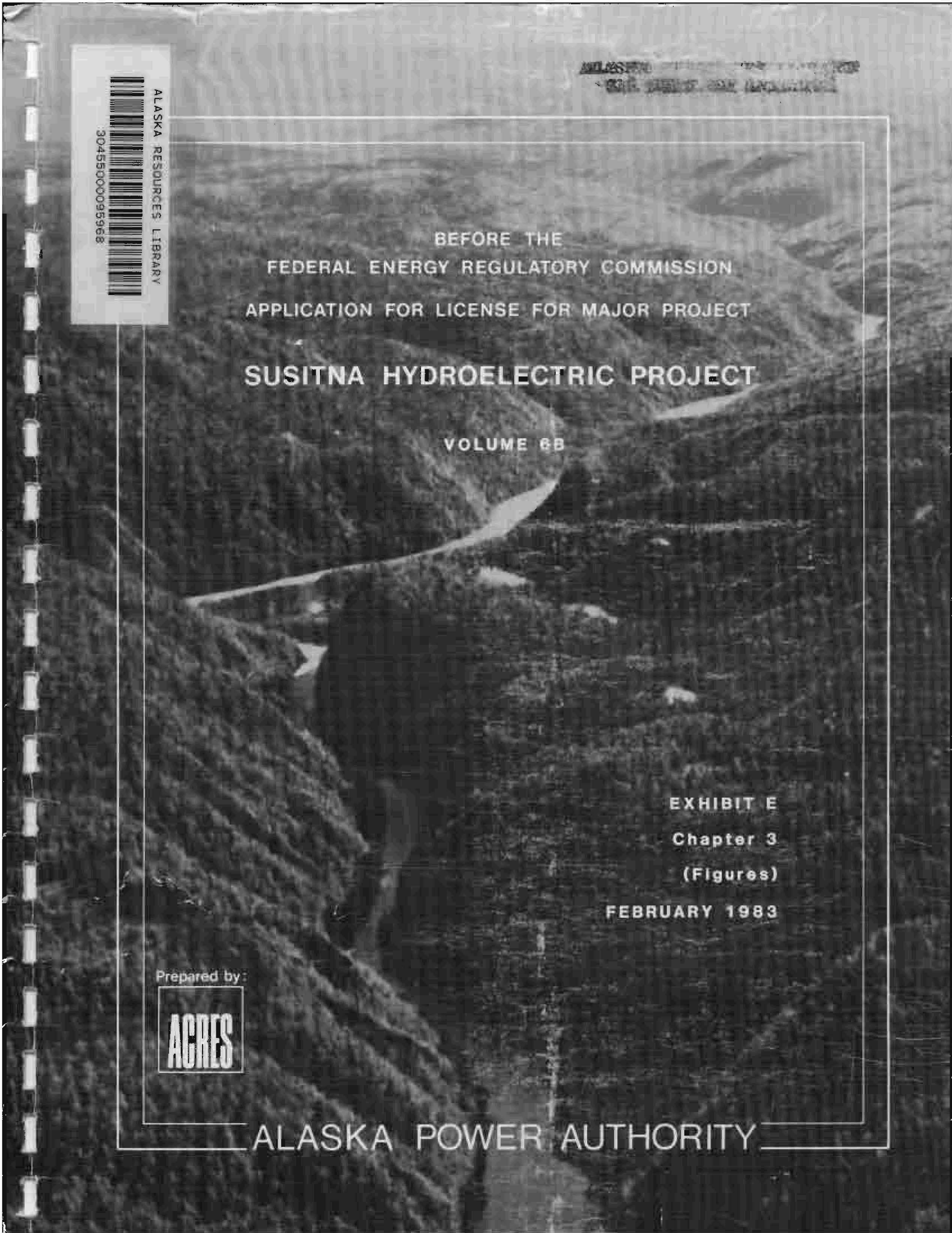

BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

APPLICATION FOR LICENSE FOR MAJOR PROJECT

SUSITNA HYDROELECTRIC PROJECT

VOLUME 6B

EXHIBIT E
Chapter 3
(Figures)

FEBRUARY 1983

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EXHIBIT E CHAPTER 3

FISH, BOTANICAL, AND WILDLIFE RESOURCES

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TABLE E.3.1: MITIGATION OPTIONS ANALYSIS STRUCTURE RECOMMENDED BY SUSITNA HYDROELECTRIC PROJECT, ALASKA DEPARTMENT OF FISH AND GAME (ADF&G) AND THE U.S. FISH AND WILDLIFE SERVICE (USFWS). DESIRABILITY OF OPTIONS DECREASES FROM TOP TO BOTTOM. EXPLANATIONS OR EXAMPLES OF EACH OPTION AS DESCRIBED BY AGENCIES ARE SHOWN.

OPTION	DEFINITION: ALASKA DEPARTMENT OF FISH AND GAME	DEFINITION: U.S. FISH & WILDLIFE SERVICE
AVOIDANCE	Avoid Impact by Not Taking a Certain Action - Keep as much existing natural habitat as possible. - Maintain fish and game populations and critical habitats.	Modify Project Design to Avoid Impact - No-project alternative is one mode. - Design modifications in action type, magnitude, timing and locations are options.
MINIMIZATION	Minimize Impacts by Limiting Magnitude of Action - Maintain habitat diversity and the capacity of each system to restore itself naturally.	Modify Project Design to Minimize Impacts - Design modifications in action type, magnitude, timing and location are options.
RECTIFICATION	Rectify Impacts by Rehabilitating Environment - Repair, rehabilitate or restore abused aquatic or terrestrial systems. - Restore the same functions or structure of habitats.	Restore Damaged Environments - Reclaim disturbed sites by seeding, etc. - Restock lost fish and wildlife.
RESTRICTION	Reduce (or Eliminate) Impact Over Time by Maintenance - Operate and maintain mitigation measures to reduce impacts over time.	Maintain Mitigation Effort to Reduce Impact - Monitor and maintain mitigation measures. - Train mitigation personnel.
COMPENSATION	Compensate for Impact by Substitute Resources - Create or restore fish, wildlife and habitat values, and resource use opportunities that were unavoidably lost. - Compensation by providing substitute resources or environments is least desirable; the preferred mode is onsite mitigation.	Restore Lost Resources by Management or Replacement - Intensify production through management. - Initiate hatcheries; restocking programs. - Lease or buy new lands for enhanced management.

TABLE E.3.2: COMMON AND SCIENTIFIC NAMES OF FISH SPECIES RECORDED FROM THE SUSITNA BASIN

SCIENTIFIC NAME	COMMON NAME
Petromyzontidae	
Lampetra japonica	Arctic Lamprey
Salmonidae	
Coregonus laurettae	Bering Cisco
Coregonus pidschian	Humpback Whitefish
Oncorhynchus gorbuscha	Pink Salmon
Oncorhynchus keta	Chum Salmon
Oncorhynchus kisutch	Coho Salmon
Oncorhynchus nerka	Sockeye Salmon
Oncorhynchus tshawytscha	Chinook Salmon
Prosopium cylindraceum	Round Whitefish
Salmo gairdneri	Rainbow Trout
Salvelinus malma	Dolly Varden
Salvelinus namaycush	Lake Trout
Thymallus arcticus	Arctic Grayling
Osmeridae	
Thaleichthys pacificus	Eulachon
Esocidae	
Esox lucius	Northern Pike
Catostomidae	
Catostomus catostomus	Longnose Sucker
Gadidae	
Lota lota	Burbot
Gasterosteidae	
Gasterosteus aculeatus	Threespine Stickleback
Cottidae	
Cottus sp.	Sculpin

TABLE E.3.3: COMMERCIAL CATCH OF UPPER COOK INLET SALMON IN NUMBERS OF FISH BY SPECIES, 1954 - 1982

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1954	63,780	1,207,046	321,525	2,189,307	510,068	4,291,726
1955	45,926	1,027,528	170,777	101,680	248,343	1,594,254
1956	64,977	1,258,789	198,189	1,595,375	782,051	3,899,381
1957	42,158	643,712	125,434	21,228	1,001,470	1,834,002
1958	22,727	477,392	239,765	1,648,548	471,697	2,860,129
1959	32,651	612,676	106,312	12,527	300,319	1,064,485
1960	27,512	923,314	311,461	1,411,605	659,997	3,333,889
1961	19,210	1,162,303	117,778	34,017	349,628	1,683,463
1962	20,210	1,147,573	350,324	2,711,689	970,582	5,200,378
1963	17,536	942,980	197,140	30,436	387,027	1,575,119
1964	4,531	970,055	452,654	3,231,961	1,079,084	5,738,285
1965	9,741	1,412,350	153,619	23,963	316,444	1,916,117
1966	9,541	1,851,990	289,690	2,006,580	531,825	4,689,626
1967	7,859	1,380,062	177,729	32,229	296,037	1,894,716
1968	4,536	1,104,904	470,450	2,278,197	1,119,114	4,977,201
1969	12,398	692,254	100,952	33,422	269,855	1,108,881
1970	8,348	731,214	275,296	813,895	775,167	2,603,920
1971	19,765	636,303	100,636	35,624	327,029	1,119,357
1972	16,086	879,824	80,933	628,580	630,148	2,235,571
1973	5,194	670,025	104,420	326,184	667,573	1,773,396
1974	6,596	497,185	200,125	483,730	396,840	1,584,476
1975	4,780	684,818	227,372	336,359	951,796	2,205,135
1976	10,867	1,664,150	208,710	1,256,744	469,807	3,610,278
1977	14,792	2,054,020	192,975	544,184	1,233,733	1,049,704
1978	17,303	2,622,487	219,234	1,687,092	571,925	5,118,041
1979	13,738	924,415	265,166	72,982	650,357	1,926,658
1980	12,497	1,584,392	283,623	1,871,058	387,078	4,138,648
1981	11,548	1,443,294	494,073	127,857	842,849	2,919,621
Average	19,548	1,114,408	229,684	even-1,701,026 odd- 124,459	614,384	2,891,894
1982[1]	20,636	3,237,376	777,132	788,972	1,428,621	6,252,737

[1] ADF&G Preliminary data.

TABLE E.3.4: COMMERCIAL CATCH OF LOWER COOK INLET SALMON IN NUMBERS OF FISH BY SPECIES, 1954-1982[1]

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1954	1,545	39,626	15,159	270,744	265,591	592,665
1955	573	36,600	9,675	1,184,328	68,710	1,299,886
1956	333	36,306	9,345	207,920	88,218	342,122
1957	419	26,917	1,765	285,613	206,450	521,164
1958	120	19,450	1,796	949,766	124,482	1,095,614
1959	132	21,637	6,352	124,748	110,833	263,707
1960	27	24,726	2,692	611,647	116,082	755,174
1961	41	22,776	1,619	303,377	55,593	383,406
1962	60	25,286	7,727	2,248,341	179,259	2,460,673
1963	96	15,121	6,736	203,616	138,510	364,079
1964	91	20,654	9,460	1,055,417	323,335	1,408,957
1965	10	14,002	862	115,598	28,076	158,548
1966	62	15,333	5,411	579,240	129,062	729,108
1967	176	29,044	2,726	375,488	85,445	492,879
1968	64	95,242	4,883	585,441	75,134	760,764
1969	64	122,796	623	202,444	61,203	387,130
1970	107	22,312	4,860	574,284	224,158	825,721
1971	73	22,234	4,561	392,871	148,602	568,341
1972	88	57,897	2,234	28,663	75,543	164,425
1973	145	29,209	2,101	307,403	115,513	554,371
1974	183	27,428	6,514	50,601	19,210	103,936
1975	143	28,142	6,211	1,063,432	21,646	1,119,574
1976	450	58,159	3,216	136,445	50,822	249,092
1977	217	100,058	2,872	1,292,153	145,778	1,541,078
1978	1,747	156,404	6,529	352,561	73,518	590,759
1979	1,238	64,417	12,250	2,986,534	223,028	3,287,467
1980[2]	401	66,360	11,411	894,819	74,851	1,047,842
1981[2]	347	110,365	10,146	3,300,805	321,619	3,743,281
1982[2]	1,506	131,688	46,398	552,028	198,202	929,192
29 Yr Avg	345	49,662	7,108	732,287	129,252	918,653

[1]Data Source: ADF&G Final IBM Computer Runs, 1954-1981, and Processor Catch Reports.

[2]ADF&G Preliminary Data.

TABLE E.3.5: SIDE-SCAN SONAR COUNTS OF SALMON MIGRATING PAST YENTNA STATION AND PETERSON POPULATION ESTIMATES AND CORRESPONDING 95% CONFIDENCE INTERVALS OF SALMON MIGRATING TO SUNSHINE, TALKEETNA AND CURRY STATIONS, 1981 - 1982

Station		Chinook		Sockeye		Coho		Chum		Pink	
		1981	1982	1981	1982	1981	1982	1981	1982	1981	1982
Yentna Station		--	--	139,000	114,000	17,000	34,100	19,800	27,800	36,100	447,000
Sunshine Station	No.	--	49,600	133,000	151,000	19,800	45,700	263,000	430,000	49,500	443,000
	95% Confidence Interval		45,000 55,100	120,000 150,000	139,000 167,000	18,000 22,000	42,000 50,300	235,000 298,000	408,000 456,000	46,400 53,100	407,000 487,000
Talkeetna Station	No.	--	10,900	4,800	3,100	3,300	5,100	20,800	49,100	2,300	73,000
	95% Confidence Interval		8,300 12,500	4,300 5,400	2,800 3,500	2,800 6,200	4,300 6,200	18,400 22,800	45,200 53,800	1,900 2,943	70,500 75,800
Curry Station	No.	--	11,300	2,800	1,300	1,100	2,400	13,100	29,400	1,000	59,000
	95% Confidence Interval		8,300 16,000	2,600 3,100	1,100 1,500	7,090 2,500	1,800 3,800	11,800 14,600	26,700 32,700	700 2,100	53,600 65,300

Source: ADF&G (1981a)
ADF&G (1983)

TABLE E.3.6: SUSITNA BASIN SPORT FISH HARVEST AND EFFORT BY FISHERY AND SPECIES - 1978, 1979, 1980 and 1981

Locations	Days Fished	1978									
		KS	SS	RS	PS	CS	RT	DV	LT	GR	BB
Willow Creek	22,682	47	905	56	18,901	2,458	913	280	0	208	9
Caswell Creek	--										
Montana Creek	25,762	408	2,451	85	15,619	4,429	1,193	633	0	958	9
Sunshine Creek	--										
Clear (Chunilna) Creek	5,040	12	2,200	28	2,074	1,912	1,501	1,817	0	859	27
Sheep Creek	11,869	256	478	14	6,981	1,697	470	108	0	461	18
Little Willow Creek	5,687	0	151	28	3,142	1,015	334	63	0	334	0
Deshka River	9,111	850*	1,798	0	697	0	3,634	0	0	579	0
Lake Creek	8,767	326*	2,212	254	2,833	1,015	2,721	154	36	2,115	45
Alexander Creek	6,914	769*	2,401	183	1,146	215	2,640	136	0	1,871	0
Talachulitna River	732	12*	88	141	31	234	0	235	0	99	0
Lake Louise, Lake Susitna, Tyone River	13,161	0	0	0	0	0	0	0	2,522	2,278	2,947
Others	14,970	163	2,388	56	3,994	2,692	1,519	2,739	877	3,770	208
1978 Total	124,695	2,843	15,072	845	55,418	15,667	14,925	6,165	3,435	13,532	3,263

KS = chinook salmon
SS = coho salmon
RS = sockeye salmon
PS = pink salmon
CS = chum salmon

RT = rainbow trout
DV = Dolly Varden
LT = lake trout
GR = arctic grayling
BB = burbot

* Chinook less than 20 inches

Source: Mills (1979-1982)

TABLE E.3.6 (Cont'd)

Locations	Days Fished	1979 KS	SS	RS	PS	CS	RT	DV	LT	GR	BB
Willow Creek	18,911	459	462	94	3,445	582	1,500	618	0	1,654	18
Caswell Creek	3,710	156	624	0	100	9	282	91	0	354	0
Montana Creek	22,621	312	1,735	346	2,472	745	1,536	527	0	791	9
Sunshine Creek	3,317	10*	774	157	700	55	382	264	0	0	45
Clear (Chunilna) Creek	5,125	312	1,248	31	645	355	1,373	827	0	1,045	9
Sheep Creek	6,728	10	462	31	2,418	682	573	127	0	645	64
Little Willow Creek	5,171	0	262	141	745	118	345	336	0	1,091	0
Deshka River	13,236	2,811	973	0	109	0	3,182	0	0	1,463	82
Lake Creek	13,881	1,796	2,671	440	882	136	4,527	164	9	1,963	109
Alexander Creek	8,284	712	1,560	79	236	45	1,182	182	0	745	145
Talachulitna River	2,185	293	125	47	100	55	0	155	0	664	45
Lake Louise, Lake Susitna, Tyone River	12,199	0	0	0	0	0	0	0	2,618	2,936	2,363
Others	12,639	39	1,997	220	664	1,245	3,472	909	472	4,918	282
1979 Total	128,007	6,910	12,893	1,586	12,516	4,072	18,354	4,200	3,099	13,342	3,171

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* Chinook less than 20 inches

Source: Mills (1979-1982)

TABLE E.3.6 (Cont'd)

Locations	Days Fished	1980 KS	SS	RS	PS	CS	RT	DV	LT	GR	BB
Willow Creek	29,011	289	1,207	83	23,638	989	1,168	636	0	1,868	0
Caswell Creek	4,963	215	1,124	77	1,663	19	154	83	0	353	26
Montana Creek	19,287	559	2,684	257	8,230	571	854	167	0	655	13
Sunshine Creek	5,208	132	1,534	116	2,408	225	193	39	0	0	39
Clear (Chunilna) Creek	4,388	172	661	6	622	385	950	751	0	1,348	32
Sheep Creek	8,041	45*	430	9	6,362	648	385	83	0	725	45
Little Willow Creek	8,190	32*	494	77	6,420	270	353	122	0	1,156	0
Deshka River	19,364	3,685	2,290	0	689	0	4,305	0	0	1,817	224
Lake Creek	8,325	775	2,351	267	2,101	69	2,144	121	9	1,972	0
Alexander Creek	6,812	1,438	999	52	809	121	1,945	353	0	1,145	0
Talachulitna River	2,542	121	491	112	276	17	379	982	0	1,713	0
Lake Louise, Lake Susitna, Tyone River	10,539	0	0	0	0	0	0	0	2,609	4,477	6,612
Others	12,216	45*	2,234	257	3,403	1,445	2,658	790	267	4,854	212
1980 Total	138,886	7,389	16,499	1,304	56,621	4,759	15,488	4,127	2,876	22,083	7,203

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GR = arctic grayling
BB = burbot

* Chinook less than 20 inches

Source: Mills (1979-1982)

TABLE E.3.6 (Cont'd)

Locations	Days Fished	KS*	KS	SS	RS	PS	CS	RT	DV	LT	GR	BB
		1981										
Willow Creek	14,060	144	441	747	77	2,797	1,533	1,475	249	0	1,188	48
Caswell Creek	3,860	77	172	901	38	335	0	326	38	0	144	0
Montana Creek	16,657	239	422	2,261	182	1,782	805	1,111	240	0	891	0
Sunshine Creek	3,062	57	0	968	220	958	125	249	10	0	57	115
Clear (Chunilna) Creek	3,584	86	287	422	29	19	57	1,226	1,418	0	996	0
Sheep Creek	6,936	0	0	326	105	1,236	987	201	57	0	872	0
Little Willow Creek	3,845	0	0	29	67	604	192	374	48	0	623	0
Deshka River	13,248	738	2,031	632	0	19	0	3,631	10	0	1,255	96
Lake Creek	6,471	163	632	1,035	211	412	48	2,874	67	19	1,600	29
Alexander Creek	6,892	278	843	891	67	57	10	2,290	287	0	1,130	29
Talachulitna River	1,378	57	0	240	172	29	0	0	0	0	479	0
Lake Louise, Lake Susitna, Tyone River	14,397	115	0	0	0	0	0	0	0	4,093	4,892	5,292
Others	7,850	277	0	939	115	412	450	3,851	814	287	7,089	57
1981 Total	102,240	2,748	4,828	9,391	1,283	8,660	4,207	13,757	3,238	4,399	21,216	5,666

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* Chinook less than 20 inches

Source: Mills (1979-1982)

TABLE E.3.7: CHINOOK SALMON ESCAPEMENT COUNTS OF SUSITNA RIVER BASIN STREAMS FROM 1976 to 1982, ADULT ANADROMOUS INVESTIGATIONS, SUSITNA HYDRO STUDIES, 1982[1]

	YEAR						
Stream	1976	1977	1978	1979	1980	1981	1982
Alexander Creek	5,412	9,246	5,854	6,215	a	a	2,546
Deshka River	21,693	39,642	24,639	27,385	a	a	16,000e
Willow Creek	1,660	1,065	1,661	1,086	a	1,357	592d
Little Willow Creek	833	598	436	324c	a	459	316d
Kashwitna River (North Fork)	203	336	362	457	a	557	156d
Sheep Creek	455	630	1,209	778	a	1,013	527d
Goose Creek	160	133	283	b	a	262	140d
Montana Creek	1,445	1,443	881	1,094c	a	814	887d
Lane Creek	b	b	b	b	b	40	47
Indian River	537	393	114	285	a	422	1,053
Portage Creek	702	374	140	190	a	659	1,111
Prairie Creek	6,513	5,790	5,154	a	a	1,900	3,844
Clear Creek	1,237	769	997	864c	a	a	982
Chulitna River (East Fork)	112	168	59	a	a	a	119d
Chulitna River (MF)	1,870	1,782	900	a	a	a	644d
Chulitna River	124	229	62	a	a	a	100d
Honolulu Creek	24	36	13	37	a	a	27d
Byers Creek	53	69	a	28	a	a	7d
Troublesome Creek	92	95	a	a	a	a	36d
Bunco Creek	112	136	a	58	a	a	198
Peters Creek	2,280	4,102	1,335	a	a	a	a
Lake Creek	3,735	7,391	8,931	4,196	a	a	3,577
Talachulitna River	1,319	1,856	1,375	1,648	a	a	3,101
Canyon River	44	135	b	b	b	2,129	b
Quartz Creek	b	8	b	b	b	8	b
Red Creek	b	1,511	385	b	b	749	b

[1] 1976-1980 counts - Kubik, S.W.

a No total count due to high turbid water
b Not counted
c Poor counting conditions
d Counts conducted after peak spawning
e Estimated peak spawning count (ADF&G/Delaney, K.)

TABLE E.3.8: 1982 CHINOOK SALMON ESCAPEMENT SURVEYS OF SUSITNA RIVER BASIN STREAMS
ADULT ANADROMOUS INVESTIGATIONS, SUSITNA HYDRO STUDIES, 1982

Stream Surveyed	Date	Survey Method	Condition	Chinook Salmon Counted Live	Dead	Total
Alexander Creek (Mount to Lake)	7/31	Hel.	Good	1,687	0	1,687
Wolverine Creek (Alexander Creek Drainage)	7/28	Hel.	Good	537	0	537
Sucker Creek (Alexander Creek Drainage)	7/28	Hel.	Good	322	0	322
Bunco Creek	8/7	Hel.	Fair	168	30	198
Byers Creek	8/12	Hel.	Excellent	7	0	7
Chase Creek	8/11	Foot	Good	8	7	15
Cheechako Creek (Devil Canyon)	8/6	Hel.	Good	16	0	16
Chinook Creek (Devil Canyon)	8/6	Hel.	Good	5	0	5
Chulitna River	8/12	Hel.	Excellent	49	51	100
Chulitna River (East Fork)	8/12	Hel.	Excellent	67	52	119
Chulitna River (Middle Fork)	8/12	Hel.	Excellent	385	259	644
Clear Creek	7/21	Hel.	Fair	978	4	982
Deshka River[1]	8/5-9	Hel.	Fair	10,471	200	10,671
Gold Creek	8/3	Hel.	Good	122	20	142
Goose Creek	8/7	Hel.	Good	98	42	140
Honolulu Creek	8/12	Hel.	Excellent	11	16	27
Indian River	7/21	Hel.	Good	1,049	4	1,053
Jack Long Creek	8/4	Foot	Excellent	2	0	2
4th of July Creek	9/29	Foot	Good	55	1	56
Kashwitna River (North Fork)	8/10	Hel.	Excellent	128	28	156
Lake Creek	8/2	Hel.	Good	2,267	50	2,317
Camp Creek (Lake Creek Drainage)	8/2	Hel.	Excellent	517	0	517
Sunflower Creek (Lake Creek Drainage)	8/2	Hel.	Excellent	743	0	743
Lane Creek	7/12	Foot	Excellent	47	0	47
	7/28	Foot	Excellent	40	1	41

TABLE E.3.8 (Cont'd)

Stream Surveyed	Date	Survey Method	Condition	Chinook Salmon Counted Live	Dead	Total
Little Willow Creek	8/7	Hel.	Good	190	126	316
Montana Creek	8/5	Foot	Good	829	58	887
Portage Creek	7/21	Hel.	Excellent	955	0	955
	8/8	Hel.	Excellent	1,081	30	1,111
Prairie Creek	7/31	Hel.	Excellent	3,782	62	3,844
Sheep Creek	8/7	Hel.	Good	316	211	527
Spink Creek	8/7	Hel.	Excellent	12	0	12
Troublesome Creek	8/12	Hel.	Excellent	34	2	36
Talachulitna River	8/1	Hel.	Excellent	3,101	0	3,101
Willow Creek	8/6	Foot	Fair	506	86	592
Deception Creek (Willow Creek Drainage)	8/6	Foot	Fair	212	17	229

[1] Partial count; Mainstem Deshka from Trapper Creek to Forks; Trapper Creek not surveyable, estimated peak spawning count was 16,000 (see Table E.3.7).

[2] Survey conditions on Deshka River and tributaries ranged from good to poor.

Source: ADF&G 1982d

TABLE E.3.9: PRELIMINARY RESULTS OF 1982 SMOLT TRAP CATCHES AT TALKEETNA STATION

Date	No. of Samples	Mean Catch per Hour				
		Chinook	Sockeye	Coho	Chum	Pink
6/18-6/24	7	0.53	1.40	3.86	4.97	0
6/25-7/1	4	0.57	1.32	1.10	2.31	0
7/2-7/8	6	0.41	7.52	0.47	0.92	0.06
7/9-7/15	7	0.55	2.37	0.33	0.71	0.02
7/16-7/22	7	0.14	1.63	0.53	0.39	0
7/23-7/29	7	0.46	2.43	0.63	0.12	0
7/30-8/5	7	0.14	1.02	0.49	0.05	0
8/6-8/12	7	0.08	0.84	0.53	0.02	0
8/13-8/19	7	0.02	0.35	0.36	0.01	0
8/20-8/26	7	0.03	0.23	0.20	0	0
8/27-9/2	3	0.04	0.12	0.15	0	0
9/3-9/9	5	0	0.07	0.22	0	0
9/10-9/16	7	0.01	0.03	0.21	0	0
9/17-9/23	6	0.11	0.14	0.48	0	0
9/24-9/30	7	0	0.10	0.48	0	0
10/1-10/7	5	0.01	0.09	0.20	0	0
10/8-10/12	5	0	0.03	0.29	0	0

Source: ADF&G (1982f)

TABLE E.3.10: ADULT SALMON MIGRATION RATES (IN MILES PER DAY)

Species	Sunshine to Talkeetna (23 miles) 1981	1982	Sunshine to Curry (40 miles) 1981	1982	Talkeetna to Curry (17 miles) 1981	1982
Chinook						
Mean Rate	--	2.1	--	3.1	--	2.2
Maximum Rate	--	7.7	--	6.7	--	17.0
Sockeye						
Mean Rate	4.6	2.7	3.0	3.4	3.5	--
Maximum Rate	7.7	11.5	8.0	10.0	17.0	17.0
Coho						
Mean Rate	4.0	5.3	--	--	11.3	10.0
Maximum Rate	--	--	--	--	8.5	--
Chum						
Mean Rate	4.6	7.4	--	6.3	3.8	6.5
Maximum Rate	11.5	23.0	--	20.0	17.0	17.0
Pink						
Mean Rate	2.6	7.4	--	7.1	6.0	10.0
Maximum Rate	11.5	23.0	--	20.0	17.0	17.0

Source: ADF&G (1981a)
ADF&G (1983)

TABLE E.3.11: ANALYSIS OF SOCKEYE SALMON AGE DATA BY PERCENT FROM ESCAPEMENT SAMPLES COLLECTED AT SUSITNA, YENTNA, SUNSHINE, TALKEETNA AND CURRY STATIONS, ADULT ANADROMOUS INVESTIGATIONS, SUSITNA HYDRO STUDIES, 1981

	AGE CLASS 1/											BROOD YEAR			
Collection Site	n	3_1	3_2	4_1	4_2	4_3	5_1	5_2	5_3	6_2	6_3	1975	1976	1977	1978
Susitna Station	1709	0.0	0.6	0.0	8.4	0.0	0.0	83.9	2.7	0.1	4.3	4.4	86.6	8.4	0.6
Yentna Station	1193	0.1	0.7	0.7	7.5	0.4	1.9	80.8	3.5	2.4	2.0	4.4	86.2	8.6	0.8
Sunshine Station	976	0.0	1.1	0.6	21.0	0.6	0.0	70.2	2.6	0.2	3.7	3.9	72.8	22.2	1.1
Talkeetna Station	110	0.0	0.0	1.8	22.8	0.0	0.0	70.2	1.8	1.8	1.8	3.6	71.8	24.6	0.0
Curry Station	270	0.0	0.7	1.1	27.4	0.0	0.0	65.9	3.4	0.0	1.5	1.5	69.3	28.5	0.7

1/ Gilbert-Rich Notation

Source: ADF&G 1981a

TABLE E.3.12: ESTIMATED NUMBER OF SLOUGH SPAWNING SOCKEYE, CHUM AND PINK SALMON IN SLOUGHS BETWEEN DEVIL CANYON AND TALKEETNA, 1981 TO 1982[1]

Slough	River Mile	Sockeye 1981	Sockeye 1982	Chum 1981	Chum 1982	Pink 1981	Pink 1982
1	99.6	0	0	6	0	0	0
2	100.4	0	0	30	0	0	0
3B	101.4	2	0	0	0	0	0
3A	101.9	9	0	0	0	1	0
5	107.2	0	0	0	2[a]	0	0
6A	112.3	1	0	11	2	0	35[a]
8	113.2	0	0	480	0	25	0
8D	121.8	0	0	0	23[a]	0	0
8C	121.9	0	2	0	75	0	0
8B	122.2	0	5	1	80[a]	0	0
Moose	123.5	0	8	167[a]	65	0	9
A'	124.6	0	0	140[a]	0	0	0
A	124.7	0	0	60	0	2	0
8A	125.1	191	133	620[a]	748	0	28
B	126.3	0	9	0	73	0	32[a]
9	128.3	14	6	260[a]	420	0	32
9B	129.3	203	1	190	5	0	0
9A	133.3	3	1	207	173	0	0
10	133.8	0	0	0	2	0	0
11	135.3	1762	1131	765	732	0	276
13	135.7	0	0	5	0	0	0
15	137.2	0	0	1	1	0	135
16	137.3	10	0	3	0	0	0
17	138.2	49	0	94	21[a]	0	0
19	139.7	2[a]	0	3	1	0	1
20	140.1	64	106	16	30[a]	0	133
21	141.0	0	0	457	1222	0	64[a]
21A	145.5	0	0	10	2	0	0
Estimated Total		2315	1402	3526	3674	28	735

1981 Estimated Total: 5869 slough spawning salmon.
1982 Estimated Total: 5811 slough spawning salmon.

1 Total numbers estimated by calculating the area under the curve formed from plotting number of live salmon in sloughs versus the date and dividing by the average estimated stream life (as in Bell, 1980). The estimated stream life was 12 days for sockeye, 10 days for chum and 7 days for pinks (Bechtel Civil and Minerals, Inc., 1983).

In some cases the peak live count exceeded the calculated total count. These are indicated by "a" and the peak live count is used.

TABLE E.3.13: MAINSTEM SUSITNA RIVER SALMON SPAWNING LOCATIONS IDENTIFIED IN 1981-1982

River Mile	Date 1981	Date 1982	Species Caught or Observed: Sockeye	Pink	Chum	Coho	Other
68.3	9-21		0	0	6	0	
76.6	9-21		0	0	1	2	
	9-27		0	0	16	0	
83.3	9-5		0	0	17	0	
92.2	10-9		0	0	11	0	
96.8	9-2		0	0	1	0	
97.0	9-17		0	0	20	0	
100.5	9-24		0	0	0	0	eggs pumped from redds
114.4		9-2	0	0	18	1	
117.6	9-23		0	0	0	6	
117.7		8-13	0	12	15	0	
		9-2	0	0	0	8	
128.6		9-5	0	0	10	0	
		9-7	0	0	7	0	
129.2	9-8		0	0	2	1	
129.8		9-12	0	0	5	0	
130.5	9-8		0	0	3	0	
131.1	9-7		0	0	3	0	
131.3		8-19	0	0	3	0	
		9-4	0	0	12	0	
135.2	9-6		0	0	6	0	
136.0		8-12	0	20	14	4	
		9-4	0	0	50	0	
137.4		8-19	0	0	25	0	
138.2		9-27	0	0	0	0	eggs pumped from redds
138.9		9-4	0	0	16	0	
143.3		9-4	0	0	22	0	
148.2		8-18	0	0	400	0	
		9-5	1	0	4	1	

Source: ADF&G (1981a)
ADF&G (1982e)

TABLE E.3.14: COHO SALMON JUVENILES, PERCENT INCIDENT AT HABITAT LOCATION SITES ON THE MAINSTEM SUSITNA RIVER AND ITS TRIBUTARY MOUTHS BETWEEN COOK INLET AND DEVIL CANYON - NOVEMBER 1980 TO MAY 1981

	Percent Incidence						
	Nov	Dec	Jan	Feb	Mar	Apr	May
Cook Inlet to Talkeetna	83.3	0.0[a]	42.9	60.0	63.6	0.0[b]	57.7
Tributary Mouth Sites	100.0	0.0	66.7	66.7	66.7	0.0	83.3
Mainstem and Slough Sites	50.0	0.0	25.0	50.0	50.0	0.0	50.0
Talkeetna to Devil Canyon	-	-	0.0	42.9	50.0	42.9	-
Tributary Mouth Sites	-	-	0.0	0.0	25.0	0.0	-
Mainstem and Slough Sites	-	-	0.0	75.0	66.7	50.0	-

a Extrme cold (-25° to -40°F) hampered sampling efforts during December 1980.

b Hazardous ice conditions prior to spring breakup limited sampling efforts to three habitat location sites in April 1981.

Source: ADF&G 1981f

TABLE E.3.15: COHO SALMON JUVENILES, PERCENT INCIDENT AT HABITAT LOCATION SITES ON THE MAINSTEM SUSITNA RIVER AND ITS TRIBUTARY MOUTHS BETWEEN COOK INLET AND TALKEETNA, JUNE TO SEPTEMBER 1981

	Percent Incidence							
	June 1-15	June 16-30	July 1-15	July 16-31	Aug. 1-15	Aug. 16-30	Sept. 1-15	Sept. 16-31
Tributary (Mouth) Habitat Sites	80.0	66.7	80.0	81.3	93.8	100.0	100.0	91.7
Mainstem	40.0	11.1	55.6	20.0	18.2	22.2	50.0	62.5
Combined Habitat Sites	60.0	42.9	70.8	57.7	63.0	72.0	83.3	80.0

Source: ADF&G 1981f

TABLE E.3.16: ARCTIC GRAYLING HOOK AND LINE TOTAL CATCH BY TRIBUTARY BETWEEN THE MOUTH AND PROPOSED IMPOUNDMENT ELEVATIONS (PIE*) AND MOUTH IN THE IMPOUNDMENT STUDY AREA, 1981

	CATCH					
Tributary	May	June	July	August	September	Total
Fog Creek	22	17	23	5	5	72
Tsusena Creek	23	19	74	18	1	135
Deadman Creek	53	86	42	6	3	190
Watana Creek	1	49	16	172	28	266
Kosina Creek	136	246	143	67	187	779
Jay Creek	3	178	70	16	50	317
Goose Creek	121	136	82	37	6	382
Oshetna River	19	92	155	73	167	506
TOTAL CATCH	378	823	605	394	447	2,647

* PIE for Fog and Tsusena Creeks = 1455 ft; all other tributaries = 2185 ft.

Source: ADF&G 1981f

TABLE E.3.17: ARCTIC GRAYLING POPULATION ESTIMATES FOR THE REACH OF MAJOR TRIBUTARIES IN THE WATANA AND DEVIL CANYON IMPOUNDMENT AREAS

		Petersen Population Estimate[1]		
Stream	Reservoir	1981	1982 Number	1982 Number per mile
Fog Creek	Devil Canyon	176	--	--
Tsusena Creek	Devil Canyon	1,000	--	--
Deadman Creek	Watana	979	734	1,835
Watana Creek	Watana	--	3,903	323
Kosina Creek	Watana	2,787	5,544	1,232
Jay Creek	Watana	1,089	1,592	455
Goose Creek	Watana	1,327	949	791
Oshetna River	Watana	2,017	2,426	1,103

[1] 1981 Estimate based on Arctic grayling greater than 8 inches (200 mm) long.

1982 Estimate based on all ages, but underestimates ages 1 and 2.

Source: ADF&G 1981f
ADF&G 1982e

TABLE E.3.18: PETERSEN POPULATION ESTIMATE FOR ARCTIC GRAYLING BY AGE GROUP IN THE WATANA IMPOUNDMENT AREA, SUMMER 1982

Age	Number Marked	Number Recaptured	Number Caught	Estimated Number in Age Group
1 & 2	91	3	84	1955
3	226	10	222	4602
4	263	23	263	2904
5	321	44	342	2454
6	204	48	270	1134
7	81	16	107	521
7 and above	27	7	41	180
Totals	1281	153	1337	13,750

TABLE E.3.19: STREAMS CROSSED BY DENALI HIGHWAY (CANTWELL TO WATANA ACCESS JUNCTION)

Stream	Miles from Richardson Highway	Species Present
Trib. to Jack R.	132.5	grayling
Trib. to Jack R.	132	grayling
Unnamed Creek (Jack R. System)	128	grayling[1]
Edmonds Creek	121	Various species from the Nenana River, including grayling, northern pike, burbot, whitefish, and sculpin.
Nenana R. Oxbow	119.75	"
Nenana R. Oxbow	119.5	"
Trib. to Nenana R.	118	"
Trib. to Nenana R.	117.8	"
Trib. to Nenana R.	116.8	"
Unnamed Creek (Nenana System)	114.5	"

[1] Can be reasonably expected, but not verified.

TABLE E.3.20: STREAMS TO BE CROSSED BY WATANA ACCESS ROAD (DENALI HIGHWAY TO WATANA DAM)

Stream	Miles from Denali Highway	Species Present
Unnamed Creek (Nenana System)	0.3	(grayling)[1]
Tributary to Lily Creek	2.0	(grayling, cottids)[1]
Lily Creek	3.2	(grayling, cottids)[1]
Seattle Creek	6.0	(grayling, cottids)[1]
Unnamed Creek (Seattle System)	7.8	(grayling, cottids)[1]
Unnamed Creek (Seattle System)	8.8	(grayling, cottids)[1]
Trib. to Brushkana Creek	11.0	(grayling, cottids)[1]
Trib. to Brushkana Creek	11.6	(grayling, cottids)[1]
Brushkana Creek	12.0	(grayling, cottids)[1]
Trib. to Brushkana Creek	14.0	(grayling, cottids)[1]
Unnamed Creek (Brushkana System)	17.0	(grayling, cottids)[1]
Unnamed Creek (Brushkana System)	18.5	(grayling, cottids)[1]
Deadman Creek	20.1	grayling, (whitefish, suckers, & cottids)[1]
Trib. to Deadman Creek	23.2	(grayling, cottids)[1]
Trib. to Deadman Creek	24.3	probably none[2]
Trib. to Deadman Creek	25.1	probably none[2]
Trib. to Deadman Creek	28.0	(grayling, cottids)[1]
Trib. to Deadman Creek	29.1	probably none[2]
Trib. to Deadman Creek	29.8	probably none[2]
Trib. to Deadman Creek	31.8	probably none[2]
Trib. to Deadman Creek	37.8	(grayling, cottids)[1]
Trib. to Deadman Creek	38.5	(grayling, cottids)[1]

1 Can be reasonably expected, but not verified.

2 Steep contours on downstream side of road probably preclude fish from this reach.

TABLE E.3.21: STREAMS TO BE CROSSED BY DEVIL CANYON ACCESS ROAD AND TRANSMISSION LINE BETWEEN WATANA AND DEVIL CANYON, AND RAILROAD SPUR FROM GOLD CREEK TO DEVIL CANYON

Stream	Miles from Watana Road	Species Present
Tsusena Creek	2.5	grayling, whitefish, longnose sucker, Dolly Varden, and sculpin
Unnamed Creek	8.0	(grayling)[1]
Unnamed Creek	8.6	(grayling)[1]
Unnamed Creek	12.2	(grayling)[1]
Unnamed Creek	13.9	(grayling)[1]
Unnamed Creek	15.9	(grayling)[1]
Trib. to Devil Creek	18.8	(grayling)[1]
Devil Creek	22.0	(grayling)[1]
Trib. to Devil Creek	24.4	(grayling)[1]
Trib. to Devil Creek	24.6	(grayling)[1]
Trib. to Devil Creek	26.3	(grayling)[1]
Susitna River	35.1	grayling; chinook, coho, pink and chum salmon; whitefish; sucker; burbot; sculpin; and Dolly Varden
Unnamed Creek	36.0	(grayling)[1]
Stream	**Miles from Gold Creek Station**	**Species Present**
Gold Creek	0.4	chinook, coho, pink salmon
Susitna River Encroachment	2.5	chinook, coho, chum, pink and sockeye salmon; grayling; rainbow trout; whitefish; sucker; burbot; Dolly Varden; and sculpin.
Unnamed Creek	3.6	(grayling, Dolly Varden)[1]
Unnamed Creek	4.8	(grayling, Dolly Varden)[1]
Jack Long Creek Trib.	9.5	(grayling, Dolly Varden)[1]
Jack Long Creek Encroachment	9-12	chinook, coho, chum, and pink salmon

[1] Can be reasonably expected, but not verified.

TABLE E.3.22: WATER BODIES TO BE CROSSED BY THE SUSITNA TRANSMISSION LINE (ANCHORAGE TO WILLOW)

Stream	Fish Species Present
Ship Creek	pink, chinook, coho, chum, and sockeye salmon; Dolly Varden; rainbow trout.
Fossil Creek	none
Otter Creek	rainbow trout
Knik Arm	pink, chinook, coho, chum, and sockeye salmon
Unnamed Creek (T, R4W, Sec. 18)	unknown
Little Susitna River	coho, pink, chinook, chum, and sockeye salmon; rainbow trout; Dolly Varden; grayling
Tributary to Fish Creek (T17N, R5W, Sec. 18, 19)	(rainbow trout; coho, chinook salmon)[1]
Fish Creek	chinook, sockeye, pink, and coho salmon; rainbow trout
Unnamed Creek (T18N, R5W, Sec. 8)	(coho)[1]
Unnamed Creek (T18N R5W, Sec. 5)	(coho)[1]
Unnamed Creek (T19N, R5W, Sec.)	unknown
Willow Creek	coho, chum, pink, and chinook salmon; grayling; rainbow trout; Dolly Varden; whitefish

[1] Can be reasonably expected, but not verified.

TABLE E.3.23: WATER BODIES TO BE CROSSED BY THE SUSITNA TRANSMISSION LINE (HEALY TO FAIRBANKS)

Stream	Fish Species Present
Nenana River #1	coho salmon, grayling, round whitefish, longnose sucker, slimy sculpin, burbot, Dolly Varden
Dry Creek	unknown
Panguinge Creek	coho salmon, longnose sucker, round whitefish, Dolly Varden, grayling, slimy sculpin
Little Panguinge Creek	coho salmon, grayling, round whitefish, slimy sculpin, Dolly Varden, longnose sucker
Slate Creek	unknown
Tributary to Slate Creek	unknown
Rock Creek	unknown
Unnamed Creek T9S, R9W, S36, FM	unknown
June Creek	unknown
Bear Creek	unknown
Nenana River #2	grayling; northern pike; slimy sculpin;[1] chum, chinook and coho salmon; inconnu; whitefish; burbot
Unnamed Creek T8S, R8W, S31, FM	unknown
Windy Creek	unknown
Tributary to Windy Creek	unknown
Unnamed Creek T82, R9W, S1, FM	unknown
Unnamed Creek T7S, R8W, S18, FM	unknown
Unnamed Creek T72, R7W, S8, FM	unknown
Unnamed Creek T7S, R7W, S5, FM	unknown
Unnamed Creek T6S, R7W, S32, FM	unknown
Tributary to Fish Creek T6S, R7W, S21, FM	(grayling and other species found in Fish Creek)[2]
Tributary to Fish Creek T6S, R7W, S22, FM	(grayling and other species found in Fish Creek)[2]
Fish Creek	grayling, round whitefish, slimy sculpin[3] Dolly Varden, longnose sucker

TABLE E.3.23 (Cont'd)

Stream	Fish Species Present
Unnamed Creek (2 crossings) T6S, R7W, S10, FM	unknown
Unnamed Creek (2 crossings) T6S, R7W, S3, FM	unknown
Unnamed Creek T4S, R7W, S34, FM	unknown
Unnamed Creek T4S, R7W, S28, FM	unknown
Tanana River complex	chum, coho and chinook salmon; inconnu; northern pike; grayling; whitefish; burbot
Tanana Tributary complex	unknown
Little Goldstream Creek	grayling, round whitefish, blackfish[4], longnose sucker, slimy sculpin
Little Goldstream Tributary T3S, R6W, S4, FM	(grayling and other species found in Little Goldstream Creek)[2]
Little Goldstream Tributary R3S, R6W, S3 FM	(grayling and other species found in Little Goldstream Creek)[2]
Little Goldstream Tributary T3S, R6W, S2, FM	(grayling and other species found in Little Goldstream Creek)[2]
Little Goldstream Tributary T3S, R6W, S1, FM	(grayling and other species found in Little Goldstream Creek)[2]
Little Goldstream Tributary T2S, R5W, S32, FM (2 crossings)	(grayling and other species found in Little Goldstream Creek)[2]
Bonanza Creek Tributary T2S, R5W, S33, 34, 36, FM (3 crossings)	unknown
Ohio Creek Tributary T2S, R5W, S7, FM	unknown
Ohio Creek Tributary T2S, R4W, S5, FM (2 crossings)	unknown
Ohio Creek Tributary T1S, R4W, S33, FM	unknown
Ohio Creek Tributary T1S, R4W, S27, FM	unknown

TABLE E.3.23 (Cont'd)

Stream	Fish Species Present
Ohio Creek Complex	unknown
Ohio Creek Complex	unknown
Alder Creek Complex	unknown
Emma Creek	unknown
Alder Creek Tributary T1S, R3W, S13, FM	unknown

1 Inconnu = Stenodus leucichthys
2 Not verified but can reasonably be expected
3 Slimy sculpin = Cottus cognatus
4 Blackfish = Dallia pectoralis

Sources: ADF&G (1982g)
Tarbox et al. (1978)

TABLE E.3.24: EFFECTS OF SURFACING AND EARTHWORK ON PHYSICAL AND CHEMICAL CHARACTERISTICS OF AQUATIC HABITAT

Construction Activity/ Physical and Chemical Effects	Clearing	Earthwork	Rock Excavation	Subgrade Stabilization	Aggregate Production	Equipment Areas	Borrow Pits & Landfills	Long-term Effects
Increased Surface Runoff	X	X		X	X	X	X	X
Lower Water Table	X	X						X
Leaching of Soil Mineral	X	X						
Fluctuation of Streamflow	X	X		X	X	X		X
Fluctuation in Water Level	X	X		X	X	X		X
Downstream Flooding	X	X			X	X		X
Increased Sedimentation	X	X	X	X	X	X		X
Reduced Habitat Diversity	X	X	X		X	X		X
Increased Turbidity	X	X	X	X	X	X	X	X
Changes in Water Temperature	X	X	X		X	X		
Changes in pH	X	X	X		X	X		
Change in Chemical Composition	X	X	X	X	X	X		
Addition of Hydrocarbons				X		X		
Increased Oxygen Demand	X	X	X		X			

Source: Darnell et al. 1978.

TABLE E.3.25: INCREASE IN WATER SURFACE ELEVATION (WSEL) DURING INITIAL FILL OF WATANA RESERVOIR*

1ST YEAR

Month	Rate (ft/day)	End of Month WSEL (ft)	Increase in WSEL (ft)
APR	-	1460	-
MAY	5.4	1626	166
JUN	2.4	1699	73
JUL	4.0	1823	124
AUG	0.9	1851	28
SEPT	0.6	1869	18
OCT	0.2	1875	6
NOV	-	1875	-
DEC	-	1875	-

Total increase in water surface elevation for the year is 415 ft.

2ND YEAR

Month	Rate (ft/day)	End of Month WSEL (ft)	Increase in WSEL (ft)
JAN	-	1875	-
FEB	-	1875	-
MAR	-	1875	-
APR	<0.1	1875	-
MAY	1.0	1908	33
JUN	2.5	1984	76
JUL	1.7	2036	52
AUG	0.8	2062	26
SEPT	0.3	2070	8
OCT	0.3	2080	10
NOV	0.1	2080	-
DEC	<0.1	2080	-

Total increase in water surface elevation for the year is 208 ft.

3RD YEAR

Month	Rate (ft/day)	End of Month WSEL (ft)	Increase in (WSEL (ft)
JAN	-	2080	-
FEB	-	2080	-
MAR	-	2080	-
APR	<0.1	2080	-
MAY	0.5	2197	17
JUN	1.3	2139	42
JUL	1.0	2171	32
AUG	0.4	2185	14

Total increase in water surface elevation for the year is 102 ft.

* Under median flow conditions.

TABLE E.3.26: COMPARISON OF AVERAGE MONTHLY STREAMFLOWS AT GOLD CREEK DURING INITIAL FILLING OF WATANA RESERVOIR*

Month	Pre-Project (cfs)	Proposed Minimum (cfs)	Forecast Streamflows					
			1st yr (cfs)	% Change	2nd yr (cfs)	% Change	3rd yr (cfs)	% Change
OCT	5800	2000	-	-	4300	-26	2000	-66
NOV	2600	1000	-	-	2600	0	2600	0
DEC	1800	1000	-	-	1800	0	1800	0
JAN	1500	1000	-	-	1500	0	1500	0
FEB	1200	1000	-	-	1200	0	1200	0
MAR	1100	1000	-	-	1100	0	1100	0
APR	1400	1000	-	-	1200	-14	1400	0
MAY	13200	6000	9800	-26	6000	-55	6000	-55
JUN	27800	6000	22200	-20	6000	-78	6800	-76
JUL	24400	6500	7300	-70	6500	-73	6500	-73
AUG	22200	12000	16800	-24	12000	-46	14100	-36
SEPT	13300	9300	9300	-30	9300	-30	13300	0
AVERAGE ANNUAL	9700	4000	6900	-29	4500	-54	4900	-49

*Under median flow conditions.

TABLE E.3.27: MAJOR IMPACT ISSUES DURING FILLING OF WATANA RESERVOIR REGARDING SALMONIDS IN THE TALKEETNA-TO-DEVIL CANYON REACH

Species	Passage Into Sloughs	Passage Into Tributaries	Reduced Slough + Mainstem Spawning Habitat	Reduced Ground Water Upwelling	Rearing in Mainstem	Increased Winter Water Temp.	Decreased Summer Water Temp.	Decreased Mainstem Turbidity	Decreased Mainstem Scouring	Downstream Passage in Mainstem	Downstream Passage from Sloughs
Chum											
- Adult	-	o	-				-				
- Embryo				-		-			+		
- Juvenile				o		-		o		o	-
Sockeye											
- Adult	-		-				-				
- Embryo				-		-		+		o	
- Juvenile	-			o	o	-		+		o	-
Chinook											
- Adult		o	o				-				
- Juvenile	o	o		-	+	+	-	+	+	o	o
Coho											
- Adult		o	o				-				
- Juvenile	o	o		-	+	+	-	+	+	o	o
Pink											
- Adult	-	o	-				-				
- Embryo				o		-			+		
- Juvenile						-		o		o	-
Rainbow Trout											
- Adult	-	o	o	o	+	+	-	+	+	o	o
- Juvenile	o	o		o	+	+	-	+	+	o	o

Note: o = no impact
+ = beneficial impact
- = adverse impact
Blank = not present in the habitat considered.

TABLE E.3.28: MAJOR TRIBUTARIES TO BE INUNDATED[1]

TRIBUTARIES INUNDATED BY THE WATANA RESERVOIR

Tributary	Total Length Inundated	Length Exposed During Annual Drawdown	Length Re-inundated During May-June[2]
Deadman Creek	2.3 miles	0.8	0.4
Watana Creek	10.0	0.7	0.5
Kosina Creek	4.2	0.8	0.4
Jay Creek	3.2	0.8	0.4
Goose Creek	1.2	0.8	0.3
Oshetna River	2.0	1.6	0.6

TRIBUTARIES INUNDATED BY THE DEVIL CANYON RESERVOIR

Tributary	Total Length Inundated
Tsusena Creek	0.2 miles
Fog Creek	1.0
Devil Creek	1.4
Chinook Creek (RM 157)	1.3
Cheechako Creek (RM 152.4)	1.6

1 See Tables E.2.10 and E.2.11 for complete list of tributaries to be inundated, and Figures E.3.21 and E.3.23 for locations.

2 May-June = Arctic grayling spawning and incubation period.

TABLE E.3.29: COMPARISON OF AVERAGE MONTHLY STREAMFLOWS AT SUNSHINE DURING INITIAL FILLING OF WATANA RESERVOIR*

Month	Pre-Project (cfs)	Proposed Minimum (cfs)	Forecast Streamflow 1st yr (cfs)	% Change	2nd yr (cfs)	% Change	3rd yr (cfs)	% Change
OCT	13700	10100	-	-	12400	-9	10100	-26
NOV	5800	4400	-	-	5800	0	5800	0
DEC	4200	3400	-	-	4200	0	4200	0
JAN	3500	3000	-	-	3500	0	3500	0
FEB	3000	2700	-	-	3000	0	3000	0
MAR	2600	2500	-	-	2600	0	2600	0
APR	3200	2800	-	-	3000	-6	3200	0
MAY	27700	20400	24200	-13	20400	-26	20400	-26
JUN	64200	42300	58200	-9	42300	-34	43100	-33
JUL	63200	45800	46600	-26	45800	-28	45800	-28
AUG	55900	46400	51200	-8	46400	-17	45800	-13
SEPT	32300	28400	28400	-12	28400	-12	32300	0
AVERAGE ANNUAL	23300	17700	20400	-12	18200	-22	18300	-21

* Under median flow conditions.

TABLE E.3.30: COMPARISON OF AVERAGE MONTHLY STREAMFLOWS AT SUSITNA STATION DURING INITIAL FILLING OF WATANA RESERVOIR*

Month	Pre-Project (cfs)	Proposed Minimum (cfs)	Forecast Streamflow 1st yr (cfs)	% Change	2nd yr (cfs)	% Change	3rd yr (cfs)	% Change
OCT	30100	26400	30100	0	28700	-5	26400	-12
NOV	12700	11200	12700	0	12700	0	12700	0
DEC	8200	7400	8200	0	8200	0	8200	0
JAN	7900	7500	7900	0	7900	0	7900	0
FEB	7000	6800	7000	0	7000	0	7000	0
MAR	6300	6200	6300	0	6300	0	6300	0
APR	7000	6600	7000	0	6800	-3	7000	0
MAY	60500	53100	56900	-6	53100	-12	53100	-12
JUN	123700	101800	118000	-5	101800	-18	102600	-17
JUL	131900	114600	115400	-13	114600	-13	114600	-13
AUG	110800	101400	106200	-4	101400	-8	103500	-7
SEPT	66000	62100	62100	-6	62100	-6	66000	0
AVERAGE ANNUAL	47700	42100	44800	-6	42600	-11	42900	-10

* Under median flow conditions.

TABLE E.3.31: MAJOR IMPACT ISSUES DURING OPERATION OF WATANA RESERVOIR REGARDING SALMONIDS IN THE TALKEETNA-TO-DEVIL CANYON REACH

Species	Passage Into Sloughs	Passage Into Tributaries	Reduced Slough Spawning Habitat	Reduced Ground Water Upwelling	Rearing in Mainstem	Over-wintering Habitat	Increased Winter Water Temp.	Decreased Mainstem Turbidity	Decreased Mainstem Scouring	Downstream Passage in Mainstem	Downstream Passage from Sloughs
Chum											
- Adult	-	o	-	-			-				
- Embryo				-			-		+		
- Juvenile								o		o	-
Sockeye											
- Adult	-		-	-							
- Embryo				-			-				
- Juvenile	-				o		-	+		o	-
Chinook											
- Adult		o	o								
- Juvenile	o	o			+	+	+	+	o	o	o
Coho											
- Adult		o	o								
- Juvenile	o	o			+	+	+	+	o	o	o
Pink											
- Adult	-	o	-	o							
- Embryo				o			-	+			
- Juvenile				o			-		o	-	-
Rainbow Trout											
- Adult	-	o	o	o		+	+	+	o	o	o
- Juvenile	o	o		o	+	+	+	+	o	o	o

Note: o = no impact
+ = beneficial impact
- = adverse impact
blank = not present in the habitat considered.

TABLE E.3.32: COMPARISON OF AVERAGE MONTHLY STREAMFLOWS AT GOLD CREEK STATION UNDER OPERATION OF WATANA DAM

Month	Pre-Project (cfs)	Post-Project (cfs)	% Change
OCT	5700	8000	+40
NOV	2500	9200	+268
DEC	1800	10700	+494
JAN	1500	9700	+547
FEB	1200	9000	+650
MAR	1100	8300	+655
APR	1400	7700	+450
MAY	13200	10400	-22
JUN	27800	11400	-59
JUL	23900	9200	-62
AUG	21700	13400	-38
SEPT	13300	9800	-26

TABLE E.3.33: COMPARISON OF AVERAGE MONTHLY STREAMFLOWS AT SUNSHINE STATION UNDER OPERATION OF WATANA DAM

Month	Pre-Project (cfs)	Post-Project (cfs)	% Change
OCT	13700	16000	+17
NOV	5800	12400	+114
DEC	4200	13000	+210
JAN	3500	11700	+234
FEB		10600	+266
MAR	2600	9800	+277
APR	2900	9500	+206
MAY	27700	24900	-10
JUN	64500	47900	-26
JUL	63300	48300	-24
AUG	56500	47400	-16
SEPT	32700	29000	-11

TABLE E.3.34: COMPARISON OF AVERAGE MONTHLY STREAMFLOWS AT SUSITNA STATION UNDER OPERATION OF WATANA DAM

Month	Pre-Project (cfs)	Post-Project (cfs)	% Change
OCT	30400	32400	+7
NOV	12800	19200	+50
DEC	8300	17000	+105
JAN	8000	16100	+101
FEB	7100	14700	+107
MAR	6300	13500	+114
APR	7000	13300	+90
MAY	60800	57600	-5
JUN	124500	107400	-14
JUL	132400	117000	-12
AUG	112000	102300	-9
SEPT	66800	62600	-6

TABLE E.3.35: COMPARISON OF AVERAGE MONTHLY STREAMFLOWS AT GOLD CREEK OF THE TWO OPERATIONAL WATANA AND DEVIL CANYON DAMS

Month	Pre-Project (cfs)	Watana Alone (cfs)	Watana/ Devil Canyon (cfs)	% Change Compared to: Pre-Project	Watana Alone
OCT	5,700	8,000	7,800	+ 37	- 3
NOV	2,500	9,200	9,600	+284	+ 4
DEC	1,800	10,700	11,300	+528	+ 6
JAN	1,500	9,700	10,600	+607	+ 9
FEB	1,200	9,000	10,200	+750	+13
MAR	1,100	8,300	9,300	+745	+12
APR	1,400	7,700	8,100	+479	+ 5
MAY	13,200	10,400	8,700	- 34	-16
JUN	27,800	11,400	9,900	- 64	-13
JUL	23,900	9,200	8,400	- 65	- 9
AUG	21,700	13,400	12,600	- 42	- 6
SEPT	13,300	9,800	10,500	- 21	+ 7

TABLE E.3.36: COMPARISON OF AVERAGE MONTHLY STREAMFLOWS AT SUNSHINE OF THE TWO OPERATIONAL WATANA AND DEVIL CANYON DAMS

Month	Pre-Project (cfs)	Watana Alone (cfs)	Watana/ Devil Canyon (cfs)	% Change Compared to: Pre-Project	% Change Compared to: Watana Alone
OCT	13,700	16,000	15,800	+ 15	- 1
NOV	5,800	12,400	12,900	+122	+ 4
DEC	4,200	13,000	13,600	+223	+ 5
JAN	3,500	11,700	12,600	+260	+ 8
FEB	2,900	10,600	11,800	+301	+11
MAR	2,600	9,800	10,700	+307	+ 9
APR	3,100	9,500	9,800	+216	+ 3
MAY	27,700	24,900	23,200	- 16	- 7
JUN	64,500	47,900	46,200	- 28	- 4
JUL	63,300	48,300	47,600	- 25	- 1
AUG	56,500	47,400	46,800	- 17	- 1
SEPT	32,700	29,000	29,600	- 9	+ 2

TABLE E.3.37: COMPARISON OF AVERAGE MONTHLY STREAMFLOWS AT SUSITNA OF THE TWO OPERATIONAL WATANA AND DEVIL CANYON DAMS

Month	Pre-Project (cfs)	Watana Alone (cfs)	Watana/Devil Canyon (cfs)	% Change Compared to: Pre-Project	% Change Compared to: Watana Alone
OCT	30,400	32,400	32,200	+ 6	< 1
NOV	12,800	19,200	19,800	+ 55	+ 3
DEC	8,300	17,000	17,600	+112	+ 4
JAN	8,000	16,100	17,000	+113	+ 6
FEB	7,100	14,700	15,900	+124	+ 8
MAR	6,300	13,500	14,400	+129	+ 7
APR	7,000	13,300	13,600	+ 94	+ 2
MAY	60,800	57,600	55,900	- 8	- 3
JUN	124,500	107,400	105,700	- 15	- 2
JUL	132,400	117,000	116,300	- 12	+ 1
AUG	112,000	102,300	101,700	- 9	+ 1
SEPT	66,800	62,600	63,300	- 5	+ 1

TABLE E.3.38: IMPACT ISSUES AND PROPOSED MITIGATION FEATURES FOR ANTICIPATED FILLING AND OPERATIONAL IMPACTS TO AQUATIC HABITATS, SUSITNA HYDROELECTRIC PROJECT

IMPACT ISSUE	OCCURRENCE				MITIGATION FEATURE			
	Watana Development		Devil Canyon Development		Watana Development		Devil Canyon Development	
	Filling	Operation	Filling	Operation	Filling	Operation	Filling	Operation
Passage of Adult Salmon	X	X		X	- Downstream release	- Downstream release		- Downstream release
Adverse Impacts to Slough Habitat	X	X		X	- Downstream release - Slough modification - Replacement habitat through modification of side channels	- Downstream release - Slough modification - Replacement habitat through modification of side channels		- Downstream release - Slough modification - Replacement habitat through modification of side channels
Loss of Side-Channel and Mainstem Salmon Spawning Areas	X	X		X	- Replacement habitat through modification of side channels	- Replacement habitat through modification of side channels		- Replacement habitat through modification of side channels
Altered Thermal Regime	X	X		X		Multiple level outlet		Multiple level outlet
Gas Supersaturation	X	X			Fixed cone valves			Fixed cone valves
Inundation of Tributary Habitat	X		X		Grayling propagation and restocking program		Grayling propagation and restocking program	
Out-migration of Juvenile Anadromous Fish	X	X		X	Downstream release	Downstream release		Downstream release

TABLE E.3.39: PROPOSED FISHERIES MITIGATIONS WITH ESTIMATED CAPITAL AND ANNUAL OPERATING AND MAINTENANCE COSTS

Mitigation Feature	Number Proposed	Capital Costs (x 1000 Dollars) Labor	Materials	Total	Annual Operating and Maintenance Costs (x 1000 dollars)
Downstream Mitigation[1]					
Protective Slough Berms	10	1,100	400	1,500	75
Restructured Slough Mouth	8	96	64	160	8
Lowered and Restructured Slough Profile	8	1,152	768	1,920	96
Augmented Upwelling System	4	444	296	740	37
Side-Channel Scarifying	4	240	160	400	20
Slough Gravel Cleaning	3	350	250	600	600
Mainstem Spawning Bed	2	636	424	1,060	80
			Total	$ 6,380	Total 916
Impoundment Mitigation					
Grayling Propagation Research[2]	1	143	47	190	NA
Grayling Hatchery[3]	1	450	300	750	110
Rainbow Trout Production[3]	1	225	150	357	38
			Total	$ 1,315	Total 148
Dam Structures[4]					
Multiple Level Intakes	1	18,400	-	18,400	NA
Cone Valves - Watana	6	47,100	-	47,100	NA
Cone Valves - Devil Canyon	7	14,600	-	14,600	NA
			Total	$80,100	
		Total for Fisheries Mitigation		$87,795	Annual O & M 1,064

[1] Costing details are in Table E.3.45

[2] Assumes 3-year study, costing details are in Table E.3.45

[3] Addition to an existing facility, costing details are in Table E.3.45

[4] Costing details are in Exhibit D

TABLE E.3.40: SCHEDULE FOR IMPLEMENTING FISHERIES MITIGATION PROGRAM

Mitigation Measure	Project Phase for Implementation	Year of Implementation Design or Construction Planning or Starting	
Construction Mitigation			
Preconstruction Design and Planning	Final Design	1983	(NA)
Construction Monitoring	Watana Construction	1984	1985
Operational Mitigation			
Downstream Mitigation			
Protective Slough Berms	Watana Filling	1985	1991
Slough Mouth Excavation	Watana Filling	1985	1991
Lowered and Restructured Sloughs	Watana Filling	1985	1991
Induced Upwelling	Watana Filling	1985	1991
Side-Channel Scarifying	Watana Filling	1985	1991
Slough Gravel Cleaning	Watana Filling	1985	1991
Mainstream Spawning Beds	Watana Filling	1985	1991
Impoundment Mitigation			
Grayling Propagation Research	Final Design	1983	1984
Grayling Hatchery	Watana Construction	1986	1989
Rainbow Trout Introductions	Devil Canyon Operation	2000	2002
Multiple Level Intakes	Watana Filling	1984	1993 (on-line)
Cone Valves	Watana Operation	1984	1994 (on-line)
Operational Monitoring	Watana Filling	1985	1991

TABLE E.3.41: CONSTRUCTION COSTS FOR WATER QUALITY AND FISHERIES MONITORING IN 1982 DOLLARS FROM 1985 TO 2002

Year	Management ($70/hr)	Field Labor ($50/hr)	Field Equipment	Travel ($200/hr)	Total (x 1000)
1985[1]	140,000	240,000	15,000	9,600	404.6
1986	140,000	240,000	5,000	9,600	394.6
1987	140,000	240,000	5,000	9,600	394.6
1988	140,000	240,000	5,000	9,600	394.6
1989[2]	210,000	720,000	40,000	19,200	989.2
1990	227,500	960,000	15,000	28,800	1,231.3
1991	227,500	960,000	5,000	28,800	1,221.3
1992	227,500	960,000	5,000	28,800	1,221.3
1993	175,000	720,000	5,000	19,200	919.2
1994	140,000	240,000	5,000	9,600	394.6
1995	140,000	240,000	5,000	9,600	394.6
1996[3]	175,000	480,000	25,000	19,200	699.2
1997	175,000	480,000	5,000	19,200	679.2
1998	175,000	480,000	5,000	19,200	679.2
1999	175,000	480,000	5,000	19,200	679.2
2000	175,000	480,000	5,000	19,200	679.2
2001	140,000	240,000	5,000	9,600	394.6
2002	140,000	240,000	5,000	9,600	394.6
				Total	$12,165.1

[1] Construction of access road and facilities.

[2] Construction of Watana Dam and facilities plus transmission line.

[3] Construction of Devil Canyon Dam and facilities plus postconstruction monitoring of Watana facilities.

TABLE E.3.42: ALASKA DEPARTMENT OF FISH AND GAME STANDARDS FOR PASSING ARCTIC GRAYLING TO BE USED ON SUSITNA HYDROELECTRIC PROJECT STREAM CROSSINGS[1]

Length of Culvert (feet)	Average Cross-Sectional Velocities at Outlet[2] (ft/sec)
30	4.6
40	3.8
50	3.2
60	2.8
70	2.6
80	2.3
90	2.1
100	2.0
150	1.8
200	1.8
200	1.8

1 Each culvert must be installed so that at least 20 percent of the diameter of each round culvert or at least 6 inches of the height of each elliptical or arch type culvert are set below the streambed at both the inlet and outlet of the culvert except when using bottomless arch culverts or to avoid solid rock excavation.

2 Average cross-sectional velocities at the outlet of the culvert may not exceed the velocities in the table except for a period not exceeding 48 hours during the mean annual flood.

Source: Edfelt 1981

TABLE E.3.43: ALASKA DEPARTMENT OF FISH AND GAME TEMPORARY STREAM DIVERSION STANDARDS

Temporary diversion channels in all streams frequented by fish must be constructed and controlled in the following manner:

(1) The width and depth of the temporary diversion channel must equal or exceed 75 percent of the width and the depth, respectively, of that portion of the streambed which is covered by ordinary high water at the diversion site, unless a lesser width or depth is specified by the department on the permit for activities undertaken during periods of lower flow;

(2) During excavation or construction, the temporary diversion channel must be isolated from water of the stream to be diverted by natural plugs (unaltered streambank) left in place at the upstream and downstream ends of the diversion channel;

(3) The diversion channel must be constructed so that the bed and banks will not significantly erode at expected flows;

(4) Diversion of water flow into the temporary diversion channel must be conducted by first removing the downstream plug, then removing the upstream plug, then closing the upstream end and the downstream end, respectively, of the natural channel of the diverted stream;

(5) Rediversion of flow into the natural stream must be conducted by removing the downstream plug from the natural channel and then the upstream plug, then closing the upstream and the downstream end, respectively, of the diversion channel;

(6) After use, the diversion channel and the natural stream must be stabilized and rehabilitated as may be specified by permit conditions.

Source: Edfelt (1981)

TABLE E.3.44: ALASKA DEPARTMENT OF FISH AND GAME STANDARDS FOR BLASTING NEAR AN ANADROMOUS FISH STREAM

DISTANCE TO ANADROMOUS FISH STREAM MEASURED IN FEET[1]

	Explosive Charge Weight in Pounds							
Substrate	1	2	5	10	25	100	500	1000
Rock	50	80	120	170	270	530	1180	1670
Frozen Material	50	70	110	160	250	500	1120	1580
Stiff Clay, Gravel, Ice	40	60	100	140	220	440	990	1400
Clayey Silt, Dense Sand	40	50	80	120	180	370	820	1160
Medium to Dense Sand	30	50	70	100	160	320	720	1020
Medium Organic Clay	20	30	50	70	100	210	460	660
Soft Organic Clay	20	30	40	60	100	190	440	620

1 Required distances for charge weights not set forth in this table must be computed by linear intropolation between the charge weights bracketing the desired charge if the charge weight is between one and 1000 pounds; example: for 15 pounds of explosive in rock substrate - required distance =

$$170 \text{ feet} + \frac{15 \text{ lbs}-10 \text{ lbs}}{25 \text{ lbs}-10 \text{ lbs}} (270 \text{ feet}-170 \text{ feet}) = 203 \text{ feet};$$

for charge weights greater than 1000 pounds, the required distance may be determined by linear extropolation.

Source: Edfelt 1981

TABLE E.3.45: COST ASSUMPTIONS USED IN DEVELOPING ESTIMATED COSTS FOR FISHERIES MITIGATIONS

Mitigation Feature		Cost
1. Protective Berm:		
Assumes constructing a 5,000-cubic yard berm with an impermeable core at $30 per yard.		
Construction		
Labor		$110,000
Materials[1]		40,000
	Total	$150,000
Maintenance[2]		$ 7,500/year
2. Restructured Slough Mouth:		
Assumes excavating a 6-foot wide channel for a distance of 500 feet to a depth of 3 feet with stabilization allowing an effective depth of 2 feet at $30 per yard.		
Construction		
Labor		$ 12,000
Materials		8,000
	Total	$ 20,000
Maintenance[2]		$ 1,000/year
3. Lowered and Restructured Slough:		
Assumes lowering a 30-foot wide channel for a distance of 1,200 feet to a depth of 1.5 feet at $30 per yard.		
Construction		
Labor		$ 72,000
Materials		48,000
	Total	$120,000
Maintenance[2]		$ 6,000/year
4. Augmented Upwelling System:		
Assumes cross pipes for upwelling every 5 feet for two 200-foot sections at a width of 30 feet located 300 feet from a water source.		
Construction		
Labor		$ 33,000
Materials		22,000
Cross Pipes		10,000
Distribution and Control		20,000
Material Processing		110,000
	Total	$185,000
Maintenance[2]		$ 9,250

TABLE E.3.45 (Cont'd)

Mitigation Feature		Cost
5. Side-Channel Scarifying:		
Assumes scarifying a 30-foot wide channel for a distance of 1,000 feet at $30 per yard.		
Construction		
Labor		$ 60,000
Materials		40,000
	Total	$100,000
Maintenance[2]		$ 5,000
6. Slough Gravel Cleaning:		
Assumes cleaning a 30-foot wide channel for a distance of 1,200 feet to a depth of 3 feet at $50 per yard.		
Construction		
Labor		$120,000
Materials		80,000
	Total	$200,000
7. Mainstem Spawning Bed:		
Creation of a submerged bed to 60 feet wide and 1,000 feet long with 3 feet of fill at $80 per yard.		
Construction		
Labor		$318,000
Materials		212,000
	Total	$530,000
Maintenance[2]		$26,500
8. Grayling Propagation Research:		
Assumes 2 research personnel 6 months/year for 3 years.		
Labor		$143,000
Materials		47,000
	Total	$190,000
9. Grayling Hatchery:		
Assumes it is appended to an existing facility; costs are based on square footage, including the cost of one additional housing unit.		
Construction		
Labor		$450,000
Materials		300,000
	Total	$750,000[3]

TABLE E.3.45 (Cont'd)

Mitigation Feature		Cost
<u>Operation and Maintenance</u>		
Labor		$ 78,000
Materials		32,000
	Total	$ 110,000 per year
Planting Costs		$ 10,000 per year
10. Rainbow Trout Introductions:		
Assumes the need to provide production facilities with half the capacity of the grayling hatchery.		
<u>Construction</u>		
Labor		$ 225,000
Materials		150,000
	Total	$ 375,000
<u>Operation and Maintenance</u>		
Labor		$ 35,000
Materials		3,000
	Total	$ 38,000
11. Aquatic Studies Program:		
Continue aquatic studies during project construction.		
<u>Construction</u>		
Labor		$5,000,000
Materials		1,000,000
	Total	$6,000,000
<u>Operation</u>		
Labor		$ 394,800
Materials		116,600
	Total	$ 511,400

[1] Includes equipment rental.

[2] Average Annual Operating Cost. Yearly maintenance is not anticipated; maintenance may be needed on a 3-5 year cycle.

[3] Residence = $150,000
Hatchery = $600,000

TABLE E.3.46: ESTIMATED SQUARE FEET OF SALMON SPAWNING HABITAT MADE AVAILABLE BY MITIGATION PROCEDURES

Mitigation Feature	Estimated Habitat Area (square feet)
Protective slough bern	--[1]
Restructured slough mouth	--[2]
Lowered and restructured slough	144,000
Augmented upwelling	48,240
Side-channel scarifying	120,060
Slough gravel cleaning	--[3]
Mainstem spawning bed	120,015
Total habitat reclaimed	432,315

1 Protects slough from mainstem flow during winter.
2 Allows access to slough habitats.
3 Maintains quality of slough spawning gravels.

TABLE E.3.47: ANNUAL OPERATING COSTS OF FISHERIES MONITORING PROGRAM IN 1982 DOLLARS[1]

Task	Total Personnel Months Per Year	Personnel Cost (1982 Dollars)
Management and Analysis	12	48,000
Adult and Smolt[2] Enumeration	39	116,500
Talkeetna to Devil Canyon Production Monitoring	30	92,100
Resident Fish Stocking Program	15	45,900
Total Personnel Cost		302,500
Contractual Services		56,900
Materials		59,700
Administration and Support Costs		92,300
Average Annual Fisheries Monitoring Costs		511,400

[1] Costs are based on 1982 Susitna Hydro Aquatic Studies costs and the estimated level of effort required to perform the monitoring studies.

[2] Assumes fish wheels at Sunshine and Curry and a smolt trap at Curry.

TABLE E.3.48: VASCULAR PLANT SPECIES IN THE WATANA AND GOLD CREEK WATERSHEDS AND DOWNSTREAM FLOODPLAIN WHICH ARE OUTSIDE THEIR RANGE AS REPORTED BY HULTEN (1968)(FROM MCKENDRICK ET AL. 1982)

Middle and Upper Basin Extensions:

Equisetum fluviatile	Swamp horsetail
Lycopodium selago ssp. *selago*	Fir clubmoss
Lycopodium complanatum	Ground cedar
*Picea mariana**	Black spruce
Carex filifolia	Thread-leaf sedge
Danthonia intermedia	Timber oatgrass
Luzula wahlenbergii	Wahlenberg woodrush
Veratrum viride	Helebore
*Listera cordata***	Heart-leaved twinblade
Platanthera convallariaefolia	Northern bog-orchis
Platanthera hyperborea	Northern bog-orchis
Platanthera dilatata	White bog-orchis
Echinopanax horridum	Devil's club
Senecio sheldonensis	Sheldon groundsel
*Myrica gale**	Sweet gale
Ranunculus occidentalis	Western buttercup
Potentilla biflora	Two-flower cinquefoil
*Rubus idaeus**	Raspberry
Rubus pedatus	Five-leaf bramble
Pedicularis kanei kanei	Kane lousewort
Pedicularis parviflora	Lousewort
Potamogeton robbinsii	Robbins pondweed

Downstream Extensions:

Echinopanax horridum	Devil's club
*Rubus idaeus****	Raspberry
Scirpus microcarpus	Small-fruit bulrush
Galium triflorum	Sweet-scented bedstraw
Alnus tenuifolia	Thinleaf alder
Circaea alpina	Enchanter's nightshade
Actaea rubra	Baneberry
*Ribes hudsonianum****	Northern black currant
Arnica chamissonis	Arnica

* Viereck and Little (1972) include the upper Susitna River basin in the range of this species.

** This species was recorded by the bird and small mammal survey group from the University of Alaska Museum.

*** Viereck and Little (1972) include the downstream area in the range of this species.

TABLE E.3.49: CANDIDATE ENDANGERED AND THREATENED PLANT TAXA* SOUGHT IN THE WATANA AND GOLD CREEK WATERSHED SURVEYS WITH NOTES ON THEIR HABITATS AND KNOWN LOCALITIES (FROM MCKENDRICK ET AL. 1982)

Species and Habitat	Unofficial Status**
Smelowskia pyriformis Drury & Rollins North American endemic calcareous scree, talus, in upper Kuskokwim R. drainage	Threatened species
Aster yukonensis Cronq. North American endemic river banks, dry streambeds, river delta sands and gravels Kluane Lake, Koyukuk River	Endangered species
Montia bostockii (A. E. Porsild) S. L. Welsh North American endemic wet, alpine meadows, St. Elias Mtns., Wrangell Mtns.	Endangered species
Papaver alboroseum Hult. Amphi-Beringian well-drained alpine tundra, Wrangell Mtns., St. Elias Mtns. Cook Inlet lowlands, Alaska Range	Endangered species
Podistera yukonensis Math & Const. North American endemic S.-facing rocky slopes, grasslands at low elevations, Eagle area, Yukon border	Endangered species
Smelowskia borealis (Greene) Drury & Rollins var. villosa North American endemic alpine calcareous scree, Mt. McKinley Park, Alaska Range	Endangered species
Taraxacum carneocoloratum Nels. North American endemic alpine rocky slopes, Alaska Range, Yukon Ogilvie Mtns.	Endangered species
Other Endangered Species Possibilities	
Cryptantha shackletteana	Upper Yukon River
Eriogonum flavum var. aquilinum	Eagle, Alaska
Erysimum asperum var. angustatum	Upper Yukon River

* Information and status from Murray (1980).

**All species are under review by the U.S. Fish & Wildlife Service for inclusion in the Endangered Species Act of 1973.

TABLE E.3.50: VEGETATION TYPES (AND SAMPLE LOCATION NUMBERS) SAMPLED IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982

Vegetation Type	Sample Location Number*
Mat and cushion tundra	1-8
Sedge-grass tundra	9-10
Herbaceous tundra	11
Wet sedge-grass tundra	12-14
Open black spruce	15-17
Woodland black spruce	18-22
Open white spruce	23-27
Woodland white spruce	28
Closed birch forest	29-32
Open birch forest	33-34
Closed balsam poplar	35-36
Open balsam poplar	37
Closed aspen	38
Closed mixed conifer-deciduous forest	39-41
Open mixed conifer-deciduous forest	42-49
Closed tall shrub	50-52
Open tall shrub	53
Mixed low shrub	54-62
Willow shrub	63-64

* Sample locations are given in Figure E.3.74

TABLE E.3.51: HECTARES AND PERCENTAGE OF TOTAL AREA COVERED BY VEGETATION TYPES IN THE WATANA AND GOLD CREEK WATERSHEDS* (FROM MCKENDRICK ET AL. 1982)

Vegetation Type	Hectares**	Percent of Total Area
Total Vegetation	1,387,607***	85.08
Forest	348,232	21.35
Conifer	307,586	18.86
Woodland spruce	188,391	11.55
Open spruce	118,873	7.29
Closed spruce	323	0.02
Deciduous	1,290	0.08
Open birch	968	0.06
Closed birch	323	0.02
Mixed	39,355	2.41
Open	23,387	1.43
Closed	15,968	0.98
Tundra	394,685	24.20
Wet sedge-grass	4,839	0.30
(Mesic) sedge-grass	184,358	11.30
Herbaceous alpine	807	0.05
Mat and cushion	65,001	3.99
Mat and cushion/sedge-grass	139,680	8.56
Shrubland	644.690	39.53
Tall shrub	129,035	7.91
Low shrub	515,655	31.62
Birch	33,549	2.06
Willow	10,645	0.65
Mixed	471,461	28.91
Unvegetated	243,392	14.92
Water	39,840	2.44
Lakes	25,162	1.54
Rivers	14,678	0.90
Rock	113,712	6.97
Snow and ice	89,841	5.51
Total Area	1,630,999	100.00

* Based on maps produced at a scale of 1:250,000.

** Differences in resolution as a result of differences in scale may result in some discrepancies for common areas between these figures and those presented in Table E.3.52.

*** 1 hectare = 2.471 acres.

TABLE E.3.52: HECTARES AND PERCENTAGE OF TOTAL AREA COVERED BY VEGETATION TYPES FOR THE AREA 16 km ON EITHER SIDE OF THE SUSITNA RIVER FROM GOLD CREEK TO THE MACLAREN RIVER*
(FROM MCKENDRICK ET AL. 1982)

Vegetation Type	Hectares**	Percent of Total Area
Forest	142,306***	30.75
Conifer	115,048	24.87
Woodland spruce-black	62,993	13.62
Woodland spruce-white	13,291	2.87
Open spruce-black	28,304	6.12
Open spruce-white	10,460	2.26
Deciduous	4,393	.94
Open birch	1,498	0.32
Closed birch	2,324	0.50
Closed balsam poplar	571	0.12
Mixed	22,865	4.94
Open conifer deciduous	9,639	2.08
Closed conifer deciduous	13,226	2.86
Tundra	114,728	24.81
Wet sedge grass	3,517	0.76
Sedge grass	27,505	5.95
Sedge shrub	20,073	4.34
Mat and cushion	63,633	13.76
Shrubland	177,264	38.34
Open tall shrub	15,524	3.36
Closed tall shrub	15,767	3.41
Birch shrub	42,880	9.27
Willow shrub	8,230	1.78
Mixed low shrub	94,863	20.52
Herbaceous	18	0.01
Grassland	1,079	0.23
Disturbed	24	0.01
Unvegetated	26,979	5.83
Rock	16,603	3.59
Snow and ice	249	0.05
Water		
River	4,236	0.92
Lake	5,891	1.27
Total Area	462,398	99.98

* Based on maps produced at a scale of 1:63,360.

** Differences in resolution as a result of differences in map scale may result in some discrepancies for common areas between these figures and those presented in Table E.3.51.

*** 1 hectare = 2.471 acres.

TABLE E.3.53: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN OPEN CONIFER VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		98
Overstory (>10 cm dbh)		24
Picea glauca	White spruce	24
Picea mariana	Black spruce	2
Understory (2.5 - 10 cm dbh)		10
Picea glauca	White spruce	3
Picea mariana	Black spruce	2
Shrub layer (>0.5 m tall, <2.5 cm dbh)		5
Picea glauca	White spruce	1
Picea mariana	Black spruce	3
Ground layer (<0.5 m tall)		94
Mosses, unidentified		11
Feather mosses	Feather moss	29
Ptilium spp.		13
Empetrum nigrum	Crowberry	6
Ledum decumbens	Northern Labrador tea	5
Vaccinium uliginosum	Bog blueberry	7
Vaccinium vitis-idaea	Mountain cranberry	6
Equisetum arvense	Meadow horsetail	6
Equisetum silvaticum	Woodland horsetail	8
Linnaea borealis	Twinflower	8
Picea mariana	Black spruce	1
Calamagrostis canadensis	Bluejoint	14

* Number of areas sampled was 9.
** Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.54: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN OPEN WHITE SPRUCE VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		100
Overstory (>10 cm dbh)		35
Pica glauca	White spruce	35
Understory (2.5 - 10 cm dbh)		11
Picea glauca	White spruce	3
Alnus sinuata	Sitka alder	6
Shrub layer (>0.5 m tall, <2.5 cm dbh)		4
Picea glauca	White spruce	1
Alnus crispa	American green alder	4
Rosa acicularis	Prickly rose	3
Ground layer (<0.5 m tall)		94
Feather mosses	Feather moss	30
Ptilium spp.		24
Equisetum arvense	Meadow horsetail	11
Equisetum silvaticum	Woodland horsetail	6
Linnaea borealis	Twinflower	15
Betula glandulosa	Resin birch	6
Rosa acicularis	Prickly rose	5
Calamagrostis canadensis	Bluejoint	23

* Number of areas sampled was 5.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.55: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN OPEN BLACK SPRUCE VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM McKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		96
Overstory (>10 cm dbh)		14
Picea glauca	White spruce	13
Picea mariana	Black spruce	5
Understory (2.5 - 10 cm dbh)		10
Picea glauca	White spruce	4
Picea mariana	Black spruce	5
Shrub layer (>0.5 m tall, <2.5 cm dbh)		7
Picea mariana	Black spruce	8
Salix spp.	Willow	2
Ground layer (<0.5 m tall)		93
Mosses, unidentified		34
Feather mosses	Feather moss	30
Cladonia spp.		7
Empetrum nigrum	Crowberry	14
Ledum decumbens	Northern Labrador tea	14
Vaccinium uliginosum	Bog blueberry	10
Vaccinium vitis-idaea	Mountain cranberry	15
Equisetum silvaticum	Woodland horsetail	12
Salix spp.	Willow	7
Picea mariana	Black spruce	4

* Number of areas sampled was 3.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.56: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN WOODLAND CONIFER VEGETATION TYPE * IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		99
Overstory (>10 cm dbh)		1
Pica glauca	White spruce	
Understory (2.5 - 10 cm dbh)		12
Picea mariana	Black spruce	11
Shrub layer (>0.5 m tall, <2.5 cm dbh)		17
Picea mariana	Black spruce	15
Ground layer (<0.5 m tall)		93
Feather mosses	Feather moss	5
Sphagnum spp.	Sphagnum moss	62
Empetrum nigrum	Crowberry	8
Ledum decumbens	Northern Labrador tea	5
Ledum groenlandicum	Labrador tea	5
Vaccinium uliginosum	Bog blueberry	23
Equisetum silvaticum	Woodland horsetail	10
Rubus arcticus	Nagoonberry	15
Rubus chamaemorus	Cloudberry	5
Picea mariana	Black spruce	3
Carex bigelowii	Bigelow sedge	7
Carex spp.	Sedge	6

* Number of areas sampled was 6.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.57: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN CLOSED BALSAM POPLAR FOREST VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		99
Overstory (>10 cm dbh)		80
Pica glauca	White spruce	1
Populus balsamifera	Balsam poplar	75
Understory (2.5 - 10 cm dbh)		5
Populus balsamifera	Balsam poplar	5
Shrub layer (>0.5 m tall, <2.5 cm dbh)		10
Populus balsamifera	Balsam poplar	5
Ground layer (<0.5 m tall)		85
Ptilium spp.		20
Polytrichum spp.		5
Empetrum nigrum	Crowberry	30
Ledum decumbens	Northern Labrador tea	40
Vaccinium uliginosum	Bog blueberry	40
Vaccinium vitis-idaea	Mountain cranberry	20
Cornus canadensis	Bunchberry	40
Populus balsamifera	Balsam poplar	1
Spiraea beauverdiana	Beauverd spiraea	5

* Number of areas sampled was 1.

**Includes only those species with at least 5 percent cover.

TABLE E.3.58: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN CLOSED BIRCH DECIDUOUS FOREST VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		99
Overstory (>10 cm dbh)		73
Pica glauca	White spruce	8
Betula papyrifera	Paper birch	68
Understory (2.5 - 10 cm dbh)		9
Picea glauca	White spruce	5
Betula papyrifera	Paper birch	3
Shrub layer (>0.5 m tall, <2.5 cm dbh)		3
Picea glauca	W[illegible] spruce	1
Betula papyrifera	Paper birch	3
Ground layer (<0.5 m tall)		95
Ptilium spp.		15
Polytrichum spp.		5
Vaccinium uliginosum	Bog blueberry	15
Vaccinium vitis-idaea	Mountain cranberry	5
Equisetum silvaticum	Woodland horsetail	10
Cornus canadensis	Bunchberry	16
Calamagrostis canadensis	Bluejoint	38
Gymnocarpium dryopteris	Oak-fern	20
Mertensia paniculata	Tall bluebell	10

* Number of areas sampled was 2.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.59: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN CLOSED ASPEN DECIDUOUS VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		99
Overstory (>10 cm dbh)		80
Betula papyrifera	Paper birch	5
Populus tremuloides	Trembling aspen	80
Understory (2.5 - 10 cm dbh)		5
Betula papyrifera	Paper birch	5
Populus tremuloides	Trembling aspen	5
Shrub layer (>0.5 m tall, <2.5 cm dbh)		5
Picea glauca	White spruce	5
Betula papyrifera	Paper birch	5
Betula glandulosa	Resin birch	5
Rosa acicularis	Prickly rose	5
Salix spp.	Willow	5
Populus tremuloides	Trembling aspen	5
Ground layer (<0.5 m tall)		85
Ptilium spp.		5
Polytrichum spp.		5
Ledum decumbens	Northern Labrador tea	20
Vaccinium uliginosum	Bog blueberry	10
Linnaea borealis	Twinflower	5
Cornus canadensis	Bunchberry	80
Mertensia paniculata	Tall bluebell	5
Epilobium angustifolium	Fireweed	5
Geocaulon lividum	Sandalwood	5
Spiraea beauverdiana	Beauverd spiraea	5
Vaccinium vitis-idaea	Mountain cranberry	10
Betula nana	Dwarf arctic birch	5
Viburnum edulis	Highbush cranberry	5
Lycopodium annotinum	Stiff clubmoss	5
Lycopodium clavatum	Running clubmoss	5

* Number of areas sampled was 1.

**Includes only those species with at least 5 percent cover.

TABLE E.3.60: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN OPEN MIXED CONIFER-DECIDUOUS FOREST VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		100
Overstory (>10 cm dbh)		38
Picea glauca	White spruce	20
Betula papyrifera	Paper birch	12
Understory (2.5 - 10 cm dbh)		7
Picea glauca	White spruce	5
Betula papyrifera	Paper birch	1
Shrub layer (>0.5 m tall, <2.5 cm dbh)		17
Picea glauca	White spruce	2
Betula papyrifera	Paper birch	2
Salix novae-angliae	Tall blueberry willow	11
Ground layer (<0.5 m tall)		79
Feather mosses	Feather moss	18
Ptilium spp.		34
Empetrum nigrum	Crowberry	6
Ledum decumbens	Northern Labrador tea	6
Vaccinium uliginosum	Bog blueberry	16
Vaccinium vitis-idaea	Mountain cranberry	9
Equisetum silvaticum	Woodland horsetail	3
Cornus canadensis	Bunchberry	13
Picea glauca	White spruce	2
Calamagrostis canadensis	Bluejoint	11
Gymnocarpium dryopteris	Oak-fern	8

* Number of areas sampled was 8.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.61: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN CLOSED MIXED CONIFER-DECIDUOUS FOREST VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		98
Overstory (>10 cm dbh)		60
Picea glauca	White spruce	33
Betula papyrifera	Paper birch	35
Understory (2.5 - 10 cm dbh)		8
Picea glauca	White spruce	3
Betula papyrifera	Paper birch	4
Shrub layer (>0.5 m tall, <2.5 cm dbh)		4
Picea glauca	White spruce	3
Ground layer (<0.5 m tall)		88
Ptilium spp.		40
Empetrum nigrum	Crowberry	3
Vaccinium vitis-idaea	Mountain cranberry	8
Equisetum silvaticum	Woodland horsetail	24
Cornus canadensis	Bunchberry	13
Rubus arcticus	Nagoonberry	7
Calamagrostis canadensis	Bluejoint	30

* Number of areas sampled was 3.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.62: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN WET SEDGE-GRASS TUNDRA VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		99
Shrub layer (>0.5 m tall, <2.5 cm dbh)		13
Salix planifolia ssp. pulchra	Diamondleaf willow	8
Salix spp.	Willow	5
Ground layer (<0.5 m tall)		86
Mosses, unidentified		20
Sphagnum spp.	Sphagnum moss	22
Salix fuscescens	Alaska bog willow	5
Calamagrostis canadensis	Bluejoint	14
Carex aquatilis	Water sedge	38
Carex bigelowii	Bigelow sedge	23

* Number of areas sampled was 3.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.63: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN MESIC SEDGE-GRASS TUNDRA VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		65
Ground layer (<0.5 m tall)		65
Polytrichum spp.	Hairy-cap moss	5
•	Willow	13
arex bigelowii	Bigelow sedge	30
Carex spp.	Sedge	4

* Number of areas sampled was 2.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.64: PLANT SPECIES LIST OF ONE HERBACEOUS ALPINE TUNDRA STAND IN WATANA AND GOLD CREEK WATERSHEDS (MCKENDRICK ET AL. 1982)

Category	Common Names
Lycopodium alpinum	Alpine clubmoss
Lycopodium annotinum	Stiff clubmoss
Lycopodium selago	Fir clubmoss
Equisetum spp.	Horsetail
Carex bigelowii	Bigelow sedge
Carex filifolia	Thread-leaf sedge
Eriophorum angustifolium	Tall cottongrass
Calamagrostis purpurascens	Purple reedgrass
Deschampsia caespitosa	Tufted hairgrass
Festuca rubra	Red fescue
Phleum commutatum	Timothy
Juncus spp.	Rush
Luzula confusa	Northern woodrush
Luzula tundricola	Tundra woodrush
Myosotis alpestris	Forget-me-not
Campanula lasiocarpa	Mountain harebell
Aster sibiricus	Siberian aster
Artemisia arctica	Wormwood
Petasites frigidus	Arctic sweet coltsfoot
Senecio atropurpureus	Ragwort
Sedum rosea	Roseroot
Silene acaulis	Moss campion
Diapensia lapponica	Diapensia
Cassiope tetragona	Four-angle mountain-heather
Epilobium latifolium	Dwarf fireweed
Polemonium acutiflorum	Jacob's ladder
Polygonum bistorta	Meadow bistort
Rumex arcticus	Arctic dock
Aconitum delphinifolium	Monkshood
Anemone narcissiflora	Anemone
Caltha leptosepala	Mountain marsh-marigold
Sanguisorba stipulata	Sitka burnet
Sibbaldia procumbens	Sibbaldia
Salix phlebophylla	Skeletonleaf willow
Salix polaris	Polar willow
Salix reticulata	Netleaf willow
Salix rotundifolia	Least willow
Boykinia richardsonii	Richardson boykinia
Saxifraga tricuspidata	Three-tooth saxifrage
Veronica wormskjoldii	Alpine speedwell
Valeriana capitata	Capitate valerian
Polytrichum spp.	Hairy-cap moss

TABLE E.3.65: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN CLOSED MAT AND CUSHION TUNDRA VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		78
Ground layer (<0.5 m tall)		78
Lichens, unidentified		14
Cladonia spp.		8
Empetrum nigrum	Crowberry	8
Ledum decumbens	Northern Labrador tea	7
Vaccinium uliginosum	Bog blueberry	8
Arctostaphylos spp.	Bearberry	7
Betula glandulosa	Resin birch	6
Betula nana	Dwarf arctic birch	10

* Number of areas sampled was 8.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.66: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN CLOSED TALL ALDER VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		96
Understory (2.5 - 10 cm dbh)		57
Alnus sinuata	Sitka alder	25
Alnus crispa	American green alder	32
Shrub layer (>0.5 m tall, <2.5 cm dbh)		38
Alnus sinuata	Sitka alder	28
Alnus crispa	American green alder	10
Ribes spp.	Currant	8
Ground layer (<0.5 m tall)		62
Equisetum silvaticum	Woodland horsetail	31
Ribes spp.	Currant	8
Alnus sinuata	Sitka alder	7
Calamagrostis canadensis	Bluejoint	35

* Number of areas sampled was 3.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.67: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN OPEN TALL ALDER VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total Vegetation		85
Overstory (>10 cm dbh)		10
Picea glauca	White Spruce	10
Understory (2.5 - 10 cm dbh)		45
Picea glauca	White Spruce	5
Alnus sinuata	Sitka alder	40
Ground layer (<0.5 m tall		25
Linnaea borealis	Twinflower	5
Alnus Sinuata	Sitka alder	5
Calamagrostis canadensis	Bluejoint	10

* Number of areas sampled was 1.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.68: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN CLOSED LOW SHRUB VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		93
Shrub layer (>0.5 m tall, <2.5 cm dbh)		42
Betula glandulosa	Resin birch	10
Salix planifolia ssp. *pulchra*	Diamondleaf willow	8
Ground layer (<0.5 m tall)		52
Mosses, unidentified		17
Feather mosses	Feather moss	6
Empetrum nigrum	Crowberry	7
Ledum decumbens	Northern Labrador tea	18
Ledum groenlandicum	Labrador tea	4
Vaccinium uliginosum	Bog blueberry	8
Vaccinium vitis-idaea	Mountain cranberry	8
Arctostaphylos rubra	Red-fruit bearberry	6
Betula glandulosa	Resin birch	34
Betula nana	Dwarf arctic birch	9

* Number of areas sampled was 10.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.69: COVER PERCENTAGES FOR TOTAL VEGETATION, VERTICAL STRATA, AND PLANT SPECIES IN OPEN LOW SHRUB VEGETATION TYPE* IN WATANA AND GOLD CREEK WATERSHEDS (FROM MCKENDRICK ET AL. 1982)

Category		Average Cover** (percent)
Total vegetation		100
Shrub layer (>0.5 m tall, <2.5 cm dbh)		17
Betula glandulosa	Resin birch	5
Ground layer (<0.5 m tall)		83
Feather mosses	Feather moss	13
Ledum groenlandicum	Labrador tea	5
Vaccinium uliginosum	Bog blueberry	15
Betula glandulosa	Resin birch	15
Carex aquatilis	Water sedge	43

* Number of areas sampled was 2.

**Includes only those species with at least 5 percent cover in any one area sampled.

TABLE E.3.70: AQUATIC PLANT SURVEY, SUSITNA HYDROELECTRIC PROJECT, AUGUST 1980 (FROM MCKENDRICK ET AL. 1982)

SPECIES	Pond or Lake (#)																							
"TRUE" AQUATICS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Climacium sp. -- Moss															d(*)				c					
Isoetes muricata -- Quillwort											s													
Equisetum fluviatile -- Horsetail	d	d	d					c										d				s		s
Sparganium angustifolium -- Bur reed	c	d	d	d			d			d	d	c	d	c		c	d	s			s	c	c	c
Potamogeton sp. -- Pondweed (narrow-leaved)		c					c	s																
Potamogeton sp. -- Pondweed (broad-leaved)								s										s				c		d
Potamogeton robbinsii -- Pondweed																				d				
Potamogeton filiformis -- Pondweed																			s		s			
Eriophorum spp. -- Cotton grass																		s						
Carex aquatilis -- Sedge	d	d			c	c		d	d								c	d						
Nuphar polysepalum -- Yellow pond lily		c				d	d	d	d	d	c	d	d	d		d	c		d		d	d	d	d
Ranunculus confervoides -- Buttercup		c		d		d		s		s					s	s								
Potentilla palustris -- Marsh fivefinger										s														
Callitriche verna -- Water starwort															d									
Hippuris vulgaris -- Mare's tail							c			c	s				d		c		c		s	s		s
Menyanthes trifoliata -- Buckbean																							s	
Utricularia vulgaris -- Bladderwort											c	d		c	c	d	d				s		s	d

* d = dominant, c = common, s = sparse

TABLE E.3.70 (Contd.)

SPECIES "BANK" SPECIES	Pond or Lake (#) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Sphagnum spp. -- Sphagnum moss															c(*)	d							d	
Equisetum fluviatile -- Horsetail		d	d					d		s														
Woodsia sp. -- Woodsia												s												
Calamagrostis canadensis -- Reed bent grass				d	d			d		c							c							s
Eriophorum spp. -- Cotton grass				d	d	c			d			d	d	c				s			d		c	
Carex sp. -- Sedge						d							d								d			
Carex aquatilis -- Sedge		d	d	d	d	d	d	d	d	d		d	s	d	d	d	d	d		d	d	d	d	
Carex rhyncophysa -- Sedge			s														s							
Iris setosa -- Iris		s																						
Salix sp. -- Willow					c							s												s
Potentilla palustris -- Marsh fivefinger				c	d		c	c		d		c			c	d	c	s	s			c	d	c
Andromeda polifolia -- Andromeda					c																			
Menyanthes trifoliata -- Buckbean		s						c		c			d								s		c	

* d = dominant, c = common, s = sparse

TABLE E.3.70 (Contd)

	Pond or Lake #																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Total Cover (%)	<1	<5	-(*)	0-1	-	-	10-20	<5	-	0-5	0-1	1-5	1-2	80-90	80-100	50-60	1-5	0-1	5-10	40-50	15	20-30	20-35	10-20
Surrounding Wetland Width (Meters)	0	2-3	-	3-6	6-9	3-6	3-6	2-9	-	15-30	0-3	15-25	3-5	15-30	15-25	30-45	3-15	1-2	2-3	0	6-9	12-15	3-6	2-3
Elevation (Feet)	1950	1700	2300	2300	2180	2180	2800	1950	1950	1975	2300	2280	2410	2340	1850	2300	2060	2750	1800	3000	2250	2560	2575	2560

* data not recorded

TABLE E.3.71: HECTARES AND PERCENTAGE OF TOTAL AREA COVERED BY VEGETATIVE COMMUNITY TYPES IN THE WATANA WATERSHED (MODIFIED FROM MCKENDRICK ET AT. 1982, BASED ON MAPS AT A SCALE OF 1:250,000)

Vegetative Community	Hectares	Acres	Percent of Total Area
Forest	310,155	766,393	21.29
conifer	300,931	743,600	20.66
woodland spruce	185,608	458,637	12.74
open spruce	115,001	284,167	7.89
closed spruce	323	798	0.02
deciduous	1,290	3,188	0.09
open birch	968	2,392	0.07
closed birch	323	798	0.02
Mixed	7,933	19,602	0.54
open	7,817	19,316	0.54
closed	134	331	0.01
Tundra	323,612	799,645	22.21
wet sedge	4,839	11,957	0.33
mesic sedge	183,834	454,254	12.62
herbaceous alpine	807	1,194	0.06
mat and cushion	51,690	127,726	3.55
mat and cushion/sedge	82,442	203,714	5.66
Shrubland	595,519	1,471,527	40.88
tall shrub	93,379	230,740	6.75
low shrub	497,140	1,228,433	34.13
birch	20,520	50,705	1.41
willow	10,645	26,304	0.73
mixed	465,975	1,151,424	31.99
Unvegetated	227,497	562,145	15.62
water	34,715	85,781	2.38
rock	103,063	254,669	7.07
snow and ice	89,720	221,698	6.16
Total vegetated area	1,229,286	3,037,566	84.38
Total area	1,456,783	3,599,711	100.00

TABLE E.3.72: HECTARES AND PERCENTAGE OF TOTAL AREA COVERED BY VEGETATIVE COMMUNITY TYPES IN THE GOLD CREEK WATERSHED (MODIFIED FROM MCKENDRICK ET AT. 1982, BASED ON MAPS AT A SCALE OF 1:250,000)

Vegetative Community	Hectares	Acres	Percent of Total Area
Forest	38,077	94,088	21.86
conifer	6,655	16,445	3.82
woodland spruce	2,783	6,877	1.60
open spruce	3,872	9,568	2.22
closed spruce	-	-	-
deciduous	-	-	-
open birch	-	-	-
closed birch	-	-	-
Mixed	31,422	77,644	18.04
open	15,570	38,474	8.94
closed	15,852	39,170	9.10
Tundra	71,073	175,621	40.80
wet sedge	-	-	-
mesic sedge	524	1,295	0.30
herbaceous alpine	-	-	-
mat and cushion	13,311	32,891	7.64
mat and cushion/sedge	57,238	141,435	32.85
Shrubland	49,171	121,501	28.22
tall shrub	30,656	75,751	17.60
low shrub	18,515	45,751	10.63
birch	13,029	32,195	7.48
willow	-	-	-
mixed	5,486	13,556	3.15
Unvegetated	15,895	39,277	9.12
water	5,125	12,664	2.94
rock	10,649	26,314	6.11
snow and ice	121	299	0.07
Total vegetated area	158,321	391,211	90.88
Total area	174,216	430,488	100.00

TABLE E.3.73: PERCENT COVER IN EARLY SUCCESSIONAL STANDS* ON DOWNSTREAM FLOODPLAIN OF SUSITNA RIVER (FROM MCKENDRICK ET AL. 1982)

Category		Mean Percent Cover
<u>Physical Features</u>		
Water		+
Bare ground		53
Gravel, cobbles		2
<u>Vegetation Categories</u>		
Litter		13
Standing dead		+
Perennial grasses		1
Perennial forbs		25
Mosses		+
Lichens		+
Low shrubs		4
Tall shrubs		+
Trees		8
Total vegetation		38
<u>Vegetation by Species or Genus</u>		
<u>Equisetum variegatum</u>	Variegated horsetail	25
<u>Populus balsamifera</u>	Balsam poplar	8
<u>Salix alaxensis</u>	Feltleaf willow	4
<u>Salix novae-angliae</u>	Tall blueberry willow	1
<u>Salix arbusculoides</u>	Little tree willow	+
<u>Salix</u> sp.	Willow	+
<u>Astragalus</u> sp.	Milk-vetch	+
<u>Hedysarum</u> sp.	Sweet-vetch	+
<u>Calamagrostis canadensis</u>	Bluejoint	+
<u>Eriophorum</u> sp.	Cottongrass	+
<u>Scirpus</u> sp.	Bulrush	+
<u>Alnus tenuifolia</u>	Thinleaf alder	+
<u>Alnus sinuata</u>	Sitka alder	+
<u>Artemisia telesii</u>	Wormwood	+
<u>Nephroma</u> sp.	Nephroma	+

*Early successional stands were numbers 1, 5, 6, 8, 9, 13, 14, 15, 20, 21, 22, and 25 shown in Figure E.3.34. Number of transects sampled was 42.

TABLE E.3.74: PERCENT COVER IN ALDER STANDS* ON DOWNSTREAM FLOODPLAIN OF SUSITNA RIVER (FROM MCKENDRICK ET AL. 1982)

Category		Mean Percent Cover
Physical Features		
Bare ground		1
Litter		99
Vegetation Categories		
Standing dead		+
Perennial grasses		38
Perennial forbs		11
Mosses		+
Lichens		+
Low shrubs		6
Tall shrubs		60
Trees		13
Total vegetation		87
Vegetation by Species or Genus		
Calamagrostis canadensis	Bluejoint	38
Alnus tenuifolia	Thinleaf alder	59
Alnus sinuata	Sitka alder	3
Viburnum edule	Highbush cranberry	1
Epilobium angustifolium	Fireweed	3
Populus balsamifera	Balsam poplar	13
Artemisia tilesii	Wormwood	3
Salix alaxensis	Feltleaf willow	5
Salix novae-angliae	Tall blueberry willow	+
Salix sp.	Willow	+
Stellaria sp.	Starwort	+
Epilobium latifolium	Dwarf fireweed	+
Rosa acicularis	Prickly rose	+
Ribes spp.	Currant	+
Hedysarum sp.	Sweet-vetch	+
Rubus arcticus	Nagoonberry	+
Rubus idaeus	Raspberry	+
Trientalis europaea	Arctic starflower	+
Galium sp.	Bedstraw	+
Poa sp.	Bluegrass	+

* Alder stands were numbers 2, 19, 23, and 27 shown in Figure E.3.34. Number of transects sampled was 20.

TABLE E.3.75: PERCENT COVER IN IMMATURE BALSAM POPLAR STANDS* ON DOWNSTREAM FLOODPLAIN (FROM MCKENDRICK ET AL. 1982)

Category		Mean Percent Cover
Physical Features		
Vegetation Categories		
Litter		95
Standing dead		+
Perennial grasses		23
Perennial forbs		9
Mosses		+
Low shrubs		6
Tall shrubs		48
Trees		62
Total vegetation		91
Vegetation by Species or Genus		
Populus balsamifera	Balsam poplar	62
Alnus tenuifolia	Thinleaf alder	40
Alnus sinuata	Sitka alder	8
Calamagrostis canadensis	Bluejoint	23
Viburnum edule	Highbush cranberry	3
Artemisia tilesii	Wormwood	3
Heracleum lanatum	Cow parsnip	1
Mertensia paniculata	Tall bluebell	1
Rosa acicularis	Prickly rose	3
Picea glauca	White spruce	+
Salix novae-angliae	Tall blueberry willow	+
Pyrola secunda	One-sided wintergreen	+
Pyrola sp.	Wintergreen	+
Rubus idaeus	Raspberry	+
Sanguisorba stipulata	Sitka burnet	+
Galium sp.	Bedstraw	+
Matteuccia struthiopteris	Ostrich fern	+
Streptopus amplexicaulis	Cucumber-root	+

*Immature balsam poplar stands were numbers 10, 12, and 26 shown in Figure E.3.34. Number of transects sampled was 18.

TABLE E.3.76: PERCENT COVER IN BIRCH-SPRUCE STANDS* ON DOWNSTREAM FLOODPLAIN, SUMMER 1981 (FROM MCKENDRICK ET AL. 1982)

Category		Mean Percent Cover
Vegetation Categories		
Litter		100
Standing dead		+
Perennial grasses		18
Perennial forbs		44
Mosses		1
Low shrubs		40
Tall shrubs		14
Trees		52
Total vegetation		93
Vegetation by Species or Genus		
Betula papyrifera	Paper birch	42
Picea glauca	White spruce	12
Alnus tenuifolia	Thinleaf alder	10
Alnus sinuata	Sitka alder	5
Viburnum edule	Highbush cranberry	19
Ribes spp.	Currant	5
Rosa acicularis	Prickly rose	20
Calamagrostis canadensis	Bluejoint	18
Dryopteris dilatata	Spinulose shield-fern	7
Gymnocarpium sp.	Oak-fern	4
Echinopanax horridum	Devil's club	4
Cornus canadensis	Bunchberry	1
Mertensia paniculata	Tall bluebell	1
Rubus idaeus	Raspberry	3
Epilobium angustifolium	Fireweed	1
Epilobium latifolium	Dwarf fireweed	+
Salix novae-angliae	Tall blueberry willow	+
Rubus sp.	Bramble	+
Rubus arcticus	Nagoonberry	+
Trientalis europaea	Arctic starflower	+

*Birch-spruce stands were numbers 4, 11, and 29 shown in Figure E.3.34. Number of transects sampled was 20.

TABLE E.3.77: HECTARES AND PERCENT OF TOTAL AREA COVERED BY VEGETATION TYPES WITHIN THE HEALY TO FAIRBANKS STUDY CORRIDOR (FROM MCKENDRICK ET AL. 1982)

Vegetation Type*	Hectares	Acres	Percent of Total Area
Forest	86,830	214,557	77.9
Woodland spruce	1,812	4,477	1.6
Open spruce	31,739	78,427	28.5
Closed spruce	1,347	3,328	1.2
Woodland deciduous	993	2,454	.9
Open deciduous	12,553	31,018	11.3
Closed deciduous	10,384	25,659	9.3
Woodland conifer-deciduous	961	2,375	0.9
Open conifer-deciduous	12,502	30,892	11.2
Closed conifer-deciduous	4,125	10,193	3.7
Open spruce/open deciduous	948	2,343	0.9
Open spruce/wet sedge-grass/ open deciduous	1,993	4,925	1.8
Open spruce/low shrub/wet sedge-grass/open deciduous	7,008	17,317	6.3
Open spruce/low shrub	465	1,149	0.4
Tundra	4,407	10,890	3.9
Wet sedge-grass	2,268	5,604	2.0
Sedge grass	277	684	0.2
Sedge shrub	566	1,399	.5
Sedge-grass/mat and cushion	1,296	3,202	1.2
Shrubland	17,199	42,499	15.4
Low mixed shrub	15,405	38,066	13.8
Willow shrub	58	143	.05
Low shrub/wet sedge-grass	1,736	4,290	1.6
Agricultural land	175	432	.2
Disturbed	431	1,065	.4
Unvegetated	2,467	6,096	2.2
Lakes	196	484	.2
River	2,143	5,295	1.9
Gravel	128	316	.1
Total Area	111,509	275,539	100.0

*The Tanana Flats portion of the transmission corridor is an area of extremely complex mosaics of various vegetation types. As a result, various complexes were recognized.

TABLE E.3.78: HECTARES AND PERCENT OF TOTAL AREA COVERED BY VEGETATION TYPES WITHIN THE WILLOW TO COOK INLET STUDY CORRIDOR (FROM MCKENDRICK ET AL. 1982)

Vegetation Type	Hectares	Acres	Percent of Total Area
Forest	25,851	63,878	67.0
Woodland spruce	2,457	6,071	6.3
Open spruce	3,402	8,406	8.8
Closed spruce	3,226	7,971	8.4
Open birch	16	40	.04
Closed birch	3,638	8,989	9.4
Open balsam poplar	100	247	.3
Closed balsam poplar	172	425	.5
Open conifer-deciduous	1,697	4,193	4.4
Closed conifer-deciduous	11,143	27,534	28.9
Wet sedge-grass	9,123	22,543	23.7
Shrubland	2,213	5,468	5.7
Closed tall shrub	92	227	.2
Low mixed shrub	2,121	5,240	5.5
Lakes	1,011	2,498	2.6
Disturbed	381	941	1.0
Total Area	38,579	95,328	100.0

TABLE E.3.79: AREAS OF DIFFERENT VEGETATION TYPES TO BE CROSSED BY WILLOW-TO-HEALY TRANSMISSION CORRIDOR*

Cover Type	Hectares	Acres	Proportion of Total Area Cleared
Moist tundra	37.5	92.8	1.5
Wet tundra	77.6	191.6	3.1
Alpine tundra	17.5	43.3	0.7
Bottomland spruce-poplar forest	215.2	531.8	8.6
Upland spruce-hardwood forest	1168.7	2888.0	46.7
Lowland spruce-hardwood forest	608.1	1502.7	24.3
Shrublands	290.3	717.3	11.6
Low brush, muskeg bog	87.6	216.4	3.5
Total:	2502.6	6183.8	100.0%

*Calculated from data in Table 22 from Commonwealth Associates (1982). The values here represent the additional clearing of the corridor to 91 m (300 ft) from the 33 m (110 ft) given by Commonwealth Associates (1982).

TABLE E.3.80: AREAS OF EACH VEGETATION TYPE TO BE CROSSED BY WATANA-TO-GOLD CREEK TRANSMISSION CORRIDORS, AND PERCENT TOTAL* FOR WATANA AND GOLD CREEK WATERSHEDS

	Watana to Devil Canyon**			Devil Canyon to Gold Creek***		
Vegetation Type	ha	acres	%*	ha	acres	%*
Forest	48.3	119.4	0.0	120.5	297.6	0.0
Woodland white spruce	27.8	68.7	0.0	-	-	-
Open white spruce	-	-	-	-	-	-
Open black spruce	-	-	-	5.6	13.8	0.0
Open birch	0.8	2.0	0.1	2.8	6.9	0.3
Closed birch	3.3	8.2	2.5	-	-	-
Closed balsam poplar	-	-	-	-	-	-
Open mixed	-	-	-	-	-	-
Closed mixed	16.4	40.5	0.1	112.1	276.9	0.7
Shrubland	184.8	456.5	0.0	-	-	-
Closed tall	51.9	128.2	0.0	-	-	-
Low (birch)	32.3	79.8	0.1	-	-	-
Low (willow)	88.3	218.1	0.8	-	-	-
Low (mixed)	12.3	30.4	0.0	-	-	-
Tundra	146.7	362.4	0.0	11.2	27.7	0.0
Wet sedge-grass	-	-	-	11.2	27.7	0.2
Sedge-grass	47.4	117.1	0.0	-	-	-
Sedge shrub	48.2	119.1	****	-	-	-
Mat and cushion	51.1	126.2	0.1	-	-	-
Total	379.8	938.3		131.7	325.3	

* Percent of total area of each vegetation type in entire Watana and Gold Creek watersheds, based on 1:250,000-scale mapping (McKendrick et al. 1982).

