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AN ASSESSMENT OF THE CUMULATIVE IMPACTS OF DEVELOPMENT AND HUMAN USES ON FISH HABITAT IN THE KENAI RIVER KENAI, ALASKA

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EXECUTIVE SUMMARY

The Kenai River Cumulative Impacts Assessment of Development Impacts on Fish Habitat, was funded in part by the ACMP's Section 309 Enhancement Grant Program. This study was designed to identify and evaluate the cumulative and secondary effects of development actions including public and private land use impacts on Kenai River fish habitat. The ADF&G established a Technical Advisory Group (TAG) to help define the issues and identify an acceptable methodology to be used for the assessment. The TAG was composed of representatives from all state and federal resource agencies with regulatory and management responsibilities on the Kenai River. The TAG was provided a summary of the results of the ADF&G's cumulative impact methodologies literature search which was completed in the initial phase of the Kenai River 309 study. The ADF&G also recommended the TAG consider the use of the U.S. Fish and Wildlife Service (USF&WS) developed Habitat Evaluation Procedures (HEP) as the process to be used for the impacts analysis portion of this study. The group concurred with this recommendation. The TAG also concurred with the ADF&G recommendation for the development of a habitat classification process for the Kenai River's fish habitats that incorporates a combination of assessment techniques including: aerial photograph assessment, field inventory, and the use of a Geographic Information System (GIS) for data compilation and analysis.

Existing mapped and/or digitized data for land ownership, soils and vegetation types were obtained through the Soil Conservation Service (SCS) and the Kenai Peninsula Borough (KPB). This information was edited and stored for use in our assessment efforts on the GIS at the ADF&G's regional office in Anchorage. Information from this data set was edited and provided to the SCS for inclusion in their technical report.

Field data compilation and groundtruthing of aerial photograph interpretation data was initiated during the fall 1992 low water period and was completed during the summer and fall of 1993. The field survey resulted in an inventory of existing bank and fish habitat conditions occurring along the entire 67 miles of Kenai River mainstem from the outlet of Kenai Lake to the Skilak Lake inlet and from Skilak Lake's outlet downstream to its confluence with Upper Cook Inlet near the City of Kenai. All natural and disturbed bank habitat conditions were inventoried using a field data inventory form and color photo documentation. Data collected included vegetation type and coverage at both the river's ordinary high water (OHW) mark and the top of bank, nearshore substrate composition, fish cover characteristics present, and documentation (description and measurement) of all structures and bank alterations observed. Positions were confirmed using Global Position Satellite (GPS) receivers that were differentially corrected to a resolution of 10.0 feet.

The diverse habitat types occurring along the river's 67 mile length (166.1 miles of water frontage) provide a varying degree of habitat value to juvenile salmon. The nearshore waters of the Kenai River provide critical early life stage rearing habitat for juvenile chinook salmon. Mainstem rearing habitat within the Kenai River, which occurs only in a very narrow (6.0 feet

wide) corridor adjacent to the river's banks, has been described in previous studies by the ADF&G and USF&WS (Bendock, et al., 1988; Burger, et al., 1983). Over 80% of all rearing juvenile chinook are found in this corridor. The total area within this narrow corridor including both the river's upland and island shorelines amounts to a mere 121 acres. It should be noted, however, that much of this 121 acres does not constitute good juvenile chinook salmon rearing habitat because: a) it is a tidally influenced reach with brackish water conditions, and no cover habitat or lacks an adequate food source; b) it is naturally unsuitable to rearing juvenile salmon due to high water velocities and/or a lack of cover habitat; c) alteration of natural conditions by man associated with river access have led to vegetation loss and/or bank erosion; d) the nearshore habitat has been altered as a result of bank stabilization and property protection efforts.

The field inventory and fish habitat classification analysis completed in this study has documented that between 11.1 % to 12.4 % (18.4 to 20.6 miles) of the river's 134 miles of upland and 32 miles of island shoreline and nearshore habitats have been impacted by bank trampling, vegetation denuding, and structural development along the river's banks. The two different lengths or percentages cited above relate to the habitat impacts measured at either the OHW line or at the top of the bank. Optimum fish rearing conditions (i.e., water velocities less than 1.0 foot per second, undercut banks with overhanging vegetation, and gravel/cobble substrates) occurs on only 80,442.8 feet (15.2 miles or 9.2 %) of this important fish rearing corridor along the entire river length. Study results indicate that 63,299.0 feet (12.0 miles) of this corridor is currently in the developed/impacted category. This amounts to approximately 8.7 acres of the total 121 acres of the river's available juvenile rearing habitat. The sum of the impacted habitats (8.7 acres) and the naturally unsuitable habitat for rearing fish (which includes all of the Kenai River 309 Study's Reach 1 or lower 10 miles of river nearshore habitat)(15.7 acres) and the heavily trampled or denuded areas documented on the river (5.1 acres) equals 29.5 acres or 24.4% of the river's total nearshore habitat. This leaves a total of 91.5 acres (75.6%) of useable mainstem habitat for juvenile fish of which only 11.0 acres (9.2%) provide their ideal rearing conditions.

The field inventory information collected was entered into the GIS database for tabulation and graphical analysis. The tabulated data was then used to complete a HEP analysis. HEP converts both the natural and developed habitat areas into a relative value for fish habitat. HEP was developed as a tool to document the quantity and quality of available habitat for a selected fish and/or wildlife species in a given area and uses a species/habitat relationship approach to impact assessment. HEP identifies key habitat components for a species of interest (e.g., an indicator species) which are used for a comparison of existing or future habitat conditions to the optimum habitat conditions for that species.

The HEP assessment approach is based on the fundamental assumption that certain specified habitat parameters can be described numerically and ranked. This ranking allows for the comparative analysis of habitat change over time resulting from individual or multiple development projects or other habitat altering activities (e.g public and private access, recreational uses, etc.). Comparative analysis is used to determine the overall impact of habitat change within a system in terms of net gain or loss of habitat units (HU's) associated with these activities.

HEP characterizes habitat quality using a Habitat Suitability Index (HSI) value. HSI's are derived from established or project developed Suitability Indices (SI) or Curves. The HSI is a numerical value ranging from 0.0 to 1.0 and is generated from an analysis of the ability of key habitat components to supply the life requisites of the indicator species. HSI's assign a value to a species' key habitat component(s) or variables. This value represents that habitat components relative importance to the evaluation species and is based upon what is considered optimum habitat for that species.

Overall habitat impact can be assessed by calculating the gain or loss of Habitat Units (HU's) associated with a land use or development action affecting fish habitat. Mean HSI values (the sum of all the suitability index values identified for a species individual habitat components divided by the total number of habitat component SI's defined) are used to calculate the HU's available for the species of concern. The mean HSI values, which are calculated for the habitat conditions occurring as a result of a project or use that has changed the naturally occurring habitat characteristics, are multiplied by the area affected by the habitat altering activity. The product of this calculation defines the HU's available to the indicator species as a result of the activity. The HU's can be used for comparative analysis or an assessment of the amount of habitat gained or lost to the overall system resulting from an action or group of actions which has or will likely affect the system.

The Kenai River 309 study results indicate that there are 1,482,790 HU's currently available to juvenile chinook salmon in the Kenai River mainstem (See Table 14). These units are distributed throughout six different undeveloped shoreline habitat categories and another six developed shoreline or structures categories. These fish habitat classification categories include: ideal rearing habitat, vegetated undeveloped habitat, vegetated slightly degraded habitat, heavily degraded habitat, non-eroding gravel banks, and erosional gravel banks. The developed categories include: boat launches and access; docks, decks and other structures; bank protection measures; bulkheads; jetties and groins; and "other development".

Of the total 877,074.2 feet (166.1 miles) of waterfront on the river, 813,775.2 feet (154.1 miles) are in natural state and provide 1,409,601 HU's for rearing chinook salmon. There is currently another 63,299.0 feet (12.0 miles) of water frontage in some form of developed status which, while providing less favorable conditions for rearing fish than that of the natural bank, comprises another 73,189 HU's for these fish. Together they amount to 1,482,790 HU's in the Kenai River for rearing juvenile chinook salmon.

By defining the area of habitat within the river's 6.0 foot corridor along the banks that is either currently developed or altered by man-made structures or that which has been severely impacted by access resulting in heavy trampling, vegetation loss and bank instability, we have estimated that prior to the presence of these impacts, there was originally 1,523,144 HU's available to rearing juvenile chinook salmon in the Kenai River mainstem (See Table 15). The difference between this figure and the 1,482,790 HU's which currently exist is the amount of habitat lost or gained (lost in this case) to rearing fish. This amounts to 40,354 HU's.

The Development Trends Analysis, currently underway and scheduled to be completed in June 1994, will provide an important insight into the rate at which this habitat loss is occurring on

the Kenai River. This analysis uses aerial photograph interpretation of development conditions that existed in 1963/64 and compares those conditions to the documented development scenario observed during the 1993 Kenai River 309 study. Such an analysis can be used not only to determine how much development has taken place over the last 30 years, but can also be used as an interpretive tool to extrapolate future development scenarios and estimate the level of additional impact and habitat change (loss or gain) that can be anticipated in the future. This analysis will be included in the final cumulative impact report due in June.

All future development projects, maintenance projects, and land uses that affect the river and its shoreline will have to consider the limits of available habitat within this system that is critical to the continued production of the Kenai's world class chinook salmon population. If we are to continue to be afforded the opportunity to harvest these fish either commercially, recreationally, or under personal use methods and means, we must avoid the continued cumulative loss of their nursery habitat.

The results of this analysis are intended to provide a basic understanding of the current condition of the nearshore fish habitat occurring on the Kenai River mainstem. This information is intended to help educate the general public of the effects of development and access related habitat impacts that potentially affect the river's ability to continue to produce healthy runs of chinook salmon. The data will provide a basis for the ADF&G to draft Alaska Coastal Management Program ABC list proposals that result in the approval of sound development projects while promoting efficiency in the application of the coastal review process.

One of the primary objectives for the use of the Kenai River 309 project results has been to assist the local coastal district (Kenai Peninsula Borough)(KPB) in the review of their existing coastal management plans policies. The study results are intended to be used as a tool in the district's effort to develop revised or new enforceable policies that can be implemented by the KPB as well as the existing state and federal regulatory agencies charged with Kenai River management responsibilities.

Finally, the developed database and analysis process will be used by the ADF&G and hopefully other management agencies to evaluate all future development actions using a cumulative impacts assessment approach which considers the entire Kenai River watershed rather than just the individual project and its immediate and/or local effects.

APPENDIX A

TABLES

TABLE 1

FISH COVER TYPES AND SUBSTRATE CATEGORIES WITHIN THE KENAI RIVER

COVER AND SUBSTRATE TYPE	CODE
COVER TYPE	
No Object Cover	COV-NC
Emergent Vegetation	COV-EV
Aquatic Vegetation	COV-AV
Debris or Deadfall	COV-DD
Overhanging Riparian Vegetation	COV-OV
Undercut Banks	COV-UB
SUBSTRATE CATEGORIES	
Mud, Silt or Sand (0" to 0.25")	SUB_M
Gravel (0.25" to 3" diameter)	SUB_G
Cobble (3" to 5" diameter)	SUB_C
Rubble (5" or greater in diameter)	SUB_R

TABLE 2
(Code Key)

PROPERTY OWNERSHIP CODE DEFINITIONS

CODE	LAND OWNERSHIP
RSU	Residential, Undeveloped
RSD	Residential, Developed
COU	Commercial, Undeveloped
COD	Commercial, Developed
FBU	Federal Bureau of Land Management, Undeveloped
FBD	Federal Bureau of Land Management, Developed
FSU	Federal Forest Service Lands, Undeveloped
FSD	Federal Forest Service Lands, Developed
FWU	Federal Fish and Wildlife Service, Undeveloped
FWD	Federal Fish and Wildlife Service, Developed
SPU	State Parks and Outdoor Recreation, Undeveloped
SPD	State Parks and Outdoor Recreation, Developed
SOU	State Division of Lands, Undeveloped
SOD	State Division of Lands, Developed

CODE	LAND OWNERSHIP
NCU	Native Land, CIRI, Undeveloped
NCD	Native Land, CIRI, Developed
NSU	Native Land, Salamatof Corp., Undeveloped
NSD	Native Land, Salamatof Corp., Developed
KBU	Kenai Peninsula Borough, Undeveloped
KBD	Kenai Peninsula Borough, Developed
CSU	City of Soldotna, Undeveloped
CSD	City of Soldotna, Developed
CKU	City of Kenai, Undeveloped
CKD	City of Kenai, Developed
UAU	Univeresity of Alaska, Undeveloped
UAD	University of Alaska, Developed
OTH	Other (Church of Kenai)

TABLE 2

LAND OWNERSHIP, DEVELOPMENT STATUS AND WATERFRONTAGES BY STUDY REACH

OWNER CODE	STUDY REACH 1			STUDY REACH 2			STUDY REACH 3		
	OWNER COUNT	WATER FRONTAGE	% OF ZONE	OWNER COUNT	WATER FRONTAGE	% OF ZONE	OWNER COUNT	WATER FRONTAGE	% OF ZONE
CKD	6	3302.8	2.9	0	0	0	0	0	0
CKU	19	66026.9	57.9	2	4980.3	4.3	0	0	0
COD	8	5129.6	4.5	25	14836.1	12.8	30	8230.2	3.4
COU	0	0	0	0	0	0	6	3199.6	1.3
CSD	0	0	0	0	0	0	4	5909.5	2.4
CSU	0	0	0	0	0	0	12	10980.6	4.5
FBD	0	0	0	0	0	0	0	0	0
FBU	0	0	0	0	0	0	0	0	0
FSD	0	0	0	0	0	0	0	0	0
FSU	0	0	0	0	0	0	0	0	0
FWD	0	0	0	0	0	0	0	0	0
FWU	0	0	0	0	0	0	0	0	0
KBD	0	0	0	0	0	0	0	0	0
KBU	0	0	0	2	68.0	0.1	3	2996.2	1.2
NCU	0	0	0	3	3725.0	3.2	1	6262.1	2.6
NSD	0	0	0	0	0	0	4	1022.6	0.4
NSU	0	0	0	0	0	0	52	27949.7	11.5
OTH	1	140.0	0.1	0	0	0	0	0	0
RSD	35	7851.0	6.9	91	14613.0	12.6	397	67571.6	27.9
RSU	59	14215.0	12.5	84	17166.3	14.8	432	72543.1	30.1
SOD	0	0	0	1	600.0	0.5	6	5146.2	2.1
SOU	4	17325.0	15.2	20	53095.8	45.9	14	23293.1	9.6
SPD	0	0	0	2	2775.0	2.4	3	4383.8	1.8
SPU	0	0	0	2	3836.1	3.4	1	1273.6	0.5
UAU	0	0	0	0	0	0	1	1350.0	0.7
TOTAL	132	113,990.3	101.0	232	115,695.6	100.0	966	242,111.9	100.0

TABLE 2 (Continued)

LAND OWNERSHIP, DEVELOPMENT STATUS AND WATER FRONTAGE BY STUDY REACH

OWNER CODE	STUDY REACH 4			STUDY REACH 5			TOTAL KENAI RIVER		
	OWNER COUNT	WATER FRONTAGE	% OF REACH	OWNER COUNT	WATER FRONTAGE	% OF REACH	OWNER COUNT	WATER FRONTAGE	% OF TOTAL
CKD	0	0	0	0	0	0	6	3302.8	0.4
CKU	0	0	0	1	746.1	0.3	22	71753.3	8.2
COD	4	624.4	0.4	5	3298.2	1.3	72	32118.5	3.7
COU	0	0	0	0	0	0	6	3199.6	0.4
CSD	0	0	0	0	0	0	4	5909.5	0.8
CSU	0	0	0	0	0	0	12	10900.6	1.3
FBD	0	0	0	1	2917.3	1.2	1	2917.3	0.3
FBU	0	0	0	1	1265.8	0.5	1	1265.8	0.1
FSD	0	0	0	3	15170.6	6.1	3	15170.6	1.7
FSU	0	0	0	8	36065.3	14.5	8	36065.3	4.1
FWD	9	910.0	0.6	3	10299.9	4.2	12	11289.9	1.3
FWU	21	60863.7	38.7	24	141587.1	57.1	45	202450.8	23.1
KBD	0	0	0	1	450.6	0.2	1	450.6	0.1
KBU	2	330.5	0.2	1	148.8	0.1	8	3543.3	0.4
NCU	36	29072.2	18.5	0	0	0	48	38959.3	4.4
NSD	0	0	0	0	0	0	4	1072.6	0.1
NSU	0	0	0	0	0	0	52	27949.7	3.2
OTH	0	0	0	0	0	0	1	140.0	0.1
RSD	136	28208.4	18.0	40	7704.6	3.1	699	125948.6	14.3
RSU	69	13420.9	8.5	13	1672.4	0.7	657	119017.7	13.5
SOD	27	6909.3	4.4	12	11126.7	4.5	46	23702.2	2.6
SOU	34	10523.8	6.7	13	15698.4	6.2	85	119928.1	13.6
SPD	0	0	0	0	0	0	5	7150.8	0.8
SPU	16	6269.4	4.0	0	0	0	19	11379.1	1.3
UAU	0	0	0	0	0	0	1	1350.0	0.2
TOTAL	354	157,132.6	100.0	126	248,143.8	100.0	1,910	877,074.2	100.0

TABLES 3-7
(Code Key)

KENAI RIVER STRUCTURES DATABASE CODES

Structure Code	Structure Activity
Buoys - B	
BMO	Mooring
BSN	Sail Net
BNV	Navigation or Marker
Docks - D	
DFP	Public Permanent Pile Supported
DTP	Public Temporary Pile Supported
DFF	Public Permanent Floating
DTF	Public Temporary Floating
DCP	Commercial Permanent Pile Supported
DCT	Commercial Temporary Pile Supported
DCF	Commercial Permanent Floating
DCS	Commercial Seasonal Floating
DIP	Private/Individual Permanent Pile Supported
DIT	Private/Individual Temporary Pile Supported
DIF	Private/Individual Permanent Floating
DIS	Private Individual Temporary Seasonal Floating
DCL	Dock, Cantilevered
DOT	Dock, Other (describe)
CST	Dock, Cantilevered
Piling - P	
PSS	Piling Structure/Pile Supported Structure
PSD	Pile Supported Deck
PSB	Pile Supported Boat House
PSW	Pile Supported Boatwalk
DDL	Piling, Mooring Dolphin
Launches - L	
LPI	Public Improved Boat Launch
LPU	Public Unimproved Boat Launch
LCI	Commercial Improved Boat Launch
LCU	Commercial Unimproved Boat Launch
LII	Private/Individual Improved Boat Launch
LIU	Private/Individual Unimproved Boat Launch
CWP	Campsite Beach Damage
CWL	Cowalk
VSC	Vessel Beach Scour/Scars
VSP	Vessel Slips
VSW	Vessel Basins
LDR	Beach Ladder Stairway

Structure Code	Structure Activity
Outfalls - O	
OSW	Stormwater Outfall
OSE	Sewer Outfall
OSP	Seafood Processing Waste Outfall
OFT	Fish Cleaning Table Outfall
Bank Stabilization - S	
SLG	Logs
STB	Timbers
SCT	Cabled Trees
SCR	Concrete Rubble
SSP	Steel Piling
SLW	Leveling Mat
SCB	Concrete Block
SBW	Bank Mortar
SPE	Pipe
SCF	Chain Link Fence
STR	Tires
SMC	Gabions
SGB	Gabions
SSB	Bank Rip Rap
SBE	Soil Bioengineering
SOT	Other (Describe)
SRL	Remove/Fill Gallon Drums
SRO	Bridge Right-of-Way
SDW	Boardwalk
Fuel - F	
FSU	Seasonal Use Only Fuel
FYR	Year Around Use Fuel
FWS	Fuel/Wet Slip
SNF	Snow Facility
WLF	Wetlands Fill
UPL	Uplands Fill
Mining - M	
MRO	Recreational Placer Mining, Dredging
MCD	Commercial Placer Mining, Dredging
MCP	Commercial Placer Mining, Other Means
SMT	Subsistence Access Ramp/Corridor
OTH	Other (Describe)
ITY	Intake/Outlets

TABLE 6

DEVELOPMENT/ACCESS STRUCTURES INVENTORY BY STUDY REACH

TOTAL FOR ALL FIVE STUDY REACHES

[illegible]

[illegible]

[illegible] REACH #	[illegible] COUNT	% OF [illegible] [illegible]	[illegible] [illegible] (FEET)	[illegible] [illegible] (FEET)	[illegible] [illegible] [illegible] [illegible] [illegible] (SQ. FT.)	% OF [illegible] [illegible] [illegible]
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 9

PERCENTAGE OF TOTAL WATERFRONT AFFECTED BY

STRUCTURES AND/OR BANK TRAMPLING

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 10

TRAMPLED VERSUS NATURALLY NON-VEGETATED RIVERBANK

AT ORDINARY HIGH WATER AND TOP OF RIVER BANK

STUDY REACH #	RIVER BANK SITE	REACH WATER-FRONTAGE (FEET)	TOTAL NO VEG. COVER (FEET)	NATURAL NO VEG. COVER (FEET)	% OF TOTAL NO VEG. COVER	% REACH WATER FRONT	TRAMPLED NO VEG. COVER (FEET)	% OF TOTAL NO VEG. COVER	% OF REACH WATER FRONT
1	OHW	[illegible]	[illegible]	[illegible]	97.68	70.29	2131.7	2.33	1.87
1	TOB	[illegible]	[illegible]	[illegible]	88.16	27.53	4213.2	11.84	3.70
2	OHW	[illegible]	[illegible]	[illegible]	89.20	24.47	3428.8	10.80	2.96
2	TOB	[illegible]	[illegible]	[illegible]	43.48	9.84	7584.9	56.52	6.56
3	OHW	[illegible]	[illegible]	[illegible]	88.48	13.79	[illegible]	19.52	3.34
3	TOB	[illegible]	[illegible]	[illegible]	48.12	7.69	12312.7	39.88	5.10
4	OHW	[illegible]	[illegible]	[illegible]	88.16	26.97	5782.2	11.86	3.63
4	TOB	[illegible]	[illegible]	[illegible]	78.19	18.79	4727.7	21.81	3.81
5	OHW	[illegible]	[illegible]	[illegible]	88.63	34.59	11234.7	11.58	4.53
5	TOB	[illegible]	[illegible]	[illegible]	51.32	3.15	7620.5	48.78	3.88
[illegible]	OHW	[illegible]	[illegible]	[illegible]	98.33	31.82	[illegible]	9.80	3.49
[illegible]	TOB	[illegible]	[illegible]	[illegible]	68.94	9.19	[illegible]	31.86	4.14

TABLE 11

VEGETATION TYPES BY STUDY REACH AT ORDINARY HIGH WATER AND TOP OF RIVER BANK

STUDY REACH #	RIVER BANK SITE	HERB-ACEOUS COVER	% TOTAL REACH COVER	WOODY COVER (FEET)	% TOTAL REACH COVER	TREE COVER (FEET)	% TOTAL REACH COVER	NO VEG. NO COVER	% TOTAL REACH COVER	TOTAL COVER (FEET)
1	OHW	20667.2	18.13	1236.9	1.08	709.8	0.63	91376.4	80.16	113990.3
1	TOB	67820.8	59.49	4095.6	3.59	6480.5	5.69	35593.6	31.23	113990.5
2	OHW	49116.8	42.45	19669.4	17.01	15171.0	13.11	31737.1	27.43	115694.3
2	TOB	43610.1	37.68	16990.9	14.69	41682.3	36.03	13419.0	11.60	115702.3
3	OHW	162008.0	66.90	25369.1	10.47	13248.4	5.48	41483.6	17.13	242109.1
3	TOB	62892.4	25.98	51676.0	21.35	96533.8	39.89	30990.8	12.80	242093.0
4	OHW	87175.2	55.47	15300.4	9.74	6582.6	4.19	48076.2	30.60	157134.4
4	TOB	54430.7	34.64	18935.5	12.05	62089.7	39.51	21678.6	13.80	157134.5
5	OHW	79729.5	32.13	44109.5	17.78	17905.3	7.22	106399.3	42.89	248143.6
5	TOB	53657.0	21.62	58272.9	23.48	101714.0	40.99	34580.9	13.90	248164.8
TOTAL	OHW	398696.7	45.46	105685.3	12.05	53617.1	6.11	319072.6	36.38	877071.7
TOTAL	TOB	282411.0	32.20	149970.9	17.10	308500.3	35.17	136182.9	15.53	877065.1

TABLE 12

SUBSTRATE TYPES LISTED BY STUDY REACH

(Measured in Feet)

STUDY REACH #	SUBSTRATE TYPE									
	MUD, SILT SAND	%	GRAVEL (0 - 3")	%	COBBLE (3 - 5")	%	BUBBLE (> 5")	%	TOTAL SUB FOOTAGE	%
1	96086.8	84.3	17259.9	15.1	226.0	0.2	417.6	0.4	113990.3	100.0
2	33068.3	28.6	51506.2	44.5	26646.8	23.0	4561.7	3.9	115783.0	100.0
3	14645.6	6.1	89980.5	37.2	98542.6	40.7	38943.2	16.1	242111.9	100.0
4	32963.9	21.0	81223.1	51.7	36857.1	23.5	6085.7	3.9	157129.8	100.0
5	9810.4	4.0	60280.1	24.3	77655.5	31.3	100313.2	40.4	248059.2	100.0
TOTAL	186,575.0	21.3	300,249.8	34.2	239,928.0	27.4	150,321.4	17.1	877,074.2	100.0

TABLE 13

AVAILABLE FISH HABITAT COVER TYPES AT OR BELOW ORDINARY HIGH WATER LINE BY STUDY REACH

(Measured in Feet)

