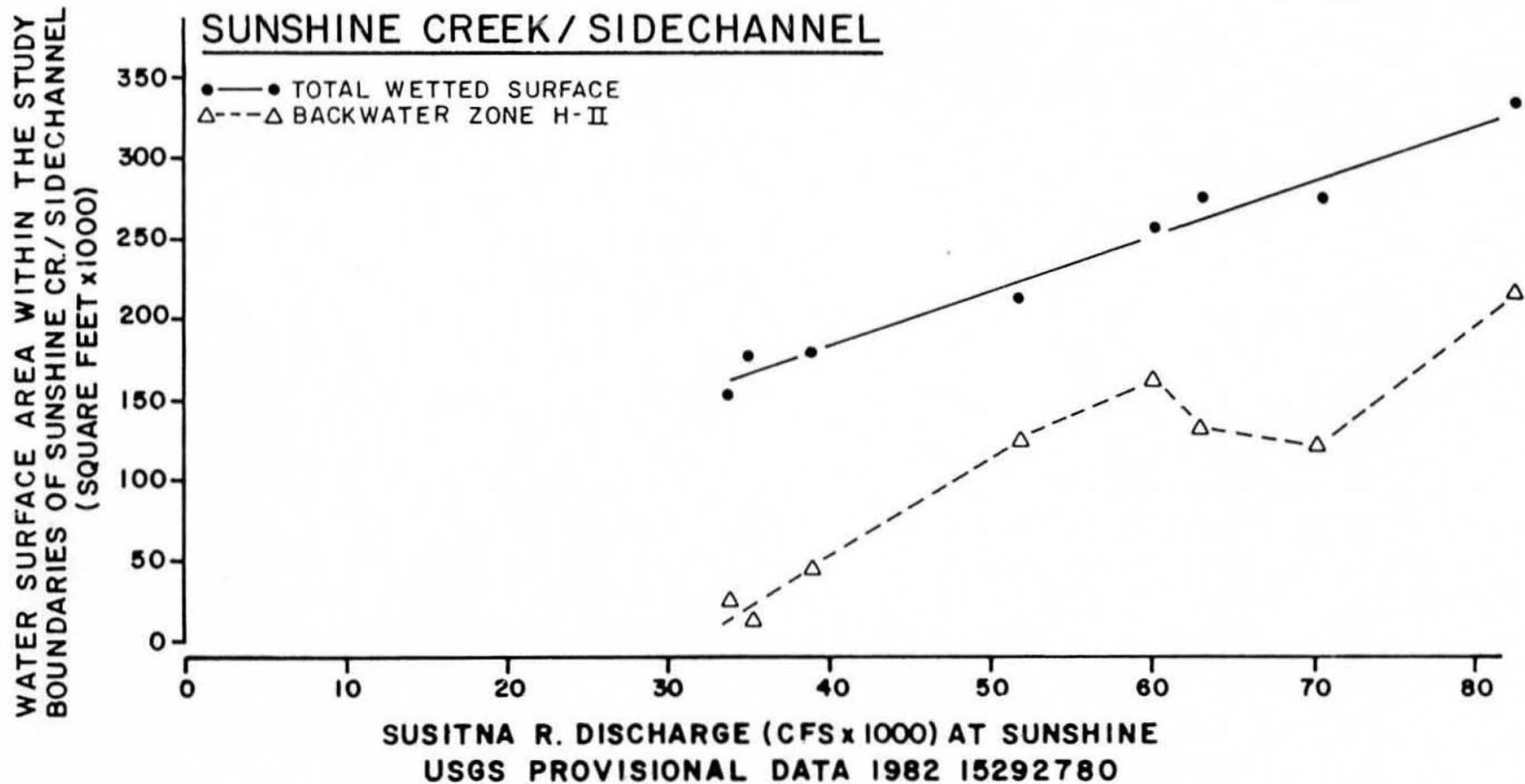
Appendix Figure E-8. Wetted surface area at Slough 6A versus mainstem discharge at Gold Creek. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-8.



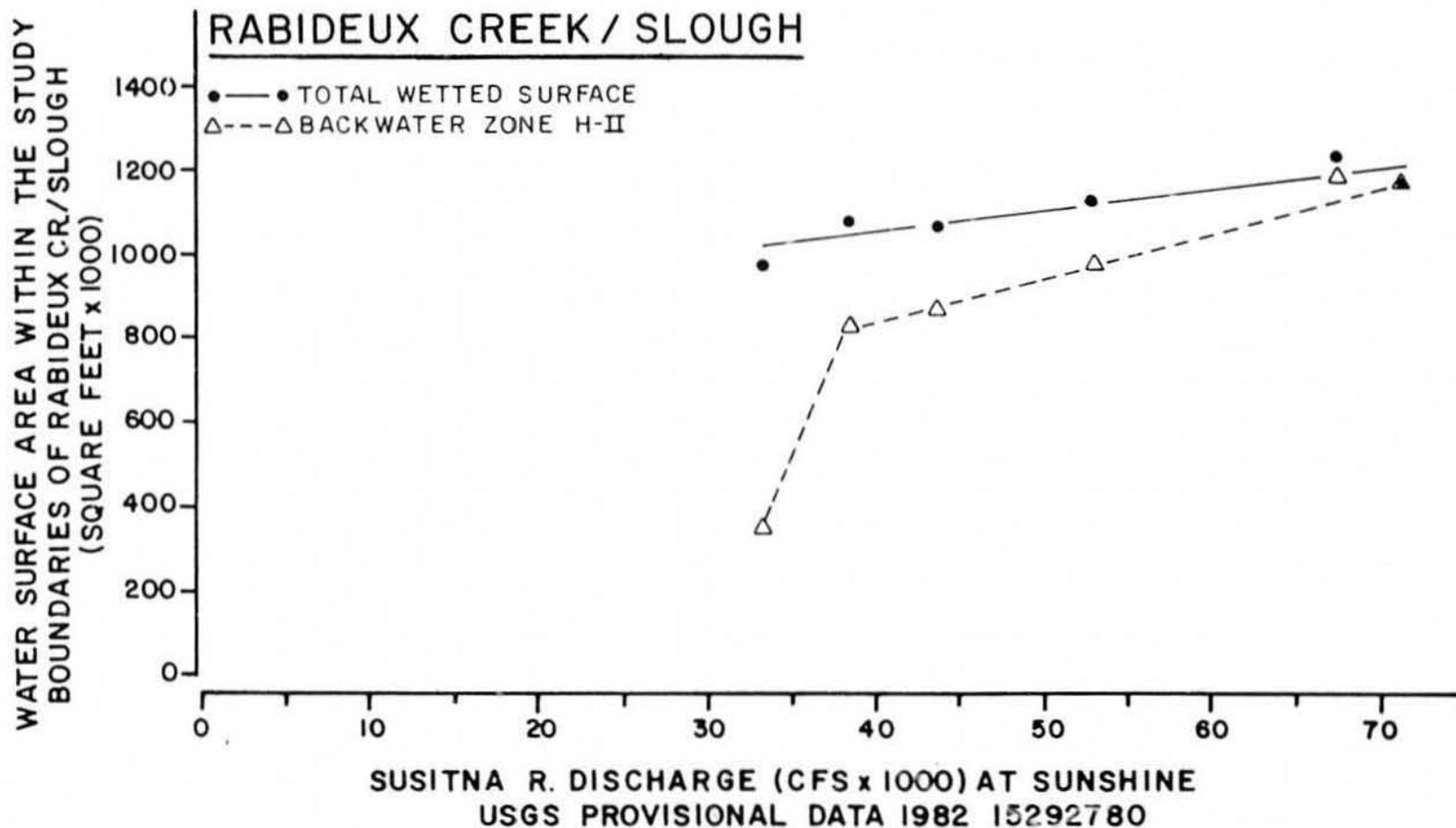
Appendix Figure E-9. Wetted surface area at Whiskers Creek / Slough versus mainstem discharge at Gold Creek. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-9.



Appendix Figure E-10. Wetted surface area at Birch Creek / Slough versus mainstem discharge at Sunshine. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-10.