** Based on clearing width of 300 ft.

*** Based on clearing width of 510 ft.

**** Data not available for entire Watana and Gold Creek watersheds.

TABLE E.3.81: VEGETATION AND WETLAND CLASSES FOUND IN THE PROPOSED SUSITNA IMPOUNDMENT AND BORROW AREAS

Mapping Unit (Viereck & Dyrness 1980)	FWS Wetland Class (Cowardin et al. 1979)
Lakes, ponds	Lacustrine unconsolidated bottom, aquatic bed, unconsolidated shore
Rivers, streams	Riverine Upper Perennial rock bottom, unconsolidated bottom, rocky shore, unconsolidated shore
Wet sedge-grass	Palustrine or Lacustrine emergent
Low shrub	Palustrine scrub-shrub
Birch shrub	Palustrine scrub-shrub
Willow shrub	Palustrine scrub-shrub
Open black spruce	Palustrine forested
Woodland black spruce	Palustrine forested
Open white spruce	Palustrine forested
Closed white spruce	Palustrine forested
Open balsam poplar	Palustrine forested
Closed balsam poplar	Palustrine forested

TABLE E.3.82: HECTARES OF DIFFERENT WETLAND TYPES* BY PROJECT COMPONENT (FROM MCKENDRICK ET AL. 1982)

WATANA FACILITY

Wetland Type	Impoundment, Dam and Spillways	Camp, Village and Airstrip	BORROW AREAS A	D	E	F	H	I
Palustrine forested	7,408		252	16	133	80	345	15
Palustrine scrub-shrub	1,126	142	62	212		199	38	
Palustrine emergent	139		8	8				
Lacustrine emergent	4							
Lacustrine	54	8						
Riverine	2,182							
Total	10,913	150	322	236	133	279	383	15

DEVIL CANYON FACILITY

Wetland Type	Impoundment, Dam and Spillways	Camp and Village	Borrow Area K
Palustrine forested	800		11
Palustrine shrub-scrub	43		29
Palustrine emergent	12		
Lacustrine emergent			
Lacustrine	1		
Riverine	810		
Total	1,666	-0-	40

*Wetland types according to Cowardin et al. (1979).

TABLE E.3.83: HECTARES OF DIFFERENT VEGETATION TYPES TO BE IMPACTED BY THE WATANA FACILITY COMPARED WITH TOTAL HECTARES OF THAT TYPE UPSTREAM OF GOLD CREEK IN THE SUSITNA WATERSHED AND IN THE AREA WITHIN 16 km OF THE SUSITNA RIVER* (MODIFIED FROM MCKENDRICK ET AL. 1982)

Vegetation Type	Dam and Spillways	Impoundment	Camp	Village	Airstrip	Borrow Areas[1] A	D	E	F	H	I	Total	Percent of Watershed Total For That Type	Percent of 16 km* Area For That Type
Forest	34****	10784				181	53	180	81	451	34	11798	3.4	8.3
Woodland spruce-black	8	3870				179	16			224		4297	3.1	6.8
Woodland spruce-white		397						71	69			537	3.1	4.0
Open spruce-black		2864								121	15	3000	4.0	10.6
Open spruce-white		769				2		62	11			844	4.0	8.0
Open birch	1	325										326	33.7	21.8
Closed birch	13	460					5					478	148.0**	20.5
Closed balsam poplar		3										3	***	0.5
Open conifer-deciduous	5	1337					32			106		1480	6.4	15.4
Closed conifer-deciduous	7	759						47	1		19	833	5.2	6.3
Tundra		84				70	8					162	0.1	0.1**
Wet sedge-grass		84					8					92	1.9	2.6
Sedge-grass														
Sedge shrub														
Mat and cushion						70						70	0.1	0.1**
Shrubland	46	1674	63	62	17	81	224		199	38		2449	0.4	1.4
Open tall shrub	6	227				1						234	0.4	1.5
Closed tall shrub	17	287				1	12					317	***	2.0
Birch shrub	1	443	34	35	13	4	88		195			813	2.4	1.9
Willow shrub		66							4	17		87	0.8	1.0
Mixed low shrub	22	651	29	27	4	75	124			21		953	0.2	1.0
Herbaceous		45										45	***	250.0**
Grassland														
Disturbed														
Unvegetated	13	2104		8		1	2					2128	0.8	7.9
Rock	1	59					2					62	0.1	0.4
Snow and ice														
River	12	2007										2019	13.7	47.7
Lake		38		8		1						47	0.2	0.8
Total	93	14736	63	70	17	333	287	180	280	489	34	16582	1.0	3.6

1 Area given is above maximum impoundment fill level.
* An area 16 km (10 mi) on either side of the Susitna River from Gold Creek to the mouth of the Maclaren River.
** Hectares are apparently greater in the impact areas than for the entire basin, because the basin was mapped at a much smaller scale, and many of the stands did not appear at that scale.
*** Areas of this type were too small to be mapped at the scale at which the watershed was mapped.
**** 1 hectare = 2.471 acres.

TABLE E.3.84: HECTARES OF DIFFERENT VEGETATION TYPES TO BE AFFECTED BY THE DEVIL CANYON FACILITY COMPARED WITH TOTAL HECTARES OF THAT TYPE IN THE WATANA AND GOLD CREEK WATERSHEDS AND IN THE AREA WITHIN 16 km OF THE SUSITNA RIVER* (MODIFIED FROM THE MCKENDRICK ET AL. 1982)

Vegetation Type	Dam and Spillways	Impoundment	Camp	Village	Borrow***** Area K	Total	Percent of Watershed Total For That Type	Percent of 16 km* Area For That Type
Forest	16****	2289	36	39	119	2 499	0.7	1.8
Woodland spruce-black		133				133	0.3	0.2
Woodland spruce-white		20				20	0.3	0.2
Open spruce-black	4	300			11	315	1.3	1.1
Open spruce-white		329				329	1.3	3.2
Open birch		57				57	5.9	3.8
Closed birch	3	430				433	133.7**	18.6
Open balsam poplar		6				6	***	
Closed balsam poplar		8				8	***	1.4
Open conifer-deciduous	7	279				286	1.2	3.0
Closed conifer-deciduous	2	727	36	39	108	912	5.7	6.9
Tundra		11				11	0.0	0.0
Wet sedge-grass		11				11	0.2	0.3
Sedge-grass								
Sedge shrub								
Mat and cushion								
Shrubland		70			18	88	0.0	0.1
Open tall shrub		2				2	0.0	0.0
Closed tall shrub		1				1	0.0	0.0
Birch shrub		49			18	67	0.2	0.1
Willow shrub		14				14	0.1	0.2
Mixed low shrub		4				4	0.0	0.0
Herbaceous								
Grassland								
Disturbed								
Unvegetated	2	826			11	839	0.3	3.1
Rock		15				15	0.0	0.1
Snow and ice								
River	1	810				811	5.6	19.2
Lake	1	1			11	13	0.1	0.2
Total	18	3 196	36	39	148	3 437	0.2	0.7

* An area 16 km (10 mi) on either side of the Susitna River from Gold Creek to the mouth of the Maclaren River.

** Hectares of closed birch are apparently greater in the impact areas than for the entire basin, because the basin was mapped at a much smaller scale, and many of the closed birch stands did not appear at that scale.

*** Balsam poplar stands were to small to be mapped at the scale at which the watershed was mapped.

**** 1 hectare = 2.471 acres.

***** Borrow area G (not included) will consist of approximately 22 ha with stands of woodland and open black spruce, closed mixed forest, and open tall shrub.

TABLE E.3.85: AREAS OF EACH VEGETATION TYPE TO BE CLEARED FOR ACCESS, AND PERCENT TOTAL* FOR WATANA AND GOLD CREEK WATERSHEDS

	Denali Highway to Watana (Road) **			Watana to Devil Canyon (Road) **			Devil Canyon to Gold Creek (Railroad)***		
Vegetation Type	ha	acres	%	ha	acres	%*	ha	acres	%*
Forest	0.3	0.9	0.0	37.4	92.4	0.0	28.3	70.0	0.0
Woodland white spruce	-	-	-	14.1	34.8	0.0	-	-	-
Open white spruce	0.3	0.9	0.0	3.7	9.1	0.0	-	-	-
Open black spruce	-	-	-	-	-	-	1.5	3.7	0.0
Open birch	-	-	-	-	-	-	0.6	1.5	0.1
Closed birch	-	-	-	0.7	1.7	0.8	-	-	-
Closed balsam poplar	-	-	-	-	-	-	0.3	0.7	****
Open mixed	-	-	-	4.2	10.4	0.0	5.7	14.1	0.0
Closed mixed	-	-	-	14.7	36.3	0.1	20.2	50.0	0.3
Shrubland	138.8	342.8	0.1	90.8	224.3	0.0	-	-	-
Closed tall	-	-	-	24.8	61.3	0.0	-	-	-
Low (birch)	50.6	125.0	0.2	12.4	30.6	0.0	-	-	-
Low (willow)	73.5	181.6	0.7	48.4	119.6	0.5	-	-	-
Low (mixed)	14.7	36.3	0.0	5.2	12.8	0.0	-	-	-
Tundra	53.4	131.9	0.0	61.1	150.9	0.0	0.8	2.0	0.0
Wet sedge-grass	10.2	25.2	0.2	-	-	-	0.8	2.0	0.0
Sedge-grass	15.1	37.3	0.0	10.4	25.7	0.0	-	-	-
Sedge shrub	-	-	-	16.7	41.3	****	-	-	-
Mat and cushion	28.1	69.4	0.0	34.0	84.0	0.1	-	-	-
TOTAL	192.5	476.5		189.3	467.6		29.1	72.0	

* Percent of total area of each vegetation type in entire Watana and Gold Creek watersheds, based on 1:250,000-scale mapping (McKendrick et al. 1982).

** Based on clearing width of 120 ft.

*** Based on clearing width of 50 ft.

**** Data not available for entire Watana and Gold Creek watersheds.

TABLE E.3.86: AREAS OF DIFFERENT VEGETATION TYPES TO BE CROSSED BY TRANSMISSION CORRIDORS*

Vegetation/Habitat Type	Healy to Fairbanks		Willow to Cook Inlet		Total	
	ha	acres	ha	acres	ha	acres
Forest	1150.7	2843.4	535.3	1322.9	1686.0	4166.3
Woodland spruce-black	33.3	82.2	15.5	38.2	48.8	120.4
Woodland spruce-white						
Open spruce-black	514.1	1270.2	73.5	181.6	587.6	1451.8
Open spruce-white						
Closed spruce	55.9	138.2	46.3	113.9	102.2	252.1
Open deciduous	112.4	277.6	--	--	112.4	277.6
Closed deciduous	55.9	141.5	--	--	55.9	141.5
Open brich	--	--	--	--	--	--
Closed birch	--	--	86.1	212.8	86.1	212.8
Woodland conifer-deciduous	21.6	53.4	--	--	21.6	53.4
Open conifer-deciduous	188.3	465.2	83.9	207.3	272.2	672.5
Closed conifer-deciduous	45.2	111.6	228.9	568.3	274.1	679.9
Open spruce/open deciduous	23.1	57.0	--	--	23.1	57.0
Open spruce/wet sedge-grass/ open deciduous	32.2	79.6	--	--	32.2	79.6
Open spruce/low shrub/ wet sedge-grass/ open deciduous	52.5	129.8	--	--	52.5	129.8
Open spruce/low shrub	14.7	36.4	--	--	14.7	36.4
Tundra	37.2	91.8	75.5	186.6	112.7	278.4
Wet sedge-grass	23.3	55.2	75.5	186.6	98.8	241.8
Sedge-grass	7.5	18.4	--	--	7.5	18.4
Sedge shrub	7.4	18.2	--	--	7.4	18.2
Shrubland	231.7	572.4	37.7	93.2	269.4	665.6
Open tall shrub	--	--	--	--	--	--
Closed tall shrub	--	--	--	--	--	--
Birch shrub	--	--	--	--	--	--
Low mixed shrub	220.6	545.1	37.7	93.2	258.3	638.3
Low shrub/wet sedge-grass	11.1	27.3	--	--	11.1	27.3
Disturbed	9.3	22.9	--	--	9.3	22.9
Unvegetated	13.8	34.1	0.9	2.3	14.7	36.4
Lakes	2.7	6.7	0.9	2.3	3.6	9.0
Rivers	11.1	27.3	--	--	11.1	27.3
Totals:	2875.7	7105.7	1299.0	3209.3	4174.7	10315.7

*Calculated from values in Table 53 in McKendrick et al. (1982). Right-of-way width was adjusted to 91 m (300 ft) along the entire transmission corridor.

TABLE E.3.87: COMPARISON BETWEEN AERIAL HABITAT CLASSIFICATIONS AND THOSE OF VIERECK AND DYRNESS (1980) USED TO CLASSIFY OBSERVATIONS OF RADIO-COLLARED MOOSE IN THE NELCHINA AND SUSITNA RIVER BASINS OF SOUTH-CENTRAL ALASKA FROM 1977 THROUGH MID-AUGUST

(from ADF&G 1982a)

Aerial Habitat Classifications	Equivalent Classification from Viereck and Dyrness (1980)
Dense tall spruce (white or unknown)	Open white spruce
Medium density, tall height spruce (white or unknown)	Open white spruce, open mixed forest, closed mixed forest
Sparsely dense tall spruce (white or unknown)	Woodland white spruce, open mixed forest, closed mixed forest
Dense medium height spruce (white, black or unknown)	Open black spruce
Medium density, medium height spruce (white, black or unknown)	Open black spruce, open mixed forest, closed mixed forest
Sparsely dense, medium height spruce (white, black or unknown)	Woodland white spruce, open mixed forest, closed mixed forest
Medium density, short spruce (black or unknown)	Open black spruce, open mixed forest, closed mixed forest
Sparsely dense short spruce	Woodland black spruce, open mixed forest, closed mixed forest
Riparian willow	Willow shrub, wet sedge-grass tundra
Upland willow & brush	Willow shrub, sedge shrub tundra, mixed low shrub
Aspen	Closed balsam poplar
Riparian hardwood or unidentified	Open birch forest, closed birch forest
Alder	Closed tall shrub, open tall shrub, willow shrub
Rock/Ice	Rock/Ice

TABLE E.3.88: MONTHLY USE OF HABITAT TYPES BY RADIO-COLLARED MOOSE OF BOTH SEXES AND ALL AGES AS DETERMINED FROM FIXED-WING AIRCRAFT FROM OCTOBER 1976 THROUGH MID-AUGUST 1981 IN THE MIDDLE AND UPPER SUSITNA AND NELCHINA RIVER BASINS

(from ADF&G 1982a)

Vegetation[1] Classification	Jan. #	Jan. %	Feb. #	Feb. %	Mar. #	Mar. %	April #	April %	May #	May %	June #	June %	July #	July %	Aug. #	Aug. %	Sept. #	Sept. %	Oct. #	Oct. %	Nov. #	Nov. %	Dec. #	Dec. %	Total #	Total %
Birch	0	0	0	0	0	0	0	0	2	.7	1	.3	1	.6	0	0	0	0	0	0	0	0	0	0	4	.2
Unidentified hardwood	0	0	0	0	0	0	0	0	0	0	1	.3	0	0	0	0	0	0	0	0	1	1.1	1	1.1	3	.2
Dense medium height black spruce	2	4.8	2	3.3	0	0	8	6.7	12	4.4	21	6.8	10	5.9	10	7.4	9	7.8	4	3.0	2	2.2	1	1.1	81	4.6
Dense medium height white spruce	0	0	0	0	0	0	3	2.5	2	.7	0	0	0	0	0	0	1	.9	2	1.5	1	1.1	0	0	9	.5
Dense short black spruce	2	4.8	1	1.7	1	.5	2	1.7	6	2.2	5	1.6	0	0	1	.7	5	4.3	1	.7	2	2.2	1	1.1	27	1.5
Dense tall black spruce	0	0	0	0	1	.5	1	.8	0	0	0	0	4	2.4	0	0	0	0	0	0	0	0	1	1.1	7	.4
Dense tall white spruce	1	2.4	6	10.0	7	3.4	4	3.4	9	3.3	8	2.6	2	1.2	0	0	2	1.7	2	1.5	2	2.2	4	4.3	47	2.7
Alder	0	0	0	0	0	0	0	0	0	0	0	0	2	1.2	2	1.5	0	0	0	0	0	0	0	0	4	.2
Dense medium height black spruce	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1.5	0	0	0	0	0	0	0	0	2	.1
Medium dense medium height black spruce	4	9.5	17	28.3	57	27.8	38	31.9	84	31.0	59	19.1	36	21.3	23	16.9	27	23.3	18	13.3	13	14.1	17	18.3	393	22.5
Medium dense short spruce	6	14.3	2	3.3	21	10.2	7	5.9	15	5.5	29	9.4	9	5.3	11	8.1	8	6.9	2	1.5	2	2.2	2	2.2	114	6.5

TABLE E.3.88 (Page 2)

Vegetation Classification[1]	Jan. #	Jan. %	Feb. #	Feb. %	Mar. #	Mar. %	April #	April %	May #	May %	June #	June %	July #	July %	Aug. #	Aug. %	Sept. #	Sept. %	Oct. #	Oct. %	Nov. #	Nov. %	Dec. #	Dec. %	Total #	Total %
Medium dense tall spruce	0	0	0	0	1	.5	3	2.5	3	1.1	2	.6	5	3.0	4	2.9	0	0	0	0	0	0	1	1.1	19	1.1
Medium dense tall white spruce	2	4.8	5	8.3	5	2.4	9	7.6	14	15.2	18	5.8	4	2.4	11	8.1	7	6.0	10	7.4	3	3.3	4	4.3	92	5.3
Upland brush and willow	14	33.3	18	30.0	34	16.6	12	10.1	44	16.2	72	23.3	53	31.4	32	23.5	29	25.0	58	43.0	35	38.0	40	43.0	441	25.2
Sparse dense medium spruce	8	19.0	6	10.0	58	28.3	24	20.2	56	20.7	57	18.4	21	12.4	17	12.5	14	12.1	24	17.8	19	20.7	11	11.8	315	18.0
Sparse short spruce	2	4.8	1	1.7	13	6.3	3	2.5	14	5.2	22	7.1	17	10.1	6	4.4	9	7.8	2	1.5	7	7.6	8	8.6	104	6.0
Sparse tall spruce	1	2.4	0	0	1	.5	0	0	4	1.5	0	0	5	3.0	4	2.9	1	.9	0	0	2	2.2	0	0	18	1.0
Sparse tall white spruce	0	0	2	3.3	6	2.9	5	4.2	6	2.2	14	4.5	0	0	13	9.6	4	3.4	12	8.9	3	3.3	2	2.2	67	3.8
Column Total	42	2.4	60	3.4	205	11.7	119	6.8	271	15.5	309	17.7	167	9.7	136	7.8	116	6.6	135	7.7	92	5.3	93	5.3	1747	100.0

[1] Aerial habitat classifications and the approximate Viereck & Dyrness equivalents are given in Table E.3.87.

TABLE E.3.89: SUMMARY OF ELEVATIONAL USE BY APPROXIMATELY 200 RADIO-COLLARED MOOSE (BOTH SEXES AND ALL AGE CLASSES) FROM OCTOBER 1976 THROUGH MID-AUGUST 1981 IN THE MIDDLE AND UPPER SUSITNA AND NELCHINA RIVER (from ADF&G 1982a)

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Mean elevation	2800	2736	2686	2577	2641	2690	2755	2790	2745	2997	2953	2955	2749
Standard deviation	461.8	468.0	442.4	461.9	449.0	426.6	531.2	509.6	451.8	488.6	480.4	475.7	
Sample size	66	98	285	204	341	424	218	174	130	193	168	116	2417
Range of elevations													
Minimum	1800	1400	1700	1500	1400	1300	-	1800	1800	1400	1450	1600	
Maximum	3900	3900	4600	4100	3800	4400	4200	4800	4000	4200	4400	4600	

TABLE E.3.90: OCCURRENCE AND MEAN PERCENT OF CANOPY COVERAGE FOR SPECIES OF RIPARIAN (R) AND NON-RIPARIAN (NR) VEGETATION AND HABITAT TYPES OBSERVED AT RELOCATION SITES FOR 6 MALE MOOSE CAPTURED AND RADIO-COLLARED ALONG THE SUSITNA RIVER SOUTH OF TALKEETNA, ALASKA, AND MONITORED DURING CALVING, SUMMER, BREEDING, AND TRANSITIONAL PERIODS FROM MARCH 16 TO OCTOBER 15, 1981
(from ADF&G 1982b)

Vegetative type	Seasonal Period[1]															
	Calving				Summer				Breeding				All Transitions			
	NR	%	R	%	NR	%	R	%	NR	%	R	%	NR	%	R	%
	(N[2]=30)		(N=0)		(N=38)		(N=3)		(N=21)		(N=4)		(N=58)		(N=6)	
Total % of relocations	100%		0%		93%		7%		84%		16%		91%		9%	
Alder	10	20	0	-	25	24	3	30	17	34	2	80	15	21	3	31
Birch	22	52	0	-	29	45	3	37	12	33	3	23	43	47	2	30
Spruce	24	28	0	-	30	19	3	23	20	21	2	25	53	35	5	16
Cottonwood	1	40	0	-	2	31	1	T	3	13	1	T	5	22	4	73
Sedge	7	30	0	-	2	20	1	20	0	-	0	-	1	50	0	-
Grass	5	37	0	-	4	23	0	-	0	-	0	-	2	55	0	-
Sedge and/or grass	0	0	0	-	15	35	0	-	13	32	2	10	5	55	0	-
Willow	7	26	0	-	2	35	0	-	1	10	0	-	6	23	5	15
Fern	0	-	0	-	2	10	0	-	0	-	0	-	1	10	0	-
Devil's Club	1	30	0	-	18	21	1	10	2	20	0	-	6	23	0	-
Horsetail	2	T	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Muskeg	1	50	0	-	2	15	0	-	4	50	1	50	3	47	0	-
Aspen	0	-	0	-	0	-	0	-	0	-	0	-	3	38	0	-
Water	0	-	0	-	0	-	0	-	0	-	1	50	0	-	0	-

1 Calving = May 14 - June 17; Summer = July 1 to August 31; Breeding = September 14 - October 31; All Transitions = remainder of time from April 16 to October 15, excluding calving, summer, and breeding periods. NR = non-riparian and R = riparian, within the outmost banks of the Susitna River; Percent = average for percents of canopy coverage at sites where present; T = trace, less than 10 percent per observation; and

2 N = number of moose relocations (higher in every season in non-riparian vegetation types).

TABLE E.3.91: OCCURRENCE AND MEAN PERCENT OF CANOPY COVERAGE FOR SPECIES OF RIPARIAN (R) AND NON-RIPARIAN (NR) VEGETATION AND HABITAT TYPES OBSERVED AT RELOCATION SITES FOR 19 FEMALE MOOSE CAPTURED AND RADIO-COLLARED ALONG THE SUSITNA RIVER SOUTH OF TALKEETNA, ALASKA, AND MONITORED DURING CALVING, SUMMER, BREEDING, AND TRANSITIONAL PERIODS FROM MARCH 16 TO OCTOBER 15, 1981

(from ADF&G 1982b)

Vegetative Type	Seasonal Period[1]															
	Calving				Summer				Breeding				All Transitions			
	NR (N[2]=78	%	R (N=15)	%	NR (N=110)	%	R (N=16)	%	NR (N=68)	%	R (N=17)	%	NR (N=153)	%	R (N=55)	%
Total % of relocations	83%		16%		82%		13%		80%		20%		73%		26%	
Alder	12	27	9	34	64	28	12	41	51	27	14	34	37	27	16	31
Birch	50	56	7	34	107	40	11	36	57	41	8	38	137	48	18	41
Spruce	71	31	10	9	104	20	3	7	66	24	13	15	148	33	40	28
Cottonwood	1	60	10	55	2	10	12	35	2	10	9	43	12	31	40	63
Sedge	13	33	2	15	1	30	0	-	0	-	0	-	2	10	2	T
Grass	7	20	2	35	14	25	3	20	0	-	0	-	4	20	0	-
Sedge and/or grass	0	-	0	-	28	40	3	13	43	21	10	24	13	25	3	25
Willow	13	33	6	35	2	15	5	26	0	-	0	-	11	16	21	32
Fern	0	-	0	-	6	13	0	-	4	15	0	-	3	13	0	-
Devil's Club	1	10	0	-	57	19	1	10	5	12	0	-	15	21	3	13
Horsetail	2	0	0	-	0	-	0	-	0	-	0	-	2	T	0	-
Muskeg	14	50	0	-	4	43	0	-	9	52	1	50	2	45	0	-
Aspen	1	40	-	-	0	-	1	50	1	10	0	-	8	28	0	-
Water	0	-	0	-	0	-	0	-	0	-	1	50	0	-	0	-

1 Calving = May 14 - June 17; Summer = July 1 to August 31; Breeding = September 14 - October 31;
All Transitions = remainder of time from April 16 to October 15, excluding calving, summer, and breeding periods.
NR = non-riparian and R = riparian, within the outmost banks of the Susitna River;
Percent = average for percents of canopy coverage at sites where present;
T = trace, less than 10 percent per observation; and

2 N = number of moose relocations (higher in every season in non-riparian habitats).

TABLE E.3.92: WINTER CARRYING CAPACITY OF THE WATANA IMPOUNDMENT ZONE (INCLUDING ADJACENT PROJECT FACILITIES) AND SUSITNA WATERSHED UPSTREAM OF GOLD CREEK FOR MOOSE BASED ON THE BIOMASS OF TWIGS AVAILABLE IN WINTER (SEE TEXT AND APPENDIX EH FOR DETAILED EXPLANATION OF METHODS USED).

Vegetation Type (Level 3)	Area (ha) Impoundment Zone	Area (ha) Basin	Available Browse (kg/ha)	n	Twig Biomass ($kg \times 10^3$) Impoundment Zone	Twig Biomass ($kg \times 10^3$) Basin	Moose Days Impoundment Zone	Moose Days Basin	Winter Residents Impoundment Zone	Winter Residents Basin
Open coniferous forest	3,844	96,100	29.9	240	114.9	2,873.4	22,980	574,680	127.7	3,192.7
Woodland coniferous forest	4,834	156,513	10.0	45	48.3	1,565.1	9,660	313,020	53.7	1,739.0
Open deciduous forest	326	968	5.5	15	1.8	5.3	360	1,060	2.0	5.9
Open mixed forest	1,480	23,125	34.0	15	50.3	786.3	10,060	157,260	55.9	873.7
Low mixed shrubland	1,853	520,250	29.8	363	55.2	15,503.5	11,040	3,100,700	61.3	17,226.1
TOTALS				678	270.5	20,733.6	54,100	4,146,720	301	23,037

TABLE E.3.93: DATES INDICATING CHRONOLOGY OF DEPARTURE FROM SUSTINA RIVER WINTERING AREAS FOR MALE AND FEMALE MOOSE RADIO-COLLARED ON THE SUSITNA RIVER DOWNSTREAM FROM TALKEETNA, MARCH 10-12, 1981 (from ADF&G 1982b)

Date[1]	Females		Males	
	Riparian[2]	Non-riparian	Riparian	Non-riparian
March 10-12	16	0	4	0
March 16	9	7	4	0
March 23	8	8	1	3
April 3	7	5	0	2
April 6	7	9	0	4
April 14	3	7	0	1
April 20	6	11	1	3
April 22-23	4	13	0	4
April 28	3	14	0	4

1 All individuals not relocated on each date.

2 Riparian = individuals relocated within the outmost banks of the Susitna River;
Non-riparian = individuals relocated outside the outmost banks of the Susitna River.

TABLE E.3.94: MINIMUM, MAXIMUM AND MEAN DISTANCE (km) TO THE SUSITNA RIVER FROM GEOMETRICAL CENTERS OF THE CALVING RANGE, SUMMER RANGE, AND BREEDING RANGE FOR MALE AND FEMALE MOOSE RADIO-COLLARED IN SEVERAL LOCATIONS ALONG THE SUSITNA RIVER BETWEEN DEVIL CANYON AND THE DELTA ISLANDS, ALASKA 1980-81

(from ADF&G 1982b)

Sex	Calving range May 14 to June 17					Summer range July 1 to August 31					Breeding range September 14 to October 31				
Location[1]	N[2]	Min[3]	Max	Mean	SD	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
Females															
Upstream	8	0.0	5.0	2.25	2.25	8	0.7	4.3	2.60	2.24	8	1.2	4.9	3.09	1.42
Downstream Westside	14	0.0	19.9	9.22	7.86	14	0	24.0	10.37	8.68	13	0	25.0	10.74	9.56
Eastside	4	2.1	4.6	5.33	2.63	7	2.2	10.1	6.67	3.54	7	32.2	16.9	8.91	6.28
Males															
Upstream	2	3.0	3.4	3.2	0.28	3	1.7	3.0	2.37	0.65	3	1.6	2.0	1.8	0.2
Downstream Westside	1	30.6	30.6	-	-	2	26.7	36.2	31.5	-	2	26.4	35.3	30.9	-
Eastside	5	1.5	30.9	9.80	12.06	6	3.2	29.2	10.48	9.96	6	2.0	28.8	10.28	9.49

1 Upstream = moose radio-collared north of Talkeetna; downstream = moose radio-collared south of Talkeetna; westside = moose spending the breeding season on the west side of the Susitna River; and eastside = moose spending the breeding season on the east side of the Susitna River.

2 N = moose seasons of data: 2 moose each studied 1 season = 1 moose studied for 2 seasons and each equals N=2.

3 Min = minimum, Max = maximum and SD = standard deviation for distance values in each category.

TABLE E.3.95: PROXIMITY TO THE SUSITNA RIVER OF RELOCATIONS OF 9 MALE (M) AND 29 FEMALE (F) MOOSE RADIO-COLLARED ALONG THE SUSITNA RIVER BETWEEN DEVIL CANYON AND THE DELTA ISLANDS, ALASKA, 1980-81

(from ADF&G 1982b)

Location[1]	Sex	Number: Individuals	Number: Relocations	Distance of Relocations from River: River	0-1.6km (0-1 mi)	1.6-4.8km (1-3 mi)	4.8-8.1km (3-5 mi)	8.1-16.1km (5-10 mi)	16.1-24.2km (10-15 mi)	24.2-32.3km (15-20 mi)	32.3+km (20+ mi)
Upstream											
	M	2[2]	74	3	36	29	6				
	F	10	222	21	82	90	22	6	0	1	
Downstream Westside	M	6[3]	162	13	10	55	21	43	0	19	1
	F	15	403	101	41	67	14	87	74	19	
Eastside	M	1[4]	45	0	0	2	1	0	9	11	22
	F	4[5]	166	5	4	17	32	77	22	9	

[1] Upstream - moose captured north of Talkeetna.
Downstream - moose captured south of Talkeetna.
Westside - captured moose that spent the breeding season to the west of the Susitna River.
Eastside - captured moose that spent the breeding season to the east of the Susitna River.

[2] One individual studied 1-1/2 years.

[3] One individual studied 1-1/2 years.

[4] One individual studied for 1-1/2 years.

[5] Three individuals studied for 1-1/2 years.

TABLE E.3.96: SUMMARY OF MOOSE SEX AND AGE COMPOSITION DATA COLLECTED ANNUALLY IN COUNT AREA 6 IN GAME MANAGEMENT UNIT 13 OF SOUTHCENTRAL ALASKA

(modified from ADF&G 1982a)

Date	Total Males Per 100 Females	Small Moose % In Herd	Calves per 100 Females	Incidence of Twins Per 100 Females With Calf	Calf % In Herd	Total Sample
1955[a]	84.1	11.0	43.2	5.6	19.0	400
1956[a]	61.6	7.7	28.1	0.0	14.8	351
1957[a]	43.3	3.5	38.3	10.2	21.1	256
1958[a]	44.9	6.4	40.2	6.9	21.7	957
1959			NO DATA			
1960[a]	57.2	9.0	46.4	4.0	22.4	343
1961	70.1	12.5	48.4	16.0	22.2	424
1962	44.2	-	28.3	4.6	16.4	414
1963[a]	35.6	6.5	46.6	7.4	25.6	798
1964[a]	33.3	3.1	44.4	20.0	25.0	96
1965[a]	30.4	6.3	25.8	1.5	16.5	806
1966[a]	27.7	3.2	28.0	3.5	17.9	658
1967	29.7	3.4	28.8	0.8	18.1	681
1968	29.7	3.2	26.3	2.4	16.9	504
1969	35.7	7.8	33.5	2.8	19.3	384
1970	26.6	6.2	14.2	6.9	10.1	308
1971	30.0	2.8	22.8	3.9	14.9	362
1972	10.1	2.9	23.1	0.0	17.3	277
1973	20.7	5.2	19.0	2.3	13.6	324
1974	16.0	5.2	34.4	9.0	22.9	328
1975	17.6	5.7	18.5	5.6	13.6	279
1976	20.6	5.8	24.3	4.6	16.8	274
1977	16.7	3.7	33.8	13.2	22.4	352
1978	24.1	6.0	28.6	11.7	18.8	368
1979	14.6	2.2	25.3	9.3	18.1	326
1980	15.1	5.2	29.7	8.1	20.5	423
1981	26.5	9.6	38.6	5.1	23.4	530

Remarks: [a] Area boundary change - see ADF&G (1982a).

TABLE E.3.97: SUMMARY OF MOOSE SEX AND AGE COMPOSITION DATA COLLECTED ANNUALLY IN COUNT AREA 7 IN GAME MANAGEMENT UNIT 13 OF SOUTHCENTRAL ALASKA

(modified from ADF&G 1982a)

Date	Total Males Per 100 Females	Small Moose % in Herd	Calves per 100 Females	Incidence of Twins Per 100 Females With Calf	Calf % in Herd	Total Sample
1957			NO DATA			
1958			NO DATA			
1959			NO DATA			
1960			NO DATA			
1961			NO DATA			
1962			NO DATA			
1963[a]	47.7	3.3	38.5	0.0	20.7	121
1964[b]	39.7	6.3	31.4	2.8	18.4	207
1965[a]	59.8	7.8	16.2	0.0	9.2	412
1966	48.3	3.8	20.1	0.0	11.9	293
1967	41.0	4.4	20.6	2.5	12.8	642
1968			NO DATA			
1969			NO DATA			
1970	34.7	5.0	42.1	8.6	23.6	864
1971	26.3	5.3	33.2	7.1	20.8	624
1972	20.6	2.0	17.5	3.7	12.6	665
1973	21.9	6.0	16.3	2.9	11.8	890
1974	12.6	3.0	28.3	6.3	20.1	672
1975	10.0	3.4	15.9	4.8	12.7	695
1976	12.3	3.2	21.6	7.1	16.1	865
1977	10.8	3.0	28.7	6.0	20.6	954
1978	14.8	5.9	20.2	4.1	15.0	1030
1979	8.8	1.8	23.3	5.8	17.7	838
1980	13.3	5.6	25.1	1.1	17.9	946
1981	14.2	3.4	31.6	0.0	21.7	1284

Remarks: [a] Area boundary change - see ADF&G (1982a).
[b] Early 1965 data used for 1964.

TABLE E.3.98: SUMMARY OF MOOSE SEX AND AGE COMPOSITION DATA COLLECTED ANNUALLY IN COUNT AREA 14 IN GAME MANAGEMENT UNIT 13 OF SOUTHCENTRAL ALASKA

(modified from ADF&G 1982a)

Date	Total Males Per 100 Females	Small Moose % In Herd	Calves per 100 Females	Incidence of Twins Per 100 Females With Calf	Calf % In Herd	Total Sample
1955[a]	105.6	10.5	73.2	10.6	26.0	200
1956			NO DATA			
1957	72.5	5.2	50.3	4.9	22.6	381
1958[a]	86.8	5.0	37.0	7.4	16.6	441
1959			NO DATA			
1960[a]	71.1	8.6	56.7	21.4	24.5	139
1961[a]	62.0	12.2	55.7	7.6	25.6	555
1962	56.3	10.1	23.8	1.8	13.2	416
1963			NO DATA			
1964			NO DATA			
1965	28.6	7.2	21.6	0.0	14.4	278
1966[a]	20.0	5.9	33.5	0.0	21.8	238
1967	39.0	3.9	34.1	2.9	19.7	355
1968[a]	9.4	2.8	36.5	3.8	25.0	108
1969	17.5	4.0	40.1	2.0	25.4	405
1970	19.4	2.2	44.4	2.1	25.9	185
1971	27.1	5.7	20.7	5.0	14.0	300
1972	21.4	6.2	25.5	0.0	17.4	288
1973	22.0	5.1	17.3	2.0	12.4	411
1974	15.4	3.4	35.2	3.7	23.4	500
1975	9.9	3.3	21.7	1.9	16.5	333
1976	9.2	3.6	19.9	3.0	15.4	447
1977			NO DATA			
1978	20.5	6.6	18.3	2.0	13.2	379
1979			NO DATA			
1980	13.7	7.4	16.2	3.8	12.5	447
1981			NO DATA			

Remarks: [a] Area boundary change - see ADF&G (1982a).

TABLE E.3.99: SUMMARY OF MOOSE CENSUS DATA AND SUBSEQUENT POPULATION ESTIMATES FOR COUNT AREAS 7 AND 14 DERIVED FROM SURVEYS CONDUCTED ALONG THE SUSITNA RIVER FROM NOVEMBER 5 THROUGH NOVEMBER 8, 1980

(modified from ADF&G 1982a)

Moose Density Stratum	Low	Medium	High
Number of sample areas censused	11	9	6
Total number of sample areas in each stratum	26	27	18
Area of each stratum (km^2)	864	920	663
Moose density per stratum	1.125	1.847	3.726
Population estimate per stratum	375	656	954
Total population estimate 90% CI = 1986 $\pm$ 371			
Sightability correction factor = 1.03			
Corrected population estimate = 2046 $\pm$ 382			

TABLE E.3.100: DENSITY (MOOSE/KM OF RIVER) OF MOOSE OBSERVED ON 10 AERIAL CENSUSES IN 4 ZONES OF RIPARIAN HABITAT ALONG THE SUSITNA RIVER FROM DEVIL CANYON TO COOK INLET, ALASKA, 1981-82

(adapted from ADF&G 1982b, ADF&G unpubl. data)

River Zone[a]		Aerial Census Number[b] 1	2	3	4	5	6	7	8	9	10
I	moose/mi^2	3.27	1.64	0.73	0.64	2.27	0.64	1.64	5.18	6.91	6.91
	moose/km^2	1.26	0.63	0.28	0.25	0.88	0.25	0.63	2.00	2.67	2.67
II	moose/mi^2	1.78	2.11	0.56	1.89	2.78	2.00	0.44	3.11	5.11	9.56
	moose/km^2	0.69	0.81	0.21	0.73	1.07	0.77	0.17	1.20	1.97	3.69
III	moose/mi^2	3.67	4.78	3.35	5.95	4.15	1.43	1.50	5.80	7.30	11.50
	moose/km^2	1.42	1.84	1.29	2.30	1.60	0.55	0.58	2.24	2.82	4.44
IV	moose/mi^2	4.92	3.84	3.68	4.28	1.64	--	3.56	6.36	16.48	12.48
	moose/km^2	1.90	1.48	1.42	1.65	0.63	--	1.37	2.46	6.36	4.82
All zones	moose/mi^2	3.79	3.81	2.81	4.34	3.02	1.37	2.01	5.60	9.72	10.99
	moose/km^2	1.46	1.47	1.08	1.68	1.17	0.53	0.78	2.16	3.75	4.24

[a] = Area within each census zone (land area only; water not included)

I = Devil Canyon to Talkeetna, 29 km^2 (11 mi^2)
II = Talkeetna to Montana Creek, 23 km^2 (9 mi^2)
III = Montana Creek to Yentna River, 104 km^2 (40 mi^2)
IV = Yentna River to Cook Inlet, 65 km^2 (25 mi^2)
All Zones = 220 km^2 (85 mi^2)

[b] 1 = December 9-10, 1981
2 = December 28, 1981 and January 4, 1982
3 = February 2 and 6, 1982
4 = March 1-2, 1982
5 = March 23-24, 1982
6 = April 12, 1982
7 = October 29 and November 6, 1982
8 = November 10 and 18, 1982
9 = December 1, 2, and 6, 1982
10 = December 20-22, 1982

TABLE E.3.101: SUMMARY OF MOOSE SEX AND AGE COMPOSITION DATA OBTAINED DURING SURVEYS OF RIPARIAN COMMUNITIES ALONG THE LOWER SUSITNA RIVER

(derived from ADF&G 1982b and ADF&G unpubl. data)

River Zone[a]	Total Males Per 100 Females		Incidence: Calves Per 100 Females		Incidence: Twins Per 100 Females With Calf		Incidence: Calf % in Herd		Total Sample	
	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982
I	40.0	16.7	40.0	24.1	0.0	8.3	22.2	17.1	36	76
II	37.5	40.0	62.5	44.0	25.0	0.0	31.3	23.9	16	46
III	10.9	12.3	45.7	50.8	13.5	14.1	30.6	31.2	147	292
IV	33.3	18.1	53.0	25.4	12.9	9.0	28.5	17.7	123	412
TOTAL	23.1	17.1	48.4	34.5	12.5	10.8	28.9	22.8	322	826

a I = Devil Canyon to Talkeetna.
II = Talkeetna to Montana Creek.
III = Montana Creek to Yentna River.
IV = Yentna River to Cook Inlet.

TABLE E.3.102: PROPORTION OF RADIO-COLLARED CARIBOU SIGHTINGS IN EACH VEGETATION TYPE

(data from ADF&G 1982c)

Habitat	Calving, Summer Cows	Calving, Summer Bulls	Autumn Cows	Autumn Bulls	Spring, Rut, Winter, Cows	Spring, Rut, Winter Bulls	Total Cows	Total Bulls
Spruce forest	0.0	23.3	36.4	25.0	58.5	77.7	34.2	50.9
Tundra-herbaceous	72.5	36.7	29.1	20.8	11.6	9.3	36.0	19.4
Shrubland	26.7	36.7	16.4	41.7	24.3	9.3	23.9	24.1
Bare substrate	0.8	3.3	18.2	12.5	5.5	3.7	5.9	5.6
Total sightings	120	30	55	24	164	54	339	108

TABLE E.3.103: NELCHINA CARIBOU HERD POPULATION ESTIMATES
(Fall estimates for years after 1962)
(from ADF&G 1982c)

Year	Total Estimate	Female Estimate	Male Estimate	Calf Estimate
1955	40,000[a]	-	-	-
1962	71,000[b]	-	-	-
1967	61,000[c]	-	-	-
1972	7,842	4,800	1,622	1,420
1973	7,693	4,646	1,268	1,779
1976	8,081	4,979	1,663	1,439
1977	13,936	7,509	2,868	3,559
1978	18,981	9,866	4,429	4,686
1980	18,713	9,164	5,673	3,876
1981	20,694	10,154	6,184	4,356

[a] Watson and Scott (1956), February census.
[b] Siniff and Skoog (1964), February census perhaps should be adjusted downward by as many as 5,000 caribou due to presence of Mentasta herd.
[c] Felt by some to be an unreasonably high estimate.

TABLE E.3.104: REPORTED HUNTER HARVEST OF THE NELCHINA CARIBOU HERD, 1972-1981

(derived from ADF&G 1982c, unpubl. data)

Year	Total Harvest	Females No.	Females (%)	% of Total Females	Males No.	Males (%)	% of Total Males	% of Total Herd
1972	555	153	(28)	3%	338	(72)	21%	7%
1973	629	203	(33)	4%	411	(67)	32%	8%
1974	1,036	343	(34)	-	656	(66)	-	-
1975	669	201	(31)	-	441	(69)	-	-
1976	776	201	(26)	4%	560	(74)	34%	10%
1977	360	77	(22)	1%	275	(78)	10%	3%
1978	539	111	(21)	1%	416	(79)	9%	3%
1979	630	90	(14)	-	509	(81)	-	-
1980	621	117	(21)	1%	453	(79)	8%	3%
1981	901	164	(18)	2%	737	(82)	12%	4%

TABLE E.3.105: COMPILATION OF HIGHEST YEARLY COUNTS COMPLETED IN WATANA HILLS SHEEP TREND COUNT AREA
(from ADF&G 1982d)

Year	Legal Rams*	Lambs	Total	% Legal Rams	% Lambs	Surveyor
1950	--	--	0	--	--	Scott
1967	--	--	230	--	--	Nichols
1968	--	--	183	--	26.6	Nichols, August
1973	10	40	176	5.6	22.7	McIlroy, August
1974	6	18	76	7.9	23.7	Harkness, April
1976	4	30	130	3.1	23.0	Eide, August
1977	4	33	152	2.6	21.7	Spraker, July 11
1978	5	34	189	2.6	18.0	Eide, July 23
1980	9	42	174	5.1	24.1	Tobey, July 22
1981	2	43	209	>1.0	20.6	Westlund, July 28

*A legal ram is defined as having a 3/4 curl or greater horn. Beginning in 1979 a legal ram is defined as having a 7/8 curl or greater horn.

TABLE E.3.106: NUMBER AND AGE-SEX CLASSIFICATION OF SHEEP OBSERVED AT JAY CREEK MINERAL LICKS FROM MAY 6 THROUGH JUNE 24, 1981 (from ADF&G 1982d)

Date	Time	Location	Sheep	Ewes	Yearlings	Lambs	Rams
5/06	-	West side[a]	5				
5/08	-	West side	15	2	2		
5/09	a.m.	West side	4				
5/13	1645	West side	2				
5/14	0900	West side	4				
5/18	1355	West side	4	1	1		6
5/21	-	West side	8				
5/22	1700	West side	8	1	1		6
5/23	1145	East side	9	2	1		6
5/24	1840	West side	9	1	2		6-7
5/25	1152	East side[b]	14	1	1		12
5/26	1808	-	0				
5/27	2225	-	0				
5/30	-	East side	5				
6/02	-	-	0				
6/03	1405	Upstream E.[c]	1				1
6/03	1408	Upstream W.	9				9
6/04	1926	-	0				0
6/05	1900	East side	9				9
6/06	2146	West side	9				
6/07	2025	East side	9				
6/08	2115	East side	10				
6/09	-	West side	7	7			
6/10	0955	West side	4	2	2		
6/11	-	West side	4	3		1	
6/12	1939	Upstream	10				
6/13	1154	East side	1	1			
6/13	1154	Upstream W.	7	4		3	
6/14	0933	-	0				
6/15	1509	West side	4	4			
6/15	1509	Upstream	3	2		1	
6/16	1102	Upstream W.	4	3		1	
6/17	1155	Upstream E.	1	1			
6/19	1000	Upstream	1	4			1
6/19	1000	West side	1	1			
6/21	1545	West side	14				
6/24	0847	West side	7				7

[a] Bluff on western bank of lower Jay Creek.

[b] Directly across Jay Creek from above site.

[c] Two miles upstream from above site.

TABLE E.3.107: NUMBER OF AERIAL BROWN BEAR OBSERVATIONS BY MONTH IN EACH OF 5 MAJOR HABITAT CATEGORIES (from ADF&G 1982e)

Habitat	May	June	July	August	September	October/ April	All Months (%)
Spruce	44	50	17	16	9	5	141
% of Months[1]	31.2	35.5	12.1	11.3	6.4	3.5	(25.0)
% of Habitats[2]	31.0	29.6	19.3	17.6	25.0	13.2	-
Riparian	16	26	22	20	4	1	89
% of Months	18.0	29.2	24.7	22.5	4.5	1.1	(15.8)
% of Habitats	11.3	15.4	25.0	22.0	11.1	2.6	-
Shrubland	39	75	46	52	21	5	238
% of Months	16.4	31.5	19.3	21.8	8.8	2.1	(42.2)
% of Habitats	27.5	44.4	52.3	57.1	58.3	13.2	-
Tundra	12	14	1	1	0	0	28
% of Months	42.9	50.0	3.6	3.6	0	0	(5.0)
% of Habitats	8.5	8.3	1.1	1.1	0	0	-
Other	31	4	2	2	2	27	68
% of Months	45.6	5.9	2.9	2.9	2.9	39.7	(12.1)
% of Habitats	21.8	2.4	2.3	2.2	5.6	71.1	-
All Habitats	142	169	88	91	36	38	564
(%)	(25.2)	(30.0)	(15.6)	(16.1)	(6.4)	(6.7)	(100.0)

1 The proportion of sightings of bears in spruce habitat that occurred in each month (e.g., 31.2% of the bear sightings in spruce occurred in May).

2 For each month, the proportion of sightings that were in that particular habitat type.

TABLE E.3.108: COMPARISON OF REPORTED HOME RANGE SIZES OF BROWN/GRIZZLY BEARS IN NORTH AMERICA
(adapted from Reynolds 1980)

Area	Sex	Sample Size	Mean Home Range km^2	Mean Home Range mi^2	Source
Kodiak Island, AK	M	7	24	9.3	Berns et al. 1977
	F	23	12	4.6	
Yellowstone National Park	M	6	161	62.2	Craighead 1976
	F	14	73	28.2	
Southwestern Yukon	M	5	287	110.8	Pearson 1975
	F	8	86	33.2	
Northern Yukon	M	9	414	159.8	Pearson 1976
	F	12	73	28.2	
Western Montana	M	3	513	198.1	Rockwell et al. 1978
	F	1	104	40.2	
Upper Susitna and Nelchina basins	M	14	790	305.0	This study (1978 and 1980 results only)
	F	19	316	122.0	
Northwestern Alaska	M	8	1350	521.2	Reynolds 1980
	F	18	744	132.8	

TABLE E.3.109: DENSITIES OF SELECTED NORTH AMERICAN BROWN BEAR POPULATIONS (from ADF&G 1982e)

mi^2/Bear	km^2/Bear	Location	Source
0.6	1.6	Kodiak Island, AK	Troyer and Hensel 1964
6.0[a]	15.5	Alaska Peninsula, AK	Glenn, unpubl. data
8.2	21.2	Glacier National Park, Montana	Martinka 1974[b]
11.0	28.5	Glacier National Park, BC	Mundy and Flook 1973[b]
9-11	23-27	SW Yukon Territory	Pearson 1975
16-24	41-62	Upper Susitna River, AK	Miller and Ballard 1980
88 (16-300)[c]	288 (42-780)[c]	Western Brooks Range (NPR-A), AK	Reynolds 1980
100	260	Eastern Brooks Range, AK	Reynolds 1976

[a] Data refer to a 4,662 km^2 (1,800 mi^2) intensively studied area of the central Alaska Peninsula.

[b] Taken from Pearson 1975.

[c] Mean is for the entire National Petroleum Reserve, Alaska; the range represents values for different habitat types in this reserve. The highest density occurred in an intensively studied experimental area.

TABLE E.3.110: AVERAGE AGE AND SEX RATIOS OF BROWN BEAR POPOULATIONS IN THE MIDDLE AND UPPER SUSITNA AND NELCHINA RIVER BASINS
(from ADF&G 1982e)

	Males			Females				
Subpopulations	Average Spring Age (Years)	(Range)	n	Average Spring Age (Years)	(Range)	n	Average Both Sexes (Years)	Sex Ratio % Males
GMU 13 fall harvests, 1970-1980	8.0	(3.5-23.5)	208	7.7	(3.5-28.5)	191	7.9	52
1979 Upper Susitna studies (Miller & Ballard 1980)	7.4	(3.5-21.5)	17	7.4	(3.5-16.5)	15	7.4	53
Middle Susitna Basin (1980-1981): all captures	7.7	(3.5-14.5)	14	7.9	(3.5-13.5)	15	7.8	48
Radio-collared bears (1980-1981) with $\geq$5 captures	6.0	(3.5-10.5)	4	8.6	(3.5-13.5)	13	8.0	24[a]

[a] Because adult male bears lost their collars more easily than adult females, this ratio underestimated the percentage of males.

TABLE E.3.111: LITTER SIZES OF VARIOUS NORTH AMERICAN BROWN BEAR POPULATIONS
(from ADF&G 1982e)

Source	Area	Average litter size (no. of litters observed) age of litter		
		0.5	1.5	0.5-1.5
Pearson 1975	Southwestern Yukon Territory	1.7(11)	1.5(11)	1.6(22)
Martinka 1974	Glacier National Park, Montana	1.7(35)	1.8(30)	1.7(65)
This Study	Nelchina Basin, Alaska	2.3(9)	1.6(16)	1.7(10)
Reynolds 1976'	Eastern Brooks Range, Alaska	1.8(13)	2.0(7)	1.9(20)
Reynolds 1980*	Western Brooks Range, Alaska	2.0(33)	1.9(21)	2.0(54)
Mundy 1963	Glacier National Park, B.C.	1.9(81)	1.8(45)	1.9(126)
Klein 1958	Southeastern Alaska	2.2(25)	1.9(35)	2.0(60)
Glenn et al. 1976	McNeil River, Alaska	2.5(41)	1.8(69)	2.1(110)
Glenn 1976 & updated	Black Lake, Alaska Peninsula	2.1(19)	2.1(51)	2.1(70)
Hensel et al. 1969	Kodiak Island, Alaska	2.2(98)	2.0(103)	2.1(201)
Craighead et al. 1976	Yellowstone National Park	2.2(68)	-	-

*Calculations from data presented in Table 3 of Reynolds (1980)

TABLE E.3.112: REPRODUCTIVE RATES OF NORTH AMERICAN BROWN BEAR POPULATIONS
(from ADF&G 1982e)

Area	Mean Age at 1st Production to Maximum Age of Breeding	Potential Reproduction Life ÷ Reproductive Interval		Litter Size		Potential Production of Cubs	$\bar{x}$ Reproductive Rate (No. cubs/adult female/year)
Yellowstone Park (Craighead et al. 1976)	6.3 - 24.8	$\frac{18.5 \text{ years}}{3.40}$	x	2.24	=	12.2	0.66
Alaska Peninsula (Glenn et al. 1976)**	6.3 - 24.8	$\frac{18.5 \text{ years}}{3.77}$	x	2.50	=	12.3	0.66
Eastern Brooks Range (Reynolds 1976)**	0.1 - 24.8	$\frac{14.7 \text{ years}}{4.24}$	x	1.78	=	6.2	0.42
Western Brooks Range (Reynolds 1980)	8.4 - 24.8	$\frac{16.4 \text{ years}}{4.03}$	x	2.03	=	8.3	0.50
Nelchina Basin (This study)	5.2 - 24.8	$\frac{19.6 \text{ years}}{3.3}$	x	2.3	=	13.7	0.70
Nelchina Basin (This study)	5.2 - 14.4***	$\frac{9.2 \text{ years}}{3.3}$	x	2.3	=	6.4	0.70

* This potential may be close to actual in lightly hunted populations in Yellowstone and the Brooks Range, it probably over estimates productivity of heavily hunted population (Alaska Peninsula).

** Reynold's (1980) analysis of data presented by others.

***Maximum age based on age of 30 females ($\geq$12 years) in the sport harvest 1970-1980.

TABLE E.3.113 SUMMARY OF BROWN BEAR HARVEST FROM ALASKA'S GAME MANAGEMENT UNIT 13, 1973-1980 (from ADF&G 1982e)

Year	Total Sport Take	Average Age (N)			% Total Harvest Taken in Fall[a]			% of Total Take By Non-Residents
		Males	Females	Both	Males	Females	Both	
1973	44	6.9(25)	7.3(15)	7.1(40)	100	100	100	59
1974	72	6.3(39)	7.3(28)	6.7(67)	100	100	100	47
1975	80	7.2(40)	7.7(31)	7.4(71)	100	100	100	46
1976	59	6.8(28)	5.0(25)	5.9(53)	100	100	100	39
1977	38	6.1(28)	7.1(6)	6.3(34)	100	100	100	32
1978	63	6.1(32)	6.5(24)	6.2(56)	100	100	100	44
1979	73	6.5(34)	8.1(28)	7.2(62)	100	100	100	42
1980	84	5.0(39)	5.8(31)	5.4(70)	79	85	82	30
73-80	513	6.2(265)	6.8(188)	6.5(453)	96	97	42	
Fall Only -		6.3(255)	6.9(183)	6.5(438)				
Spring Only -		7.7(10)	6.2(5)	7.2(15)				

[a] Only fall seasons prior to 1980.

TABLE E.3.114: NUMBER OF AERIAL BLACK BEAR OBSERVATIONS BY MONTH IN EACH OF 5 HABITAT CATEGORIES
(from ADF&G 1982e)

Habitat	May	June	July	August	September	October-April	All Months
SPRUCE	82	95	54	68	44	15	358
% by Months[1]	22.9	26.5	15.1	19.0	12.3	4.2	(39.4)
% by Habitat[2]	50.3	46.3	35.8	31.8	30.8	46.9	
RIPARIAN	23	33	23	18	23	1	121
% by Months	19.0	27.3	19.0	14.9	19.0	.8	(13.3)
% by Habitat	14.1	16.1	15.2	8.4	16.1	3.1	
SHRUBLAND	50	70	69	119	71	9	388
% by Months	12.9	18.0	17.8	30.7	18.3	2.3	(42.7)
% by Habitat	30.7	34.1	45.7	55.6	49.7	28.1	
TUNDRA	3	3	3	6	2	0	17
% by Months	17.6	17.6	17.6	35.3	11.8	0	(1.9)
% by Habitat	1.8	1.5	2.0	2.8	1.4	0	
OTHER	5	4	2	3	3	7	24
% by Months	20.8	16.7	8.3	12.5	12.5	29.2	(2.6)
% by Habitat	3.1	2.0	1.3	1.4	2.1	21.9	
TOTALS	163	205	151	214	143	32	908
	(18.0)	(22.6)	(16.6)	(23.6)	(15.7)	(3.5)	(100.0)

[1] The proportion of sightings of bears in spruce habitat that occurred in each month (eg., 22.9% of the bear sightings in spruce occurred in May).

[2] For each month, the proportion of sightings that were in that particular habitat type.

TABLE E.3.115: SUMMARY OF REPORTED BLACK BEAR HARVESTS FROM ALASKA'S GAME MANAGEMENT UNIT 13, 1973-1980 (from ADF&G 1982e)

Year	Total Sport Take	Average Age (n)[a]			% Males			% Total Harvest Taken In Fall			A[d]	B[d]	C[d]
		Males	Females	Both	Spring	Fall	Both	Males	Females	Both			
1973	70	5.9(39)	5.2(20)	5.6	NA	63	63	100	100	100	49	14	-
1974	48	5.7(26)	7.8(14)	6.4	86	64	67	81	93	85	21	25	-
1975	67				75	75	75	67	67	67	19	36	-
1976	63	5.2(5)			63	70	67	63	55	62	21	26	55
1977[b]	58	5.1(26)	4.8(12)	5.0	81	64	69	66	82	71	19	26	52
1978[c]	70	5.4(13)			80	63	68	64	81	69	20	7	64
1979[c]	70				68	50	55	64	79	70	11	18	73
1980	85				77	74	75	67	71	69	24	32	67
73-80	531	5.6(121)	5.9(58)	5.7	74	65	68	71	79	74	23	184	63
Fall only -		5.5(88)	5.9(49)	5.6									
Spring only -		5.7(33)	6.3(9)	5.8									

[a] Mean age given only when $n \geq 5$.
[b] Only fall bears aged.
[c] Only spring bears aged.
[d] A % of total take by non-residents.
B Number taken by hunters reporting aircraft as primary source of transportation.
C % of total where meat was salvaged for food.

TABLE E.3.116: COMPARISONS OF FOOD REMAINS IN WOLF SCATS COLLECT AT DEN AND RENDEZVOUS SITES IN 1980 AND 1981 FROM THE EASTERN SUSITNA BASIN AND ADJACENT AREAS
(from ADF&G 1982f)

Food Items	1980 727 Scats		1981 290 Scats	
	No. Items	% Occurrences	No. Items	% Occurrences
Adult moose	105	12.00	24	6.15
Calf moose	369	42.17	87	22.31
Moose, age unknown	22	2.51	21	5.38
Adult caribou	30	3.43	31	7.95
Calf caribou	13	1.49	19	4.87
Caribou, age unknown	8	0.91	5	1.28
Moose or caribou	31	3.54	9	2.31
Beaver	48	5.49	37	9.49
Muskrat	26	2.97	24	6.15
Snowshoe hare	55	6.29	21	5.38
Microtine	40	4.57	37	9.49
Unidentified small mammal	15	1.71	20	5.13
Bird	16	1.83	8	2.05
Fish	1	0.11	2	0.51
Vegetation	22	2.51	5	1.28
Wolf	4	0.46	1	0.26
Unknown	70	8.00	39	10.00
Total	875	100.00	390	100.00

TABLE E.3.117: ESTIMATE OF NUMBERS OF WOLVES BY INDIVIDUAL PACK INHABITING THE SUSITNA HYDROELECTRIC STUDY AREA IN SPRING AND FALL 1980 AND 1981

(from ADF&G 1982f)

Pack Area	Spring 1980 (Post-Hunt)	Fall 1980 (Prehunt)	Spring 1981	Fall 1981
Butte Lake	3-4	3-4+	3	5
Fish Lake	?	2	9	12+
Jay Creek	6	7-8	?	10
Keg Creek	?	?	2-3	2-3
Maclaren River	2	4-5	?	2-3
Portage Creek	?	?	?	6
Stephan Lake	2+	11	?	?
Susitna	4	10	5	4
Susitna-Sinona	4	4-5	2	?
Tolsona	9	16	13	15
Tyone Creek	4	2	0	?
Upper Talkeetna River	?	?	?	2
Watana	5	14	8	14
Total	40	77	42-43	72-74

TABLE E.3.118: NUMBER OF SAMPLE UNITS CONTAINING INDICATED LEVEL OF BEAVER ACTIVITY DURING SUMMER 1982 DOWNSTREAM SURVEY
(See text for explanation)
(from Gipson, unpub. data)

	None No Sign Seen	Low Tracks, Cuttings	Mod. Dams, Trails	High Dens, Lodges	
Main channel	22	-	-	-	
Side channel	22	5	1	4	UPPER SECTION
Slough	2	3	1	5	n = 38
Clearwater	-	2	2	3	
Main channel	4	-	-	-	
Side channel	1	1	6	3	MIDDLE SECTION
Slough	-	1	3	1	n = 11
Clearwater	-	-	-	4	
Main channel	1	-	-	-	
Side channel	1	-	3	9	LOWER SECTION
Slough	1	-	1	3	n = 8
Clearwater	*				

* Lower section contained no clearwater habitat in sample units surveyed.

TABLE E.3.119: 1982 AERIAL COUNTS OF BEAVER STRUCTURES ALONG 15.2 KM (9.4 MI) OF LOWER DEADMAN CREEK IMMEDIATELY DOWNSTREAM FROM DEADMAN LAKE, AND A MARSHY SECTION OF UPPER DEADMAN CREEK FROM ITS MOUTH AT DEADMAN LAKE 3.2 KM (2.0 MI) UPSTREAM FROM THE LAKE (from Gipson, unpub. data)

Location	Caches	Lodges		Dams	
		Active	Inactive	Active	Inactive
Lower Deadman Creek	8	9[1]	5	3	4
Upper Deadman Creek	5	5	0	0	0
TOTAL	13	14	5	3	4

[1]Two apparently active lodges were observed within 30 meters (33 yards) of each other and only one food cache was noted between the lodges. Possibly both of these lodges had been active during summer, but only one would remain active through winter.

TABLE E.3.120: RESULTS OF SURVEYS FOR MUSKRAT PUSHUPS UPSTREAM FROM GOLD CREEK DURING SPRING 1980
(from Gipson et al. 1982)

Lake Number	Elevation MSL (m)	(ft)	No. Pushups	Location of Lakes: Quarter Section	Section	Range	Township
001	267	876	2	SW	31	1W	32N
				SE	31	1W	32N
002	472	1549	4	SE	30	1W	32N
				SW	29	1W	32N
003	526	1726	14	NE	30	1W	32N
				NW	29	1W	32N
004	640	2100	0	NE	20	1W	32N
				NW	21	1W	32N
				SE	20	1W	32N
005	500	1641	26	SE	15	1W	32N
				SW	14	1W	32N
				SE	14	1W	32N
				NW	23	1W	32N
006	495	1624	0	NW	23	1W	32N
				NE	23	1W	32N
007	480	1575	0	NW	24	1W	32N
				SW	24	1W	32N
				SE	23	1W	32N
				NE	23	1W	32N
008	463	1519	0	SW	6	1E	31N
009	463	1519	0	SE	6	1E	31N
010	442	1450	0	SW	32	1E	32N
011	472	1549	0	SE	32	1E	32N
012	419	1375	0	SE	32	1E	32N
013	542	1778	0	SW	4	1E	32N
				SE	4	1E	32N
014	724	2375	0	NW	28	1E	32N
015	724	2375	0	NE	21	1E	32N
				NW	22	1E	32N
				SW	22	1E	32N
				NW	27	1E	32N
				SE	21	1E	32N
016	712	2336	0	SW	16	1E	32N
				SE	16	1E	32N
				SW	15	1E	32N
				NW	22	1E	32N
				NE	21	1E	32N
017	754	2474	0	NE	22	1E	32N
				NW	23	1E	32N
018	572	1878	0	NW	35	1E	32N
019	503	1650	0	SW	35	1E	32N
				NW	2	1E	31N
020	541	1775	0	SE	35	1E	32N
				NE	2	1E	31N
021	724	2375	0	NW	36	1E	32N
022	724	2375	0	NW	36	1E	32N
023	686	2250	0	SW	24	1E	32N
				SE	24	1E	32N
				SW	19	2E	32N
				NW	30	2E	32N
				NE	25	1E	32N
				NW	25	1E	32N
024	724	2375	0	NE	19	2E	32N
				NW	20	2E	32N
025	722	2369	0	NW	20	2E	32N
				NE	20	2E	32N
				SE	20	2E	32N
				SW	20	2E	32N

TABLE E.3.120 (Page 2)

Lake Number	Elevation MSL (m)	(ft)	No. Pushups	Location of Lakes: Quarter Section	Section	Range	Township
026	709	2326	0	SW	21	2E	32N
027	533	1749	0	NW	27	2E	32N
				NE	27	2E	32N
				SE	27	2E	32N
				SW	27	2E	32N
028	754	2474	0	NE	7	4E	31N
029	716	2349	0	SW	8	4E	31N
030	602	1975	0	NW	17	4E	31N
031	602	1975	0	NE	17	4E	31N
032	693	2274	1	NW	5	5E	31N
				SW	5	5E	31N
033	693	2274	0	SW	5	5E	31N
034	716	2349	0	SW	4	5E	31N
				SE	5	5E	31N
035	680	2231	0	SW	9	5E	31N
				SE	9	5E	31N
				NE	16	5E	31N
				NW	16	5E	31N
				NE	17	5E	31N
				NW	17	5E	31N
				NE	18	5E	31N
				SE	7	5E	31N
				SW	8	5E	31N
				SE	8	5E	31N
036	678	2225	8	SW	10	5E	31N
				SE	9	5E	31N
037	693	2274	0	SE	3	5E	31N
				SW	3	5E	31N
				SE	10	5E	31N
				SW	10	5E	31N
				NE	9	5E	31N
038	643	2110	0	SE	11	5E	31N
				SW	11	5E	31N
				NW	14	5E	31N
				NE	15	5E	31N
				SW	15	5E	31N
				NW	15	5E	31N
				SW	10	5E	31N
039	709	2326	0	NW	3	5E	31N
040	683	2241	0	SW	21	5E	32N
041	678	2225	1	NW	21	5E	32N
042	683	2241	0	NE	21	5E	32N
043	689	2261	1	NE	21	5E	32N
				NW	22	5E	32N
				SE	21	5E	32N
				NE	21	5E	32N
044	693	2274	0	SW	15	5E	32N
				NW	22	5E	32N
045	683	2241	0	SE	16	5E	32N
				NE	21	5E	32N
046	693	2274	0	SE	15	5E	32N
				SW	45	5E	32N
047	683	2241	7	NW	15	5E	32N
				NE	16	5E	32N
048	739	2425	6	NW	10	5E	32N
049	716	2340	0	NW	14	5E	32N
				SW	14	5E	32N
050	716	2349	0	NW	14	5E	32N
051	716	2349	0	NW	14	5E	32N

TABLE E.3.120 (Page 3)

Lake Number	Elevation MSL (m)	(ft)	No. Pushups	Location of Lakes: Quarter Section	Section	Range	Township
052	716	2349	0	NW	14	5E	32N
				NE	14	5E	32N
053	716	2349	0	NE	14	5E	32N
054	716	2349	0	SE	14	5E	32N
055	716	2349	0	NE	14	5E	32N
				SE	14	5E	32N
056	716	2349	0	NE	14	5E	32N
				NW	13	5E	32N
057	693	2274	0	SW	35	5E	32N
058	708	2323	0	NE	53	5E	32N
059	693	2274	32	NE	13	5E	32N
				NW	18	5E	31N
				SW	18	5E	31N
				SE	13	5E	31N
				SW	13	5E	31N
				SE	14	5E	31N
				NE	14	5E	31N
				NE	13	5E	31N
060	692	2270	0	SW	5	6E	31N
				SE	5	6E	31N
				NE	8	6E	31N
				SE	7	6E	31N
				SW	7	6E	31N
				NE	7	6E	31N
				NW	8	6E	31N
061	678	2225	3	SW	4	6E	31N
				SE	5	6E	31N
062	678	2225	0	NW	2	6E	31N
063	709	2326	0	SE	19	6E	32N
064	724	2375	0	NW	19	6E	32N
				NE	24	6E	32N
065	747	2451	3	SW	18	6E	32N
066	716	2349	0	NE	18	6E	32N
				NW	18	6E	32N
067	716	2349	24	SW	7	6E	32N
				SE	7	6E	32N
				SW	8	6E	32N
				SE	8	6E	32N
				NE	17	6E	32N
				NW	17	6E	32N
				NE	18	6E	32N
068	692	2270	15	SE	17	6E	32N
				SW	16	6E	32N
				NW	21	6E	32N
				NE	20	6E	32N
069	693	2274	14	SE	11	6E	32N
070	709	2326	8	NW	12	6E	32N
071	533	1749	5	SE	24	6E	32N
072	503	1650	2	NW	31	7E	32N
073	610	2001	0	SW	29	7E	32N
074	625	2051	2	NW	29	7E	32N
				NE	29	7E	32N
				SE	29	7E	32N
075	625	2051	0	SE	29	7E	32N
				NE	32	7E	32N
076	625	2051	2	SW	28	7E	32N
077	625	2051	0	SE	29	7E	32N
078	625	2051	0	SE	29	7E	32N
079	960	3150	0	SE	23	7E	31N
080	838	2749	0	SE	6	8E	31N

TABLE E.3.120 (Page 4)

Lake Number	Elevation MSL (m)	(ft)	No. Pushups	Location of Lakes: Quarter Section	Section	Range	Township
081	823	2700	0	SE	6	8E	31N
				SW	5	8E	31N
082	564	1850	2	SW	8	8E	31N
083	770	2526	0	SW	33	8E	32N
				NE	33	8E	32N
084	770	2526	0	NW	3	8E	31N
085	808	2651	0	SW	2	8E	31N
				SE	2	8E	31N
086	808	2651	0	SE	2	8E	31N
087	808	2651	0	SE	2	8E	31N
088	741	2431	1	SE	7	9E	31N
089	866	2841	25	SE	25	11E	30N
				SW	30	11E	30N
				NW	31	11E	30N
				NE	36	11E	30N
090	870	2854	2	SE	30	11E	30N
				NW	31	11E	30N
091	869	2851	0	NW	31	11E	30N
092	777	2549	1	SW	5	11E	29N
				NW	8	11E	29N
093	777	2549	0	NW	8	11E	29N
				NE	8	11E	29N
				SE	8	11E	29N
				SW	8	11E	29N
094	780	2559	0	SE	5	11E	29N
				NE	8	11E	29N
095	777	2549	0	SW	4	11E	29N
096	777	2549	0	NW	9	11E	29N
097	777	2549	0	NW	9	11E	29N
098	777	2549	0	NW	9	11E	29N
				SW	9	11E	29N
099	777	2549	0	SE	8	11E	29N
				SW	9	11E	29N
100	853	2799	1	NE	26	10E	30N
101	853	2799	0	NE	26	10E	30N
				NW	25	10E	30N
102	853	2799	0	SW	24	10E	30N
103	853	2799	0	SW	23	3E	30N
				NW	26	3E	30N

TABLE E.3.121: NUMBERS OF FURBEARER TRACKS SEEN DURING AERIAL TRANSECTS IN THE MIDDLE SUSITNA BASIN, NOVEMBER 1980
(from Gipson et al. 1982)

Transect Number[a]	Marten	Fox	Short-tailed Weasel	Mink	Otter	Totals
01	41	1	3	5	2	52
02	80	0	7	1	6	94
03	91	9	5	3	0	108
04	198	0	20	0	3	221
05	84	0	11	1	0	96
06	163	0	6	0	1	170
07	202	23	39	0	2	266
08	86	11	0	2	5	104
09	85	11	1	2	0	99
10	125	20	95	2	3	245
11	39	30	58	2	1	130
12	40	38	96	5	1	180
13	7	60	77	5	3	152
14	112	10	328	6	3	459
Totals	1353	213	746	34	30	2376

[a] See Figure E.3.101 for transect locations.

TABLE E.3.122: TABULATION OF NOVEMBER 1980 AERIAL TRANSECT DATA, SPECIES BY VEGETATION TYPE
(from Gipson et al. 1982)

Vegetation Type	Marten	Fox	Short-tailed Weasel	Mink	Otter	Totals
Forest, white spruce	35	1	4	0	0	40
Forest, birch	3	0	2	0	0	5
Forest, poplar	0	0	1	0	0	1
Forest, black spruce	0	2	0	0	0	2
Forest, mixed	54	0	1	0	0	55
Alpine mat-cushion	3	5	29	0	0	37
Woodland, white spruce	525	5	88	1	0	619
Woodland, black spruce	605	61	401	3	1	1071
Woodland, mixed	29	0	5	0	0	34
Shrub, low	12	9	8	0	0	29
Shrub, medium	35	108	190	0	0	333
Shrub, alder	25	2	11	0	0	38
River ice	2	1	2	20	20	45
Lake ice	0	4	0	0	0	4
Creek ice	6	0	2	4	2	14
Marsh	3	4	0	3	0	10
River bar	9	8	1	3	7	28
Rock	0	0	1	0	0	1
TOTALS	1353	213	746	34	30	2376

TABLE E.3.123: NUMBER OF TRACKS OF OTTER AND MINK OBSERVED AT NORTH AND SOUTH SIDES OF 37 SUSITNA RIVER CHECK POINTS, NOVEMBER 10-12, 1980[a] (from Gipson et al. 1982)

Checkpoint	North		South	
Numbers	Otters	Mink	Otters	Mink
01	3	0	0	0
02	0	2	0	0
03	0	0	0	0
04	0	0	3	1
05	0	0	2	0
06	0	0	0	0
07	0	1	0	1
08	0	0	0	2
09	0	0	1	0
10	0	0	0	2
11	4	1	0	1
12	3	1	0	0
13	0	0	0	1
14	2	0	3	1
15	0	0	4	0
16	3	1	0	2
17	0	3	0	4
18	0	0	0	2
19	0	0	1	2
20	2	0	1	0
21	1	1	0	0
22	0	0	0	0
23	2	1	0	2
24	0	0	0	0
25	0	0	0	0
26	0	0	0	0
27	0	0	4	0
28	0	0	4	0
29	0	0	0	2
30	0	0	0	0
31	0	0	0	0
32	0	0	0	3
33	0	2	0	3
34	0	1	0	2
35	0	1	2	3
36	0	0	2	2
37	0	1	0	2
Totals	20	16	27	38

[a] See Figure E.3.101 for locations of river check points.

TABLE E.3.124: RESULTS OF MARTEN SCAT ANALYSES BY SEASON, BASED UPON PERCENT FREQUENCY OF OCCURRENCE

(from Gipson et al. 1982)

	Autumn 1980	Winter 1980-81	Spring 1981	Autumn 1981	Unknown Season	Total
Unknown Mammal	0.0	0.7	3.9	0.7	0.0	1.2
Microtine	83.3	85.6	82.7	98.7	85.7	88.8
Shrew	16.7	2.7	2.9	0.0	1.3	2.4
Sciurid	4.2	9.6	15.4	0.0	3.9	6.8
Ungulate	16.7	0.0	1.9	1.4	6.5	2.6
Snowshoe Hare	0.0	1.4	0.0	0.0	3.9	1.0
Muskrat	0.0	3.4	2.9	0.0	0.0	1.6
Bird	4.2	17.1	12.5	3.4	5.2	9.6
Berry	41.7	39.7	29.8	1.4	19.5	23.3
Fish	0.0	0.7	1.0	0.0	1.3	0.6
Human Foods	0.0	0.0	0.0	0.0	7.8	1.2
Total Scats	24.0	146.0	104.0	148.0	77.0	499.0
Food Items/Scat	1.7	1.7	1.6	1.1	1.4	1.5

TABLE E.3.125: TRACKS OF RED FOXES ENCOUNTERED DURING NOVEMBER 1980 AERIAL TRANSECT SURVEYS
(from Gipson et al. 1982)

	Number of Fox Tracks	
Elevation (m)	North side Susitna	South side Susitna
516 - 547		1
548 - 581	2	4
582 - 613	5	-
614 - 645	1	-
646 - 677	-	-
678 - 709	-	-
710 - 741	20	2
742 - 774	9	6
775 - 806	10	18
807 - 838	-	2
839 - 870	12	47
871 - 902	5	1
903 - 935	-	38
936 - 967	5	1
968 - 1000	7	2
1001 - 1032	-	1
1033 - 1064	-	2
1065 - 1096	3	11
1097 - 1129	-	15
Total	79	151
Transects 1 - 11	67	51

TABLE E.3.126: RED FOX DEN CLASSIFICATION SYSTEM
(from Gipson et al. 1982)

Importance Ranking	Den Type	Description
1	Primary	Active or believed to have been active in 1979, 1980, or 1981. Natal den. Multiple burrow system. Believed to have traditional use. Large dirt mounds at burrow entrances and wear patterns. Five or more entrances.
2	Secondary	Not active in 1980 or 1981. Multiple burrow system. Large dirt mounds at entrances. Wear patterns but obscured to various degrees by recent vegetative recolonization. Probably natal den when in use. May be used as a resting site. Five or more entrances.
3	Primary Alternative	Found near primary or secondary sites. Signs of recent or present use. Two to five entrances usually. Probably occupied and used primarily by pups. First pup movements away from natal den are usually to these sites. Presence of digging activity.
4	Tertiary	Usually two to five entrances. Old food remains and/or scats present. Probably not used in recent years. May be used as a resting site.
5	Shelter	One burrow. Probably used for shelter only.

TABLE E.3.127: LOCATION AND STATUS OF RAPTOR AND RAVEN NEST SITES IN THE MIDDLE SUSITNA BASIN, ALASKA

Species	Nesting Location No.	Corresponding U of A Museum No. (Kessel et al. 1982a; B. Cooper 1982 pers. comm.)	Status[a] 1974[b]	1980[c]	1981[c]	1982[d]	USGS Talkeetna Mountains 15 ft x 30 ft Quad No.	Location Township	Range	Section	Estimated[e] Elevation m (ft)
Golden eagle	GE-1	V, C, ll	-	x	x	NC	C-1	T30N	R11E	7	716-731 (2,350-2,400)
	GE-2	D, T, gg	-	x	x	NC	D-2	T31N	R9E	17	610-655 (2,000-2,150)
	GE-3	E, kk, ll	-	x	x	NC	D-2	T31N	R8E	1	715 (2,400)[f]
	GE-4	qq	-	-	0	x	D-2	T31N	R8E	15, 22	564 (1,850)
	GE-5	F	-	x	0	NC	D-2	T31N	R8E	9, 10	549 (1,800)
	GE-6	-	0	-	-	NC	D-2	T31N	R8E	8, 9	<579 <(1,900)
	GE-7	R	-	-	x	NC	D-3	T31N	R7E	14	945 (3,100)[f]
	GE-8	G	-	x	0	NC	D-3	T32N	R6E	28	490-518 (1,600-1,700)
	GE-9	ff	-	-	0	NC	D-3	T32N	R6E	29	490-518 (1,600-1,700)
	GE-10	-	-	-	0	NC	D-4	T33N	R5W	28	1,189 (3,900)
	GE-11	dd	-	-	0	NC	D-4	T32N	R4E	25	490-518 (1,600-1,700)
	GE-12	-	0	-	-	NC	D-4	T31N	R3E	15, 14	<549? <(1,800?)
	GE-13	Z	-	0	0	NC	D-4	T31N	R3E	17, 18	427-442 (1,400-1,450)

TABLE E.3-127 (Page 2)

Species	Nesting Location No.	Corresponding U of A Museum No. (Kessel et al. 1982a; B. Cooper 1982 pers. comm.)	Status[a] 1974[b]	1980[c]	1981[c]	1982[d]	USGS Talkeetna Mountains 15 ft x 30 ft Quad No.	Location Township	Range	Section	Estimated[e] Elevation m (ft)
Golden eagle (contd)	GE-14	-	0	-	-	NC	D-4	T31N	R3E	12	427-457? (1,400-1,500?)
	GE-15	X, Y	-	-	0	NC	D-5	T32N	R2E	22, 23	518-579 (1,700-1,900
	GE-16	I	-	x	x	NC	D-5	T32N	R2E	27	470-485 (1,540-1,590)
	GE-17	pp	-	-	0	NC	D-5	T31N	R2E	17	610-625 (2,000-2,050)
	GE-18	M	-	-	x	NC	D-5	T32N	R1E	32	335 (1,100)
Bald eagle	BE-1	-	0	-	-	NC	C-1	T31N	R12E	28, 33	686-694 (2,250-2,275)
	BE-2	B	-	x	x	NC	C-1	T29N	R11E	9, 10	663-671 (2,175-2,210)
	BE-3	hh	x	-	0	NC	C-2	T30N	R10E	16	579 (1,900)
	BE-4	S	x	-	x	NC	D-2	T31N	R8E	11	540-549 (1,775-1,800)
	BE-5	A	x	x	0	NC	D-3	T31N	R7E	2	497-503 (1,630-1,650)
	BE-6	K	-	x	x	NC	D-3	T33N	R5E	34	760 (2,500)
	BE-7	N	-	-	x	NC	C-4	T30N	R3E	1	564-572 (1,850-1,875)
	BE-8	L	0	x	x	NC	D-6	T31N	R2W	9, 10	230 (750)

TABLE E.3.127 (Page 3)

Species	Nesting Location No.	Corresponding U of A Museum No. (Kessel et al. 1982a; B. Cooper 1982 pers. comm.)	Status[a] 1974[b]	1980[c]	1981[c]	1982[d]	USGS Talkeetna Mountains 15 ft x 30 ft Quad No.	Location Township	Range	Section	Estimated[e] Elevation m (ft)
Raven	R-8	-	x	-	-	NC	D-3	T32N	R7E	33	519 (1,700)
	R-9	-	x	-	-	NC	D-3	T32N	R6E	25	488 (1,600)
	R-10	-	x	0	-	NC	D-3	T32N	R6E	28	488 (1,600)
	R-11	-	0	-	-	NC	D-3	T32N	R5E	26, 35	564 (1,850)
	R-12	Q	-	-	x	NC	D-3	T32N	R5E	23, 26	625 (2,050)
	R-13	P, ee	-	-	x	NC	D-4	T32N	R5E	20	549 (1,800)
	R-14	mm, nn, cc	-	-	0	NC	D-4	T31N	R4E	14	549-580 (1,800-1,900)
	R-15	O, aa, bb	-	-	x	NC	D-4	T31N	R4E	15	519-580 (1,700-1,900)
	R-16	-	0	-	-	NC	D-4	T31N	R3E	18	442 (1,450)
	R-17	-	0	-	-	NC	D-4	T31N	R3E	13	442 (1,450)
	R-18	-	0	-	-	NC	D-5	T32N	R2E	36	427 (1,400)
	R-19	J	x	x	-	NC	D-5	T32N	R2E	27	458 (1,500)
	R20	W	-	-	0	NC	D-5	T32N	R2E	33	366 (1,200)

TABLE E.3.127 (Page 4)

Species	Nesting Location No.	Corresponding U of A Museum No. (Kessel et al. 1982a; B. Cooper 1982 pers. comm.)	Status[a] 1974[b]	1980[c]	1981[c]	1982[d]	USGS Talkeetna Mountains 15 ft x 30 ft Quad No.	Location Township	Range	Section	Estimated[e] Elevation m (ft)
Raven	R-8	-	x	-	-	NC	D-3	T32N	R7E	33	519 (1,700)
	R-9	-	x	-	-	NC	D-3	T32N	R6E	25	488 (1,600)
	R-10	-	x	0	-	NC	D-3	T32N	R6E	28	488 (1,600)
	R-11	-	0	-	-	NC	D-3	T32N	R5E	26, 35	564 (1,850)
	R-12	Q	-	-	x	NC	D-3	T32N	R5E	23, 26	625 (2,050)
	R-13	P, ee	-	-	x	NC	D-4	T32N	R5E	20	549 (1,800)
	R-14	mm, nn, cc	-	-	0	NC	D-4	T31N	R4E	14.	549-580 (1,800-1,900)
	R-15	O, aa, bb	-	-	x	NC	D-4	T31N	R4E	15	519-580 (1,700-1,900)
	R-16	-	0	-	-	NC	D-4	T31N	R3E	18	442 (1,450)
	R-17	-	0	-	-	NC	D-4	T31N	R3E	13	442 (1,450)
	R-18	-	0	-	-	NC	D-5	T32N	R2E	36	427 (1,400)
	R-19	J	x	x	-	NC	D-5	T32N	R2E	27	458 (1,500)
	R20	W	-	-	0	NC	D-5	T32N	R2E	33	366 (1,200)

TABLE E.3.127 (Page 5)

Species	Nesting Location No.	Corresponding U of A Museum No. (Kessel et al. 1982a; B. Cooper 1982 pers. comm.)	Status[a] 1974[b]	1980[c]	1981[c]	1982[d]	USGS Talkeetna Mountains 15 ft x 30 ft Quad No.	Location Township	Range	Section	Estimated[e] Elevation m (ft)
Raven (Contd)	R-21	-	0	-	-	NC	D-5	T32N	R1E	32	427 (1,400)

[a]Status unknown, x = possibly active, x = active, 0 = inactive, - = not reported (1974) or not located (1980 - 1981) (although suitable habitat was present in most cases), NC = not checked.
[b]Data from White (1974).
[c]Data from Kessel et al. (1982a), B. Kessel and B. Cooper (unpubl. data).
[d]Data from Kessel and Cooper (unpubl. data).
[e]Differences occur between elevations given here and those reported by Kessel et al. (1982). Original estimates were obtained by attempting to locate nests as accurately as possible on USGS 1:63,360 maps with contour intervals of 100' (majority) or 50' (Talkeetna Mtns),C-1 but it was often difficult to precisely locate nests and to locate them relative to tightly spaced contour intervals (Cooper 1982 pers. comm.). All elevations have been reviewed and some revisions were made; however, in some cases estimates given here may contain errors of as much as $\pm$100'. All elevations must be considered approximate (unless otherwise noted) until the majority are rechecked with a precision altimeter.
[f]Elevation checked with helicopter altimeter ($\pm$ 30-foot accuracy, 20-foot increments) on October 11, 1982.

TABLE E.3.127b: LOCATION OF RAPTOR NESTS IN THE MIDDLE SUSITNA BASIN

GE-1	2.4 km (1.5 mi) upriver from Vee Canyon and 0.5 to 0.6 km (0.3 to 0.4 mi) up a narrow canyon on the north side of the Susitna River. Three nests present; 1980 nest 26 m (85 ft) up a 33 m (110 ft) cliff, 100 m (330 ft) back from and 67 m (220 ft) above unnamed creek, 1981 nest 8 m (26 ft) up 12 m (40 ft) cliff 81 m (265 ft) back from and 67 m (220 ft) above unnamed creek (Kessel et al. 1982a; Kessel, unpubl. data).
GE-2	4.2 km (2.6 mi) up the Susitna River from the mouth of Jay Creek and in a canyon on the north side of the Susitna River. Three nests were present; 1980 nest 5 m (15 ft) up 13 m (40 ft) cliff, 10 m (35 ft) back from and 18 m (60 ft) above unnamed creek, 1981 nest 1 m (5 ft) up 5 m (15 ft), vegetated cliff, 14 m (45 ft) back from and 33 m (110 ft) above unnamed creek (Kessel et al. 1982a; Kessel, unpubl. data).
GE-3	2.4 km (1.5 mi) up Jay Creek from its confluence with the Susitna River. Three nests were present; 1981 nest 5 m (15 ft) up 30 m (100 ft) cliff, 150 m (490 ft) from west bank and 115 m (375 ft) above Jay Creek (Kessel et al. 1982a; Kessel, unpubl. data).
GE-4	1.6 km (1.0 mi) up Kosina Creek from its confluence with the Susitna River and on the east side of Kosina Creek. This nest was identified as an inactive raven nest in 1981 but golden eagles nested there in 1982 (B. Cooper 1982 pers. comm.).
GE-5	1.0 km (0.6 mi) down the Susitna River from the mouth of Kosina Creek. The nest is 32 m (105 ft) up 38 m (125 ft) cliff on north riverbank (Kessel et al. 1982a).
GE-6	2.8 km (1.7 mi) down the Susitna River from the mouth of Kosina Creek on the north bank of the river. White (1974) reported a golden eagle nest at this location in 1974, but his location may correspond to GE-5 since the area he indicated does not contain suitable nesting habitat.
GE-7	9.6 km (6.0 mi) down the Susitna River from the mouth of Kosina Creek and 7 m (25 ft) up a 12 m (40 ft) cliff on a south-facing hillside above the south bank of the river (Kessel et al. 1982a).
GE-8	4.0 km (2.5 mi) down the Susitna River from the mouth of Watana Creek and 13 m (45 ft) up a 23 m (75 ft) cliff, 40 m (130 ft) back from and 34 m (110 ft) above the north bank of the river. This nest was inactive in 1981 although it did have a fresh spruce lining (Kessel et al. 1982a; Kessel, unpubl. data).
GE-9	5.4 km (3.4 mi) up the Susitna River from the mouth of Deadman Creek on a cliff on the north bank of the river (Kessel, unpubl. data).
GE-10	11.2 km (7.0 mi) north of the proposed Watana damsite, high on the southeast side of Tsusena Butte (Kessel, unpubl. data).
GE-11	1.0 km (0.6 mi) down the Susitna River from the mouth of Tsusena Creek and 0.8 km (0.5 mi) up and on the east bank of a small unnamed drainage (Kessel, unpubl. data).
GE-12	10.0 km (6.3 mi) down the Susitna River from the mouth of Fog Creek on the north bank of the river. White (1974) reported a golden eagle nest at this location in 1974, but his location probably corresponds to GE-13, since the area he indicated does not appear to contain suitable nesting habitat.

GE-13	9.4 km (5.9 mi) up the Susitna River from the mouth of Devil Creek on a cliff on the north bank of the river (Kessel, unpubl. data).
GE-14	5.6 km (3.5 mi) up the Susitna River from the mouth of Devil Creek. A golden eagle nest was reported at this location on the west side of the river in 1974 (White 1974); but the nearest suitable habitat appears to be 1.4 km (0.9 mi) and 2.0 km (1.3 mi) further downstream (B. Cooper 1982 pers. comm.) and one of these locations may represent the actual 1974 location.
GE-15	2.8 km (1.8 mi) up Devil Creek from its confluence with the Susitna River. Two nests (alternates) are present; one on the cliffs on the west side of Devil Creek and one on the cliffs on the north side of a small, unnamed tributary that empties into Devil Creek (Kessel, unpubl. data).
GE-16	0.6 km (0.4 mi) up Devil Creek from its confluence with the Susitna River and 30 m (100 ft) up 45 m (150 ft) vegetated cliff, 100 m (330 ft) back from and 120 m (395 ft) above Devil Creek on the west bank (Kessel et al. 1982a).
GE-17	6.8 km (4.3 mi) down the Susitna River from the mouth of Devil Creek and 3.5 km (2.2 mi) up and on the east side of a small drainage that joins the river from the south (Kessel unpubl. data).
GE-18	3.4 km (2.1 mi) up the Susitna River from the mouth of Portage Creek on a moderate-sized cliff on the north bank (Kessel et al. 1982a).
BE-1	4.2 km (2.6 mi) up the Susitna River from the mouth of Tyone River. White (1974) reported two closely associated nests on the east side of the Susitna River in 1974 but they appeared to be gone by 1980-81.
BE-2	3.4 km (2.1 mi) up the Oshetna River from its confluence with the Susitna River and 4 m (15 ft) from edge of the west bank in a 22 m (70 ft) white spruce (Kessel et al. 1982a).
BE-3	4.0 km (2.5 mi) down the Susitna River from the midpoint of Vee Canyon on the south bank of the Susitna River, just west of the mouth of a small unnamed tributary (White 1974; Kessel, unpubl. data).
BE-4	1.8 km (1.1 mi) up the Susitna River from the mouth of Kosina Creek and 25 m (80 ft) up a 33 m (110 ft) cliff on the north bank of the river (White 1974; Kessel et al. 1982a).
BE-5	8.8 km (5.5 mi) up the Susitna River from the mouth of Watana Creek on a wooded island in a live white spruce (White 1974, Kessel et al. 1982a).
BE-6	9.2 km (5.7 mi) up Deadman Creek from its confluence with the Susitna River on top of a 15 m (50 ft), broken-topped balsam poplar, 25 m (80 ft) from the north bank of Deadman Creek (Kessel et al. 1982a).
BE-7	On the south shore of a small pond (WB105), 1.2 km (0.7 mi) east of the northeast end of Stephan Lake and on top of a 13 m (45 ft), broken-topped balsam poplar (Kessel et al. 1982a).
BE-8	1.0 km (0.6 mi) up the Susitna River from its confluence with Indian River and on top of a 23 m (75 ft), broken-topped poplar, 4 m (15 ft) from the north riverbank (White 1974; Kessel et al. 1982a).

GYR-1	At midpoint of Vee Canyon and 100 m (330 ft) up a 113 m (370 ft) cliff on the south bank of the Susitna River (White 1974, Kessel et al. 1982a).
GYR-2	6.8 km (4.2 mi) down the Susitna River from the mouth of Devil Creek and 2.6 km (1.6 mi) up a gorge on the south side of the river. Nest is 100 m (330 ft) up 105 m (345 ft) cliff in the creek canyon (White 1974, Kessel et al. 1982a).
GYR-3	1.8 km (1.1 mi) due south of the proposed Devil's Canyon damsite. An active nest was reported in 1974 and White (1974) commented that it was "...back from high water limits about 1/2 mile...."
GOS-1	0.3 km (0.2 mi) west of the mouth of Kosina Creek on the south bank of the Susitna River (B. Cooper 1982 pers. comm.).
GOS-2	1.6 km (1.0 mi) up the Susitna River from the mouth of Fog Creek and on the southeast side of the river. Goshawk nests reported at this location in 1974 (White 1974).
GOS-3	2.0 km (1.3 mi) southeast of the Devil's Canyon damsite in paper birch on steep slope (B. Cooper 1982 pers. comm.; Kessel 1982 pers. comm.).
R-1	2.4 km (1.5 mi) upriver from Vee Canyon and 0.6 km (0.4 mi) up a narrow canyon on the north side of the Susitna River. A nest was reported on the east side of the narrow canyon about 0.2 km (0.1 mi) from a small stream in 1974 (White 1974).
R-2	0.6 km (0.4 mi) up the Susitna River from the midpoint of Vee Canyon. An active nest was reported on the north side of the Susitna River on a south-facing cliff in 1974 (White 1974).
R-3	At midpoint of Vee Canyon an active nest was reported on the south-facing slope of the north bank of the Susitna River in 1974 (White 1974).
R-4	5.6 to 6.6 km (3.5-4.1 mi) down the Susitna River from the midpoint of Vee Canyon on the north bank. An active nest was reported at this general location in 1974 (White 1974). It was probably located on one of the two small existing south-facing cliff areas.
R-5	1.6 km (1.0 mi) up Jay Creek from its confluence with the Susitna River. An active nest was reported about 0.1 km (300 ft) east of Jay Creek up a small unnamed tributary that joins Jay Creek (White 1974).
R-6	1.4 km (0.8 mi) up Kosina Creek from its confluence with the Susitna River. An active nest was reported about 0.2 km (0.1 mi) east of Kosina Creek on a northwest-facing hill (White 1974).
R-7	4.6 km (2.8 mi) down the Susitna River from the mouth of Kosina Creek. An active nest was reported on the north bank of the Susitna River in 1974 (White 1974).
R-8	5.0 km (3.1 mi) up the Susitna River from the mouth of Watana Creek. An active nest was reported on the north bank of the Susitna River in 1974 (White 1974).
R-9	1.0 km up (0.6 mi) the Susitna River from the mouth of Watana Creek. An active nest was reported on the north bank of the Susitna River in 1974 (White 1974).

R-10	4.6 km (2.8 mi) down the Susitna River from the mouth of Watana Creek. An active nest was reported on the north bank of the Susitna River in 1974 (White 1974). The nest was inactive in 1980 (Kessel et al. 1982a).
R-11	0.2 km (0.1 mi) down the Susitna River from the mouth of Deadman Creek. A nest was reported on the south bank of the Susitna almost opposite the mouth of Deadman Creek (White 1974).
R-12	1.4 km (0.9 mi) up Deadman Creek from its confluence with the Susitna River and 13 m (45 ft) up a 32 m (105 ft) cliff on the east bank of the creek (Kessel et al. 1982a).
R-13	4.2 km (2.6 mi) up Tsusena Creek from its confluence with the Susitna River. Two nests (alterates) were reported to be on a cliff on the east bank of the creek. (Kessel et al. 1982a).
R-14	3.8 km (2.4 mi) up Fog Creek from its confluence with the Susitna River. Two nests (alternates) were located on the north side of the creek and another alternate nest was located on the south side. (Kessel et al. 1982a).
R-15	2.4 km (1.5 mi) up Fog Creek from its confluence with the Susitna River. Two nests (alternates) were located on the north side of the creek and an active nest was located on the south side of the creek (Kessel et al. 1982a).
R-16	7.4 km (4.6 mi) up the Susitna River from the mouth of Devil Creek. Nests were reported on the north bank of the Susitna River in 1974 (White 1974).
R-17	7.4 km (4.6 mi) up the Susitna River from the mouth of Devil Creek and 0.5 km up a small drainage that flows south into the Susitna River. A nest was reported at this location in 1974 (White 1974).
R-18	2.4 km (1.5 mi) up the Susitna River from the mouth of Devil Creek. A nest was reported on the north shore of the Susitna River in 1974 (White 1974).
R-19	1.0 km (0.6 mi) up Devil Creek from its confluence with the Susitna River and near the top of a cliff on the west bank of the creek. An active nest was reported here in 1974 (White 1974) and it was active in 1980 (Kessel et al. 1982a).
R-20	1.9 km (1.2 mi) down the Susitna River from the mouth of Devil Creek on cliffs on the northwest side of the river (Kessel, unpubl. data).
R-21	3.6 km (2.3 mi) up the Susitna River from the mouth of Portage Creek and 0.6 km (0.4 mi) downstream from the proposed Devil Canyon damsite on the north bank of the river. A nest was reported at this location in 1974 (White 1974).

TABLE E.3.128: BREEDING PHENOLOGIES OF EAGLES, GYRFALCON, AND COMMON RAVEN IN INTERIOR ALASKA (from Kessel et al. 1982a)

Species	Status[a]	Dates of Phases of Breeding Cycle				
		Arrival/Courtship	Egg-Laying	Incubation	Nestlings	Fledging/Dispersal
Golden eagle[b]	M	Mar 5-Apr 30	Apr 1-May 10	Apr 15-June 20	June 1-Sept 1	Aug 1-Sept 25
Bald eagle[b]	M/R	Mar 10- May 1	Mar 20-May 10	Apr 30-June 30	May 20-Sept 15	Aug 1-Sept 30
Gyrfalcon[b]	R	Mar 1-Apr 10	Apr 1-May 20	Apr 5-June 25	May 15-Aug 15	July 10-Sept 30
Raven[c]	R	Mar 1-Apr 15	Apr 1-May 5	Apr 5-May 25	Apr 25-June 25	May 25-July 15

a M = migrant, R = resident
b Data summarized from Roseneau et al. (1981)
c Based on calculations from Kessel (unpublished data) and Brown (1974)

TABLE E.3.129: DATA ON BALD EAGLE NESTS ALONG THE SUSITNA RIVER, BETWEEN DEVIL CANYON AND COOK INLET. NESTS IN 1980 WERE OBSERVED IN APRIL BY U.S. FISH AND WILDLIFE SERVICES; 1981 NESTS WERE LOCATED ON 26 JUNE BY TERRESTRIAL ENVIRONMENTAL SPECIALISTS, INC.; THE 1982 NESTS WERE RESULTS OF UNIVERSITY OF ALASKA MUSEUM SURVEYS. ALL 1982 NESTS WERE LOCATED IN LARGE, OLD COTTONWOOD TREES. (from Kessel et al. 1982b)

Year and Status 80	81	82	No. Chicks 1982		Locality	Nest Height (m)	Tree Height (m)	Broken Topped ?	Tree dead or alive	Distance from river (m)	Elevation (m/ft)
N	A	A	1	62°47'N 149°38'W:	North bank of Susitna River 1 km upstream from confluence with Indian River	23	23	Yes	live	4	244 (800)
N	A	I	0	62°40'N 149°55'W:	Island in Susitna River 4 km downstream from Sherman	21	21	Yes	dead	250	182 (600)
N	A	A	2	62°20'N 150°10'W:	Confluence of Chulitna and Susitna rivers	25	33	No	dead	200	107 (350)
-	-	A	2	62°21'N 150°03'W:	South bank of Talkeetna River 3 km upstream from confluence with Susitna River	27	30	No	live	3	116 (380)
-	-	A	1	62°19'N 150°08'W:	West bank of Susitna River opposite Talkeetna	30	33	No	live	10	107 (350)
N	A	A	≥1	62°13'N 150°06'W:	East bank of Susitna River 4.5 km upstream from Parks Highway Bridge	22	33	No	live	5	91 (300)
N	-	A	-	62°10'N 150°10'W:	East bank of Susitna River 2 km downstream from Parks Highway Bridge	-	-	-	-	-	91 (300)
-	A	A	-	62°01'N 150°06'W:	Island in Susitna River near Sheep Creek Slough	-	-	-	-	-	76 (250)
N	-	A	-	61°49'N 150°10'W:	Island in Susitna River west of Kashwitna Lake	12	23	No	live	30	30 (100)
N	-	A	≥1	61°47'N 150°10'W:	Island in Susitna River opposite mouth of Willow Creek	23	30	No	live	10	30 (100)
N	-	A	1	61°46'N 150°13'W:	Island in Susitna River 2 km west of mouth of Willow Creek	30	34	No	dead	90	24 (80)
-	-	A	2	61°45'N 150°15'W:	Northwest corner of Delta Islands	30	30	Yes	live	40	24 (80)
N	A	A	≥1	61°43'N 150°19'W:	West bank of Susitna River .5 km upstream from mouth of Kroto Creek	28	28	Yes	live	100	30 (100
N	-	I	0	61°43'N 150°17'W:	East bank of Susitna River opposite mouth of Kroto Creek	22	30	No	live	20	27 (90)
N	-	A	≥1	61°40'N 150°19'W:	East bank of Susitna River opposite Kroto Slough	23	27	Yes	live	5	30 (100)
N	-	I	0	61°39'N 150°20'W:	Island in Susitna River near Kroto Slough	20	27	No	live	100	24 (80)
N	-	I	0	61°39'N 150°21'W:	Island in Susitna River near Kroto Slough	27	30	No	live	5	24 (80)
-	-	A	-	61°37'N 150°23'W:	Island in Susitna River 5 km upstream from Yentna River mouth	23	30	No	live	100	20 (60)
-	-	A	-	61°35'N 150°25'W:	Island at confluence of Yentna and Susitna rivers	-	-	-	-	-	17 (50)
-	-	A	≥1	61°28'N 150°30'W:	East bank of Susitna River east of Flat Horn Lake	23	27	Yes	live	5	10 (30)
-	-	I	0	61°28'N 150°32'W:	West bank of Susitna River east of Flat Horn Lake	23	25	Yes	live	3	10 (30)
-	-	A	-	61°24'N 150°30'W:	South end of Bell Island	-	-	-	-	-	7 (20)
-	-	I	0	61°22'N 150°36'W:	Northern end of Big Island	20	34	No	live	1	3 (10)
-	-	I	0	61°22'N 150°37'W:	West bank of Susitna River west of Big Island	18	23	No	live	2	3 (10)
-	-	I	0	61°20'N 150°38'W:	West side of Big Island	20	23	Yes	dead	20	3 (10)
-	-	I	0	61°20'N 150°28'W:	West side of Big Island	20	20	Yes	dead	20	3 (10)
-	-	I	0	61°25'N 150°28'W:	East bank of Susitna River near Maid Lake	-	-	Yes	-	-	3 (10)
-	-	I	0	61°22'N 150°31'W:	Island in the Susitna River west of Beaver Lake	-	-	Yes	-	-	3 (10)
N	-	-	-	61°22'N 150°01'W:	Confluence of the Chunilna and Talkeetna rivers	-	-	-	-	-	137 (450)
N	-	-	-	62°20'N 150°05'W:	Island 1 km up to Talkeetna River	-	-	-	-	-	107 (350)
N	-	-	-	62°17'N 150°08'W:	Island in Susitna River 3 km downstream from Talkeetna	-	-	-	-	-	107 (350)
N	-	-	-	62°16'N 150°09'W:	West bank of Susitna River 6 km downstream from Talkeetna	-	-	-	-	-	107 (350)
-	A	-	-	61°59'N 150°07'W:	Island in Susitna River near mouth of Sheep Creek	-	-	-	-	-	60 (200)
N	-	-	-	61°54'N 150°07'W:	East bank of Susitna River near mouth of 196 Mile Creek	-	-	-	-	-	45 (150)
N	-	-	-	61°46'N 150°13'W:	North end of Delta Islands	-	-	-	-	-	30 (100)
-	A	-	-	61°28'N 150°32'W:	West bank of Susitna River west of Bell Island	-	-	-	-	-	7 (20)
-	A	-	-	61°27'N 150°30'W:	Island in Susitna River east of Bell Island	-	-	-	-	-	7 (20)
N	-	-	-	61°57'N 150°06'W:	Island in Susitna River 1 km upstream from Caswell Creek mouth	-	-	-	-	-	55 (180)

Key: N = nest, A = active nest, I = inactive next, - = no information

TABLE E.3.130: SUMMARY OF TOTAL NUMBERS AND SPECIES COMPOSTION OF WATERBIRDS SEEN ON LAKES SURVEYED IN SUMMER 1981 IN THE MIDDLE SUSITNA BASIN
(based on Kessal et al. 1982a)

Species	Summer 1981	
	Adults	Broods
Common loon	22	3
Arctic loon	2	0
Red-throated loon	8	0
Red-necked grebe	7	1
Horned grebe	5	5
Trumpeter swan	16	1
Mallard	10	1
Pintail	7	2
Green-winged teal	2	1
Northern shoveler	7	1
American wigeon	8	6
Scaup, greater and lesser	70	5
Goldeneye, common and Barrow's	6	1
Oldsquaw	47	11
White-winged scoter	81	0
Surf scoter	33	2
Black scoter	26	11
Scoter spp.	6	1
Red-breasted merganser	1	1
Merganser spp.	1	0
Mew gull	83	7
Bonaparte's gull	5	0
Arctic tern	48	0
Total birds	461	60
Total wetland area surveyed (km^2)	20.5	20.5
Density (birds/km^2 of wetlands)	22.5	2.9

TABLE E.3.131: SUMMARY OF TOTAL NUMBERS AND SPECIES COMPOSITION OF WATERBIRDS SEEN ON SURVEYED WATERBODIES DURING AERIAL SURVEYS OF THE UPPER SUSITNA RIVER BASIN, FALL 1980 (from Kessel et al. 1982a)

Species	DATE OF SURVEY 7 Sept	11 Sept	16 Sept	20 Sept	26 Sept	3 Oct	TOTAL
Loon spp.				4	1		5
Common loon		3	2	3			8
Red-necked grebe	2	3	4		5	3	17
Horned grebe	1	4	17	9	2	2	35
Swan spp.		34	29	9	12	20	104
Canada goose				1	20		21
American wigeon		155	325	97	88	56	721
Green-winged teal		30	83	9	1	2	125
Mallard	10	64	14	116	110	124	438
Pintail	60	60	53	21	3	4	201
Blue-winged teal		1					1
Northern shoveler		8	20				28
Ring-necked duck			2	12			14
Scaup spp.	165	347	499	370	293	180	1854
Oldsquaw	7	4	13	13	16	4	57
Black scoter		8	38	25	24	10	105
Scoter spp.*				6	56	72	134
surf scoter		5	4	2			11
white-winged scoter	10			1	6	1	18
Bufflehead		33	40	95	127	101	396
Goldeneye spp.	15	36	68	124	95	133	471
Merganser spp.		8	30	36	68	19	161
TOTAL BIRDS	270	803	1241	953	927	731	4925
Total wetland area surveyed (km^2)	13.11	22.08	25.76	27.53	29.00	24.25	
Density (birds/km^2 of wetlands)	20.6	36.4	48.2	34.6	32.0	30.1	

* Surf or white-winged scoter

TABLE E.3.132: SUMMARY OF TOTAL NUMBERS AND SPECIES COMPOSITION OF WATERBIRDS SEEN ON SURVEYED WATERBODIES DURING AERIAL SURVEYS OF THE UPPER SUSITNA RIVER BASIN, FALL 1981 (from Kessel et al 1982a)

Species	DATE OF SURVEY 15-16 Sept	26 Sept	26 Sept-9 Oct	12-19 Oct	20-23 Oct	TOTAL
Common loon	2	3	3	1		9
Arctic loon						
Red-throated loon						
Loon spp.						
Red-necked grebe	12	3	1			16
Horned grebe						
Whistling swan	-	18	24			42
Trumpeter swan	6		10	14		30
Swan spp.		41	25	22	13	101
Canada goose				50		50
Mallard	41	153	131	142		467
Pintail	32					32
Green-winged teal	13	3				16
Northern shoveler						
American wigeon	133		14	5		152
Canvasback						
Redhead						
Scaup, greater and lesser	479	166	51	90		786
Goldeneye, common and Barrow's	18	125	68	36		247
Bufflehead	17	20	29	52		118
Oldsquaw	15	31	7	1		54
White-winged scoter			69	13		82
Surf scoter				29		29
Black scoter	1	6	2	1		10
Scoter, spp.	69		1	92		162
Common merganser			1	2		3
Red-breasted merganser						
Merganser spp.	77	38		18		133
TOTAL BIRDS	915	607	436	568	13	2539
Total wetland area surveyed (km^2)	25.68	25.68	21.31	11.57	6.62	
Km^2 of 100% frozen waterbodies surveyed*	0	1.41	3.91	3.76**	2.00	
Density (birds/km^2 of wetlands)	35.6	23.6	20.5	49.1	1.96	

* Other waterbodies had at least some open water

** An additional 9.22 km^2 of 100% frozen waterbodies were not surveyed in mid-October because they were known to be frozen. By late October only Stephen and Murder Lakes still had some open water.

TABLE E.3.133: SUMMARY OF TOTAL NUMBERS AND SPECIES COMPOSITION OF WATERBIRDS SEEN ON SURVEYED WATERBODIES DURING AERIAL SURVEYS OF THE UPPER SUSITNA RIVER BASIN, SPRING 1981 (from Kessel et al. 1982a)

Species	DATE OF SURVEY 3 May	10 May	26 May	TOTAL
Common loon			4	4
Arctic loon			5	5
Red-throated loon			2	2
Loon spp.		3	4	7
Red-necked grebe			4	4
Horned grebe		1	1	2
Whistling swan				
Trumpeter swan	2		6	8
Swan spp.		11	10	21
Canada goose				
Mallard	97	78	121	296
Pintail	71	70	116	257
Green-winged teal	67	47	38	152
Northern shoveler		12	28	40
American wigeon	5	94	99	198
Canvasback		1		1
Redhead			28	28
Scaup, greater and lesser		103	513	616
Goldeneye, common and Barrow's		51	38	89
Bufflehead		2	10	12
Oldsquaw		2	84	86
White-winged scoter			16	16
Surf scoter		4	35	39
Black scoter		1	42	43
Scoter, spp.		12	74	86
Common merganser			7	7
Red-breasted merganser			2	2
Merganser spp.			25	25
TOTAL BIRDS	242	492	1312	2046
Total wetland area surveyed (km^2)	25.68	25.68	25.68	
Km^2 of 100% frozen waterbodies surveyed*	14.31	1.97	0	
Density (birds/km^2 of wetlands)	9.4	19.2	51.1	

*Other waterbodies had atleast some open water.

TABLE E.3.134: SEASONAL POPULATION STATISTICS FOR THE MORE IMPORTANT OF SURVEYED WATERBODIES OF THE MIDDLE SUSITNA RIVER BASIN, 1980-81. INCLUDED ARE WATERBODIES THAT WERE AMONG THOSE HAVING THE SIX HIGHEST IMPORTANCE VALUE RATINGS IN AT LEAST ONE SEASON (from Kessel et al. 1982a)

		Fall 1980**			Fall 1981**			Spring 1981††			Summer 1981			
Waterbody	Size (km^2)	Mean no. birds	Mean density (no/km^2)	Mean no. species	Mean no. birds	Mean density (no/km^2)	Mean no. species	Mean no. birds	Mean density (no/km^2)	Mean no. species	no. adults	Density of adults	no. species	no. broods
Murder Lake - WB107	0.15	39.0	260.0	4.3	38.0	253.3	3.0	51.3	342.2	5.0	23	153.3	5	1
Stephan Lake - WB106	3.55	156.0	43.9	9.5	168.5	47.5	5.0	99.7	28.1	7.3	87	24.5	9	2
(Tyone R - Oshetna R group - WB140)	0.90	53.5	59.4	5.0	30.5	33.9	2.5	48.3†	53.7†	3.7†	75	83.3	11	4
(MacLaren R- Tyone R group - WB131)	1.04	212.8	204.6	6.5	123.0	118.3	5.0	54.7†	52.6†	3.7†	-	-	-	-
(Clarence Lake group-WB145)	1.60	103.8	64.8	7.0	42.5	26.6	4.5	58.7	36.7	7.0	35	21.9	8	6
(Fog Lakes group I-WB059)	1.44	72.8	50.5	6.5	55.0	38.2	3.0	21.3	14.8	4.7	54	37.5	11	5
Watana Lake - WB148	1.25	95.8	76.6	3.8	34.5	27.6	2.0	21.3†	17.1†	3.0†	8	6.4	3	0
Pistol Lake (Lower Deadman Creek group-WB067)	0.76	19.0*	17.9*	4.0*	4.0†	5.3	1.5†	85.0	111.8	6.0	15	19.7	8	5
(Fog Lakes group II-WB032)	0.07	-	-	-	-	-	-	-	-	-	8	114.3	4	6
Swimming Bear Lake-WB150	0.57	-	-	-	11.5	20.2	0.5	4.7†	8.2†	0.7†	33	57.9	5	4

[1] Codes are those used by Kessel et al. (1982a)
* Combines WB 064-067
**September 11, 16, 20 and 26, 1980; September 15 and 26, 1981
† 100 percent frozen on at least one survey
††May 3, 10, and 26, 1981
\- Not surveyed

TABLE E.3.135: SUMMARY OF TOTAL NUMBERS AND SPECIES COMPOSITION OF WATERBIRDS SEEN DURING SPRING AERIAL SURVEYS OF THE LOWER SUSITNA RIVER, 1981 AND 1982
(from Kessel et al. 1982b, B. Kessel, unpub. data)

Species	Devil Canyon to Talkeetna (74 km)				Talkeetna to Montana (33 km)				Montana to Kashwitna Lake (29 km)				Kashwitna Lake to mouth of Yentna River (36 km)				Mouth Yentna River to Cook Inlet (37 km)			
	May				May				May				May				May			
	7/81	10/82	21/82	28/82	7/81	10/82	21/82	28/82	7/81	10/82	21/82	28/82	7/81	10/82	21/82	28/82	7/81	10/82	21/82	28/82
Arctic loon				2																
Red-throated loon																			1	1
Loon spp.																	8			
Red-necked grebe													1				4			
Swan spp.				2										2		1	60	400	20	
White-fronted goose																				
Brant																	2			
Canada goose										1				4			1			21
Green-winged teal	34				5				3											
Mallard	18	8	2	1	23	12			23			2	7	1		1	2	2	3	12
Pintail	13								3											3
American wigeon	2								14				4				9			5
Canvasback	2																20			
Scaup spp.		1			2												100			
Scoter spp.									2											
Goldeneye spp.	11		2		6				2				3				10			2
Bufflehead			2		2				14											
Common merganser			2	4			6	2							9	1	70	8	64	119
Merganser spp.	6		4		6				61				8				102			
Total no. species		11				7				9				9				14		
Mean no. birds/survey		29				16				31				12				296		
Mean no. birds/km		0.4				0.5				1.1				0.3				8.0		

TABLE E.3.136: NUMBER OF TERRITORIES OF EACH SPECIES ON EACH 10-HECTARE CENSUS PLOT, UPPER SUSITNA RIVER BASIN, ALASKA, 1981 (+ = SMALL PORTION OF A BREEDING TERRITORY ON CENSUS PLOT, COUNTED AS 0.1 IN DENSITY AND DIVERSITY CALCULATIONS: V = VISITOR TO PLOT.)