STUDY REACH #	FISH COVER TYPES							
	NO COVER	%	EMER. VEG.	%	AQUA. VEG.	%	DEBRIS	%
1	104019.6	82.9	9572.5	07.6	25.0	00.1	1912.6	01.5
2	27330.0	14.6	8262.0	04.4	108.0	00.1	10954.6	05.8
3	30682.4	07.7	15457.8	03.9	3297.1	00.8	8152.5	02.1
4	80223.9	38.8	4586.7	02.2	430.0	00.1	11073.5	05.4
5	97027.5	31.6	6574.4	02.1	0.0	00.0	40568.1	13.2
TOTAL	339,283.4	27.7	44,453.4	3.6	3,860.1	0.3	72,661.3	6.0

STUDY REACH #	FISH COVER TYPES					
	OVERHANG VEG.	%	UNDERCUT BANKS	%	TOTAL COVER	%
1	4873.7	03.9	5033.5	4.1	125436.9	100.0
2	72576.9	38.6	68379.9	36.5	187611.4	100.0
3	183062.8	46.2	155704.3	39.3	396356.9	100.0
4	64389.6	31.2	45790.2	22.2	206493.9	100.0
5	101946.9	33.2	61371.3	20.0	307488.2	100.0
TOTAL	426,849.9	34.9	336,279.2	27.6	1,223,387.3	100.0

TABLE 14

HABITAT SUITABILITY INDICES AND AVAILABLE HABITAT UNITS FOR JUVENILE CHINOOK SALMON IN THE KENAI RIVER MAINSTEM

TOTAL HABITAT UNITS (HU'S) FOR THE KENAI RIVER MAINSTEM

1,482,790 HU'S

COVER TYPE STRUCTURE OR USE	WATER-FRONTAGE (MILES)	(FEET)	TOTAL AREA AFFECTED (ACRES)	(FT^2)	MEAN HSI'S	HABITAT UNITS (HU'S)
UNDEVELOPED WATERFRONTAGE						
IDEAL REARING	15.1	79,483.0	10.9	476,898.0	0.77	367,211.5
VEGETATED UNDEVELOPED	19.4	102,606.4	14.1	615,638.4	0.30	184,691.5
VEGETATED SLIGHTLY DEGRADED	79.8	421,413.6	58.1	2,528,481.6	0.26	657,405.2
HEAVILY DEGRADED	7.0	36,827.7	5.1	220,966.2	0.20	44,193.2
GRAVEL NON ERODING	5.3	27,805.5	3.8	166,833.0	0.15	25,025.0
EROSIONAL GRAVEL BANK	27.5	145,639.0	20.1	873,834.0	0.15	131,075.1
SUBTOTAL	154.1	813,775.2	112.1	4,882,651.2	N/A	1,409,601.5
DEVELOPED WATERFRONTAGE						
BOAT LAUNCHES	0.5	2,391.0	0.3	14,346.0	0.17	2,438.8
DOCKS, DECKS & STRUCTURES	2.0	10,378.0	1.4	62,268.0	0.28	17,435.0
BANK PROTECTION MEASURES	4.3	22,757.0	3.1	136,542.0	0.17	23,212.1
BULKHEADS	1.5	7,806.0	1.1	46,836.0	0.14	6,557.0
JETTY'S	0.2	1,152	0.2	6,912.0	0.14	967.7
OTHER DEV.	3.6	18,815.0	2.6	112,890.0	0.20	22,578.0
SUBTOTAL	12.0	63,299.0	8.7	379,794.0	N/A	73,188.6
TOTALS	166.1	877,074.2	120.8	5,262,445.0	N/A	1,482,790.1

TABLE 15

HABITAT SUITABILITY INDICES AND AVAILABLE HABITAT UNITS FOR JUVENILE CHINOOK SALMON IN THE KENAI RIVER MAINSTEM

TOTAL HABITAT UNITS (HU'S) FOR THE KENAI RIVER MAINSTEM WITHOUT STRUCTURES OR TRAMPLING

1,523,144 HU'S

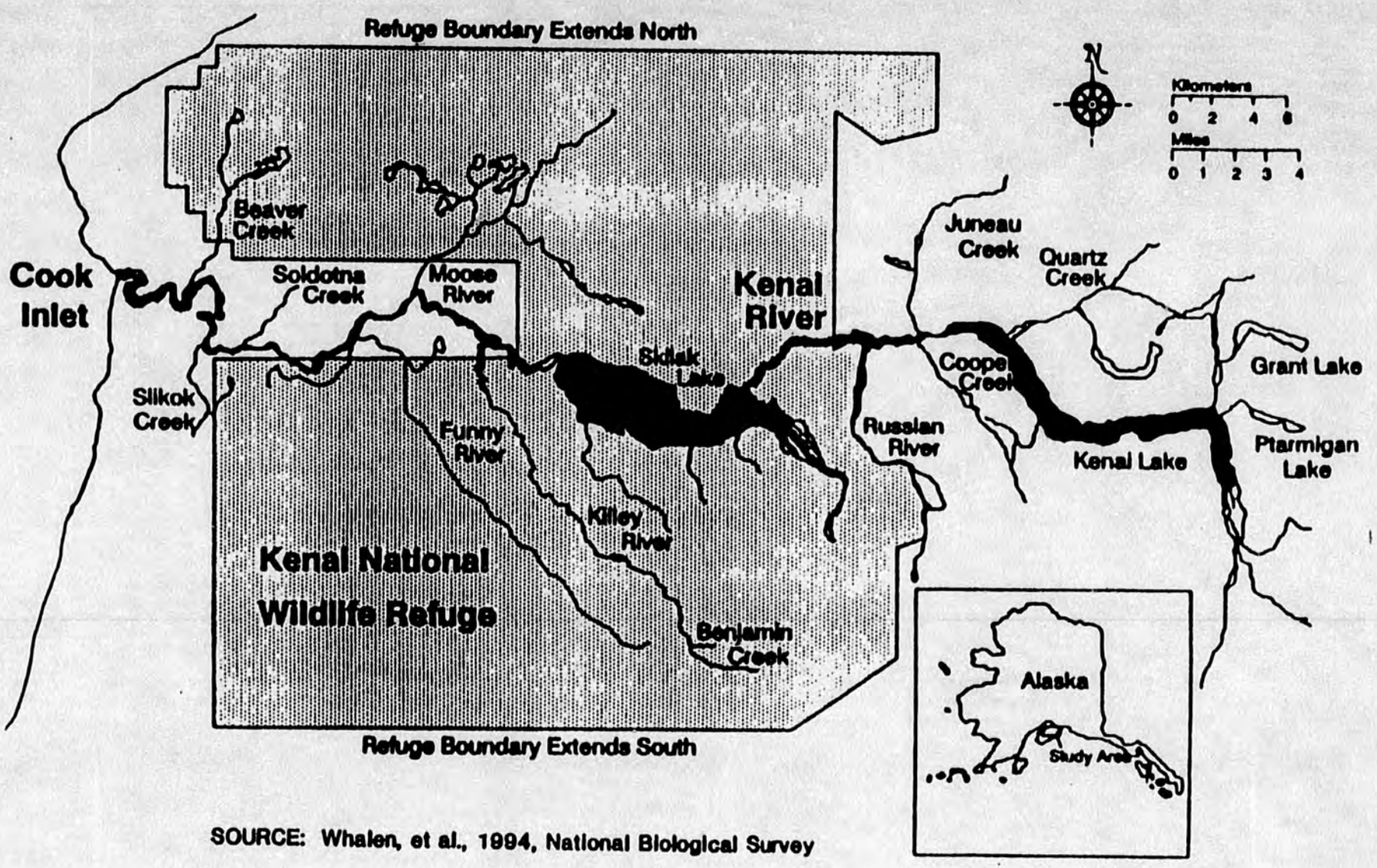
COVER TYPE STRUCTURE OR USE	WATER-FRONTAGE (MILES)	(FEET)	TOTAL AREA AFFECTED (ACRES)	(FT^2)	MEAN HSI'S	HABITAT UNITS (HU'S)
UNDEVELOPED WATERFRONTAGE						
IDEAL REARING	15.3	80,779.0	11.1	484,674.0	0.77	373,199.0
VEGETATED UNDEVELOPED	26.6	106,309.0	19.4	843,234.6	0.30	252,970.4
VEGETATED SLIGHTLY DEGRADED	87.1	459,941.6	63.4	2,759,649.6	0.26	717,508.9
NATURALLY DEGRADED	2.0	10,776.1	1.5	64,656.6	0.20	12,931.3
GRAVEL NON ERODING	6.8	35,840.5	4.9	215,043.0	0.15	32,256.5
EROSIONAL GRAVEL BANK	28.3	149,198.0	20.6	895,188.0	0.15	134,278.2
TOTAL W/O STRUCTURES OR TRAMPLING	166.1	877,074.2	120.9	5,262,445.8	N/A	1,523,144.3
TOTAL WITH STRUCTURES	166.1	877,074.2	120.8	5,262,445.8	N/A	1,482,790.0
TOTAL HABITAT UNITS LOST (-) GAINED (+)						- 40,354.0

APPENDIX B

FIGURES

Figure 1

KENAI RIVER LOCATION MAP



SOURCE: Whalen, et al., 1994, National Biological Survey

Figure 2
Kenai River 309 Project
Study Area Boundary

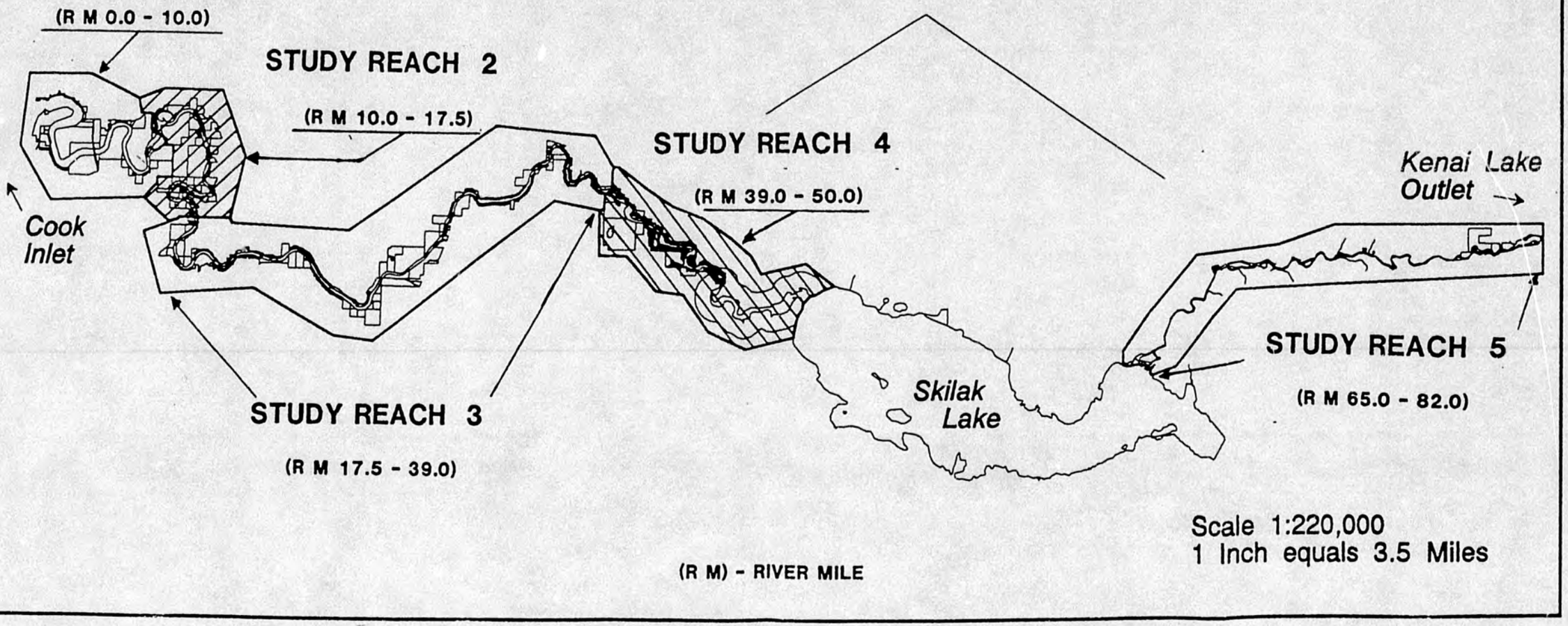
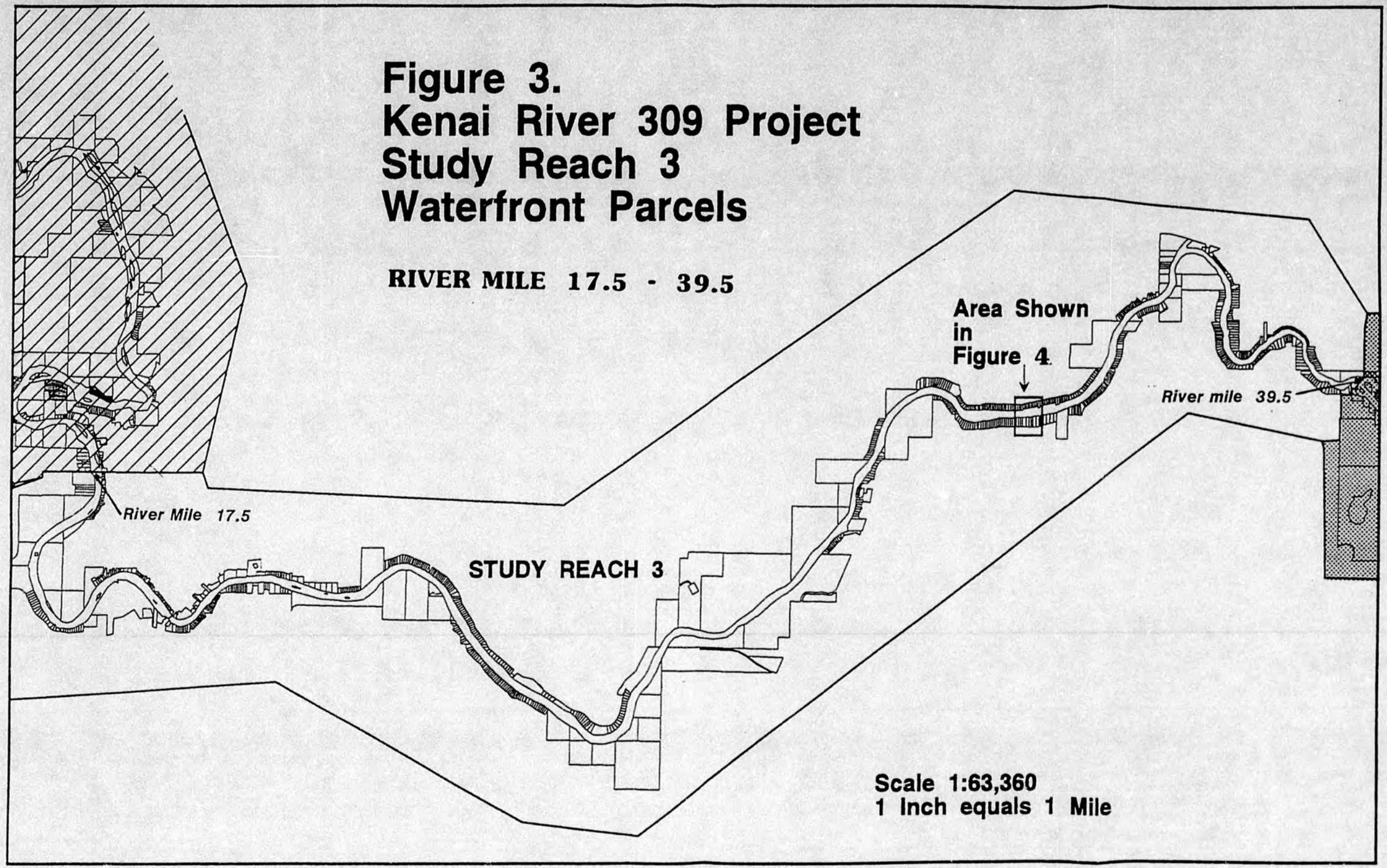


Figure 3.
Kenai River 309 Project
Study Reach 3
Waterfront Parcels

RIVER MILE 17.5 - 39.5



Scale 1:63,360
1 Inch equals 1 Mile

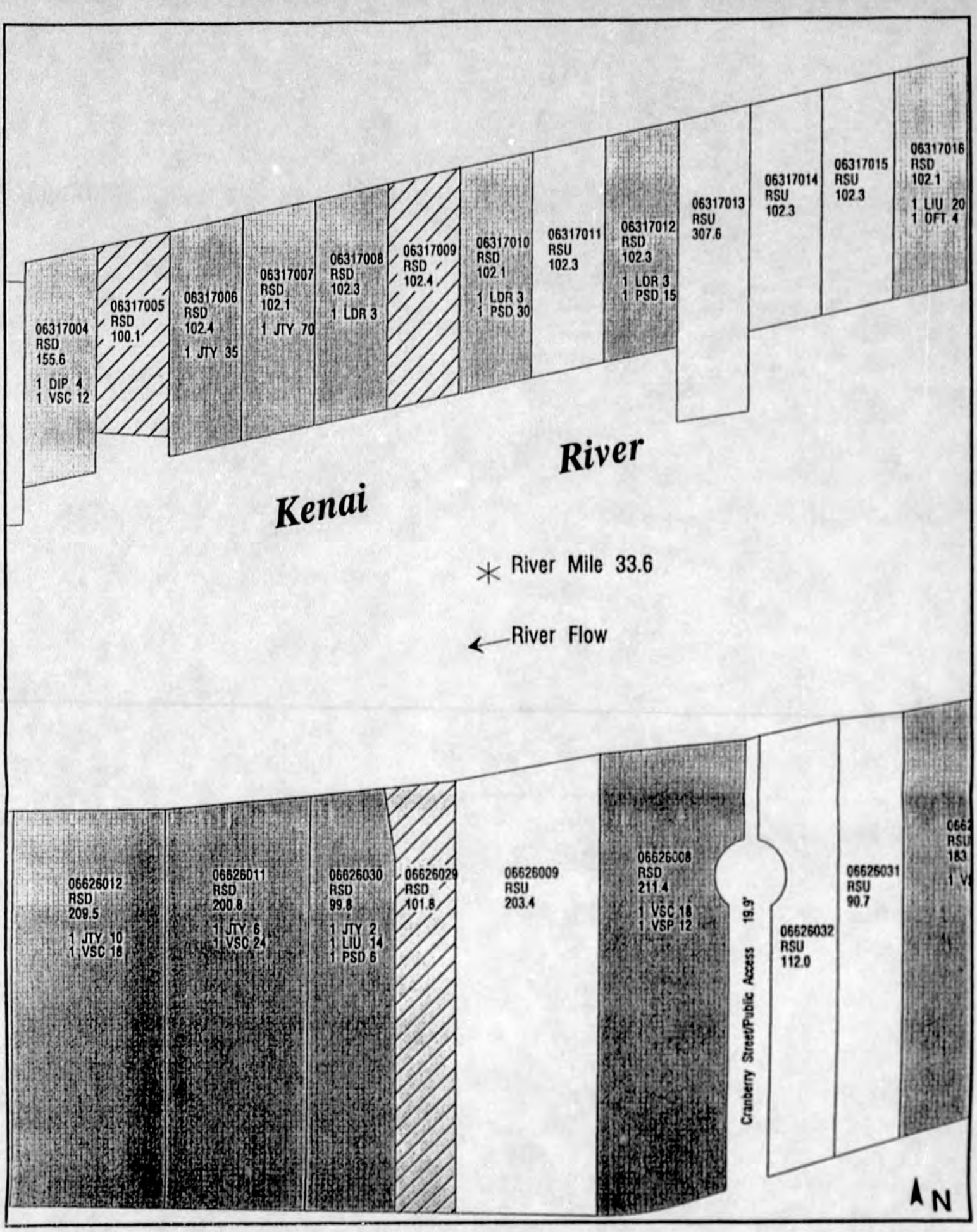


Figure 4. Kenai Riverfront Property Development

Undeveloped Parcel

Developed Parcel With Altered Waterfrontage

Developed Parcel With Unaltered Waterfrontage

Taxid =	06626012
Ownership =	RSD
Waterfront Length =	209.5
Structures-Number,Type,Length =	1 JTY 10
Structures-Number,Type,Length =	1 VSC 18

ALL LENGTHS ARE IN FEET.

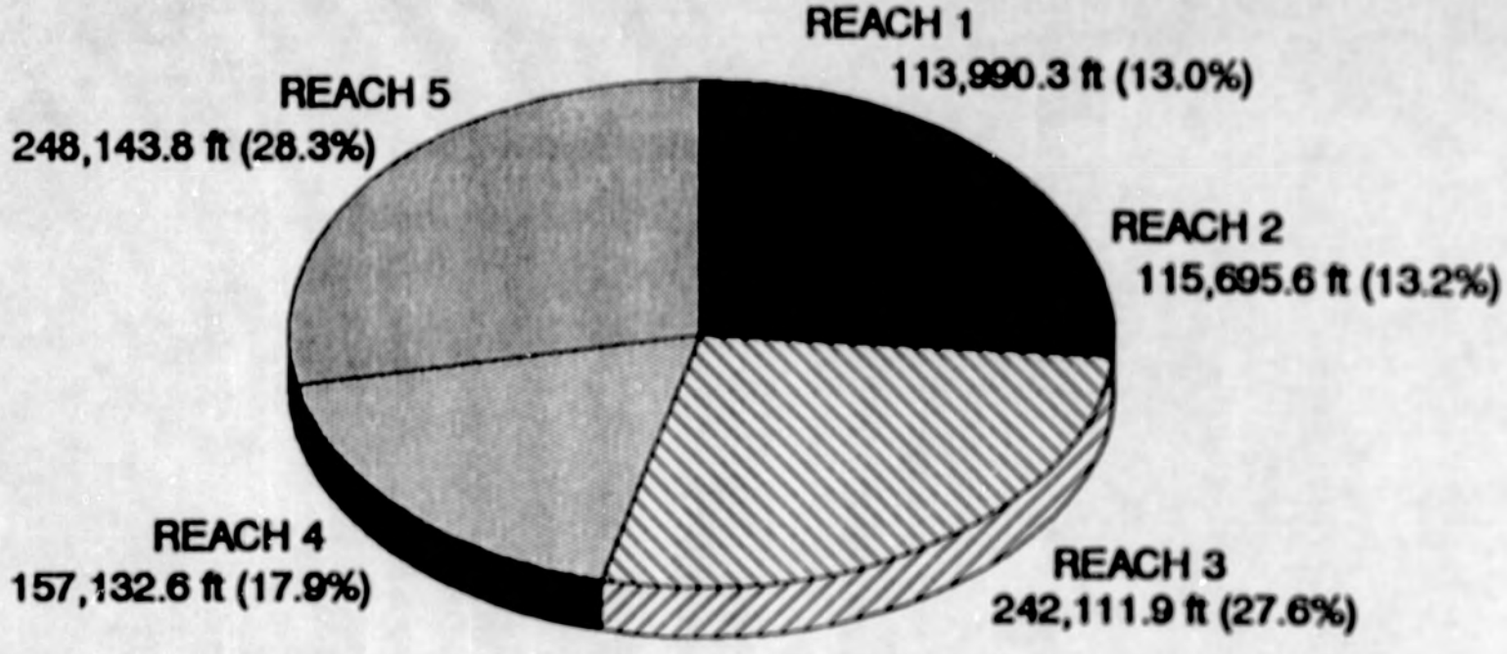
See Table 1 for definition of structure type abbreviations.

See Table 2 for land ownership code definitions.

Note: Total structure type lengths do not necessarily equal total waterfront length for each parcel.