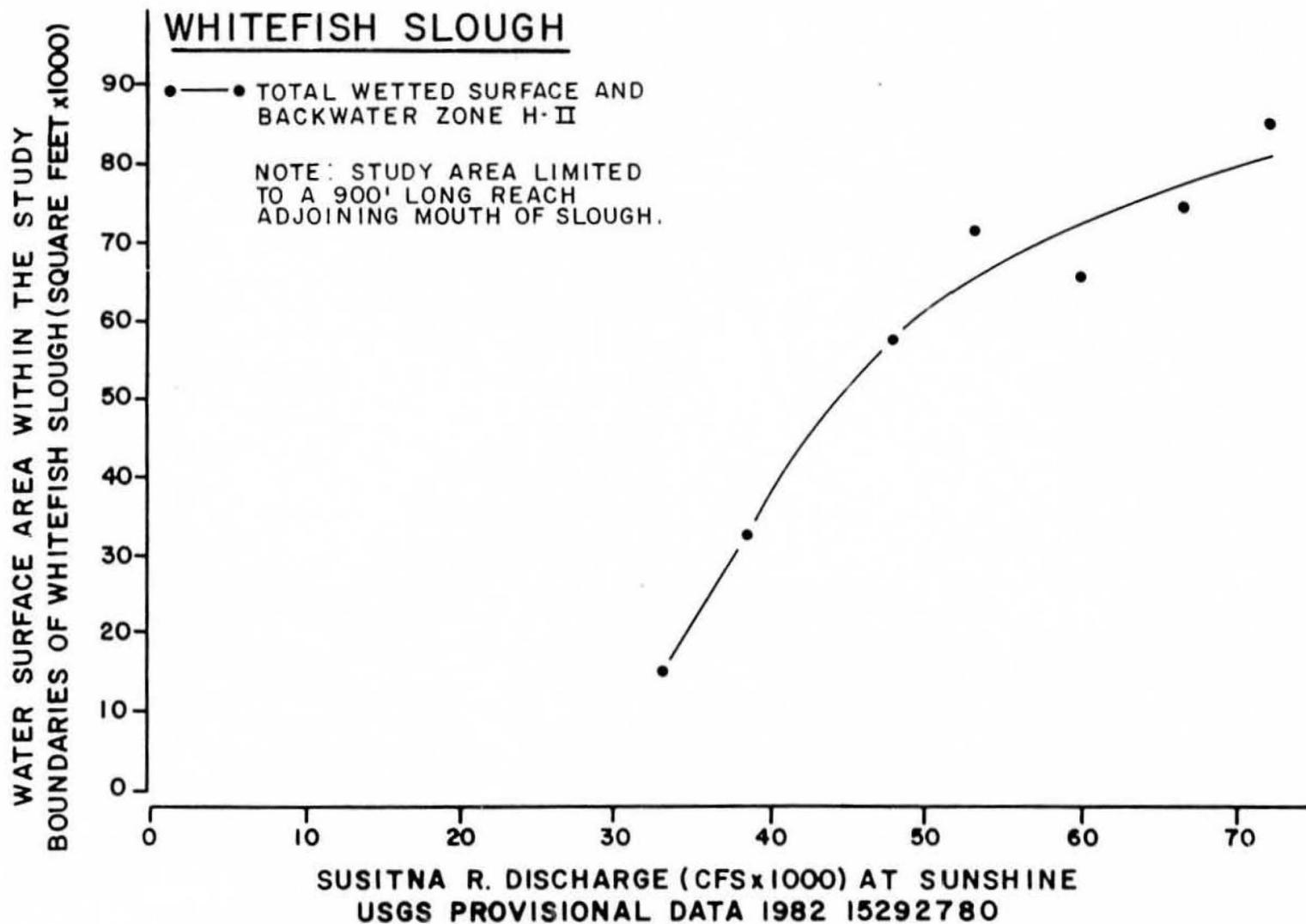


Appendix Figure E-11. Wetted surface area at Sunshine Creek/Side Channel versus mainstem discharge at Sunshine. The measurements represent the areas within the study boundaries illustrated in appendix Plate E-11.

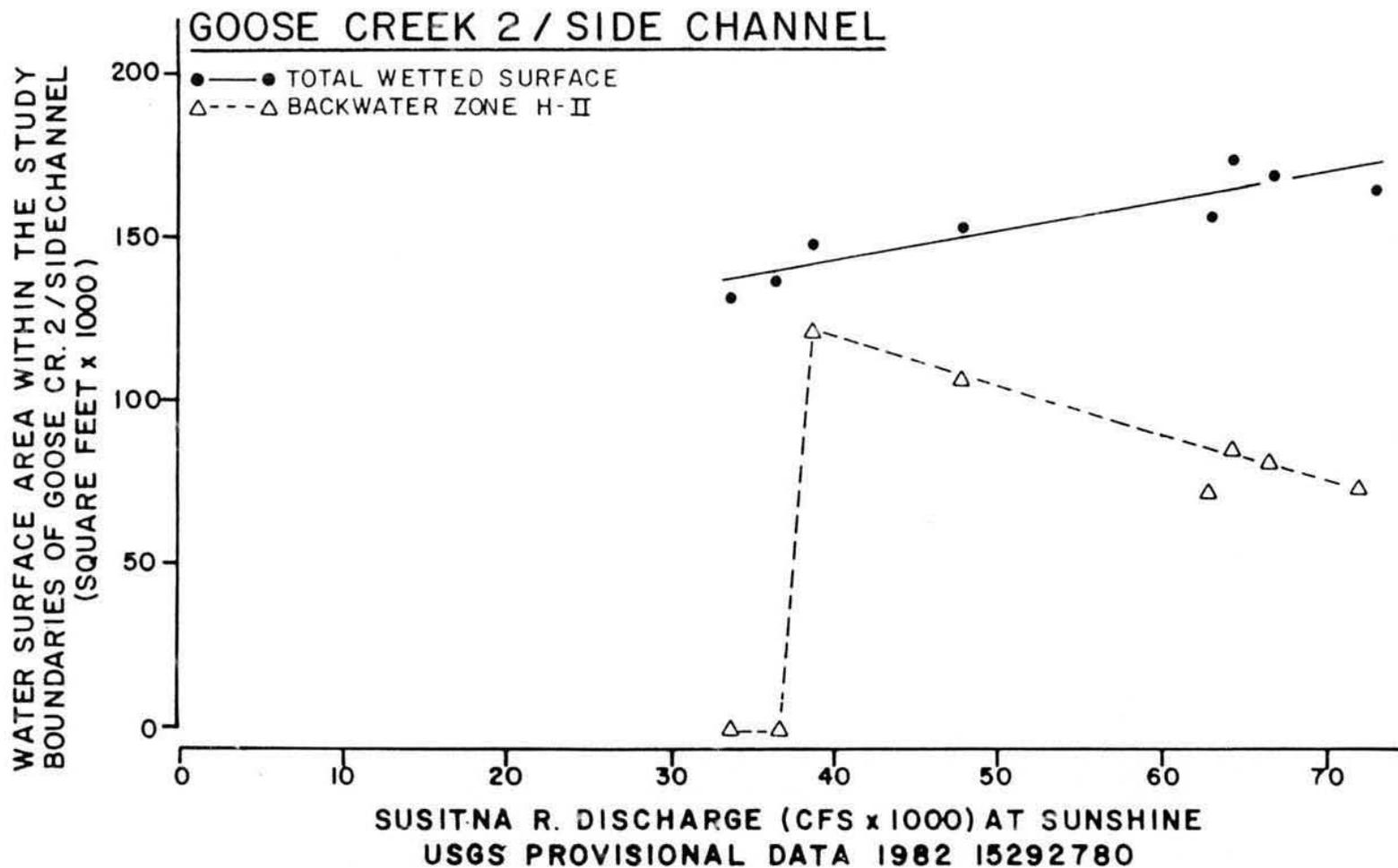


Appendix Figure E-12.

Wetted surface area at Rabideux Creek/Slough versus mainstem discharge at Sunshine. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-12.



Appendix Figure E-13. Wetted surface area at Whitefish Slough versus mainstem discharge at Sunshine. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-13.



Appendix Figure E-14.

Wetted surface area at Goose Creek 2/ Side Channel versus mainstem discharge at Sunshine. The measurements represent the areas within the study boundaries illustrated in Appendix Plate E-14.

The wetted surface areas of the upper portions of several sites were greatly reduced as flows declined, and the habitat (types) present in many of these areas changed considerably over the range of mainstem discharges observed. Total wetted surface area plots are typically represented by simple linear regressions. In contrast, backwater area plots are more complex. In part, this complexity is attributed to these areas receding and reforming downstream as flow decreased (see Volume 4 for more discussion of this topic).

At Slough 6A and at Whitefish Slough, the total wetted and backwater surface areas are identical within the range of discharges observed.

The reaches of Sloughs 8A and 11 which were mapped consisted predominantly of backwater areas. At these and other habitat locations, except when zone 9 (calm water) pools were present (Appendix Table E-2), the difference between the total wetted and backwater surface areas reported equals the surface area of water present in the study area which had appreciable velocity. Appreciable velocity was generally defined as a velocity of 0.5 ft/sec or greater (Volume 4, Part II). Conversely, the sum of the pool plus backwater surface area equals the low velocity (0.0 to 0.5 ft/sec) surface areas present within the boundaries mapped at a habitat site. Additional discussion relating surface areas to habitat is found in Appendix F of this report.

A summation of the total wetted surface areas, within the boundaries of all upper and lower Susitna River study sites sampled, is shown in Appendix Tables E-3 and E-4, and in Appendix Figures E-15 and E-16.

Appendix Table E-2. Surface areas of morphological pools^a not regulated by mainstem Susitna River discharge at Designated Fish Habitat (DFH) sites, and mainstem Susitna River discharges, June through September, 1982.

DFH Site	Discharge cfs	Date	Zone 9	
			Surface Area	Surface Area
Goose Creek and Sidechannel	36,400	9/13	64,200	
	33,900	9/29	77,400	
Lane Creek/Slough 8	22,400	7/22	22,200	
	18,100	7/08	23,100	
	16,600	8/08	19,500	
	15,000	9/25	18,800	
	14,400	9/10	18,900	
	12,500	8/20	18,700	
Rabideaux Creek and Slough Slough 20	33,400	9/30	308,000	
	33,250	6/20	40,500	
	26,800	7/24	54,800	
	23,000	6/04	36,300	
	18,100	7/08	11,500	
	16,500	8/07	20,300	
	14,400	9/04	18,100	
	14,000	9/26	18,100	
	12,500	8/20	15,900	
		37,000	6/21	41,400
Whisker Creek and Slough	31,900	7/25	8,400	
	25,000	6/03	none	
	23,000	7/10	55,200	
	16,600	8/08	25,100	
	13,800	9/27	23,500	
	13,400	9/09	23,500	
	12,200	8/22	19,500	

^aThese areas were identified as zone 9 and occurred (as calm water morphologic pools) in free flowing tributary or ground water areas.