(from Kessel et al. 1982a)

Species	Alpine Tundra	Dwarf-Low Birch Shrub Thicket	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cotton-wood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest I	White Spruce-Paper Birch Forest II	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
Pintail				V								
Goshawk					V					V		
Marsh hawk												V
Spruce grouse					V	V	V	1.0	1.0	V	V	
Ruffed grouse										+		
Willow ptarmigan		0.5		V								V
Rock ptarmigan		0.7										
White-tailed ptarmigan	+											
American golden plover	V											
Greater yellowlegs											+	
Common snipe			V	V							0.5	1.0
Baird's sandpiper	0.8	V										
Long-tailed jaeger		V										
Short-eared owl		V		V								
Common flicker									V			
Hairy woodpecker						1.0			1.0			
Downy woodpecker						0.5						
N. three-toed woodpecker								V	0.3	1.0	V	V
Alder flycatcher						1.0						
Olive-sided flycatcher									V	V		
Horned lark	0.3	V										
Tree swallow			V	V		V						
Gray jay					1.0		V	0.5	0.5	1.0	+	V
Black-billed magpie					V							
Common raven												V
Black-capped chickadee						1.8	V	V	V			
Boreal chickadee							V	1.7	1.0	V	V	1.0
Brown creeper						2.0			1.0			
American robin					0.5		V			V	0.5	0.5
Varied thrush					1.5	10.0	3.5	2.5	3.3	2.9	V	V
Hermit thrush					2.2	V	6.1	3.8	V			
Swainson's thrush						6.9	5.5	5.4	8.0	3.0	V	V
Gray-cheeked thrush						3.8	V	V			3.9	2.5
Arctic warbler			4.8	3.6							2.8	

TABLE E.3.136 (Page 2)

Species	Alpine Tundra	Dwarf-Low Birch Shrub Thicket	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cotton-wood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest I	White Spruce-Paper Birch Forest II	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
Ruby-crowned kinglet						V	V	3.3	1.0	4.2	0.8	4.0
Water pipit	0.5											
Bohemian waxwing												V
Orange-crowned warbler											V	
Yellow-rumped warbler					+	7.0	9.8	7.5	9.5	1.0	0.8	2.5
Blackpoll warbler			V			4.4	3.9	1.8	0.5		2.0	1.5
Northern waterthrush						6.1	+	2.5	V			
Wilson's warbler			8.8	9.2	1.2	4.0	3.8	4.0			9.4	
Rusty blackbird												V
Common redpoll		V	V	1.5	V	2.5	2.0	2.0	3.0	V	0.5	1.0
Pine siskin							V			V		
White-winged crossbill					V	V		V	V	V	V	V
Savannah sparrow	1.0	5.8	3.0	12.3						V	2.5	0.8
Dark-eyed junco					2.8	1.8	2.5	3.9	4.5	2.5	2.0	2.0
Tree sparrow		2.5	11.8	15.0	1.5						7.9	2.6
White-crowned sparrow		0.3	4.1	3.8	+	3.5					6.5	2.5
Fox sparrow				V	1.6	4.6	1.0	1.9	V		3.5	2.9
Lincoln's sparrow				V								
Lapland longspur	1.0	0.8										
Snow bunting	0.2											

TABLE E.3.137: NUMBER OF TERRITORIES OF EACH BIRD SPECIES ON EACH 10-HECTARE CENSUS PLOT, UPPER SUSITNA RIVER BASIN, ALASKA, 1982 (+ = SMALL PORTION OF A BREEDING TERRITORY ON CENSUS PLOT, COUNTED AS 0.1 IN DENSITY AND DIVERSITY CALCULATIONS; V = VISITOR TO PLOT.)

(from Kessel, unpubl. tables)

Species	Alpine Tundra	Dwarf-Low Birch Shrub Thicket	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cotton-wood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest I	White Spruce-Paper Birch Forest II	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
Goshawk									V	+		
Marsh hawk			V									
Spruce grouse							+		0.5	+		
Willow ptarmigan		+		+								
Rock ptarmigan		V										
American golden plover	0.5											
Whimbrel												
Greater yellowlegs											+	
Common snipe		V	V	+							0.5	
Long-billed dowitcher		V										
Baird's sandpiper	2.0											
Great horned owler						V						
Hawk owl											V	
Short-eared owl		V										
Common flicker										V		
Hairy woodpecker						1.0						
Downy woodpecker						0.5						
N. three-toed woodpecker										0.5		
Olive-sided flycatcher										+		
Horned lark	0.6	0.3										
Tree swallow						V				V		
Violet-green swallow										V		
Gray jay					V			0.8	1.0	0.5	V	
Black-billed magpie					V							
Common raven	V											
Black-capped chickadee						2.0						
Boreal chickadee							V	1.0	2.0	V		
Brown creeper						+			1.0			
American robin					+	+				+	V	0.9
Varied thrush				+	0.5	3.5	2.0	2.0	1.0	1.0	V	
Hermit thrush					1.8		4.0					
Swainson's thrush					+	2.5	1.0	4.1	5.0	4.0		
Gray-cheeked thrush					3.0					V	1.3	2.5
Wheatear	V											

TABLE E.3.137 (Page 2)

Species	Alpine Tundra	Dwarf-Low Birch Shrub Thicket	Medium Birch Shrub Thicket	Low-Medium Willow Shrub Thicket	Tall Alder Shrub Thicket	Cotton-wood Forest	Paper Birch Forest	White Spruce-Paper Birch Forest I	White Spruce-Paper Birch Forest II	White Spruce Forest	White Spruce Scattered Woodland	Black Spruce Dwarf Forest
Arctic warbler			5.0	3.0							2.0	
Ruby-crowned kinglet								2.8	3.8	4.1	1.5	1.8
Water pipit		2.0										
Orange-crowned warbler					0.8		V		+	V		
Yellow-rumped warbler					0.8	2.0	4.0	4.3	5.8	3.0		1.8
Blackpoll warbler						2.5	3.0	0.8	V	+	V	0.8
Northern waterthrush						2.3		1.3	+	V		
Wilson's warbler			2.7	4.0	2.3	V	2.0	3.5	0.3	V	3.7	
Common redpoll	V	V	V		V	V		V	V	1.0		0.5
Pine grosbeak									V	V		
White-winged crossbill										V		V
Savannah sparrow	1.0	8.3	3.2	6.3					1.0			+
Dark-eyed junco					2.3		3.3	2.8	5.0	3.5	V	1.4
Tree sparrow		3.0	7.8	7.6							3.6	1.5
White-crowned sparrow		+	2.0	3.4	V	1.5					4.5	2.0
Golden-crowned sparrow				0.8								
Fox sparrow			V		3.1	4.0	2.0	3.0			2.0	3.5
Lincoln's sparrow												V
Lapland longspur	1.0	0.5										
Snow bunting	V											

TABLE E.3.138: COMPARISON OF BREEDING BIRD DENSITIES, 1981 AND 1982, MIDDLE SUSITNA RIVER IN ALASKA
(based on Kessel et al. 1982a, Kessel unpub. data)

Avian Census Plots[4]	No. Breeding Species		Diversity[3] (H')		Density (No. territories/ 10 ha)		
	1981	1982	1981	1982	1981	1982	Change[2] (%)
(1) Alpine tundra[1]	10	7	1.73	1.66	4.8	6.2	+23.1
(2) Dwarf-low birch shrub[1]	7	6	1.29	0.91	11.9	11.6	0
(3) Medium birch shrub	5	5	1.48	1.49	32.5	20.7	-36.3
(4) Low-medium willow shrub	6	9	1.56	1.80	45.4	25.4	-44.1
(5) Tall alder shrub	10	9	2.05	2.02	12.5	11.8	-5.6
(6) Cottonwood forest	16	13	2.55	2.30	60.9	25.0	-58.9
(7) Paper birch forest	10	9	2.05	2.02	38.1	21.4	-43.8
(8) White spruce-paper birch forest I	14	11	2.47	2.26	41.8	26.4	-36.8
(9) White spruce-paper birch forest II	13	13	2.07	2.09	34.6	26.6	-23.1
(10) White spruce forest	8	13	1.83	1.84	15.7	18.1	+15.3
(11) White spruce woodland	16	9	2.29	1.95	43.8	19.2	-56.2
(12) Black spruce dwarf forest	13	11	2.43	2.13	24.8	16.8	-32.3

[1] Based on 25-ha plot; other plots were 10 ha.
[2] Overall number of territories on 150 ha of censused plots decreased 37.5 percent.
[3] Shannon-Weaver diversity index.
[4] Plot numbers from Table E.3.139 given in parentheses. Names from Kessel et al. (1982a).

TABLE E.3.139: HABITAT DISCRIPTIONS OF 10 HA AVIAN CENSUS PLOTS
(modified from descriptions in Kessel et al. 1982a)

Kessel et al. (1982a) Plot Names	Equivalent Kessel (1979) Avian Habitats[1]	Approximate Viereck and Dyrness (1980) Equivalents[1]	Equivalent Mappable (1:63,360 Scale) Vegetation Type Units (McKendrick et al. (1982))
(1) alpine tundra	dwarf shrub mat (<0.4m), dwarf shrub meadow and block field	mat and cushion tundra, mesic sedge-grass tundra	[2]mat and cushion tundra, dwarf sedge shrub meadow and mesic sedge-grass tundra.
(2) dwarf-low birch shrub thicket and (3) medium birch shrub thicket	low shrub thicket (0.4-1.1m), and medium shrub thicket (1.2-2.4m)	low shrubland (<1.5m) and tall shrubland (>1.5m)	low birch shrub
(4) low-medium willow shrub thicket	low shrub thicket (0.4-1.1m), and medium shrub thicket (1.2-2.4m)	low shrubland (>1.5m) and tall shrubland (>1.5)	[3]low mixed shrub
(5) tall alder thicket	tall shrub thicket (2.5-4.9m)	tall shrubland (>1.5m)	tall shrubland
(6) cottonwood forest	deciduous forest (90% of canopy)	closed deciduous forest (75% closed canopy cover)	closed balsam poplar forest
(7) paper birch forest	deciduous forest (90% of canopy)	closed deciduous forest (75% closed canopy cover)	closed birch forest
(8) white spruce-paper birch forest I and (9) white spruce-paper birch forest II	coniferous forest (10-90% of canopy)	deciduous forest (25-75% closed canopy	deciduous forest
(10) white spruce forest	coniferous forest (90% of canopy)	closed conifer forest (75% closed canopy cover)	closed conifer forest
(11) white spruce scattered woodland	scattered woodland (≥5m)	conifer and deciduous woodland (10-24% closed canopy cover)	[4]woodland white spruce
(12) black spruce dwarf forest	dwarf forest (<5m, stunted growth 0.2-20% canopy)	conifer and deciduous woodland (10-24% closed canopy cover)	[4] woodland black spruce

[1]As given by Kessel et al. (1982a).

[2]Kessel et al. (1982a): "The alpine tundra plot contained 3 distinct avian habitats, all typical of and widespread in the high country of the region: dwarf shrub meadow, dwarf shrub mat and block field (rock scree)." "The dwarf shrub meadow was dominated by *Carex microchaeta* and contained significant quantities of dwarf shrub (up to 50% ground over)..."

[3]Kessel et al. (1982a) characterized the low-medium willow shrub thicket plot as heterogeneous with medium height shrub birch and willow over 2/3 of the plot.

[4]White spruce scattered woodland and black spruce dwarf forest are assigned to woodland conifer types rather than the woodland mixed conifer-deciduous types suggested by Kessel et al. (1982a) on the basis of Kessel et al.'s (1982a) descriptions of plot vegetation. In particular, no deciduous tree component appears to have been present in either plot (see Kessel et al. 1982a:39 and Table 2, page 28).

TABLE E.3.140: MAJOR AVIAN HABITATS OF THE MIDDLE SUSITNA BASIN AND THEIR MOST COMMON AVIAN SPECIES
(from Kessel et al. 1982a)

- Lacustrine Waters and Shorelines: arctic tern, mew gull, greater and lesser scaup, common loon
- Fluviatile Waters, Shorelines and Alluvia: spotted sandpiper, mew gull, violet-green swallow, harlequin duck
- Upland Cliffs and Block-fields: gray-crowned rosy finch, common redpoll, horned lark, American golden plover, water pipit
- Dwarf Shrub Mat: water pipit; American golden plover, horned lark, Lapland longspur, rock ptarmigan
- Low Shrub: savannah sparrow, tree sparrow, Lapland longspur, white-crowned sparrow
- Medium Shrub: tree sparrow, white-crowned sparrow, savannah sparrow, arctic warbler, Wilson's warbler
- Tall Shrub: hermit thrush, Wilson's warbler, fox sparrow, white-crowned sparrow, tree sparrow
- Scattered Woodland and Dwarf Forest: white-crowned sparrow, American robin, bohemian waxwing, tree sparrow, ruby-crowned kinglet
- Mixed Deciduous-Coniferous Forest: hermit thrust, dark-eyed junco, yellow-rumped warbler, Swainson's thrush, varied thrush
- Deciduous Forest: yellow-rumped warbler, common redpoll, Swainson's thrush, blackpoll warbler
- Coniferous Forest: ruby-crowned kinglet, varied thrush, dark-eyed junco, yellow-rumped warbler, Swainson's thrush

TABLE E.3.141: RELATIVE ABUNDANCE OF BIRDS BY HABITAT AND VEGETATION SUCCESSION STAGE, LOWER SUSITNA RIVER FLOODPLAIN, JUNE 10-21, 1982. FIGURES ARE THE NUMBER OF BIRDS RECORDED PER 100 MINUTES IN EACH HABITAT (from Kessel et al. 1982b)

	Early Successional Stands			Mid-Successional Stands				Late Successional Stands		
Species	Alluvia	Dwarf & Low Shrub	Medium Shrub	Tall Willow Shrub	Tall Alder Shrub	Mixed Tall Shrub	Tall Alder-Inmature Cottonwood	Cottonwood Forest	Mixed Paper Birch-Cottonwood-White Spruce Forest	Mixed Paper Birch-White Spruce Forest
Goldeneye sp.								0.3		
Semipalmated plover	-------2.1-------------									
Spotted sandpiper	------13.0-------------									
Herring gull	*									
Arctic Tern	-------4.2-------------									
Downy woodpecker								0.3		
Hairy woodpecker			1.5		0.9	0.6	1.4	0.6		
N. three-toed woodpecker										0.6
Alder flycatcher				13.3	9.1	7.0	0.5	2.0	1.7	2.1
Black-capped chickadee					0.4			2.5	1.7	
Brown creeper										0.3
Varied thrush					0.9	0.6	1.0	5.4	1.7	2.1
Gray-checked thrush					4.6	8.2	2.9	7.1	8.3	1.7
Swainson's thrush					0.4			3.7	5.0	7.4
American robin				3.3	1.4			2.8	3.3	0.6
Ruby-crowned kinglet									1.7	2.4
Bohemian waxwing								1.1		0.3
Orange-crowned warbler						1.9			3.5	
Yellow warbler				3.3	1.8	1.9	7.3	0.3		
Yellow-rumped warbler					3.2	1.3	3.9	6.2	18.3	13.3
Blackpoll warbler				6.7	3.2	9.5	2.4	6.5	6.7	5.3
Northern waterthrush			1.5		7.3	12.0	2.9	12.5	10.0	3.3
Wilson's warbler						1.9		0.8	3.3	0.3
Common redpoll					0.9	5.7		0.6		2.1
Fox sparrow			1.5	3.3	4.1	1.9		4.3	3.3	1.5
White-crowned sparrow			13.8		2.3	1.3	0.5	2.5	1.7	1.2
Dark-eyed junco						0.6		1.7	1.7	2.1
Total no. of species	4	+	4	5	14	14	9	19	15	17
Total no. of species in stand type		8			17				22	
No. minutes of censuses/habitat	127	+	65	30	219	158	206	352	60	358
Total no. minutes of census per stand type		192			613				750	
Relative abundance/habitat	19.3	+	18.5	30.0	40.6	54.4	22.8	61.1	71.7	46.5
Total relative abundance per stand type		25.5			37.5				51.5	

TABLE E.3.142: NUMBER OF SMALL MAMMALS CAPTURED PER 100 TRAP NIGHTS DURING FOUR SAMPLING PERIODS BETWEEN AUGUST 1980 AND AUGUST 1982, MIDDLE SUSITNA RIVER BASIN (Number of Captures are Given in Parentheses.)
(from S. O. MacDonald, unpub. data)

Species	Captures per 100 Trap Nights (No. of Captures) Fall 1980	Spring 1981	Fall 1981	Fall 1982	Number of Captures All Trapping Periods	Percent of Total
Sorex cinereus	9.12 (361)	0.93 (39)	11.36 (847)	0.56 (42)	(1289)	34.6
S. monticolus	2.42 (96)	0	0.64 (48)	0.03 (2)	(146)	3.9
S. arcticus	2.98 (118)	0.07 (3)	2.31 (172)	0.13 (10)	(303)	8.1
S. hoyi	0.13 (5)	0	0.07 (5)	0	(10)	0.3
Clethrionomys rutilus	8.41 (333)	2.23 (93)	10.95 (816)	2.89 (216)	(1458)	39.1
Microtus pennsylvanicus	0.33 (13)	0	0.74 (55)	0.47 (35)	(103)	2.8
M. oeconomus	0.61 (24)	0.05 (2)	2.12 (158)	0.53 (40)	(224)	6.0
M. miurus	0	0	0.91 (68)	1.07 (80)	(148)	4.0
Lemmus sibiricus	0	0.02 (1)	0.23 (17)	0.15 (11)	(29)	0.8
Synaptomys borealis	0	0	0.05 (4)	0.15 (11)	(15)	0.4
Total captures	24.00 (950)	3.30 (138)	29.38 (2,190)	5.98 (447)	(3725)	100.0
Number of trap nights	3960	4176	7455	7470		

TABLE E.3.143: STANDARDIZED HABITAT NICHE BREADTH VALUES FOR TEN SMALL MAMMAL SPECIES SAMPLED BY SNAP AND PITFALL TRAPPING AT 43 SITES, MIDDLE SUSITNA RIVER BASIN, FALL 1981 (Niche Breadth Measures were Calculated Using Formula Employed by Krebs and Wingate (1976))

(from Kessel et al. 1982a)

Species (d_T)	Standardized Habitat Niche Breadth Value[a]
Masked shrew (464.7)	0.60
Northern red-backed vole (454.8)	0.59
Dusky shrew (28.3)	0.45
Arctic shrew (96.3)	0.38
Brown lemming (10.2)	0.21
Tundra vole (87.7)	0.17
Northern bog lemming (2.2)	0.09
Meadow vole (43.8)	0.08
Pygmy shrew (2.8)	0.08
Singing vole (42.7)	0.05

[a]High niche breadth values indicate that a species habitat included a wide range of vegetation types whereas low values indicate that a species occurred in few vegetation types.

TABLE E.3.144: TIME SCHEDULE OF ANTICIPATED IMPACTS TO TERRESTRIAL VERTEBRATES RESULTING FROM SUSITNA HYDRO PROJECT

	Watana (alone)		Devil Canyon (additional)	
	Area affected (ha)	Time period over which area increases	Area (ha)	Time Period
1. Permanent Habitat Loss				
Dam and spillways	131	1985 - 1991	21	1996 - 1999
Impoundment	14,691	1985 - 1993	3,196	1996 - 2001
- flooding	14,691	1991 - 1993	3,196	1999 - 2001
- spoil sites	(all below fill level)	1985 - 1991	(also below fill level)	1996 - 1999
- erosion of shore after filling	app. 558	1993 - ?	?	2001 - ?
Access corridor (includes borrow sites for access)	192	1985	218	1988 - 1994
- Denali Highway to Watana	192	1985	--	--
- Watana to Devil Canyon	--	--	189	1988
- Rail, DC to Gold Creek	--	--	29	1991 - 1994
Permanent village	27	1987 - 1988	--	--
Permanent airstrip	47	1985	9	1994
2. Habitat Alteration and Temporary Habitat Loss				
- Impoundment clearing	12,545	1989 - 1992	1,942	1999 - 2001
- Temporary village	49	1987 - 1988	24	1995 - 2002
- Temporary camp	58	1985 - 1994	24	1994 - 2002
- Borrow Areas (above impoundment level)	1,323	1987 - 1991	148	1996 - 1999
- A	333		--	--
- D	287		--	--
- E	180	dates not	--	--
- F	280	available	--	--
- H	489		--	--
- I	34		--	--
- K	--	--	148	date not available
- Contractor Work Areas	300	1985 - 1995	195	1994 - 2002
Staging Areas				
- mid access road	data not available		--	--
- Cantwell	61	1985 - 2002	--	--
- Gold Creek	--	--	61	1994 - 2002
Accessory roads	data not available	1985 - ?	?	1994 - 2002
Temporary airstrip (adjacent to dam)	data not available ?	?	?	?
Transmission corridor				
- Watana to Devil Canyon	379.8	dates not	209 additional	
- Devil Canyon to Gold Creek	77.5	availale		

TABLE E.3.144 (Page 2)

Watana and Devil Canyon	Area Affected
Climatic induced alteration	
- downstream reach - near impoundment	(Total area affected cannot be determined. Exact impact mechaisms hypothesized include: 1) delayed plant phenology due to snow drifting and decreased summer temperature, 2) increased rainfall in summer, 3) increased winds, and 4) decreased summer temperatures)
Hydrologic induced alteration - downstream reach	(Total area affected cannot be determined. Exact impact mechanisms hypothesized include: 1) lowering water table, 2) frosting of vegetation, 3) earlier plant phenology due to higher water temperature, and 4) altered frequency and mechanisms of creation of early successional vegetation.

3. Barriers, Impediments or Hazards to Movement

Watana	Date of initiation of impact	Comments
- Impoundment	1991	- water and/or ice shleving may act as barrier or hazard to some species. - snow drifting may block or impede movements for some species.
- Access corridor - Denali to Watana	1985	- may be a physical or visual barrier to some species
- Open water downstream	1993	- may block crossings by some species.
- Transmission corridor	1989 - 1990	- "hum" may cause frequent headaches, thereby reducing frequency of intromission and natality for some species. - drifting of snow has been hypothesized by some to present a barrier to movements of some species.
Devil Canyon		
- Impoundment	1999 - 2001	- as Watana above
- Access corridor - Watana to Devil Canyon - Rail, DC to Gold Creek	 1991 1991 - 1994	 - as Watana above
- Open water downstream	2001	- will persist further downstream w/D.C.
- Increased aufeis downstream	2001	- may be hazard to some species
- Transmission corridor	1991 - 2001	- "hum" will be louder with D.C. - corridor will be wider and snow drifting has been hypothesized by some to present a barrier to movements of some species.

TABLE E.3.144 (Page 3)

4. Disturbance Associated with Construction Activities

Watana & Devil Canyon	Duration for Watana	Duration for Devil Canyon
Containment Structures	1985 - 1991	1996 - 1999
Borrow Areas	1985 - 1991	1996 - 1999
- A	?	--
- D	?	--
- E	?	--
- F	?	--
- H	?	--
- I	?	--
- K	--	?
Impoundment clearing	1989 - 1992	1999 - 2001
Access roads		
- Denali Highway to Watana	1985	--
- Watana to D.C.	--	1991
- rail, D.C. to Gold Creek	--	1991 - 1994
Temporary camp	1985 - 1994	1994 - 2002
Permanent village	1987	--
Temporary airstrip	?	?
Additional airplane and helicopter disturbance	1982	1982
Contractor work areas	1985 - 1995	1994 - 2002
Staging areas		
- mid access road	?	--
- Cantwell	1985 - 2002	--
- Gold Creek	--	1994 - 2002
Transmission corridor		
- clearing	1989 - 1990	1989 - 1990
- maintenance	as required	as required
Accessory roads	?	?

5. Increased Human Access

Hypothesized Impacts of both projects	Date of Initiation of Impact
Increased hunting and poaching	1982-
Increased risk of fire	1982-
Increased mortality due to collisions with vehicles	1982-
Increased recreational disturbance	1982-
Increased human/wildlife conflicts (especially bear encounters)	1982-

TABLE E.3.145: ANTICIPATED AND HYPOTHESIZED IMPACTS TO MOOSE

(1) Permanent Habitat Loss:	
- Watana	
--impoundment area and permanent facilities	. Wintering habitat loss will be severe impact winter carrying capacity 266 moose. . Spring habitat loss, especially calving habitats in lowland riparian areas, will be a major impact. . Summer and fall habitats are mostly in upland areas, a small number of non-migratory moose will be displaced.
--access corridor	. Small area of non-critical habitat loss. . May affect location of new special-use areas following impoundment filling.
- Devil Canyon	
--impoundment area and permanent facilities	. Wintering habitat loss will affect an estimated 36 moose based on carrying capacity data. . Spring habitat loss will be minor but may displace a small number of moose which calve in this area. . No significant loss of summer or fall habitats.
--access corridor	. Small area of non-critical habitat loss.
(2) Habitat Alteration and Temporary Habitat Loss:	
- Watana	
--impoundment clearing	. Clearing will reduce winter capacity prior to flooding.
--reclaimed areas	. Winter habitat for 37 moose will be affected. Revegetation is likely to restore these areas as moose habitat between 2-20 years following disturbance.
--impoundment shore erosion	. Will occur on steep slopes of little value to moose.
--transmission corridor	. Nearly all 30,000 ha of the corridor is likely to become winter habitat of reasonable quality to moose. No existing winter habitat will be made unusable. Corridor will be maintained in early succession throughout the life of the project. . Drifting snow is unlikely to be a significant factor in the 285-foot corridor and will not reduce forage availability.
--climatic-induced habitat alteration	. Snow drifting from the reservoir surface is unlikely to extend far into wooded winter habitats. Drawdown and ice-shelving will catch much windblown snow and further drifting will occur at the edge of open habitat and wooded areas. It is unlikely that the value of the Fog Lakes area as winter range will be negatively affected. . Delayed melt-off of drifts which do occur will reduce the availability of low shrub habitat in spring in a narrow band on the southwest shore of the impoundment.

	• Increased summer rainfall, increased winds and cooler summer temperatures in the basin are unlikely to measurably reduce carrying capacity. Available data indicate that any such changes in rainfall patterns will be indetectable (R. Skog, unpub. data from Williston Reservoir, B.C.). • Delayed plant phenology may occur immediately adjacent to the reservoir due to its cooling effect.
--hydrologic-induced habitat alteration	• Decreased flows may lower the water table in downstream reaches. This is unlikely to affect willow colonization due to the wet climate. • Open water may cause frosting of vegetation as far downstream as Gold Creek. Heavy frosting may make some browse unavailable. Lighter frosting will increase metabolic demand on moose which consume large quantities of ice. • Altered frequency and mechanism of creation of early successional habitats will occur in downstream reaches. Two factors of altered hydrology are responsible: (1) reduced summer flow, and (2) increased winter flow. The specific impacts are: (1) reduced frequency of bank-full floods and a decrease in all flood stages will decrease creation of early successional habitat; (2) decrease in ice jamming in spring due to lower flood stage will decrease creation of early successional habitat; (3) increased ice scouring during winter caused by high fall flow and constant high winter flow will increase creation of early successional habitat; and (4) increased aufeis in winter due to high winter flows will increase creation of early successional habitat. No prediction of areas scoured each year is possible based on current data.
- Devil Canyon	
--impoundment clearing	• Clearing will reduce winter carrying capacity prior to flooding.
--reclaimed areas	• Borrow area K and the temporary camp and village contain winter browse for 1 moose based on carrying capacity data. Total winter browse for 340 moose will be lost if both projects are constructed (permanent plus temporary). Reclaimed areas will improve as winter habitat between 2-20 years following disturbance.
--impoundment shore erosion	• Will occur on steep slopes of little value to moose.
--transmission corridor	• As for Watana.
--climatic alteration	• Smaller, narrower impoundment makes detectable changes less likely than for Watana.
--hydrologic-induced alteration	• Increased water temperatures and open water in winter will occur downstream as far as Talkeetna, otherwise impacts as described for Watana.

(3) Barriers, Impediments, and Hazards to Movement:	
- Watana	
--impoundment	. Open water and/or ice shelving may block access to traditional calving and wintering areas. Moose could be expected to establish new areas and alter movement patterns, but some mortality may occur from attempts to cross the reservoir. . Prior to filling, clearcut areas in the impoundment may inhibit movements. . Snow drifting has been hypothesized to impede movements south and southwest of the reservoir and to reduce the value of Fog Lakes as winter range.
--access corridor	. May inhibit migration between summer and winter range especially in the Watana-Butte Creek areas and the Watana-Deadman Creek areas. Construction activities will be more severe barrier than subsequent traffic except during hunting season when moose will avoid the corridor. . Increased mortality due to collisions. May be substantial during construction phase during winter due to darkness and poor weather. Train collisions may be substantial between Houston and Talkeetna.
--downstream	. Open water may restrict movements to island calving areas for those cows which use them (as far downstream as Gold Creek). . Attempted crossings during winter may thermally stress animals, may lead to mortality. . Ice cover and aufeis will increase downstream due to increased winter flow and may result in same mortality from moose falling down (R. Modafferi 1982 pers. comm.).
- Devil Canyon	
--impoundment	. Impacts as for Watana, less severe. No major movement corridors occur, but movements may increase after building of Watana. Little ice-shelving will occur due to low (1 m) drawdown.
--access corridor	. Rail corridor may cause substantial mortality, especially during winters with heavy snowfall when moose may become trapped in the corridor.
--downstream	. As for Watana, except open water may occur as far downstream as Talkeetna.
(4) Disturbance Related to Construction Activities:	
--construction activities	. Winter habitats and calving areas are most sensitive to disturbance. Impacts will be affected through avoidance and consequent habitat loss.
--impoundment clearing	. Noisy and unpredictable disturbances such as impoundment clearing are most serious and will probably cause avoidance of the area at any season.

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--access road traffic	. Traffic and other neutral or predictable disturbances can be habituated to (borrow area use, village activities, dam construction).
--air traffic	. Overflights can be a serious impact, especially during calving and in winter. Repeated harassment can be detrimental at all times of year. . Habituation is possible to neutral and predictable disturbances as near airports if animals are not deliberately harassed.
(5) Increased Human Access:	
--hunting and poaching	. Increased mortality; most serious in easily accessible areas, will also cause avoidance of access corridor during hunting season. Can be regulated.
--increased risk of fire	. Impossible to predict. Fires would eventually improve moose habitat in decadent stands. Natural fires are usually considered beneficial to moose but have been suppressed in recent years.
--vehicle collisions	. Less serious after construction during operation phase.
--recreational disturbance	. Impossible to quantify. May become serious problem in time, particularly during winter and calving.

TABLE E.3.146: LOSS OF COVER TYPES COMMONLY USED BY MOOSE, IN RELATION TO THEIR AVAILABILITY. THE PROPORTIONATE SEASONAL USE OF EACH TYPE BY RADIO-COLLARED MOOSE IS ALSO SHOWN. (data from ADF&G 1982a and McKendrick et al. 1982)

Forest Cover Type	WATANA Area Affected (ha) Impoundment	Construction	Proportionate Loss	DEVIL CANYON Area Affected (ha) Impoundment	Construction	Proportionate Loss	Proportion of Relocations Spring	Summer-Fall	Winter	N
Woodland spruce forests	4267	567	0.03	153	0	0.06	0.56[c]	0.43	0.40	791
Open spruce forests	3633	75	0.03	629	15	0.17	0.29[c]	0.28	0.30	504
Birch forests	785	19	0.62	487	3	-[d]	<0.01	<0.01	<0.01	7
Mixed forests	2099	207	0.29	1506	162	0.04	-[d]	-	-	-
Tall shrub	514	37	<0.01	3	0	<0.01				
Birch shrub	443	288	0.04	49	18	<0.01	0.14[e]	0.29[e]	0.29[e]	445[e]
Willow and mixed low shrub	717	283	<0.01	18	0	<0.01				
Tundra	84	78	<0.01	11	0	<0.01				

[a] Proportionate loss is expressed as the amount of the cover type lot (ha) in relation to its total coverage (ha) in the respective watershed. (See Section 3.3 - Botanical Resources for a description of the watershed and area estimates of the forest cover types.)

[b] Proportion of moose relocations in that habitat during April-May, June-October, and November-March, respectively.

[c] ADF&G (1982a) included mixed forest communities in their spruce forest classifications and therefore moose use in mixed forest cover types cannot be separately estimated.

[d] Vegetation in areas beyond the impoundment and construction zones was mapped at a scale too small to adequately assess the availability of this cover type.

[e] ADF&G (1982a) included all shrub types in a single shrub category and therefore use in various shrub types cannot be separately estimated.

TABLE E.3.147: ANTICIPATED AND HYPOTHESIZED IMPACTS TO CARIBOU

(1) Permanent Habitat Loss:	
- Watana	
--impoundment area and village and airstrip	. Total area permanently lost represents 0.3% of total range, low quality grazing habitat.
--access corridor	. Total area permanently lost an inconsequential proportion of total range.
- Devil Canyon	
--impoundment area and village and airstrip	. Little historical use of this portion of range has been documented. An inconsequential proportion of total range.
--access corridor	. No impact on caribou through habitat lost.
(2) Habitat Alteration and Temporary Habitat Loss:	
- Watana	
--impoundment clearing	. Poor quality range, inconsequential proportion of range affected.
--reclaimed areas	. Borrow sites A, D, and F are in areas frequented by bulls in summer. Total area 900 ha = 0.02% of range. Total loss (including permanent) = 0.3% of range.
--shore erosion	. Will occur on steep slopes of little value to caribou.
--transmission corridor	. Areas of low use historically, poor quality range. No negative impacts.
--climatic induced alteration	. Snow drifting will not affect critical winter or spring range. . Increased summer precipitation and decreased summer temperatures would occur mainly downwind of reservoir and are unlikely to affect caribou range.
- Devil Canyon	. No impacts to caribou.
(3) Barriers, Impediments, and Hazards to Movement:	
- Watana	
--impoundment	. Intersects a major caribou migration route. Effects likely: (1) altered movement patterns will reduce frequency of crossing with consequent decreases in use of portions of range reducing carrying capacity; (2) isolate subherds having separate calving grounds; (3) increase accidental mortality associated with ice shelving, drifting ice flows, floating debris, and extensive mud flats. . Drifting south and southwest of the reservoir may block movements.

--access corridor	. Between the Denali Highway and the Watana damsite traverses on historically important area of range currently used by a subherd of approximately 2500 animals and portions of main herd. Road is west of main calving area. Altered movements likely where road berms are high. Accidental mortality will occur. Wolves may use road to their advantage when hunting.
- Devil Canyon	
--all facilities	. Crossings less hazardous and less frequent. No impacts to caribou are anticipated.
(4) Disturbance Related to Construction Activities:	
- Watana	
--impoundment	. Females and calves will avoid construction sites. No population-level impacts.
--borrow areas	. Areas A, D, and F most likely to disturb bull caribou in summer. Inconsequential loss of summer habitat.
--access road	. Between Denali Highway and Watana considerable disturbance is likely from construction traffic. Cows in late pregnancy and cows with newborn calves most sensitive. Altered movements likely where traffic levels are high. High disturbance levels may increase energy and demands.
--air traffic	. Intentional harassment could lead to direct mortality, especially for young animals. . Regular overflights may adversely impact caribou through increased energy costs. Very high levels of aircraft disturbance may affect productivity. Groups with females and calves most sensitive.
(5) Increased Human Access:	
--hunting and poaching	. Current permit system controls numbers taken. Increased access will impact the distribution of hunter take more than actual size of harvest. Should distribute take over larger set of sub-herds than current take.
--vehicle collisions	. Traffic volume will be less in postconstruction period, but recreational use traffic will continue.
--recreational disturbance	. Could become a major factor. Particularly sensitive periods include winter and calving. At worst a change in range use, disruption of migration, and abandonment of traditional calving areas.
--increased risk of fire	. Impossible to quantify. Caribou are less likely than moose to benefit from occurrence of fire. Range value would decrease for a prolonged period following fire.

TABLE E.3.148: ANTICIPATED AND HYPOTHESIZED IMPACTS TO DALL SHEEP

(1) Permanent Habitat Loss:	
- Watana	
--impoundment	• Partial inundation of Jay Creek mineral lick. Inundation will occur over 22% of the lick surface area during months of maximum use. At maximum impoundment level in October, 42% of lick surface will be flooded.
--access corridor	• No critical or regularly used habitats affected.
- Devil Canyon	
--impoundment and access	• No critical or regularly used habitats affected.
(2) Habitat Alteration and Temporary Habitat Loss:	
- Watana	
--impoundment	• Jay Creek mineral lick may have ice shelves in lower sections in early spring. Areas of lick below maximum fill level may suffer some leaching making them less desirable when they are available.
--climatic alteration	• Probably limited to impoundment area. Undetectable. • No other critical or regularly used habitats affected.
- Devil Canyon	• No critical or regularly used habitats affected.
(3) Barriers, Impediments, and Hazards to Movement:	
- Watana	
--air traffic	• Serious impacts to all Dall sheep in the middle basin may occur if low-flying aircraft are uncontrolled. The Jay Creek mineral lick is a particularly sensitive area. Frequently disturbed sheep may suffer increased metabolic energy requirements and may abandon areas where severe disturbances occur. Deliberate harassment (including "sight-seeing") constitutes a severe disturbance at the Jay Creek mineral lick. Lambing areas and winter habitats also sensitive to disturbance.
--other construction activities	• Most will occur some distance from critical and regularly used range and can be habituated to in the absence of deliberate harassment. Spring habitats at low elevations and winter concentrations on south slopes may be sensitive to disturbance from reservoir clearing operations.
--air traffic	• Additional impacts as described for Watana.

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- Devil Canyon	
--construction activities	. No other disturbance impacts anticipated.
(5) Increased Human Access:	
--hunting and poaching	. Size of legal harvest not expected to increase as most or all legal rams in area are already harvested each year.
--recreational disturbance	. Air traffic can severely affect use of the Jay Creek mineral site as described under "disturbance" above. . Boats on the Watana reservoir are also likely to affect use of the Jay Creek mineral lick.

TABLE E.3.149: ANTICIPATED AND HYPOTHESIZED IMPACTS TO BROWN BEARS

(1) Permanent Habitat Loss:	
- Watana	
--impoundment	• Den habitat--no dens known below impoundment level, 0% of denning habitat lost. • Spring feeding areas (lower elevation spruce habitats) flooded. Three of 12 radio-collared bears without cubs moved to areas to be impounded by the Watana reservoir in spring 1980 (25%). Seven of 13 (54%) in 1981. • Effects on prey populations may impact brown bears, but the importance of ungulate prey is unknown.
--access corridor and village and airstrip	• Insignificant habitat loss. • May affect denning locations. Number of dens affected not determinable from current maps of den and access road locations.
- Devil Canyon	
--impoundment	• No impact on denning habitat. • Spring feeding areas. Three of 12 radio-collared bears without cubs (75%) moved to areas to be impounded by the Devil Canyon impoundment in spring 1980. One of 13 (8%) in 1981. Total for both impoundments was 6 of 12 (50%) in 1980 and 8 of 13 (61%) in 1981. • Prey population reduction may affect brown bears. Importance of ungulate prey is unknown.
--access corridor	• Insignificant habitat loss (see also disturbance section of table). • No denning habitat lost (see also disturbance section of table).
(2) Habitat Alteration and Temporary Habitat Loss:	
- Watana	
--impoundment clearing	• Spring feeding areas in lower elevation spruce habitats used by 25% of radio-collared bears without cubs in 1980 and 54% in 1981. • Deleterious effects on prey populations may benefit brown bears temporarily.
--reclaimed areas	• Not a significant amount of habitat loss. Revegetation with grasses and forbs will temporarily improve the value of these areas for spring and early summer habitats (see also disturbance section of this table).
--impoundment shore erosion	• Possible (unpredictable) impact on potential denning areas.
--transmission corridor	• Both positive and negative impacts, but net impact is minor.
--climatic-induced alteration	• Any changes which may occur are likely to be indetectable and minor (R. Skog, unpub. data on Williston Reservoir B.C.).
--hydrologic-induced alteration	• Reduction in prey populations (ungulate and salmon) if they occur may impact brown bears in downstream reaches.

- Devil Canyon	
--impoundment clearing	. Spring feeding areas in lower elevation spruce habitats used by 25% of radio-collared bears without cubs in 1980 and 8% in 1981. Total for both impoundments 50% of radio-collared bears without cubs in 1980 and 61% in 1981.
--reclaimed areas	. Not significant amount of habitat loss. Revegetation with grasses and forbs will temporarily improve the value of these areas as spring and early summer habitats.
--other areas	. As treated above.
(3) Barriers, Impediments, and Hazards to Movement:	
- Watana	
--impoundment	. Broken ice and/or ice-shelving may block or hinder access to habitually used areas for some individuals in early spring. Crossing of the reservoir in other seasons is not anticipated to be a major problem for bears. . (Disturbance treated in next section of table.)
--access corridor	. Mortalities from collisions unlikely. . Altered movements between seasonal use areas possible. Not a significant impact on productivity or habitat use. . (Disturbance treated in next section of table.)
- Devil Canyon	
--impoundment	. No impact on movements anticipated.
--access corridor	. Minor impacts described above.
(4) Disturbance Related to Construction Activities:	
--general	. Some bears will avoid areas of intense human activities, others will habituate and some habituated bears will be attracted to such areas. . Feeding of bears by employees or non-project personnel will endanger the bears and all humans in the vicinity. Maulings and destruction of the "offending bear" will eventually occur. . Human/bear conflicts have a great potential to cause significant loss of work time for contractors, injuries to employees, and property damage. . Cubs will habituate readily to human presence and subsequently become problem animals as they grow up. . Habituated bears also become more susceptible to hunting.
--impoundment clearing	. Mortalities due to human/bear conflicts. Concentrations in impoundment areas in spring.

TABLE E.3.149 (Page 3)

	. Altered movements due to avoidance or attraction.
--impoundment facilities, staging areas, borrow sites	. Mortalities due to human/bear conflicts. . Altered movements due to avoidance or attraction. Bears will be attracted to garbage dumps and to improperly disposed or inadequately incinerated garbage. . Individual bears whose home ranges overlap these sites will be displaced. . Bears are likely to be attracted to revegetated areas. This will increase their contact with humans and cause problems with habituated bears.
--air traffic	. Extremely sensitive to harassment. Also sensitive to frequent disturbance in concentration areas. May disrupt normal feeding, resting, and denning activities.
--access road	. Altered movements during periods of high traffic levels are possible due to avoidance. Habituated bears may become attracted to the roads as a food source if fed. . Road construction activities may cause abandonment of some dens during winter, resulting in mortality of those bears. . Use of adjacent forage habitat may be disrupted or eliminated. . Habituated bears are more susceptible to hunting and trapping. . Some denning habitat may be made unacceptable by the presence of the road. (Three known den sites may become unsuitable.) However, there is no evidence to indicate that den sites are limiting and no population-level effects are anticipated.
--transmission corridor	. Clearing in winter may cause abandonment of some dens with direct mortality of those animals affected.
(5) Increased Human Access:	
--hunting and poaching	. Possibly a serious impact, depending on management strategies and priorities. Brown bear may be sacrificed to the benefit of more desirable ungulate species by future management guidelines. This is obviously beyond the control of the Alaska Power Authority.
--human/bear conflicts	. Will result in destruction of offending bears. Outside of construction activities (treated above) these interactions are inevitable and difficult to control. . Attraction to revegetated areas near villages will result in increased encounters of bears and humans.
--collisions with vehicles	. Unlikely to be of any significance.
--recreational disturbances	. Possible effect on bears in dens and in concentration areas, particularly salmon runs on Prairie Creek. Recreational development of this area is likely to greatly increase the occurrence of bear-human encounters with negative effects on both.

TABLE E.3.150: ANTICIPATED AND HYPOTHESIZED IMPACTS TO BLACK BEAR

(1) Permanent Habitat Loss:	
- Watana	
--impoundment area and village and airstrip	• Black bear are highly dependent on spruce forest habitats. 10,016 ha/346,637 = 3% of conifer habitat in Devil Canyon and Watana Basin total will be lost. A viable population is unlikely to remain above Watana Creek after filling. The narrow band of spruce forests remaining will leave resident bears susceptible to interactions with brown bears and necessitate altered movement patterns. • Den habitats - 69% of known black bear dens are in impoundment area (9/13 den sites).
--access corridor	• Black bears do not normally occur near the corridor north of Deadman Lake.
- Devil Canyon	
--impoundment area	• Loss of spruce forest habitats. 1,801/346,637 = 0.5% of conifer habitat in Devil Canyon and Watana Basins total will be lost. Little spruce habitat occurs in impoundment areas. • Den habitats - 6% of known black bear dens are in impoundment area (1/16 den sites).
--access corridor	• Most of Watana-Devil Canyon segment is at elevations above acceptable black bear habitat.
(2) Habitat Alteration and Temporary Habitat Loss:	
- Watana	
--impoundment clearing	• 10,016 ha of spruce forest habitat for black bears will be eliminated.
--reclaimed areas	• 975 ha of spruce forest habitat in the borrow sites for Watana (10,991 total impoundment and borrow areas). Borrow Areas D and F in areas used for berries in late summer. Revegetation likely to improve availability of early spring forage temporarily.
--impoundment shore erosion	• Possible impact to some den habitats.
--transmission corridor	• Likely to improve habitat for black bear.
--climatic-induced alteration	• Indetectable. • Snow drifts in a small area S and SW of impoundment may slightly reduce availability of low shrub habitat in spring.
--hydrologic-induced alteration	• Reduction in prey populations (if they occur) would negatively impact black bears (salmon). • Alteration of phenology of vegetation may cause greater availability of early spring forage in downstream areas. • Alteration of frequency of mechanism of creation of early successional habitats may alter availability of riparian spring forage.

- Devil Canyon	
--impoundment clearing	• 1,801 ha of spruce forest habitat.
--reclaimed areas	• 194 ha of spruce forest habitat (1,995 ha total Devil Canyon; 12,986 total Watana and Devil Canyon = 3.75% of total in Watana and Devil Canyon Basins). Revegetation likely to improve availability of early spring forage temporarily.
--other areas	• As described above.
(3) Barriers, Impediments, and Hazards to Movement:	
- Watana	
-- impoundment	• Broken ice floes and/or ice shelving may block or hinder access to habitually used areas for some individuals in early spring. Crossings are not anticipated to present any problem for bears at other seasons. • Animals displaced during filling will be susceptible to mortality from brown bears they may encounter on dispersal. Cubs will be particularly vulnerable to brown bear predation. Displacement will also increase intra-specific competition causing decreased productivity.
--operating facilities	• May block access or alter movements of downstream animals to late summer foraging areas upstream of Tsusena Creek (see disturbance section).
--access corridor	• Black bears do not normally occur near the corridor north of Deadman Creek.
- Devil Canyon	
--impoundment and facilities	• No impediment or hazard to movements anticipated.
--access corridor	• Most of corridor at elevations above acceptable black bear habitat (see disturbance section).
(4) Disturbance Related to Construction Activities:	
--impoundment clearing	• Habituation problems treated for brown bear (Table E.3.149) will also occur with black bears. Location of facilities may cause even greater problems with black bears. • Will displace black bears from forested areas. Result in increased human/bear interactions, predation by brown bears. • Winter clearing will cause denning bears to leave their dens, resulting in mortality.
--impoundment facilities, staging areas, and borrow sites	• Mortalities due to human/bear conflicts. • Altered movements due to avoidance or attraction. Bears will be attracted to garbage dumps and to improperly disposed or inadequately incinerated garbage. • Individual bears whose home ranges overlap these sites will be displaced. • Bears will avoid denning near areas with frequent disturbances.

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	. Bears are likely to be attracted to revegetated areas. This will increase their contact with humans and cause problems with habituated bears.
--air traffic	May disrupt normal feeding, resting and denning activities.
--access road	. Reduce use of adjacent tableland habitats used by bears foraging for berries in late summer. . Habituated bears more susceptible to hunting and poaching.
--transmission corridor	. Clearing in winter in forested habitats may cause abandonment of some dens with direct mortality of most animals effected.
(5) Increased Human Access	
--hunting and poaching	. Intensity of impact dependent on management strategies of ADF&G. Potential for serious impact if bears receive low management priorities.
--human-bear conflicts	. Inevitable result of increased human use. . Attraction to revegetated and improperly disposed garbage will increase frequency of encounters between bears and humans.
--collisions with vehicles	. Unlikely to be significant.
--recreational disturbance	. Impacts greatest in denning and concentration areas, particularly salmon runs.

TABLE E.3.151: ANTICIPATED AND HYPOTHESIZED IMPACTS TO WOLVES

(1) Permanent Habitat Loss:	
- Watana	
--Impoundment and permanent facilities	• No known den or rendezvous sites will be inundated. • Watana pack members may be affected as 1/3 of all radio-locations for pack members were in the impoundment zone. • Secondary effects of the elimination of the Watana pack's range will be upheaval of the historical distribution of packs and associated social strife. • Reductions in moose carrying capacity will reduce wolf carrying capacity, though wolves have not obtained carrying capacity in the basin for several decades due to wolf control measures, hunting and trapping. In the absence of specific measures by ADF&G to protect wolves, they will never reach carrying capacity, and prey availability will have no limiting effect.
--access corridor	• Minor component of habitat loss.
- Devil Canyon	
--Impoundment and permanent facilities	• No known den or rendezvous sites will be inundated. • Small reduction in moose carrying capacity.
--access corridor	• Minor component of total habitat loss.
(2) Habitat Alteration and Temporary Habitat Loss:	
- Watana	
--Impoundment clearing	• Displacement of resident and migratory moose from the impoundment area during clearing may increase wolf densities in the adjacent areas temporarily.
--other areas	• Reduction in carrying capacity of prey will reduce capacity for wolves.
- Devil Canyon	
--all areas	• As described above.
(3) Barriers, Impediments, and Hazards to Movement:	
- Watana	
--Impoundment and facilities	• May reduce access to caribou and moose calving areas for some packs.
--access corridor	• Wolves may use the road to their benefit when hunting ungulate prey.
--downstream reaches	• Open water in winter may be a hazard to wolves attempting to cross, but few wolves occur in downstream reaches.
- Devil Canyon	
-- all areas	• As described above.

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(4) Disturbance Related to Construction Activities:	
- construction activities	. Wolves are likely to respond similarly to all construction activities. Avoidance will occur initially, but habituation to predictable disturbances is likely. . Den sites are most sensitive and wolves will abandon dens which are disturbed frequently. Pup mortality may result if dens are abandoned during the first week of life. . Habituated wolves have the potential to become nuisance animals, increasing the likelihood of destruction and exposure of workers and their pets to rabies.
- air traffic	. Den sites are sensitive and will be abandoned if frequent air traffic occurs at low altitudes near dens. Pup mortality will result if dens are abandoned in the first week of life.
- access road traffic	. Wolves will habituat to moderate levels of traffic. Wolves will probably avoid the corridor during periods of high traffic levels.
(5) Increased Human Access:	
- hunting and poaching	. Much of the current harvest is illegal and the illegal harvest will increase in the absence of better control. Current legal harvest is also high (bag limit = 7 wolves) and will increase. The current annual take is 40-45% of the population.
- increased human/wolf conflicts	. Habituated animals will become pests increasing the likelihood of their destruction and the possibility of exposure of humans to rabies.
- increased recreational disturbance	. Particularly susceptible at den sites.

TABLE E.3.152: ANTICIPATED AND HYPOTHESIZED IMPACTS TO WOLVERINE

(1) Permanent Habitat Loss:	
- Watana	
--Impoundment area and	. Wintering foraging habitat will be lost with a substantial decrease in availability of small mammel and grouse. Increase in availability of carrier in winter habitat, due to more rapid turnover in the moose population - the result of development caused sources of increased accidental mortality and predation, will occur. Changes in prey density will affect movements, densities and productivity.
--access corridor	. Small area of abundant summer range.
- Devil Canyon	
-- Impoundment and permanent facilities	. Minor loss of winter foraging habitat.
--access corridor	. As above for Watana
(2) Temporary Habitat Loss and Habitat Alteration	
- Watana	
-Impoundment clearing	. In winter will displace wolverine from impoundment area. . May increase availability of prey in adjacent areas as other species are also displaced.
- reclamined areas	. Small area relative to wolverine ranges. Likely to increase availability of small mammal prey after revegetation.
-transmission corridor	. Increased carrying capacity for moose and ptarmigan may benefit wolverine. Likely a small impact.
-climatic-induced alteration	. No impact.
-hydrologic-induced alteration	. No impact.
- Devil Canyon	
-all areas	. Very small impact overall.
(3) Barriers, Impediments, and Hazards to Movement:	
- Watana	
-Impoundment	. May form home range boundaries for animals in basin. Altered movements and use patterns for individuals currently residing in basin are expected.
-access corridor	. Mortality from vehicle collisions unlikely source of mortality.
- Devil Canyon	
-Impoundment	. Impediment or hazard to movements not anticipated. Small size of reservoir make altered use pattens and movements less important.
-access corridor	. Mortality due to collisions with vehicles unlikely.

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(4) Disturbance Associated with Construction Activities	
- all construction areas and impoundment clearing	. Wolverine are likely to avoid all areas of active disturbance. Short term impact for most areas, without population level effects. Wolverine may avoid the access corridor during periods of heavy use for the duraton of construction. Impoundment clearing will cause dispersal from area. May utilize road kills as a food source - but only during periods of low traffic.
(5) Increased Human Access	
- hunting and poaching	. Could become a serious impact if wolverine are not specifically protected by ADF&G management. Trapping is already the major source of mortality.
- vehicle collisions	. Unlikely to become a major source of mortality.
- recreational disturbance	. May become a serious impact. Wolverine are wide-ranging enough that they are likely to be able to avoid low level recreational disturbance. High levels of motorized vehicle noise and traffic would exclude wolverines from an area.

TABLE E.3.153: ANTICIPATED AND HYPOTHESIZED IMPACTS TO AQUATIC FURBEARERS (beaver and muskrat)

(1) Permanent Habitat Loss:	
- Watana	
--impoundment	• No active beaver lodges were found in the impoundment area. • About 5-10 muskrats occur in the impoundment and borrow areas D and E.
--access corridor	• Upper Deadman Creek provides habitat for 65 beaver. Reduction in number of beaver is anticipated due to road. Additional negative impacts are anticipated to result from adjacent material sites. • Muskrat likely occur in conjunction with beaver in upper Deadman Creek.
- Devil Canyon	
--impoundment	• No beaver are known to occupy the reservoir area. However, beaver may colonize this reach between completion of Watana and completion of Devil Canyon dams. These animals will be displaced. • Beaver may successfully colonize this impoundment due to small annual drawdown, particularly during wet years. In other years, drawdown will occur at a critical period when food caches are being made and it is unlikely that they will be able to overwinter. • No muskrat habitat occurs in impoundment area.
--access corridor	• Muskrat are known to overwinter in several lakes along the corridor between Watana and Devil Canyon.
(2) Habitat Alteration and Temporary Habitat Loss	
- Watana	
--access corridor	• Borrow sites for the access corridor will remove habitat for approximately 40 of 65 beaver along Deadman Creek.
--borrow areas	• 5 of 17 lakes surveyed in areas D and E and the impoundment zone supported overwintering muskrats.
--hyrologic-induced alteration	• Increased winter flows are likely to benefit beaver allowing overwintering in more sites than are currently available. • Stabilized flows will allow beaver greater security in anchoring food caches. • Lack of ice cover will allow colonization of much shallower reaches. • Muskrat will likely benefit from increased number of beaver ponds downstream.

TABLE E.3.153 (Page 2)

- Devil Canyon	
--borrow areas and campsite	. Area K and the campsite support approximately 10 beaver.
--hydrologic-induced alteration	. Open water as far downstream as Talkeetna will allow colonization of waters currently too shallow.
	. Other impacts as described for Watana.
(3) Barriers, Impediments, or Hazards to Movement:	
- access corridors	. May be insignificant source of mortality due to vehicle collisions.
(4) Disturbance Related to Construction Activities:	
	. Beaver and muskrat are not likely to be significantly affected by disturbance alone. Animals will be displaced as habitats are destroyed by development.
(5) Increased Human Access	
- hunting and poaching	. Likely to effect a much larger area than any of the other development impacts. Prime habitat occurs in adjacent undisturbed areas which will remain relatively inaccessible. Impacts will depend on fur value fluctuations.

TABLE E.3.154: NUMBER OF LAKES WITH MUSKRAT PUSHUPS IN SPRING 1980 OCCURRING WITHIN BORROW AREAS AND IMPOUNDMENTS
(data from Gipson et al. 1982)

	Lakes Sampled	# Lakes With Pushups	Total # of Pushups
Watana			
Borrow Areas D & E	8	0	0
Impoundment	9	5	13
Devil Canyon			
Borrow Areas	5	0	0
Impoundment	0	0	0

TABLE E.3.155: ANTICIPATED AND HYPOTHESIZED IMPACTS TO SEMI-AQUATIC FURBEARERS (MINK AND OTTER)

(1) Permanent Habitat Loss:	
- Watana	
--impoundment area and permanent facilities	. Eliminates a substantial portion of good quality habitat for both species, 85 km of mainstem plus 15.6 km of stream habitat. . Reduce prey availability for both species.
- Devil Canyon	
--impoundment	. Less severe than Watana, but similar.
(2) Habitat Alteration and Temporary Habitat Loss:	
- Watana	
--impoundment clearing	. Likely to eliminate mink and otter from the impoundment area. Decrease cover and prey availability.
--reclaimed areas	. Will increase small mammal prey availability for mink.
--hydrologic-induced alteration	. Downstream flow stabilization and open water will benefit otter and mink. Increased number of beaver will benefit both.
(3) Barriers, Impediments, and Hazards to Movement:	. None.
(4) Disturbace Related to Construction Activities:	
- impoundment clearing	. Likely to eliminate mink and otter from affected areas.
- construction sites	. May disturb daily activities and force abandonment of aquatic habitats where they occur near construction zones.
(5) Increased Human Access:	
- increased hunting and poaching	. May become serious impact. Few animals are currently taken from the area.
- recreational disturbance	. Both species are somewhat sensitive to disturbance and may suffer significantly from increased presence of fishermen and recreational river users in remaining river habitat.

TABLE E.3.156: ANTICIPATED AND HYPOTHESIZED IMPACTS ON FOX

(1) Permanent Habitat Loss:	
- Watana	
--impoundment and other facilities	. No known den sites lost. . Higher elevation areas are more heavily used. . Loss of some summer prey, probably not limiting.
- Devil Canyon	
--impoundment and other facilities	. As above for Watana.
(2) Habitat Alteration and Temporary Habitat Loss:	
- Watana	
--impoundment clearing	. Habitat destruction may increase availability of some prey.
--reclaimed areas	. Will enhance availability of small mammal prey.
- Devil Canyon	
--all areas	. As above for Watana.
(3) Barriers, Impediments, or Hazards to Movement:	
- Watana	
--impoundment	. Will serve as home range boundary for resident animals, but will not prohibit movements across impoundment.
--downstream	. Open water in winter may make crossings hazardous or infrequent.
- Devil Canyon	
--all areas	. As above for Watana.
(4) Disturbance Related to Construction Activities:	
--impoundment clearing	. Will temporarily displace foxes.
--other sites	. Habituation will occur to most disturbances. . Den sites are sensitive to disturbance, particularly during early denning and early post-partum. . Habituated foxes can become pests, leading to increased probability of exposure to rabies.
--access road traffic	. Habituation will occur readily in the absence of hunting.

TABLE E.3.156 (Page 2)

(5) Increased Human Access:	
--hunting and poaching	. Possible serious impact dependent on market price of fur.
--recreational disturbance	. Dens are particularly sensitive. . Habituated foxes can become pests.

TABLE E.3.157: ANTICIPATED AND HYPOTHESIZED IMPACTS TO MARTEN, WEASEL, AND LYNX

(1) Permanent Habitat Loss:	
- Watana	
--impoundment and permanent facilities	. Loss of forest habitat will result in considerable decrease in carrying capacity for all species. . Loss of low elevation habitat near tributary mouths will eliminate lynx. . 100 marten (3.5 to 7.5% of basin pop.) will be lost. 766 ha of closed conifer- deciduous forest, 5% of total in Gold Creek and Watana watersheds.
--access corridor	. Minor habitat loss will result in redistribution of home ranges of those marten and weasel resident in adjacent forest areas. Little forest habitat occurs in Denali Highway to Watana section.
- Devil Canyon	
--impoundment and permanent facilities	. Approximately 14 marten will be lost to D.C. impoundment. 729 ha of closed conifer-deciduous forest, 5% of total, 9% of total in Gold Creek and Watana watersheds with both Watana and Devil Canyon impoundments. 11.5% of Watana and Gold Creek watersheds marten population lost with both projects.
--access corridor	. Minor habitat loss, as with Watana with result in redistribution of home ranges of marten and weasel resident in adjacent forest.
(2) Habitat Alteration and Temporary Habitat Loss:	
- Watana	
--impoundment clearing	. Will eliminate forest habitat for all species. Most will abandon area.
--reclaimed areas	. 67 ha of closed conifer-deciduous, 908 of spruce forests. Revegetation is unlikely to restore conifer forests in the license period. Total closed conifer-deciduous for Watana is 833/15,986 ha = 5.2%. Total spruce forest for Watana is 10,924/346,637 = 3.1%.
--transmission corridor	. No population level impacts anticipated due to habitat alteration.
- Devil Canyon	
--impoundment clearing	. Will eliminate forest habitat for all species.
--reclaimed areas	. 183 ha of closed conifer-deciduous, 194 of spruce forests total. Revegetation unlikely to restore conifer forests in license period. Total closed conifer-deciduous for both projects is 1016/15,986 ha = 6.4%. Total spruce forest for both projects is 11,118/346,637 = 3.2%.

--transmission corridor	. As described above for Watana.
(3) Barriers, Impediments and Hazards to Movement:	
- Watana	
--impoundment	. Will be a barrier to dispersal for marten. Will impede dispersal of lynx and weasel. Not a major impact. Animals in impoundment area will re-distribute home ranges along impoundment areas.
--access corridor	. Increased mortality from road kills. Not a population level impact.
--open water	. A barrier to crossing for marten.
- Devil Canyon	
--impoundment	. Barrier to marten dispersal, perhaps also for lynx and weasel. Animals in impoundment area will redistribute home ranges along impoundment shore.
--access corridor	. As for Watana.
--open water	. As for Watana
(4) Disturbance Related to Construction Activities:	
--construction sites	. Marten habituate readily to disturbance. Effects on weasel probably minimal. Lynx may be more susceptible but are uncommon and will be able to avoid areas without population level impacts.
--access road traffic	. Impacts as for other construction activities. Probably minimal. Most of access road traverses higher elevation habitats.
(5) Increased Human Access:	
--hunting and trapping	. Will become most significant mortality factor for marten. . Weasel are rarely sought by trappers in the area.
--vehicle collisions	. Unlikely to be population level impact.
--recreational disturbance	. Unlikely to affect marten or weasel. Lynx are uncommon and will be able to avoid impacted areas.

TABLE E.3.158: GENERAL TYPES OF IMPACTS TO RAPTORS
(from Roseneau et al. 1981)

Disturbance

Construction and Operation Activities

- sudden loud noises (e.g., blasting, gas venting, etc.) can lead to panic flights and damage to nest contents
- noise, human presence, etc., can lead to disruption of daily activities

Aircraft Passage

- sudden appearance and noise can lead to panic flights and damage to nest contents

Human Presence Near Nests

- inadvertent - chance occurrence of people (and dogs) near nests; people may be unaware of nest, raptors, or raptor alarm behavior
- deliberate - curious passersby, naturalists, photographers, researchers can have impacts if safeguards are not taken

Direct Impacts

Intentionally Destructive Acts (as a result of increased public access)

- shooting
- legal or illegal removal of eggs, young, or adults
- rolling of rocks off cliff tops
- cutting of nest trees

Man-Made Structures and Obstructions

- raptors may be struck on roads where they may perch or feed
- may strike wires, fences, etc.
- may be electrocuted on power poles
- raptors sometimes attack aircraft, or may accidentally strike aircraft

Environmental Contaminants

- deliberate application and accidental release of insecticides, herbicides, petrochemicals, and toxic industrial materials can affect raptors and prey by affecting hormones, enzymes, shell thickness, bird behavior, egg fertility and viability, and survival rates of nestlings, fledglings, immatures and adults

Changes in Prey Availability

- decrease in prey abundance or loss of nearby hunting areas may affect territory size, efficiency of hunting, nest occupancy, nesting success, condition of adults and young
- changes may result from aircraft overflights, construction and maintenance activities, public access, etc.

Habitat Loss

Abandonment of area due to destruction of nest, perch or important hunting habitat

TABLE E.3.159: ANTICIPATED AND HYPOTHESIZED IMPACTS TO RAPTORS AND RAVENS

(1) Permanent Habitat Loss:	
- Watana	
--Impoundment	. 5 of 16 (31%) golden eagle nesting locations will be lost. Cliff nesting habitat will become extremely limi- ted. . 4 of 8 (50%) bald eagle nesting locations will be lost. No known gyrfalcon nesting locations will be lost although all cliff nests of other raptors can be considered potential gyrfalcon nests. . 1 of 3 (33%) known goshawk nesting locations will be lost. Nesting habitat is very scarce upstream of this nest. . Considerable number of raven nesting locations and potential cliff habitat will be lost. How- ever, no major impact to ravens. . Perching habitat on cliffs and large trees will be lost. Some hunting habitat will also be lost, although this is not expected to be a significant impact on any of the raptor species. . Tree nesting habitat for smaller raptors will be lost.
--access corridor	. One bald eagle nesting location in Deadman Creek will be destroyed. Stand containing nest is best (possibly the only) bald eagle nesting habitat in Deadman Creek. . Minor amount of ground nesting habitat lost. . No cliff nesting habitat affected.
- Devil Canyon	
--Impoundment	. 2 of 16 (12%) golden eagle nesting locations. Cumulative loss to both projects 44-50% of known nest locations in basin. . No bald eagle nesting locations. . No gyrfalcon nesting locations. . 1 of 3 known goshawk nesting locations. However, nesting habitat is minimal in both impoundments. . 4 of 21 (19%) previously used raven nesting locations. A fifth nest will be only a few meters above impoundment level.
--access road	. Some ground nesting habitat lost. No cliff nesting habitat affected.
(2) Habitat Alteration and Temporary Habitat Loss:	
- Watana	
--impoundment clearing	. 3 of the 4 bald eagle nests to be lost are tree nests in the impoundment. . Tree nesting locations for smaller raptors and owls will be lost. . Clearing may make some small mammal prey more available. . 1 goshawk nesting location.
--borrow sites and reclaimed areas	. A golden eagle nesting location will be destroyed by Borrow Area E. . Revegetation will increase availability of small mammal prey.

TABLE E.3.159 (Page 2)

--transmission corridor	. Historically used peregrine falcon nest between Healy and Fairbanks. Probably will not be destroyed or made unusable. . 2 gyrfalcon nests within 0.6 km of line. . Electrocution of large raptors largest impact.
- Devil Canyon	
--impoundment clearing	. Tree nesting locations for small raptors and owls will be lost. . 1 goshawk nesting location lost.
--borrow sites and reclaimed areas	. 1 gyrfalcon nest may be located in Borrow Site K. . Revegetation will increase availability of small mammal prey.
--transmission corridor	. As for Watana.
(3) Barriers, Impediments, and Hazards to Movement:	
--none	
(4) Disturbance Related to Construction Activities:	
- Watana	
--impoundment clearing	. 7 golden eagle nests susceptible to disturbance during clearing. . 4 bald eagle nests susceptible. . 1 gyrfalcon nest susceptible. . 1 known goshawk nest susceptible. . 12 raven nests susceptible.
--borrow sites	. Golden eagle nest susceptible at Borrow Site E. May be destroyed. . 1 goshawk nest susceptible at Borrow Site I. . 2 raven nests susceptible at Borrow Site H.
--access road	. 1 bald eagle nest susceptible if it remains following construction of road in Deadman Creek.
--air traffic	. Golden eagles particularly susceptible during nestling period. Other raptors susceptible but somewhat less sensitive.
--transmission corridor	. Peregrine falcon nest susceptible if active during construction. . 2 gyrfalcon nests susceptible.
- Devil Canyon	
--impoundment clearing	. 5 golden eagle nests susceptible to disturbance. . 1 gyrfalcon nest susceptible. . 6 raven nests susceptible.
--dam construction	. 1 golden eagle nest susceptible. . 1 raven nest susceptible.

--borrow sites	. 1 gyrfalcon nest susceptible in Borrow Site K.
--access road	. 1 golden eagle nest in Watana-Devil Canyon section. . 1 bald eagle nest in Gold Creek-Devil Canyon section.
(5) Increased Human Access:	
--hunting and poaching	. Poaching unlikely to be major impact.
--recreational disturbance	. May become significant impact, particularly to nests along impoundment shores.

TABLE E.3.160: NUMBER OF KNOWN RAPTOR OR RAVEN NEST SITES IN THE MIDDL
AND DEVIL CANYON RESERVOIRS, OR THAT MAY BE AFFECTED BY

Species		Cliff-Nesting Locations			
		Golden eagle	Bald eagle	Gyrfalcon	Common
Total known nesting locations		16	1	3	21
Total recently active nesting locations		9	1	3[d]	7
Total inactive nesting locations		7[a]	0	0	14
Recently active nests to be destroyed by impoundment, borrow areas or camp sites	Watana	4[b]	1	0	5
	Devil Canyon	0	0	0	0
	Both	4[b]	1	0	5
Inactive nests to be destroyed by impoundment, borrow areas or camp sites	Watana	2[c]	0	0	6
	Devil Canyon	1-2	0	1[e]	4
	Both	3-4[c]	0	1[e]	10
Total active + inactive		7-8	1	1e	15
Percent of total to be destroyed by impoundment borrow areas or camp sites	Watana	38%	100%	0%	52%
	Devil Canyon	6-12%	0%	33%	19%
	Both	44-50%	100%	33%	71%
Recently active nests possibly affected by access and transmission routes	Watana	0	0	0	1
	Devil Canyon	1	0	0	0
	Both	1	0	0	1
Inactive nests possibly affected by access and transmission routes	Watana	0	0	0	0
	Devil Canyon	0	0	0	1[g]
	Both	0	0	0	1[g]
Total active + inactive both projects		1	0	0	2
Percent of total to be affected by access and transmission routes	Watana	0%	0%	0%	5%
	Devil Canyon	6%	0%	0%	5%
	Both	6%	0%	0%	10%
Total nests affected	Watana	6	1	0	12
	Devil Canyon	2-3	0	1[e]	5
	Both	8-9	1	1[e]	17
Total proporton of nests affected	Watana	38%	100%	0%	57%
	Devil Canyon	12-18%	0%	33%	24%
	Both	50-56%	100%	33%	81%

[a]Does not include two nesting locations reported by White (1974), but not relocated in 1980 -
White's original map, and may represent two of the total seven confirmed inactive golden eag

[b]Includes one nesting location (GE-8) that will be inundated and which is also approximately

[c]Includes one nesting location (GE-9) that will be inundated and that is also approximately 1
within Borrow Area E (see Table E.3.161).

[d]Includes one nesting location (GYR-2) occupied by gyrfalcons in 1974 (White 1974) and by an

[e]GYR-3 (recently inactive) may be within Borrow Area K (see Table E.3.161).

[f]Includes six confirmed active and six unconfirmed active raven nesting locations reported in

[g]This nesting location (R-21) may be affected by the presence of the access road, transmissio

[h]Includes one bald eagle nesting location (BE-2) very near maximum operating level of 666 m (

[i]This nesting location (BE-6) may be affected by the access corridor in Deadman Creek.

[j]This nesting location (BE-8) may be affected by the construction of the railroad between Dev

[k]This nesting location is only 0.2 km (0.1 mi) from Borrow Area I to be affected by Watana, b

E SUSITNA RIVER BASIN, ALASKA, THAT WOULD BE INUNDATED BY THE WATANA
DEVELOPMENT OF ASSOCIATED ACCESS ROUTES AND TRANSMISSION ROUTES

raven	Total cliff nesting locations	Tree Nesting Locations: Bald eagle	Goshawk	Total tree nesting locations	Total bald eagle
	41	7	3	10	8
	20	5	2	-	6
f	21	2	1	3	2
	10	3[h]	1	4	4
	0	0	0	0	0
	10	3[h]	1	4	4
	8	0	0	0	0
	6-7	0	1[k]	1	0
	13-15	0	1[k]	1	0
	23-25	3	2	5	4
%	44%	43%	33%	40%	50%
%	15-17%	0%	33%	10%	0%
%	56-61%	43%	66%	50%	50%
	1	1[i]	0	1	1
	1	1[j]	0	1	1
	2	2	0	2	2
	0	0	0	0	0
q	1	0	0	0	0
a	1	0	0	0	0
	3	2	0	2	2
%	2%	14%	0%	10%	12%
%	5%	14%	0%	10%	12%
%	7%	29%	0%	20%	25%
	19	4	1	5	5
	7-9	1[j]	1	2	1
	26-28	5	2	7	6
%	46%	57%	33%	50%	62%
%	17-22%	14%	33%	20%	12%
%	63-68%	71%	66%	70%	75%

1981. These two locations (GE-6 and GE-12) may have been mislocated on
le nesting locations.

100 m (330 ft) north of Borrow Area J.

00 m (330 ft) north of Borrow Area J, and one location (GE-11)

unknown species (probably gyrfalcon) in 1980.

1974 (White 1974).

n corridor, and construction of the dam (see Table E.3.161).

2185 ft). Assumed lost due to shoreline erosion.

il Canyon and Gold Creek (see Table E.3.161).

ut will be inundated at a later date if Devil Canyon development occurs.

TABLE E.3.161: RAPTOR AND RAVEN NESTING LOCATIONS IN THE MIDDLE SUSITNA BASIN, ALASKA, THAT MAY BE AFFECTED BY THE SUSITNA HYDROELECTRIC PROJECT DEVELOPMENT

Nesting Location Number	Estimated[a] Elevation m (ft)	Project Action	Potential Effects
GE-2	610 - 655 (2,000 - 2,150)	Filling Watana Reservoir	Inundation
GE-4	564 (1,850)	Filling Watana Reservoir	Inundation
GE-5	549 (1,800)	Filling Watana Reservoir	Inundation
[GE-6]	[<579 (<1,900)]	[Filling Watana Reservoir]	[Inundation; however, GE-6 may correspond to nearby GE-5. The elevation of this nesting location is unclear. White (1974) marked this nesting location at a place where suitable nesting habitat does not appear to occur.]
GE-8	490 - 518 (1,600 - 1,700)	Watana Borrow Site J	Watana Borrow Site J is located within 0.2 km (0.1 mi) of GE-8 and considerable disturbance may occur during material excavation and construction of the dam.
		Filling Watana Reservoir	Inundation
GE-9	490 - 518 (1,600 - 1,700)	Watana Borrow Site J	Watana Borrow Site J is located less than 0.2 km (0.1 mi) of GE-9 and considerable disturbance may result from material excavation.
		Filling Watana Reservoir	Inundation

TABLE E.3.161 (Page 2)

Nesting Location Number	Estimated[a] Elevation m (ft)	Project Action	Potential Effects
GE-10	1,189 (3,900)	Watana Borrow Site F	Minimal disturbance is anticipated although GE-10 lies about 1.1 - 1.3 km (0.7-0.8 mi) from Watana Borrow Site F. The elevation and location of the nest on the opposite side of Tsusena Butte from the borrow site will probably minimize any direct influence that excavation and/or transport of materials may have.
		Denali-Watana Access Road	Minimal disturbance is anticipated since the road lies about 2.7-2.9 km (1.7-1.8 mi) to the southeast.
GE-11	490 - 518 (1,600 - 1,700)	Watana Borrow Site E	Nesting location will be physically destroyed as it lies within Watana Borrow Site E.
[GE-12]	[<549? (<1,800?)]	[Filling Devil Canyon Reservoir]	[Inundation; however, GE-12 may correspond to nearby GE-13. White (1974) marked this nesting location at a place where suitable nesting habitat does not appear to occur.]
GE-13	427 - 442 (1,400 - 1,450)	Filling Devil Canyon Reservoir	Inundation

TABLE E.3.161 (Page 3)

Nesting Location Number	Estimated[a] Elevation m (ft)	Project Action	Potential Effects
GE-14	427 - 457? (1,400 - 1,500?)	Filling Devil Canyon Reservoir	Possible inundation. The elevation of this nest site is unclear. White (1974) marked this nesting location at a place where suitable nesting habitat does not appear to occur. GE-14 may have been located on one of two small cliff areas 1.4-2.1 km (0.9-1.3 mi) further downstream.
GE-18	335 (1,100)	Watana-Devil Canyon Access Road and Bridge	The access road route is 0.2 km (0.1 mi) from and near the top of the cliff on which GE-18 is located and the access road bridge crosses the river 0.8 km (0.5 mi) downstream from the nest location. Considerable disturbance may occur during construction.
		Devil Canyon Dam Construction	The Devil Canyon damsite is 1.0 km (0.6 mi) upstream from GE-18 and considerable disturbance may occur during construction.
		Devil Canyon Dam Substation and Transmission Corridor	The Devil Canyon Substation and transmission corridor is 0.8 km (0.5 mi) north of GE-18, and some disturbance may occur during construction.

TABLE E.3.161 (Page 4)

Nesting Location Number	Estimated[a] Elevation m (ft)	Project Action	Potential Effects
BE-2	663 - 671 (2,175 - 2,200)	Filling Watana Reservoir	Possible inundation. BE-2 lies near the limit of the impoundment flooding and the estimated elevation span of this nesting location extends slightly above and below the 666 m (2,185-ft) maximum operating level of the Watana reservoir.
BE-3	579 (1,900)	Filling Watana Reservoir	Inundation
BE-4	540 - 549 (1,775 - 1,800)	Filling Watana Reservoir	Inundation
BE-5	497 - 503 (1,630 - 1,650)	Filling Watana Reservoir	Inundation
BE-6	760 (2,500)	Denali-Watana Access Road	This nesting location lies 0.8 km (0.5 mi) east of the access road and considerable disturbance is anticipated.
BE-8	230 (750)	Devil Canyon Railroad	Devil Canyon railroad is 0.5 km (0.3 mi) from this nesting location and construction activities may result in considerable disturbance.

TABLE E.3.161 (Page 5)

Nesting Location Number	Estimated[a] Elevation m (ft)	Project Action	Potential Effects
GYR-3	579 - 610? (1,900 - 2,000?)	Devil Canyon Quarry Site K	GYR-3 may lie within this quarry site and material excavation could result in the destruction of this nesting location. (Presence or absence of this nesting location needs to be rechecked.
GOS-1	518 (1,700)	Filling Watana Reservoir	Inundation
GOS-2	442 (1,450)	Watana Borrow Site I	This material site is 0.2 km (0.1 mi) to the west of GOS-2 and considerable disturbances may result from excavation and transport of materials from this site.
		Filling Devil Canyon Reservoir	Inundation (see potential effect of Watana Borrow Site I)

TABLE E.3.161 (Page 6)

Nesting Location Number	Estimated[a] Elevation m (ft)	Project Action	Potential Effects
R-3	641 (2,100)	Filling Watana Reservoir	Inundation
R-4	610 - 778 (2,000 - 2,550)	Filling Watana Reservoir	Possible inundation. The elevation of R-4 is unclear. White (1974) marked the general location of R-4 in the vicinity of two small cliff areas on the north bank of the Susitna River. The nest was not found in 1980 or 1981 but is thought to be within the indicated elevations and potentially flooded by the 666 m (2185 ft) maximum operating level of the Watana reservoir.
R-5	641 (2,100)	Filling Watana Reservoir	Inundation
R-6	610 (2,000)	Filling Watana Reservoir	Inundation
R-7	534 - 549 (1,750 - 1,800)	Filling Watana Reservoir	Inundation
R-8	519 (1,700)	Filling Watana Reservoir	Inundation
R-9	488 (1,600)	Watana Borrow Site J	Material excavation from Watana Borrow Site J for dam construction will occur within the river basin as close as 0.2 km (0.1 mi) to R-9. Considerable disturbance may result from these activities prior to the filling of the reservoir and eventual flooding of this nesting location.
		Filling Watana Reservoir	Inundation (see potential effect of Watana Borrow Site J)

TABLE E.3.161 (Page 7)

Nesting Location Number	Estimated[a] Elevation m (ft)	Project Action	Potential Effects
R-10	488 (1,600)	Watana Borrow Site J	Watana Borrow Site J is 0.1 km (330 ft.) from R-10 and considerable disturbance may result from excavation and transport of materials from this material site prior to the filling of the reservoir and eventual flooding of this nesting location.
		Filling Watana Reservoir	Inundation (see potential effect of Watana Borrow Site J)
R-11	564 (1,850)	Watana Borrow Site J	Watana Borrow Site J is 0.1 km (330 ft.) from R-11 and considerable disturbance may result from excavation and transport of materials from this material site prior to the filling of Watana reservoir and eventual flooding of this nesting location.
		Filling Watana Reservoir	Inundation (see potential effect of Watana Borrow Site J)
R-12	625 (2,050)	Watana Camp	The camp is 1.4 km (0.6 mi) west of R-12. Minimal disturbance is anticipated as a result of construction or use of the camp.
		Denali-Watana Access Road	The access road is 1.9 km (1.1 mi) west of R-12. Little or no disturbance is anticipated as a result of the proximity of the access road.
		Filling Watana Reservoir	Inundation

Nesting Location Number	Estimated Elevation[a] m (ft)	Project Action	Potential Effects
R-13	549 (1,800)	Watana Camp) Denali-Watana Access Road) Watana Damsite)	R-13 lies 2.4 km (1.5 mi) west of the access road and 1 mi northwest of the Watana damsite; and as a result, little disturbance is anticipated.
		Transmission Corridor	The transmission line is 0.3-0.6 km (0.2-0.4 mi) from R-13 and some disturbance may occur.
R-14	549 - 580 (1,800 - 1,900)	Watana Borrow Site H	This borrow site is 0.8 km (0.5 mi) from R-14 and minimal disturbance is anticipated.
R-15	519 - 580 (1,700 - 1,900)	Watana Borrow Site H	This borrow site is 0.2 km (0.1 mi) from R-15 and considerable disturbance may occur during excavation and transportation of materials from this site.
R-16	442 (1,450)	Filling Devil Canyon Reservoir	Inundation
R-17	442 (1,450)	Filling Devil Canyon Reservoir	Inundation
R-18	427 (1,400)	Filling Devil Canyon Reservoir	Inundation
R-20	366 (1,200)	Filling Devil Canyon Reservoir	Inundation

TABLE E.3.161 (Page 9)

Nesting Location Number	Estimated[a] Elevation m (ft)	Project Action	Potential Effects
R-21	427 (1,400)	Devil Canyon Dam Construction	The damsite is 0.7 km (0.4 mi) upstream from R-21 and considerable disturbance may result from construction-related activities associated with the dam.
		Watana-Devil Canyon Access Road	This road is 0.4 km (0.25 mi) from R-21 and lies near the top of the next cliff. Considerable disturbance may result from the construction and/or use of this road.

[a]Differences occur between elevations given here and those reported by Kessel et al (1982a). Original estimates were obtained by attempting to locate nests as accurately as possible on USGS 1:63 360 maps with contour intervals of 100 ft (majority) or 50 ft (Talkeetna Mountains C-1), but it was often difficult to precisely locate nests and to locate them relative to tightly-spaced contour intervals (Cooper 1982 pers. comm.). All elevations have been reviewed and some revisions were made; however, in some cases, estimates given here may contain errors of as much as 30.5 m (100 ft). All elevations must be considered approximate (unless otherwise noted) until the majority are rechecked with a precision altimeter.

TABLE E3.162: NEST NUMBERS AND STATUS (i = inactive,
74a = active in 74 and considered inac
BE AFFECTED BY THE SUSITNA HYDRO PROJE

	WATANA		DEVIL CANYON		
	Destroyed by Inundation or Borrow Extraction	Disturbed by Access or Transmission Corridor	Destroyed by Inundation or Borrow Extraction	Disturbed by Access or Transmission Corridor	Distu Borrow Prior t
GE	2[a], 4[a], 5[a], 8[a] 9[i], 11[i]		13[i], 14[?]	18[a]	8
BE	2[a]?, 3[74], 4[a], 5[a]	6[a]		8[a]	
GYR			3[a]?		
GOS	1[a], 2[i]		2[i]		
R*	3[a], 4[a]?, 5[74a], 7[74a], 8[74a], 9[74a], 10[a], 11[74a], 12[a], 15[a]	13[a]	16[74a], 17[74a], 18[74a], 20[i]	21[74a]	9[74a],

* R-12 and R-13 are also subject to disturbance from Watana Camp.

a = active, 74 = inactive in 74 & unknown more recently,
tive more recently) OF RAPTOR NESTING LOCATIONS WHICH WILL
CT AND THE SOURCE OF IMPACTS

	WATANA		DEVIL CANYON		
rbed During Extraction o Inundation	Disturbed During Borrow Extraction Not to be Inundated	Disturbed During Clearing	Disturbed During Borrow Extraction Not to be Inundated	Disturbed During Borrow Extraction Prior to Inundation	Disturbed During Clearing
^{a}, 9^{i}	18^{a}	1^{a}, 2^{a}, 3^{a}, 4^{a}, 5^{a}, 9^{i}	18^{a}		11^{i}, 13^{i}, $14^{?}$, 15^{i}, 16^{a}
		2^{a}, 3^{74}, 4^{a}, 5^{a}			
		1^{a}	3^{a}		2^{a}
2^{i}		1^{a}		2^{i}	2^{i}, 3^{a}
10^{a}, 11^{74a}	14^{i}, 15^{a}	2^{74a}, 3^{a}, 4^{a}, 5^{74a}, 6^{74a}, 7^{74a}, 8^{74a}, 9^{74a}, 10^{a}, 11^{74a}, 12^{a}	21^{74a}		16^{74a}, 17^{74a}, 18^{74a}, 19^{a}, 20^{i}, 21^{74a}

TABLE E.3.163: FACTORS THAT AFFECT THE SENSITIVITY OF RAPTORS TO DISTURBANCES
(from Roseneau et al., 1981)

Characteristics of the Disturbance

- type of disturbance
- severity (speed, loudness, suddenness, persistence, etc.)
- frequency of occurrence

Characteristics of the Bird

- the individual (individual differences in response)
- sex
- age
- 'mood' (a factor of recent activities, weather)
- territorial status (breeder, territorial non-breeder, or non-territorial floater)
- stage of annual life cycle (winter, migration, courtship, egg-laying, rearing young, etc.)
- occurrence of other disturbances or natural stresses at the same time
- previous experience with this type of disturbance (habituation may occur)

Topography

- nearness of disturbance to raptor or nest
- relative elevations (is nest or raptor above or below the disturbance? by what distance?)
- presence of screening features (trees, intervening hill)
- direction faced by nest relative to sun, wind, disturbance
- type of nest (exposed ledge, overhung ledge, cave)
- distance of nest above foot of cliff and below lip of cliff (i.e., 'security' of nest)

Time of Day

Weather at Time of Disturbance

Potential Predators Nearby

Type of Prey Utilized by the Bird (species, location, abundance)

TABLE E.3.164: INFLUENCE OF TIMING OF DISTURBANCE ON THE POSSIBLE EFFECTS ON RAPTORS
(from Roseneau et al. 1981)

Timing	Possible Effects of Disturbance
Winter	Raptor may abandon nest, roosting cliff, or hunting area (e.g., gyrfalcon)
Arrival and courtship	Migrant raptor may be forced to use alternative nest site (if available), may remain but fail to breed or may abandon nest site
Egg-laying	Partial clutch may be abandoned and remainder (or full clutch) laid at alternative nest; breeding effort may cease or site may be abandoned
Incubation	Eggs may be chilled, overheated, or preyed upon if parents are kept off nest too long; sudden flushing from nest may destroy eggs; male may cease incubating; clutch or site may be abandoned
Nestling phase	Chilling, overheating, or predation of young may occur if adults are kept off nest; sudden flushing of parent may injure or kill nestlings; malnutrition and death may result from missed feedings; premature flying of nestlings from nest may cause injury or death; adults may abandon nest or site
Fledgling phase	Missed feedings may result in malnutrition or death; fledglings may become lost if disturbed in high winds; increased chance of injury due to extra moving about; parents may abandon brood or site
Night	Panic flight may occur and birds may become lost or suffer injury or death
General	Undue expense of energy; increased risk of injury to alarmed or defending birds; missed hunting opportunities

TABLE E.3.165: APPROXIMATE LOSSES
SUSITNA BASIN AS A

Avian Habitats (plot numbers from Table E.3.139 in parenthesis)	Approximate Vegetation Type Equivalents	Total ha in GC and Watana Watersheds	Watana Permanent Facilities	Watana Borrow and Construction Sites	Total Watana
alpine tundra (1)	mat and cushion tundra, dwarf sedge shrub meadow and mesic sedge-grass tundra	249,359	0	70	70
dwarf-low birch (2,3)	low birch shrub	33,549	492	321	813
low-medium shrub (4)	low mixed shrub	471,461	704	249	953
tall alder thicket (5)	tall shrubland	124,035	537	14	551
cottonwood forest (6)	closed balsam poplar forest	*** 1	3	0	3
paper birch forest (7)	closed birch forest	323	473	5	478
white spruce-paper birch forest (8,9)	open mixed conifer-deciduous forest	23,387	1342	138	1480
white spruce forest (10)	closed conifer forest	323	0	0	0
white spruce scattered woodland (11)	woodland white spruce	17,322	397	140	537
black spruce dwarf dwarf forest (12)	woodland black spruce	138,612	3878	419	4297

***[1]Closed balsam poplar forest stands were too small to be measured at the scale of the Gold Creek watershed maps. Most stands are in river bottomlands and will be inundated. Numerous smaller star will not be affected.

***[2]Hectares affected are apparently greater than the total in the basin because of differences in : between basin and impoundment area maps. Many small closed birch stands will not be affected.

***[3]Data averaged when type represents more than one of Kessel et al.'s (1982a) census plots, see Ta

)F AVIAN HABITATS STUDIED IN THE MIDDLE
RESULT OF THE SUSITNA HYDROELECTRIC PROJECT

Watana % of Total Watershed	D.C. Permanent Facilities	D.C. Borrow and Construction Sites	Total D.C.	D.C. % of Total Watershed	Total % Other Projects	Avian Density (Number of Territories/ 10 ha) 1981	Number of Breeding Species (1981)
0%	0	0	0	0%	0%	4.8	10
2%	49	18	67	<1%	2%	22.2	8
<1%	4	0	4	0.0%	<1%	45.4	6
<1%	3	0	3	0.0%	<1%	12.5	10
*** 1	8	0	8	*** 1	100%	60.9	16
*** 2	433	0	433	*** 2	90-100%	38.1	10
6%	286	0	286	1%	7%	38.2	17
0%	0	0	0	0%	0%	15.7	8
3%	20	0	20	<1%	3%	43.8	16
3%	133	0	133	<1%	3%	24.8	13

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TABLE E.3.166: ESTIMATED NUMBER OF SMALL- AND MEDIUM-SIZED BIRDS THAT WOULD BE ELIMINATED THROUGH HABITAT DESTRUCTION AS A RESULT OF THE SUSITNA HYDROELECTRIC PROJECT (NUMBERS WERE DERIVED FROM THE DENSITIES OF SPECIES TERRITORIES ON THE RESPECTIVE BIRD CENSUS PLOTS IN 1981, MULTIPLIED BY THE AREA OF CORRESPONDING VEGETATIVE TYPES TO BE ALTERED OR DESTROYED BY THE PROJECT AND PERCENT OF ESTIMATED TOTAL NUMBER OF BREEDING BIRDS WITHIN 16 KM (10 MI.) OF THE SUSITNA RIVER BETWEEN THE MCLAREN RIVER AND GOLD CREEK)

(from kessel unpub. tables)

	Watana Facility		Devil Canyon Facility		Access Road (Devil Canyon to Denali Highway)	Transmission Line (Between Watana and Gold Creek)	Total	
	No. Birds	%	No. Birds	%	No. Birds	No. Birds	No. Birds	%
Spruce grouse	464	9.9	242	5.2	4	26	736	15.7
Willow ptarmigan	40	1.8	4	0.2	18		62	2.9
Am. golden plover					12		12	0.2
Greater yellowlegs	10	3.8					10	3.8
Common snipe	1,550	3.9	496	1.2	6		2,052	5.1
Least sandpiper					8		8	0.4
Baird's sandpiper					8		8	0.1
Hairy woodpecker	232	9.9	122	5.2	2	12	368	15.7
N. 3-toed woodpecker	238	8.5	102	3.6	2	4	346	12.4
Gray jay	522	4.8	188	1.7	8	14	732	6.7
Boreal chickadee	2,084	8.5	416	1.7	6	36	2,542	10.3
Brown creeper	232	9.9	122	5.2	2	12	368	15.7
American robin	838	6.2	48	0.4	14		900	6.6
Varied thrush	2,560	8.1	1,238	3.9	10	80	3,888	12.3
Hermit thrush	2,104	7.7	1,060	3.9	18	58	3,240	11.9
Swainson's thrush	4,494	10.7	2,360	5.6	28	180	7,062	16.9
Gray-cheeked thrush	4,068	7.3	240	0.4	12	24	4,344	7.8
Arctic warbler	1,440	1.4	56	0.1	140		1,636	1.6
Ruby-crowned kinglet	7,628	8.1	1,160	1.2	14	64	8,866	9.4
Water pipit					12		12	0.1
Yellow-rumped warbler	9,428	9.6	3,314	3.4	38	240	12,020	13.3
Blackpoll warbler	3,564	8.7	804	1.9	10	48	4,426	10.8
Northern waterthrush	596	10.0	312	5.3	4	32	944	15.9
Wilson's warbler	5,308	2.0	988	0.4	356	108	6,760	2.5
Common redpoll	3,304	5.2	900	1.4	54	70	4,328	6.8
Savannah sparrow	5,550	1.7	184	0.1	416		6,150	1.9
Dark-eyed junco	6,212	7.2	1,616	1.8	38	124	7,990	9.3
Tree sparrow	9,142	2.0	420	0.1	550		10,112	2.2
White-crowned sparrow	5,540	3.4	296	0.2	156		5,992	3.7
Fox sparrow	5,386	7.0	604	0.8	22	48	6,060	7.8
Lapland longspur					20		20	0.1
Total Number Breeding Birds (rounded off)	82,500		17,300		1,200		103,000	

TABLE E.3.167: TOTAL AVERAGE DAILY TRAFFIC ON ACCESS ROAD AND DENALI HIGHWAY DURING PEAK CONSTRUCTION YEAR AND SEASON
(data from Frank Orth & Associates, Inc. 1982)

Denali Highway[1]	Case A*	Case B**
Cantwell to Fish Creek:		
DOT non-project related traffic projections	320	320
Project related passenger vehicles	384	240
Project support materials vehicles	20	20
Project heavy trucks	70	70
Total	794	650
Fish Creek to McClaren River:		
DOT non-project related traffic projections	130	130
Project related passenger vehicles	384	240
Project support materials vehicles	20	20
Project heavy trucks	70	70
Total	604	460
Access Road		
Project related passenger vehicles	674	484
Project support materials vehicles	20	20
Project heavy trucks	70	70
Total	508	426

* Assumes each commuting worker uses a private vehicle - one vehicle per worker.

** Assumes the application of a 1.72 commuter worker to private vehicle ratio. This ratio represents selected results of a study that examined worker/vehicle ratios in major eastern U.S. power plants under construction in 1978 and 1979 (Metz, W.C. 1981. Worker/Vehicle Ratios at Major Eastern Power Plant Construction Sites: A Time of Change. Traffic Quarterly 35 (3): 433-443. July 1981.

1 Denali Highway estimates include Alaska Dept. of Transportation projected 1990 Average Daily Traffic independent of the Susitna project.

TABLE E.3.168: STATE OF ALASKA TEMPORAL AND SPATIAL PROTECTION CRITERIA FOR NESTING RAPTORS[1]

Species	Sensitive Time Period[2]	Aerial Activity[3]	Minor Ground Activity	Major Ground Activity	Facility Siting	Habitat Disturbance
Peregrine falcon	April 15-August 31	1 mi h or 1500 ft v	1 mi	2 mi	2 mi	2 mi
Gyrfalcon	February 15-August 15	1/4 mi h or 1000 ft v	1/4 mi	1/4 mi	1/2 mi	-
Golden eagle[4]	March 15-August 31	1/2 mi h or 1000 ft v	1/4 mi	1/2 mi	1/2 mi	-
Bald eagle[4]	March 15-August 31	1/4 mi h or 1000 ft	1/8 mi	1/4 mi	1/2 mi	1/8 mi

Explanatory Notes

Raptor nest sites are assumed occupied until June 1 each year. After that date, protection measures for a specific nest site can be withdrawn for the remainder of the year if the nest is documented to be non-active.

It should be noted that any activity, disturbance, or habitat alteration that may affect historic or currently active peregrine falcon nest sites must be reviewed by the U.S. Fish and Wildlife Service, Office of Endangered Species, to evaluate the potential for detrimental impacts to the welfare of this endangered species.

Restrictions - The restriction columns provide temporal and spatial protection measures necessary to minimize disturbance to sensitive wildlife areas from aerial activity, minor ground activity, major ground activity, and the siting and operation of facilities.

Aerial activities include the potential disturbance effects from both fixed-wing aircraft and helicopters. The disturbance and "startling" impacts of low-level aircraft activity are of particular concern during raptor nesting.

Minor ground activity is characterized by limited, short-term, reconnaissance and exploration-type programs that do not involve significant amounts of personnel, equipment, surface disturbance, or noise. Examples of minor ground activity include foot reconnaissance, field inventories, topographic surveys, resistivity surveys, and some borehole/test pit exploration activities.

Major ground activity is characterized by extensive construction-related disturbance involving significant amounts of personnel, equipment, surface disturbance, noise, or vehicular activity. The duration of this disturbance may be either short-term or long-term, but the magnitude of overall activity is such that sensitive wildlife areas could be adversely affected. Typical major ground activities include clearing, pad construction, blasting, ditching, pipe laying, materials site development, and facility construction.

Facility Siting - The concerns of facility siting in proximity to sensitive wildlife areas include the long-term impacts of facility operation during duration of the project and the effects of habitat alteration on the integrity of wildlife use areas. Continuously occupied or operating facilities may generate noise or activity disturbance that could preclude wildlife occupation of a sensitive use area for the duration of the project. Alteration of adjacent habitats beyond the boundary of a defined wildlife use area may also discourage or preclude continued use of a sensitive area by wildlife.

1 Derived from "Sensitive Wildlife Areas of the Northwest Alaskan Gas Pipeline Corridor," C. E. Behlke, State Pipeline Coordinator, letter to E. A. Kuhn, NWA, July 15, 1980 (see footnote 4 below). Protection criteria are accepted guidelines followed by the Alaska Dept. of Fish and Game and the U.S. Fish and Wildlife Service.

2 Sensitive time periods listed here differ somewhat from broader phenological periods listed in Table E.3.129, but are specifically designed to encompass the great majority of nesting pairs during what are considered to be the most critical portions of the breeding season.

3 h = horizontal; v = vertical.

4 Sensitive time period dates were modified to reflect earlier nesting by some golden eagles that may winter in the Alaska Range in the milder years (Roseneau, unpubl. data) to allow for later fledging of some bald eagle nestlings (see Table E.3.129).

TABLE E.3.169: ESTIMATED MITIGATION COSTS FOR COMPENSATION FOR MOOSE, BROWN BEAR AND BLACK BEAR FORAGING HABITAT LOSS

Program	Estimated Cost
A. Controlled Burning (Compensation for moose and bears)	
1. Objective:	
To increase browse and berry production on 6400 acres* of forested land	
2. Location:	
Vicinity of Watana Creek	
3. Cost Elements - Construction Period:	
a. Labor for professional planning and fire control, 1987-1993	$ 80,000
b. Equipment and logistics	$ 20,000
c. Land lease - 1600 acres**	$ 640,000
$\frac{\$80,000}{yr}$ X 8 years	$
Total Construction Period Costs	$ 740,000
4. Cost Elements - Operation Period (average annual costs):	
a. Repeat burn, 2002-2008 (or as required)	$ 2,000
b. Land lease - 1600 acres**	$ 80,000
Total Average Annual Operation Costs 82,000/yr.	$
B. Clearing (compensation for moose)	
1. Objective:	
To increase browse production on 16,000*** of forested land	
2. Location:	
Either side of the Susitna River floodplain downstream from Devil Canyon	

TABLE E.3.169 (page 2)

Program			Estimated Cost
3. Cost elements - Construction period:			
	a. Labor and equipment		
	16,000 acres @ $600/acre		$9,600,000
		Total Construction Period Costs	$9,600,000
4. Costs elements - Operation Period (average annual costs):			
	a. Two repeat clearings during license period		$ 384,000
		Total Average Annual Operation Costs	$ 384,000

* Estimation of areas required presented in Section 4.4.2(b) - Mitigation Plan 6.

** It is arbitrarily assumed for this analysis that 4800 acres of federal or state land are obtained through interagency agreement, and that 1600 acres of privately owned land are leased. It is further assumed that the land is leased at 5% purchase value per year, that purchase value is $1000/acre, and that 8 years of lease payments are during the construction phase and 50 years in the operation phase.

*** It is arbitrarily assumed for this analysis that 16,000 acres of state or federal land are obtained through interagency agreement.

TABLE E.3.170: ESTIMATED MITIGATION COSTS FOR AERIAL PHOTOGRAPHY OF VEGETATION IN THE DOWNSTREAM FLOODPLAIN

Program	Estimated Cost (1982 dollars)
A. Aerial Photography	
1. Objective:	
To monitor changes in downstream browse availability for moose in in order to allow complete mitigation.	
2. Location:	
The river floodplain between Devil Canyon and Cook Inlet	
3. Cost Elements - Construction Period	
a. Photography flights, printing, vegetation mapping and analysis, 1988 or 1989	$10,000
Total Project Construction Costs	$10,000
4. Cost Elements - Operation Period (average annual cost)	
a. Photography flights, printing, vegetation mapping and analysis, at 10 year intervals.	
$\frac{\$10,000 \times 5}{50} = \frac{\$1,000}{\text{year}}$	$ 1,000/year
Total Project Average Annual Operation Costs	$ 1,000/year

TABLE E.3.171: ESTIMATED MITIGATION COSTS FOR BALD EAGLE HABITAT MODIFICATION*

Program Element			Estimated Cost (1982 dollars)
1. Program Design	$ 500/site x 10 =		$ 5,000
2. Construction			
a. Materials	$ 250/site x 10 =		2,500
b. Labor**	$1100/site x 10 =		11,000
		Subtotal	$13,500
3. Placement***			
a. Labor	70/hour x 80 =		5,600
b. Transportation (Helicopter)	400/hour x 30 =		12,000
		Subtotal	$17,600
	Project Construction Costs:	TOTAL	$36,100

* Construction and placement of artificial nests in trees modified for this purpose, and modification of other trees to allow eagles to build own nests (10 artificial nests assumed).

** Includes artificial nest fabrication.

*** Includes time spent locating trees suitable for modification. Assumes 1 to 3 tree modifications and 1 to 2 nest placements at each site.

TABLE E.3.172: ESTIMATED MITIGATION COSTS FOR DESIGN, CONSTRUCTION, AND PLACEMENT OF 10 NEST PLATFORMS WITH ARTIFICIAL NESTS FOR GOLDEN EAGLES (on transmission towers)

Program Element			Estimated Cost (1982 dollars)
1. Program Design			$ 5,000
2. Construction			
a. Materials			
- Platforms	$ 150 x 10 =		1,500
- Artificial Nests	50 x 10 =		500
b. Labor			
- Platforms	25/hour x 60 =		1,500
- Artificial Nests	25/hour x 60 =		1,500
		Subtotal	$ 5,000
3. Placement*			
a. Labor	70/hour x 80 =		5,600
b. Transportation (Helicopter)	400/hour x 8 =		3,200
		Subtotal	$ 8,800
	Project Construction Costs:	TOTAL	$18,800

* Placement includes supervision by raptor biologist of installation, and assumes use of contractor crew labor during erecton of towers. Cost per site would increase if fewer sites were chosen, because of fixed logistic requirements.

TABLE E.3.B173: ESTIMATED MITIGATION COSTS FOR DESIGN, CONSTRUCTION, AND PLACEMENT OF 10 NEST BOXES FOR CAVITY-NESTING RAPTORS

Program Element			Estimated Cost (1982 dollars)
1. Program Design			$ 1,000
2. Construction			
a. Materials	$30/box x 20 =		300
b. Equipment			1,000
c. Labor	25/hour x 20 =		500
		Subtotal	$ 1,800
3. Placement*			
a. Labor	70/hour x 40 =		2,800
b. Transportation (Helicopter)	400/hour x 12 =		4,800
		Subtotal	$ 7,600
		TOTAL	$ 9,400

* Placement includes locating appropriate habitat and sites within that habitat, plus physical installation, including any final modifications to create natural settings.

TABLE E.3.174: ESTIMATED MITIGATION COSTS FOR MODIFICATION OF CLIFF LOCATIONS TO PROVIDE GOLDEN EAGLE NESTING HABITAT*

Program Element			Estimated Cost (1982 dollars)
1. Program Design**	$1,000/site x 10 =		$10,000
2. Construction			
a. Materials***	$1,000/site x 10 =		10,000
b. Labor****	70 hour x 280 =		19,600
c. Transportation***** (Helicopter)	400/hour x 50 =		20,000
		Subtotal	$49,600
	Project Construction Costs:	TOTAL	$59,600

* Assumes 10 cliff locations and 2 to 3 cliff modifications per location.

** Requires prior completion of aerial surveys to establish candidate locations.

*** Includes explosives, rock drills, cement, hand tools, climbing gear, etc.

**** Costs heavily dependent on site conditions actually encountered.

***** Separate trips required to transport explosives.

TABLE E.3.175: ESTIMATED MITIGATION COSTS FOR CREATING NEW NESTING CLIFFS FOR GOLDEN EAGLES*

Program Element			Estimated Cost (1982 dollars)
1. Program Design*	$3,000/site x 4 =		$12,000
2. Construction			
a. Materials**	$4,000/site x 4 =		16,000
b. Labor***	70 hour x 600 =		42,600
c. Transportation**** (Helicopter)	400/hour x 32 =		12,800
		Subtotal	$70,800
	Project Construction Costs:	TOTAL	$82,800

* Involves removal of overburden to expose bedrock cliffs; a maximum of four locations is assumed.

** Costs will vary with equipment and explosives requirements.

*** Costs will vary with professional drilling and blasting requirements.

**** Separate trips required to transport explosives.

TABLE E.3.176: THE SUCCESS OF ARTIFICIAL NESTING STRUCTURES INSTALLED ON POWER POLES AND TRANSMISSION TOWERS
(excerpted from Olendorff et al. 1981)

Location	Type and No. of Structures	*No. Occupied (and species)
Illinois	1 wooden nestbox	1 (kestrel)
East Germany	30 iron platforms on poles	Almost all used each year (ospreys)
Colorado	12 wooden platforms 1975 25 nestboxes 1976 25 nestboxes 1977 25 nestboxes	None 12 (kestrel) 19 (kestrel) 24 (kestrel)
Idaho	6 wooden platforms (2 to 4 years each)	4 (golden eagle) 1 (red-tailed hawk) 1 (osprey) **1 (bald eagle)
Idaho Oregon	40 steel platforms on towers	too early for results
North Dakota	20 wooden or wire mesh platforms	too early for results
Oregon, Washington, Montana	1977 4 wooden/ fiberglass platforms	1 (red-tailed hawk) 1 (osprey)
	1978 5 wooden/ fiberglass platforms	1 (osprey)
	1979 5 wooden/ fiberglass platforms	1 (osprey)

*Minimum number of times used in time periods specified.
**A pair occupied a platform early one season, but did not nest successfully.

TABLE E.3.177: BOTANICAL RESOURCES MITIGATION STUDIES

PROGRAM	SCHEDULE	ESTIMATED COST
(1) Transmission corridor surveys for candidate threatened or endangered plants: Section 3.2.1	1983	$100,000*
(2) Mapping of wetland, browse, and general vegetation types: Section 3.2.1	1983	$350,000*
(3) Moose browse characterization study: Section 3.4.2	1983 or 1984	$100,000*
(4) Alphabet Hills burn study: Section 3.4.2	1984 and future 1984 and future	$ 75,000* (first year only)
(5) Downstream floodplain photography: Section 3.4.2	1988 and 10-year intervals	$ 10,000** (flight and analysis)

* Included in project capital cost for construction.
** Expenditure beyond project capital cost.