FIG. 5 WATER FRONTAGES ON THE KENAI RIVER

LENGTHS/PERCENTAGES OF WATER FRONTAGE BY REACH



TOTAL = 877,074.2 ft

% = PERCENTAGE OF TOTAL WATER FRONTAGE FOR THE ENTIRE RIVER MAINSTEM

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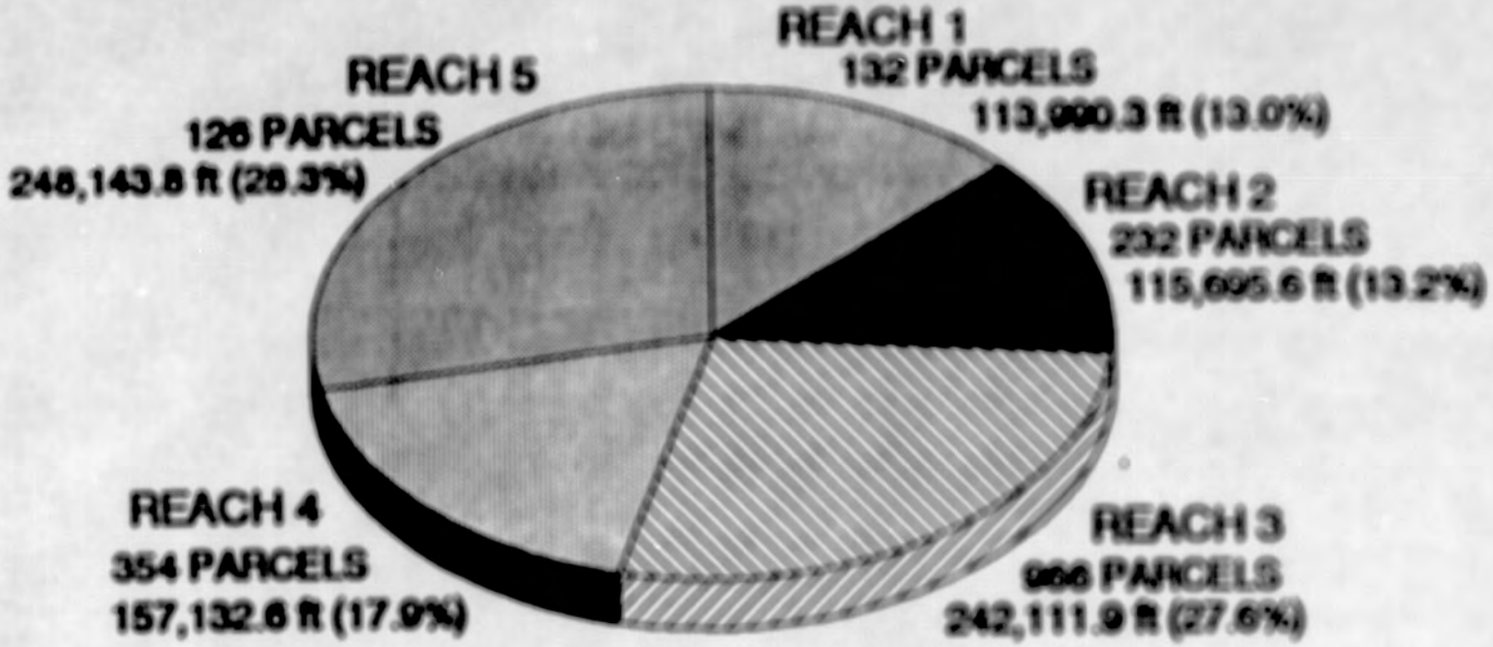
FIG. 6 KENAI RIVER OWNERSHIP BY PARCEL

PARCELS/PERCENTAGE OF WATER FRONTAGE BY REACH



TOTAL PARCELS = 1,810
TOTAL WATER FRONTAGE = 877,074.2 ft

% = PERCENTAGE OF TOTAL WATER FRONTAGE FOR THE ENTIRE RIVER MAINSTEM

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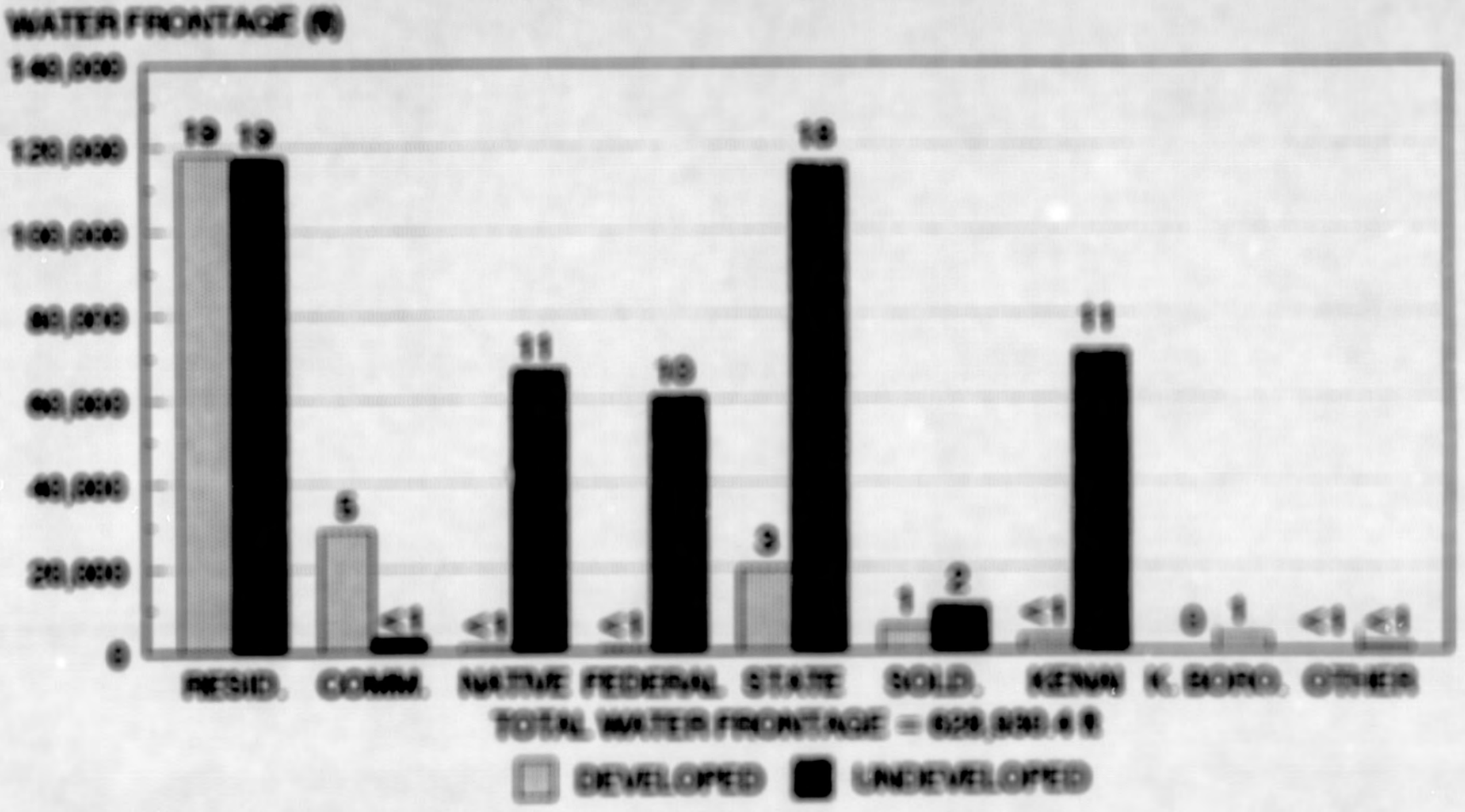
FIG. 7 KENAI RIVER OWNERSHIP CATEGORIES

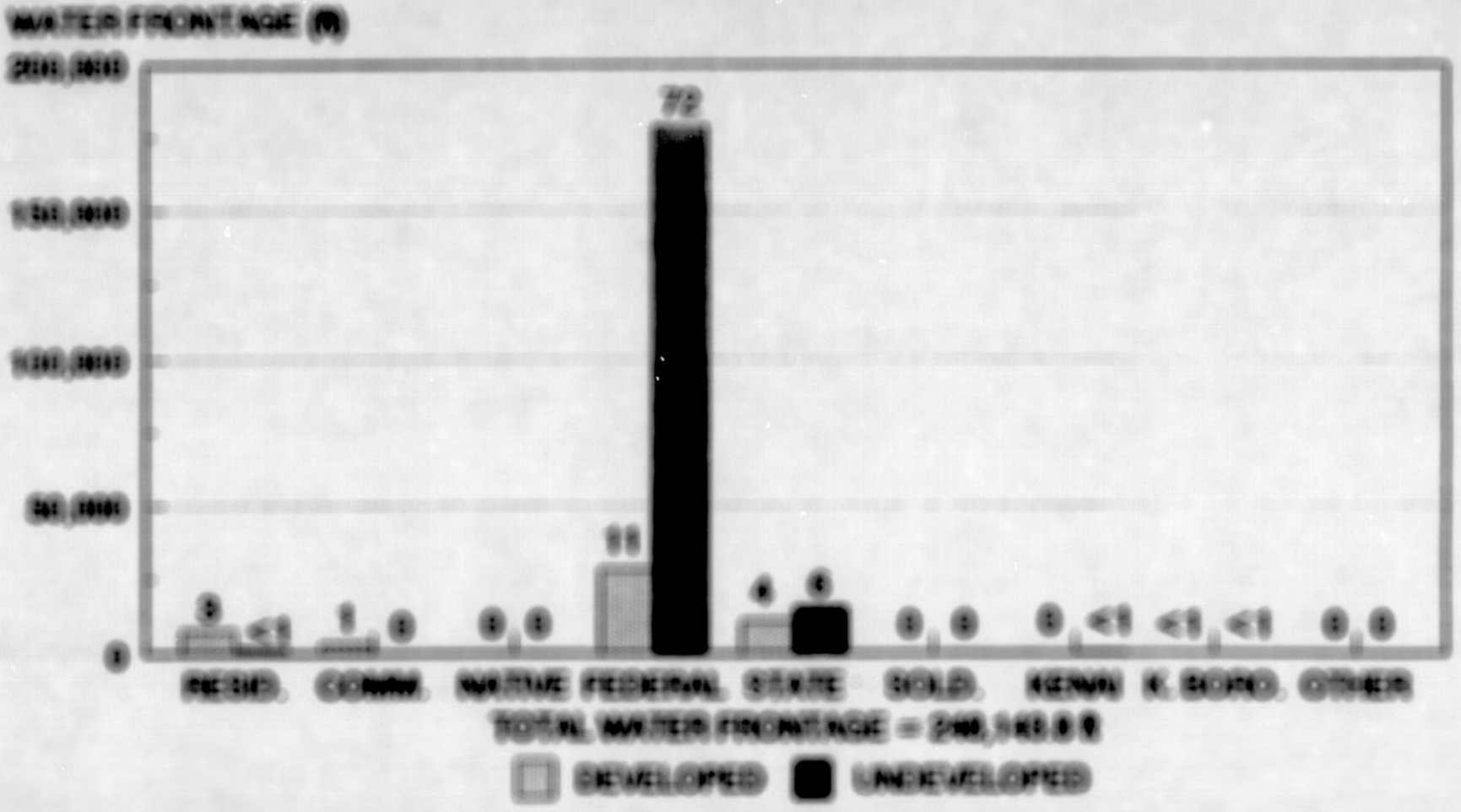
REACHES 1-4 COMBINED



NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

FIG. 8 KENAI RIVER OWNERSHIP CATEGORIES

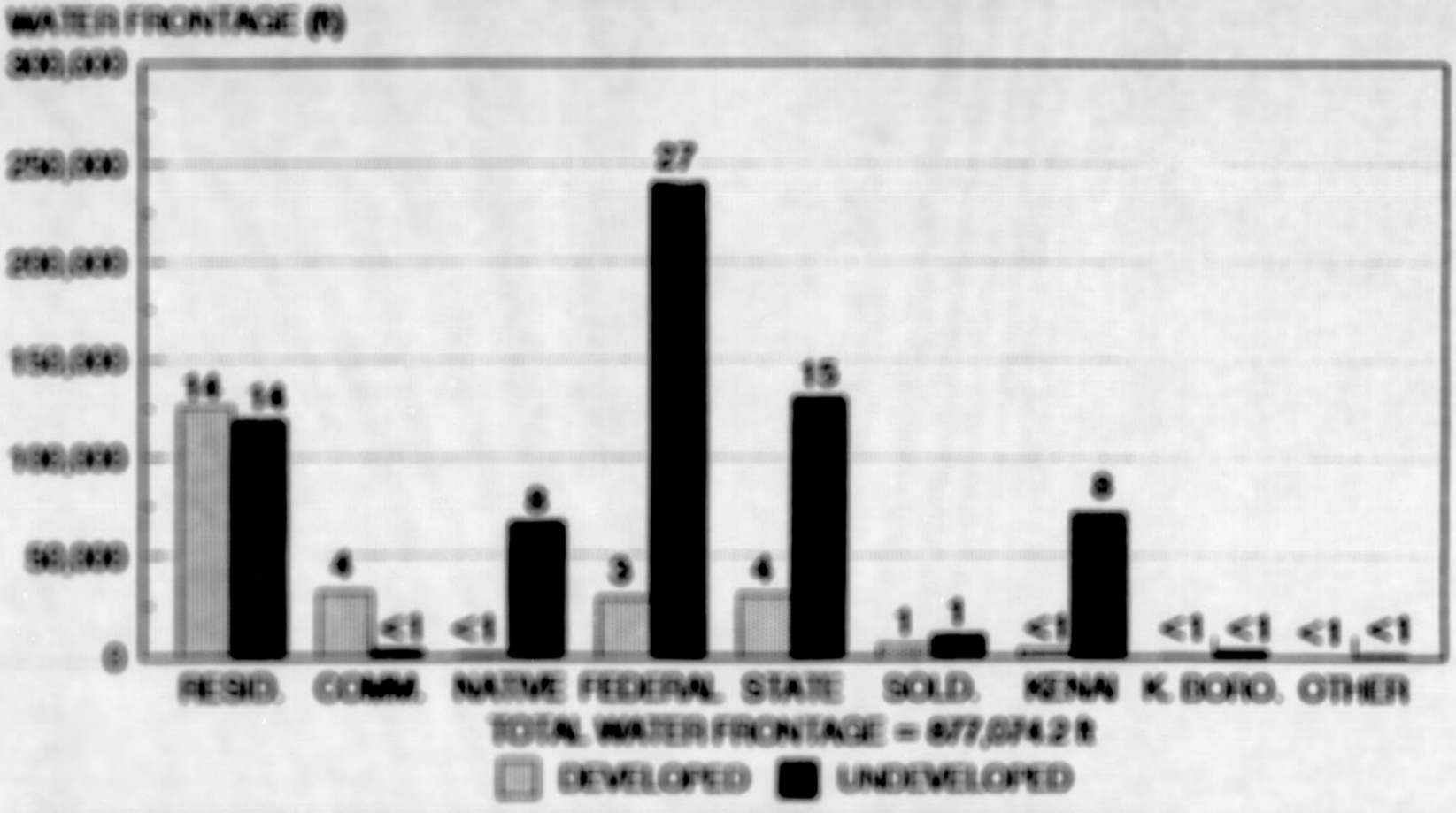
REACH 5



NUMBERS ABOVE BARS REFLECT % OF TOTAL WINNISTEW WATER FRONTAGE

FIG. 9 KENAI RIVER OWNERSHIP CATEGORIES

ALL REACHES COMBINED



NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

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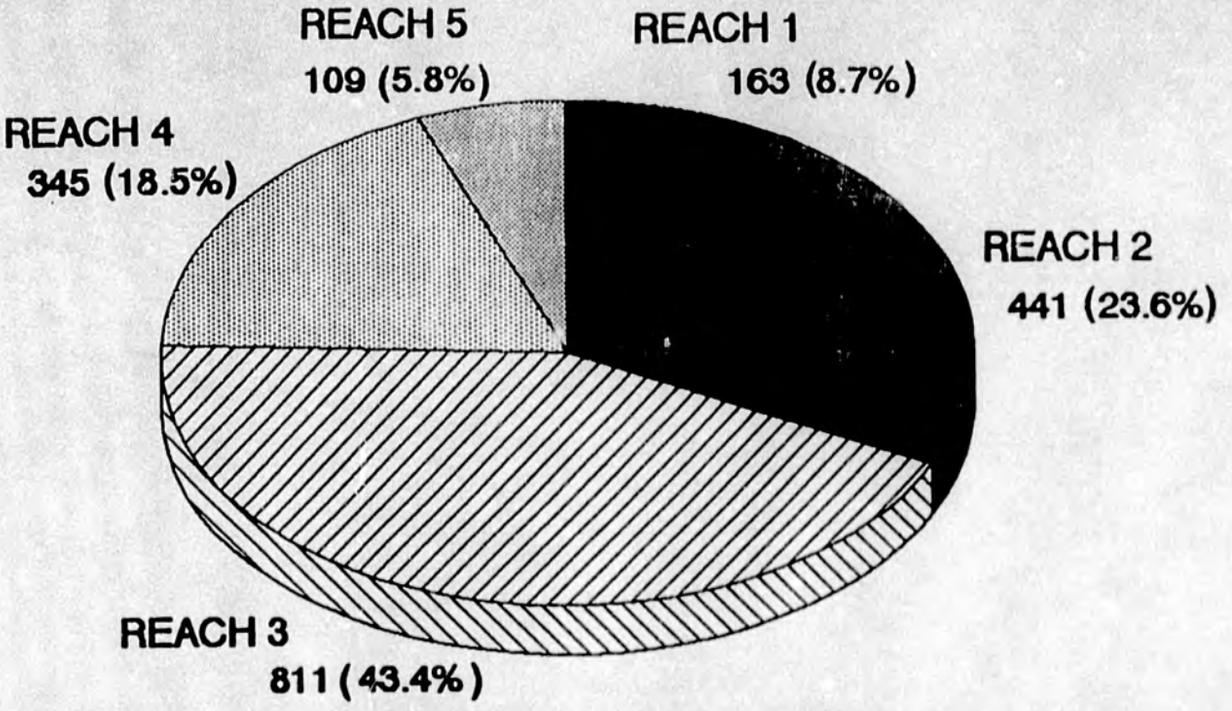
FIG. 10 STRUCTURES ON THE KENAI RIVER

NUMBERS/PERCENTAGES OF ALL STRUCTURES BY REACH



TOTAL = 1869 STRUCTURES ON 639 PARCELS

% = PERCENTAGE OF TOTAL NUMBER OF STRUCTURES FOR THE ENTIRE RIVER MAINSTEM

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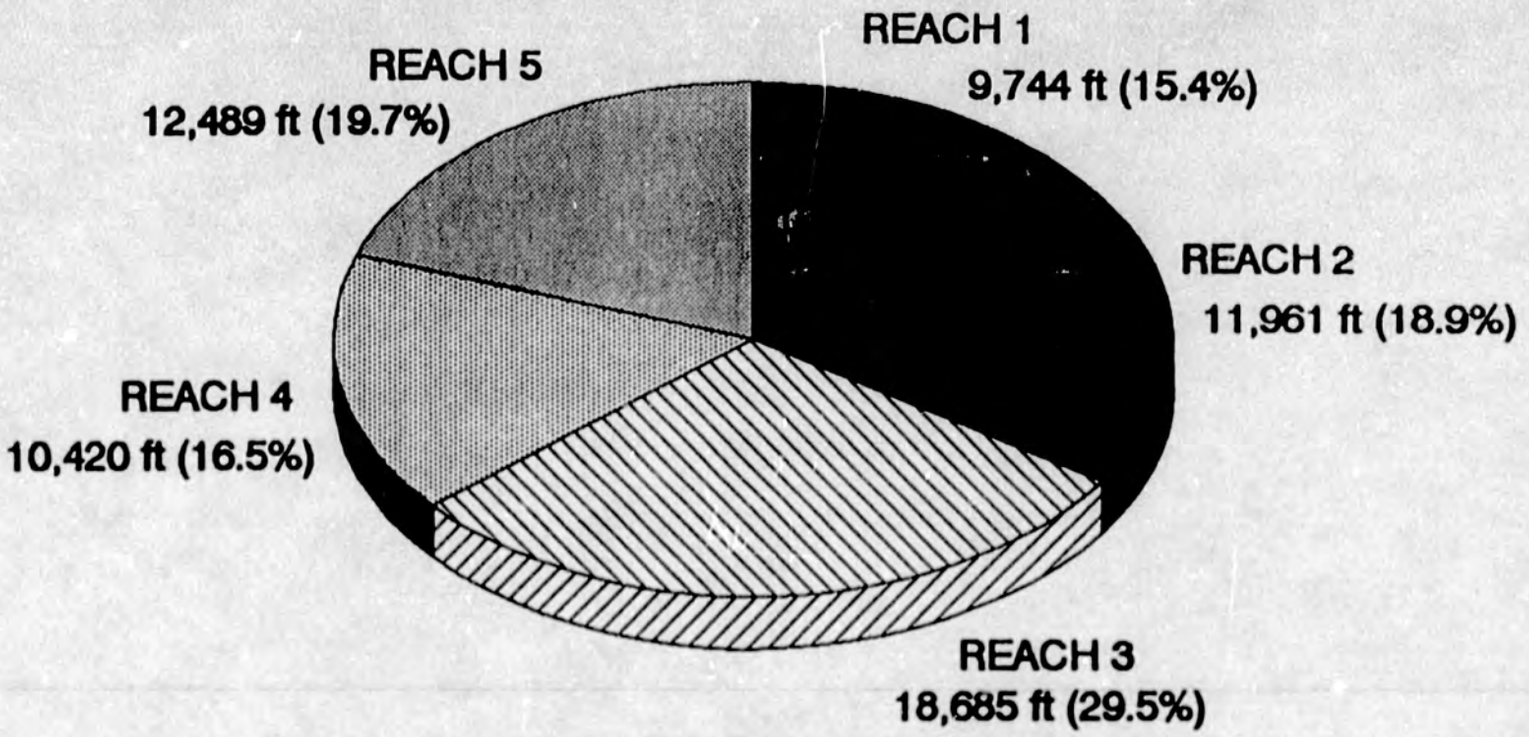
FIG. 11 STRUCTURES ON THE KENAI RIVER

LENGTHS/PERCENTAGES OF ALL STRUCTURES BY REACH



TOTAL = 63,299 ft

% = PERCENTAGE OF TOTAL STRUCTURE LENGTHS FOR THE ENTIRE RIVER MAINSTEM

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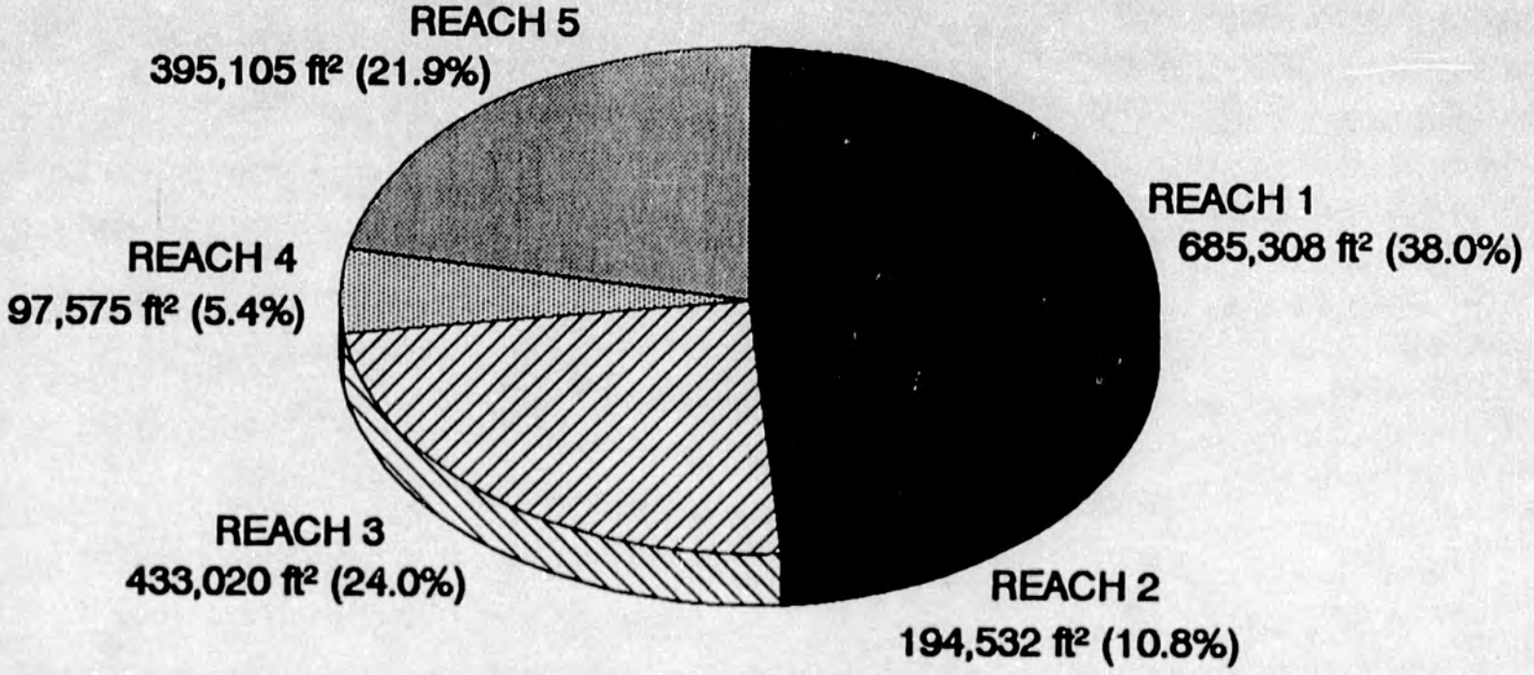
FIG. 12 STRUCTURES ON THE KENAI RIVER

AREAS/PERCENTAGES OF ALL STRUCTURES BY REACH



TOTAL AREA AFFECTED BY STRUCTURES = 1,805,540 ft²
= 34.3% OF TOTAL STUDY AREA

% = PERCENTAGE OF TOTAL STRUCTURE AREA FOR THE ENTIRE MAINSTEM

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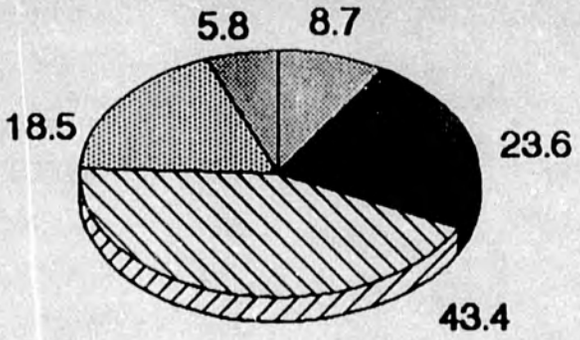
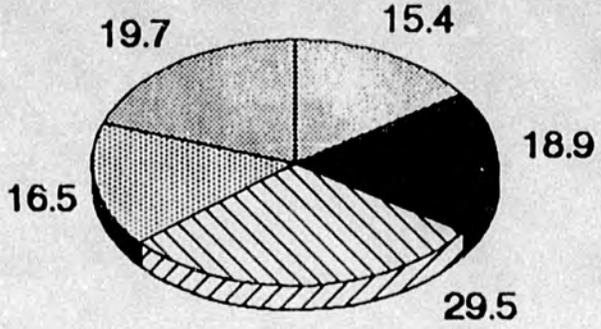
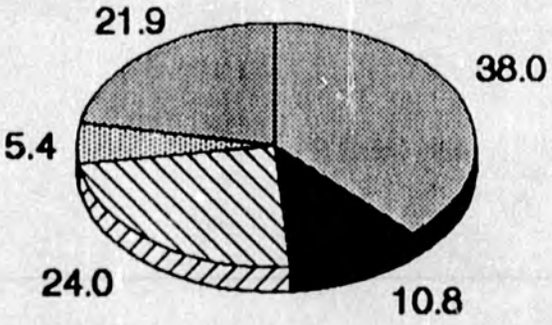
FIG. 13 SUMMARY OF KENAI RIVER WATERFRONT LENGTHS AND STRUCTURES