Appendix Table E-2. (Continued).

<u>DFH Site</u>	<u>Discharge cfs</u>	<u>Date</u>	<u>Zone 9 Surface Area</u>
Sunshine Creek and Sidechannel	35,000	9/12	8,400
	33,400	9/30	7,700
Birch Creek and Slough	38,000	8/23	33,900
	35,900	9/28	37,400
	33,800	9/11	37,400
Slough 19	15,500	9/25	5,500
	14,400	9/04	5,100
	13,300	8/19	4,600
Slough 8A			Approx 8,000 ^a

^aA small pool was located below the first beaver dam throughout most of the sampling year. This pool was not mapped as such but was the site of systematic fish captures.

Appendix Table E-3. Total wetted surface areas measured within the boundaries of nine study areas on the upper Susitna River, versus Gold Creek discharge^a, June through September, 1982.

<u>Habitat Location</u>	<u>Surface Areas^b (Square Feet x 1000) at Habitat Location, by Discharge</u>						
	<u>12,500</u>	<u>15,000</u>	<u>17,500</u>	<u>20,000</u>	<u>22,500</u>	<u>25,000</u>	<u>27,500</u>
Slough 21	88.	129.	160.	161.	163.	173.	194.
Slough 20	57.	69.	82.	94.	106.	118.	130.
Slough 19	16. ^c	20.	26.	32.	38.	44. ^d	44. ^d
Slough 11	58.	77.	97.	116.	136.	143.	145.
Slough 9	150.	171.	193.	215.	237.	259.	280.
Slough 8A	186.	194.	201.	208.	215.	223.	230.
Lane Creek/Slough 8	35.	39.	43.	47.	51.	55.	59.
Slough 6A	128.	129.	131.	132.	134.	135.	137.
Whiskers Creek/Sidechannel	<u>170.</u>	<u>179.</u>	<u>189.</u>	<u>198.</u>	<u>208.</u>	<u>217.</u>	<u>218.</u>
Total by Discharge	888.	1007.	1122.	1203.	1288.	1367.	1437.

^aUSGS Provisional data at Gold Creek, 1982, 15292000.

^bData compiled from Appendix Figures E-1 through E-9.

^cArea measured at 13,300 cfs.

^dArea measured at 24,900 cfs.

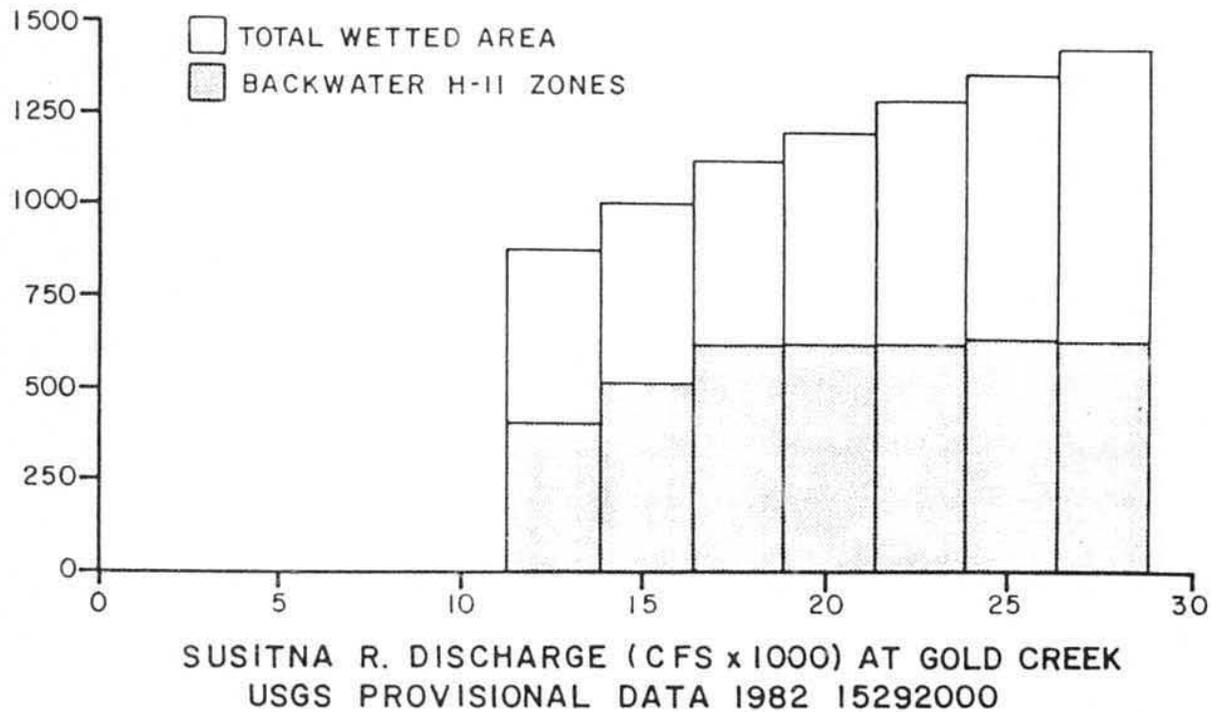
Appendix Table E-4. Total wetted surface areas^a measured within the boundaries of five study areas on the Lower Susitna River, versus Sunshine discharge^b, June through September, 1982.

<u>Habitat Location</u>	<u>Surface Areas^b (Square Feet x 1000) at Habitat Location, by Discharge</u>							
	<u>35,000</u>	<u>40,000</u>	<u>45,000</u>	<u>50,000</u>	<u>55,000</u>	<u>60,000</u>	<u>65,000</u>	<u>70,000</u>
Birch Creek	362.	368.	374.	380.	386.	394.	400.	406.
Sunshine Creek/Sidechannel	168.	185.	202.	219.	236.	253.	270.	287.
Rabideux Creek/Slough	1020.	1050.	1070.	1110.	1120.	1150.	1180.	1200.
Whitefish Slough	21.	37.	51.	61.	67.	72.	77.	80.
Goose Creek/Sidechannel	<u>139.</u>	<u>143.</u>	<u>148.</u>	<u>152.</u>	<u>157.</u>	<u>161.</u>	<u>166.</u>	<u>170.</u>
Total by Discharge	1710.	1783.	1845.	1922.	1966.	2030.	2093.	2143.

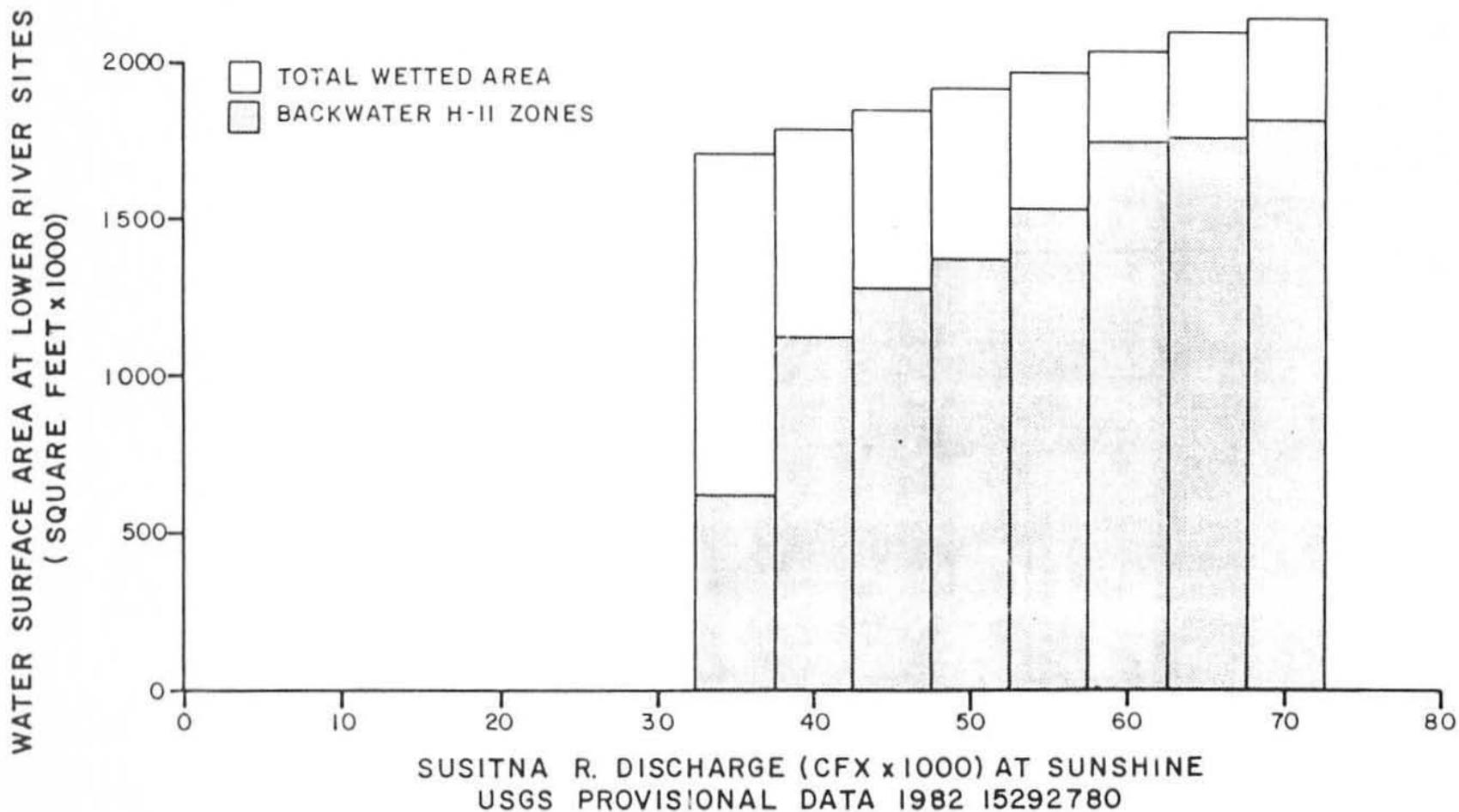
^aUSGS Provisional data at Sunshine, 1982, 15292780.