TABLE E.3.178: WILDLIFE MITIGATION SUMMARY

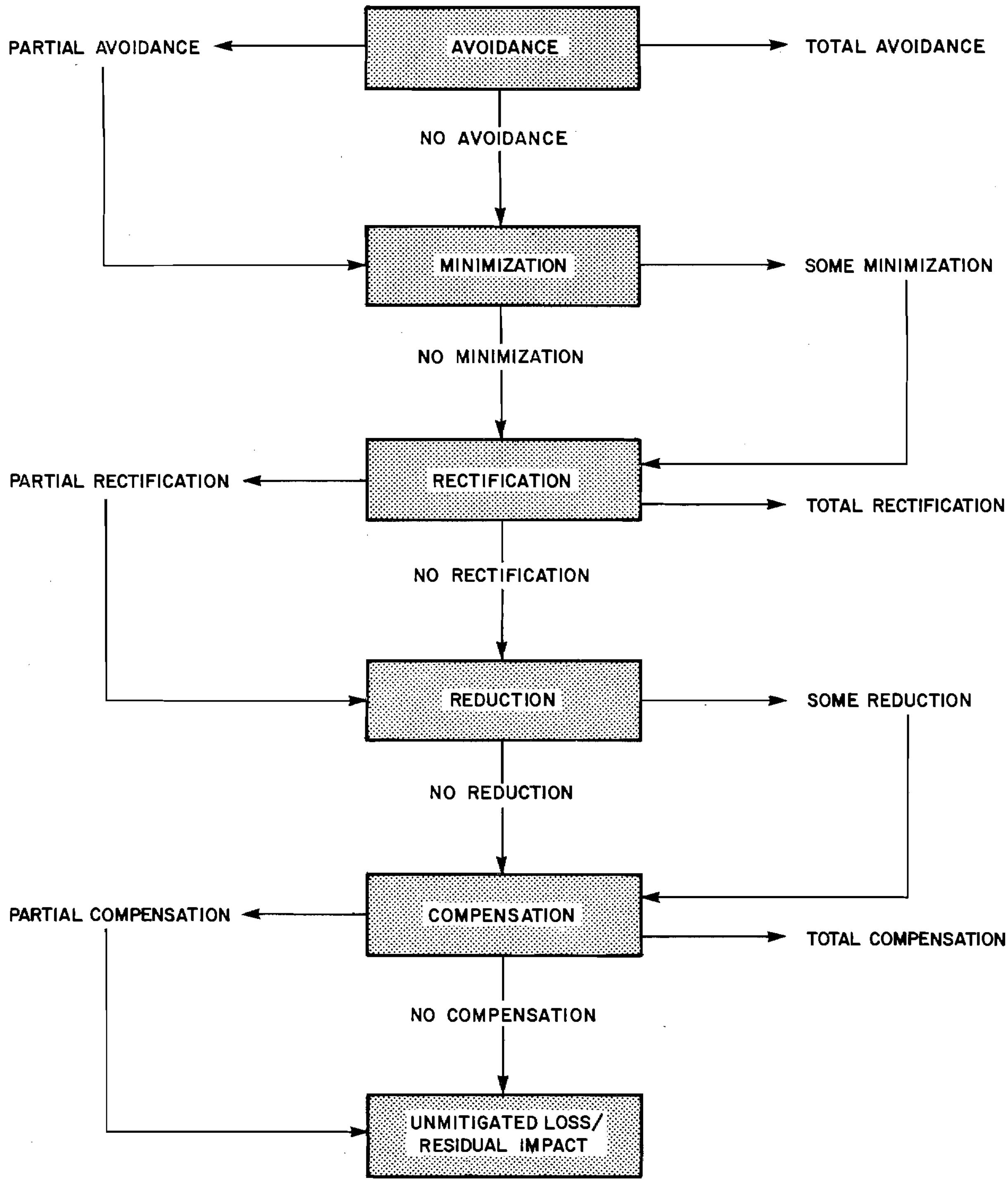
Mitigation Plans	Target Species	Schedule	Estimated Expenditure Beyond Project Capital Cost
Monitoring Study 1 (frequency and location of access road and railroad mortality)	moose, caribou	Throughout construction and operation	None
Monitoring Study 2 (downstream aerial photography to monitor vegetation changes)	moose	1988 and 10-year intervals thereafter	$10,000 per flight and analysis
Monitoring Study 3 (caribou movements)	caribou	Throughout construction and operation	None
Monitoring Study 4 (records of impoundment crossing and related mortality	moose, caribou, brown bear, black bear	Throughout Operation	None
Monitoring Study 5 (seasonal use and distribution of use of Jay Creek mineral lick)	dall sheep, moose	1983 and 3 years after filing	None
Monitoring Study 6 (den locations)	brown bear, black bear, woy and fox	Throughout construction	None
Monitoring Study 7 (woy population data)	woy (ungulates)	Throughout construction and 3 years into operation	
Monitoring Study 8 (beaver numbers and distribution)	beaver	Throughout construction and operation	None
Monitoring Study 9 (raptor nest sites)	golden eagle, bald eagle, gep falcan, peregrine falcon, goshawk (and other raptors)	Throughout construction and into operation as indicated in Mitigation Plan 20	None
Monitoring Study 10 (swan nest sites)	trumpeter swan	Construction phase	None
Monitoring Study 11 (browse productin)	moose	Throughout construction (beginning in 1983 in Alphabet Hills) and operation	None
Mitigation Plan 1 (impoundment clearing)	all species (in particular moose, black ber, furbearers, raptors, waterbirds and small birds and mammals)	2-3 years prior to filing, with modifications to avoid sensitive areas	None

TABLE E.3.178 (page 2)

Mitigation Plans	Target Species	Schedule	Estimated Expenditure Beyond Project Capital Cost
Mitigation Plan 2 (minimize habitat loss)	all species (in particular forest dwelling species, also aquatic and semi-aquatic furbearers	Throughout construction	None
Mitigation Plan 3 (revegation)	moose, brown bear, black bear, accipiters, small mammals	After abandonment of temporary sites, immediately following road construction on shoulder	None
Mitigation Plan 4 (transmission corridor design)	enhancement for moose and bird and mammal inhabitants of early seral communities; will reduce or minimize impacts to forest species	Construction and periodic clearing as needed during operation	None
Mitigation Plan 5 (maintain river temperature as close to normal as possible	moose (other species will also benefit from reduction in winter open water barrier)	Operation	None
Mitigation Plan 6 (enhancement on replacement lands)	moose; brown and black bears will also benefit from burning program	Construction and periodic enhancement as needed throughout operation	\$10,340,000 in construction phase and \$82,000 per year in operation phase
Mitigation Plan 7 (moose model and related studies)	moose	Throughout construction and operation	None
Mitigation Plan 8 (controlled moose hunt)	moose	Prior to filing	None
Mitigation Plan 9 (impoundment debris monitoring and removal)	moose, caribou, brown and balck bear	Throughout filing and operation	None
Mitigation Plan 10 (protect sensitive areas from disturbance)	dal sheep, caribou, wolf, fox, golden eagle, bald eagle, gyrfalcon, trumpeter swan, brown and black bear, moose	Throughout construction	None
Mitigation Plan 11 (design changes to access road to avoid caribou calving area)	caribou		None
Mitigation Plan 12 (central vehicle traffic)	caribou	Throughout Construction	None
Mitigation Plan 13 (exposure of new soil at Jay Creek mineral lick)	dall sheep	As needed (see monitoring study 5)	None

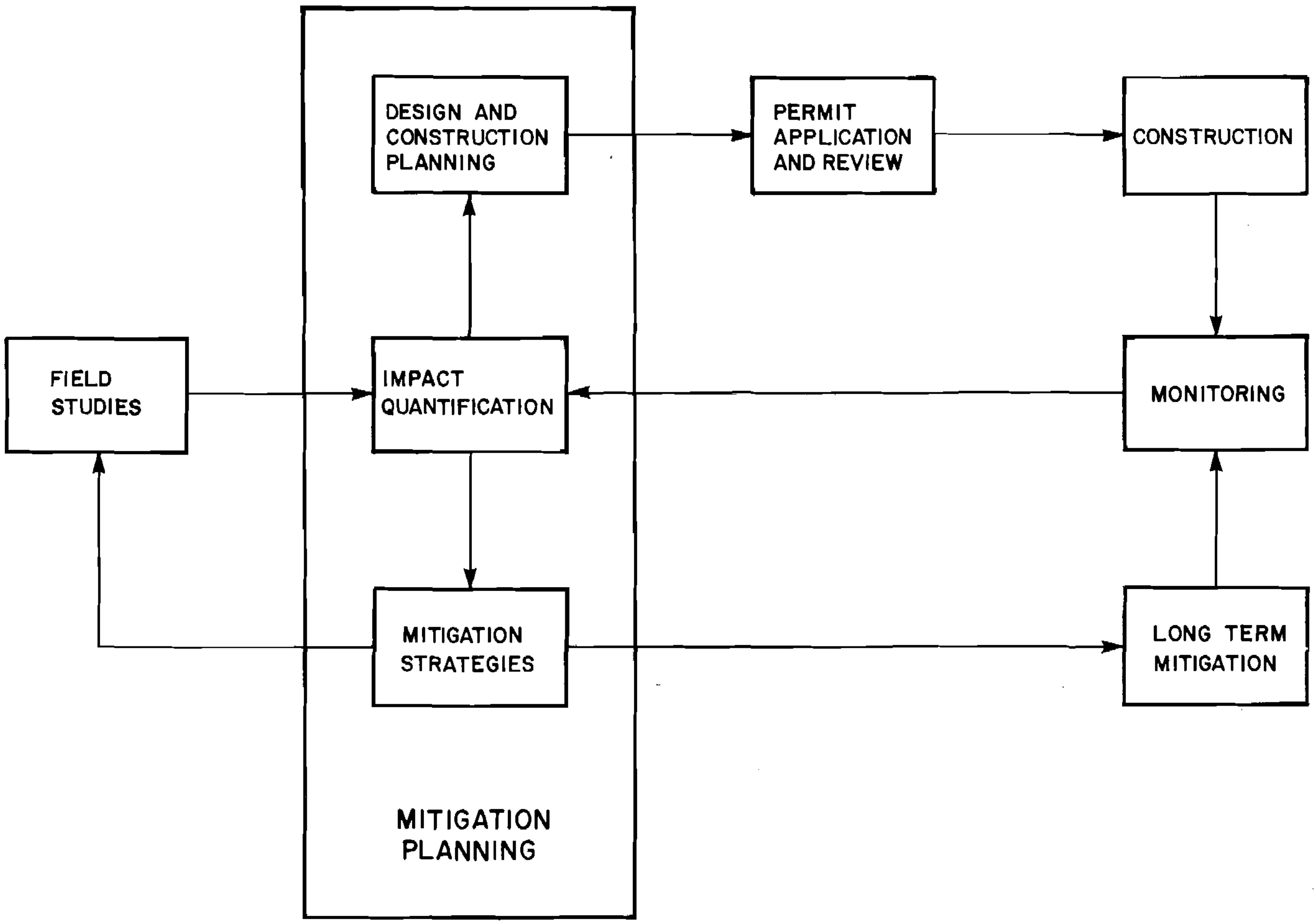
TABLE E.3.178 (page 3)

Mitigation Plans	Target Species	Schedule	Estimated Expenditure Beyond Project Capital Cost
Mitigation Plan 14 (avoid overharvest)	all game species	Throughout construction and operation	None
Mitigation Plan 15 (avoid creation of	brown bear, black bear, fox, wolf	Throughout construction and operation	None
Mitigation Plan 16 (minimize or compensate for reduction in food availability for bears)	brown bear and black bear	Throughout construction and operation	None
Mitigation Plan 17 (minimize habitat loss for aquatic furbearers)	beaver, muskrat, mink and otter	Road construction	None
Mitigation Plan 18 (beaver model)	beaver	Throughout construction and operation	None
Mitigation Plan 19 (slaugh enhancement)	beaver, muskrat, mink and otter	Throughout operation	None
Mitigation Plan 20 (avoid destruction of raptor nesting locations)	raptors	Construction	None
Mitigation Plan 21 (compensation for un-avoidable loss of raptor nesting locations)	raptors	During construction and into operation as required for 100% compensation	$206,700
Mitigation Plan 22 (avoid electrocution of raptors)	eagles	Construction	None
Mitigation Plan 23 (minimize loss of forest habitat)	black bear, marten, small birds, small mammals, red fox	Construction	None



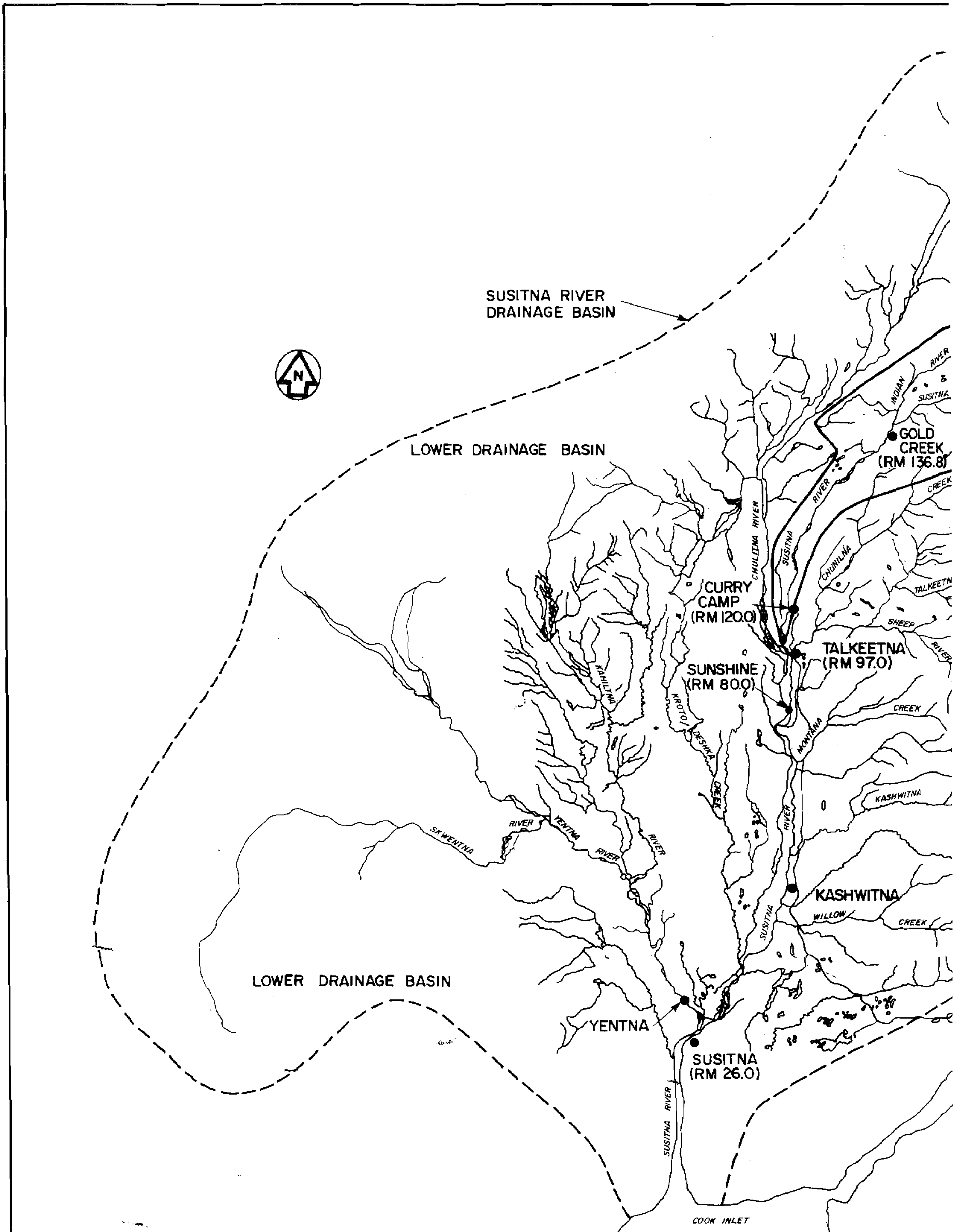
OPTION ANALYSIS

FIGURE E.3.1

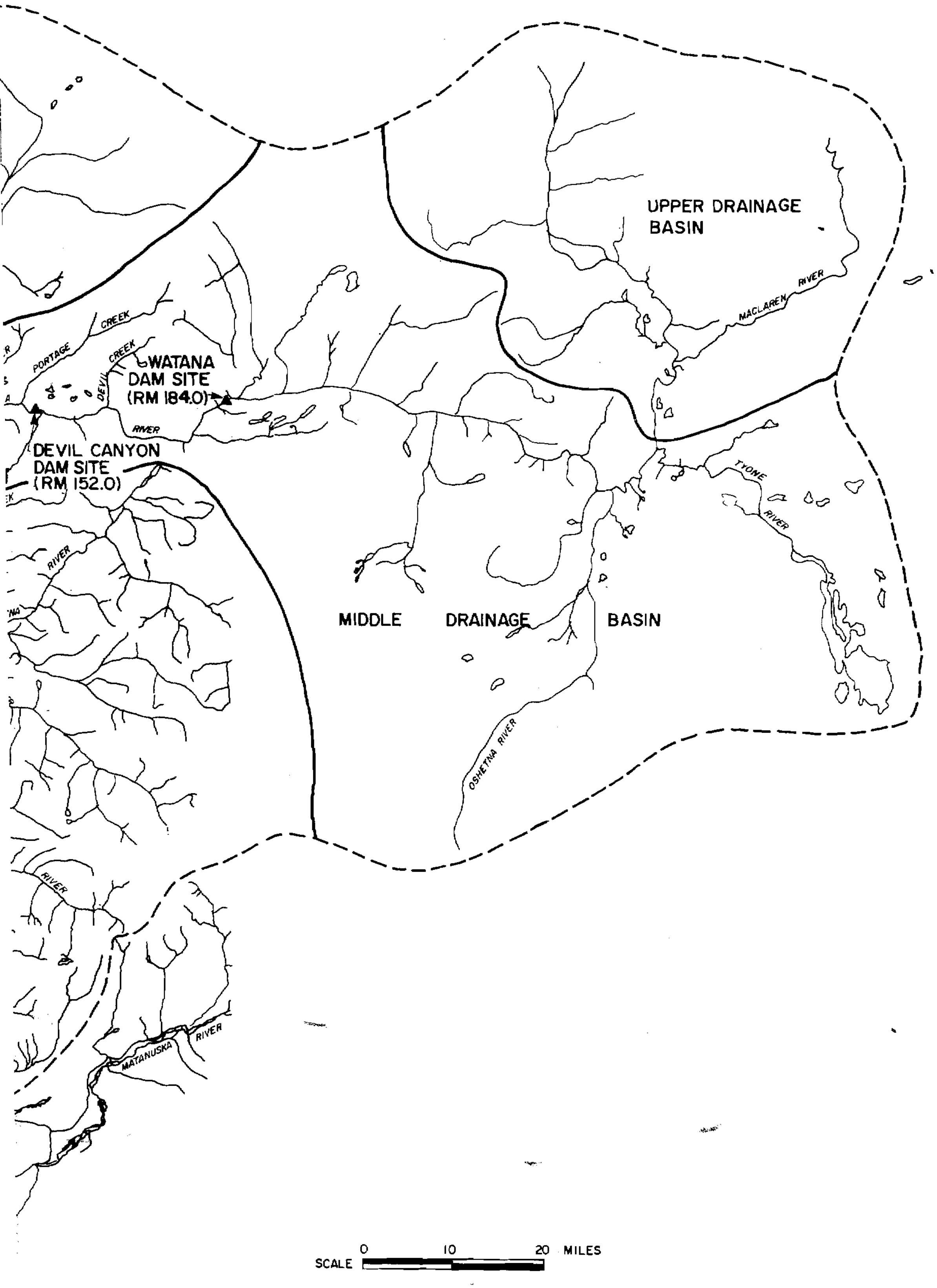


RELATIONSHIP OF FIELD STUDIES AND MONITORING
TO IMPACT ASSESSMENT AND MITIGATION PLANNING

FIGURE E.3.2

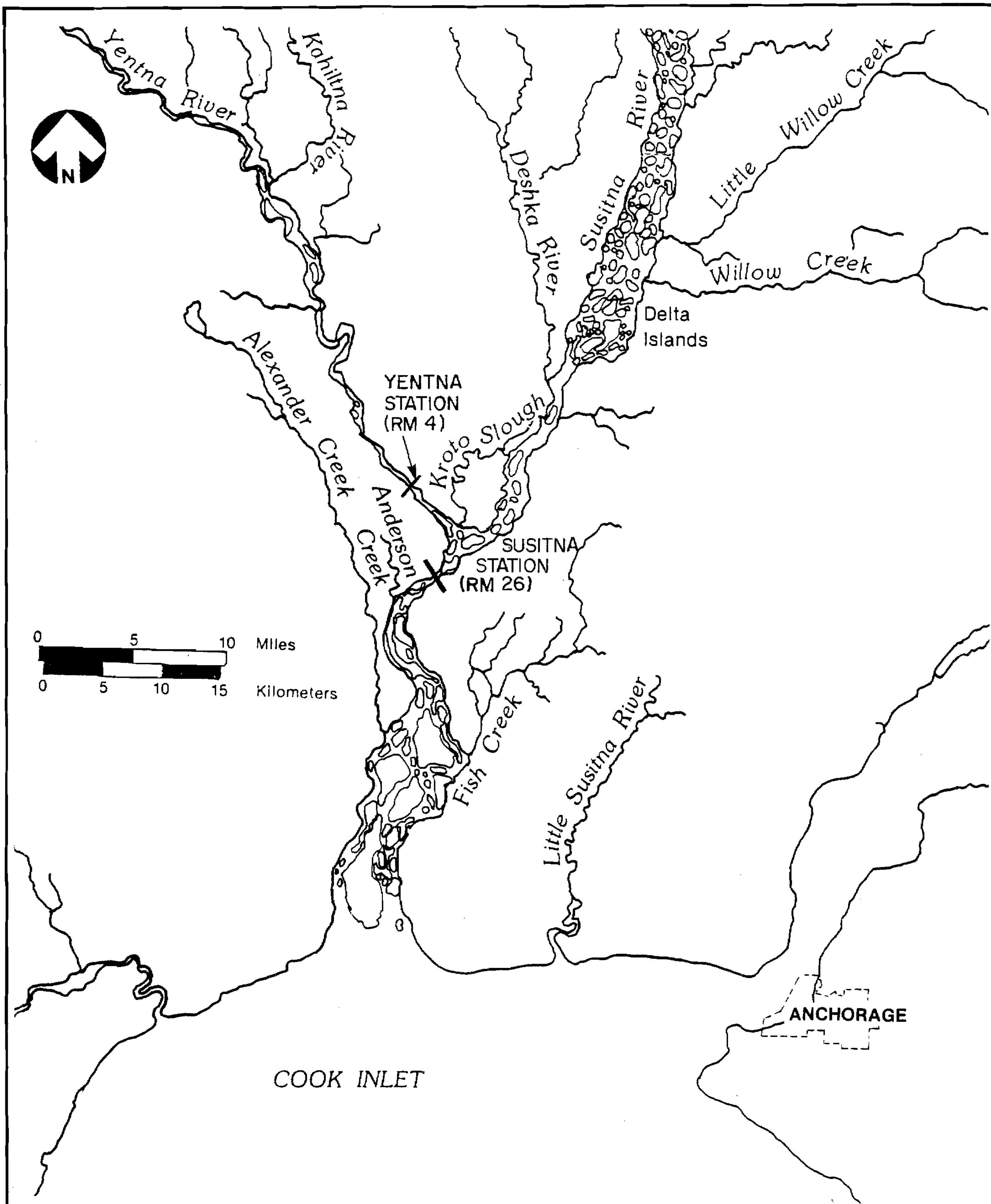

SUSITNA RIVER DRAINAGE BASIN
LOWER DRAINAGE BASIN
LOWER DRAINAGE BASIN
GOLD CREEK (RM 136.8)
CURRY CAMP (RM 120.0)
TALKEETNA (RM 97.0)
SUNSHINE (RM 80.0)
KASHWITNA
YENTNA
SUSITNA (RM 26.0)
INDIAN RIVER
SUSITNA RIVER
CHULITNA RIVER
CHUNILNA
SHEEP RIVER
KAHILTNA
KROTO
DESHKA CREEK
MONTANA CREEK
KASHWITNA
WILLOW CREEK
SKWENTNA RIVER
YENTNA RIVER
COOK INLET

SUSITNA R



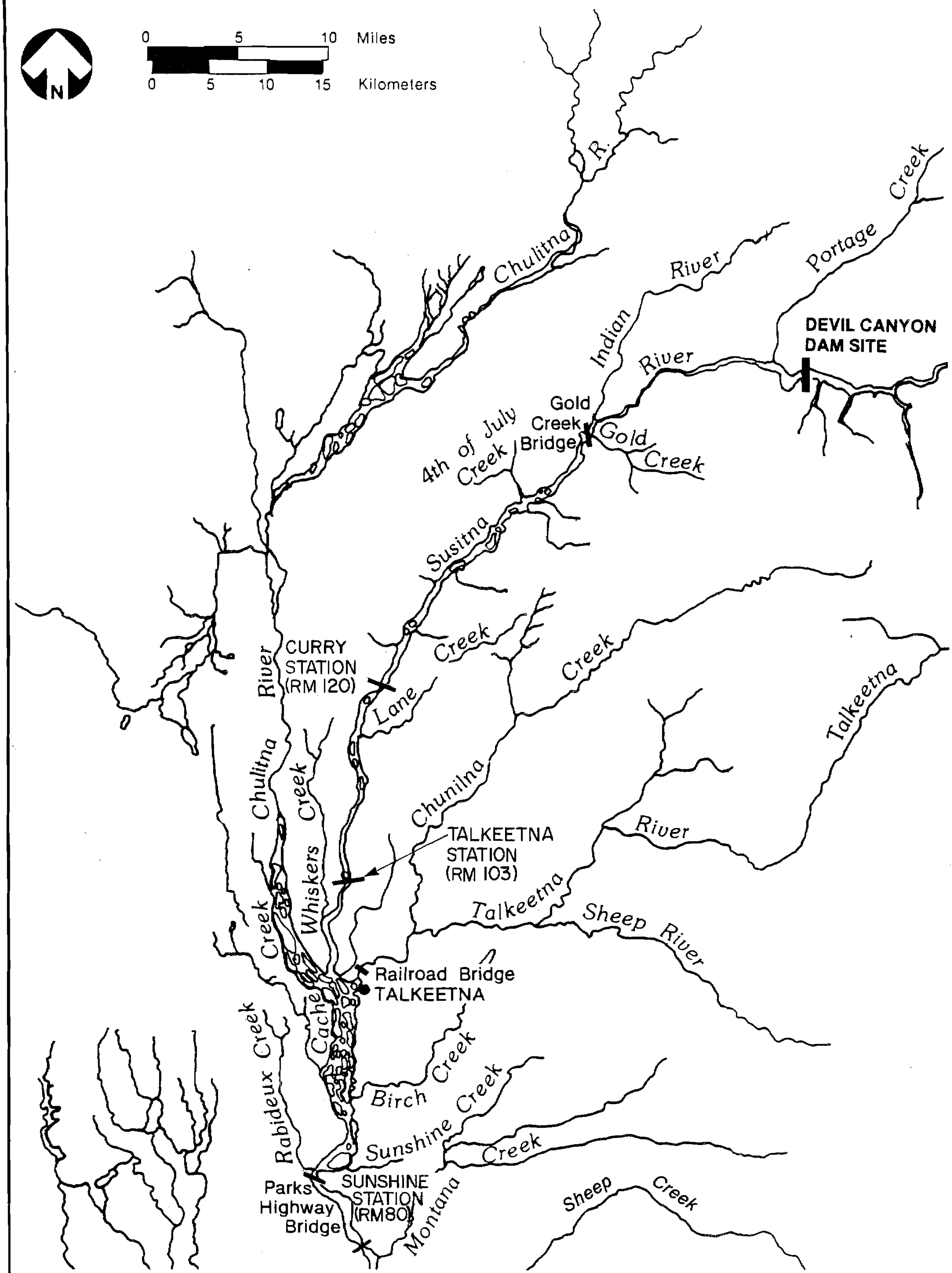
VER DRAINAGE BASIN

FIGURE E 3.3



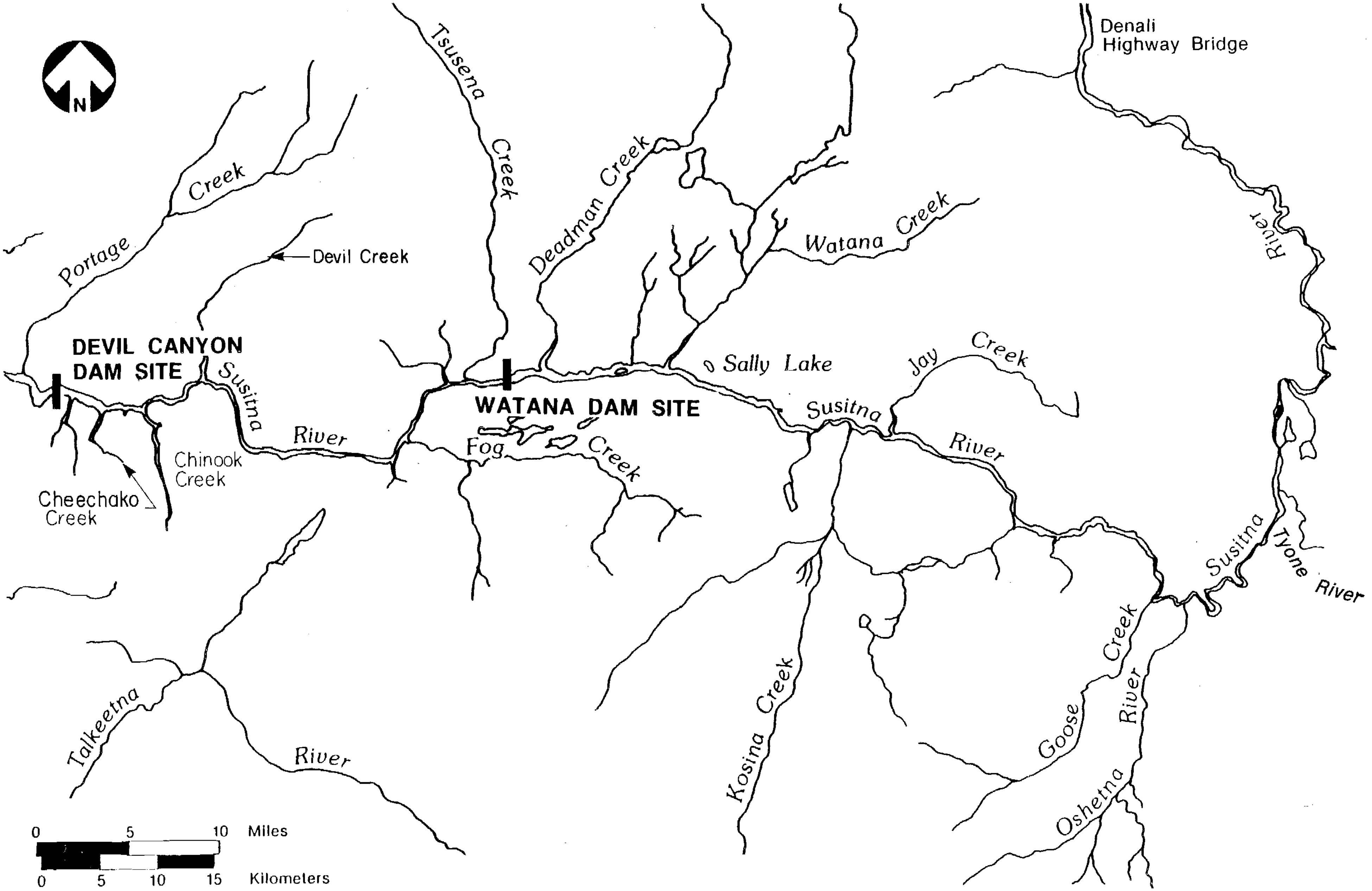
SUSITNA RIVER AND MAJOR TRIBUTARIES FROM MOUTH TO LITTLE WILLOW CREEK

FIGURE E.3.4



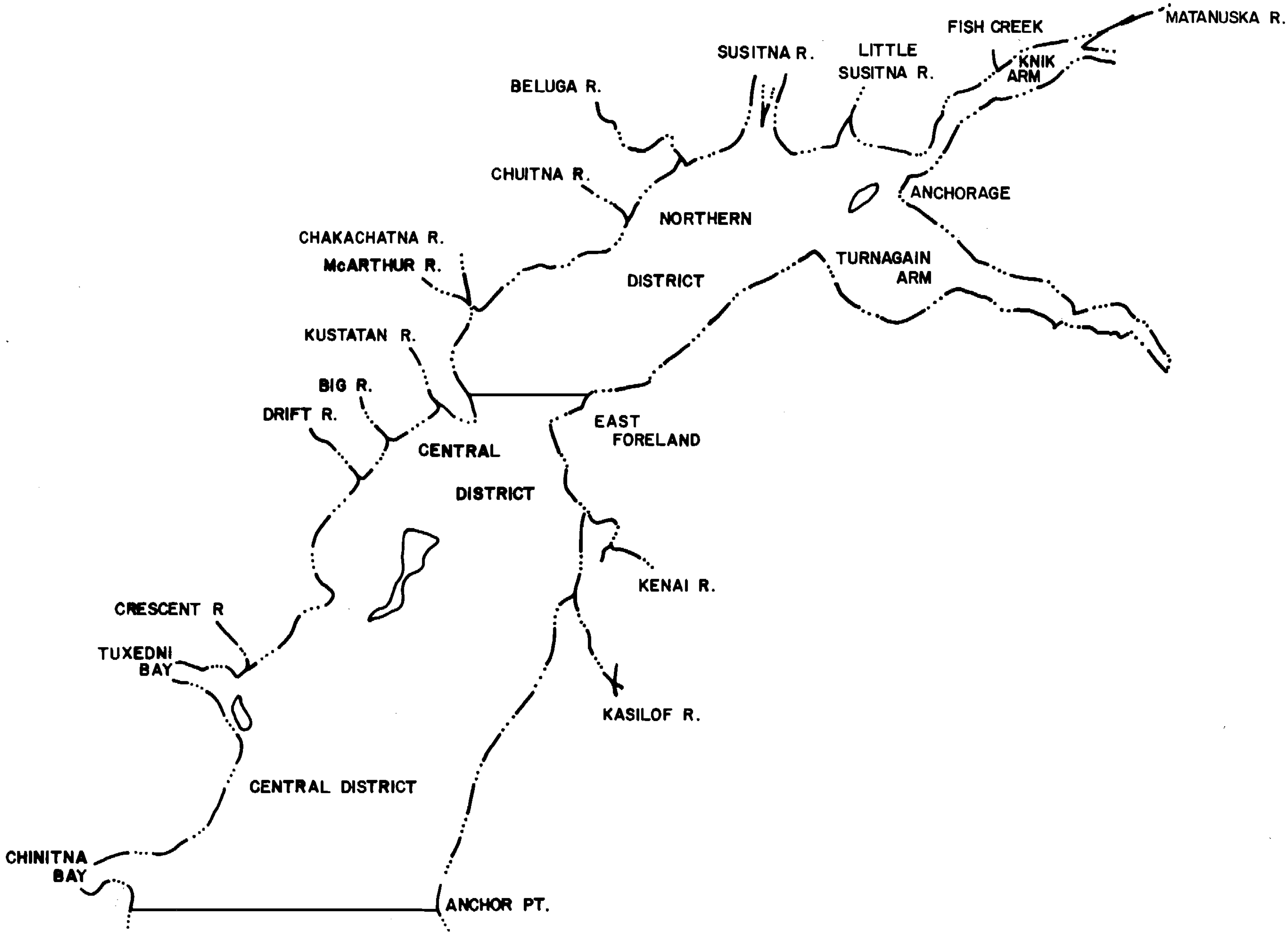
SUSITNA RIVER AND MAJOR TRIBUTARIES FROM MONTANA CREEK TO DEVIL CANYON

FIGURE E.3.5



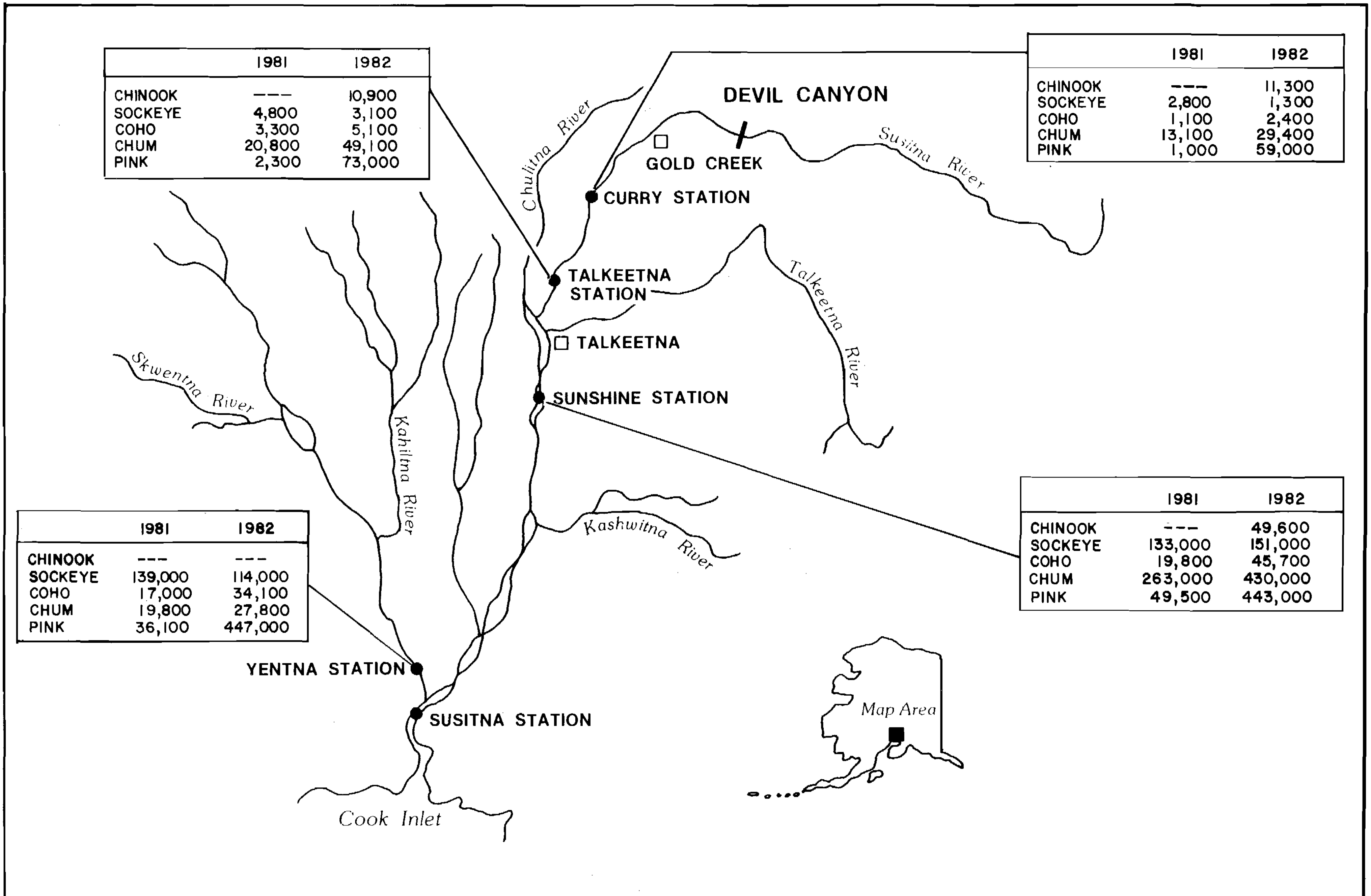
SUSITNA RIVER AND MAJOR TRIBUTARIES
FROM DEVIL CANYON TO DENALI HIGHWAY

FIGURE E.3.6



UPPER COOK INLET COMMERCIAL SALMON MANAGEMENT AREA

FIGURE E.3.7



	1981	1982
CHINOOK	---	10,900
SOCKEYE	4,800	3,100
COHO	3,300	5,100
CHUM	20,800	49,100
PINK	2,300	73,000

	1981	1982
CHINOOK	---	11,300
SOCKEYE	2,800	1,300
COHO	1,100	2,400
CHUM	13,100	29,400
PINK	1,000	59,000

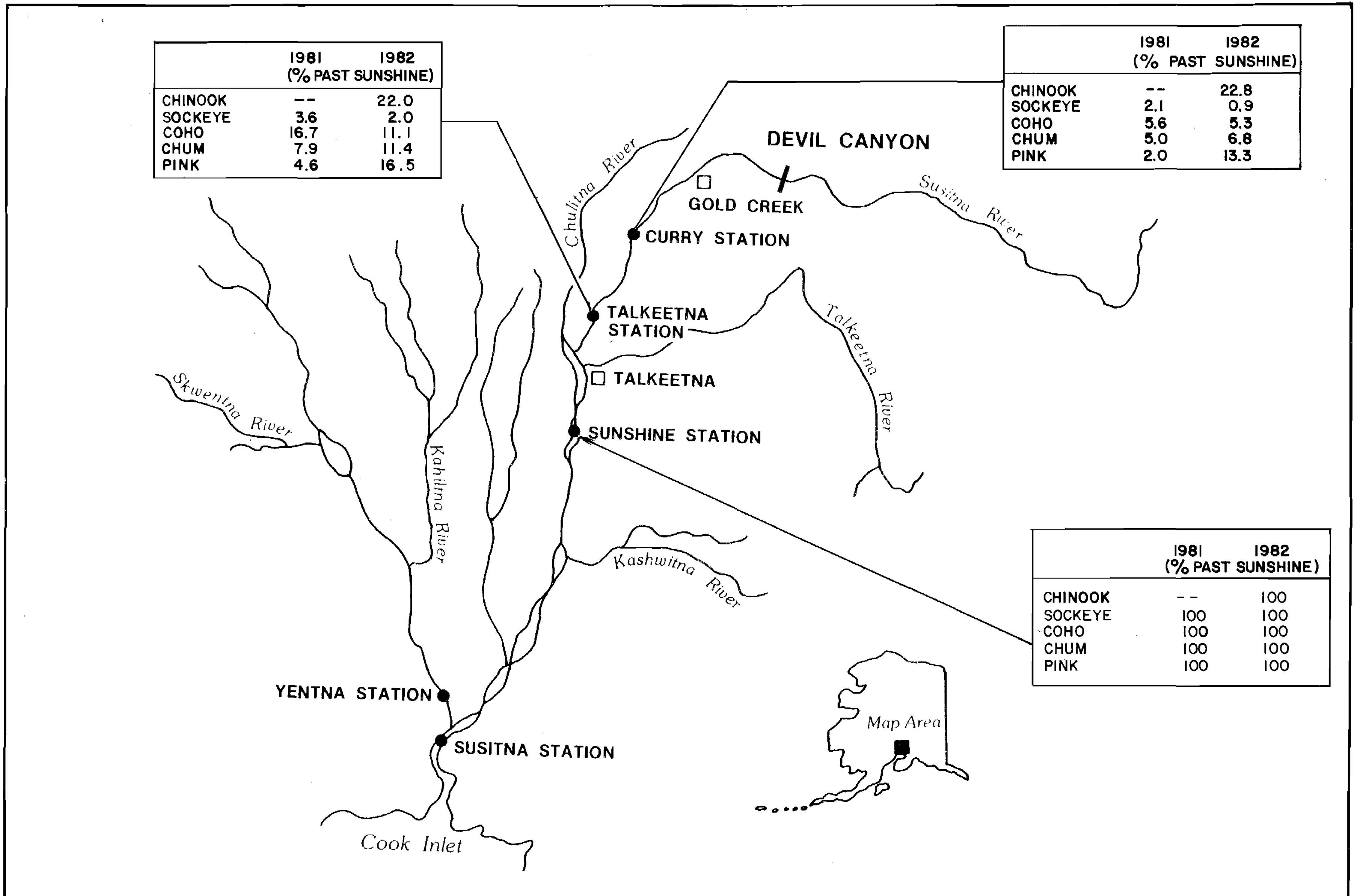
	1981	1982
CHINOOK	---	49,600
SOCKEYE	133,000	151,000
COHO	19,800	45,700
CHUM	263,000	430,000
PINK	49,500	443,000

	1981	1982
CHINOOK	---	---
SOCKEYE	139,000	114,000
COHO	17,000	34,100
CHUM	19,800	27,800
PINK	36,100	447,000

SOURCE: ADF & G 1981a, 1982a

POPULATION ESTIMATES OF ADULT SALMON IN SUSITNA RIVER

FIGURE E.3.8



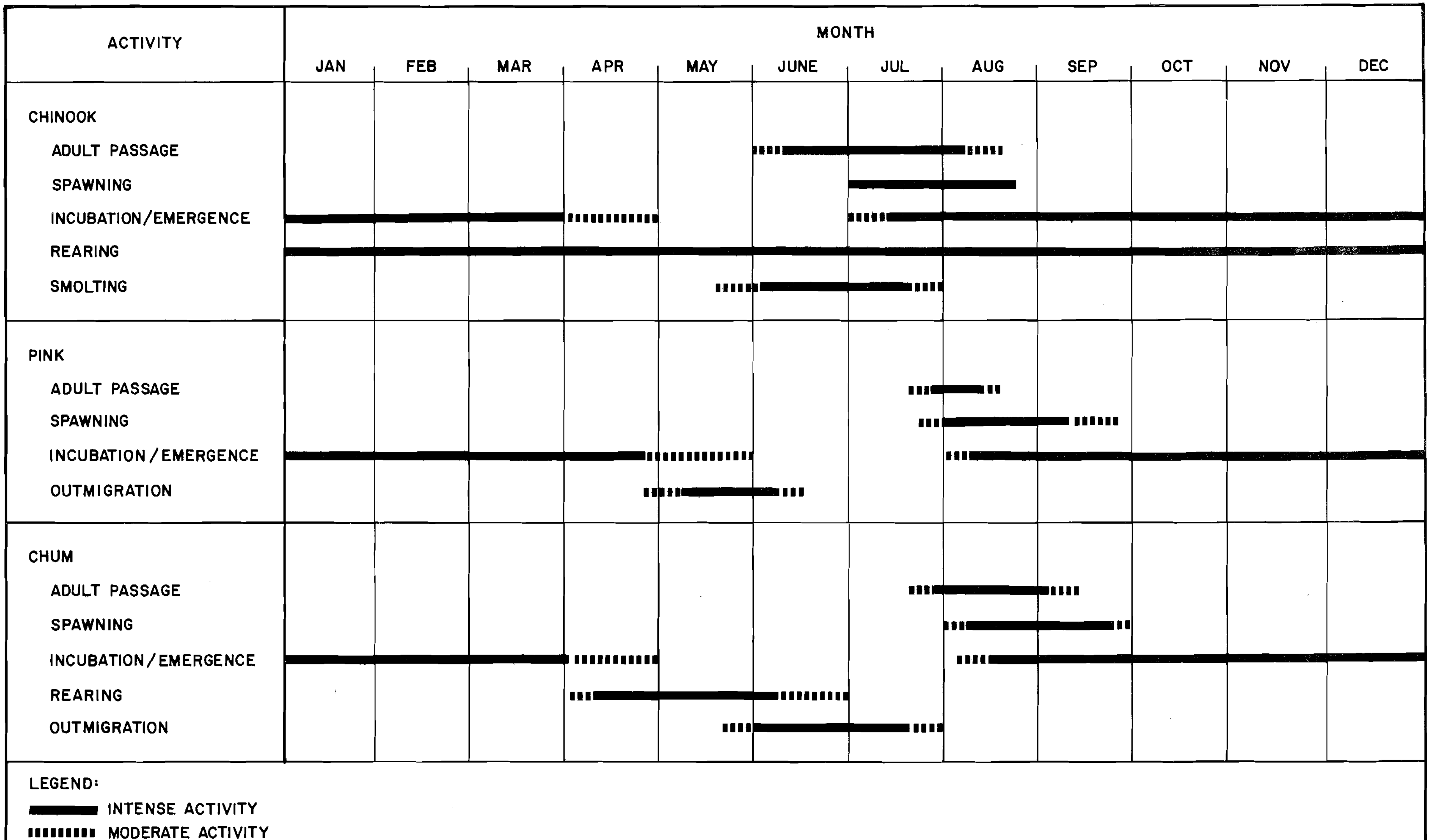
	1981	1982
	(% PAST SUNSHINE)	
CHINOOK	--	22.0
SOCKEYE	3.6	2.0
COHO	16.7	11.1
CHUM	7.9	11.4
PINK	4.6	16.5

	1981	1982
	(% PAST SUNSHINE)	
CHINOOK	--	22.8
SOCKEYE	2.1	0.9
COHO	5.6	5.3
CHUM	5.0	6.8
PINK	2.0	13.3

	1981	1982
	(% PAST SUNSHINE)	
CHINOOK	--	100
SOCKEYE	100	100
COHO	100	100
CHUM	100	100
PINK	100	100

PERCENTAGE OF SALMON MIGRATING PAST SUNSHINE

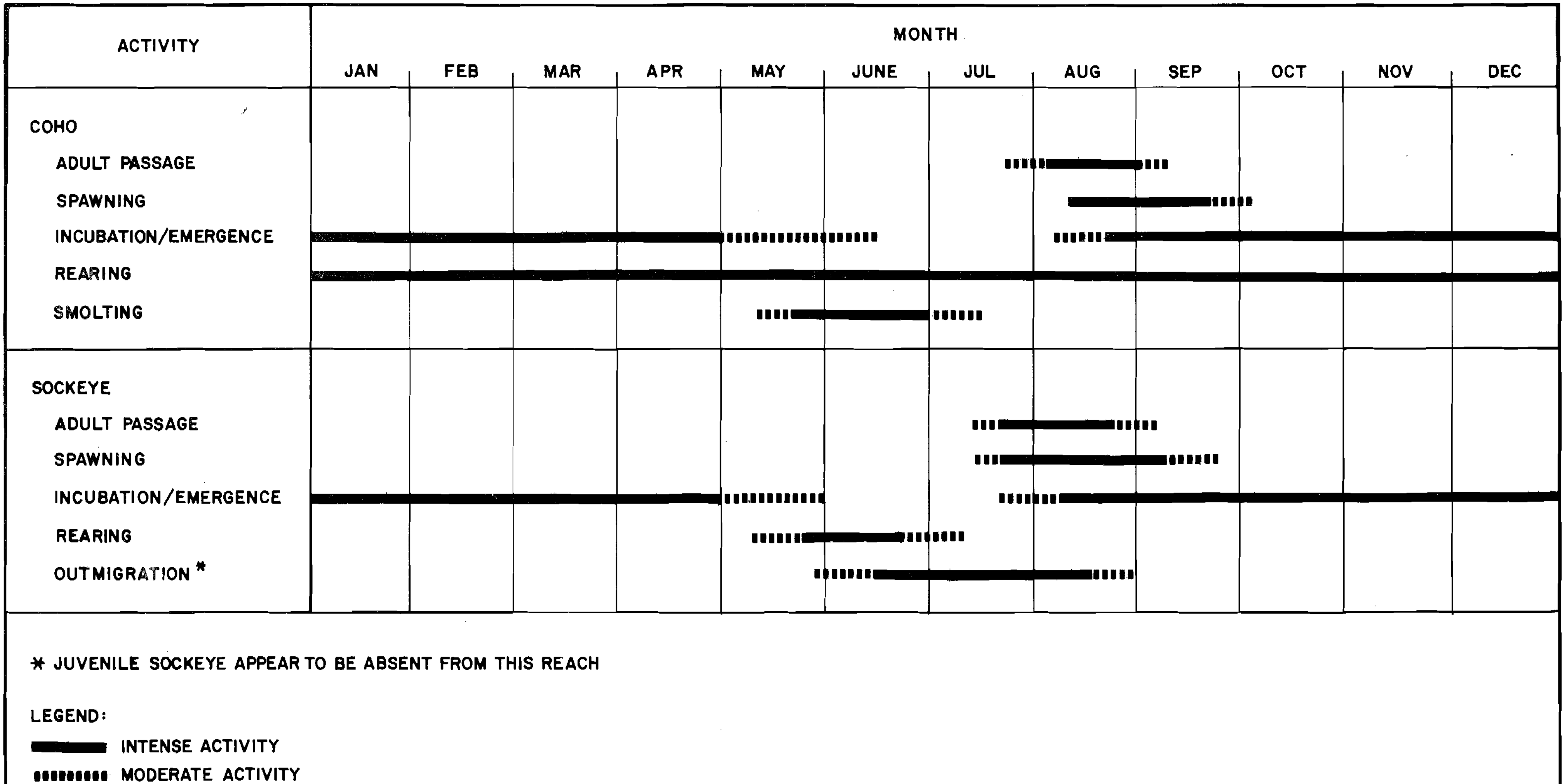
FIGURE E.3.9



TIMING OF LIFE STAGES OF SALMON IN THE SUSITNA RIVER
FROM TALKEETNA TO DEVIL CANYON
SHEET 1 OF 2

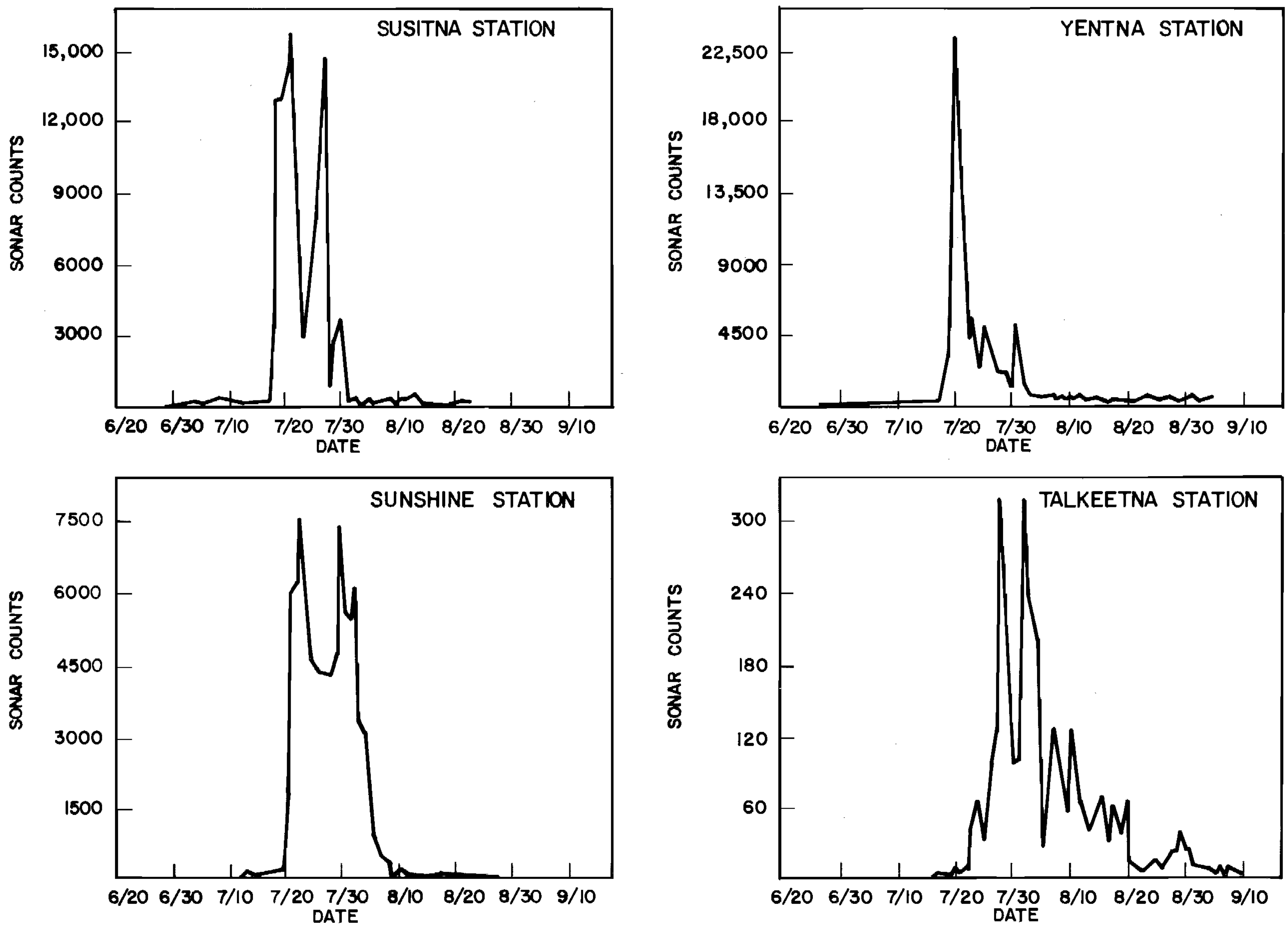
(SOURCE: ADF & G 1981a, 1981b, 1981c, 1981d, 1981e, 1981f, 1982a, 1982e, 1982f; AND MORROW 1980.)

FIGURE E.3.10



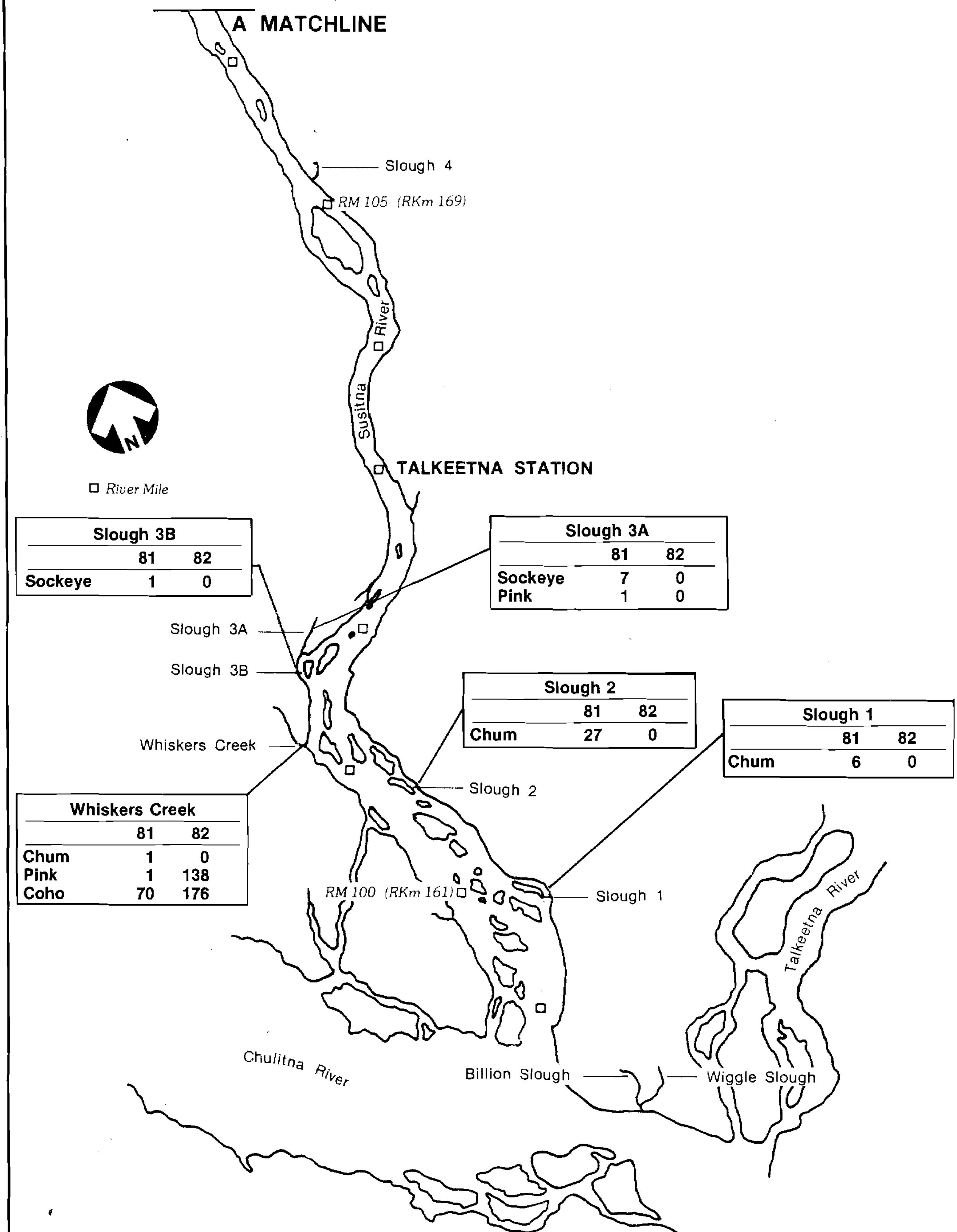
TIMING OF LIFE STAGES OF SALMON IN THE SUSITNA RIVER
FROM TALKEETNA TO DEVIL CANYON
SHEET 2 OF 2

FIGURE E.3.10



DAILY SONAR COUNTS OF SOCKEYE SALMON AT SUSITNA, YENTNA, SUNSHINE AND TALKEETNA STATIONS, ADULT ANADROMOUS INVESTIGATIONS, SU HYDRO STUDIES, 1982.

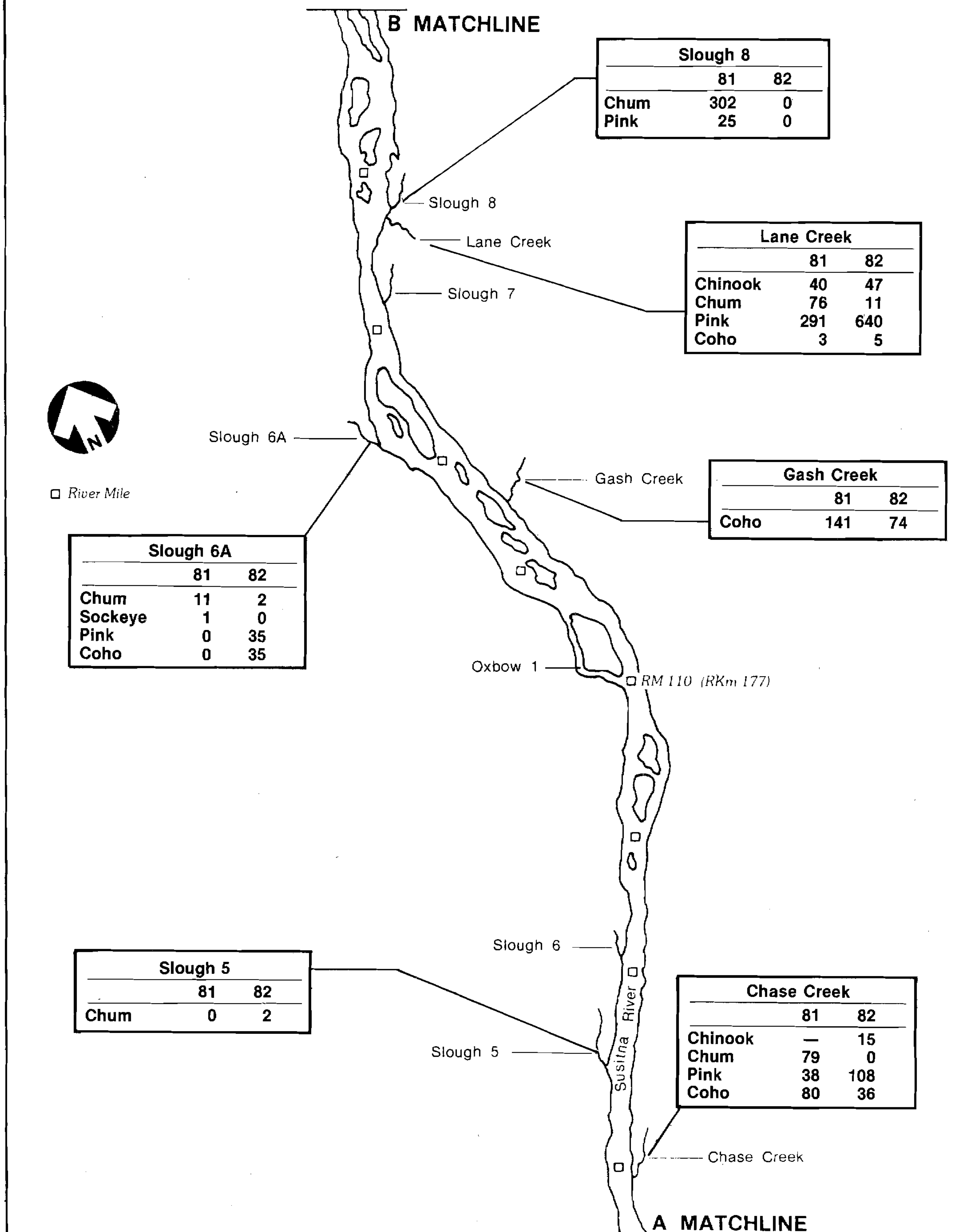
FIGURE E.3.11



SLOUGH AND TRIBUTARY INDEX AREA
PEAK SPAWNING COUNTS

FIGURE E.3.12

SOURCE: ADF & G 1981a, 1982e



Slough 8

	81	82
Chum	302	0
Pink	25	0

Lane Creek

	81	82
Chinook	40	47
Chum	76	11
Pink	291	640
Coho	3	5

Gash Creek

	81	82
Coho	141	74

Slough 6A

	81	82
Chum	11	2
Sockeye	1	0
Pink	0	35
Coho	0	35

Slough 5

	81	82
Chum	0	2

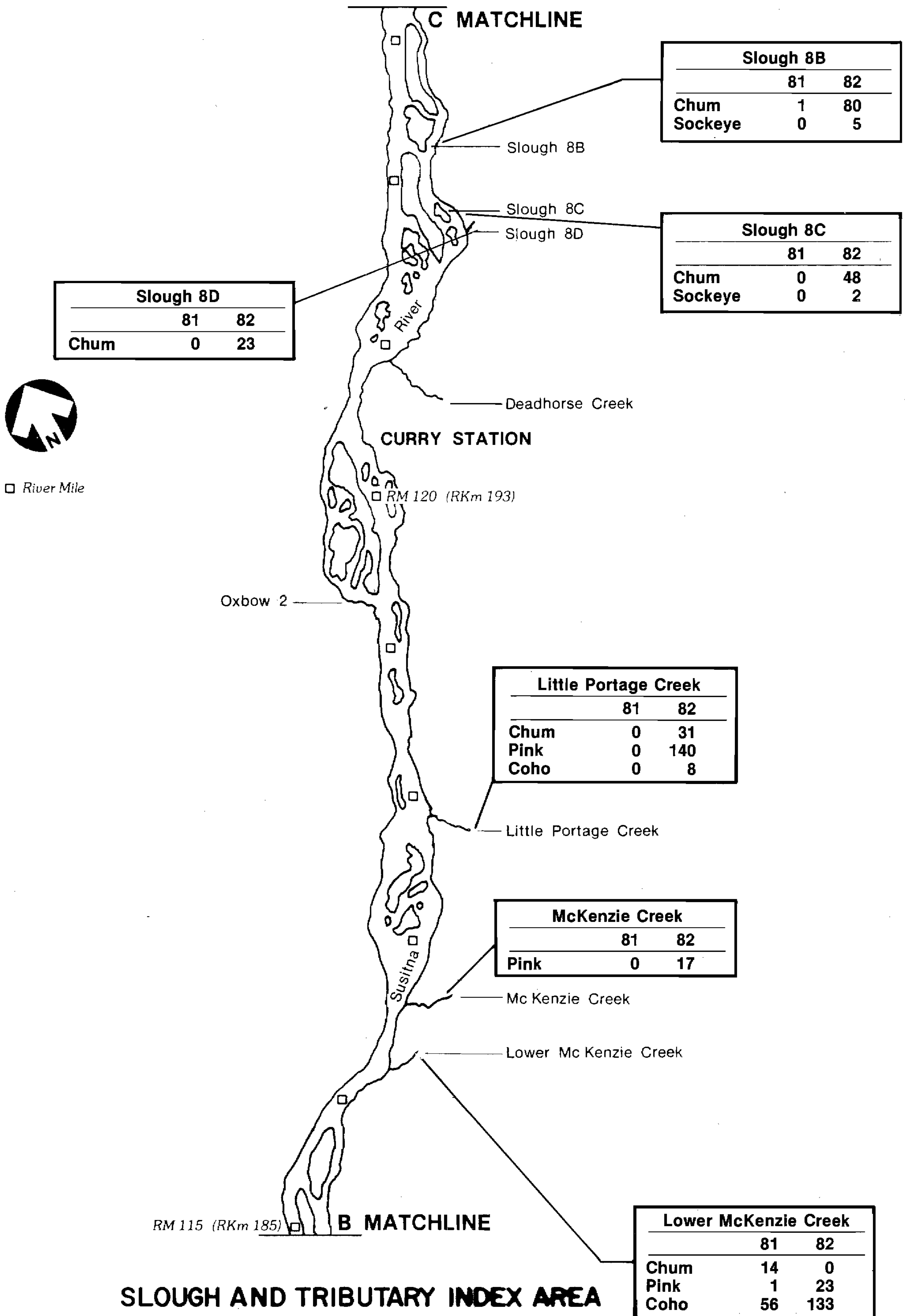
Chase Creek

	81	82
Chinook	—	15
Chum	79	0
Pink	38	108
Coho	80	36

SOURCE: ADF & G 1981a, 1982e

SLOUGH AND TRIBUTARY INDEX AREA
PEAK SPAWNING COUNTS

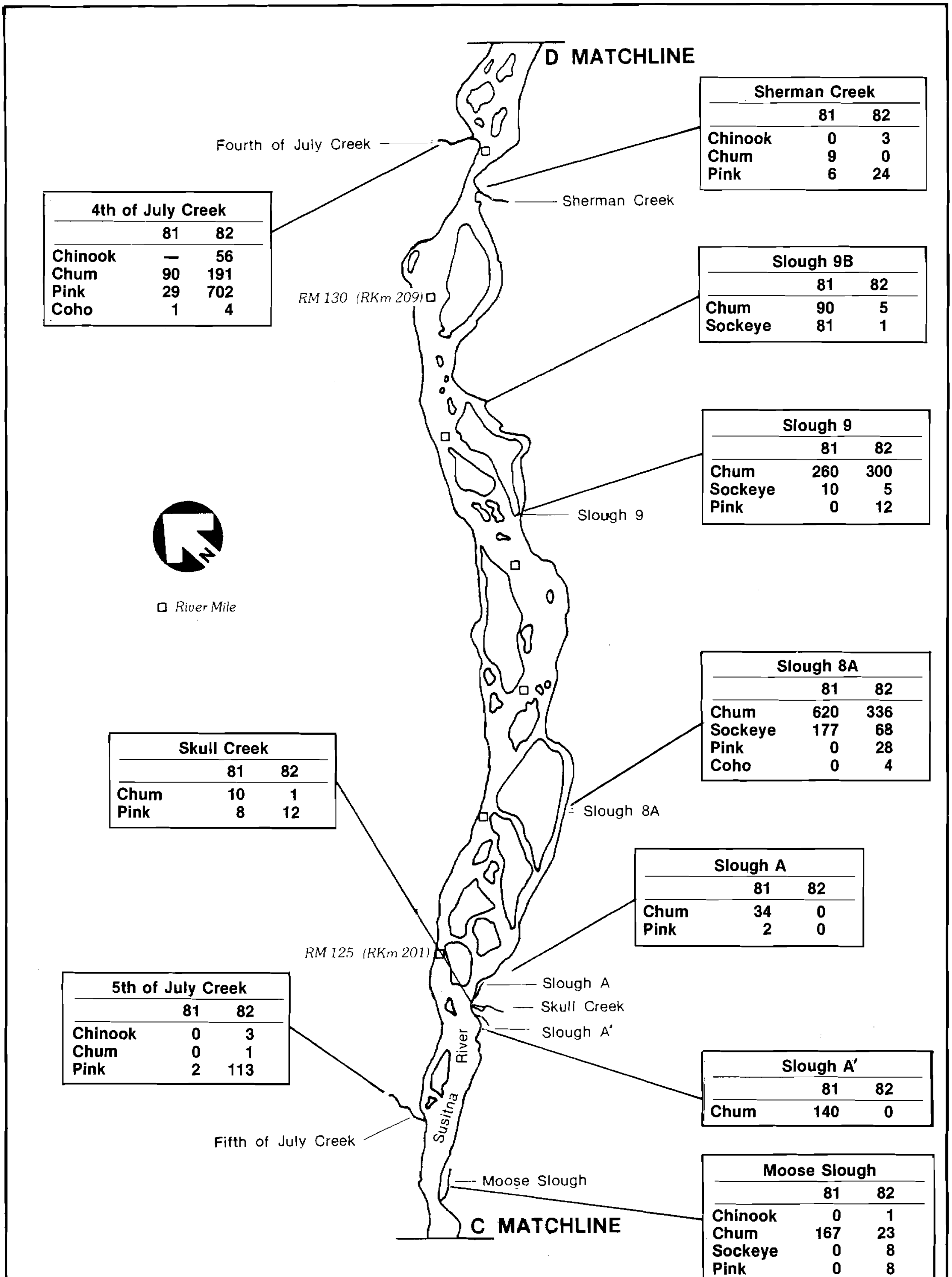
FIGURE E.3.13



SLOUGH AND TRIBUTARY INDEX AREA
PEAK SPAWNING COUNTS

SOURCE: ADF & G 1981a, 1982e

FIGURE E.3.14



4th of July Creek

	81	82
Chinook	—	56
Chum	90	191
Pink	29	702
Coho	1	4

Sherman Creek

	81	82
Chinook	0	3
Chum	9	0
Pink	6	24

Slough 9B

	81	82
Chum	90	5
Sockeye	81	1

Slough 9

	81	82
Chum	260	300
Sockeye	10	5
Pink	0	12

Slough 8A

	81	82
Chum	620	336
Sockeye	177	68
Pink	0	28
Coho	0	4

Skull Creek

	81	82
Chum	10	1
Pink	8	12

Slough A

	81	82
Chum	34	0
Pink	2	0

5th of July Creek

	81	82
Chinook	0	3
Chum	0	1
Pink	2	113

Slough A'

	81	82
Chum	140	0

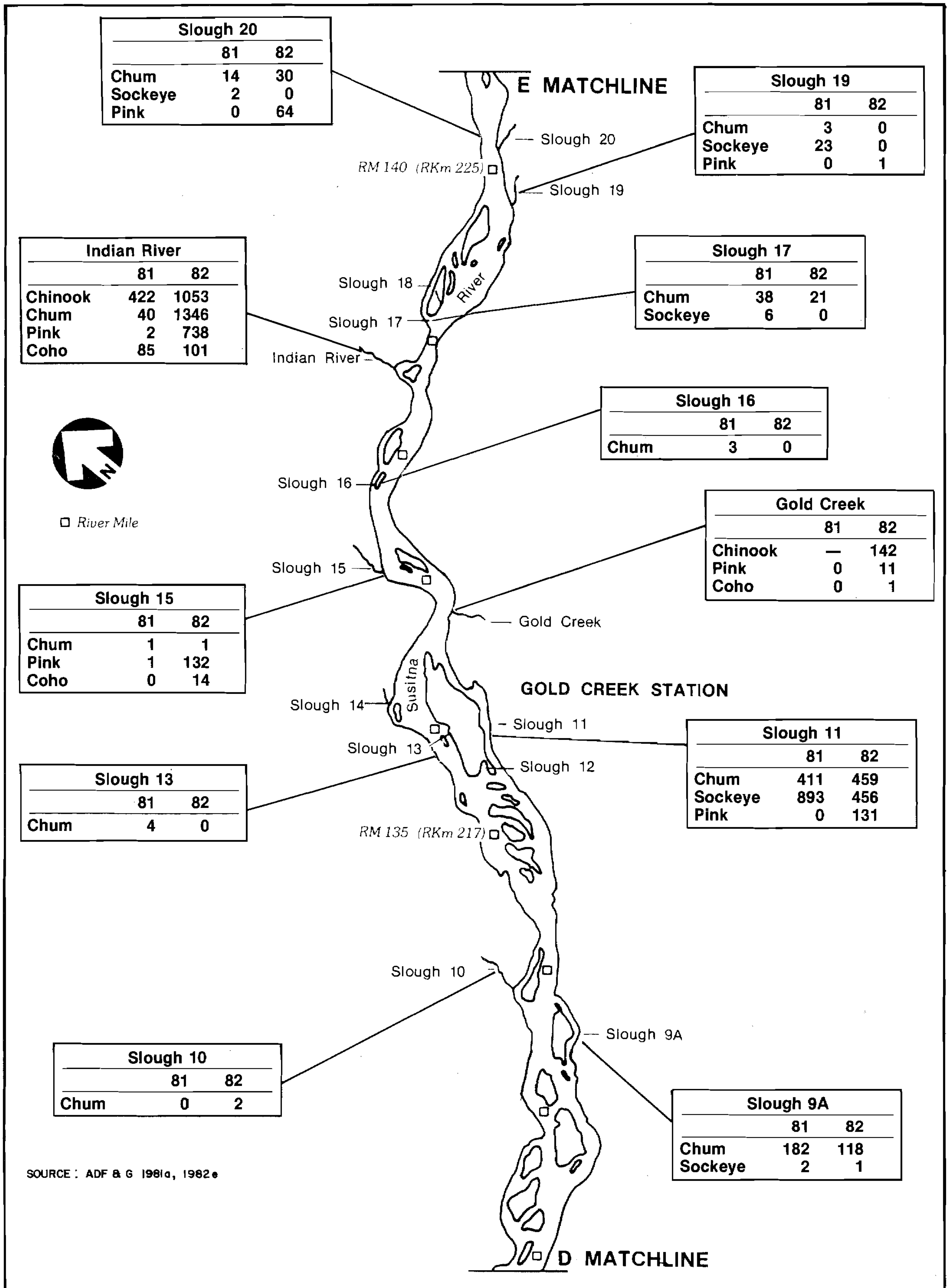
Moose Slough

	81	82
Chinook	0	1
Chum	167	23
Sockeye	0	8
Pink	0	8

SOURCE : ADF & G 1981a, 1982e

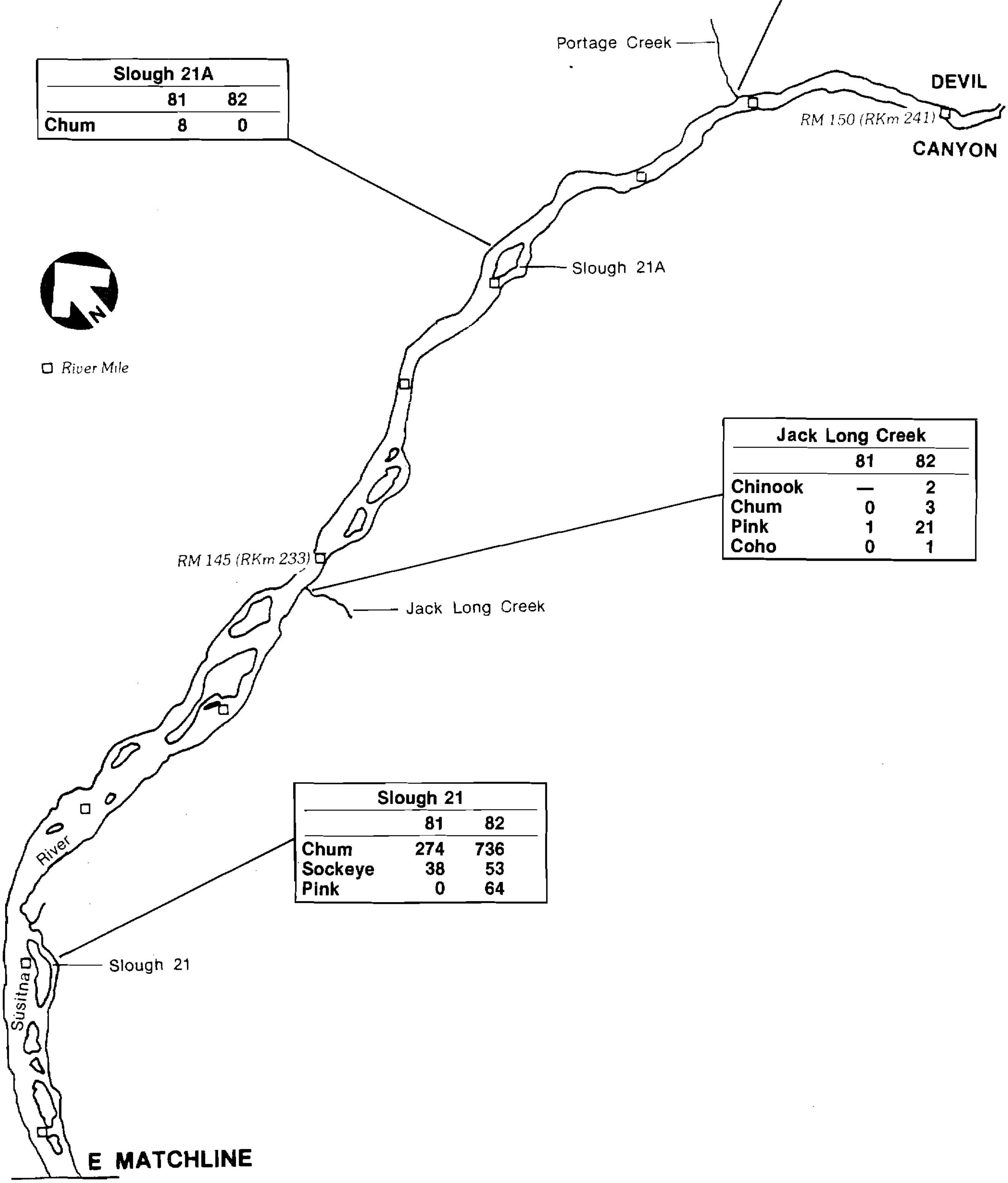
SLOUGH AND TRIBUTARY INDEX AREA PEAK SPAWNING COUNTS

FIGURE E.3.15



SLOUGH AND TRIBUTARY INDEX AREA
PEAK SPAWNING COUNTS

FIGURE E.3.16



Portage Creek	81	82
Chinook	659	1253
Chum	0	153
Sockeye	0	4
Pink	0	169
Coho	22	88

Slough 21A	81	82
Chum	8	0

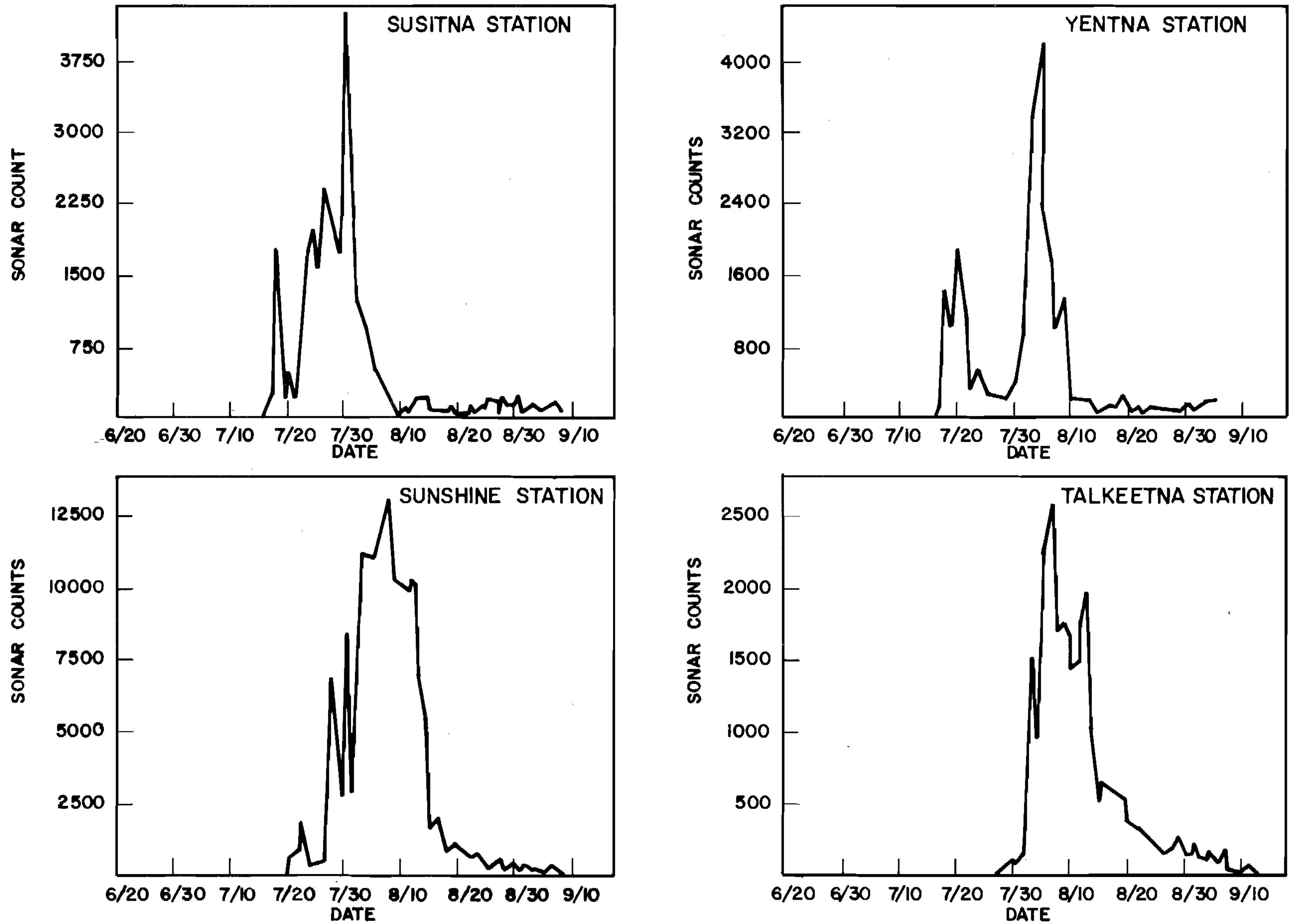
Jack Long Creek	81	82
Chinook	—	2
Chum	0	3
Pink	1	21
Coho	0	1

Slough 21	81	82
Chum	274	736
Sockeye	38	53
Pink	0	64

SLOUGH AND TRIBUTARY INDEX AREA PEAK SPAWNING COUNTS

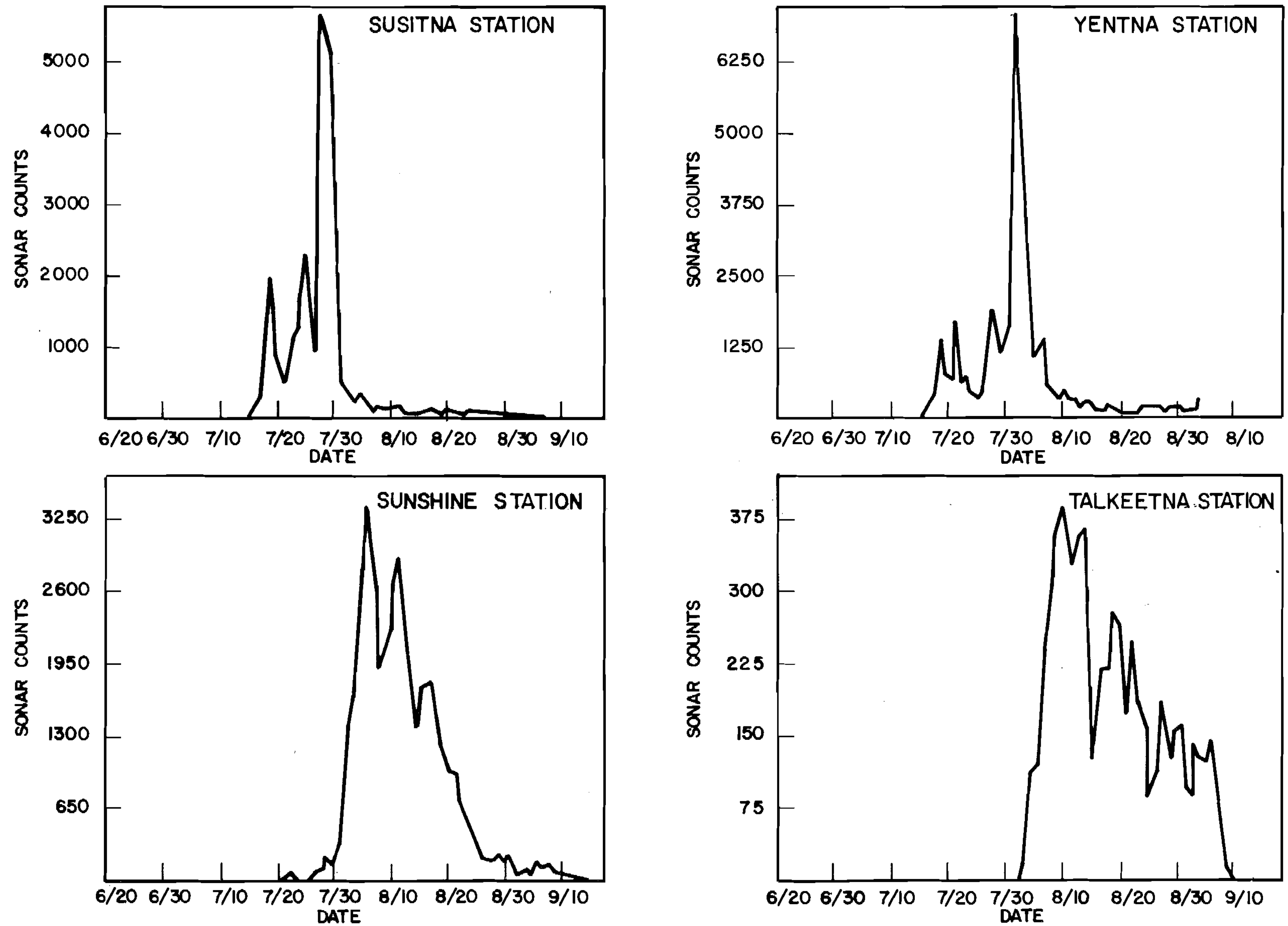
FIGURE E.3.17

SOURCE: ADF & G 1981a, 1982e



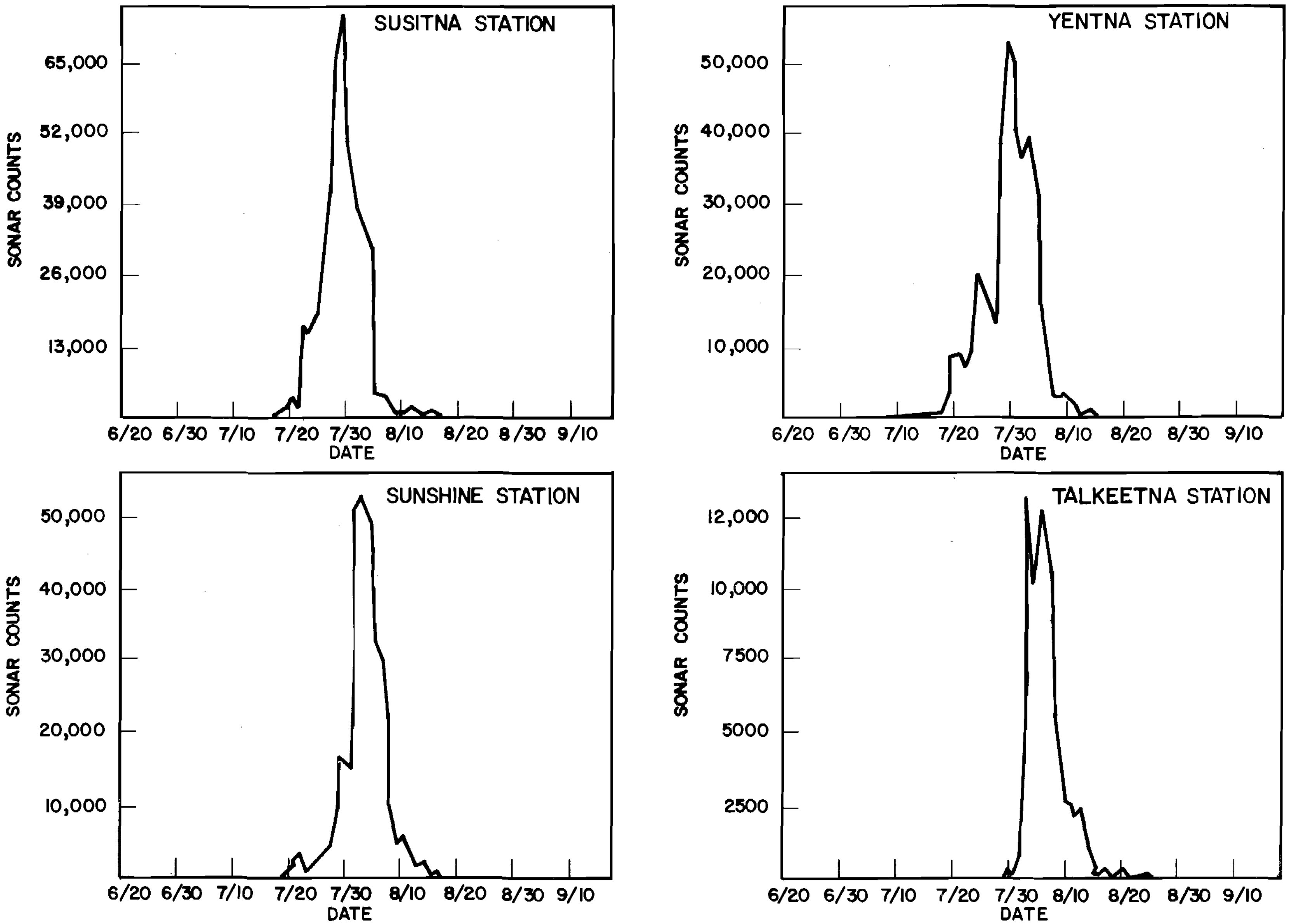
DAILY SONAR COUNTS OF CHUM SALMON AT SUSITNA, YENTNA, SUNSHINE AND TALKEETNA STATIONS, ADULT ANADROMOUS INVESTIGATIONS, SU HYDRO STUDIES, 1982.

FIGURE E.3.18



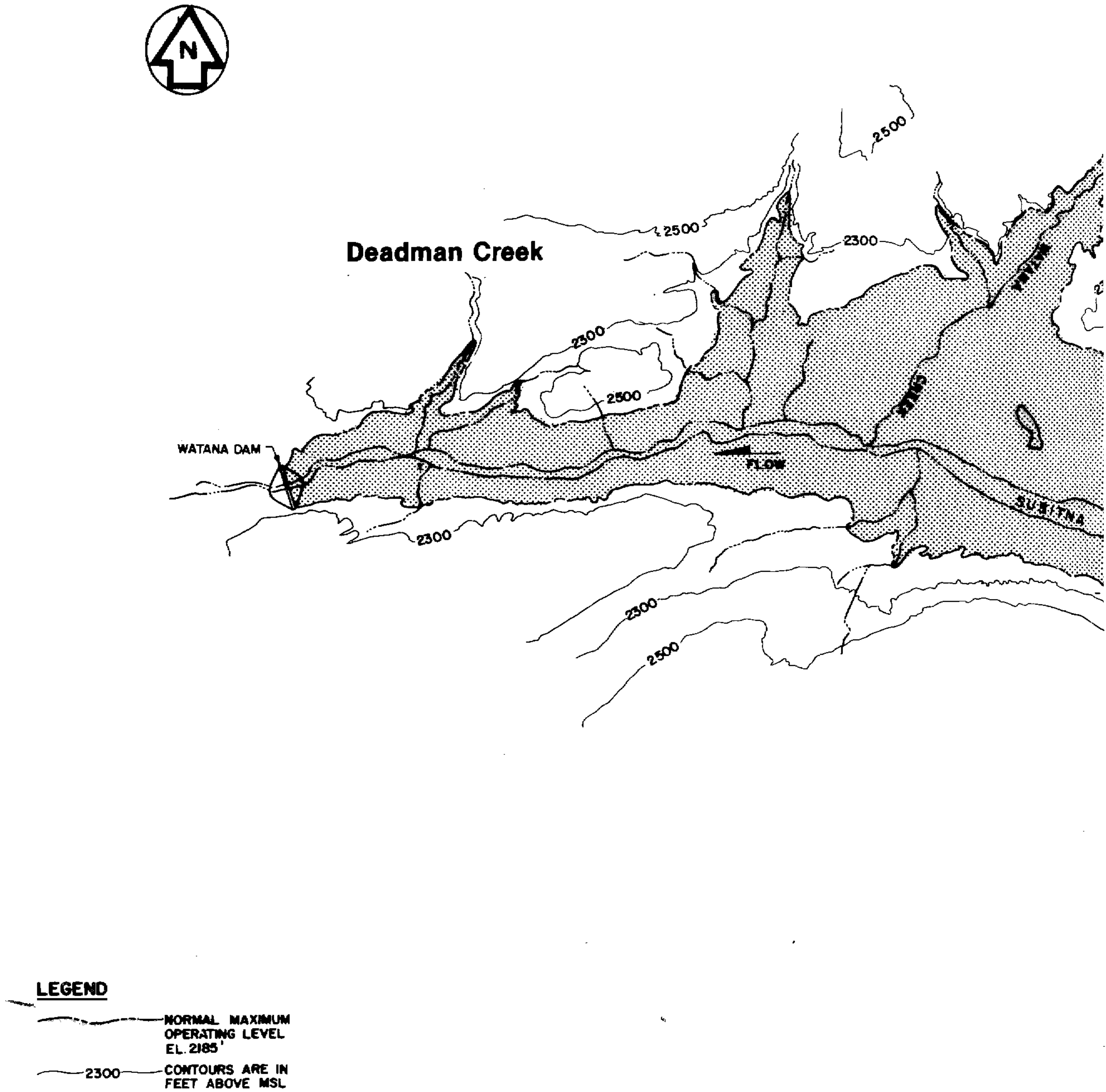
DAILY SONAR COUNTS OF COHO SALMON AT SUSITNA, YENTNA, SUNSHINE AND TALKEETNA STATIONS, ADULT ANADROMOUS INVESTIGATIONS, SU HYDRO STUDIES, 1982.

FIGURE E.3.19

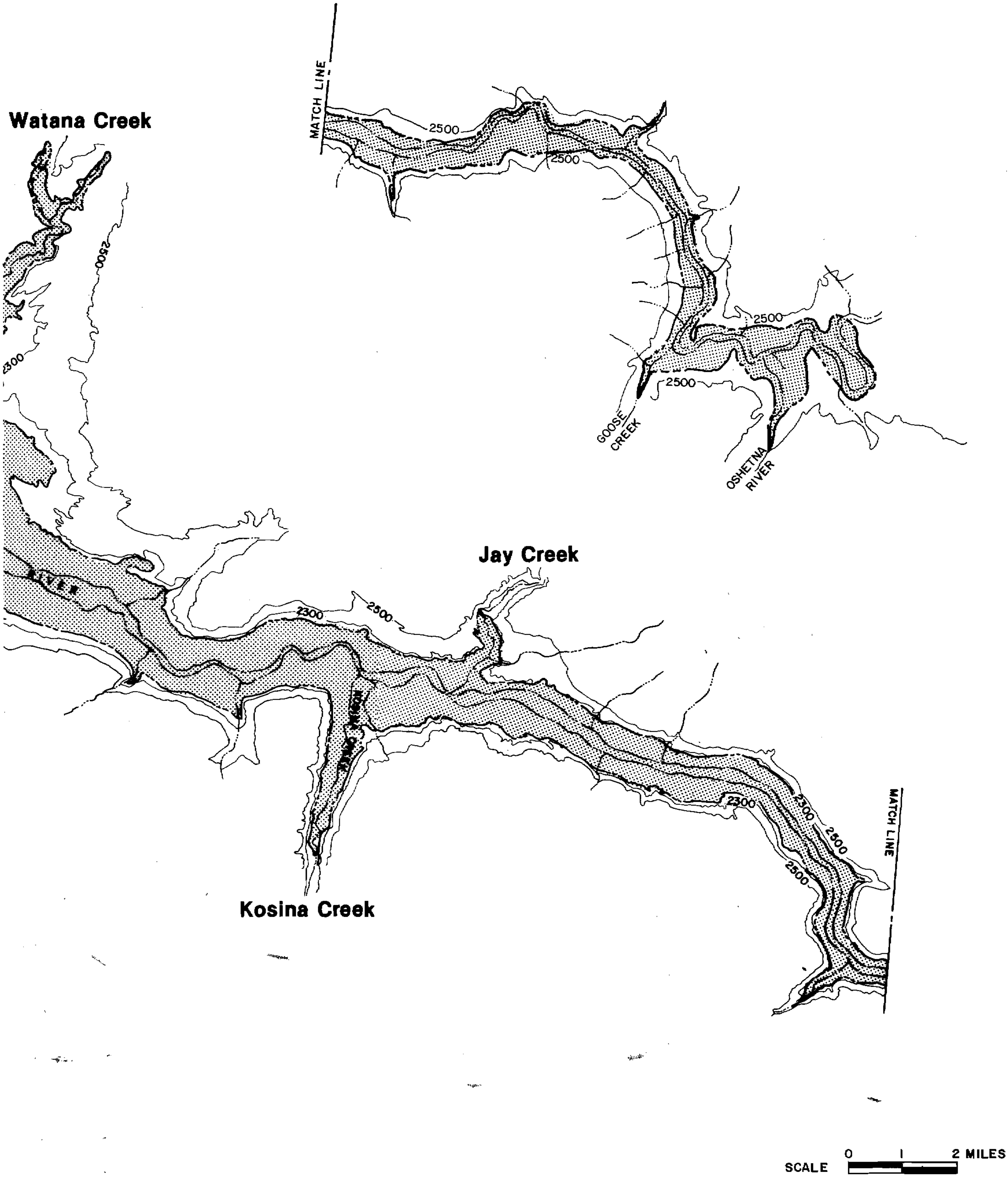


DAILY SONAR COUNTS OF PINK SALMON AT SUSITNA, YENTNA, SUNSHINE AND TALKEETNA STATIONS, ADULT ANADROMOUS INVESTIGATIONS, SU HYDRO STUDIES, 1982.

FIGURE E.3.20

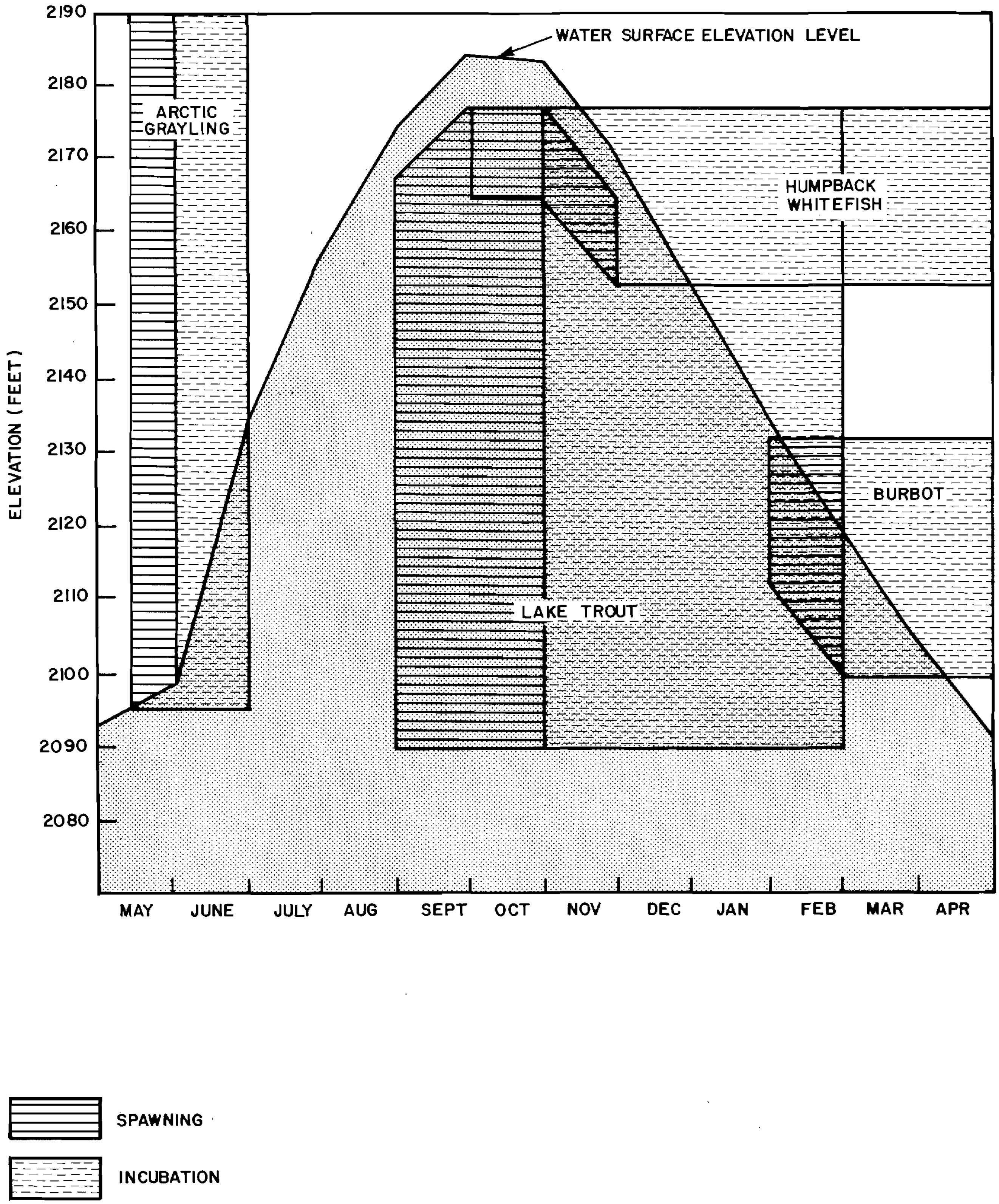


WATER BODIES TO BE INUN



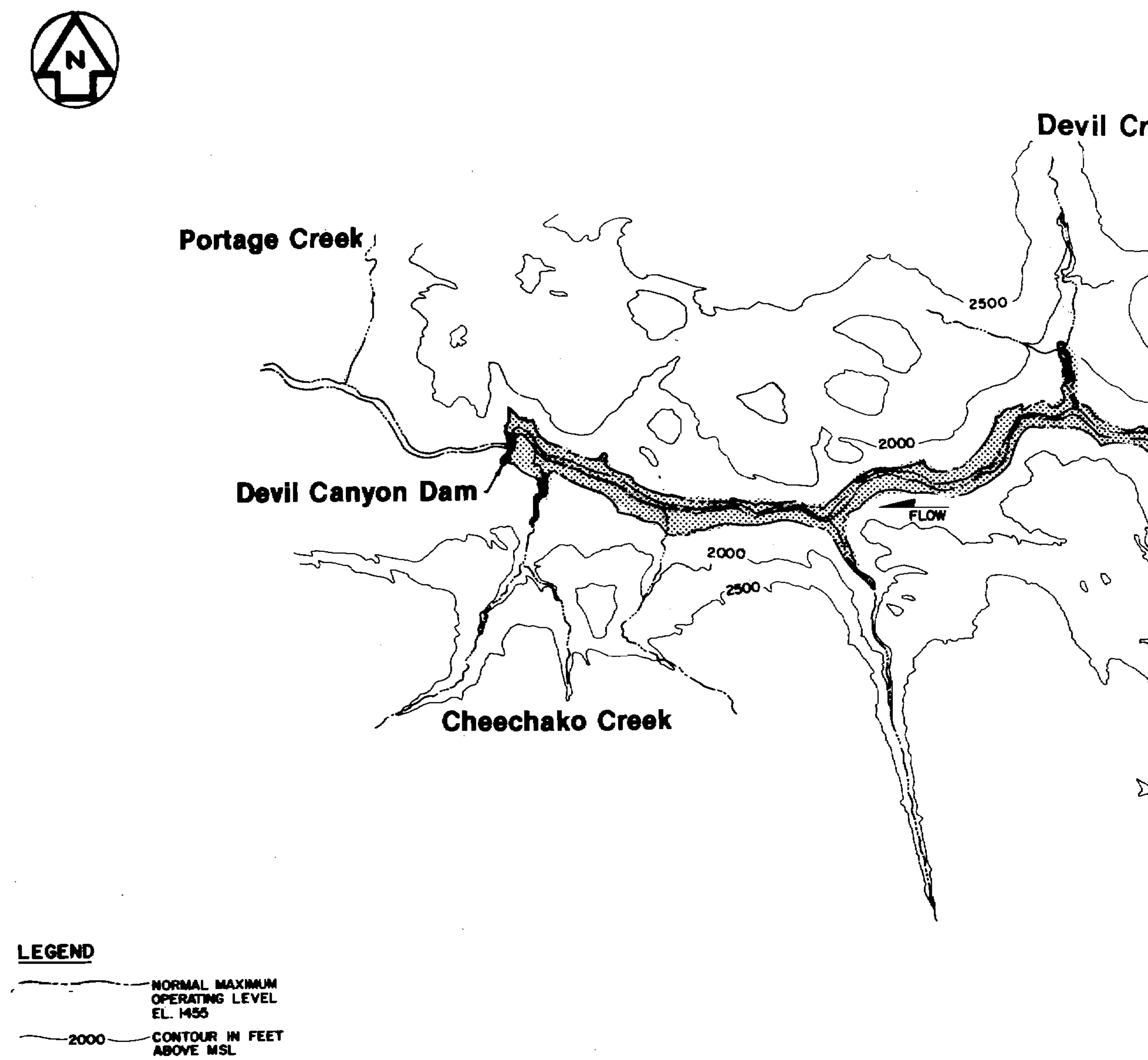
NDATED BY WATANA RESERVOIR

FIGURE E.3.21

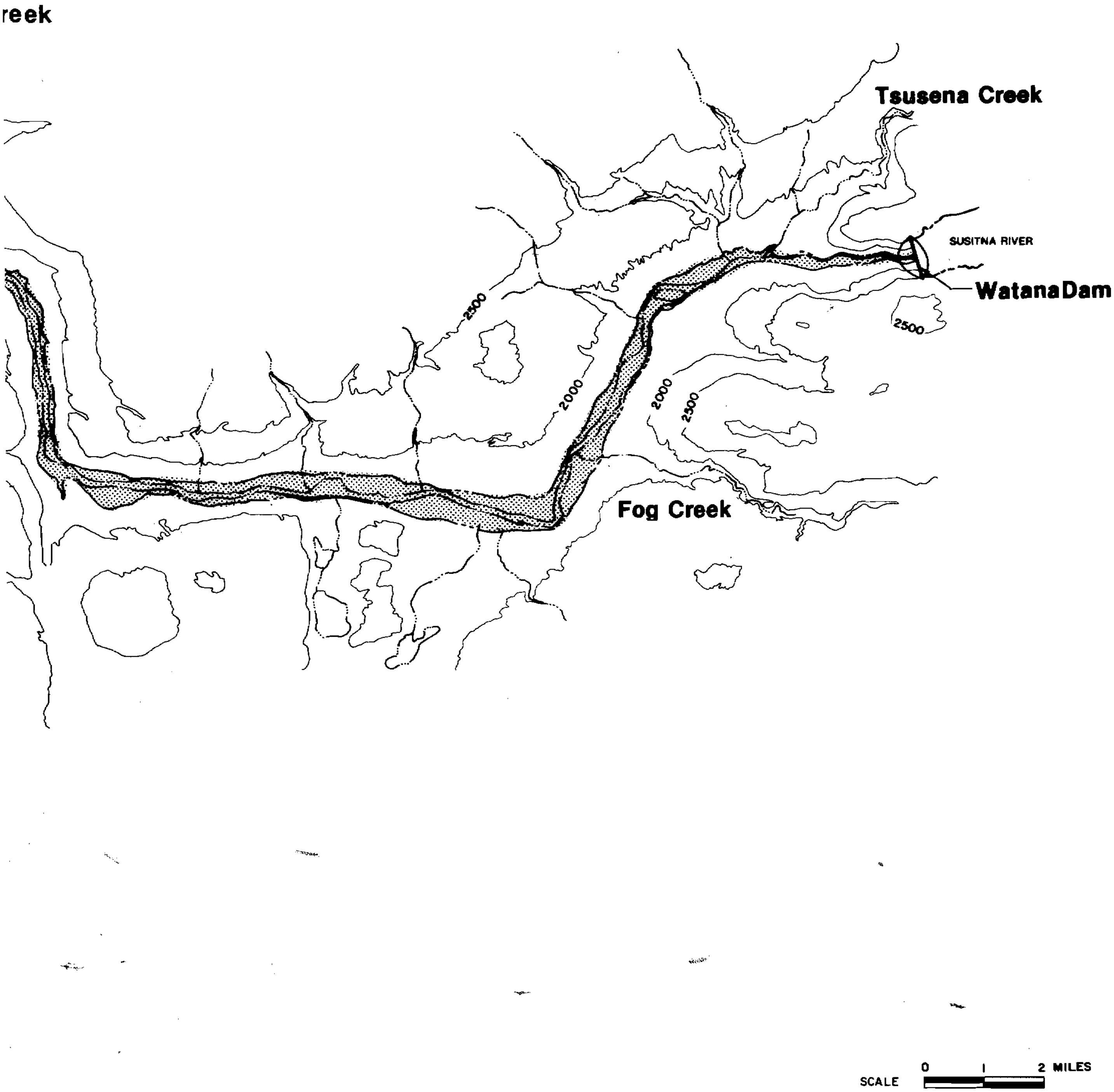


FISH SPAWNING TIMES VS. WATANA WATER SURFACE ELEVATION LEVEL

FIGURE E.3.22



WATER BODIES TO BE INUNDA



.TED BY DEVIL CANYON RESERVOIR

FIGURE E.3.23

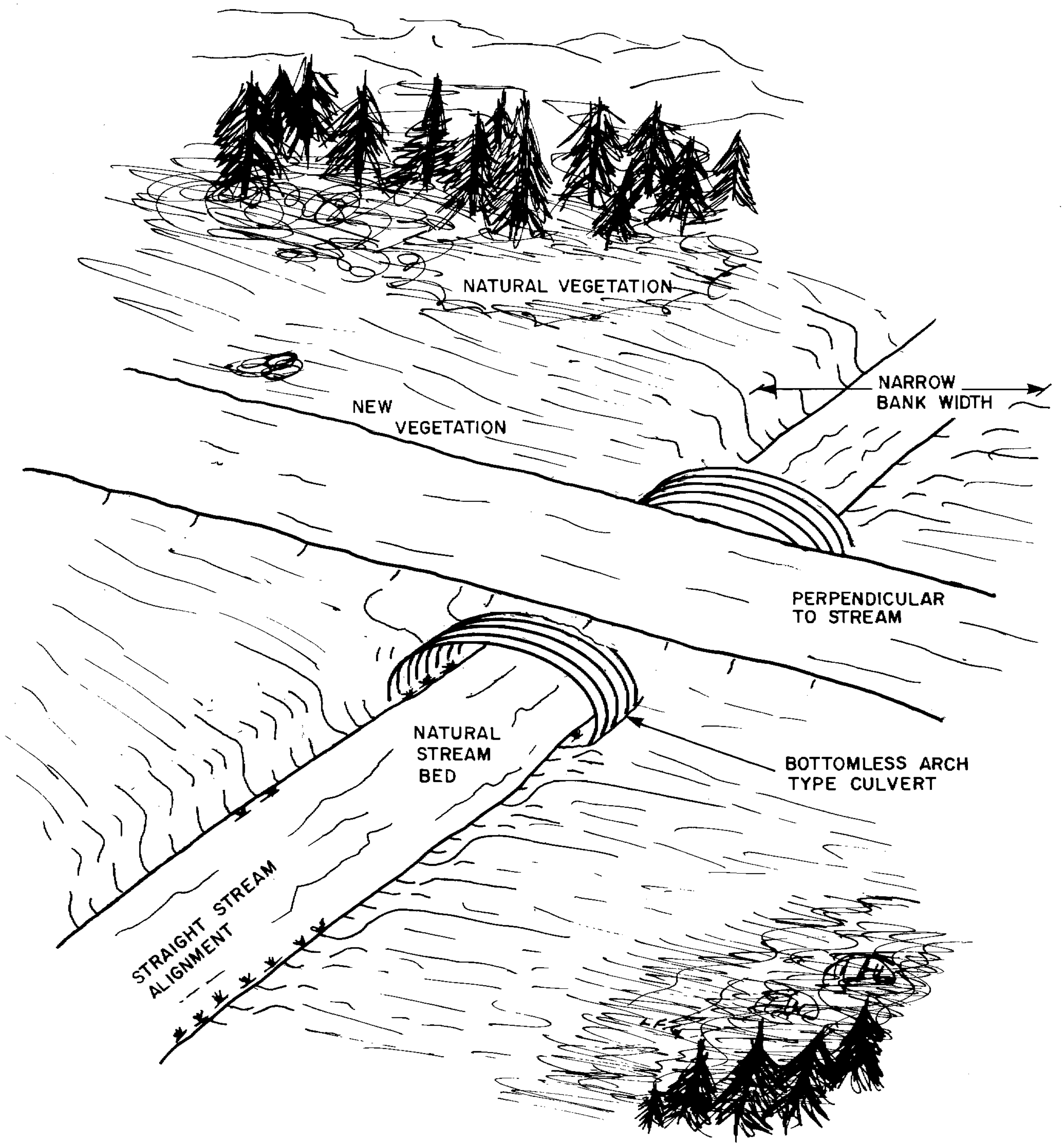
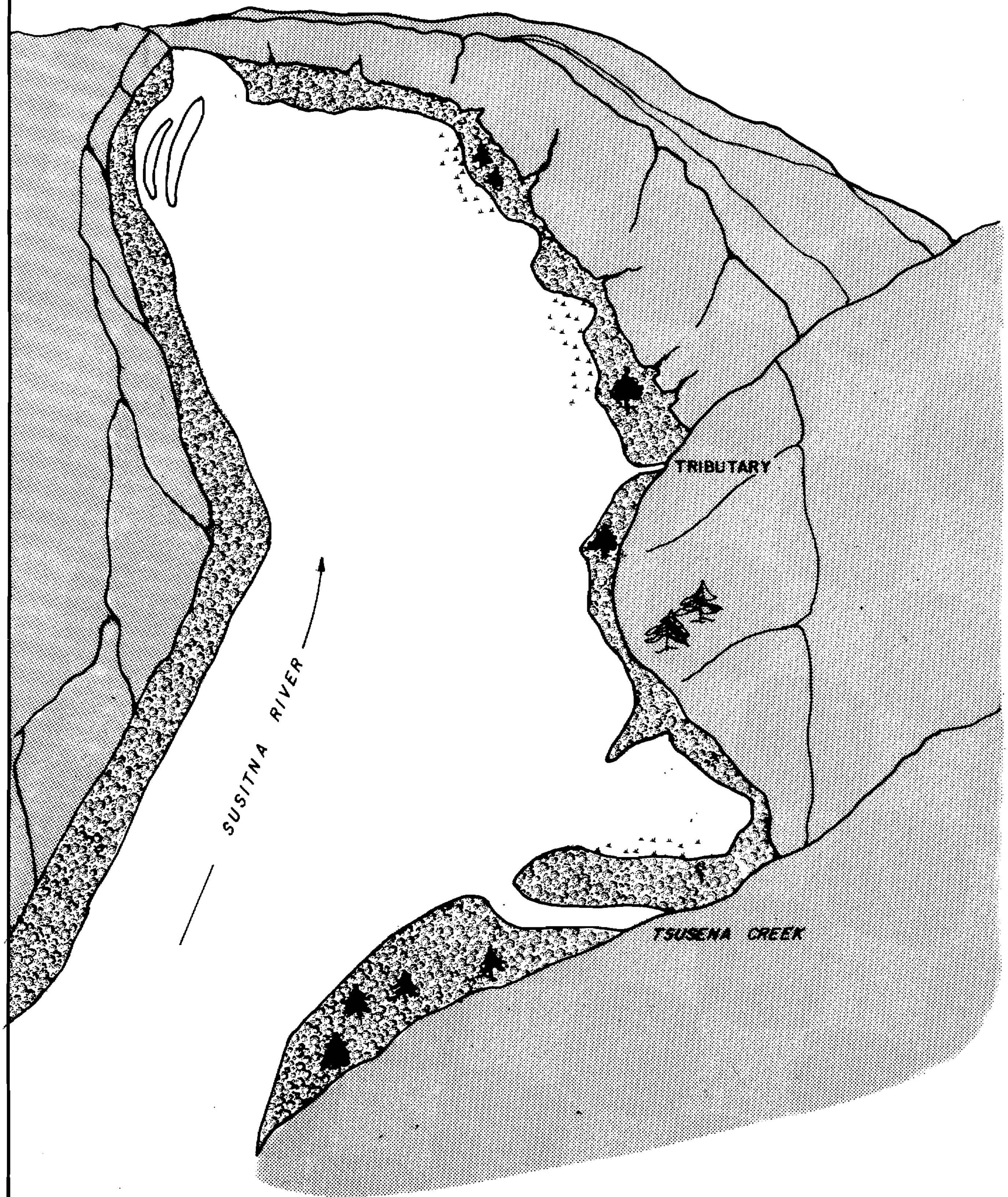


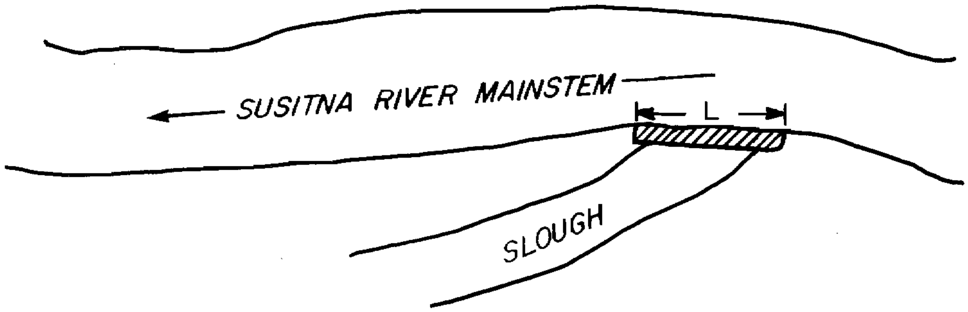
DIAGRAM OF FISH STREAM CROSSING

FIGURE E.3.24



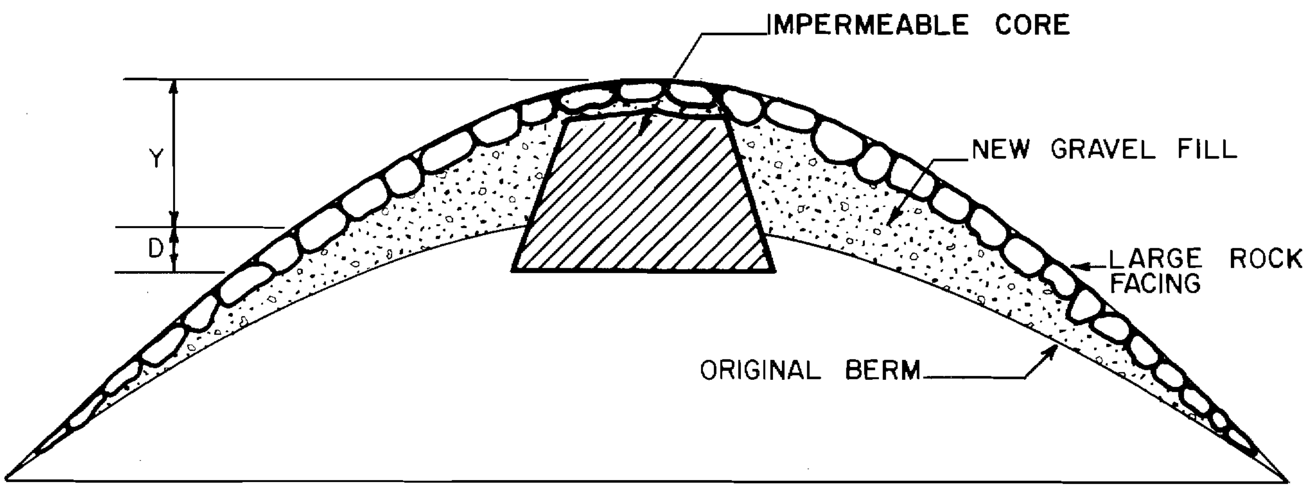
REHABILITATED TSUSENA CREEK
BORROW SITE

FIGURE E.3.25



PLAN VIEW

L = LENGTH OF BERM

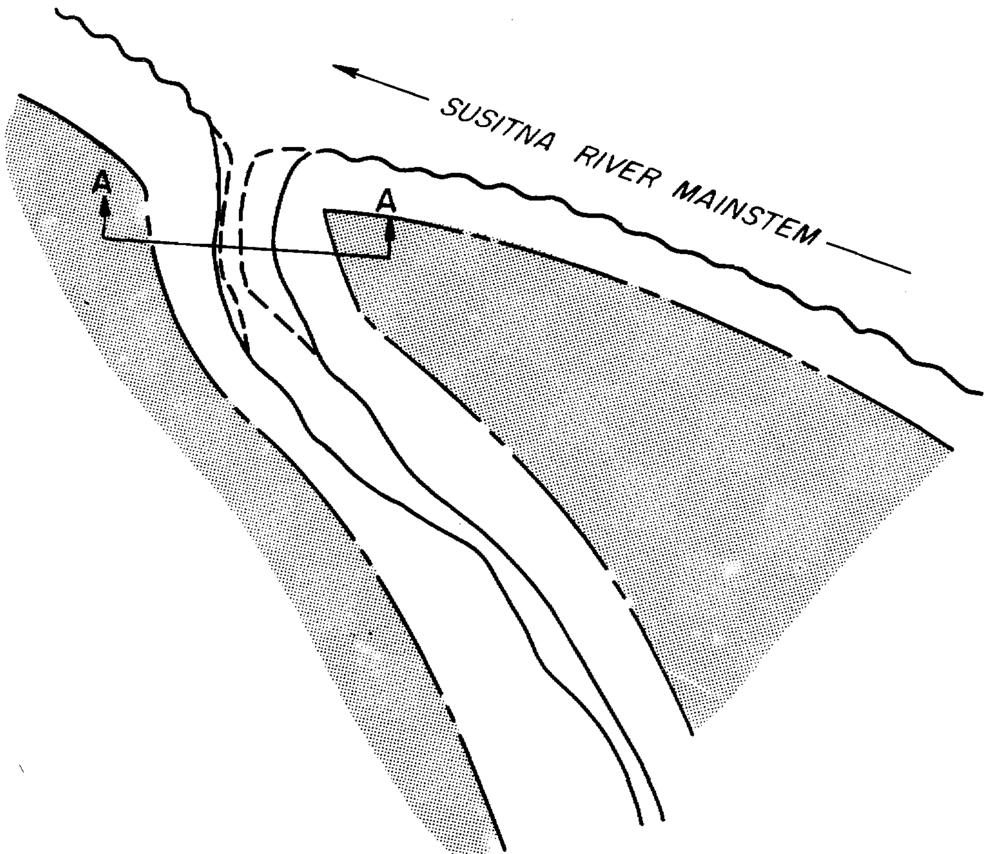


CROSS-SECTIONAL VIEW

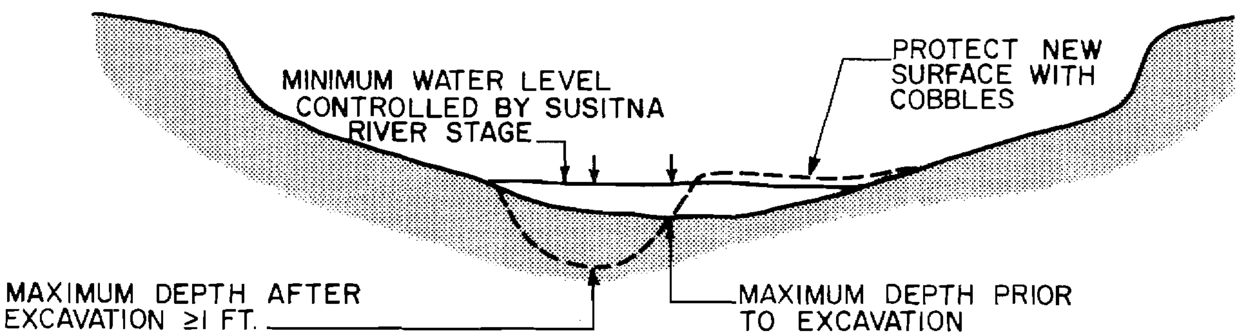
D = DEPTH OF EXCAVATION FOR IMPERMEABLE CORE
Y = INCREASED HEIGHT ABOVE ORIGINAL BERM