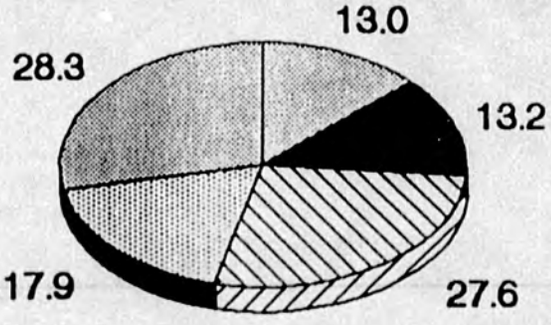
NUMBERS OF STRUCTURES
TOTAL = 1,869



LENGTHS OF STRUCTURES
TOTAL = 63,299 ft



AREAS OF STRUCTURES
TOTAL = 1,805,540 ft²



WATER FRONTAGE PER REACH
TOTAL = 877,074.2 ft

REACH 1 REACH 2 REACH 3 REACH 4 REACH 5

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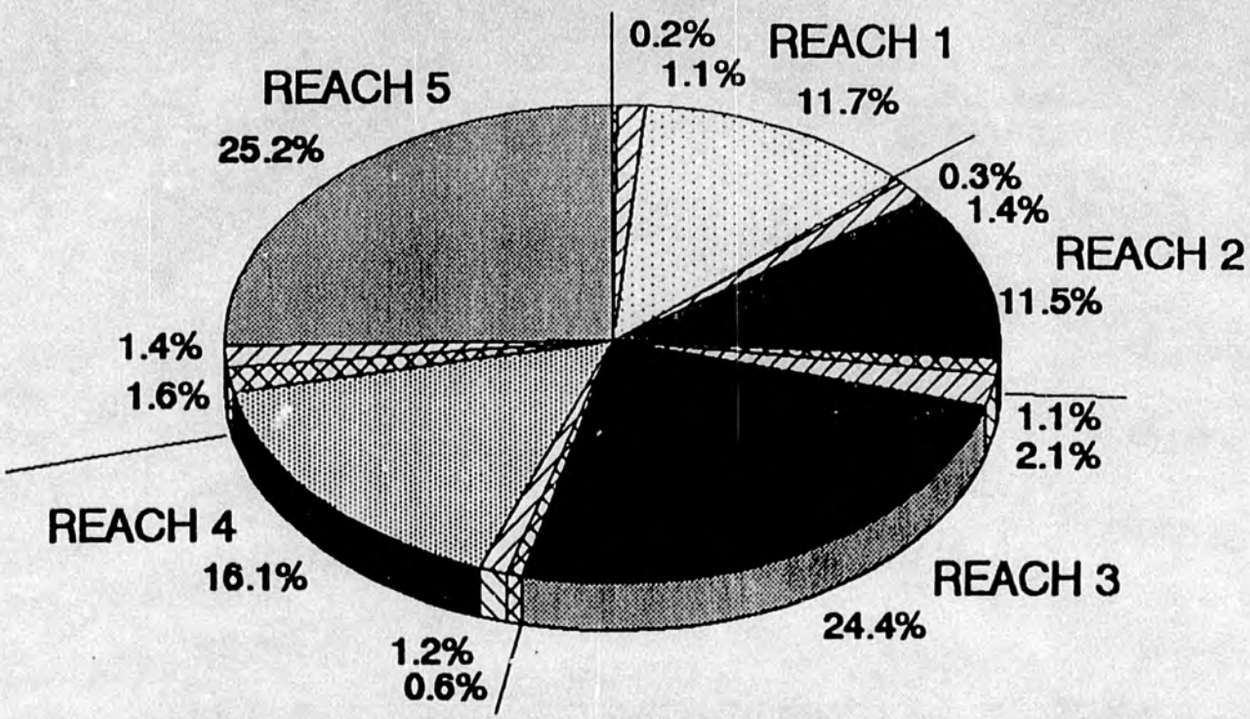
FIG. 14 KENAI RIVER WATER FRONTAGE ALTERATIONS
FOR EACH REACH AT ORDINARY HIGH WATER

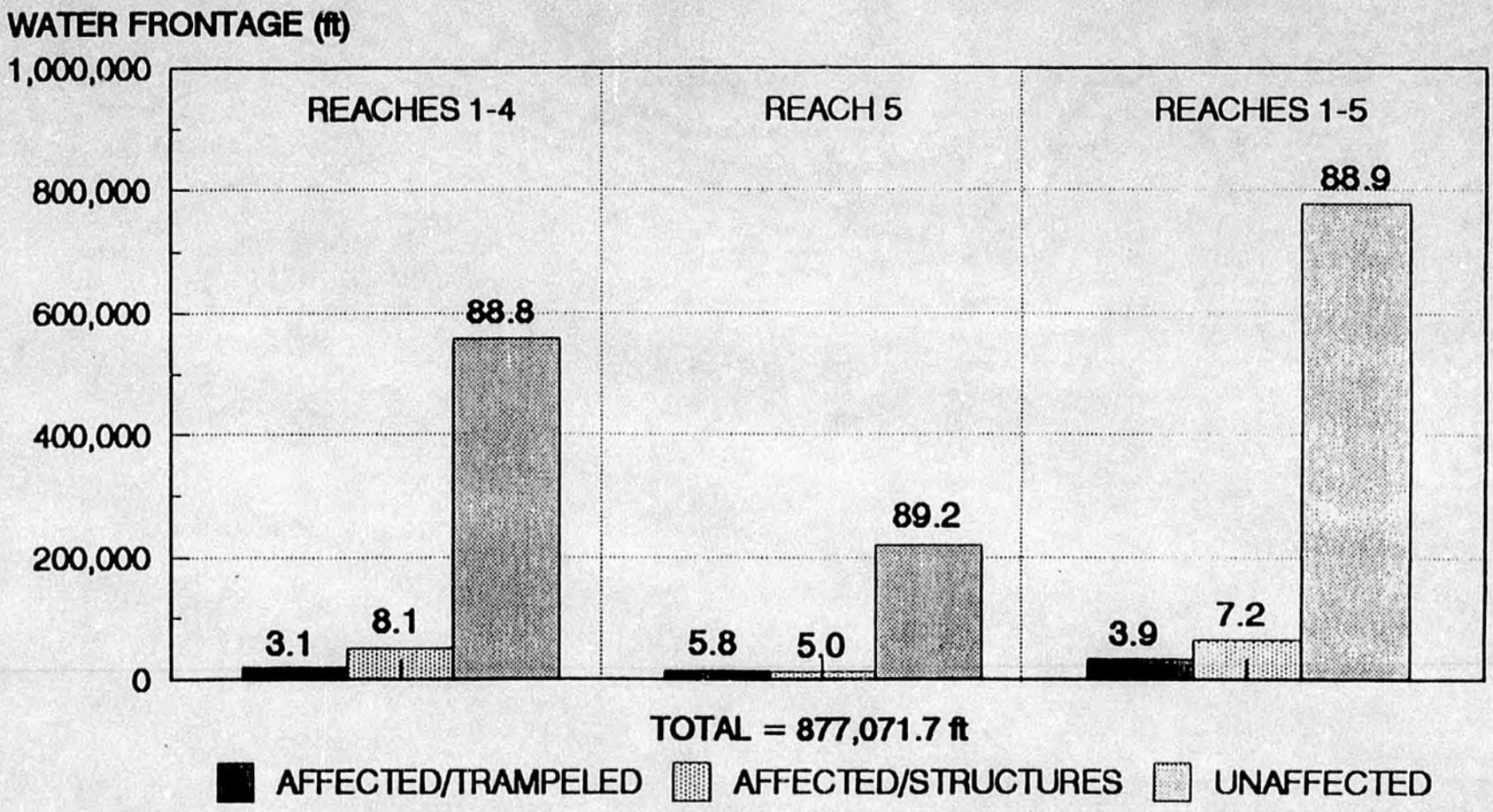


% = PERCENT OF TOTAL WATER FRONTAGE FOR THE ENTIRE RIVER MAINSTEM

ADF&G 309, 1994

FIG. 15 KENAI RIVER WATER FRONTAGE ALTERATIONS

FOR COMBINED REACHES AT ORDINARY HIGH WATER



NUMBERS ABOVE BARS REFLECT % OF TOTAL WATER FRONTAGE FOR EACH SET OF REACHES

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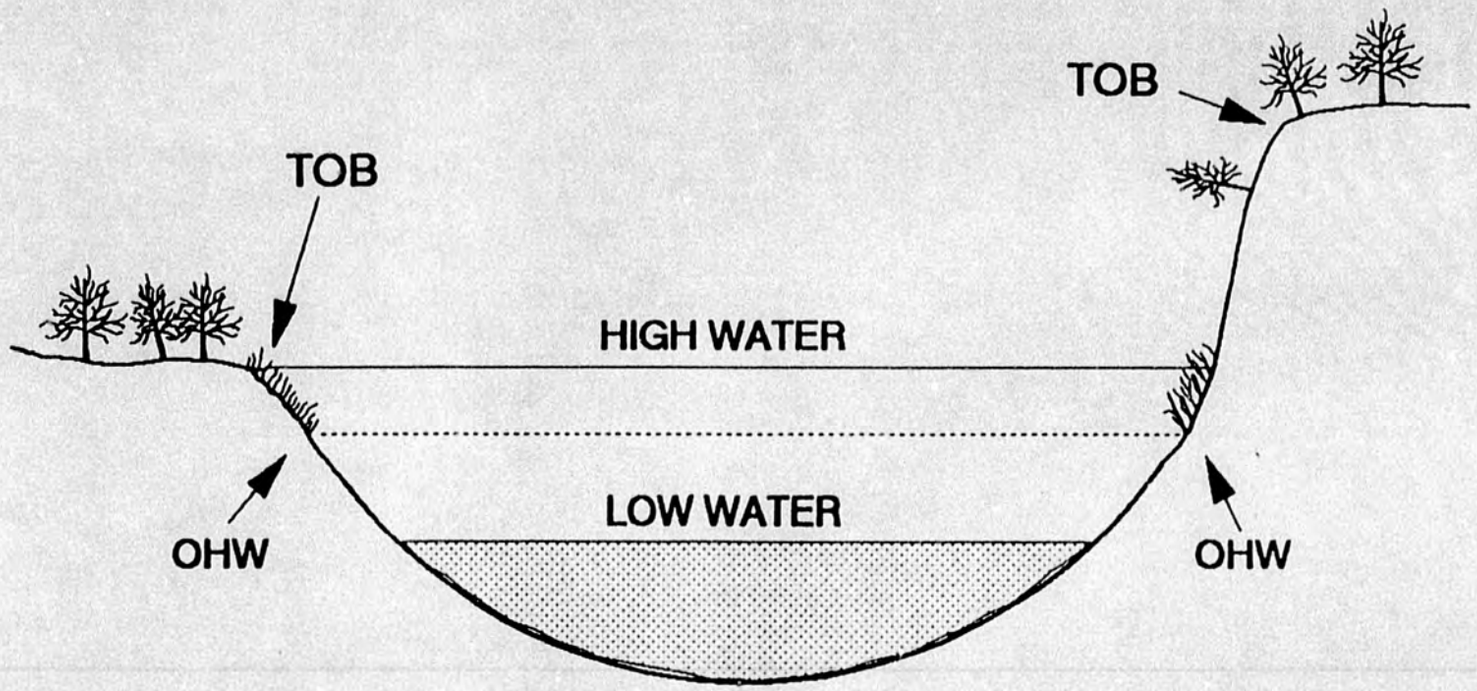
FIG. 16 WATER LEVEL AND BANK LOCATION DEFINITIONS



TOB = TOP OF BANK
OHW = ORDINARY HIGH WATER

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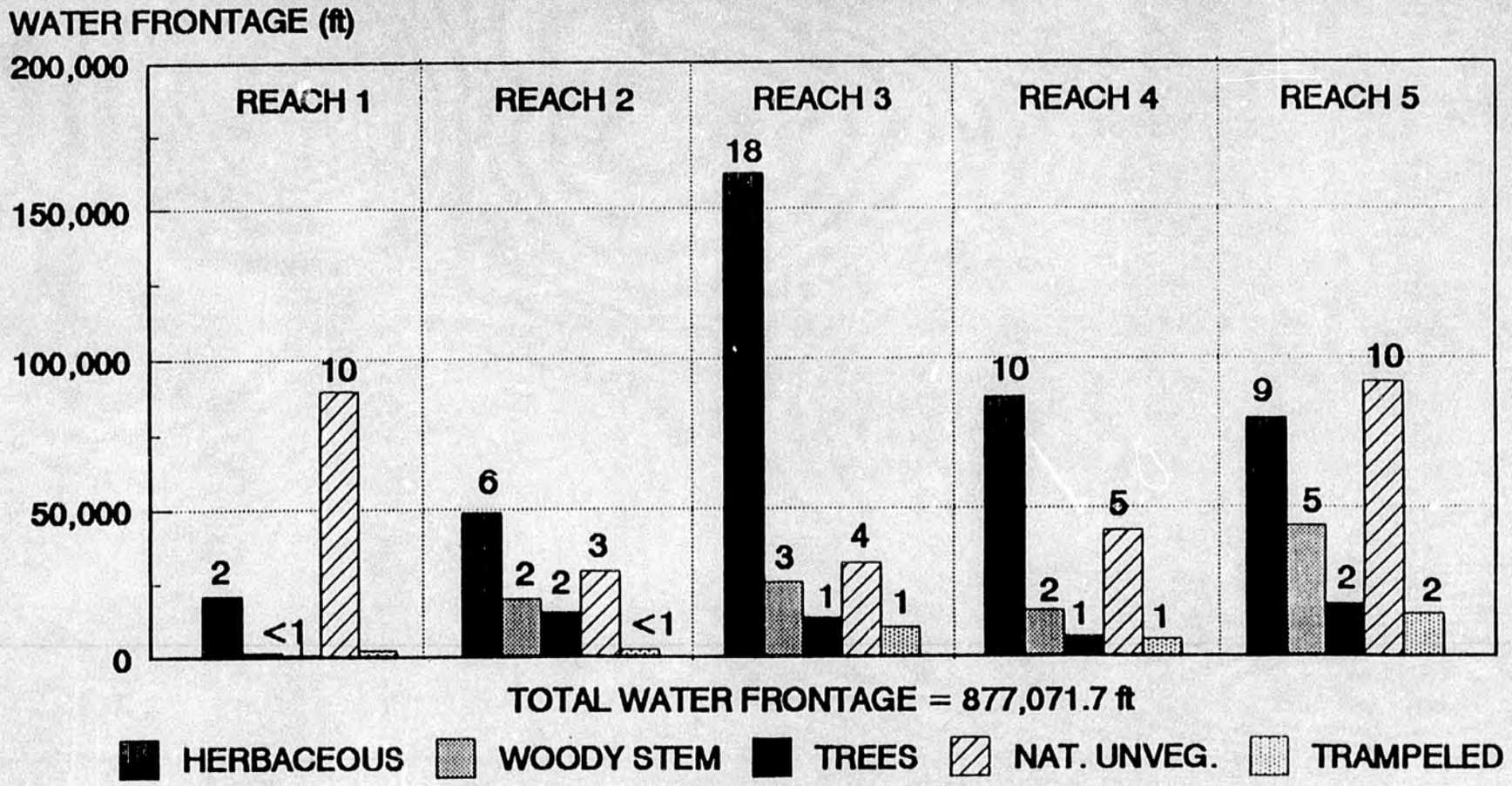
FIG. 17 KENAI RIVER BANK VEGETATION TYPES
AT ORDINARY HIGH WATER



NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

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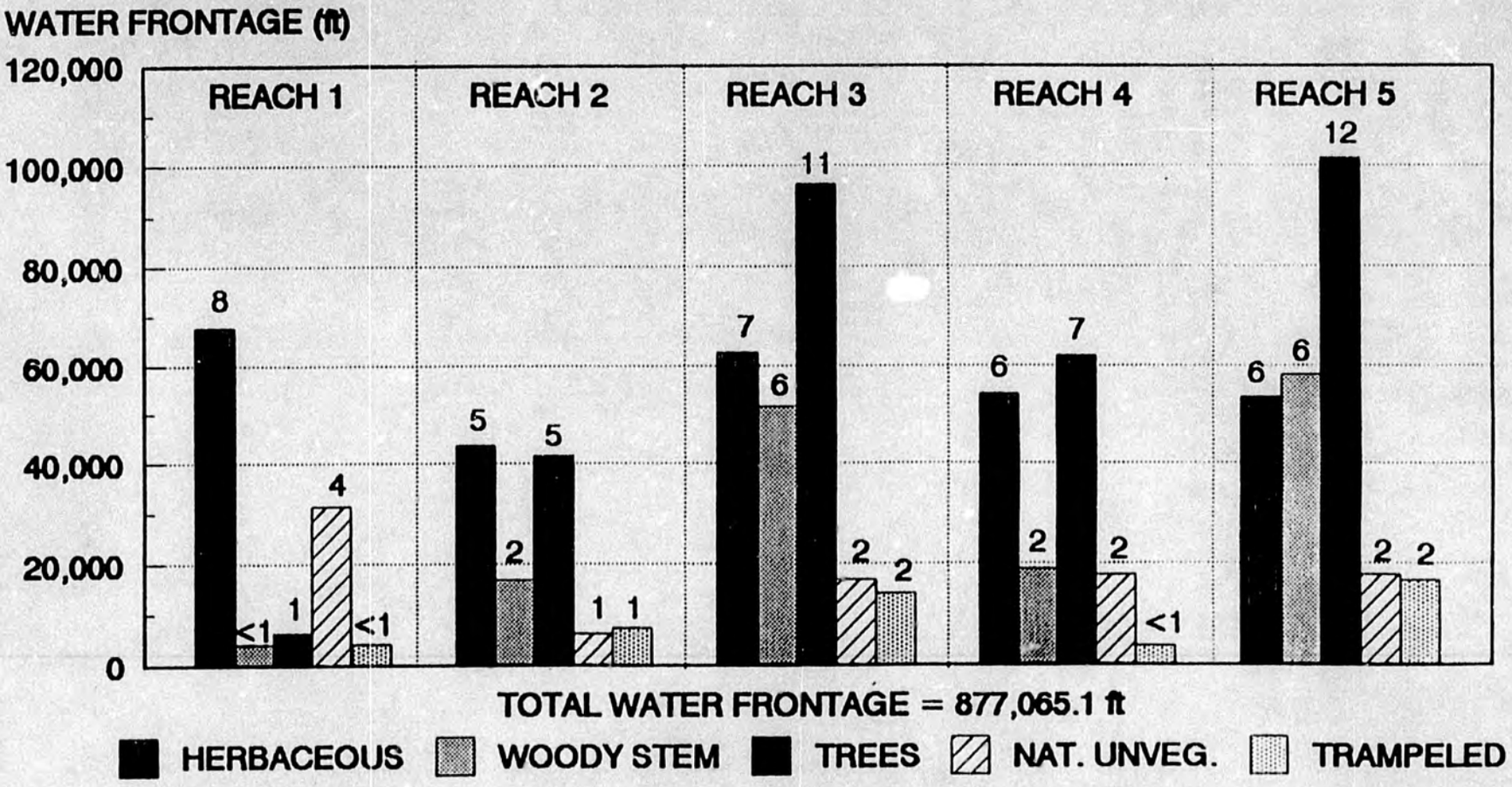
FIG. 18 KENAI RIVER BANK VEGETATION TYPES

AT TOP OF BANK



NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

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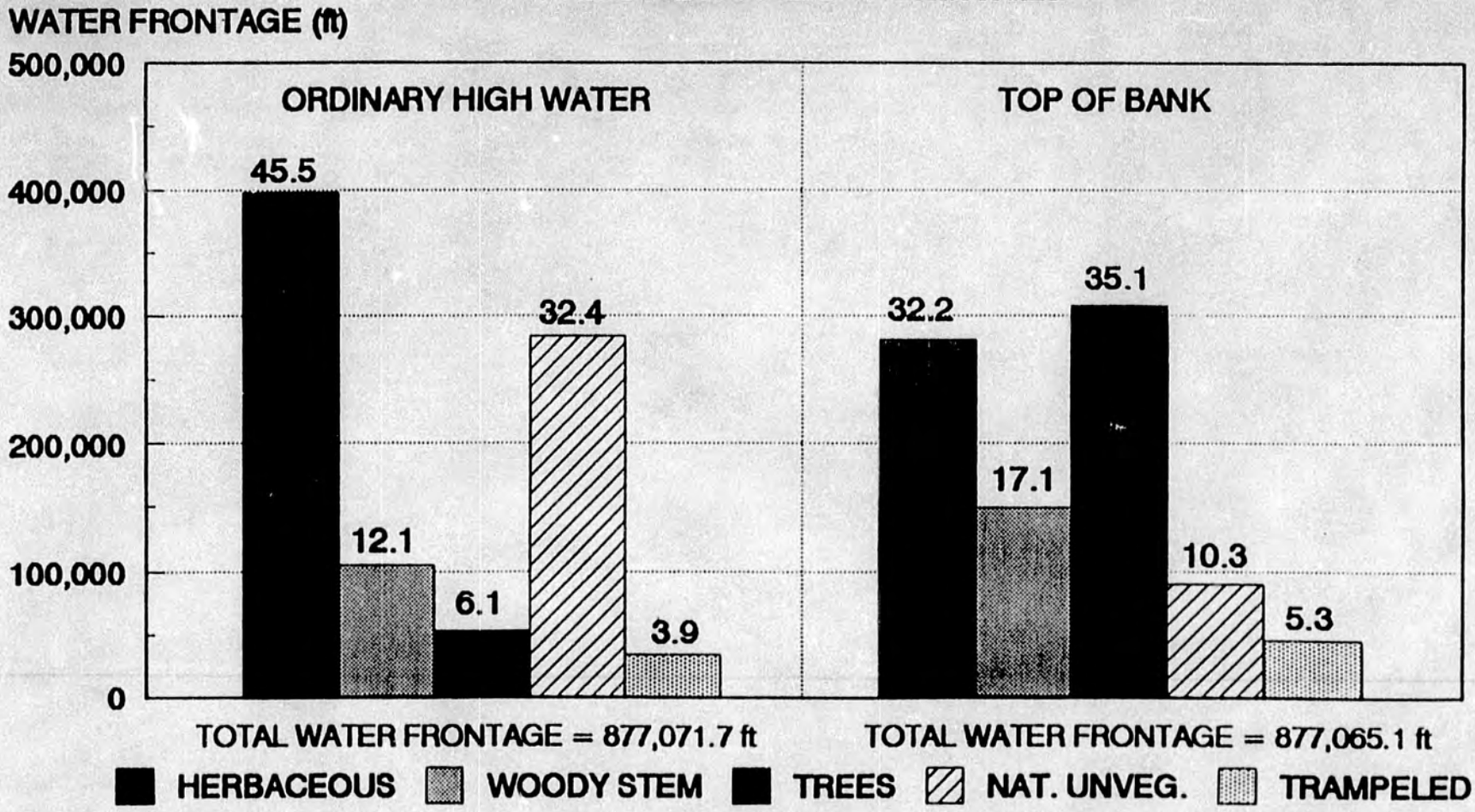
FIG. 19 KENAI RIVER BANK VEGETATION

