UNIVERSITY OF ALASKA
ARCTIC ENVIRONMENTAL INFORMATION
AND DATA CENTER
707 A STREET
ANCHORAGE, AK 99501

SUS 252

Wilson

FEB 22 1984

MEMORANDUM

R&M

TO	SUBJECT	
Dr. John Bizer	Lower Susitna River Morphology	
FROM	**DATE**	**PROJECT NO.**
Steve Bredthauer	2-21-84	352363

LOWER RIVER SEGMENTS

Representatives of R&M Consultants, Harza-Ebasco, and AEIDC met on December 21, 1983, to discuss a morphological classification system for the Susitna River below the Chulitna River confluence. The lower Susitna River was broken into 5 segments, based on river morphology and hydrology. The segments are described below and delineated on the enclosed river bluelines.

Segment I: RM 98.5 to RM 78

This segment extends from the Chulitna River confluence (Sheet 2) downstream to the head of the side-channel complex just upstream of Montana Creek (Sheet 6). The river is braided, with the main channel meandering through a wide gravel floodplain. Large expanses of gravel bars are exposed at low flows. The channel is constricted to a single channel at the Parks Highway Bridge (RM 83.8). Significant tributaries in this segment include Birch Creek, Trapper Creek, Sunshine Creek, Rabideux Creek, and Whitefish Slough. A total of six side-channel complexes were identified.

Segment II: RM 78 to RM 51

This segment extends from the side-channel above Montana Creek (Sheet 6) to the head of Delta Islands (Sheet 13) where the river splits into two main channels. The morphology in this reach is complex, with a total of 9 side-channel complexes along the edge of the river, and another 2 side-channel complexes in large island groups in mid-channel. Significant tributaries in this segment include Montana Creek, Goose Creek, Sheep Creek, and the Kashwitna River.

Segment III: RM 51 to RM 42.5

This segment encompasses the Delta Islands reach (Sheets 13-16), where two main channels exist, one on the east and one on the west. A total of five side channel complexes exist in this segment, with a major complex between the two main channels. The segment ends where the two main channels rejoin. Significant tributaries in this segment include Little Willow Creek and Willow Creek.

Segment IV: RM 42.5 to RM 28.5

This segment extends from the lower end of the Delta Island (Sheet 16) to the confluence with the Yentna River (Sheet 20). The reach is characterized by a braided pattern, with seven side-channel complexes. The Deshka River enters the upper end of this reach. Kroto Slough branches off from this segment, and extends to the Yentna River.

Segment V: RM 28.5 to RM 0

This segment extends from the Yentna River confluence to Cook Inlet. The Yentna River contributes about 40 percent of the flow at the mouth of the Susitna River. The segment is primarily a split-channel configuration down to RM 19, the head of Alexander Slough. The Susitna River has 2 channels from RM 19 to Cook Inlet, with the main channel on the east side. The west channel is primarily an overflow channel. Its upper section dewaters at low flow, while the lower segment is fed by Alexander Creek. Other tributaries entering this segment include Anderson Creek and Fish Creek.

HABITAT TYPES

Within the segments, four major morphological classifications have been identified which roughly correspond to habitat types.

Mainstem Channel

The mainstem channel is that portion of the river floodplain between the vegetated boundaries, including the wide gravel floodplain and isolated vegetated islands in mid-channel. Two subclassifications exist:

1) Mainstem river, consisting of the thalweg channel and major subchannels.

2) Alluvial island complexes, which are areas of broad gravel islands with numerous subchannels which dewater as flow decreases.

These subclassifications have not been separated while digitizing the wetted surface areas, but is would be possible to determine the areas relatively quickly.

Side-Channel Complex

The side-channel complexes are groups of side-channels flowing through vegetated islands. These are normally along the edge of the mainstem river, but may also include areas in the middle of the river, such as the Delta Islands. Two subclassifications exist:

1) Lateral side-channel, which is the outside channel of the complex, closest to the edge of the floodplain. This channel collects any groundwater seepage or tributary flow from the river banks, so usually will not completely dewater, even when its upstream berm is not breached.

2) Medial side-channels are the overflow side-channels between the mainstem and the lateral side-channel. These side-channels dewater as mainstem flow decreases.

Sloughs

Sloughs are simple, regular channels which are generally overtopped only at high flows. They are differentiated from side-channel complexes by the fact that sloughs are an isolated channel, not fed by a series of medial side-channels.

Tributary Mouths

Tributary mouths cover the area between the downstream extent of a tributary plume and the upstream effect of backwater. The area is variable, and depends both on the flow of the tributary and the mainstem stage. The length of the tributary plume may sharply increase when the tributary flows into a side-channel in which the upper end is no longer breached.

PROCEDURE

The purpose of this study was to provide a "first-cut" delineation of changes in habitat area due to changes in flow of the Susitna River below Talkeetna. This study is not intended to be definitive, but will serve as a guide to determine those segments of the lower river which require further study.

Aerial photography of the Susitna River from Cook Inlet to the Chulitna River confluence was obtained for the following four dates and flows:

Date	Flow, Susitna River at Sunshine	Remarks
8-27-83	56,500 cfs	Typical July-August flow during project operation.
9-6-83	37,500 cfs	Transitional September flow during project operation.
9-16-83	22,000 cfs	Upper bound of winter flow during project operation.
10-25-83	13,600 cfs	Lower bound of winter flow during project operation.

An aerial photo mosaic of each flight was made for segments I through IV. The mainstem, side-channel complexes, and sloughs were delineated for each segment. Segment V was not included, as it is felt that the flow flow from the Yentna River masks any changes in habitat area caused by project operation, and because tidal influence extends up to RM 20.

The wetted area of each morphological type was determined by planimetering the total area of each subsegment (mainstem or side-channel complex), then planimetering the area of each island and gravel bar within the subsegment. The area of the islands and bars was then subtracted from the total area of the subsegment, leaving the wetted area.

To obtain the above areas, the subsegment boundaries were traced onto mylar from the aerial photo mosaics. Each island and gravel bar boundary was then traced, and the island numbered. Only wetted channels which extended through an island complex were delineated although backwater areas were included. Isolated pockets of water left when the water level dropped were not planimetered, as these were not considered usable habitat. All area were digitized on an HP-9845 computer. The areas were delineated 2-4 times, and the average value used.

The available photography has a nominal scale of 1 inch = 2,000 feet. However, there are minor differences in scale from photo-to-photo and between each photo date. This loss of scale is caused by a number of factors, including wind and terrain relief, and can not be accurately quantified. To account for the differences in scale between flights, the total areas of each subsegment were compared to the corresponding total areas for the flight on September 16, 1983, which is the flight from which the enclosed bluelines were prepared. The ratios of areas are shown in Table 1. The differences in total area were generally in the range of ±10%. The larger differences usually occurred in the smaller subsegments. The flights were uncontrolled, with no photopanels or surveyed sections available for determining scale for each segment. Consequently, the areas determined for the September 16, 1983 flight have been assumed to be the base areas. All other digitized areas were adjusted to the September 16 scale by dividing by the correction ratios shown in Table 1.

RESULTS

The changes in wetted surface area for mainstem and side-channel complexes are shown in Table 2, and are plotted on Figures 1-9. The percent wetted area for each subsegment is the total wetted area divided by the total area of the subsegment (including the vegetated areas). Consequently, each subsegment will have a different maximum percent wetted area, which is determined at bankfull flows when all gravel bars are covered.

The estimated lengths of tributary mouth habitats are shown in Table 3. The upper ends of the backwater effects in the tributaries were estimated during aerial overflights within a day of the date the aerial photography was obtained. The downstream ends of the tributary plumes were estimated from the 1 inch = 2,000 feet photography. When a tributary flows into a lateral side-channel, the downstream extent of the tributary plume may extend a significantly longer distance downstream at low flows than at high flows. When the upper end of the lateral side-channel is not breached by mainstem flow, the characteristics of the tributary dominate for a much longer distance downstream.

cc: L. Gilbertson, Harza-Ebasco
W. Dyok, Harza-Ebasco
D. Martin, Harza-Ebasco
B. Wilson, AEIDC
W. Trihey
T. Trent, ADF&G
B. Barrett, ADF&G
D. Schmidt, ADF&G
C. Estes, ADF&G
L. Moulton, Woodward-Clyde

SB:mb
s1/q

s9/t1

TABLE 1
COMPARISON OF
DIGITIZED AREAS ON LOWER SUSITNA MOSAICS

SEGMENT	(Digitized Total Area for date) / (Digitized Total Area for 9-16-83)			TOTAL AREA (acres)	TOTAL AREA (10^6 sq.ft.)
	8-27-83	9-6-83	10-25-83	9-16-83	9-16-83
Main I	.987	1.002	1.058	7,434.2	324
SC I-1	1.023	1.026	1.057	107.4	4.68
SC I-2	.952	1.005	1.058	746.5	32.5
SC I-3	1.322	1.037	1.036	158.6	6.91
SC I-4	1.262	1.134	.960	31.7	1.38
SC I-5	.992	1.004	1.060	1,203.9	52.4
SC I-6	1.016	.990	1.044	182.7	7.96
TOTAL I	.991	1.003	1.057	9,866.0	430
Main II	.943	.976	1.036	10,442.0	455
SC II-1	1.001	1.048	1.063	238.5	10.4
SC II-2	.937	.982	1.032	665.6	29.0
SC II-3	.958	1.019	1.025	326.4	14.2
SC II-4	.955	1.032	1.063	1,295.9	56.4
SC II-5	.912	.989	1.052	391.4	17.0
SC II-6	.966	1.018	1.047	3,586.1	156
SC II-7	1.008	1.052	1.073	142.1	6.19
SC II-8	.960	1.024	1.058	1,246.1	54.3
SC II-9	.989	.962	1.049	150.7	6.56
SC II-10	.900	.952	1.018	106.3	4.63
SC II-11	1.015	.994	1.047	4,851.7	211
TOTAL II	.963	.994	1.043	23,442.9	1021

TABLE 1 (cont')

COMPARISON OF

DIGITIZED AREAS ON LOWER SUSITNA MOSAICS

SEGMENT	(Digitized Total Area for date) / (Digitized Total Area for 9-16-83)			TOTAL AREA (acres)	TOTAL AREA (10^6 sq.ft.)
	8-27-83	9-6-83	10-25-83	9-16-83	9-16-83
Main III	.974	.980	1.020	2,982.4	130
SC III-1	.980	.974	1.022	929.7	40.5
SC III-2	.934	.991	1.046	1,810.5	78.9
SC III-3	.977	.982	1.059	6,647.0	290
SC III-4	.952	1.014	1.076	522.0	22.7
SC III-5	.981	.991	1.039	189.8	8.27
TOTAL III	.970	.983	1.046	13,081.4	570
Main IV	.974	1.006	1.052	3,373.2	147
SC IV-1	.979	.997	1.039	426.6	18.6
SC IV-2	1.079	1.045	1.017	164.0	7.14
SC IV-3	.969	1.005	1.038	1,276.5	55.6
SC IV-4	1.011	1.009	1.061	727.4	31.7
SC IV-5	.926	1.012	1.015	69.4	3.02
SC IV-6	.978	.985	1.062	1,953.6	85.1
SC IV-7	.891	1.017	1.043	60.4	2.63
TOTAL IV	.979	1.002	1.051	8,051.9	351

s9/tt1

TABLE 2
CHANGES IN WETTED SURFACE AREA WITH FLOW
LOWER SUSITNA RIVER

Date	8-27-83		9-6-83		9-16-83		10-25-83	
Flow(cfs) @ Sunshine	56,500		37,500		22,000		13,600	
Subsegment	W.S.A.(1) (10^6 sq ft)	Percent of Subsegment Area (2)	W.S.A. (10^6 sq ft)	Percent of Subsegment Area	W.S.A. (10^6 sq ft)	Percent of Subsegment Area	W.S.A. (10^6 sq ft)	Percent of Subsegment Area
Mainstem I	203	62.8	156	48.2	123	38.1	110	34.1
SC I-1 (3)	0.82	17.3	0.67	14.1	0.44	9.3	0.46	9.8
SC I-2	3.83	11.8	3.31	10.2	2.47	7.6	2.52	7.8
SC I-3	2.76	40.0	2.27	32.9	1.63	23.6	1.14	16.6
SC I-4	0.42	30.2	0.40	28.6	0.41	29.9	0.37	26.5
SC I-5	14	26.7	11.5	21.9	8.47	16.2	6.84	13.0
SC I-6	1.67	20.9	1.29	16.2	1.14	14.3	0.55	6.9
TOTAL SC I	23.5	22.2	19.4	18.3	14.6	13.8	11.9	11.2
Mainstem II	292	64.2	229	50.3	199	43.8	160	35.2
SC II-1	1.16	11.2	1.16	11.2	0.58	5.6	0.25	2.4
SC II-2	6.33	21.8	4.27	14.7	3.12	10.8	1.41	4.9
SC II-3	3.20	22.5	2.38	16.8	2.39	16.8	0.79	5.5
SC II-4	12.1	21.4	3.54	6.3	3.69	6.5	2.59	4.6
SC II-5	6.94	40.7	4.77	28.0	4.20	24.6	2.13	12.5
SC II-6	42.8	27.4	32.1	20.5	27.1	17.3	11.9	7.6
SC II-7	1.74	28.1	0.63	10.2	0.51	8.2	0.36	5.8
SC II-8	13.5	24.9	10.1	18.7	9.25	17.0	5.88	10.8
SC II-9	0.74	11.3	0.19	3.0	0.00	0.0	0.00	0.0
SC II-10	1.50	32.5	1.29	27.9	1.25	27.0	0.59	12.8
SC II-11	33.1	15.7	18.1	8.6	16.8	7.9	6.84	3.2
TOTAL SC II	123	21.7	78.5	13.9	68.9	12.2	32.7	5.8