BERM DESIGN TO PREVENT OVERTOPPING OF SLOUGHS

FIGURE E.3.26



PLAN VIEW



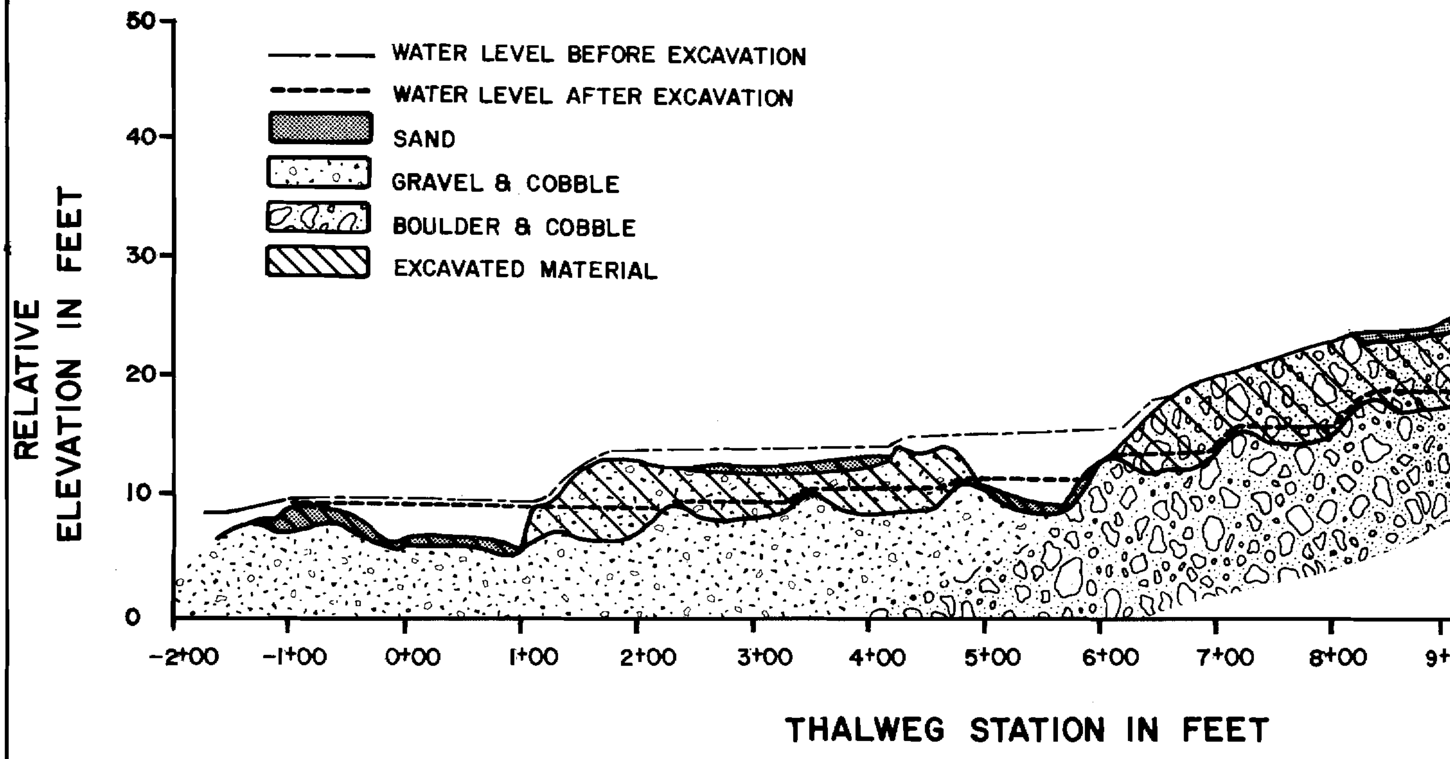
SECTION A-A

LEGEND

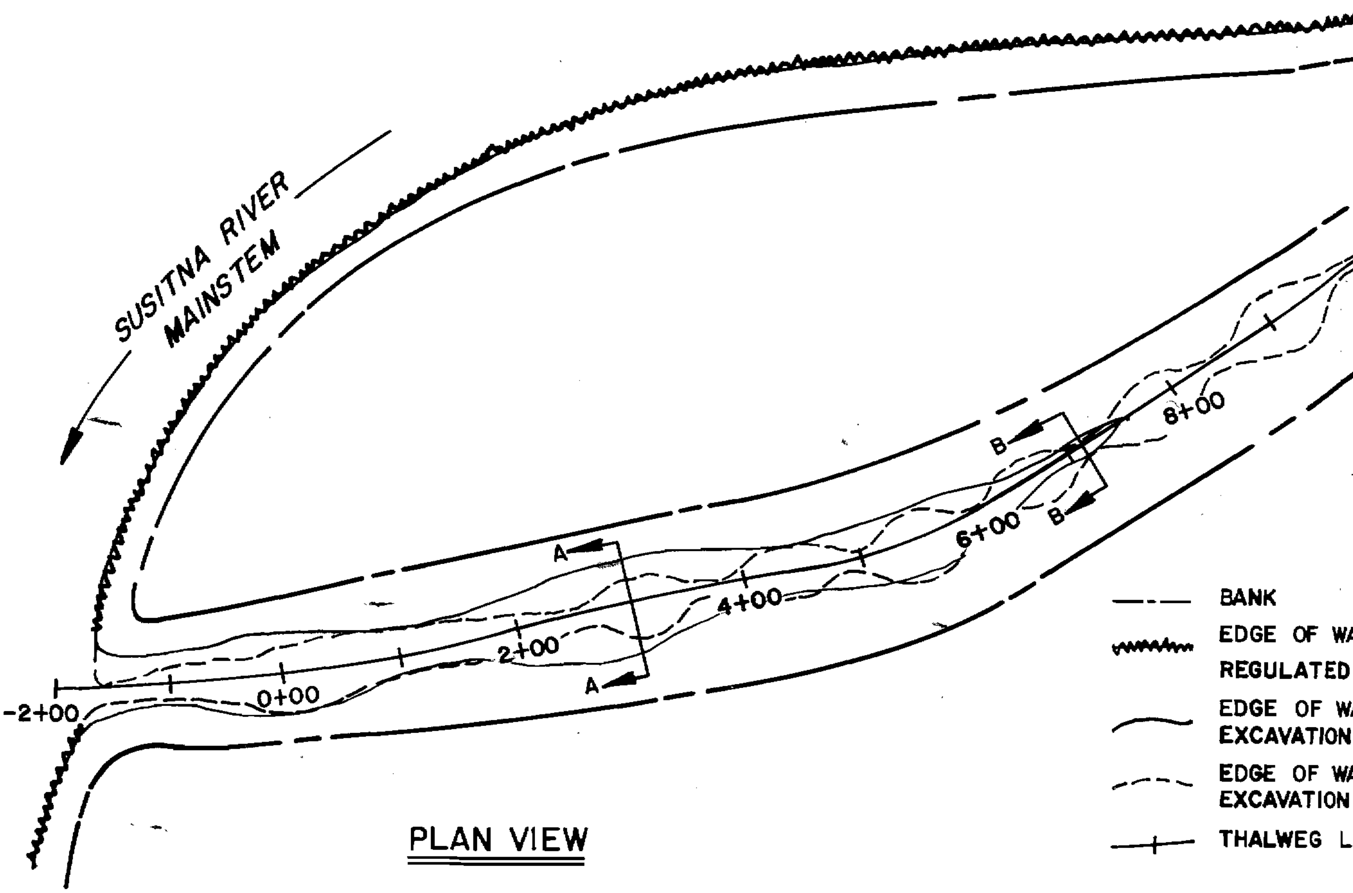
- BANK LINE
- SUSITNA MAINSTEM WATER LINE AT MINIMUM STAGE
- NATURAL SLOUGH WATER LINE
- RESTRUCTURED SLOUGH MOUTH WATER LINE

SLOUGH MOUTH RESTRUCTURED PLAN

FIGURE E.3.27

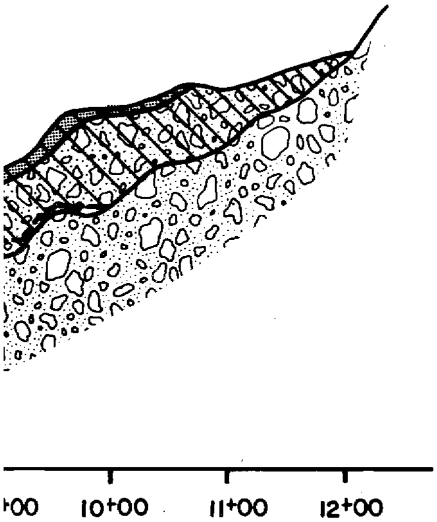


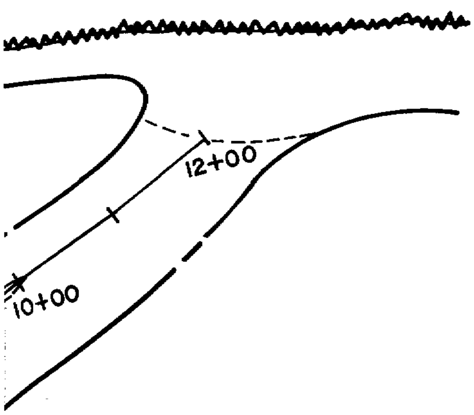
PROFILE

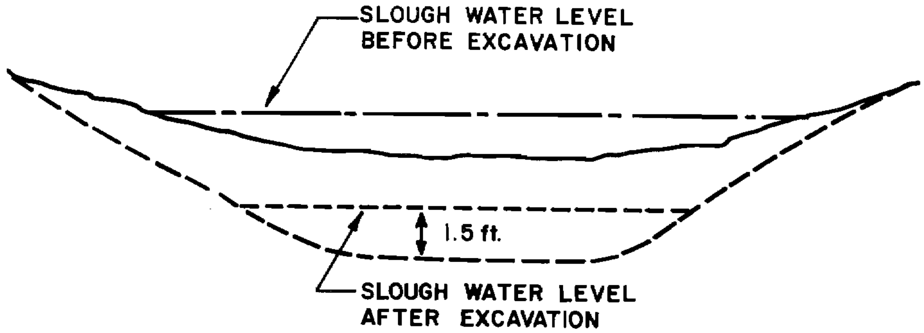


PLAN VIEW

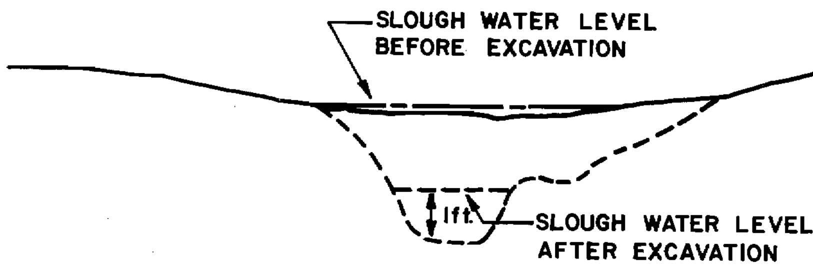
DESIGN DRAWING OF LOWERED







SECTION A-A



SECTION B-B

—·—·— SLOUGH CROSS SECTION BEFORE EXCAVATION

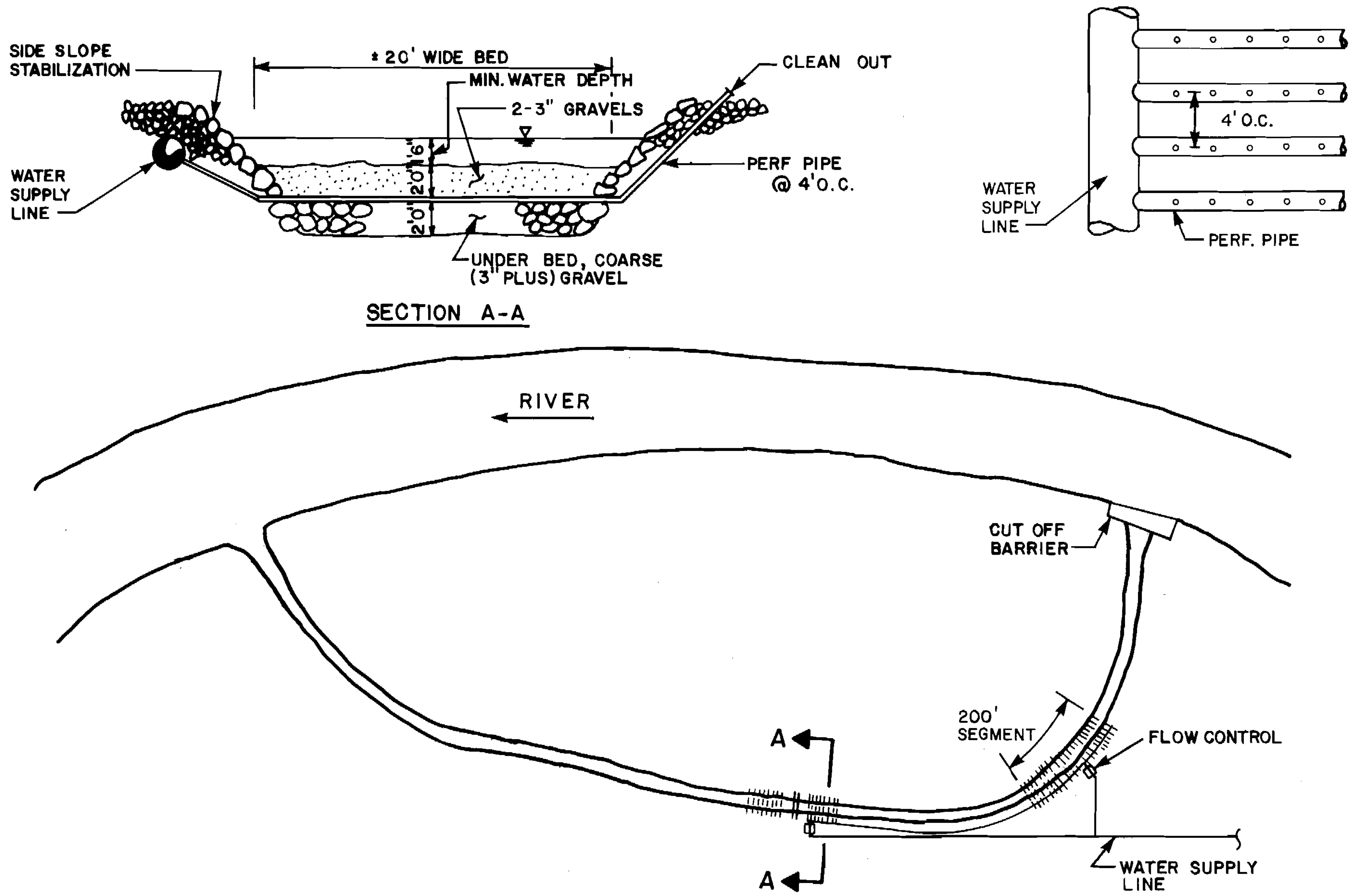
- - - - - SLOUGH CROSS SECTION AFTER EXCAVATION

TYPICAL CROSS SECTIONS

'ATER – SUSITNA RIVER
) FLOW
'ATER – SLOUGH BEFORE
I
'ATER – SLOUGH AFTER
I
.INE AND STATIONING

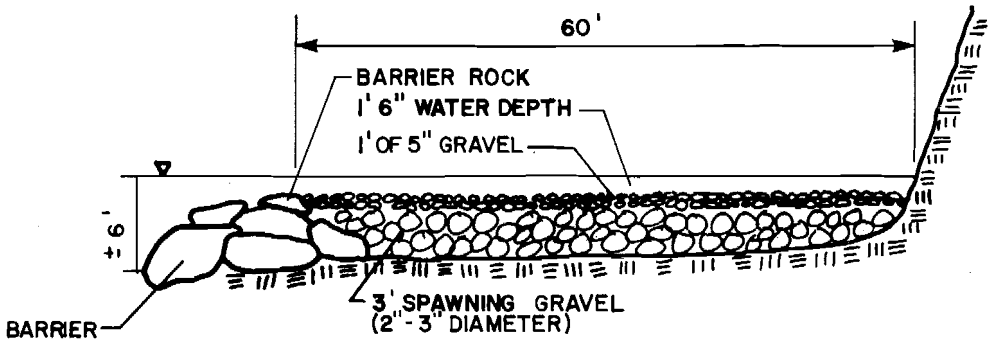
AND RESTRUCTURED SLOUGH

FIGURE E.3.28



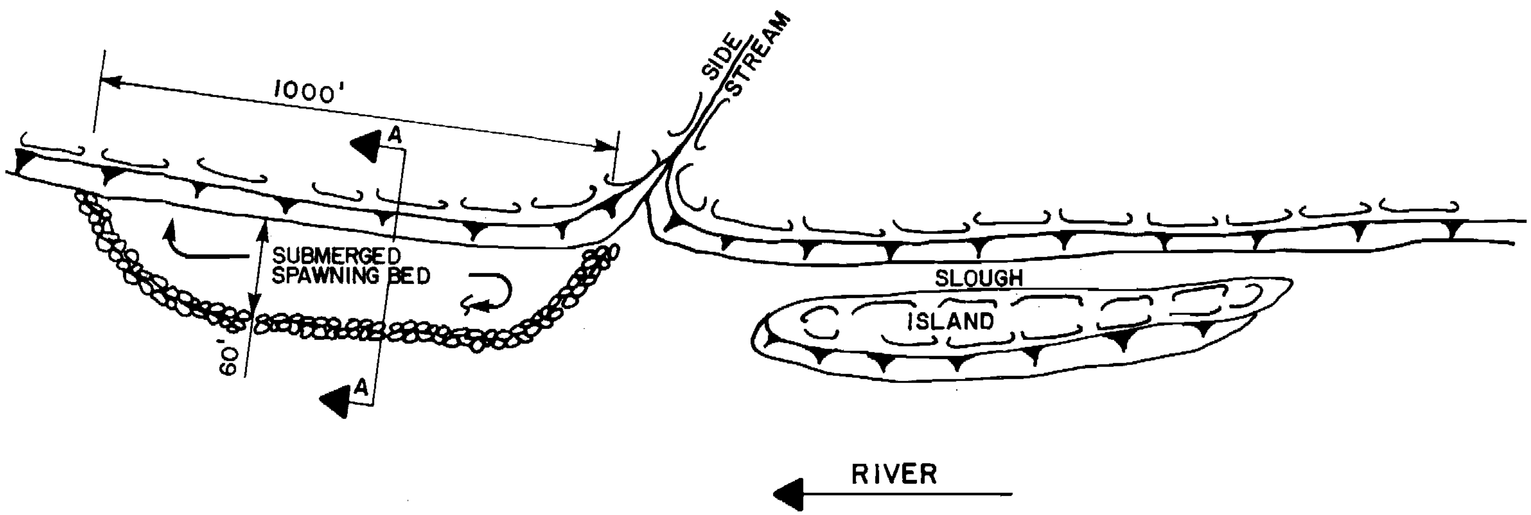
SUSITNA RIVER FISHERY MITIGATION
INDUCED UPWELLING USING
TRIBUTARY WATER SUPPLY

FIGURE E.3.29



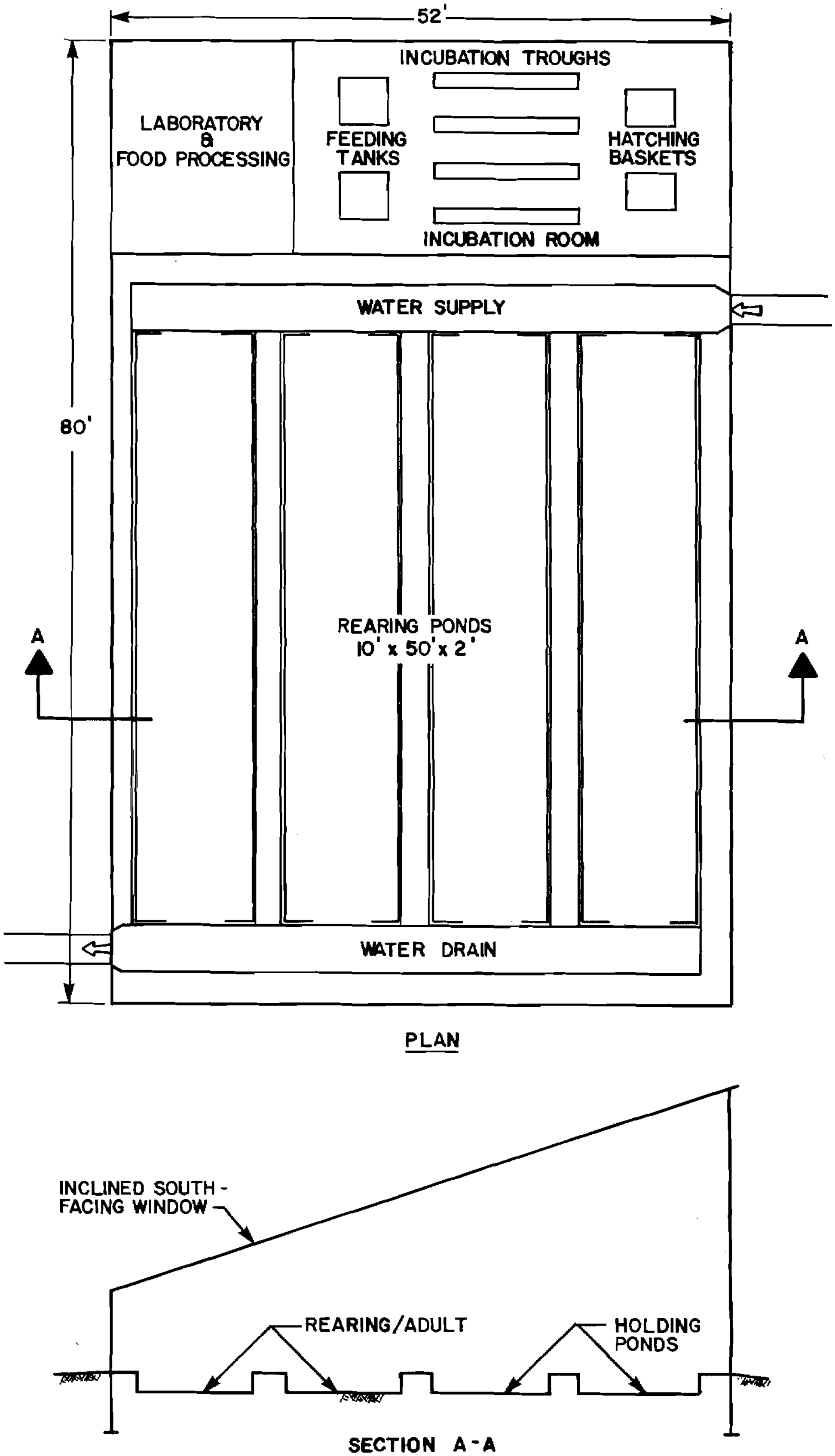
SECTION A-A

NO SCALE



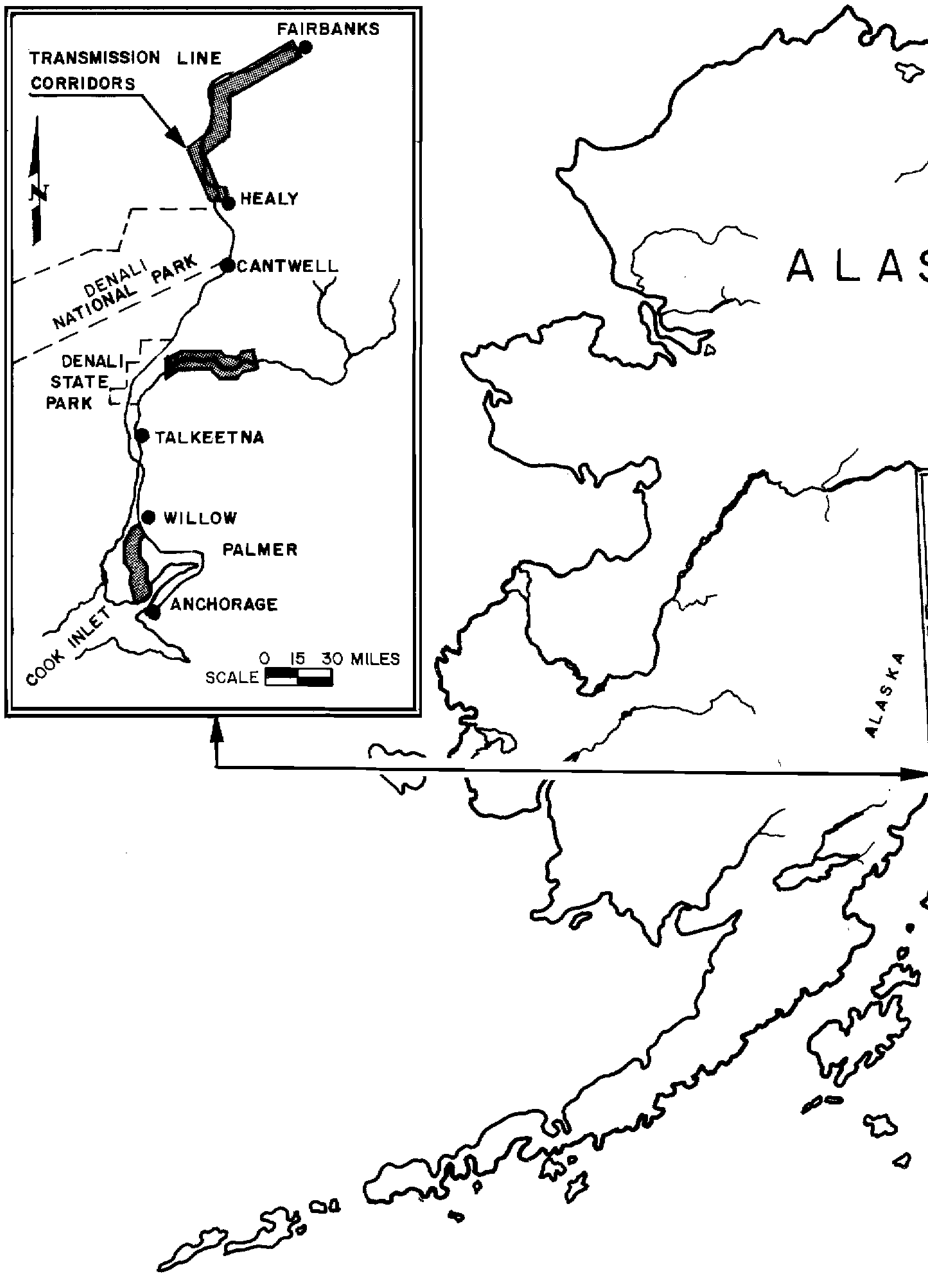
SUSITNA RIVER FISHERY MITIGATION
MAIN STREAM SPAWNING BED

FIGURE E.3.30



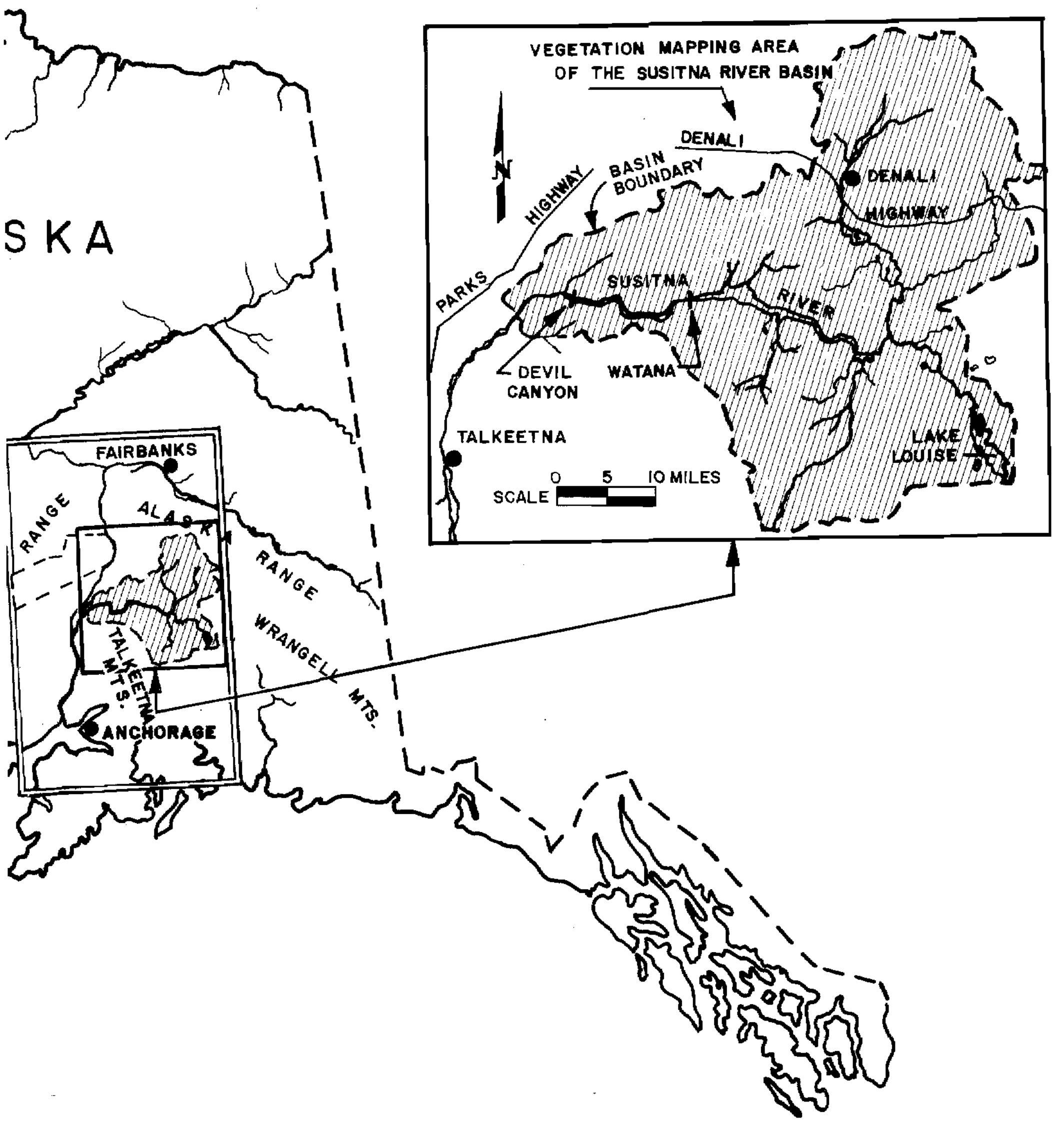
SCHEMATIC GRAYLING HATCHERY

FIGURE E.3.31



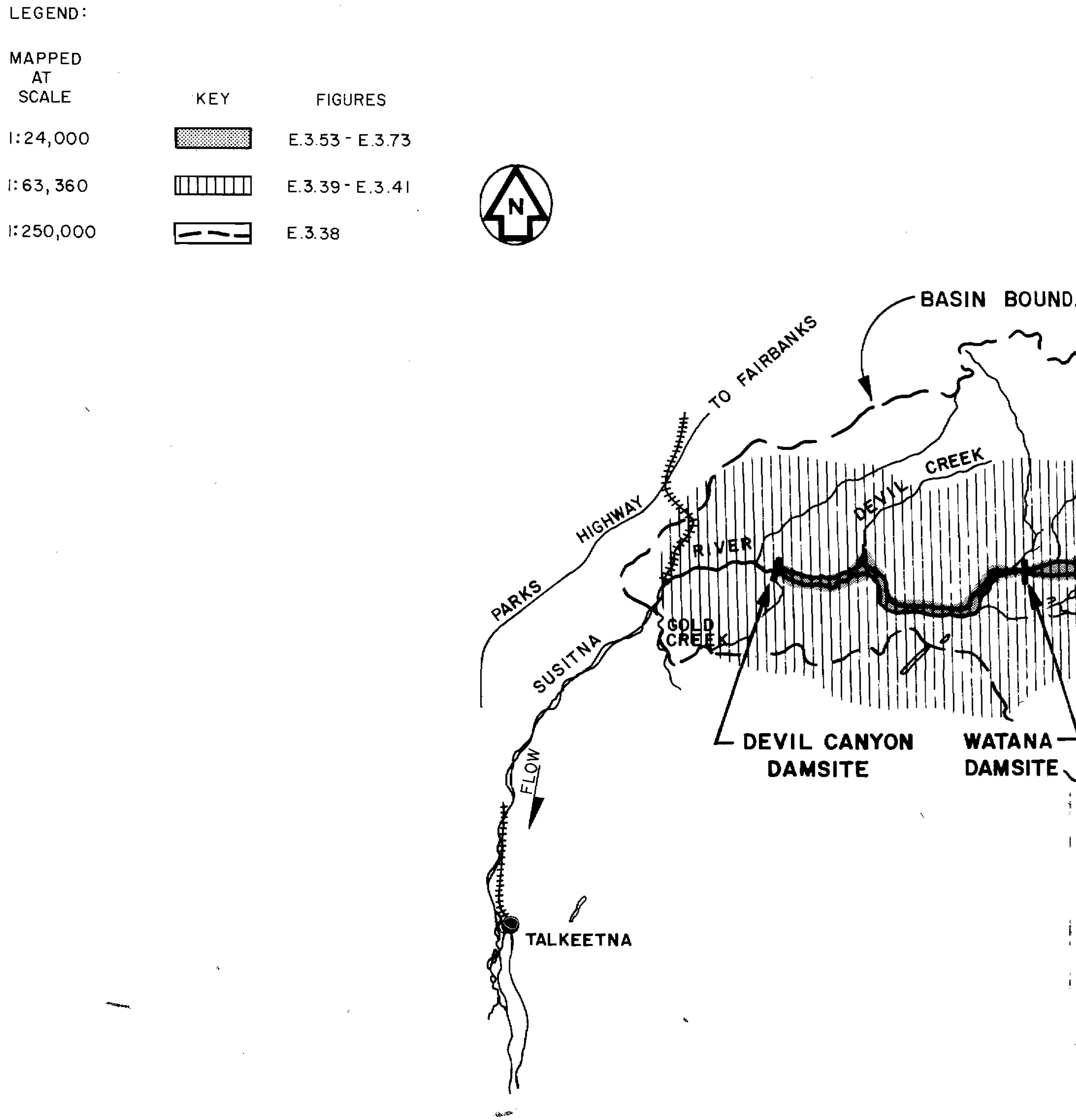
STUDY AREA
RESOURCES

FROM McKENDRICK et al. 1982



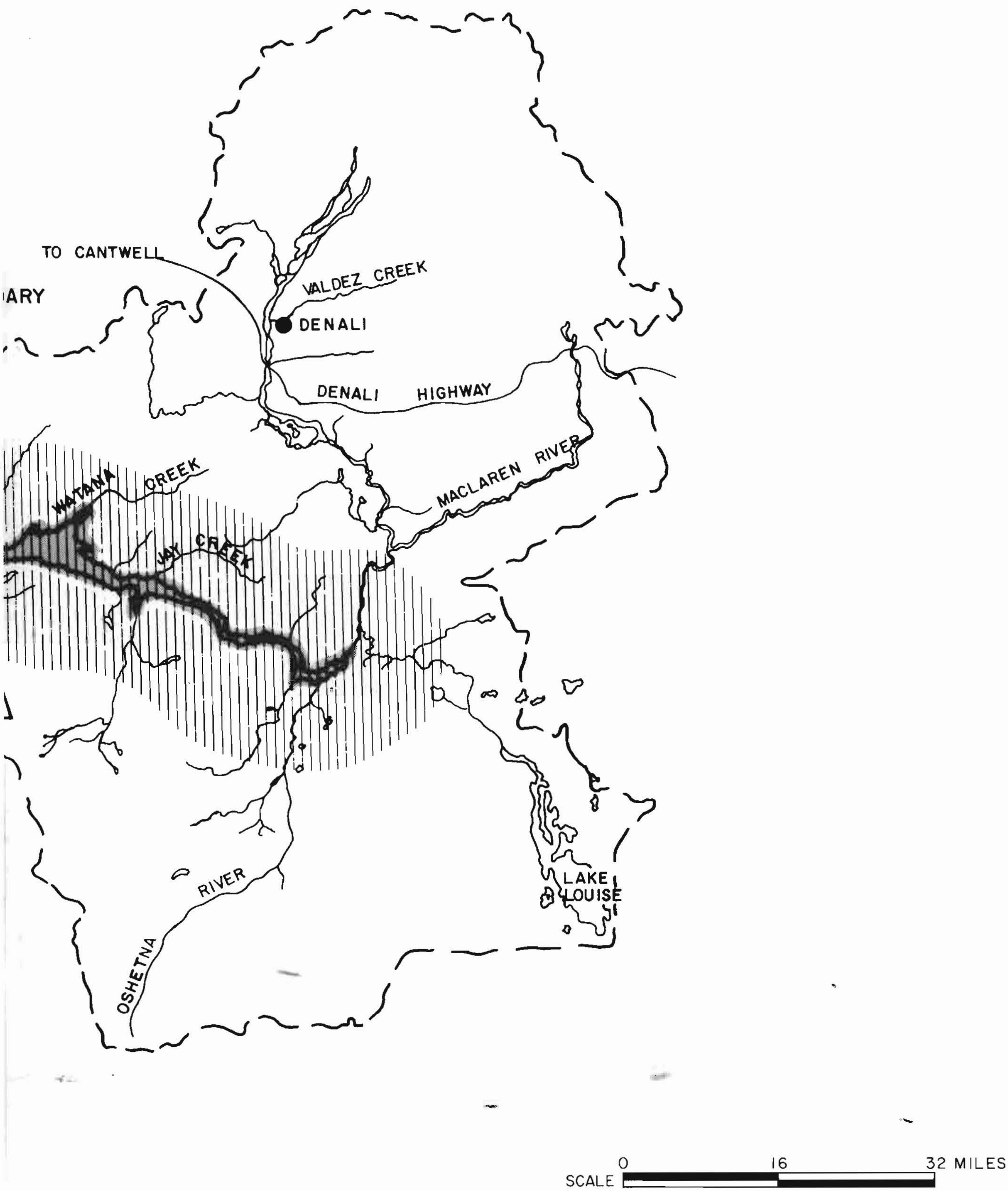
ı FOR BOTANICAL
S AND WILDLIFE

FIGURE E.3.32



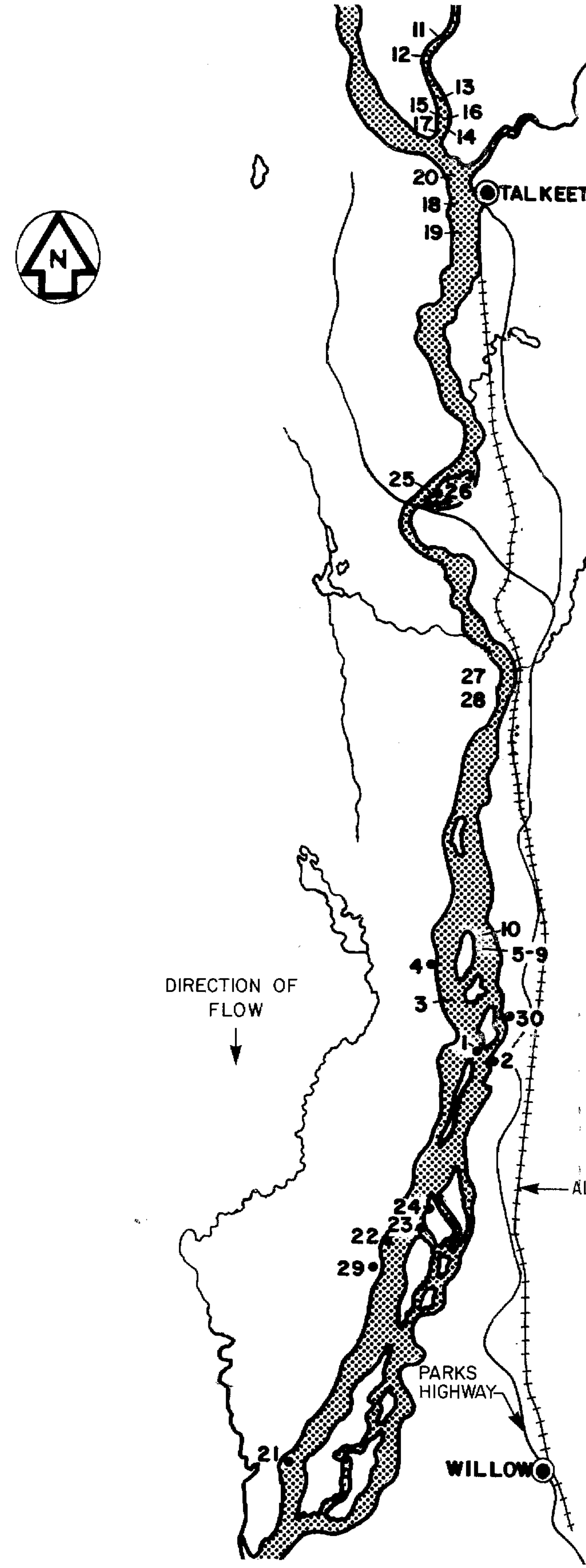
VEGETATION
THE SUSIT

FROM McKENDRICK et al. 1982



MAPPING AREAS OF
NA RIVER BASIN

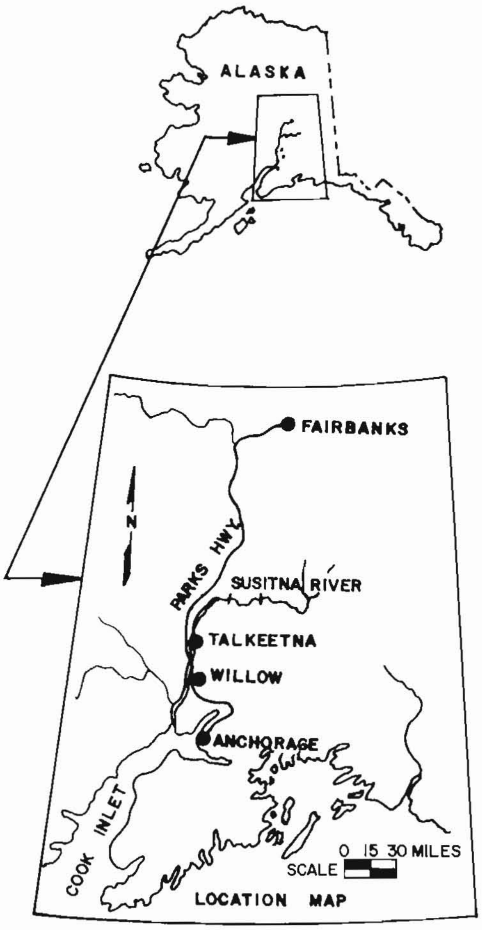
FIGURE E.3.33



LOCATIONS OF
DOWNSTREAM
SUSITN

FROM McKENDRICK et al. 1982

TNA



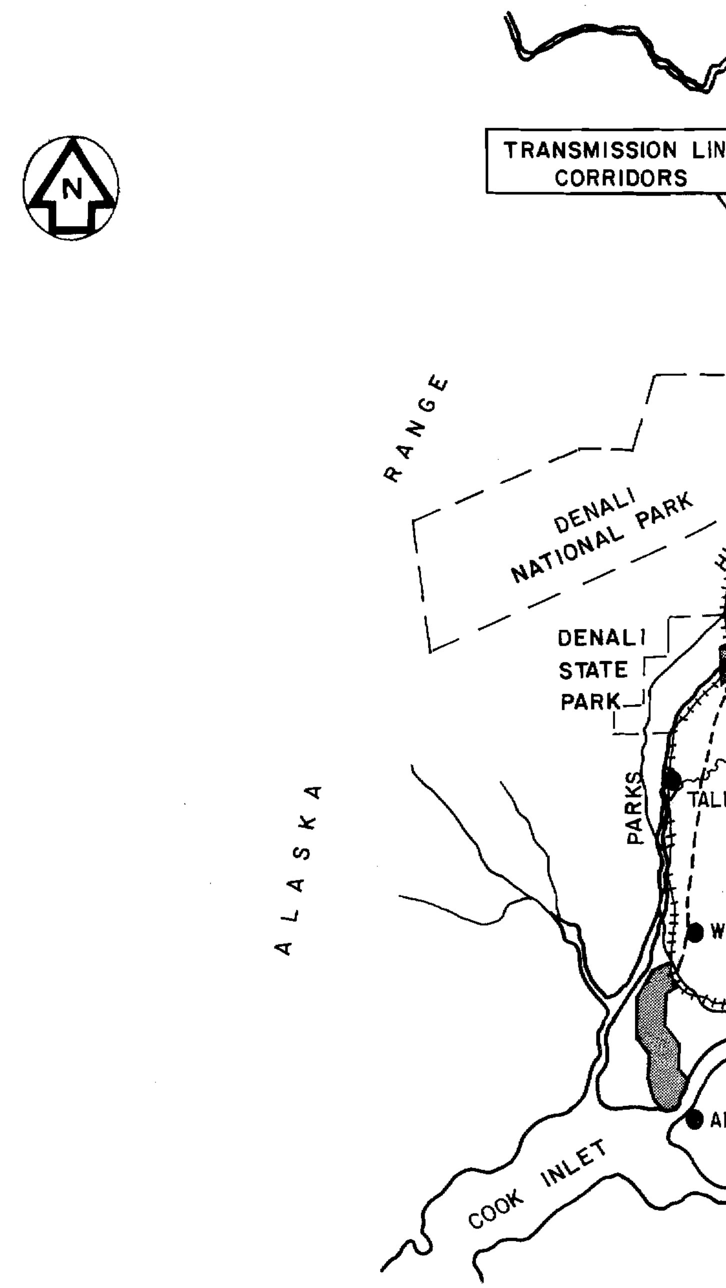
LASKA RAILROAD

0 6 12 MILES
SCALE

*STANDS ARE DESCRIBED IN TABLES E.3.73 THROUGH E.3.76

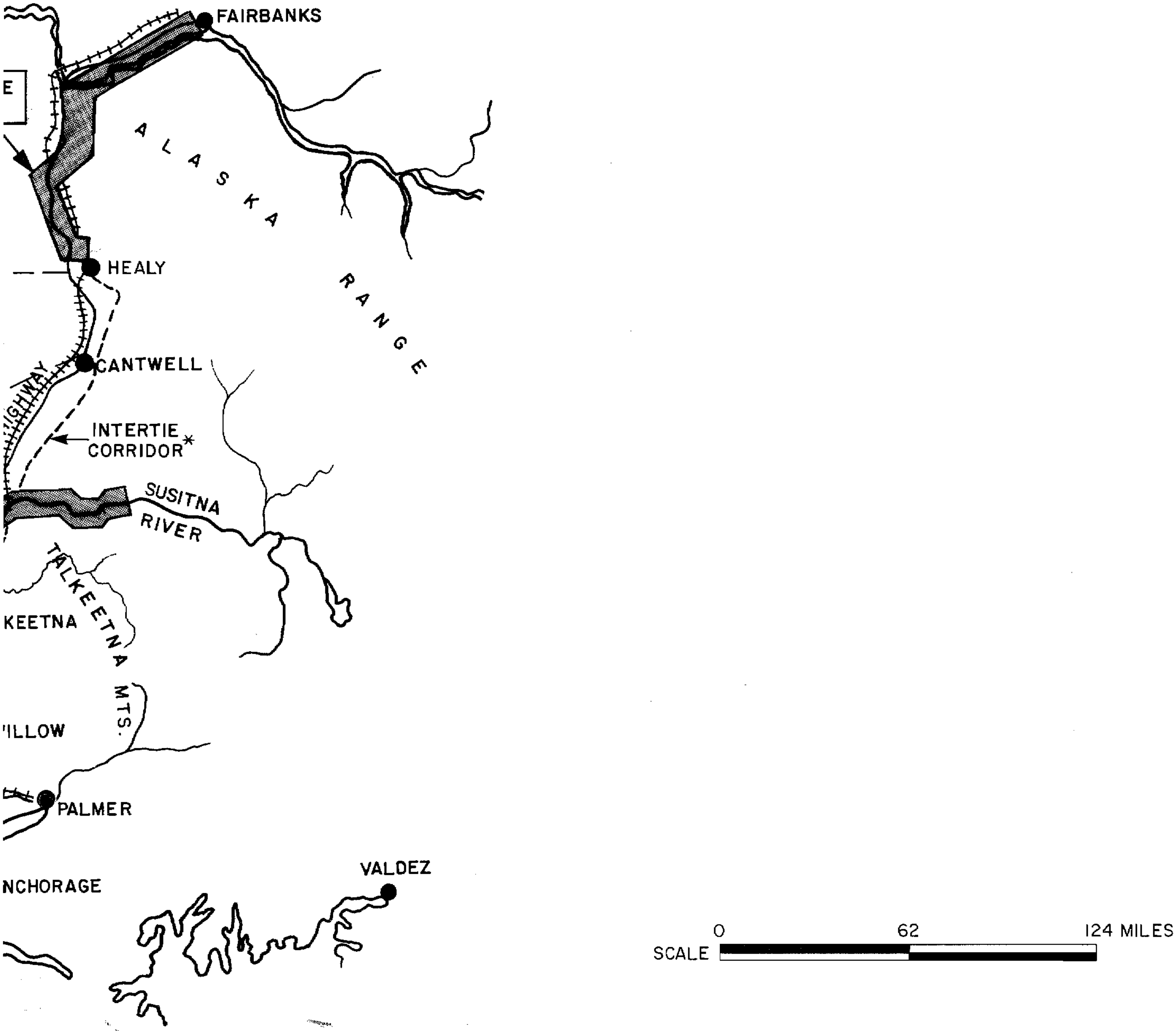
STANDS SAMPLED* ON
FLOODPLAIN OF THE
IA RIVER, 1981

FIGURE E. 3.34



VEGETATION MAPPING ARE

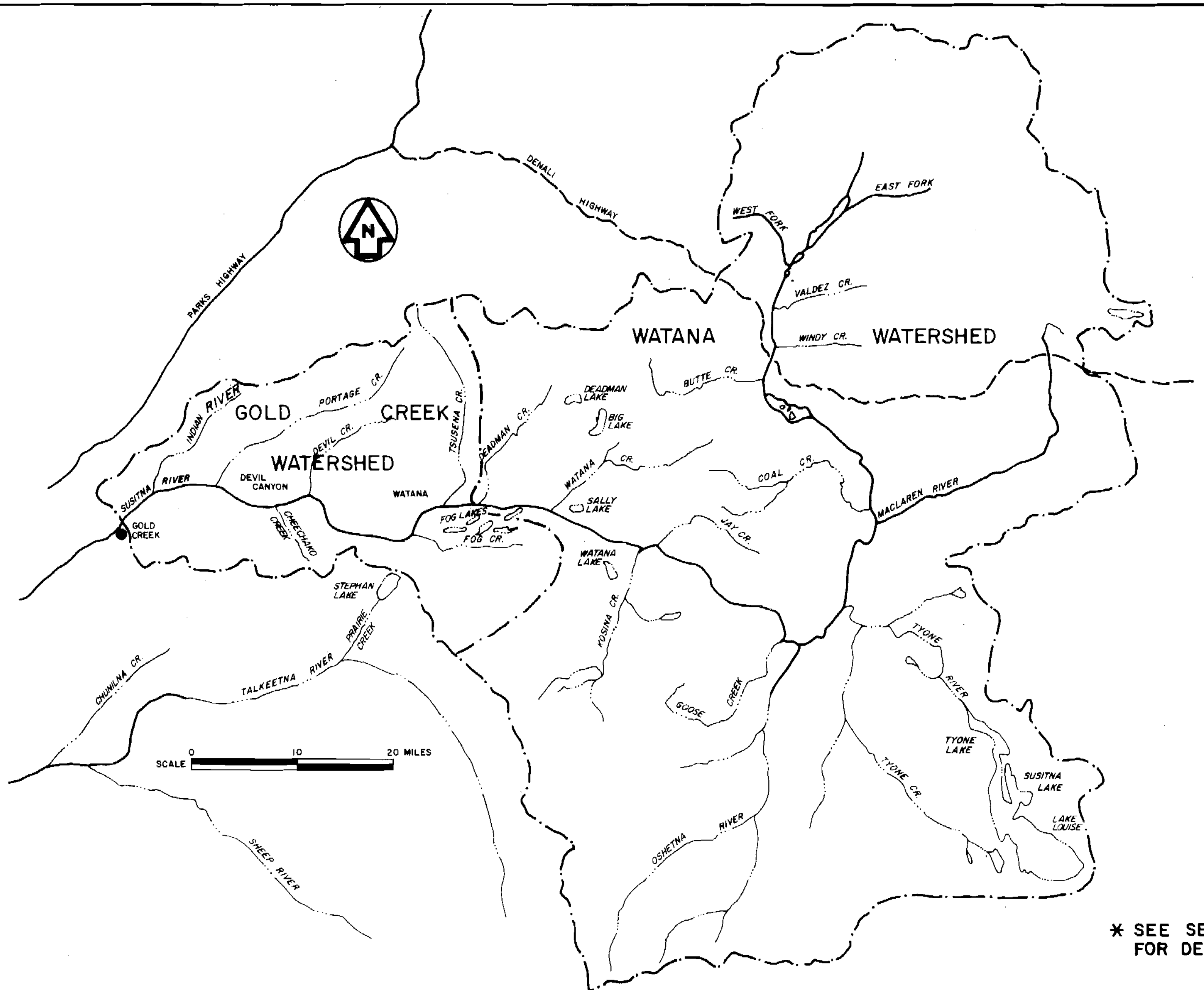
FROM McKENDRICK et al. 1982



*INTERTIE CORRIDOR CONNECTS WILLOW AND HEALY THROUGH GOLD CREEK SWITCHING STATION (SEE FIGURE E.3.37 AND COMMONWEALTH ASSOCIATES 1982)

AS FOR TRANSMISSION CORRIDORS

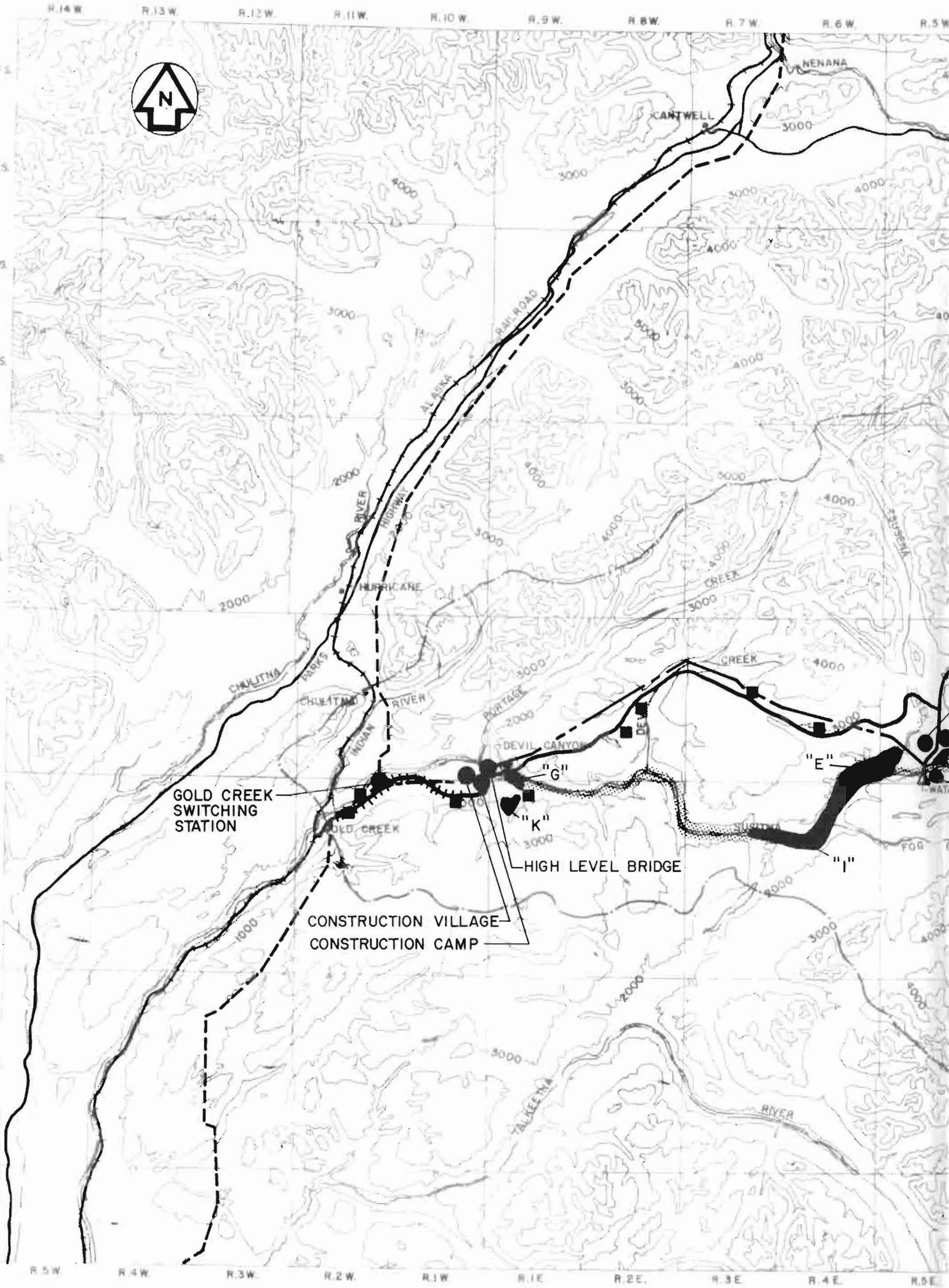
FIGURE E.3.35



* SEE SECTION 3.1 FOR DEFINITION

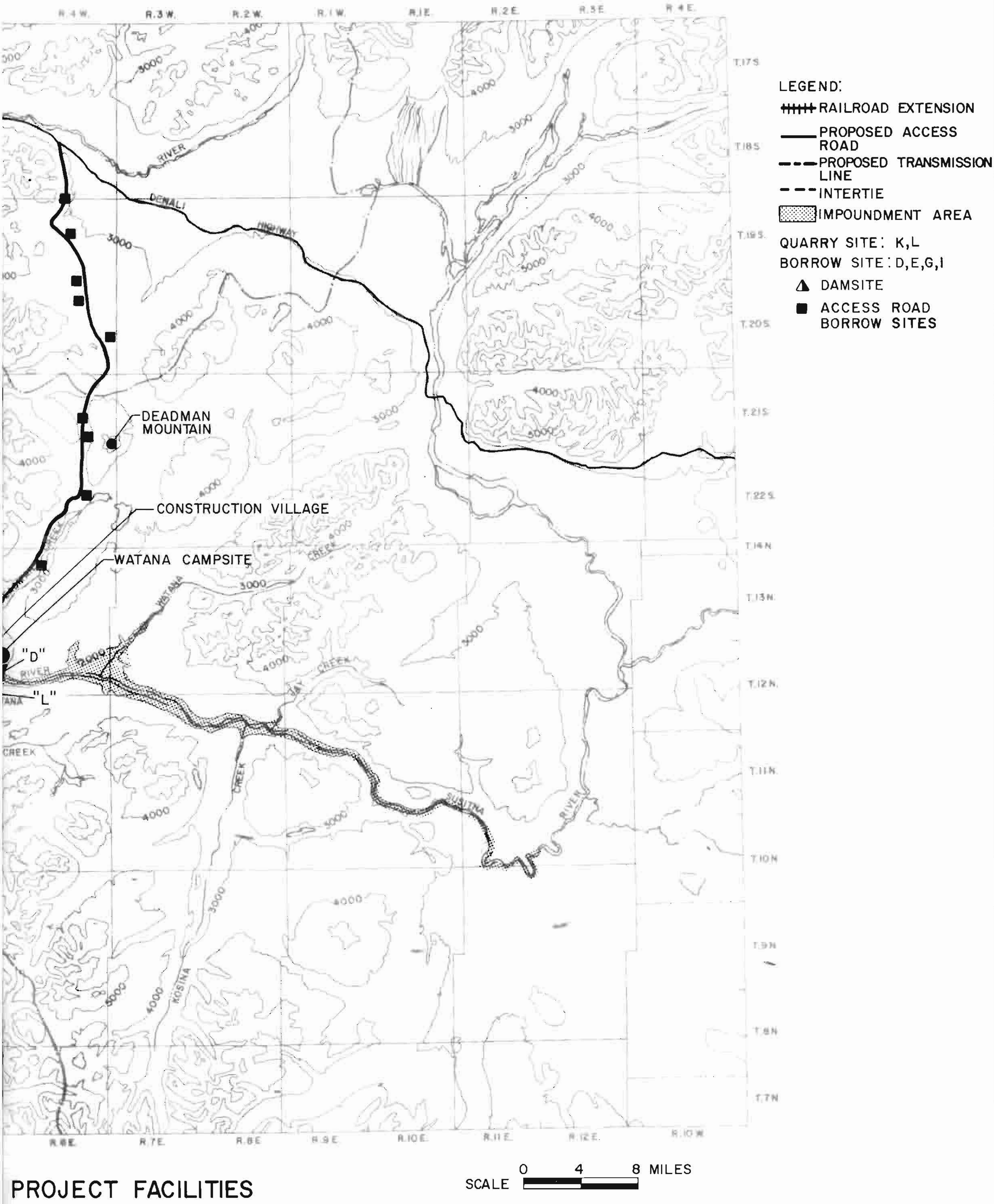
THE WATANA AND GOLD CREEK WATERSHEDS* WITH MAJOR WATER BODIES

FIGURE E.3.36



R.14 W.
R.13 W.
R.12 W.
R.11 W.
R.10 W.
R.9 W.
R.8 W.
R.7 W.
R.6 W.
R.5 W.
T.17 S.
T.18 S.
T.19 S.
T.20 S.
T.21 S.
T.22 S.
T.33 N.
T.32 N.
T.31 N.
T.30 N.
T.29 N.
T.28 N.
T.27 N.
N
NENANA
CANTWELL
ALASKA RAILROAD
PARKS HIGHWAY
HURRICANE
CHULITNA
CHULITNA RIVER
INDIAN RIVER
PORTAGE CREEK
DEVIL CANYON
GOLD CREEK
GOLD CREEK SWITCHING STATION
"G"
"K"
"E"
"I"
HIGH LEVEL BRIDGE
CONSTRUCTION VILLAGE
CONSTRUCTION CAMP
SUSITNA
FOG
TALKEETNA RIVER
R.5 W.
R.4 W.
R.3 W.
R.2 W.
R.1 W.
R.1 E.
R.2 E.
R.3 E.
R.4 E.
R.5 E.

LOCATION OF



PROJECT FACILITIES

FIGURE E.3.37

FIGURE E.3.38

Inserted in pocket inside back cover

LEGEND:

R	ROCK
S	SNOW AND ICE
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
SST	SEDGE SHRUB TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES
D	DISTURBED
— - —	PROPOSED TRANSMISSION LINE
——	PROPOSED ACCESS ROAD

MAPPED AT SCALE: 1:63,360

VEGETATION MAP OF S

FROM McKENDRICK et al. 1982

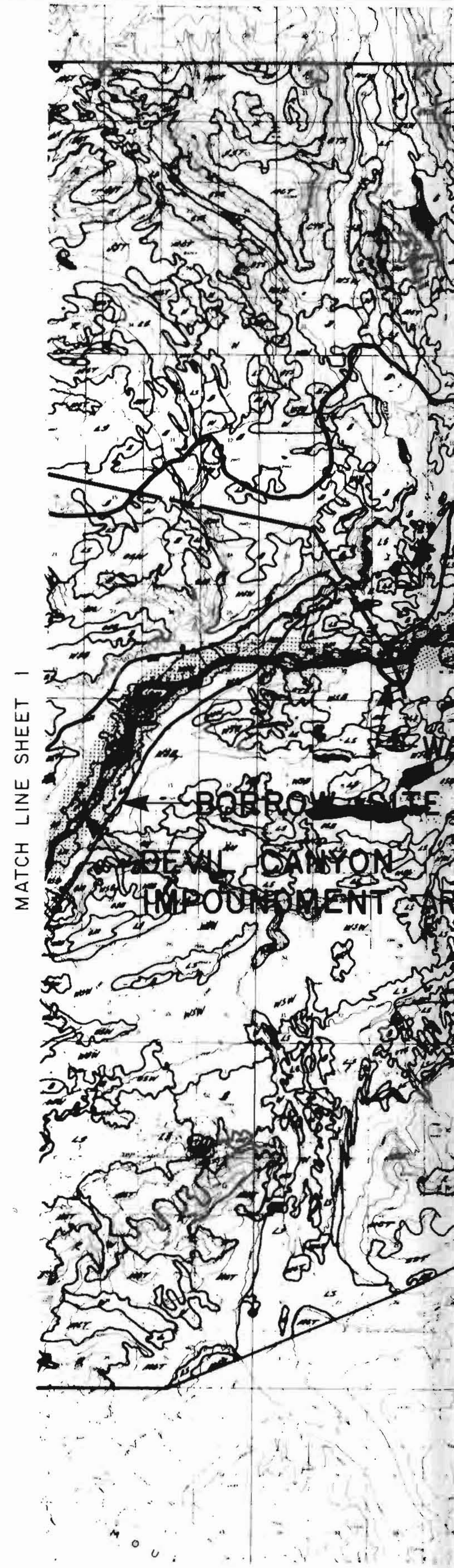
JSITNA PROJECT IMPACT AREAS

FIGURE E.3.39

LEGEND:

R	ROCK
S	SNOW AND ICE
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
SST	SEDGE SHRUB TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES
D	DISTURBED
H	HERBACEOUS
— — —	PROPOSED TRANSMISSION LINE
———	PROPOSED ACCESS ROAD

FROM McKENDRICK et al. 1982



MAPPED AT SCALE: 1:63,360

VEGETATION MAP OF SU

SCALE 0 2 4 MILES

SITNA PROJECT IMPACT AREAS

FIGURE E.3.40

LEGEND:

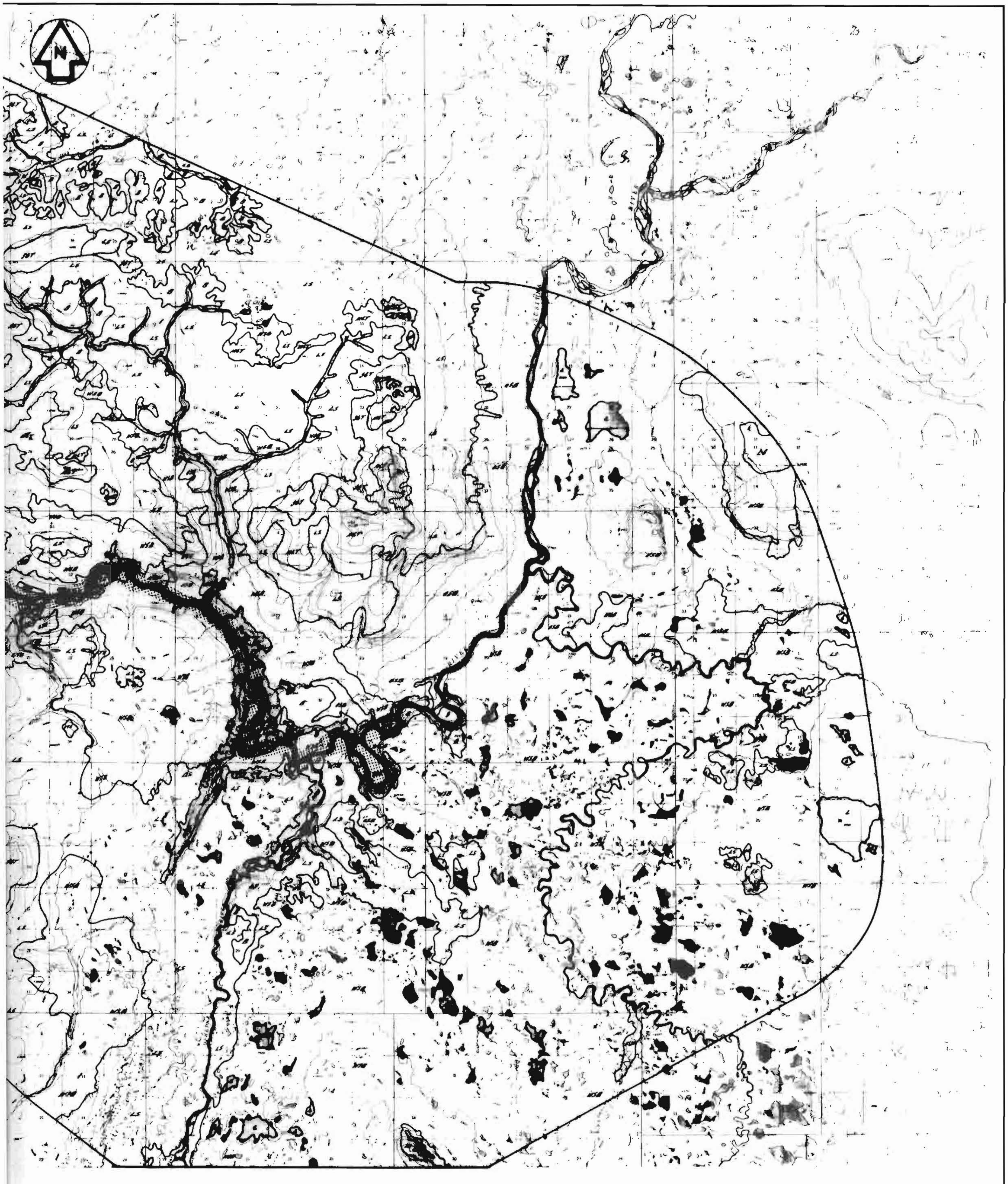
R	ROCK
S	SNOW AND ICE
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
SST	SEDGE SHRUB TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES
D	DISTURBED

MATCH LINE SHEET 2

MAPPED AT SCALE: 1: 63,360

VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982



SITNA PROJECT IMPACT AREAS

FIGURE E.3.41

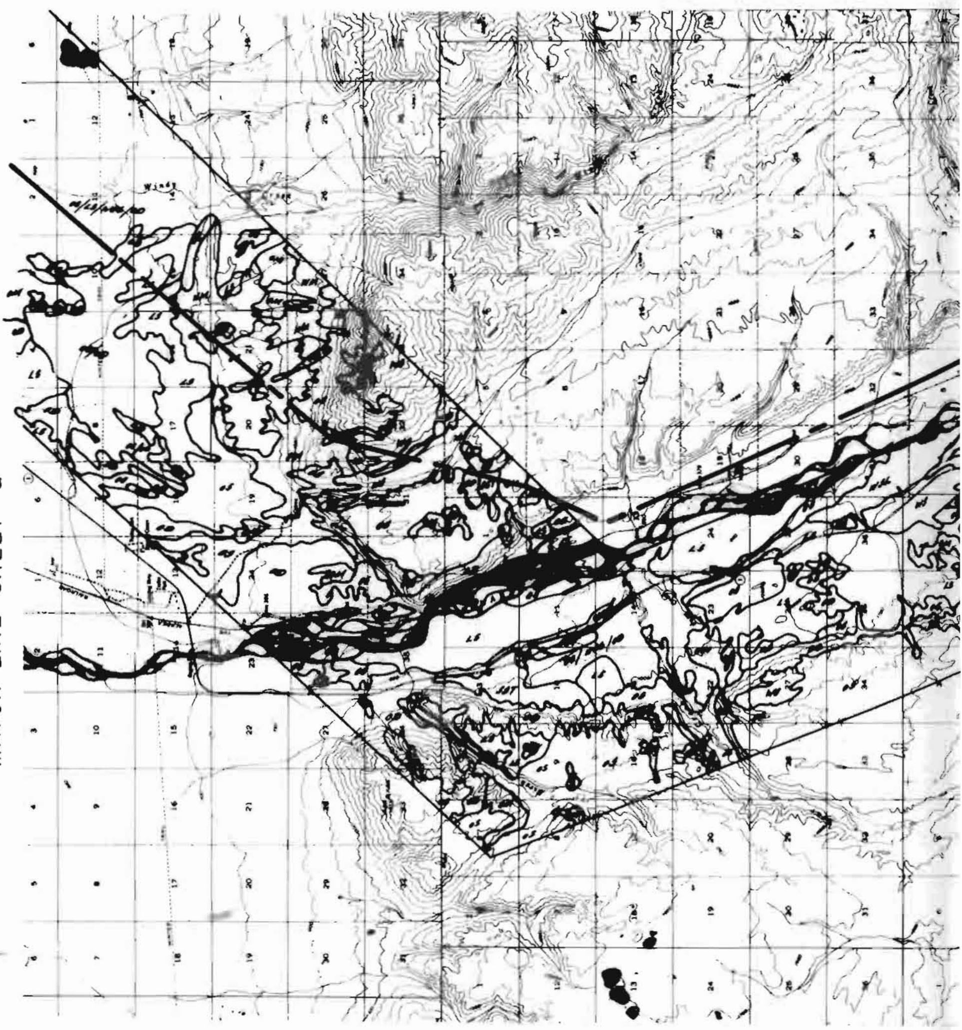
FIGURES E.3.42 THROUGH E.3.47

Inserted in pocket inside back cover

LEGEND:

CS	CLOSED SPRUCE
OS	OPEN SPRUCE
WS	WOODLAND SPRUCE
CD	CLOSED DECIDUOUS
OD	OPEN DECIDUOUS
CM	CLOSED MIXED
OM	OPEN MIXED
WM	WOODLAND MIXED
LS	LOW SHRUB
WSG	WET SEDGE GRASS
SGT	SEDGE GRASS TUNDRA
MCT	MAT AND CUSHION TUNDRA
C	CROP
L	LAKE
R	ROCK
D	DEVELOPED
— — —	PROPOSED TRANSMISSION LINE

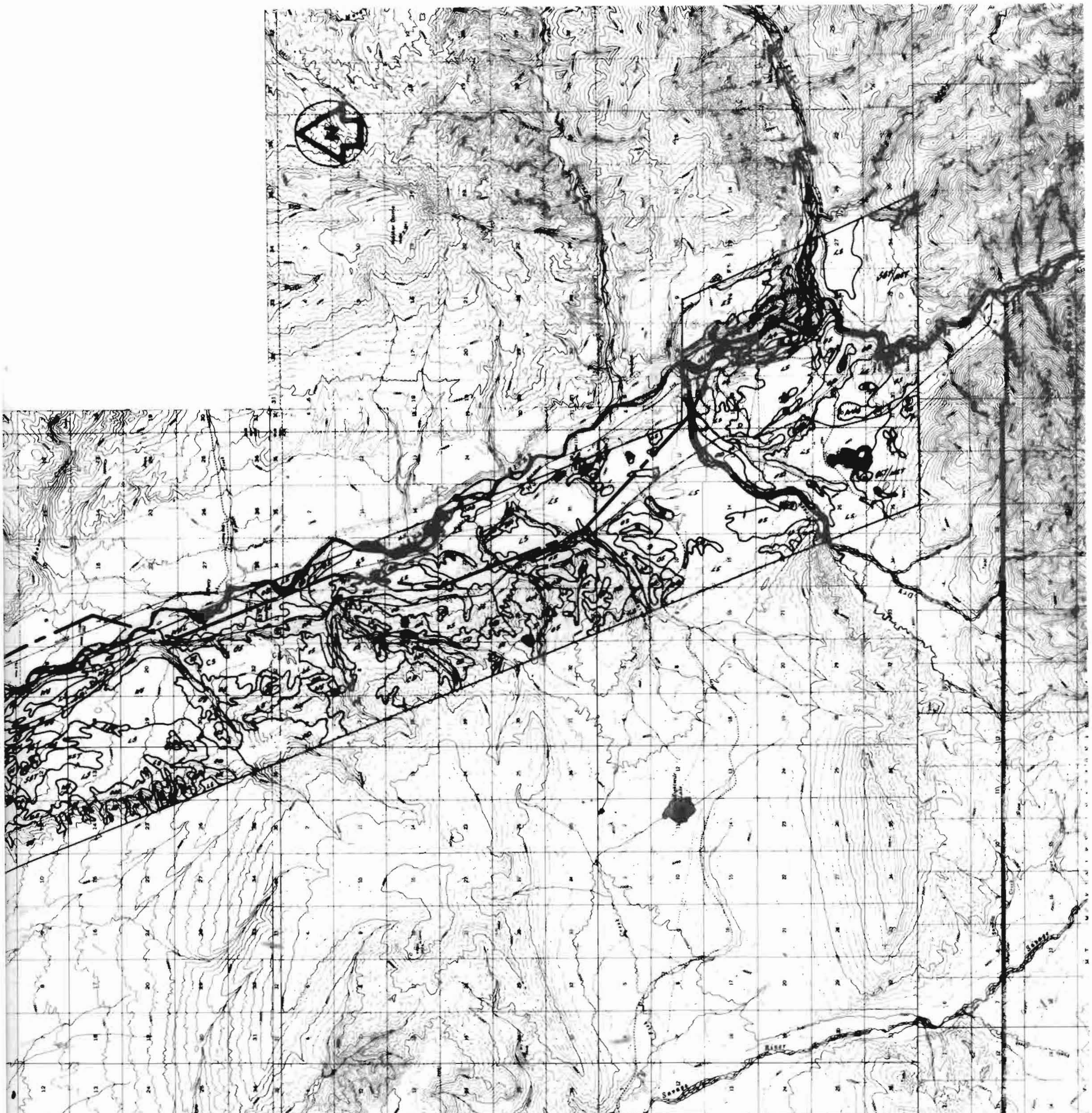
MATCH LINE SHEET 2



MAPPED AT SCALE: 1:63,360

VEGETATION MAP OF P
TRANSMIS

FROM McKENDRICK et al. 1982

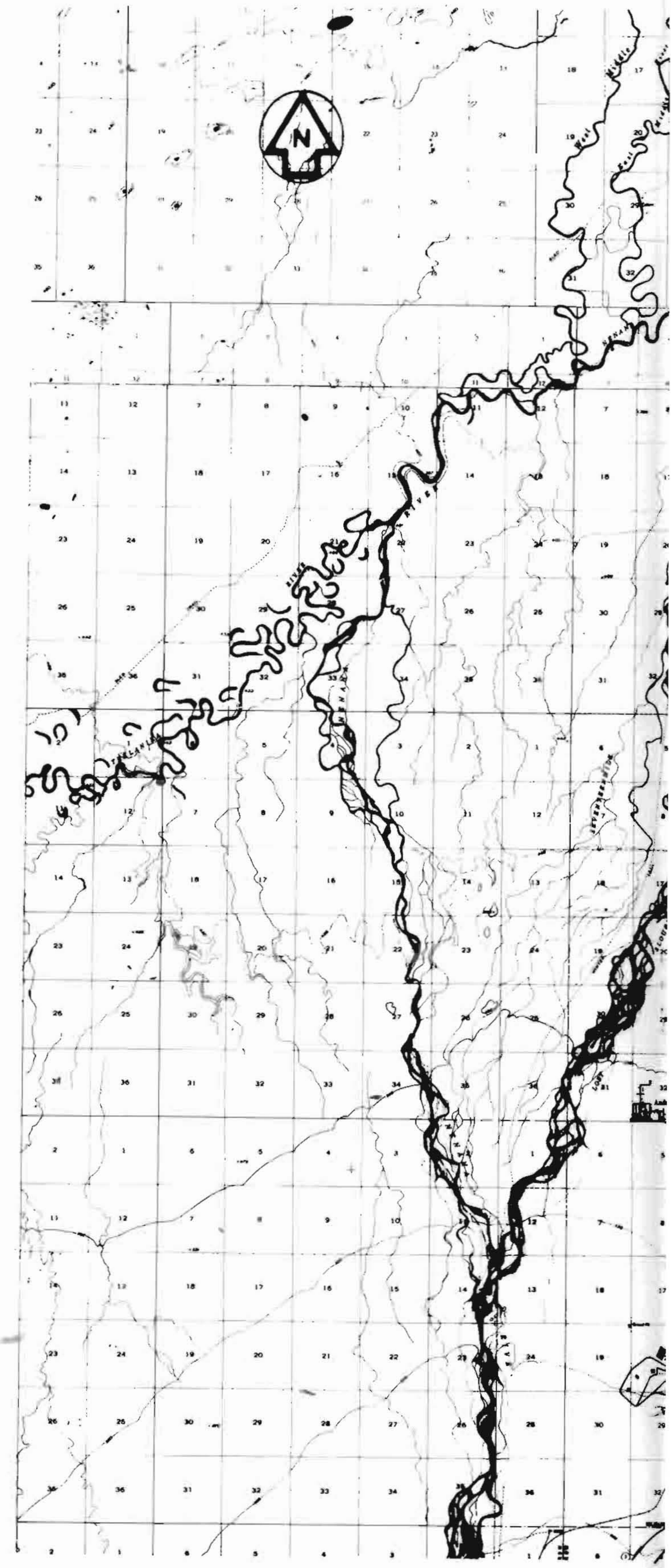


PROPOSED HEALY – FAIRBANKS
SSION CORRIDOR

FIGURE E.3.48

LEGEND:

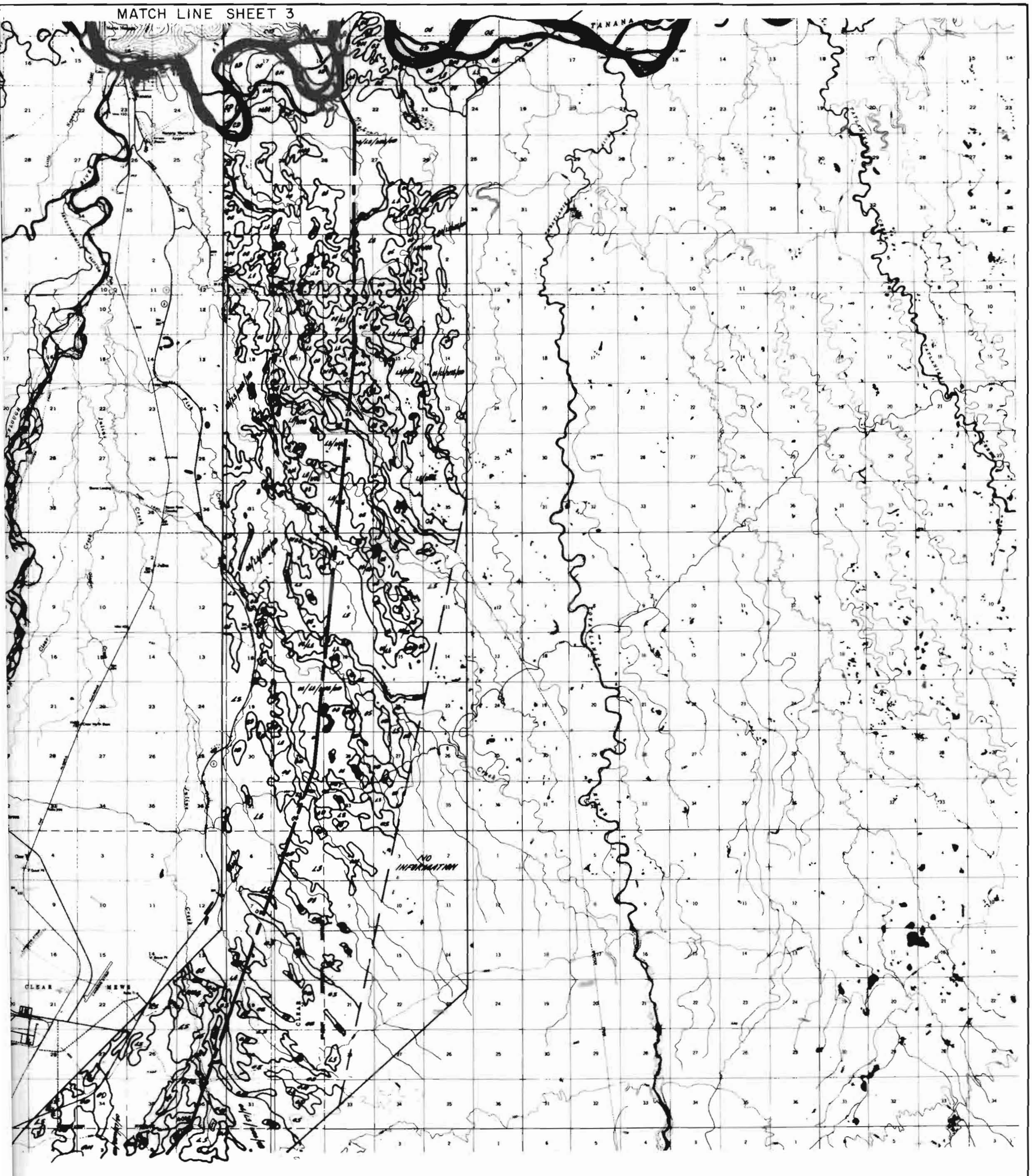
CS	CLOSED SPRUCE
OS	OPEN SPRUCE
WS	WOODLAND SPRUCE
CD	CLOSED DECIDUOUS
OD	OPEN DECIDUOUS
CM	CLOSED MIXED
OM	OPEN MIXED
WM	WOODLAND MIXED
LS	LOW SHRUB
WSG	WET SEDGE GRASS
SGT	SEDGE GRASS TUNDRA
MCT	MAT AND CUSHION TUNDRA
C	CROP
L	LAKE
R	ROCK
D	DEVELOPED
— — —	PROPOSED TRANSMISSION LINE



MAPPED AT SCALE: 1: 63,360

VEGETATION MAP OF P
TRANSMIS

FROM McKENDRICK et al. 1982



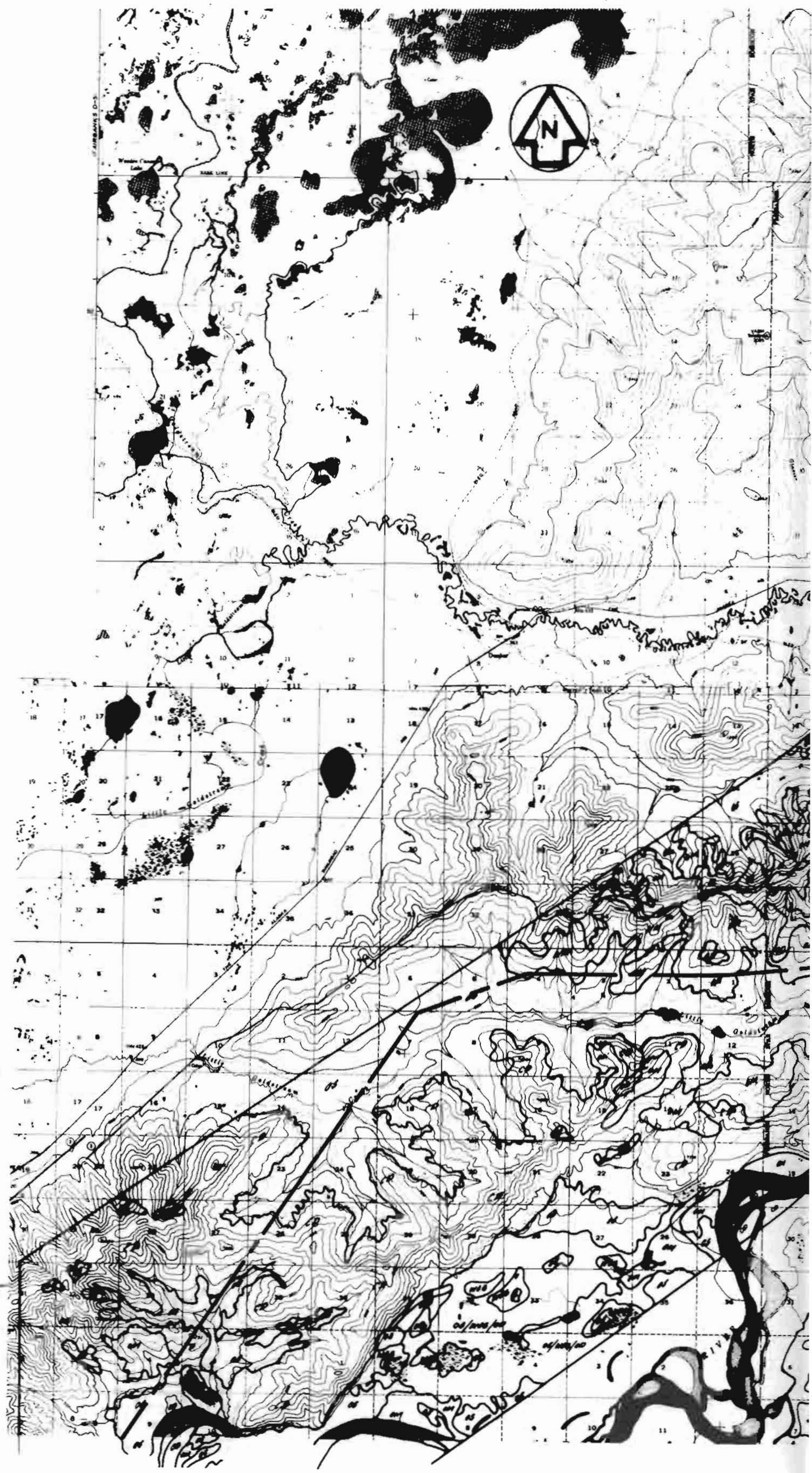
ROPOSED HEALY – FAIRBANKS
SION CORRIDOR

SCALE 0 2 4 MILES

FIGURE E.3.49

LEGEND:

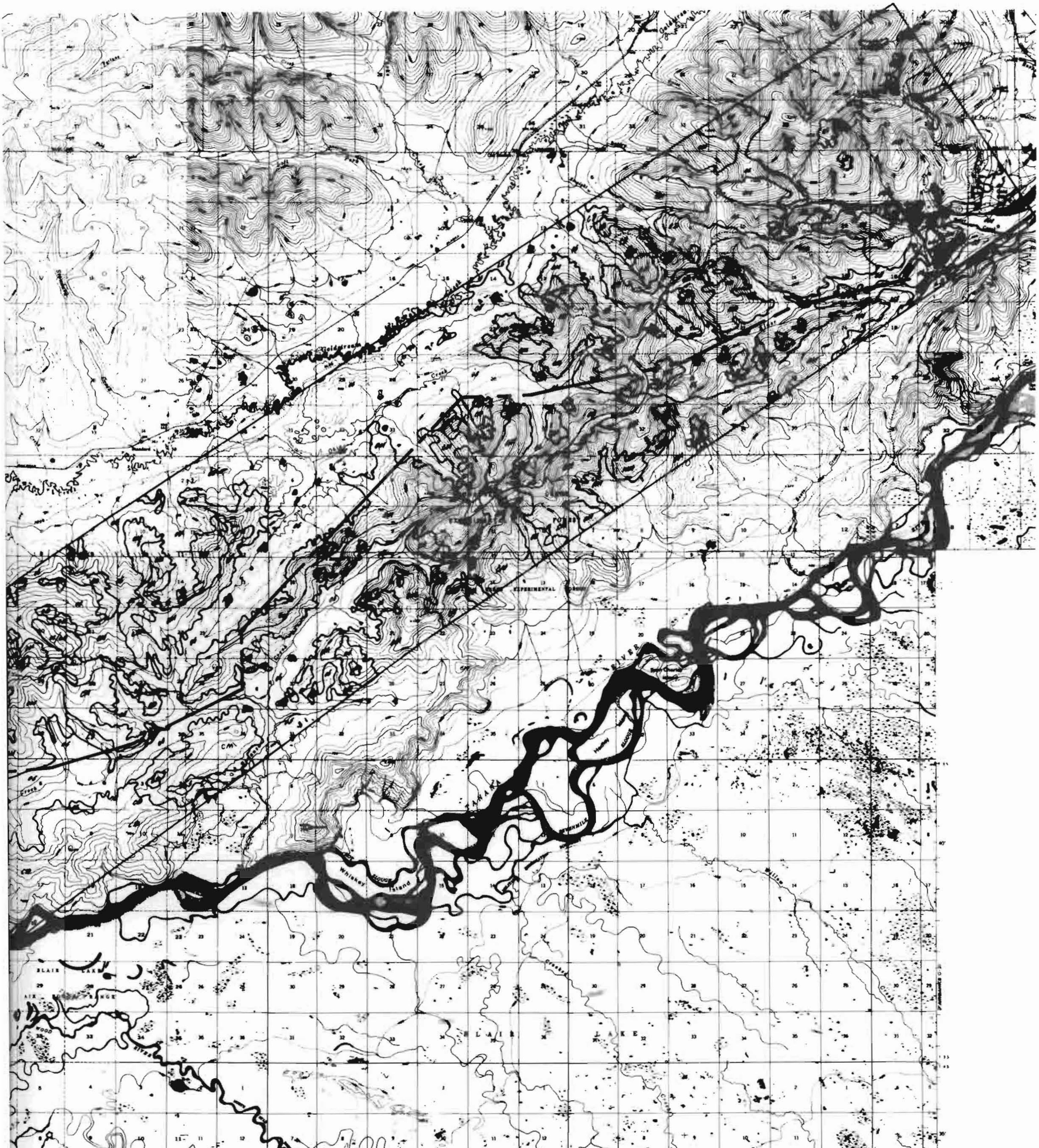
CS	CLOSED SPRUCE
OS	OPEN SPRUCE
WS	WOODLAND SPRUCE
CD	CLOSED DECIDUOUS
OD	OPEN DECIDUOUS
CM	CLOSED MIXED
OM	OPEN MIXED
WM	WOODLAND MIXED
LS	LOW SHRUB
WSG	WET SEDGE GRASS
SGT	SEDGE GRASS TUNDRA
MCT	MAT AND CUSHION TUNDRA
C	CROP
L	LAKE
R	ROCK
D	DEVELOPED
▬ ▬ ▬	PROPOSED TRANSMISSION LINE



MAPPED AT SCALE: 1:63,360

VEGETATION MAP OF P
TRANSMIS

FROM McKENDRICK et al. 1982



MATCH LINE SHEET 2

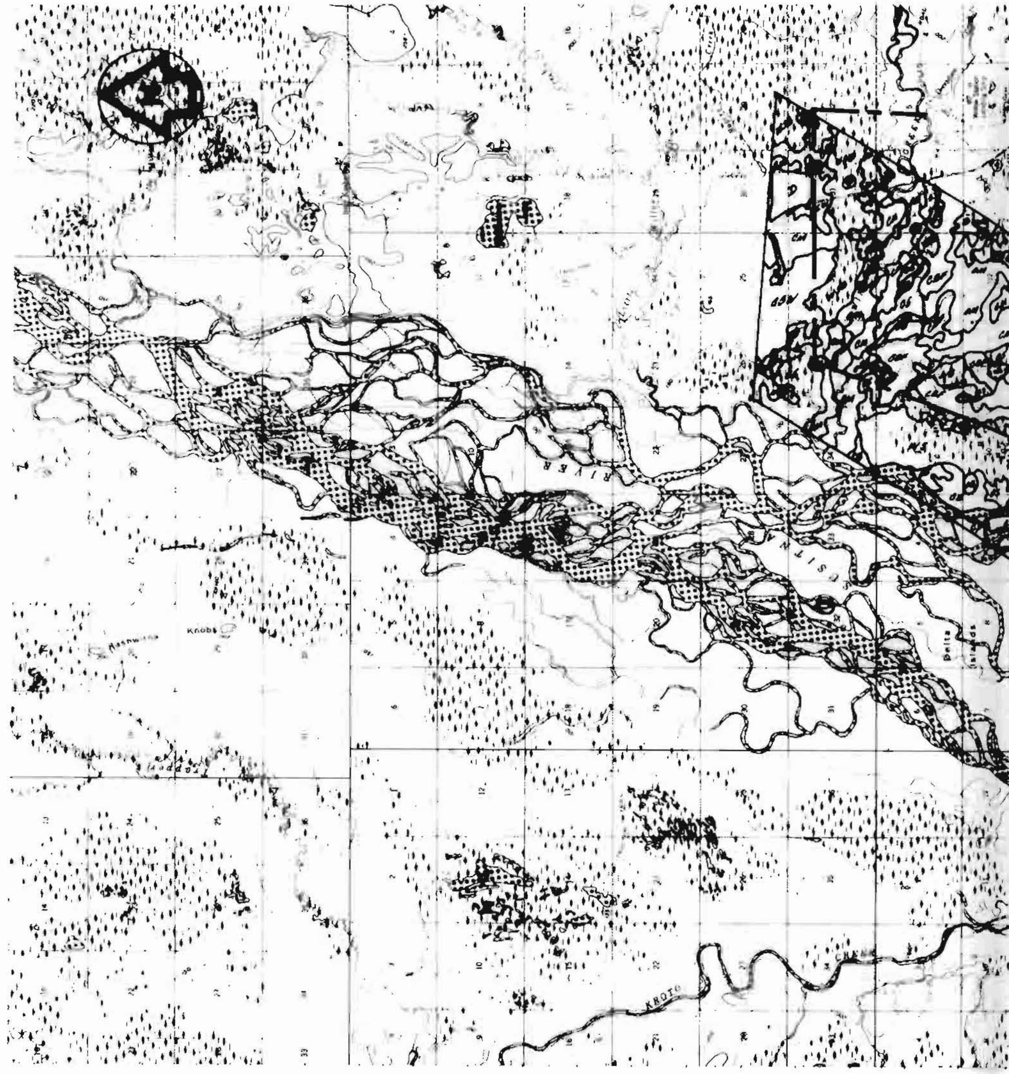
ROPOSED HEALY–FAIRBANKS
SSION CORRIDOR

SCALE 0 2 4 MILES

FIGURE E.3.50

LEGEND:

CS	CLOSED SPRUCE
WSG	WET SEDGE GRASS
OS	OPEN SPRUCE
WS	WOODLAND SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
LS	LOW SHRUB
D	DISTURBED
L	LAKES
— - —	PROPOSED TRANSMISSION LINE

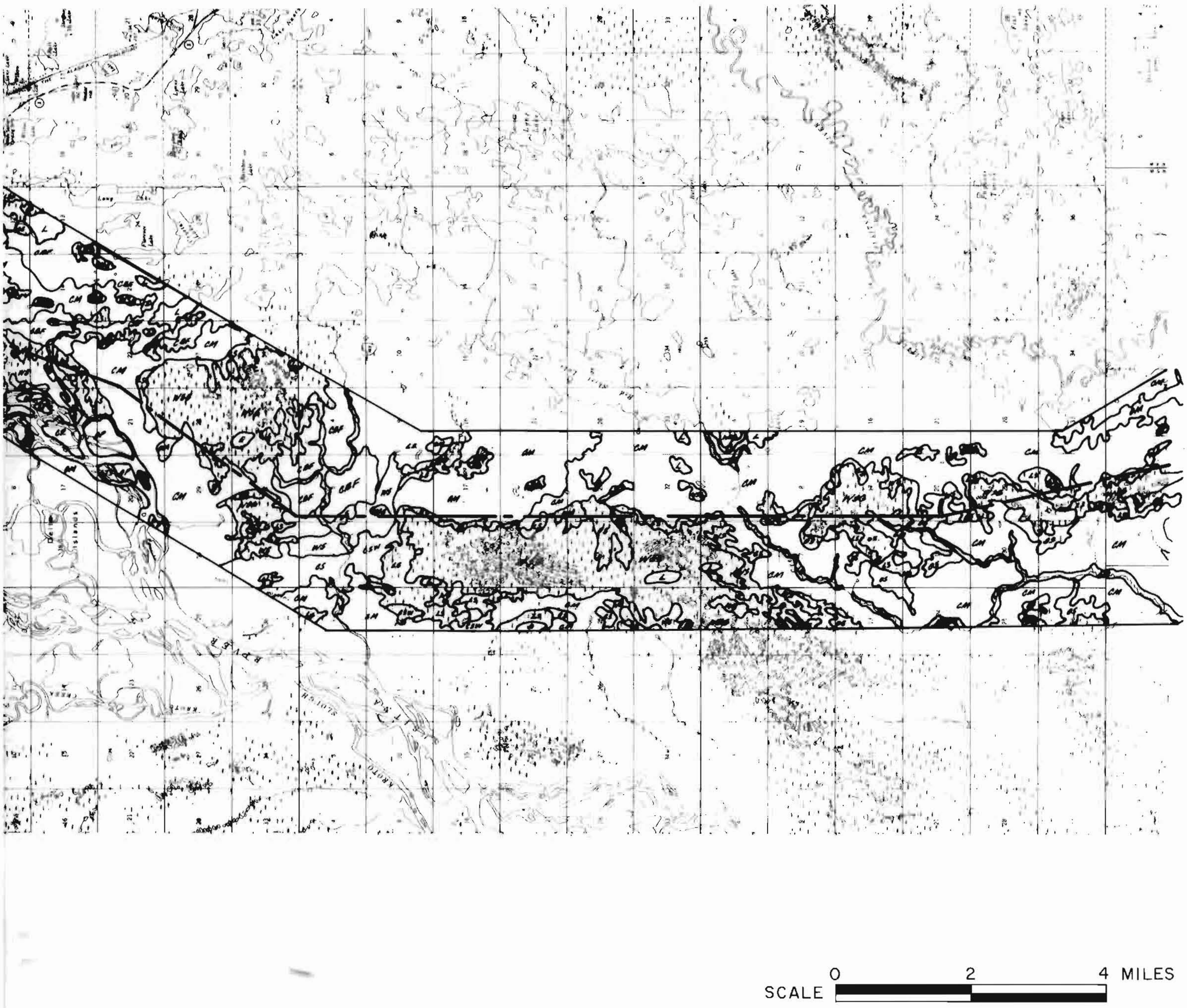


MAPPED AT SCALE: 1:63,360

VEGETATION MAP OF PROP

TRANSMISSI

FROM McKENDRICK et al. 1982



POSED WILLOW-COOK INLET
ION CORRIDOR

FIGURE E.3.51

LEGEND:

CS	CLOSED SPRUCE
WSG	WET SEDGE GRASS
OS	OPEN SPRUCE
WS	WOODLAND SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
LS	LOW SHRUB
D	DISTURBED
L	LAKES
—·—	PROPOSED TRANSMISSION LINE

MATCH LINE SHEET I

MAPPED AT SCALE: 1:63,360

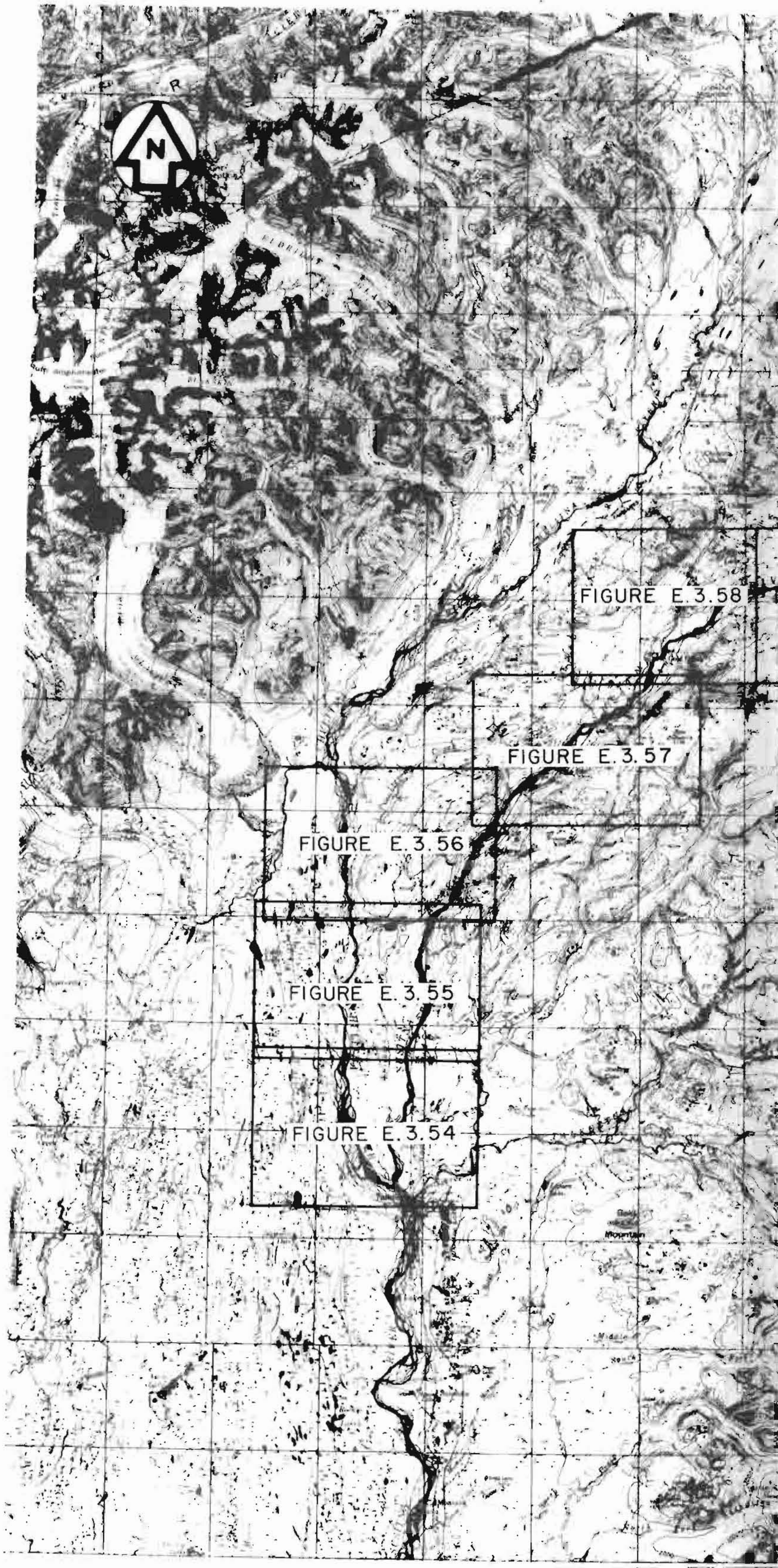
VEGETATION MAP OF PR
TRANSMIS

FROM McKENDRICK et al. 1982

ROPOSED WILLOW-COOK INLET
SSION CORRIDOR

SCALE 0 2 4 MILES

FIGURE E.3.52



VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982

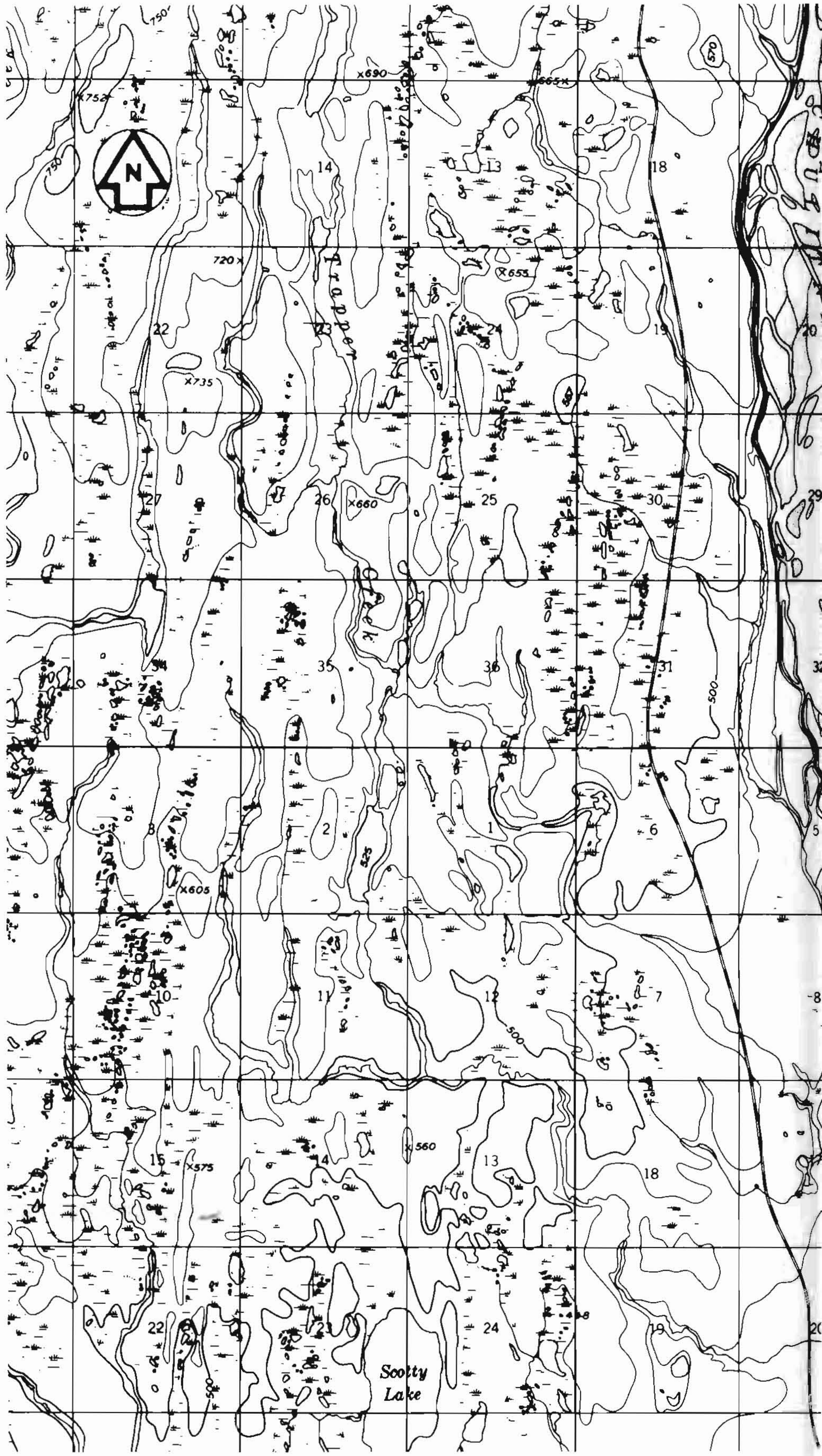
SCALE 0 12 24 MILES

JSITNA PROJECT IMPACT AREAS

FIGURE E.3.53

LEGEND:

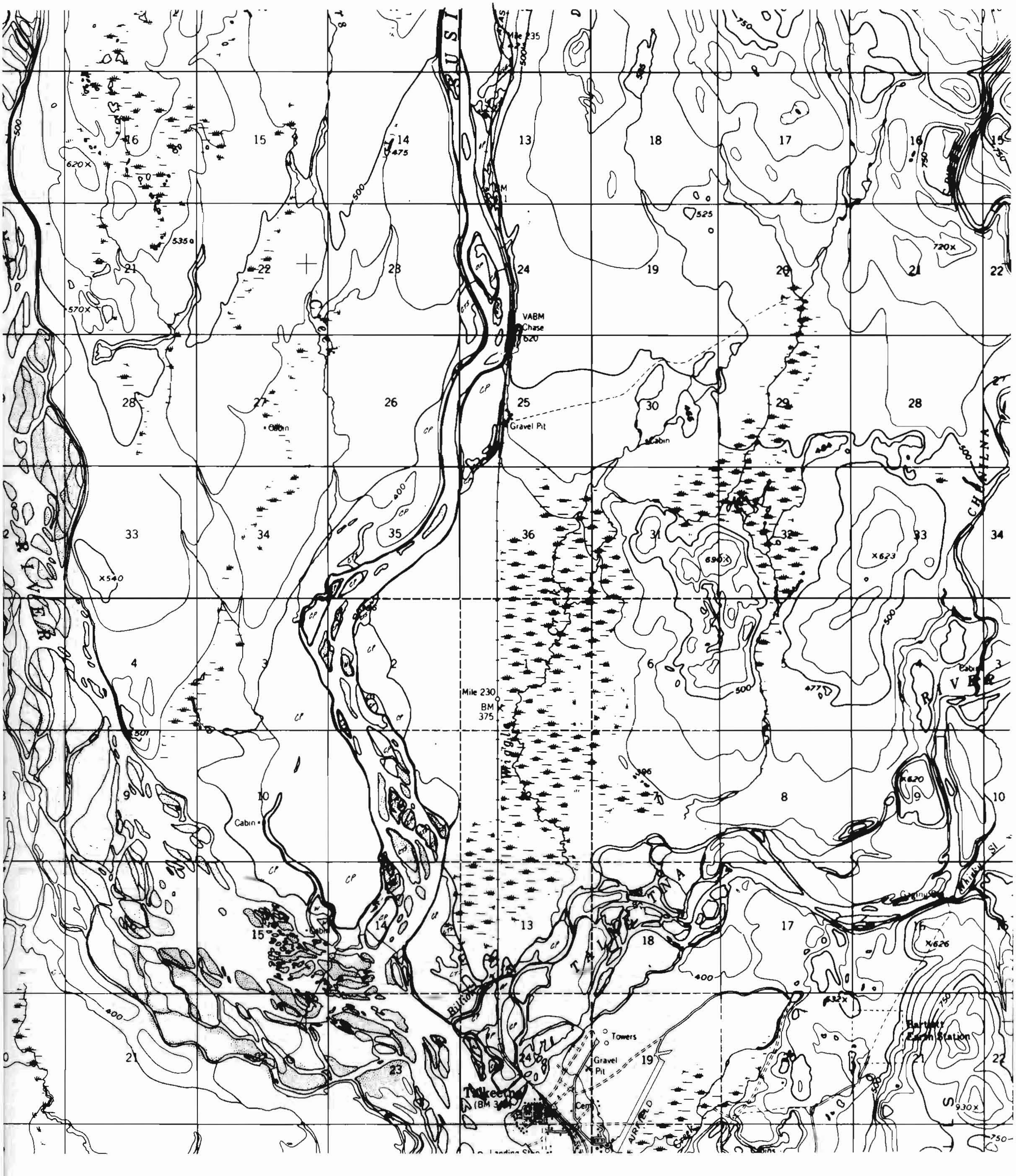
R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES



MAPPED AT SCALE: 1:24,000

VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982

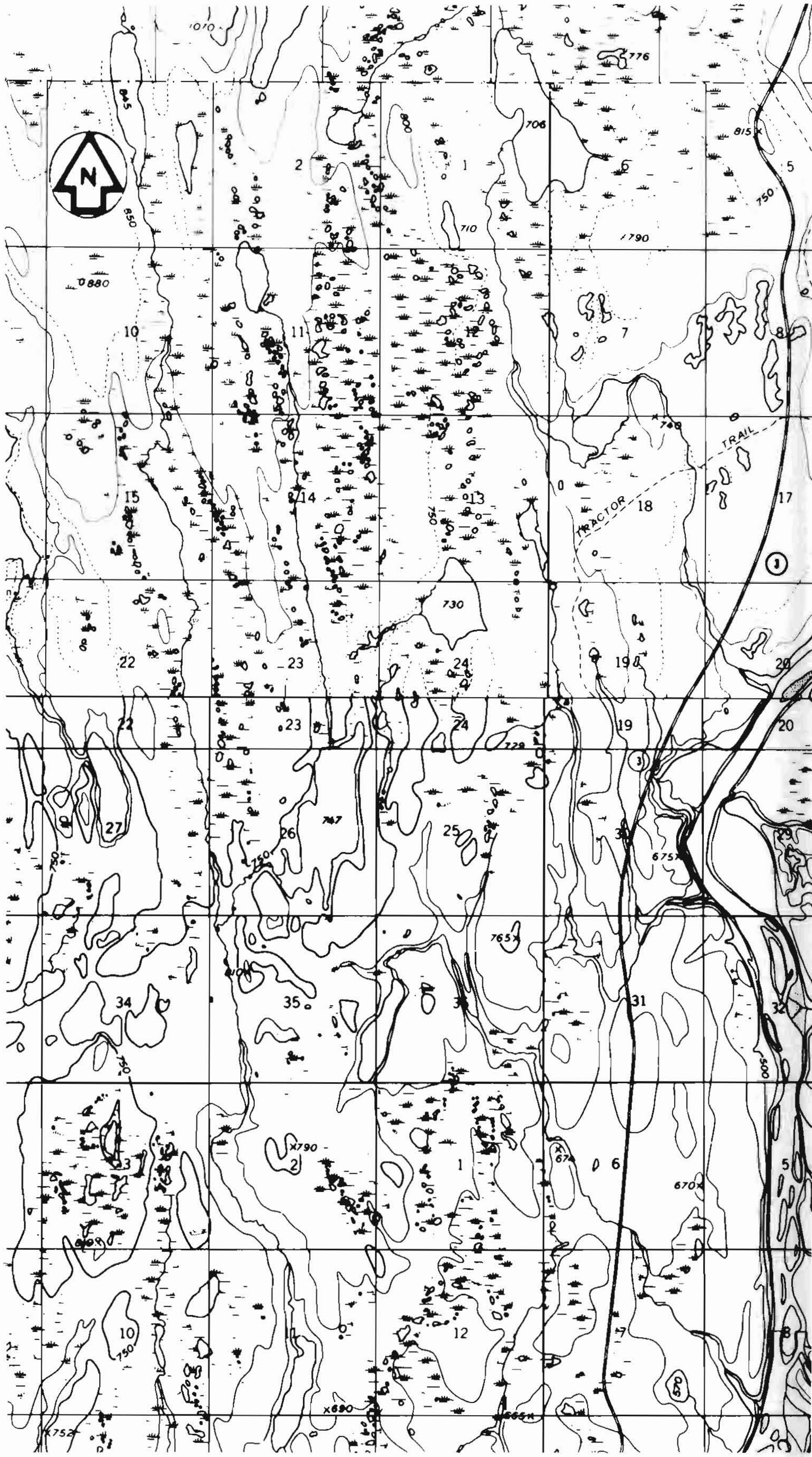


SITNA PROJECT IMPACT AREAS

FIGURE E.3.54

LEGEND:

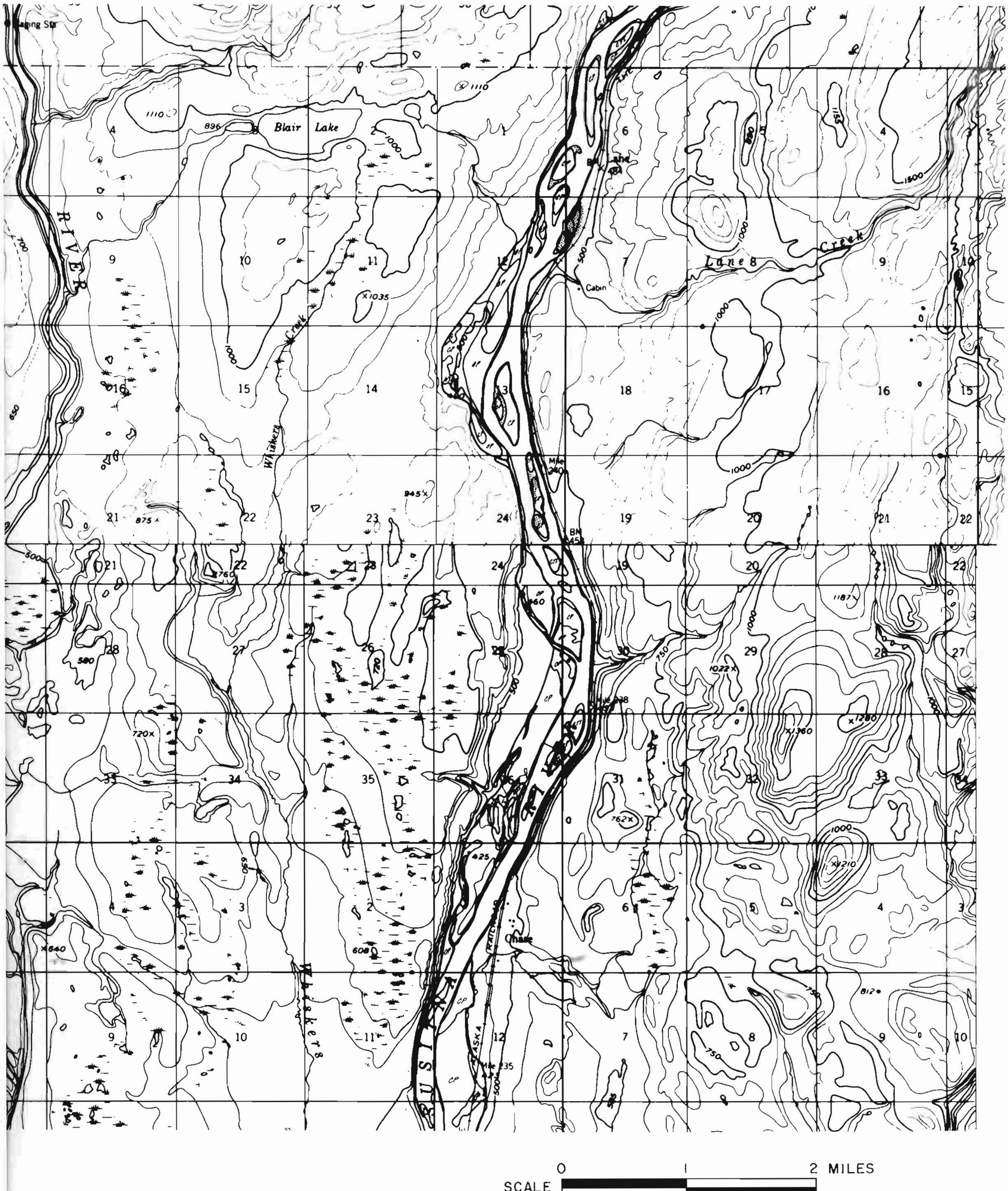
R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES



MAPPED AT SCALE: 1:24,000

VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982

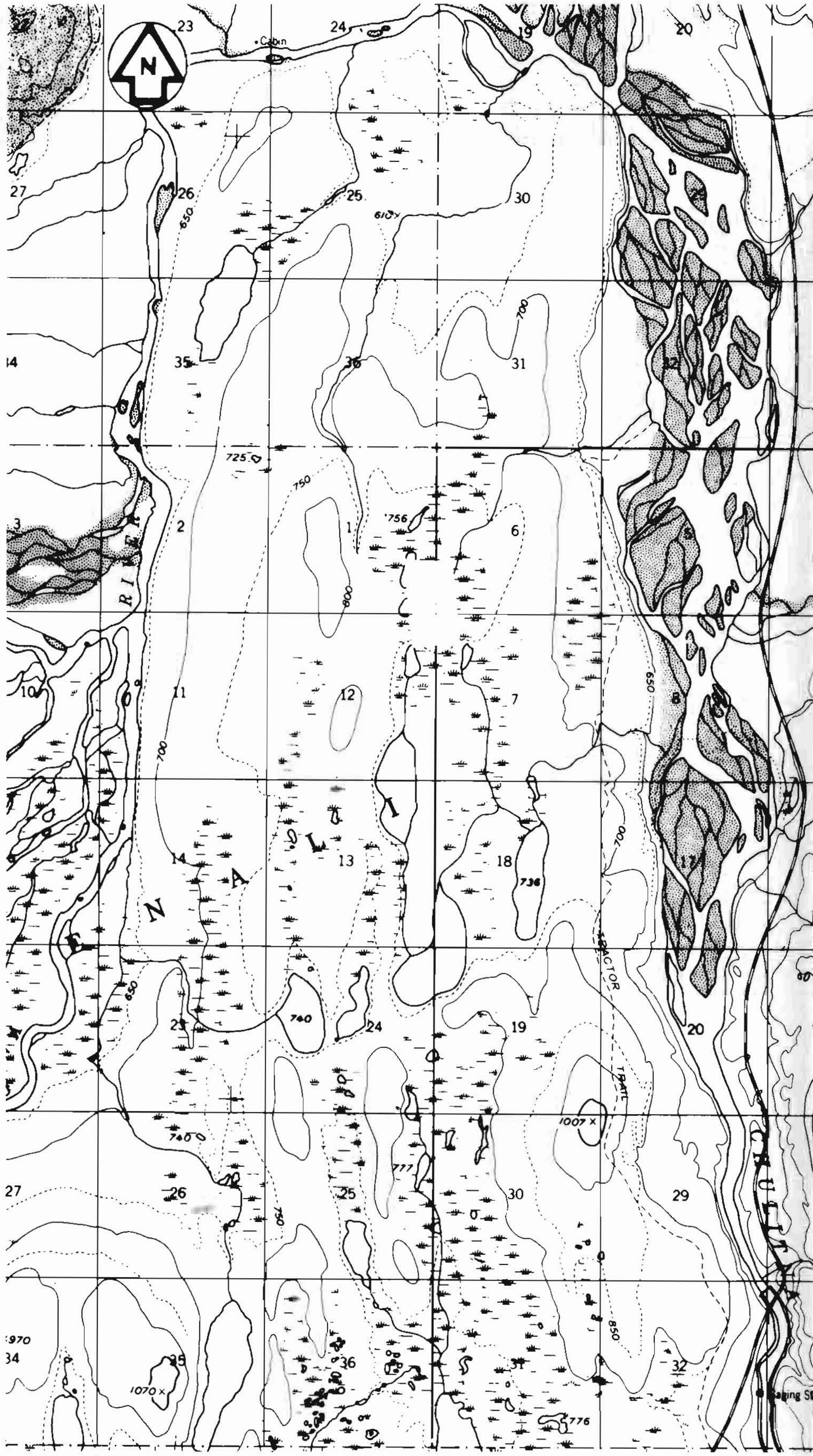


SITNA PROJECT IMPACT AREAS

FIGURE E.3.55

LEGEND:

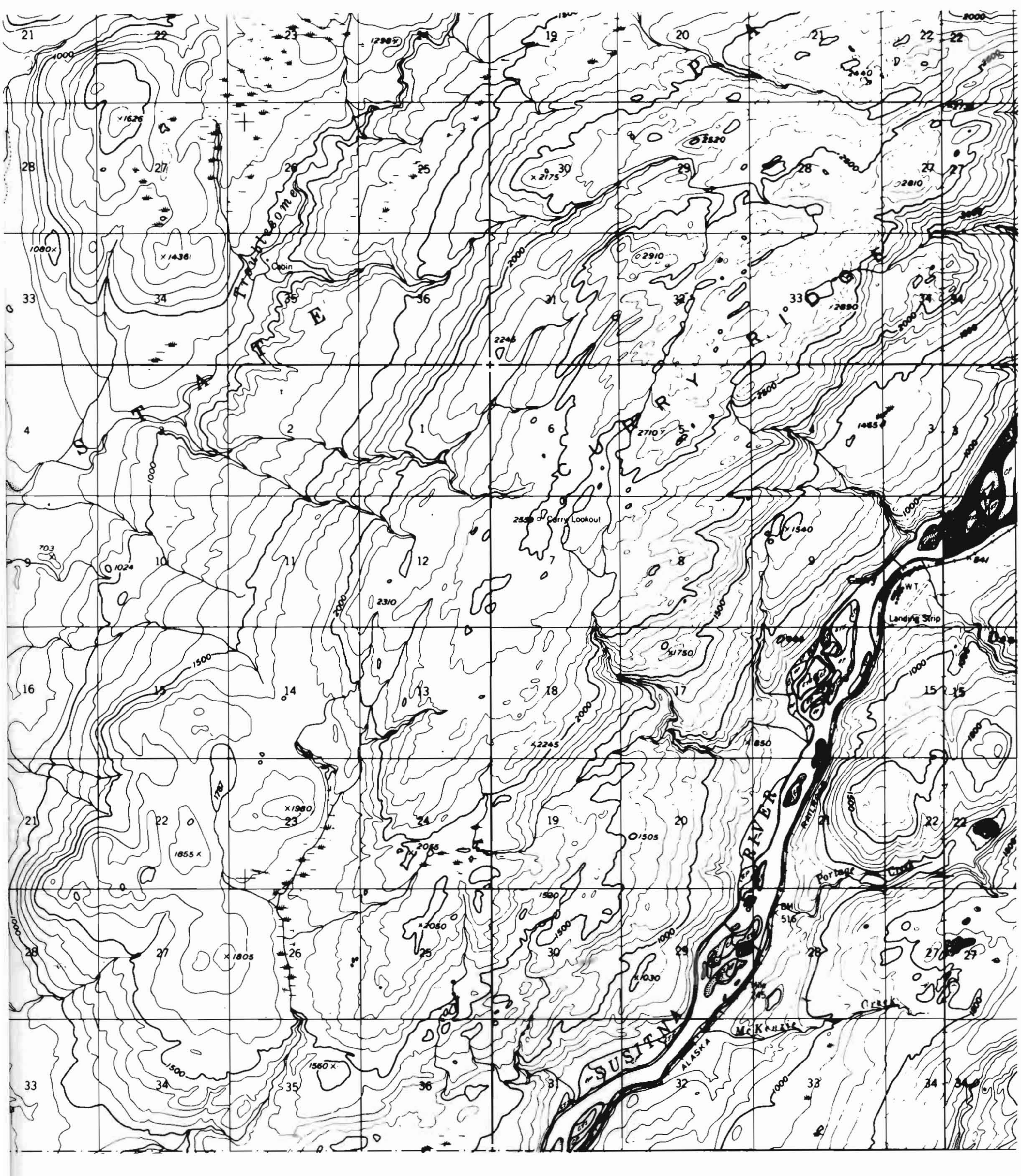
R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES



MAPPED AT SCALE: 1:24,000

VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982

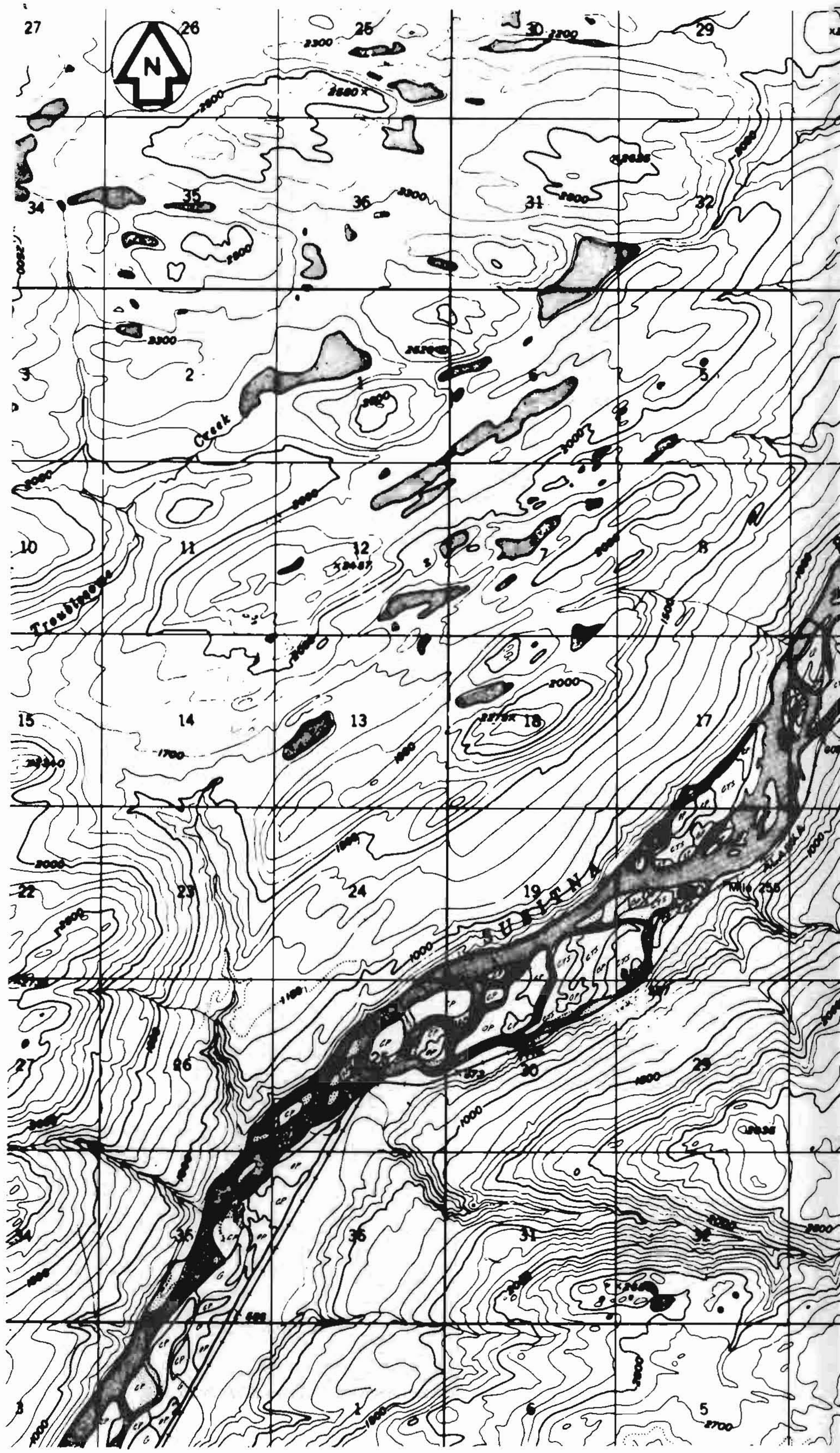


SITNA PROJECT IMPACT AREAS

FIGURE E.3.56

LEGEND:

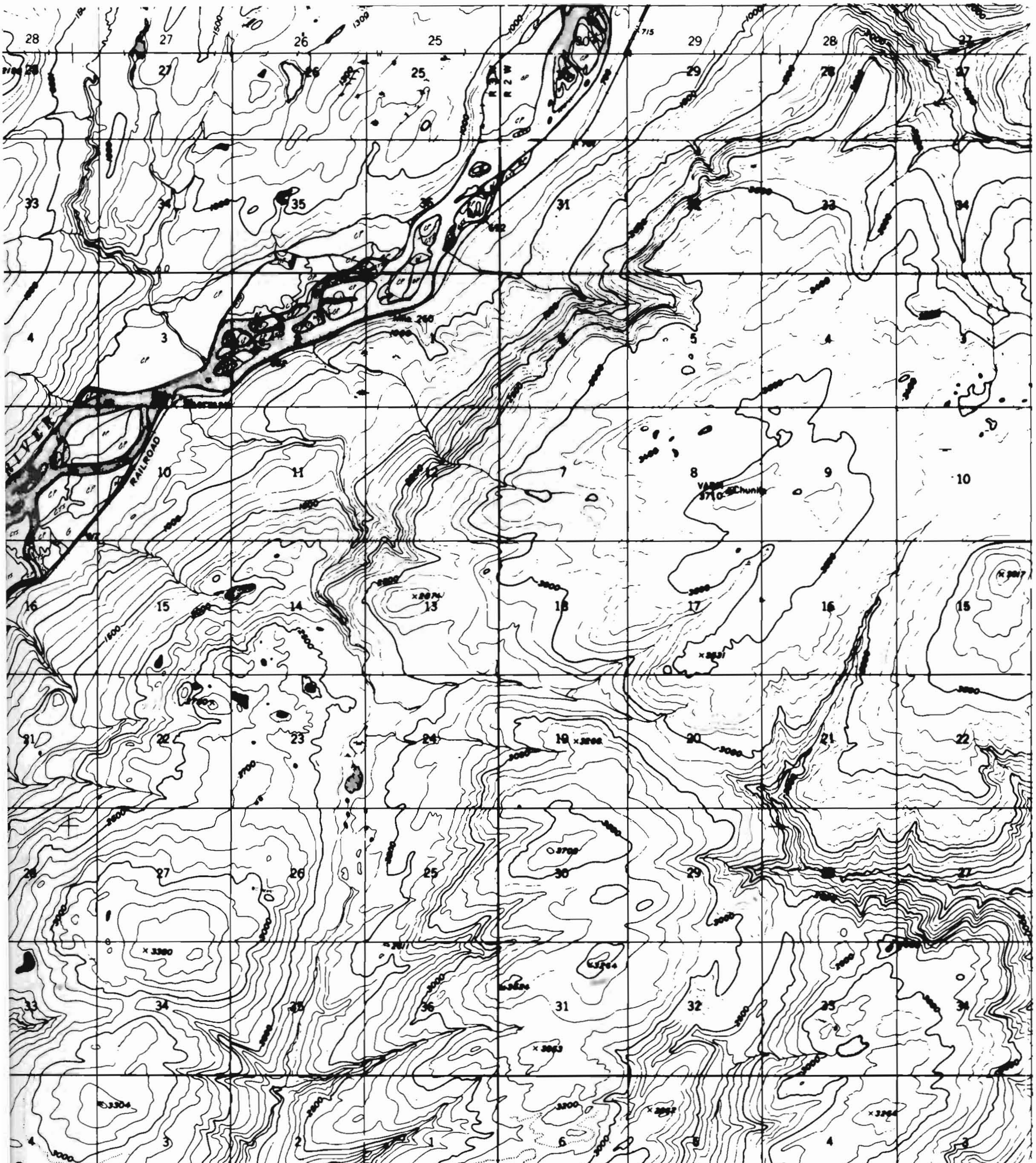
R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES



MAPPED AT SCALE: 1:24,000

VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982



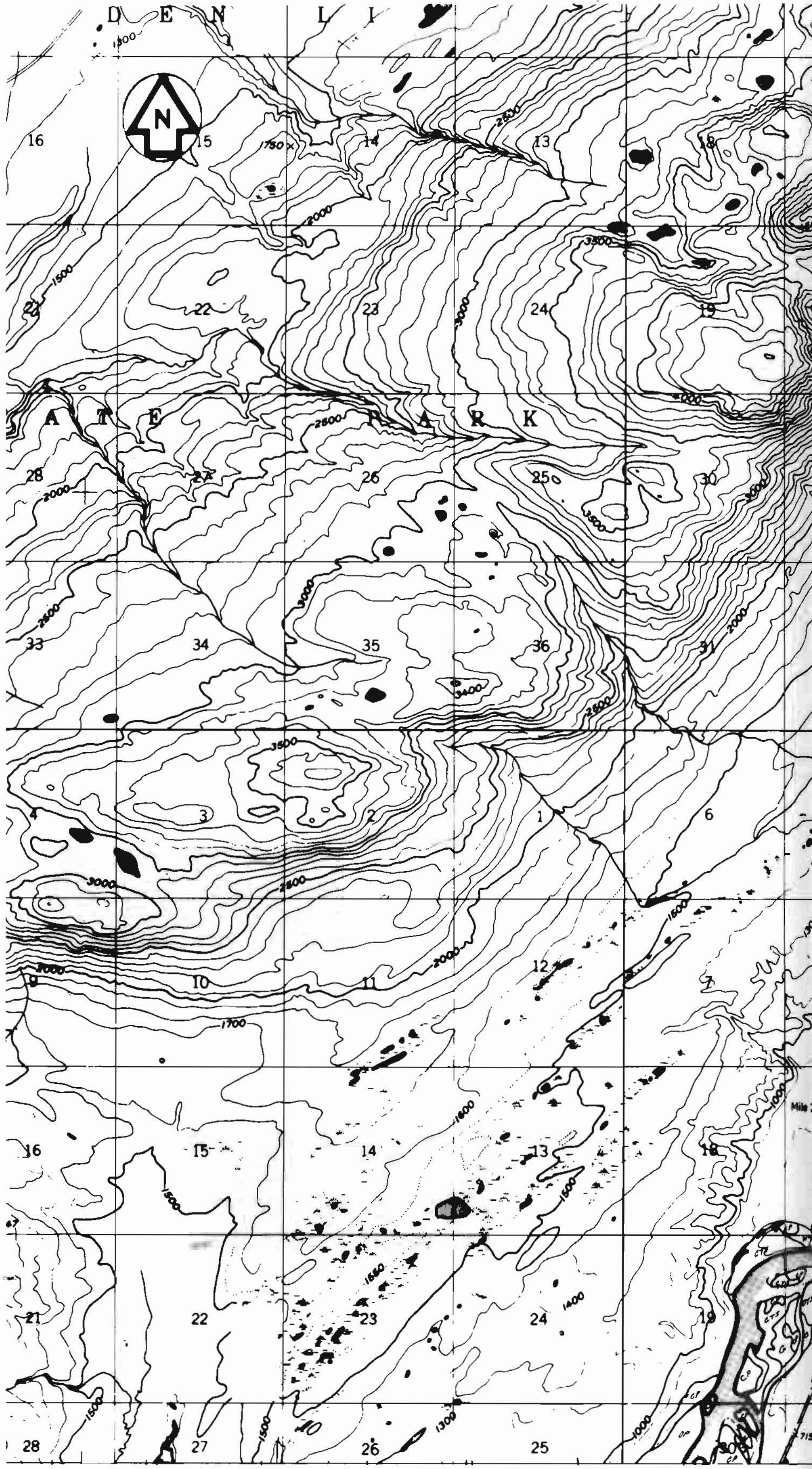
SCALE 0 1 2 MILES

SITNA PROJECT IMPACT AREAS

FIGURE E.3.57

LEGEND:

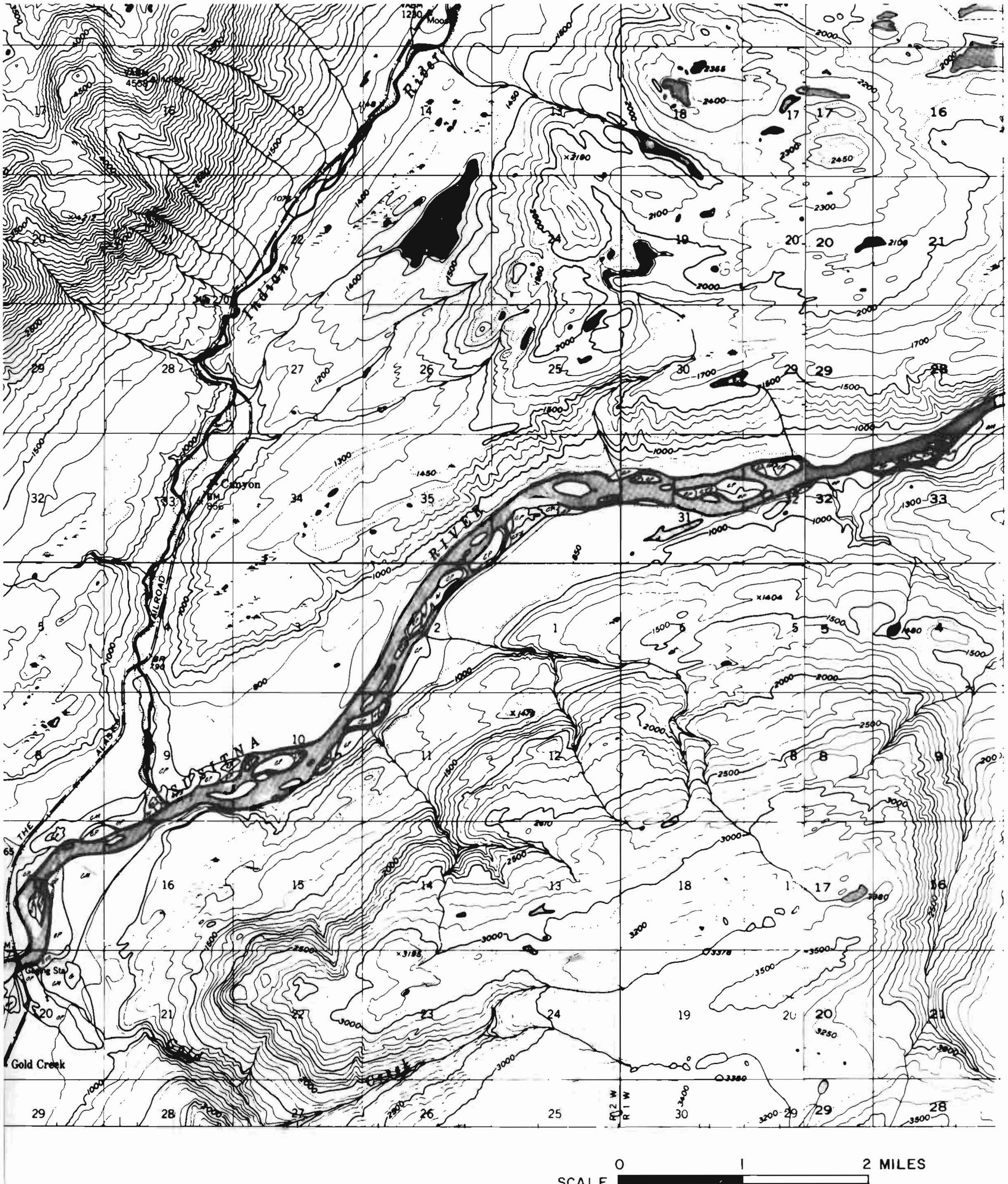
R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES



MAPPED AT SCALE: 1:24,000

VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982

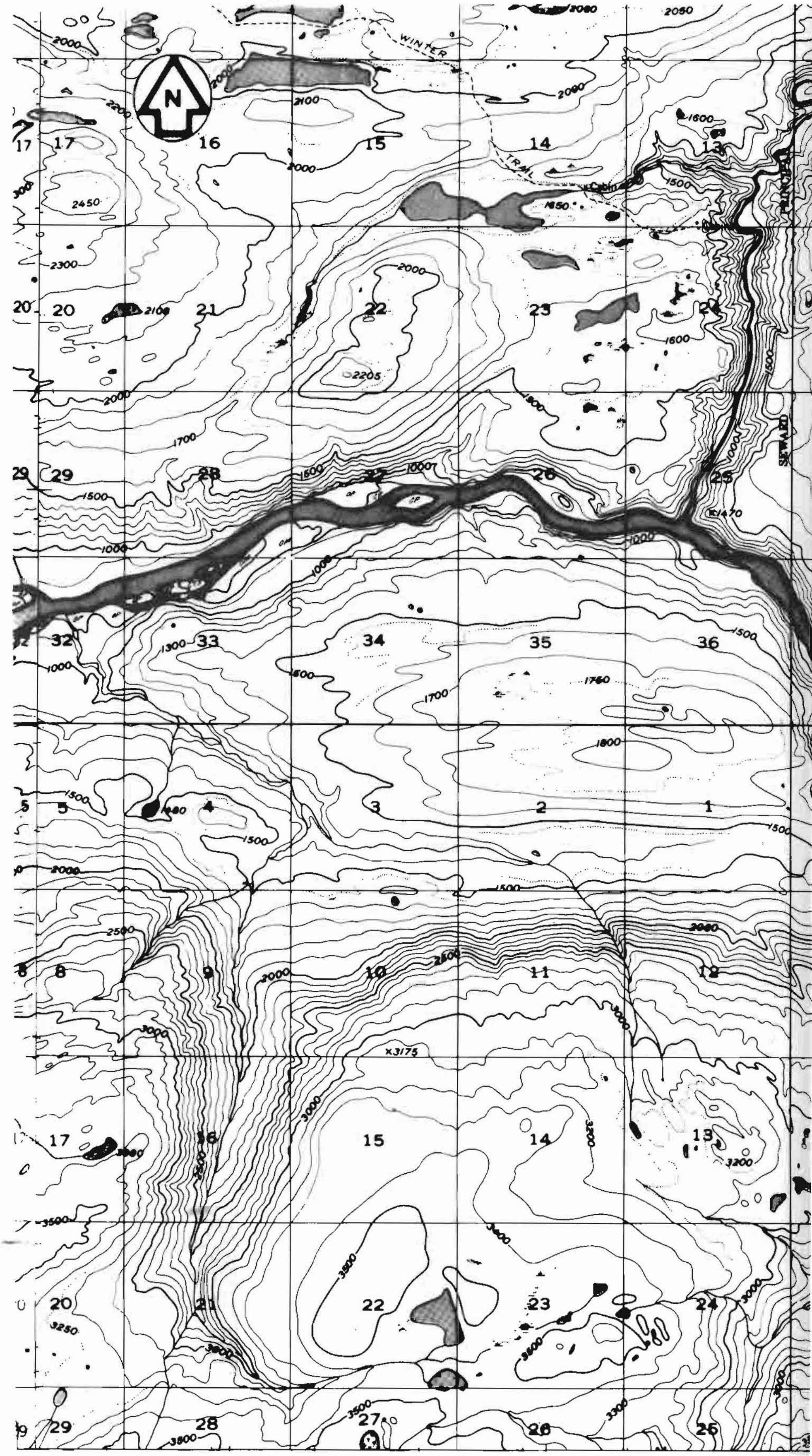


SITNA PROJECT IMPACT AREAS

FIGURE E.3.58

LEGEND:

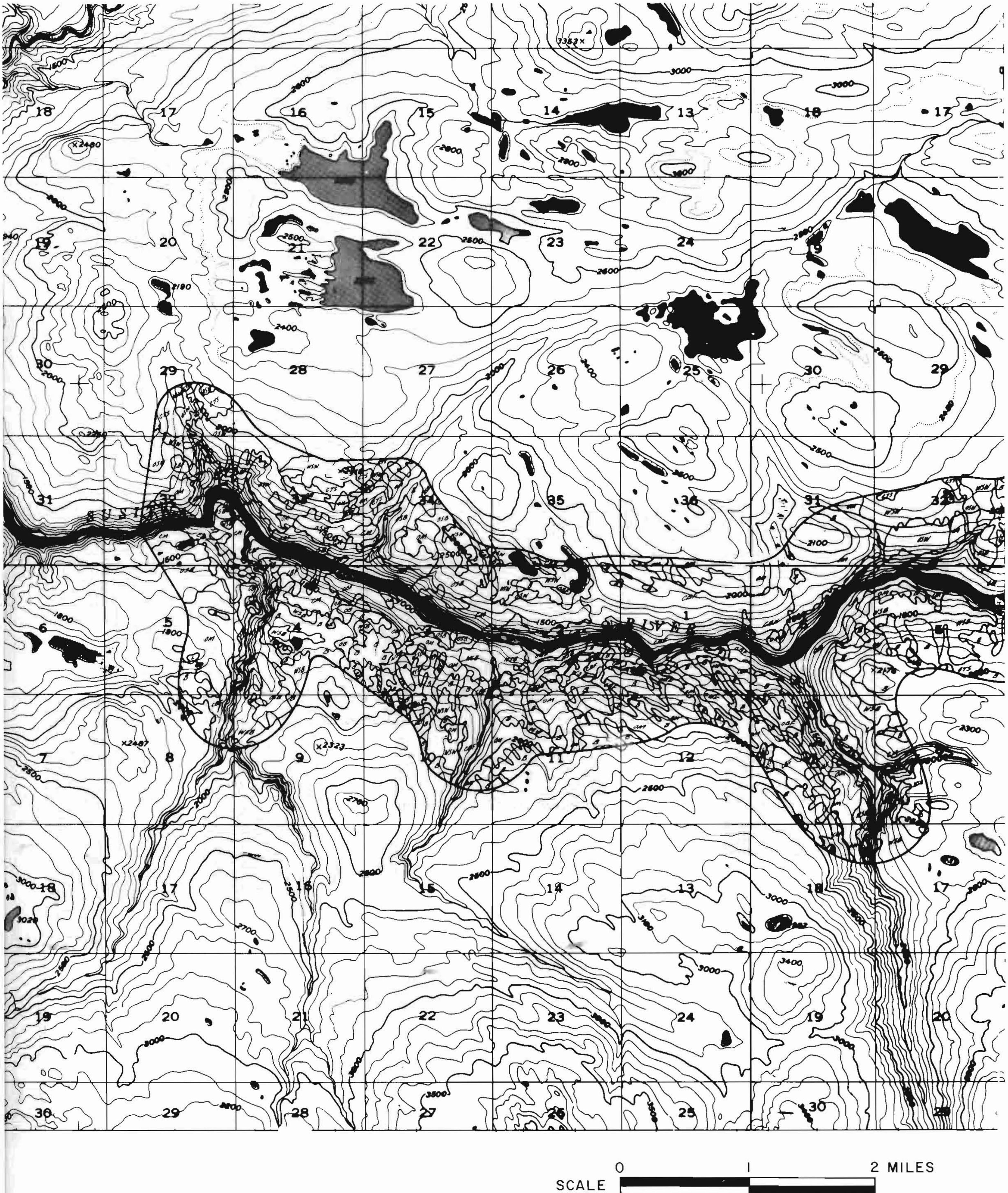
R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES



MAPPED AT SCALE: 1:24,000

VEGETATION MAP OF S

FROM McKENDRICK et al. 1982

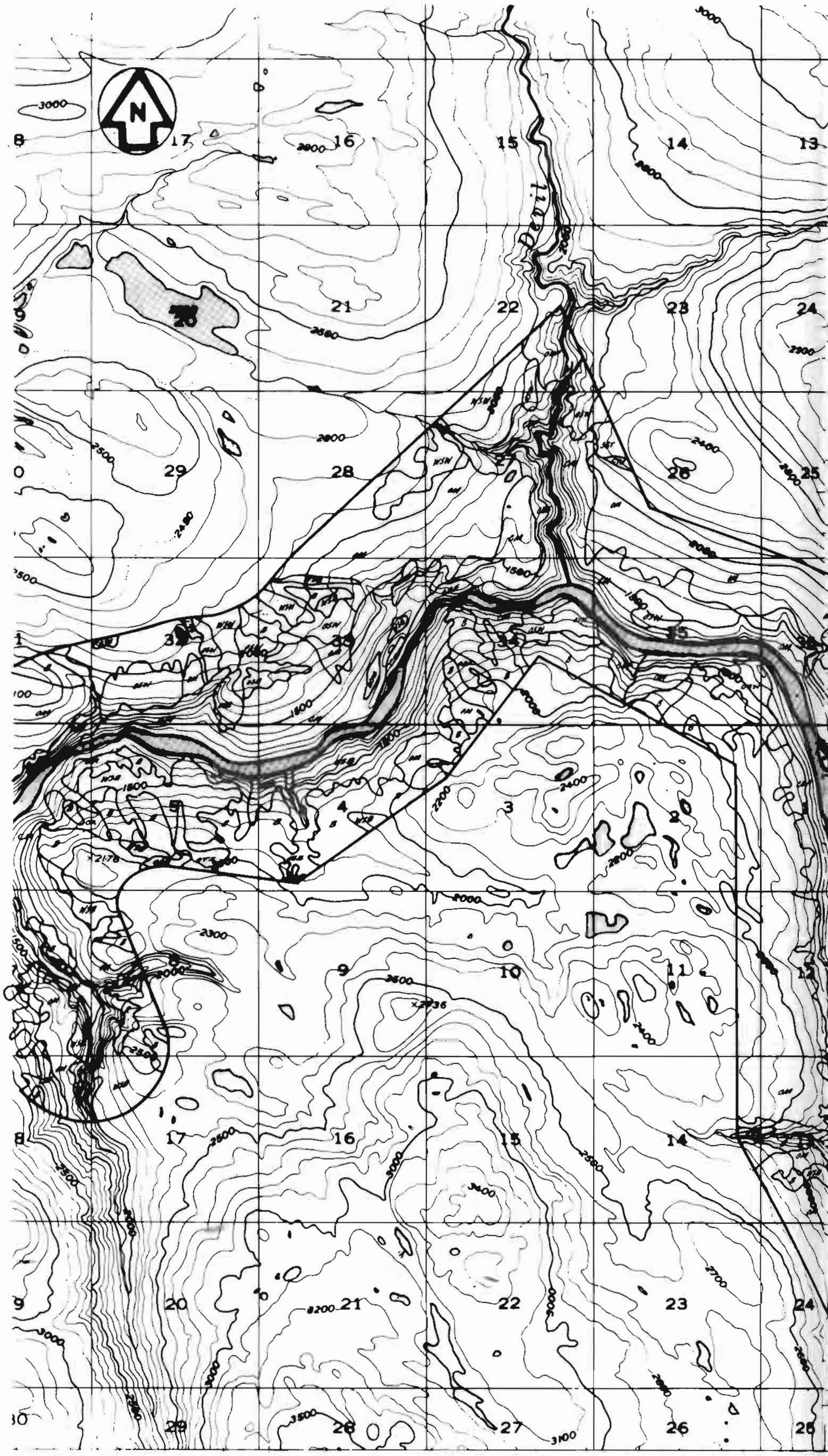


USITNA PROJECT IMPACT AREAS

FIGURE E.3.59

LEGEND:

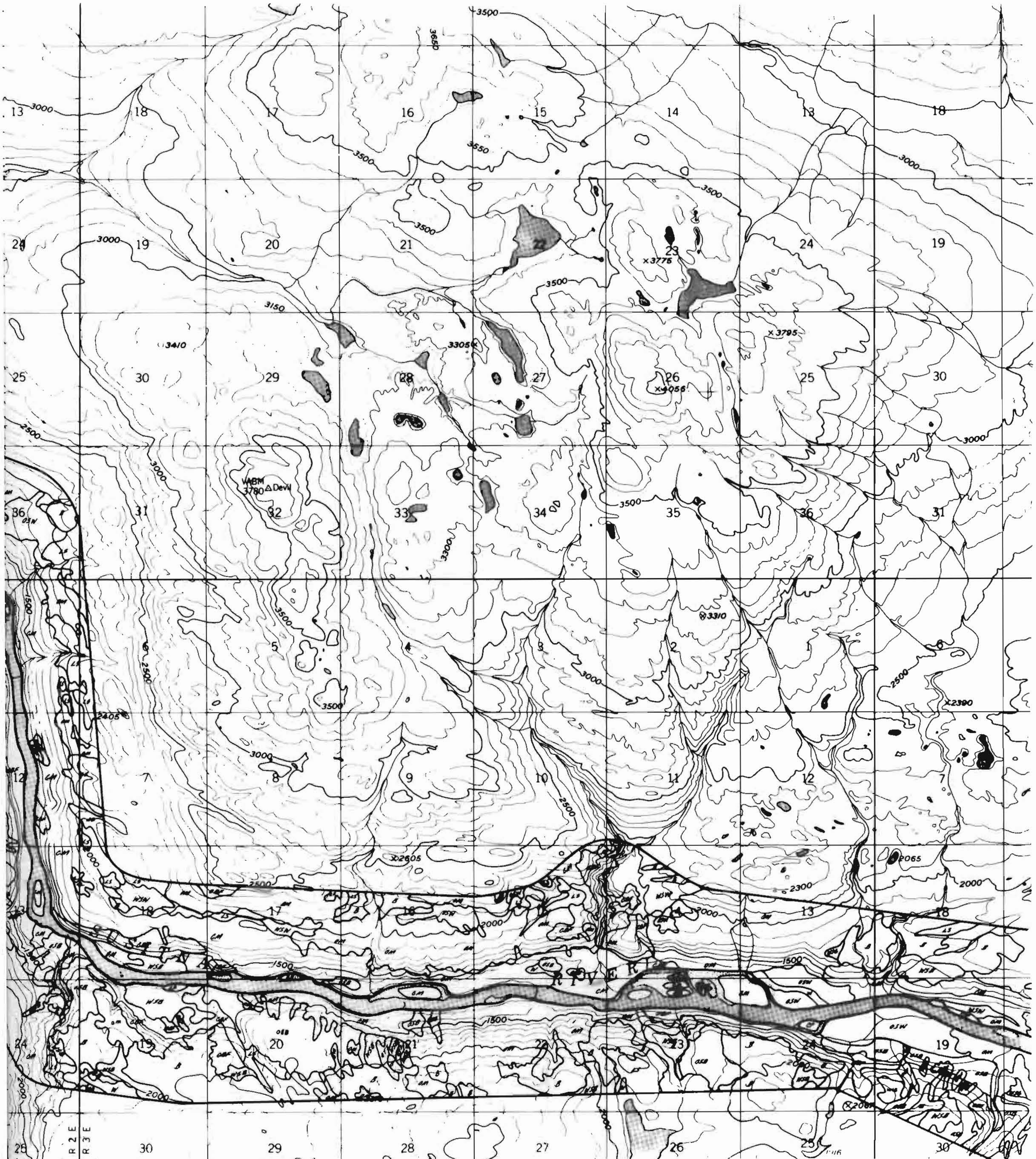
R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES



MAPPED AT SCALE: 1:24,000

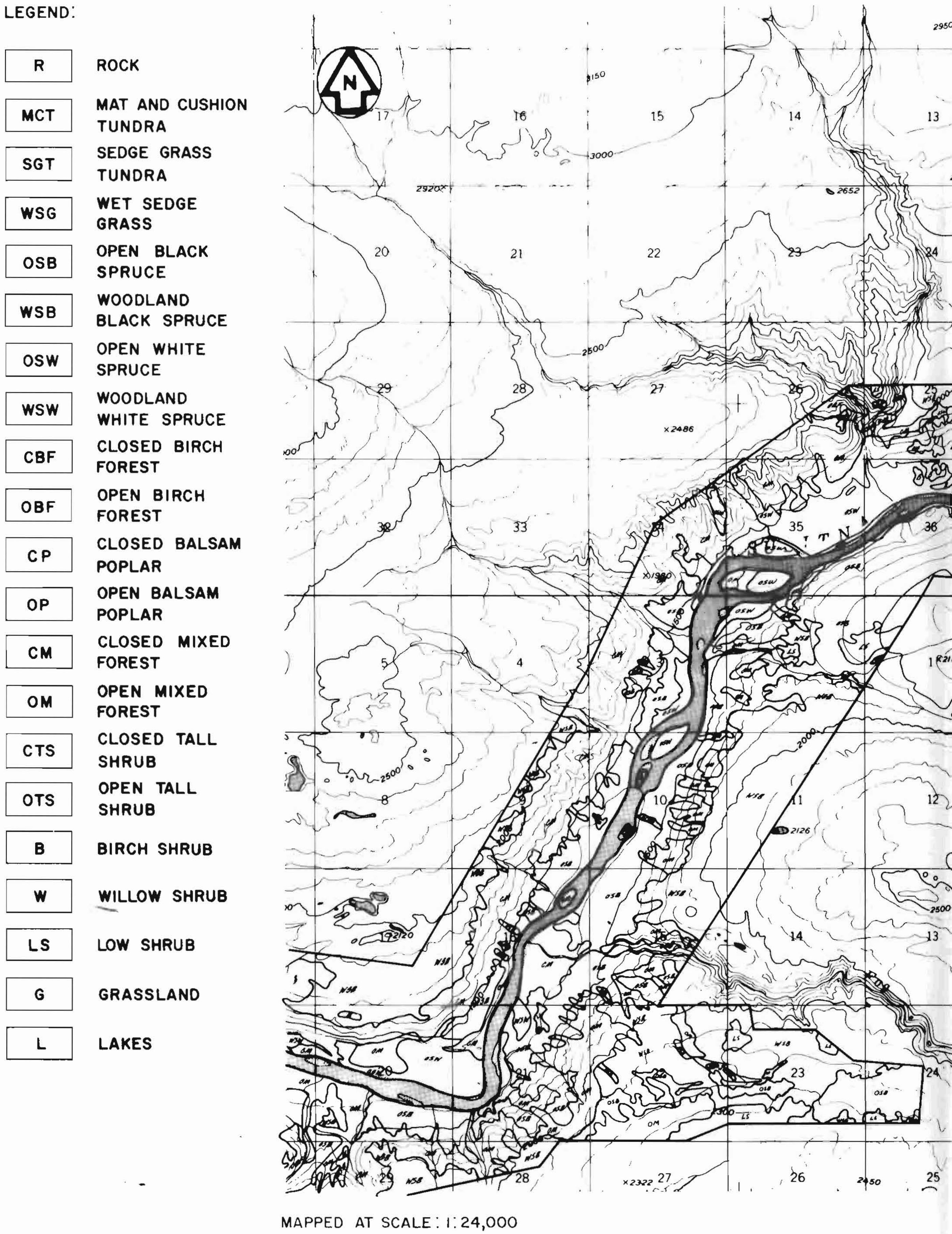
VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982



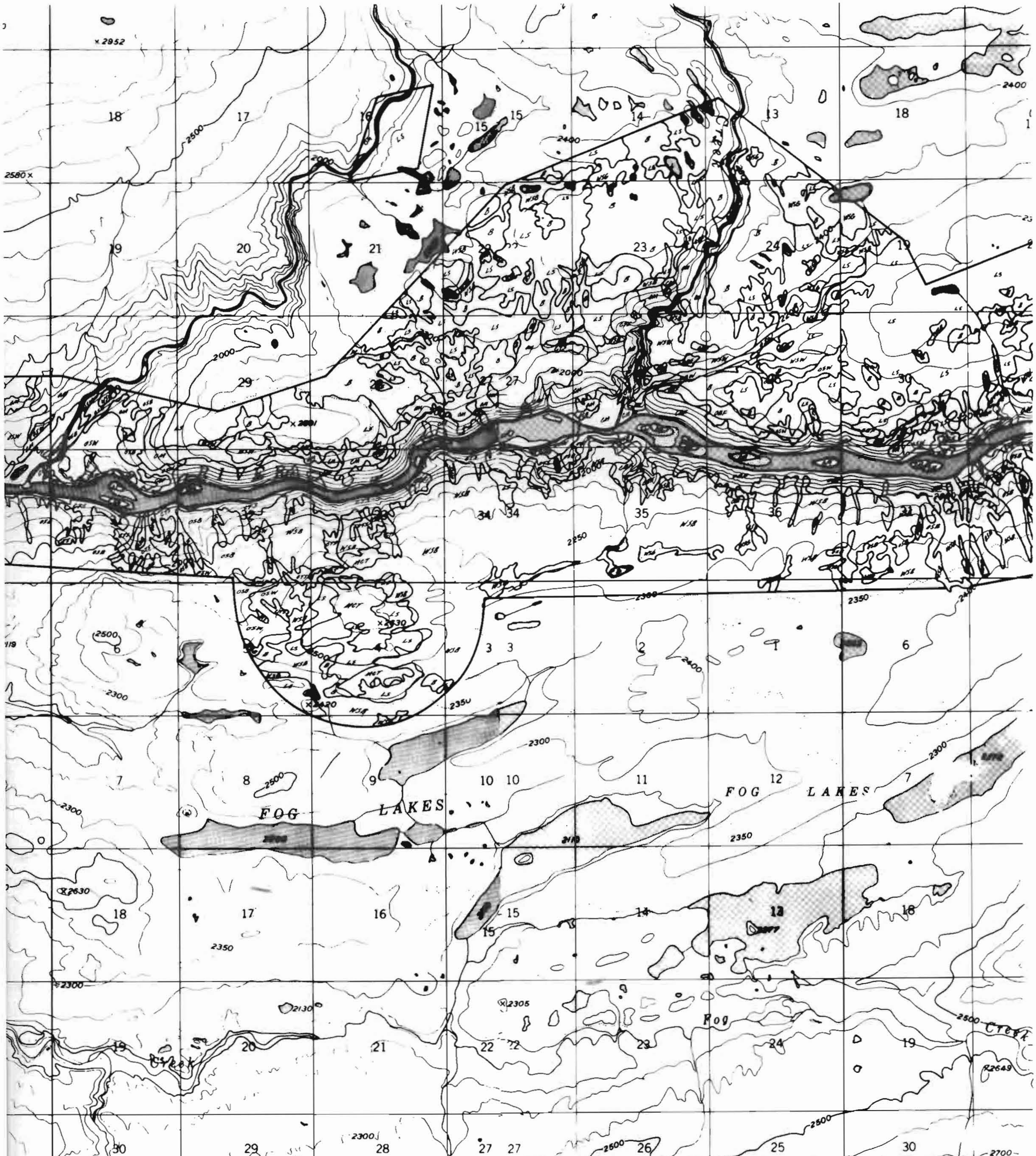
SITNA PROJECT IMPACT AREAS

FIGURE E.3.60



VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982



SCALE 0 1 2 MILES

SITNA PROJECT IMPACT AREAS

FIGURE E.3.61

LEGEND:

R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES

MAPPED AT SCALE: 1:24,000

VEGETATION MAP OF SU

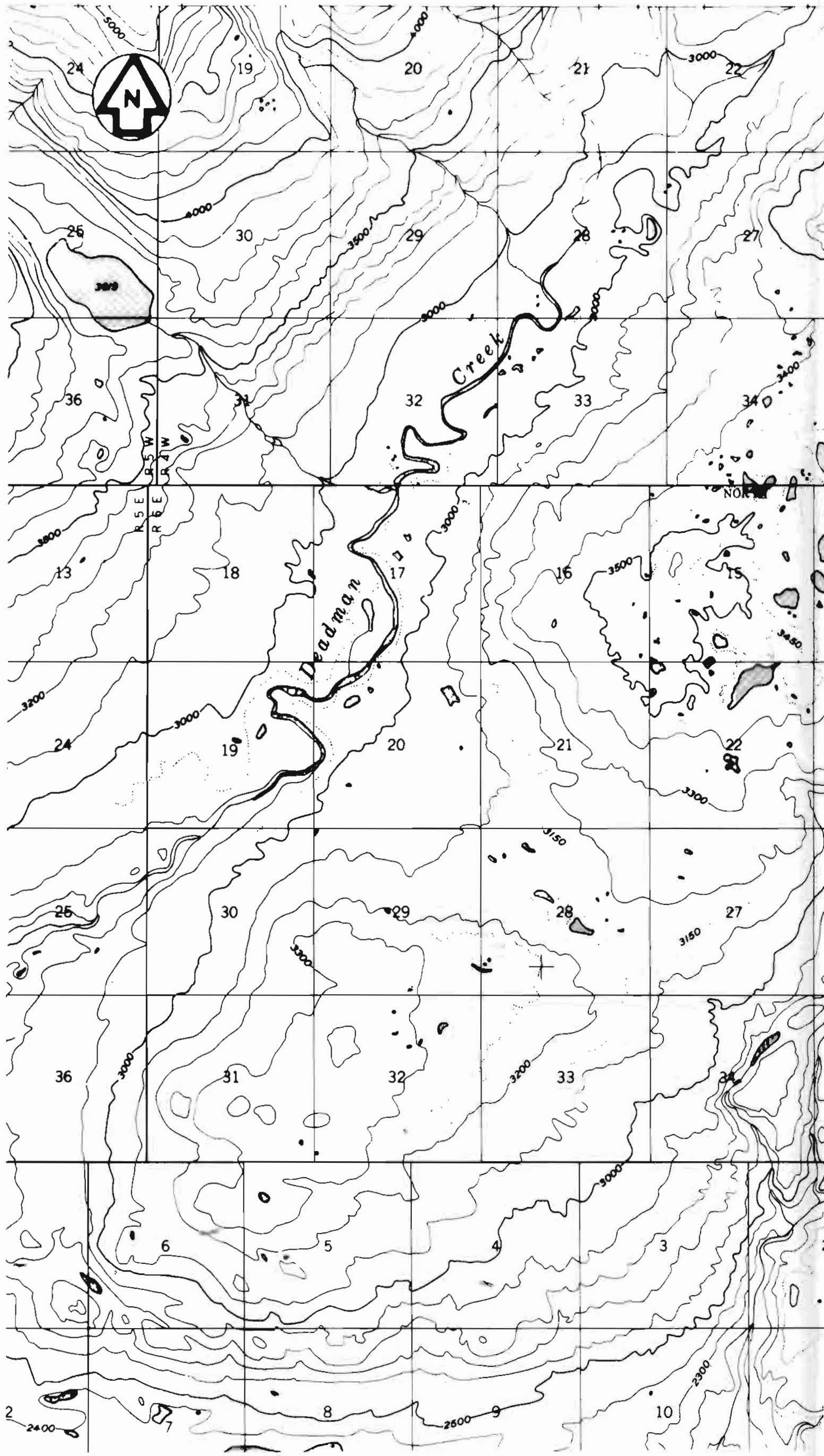
FROM McKENDRICK et al. 1982

SITNA PROJECT IMPACT AREAS

FIGURE E.3.62

LEGEND:

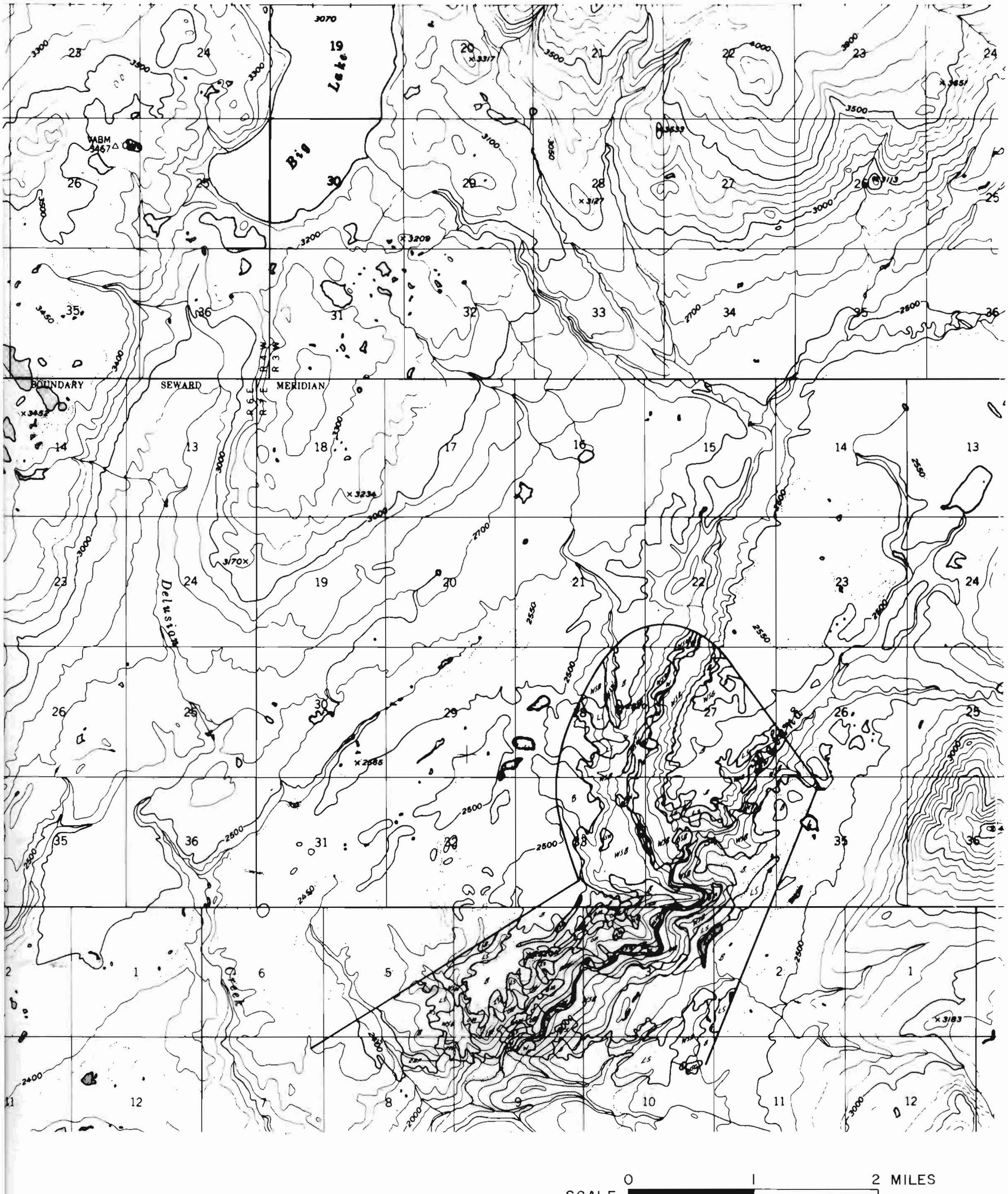
R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES



MAPPED AT SCALE: 1:24,000

VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982

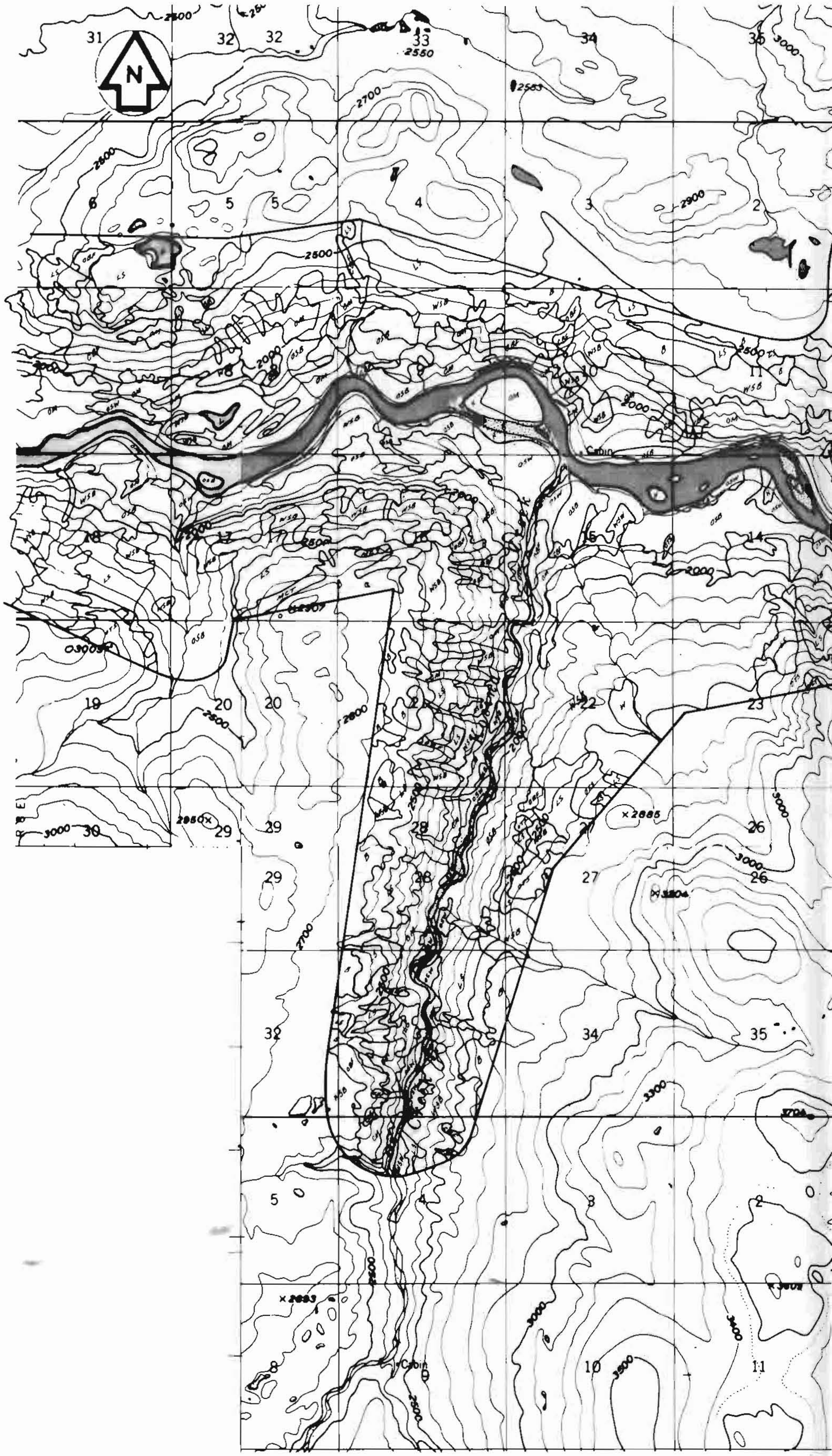


SITNA PROJECT IMPACT AREAS

FIGURE E.3.63

LEGEND:

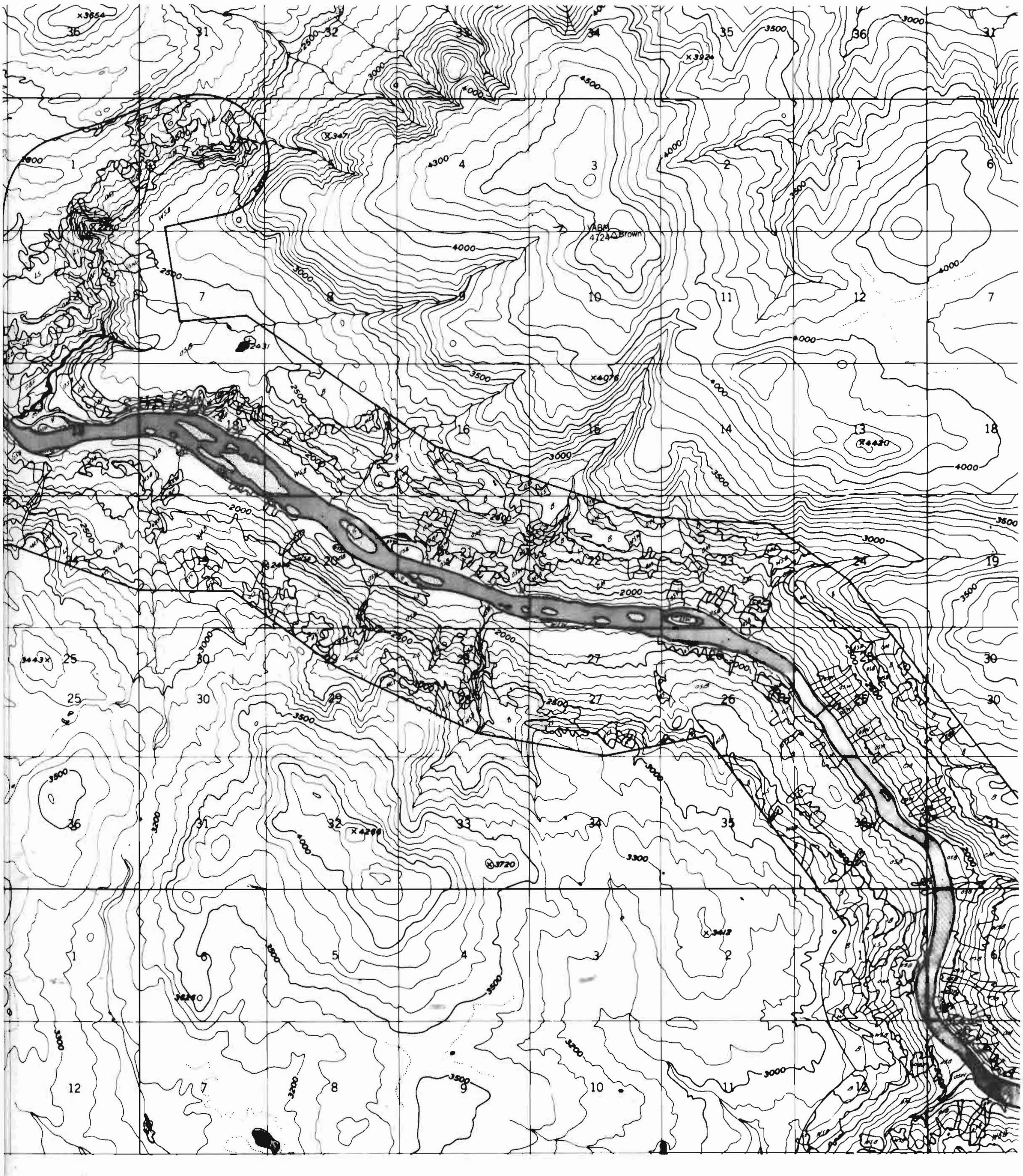
R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES



MAPPED AT SCALE: 1:24,000

VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982

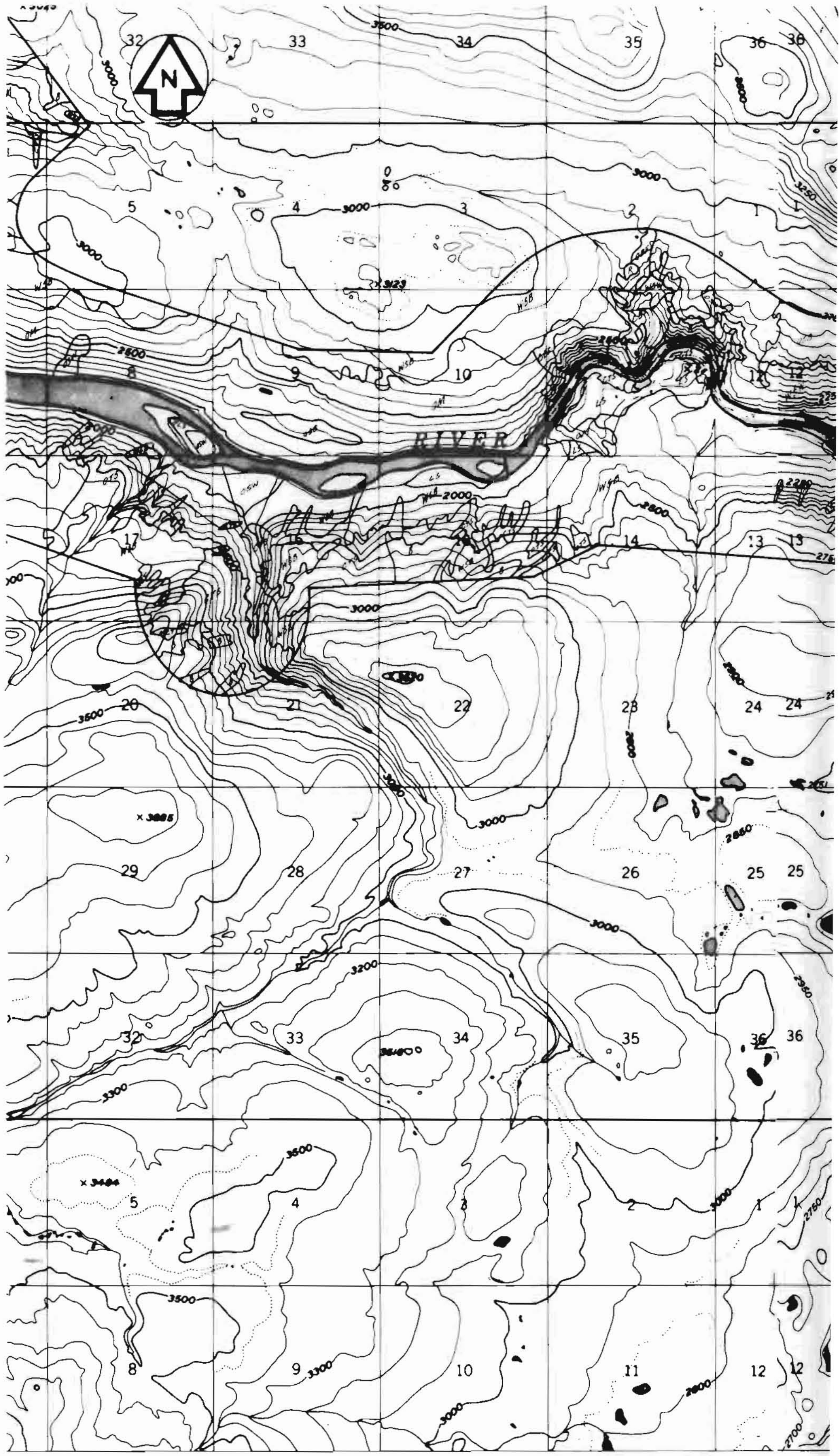


SITNA PROJECT IMPACT AREAS

FIGURE E.3.64

LEGEND:

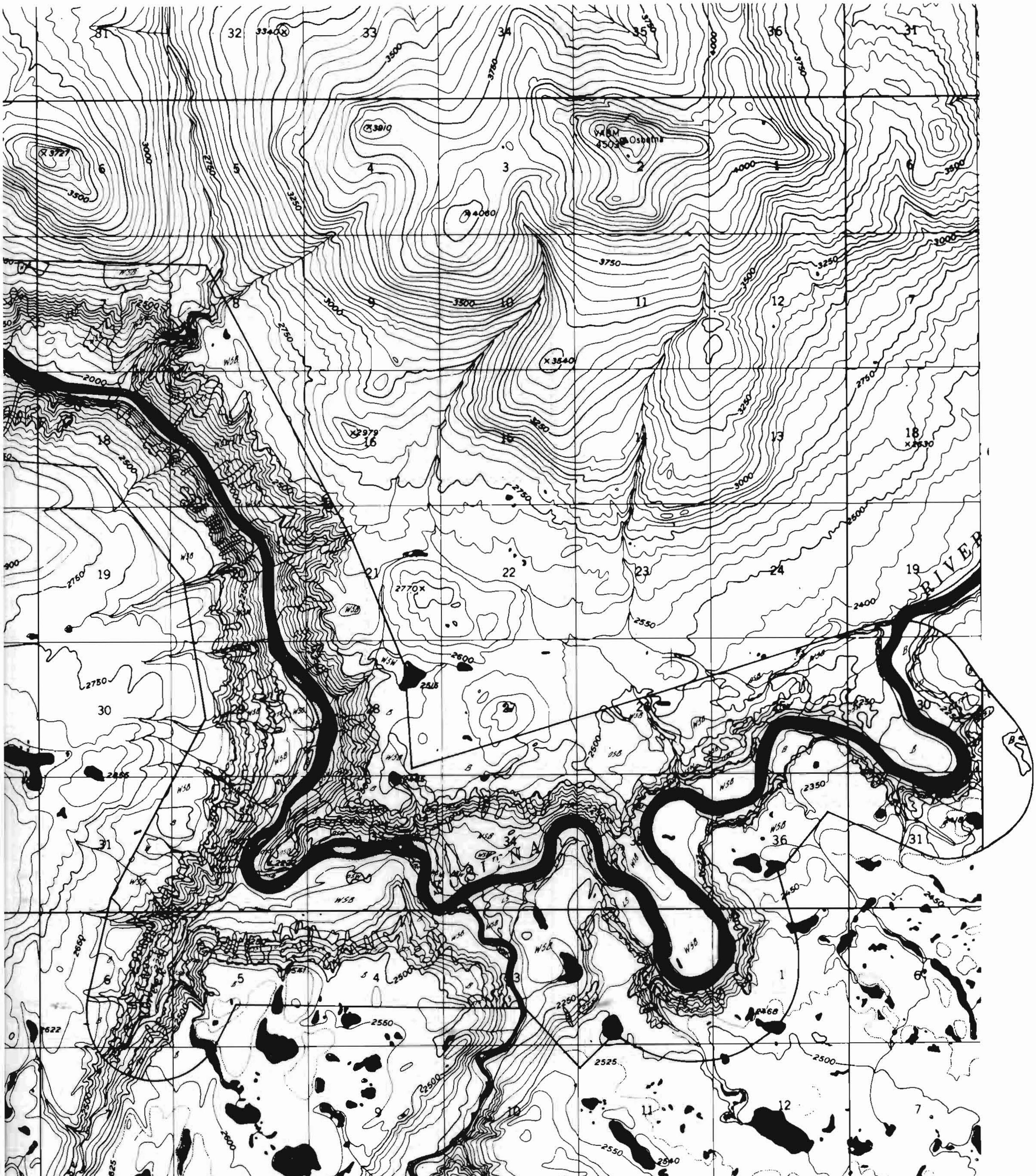
R	ROCK
MCT	MAT AND CUSHION TUNDRA
SGT	SEDGE GRASS TUNDRA
WSG	WET SEDGE GRASS
OSB	OPEN BLACK SPRUCE
WSB	WOODLAND BLACK SPRUCE
OSW	OPEN WHITE SPRUCE
WSW	WOODLAND WHITE SPRUCE
CBF	CLOSED BIRCH FOREST
OBF	OPEN BIRCH FOREST
CP	CLOSED BALSAM POPLAR
OP	OPEN BALSAM POPLAR
CM	CLOSED MIXED FOREST
OM	OPEN MIXED FOREST
CTS	CLOSED TALL SHRUB
OTS	OPEN TALL SHRUB
B	BIRCH SHRUB
W	WILLOW SHRUB
LS	LOW SHRUB
G	GRASSLAND
L	LAKES



MAPPED AT SCALE: 1:24,000

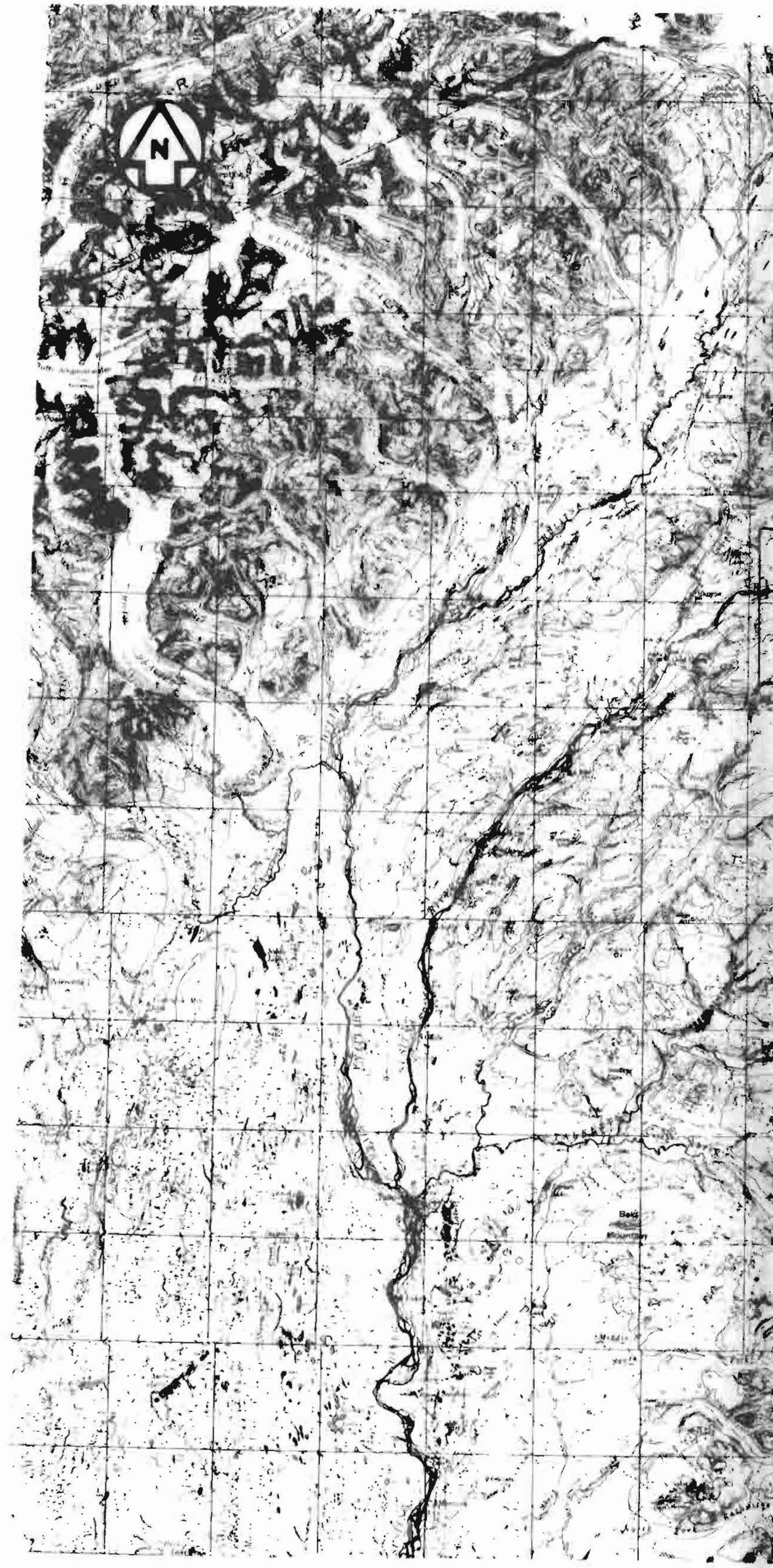
VEGETATION MAP OF SU

FROM McKENDRICK et al. 1982



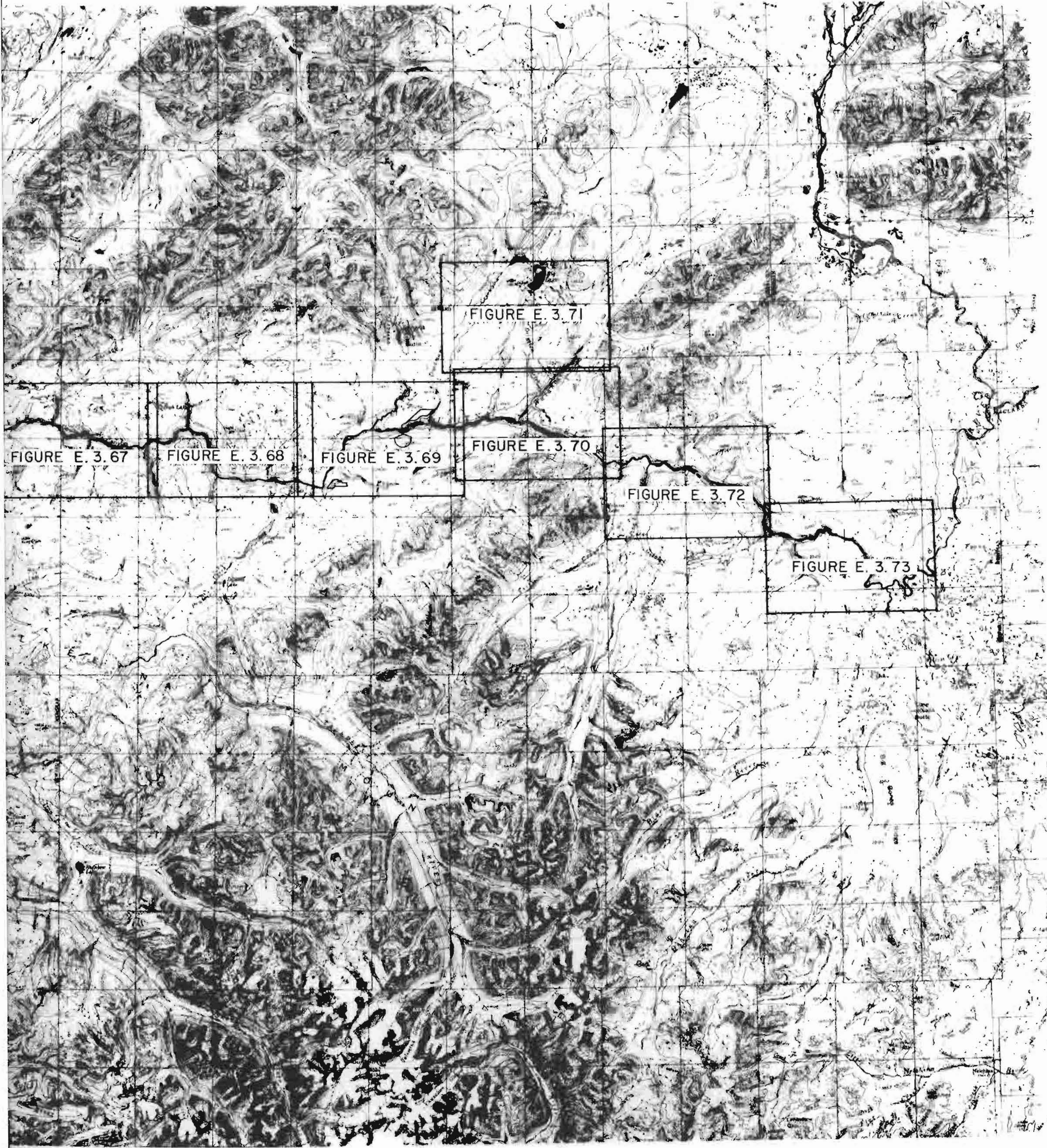
SITNA PROJECT IMPACT AREAS

FIGURE E.3.65



WETLAND MAP OF
PROJECT IMPOUNDME

FROM McKENDRICK et al. 1982

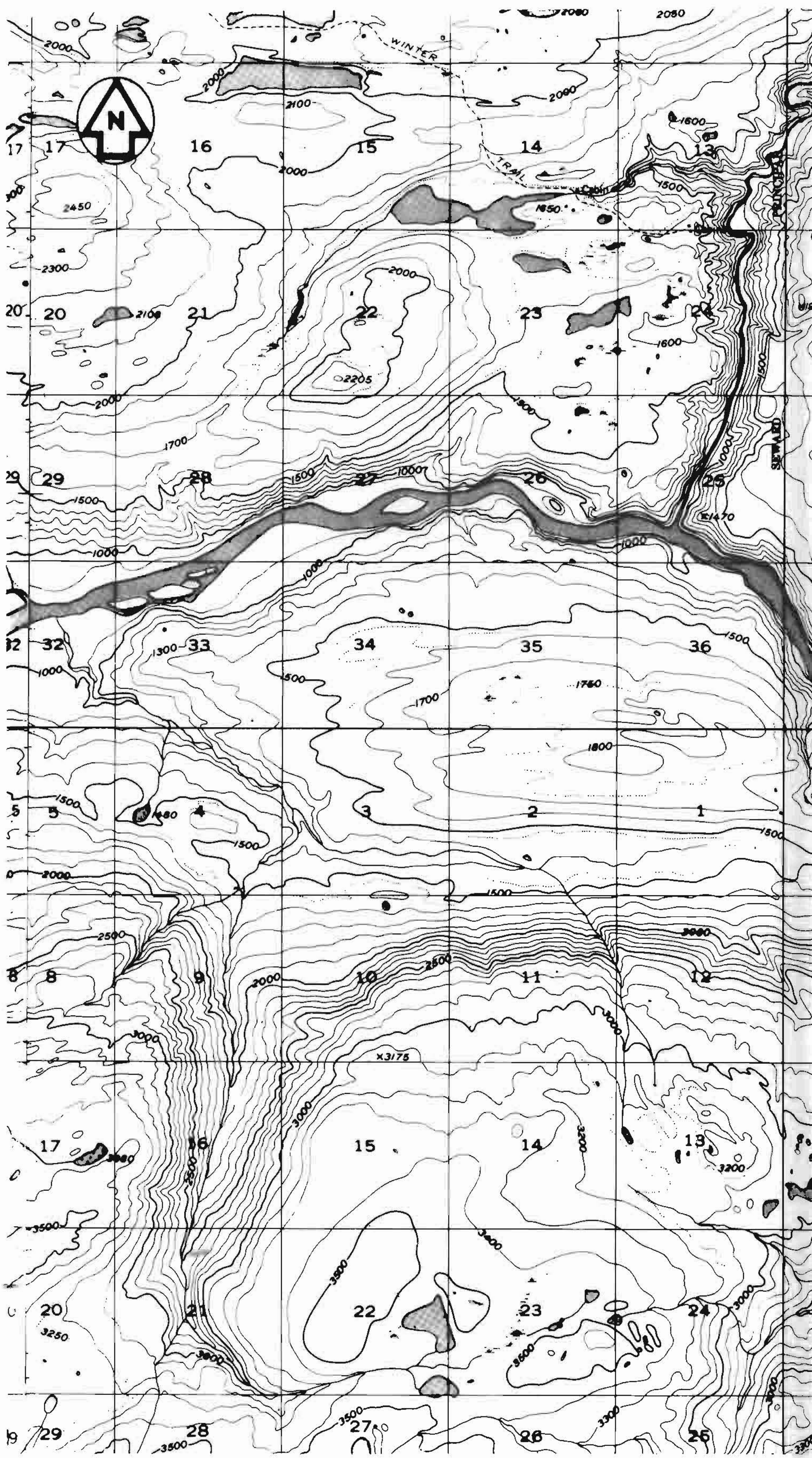


SUSITNA HYDROELECTRIC
NT AND BORROW SITES

FIGURE E.3.66

LEGEND:

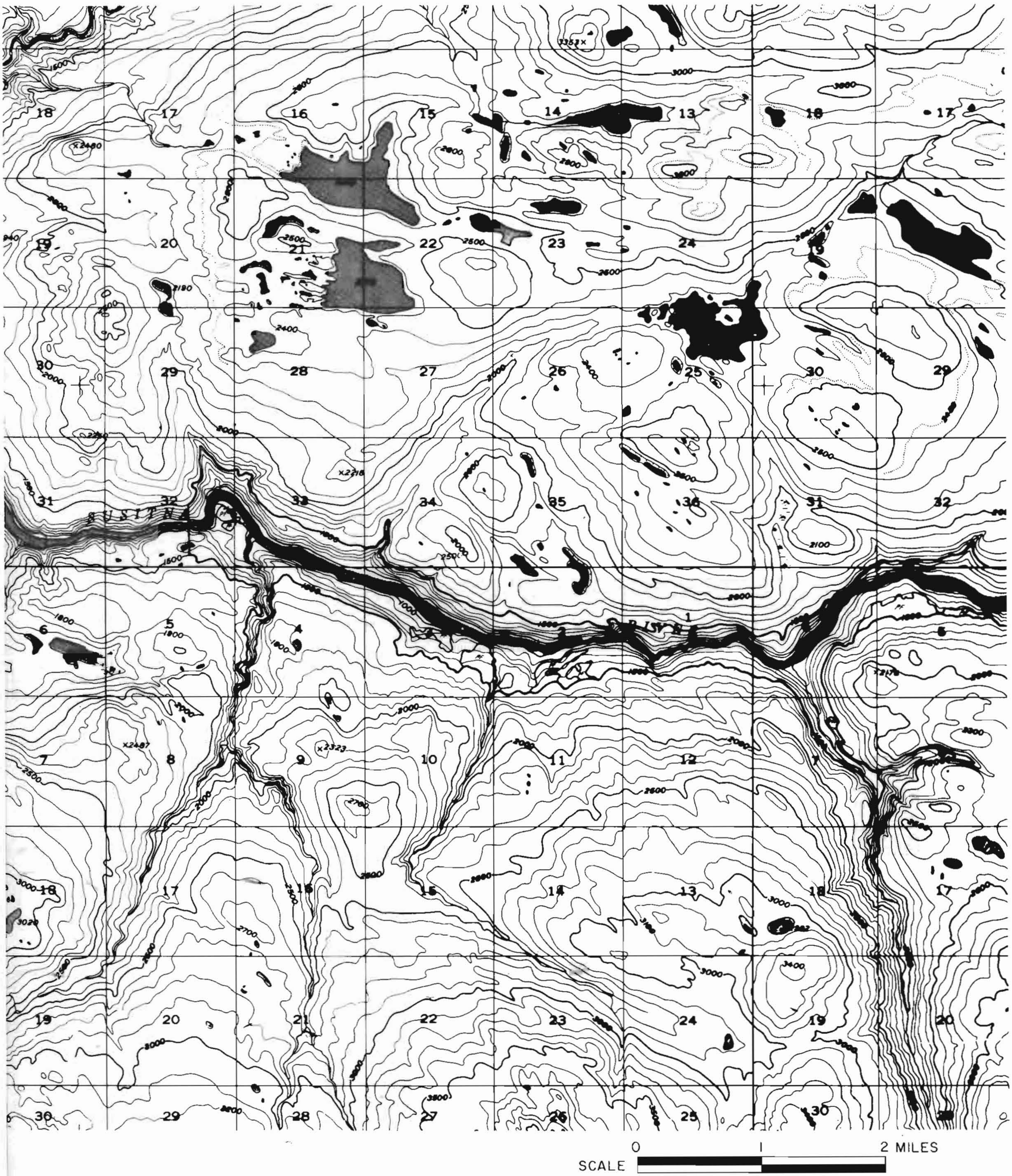
PSS	PALUSTRINE SCRUB - SHRUB
PE	PALUSTRINE EMERGENT
PF	PALUSTRINE FORESTED
LE	LACUSTRINE EMERGENT
L	LAKE



MAPPED AT SCALE 1:24,000
CLASSIFICATION: COWARDIN et al. 1979

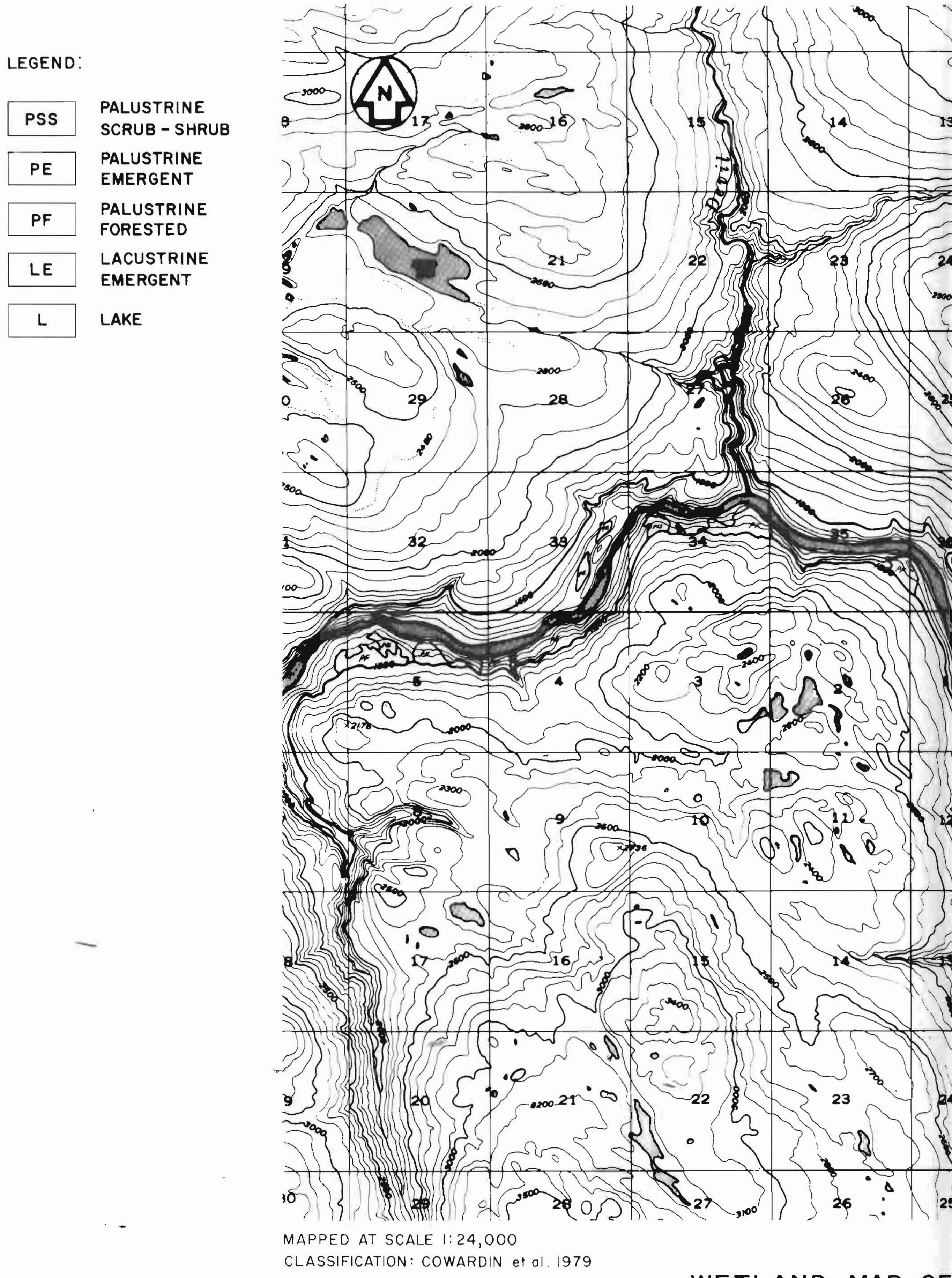
WETLAND MAP OF SUSIT
IMPOUNDMENT A

FROM McKENDRICK et al. 1982



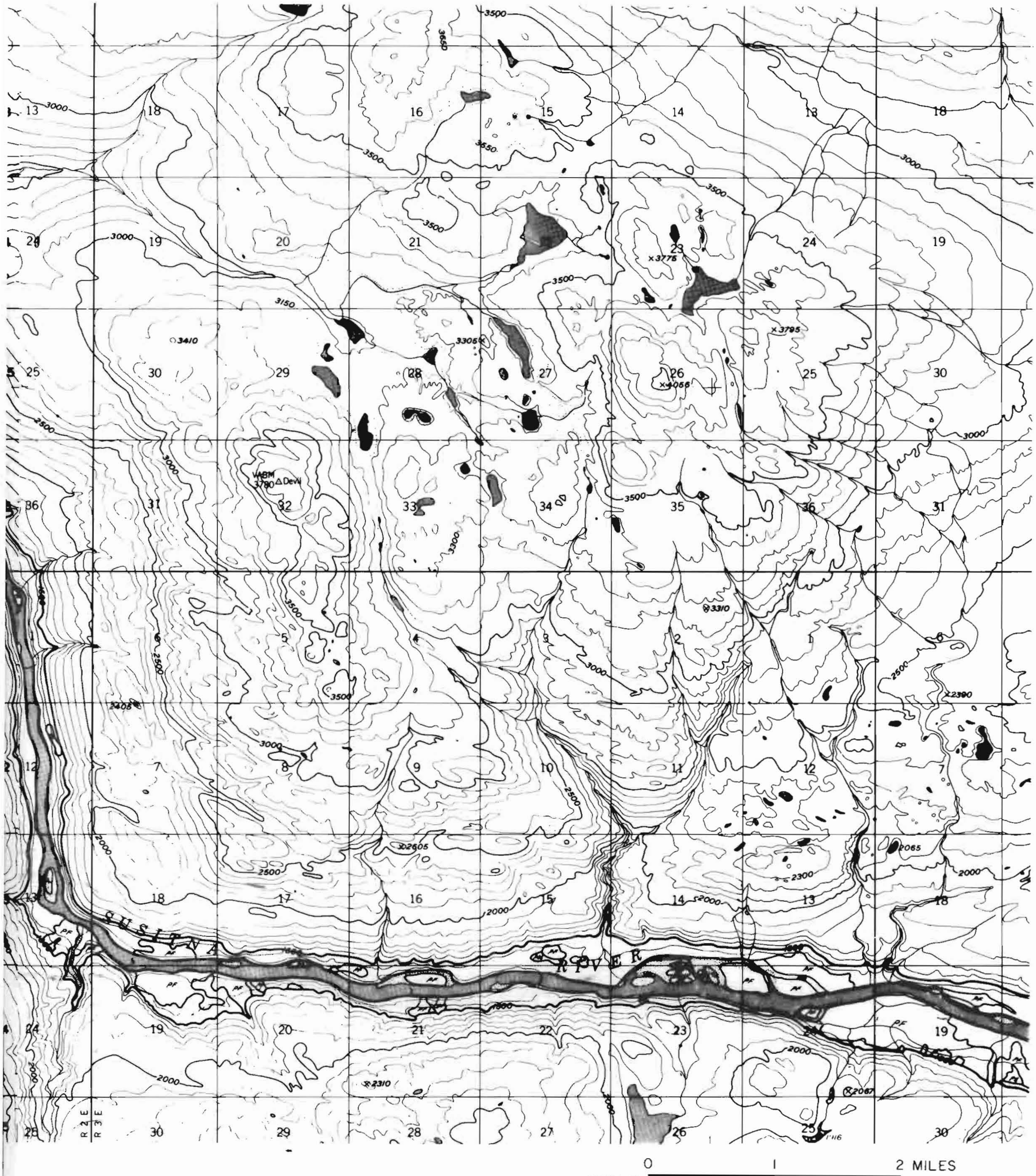
TNA HYDROELECTRIC PROJECT
AND BORROW SITES

FIGURE E. 3.67



WETLAND MAP OF
PROJECT IMPOUNDM

FROM McKENDRICK et al. 1982

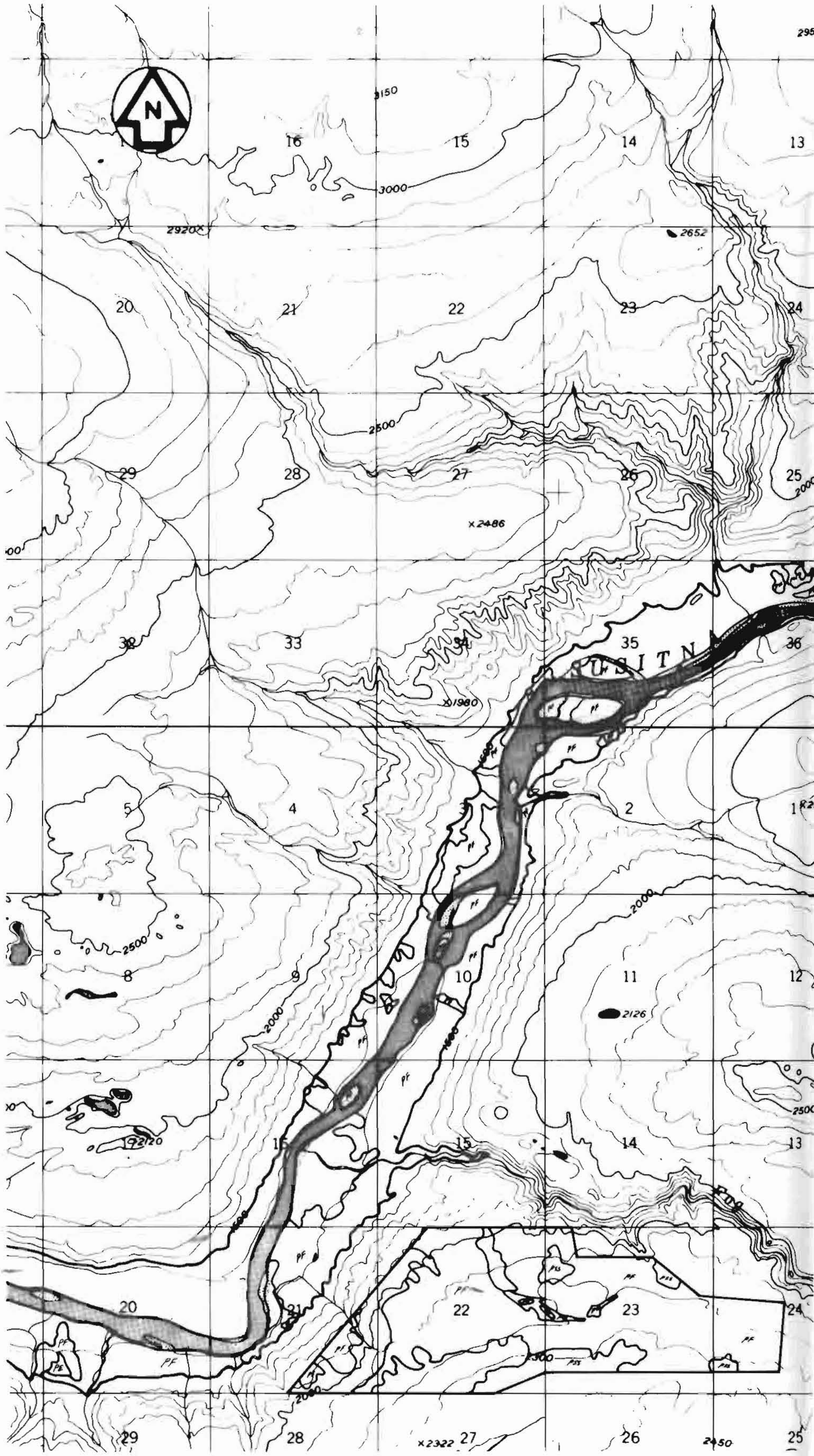


SUSITNA HYDROELECTRIC
MENT AND BORROW SITES

FIGURE E.3.68

LEGEND:

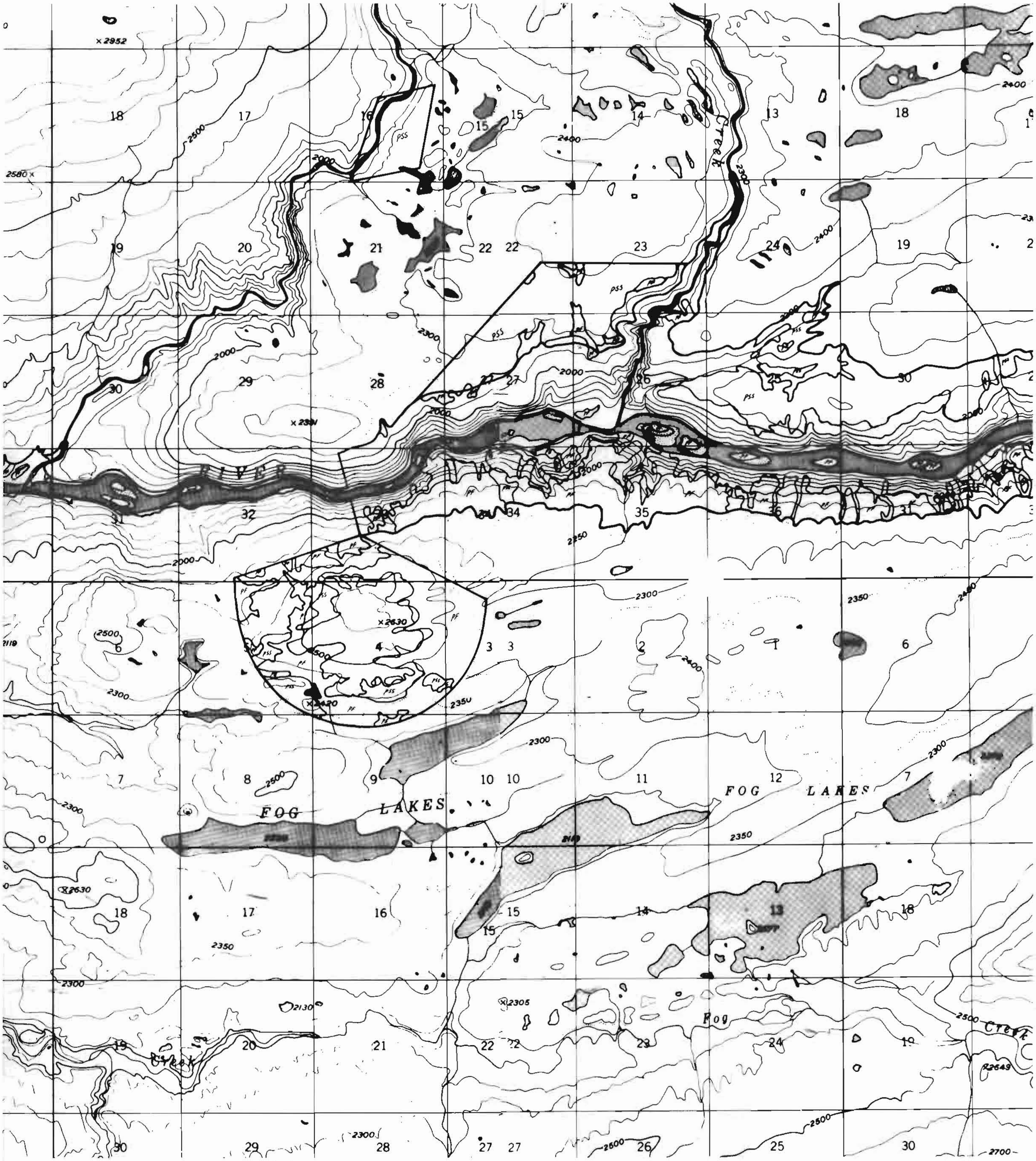
PSS	PALUSTRINE SCRUB - SHRUB
PE	PALUSTRINE EMERGENT
PF	PALUSTRINE FORESTED
LE	LACUSTRINE EMERGENT
L	LAKE



MAPPED AT SCALE 1:24,000
CLASSIFICATION: COWARDIN et al. 1979

WETLAND MAP OF SUS
IMPOUNDMENT

FROM McKENDRICK et al. 1982

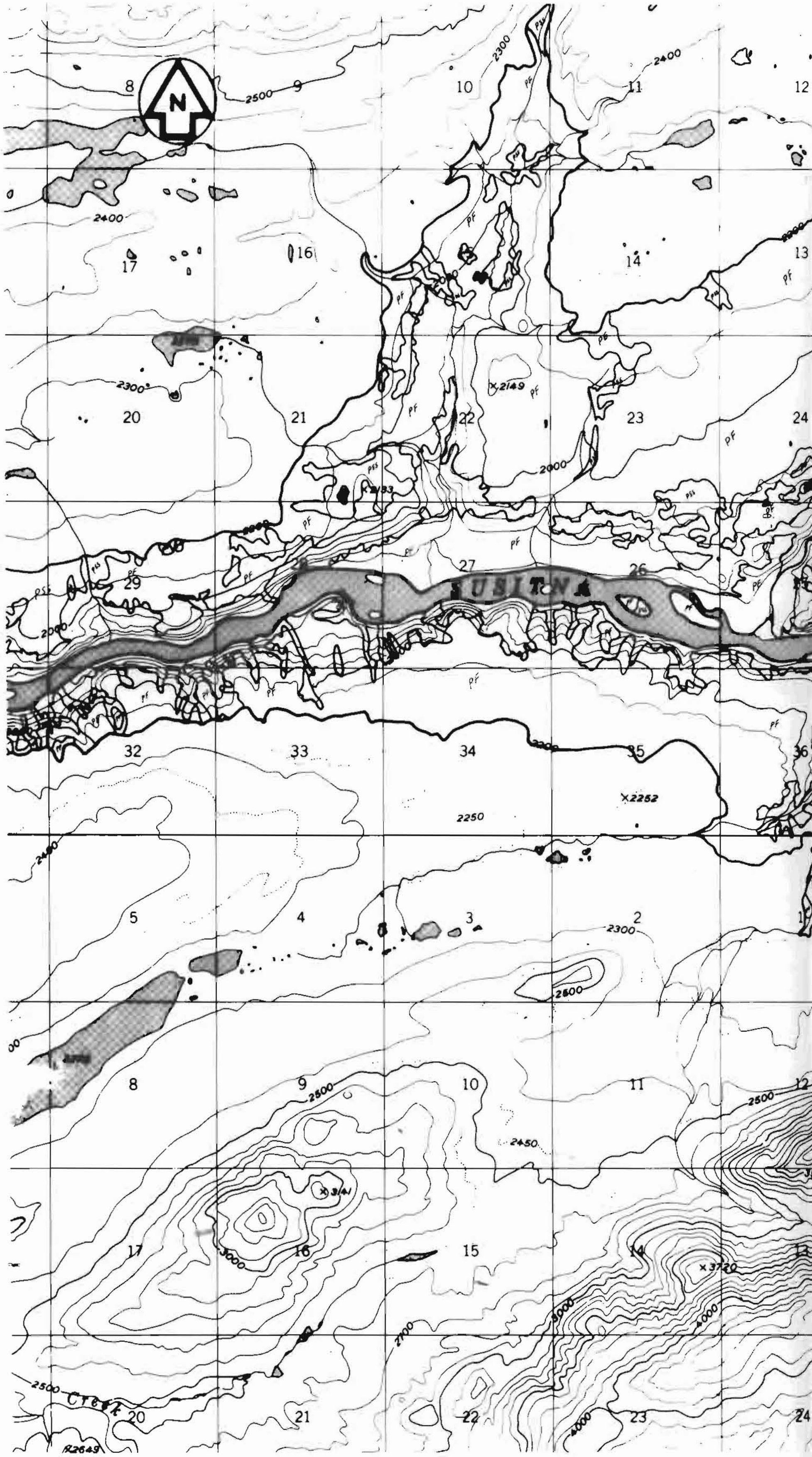


ITNA HYDROELECTRIC PROJECT
AND BORROW SITES

FIGURE E.3.69

LEGEND:

PSS	PALUSTRINE SCRUB - SHRUB
PE	PALUSTRINE EMERGENT
PF	PALUSTRINE FORESTED
LE	LACUSTRINE EMERGENT
L	LAKE



MAPPED AT SCALE 1:24,000
CLASSIFICATION: COWARDIN et al. 1979

WETLAND MAP OF SUSI
IMPOUNDMENT

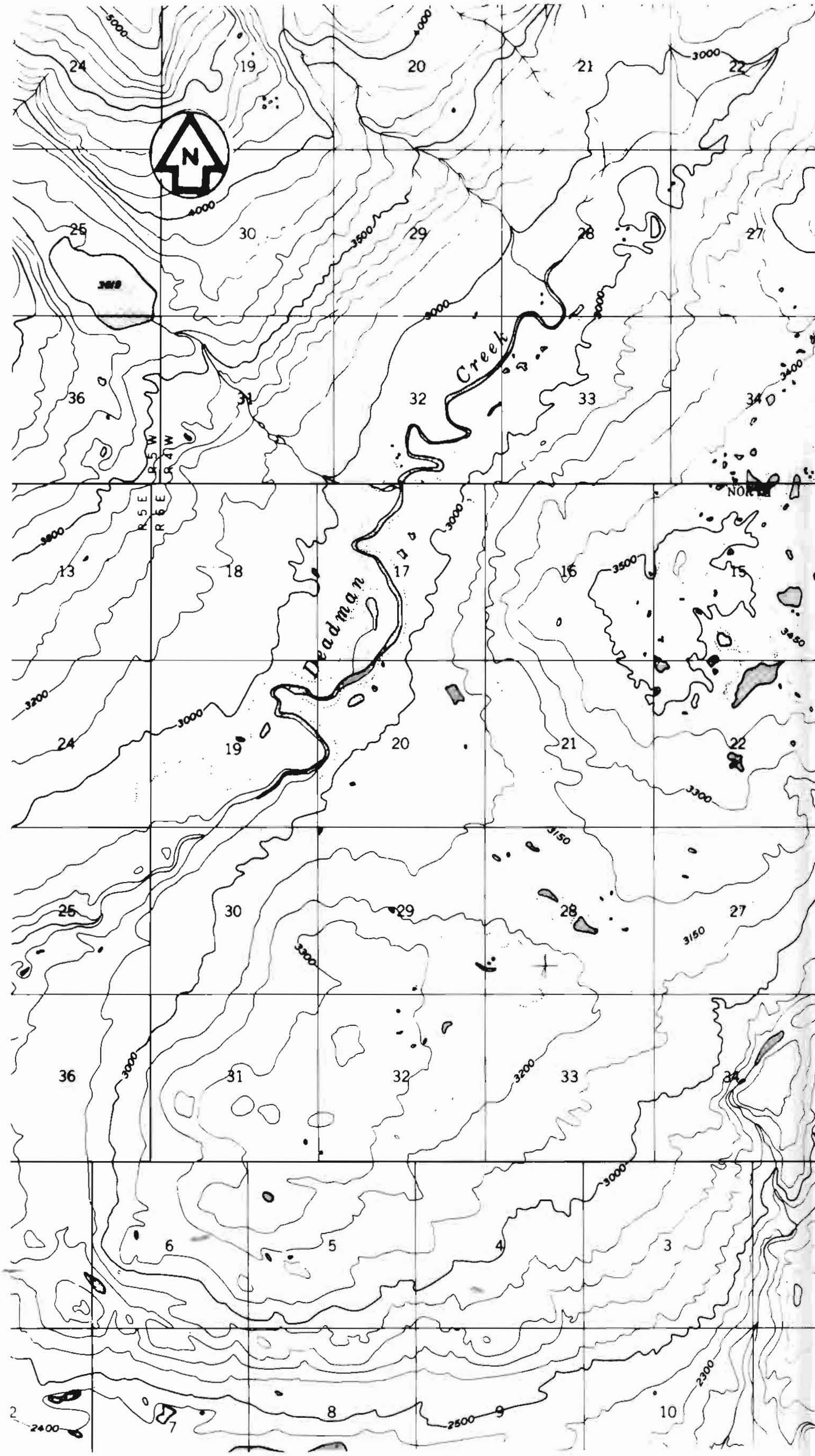
FROM McKENDRICK et al. 1982

TNA HYDROELECTRIC PROJECT
AND BORROW SITES

FIGURE E.3.70

LEGEND:

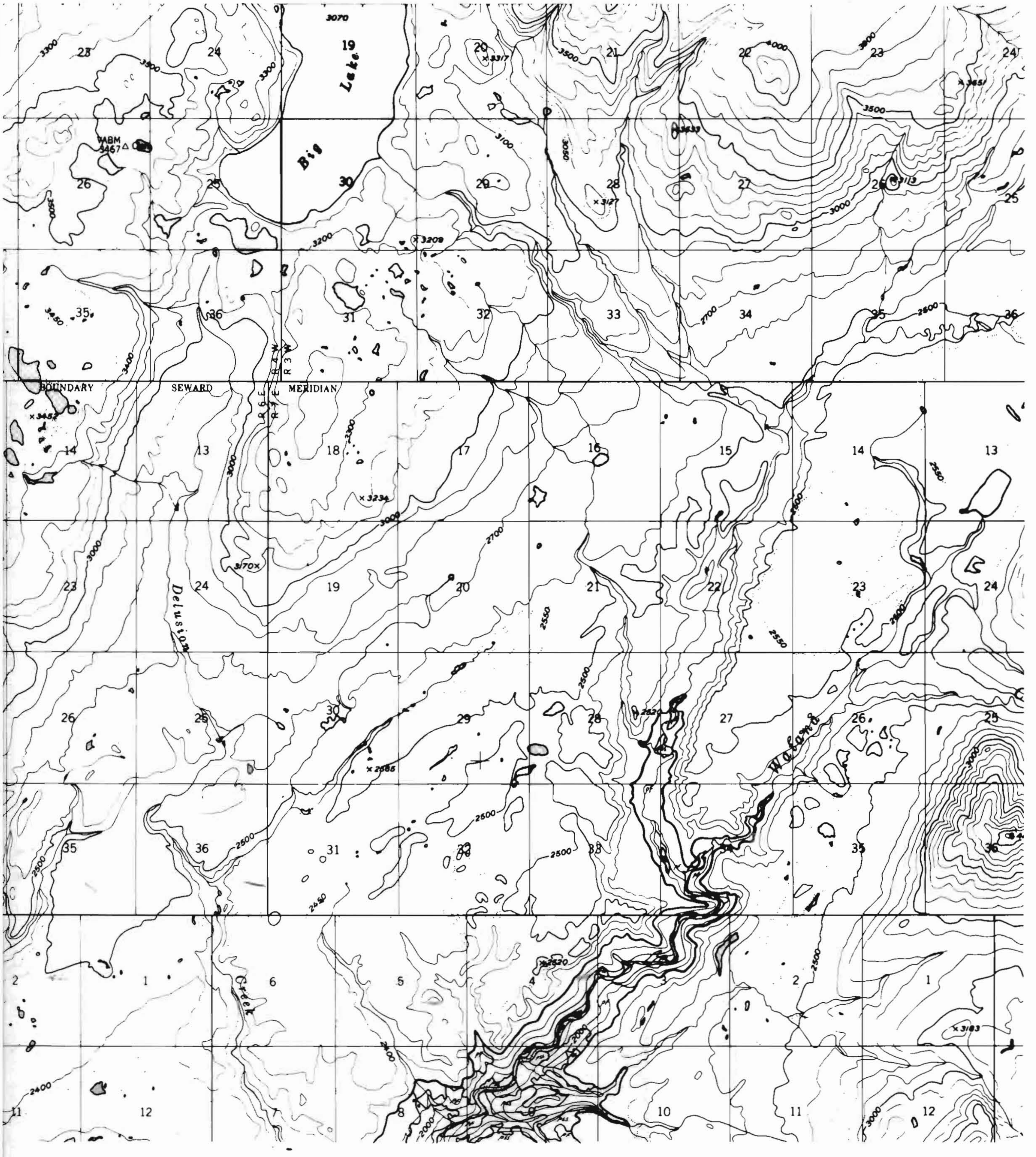
PSS	PALUSTRINE SCRUB - SHRUB
PE	PALUSTRINE EMERGENT
PF	PALUSTRINE FORESTED
LE	LACUSTRINE EMERGENT
L	LAKE