ALL REACHES COMBINED



NUMBERS ABOVE BARS REFLECT % OF TOTAL WATER FRONTAGE FOR OHW OR TOB

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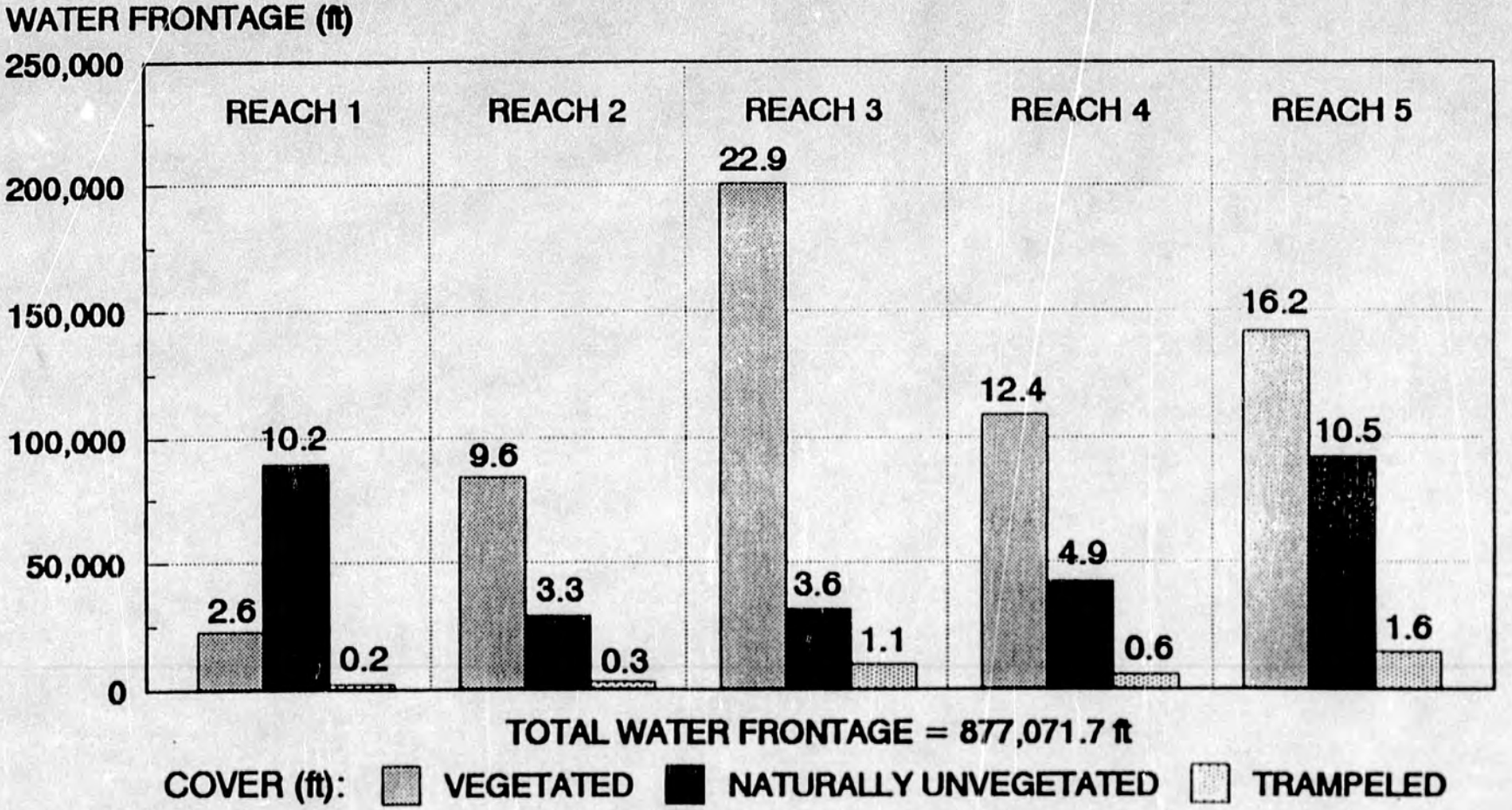
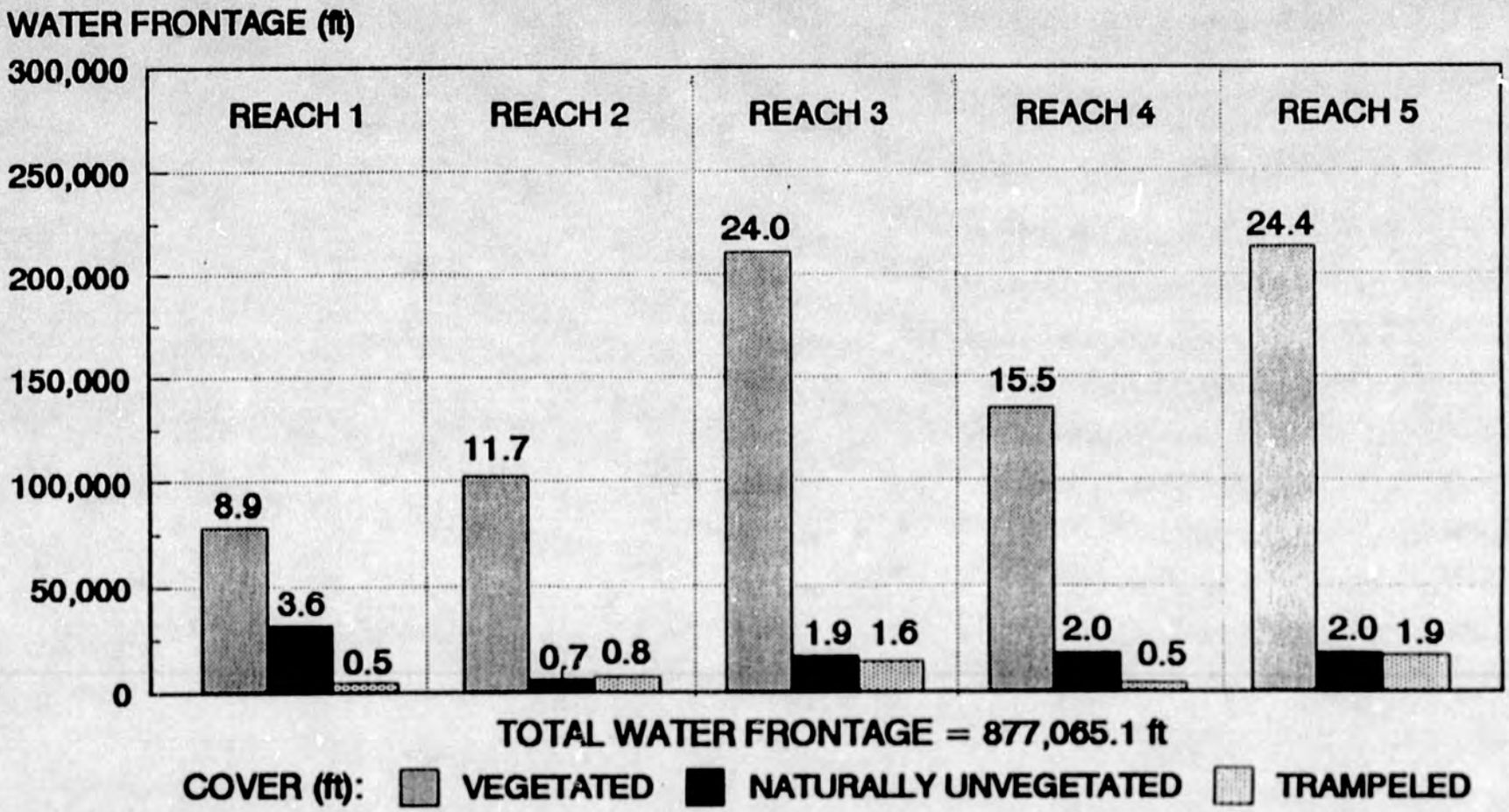
FIG. 20 KENAI RIVER BANK VEGETATION FOR ALL REACHES
AT ORDINARY HIGH WATER



NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

ADF&G 309, 1994

FIG. 21 KENAI RIVER BANK VEGETATION FOR ALL REACHES
AT TOP OF BANK



NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

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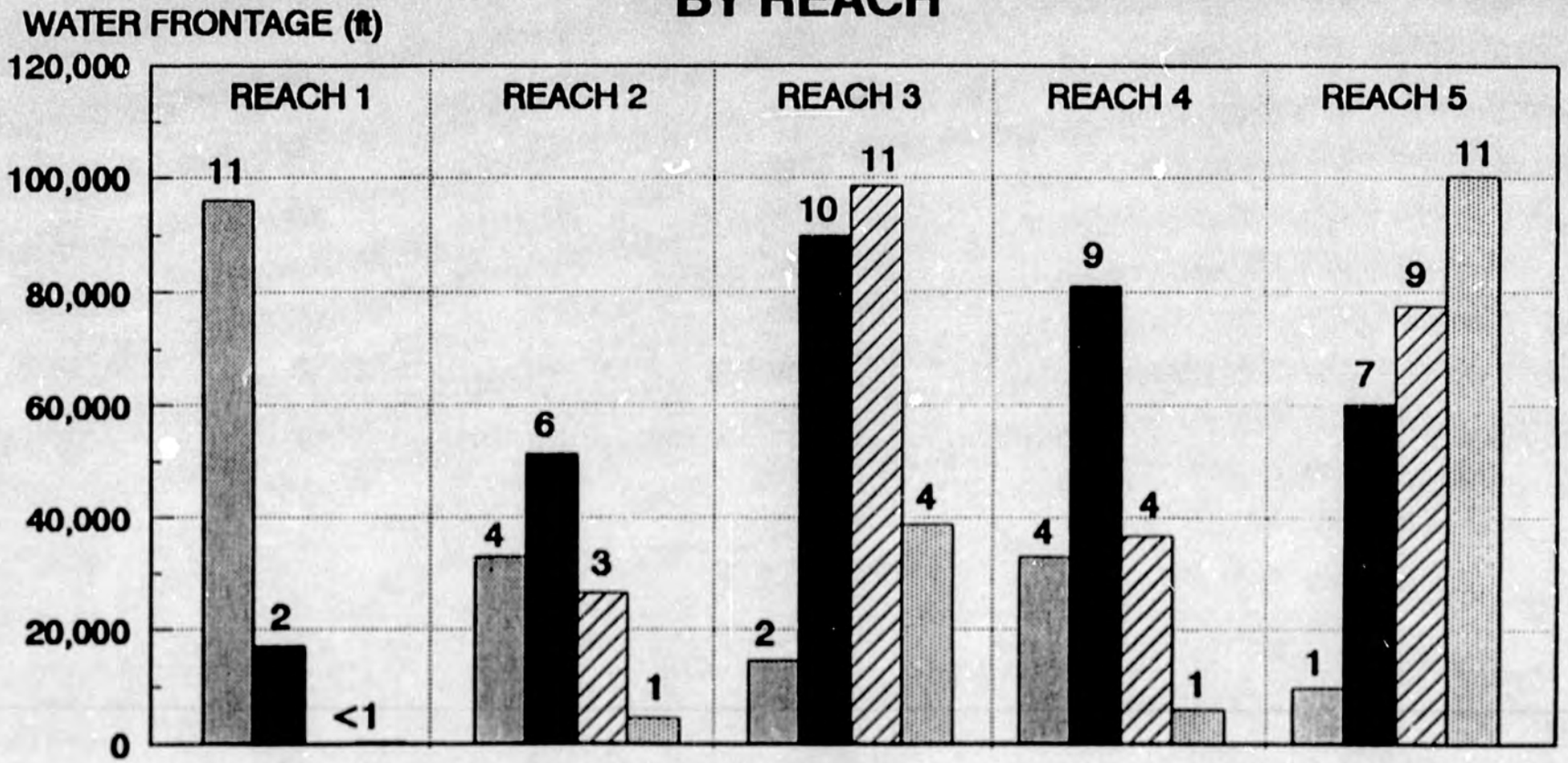
FIG. 22 KENAI RIVER NEARSHORE SUBSTRATES BY REACH



TOTAL = 877,074.2 ft

MUD/SAND/SILT (<.5 in.) GRAVEL (.5-3 in.) COBBLE (3-5 in.) RUBBLE (>5 in.)

NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

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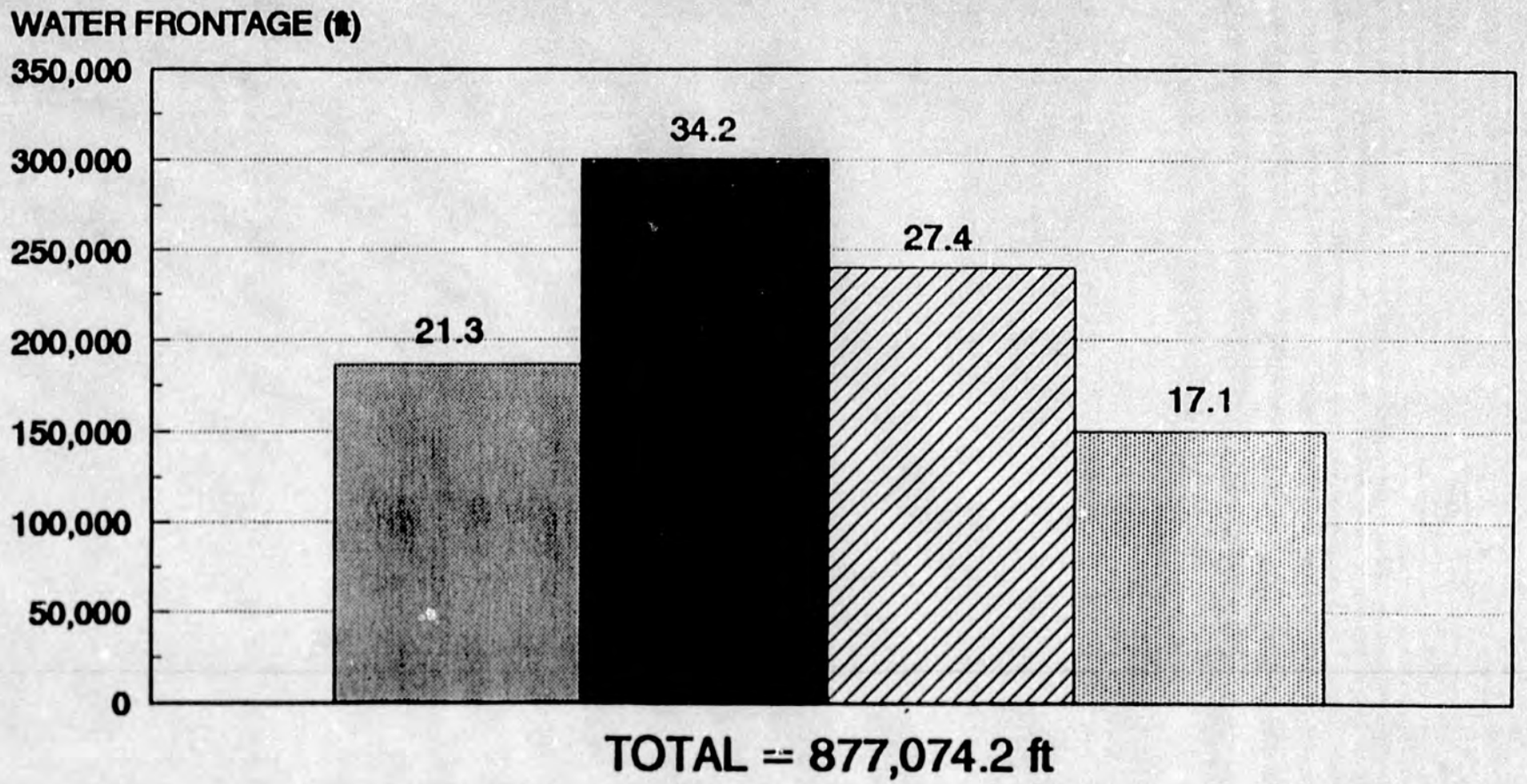
FIG. 23 KENAI RIVER NEARSHORE SUBSTRATES

ALL REACHES COMBINED



NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

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FIG. 24 KENAI RIVER FISH COVER
BY REACH

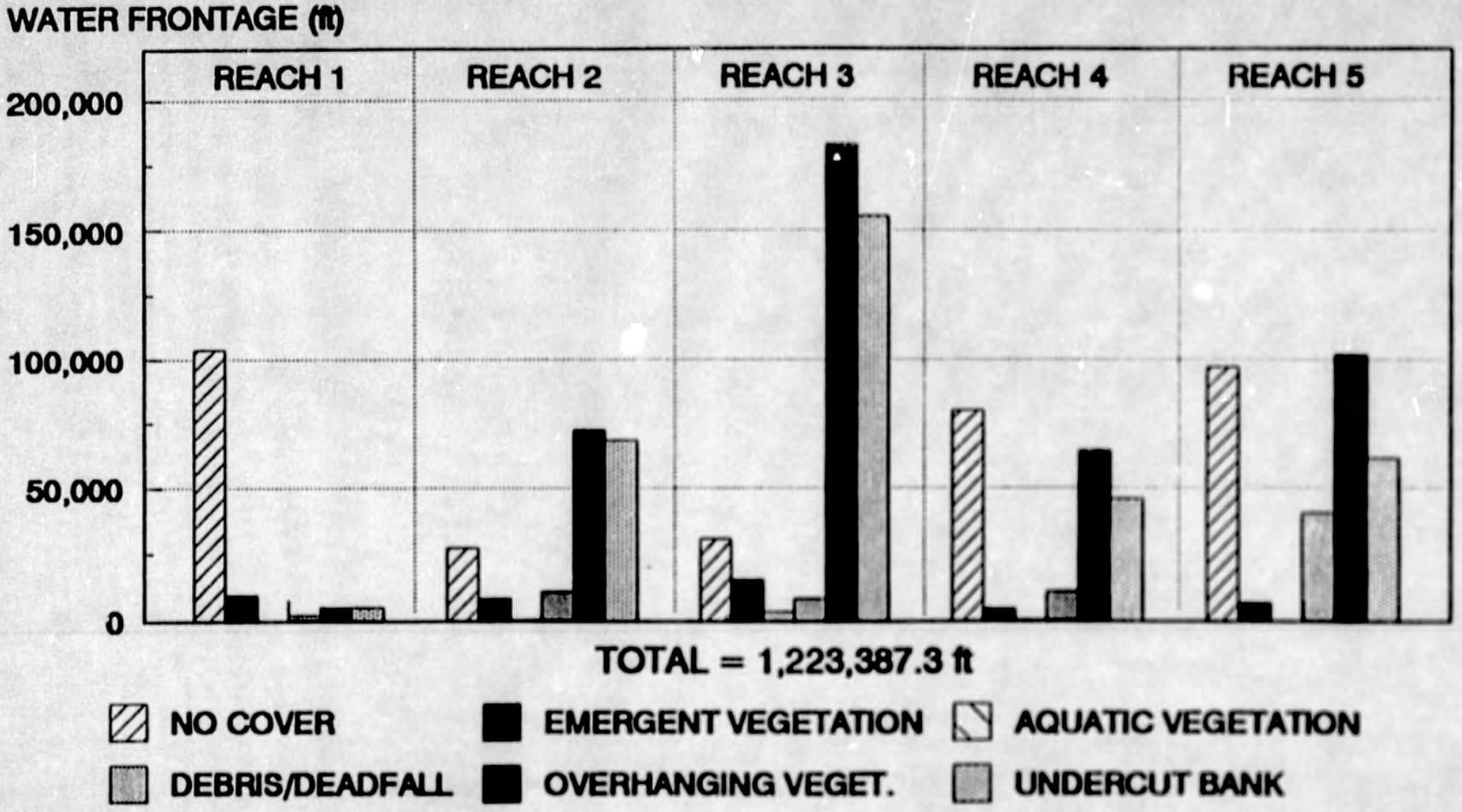

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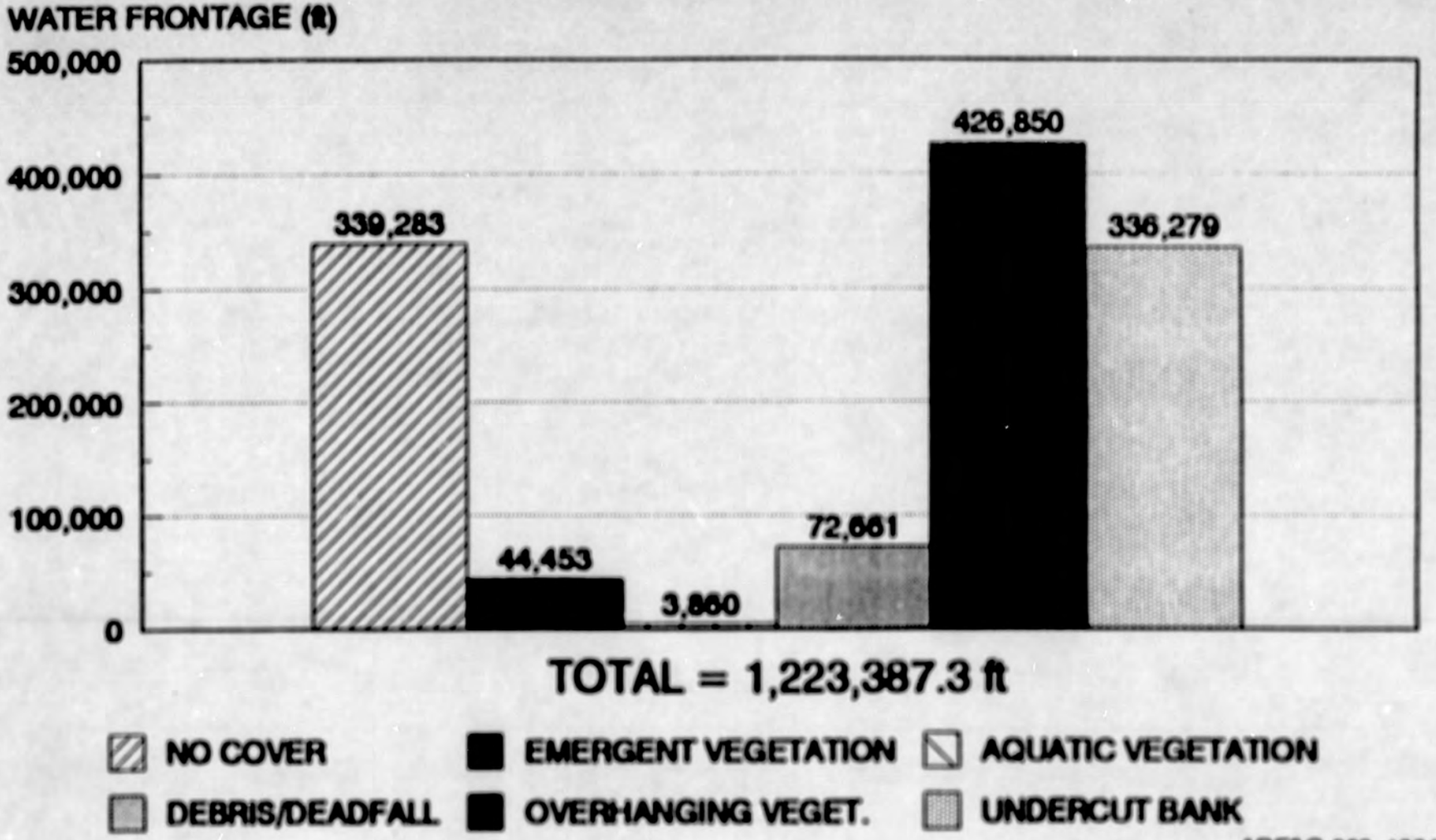
FIG. 25 KENAI RIVER FISH COVER

ALL REACHES COMBINED



ADF&G 309, 1994

HEP FORMULA

HABITAT COMPONENT (AREA) X HABITAT SUITABILITY INDEX (HSI) = HABITAT UNITS (HU's)

$$HSI = \frac{\text{SUM OF ALL HABITAT COMPONENT VARIABLES}}{\text{\# OF VARIABLES}}$$

STATE OF ALASKA
CUMULATIVE AND SECONDARY IMPACTS

Kenai River Cumulative Impacts Study:

1) Evaluation of the Effects of Structures on Physical Processes and Habitat Parameters and
2) Development of an Integrated Program for Assessment and Management

July 1994 to June 1995
$122,500

Frank Rue, Director
Habitat and Restoration Division
Alaska Department of Fish and Game
March 11, 1994

ABSTRACT: The Kenai River drainage supports the largest recreational fishery in Alaska and is a major contributor to the Cook Inlet commercial sockeye salmon fishery. In 1992, for example, the Kenai River recreational and commercial fisheries contributed over $70 million to the state economy. The nearshore waters of the Kenai River mainstem provide critical rearing habitat for over 90 percent of the Kenai River chinook salmon population. These nearshore waters and associated shorelands habitats have been substantially altered by commercial, residential, and recreation uses and activities. The public and agencies are concerned with the cumulative effects of past and future uses and activities on fish habitat. The State of Alaska initiated a study in July 1992 under the Section 309 Program as a Project of Special Merit to assess and control these impacts. By June 1994, the following will be completed: 1) a cumulative impact assessment methodology, 2) an initial impact assessment and evaluation of the assessment methodology, 3) a summary of potential non-regulatory mechanisms to control these impacts, and 4) an analysis of the socioeconomic importance of commercial and recreational fisheries to the local economy. The local coastal district will also initiate efforts to develop draft enforceable policies.

The qualitative analysis and resulting model to evaluate the effects of structures (i.e., river and riparian habitat alterations) requires substantial information on the effects of such structures on natural physical processes (e.g., erosion, sedimentation, deposition) and important habitat parameters (e.g., water velocity, substrate, cover). A comprehensive literature review by the Fish and Wildlife Service (FWS) revealed little information on the effects of structures on physical processes and habitat parameters important to fish. In the absence of this data, the Alaska Department of Fish and Game (ADF&G) cannot complete the qualitative impact assessment. This information is necessary to win public support of the specific enforceable policies necessary to effectively control cumulative impacts. In State Fiscal Year 1995 (SFY95) -- the third year of the project -- the ADF&G proposes to address this information gap and complete the qualitative assessment (Task 1). Information on the effects on physical processes and habitat parameters will be used to develop models and complete the qualitative assessment of the effects of structures on fish habitat. A joint hydrologist/biologist team will conduct the evaluation. ADF&G will make appropriate revisions to the Geographic Information System (GIS) and develop models used in the assessment.

The ADF&G, in coordination with local government, will also design an integrated approach for the continued assessment and management of cumulative impacts (Task 2). ADF&G will design and recommend an integrated approach to evaluate and improve the Kenai River cumulative impact problem statements, data, analytical tools, management approaches, and models. The project will identify authorities governing uses and activities that effect fish habitat; identify problems, needs, and priorities for future assessment and management of cumulative impacts; evaluate the applicability of ADF&G's Kenai River GIS to the integrated management approach; and identify potential funding sources for the ongoing assessment and management approach.

The primary focus of Alaska's Revised Section 309 Strategy is a proactive approach to assess, plan for, and minimize the impacts of activities on coastal resources and uses. The Kenai River is identified in the Strategy as a possible model for other coastal districts. This project should enhance other Section 309 projects related to cumulative impact issues in Alaska. The use of GIS in cumulative impact assessment, and revisions to ACMP regulations to more effectively assess and manage cumulative impacts will benefit from this SFY95 proposal.