1) Wetted Surface Area
2) (Wetted surface area/Total subsegment area) x 100
3) SC indicates side-channel complex

TABLE 2 (cont')
CHANGES IN WETTED SURFACE AREA WITH FLOW
LOWER SUSITNA RIVER

Date	8-27-83		9-6-83		9-16-83		10-25-83	
Flow(cfs) @ Sunshine	56,500		37,500		22,000		13,600	
Subsegment	W.S.A.(1) (10^6 sq ft)	Percent of Subsegment Area (2)	W.S.A. (10^6 sq ft)	Percent of Subsegment Area	W.S.A. (10^6 sq ft)	Percent of Subsegment Area	W.S.A. (10^6 sq ft)	Percent of Subsegment Area
Mainstem III	91.9	70.7	74.7	57.5	61.9	47.7	52.4	40.3
SC III-1 (3)	11.4	28.1	10.4	25.6	7.54	18.6	6.28	15.5
SC III-2	14.1	17.9	11.5	14.6	6.91	8.8	4.59	5.8
SC III-3	46.3	16.0	38.2	13.2	27.6	9.5	26.6	9.2
SC III-4	7.23	31.8	5.34	23.5	3.87	17.0	3.11	13.7
SC III-5	2.75	33.3	0.57	6.9	0.47	5.7	0.33	4.0
TOTAL SC III	81.8	18.6	66.0	15.0	46.4	10.5	40.9	9.3
Mainstem IV	103	69.8	87.5	59.5	75.0	51.1	66.3	45.2
SC IV-1	2.94	15.8	1.52	8.2	1.05	5.6	0.62	3.3
SC IV-2	2.32	32.5	1.72	24.1	1.31	18.3	0.53	7.4
SC IV-3	12.6	22.6	10.5	18.9	8.16	14.7	5.84	10.5
SC IV-4	8.08	25.5	6.64	20.9	4.76	15.0	2.80	8.8
SC IV-5	0.82	27.1	0.74	24.4	0.38	12.4	0.13	4.4
SC IV-6	26.8	31.5	22.0	25.9	17.2	20.2	12.2	14.4
SC IV-7	0.77	29.1	0.66	25.2	0.36	13.7	0.14	5.4
TOTAL SC IV	54.3	26.7	43.8	21.5	33.2	16.3	22.3	10.9

1) Wetted Surface Area
2) (Wetted surface area/Total subsegment area) x 100
3) SC indicates side-channel complex

? ... units

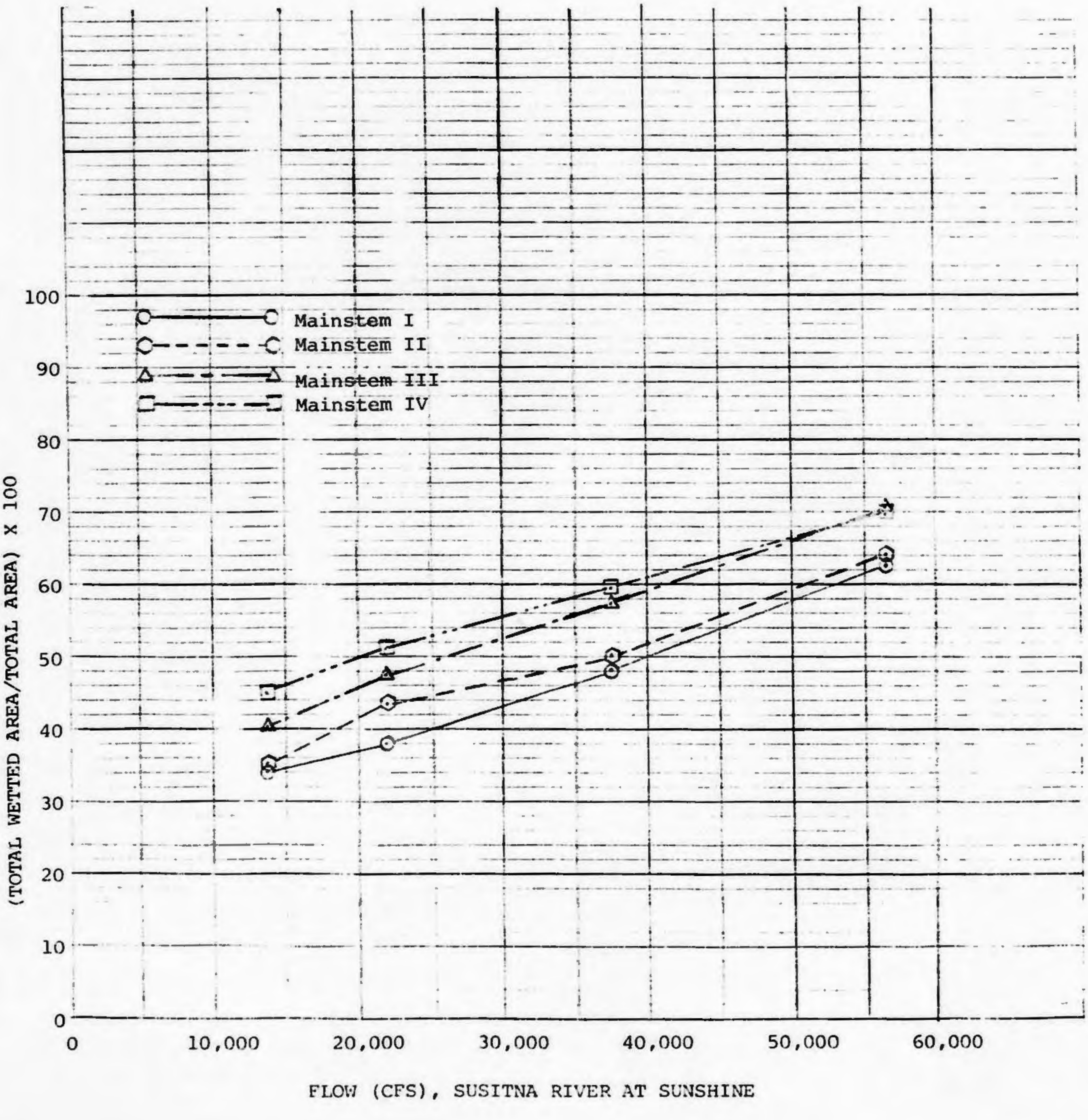
TABLE 3

ESTIMATED[1] LENGTH OF TRIBUTARY MOUTH HABITATS

LOWER SUSITNA RIVER

Date	8-27-83	9-6-83	9-16-83	10-25-83
Flow (cfs) @ Sunshine	56,500	37,500	22,000	13,600
Birch Creek	3,000	1,000	400	600
Sunshine Creek	2,300	1,000	-	6,000[2]
Montana Creek	1,700	1,300	1,300	500
Goose Creek	700	-	1,200[3]	14,700[2]
Sheep Creek	1,500	-	-	-
Little Willow Creek	700	600	6,300[2]	6,300[2]
Willow Creek	2,000	2,000	2,400[3]	2,400[3]

(1) Estimate based on observations from helicopter and from aerial photographs.
(2) Sharp increase in length due to tributary flowing into a side-channel which is no longer overtopped at upper end.
(3) Increased length of tributary plume downstream due to lower mainstem flow.



DWN.	
CKD.	
DATE.	
SCALE	

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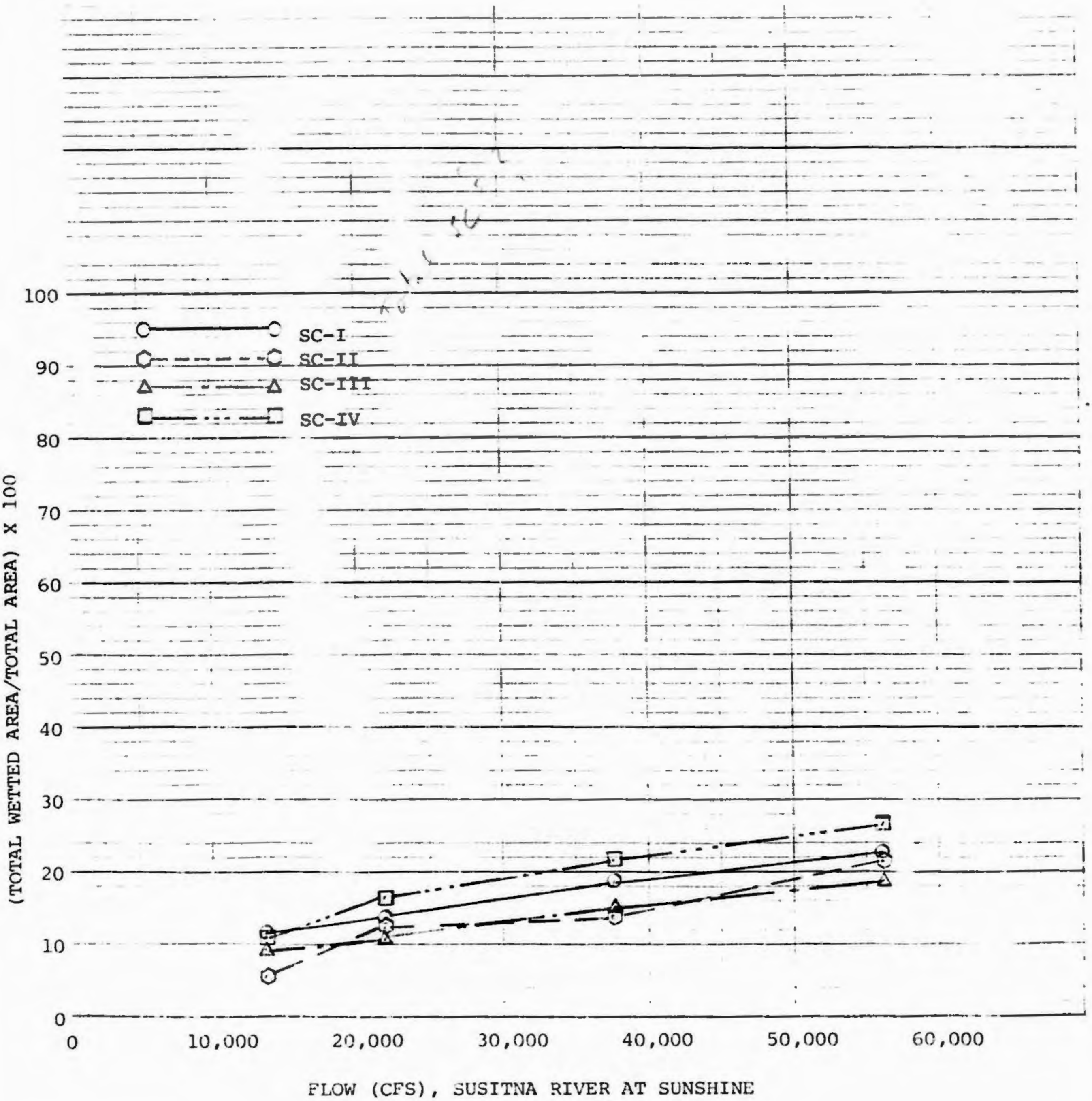
PERCENT WETTED AREA
VS. FLOW
MAINSTEM SEGMENTS
FIGURE 1

F.B.	
GRID.	
PROJ. NO.	
DWG. NO.	