MAPPED AT SCALE 1:24,000
CLASSIFICATION: COWARDIN et al. 1979

WETLAND MAP OF SUS
IMPOUNDMENT

FROM McKENDRICK et al. 1982



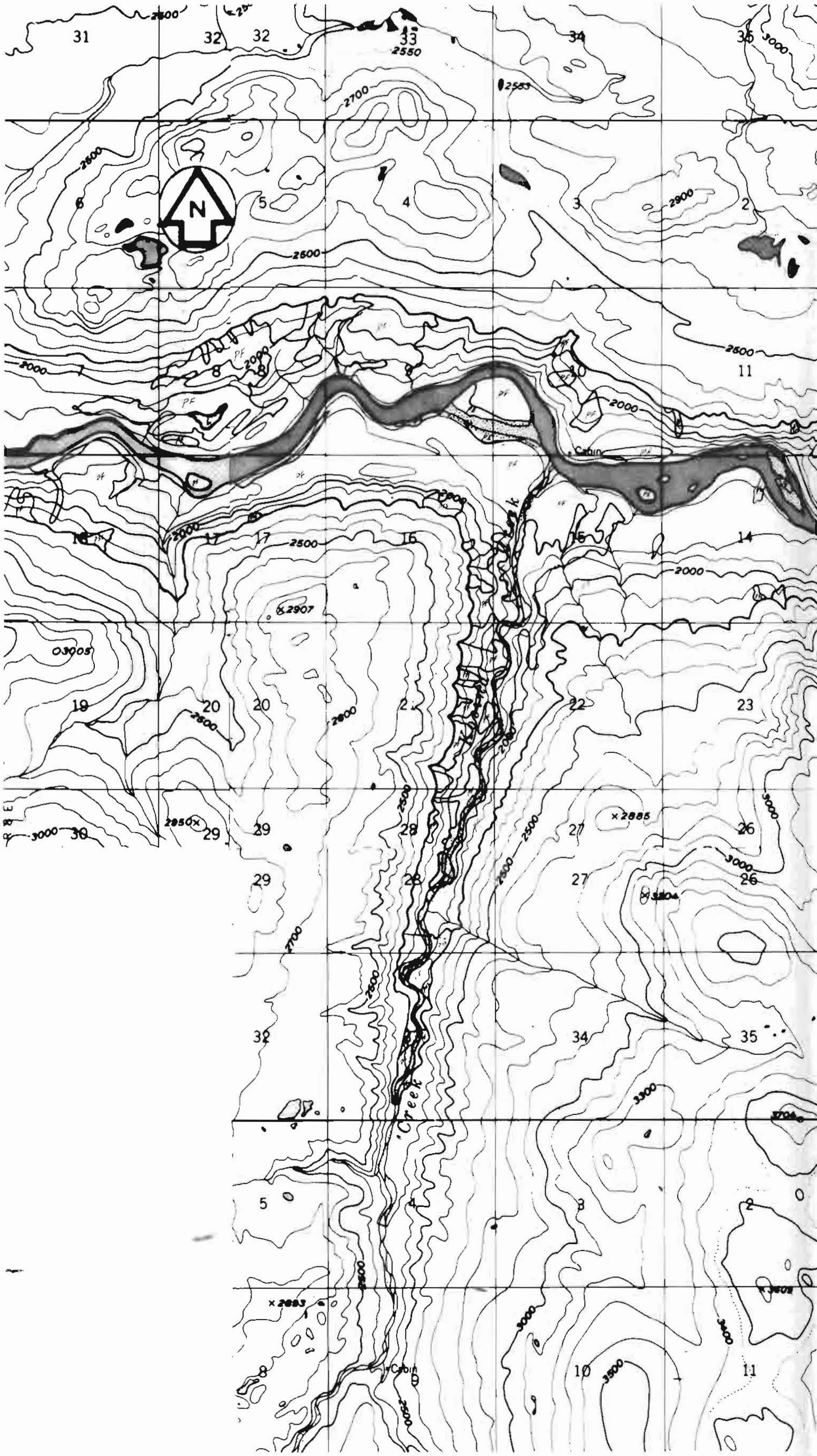
SCALE 0 1 2 MILES

ITNA HYDROELECTRIC PROJECT
AND BORROW SITES

FIGURE E.3.71

LEGEND:

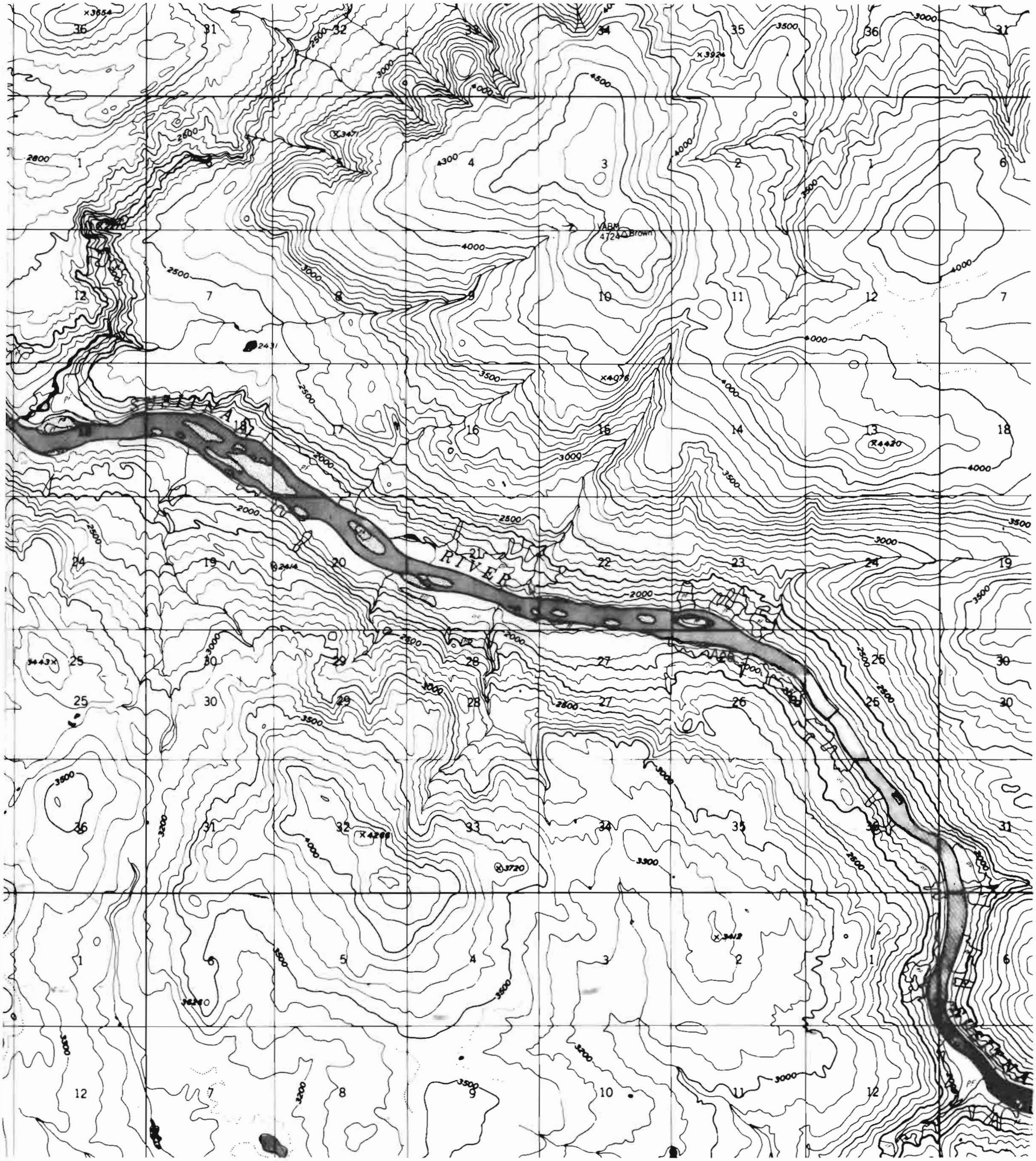
PSS	PALUSTRINE SCRUB - SHRUB
PE	PALUSTRINE EMERGENT
PF	PALUSTRINE FORESTED
LE	LACUSTRINE EMERGENT
L	LAKE



MAPPED AT SCALE 1:24,000
CLASSIFICATION: COWARDIN et al. 1979

WETLAND MAP OF SUSI
IMPOUNDMENT

FROM McKENDRICK et al. 1982

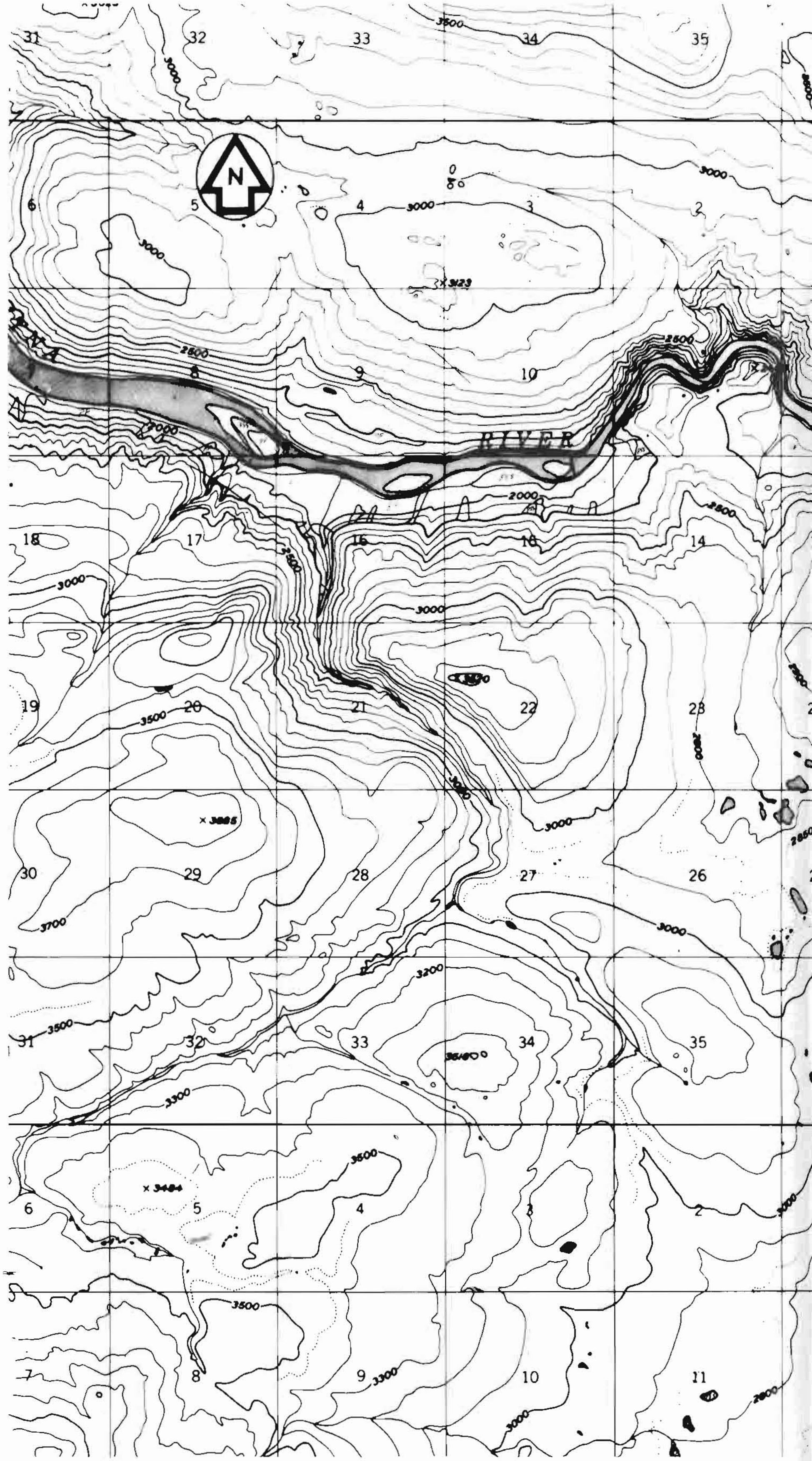


ITNA HYDROELECTRIC PROJECT
AND BORROW SITES

FIGURE E.3.72

LEGEND:

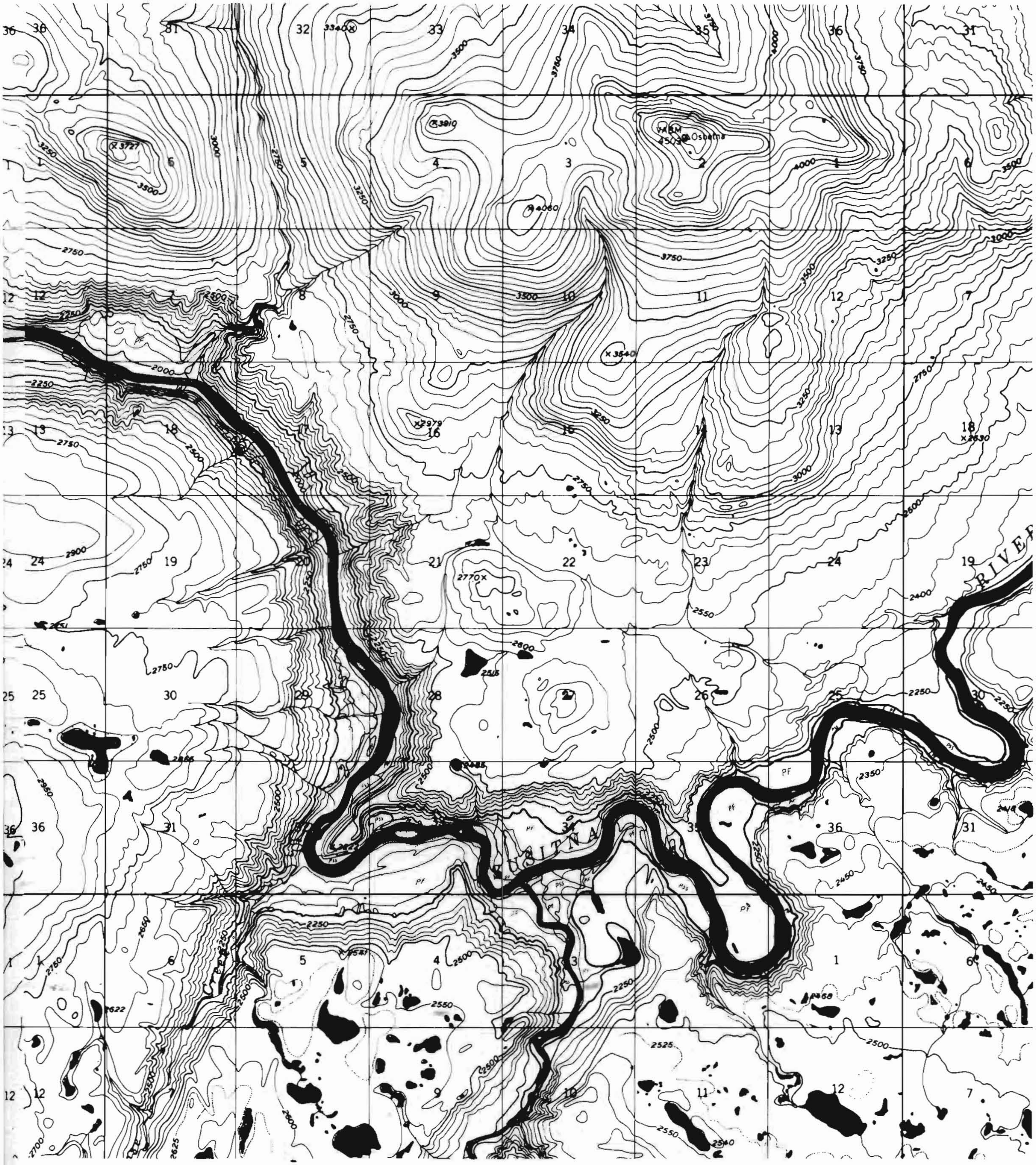
PSS	PALUSTRINE SCRUB - SHRUB
PE	PALUSTRINE EMERGENT
PF	PALUSTRINE FORESTED
LE	LACUSTRINE EMERGENT
L	LAKE



MAPPED AT SCALE 1:24,000
CLASSIFICATION: COWARDIN et al. 1979

WETLAND MAP OF SUS
IMPOUNDMENT

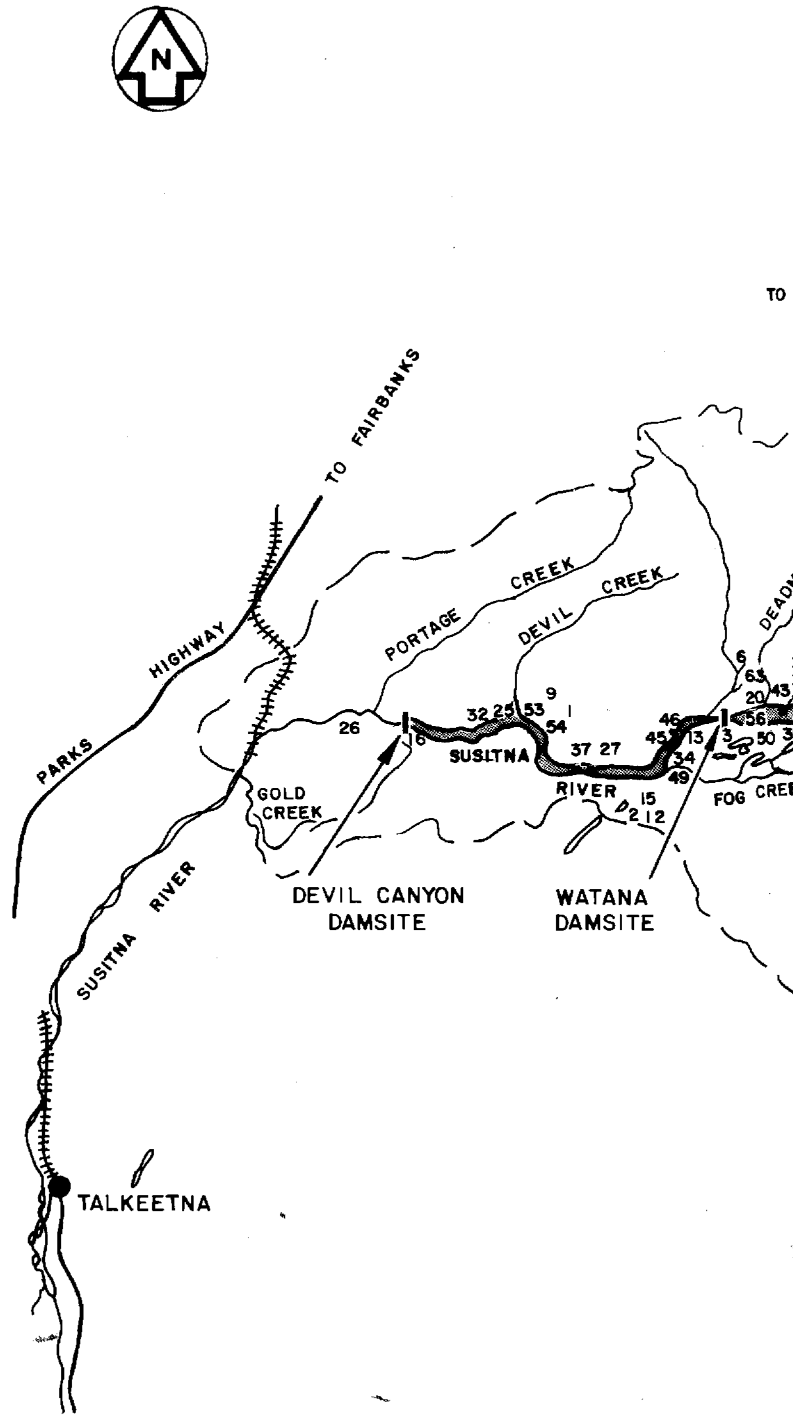
FROM McKENDRICK et al. 1982



SCALE 0 1 2 MILES

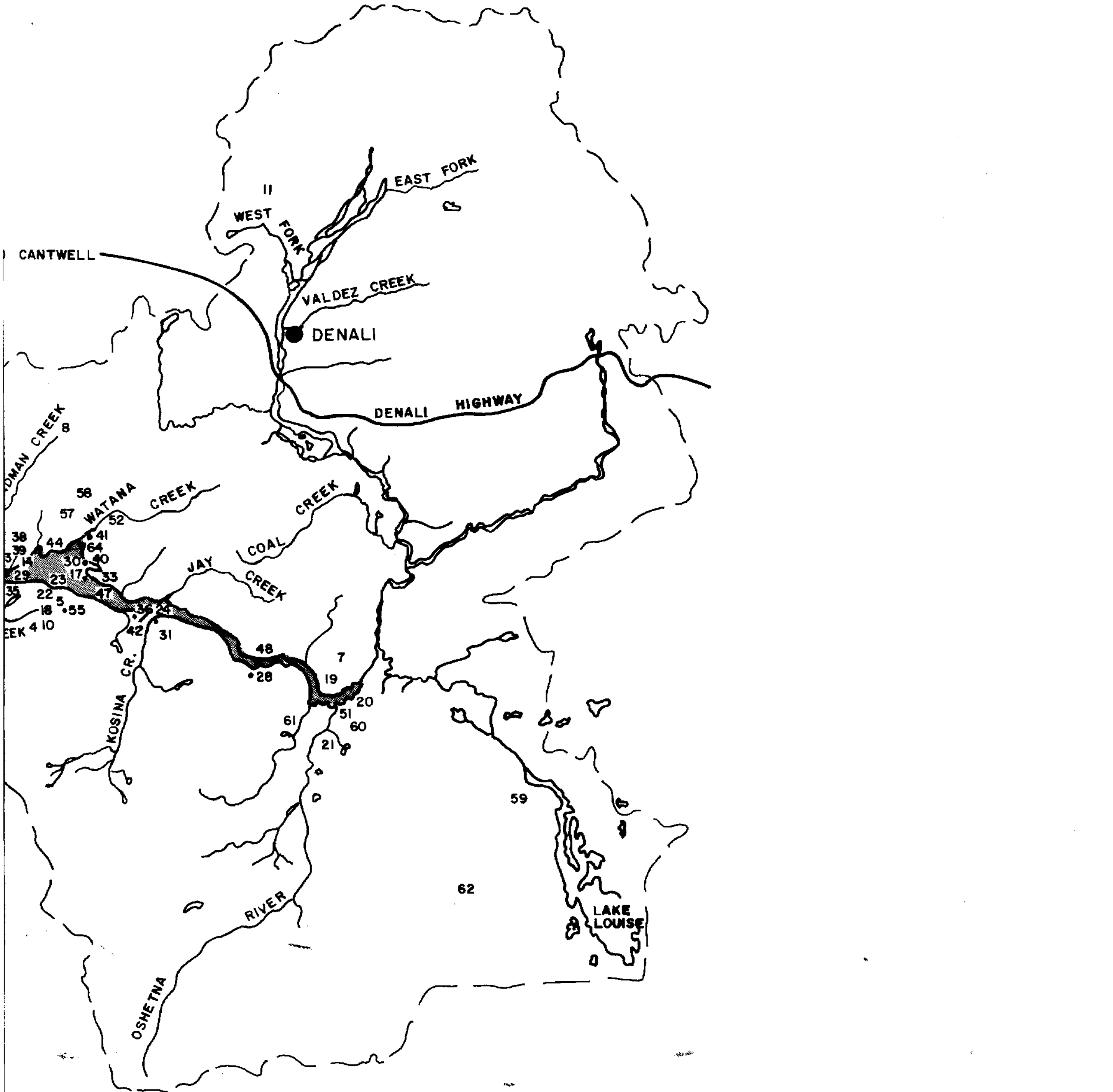
ITNA HYDROELECTRIC PROJECT
AND BORROW SITES

FIGURE E.3.73



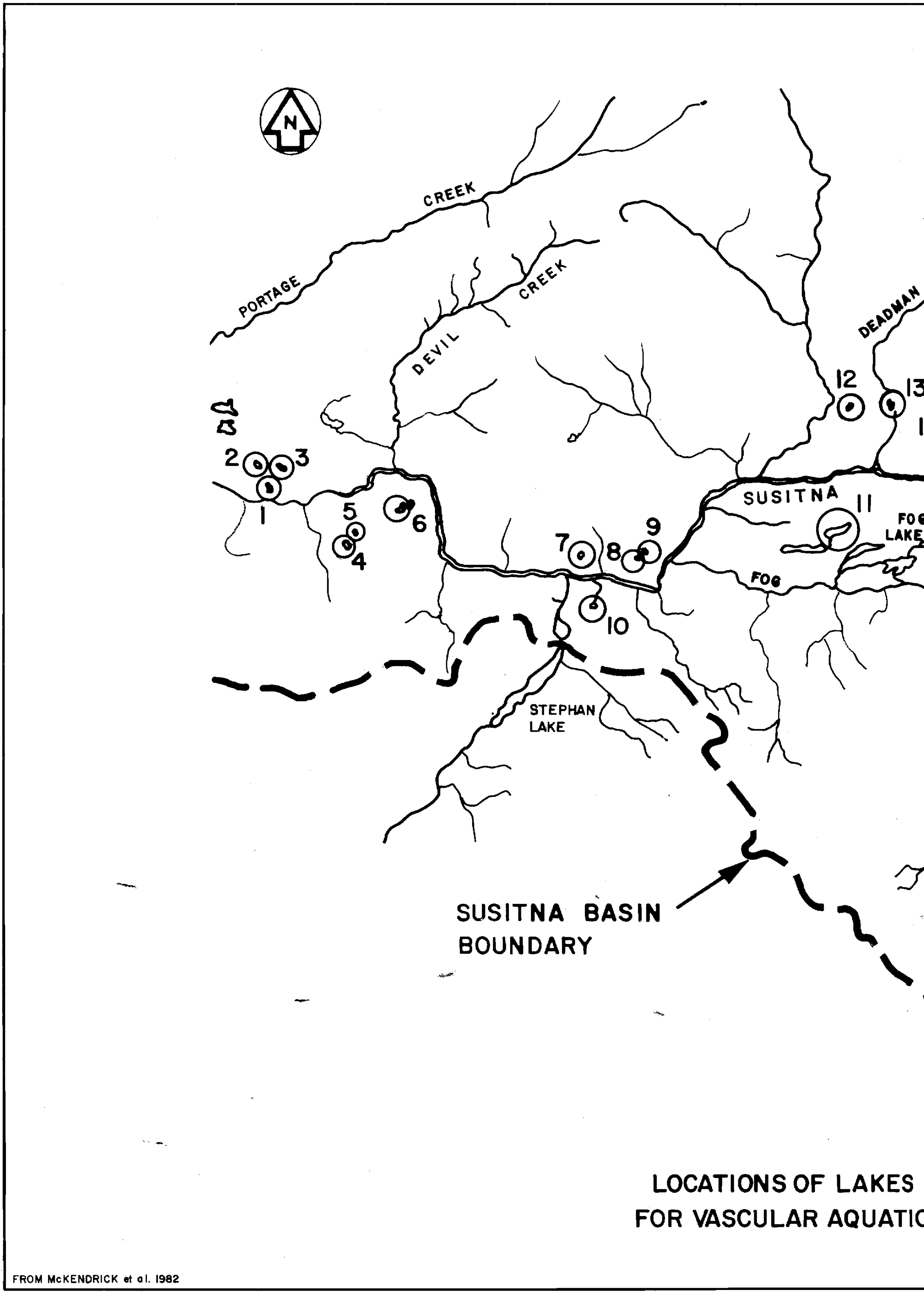
VEGETATION SA
IN SUSITNA RIV

FROM McKENDRICK et al. 1982

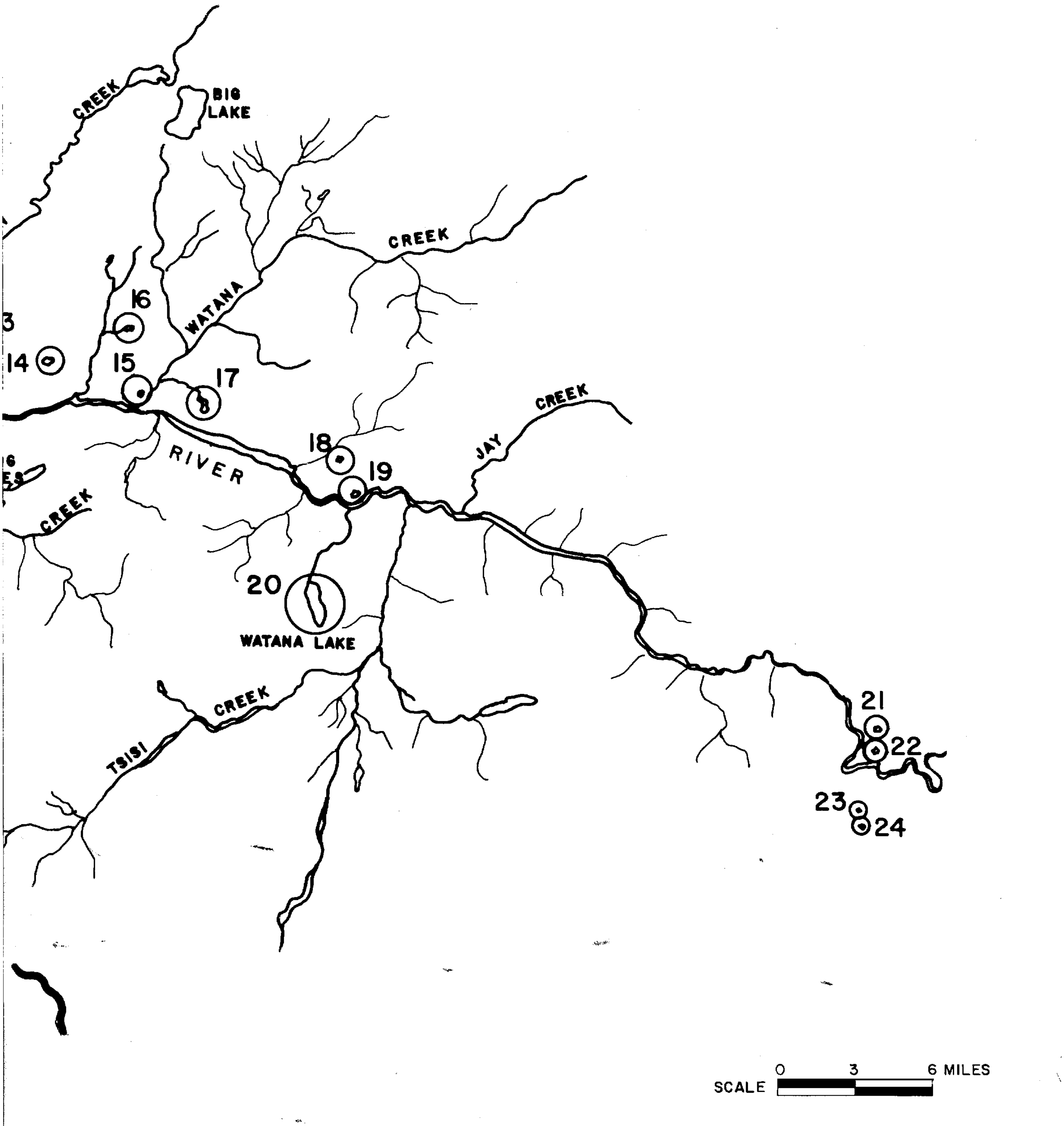


AMPLE LOCATIONS
/ER BASIN, 1980

FIGURE E.3.74

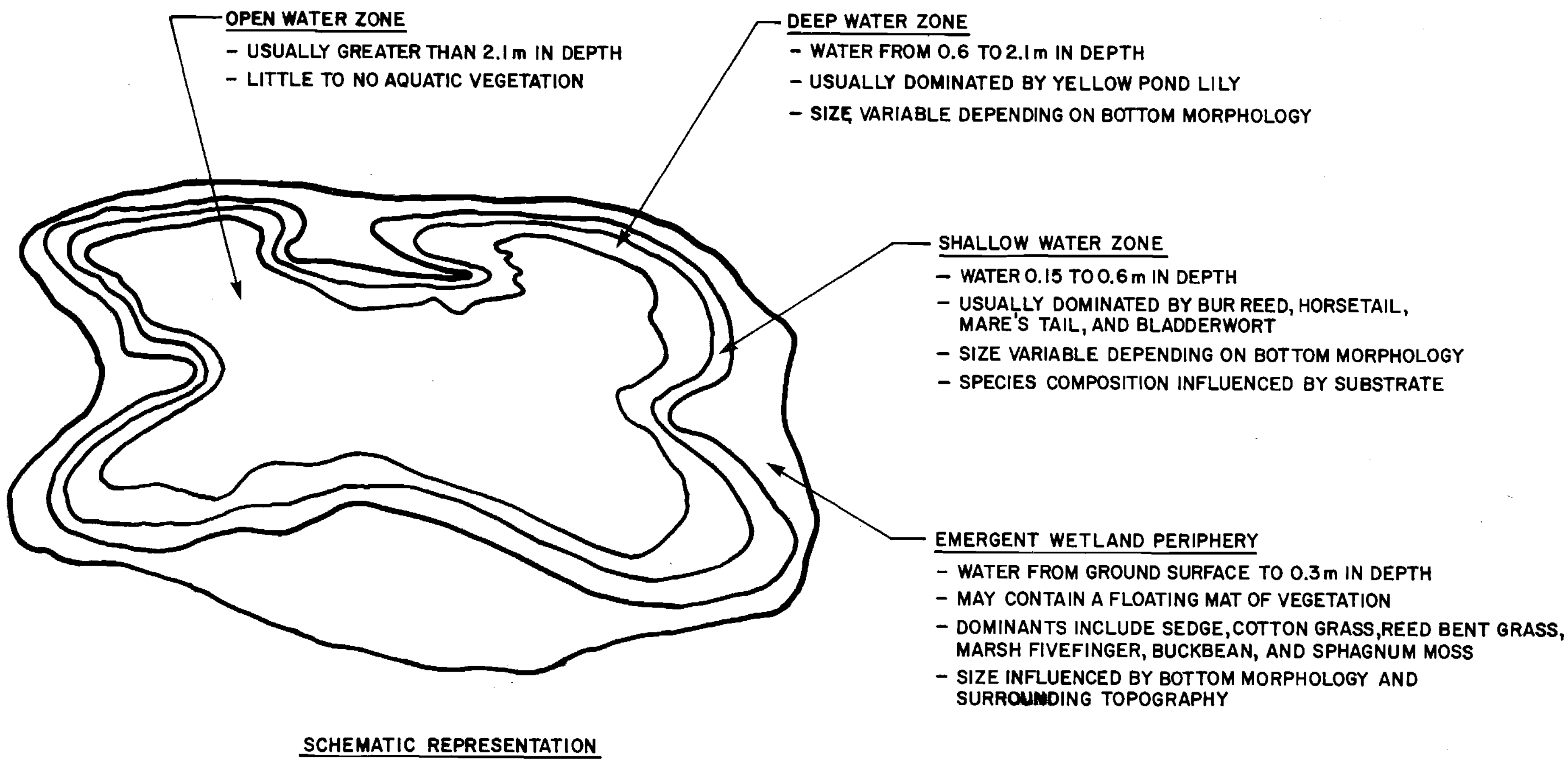


LOCATIONS OF LAKES
FOR VASCULAR AQUATIC



AND PONDS SURVEYED
C PLANTS IN AUGUST 1980

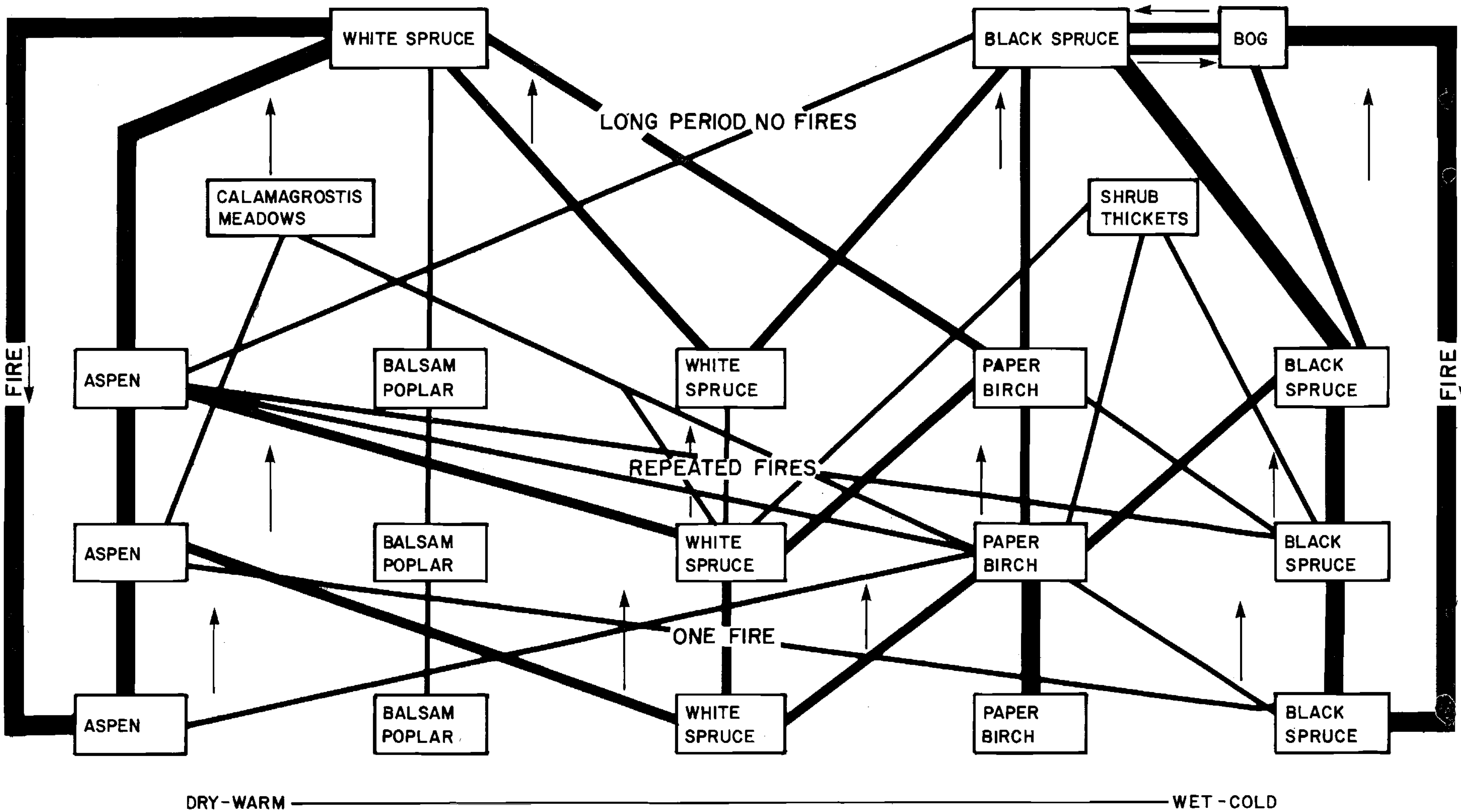
FIGURE E.3.75



A SCHEMATIC REPRESENTATION OF THE DOMINANT VEGETATION ASSOCIATED WITH MANY OF THE LAKES AND PONDS OF THE SUSITNA BASIN

FROM McKENDRICK et al. 1982

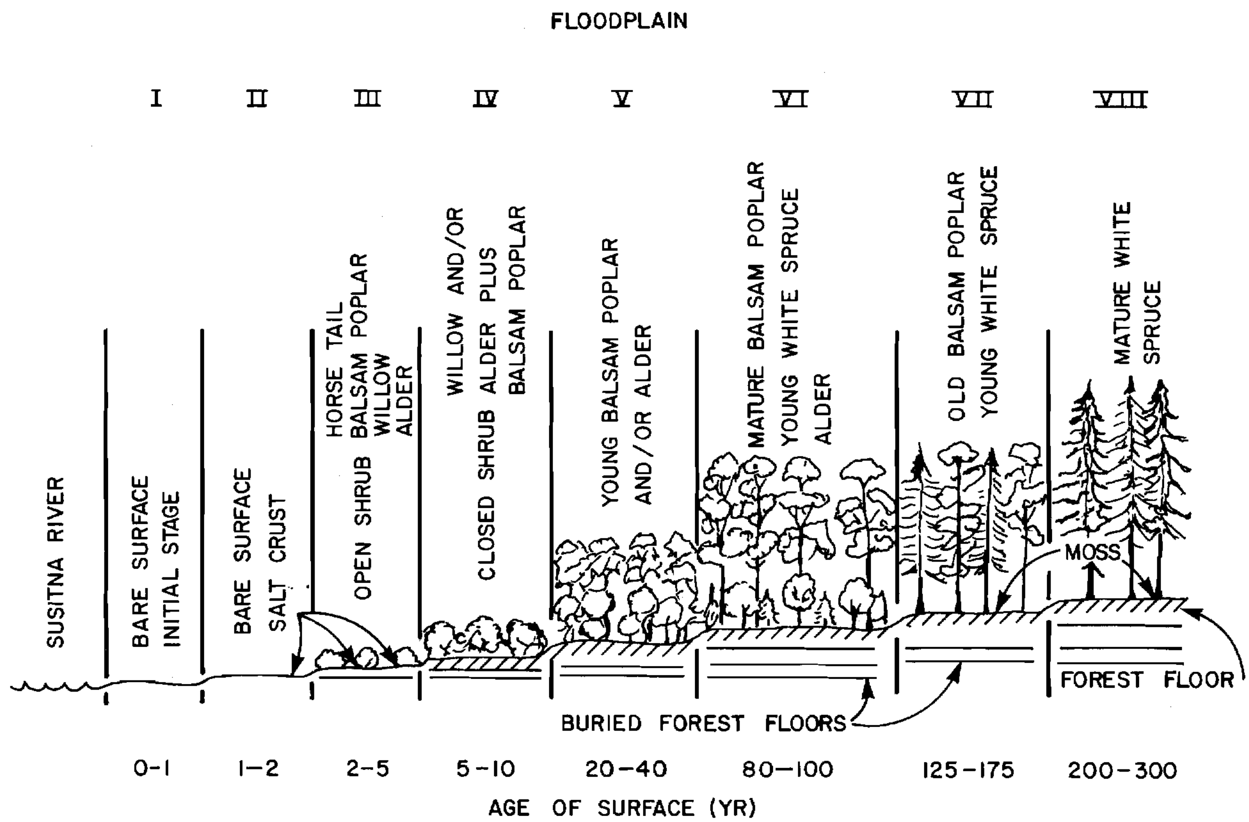
FIGURE E.3.76



PATTERNS OF FOREST SUCCESSION
FOLLOWING FIRE IN ALASKA

FROM VIERECK & SCHANDELMEIER 1980

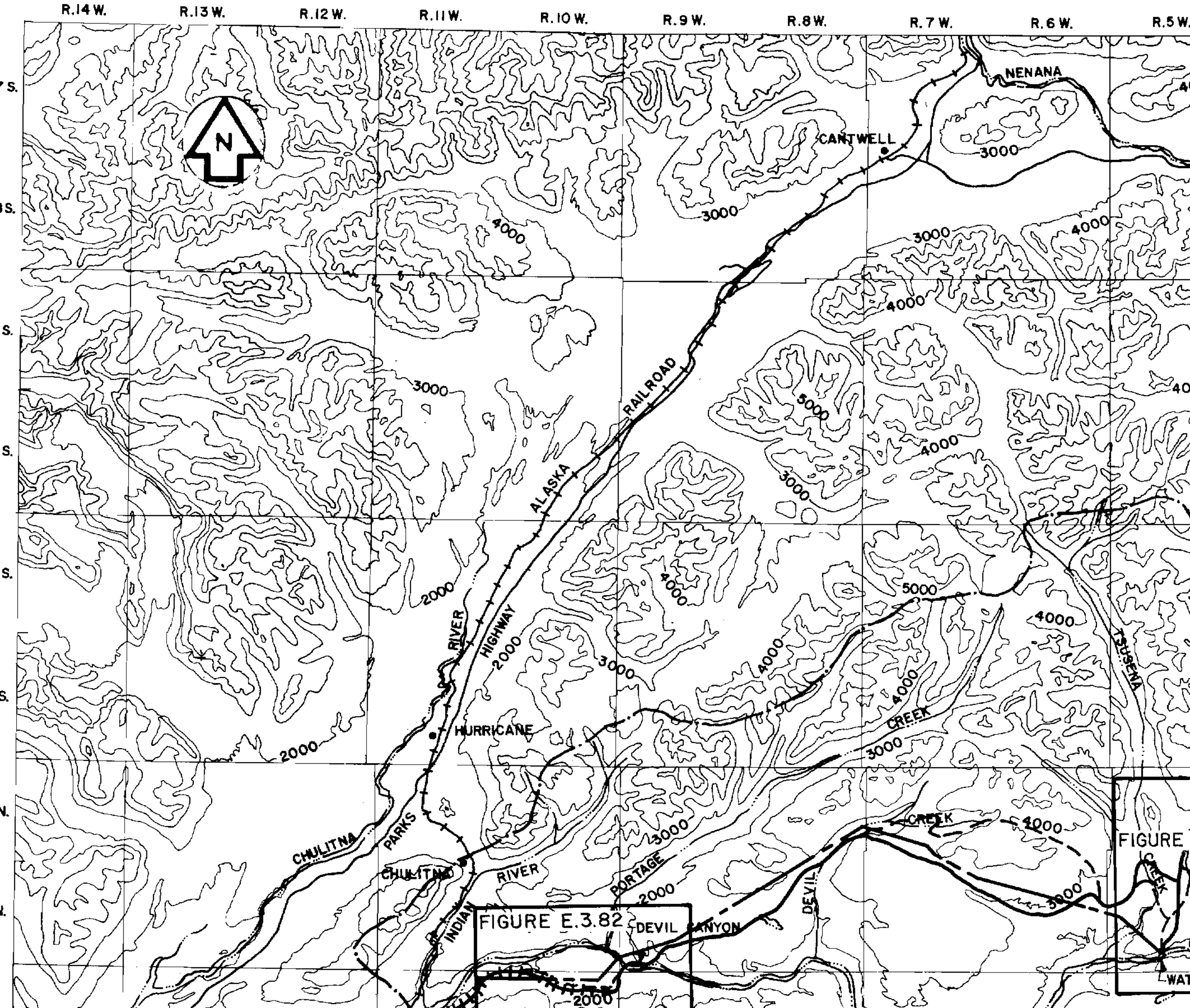
FIGURE E.3.77



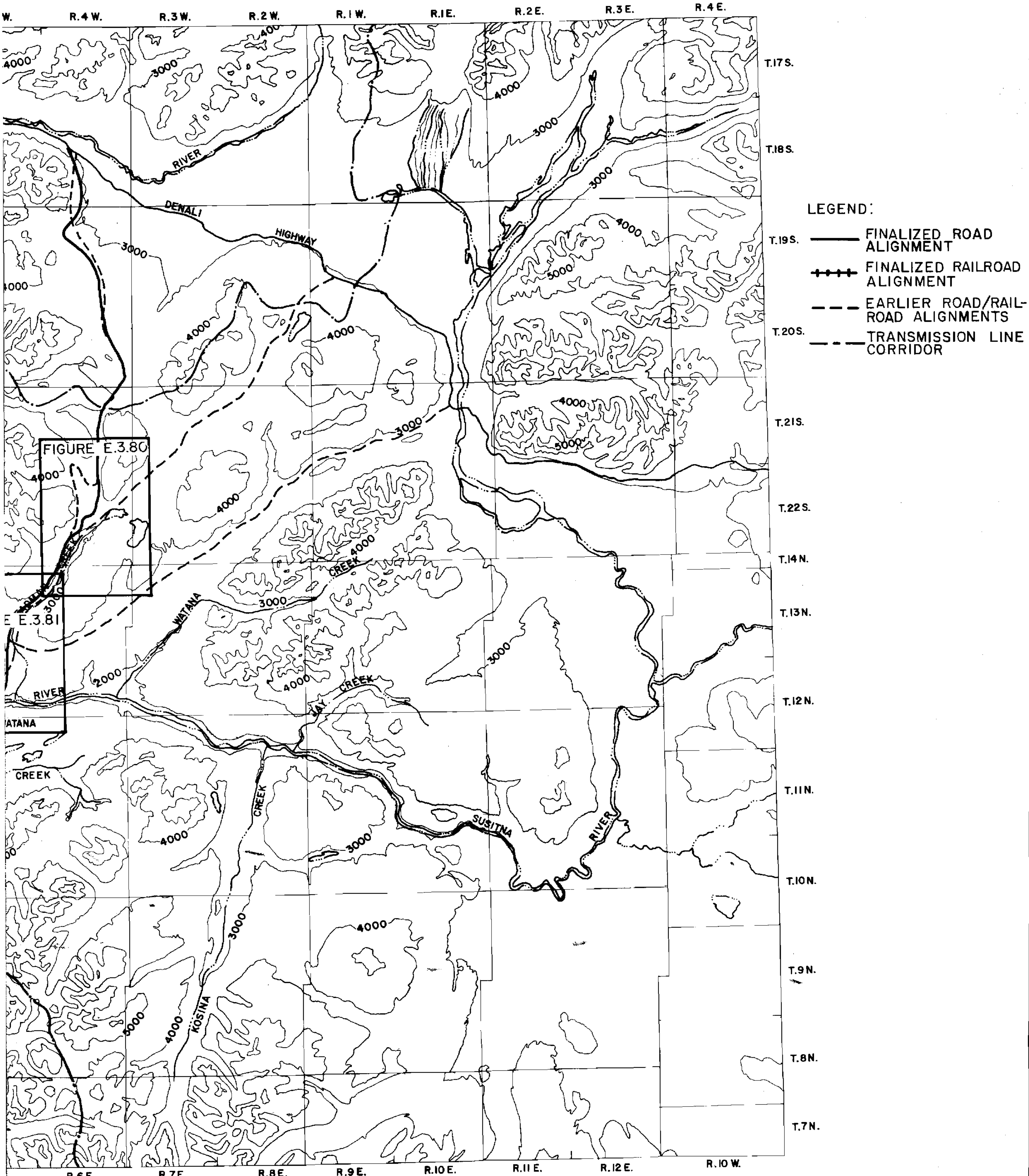
PRIMARY SUCCESSION ON THE SUSITNA FLOODPLAIN

SOURCE: VAN CLEVE AND VIERECK 1981

FIGURE E.3.78



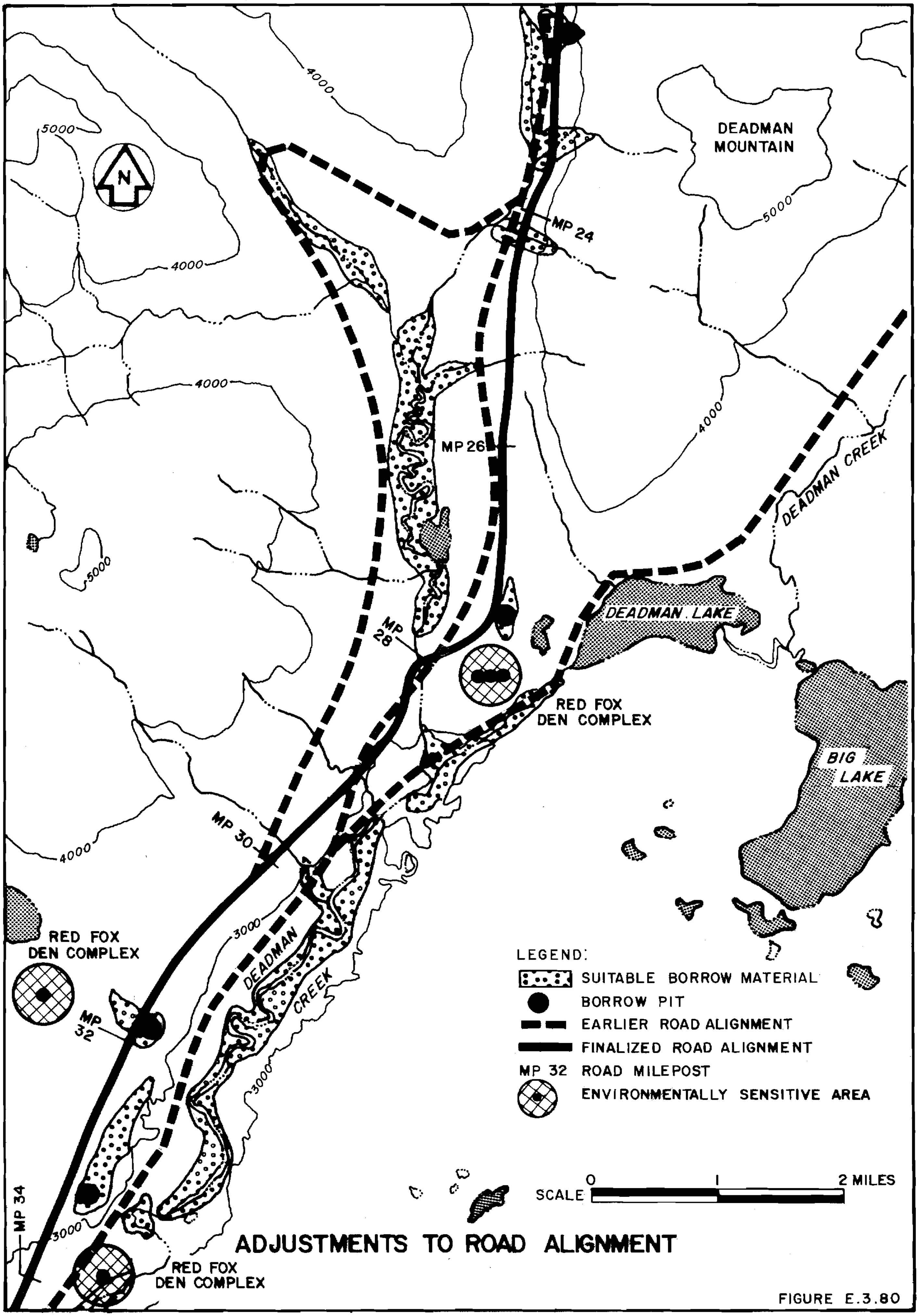
ADJUSTMENTS TO ROAD
(INDEX



SCALE 0 4 8 MILES

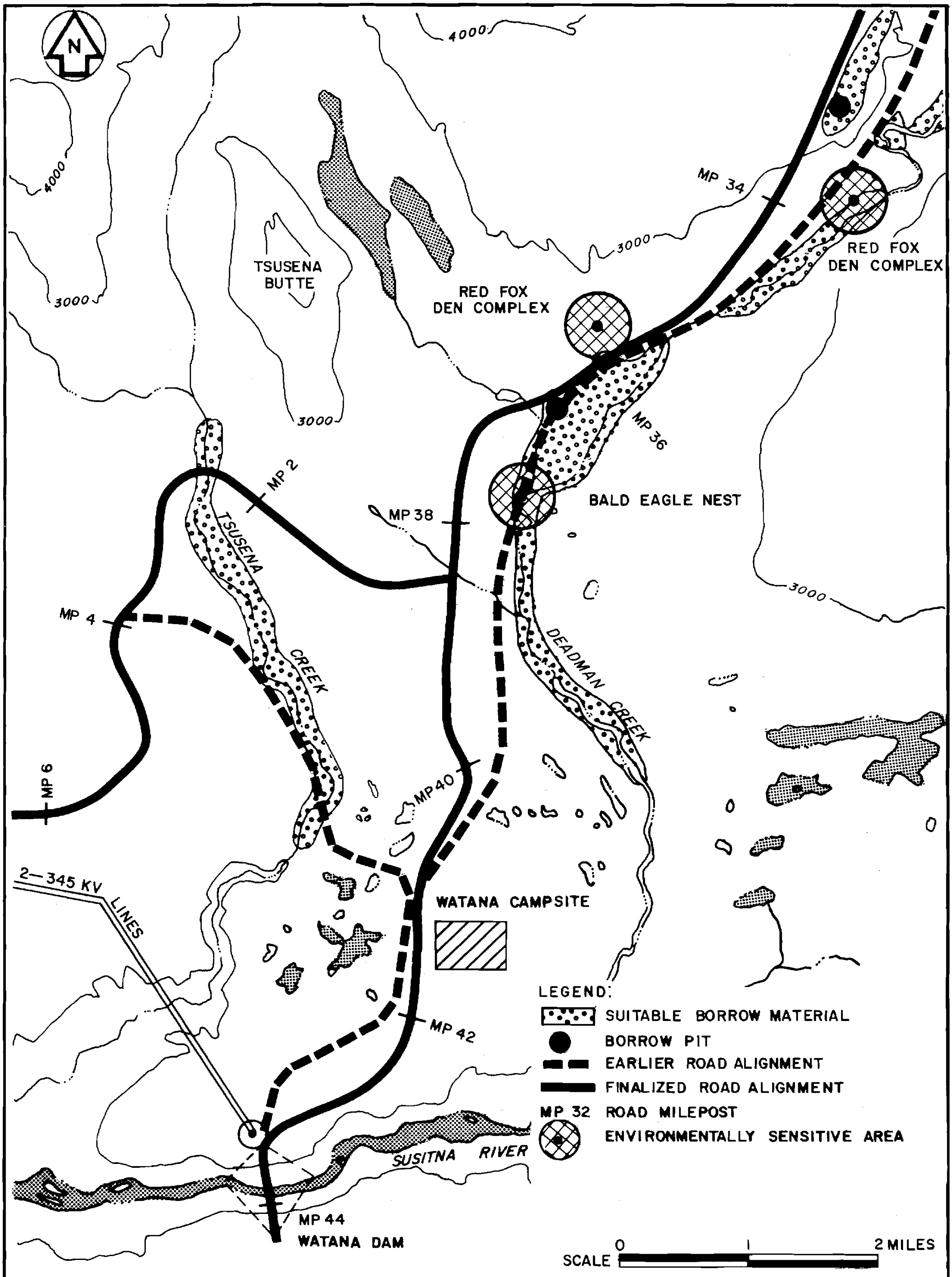
D/ RAILROAD ALIGNMENTS
X MAP

FIGURE E.3.79



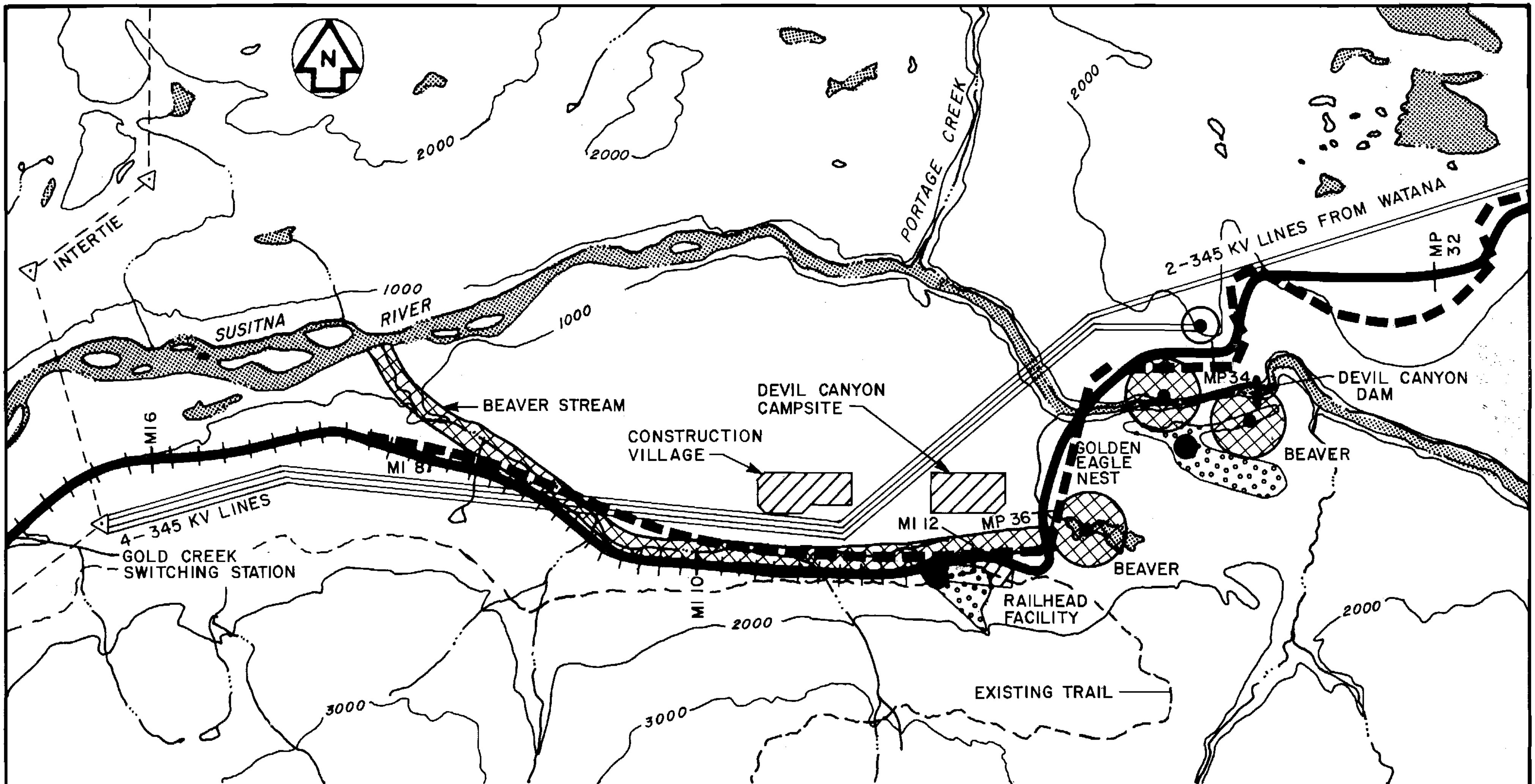
ADJUSTMENTS TO ROAD ALIGNMENT

FIGURE E.3.80



ADJUSTMENTS TO ROAD ALIGNMENT

FIGURE E.3.81



LEGEND:

SUITABLE BORROW MATERIAL

BORROW PIT

EARLIER ROAD / RAILROAD ALIGNMENT

FINALIZED ROAD ALIGNMENT

FINALIZED RAILROAD ALIGNMENT

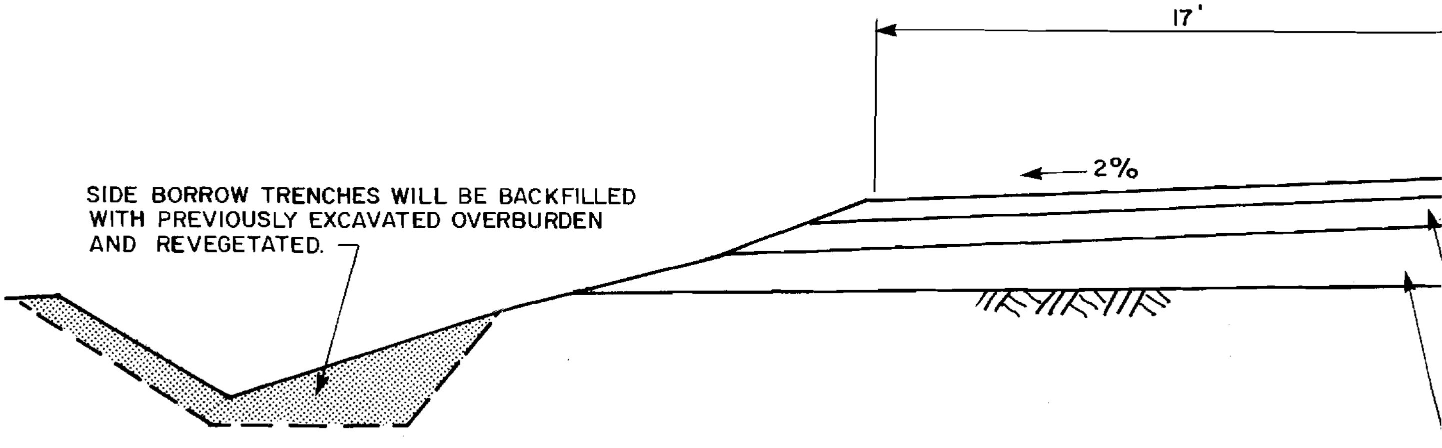
MP 32 ROAD MILEPOST

MI 12 RAILROAD MILEPOST

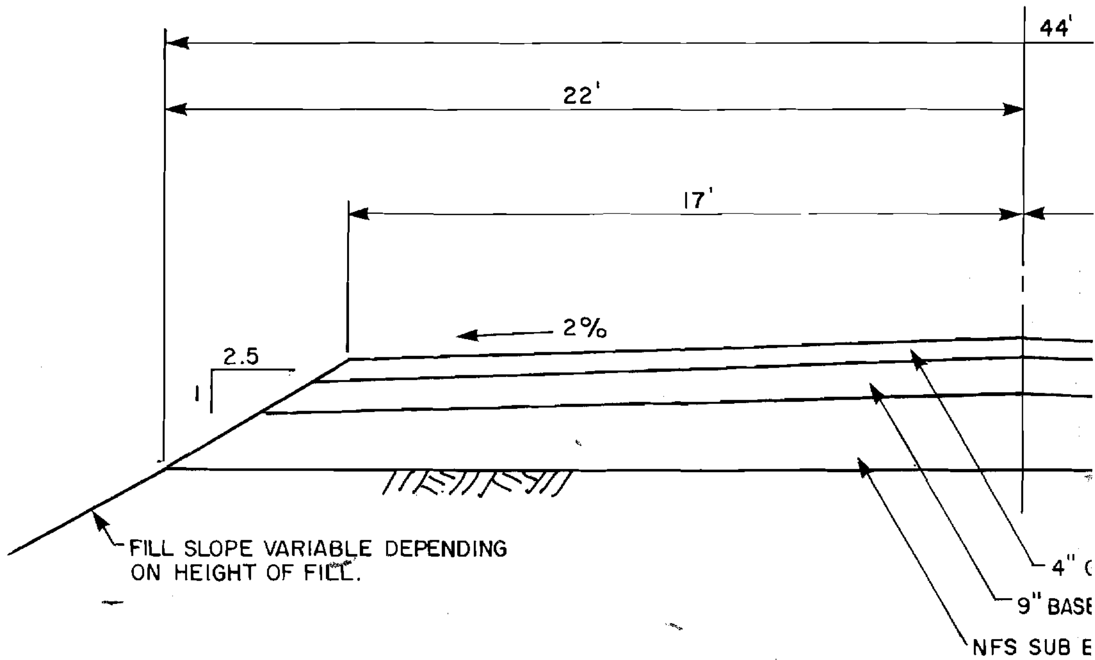
ENVIRONMENTALLY SENSITIVE AREA

ADJUSTMENTS TO ROAD AND RAILROAD ALIGNMENTS

FIGURE E.3.82

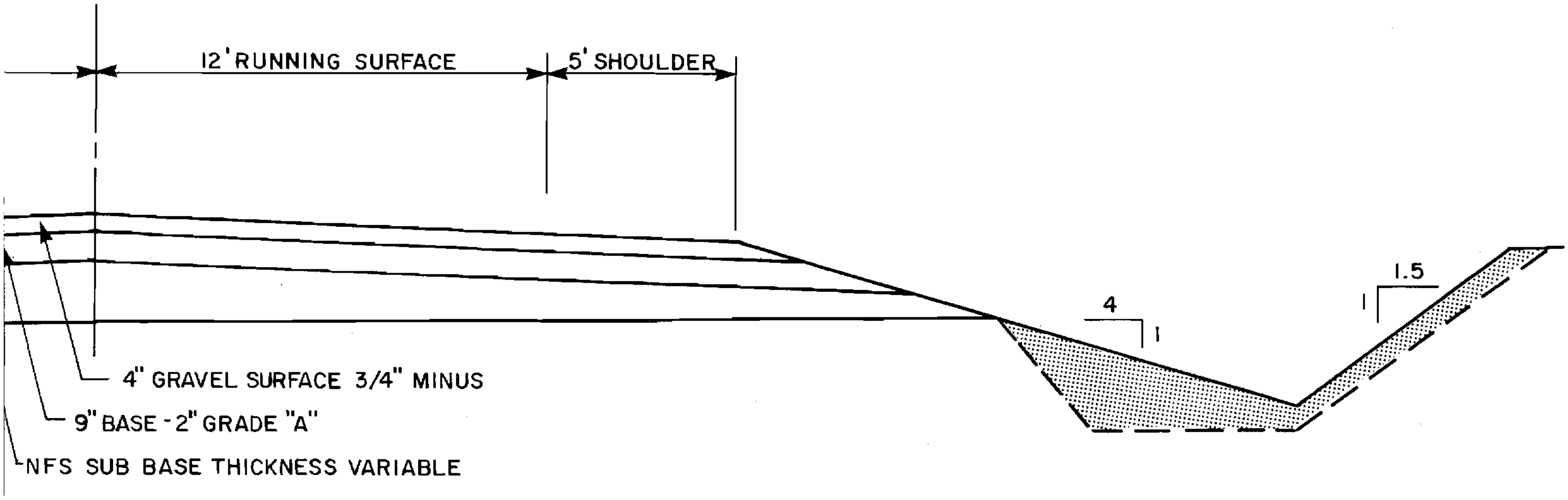


TYPICAL 'S

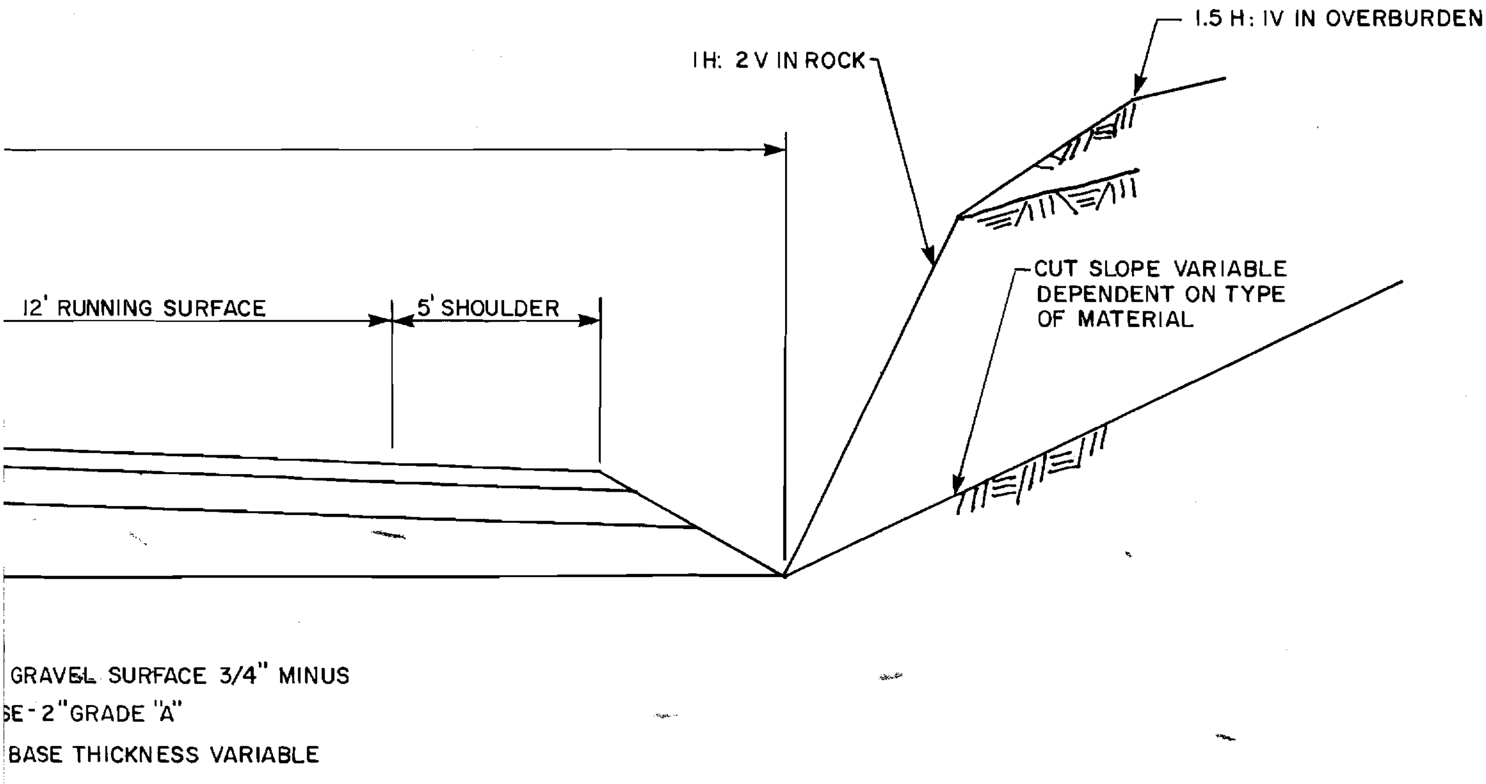


TYPICAL 'H

COMPARISON OF ROAD



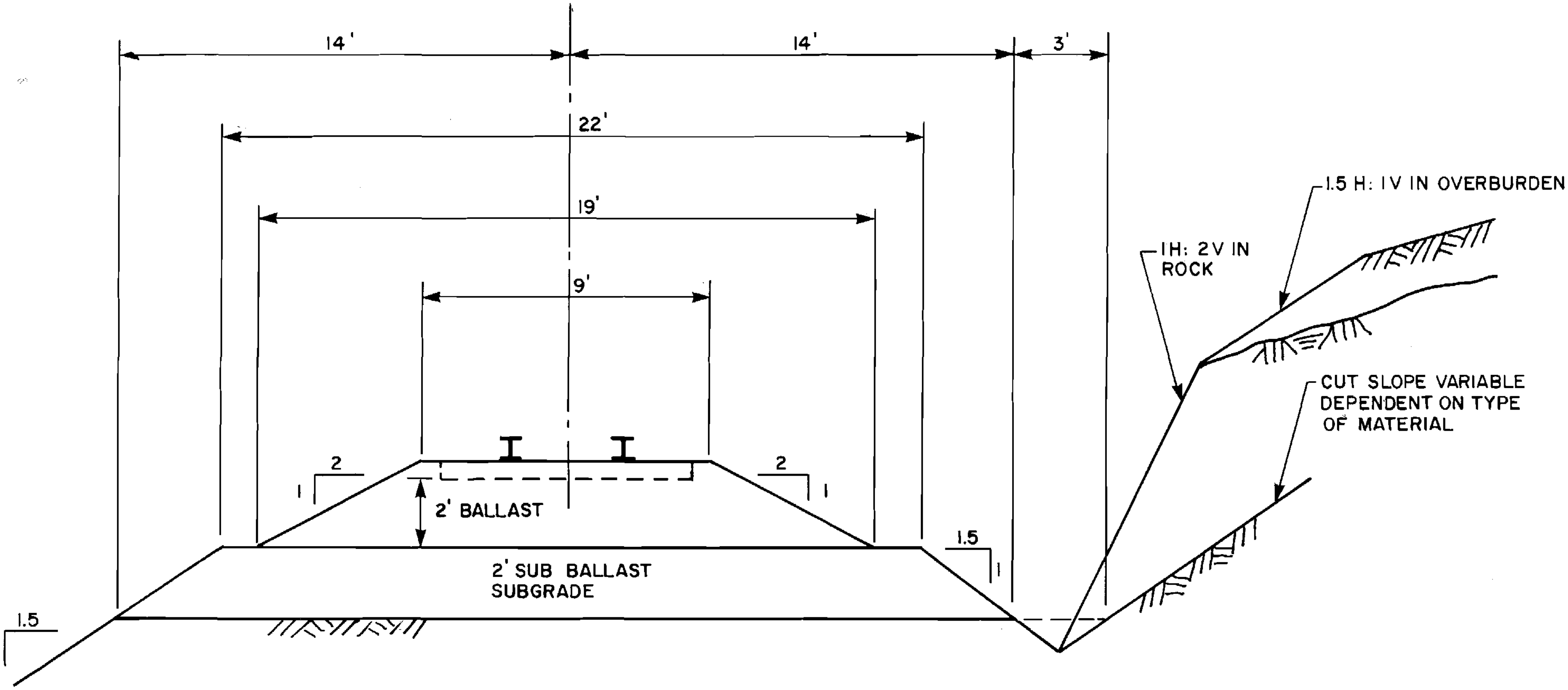
SIDE BORROW' SECTION



HILLSIDE CUT' SECTION

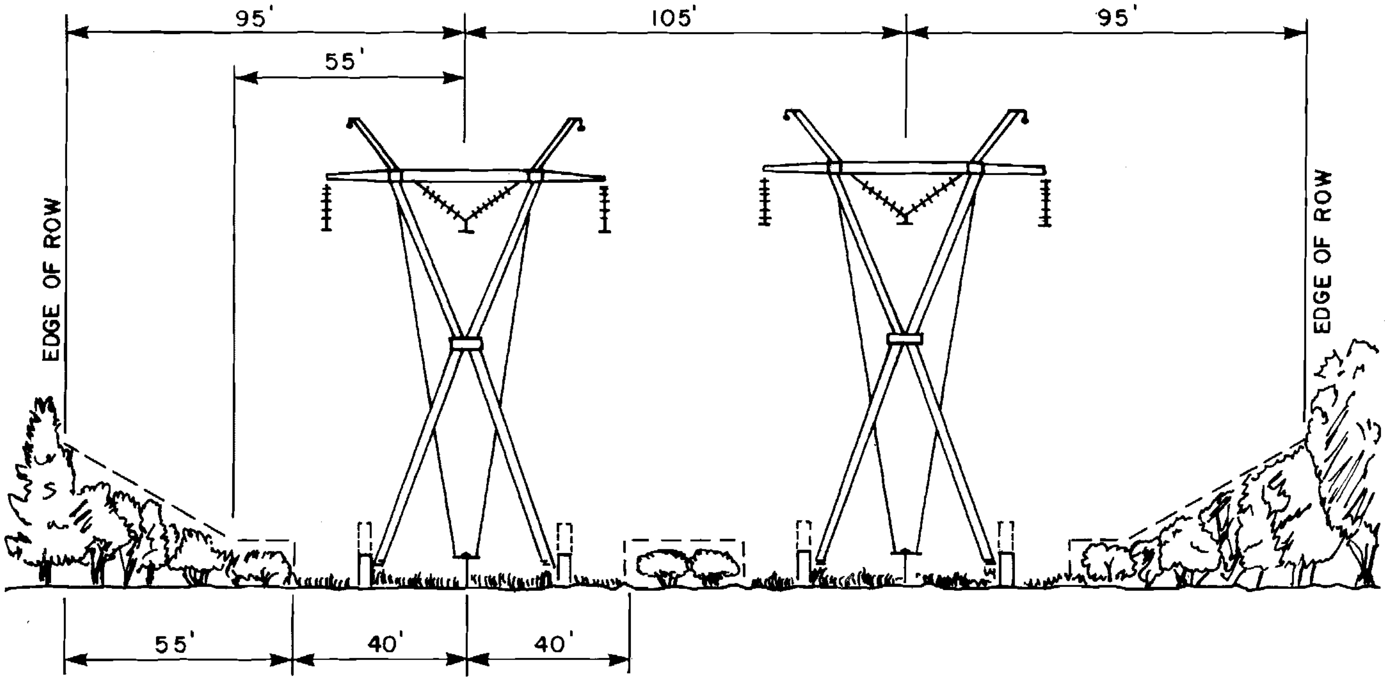
CONSTRUCTION TECHNIQUES

FIGURE E.3.83



TYPICAL HILLSIDE CUT OF RAILROAD CROSS SECTION

FIGURE E.3.84



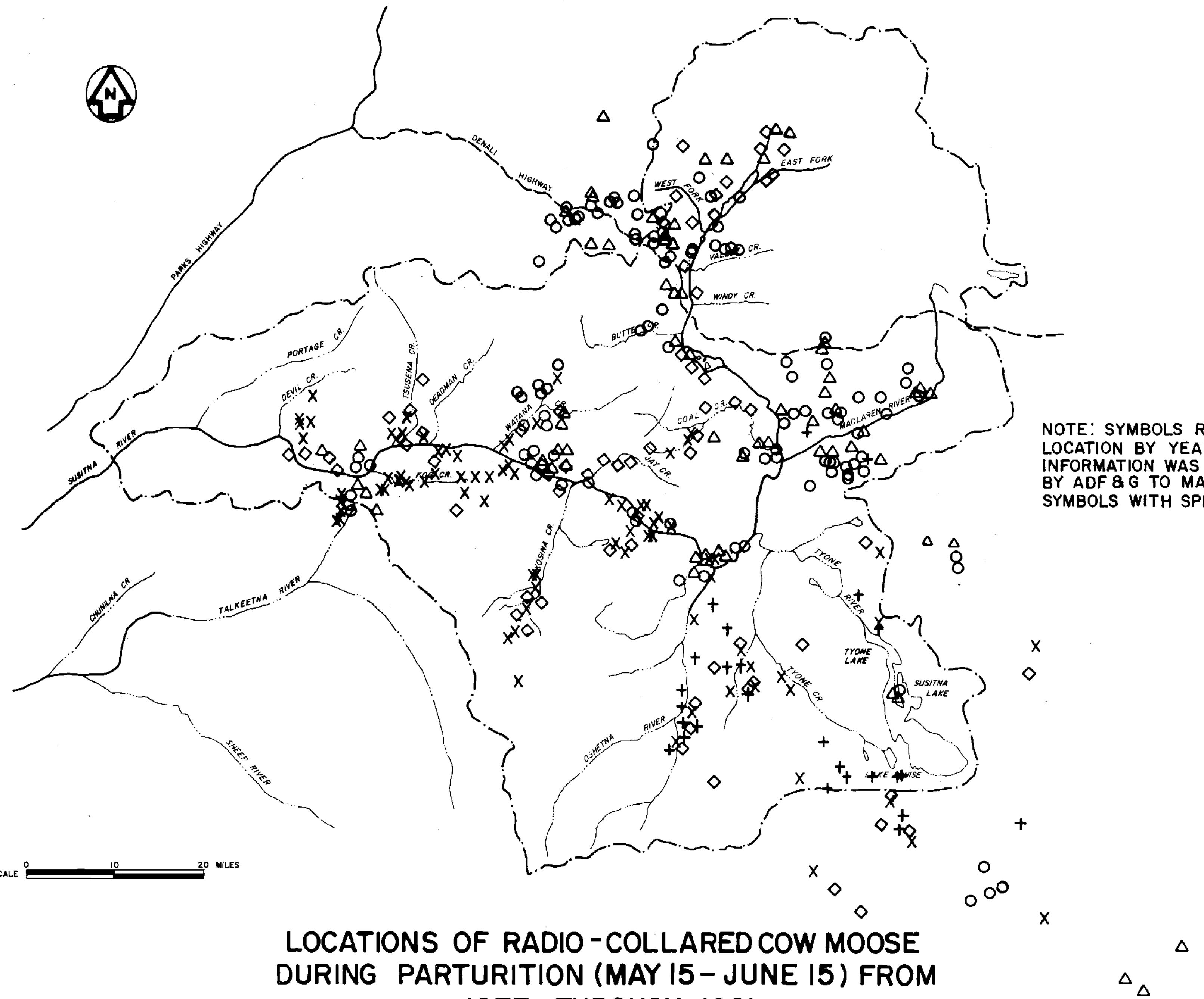
NOTE:

TOWER SPACING CENTERLINE TO CENTERLINE DISTANCE 105'.
TOWER SPACING CENTERLINE TO EDGE OF RIGHT-OF-WAY 95'.

NUMBER TOWERS	RIGHT-OF-WAY WIDTH
1	190 FEET
2	300 FEET
3	400 FEET
4	510 FEET

TYPICAL TRANSMISSION RIGHT-OF-WAY CROSS SECTION

FIGURE E.3.85

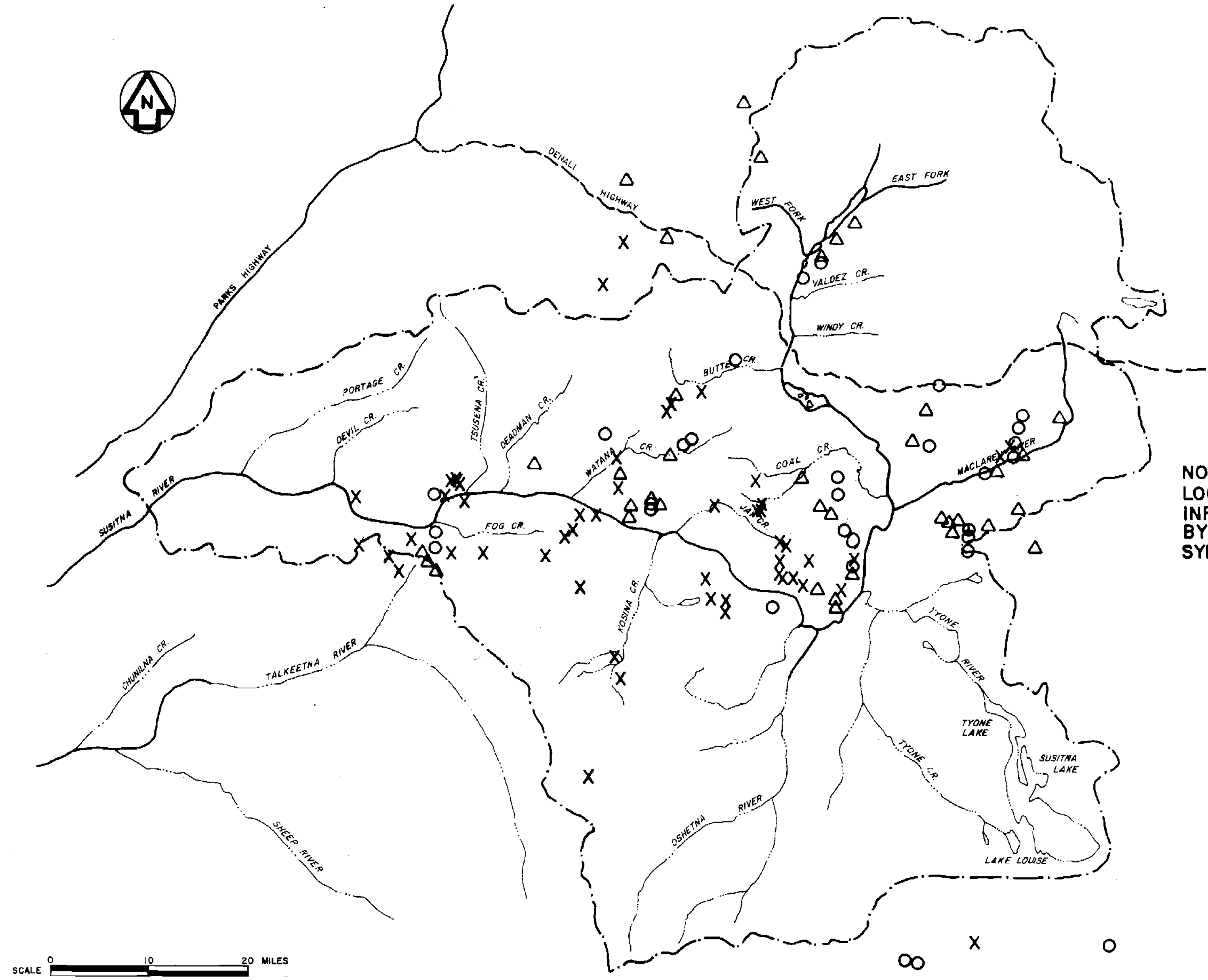


NOTE: SYMBOLS REPRESENT LOCATION BY YEAR. SUFFICIENT INFORMATION WAS NOT PROVIDED BY ADF & G TO MATCH SPECIFIC SYMBOLS WITH SPECIFIC YEARS.

LOCATIONS OF RADIO-COLLARED COW MOOSE DURING PARTURITION (MAY 15 - JUNE 15) FROM 1977 THROUGH 1981

SOURCE: ADF & G 1982 a

FIGURE E.3.86

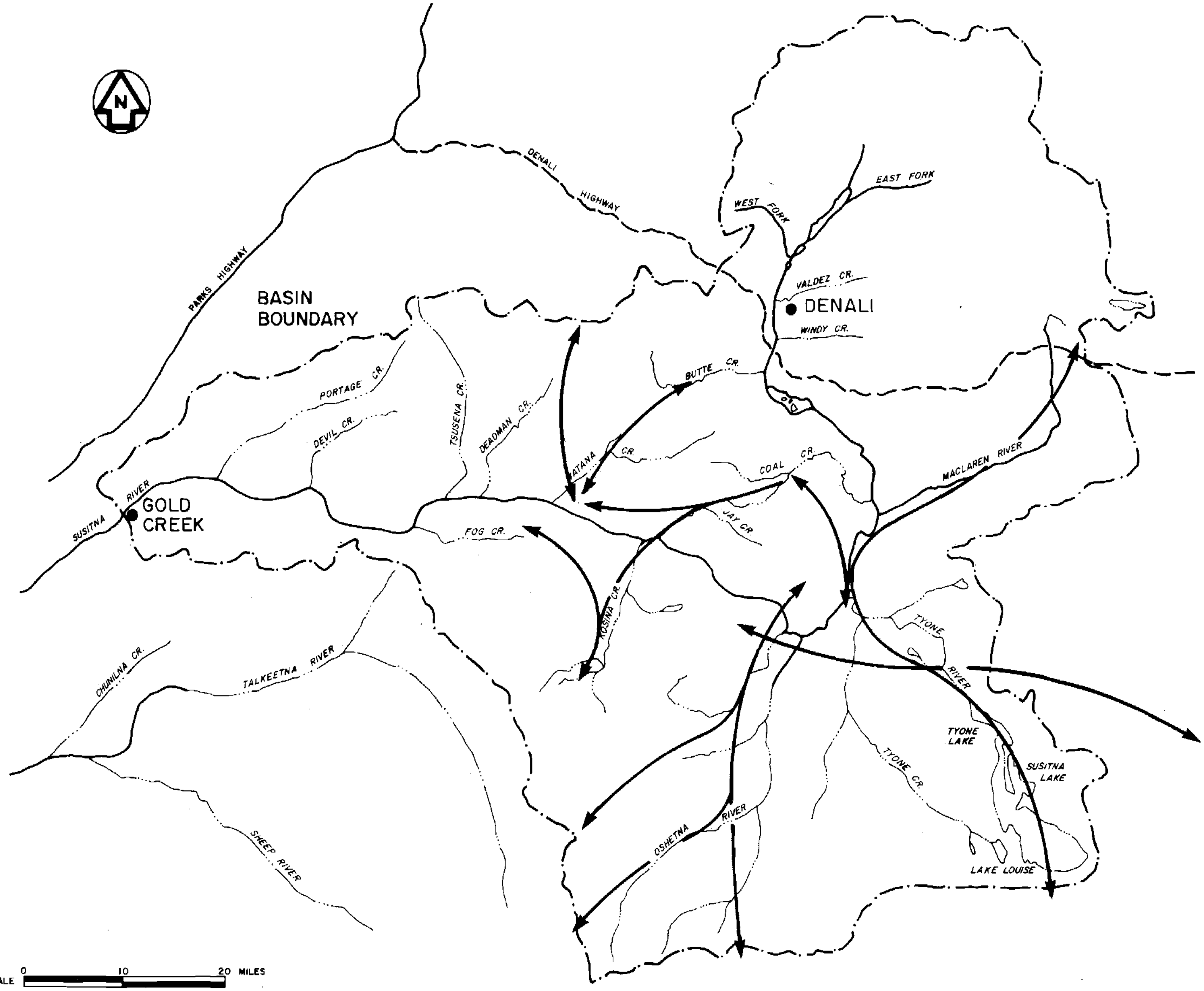


NOTE: SYMBOLS REPRESENT LOCATION BY YEAR. SUFFICIENT INFORMATION WAS NOT PROVIDED BY ADF & G TO MATCH SPECIFIC SYMBOLS WITH SPECIFIC YEARS.

LOCATIONS OF RADIO-COLLARED MOOSE DURING THE RUT (SEPTEMBER 20 - OCTOBER 20) FROM 1977 THROUGH FALL 1980

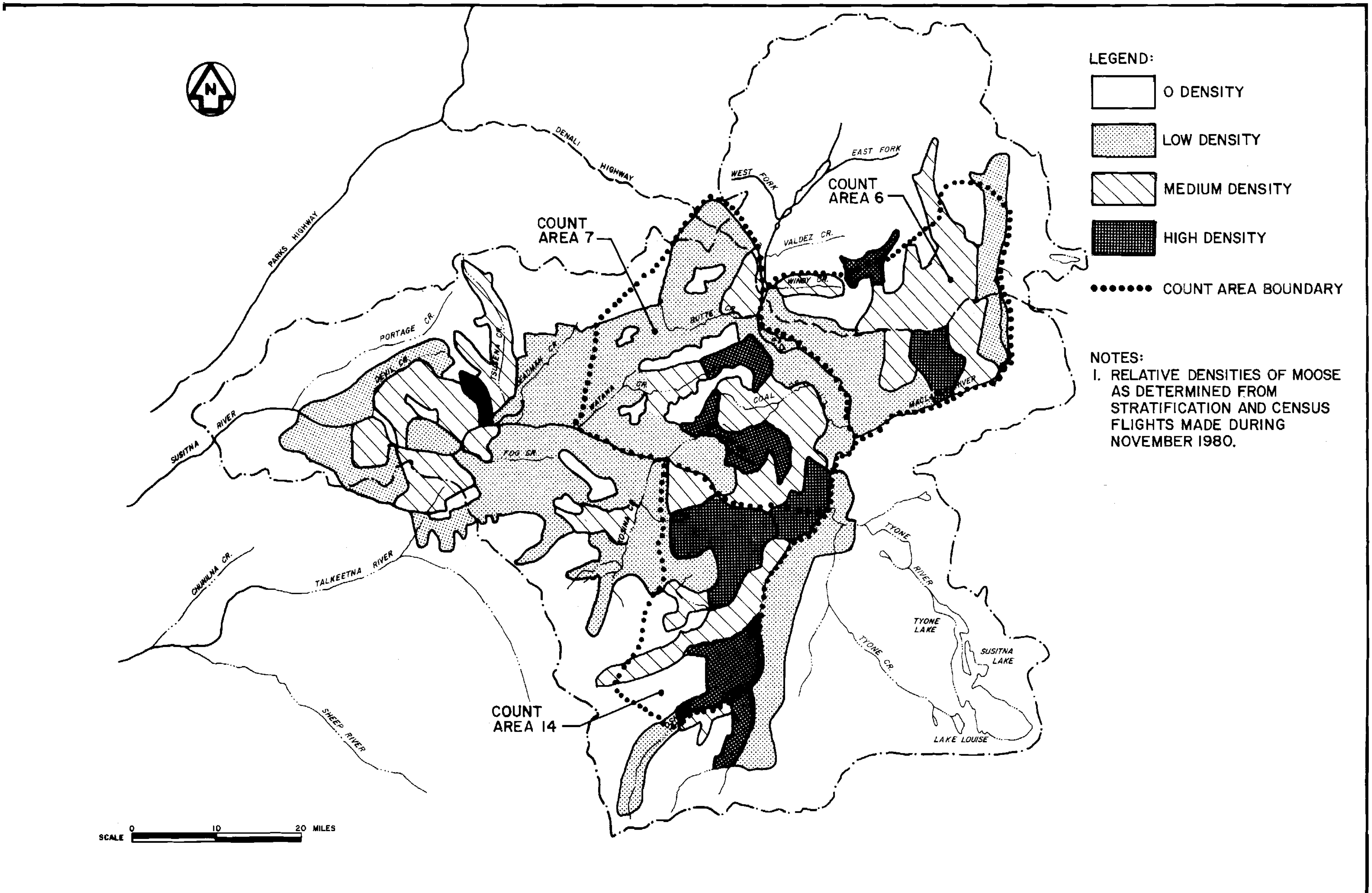
SOURCE: ADF & G 1982 a

FIGURE E.3.87



GENERAL MOVEMENT AND MIGRATION PATTERNS
OF RADIO-COLLARED MOOSE FROM OCTOBER 1976
THROUGH MID AUGUST 1981

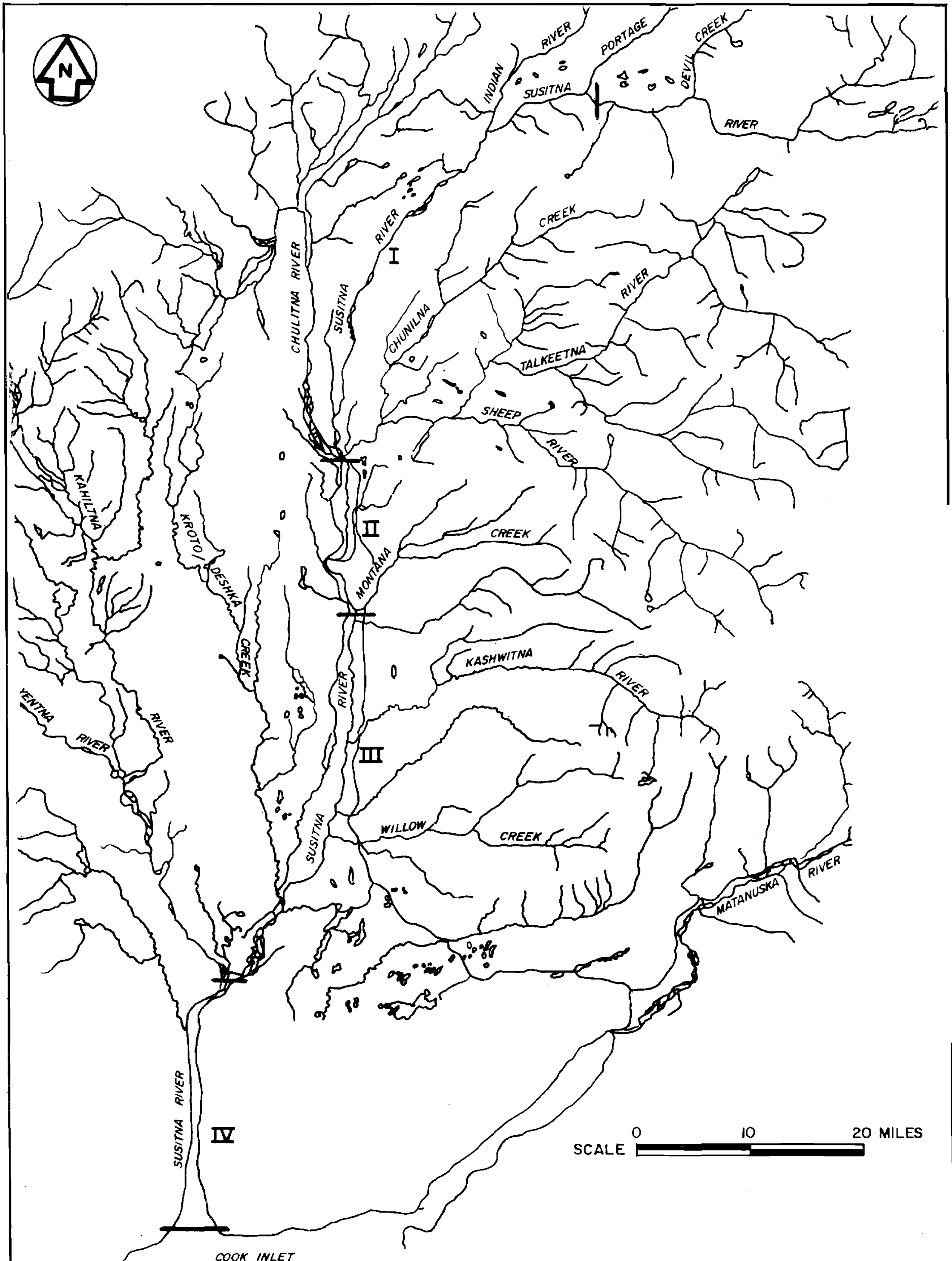
FIGURE E.3.88



BOUNDARIES OF ESTABLISHED MOOSE COUNT AREAS

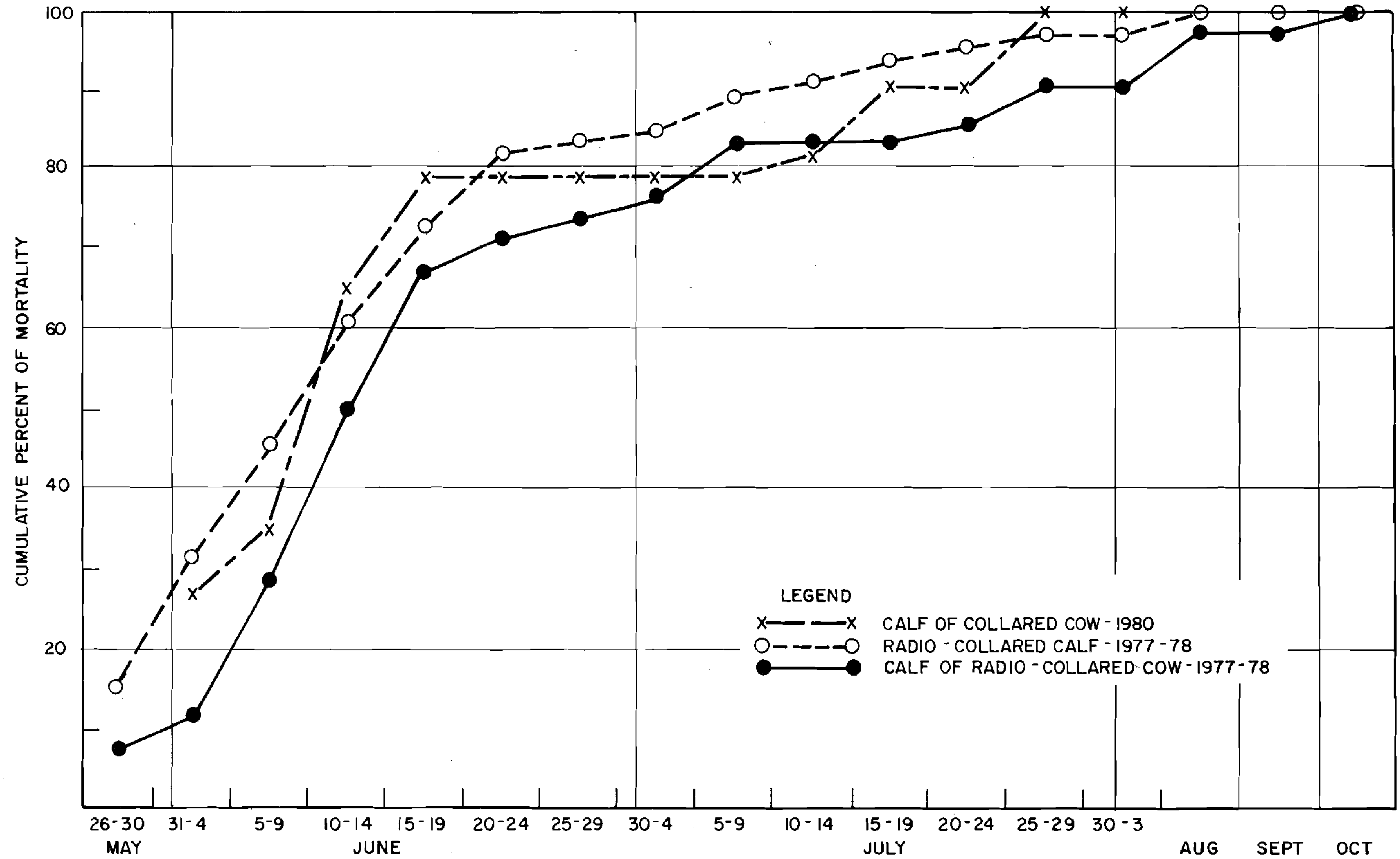
FROM ADF & G 1982a

FIGURE E.3.89



ZONES EMPLOYED TO ESTIMATE MOOSE DENSITIES WITHIN RIPARIAN COMMUNITIES ALONG THE SUSITNA RIVER

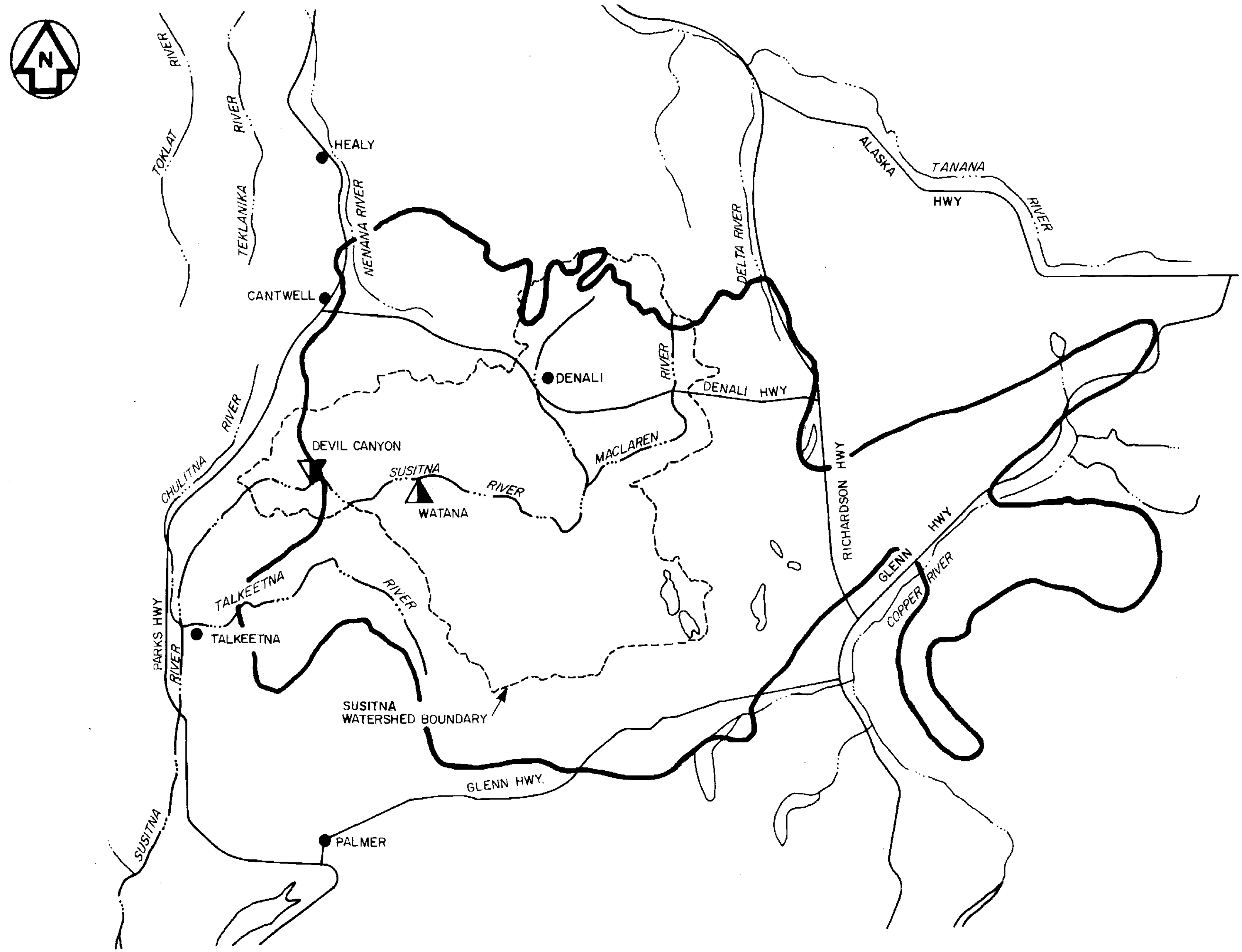
FIGURE E.3.90



DATES OF MORTALITIES OF COLLARED AND UNCOLLARED MOOSE CALVES DURING 1977, 1978, AND 1980 IN THE NELCHINA AND MIDDLE SUSITNA BASIN, ALASKA

SOURCE: ADF&G 1982a

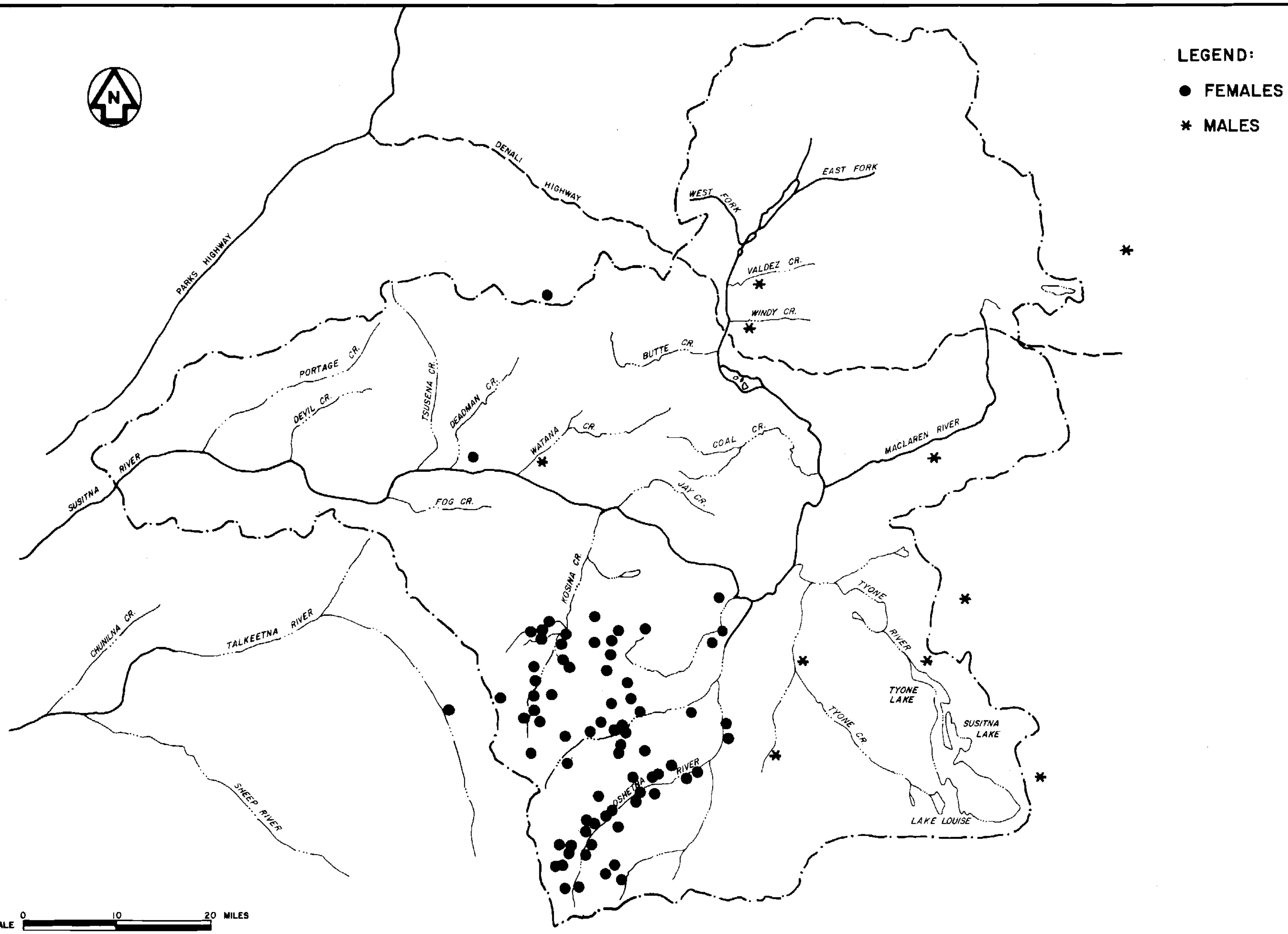
FIGURE E.3.91



HISTORICAL RANGE OF THE NELCHINA CARIBOU HERD

SOURCE: HEMMING 1971

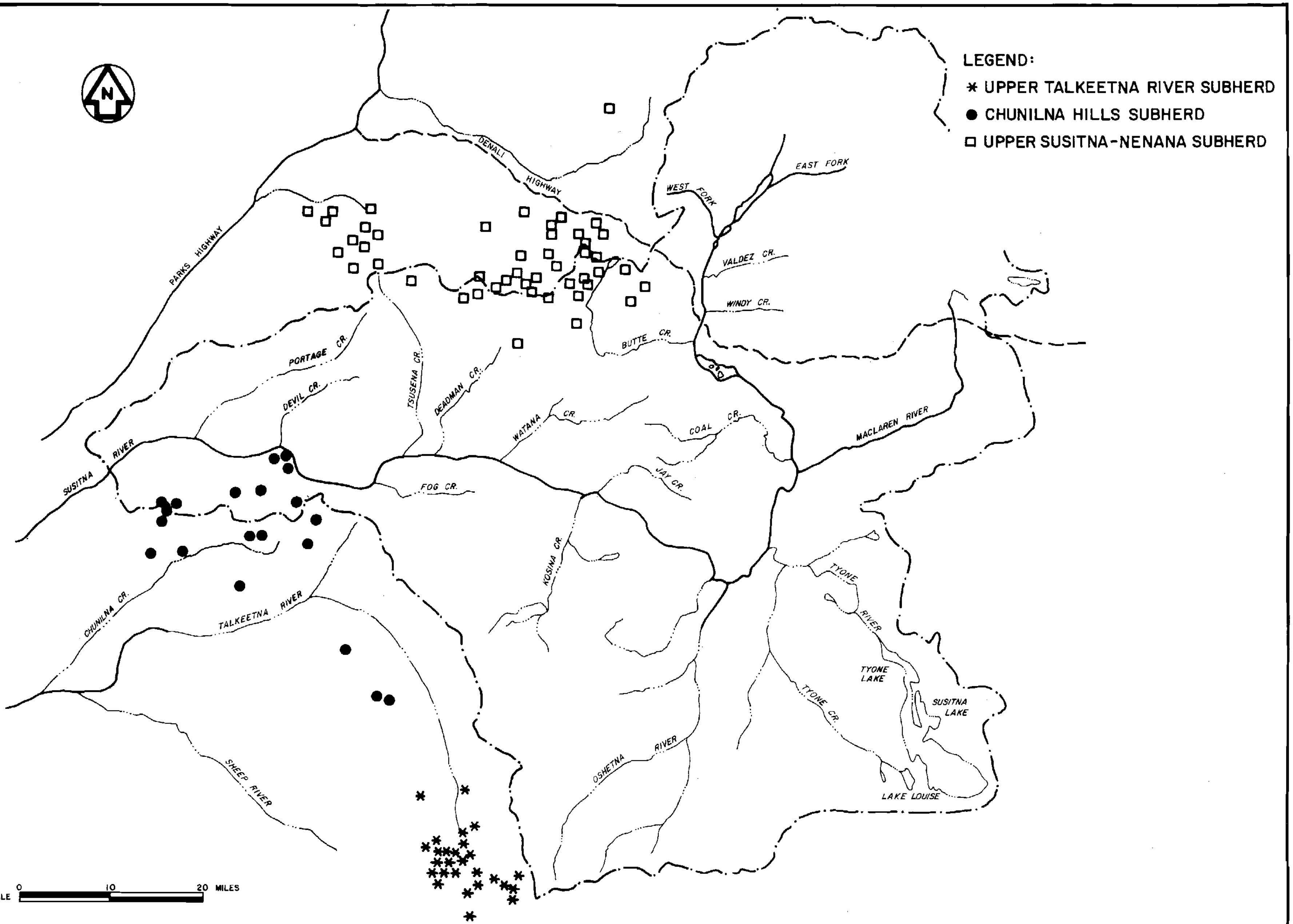
FIGURE E.3.92



DISTRIBUTION OF NELCHINA RADIO-COLLARED CARIBOU
DURING THE CALVING PERIOD MAY 15 THROUGH JUNE 10, 1980 AND 1981

SOURCE ADF & G 1982 c.