^bData compiled from Appendix Figures E-10 through E-14.

WATER SURFACE AREA AT UPPER RIVER SITES
(SQUARE FEET x 1000)



Appendix Figure E-15. Wetted surface area summations for the nine upper Susitna sites versus mainstem discharge at Gold Creek. The measurements represent the areas within the study boundaries illustrated in Appendix Plates E-1 through E-9.



Appendix Figure E-16. Wetted surface area summations for the five lower Susitna sites versus mainstem discharge at Sunshine. The measurements represent the areas within the study boundaries illustrated in Appendix Plates E-10 through E-14.

These values were obtained by determining the areas indicated at 2500 and 5000 cfs discharge intervals from Appendix Figures E-1 to E-14. The lower river plot indicates that a linear relationship between total wetted surface areas and mainstem discharge exists within the range of discharges observed. The upper river total wetted area versus Susitna River discharge data is best described by two straight lines. Below 17,500 cfs a given change in mainstem flows results in greater changes in total wetted surface areas than does a given change in flow above 17,500 cfs.

Appendix Figures E-15 and E-16 also display the corresponding backwater surface data as adapted from Tables 4I-4-1 and 4I-4-2 of the Basic Data Report. A comparison of the total wetted and backwater surface area plots requires careful interpretation. As noted above, the backwater areas occurring at each site were normally mapped in their entirety. The "total" wetted surfaces mapped were, however, selectively limited in area by study design and sampling logistics. Within the lower river slough and tributary areas sampled, the backwater surface areas decrease faster at mainstem discharges below approximately 60,000 cfs, than do total wetted areas. At mainstem discharges above 60,000 cfs, the total wetted areas increase faster than the backwater areas and the highest proportion of backwater area occurs at about 60,000 cfs. At upper river sites, the inflection point (in the backwater plot) near 17,500 cfs appears to be similar to the 60,000 cfs point in the lower river plot because above 17,500 cfs the total wetted area increases faster than backwater area. Below 17,500 cfs (in the upper river plot), it is not clear that backwater surface areas decrease faster than do total wetted

surfaces as is apparent in the lower river areas. However, data at discharges of 10,000 cfs and below may show that this is the case in the upper river as well.

Use of the slough and tributary mouth wetted surface area data to model the total wetted surfaces of the Susitna River with decreasing flows should not be attempted. These data were not obtained from areas representative of the average mainstem environment, as the proportion of free flowing mainstem surfaces included represent a small and insignificant proportion of the Susitna River's total free flowing mainstem surfaces. There is, however, confidence for using the backwater data to represent the true backwater surface area versus discharge relationship for larger reaches of the Susitna (as was done) as a significant percentage of the backwater surfaces were actually measured. At low mainstem discharges such as are present during early spring and late fall, reductions in surface area were observed at several sloughs suggesting that the total wetted and backwater surface area relationships presented should not be used to infer surface areas at mainstem discharges beyond those observed.

This information illustrates that many difficulties might be involved in attempting discharge related assessments of available juvenile fish (slough and tributary) habitat based on overly simplified parameters, such as total wetted surface areas. Total backwater area relationships, which appear to be more complex, may be better indicators for selected species and life history stages. In addition, separating those backwater areas that re-form downstream (in mainstem type environments

during low mainstem flows) from the slough and tributary backwater habitats present at higher flows, are also necessary for a habitat analysis.

LITERATURE CITED

Alaska Department of Fish and Game. 1983. Aquatic Habitat and instream flow studies. Volume 4 of ADF&G Susitna Hydro Aquatic Studies Program, Phase II, Basic Data Report. Anchorage, Alaska.



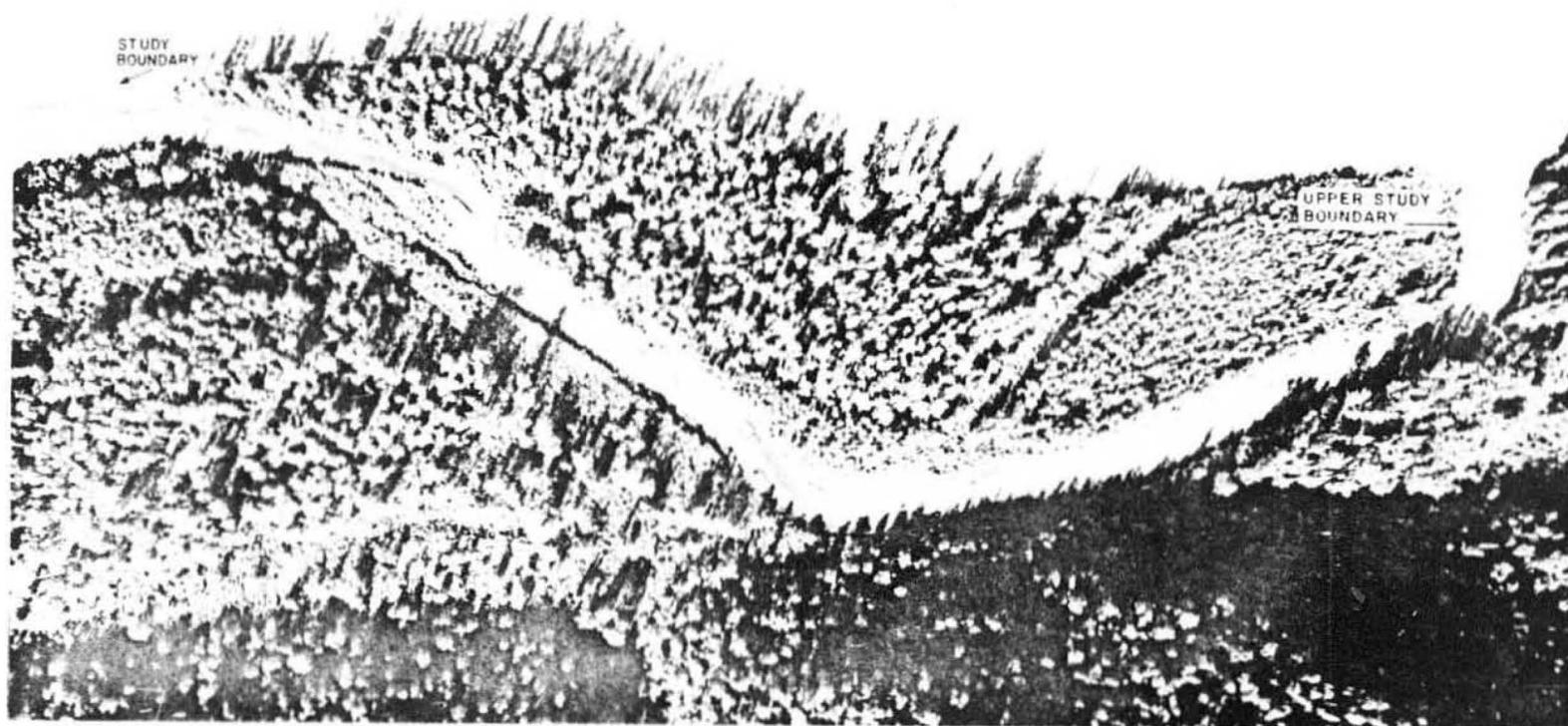
Appendix Plate E-1. August 1980 photograph of Slough 21 (RM 142.0). The surface area measurements reported are for the slough between the study boundaries shown.