DWN.
CKD.
DATE.
SCALE

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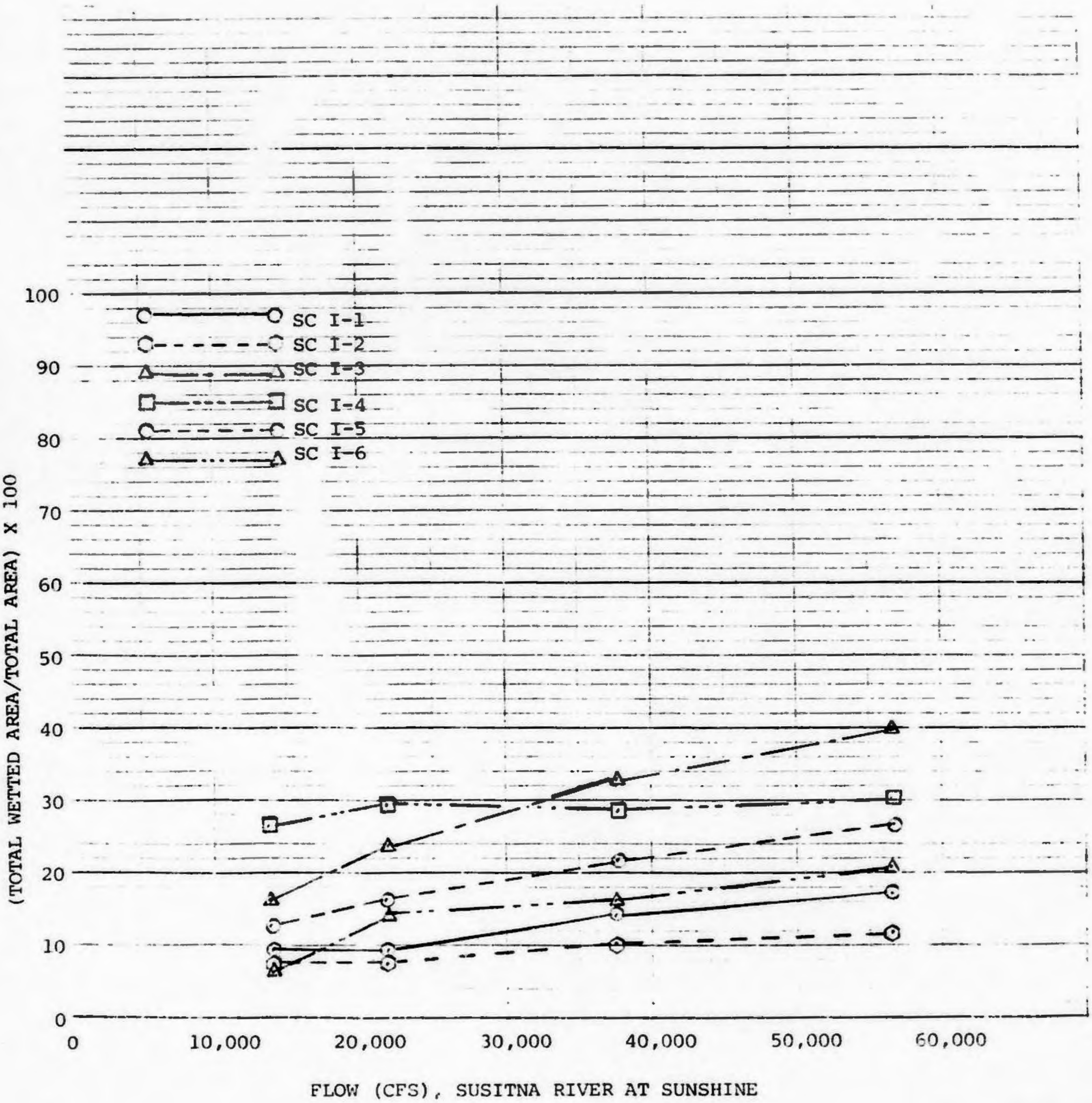
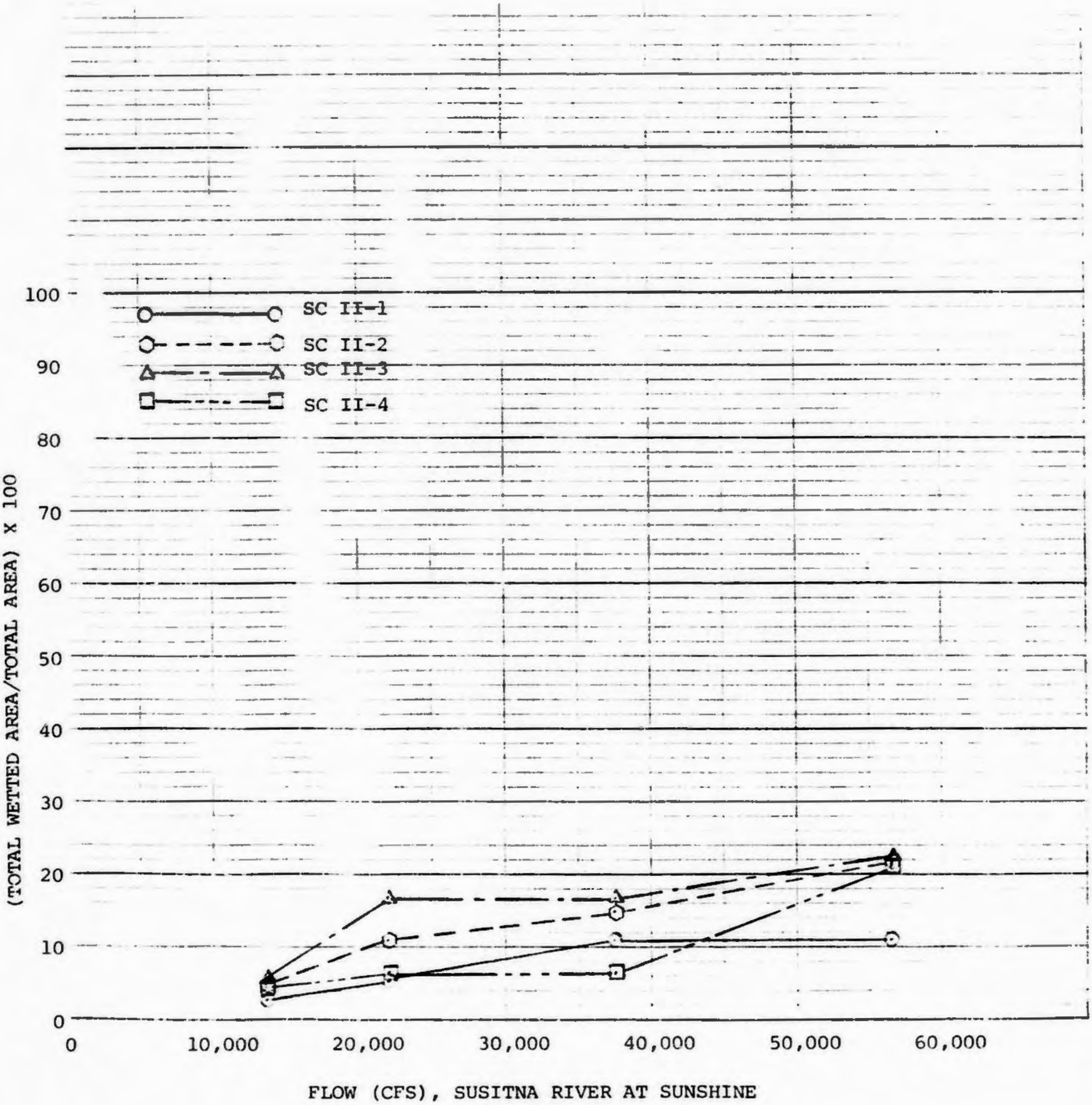
PERCENT WETTED AREA
VS. FLOW
SIDE CHANNEL COMPLEXES
FIGURE 2

F.B.
GRID.
PROJ. NO.
DWG. NO.



DWN.	R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS	PERCENT WETTED AREA VS. FLOW SC I-1 TO SC I-6 FIGURE 3	F.B.
CKD			GRID
DATE.			PROJ.NO
SCALE.			DWG.NO



DWN.
CKD.
DATE.
SCALE.

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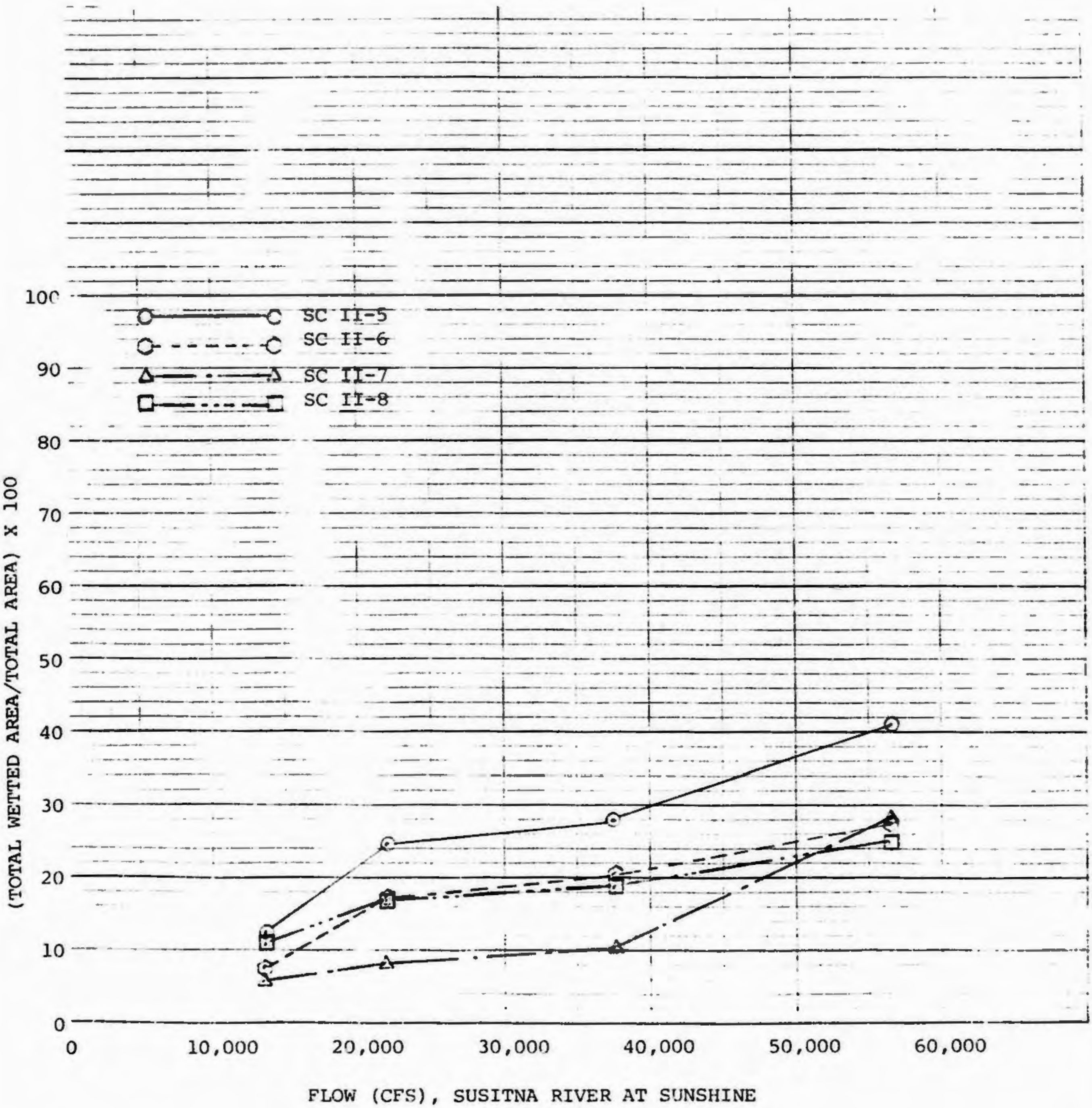
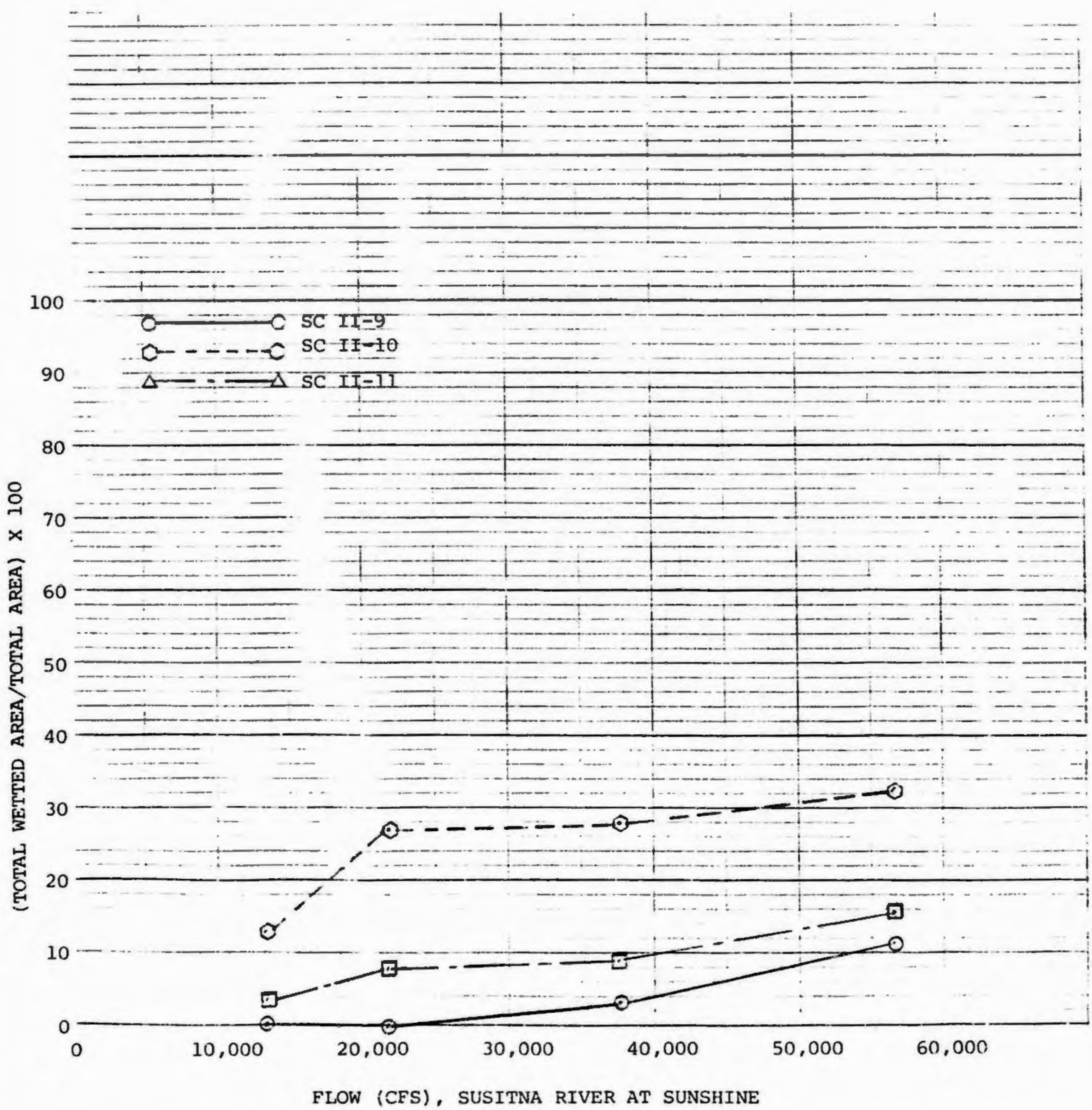
PERCENT WETTED AREA
VS. FLOW
SC II-1 TO SC II-4
FIGURE 4

F.B.
GRID.
PROJ. NO.
DWG. NO.



DWN.	R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS	PERCENT WETTED AREA VS. FLOW SC II-5 TO SC II-8 FIGURE 5	F.B.
CKD.			GRID
DATE.			PROJ. NO.
SCALE.			DWG. NO.