PROJECT NARRATIVE

INTRODUCTION

The Kenai River drainage supports the largest recreational fishery in Alaska and is a major contributor to the Cook Inlet commercial sockeye salmon fishery (2.5 to 9.0 million fish annually). In 1992, the Kenai River commercial and recreational fisheries contributed an estimated $70 million to Alaska's economy. The river provides critical habitat for several species of salmon. Over two thirds of the 50 miles of the shorelands adjoining the Kenai River mainstem below Skilak Lake are privately owned (see Attachment 1 for study area map). Much of the river and adjacent shorelands on both private and public lands are developed, or will be subject to future recreational, commercial, and residential developments or uses. Biologists, land managers, and many users of the Kenai River are concerned about the cumulative impacts of past and future development and other uses on salmon rearing habitat. Rearing habitat is the primary limiting factor in the production of chinook salmon in the Kenai River system. Over 90 percent of the chinook salmon population in Kenai River drainage rear within six feet of the shoreline of the Kenai River mainstem: an estimated 67 acres of suitable habitat.

Alaska's Section 309 Assessment and Strategy emphasizes the proactive assessment and management of cumulative impacts through planning, and identifies the Kenai River as an area of concern. A comprehensive approach to an assessment and management planning process, as described by Williamson[1], involves: (1) a *scoping phase* to define the problems and select a strategy for each program; (2) an *analysis phase* to assess the problems and their causes; (3) an *interpretation phase* to develop and document options, estimate changes with models, and develop a plan and implementation approach (both regulatory and non-regulatory mechanisms); and (4) a *direction phase* to implement and incrementally approve a management plan and systematically evaluate and improve the problem statements, data, analytical tools, and models.

In SFY93, the ADF&G received Project of Special Merit (PSM) funding under Section 309 for a study to assess and control the cumulative impacts[2] of uses and activities on Kenai River fish habitat. In the first year of the project, ADF&G completed the scoping phase (defined the problem, identified the study area, and developed an assessment methodology), initiated the analysis phase (assessment of cumulative impacts), and summarized available non-regulatory mechanisms for controlling individual and cumulative impacts. Now in the second year (SFY94) of the project, ADF&G will complete the initial cumulative impact analysis based on available information, evaluate the assessment methodology and develop project approvals for activities which maintain or enhance fish habitat. The local coastal district – the Kenai Peninsula Borough (KPB) – will complete a socioeconomic analysis of the importance Kenai River chinook and sockeye salmon fisheries to the KPB economy and start the interpretation phase (initiate revisions to the enforceable policies of the local coastal management plan).

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[1] Williamson, S.C. 1993. Cumulative Impacts Assessment and Management Planning: Lessons Learned to Date. *in* Environmental Analysis: The NEPA Experience. Lewis Publishers, Ann Arbor, pp. 391-407

[2] The concept of cumulative impacts embodies a number of related but different kinds of effects: direct, indirect, secondary, additive, and synergistic (see: Riser, A. 1987. Managing the Cumulative Effects of Coastal Land Development: Can Maine Law Meet the Challenge? Maine Law Review, 39(2): 321-389). Due to funding and practical constraints, the assessment methodology will not address all these effects. The cumulative impact assessment report in SFY94 will describe the focus of the assessment methodology.

In SFY95, the state is proposing to complete efforts on the interpretation phase and design an approach for the direction phase. Through Section 306 funding, the KPB will continue efforts to review and revise the enforceable policies of the KPB Coastal Management Program (CMP) to more effectively control cumulative impacts. In the third year through Section 309 funding, the project will complete two main tasks listed below:

Task 1:

- Evaluate the effects, both upstream and downstream, of selected structures on physical processes and fish habitat parameters.
- Develop habitat evaluation models to evaluate the habitat effects of past actions, support the development of specific enforceable policies, and evaluate the effects of future actions.

Task 2:

- Design and recommend a multi-agency, integrated approach to evaluate and improve Kenai River cumulative impact problem statements, data, analytical tools, management approaches, and models.

A comprehensive management and implementation approach will require use of regulatory and non-regulatory/cooperative implementation mechanisms. Given available funding and the focus of the Section 309 program towards "program changes," the Kenai River Section 309 project has and will continue to focus on the technical cumulative impact assessment and management through regulatory means. Program changes that will result from the SFY95 project (with previous year efforts) include revisions to KPB CMP enforceable policies and additional or revised B-list projects[3]. This project will lay the foundation for the development of Memoranda of Agreement (MOAs) or Understanding (MOUs) among participating local, state, and federal governmental agencies in outyears.

Non-regulatory or cooperative conservation approaches that can be used to control cumulative impacts will be addressed under other sources of funding. In SFY94, through Environmental Protection Agency (EPA) funding, the department will 1) identify wetlands and uplands important for maintaining the health of the Kenai River watershed, 2) assess public attitudes towards Kenai River watershed protection, and 3) develop recommendations for a full range of cooperative conservation strategies for the identified uplands. ADF&G is also seeking funding from EPA in SFY95 to 1) identify additional sources of financial and human resources support to develop cooperative conservation efforts and 2) design and hold a watershed conservation conference for public education and consensus-building of cooperative watershed conservation strategies. The Section 309 assessment/policy development efforts and the EPA non-regulatory efforts are complementary. As the lead on both projects, ADF&G will ensure that projects are coordinated.

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[3] ACMP regulations provide for classification of permits and approvals based upon the potential for impact on coastal resources and uses. A "B-List" project is a type of project that includes routine activities that can be made consistent with the ACMP by imposing standard stipulations on applicable permits. In this project, we will develop project descriptions and standard conditions for permitted uses and activities that protect, restore, or enhance fish habitat.

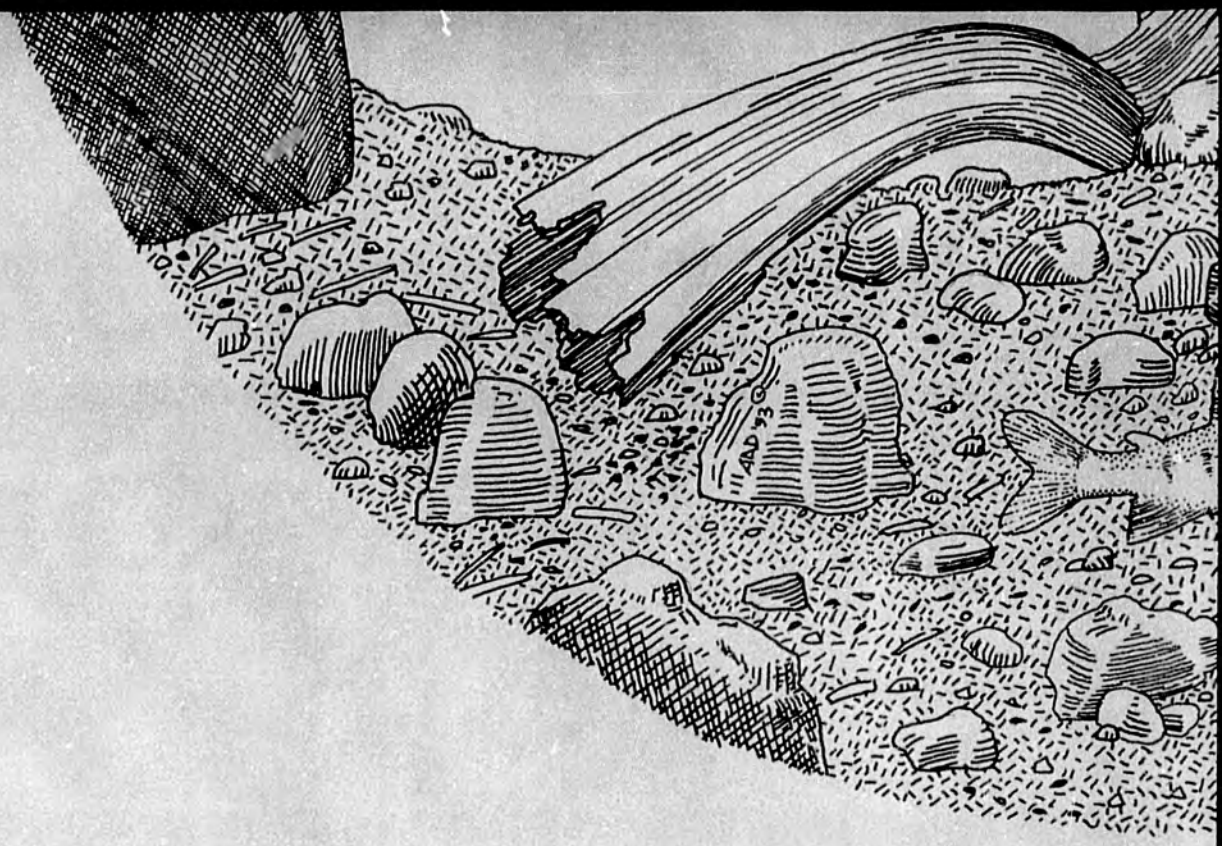
Loving A River To Death

Habitat Changes On The Kenai River

By Terry Bendock and Jon Lyman

©Russ Dixon/ADF&G

The survival of the Kenai River's world famous king salmon depends upon water flows of less than one foot per second. Although the adult fish have little trouble swimming against swift flows, the young require the reduced velocity and cover provided by naturally vegetated banks to survive. Each spring, young chinook and coho salmon migrate from upriver areas where they were hatched to the rich feeding grounds along the mainstem. Each fall they return to



Paid for by Division of Sport Fish

Produced by Public Communications Section

Flooding on Kenai, Bing's Landing, August 1984.

Users Impact on Fish Habitat

Private and commercial developments eliminate riparian vegetation. This weakens the streambank and reduces cover and food for juvenile salmon.

Land clearing increases subsurface drainage rates and streambank erosion.

Structures along the shoreline alter water velocity and decrease useable habitat for juvenile salmon.

Draining wetlands reduces subsurface flow and nutrients for juvenile salmon.

Boat wakes increase erosion along banks where the vegetation has been damaged.

Foot trails damage vegetation and root systems increasing the risk of erosion.

Removing log jams and woody debris eliminates important rearing habitat for young salmon.

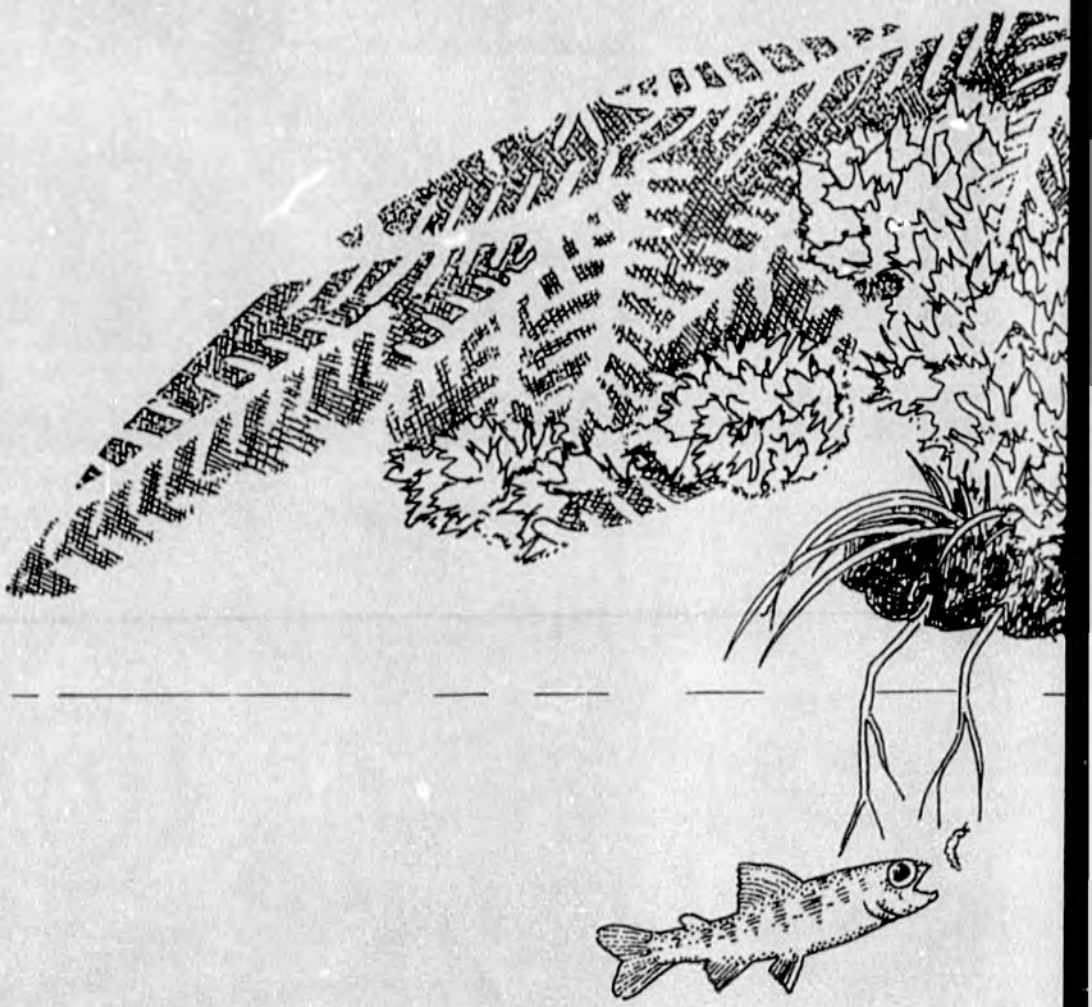
Parking riverboats along the shoreline often results in damaged vegetation and increased erosion.

Steep banks and water- saturated soils are subject to erosion and are easily damaged by **foot traffic.**

Unfiltered runoff from city and state highways and parking lots is discharged directly into the Kenai River-- lowering water quality.

overwinter in Skilak, Kenai, and other lakes. The role of streambank vegetation in modulating flow speed and providing cover is essential to the successful upriver journey of the young fish.

The Alaska Department of Fish and Game has long focused on managing the Kenai River's returning populations of adult salmon to ensure adequate numbers of spawners to reproduce the runs. Given good returns from the Pacific Ocean, management plans and modern technology assure us that sufficient salmon will survive to spawn. This, however, is only part of the picture. We must also be concerned with the young fish rearing in the river and the continuing degradation of their habitat.



Natural vegetation that overhangs the banks or trails in the water provides food for aquatic organisms which juvenile salmon eat. Natural vegetation also stabilizes banks and helps prevent erosion.

Cover is the woody vegetation along the shoreline, irregular and undercut banks, aquatic vegetation, log jams, large woody debris, rootwads, sweepers, large rocks or boulders, and the turbidity of the glacier water itself. Cover slows the speed of the river along the streambanks, creating ideal flows for young fish. Over 80 percent of the young salmon in the Kenai River can be found within 6 feet of the bank.

©Alaska State Parks

Riverbank erosion at Bing's landing, July 1992.

Anglers Can Reduce Impacts

Use developed trails, ladders, and boardwalks, when available, to access the river.

Always **launch and retrieve** boats at a developed launch site.

Select either an exposed or protected site when beaching your boat to **avoid crushing bank vegetation.**

Minimize damage from boat wakes whenever possible by **lowering speed** and traveling in mid-channel.

Fuel your boat at a site that does not discharge into the river should an accident occur.

Avoid trampling and damaging vegetation along the waters edge.

Move away from the waters edge when walking up and downstream.

Use hip boots or chest waders to avoid standing on the bank while fishing.

Avoid steep banks and water-saturated soils when bank fishing.

Remember that fish habitat **and** bank stability are often determined by the amount and quality of streamside vegetation.

Participate in local discussions on land use regulations and the need to protect fish habitat.

Tell friends and visitors of the importance of maintaining riverbanks.

Be a role model!

Anglers cannot influence most of the forces that affect the return of salmon to the Kenai River. High seas interception, harvests in mixed stock commercial fisheries, the use or misuse of private and public property along the river, natural mortality due to forces we do not understand—all have a great impact on the numbers of returning salmon. The one place where anglers can have the greatest long term impact on these fish is on the banks of the river.

Anglers and landowners need to participate in local land use planning efforts to develop public solutions to the continued degradation of river habitat. The key to maintaining the long term health of the Kenai River is the development of land use regulations to control incompatible uses along the river. While the Division of Parks and the city of Soldotna are attempting to regulate bank use on their lands, other landowners, public and private, have yet to take action to protect the habitat necessary for fish. By working with the following organizations, individuals can begin to shape the future of the river and its salmon resources. (See list of on the next page.)

Kenai River Special Management Area Advisory Board
c/o Chris Titus, Division of Parks and Recreation
Department of Natural Resources
P.O. Box 1247
Soldotna, AK 99669

In 1984 the Legislature recognized the importance of the Kenai River to all Alaskans and created the Kenai River Special Management Area. An advisory board was formed to help the Division of Parks and Recreation implement a management plan for the river. The board members represent user groups, property owners, municipalities, state and federal agencies, and other interested groups. The board continues to serve in its advisory capacity and holds monthly meetings except during the summer months.

City of Soldotna
177 North Birch
Soldotna, AK 99669

The city of Soldotna has zoned the banks of the Kenai within the city limits and has the authority to regulate land use to protect the river. The city has begun work on a Kenai River erosion control and habitat restoration demonstration project. Funded with grants from the Alaska Science and Technology Foundation and the Coastal America Program, the city is attempting to apply bioremediation technology to damaged river habitat at two city parks along the Kenai River. These sites have seen intense bank fishing which has degraded vegetation and accelerated bank erosion. The project is intended to demonstrate ways to control riverbank erosion and enhance fish habitat while continuing to allow anglers access to the river.

Kenai River Sportfishing, Inc.
c/o Ben Ellis, Executive Director
P.O. Box 1228
Soldotna, AK 99669

Kenai River Sportfishing, Inc. (KRSI) is a non-profit association dedicated to protecting the greatest salmon sport fishing in the world. The organization represents the thousands of sport anglers who fish the Kenai each year. KRSI members have long been involved with conservation measures on the river. This group launched the Kenai River Habitat Protection Program during the past year. The program awards certificates to private property owners who protect or restore fish habitat. It also works to educate the public and encourage other property owners to protect and restore river habitat.

Department of Natural Resources
Division of Parks and Outdoor Recreation
P.O. Box 1247
Soldotna, AK 99669

The Kenai River became a unit of the state parks system in 1984. The Division of Parks and Outdoor Recreation has the responsibility for providing for the public's recreation as well as for protecting and preserving the river's fish and wildlife habitats. Serious riverbank degradation has occurred as a result of intensive bank fishing at most of the public access areas along the river. Many areas are devoid of vegetation, their banks trampled into mud. The challenge is to protect the fragile riparian habitat and rehabilitate the existing sites, yet continue to provide public access.

Soil Conservation Service
P.O. Box 400
Homer, AK 99603

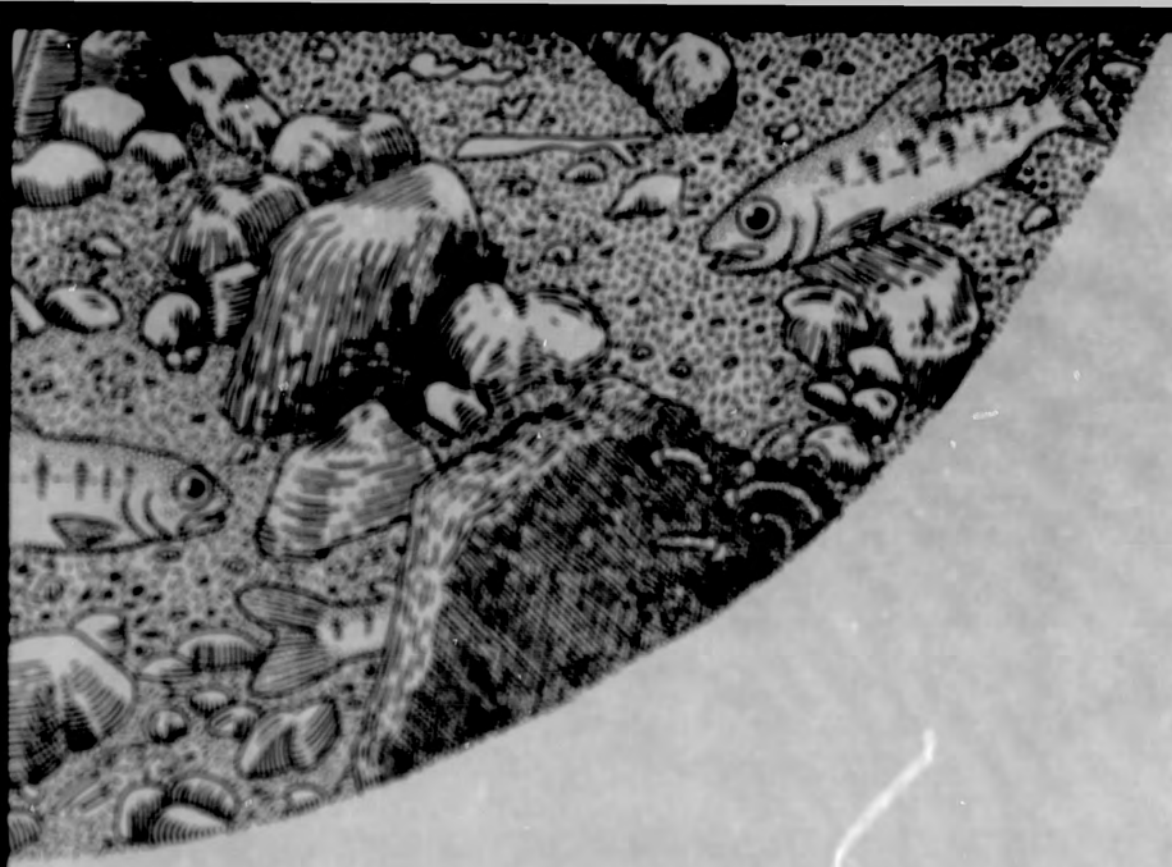
The U.S. Department of Agriculture Soil and Conservation Service has published the Kenai River Landowner's Guide. This reference guide is written to help Kenai River landowners understand and manage plants, soils, and riverbanks and to protect the Kenai River's resources. The SCS collects resource information and provides technical assistance to help both public and private land managers conserve, improve, and sustain natural resources.

Kenai River King Salmon Fund
34824 Kalifornsky Beach Rd., Suite E
Soldotna, AK 99669

The Kenai River King Salmon Fund (KRKSF) has a number of projects underway. KRKSF members are involved in the Kalifornsky Beach Elementary School's Adopt-A-Stream program for Slikok Creek, bank restoration efforts, education through local organizations and events, and the development of a display for the Kenai River Visitor Center on the river's importance and how habitat protection is crucial to its long term health.

The Alaska Department of Fish and Game
Divisions of Sport Fish and Commercial Fisheries
34828 Kalifornsky Beach Rd., Suite B
Soldotna, AK 99669 or
Habitat Division
333 Raspberry Rd.
Anchorage, AK 99518

The Alaska Department of Fish and Game has a statutory mandate to protect fisheries habitat in the Kenai River. Any persons or agency wishing to construct a project below ordinary high water must submit plans and specifications to the department and obtain a permit before proceeding.



The Alaska Department of Fish and Game encourages public interest and involvement in local land use planning efforts. We all need to help find solutions to allow for development that will not degrade Alaska's rivers for fish.

EXECUTIVE SUMMARY

AN ASSESSMENT OF THE CUMULATIVE IMPACTS OF DEVELOPMENT AND HUMAN USES ON FISH HABITAT IN THE KENAI RIVER

Technical Report No. 94-6

Prepared by:

Gary S. Liepitz
Habitat Biologist

Alaska Department of Fish and Game
Habitat and Restoration Division
333 Raspberry Road
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99518-1599

July 1994

EXECUTIVE SUMMARY

The Kenai River Cumulative Impacts Assessment of Development Impacts on Fish Habitat, was funded in part by the Alaska Coastal Management Program's (ACMP) Section 309 Enhancement Grant Program. This study was designed to identify and evaluate the cumulative impacts of development actions including public and private land use impacts on Kenai River fish habitat. The Alaska Department of Fish and Game (ADF&G) established a Technical Advisory Group (TAG) to help define the issues and identify an acceptable methodology to be used for the assessment. The TAG was composed of representatives from all state and federal resource agencies with regulatory and management responsibilities on the Kenai River. The TAG was provided a summary of the results of the ADF&G's literature search of cumulative impact methodologies. The ADF&G also recommended the TAG consider the use of the U.S. Fish and Wildlife Service's (FWS) developed Habitat Evaluation Procedures (HEP) as the process to be used for the impacts analysis portion of this study. The group concurred with this recommendation. They concurred with the ADF&G recommendation for the development of a habitat classification process for the Kenai River's fish habitats that incorporates a combination of assessment techniques including aerial photograph assessment, field inventory, and the use of a Geographic Information System (GIS) for data compilation and analysis.

Existing mapped and/or digitized data for land ownership, soils and vegetation types were obtained through the Soil Conservation Service (SCS) and the Kenai Peninsula Borough (KPB). This information was edited and stored for use in our assessment efforts on the GIS at the ADF&G's regional office in Anchorage. Information from this data set was edited and provided to the SCS for inclusion in their technical report.

Field data compilation and ground truthing of aerial photograph interpretation data was initiated during the fall 1992 low water period and was completed during the summer and fall of 1993. The field survey resulted in an inventory of existing bank and fish habitat conditions occurring along the entire 67 miles of Kenai River mainstem from the outlet of Kenai Lake to the Skilak Lake inlet and from Skilak Lake's outlet downstream to its confluence with Upper Cook Inlet near the City of Kenai. All natural and disturbed bank habitat conditions were inventoried using a field data inventory form and color photo documentation. Data collected included vegetation type and coverage at both the river's ordinary high water (OHW) mark and the top of bank, nearshore substrate composition, fish cover characteristics, and documentation (description and measurement) of all structures and bank alterations observed. Positions were confirmed using Global Position Satellite (GPS) receivers that were differentially corrected to a resolution of 10.0 feet.