0 500
FEET

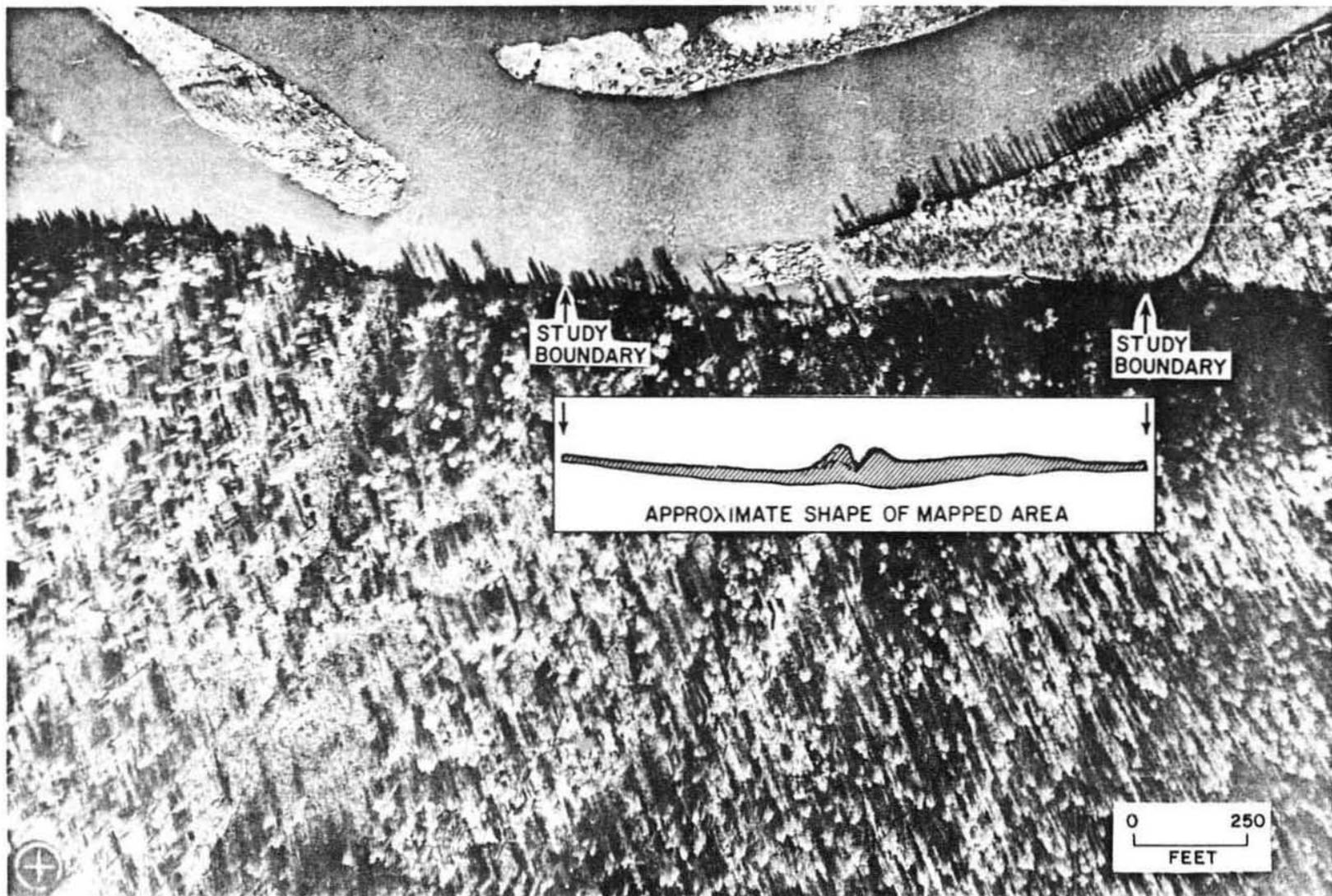
STUDY
BOUNDARY

UPPER STUDY
BOUNDARY

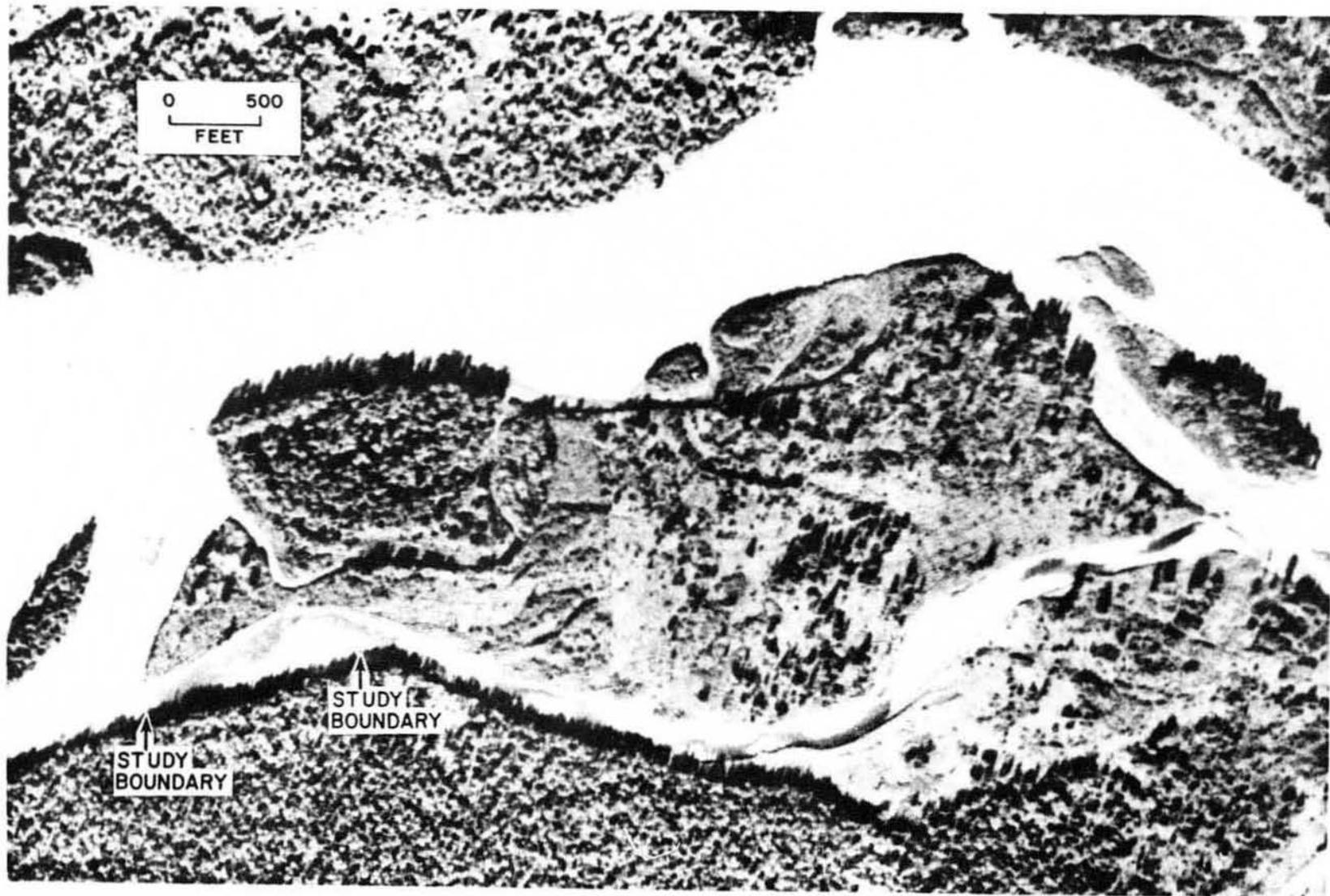
E-34



Appendix Plate E-2. August 1982 photograph of Slough 20 (RM 140.1). The surface area measurements reported are for the slough between the study boundaries shown.



Appendix Plate E-3. May 1982 photograph of Slough 19 (RM 140.0). The surface area measurements reported are for the slough and its immediately downstream reach between the study boundaries shown.



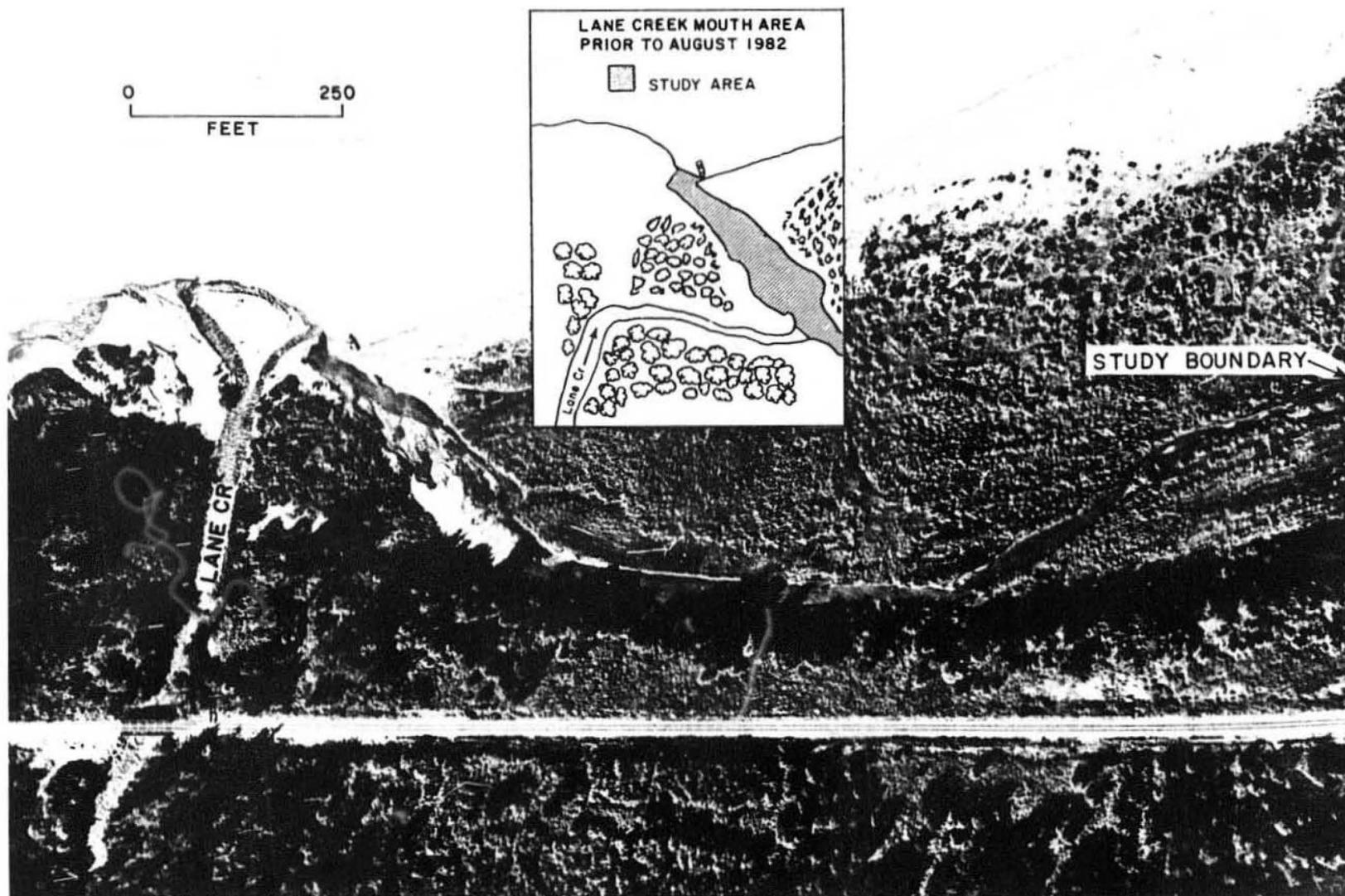
Appendix Plate E-4. August 1980 photograph of Slough 11 (RM 135.3). The surface area measurements reported are for the slough between the study boundaries shown.