DWN.	
CKD.	
DATE.	
SCALE	

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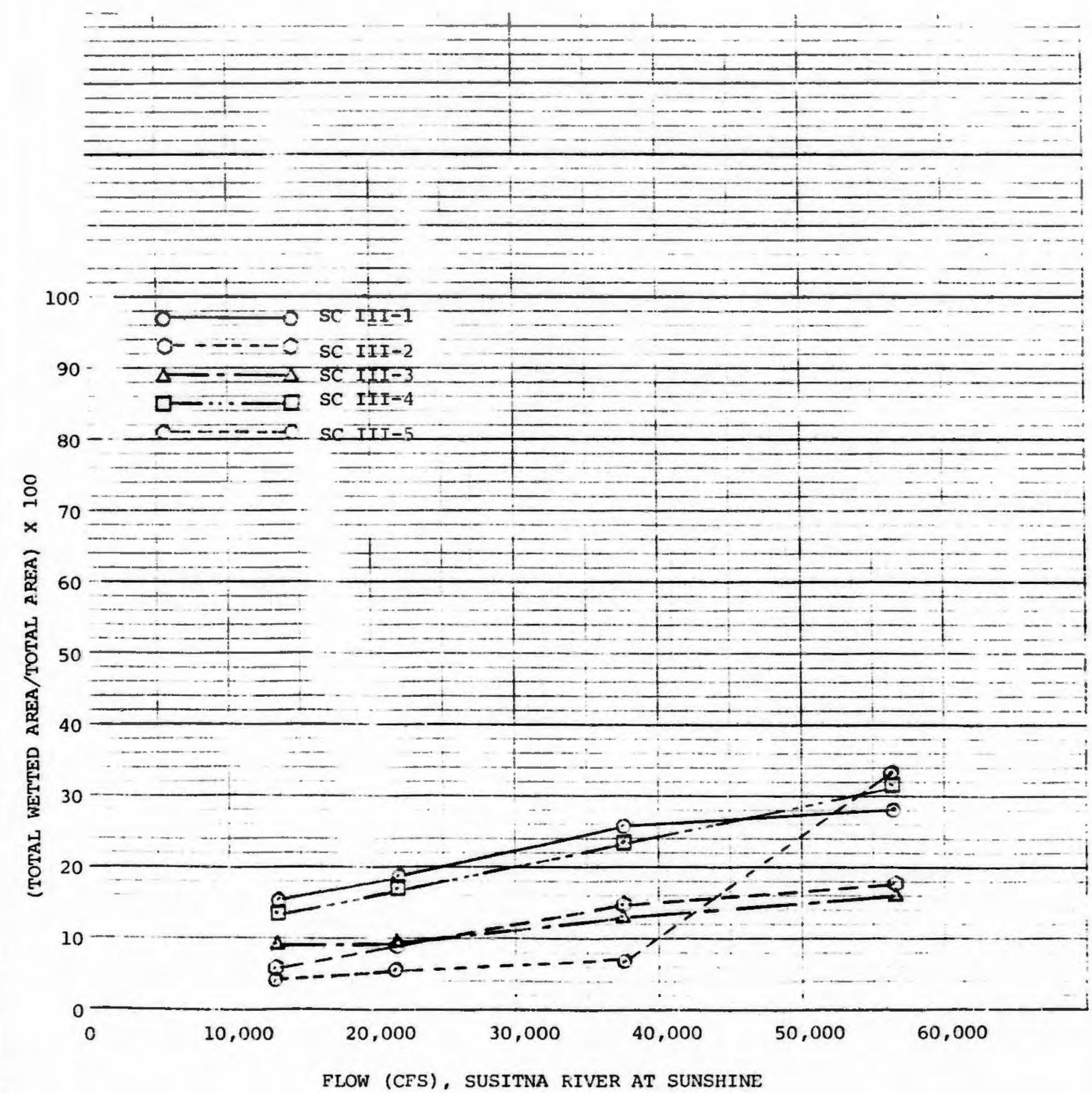
PERCENT WETTED AREA
VS. FLOW
SC II-9 TO SC II-11
FIGURE 6

F.B.	
GRID	
PROJ. NO.	
DWG. NO.	



DWN.	
CKD.	
DATE.	
SCALE.	

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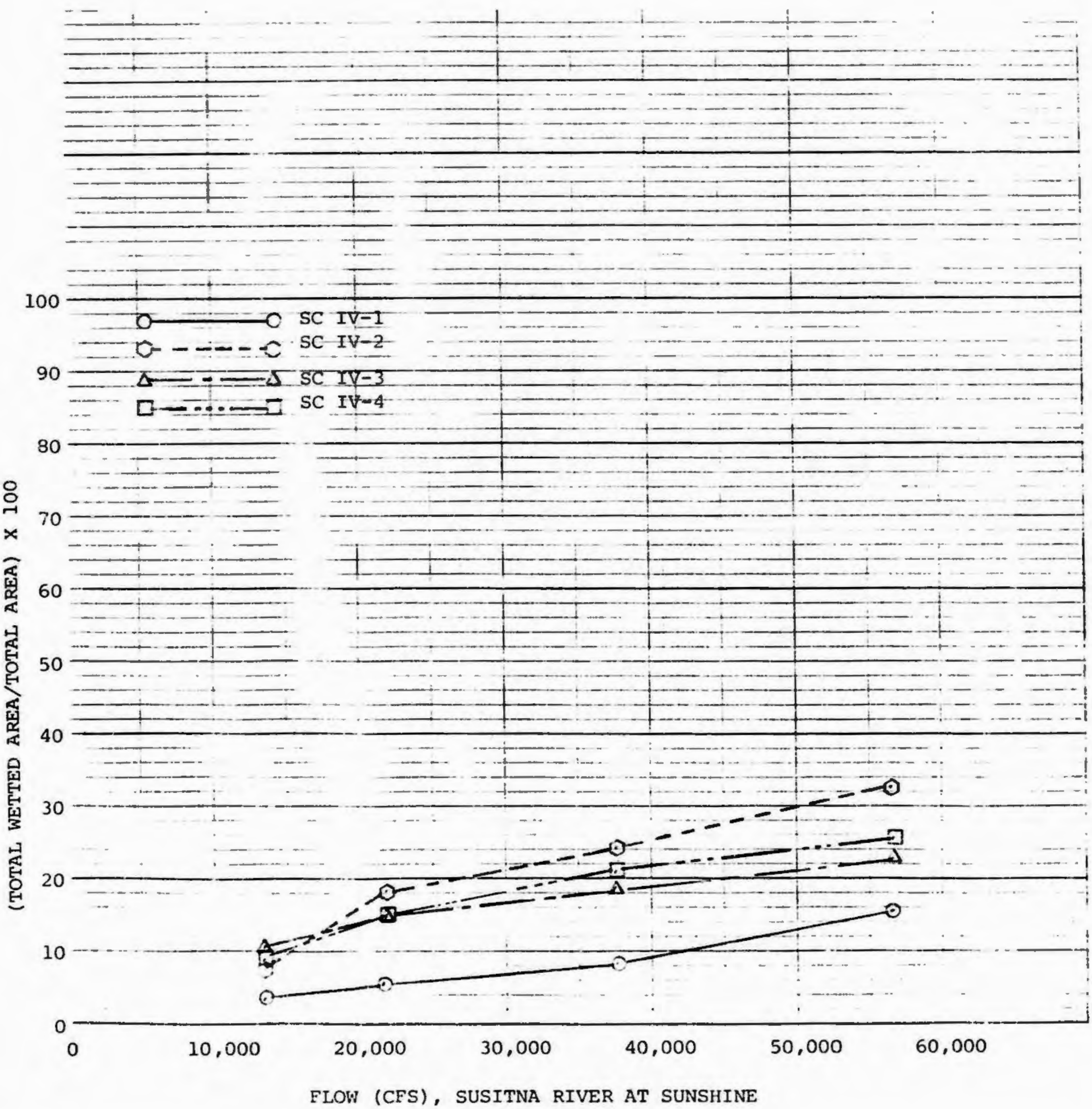
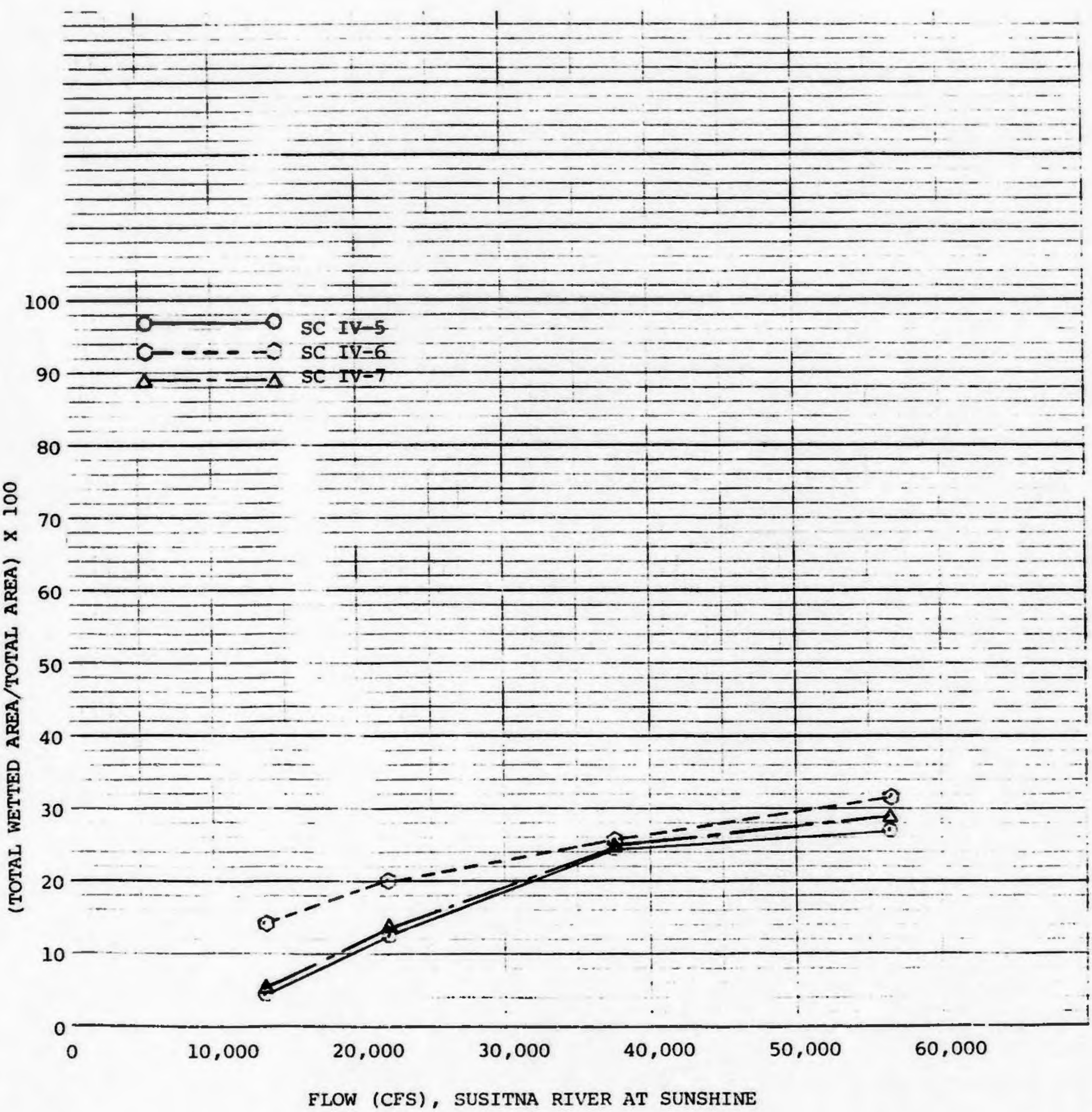
PERCENT WETTED AREA
VS. FLOW
SC III-1 TO SC III -5
FIGURE 7

FB.	
GRID.	
PROJ.NO.	
DWG.NO.	



DWN.	R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS	PERCENT WETTED AREA VS. FLOW SC IV-1 to SC IV -4 FIGURE 8	F.B.
CKD.			GRID
DATE.			PROJ. NO
SCALE.			DWG. NO



DWN.	
CKD.	
DATE.	
SCALE.	