The diverse habitat types occurring along the river's 67 mile length (approximately 166 miles of water frontage) provide a varying degree of habitat value to juvenile salmon. The nearshore waters of the Kenai River provide critical early life stage rearing habitat for juvenile chinook salmon during that period of the year when these fish are using this important part or the river

(this includeds the late spring, summer and early fall period). Mainstem rearing habitat within the Kenai River, which occurs primarily in a very narrow (6.0 foot wide) corridor adjacent to the river's banks, has been described in previous studies by the ADF&G and FWS. ADF&G surveys of fish rearing habitat indicates that over 80 percent of all rearing juvenile chinook are found within this corridor. The total area within this narrow corridor including both the river's upland and island shorelines amounts to a mere 121 acres. It should be noted, however, that much of this 121 acres does not constitute preferred juvenile chinook salmon rearing habitat because: a) it is a tidally influenced reach with brackish water conditions and no cover habitat or lacks an adequate food source; b) it is naturally unsuitable to rearing juvenile salmon due to high water velocities and/or a lack of cover habitat; c) alteration of natural conditions by man associated with river access have led to vegetation loss and/or bank erosion; or d) the nearshore fish habitat has been degraded as a result of bank stabilization and property protection efforts.

The field inventory and fish habitat classification analysis completed in this study has documented that 11.1 percent to 12.4 percent (18.4 to 20.6 miles) of the river's 134 miles of upland and 32 miles of island shoreline and nearshore habitats have been impacted by bank trampling, vegetation denuding, and structural development along the river's banks. The two different lengths or percentages cited above relate to the habitat impacts measured at either the OHW line or at the top of the bank. Optimum fish rearing conditions (i.e., water velocities less than 1.0 foot per second, undercut banks with overhanging vegetation, and gravel/cobble substrates) occur on only 80,440 feet (15.2 miles or 9.2 percent) of this important fish rearing corridor along the entire river length. Study results indicate that 63,299.0 feet (12.0 miles) of this corridor is currently in the developed/impacted category, amounting to approximately 8.7 acres of the total 121 acres of available juvenile rearing habitat. The sum of the impacted or altered habitats (8.7 acres) plus the lower quality habitat for rearing fish (which includes all of the Kenai River 309 Study's Reach 1 or lower 10 miles of river nearshore habitat)(15.7 acres) and the heavily trampled/denuded areas documented on the river (5.1 acres) equals 29.5 acres or 24.4 percent of the river's total nearshore habitat. This leaves a total of 91.5 acres (75.6 percent) of mainstem nearshore rearing habitat for juvenile fish of which only 11.0 acres (9.2 percent) provide their ideal rearing conditions.

The field inventory data was entered into the GIS database for tabulation and graphical analysis. The tabulated data was then used to complete a Habitat Evaluation Procedure (HEP) analysis. HEP converts both the natural and developed habitat areas into a relative value for fish habitat. HEP was developed as a tool to document the quantity and quality of available habitat for a selected fish and/or wildlife species in a given area and uses a species/habitat relationship approach to impact assessment. HEP identifies key habitat components for a species of interest (e.g., an indicator species) which are used for a comparison of existing or future habitat conditions to the optimum habitat conditions for that species.

The HEP assessment approach is based on the fundamental assumption that certain specified habitat parameters can be described numerically and ranked. This ranking allows for the comparative analysis of habitat change over time resulting from individual or multiple development projects or other habitat altering activities (e.g., public and private access, recreational uses, etc.). Comparative analysis determines the overall impact of habitat change

within a system in terms of net gain or loss of habitat units (HU's) associated with these activities.

HEP characterizes habitat quality using a Habitat Suitability Index (HSI) value. HSI's are derived from established or project-developed Suitability Indices (SI) or Curves. The HSI is a numerical value ranging from 0.0 to 1.0 and is generated from an analysis of the ability of key habitat components to supply the life requisites of the indicator species. HSI's assign a value to a species' key habitat component(s) or variables. This value represents that habitat component's relative importance to the evaluation species and is based upon what is considered optimum habitat for that species.

Overall habitat impact can be assessed by calculating the gain or loss of Habitat Units (HU's) associated with a land use or development action affecting fish habitat. Mean HSI values (the sum of all the suitability index values identified for a species' individual habitat components divided by the total number of habitat component SI's defined) are used to calculate the HU's available for the species of concern. The mean HSI values, which are calculated for the habitat conditions occurring as a result of a project or use that has changed the naturally occurring habitat characteristics, are multiplied by the area affected by the habitat altering activity. The product of this calculation defines the HU's available to the indicator species as a result of the activity. The HU's can be used for comparative analysis or an assessment of the amount of habitat gained or lost to the overall system resulting from an action or group of actions which has or will likely affect the system.

Study results indicate that there are 1,482,790 HU's currently available to juvenile chinook salmon in the Kenai River mainstem (see Table 14). These units are distributed throughout six different undeveloped shoreline habitat categories and another six developed shoreline or structures categories. These fish habitat classification categories include: ideal rearing habitat, vegetated undeveloped habitat, vegetated slightly degraded habitat, heavily degraded habitat, non-eroding gravel banks, and erosional gravel banks. The developed categories include: boat launches and access; docks, decks, and other structures; bank protection measures; bulkheads; jetties and groins; and "other development".

Of the total 877,070 feet (166.1 miles) of waterfront on the river, 813,775 feet (154.1 miles) is in a natural state and provides 1,416,783 HU's for rearing chinook salmon. There is currently another 63,299.0 feet (12.0 miles) of water frontage in some form of developed status which, while providing less favorable conditions for rearing fish than that of the natural bank, comprises another 73,189 HU's for these fish. Together they amount to 1,489,972 HU's in the Kenai River currently available for rearing juvenile chinook salmon.

By defining the area of habitat within the river's 6.0 foot corridor along the banks that is either currently developed or altered by man-made structures or that which has been severely impacted by access resulting in heavy trampling, vegetation loss, and bank instability, we have estimated that prior to the presence of these impacts, there was originally 1,523,144 HU's available to rearing juvenile chinook salmon in the Kenai River mainstem (see Table 15). The difference between this figure and the 1,489,972 HU's which currently exist is the amount of habitat lost or gained (lost in this case) to rearing fish. This amounts to 33,172 HU's or 2.2 percent of the

total Habitat Units originally available to rearing juvenile chinook salmon prior to any man induced alteration of the river's shoreline habitat.

A Development Trends Analysis was completed to provide important insight into the rate at which this habitat loss has been occurring on the Kenai River. This analysis used aerial photograph interpretation of development conditions that existed within and adjacent to the river in 1963/64 and compares those conditions to the documented development scenario observed during the 1993 Kenai River 309 field surveys. Such an analysis can be used not only to determine how much development has taken place over the last 30 years, but can also be used as an interpretive tool to extrapolate future development scenarios and estimate the level of additional impact and habitat change (loss or gain) that can be anticipated in the future.

Using the GIS system, the ADF&G developed mylar overlays of the property ownership land use patterns that correlated to the varying scales of the 1963 and 1964 aerial photo coverage of the Kenai River mainstem. This allowed for a direct visual comparison of the amount of development affecting the river shoreline and nearshore habitat over a 30 year time period. The ADF&G, with assistance from the FWS used stereo scopes to interpret the photos which allowed for a resolution of up to two feet. All manmade alterations observed through the scopes were identified and measured.

The final results indicate that over 76 percent of the modified banks and structures that were observed in the field surveys in 1993 and 94 have been introduced since 1963/64. The vast majority of these changes include the large increase in bank stabilization efforts and the construction of boat docks and groins or jetties.

All future development projects, maintenance projects, and land uses that affect the river and its shoreline will have to consider the limits of available habitat within this system, which is critical to the continued production of the Kenai's world class chinook salmon population. If we are to continue to be afforded the opportunity to harvest these fish either commercially, recreationally, or for personal use, we must avoid the continued cumulative loss of their nursery habitat.

The results of this analysis are intended to provide a basic understanding of the current condition of the nearshore fish habitat occurring on the Kenai River mainstem. This information is intended to help educate the general public of the effects of development and access-related habitat impacts that potentially affect the river's ability to continue to produce healthy runs of chinook salmon. The data will provide a basis for the ADF&G to draft Alaska Coastal Management Program project descriptions that result in the approval of sound development projects while promoting efficiency in the application of the coastal review process.

One of the primary objectives for the use of the Kenai River 309 project results has been to assist the local coastal district (KPB) in the review of their existing coastal management plan's policies. The study results are intended to be used as a tool in the district's effort to develop revised or new enforceable policies that can be implemented by the KPB as well as the existing state and federal regulatory agencies charged with Kenai River management responsibilities.

The developed database and analysis process will be used by the ADF&G and hopefully other management agencies to evaluate all future development actions using a cumulative impacts assessment approach which considers the entire Kenai River watershed rather than just the individual project and its immediate and/or local effects.

The application of the type of cumulative impact analysis completed during this study not only allows for the natural resource managers to make a decision to approve or deny an activity based upon the level of impact that would occur as a result of action, it would also allow for an comparison evaluation of alternatives to the proposed action and for the identification of mitigative measures necessary to offset or compensate for the unavoidable losses associated with the activity.

An important strength of this type of impact analysis is the ability for non-technical persons to better grasp the big picture of what an individual project or activity can do to the river system as a whole. By comparing HU changes that result from a proposed project, the degree of habitat impact can be defined. This should be a significant aid in helping individuals that proposing a certain project or activity to understand why that activity is denied or modified during the permitting process. It will also help explain to project proponents how to avoid or minimize project related impacts with a project redesign or the use of an alternative that reduces the identified impact. This assessment process can also be used as a tool to define those actions that improve the habitat quality or availability.

The Kenai River Cumulative Impact Assessment process can be readily used by inexperienced personnel with a minimum of training in the application of the HEP procedures and the existing software systems developed by the FWS.

With regard to the application of this cumulative impact assessment process to other similar riverine systems, it is extremely applicable. Other drainages would likely be less time consuming to evaluate in as much as the development pressure in these drainages is much less than that which has already occurred in the Kenai River and they have not been subdivided into as many small (100 foot) parcels as the Kenai River's riparian areas. Even so, the ability of aerial photograph and videography resolution can allow for detailed habitat classification of these small parcel sizes.

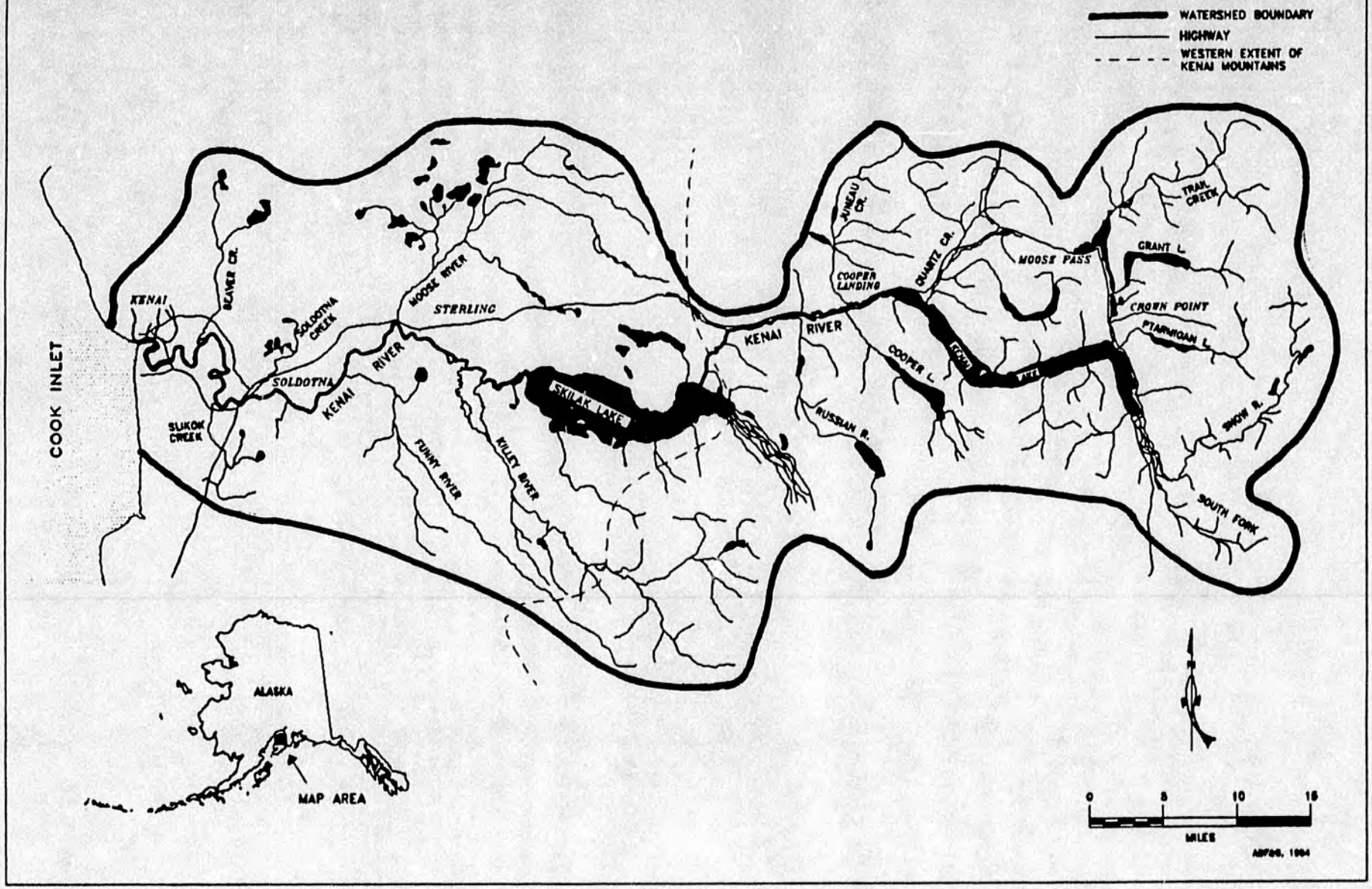
One of the benefits to the impact assessment approach used in this study is that it is a habitat based assessment which evaluates the actual or potential end result of an action as it affects the pre-existing habitat condition(s) which can occur as the result of the initial or primary activity or a spin-off effect such as a secondary impact affect. It can also effectively quantify the cumulative impact of multiple actions affecting a specific system. For example, this methodology can be used to quantify the effects of the construction of a boat launch at a given site based upon pre-project conditions. It can also quantify the effects of secondary uses such as habitat alterations in the vicinity of the project associated with the other uses that may occur as result of the initial project or action such as bank trampling associated with fisherman access provided by the launch installation. It can also assess habitat change related to bank scour or erosion (or lack thereof) associated with mooring boats either temporarily or long term and

depending on the measures taken to either protect or not protect the bank associated with the launch and the effects of accessing the moored boats.

The HEP analysis, which is a substantial part of this cumulative impact assessment methodology, has been developed with a variety of species specific suitability curves including avian, mammal and fish species, that can be used to quantify habitat loss related, not only to aquatic habitats but to wetland habitats as well. The Kenai River Cumulative Impact Assessment approach would certainly be applicable to evaluating the effects of cumulative impacts on wetland habitats within and outside of Alaska.

In reviewing the development and application of this impact assessment methodology, I would recommend that, for large scale drainage basin applications at least, a joint agency approach be used especially to accomplish the field survey and ground-truthing portion of this assessment process. This can help reduce costs to any one agency or group completing the assessment and lends credibility to the overall study results through the benefits of interagency cooperation and the sharing of technical and local biological expertise.

Kenai River Watershed



APPENDIX A

TABLES

TABLE 1

FISH COVER TYPES AND SUBSTRATE CATEGORIES WITHIN THE KENAI RIVER

COVER AND SUBSTRATE TYPE	CODE
COVER TYPE	
No Object Cover	COV-NC
Emergent Vegetation	COV-EV
Aquatic Vegetation	COV-AV
Debris or Deadfall	COV-DD
Overhanging Riparian Vegetation	COV-OV
Undercut Banks	COV-UB
SUBSTRATE CATEGORIES	
Mud, Silt or Sand (0" to 0.25")	SUB_M
Gravel (0.25" to 3" diameter)	SUB_G
Cobble (3" to 5" diameter)	SUB_C
Rubble (5" or greater in diameter)	SUB_R

TABLE 2
(Code Key)

PROPERTY OWNERSHIP CODE DEFINITIONS

CODE	LAND OWNERSHIP
RSU	Residential, Undeveloped
RSD	Residential, Developed
COU	Commercial, Undeveloped
COD	Commercial, Developed
FBU	Federal Bureau of Land Management, Undeveloped
FBD	Federal Bureau of Land Management, Developed
FSU	Federal Forest Service Lands, Undeveloped
FSD	Federal Forest Service Lands, Developed
FWU	Federal Fish and Wildlife Service, Undeveloped
FWD	Federal Fish and Wildlife Service, Developed
SPU	State Parks and Outdoor Recreation, Undeveloped
SPD	State Parks and Outdoor Recreation, Developed
SOU	State Division of Lands, Undeveloped
SOD	State Division of Lands, Developed
NCU	Native Land, CIRI, Undeveloped
NCD	Native Land, CIRI, Developed
NSU	Native Land, Salamatof Corp., Undeveloped
NSD	Native Land, Salamatof Corp., Developed
KBU	Kenai Peninsula Borough, Undeveloped
KBD	Kenai Peninsula Borough, Developed
CSU	City of Soldotna, Undeveloped
CSD	City of Soldotna, Developed
CKU	City of Kenai, Undeveloped
CKD	City of Kenai, Developed
UAU	Univeresity of Alaska, Undeveloped
UAD	University of Alaska, Developed
OTH	Other (Church of Kenai)

TABLE 2

LAND OWNERSHIP, DEVELOPMENT STATUS AND WATERFRONTAGES BY STUDY REACH

OWNER CODE	STUDY REACH 1			STUDY REACH 2			STUDY REACH 3		
	OWNER COUNT	WATER FRONTAGE	% OF ZONE	OWNER COUNT	WATER FRONTAGE	% OF ZONE	OWNER COUNT	WATER FRONTAGE	% OF ZONE
CKD	6	3302.8	2.9	0	0	0	0	0	0
CKU	17	64526.9	56.6	2	4980.3	4.3	0	0	0
COD	8	5129.6	4.5	24	13261.1	11.5	30	8230.2	3.4
COU	0	0	0	0	0	0	6	3199.6	1.3
CSD	0	0	0	0	0	0	4	5909.5	2.4
CSU	0	0	0	0	0	0	12	10980.6	4.5
FBD	0	0	0	0	0	0	0	0	0
FBU	0	0	0	0	0	0	0	0	0
FSD	0	0	0	0	0	0	0	0	0
FSU	0	0	0	0	0	0	0	0	0
FWD	0	0	0	0	0	0	0	0	0
FWU	0	0	0	0	0	0	0	0	0
KBD	0	0	0	0	0	0	0	0	0
KBU	0	0	0	2	68.0	0.1	3	2996.2	1.2
NCU	0	0	0	3	3725.0	3.2	1	6262.1	2.6
NSD	0	0	0	0	0	0	4	1022.6	0.4
NSU	0	0	0	0	0	0	52	27949.7	11.5
OTH	1	140.0	0.1	0	0	0	0	0	0
RSD	35	7851.0	6.9	91	14613.0	12.6	397	67571.6	27.9
RSU	59	14215.0	12.5	84	17166.3	14.8	432	72543.1	30.1
SOD	0	0	0	0	0	0	4	2455.1	1.0
SOU	1	3731.1	3.2	22	40905.9	35.3	10	10190.0	4.2
SPD	0	0	0	2	2175.0	1.9	7	15,129.9	6.3
SPU	4	15093.9	13.3	5	18801.0	16.3	3	6321.6	2.5
UAU	0	0	0	0	0	0	1	1350.0	0.7
TOTAL	132	113,990.3	101.0	232	115,695.6	100.0	966	242,111.9	100.0

TABLE 2 (Continued)

LAND OWNERSHIP, DEVELOPMENT STATUS AND WATER FRONTAGE BY STUDY REACH

OWNER CODE	STUDY REACH 4			STUDY REACH 5			TOTAL KENAI RIVER		
	OWNER COUNT	WATER FRONTAGE	% OF REACH	OWNER COUNT	WATER FRONTAGE	% OF REACH	OWNER COUNT	WATER FRONTAGE	% OF TOTAL
CKD	0	0	0	0	0	0	6	3302.8	0.4
CKU	0	0	0	1	746.1	0.3	22	71753.3	8.2
COD	4	624.4	0.4	5	3298.2	1.3	72	32118.5	3.7
COU	0	0	0	0	0	0	6	3199.6	0.4
CSD	0	0	0	0	0	0	4	5909.5	0.8
CSU	0	0	0	0	0	0	12	10980.6	1.3
FBD	0	0	0	1	2917.3	1.2	1	2917.3	0.3
FBU	0	0	0	1	1265.8	0.5	1	1265.8	0.1
FSD	0	0	0	3	15170.6	6.1	3	15170.6	1.7
FSU	0	0	0	8	36065.3	14.5	8	36065.3	4.1
FWD	9	910.0	0.6	3	10299.9	4.2	12	11209.9	1.3
FWU	21	60863.7	38.7	24	141587.1	57.1	45	202450.8	23.1
KBD	0	0	0	1	450.6	0.2	1	450.6	0.1
KBU	2	330.5	0.2	1	148.8	0.1	8	3543.5	0.4
NCU	36	29072.2	18.5	0	0	0	40	39059.3	4.4
NSD	0	0	0	0	0	0	4	1022.6	0.1
NSU	0	0	0	0	0	0	52	27949.7	3.2
OTH	0	0	0	0	0	0	1	140.0	0.1
RSD	136	28208.4	18.0	40	7704.6	3.1	699	125948.6	14.3
RSU	69	13420.9	8.5	13	1672.4	0.7	657	119017.7	13.5
SOD	27	6909.3	4.4	12	11126.7	4.5	46	23782.2	2.6
SOU	27	7572.3	4.8	13	15690.4	6.2	85	119928.1	13.6
SPD	0	0	0	0	0	0	5	7158.8	0.8
SPU	23	9220.9	5.9	0	0	0	19	11379.1	1.3
UAU	0	0	0	0	0	0	1	1350.0	0.2
TOTAL	354	157,132.6	100.0	126	248,143.8	100.0	1,810	877,074.2	100.0

TABLES 3-7
(Code Key)

KENAI RIVER STRUCTURES DATABASE CODES

Structure Code	Structure Activity
Buoys - B	
BMO	Mooring
BSN	Set Net
BNM	Navigation or Marker
Docks - D	
DPP	Public Permanent Pile Supported
DTP	Public Temporary Pile Supported
DPF	Public Permanent Floating
DTF	Public Temporary Floating
DCP	Commercial Permanent Pile Supported
DCT	Commercial Temporary Pile Supported
DCF	Commercial Permanent Floating
DCS	Commercial Seasonal Floating
DIP	Private/Individual Permanent Pile Supported
DIT	Private/Individual Temporary Pile Supported
DIF	Private/Individual Permanent Floating
DIS	Private Individual Temporary Seasonal Floating
DCL	Dock, Cantilevered
DOT	Dock, Other (describe)
CST	Dock, Cantilevered
Piling - P	
PSS	Piling Structure/Pile Supported Structure
PSD	Pile Supported Deck
PSB	Pile Supported Boat House
PDW	Pile Supported Boardwalk
SDL	Piling, Mooring/Dolphin
Launches - L	
LPI	Public Improved Boat Launch
LPU	Public Unimproved Boat Launch
LCI	Commercial Improved Boat Launch
LCU	Commercial Unimproved Boat Launch
LII	PVT/Individual Improved Boat Launch
LIU	PVT/Individual Unimproved Boat Launch
CMP	Campsite Bank Damage
CNL	Canals
VSC	Vessel Bank Scour/Scars
VSP	Vessel Slips
VSN	Vessel Basins
LDR	Bank Ladder/Stairway

Structure Code	Structure Activity
Outfalls - O	
OSW	Stormwater Outfall
OSA	Sewer Outfall
OSP	Seafood Processing Waste Outfall
OFT	Fish Cleaning Table Outfall
Bank Stabilization - S	
SLG	Logs
STB	Timbers
SCT	Cabled Trees
SCR	Concrete Rubble
SSP	Steel Piling
SLM	Leveling Mat
SCB	Concrete Block
SRM	Rock Mortar
SPE	Pipe
SCF	Chain Link Fence
STR	Tires
SWC	Gabions
SGB	Gabions
SRR	Rock Rip Rap
SBE	Soil Bioengineering
SOT	Other (Describe)
BRL	Barrels/55 Gallon Drums
BRG	Bridge/Right-of-Way
BDW	Boardwalk
Fuel - F	
FSU	Seasonal Use Only Fuel
FYR	Year Around Use Fuel
FVS	Fish/wheel Site
SEF	Sewer Facility
WLF	Wetlands Fill
UFL	Uplands Fill
Mining - M	
MRD	Recreational Placer Mining, Dredging
MCD	Commercial Placer Mining, Dredging
MCP	Commercial Placer Mining, Other Means
RMP	Subsistence Access Ramp/Catwalk
OTH	Other (Describe)
ITY	Intake/Drains

TABLE 8

DEVELOPMENT/ACCESS STRUCTURES INVENTORY BY STUDY REACH

TOTAL FOR ALL FIVE STUDY REACHES

RIVER MILE 0.0 - 52.0

[illegible]