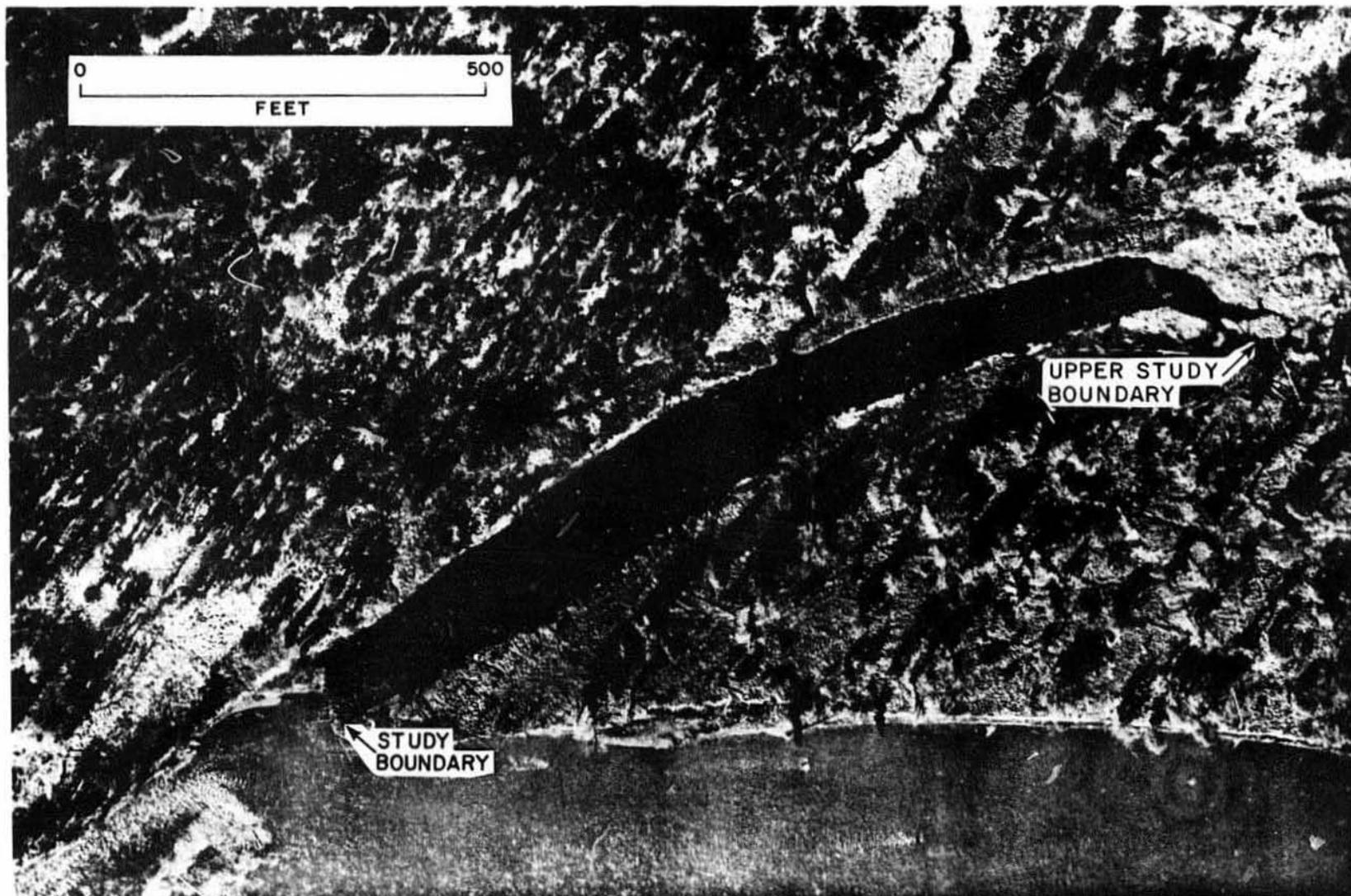
Appendix Plate E-5. August 1980 photograph of Slough 9 (RM 129.2). The surface area measurements reported are for the slough between the study boundaries shown.



Appendix Plate E-6. August 1980 photograph of Slough 8A (RM 125.3). The surface area measurements reported are for the slough between the study boundaries shown.



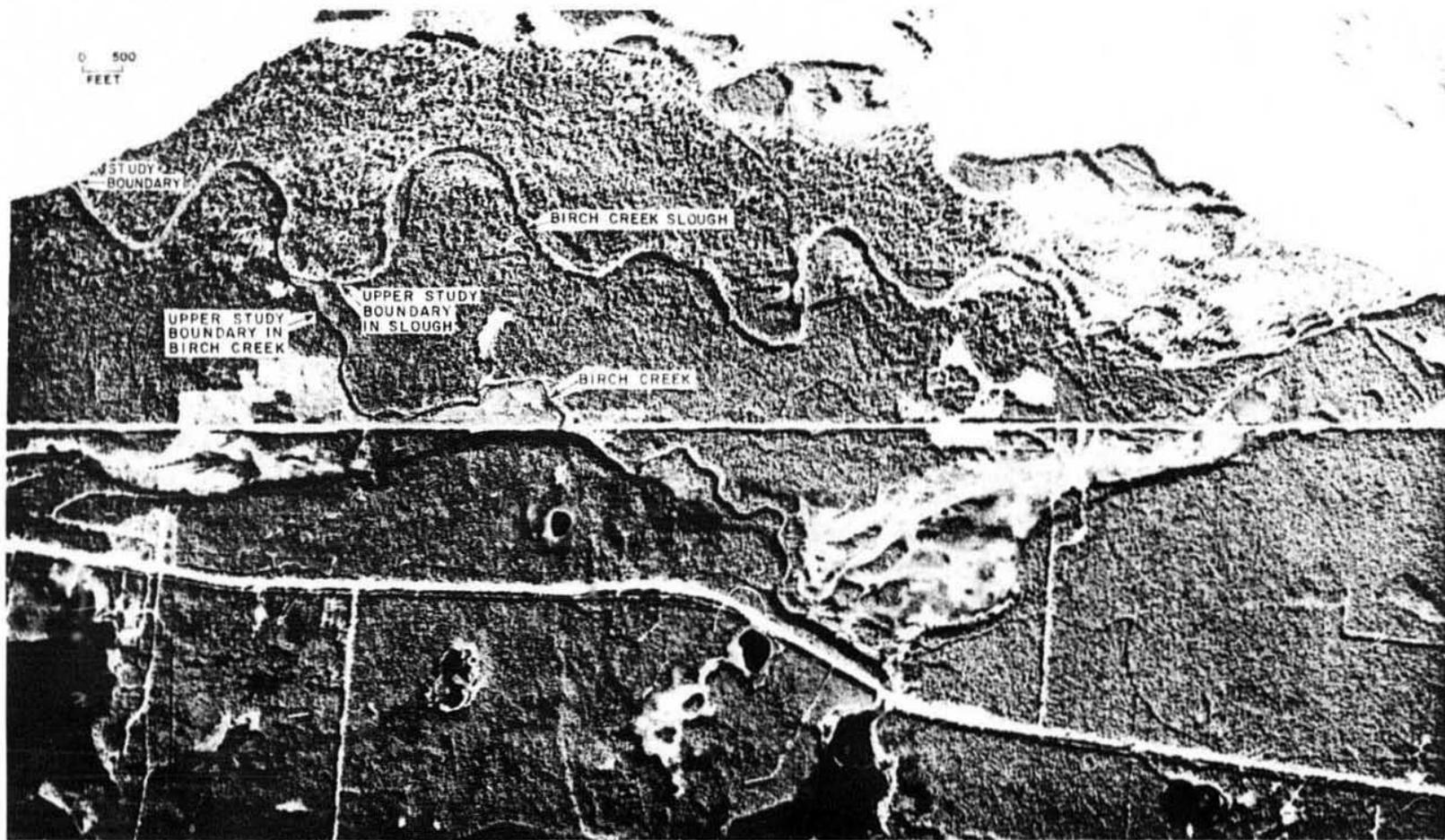
Appendix Plate E-7. August 1982 photograph of Lane Creek mouth and Slough 8 (RM 113.6). The surface area measurements reported are for the slough between its mouth (see inset) and the upper boundary shown.



Appendix Plate E-8. May 1982 photograph of Slough 6A (RM 112.3). The surface area measurements reported are for the slough between the study boundaries shown.