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PERCENT WETTED AREA
VS. FLOW
SC IV-5 TO SC IV-7
FIGURE 9

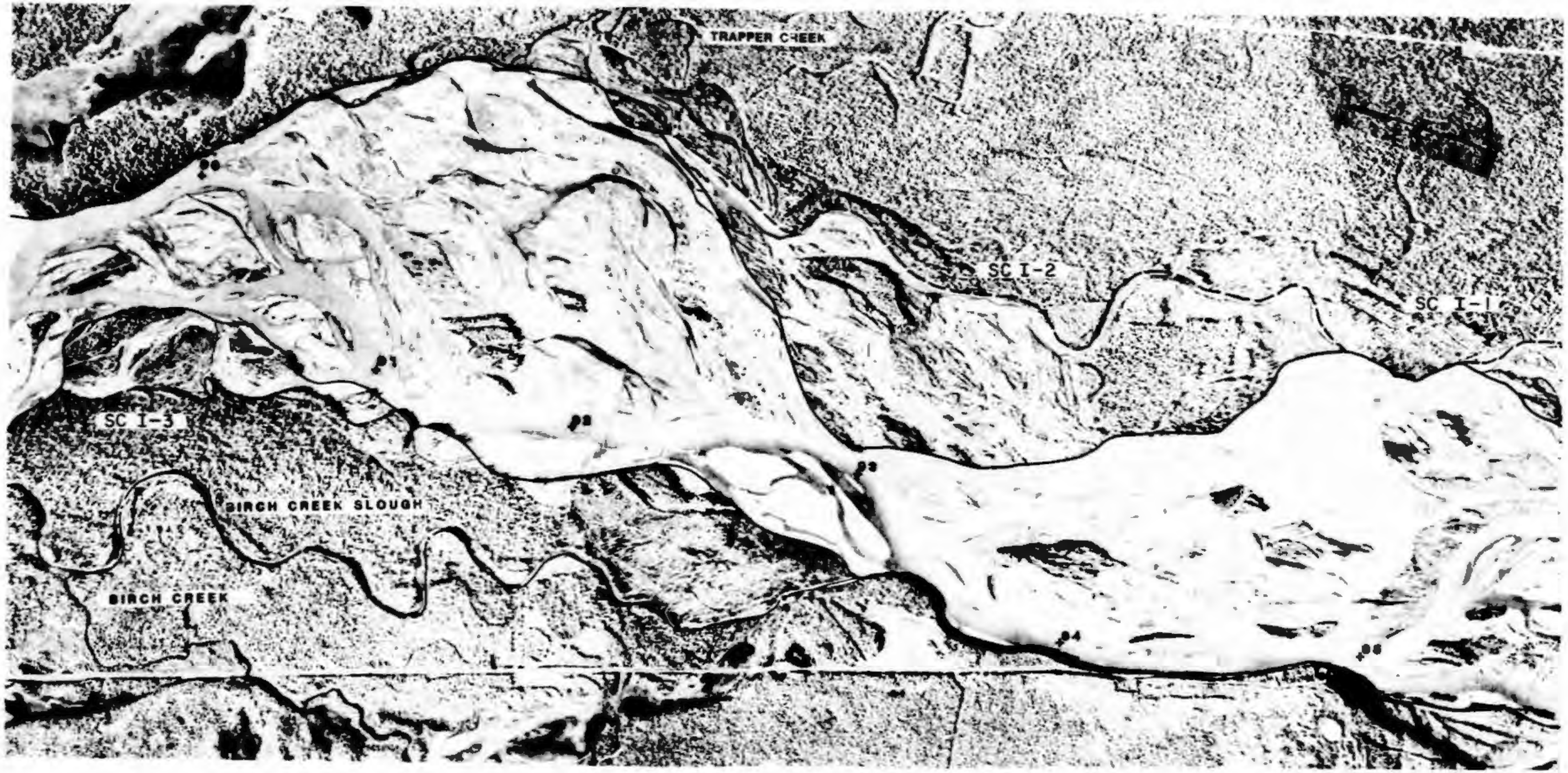
F.B.	
GRID.	
PROJ. NO.	
DWG. NO.	

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000'
SHEET 2 OF 28
DATE 2-7-84

R&M
HARZA-EBASCO
SUSITNA JOINT VENTURE



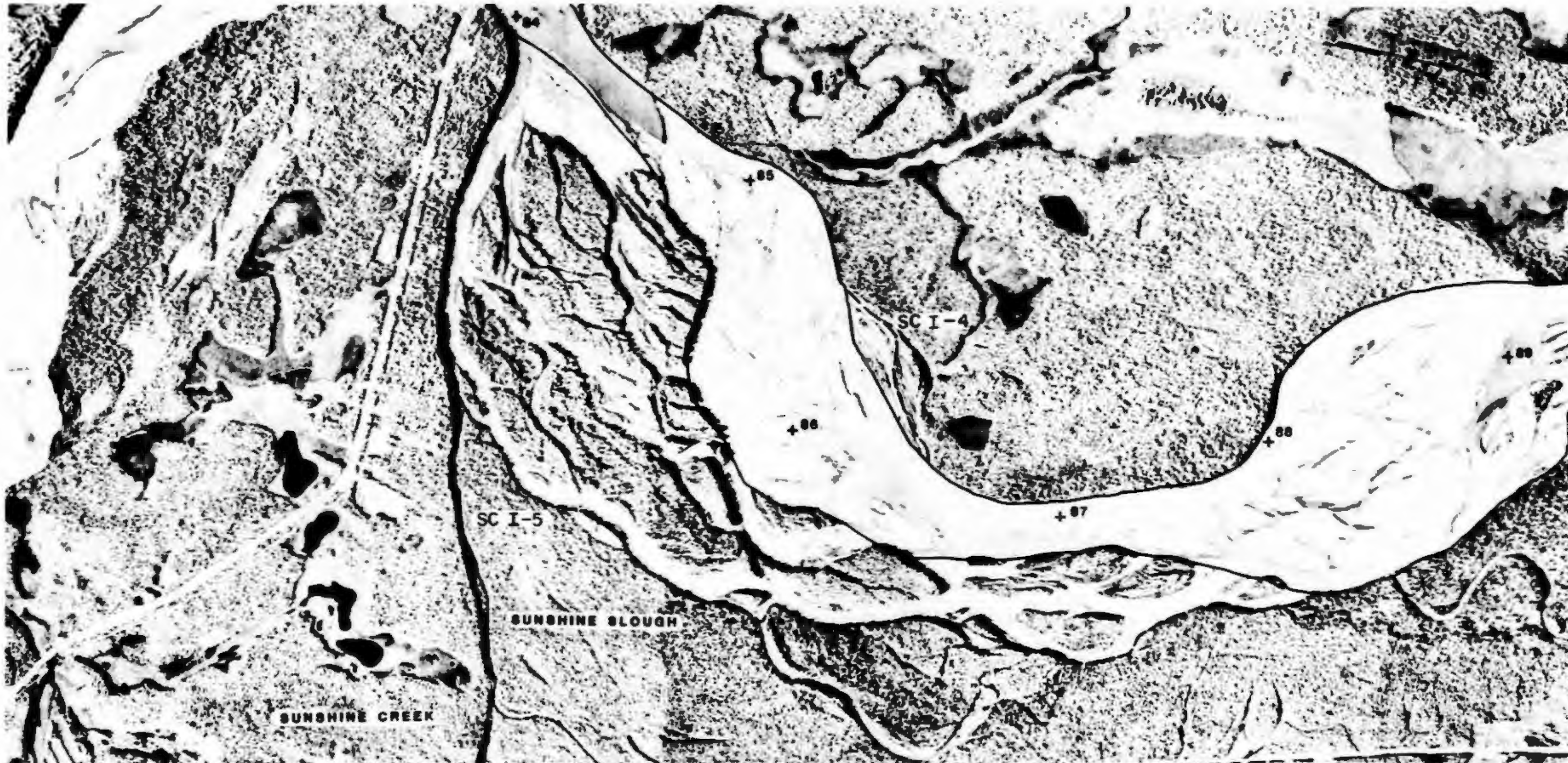
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 6, 1983
SCALE 1:2000

SHEET 1 OF 20
DATE 2-7-84

HARZA-EBASCO



ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983

SCALE 1"=2000

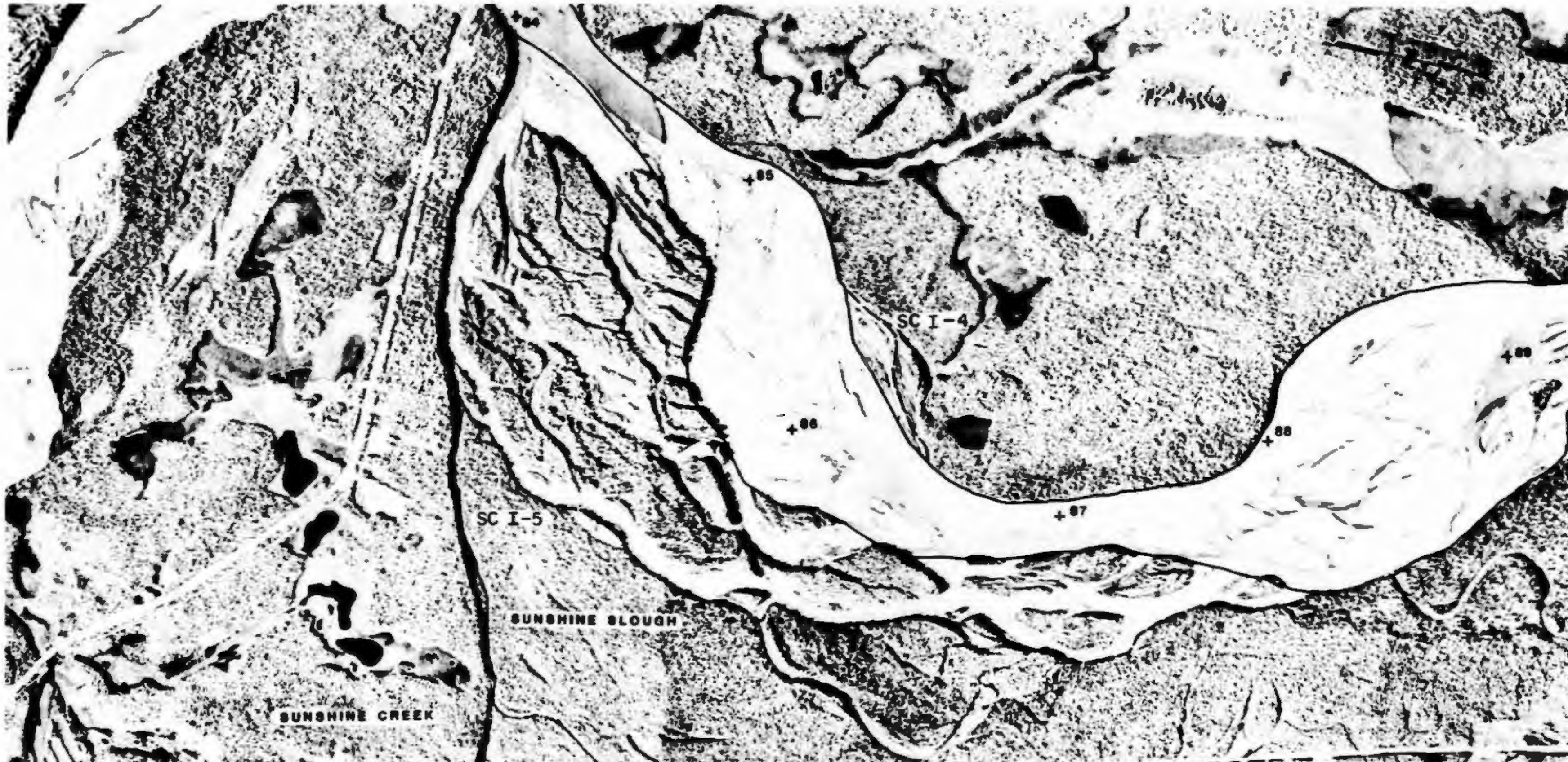
SHEET 4 OF 28

DATE 2-7-84

R&M

HARZA-EBASCO

SUSITNA JOINT VENTURE



ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

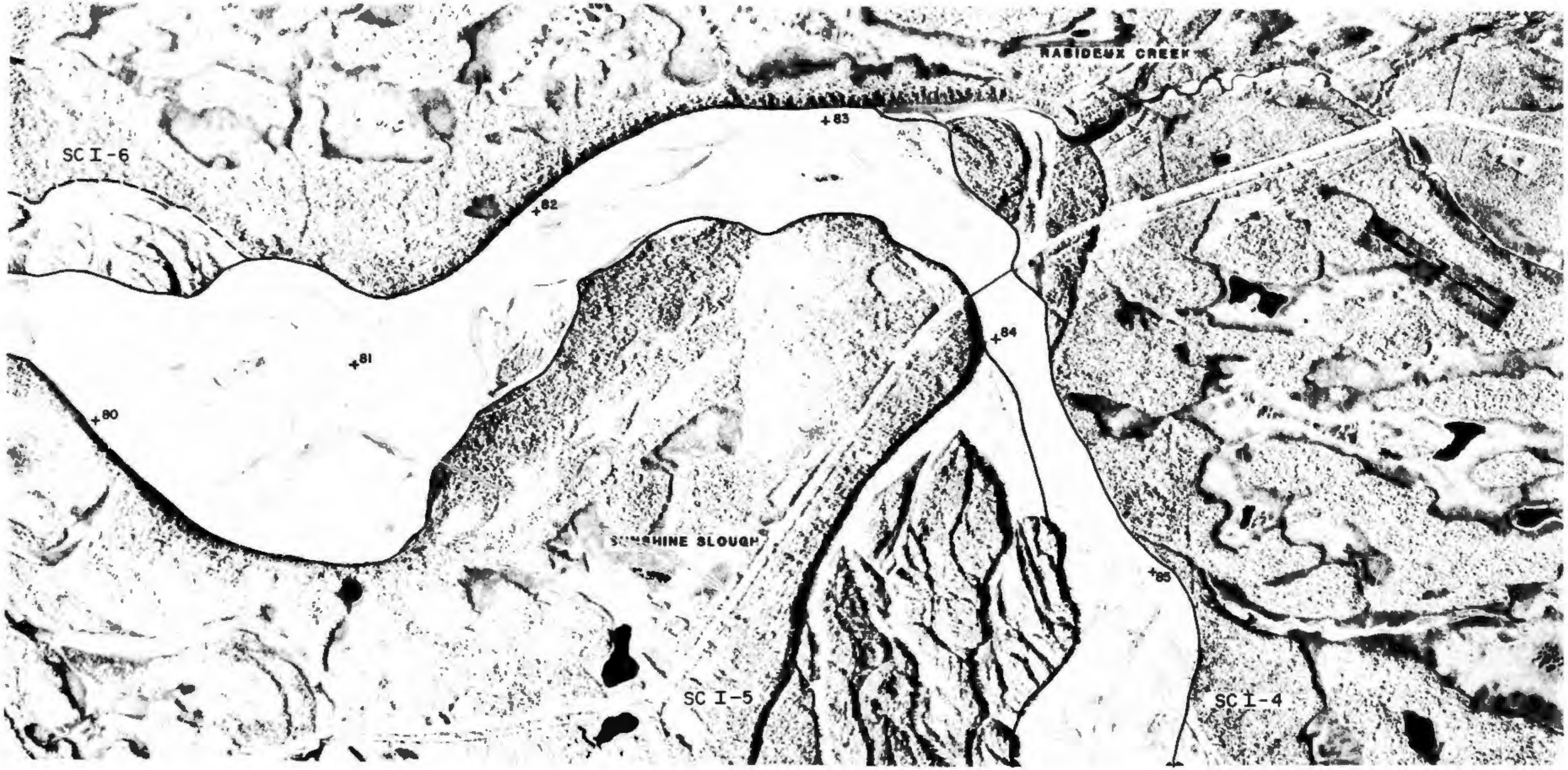
DATE OF PHOTOGRAPHY SEPT 16, 1983

SCALE [illegible]=2000

SHEET 4 OF 28

DATE 2-7-84

HARZA-EBASCO



ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE: 1" = 2000'
SHEET: 5 OF 29
DATE: 2-7-84