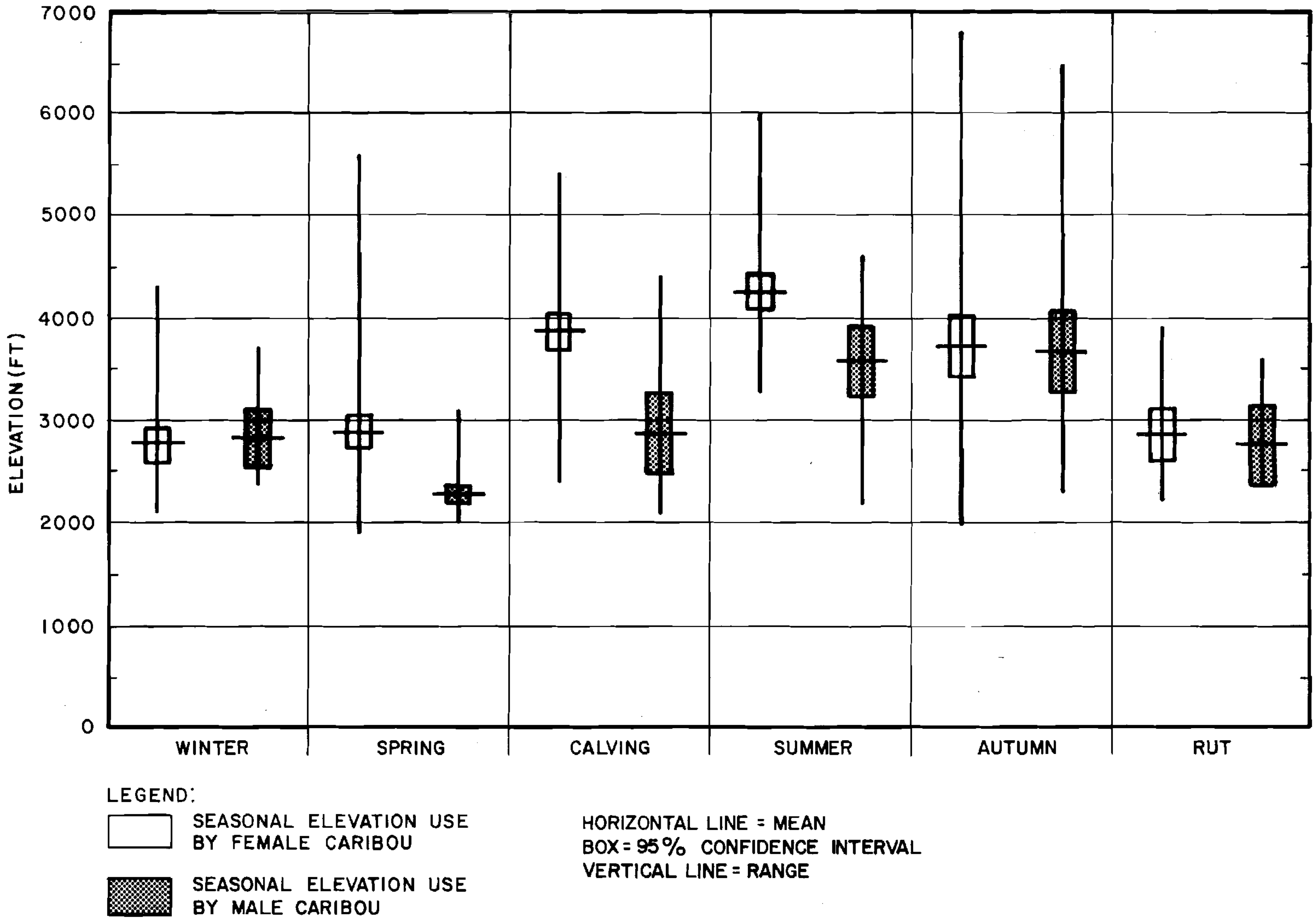
FIGURE E.3.93



LOCATION OF RADIO-COLLARED CARIBOU IN SUBHERDS, MAY 9, 1980 THROUGH SEPTEMBER 22, 1981

SOURCE: ADF & G 1982c

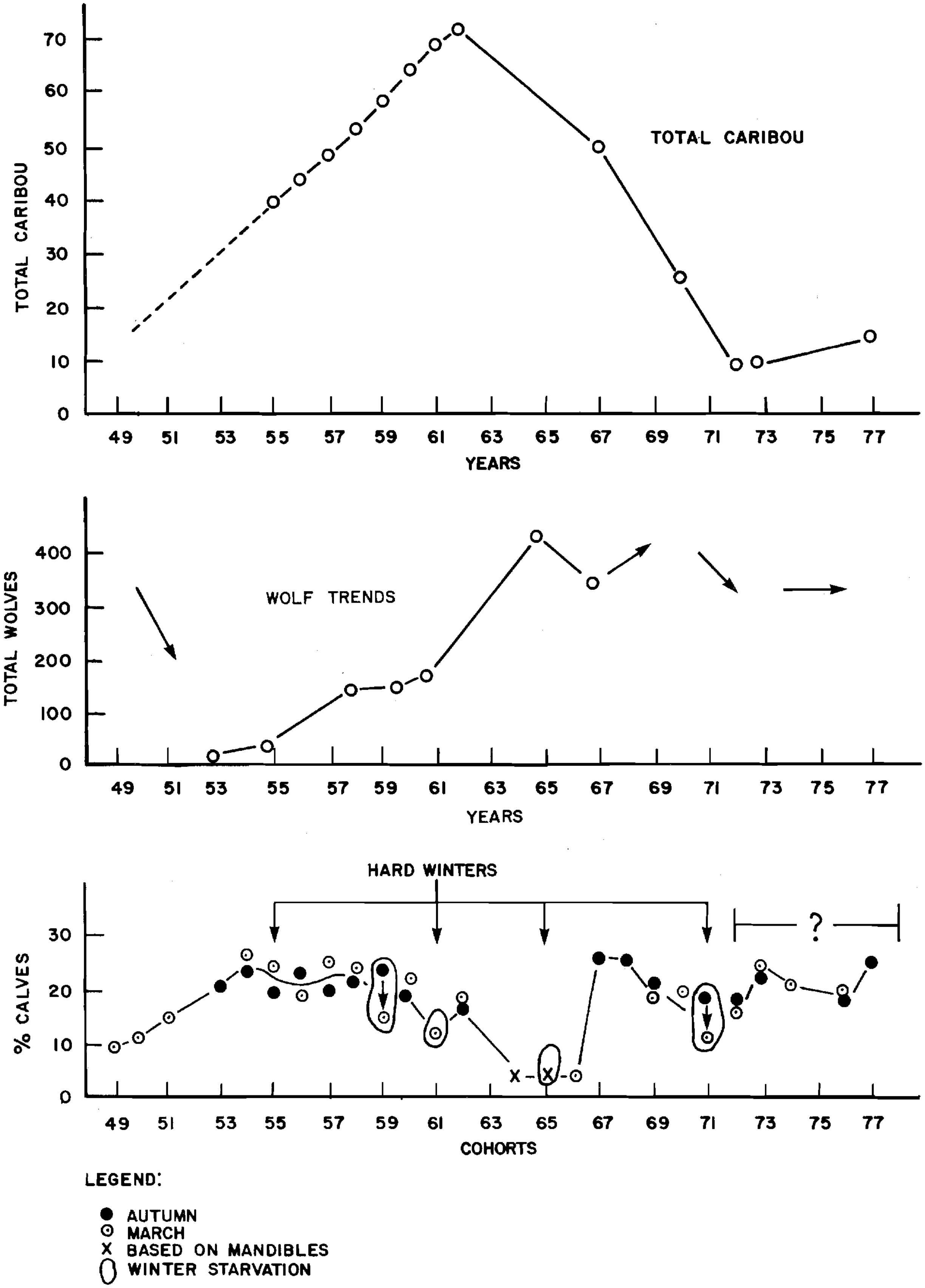
FIGURE E.3.94



SEASONAL ELEVATION USE BY CARIBOU FROM NELCHINA HERD

SOURCE: ADF & G 1982c

FIGURE E.3.95

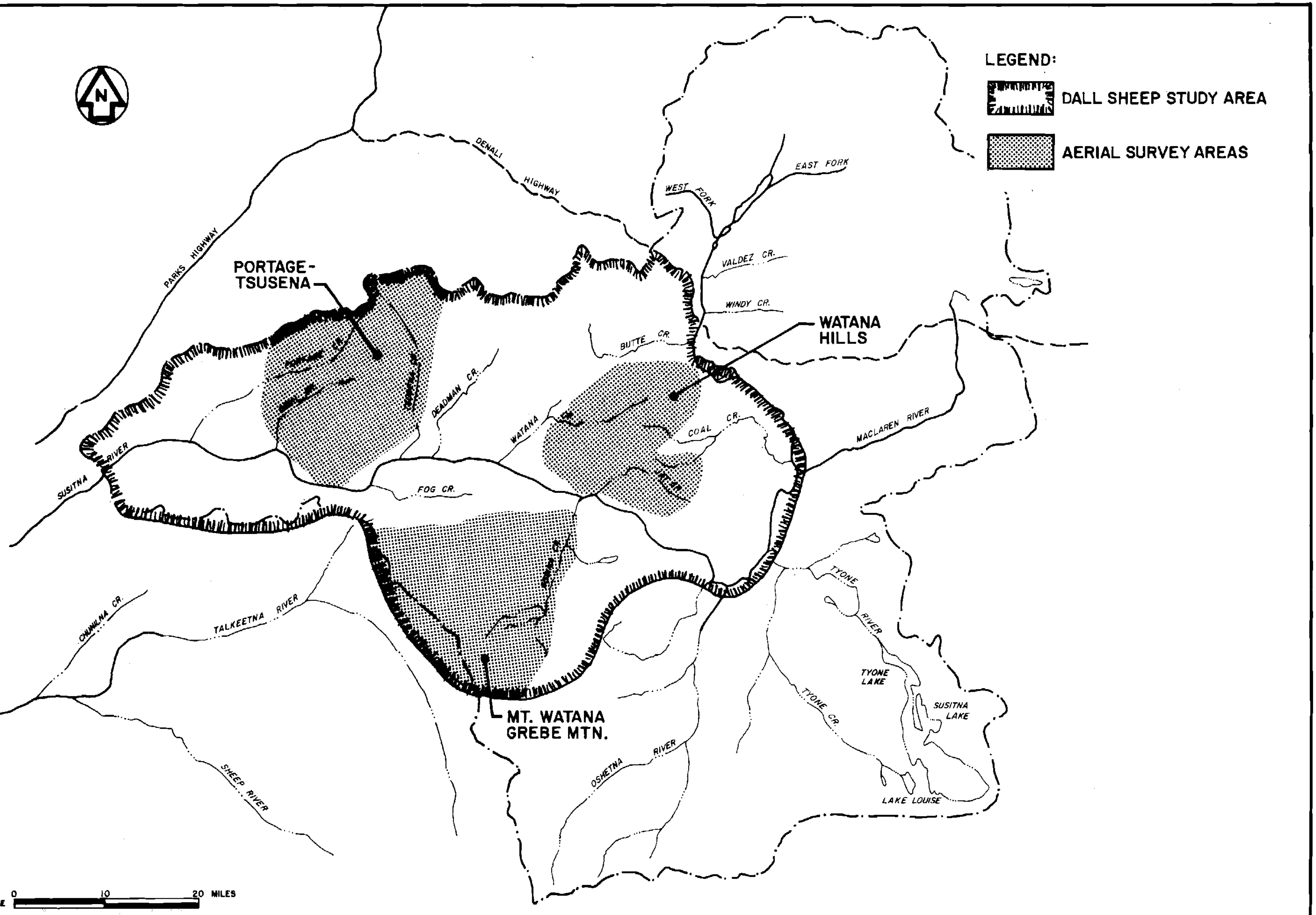


NOTE: FOR THE NELCHINA HERD IN ALASKA, WINTER STARVATION IS LISTED FOR THOSE YEARS IN WHICH THE PERCENTAGE OF CALVES IN THE SPRING WAS LOW AND THE PRIOR WINTER WAS SEVERE. HOWEVER, THE LOW CALF PERCENTAGES MAY BE DUE TO OTHER MORTALITY FACTORS OR TO SAMPLE ERROR.

CALF SURVIVAL COMPARED WITH WOLF NUMBERS AND TOTAL CARIBOU

SOURCE: BERGERUD 1980

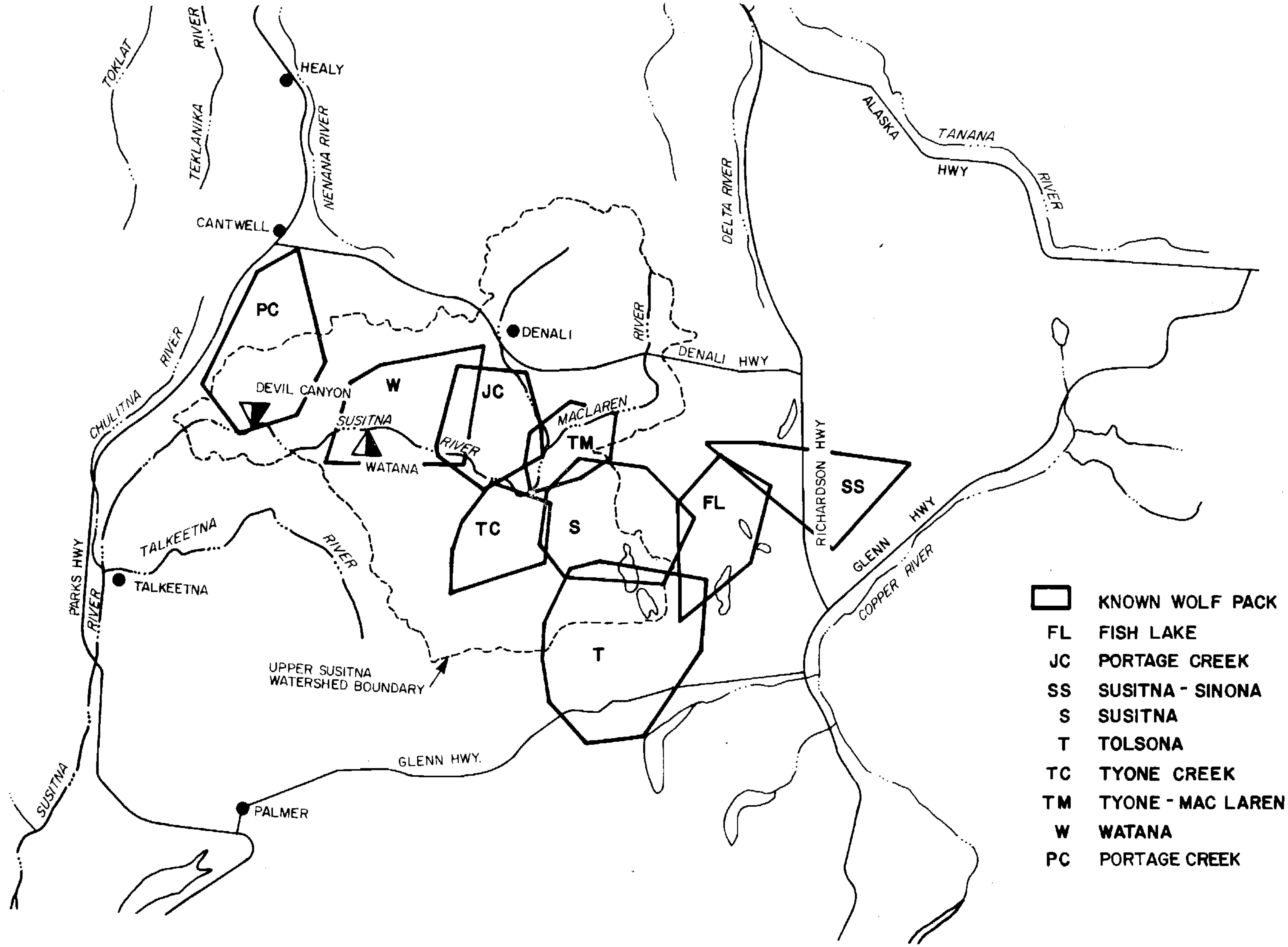
FIGURE E.3.96



LOCATION OF DALL SHEEP STUDY AND AERIAL SURVEY AREAS

SOURCE: ADF & G 1982d

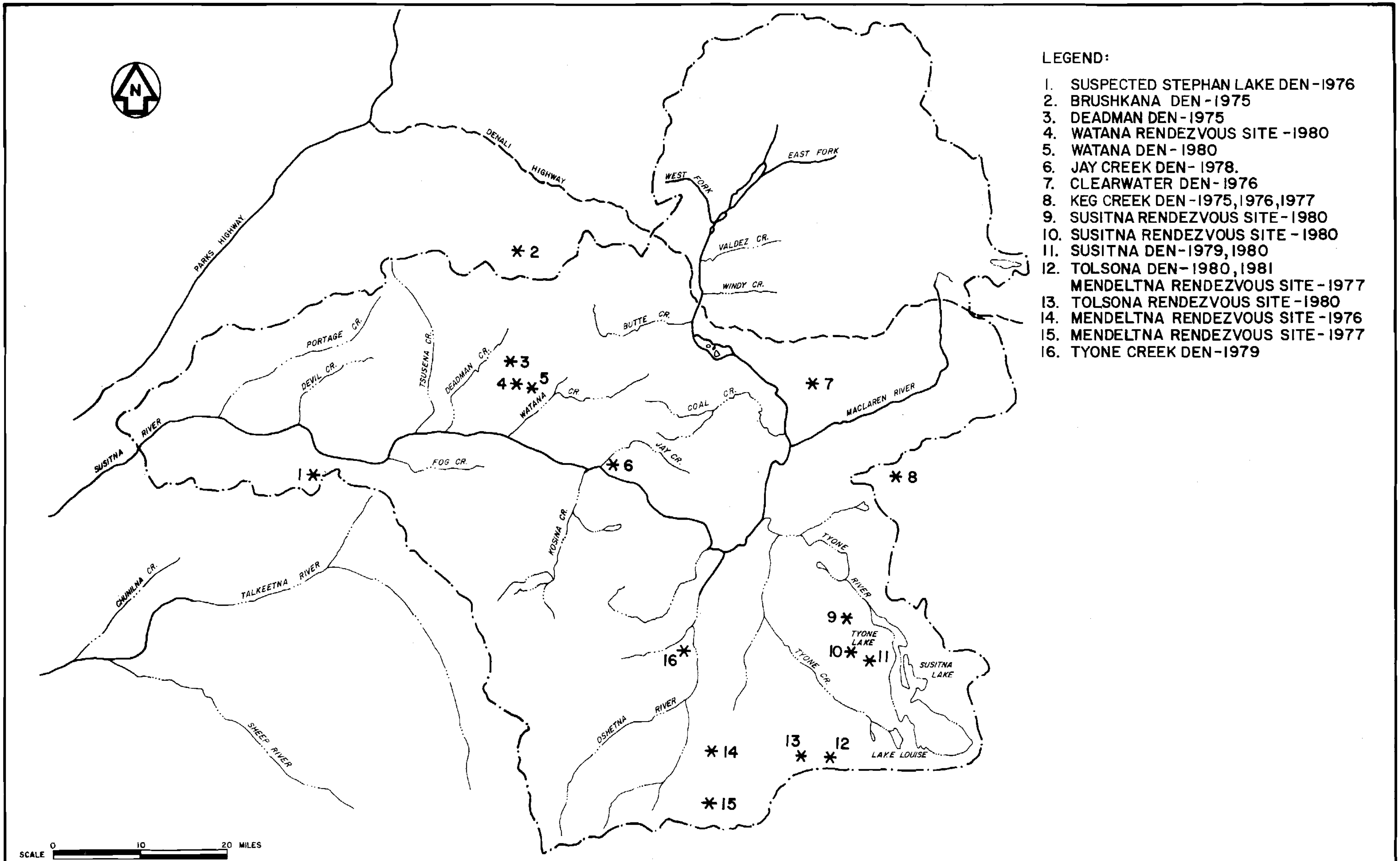
FIGURE E.3.97



SUSPECTED LOCATIONS AND TERRITORIAL BOUNDARIES OF WOLF PACKS INHABITING THE SUSITNA HYDROELECTRIC PROJECT AREA DURING 1980 AND 1981

SOURCE: ADF&G 1982f

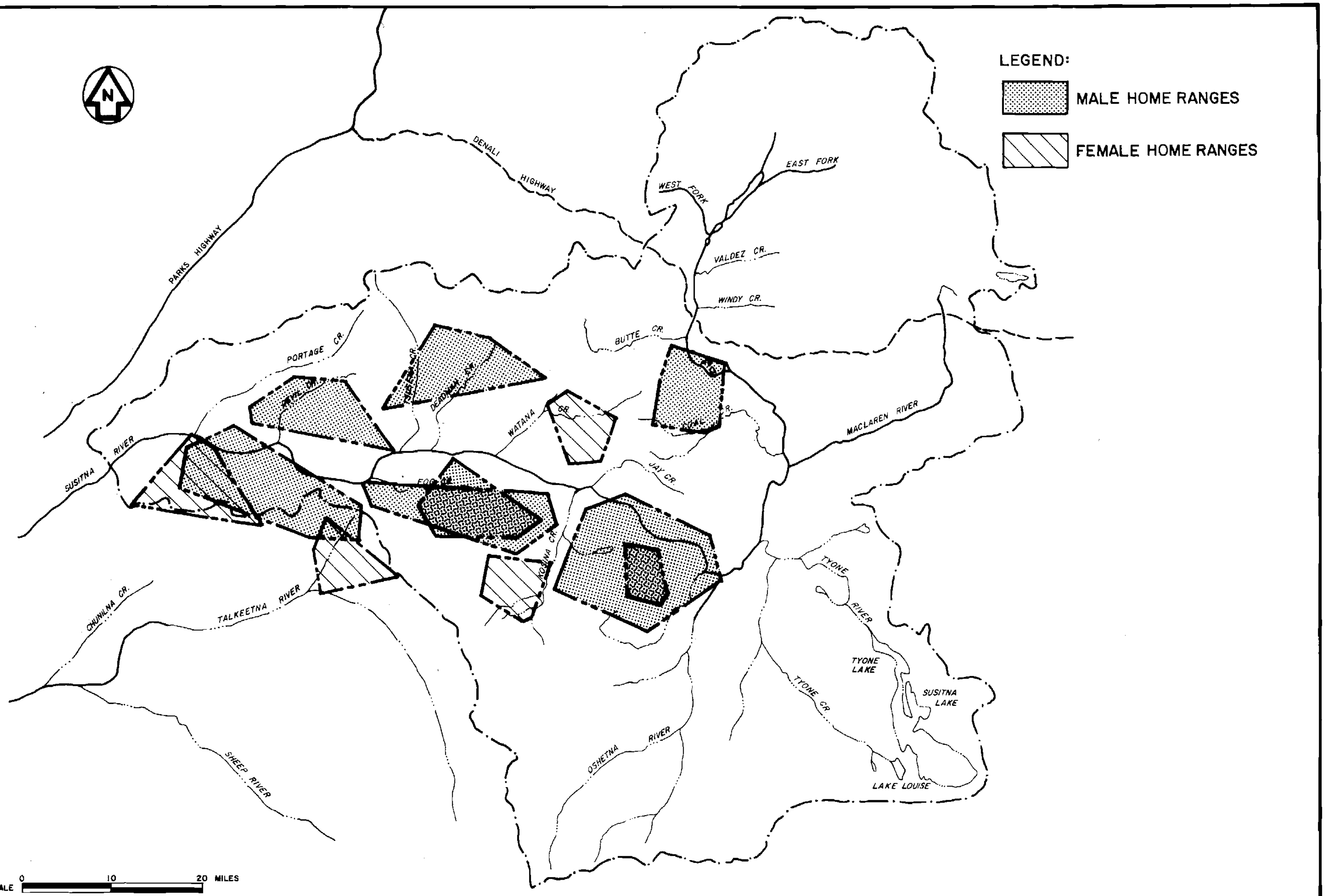
FIGURE E.3.98



GENERAL LOCATION AND YEAR OF USE OF OBSERVED WOLF DEN AND RENDEZVOUS SITES DISCOVERED IN THE SUSITNA HYDROELECTRIC PROJECT AREA FROM 1975 THROUGH 1981

SOURCE: ADF & G 1982f

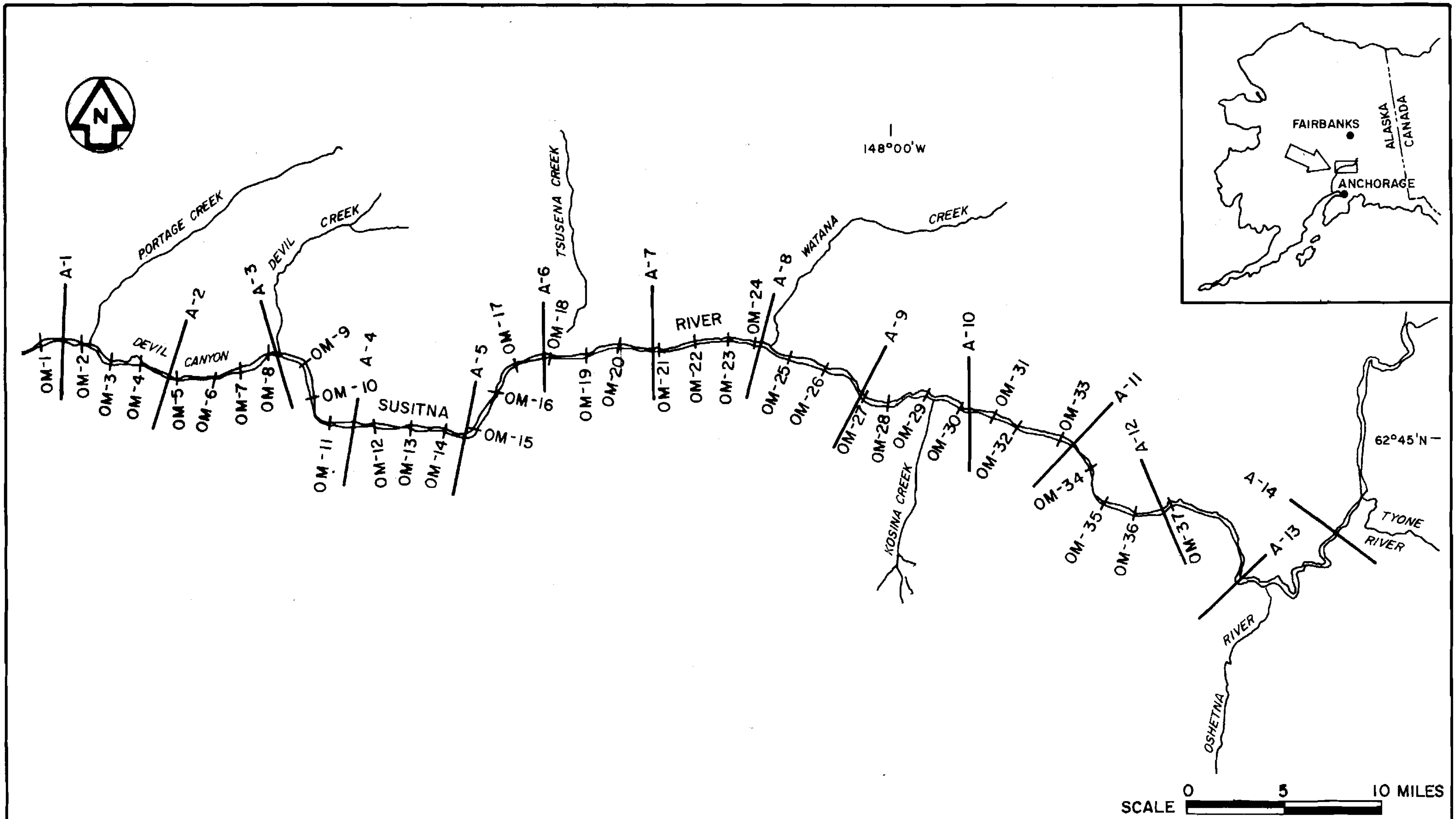
FIGURE E.3.99



OBSERVED HOME RANGES OF WOLVERINES IN THE MIDDLE SUSITNA BASIN BASED ON LOCATION OF RADIO-COLLARED ANIMALS

SOURCE: ADF & G 1982g, UNPUBL. DATA

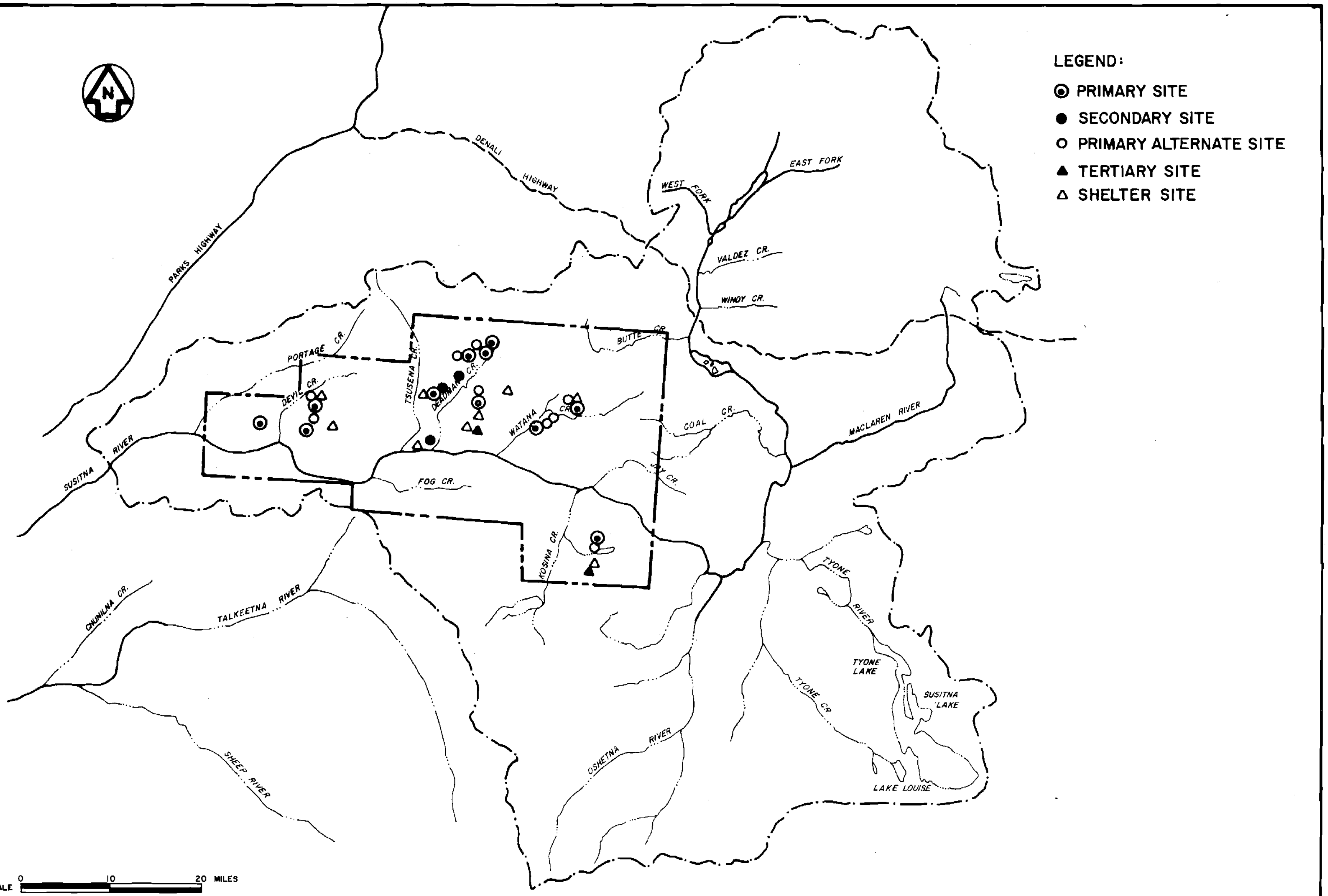
FIGURE E.3.100



AERIAL TRANSECTS FOR FURBEARERS (A) AND
CHECKPOINTS FOR OTTER AND MINK SIGN (OM)

SOURCE: GIPSON et al. 1982

FIGURE E.3.101

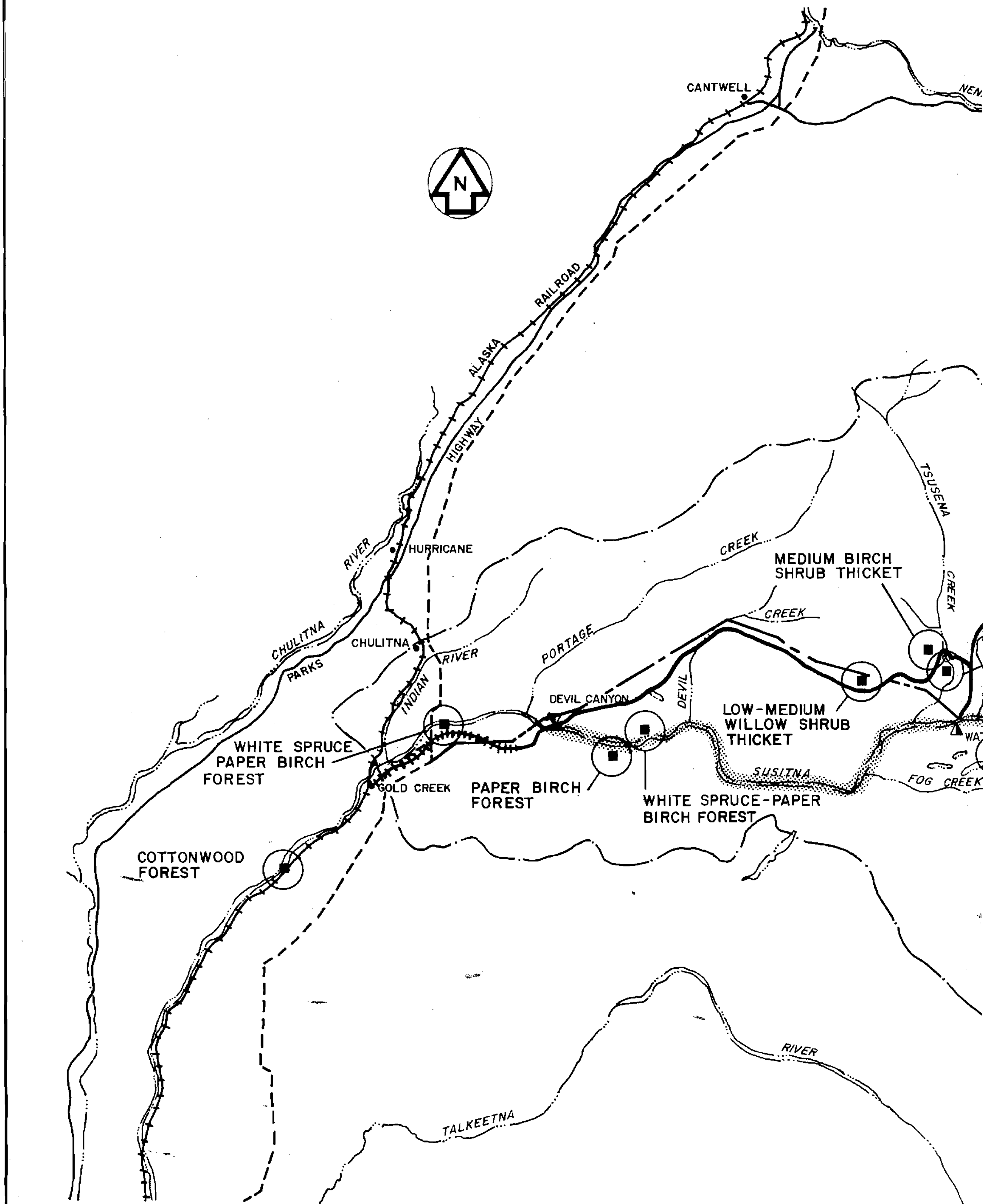


NOTE: SEE TABLE E.3.89 FOR RED FOX DEN CLASSIFICATION SYSTEM.

LOCATION AND CLASSIFICATION OF FOX DENS

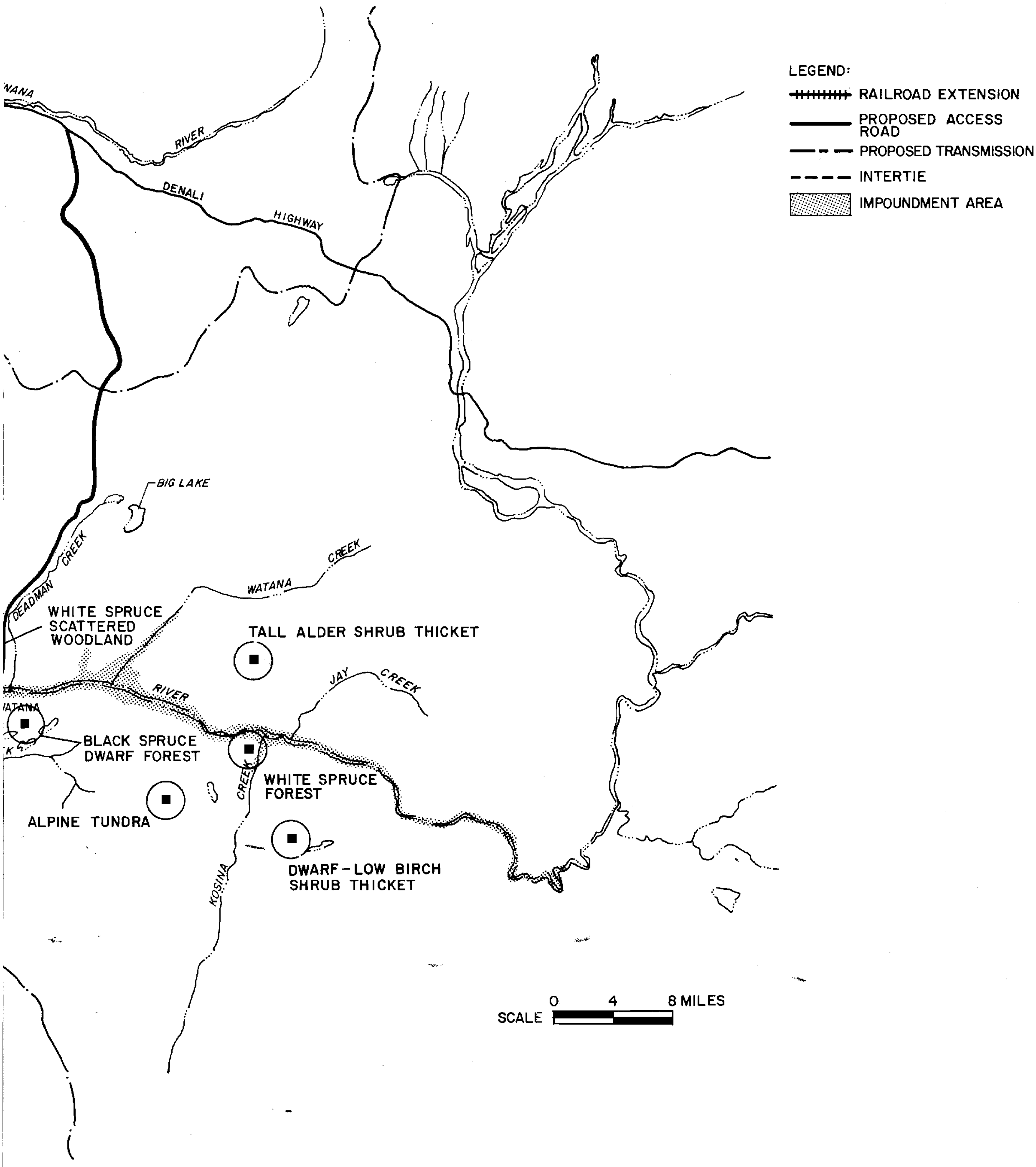
SOURCE: GIPSON et al. 1982

FIGURE E.3.102



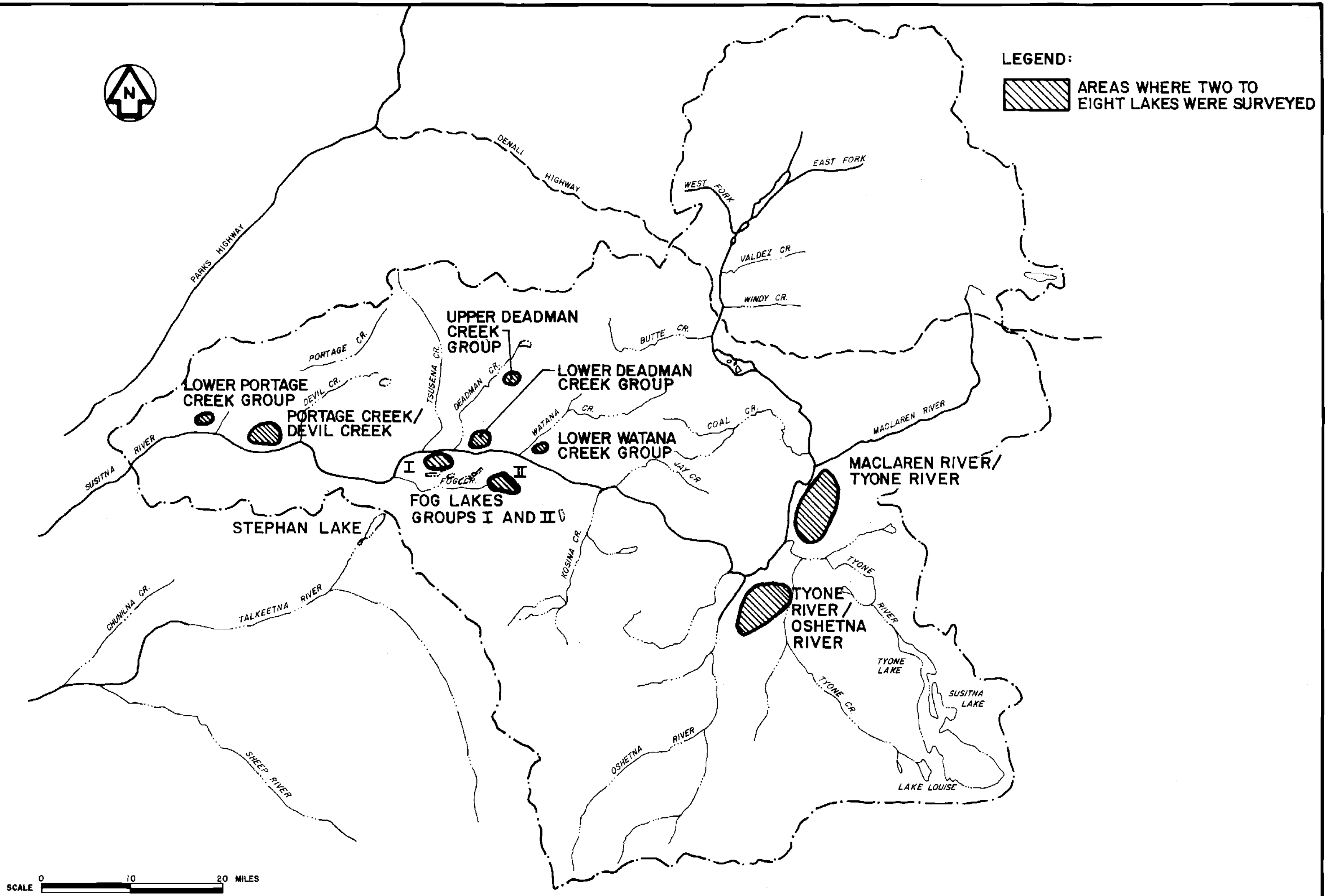
LOCATIONS OF I
IN THE MIDDLE

SOURCE: KESSEL et al. 1982a



12 BIRD CENSUS PLOTS
SUSITNA RIVER BASIN

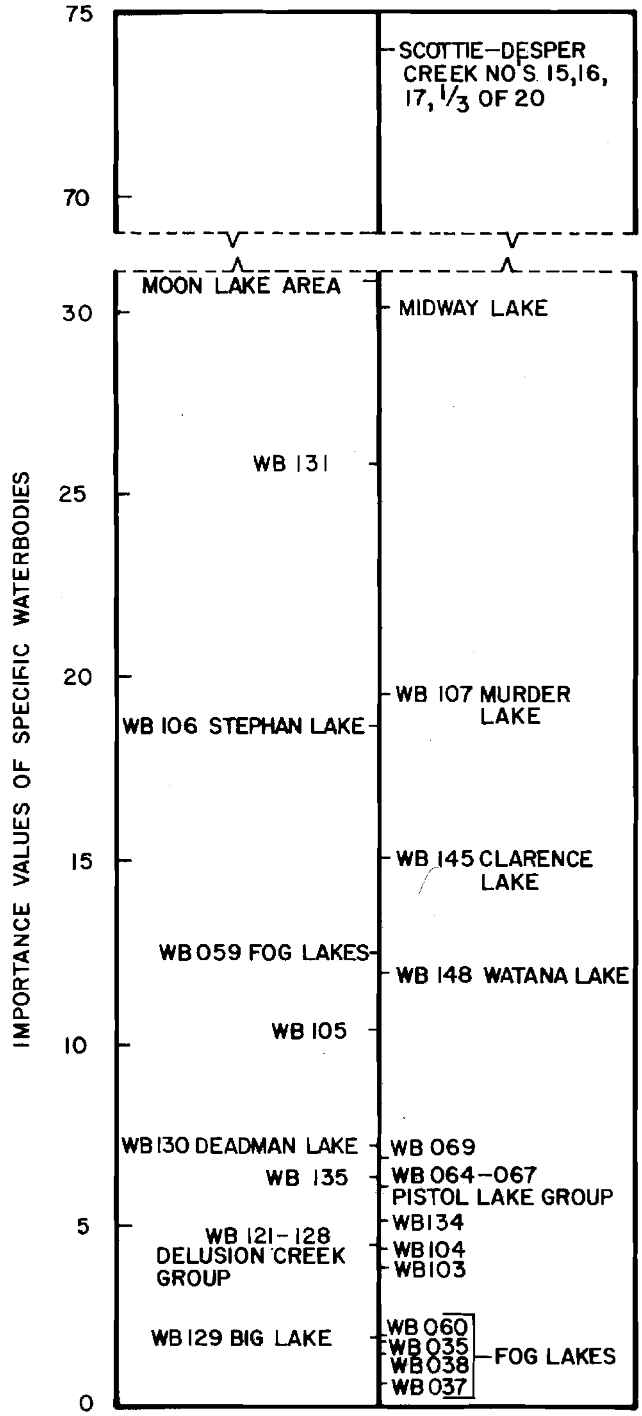
FIGURE E.3.103



LOCATIONS OF IMPORTANT LAKES AND LAKE GROUPS SURVEYED FOR WATERFOWL IN THE MIDDLE SUSITNA BASIN

SOURCE: KESSEL et al. 1982a

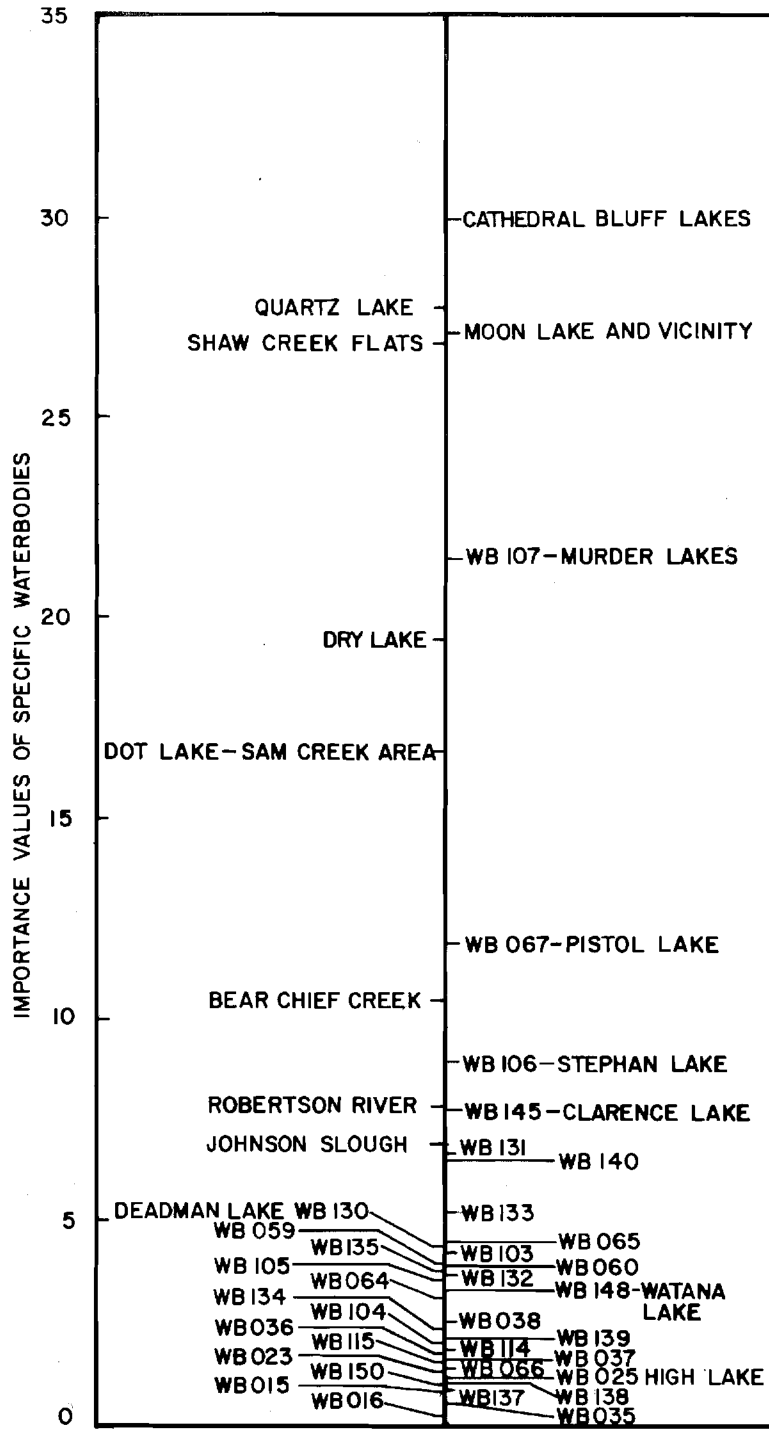
FIGURE E.3.104



IMPORTANCE VALUES OF WATER BODIES FOR MIGRANT WATERFOWL IN THE MIDDLE SUSITNA BASIN, UPPER TANANA RIVER VALLEY, AND SCOTTIE CREEK AREA — FALL 1980

SOURCE: KESSEL et al. 1982a

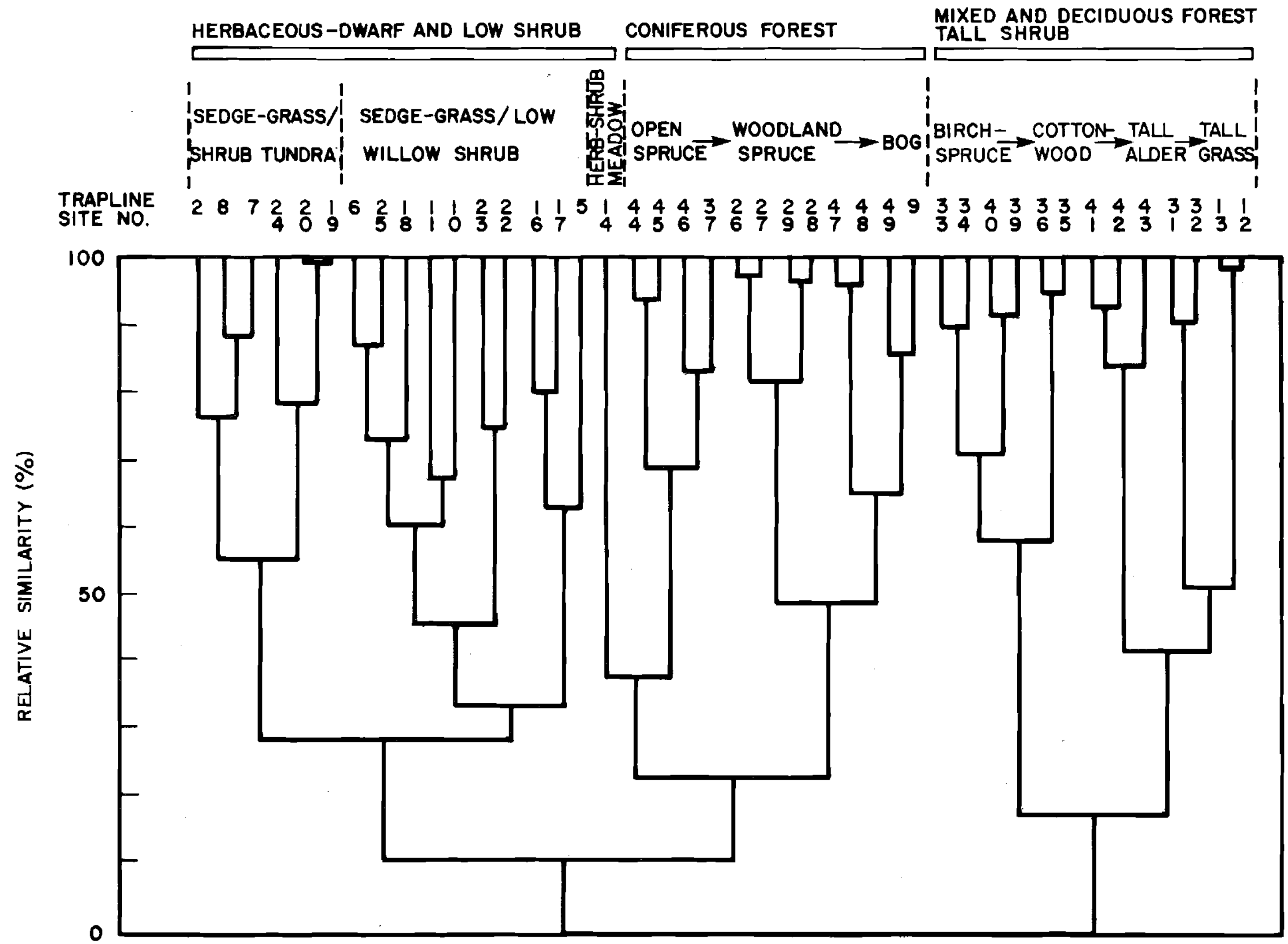
FIGURE E.3.105



IMPORTANCE VALUES OF WATER BODIES FOR MIGRANT WATERFOWL IN THE MIDDLE SUSITNA BASIN, UPPER TANANA RIVER VALLEY— SPRING 1980

SOURCE: KESSEL et al. 1982a

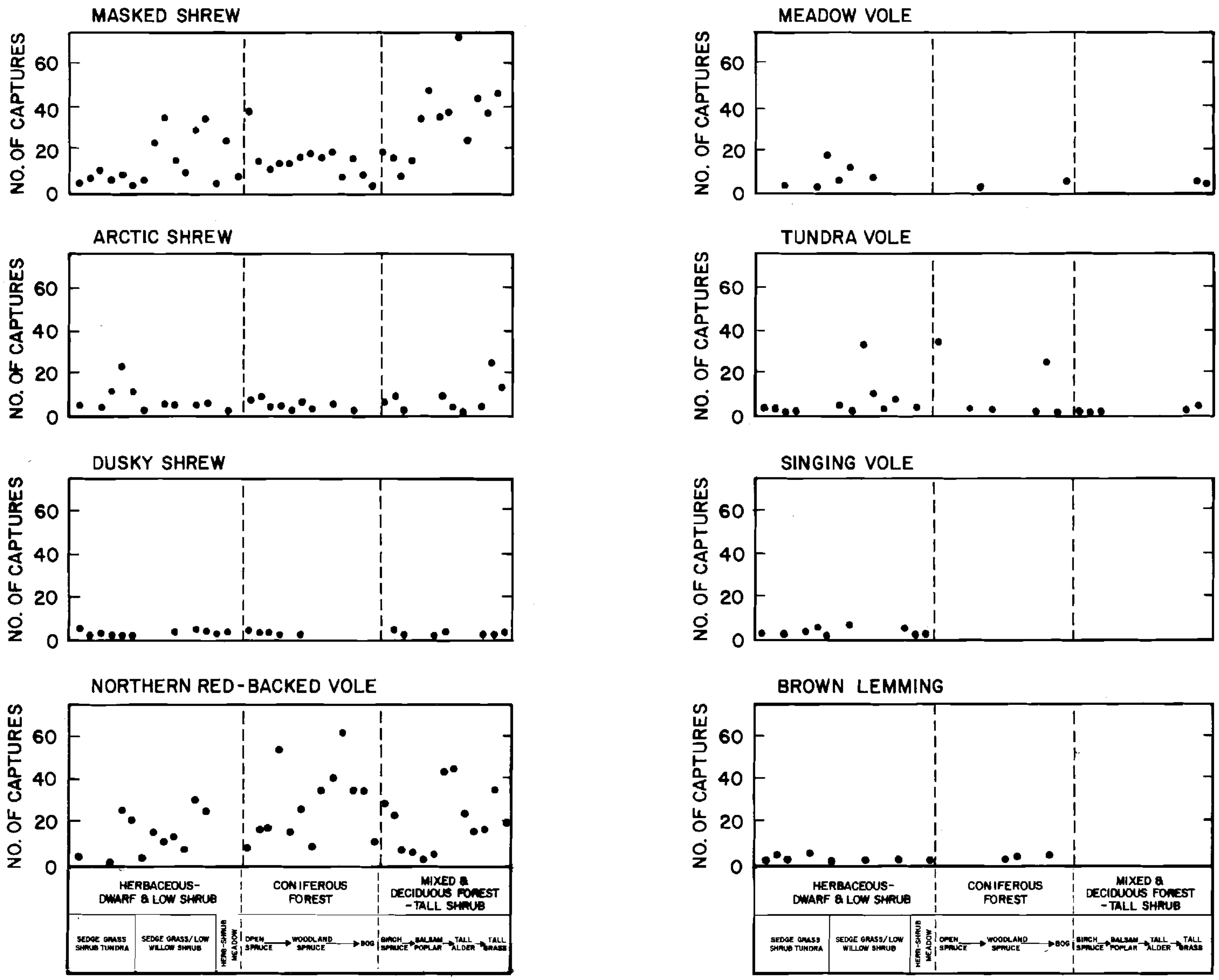
FIGURE E.3.106.



CLUSTERING OF 42 SMALL MAMMAL TRAPLINE SITES INTO SIMILAR VEGETATIVE GROUPINGS, BASED ON AN ANALYSIS OF FREQUENCY COUNTS OF 81 PLANT TAXA IN THE GROUND COVER

SOURCE: KESSEL et al. 1982a

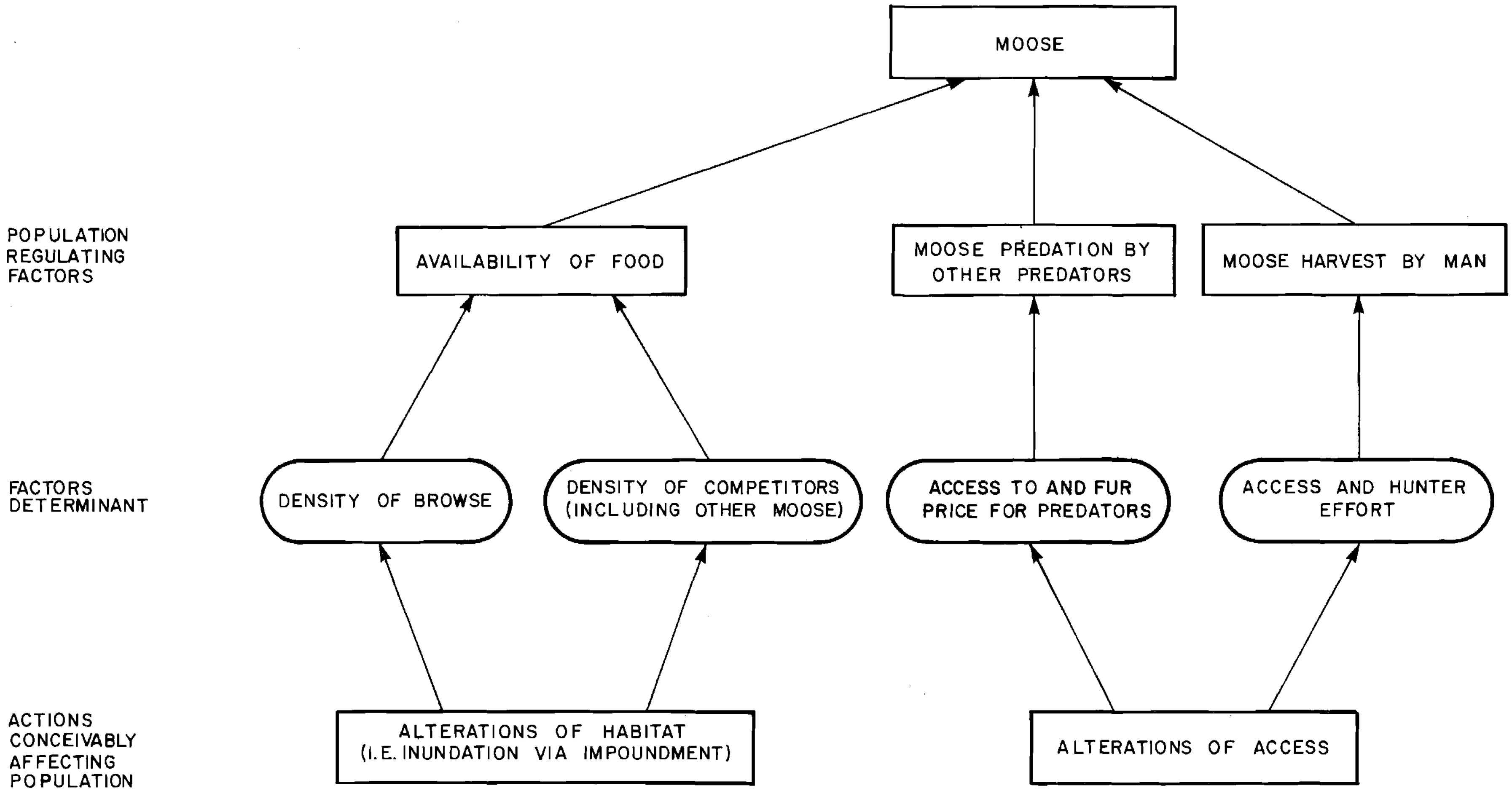
FIGURE E.3.107



ABUNDANCE PATTERNS OF EIGHT SMALL MAMMAL SPECIES RELATIVE TO VEGETATION TYPES AT 42 SITES IN THE SUSITNA RIVER BASIN, ALASKA JULY 29-AUGUST 30, 1981

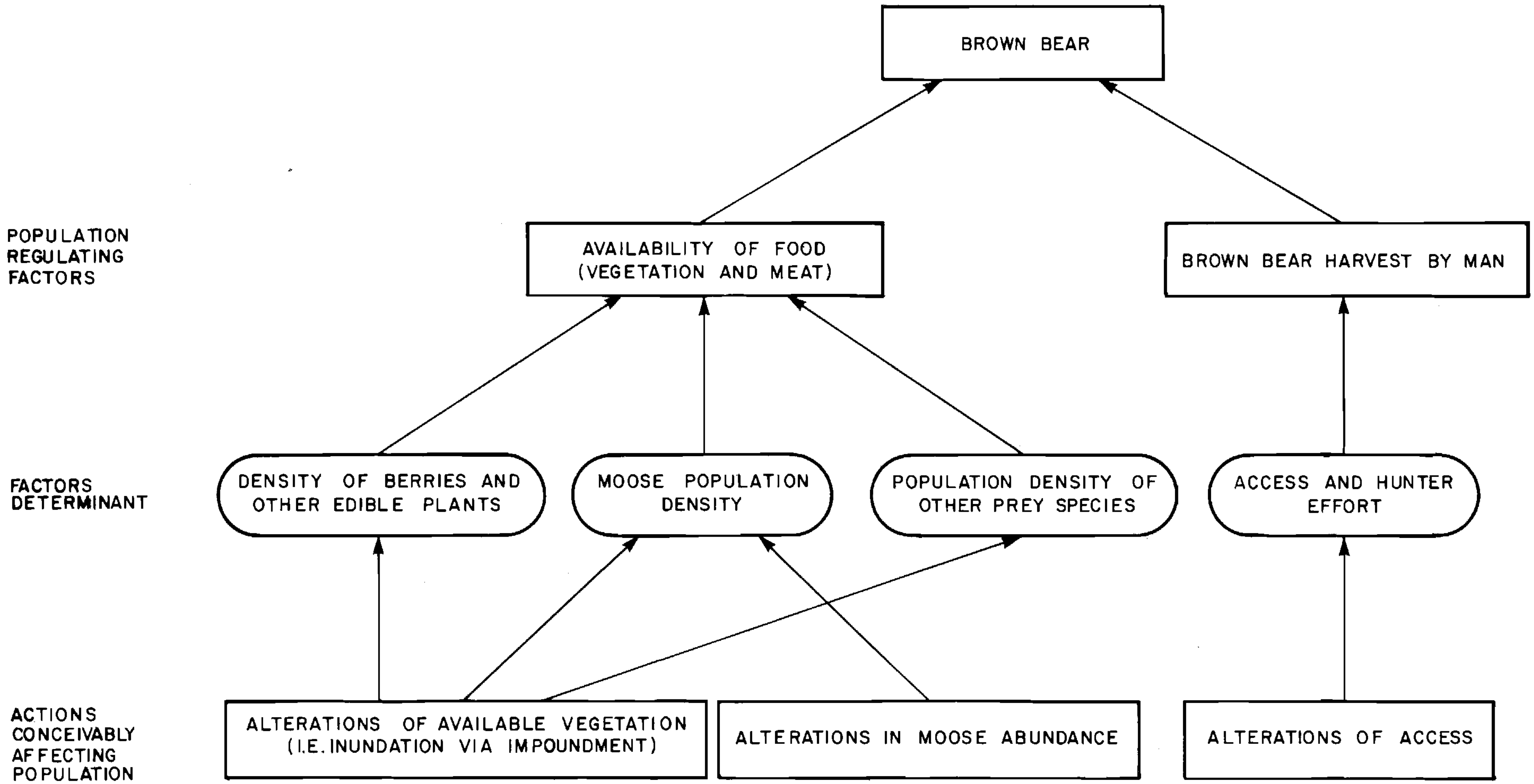
SOURCE: KESSEL et al. 1982a

FIGURE E.3.108



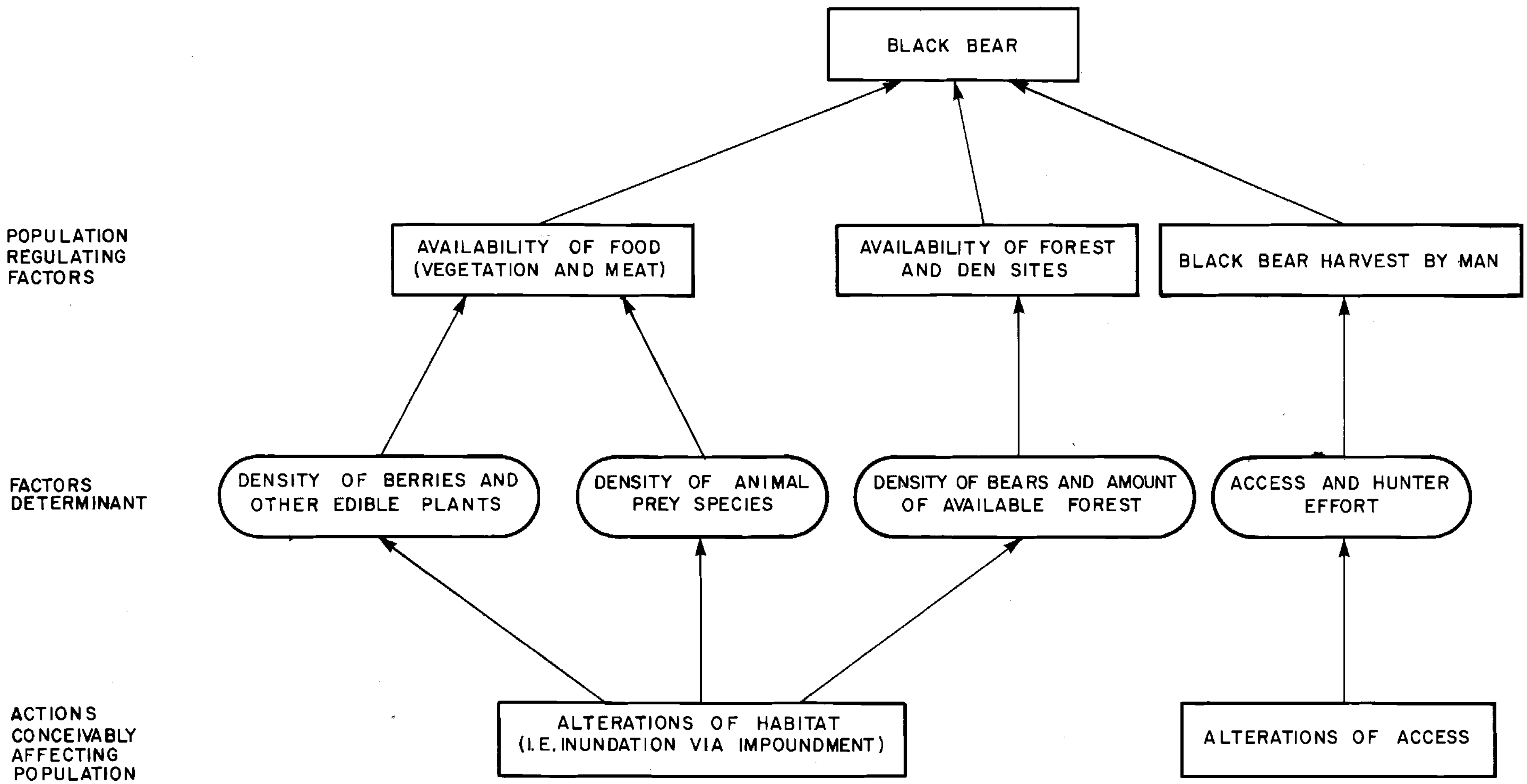
PROBABLE FACTORS REGULATING MOOSE POPULATIONS IN THE SUSITNA BASIN AND ACTIONS THAT MIGHT AFFECT THESE POPULATIONS

FIGURE E.3.109



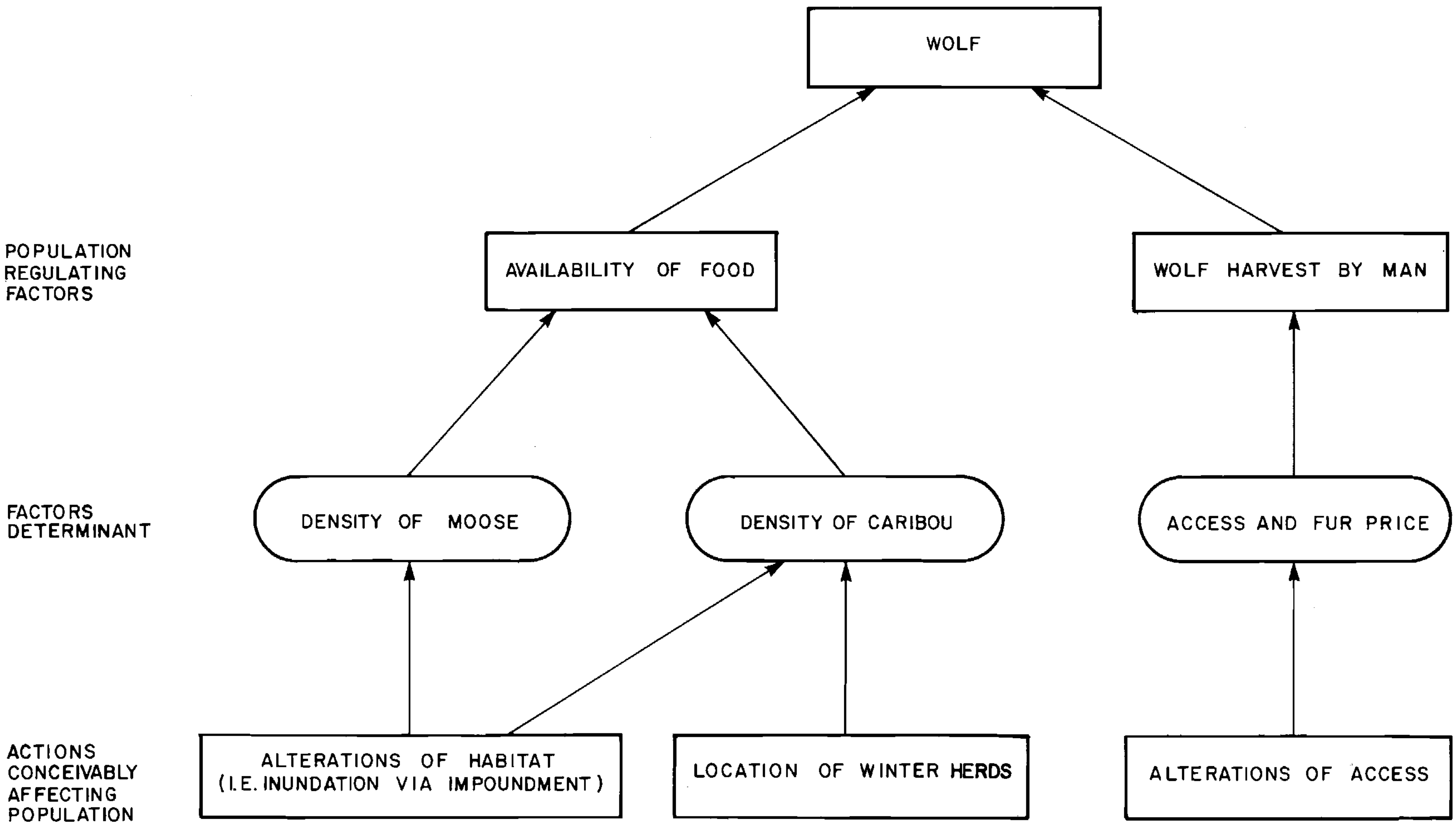
PROBABLE FACTORS REGULATING BROWN BEAR POPULATIONS IN THE SUSITNA BASIN AND ACTIONS THAT MIGHT AFFECT THESE POPULATIONS

FIGURE E.3.110



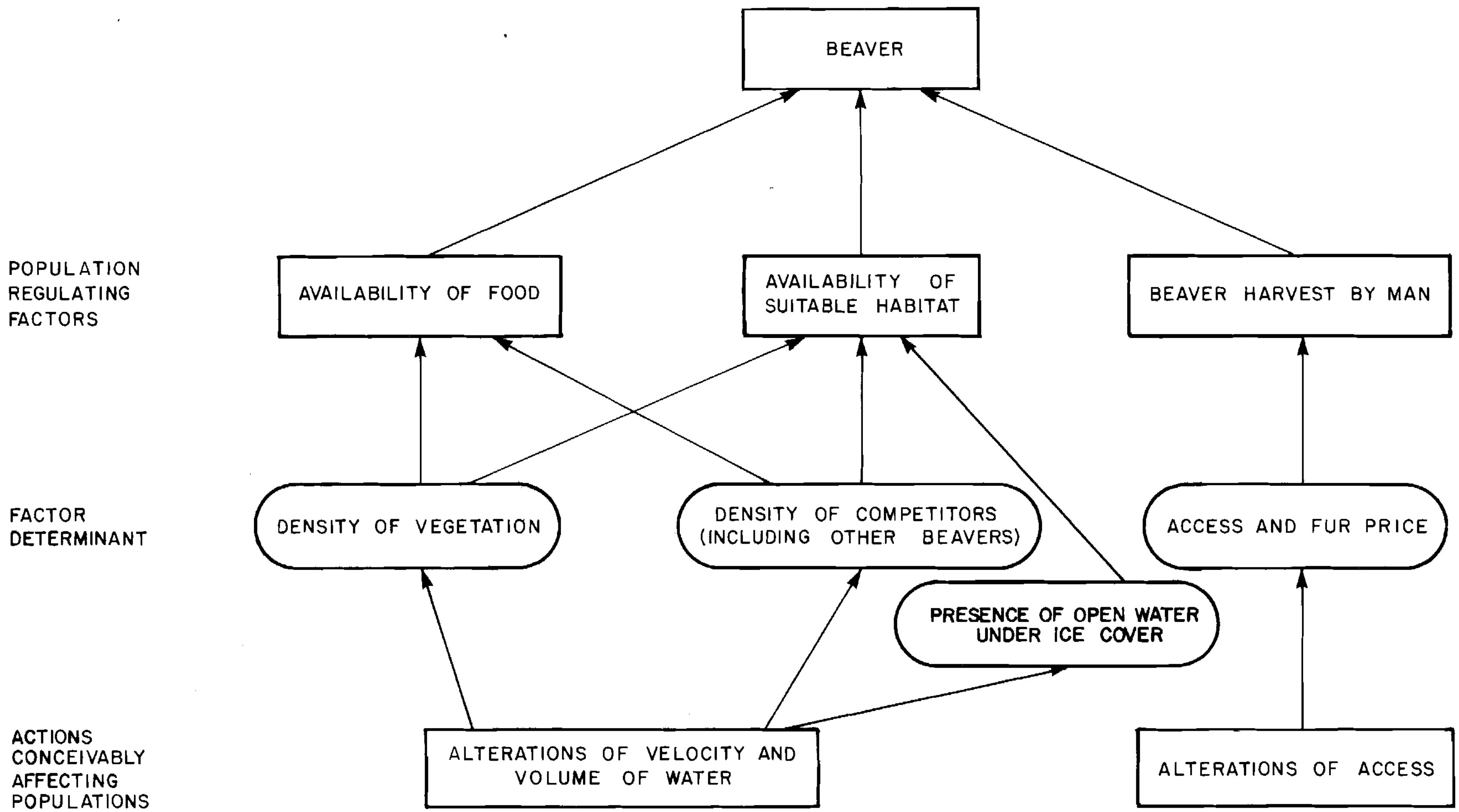
PROBABLE FACTORS REGULATING BLACK BEAR POPULATIONS IN THE SUSITNA BASIN AND ACTIONS THAT MIGHT AFFECT THESE POPULATIONS

FIGURE E.3.111



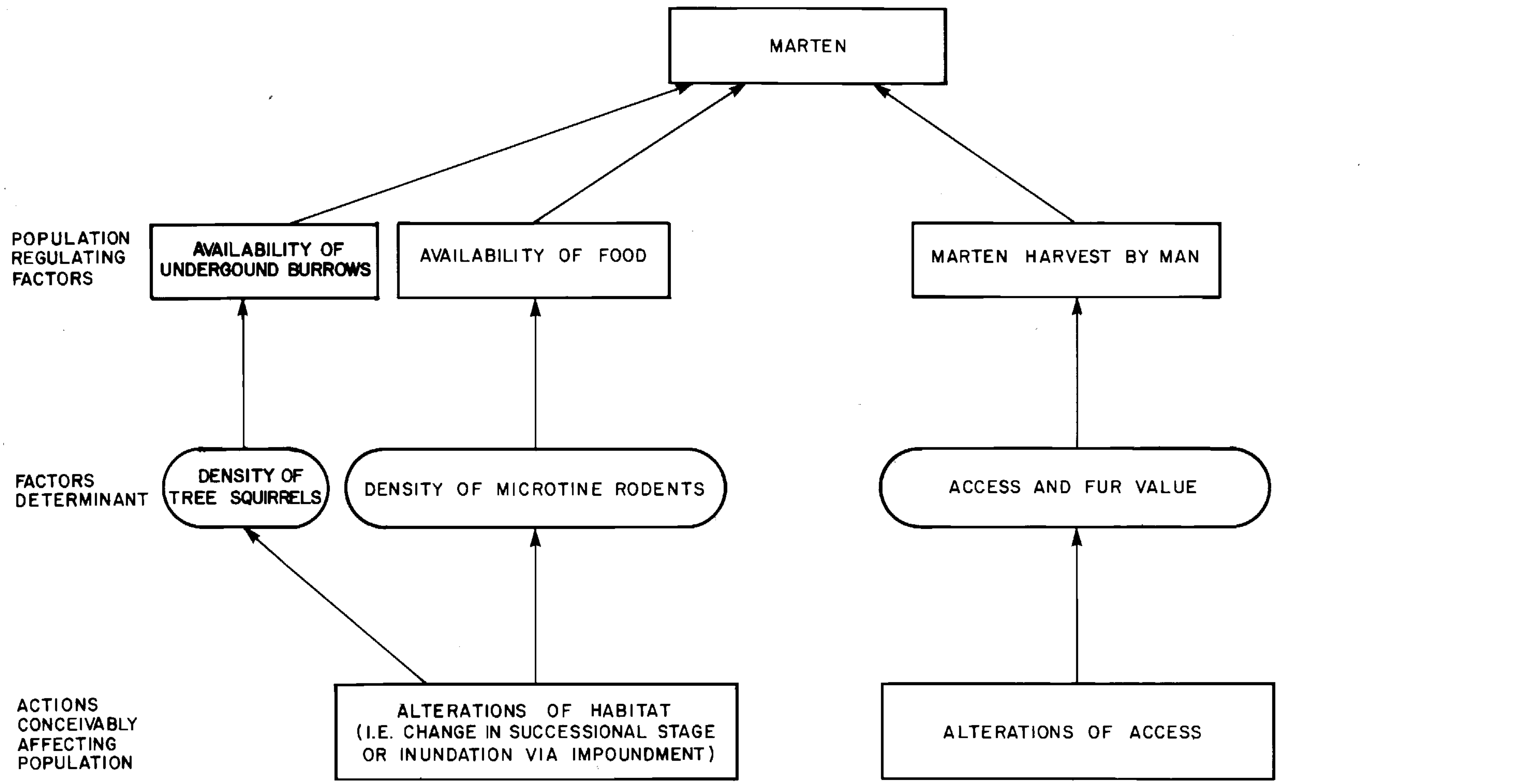
PROBABLE FACTORS REGULATING WOLF POPULATIONS IN THE SUSITNA BASIN AND ACTIONS THAT MIGHT AFFECT THESE POPULATIONS

FIGURE E.3.112



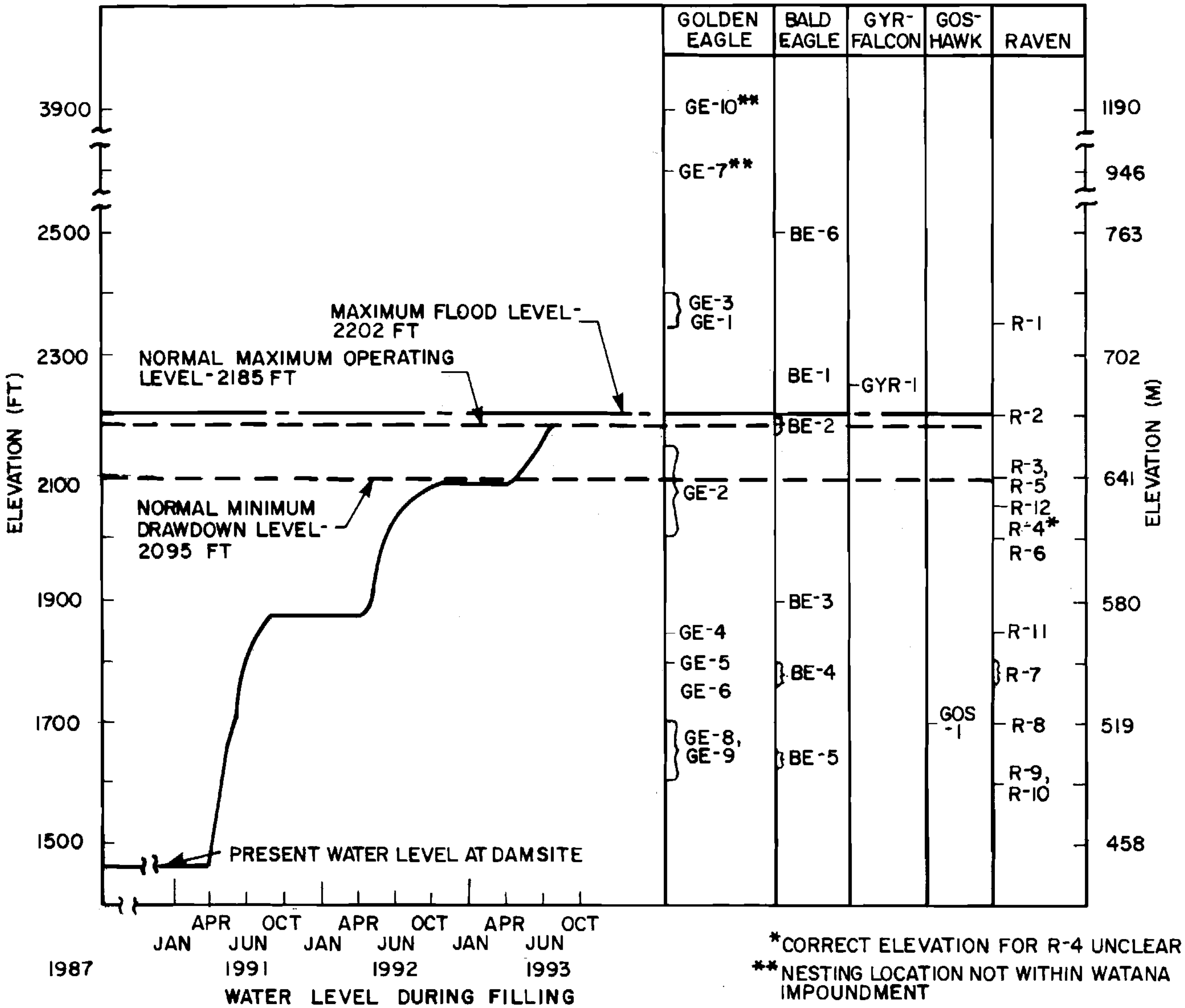
PROBABLE FACTORS REGULATING BEAVER POPULATIONS IN THE SUSITNA BASIN AND ACTIONS THAT MIGHT AFFECT THESE POPULATIONS

FIGURE E.3.113



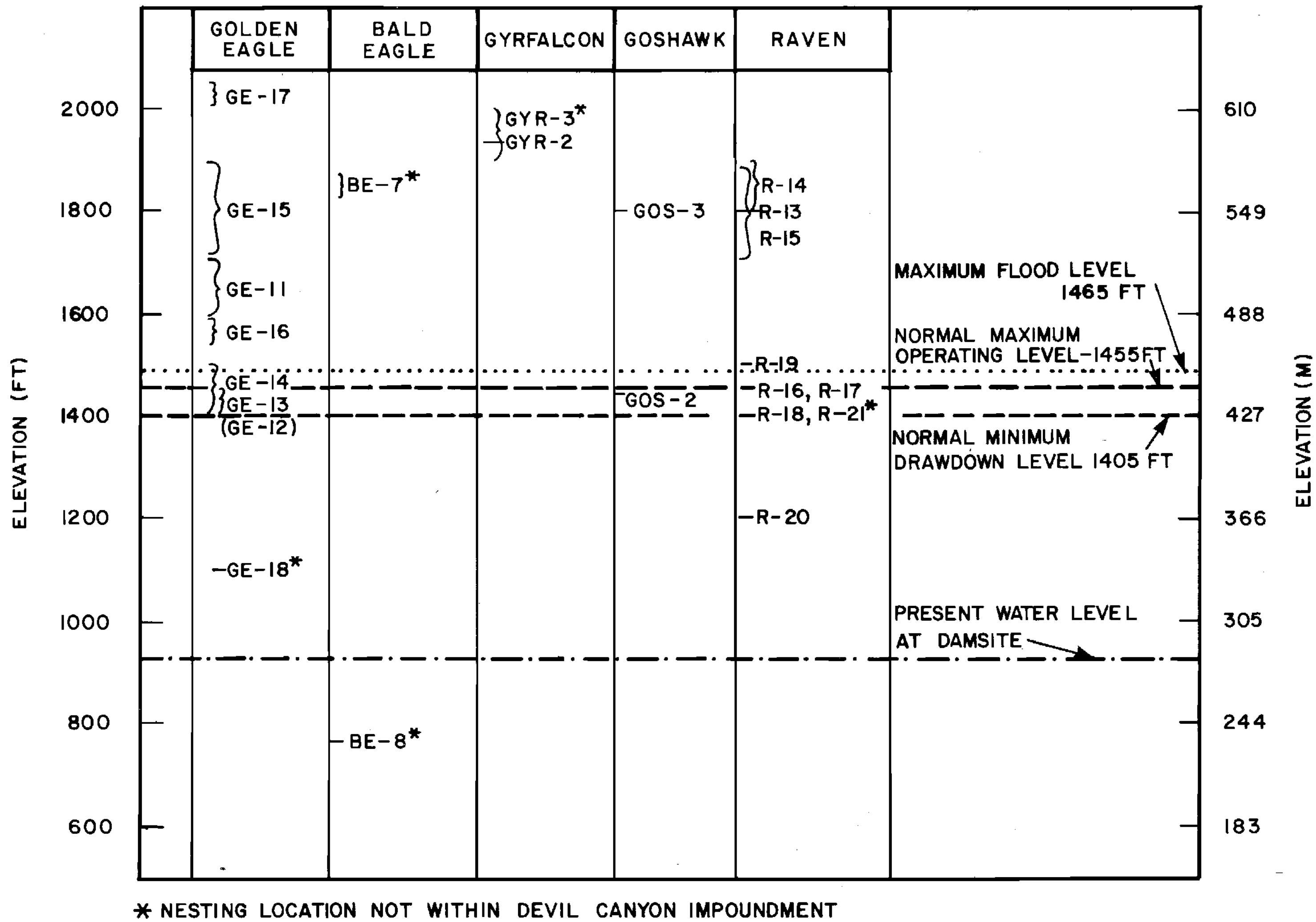
PROBABLE FACTORS REGULATING MARTEN POPULATIONS IN THE SUSITNA BASIN AND ACTIONS THAT MIGHT AFFECT THESE POPULATIONS

FIGURE E.3.114



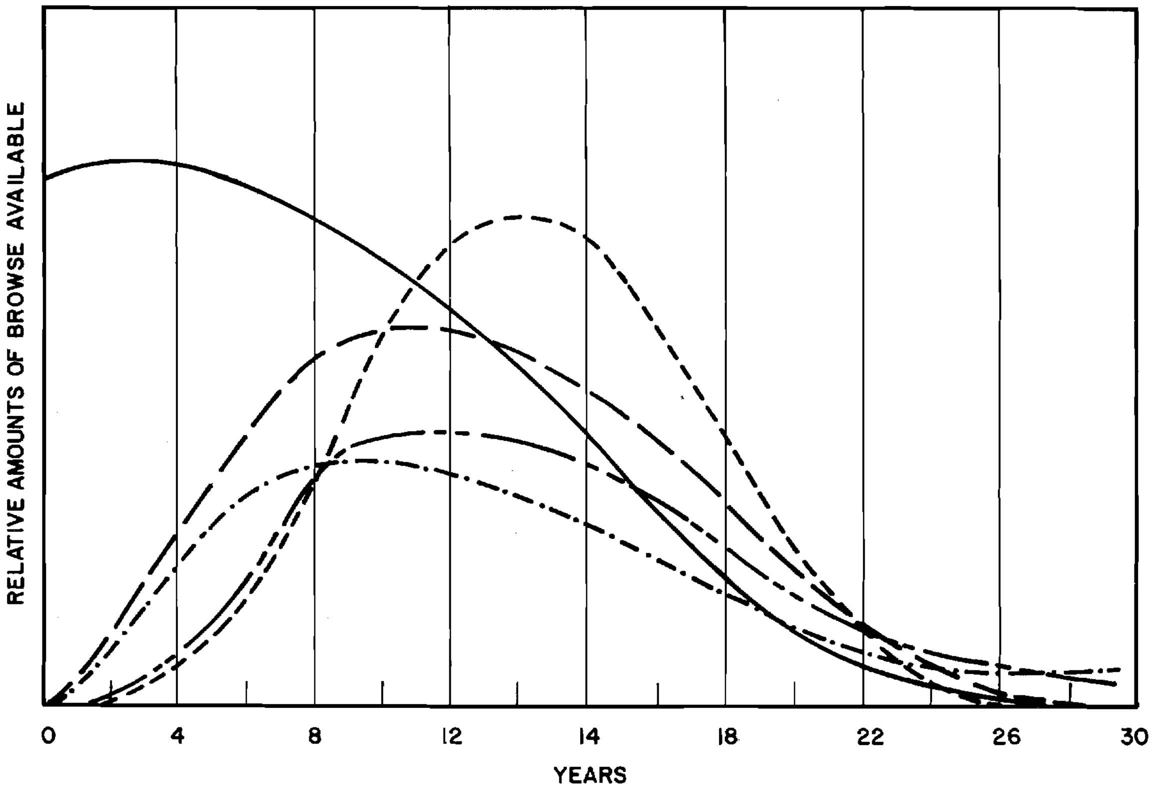
ELEVATIONS OF RAPTOR AND RAVEN NESTS IN THE VICINITY OF THE WATANA IMPOUNDMENT AREA IN RELATION TO FILLING AND OPERATION WATER LEVELS

FIGURE E.3.115



CHANGES IN ELEVATION OF THE DEVIL CANYON RESERVOIR DURING OPERATION AND ELEVATIONS OF RAPTOR AND RAVEN NESTS IN THE PROXIMITY OF THE IMPOUNDMENT ZONE

FIGURE E.3.116



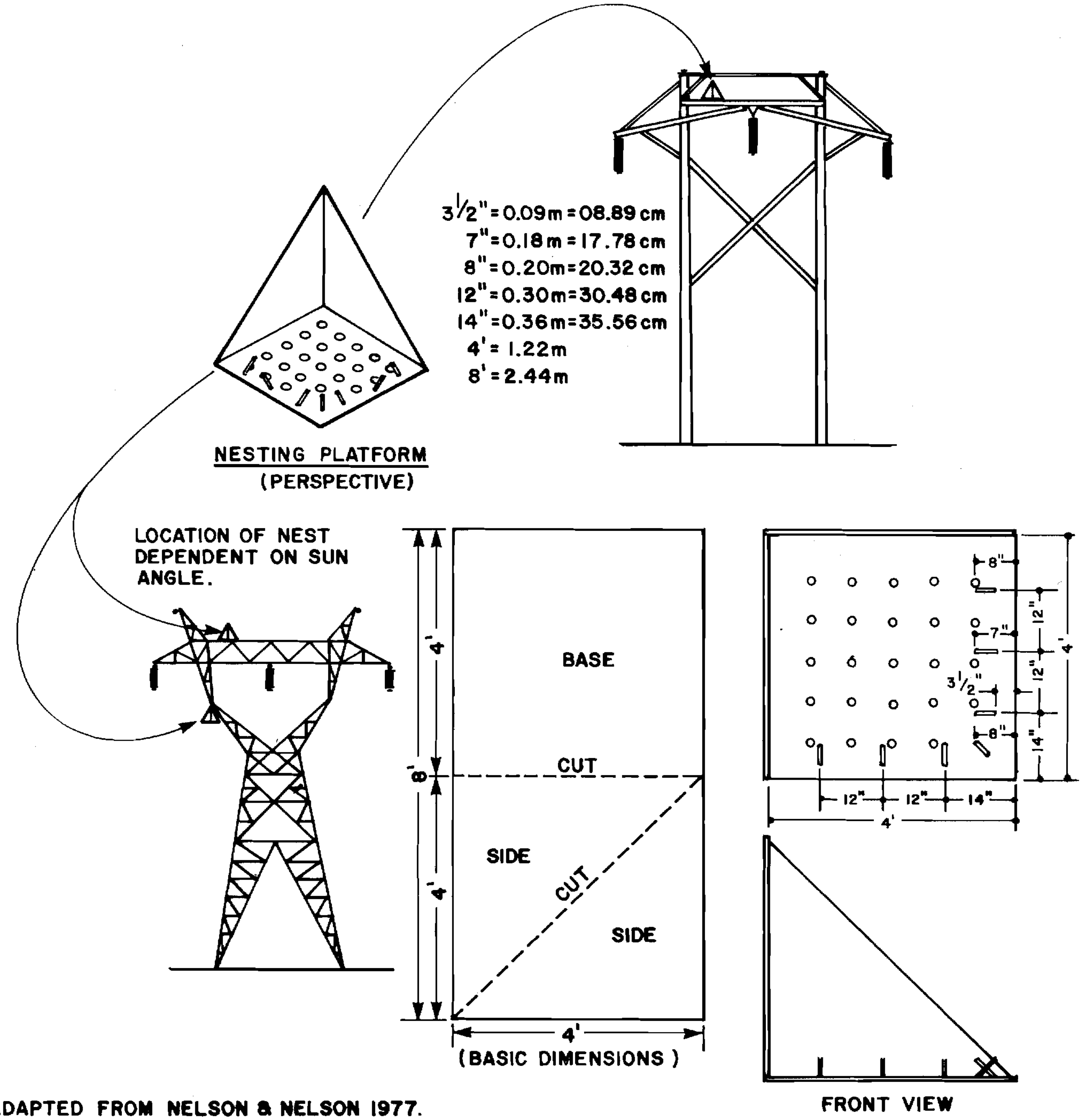
LEGEND:

- ASPEN, VEGETATIVE REPRODUCTION
- BIRCH, VEGETATIVE REPRODUCTION
- BIRCH, SEED REPRODUCTION
- WILLOW, SEED REPRODUCTION
- WILLOW, VEGETATIVE REPRODUCTION

RELATIVE AMOUNTS OF MOOSE BROWSE AVAILABLE COMPARED WITH THE TIME SINCE FIRE OR OTHER DISTURBANCE IN INTERIOR ALASKA

SOURCE: WOLFF AND ZASADA 1979

FIGURE E.3.117



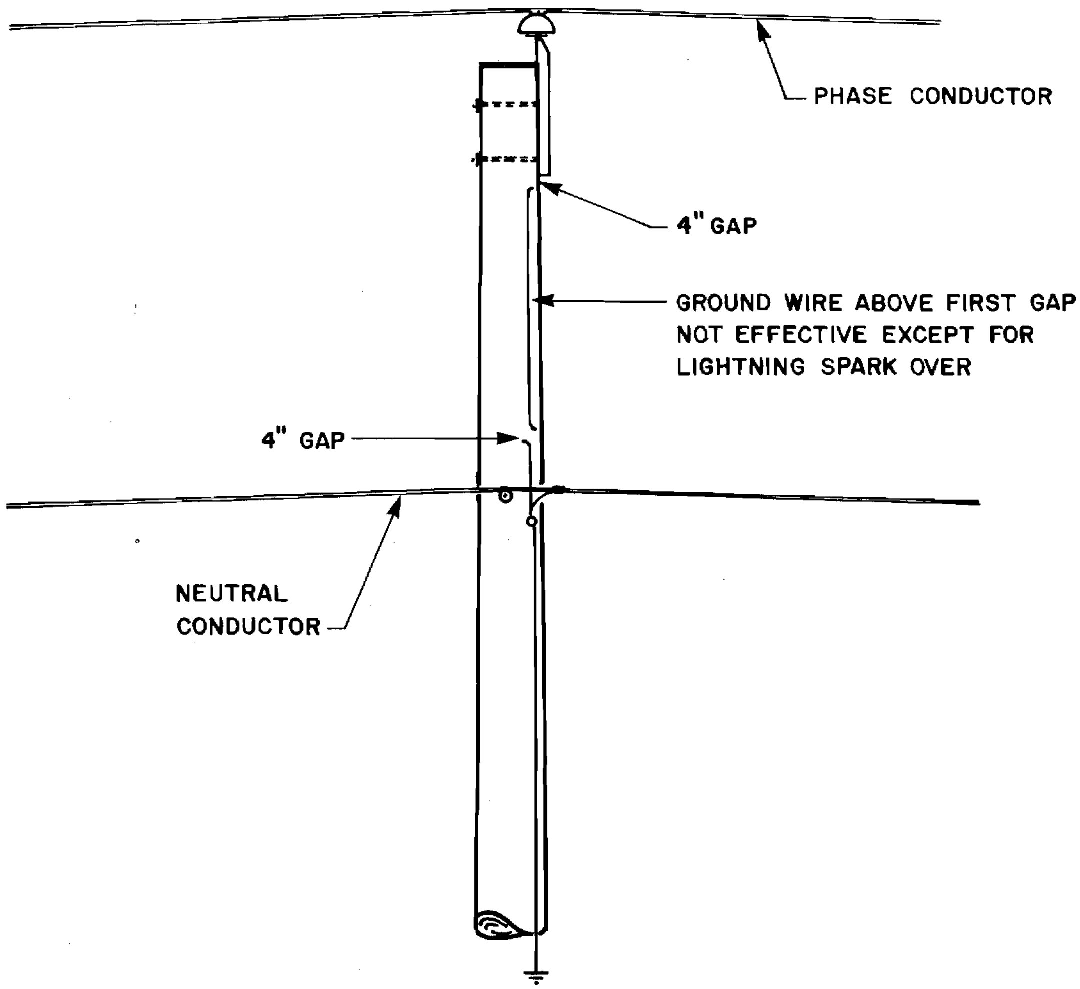
ADAPTED FROM NELSON & NELSON 1977.

CUTTING PATTERN

EAGLE NESTING PLATFORMS TO BE PROVIDED ON TRANSMISSION TOWERS

EXCERPTED FROM OLENDORFF et al. 1981

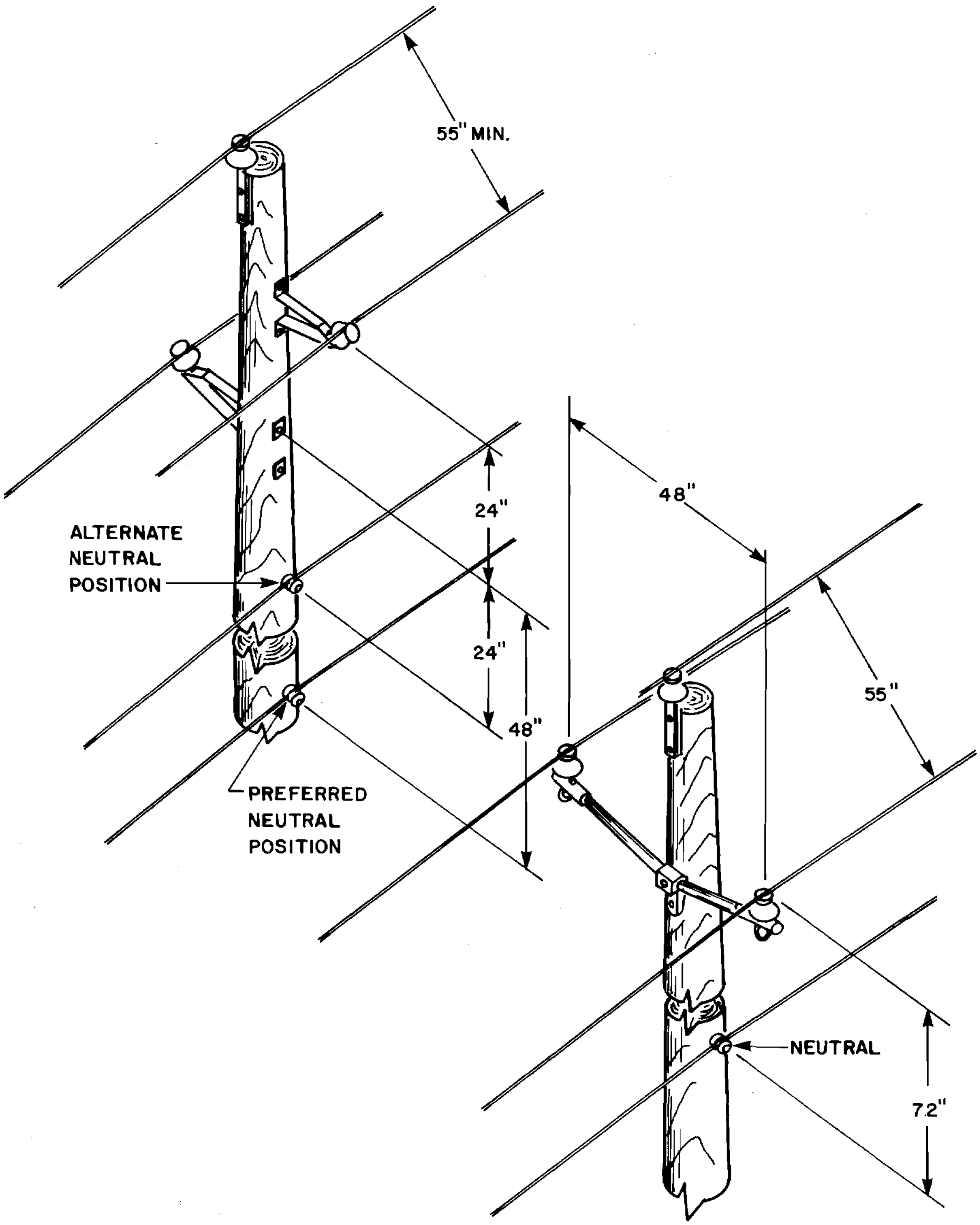
FIGURE E.3.118



GROUND WIRE GAPPING
DESIGNED TO PROTECT RAPTORS FROM ELECTROCUTION

EXCERPTED FROM OLENDORFF et al. 1981

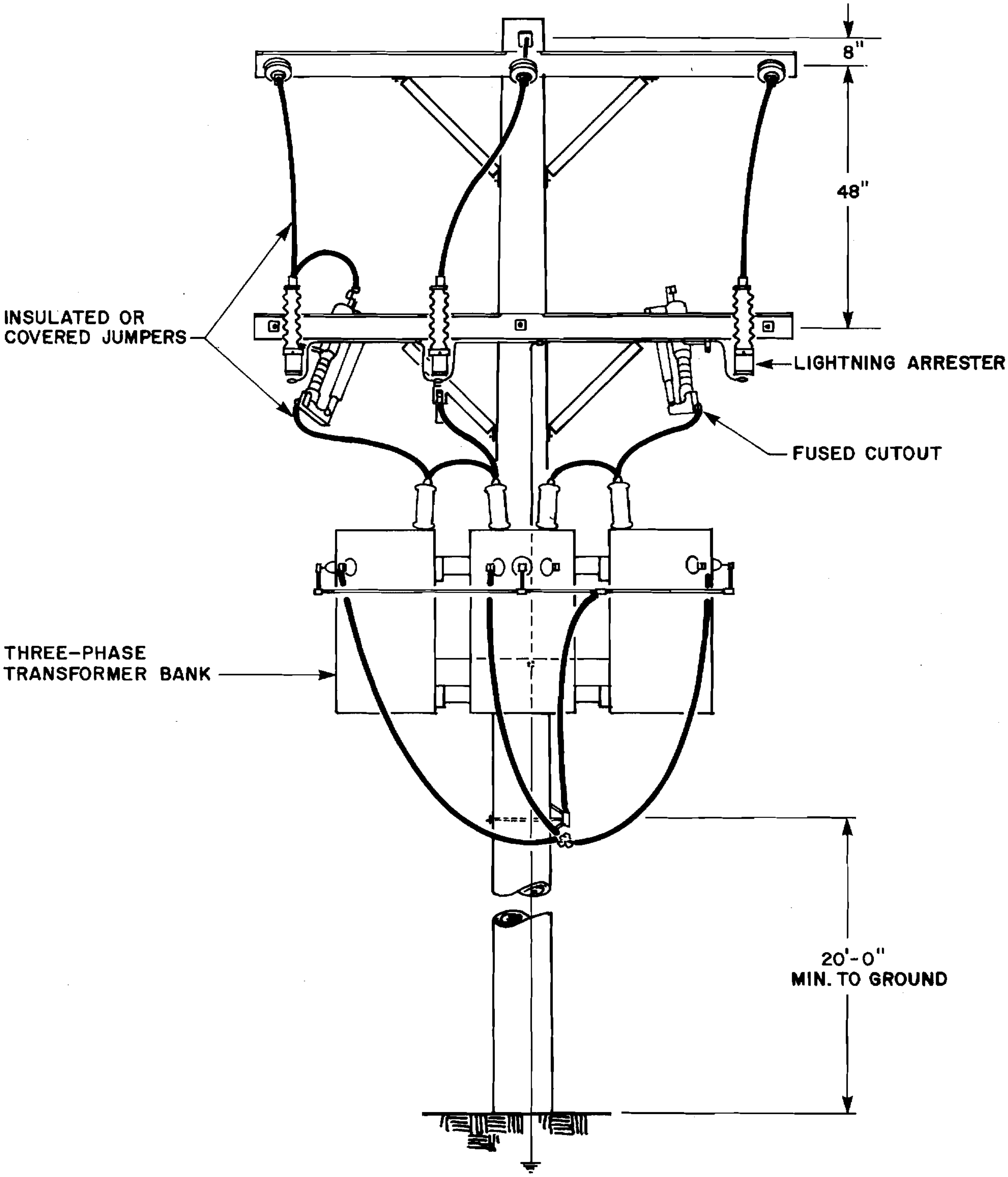
FIGURE E.3.119



ARMLESS CONFIGURATIONS
DESIGNED TO PROTECT RAPTORS FROM ELECTROCUTION

EXCERPTED FROM OLENDORFF et al. 1981

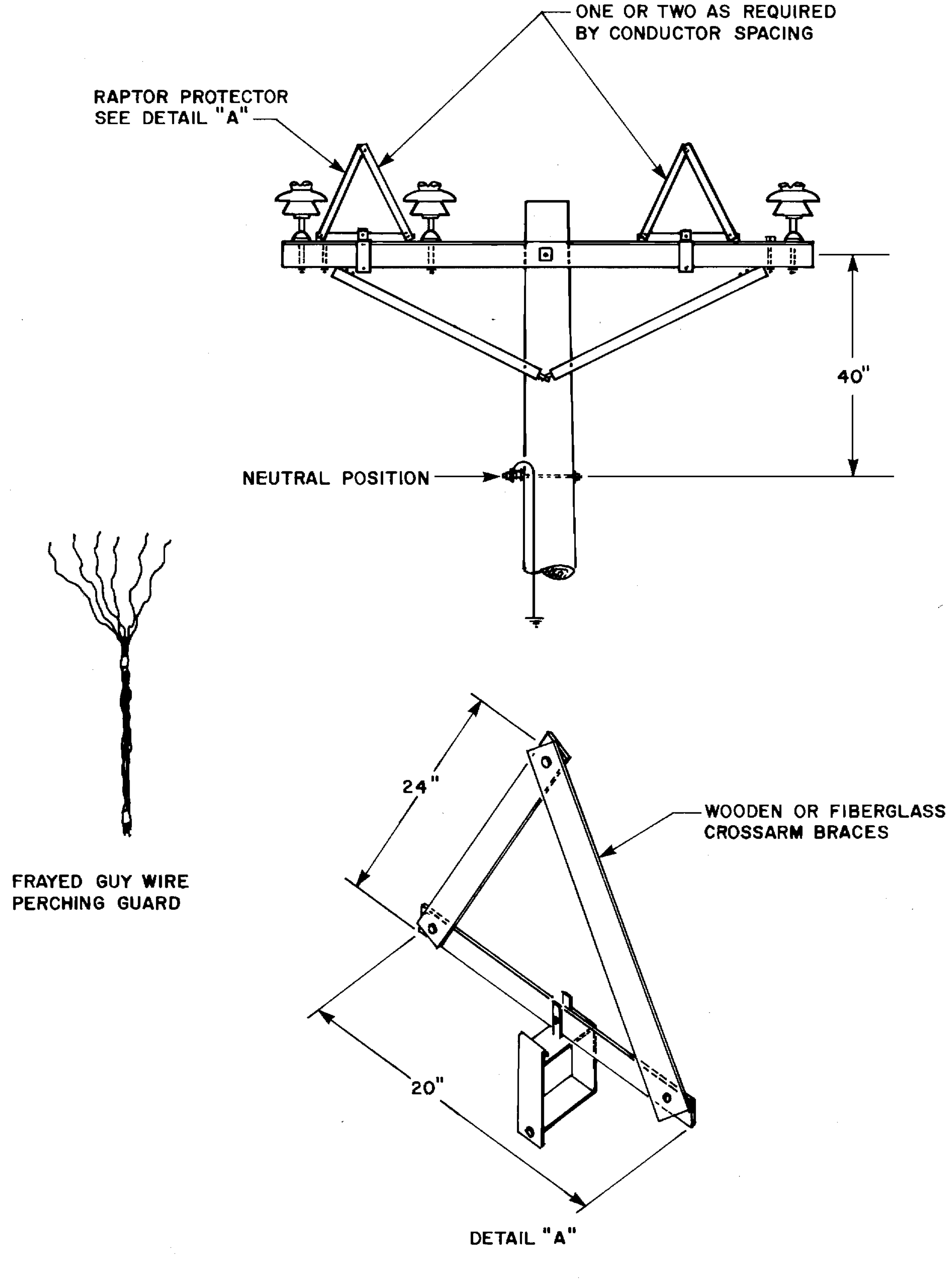
FIGURE E.3.120



INSTALLATION OF TRANSFORMER EQUIPMENT
TO PROVIDE FOR RAPTOR PERCHING

EXCERPTED FROM OLENDORFF et al. 1981

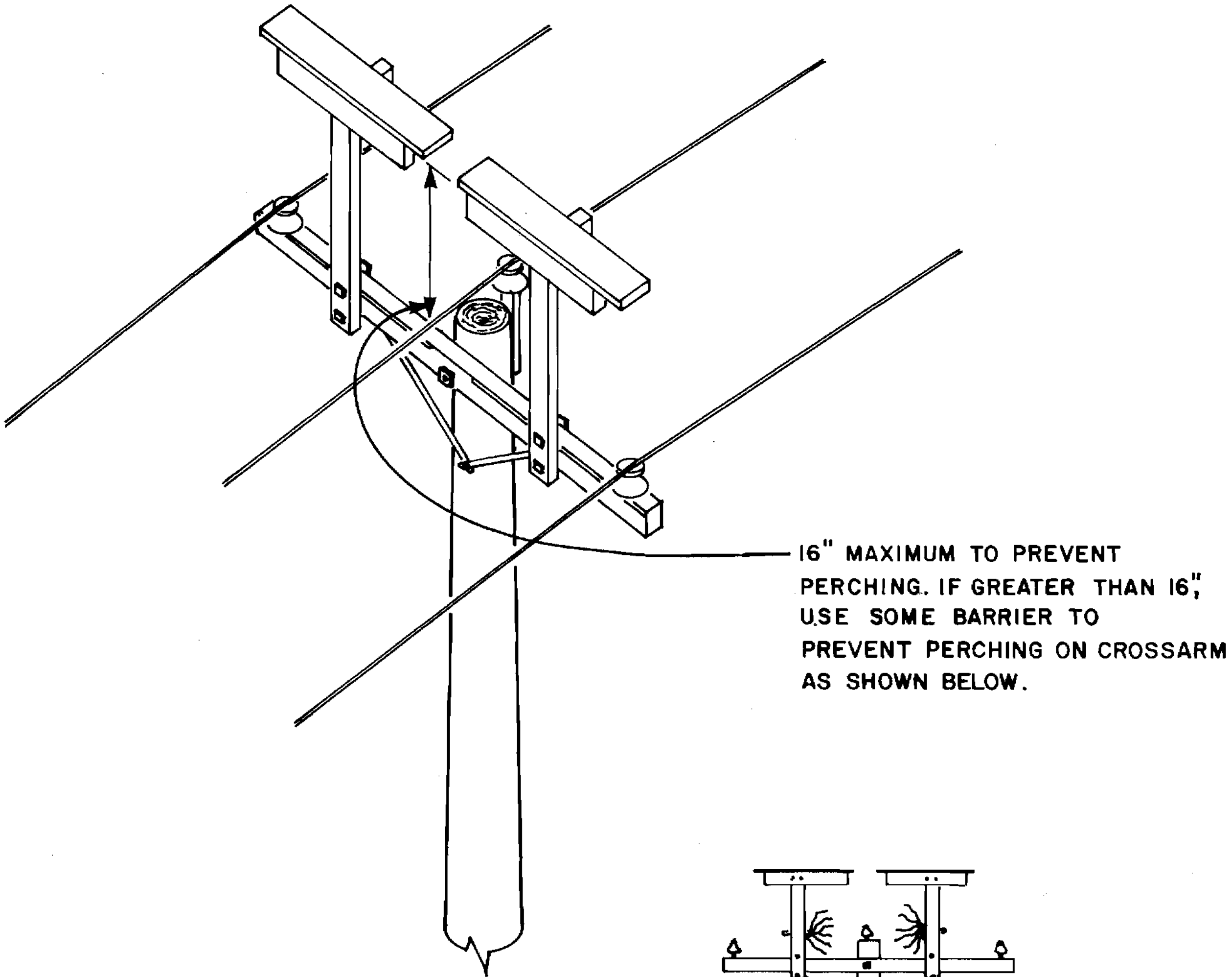
FIGURE E.3.121

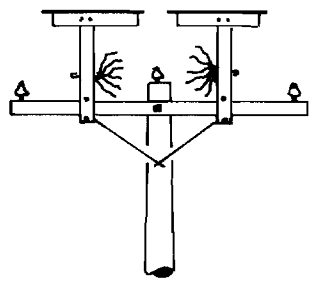


PERCH GUARDS
DESIGNED TO PROTECT RAPTORS FROM ELECTROCUTION

EXCERPTED FROM OLENDORFF et al. 1981

FIGURE E.3.122





ELEVATED PERCH CONSTRUCTION
DESIGNED TO PROTECT RAPTORS FROM ELECTROCUTION

EXCERPTED FROM OLENDORFF et al. 1981

FIGURE E.3.123