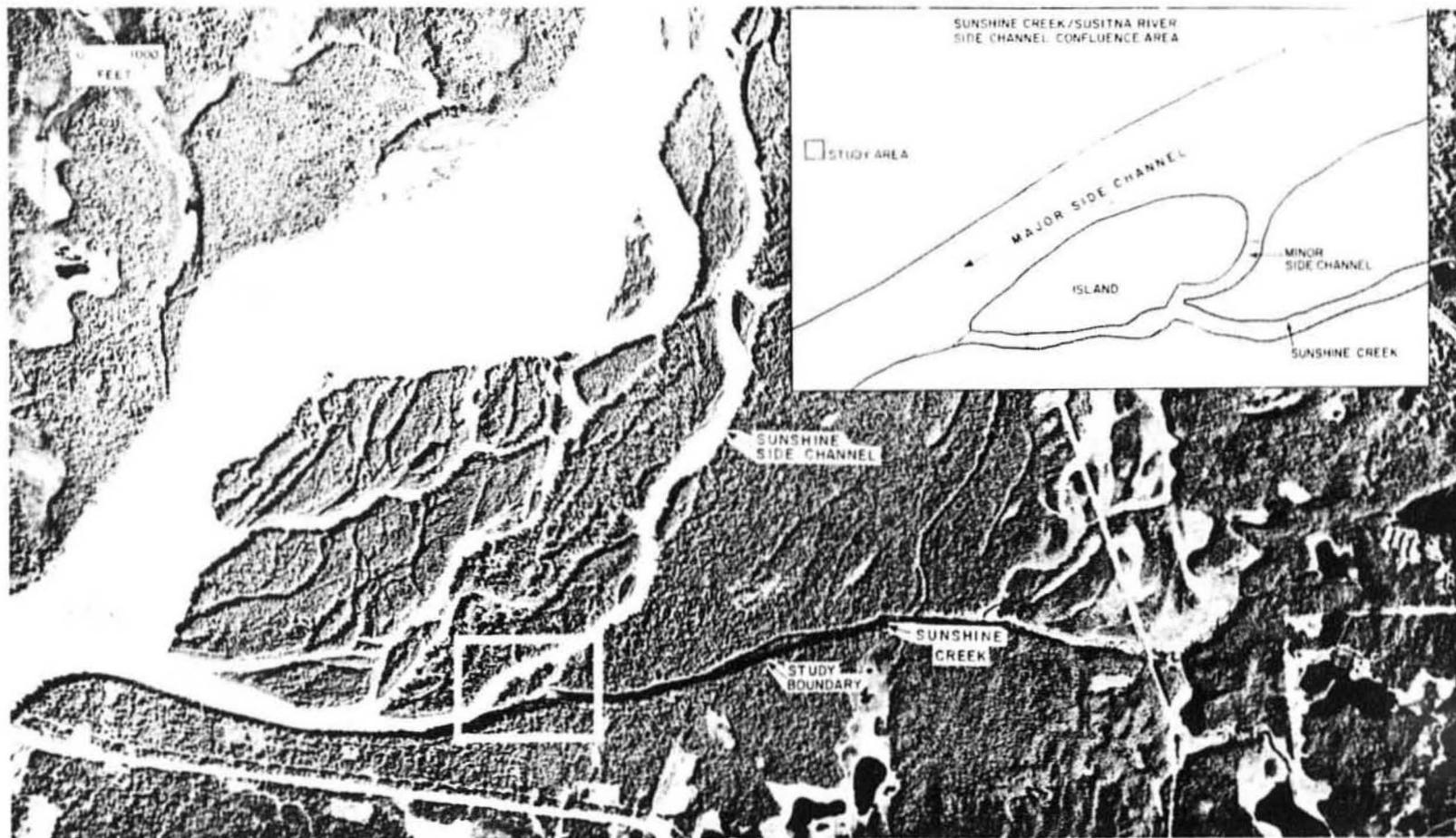


Appendix Plate E-9. May 1982 photograph of Whiskers Creek and Slough (RM 101.2). The surface area measurements reported are for the creek and slough between the study boundaries shown.