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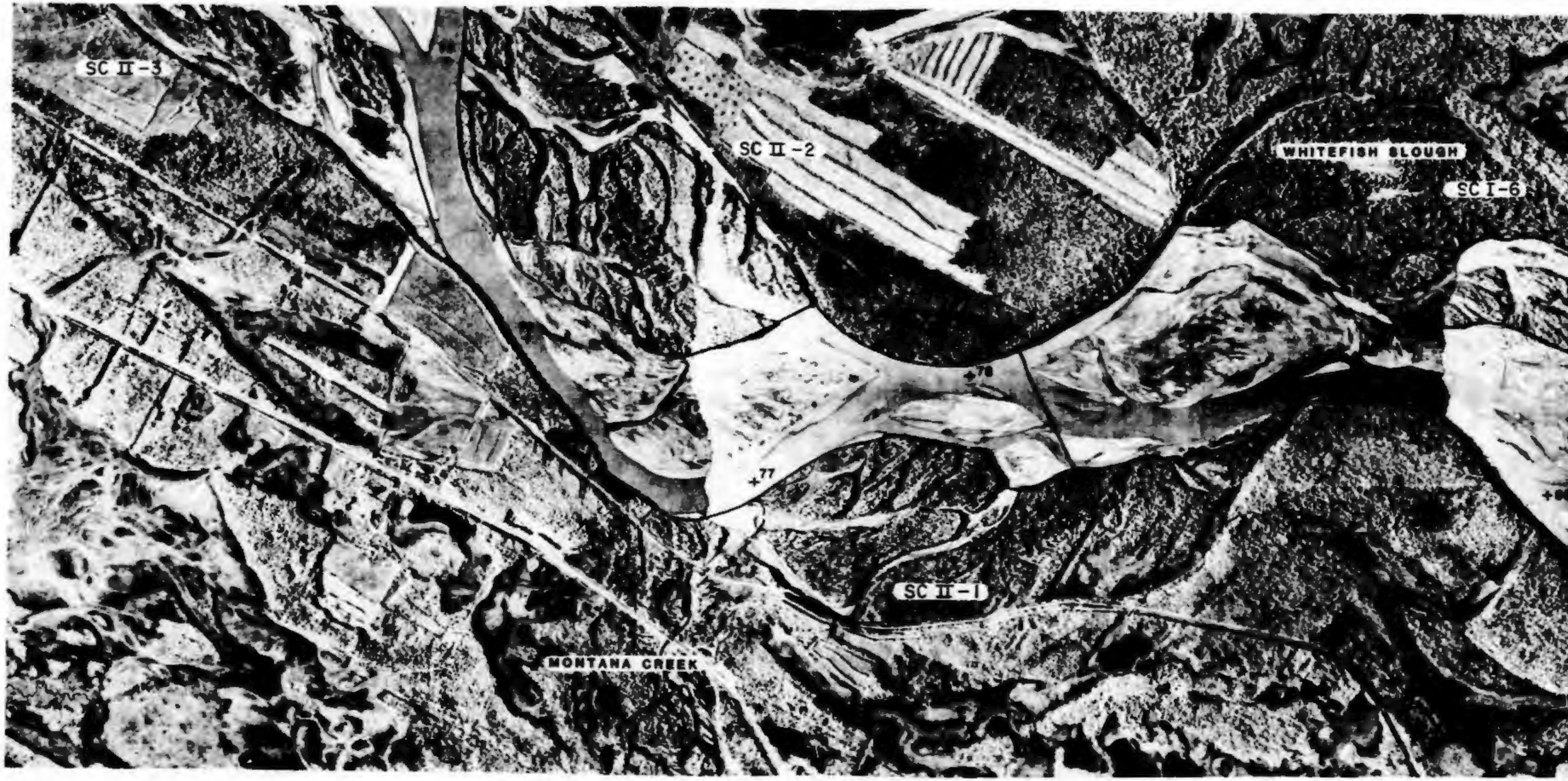
SUSITNA JOINT VENTURE



ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000
SHEET 6 OF 28
DATE 2-7-84

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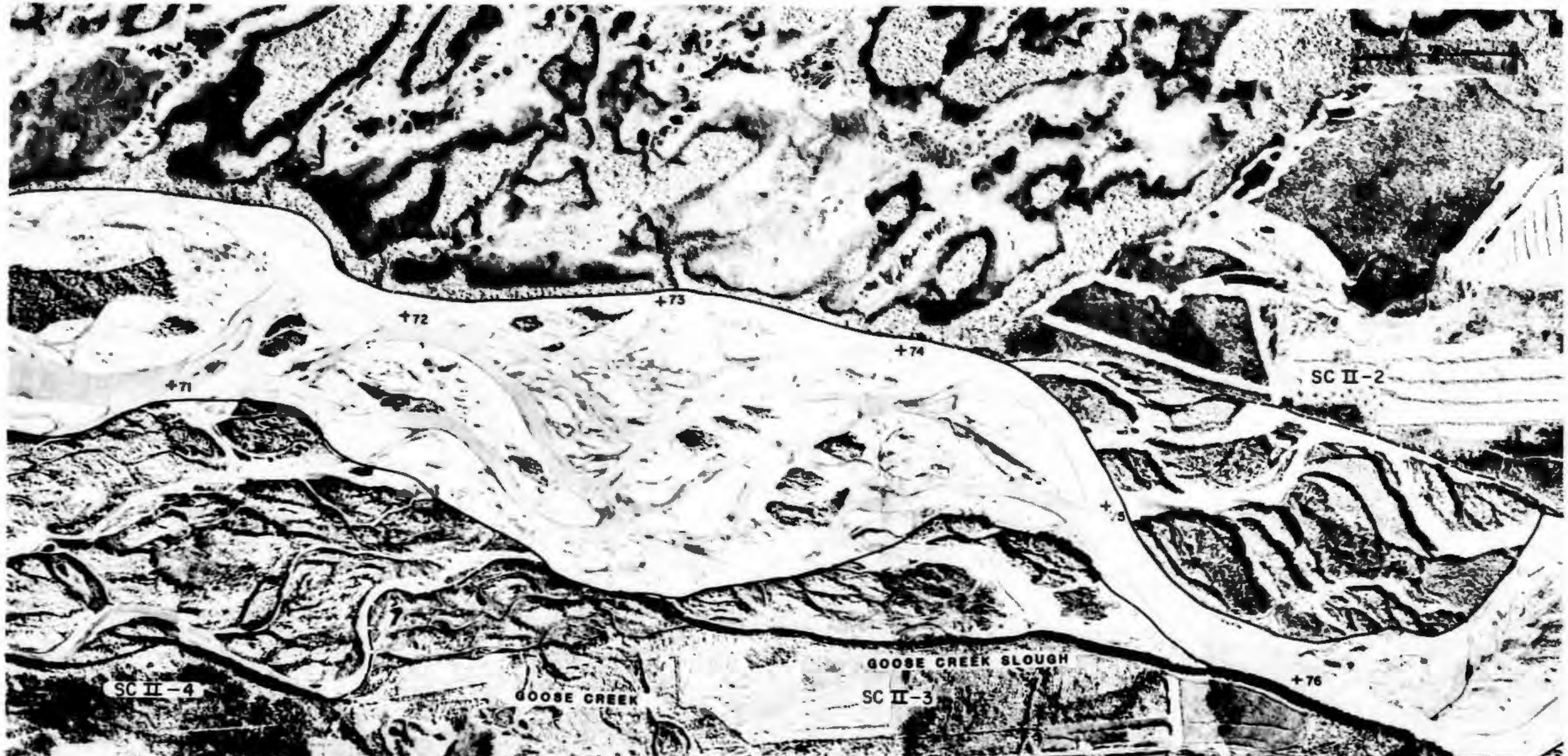

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 6, 1983
SCALE 1"=2000
SHEET 7 OF 28
DATE 2-7-84

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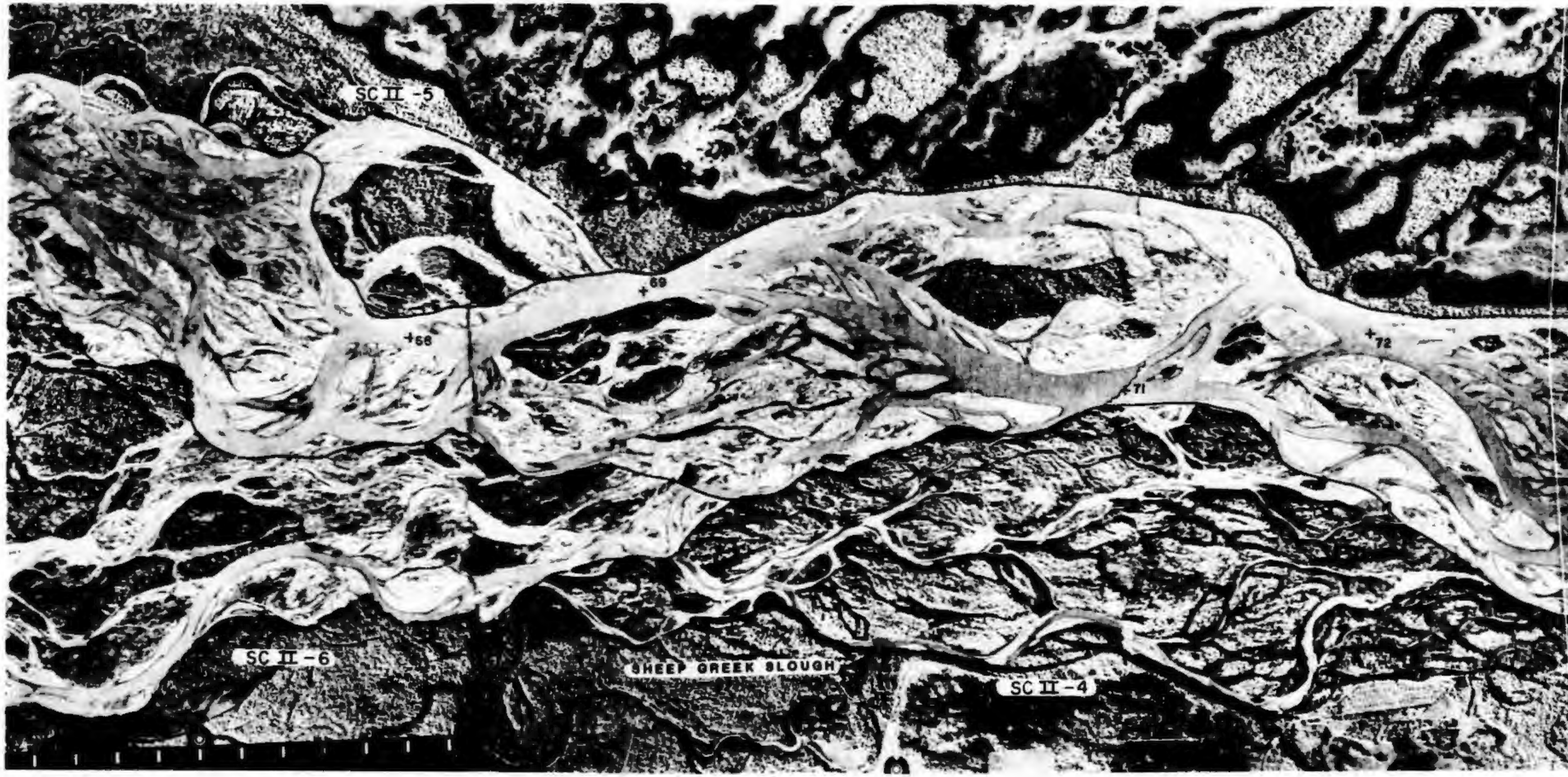

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 6, 1983
SCALE 1"=2000
SHEET 8 OF 20
DATE 2-7-84

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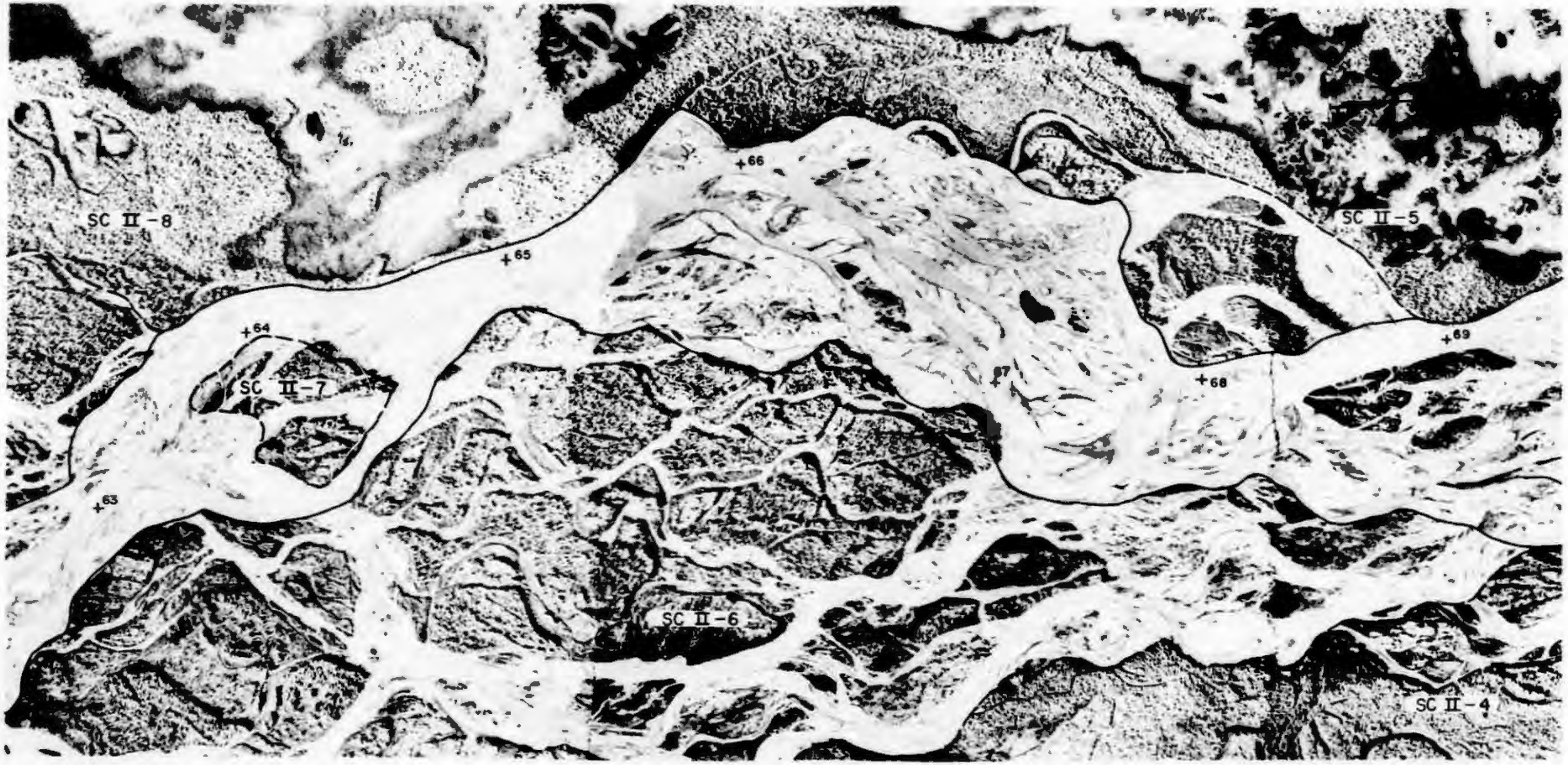

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000
SHEET 9 OF 28
DATE 2-7-84

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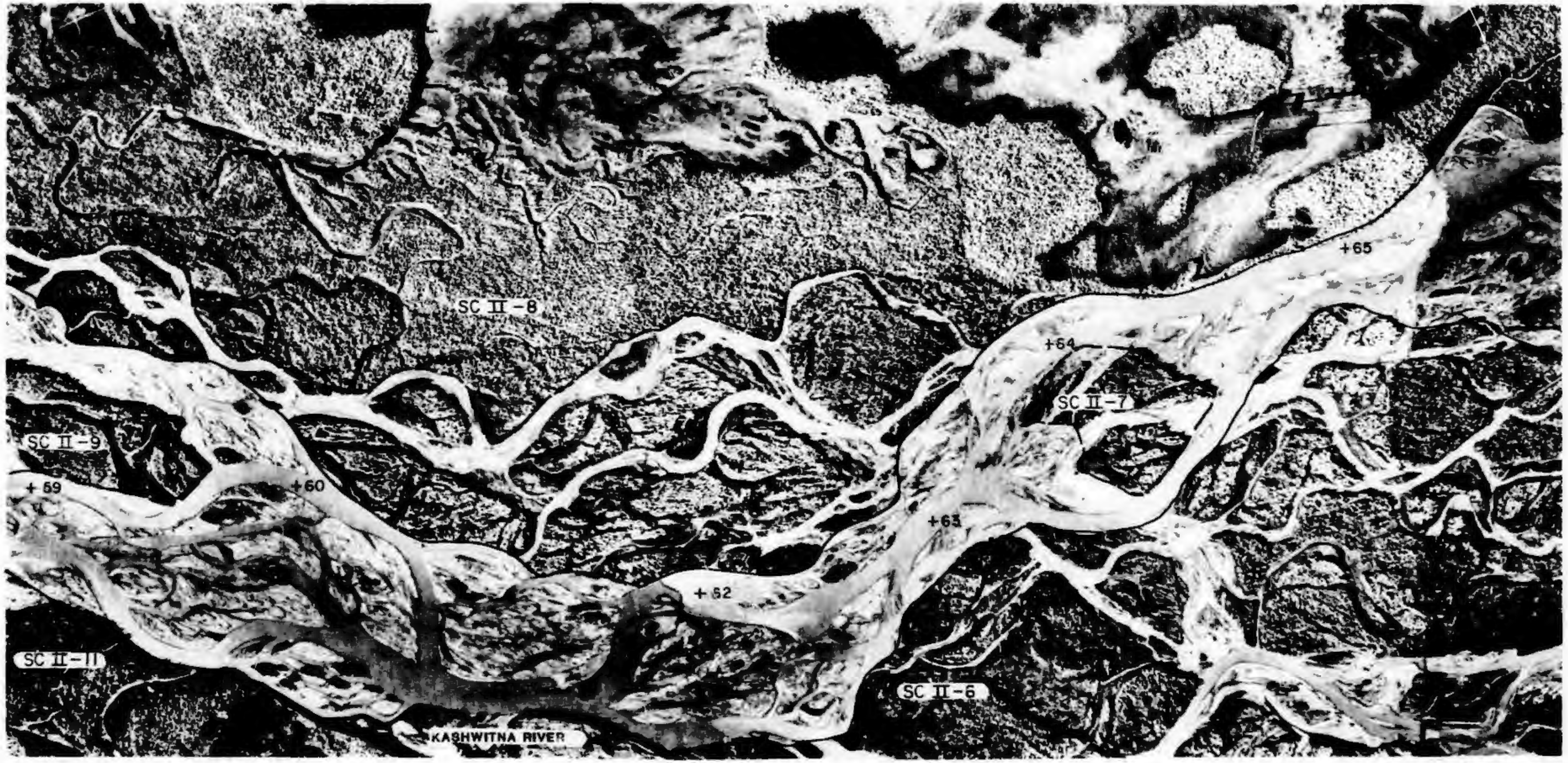
SUSITNA JOINT VENTURE



ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"= 2000'
SHEET 10 OF 20
DATE 2-7-84

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SUSITNA JOINT VENTURE

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SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 6, 1983
SCALE 1:2000
SHEET [illegible] OF 20
DATE 2-7-84

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SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000
SHEET 12 OF 28
DATE 2-7-84

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SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000'
SHEET 13 OF 28
DATE 2-7-84

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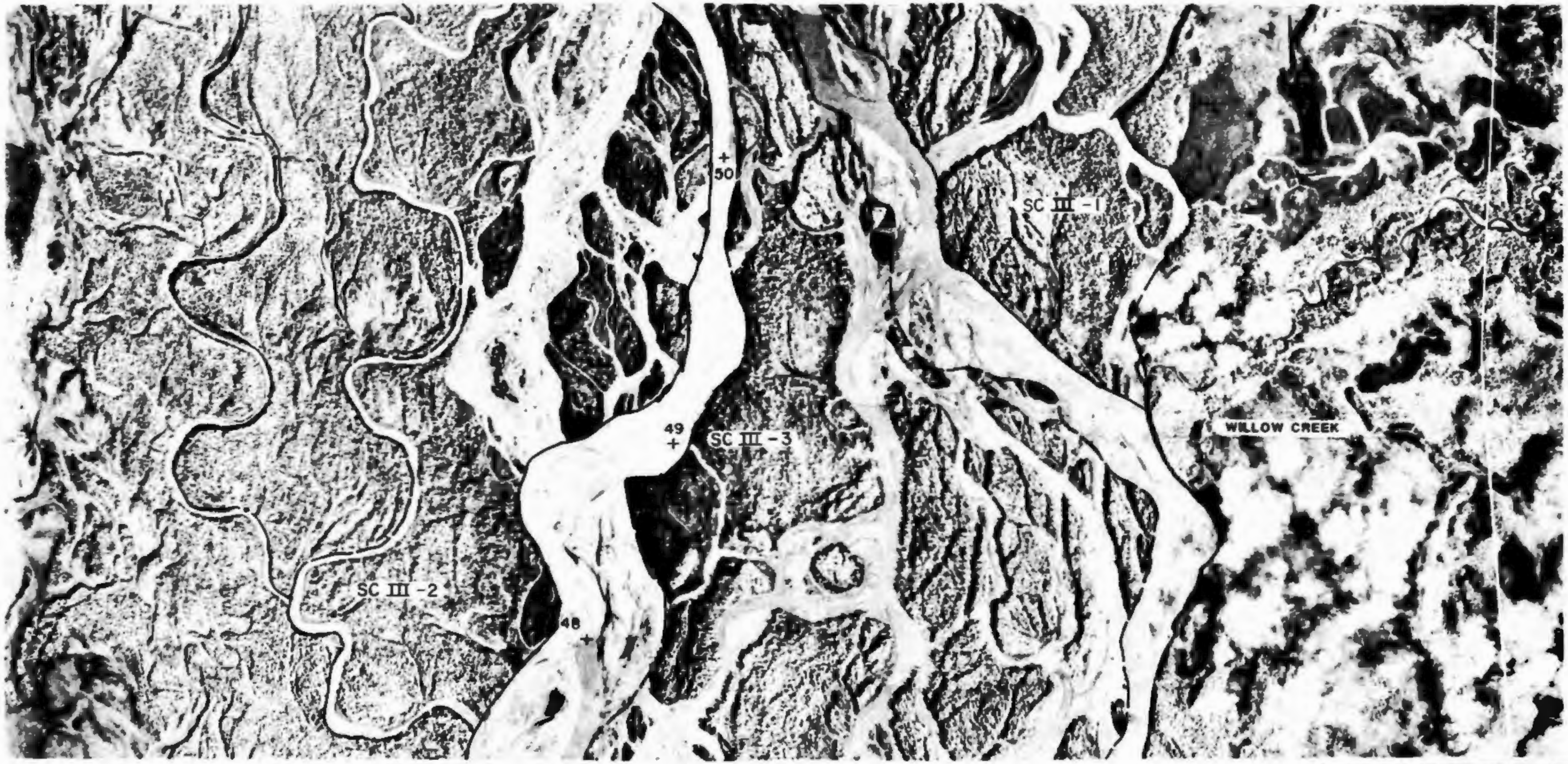

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1" = 2000'
SHEET 14 OF 28
DATE -7-84

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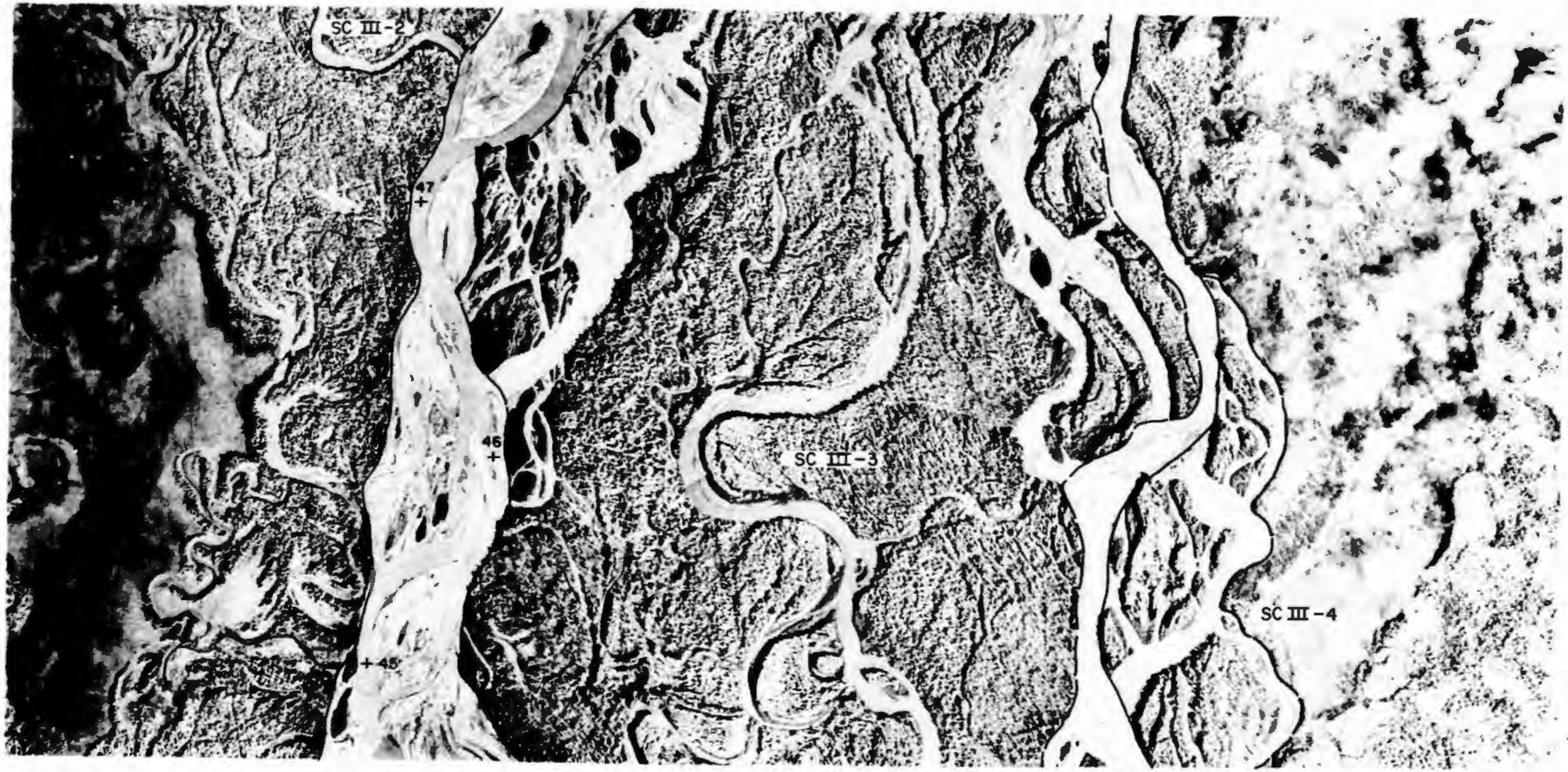
SUSITNA JOINT VENTURE



ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1" = 2000'
SHEET 15 OF 28
DATE 2-7-84

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SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1" = 2000'
SHEET 16 OF 28
DATE 2-7-84

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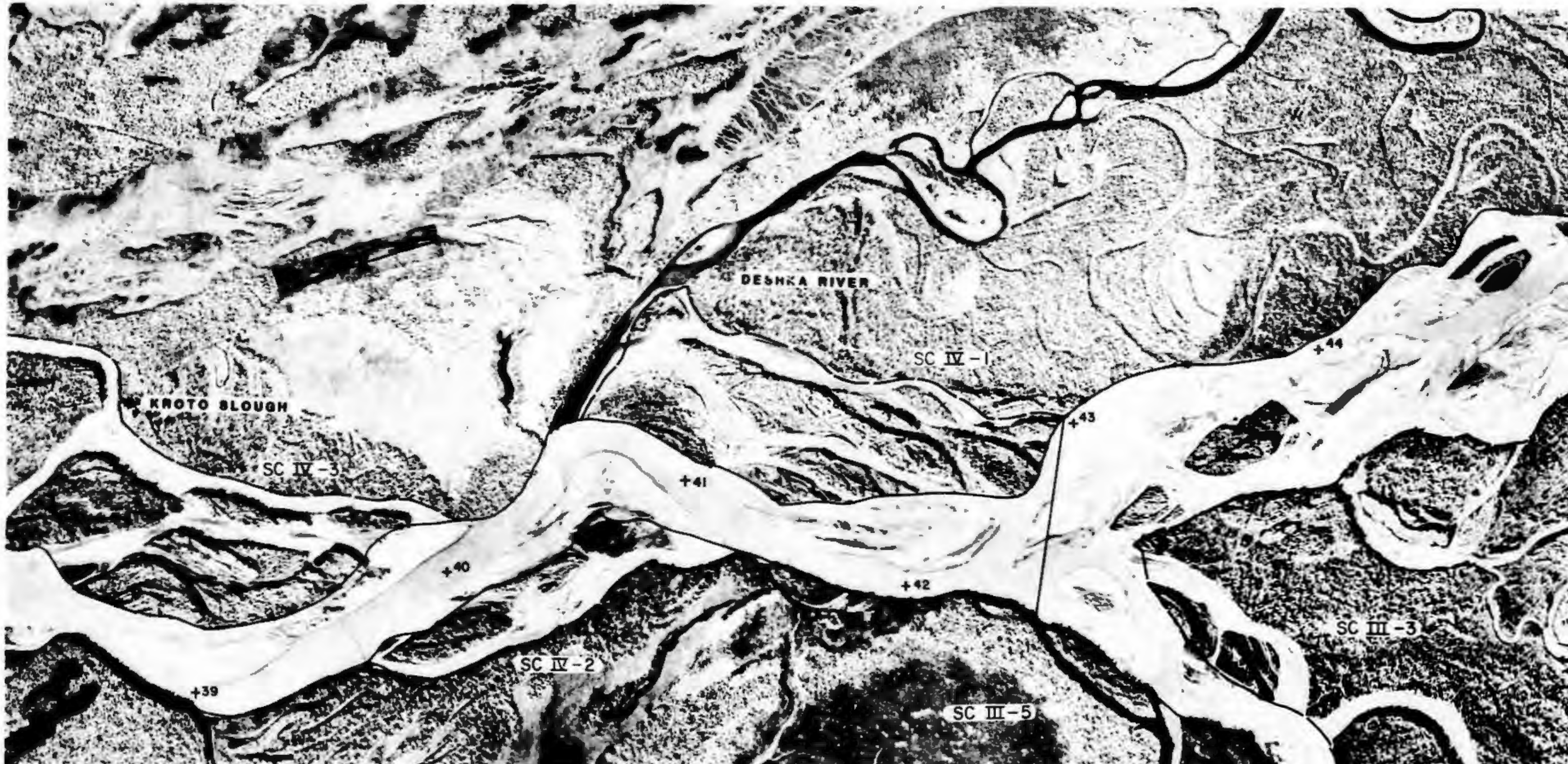
SUSITNA JOINT VENTURE



ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000'
SHEET 17 OF 28
DATE 2-7-84

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ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000
SHEET 18 OF 28
DATE 2-7-84

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SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1963
SCALE 1"=2000'
SHEET 19 OF 28
DATE 2-7-84

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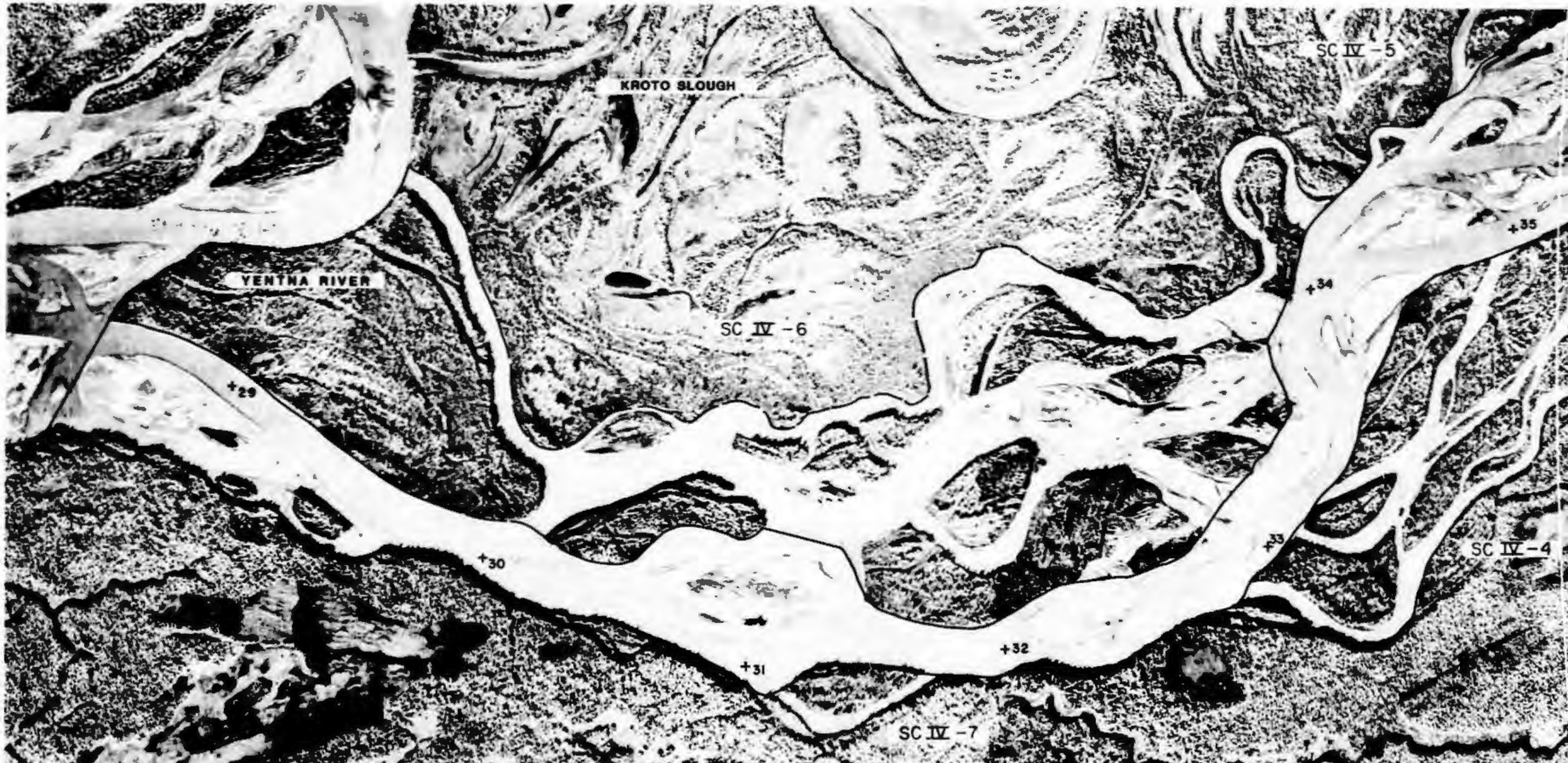
SUSITNA JOINT VENTURE



ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000
SHEET 20 OF 21
DATE 2-7-84

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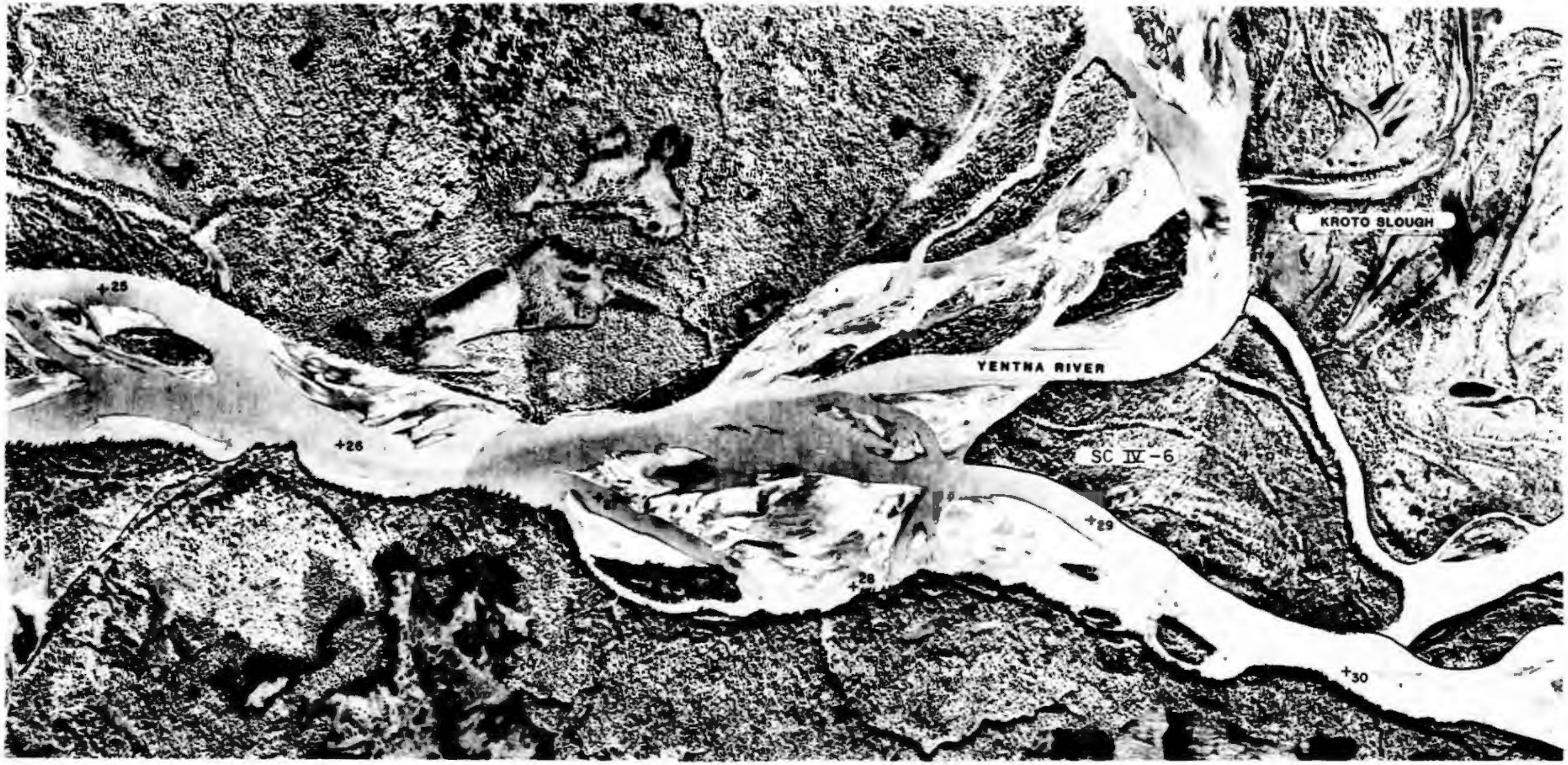
SUSITNA JOINT VENTURE



ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000
SHEET 21 OF 28
DATE 2-7-84

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SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1" = 2000
SHEET 22 OF 28
DATE 2-7-84

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ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1" 2000
SHEET 23 OF 28
DATE 2-7-84

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SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1" : 2000
SHEET 24 OF 28
DATE 2-7-84

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ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000'
SHEET 25 OF 28
DATE 2-7-84

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ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000'
SHEET 26 OF 28
DATE 2-7-84

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ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000
SHEET 27 OF 28
DATE 2-7-84

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SUSITNA JOINT VENTURE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 6, 1983
SCALE 1" = 2000'
SHEET 20 OF 20
DATE 2-7-84

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SUSITNA JOINT VENTURE