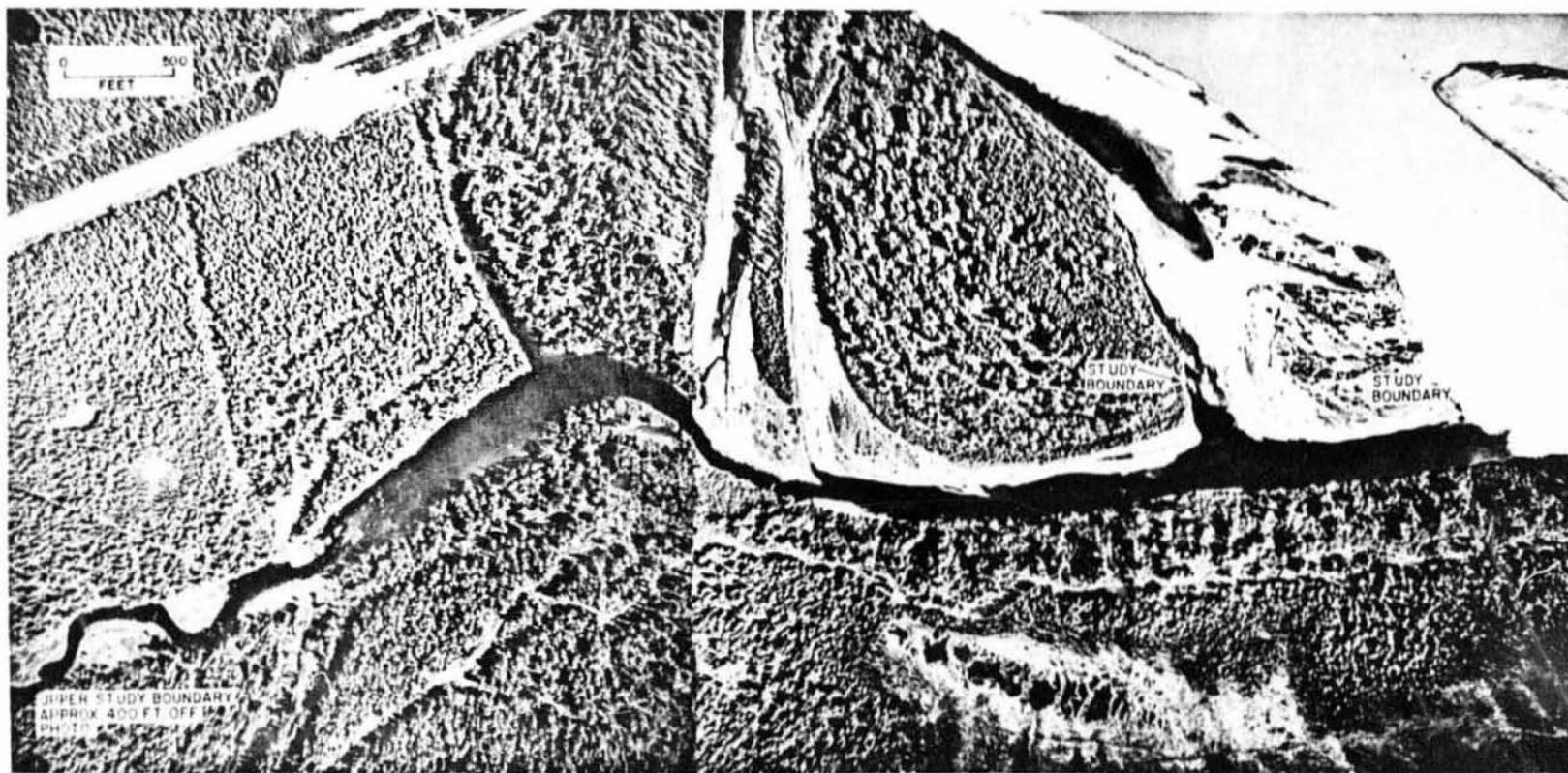


E-42

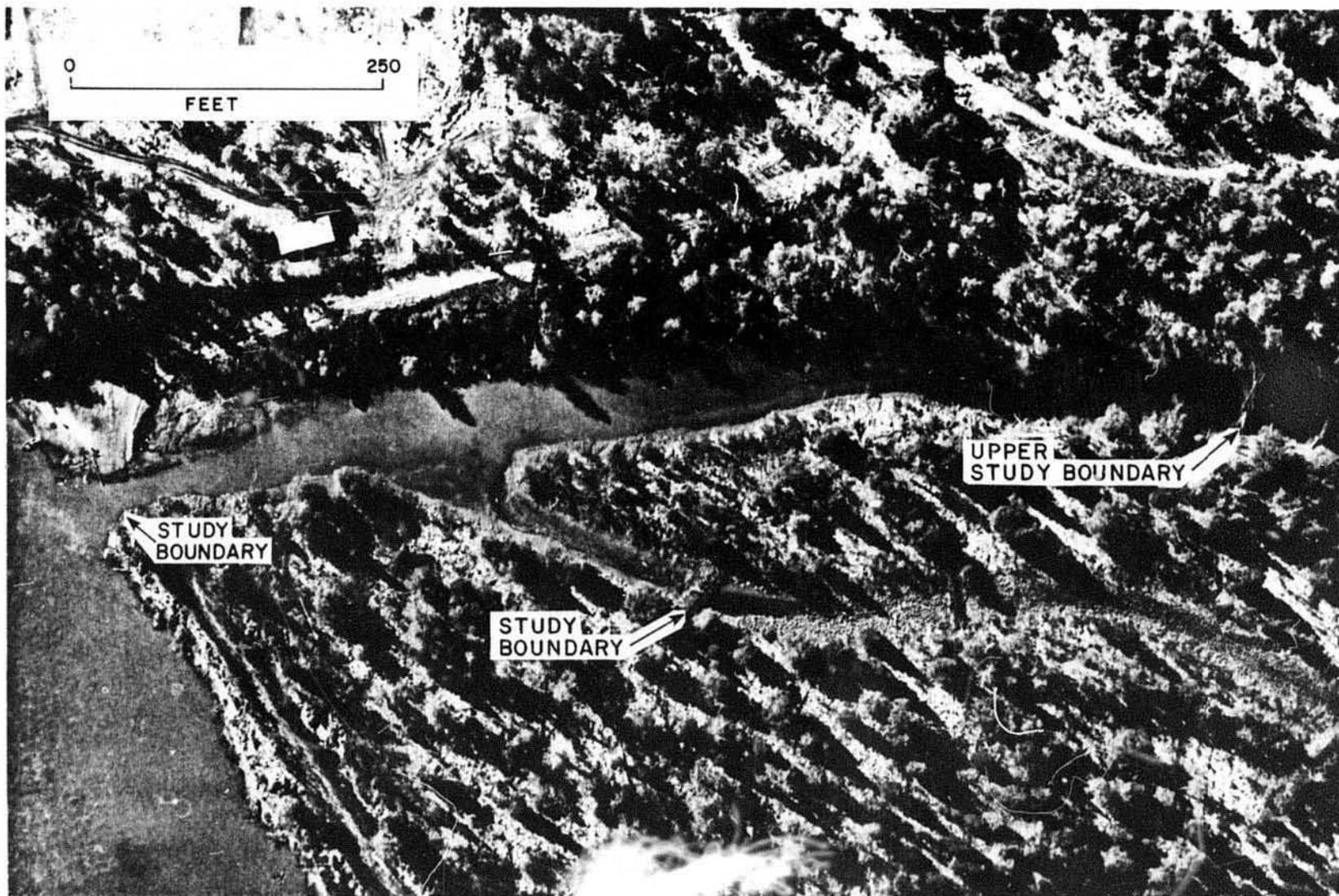
Appendix Plate E-10. August 1980 photograph of Birch Creek and Slough (RM 88.4). The surface area measurements reported are for the creek and slough between the study boundaries shown.



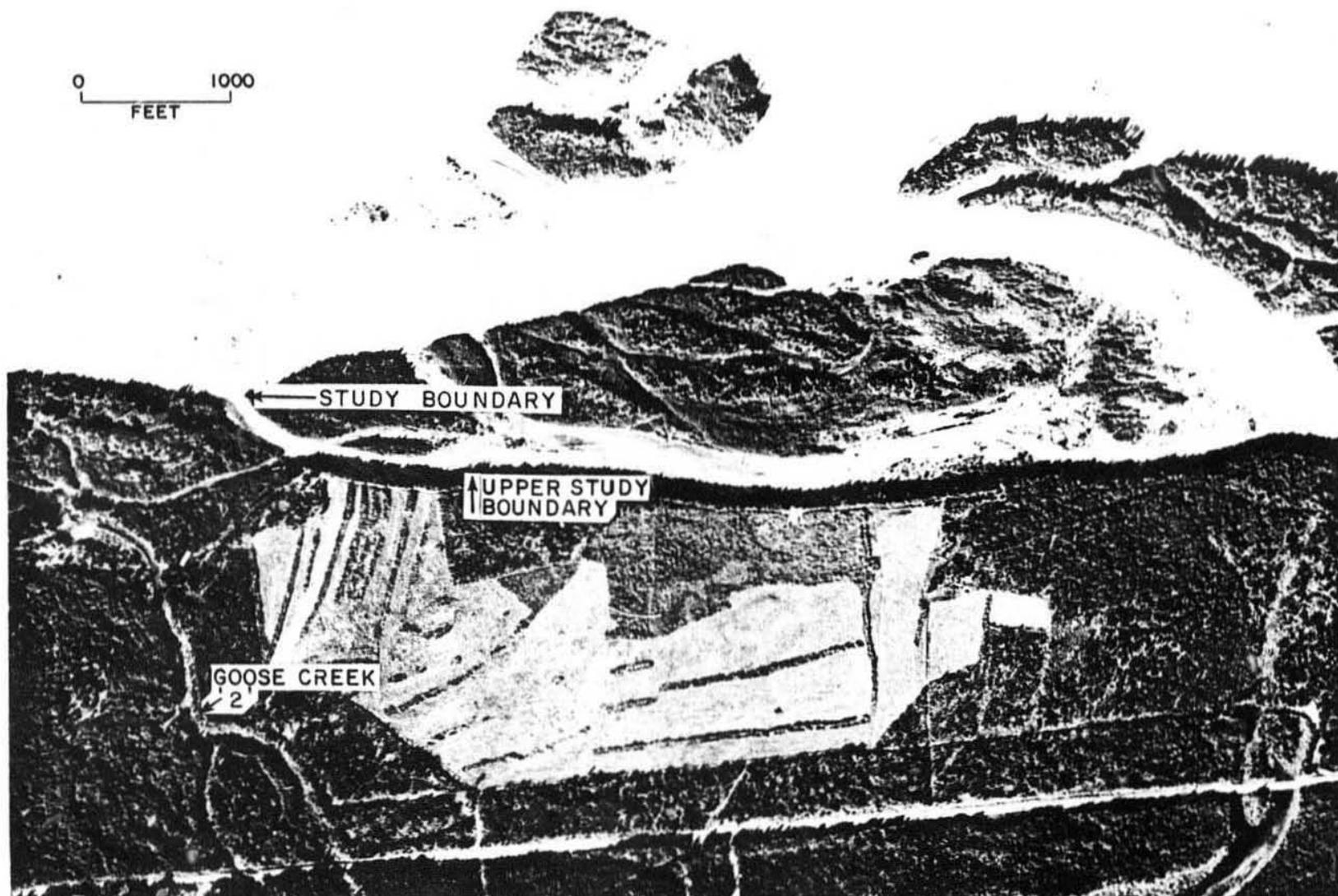
Appendix Plate E-11. August 1980 photograph of Sunshine Creek and Side Channel (RM 85.7). The surface area measurements reported are for the creek and slough areas shown in the inset and the creek above to the study boundary shown.



Appendix Plate E-12. August 1982 photograph of Rabideux Creek and Slough (RM 83.1). The surface area measurements reported are for the site between the study boundaries shown and a point on the creek about 400 ft. off the photograph.

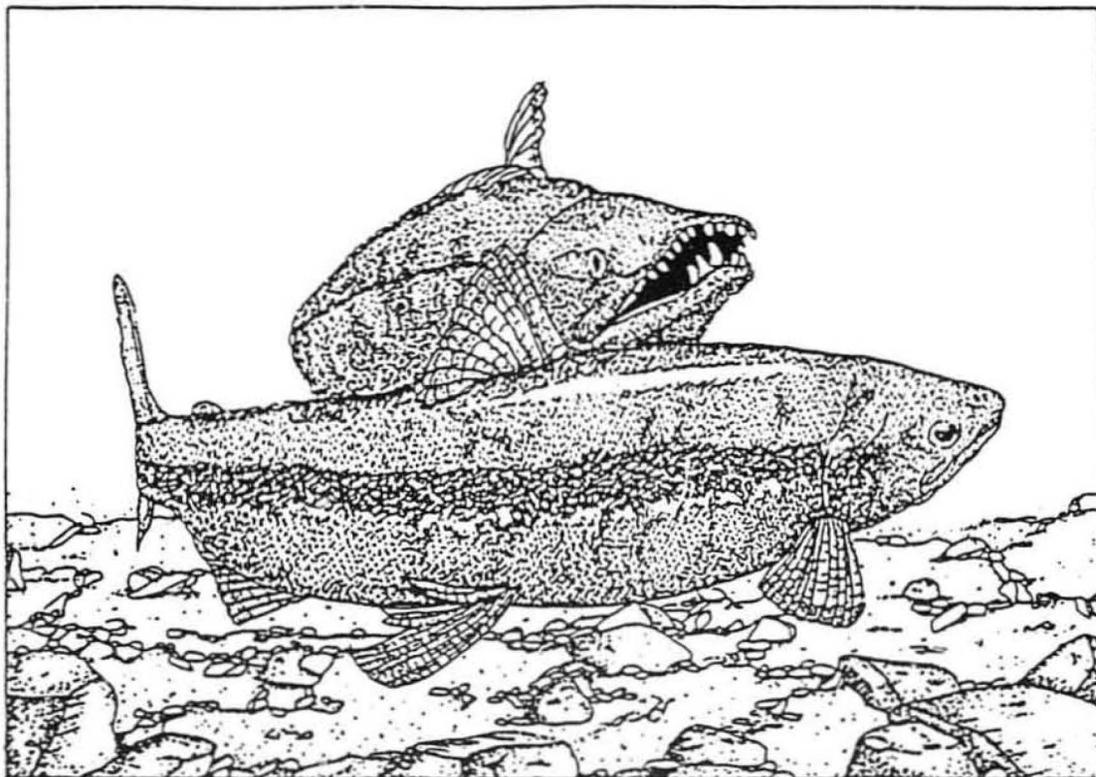


Appendix Plate E-13. May 1982 photograph of Whitefish Slough (RM 78.7). The surface area measurements reported are for the slough between the study boundaries shown.



Appendix Plate E-14. August 1980 photograph of Goose Creek 2 and Side Channel (RM 73.1). The surface area measurements reported are for the slough between the study boundaries shown.

SUS
185



SUSITNA HYDRO AQUATIC STUDIES
PHASE II REPORT

Synopsis of the 1982
Aquatic Studies and Analysis of
Fish and Habitat Relationships

— APPENDICES —



by

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

1983