STUDY REACH #	STRUCTURE COUNT	% OF TOTAL STRUCTURES	TOTAL LENGTHS (FEET)	TOTAL WIDTHS (FEET)	TOTAL AREA COVERED BY ALL STRUCTURES (SQ. FT.)	% OF TOTAL AREA COVERED
1	163	8.7	9,744	7,319	487,788	30.8
2	441	23.6	11,761	6,379	194,733	10.8
3	811	43.4	18,687	11,898	403,838	34.8
4	340	18.1	10,438	4,367	97,373	6.4
5	109	5.8	12,489	2,481	394,740	33.8
TOTAL	1,869	100.0	63,299	32,919	1,887,193	100.0

TABLE 9

PERCENTAGE OF TOTAL WATERFRONT AFFECTED BY

STRUCTURES AND/OR BANK TRAMPLING

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	
					[illegible]	[illegible]	[illegible]	[illegible]
[illegible]								
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 10

TRAMPLED VERSUS NATURALLY NON-VEGETATED RIVERBANK

AT ORDINARY HIGH WATER AND TOP OF RIVER BANK

STUDY BEACH #	RIVER BANK SITE	BEACH WATER-FRONTAGE (FEET)	TOTAL NO VEG. COVER (FEET)	NATURAL NO VEG. COVER (FEET)	% OF TOTAL NO VEG. COVER	% BEACH WATER FRONT	TRAMPLED NO VEG. COVER (FEET)	% OF TOTAL NO VEG. COVER	% OF BEACH WATER FRONT
1	OHW	[illegible]	[illegible]	[illegible]	97.68	78.79	2131.7	2.33	1.87
1	TOB	[illegible]	[illegible]	[illegible]	88.16	27.57	4233.2	11.64	3.79
2	OHW	[illegible]	[illegible]	[illegible]	89.28	24.47	3420.0	10.68	2.96
2	TOB	[illegible]	[illegible]	[illegible]	43.48	5.84	7584.9	56.72	6.56
3	OHW	[illegible]	[illegible]	[illegible]	88.48	13.79	8896.8	19.52	3.34
3	TOB	[illegible]	[illegible]	[illegible]	68.12	7.69	12302.7	39.88	5.10
4	OHW	[illegible]	[illegible]	[illegible]	88.14	26.97	9782.2	11.86	3.63
4	TOB	[illegible]	[illegible]	[illegible]	78.19	18.79	4727.7	21.81	3.84
5	OHW	[illegible]	[illegible]	[illegible]	88.40	34.59	11234.7	11.58	4.53
5	TOB	[illegible]	[illegible]	[illegible]	51.22	3.32	7620.3	48.78	3.88
[illegible]	OHW	[illegible]	[illegible]	[illegible]	88.12	31.82	38992.4	9.88	3.49
[illegible]	TOB	[illegible]	[illegible]	[illegible]	48.94	9.19	36318.8	31.86	4.34

TABLE 11

VEGETATION TYPES BY STUDY REACH AT ORDINARY HIGH WATER AND TOP OF RIVER BANK

STUDY REACH #	RIVER BANK SITE	HERB-ACEOUS COVER	% TOTAL REACH COVER	WOODY COVER (FEET)	% TOTAL REACH COVER	TREE COVER (FEET)	% TOTAL REACH COVER	NO VEG. NO COVER	% TOTAL REACH COVER	TOTAL COVER (FEET)
1	OHW	20667.2	18.13	1236.9	1.08	709.8	0.63	91376.4	80.16	113990.3
1	TOB	67820.8	59.49	4095.6	3.59	6480.5	5.69	35593.6	31.23	113990.5
2	OHW	49116.8	42.45	19669.4	17.01	15171.0	13.11	31737.1	27.43	115694.3
2	TOB	43610.1	37.68	16990.9	14.69	41682.3	36.03	13419.0	11.60	115702.3
3	OHW	162008.0	66.90	25369.1	10.47	13248.4	5.48	41483.6	17.13	242109.1
3	TOB	62892.4	25.98	51676.0	21.35	96533.8	39.89	30990.8	12.80	242093.0
4	OHW	87175.2	55.47	15300.4	9.74	6582.6	4.19	48076.2	30.60	157134.4
4	TOB	54430.7	34.64	18935.5	12.05	62089.7	39.51	21678.6	13.80	157134.5
5	OHW	79729.5	32.13	44109.5	17.78	17905.3	7.22	106399.3	42.89	248143.6
5	TOB	53657.0	21.62	58272.9	23.48	101714.0	40.99	34500.9	13.90	248144.8
TOTAL	OHW	398696.7	45.46	105685.3	12.05	53617.1	6.11	319072.6	36.38	877071.7
TOTAL	TOB	282411.0	32.20	149970.9	17.10	308500.3	35.17	136182.9	15.53	877065.1

TABLE 12

SUBSTRATE TYPES LISTED BY STUDY REACH

(Measured in Feet)

STUDY REACH #	SUBSTRATE TYPE									
	MUD, SILT SAND	%	GRAVEL (1 - 3")	%	COBBLE (3 - 5")	%	BUBBLE (> 5")	%	TOTAL SUB FOOTAGE	%
1	96086.8	84.3	17259.9	15.1	226.0	0.2	417.6	0.4	113990.3	100.0
2	33068.3	28.6	51506.2	44.5	26606.8	23.0	4561.7	3.9	115783.0	100.0
3	14645.6	6.1	89988.5	37.2	98542.6	40.7	38943.2	16.1	242111.9	100.0
4	32963.9	21.0	81223.1	51.7	36857.1	23.5	6085.7	3.9	157129.8	100.0
5	9810.4	4.0	60200.1	24.3	77655.5	31.3	100313.2	40.4	248059.2	100.0
TOTAL	186,575.0	21.3	300,249.8	34.2	239,928.0	27.4	150,321.4	17.1	877,074.2	100.0

TABLE 13

AVAILABLE FISH HABITAT COVER TYPES AT OR BELOW ORDINARY HIGH WATER LINE BY STUDY REACH

(Measured in Feet)

STUDY REACH #	FISH COVER TYPES							
	NO COVER	%	EMER. VEG.	%	AQUA. VEG.	%	DEBRIS	%
1	104019.6	82.9	9572.5	07.6	25.0	00.1	1912.6	01.5
2	27330.0	14.6	8262.0	04.4	108.0	00.1	10954.6	05.8
3	30682.4	07.7	15457.8	03.9	3297.1	00.8	8152.5	02.1
4	80223.9	38.8	4586.7	02.2	430.0	00.1	11073.5	05.4
5	97027.5	31.6	6574.4	02.1	0.0	00.0	40568.1	13.2
TOTAL	339,283.4	27.7	44,453.4	3.6	3,860.1	0.3	72,661.3	6.0

STUDY REACH #	FISH COVER TYPES					
	OVERHANG VEG.	%	UNDERCUT BANKS	%	TOTAL COVER	%
1	4873.7	03.9	5033.5	4.1	125436.9	100.0
2	72576.9	38.6	68379.9	36.5	187611.4	100.0
3	183062.8	46.2	155704.3	39.3	396356.9	100.0
4	64389.6	31.2	45790.2	22.2	206493.9	100.0
5	101946.9	33.2	61371.3	20.0	307488.2	100.0
TOTAL	426,849.9	34.9	336,279.2	27.6	1,223,387.3	100.0

TABLE 14

HABITAT SUITABILITY INDICES AND AVAILABLE HABITAT UNITS FOR JUVENILE CHINOOK SALMON IN THE KENAI RIVER MAINSTEM

TOTAL HABITAT UNITS (HU'S) FOR THE KENAI RIVER MAINSTEM

1,489,972 HU'S

COVER TYPE STRUCTURE OR USE	WATER-FRONTAGE (MILES)	(FEET)	TOTAL AREA AFFECTED (ACRES)	(FT^2)	MEAN HSI'S	HABITAT UNITS (HU'S)
UNDEVELOPED WATERFRONTAGE						
IDEAL REARING	15.2	80,108.0	11.0	480,648.0	0.77	370,099.0
VEGETATED UNDEVELOPED	19.5	102,921.4	14.2	617,528.4	0.30	185,258.5
VEGETATED SLIGHTLY DEGRADED	82.7	436,528.8	60.1	2,619,172.8	0.26	680,984.9
HEAVILY DEGRADED	3.6	18,817.5	2.6	112,905.0	0.20	22,581.0
GRAVEL NON ERODING	5.3	27,805.5	3.8	166,833.0	0.15	25,025.0
EROSIONAL GRAVEL BANK	28.0	147,594.0	20.3	885,564.0	0.15	132,834.6
SUBTOTAL	154.1	813,775.2	112.1	4,882,651.2	N/A	1,416,783.0
DEVELOPED WATERFRONTAGE						
BOAT LAUNCHES	0.5	2,391.0	0.3	14,346.0	0.17	2,438.8
DOCKS, DECKS & STRUCTURES	2.0	10,378.0	1.4	62,268.0	0.28	17,435.0
BANK PROTECTION MEASURES	4.3	22,757.0	3.1	136,542.0	0.17	23,212.1
BULKHEADS	1.5	7,806.0	1.1	46,836.0	0.14	6,557.0
JETTY'S	0.2	1,152	0.2	6,912.0	0.14	967.7
OTHER DEV.	3.6	18,815.0	2.6	112,890.0	0.20	22,578.0
SUBTOTAL	12.0	63,299.0	8.7	379,794.0	N/A	73,188.6
TOTALS	166.1	877,074.2	120.8	5,262,445.0	N/A	1,489,972.0

TABLE 15

HABITAT SUITABILITY INDICES AND AVAILABLE HABITAT UNITS FOR JUVENILE CHINOOK SALMON IN THE KENAI RIVER MAINSTEM

TOTAL HABITAT UNITS (HU'S) FOR THE KENAI RIVER MAINSTEM WITHOUT STRUCTURES OR TRAMPLING

1,523,144 HU'S

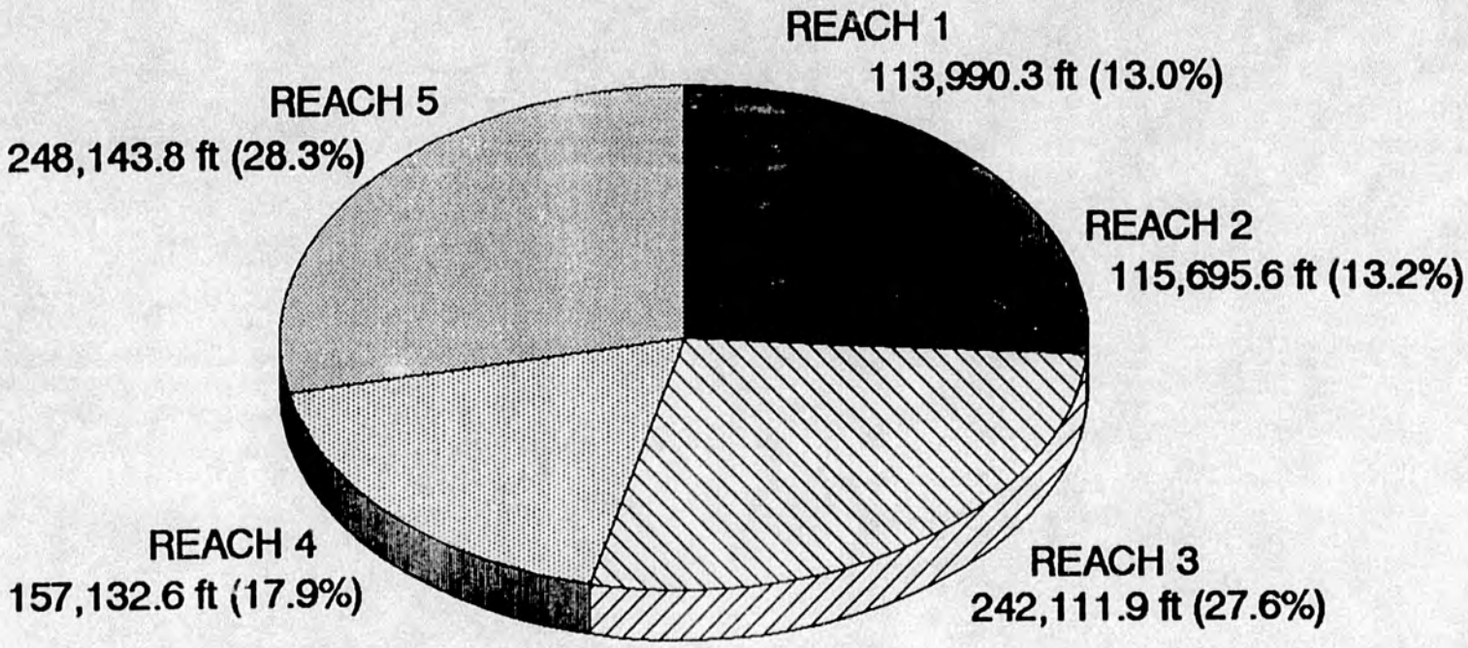
COVER TYPE STRUCTURE OR USE	WATER-FRONTAGE (MILES)	(FEET)	TOTAL AREA AFFECTED (ACRES)	(FT^2)	MEAN HSI'S	HABITAT UNITS (HU'S)
	UNDEVELOPED		WATERFRONTAGE			
IDEAL REARING	15.3	80,779.0	11.1	484,674.0	0.77	373,199.0
VEGETATED UNDEVELOPED	26.6	106,309.0	19.4	843,234.6	0.30	252,970.4
VEGETATED SLIGHTLY DEGRADED	87.1	459,941.6	63.4	2,759,649.6	0.26	717,508.9
NATURALLY DEGRADED	2.0	10,776.1	1.5	64,656.6	0.20	12,931.3
GRAVEL NON ERODING	6.8	35,840.5	4.9	215,043.0	0.15	32,256.5
EROSIONAL GRAVEL BANK	28.3	149,198.0	20.6	895,188.0	0.15	134,278.2
TOTAL W/O STRUCTURES OR TRAMPLING	166.1	877,074.2	120.9	5,262,445.8	N/A	1,523,144.3
TOTAL WITH STRUCTURES & HABITAT ALTERATIONS	166.1	877,074.2	120.8	5,262,445.8	N/A	1,489,972.0
TOTAL HABITAT UNITS LOST (-) GAINED (+)						- 33,172.3

APPENDIX B

FIGURES

FIG. 5 WATER FRONTAGES ON THE KENAI RIVER

LENGTHS/PERCENTAGES OF WATER FRONTAGE BY REACH



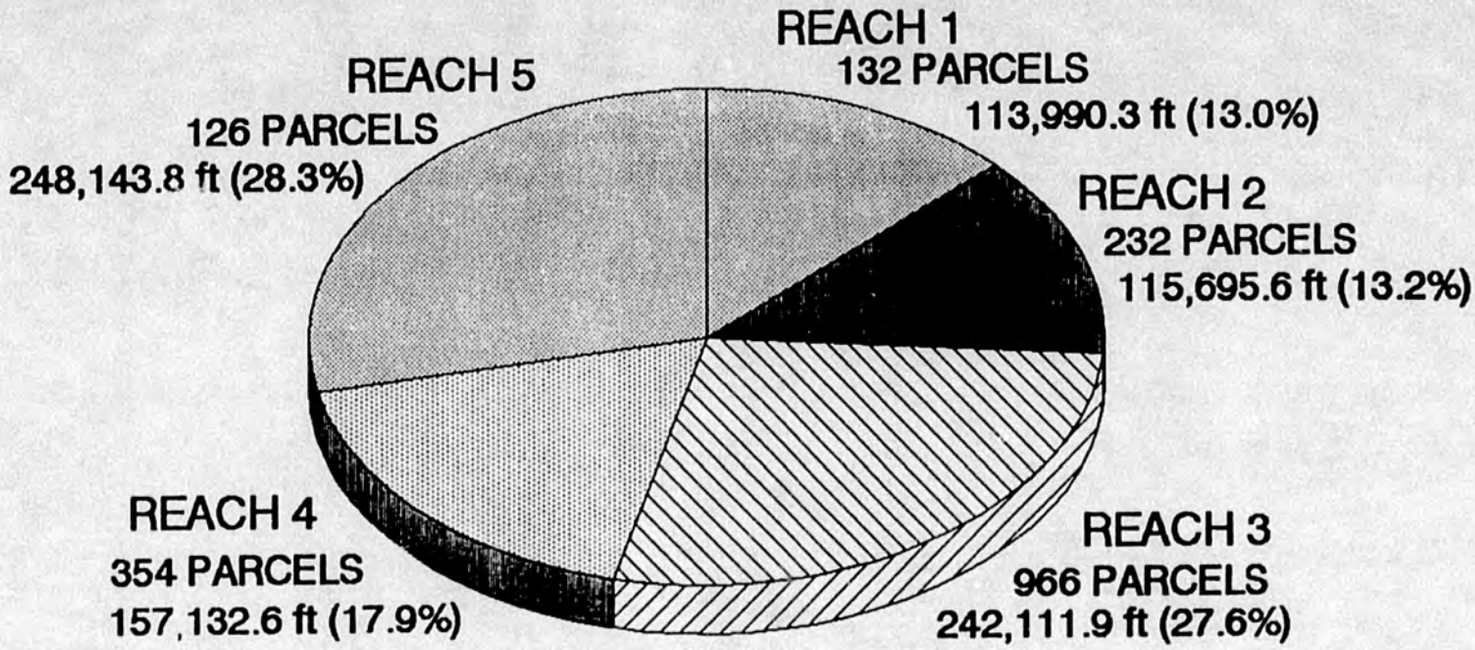
TOTAL = 877,074.2 ft

% = PERCENTAGE OF TOTAL WATER FRONTAGE FOR THE ENTIRE RIVER MAINSTEM

ADF&G 309, 1994

FIG. 6 KENAI RIVER OWNERSHIP BY PARCEL

PARCELS/PERCENTAGE OF WATER FRONTAGE BY REACH



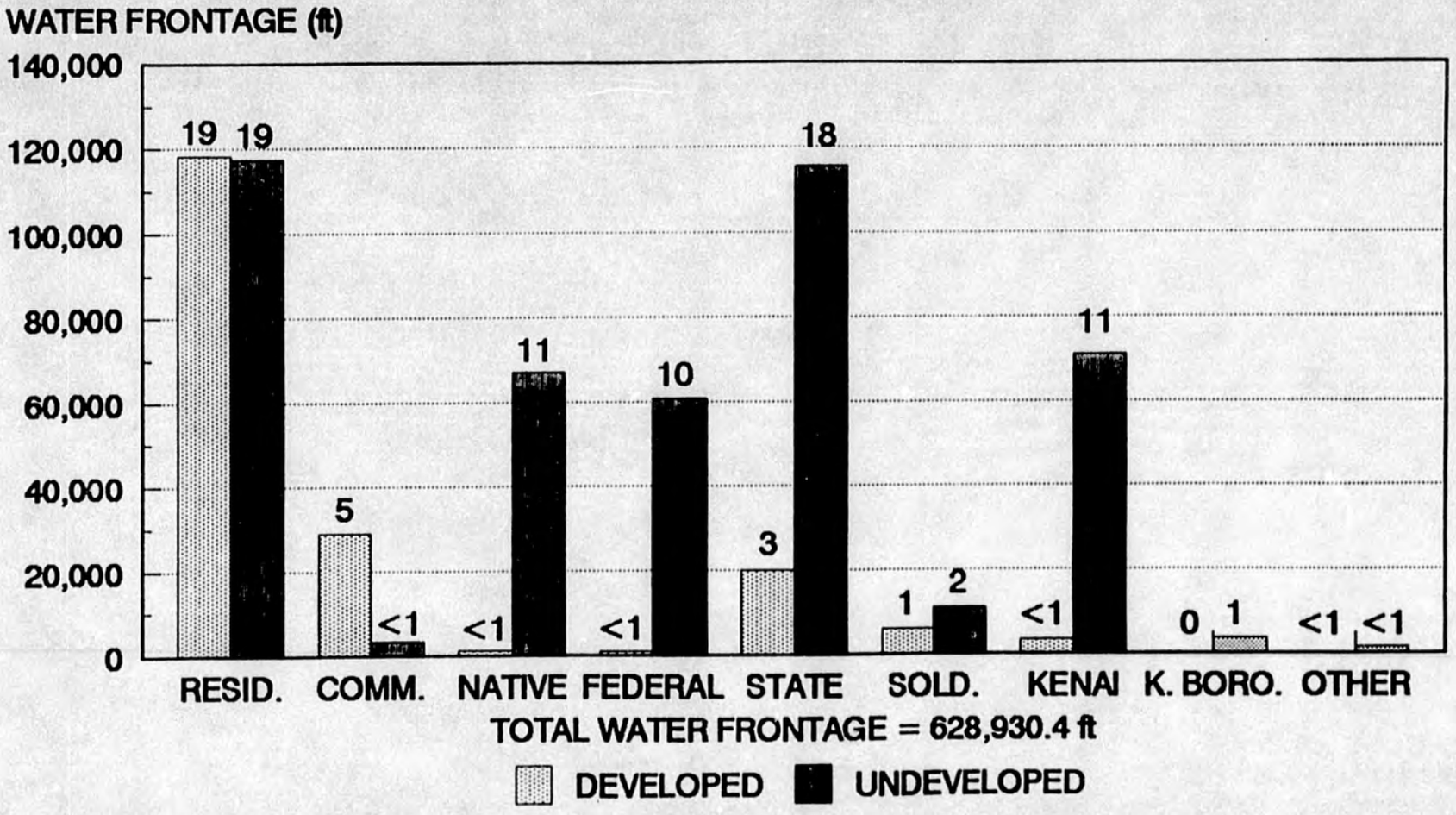
TOTAL PARCELS = 1,810
TOTAL WATER FRONTAGE = 877,074.2 ft

% = PERCENTAGE OF TOTAL WATER FRONTAGE FOR THE ENTIRE RIVER MAINSTEM

ADF&G 309, 1994

FIG. 7 KENAI RIVER OWNERSHIP CATEGORIES

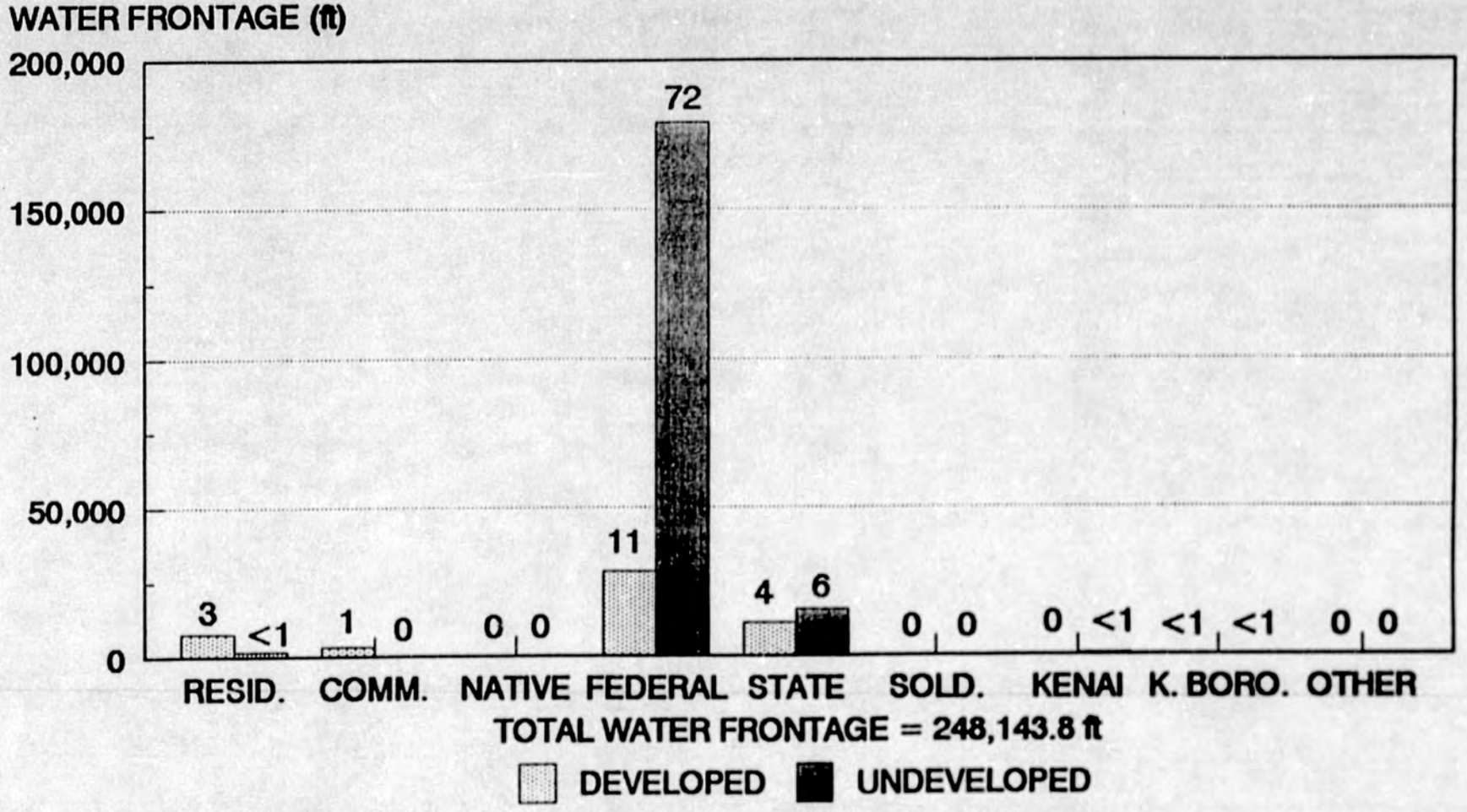
REACHES 1-4 COMBINED



NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

ADF&G 309, 1994

FIG. 8 KENAI RIVER OWNERSHIP CATEGORIES
REACH 5

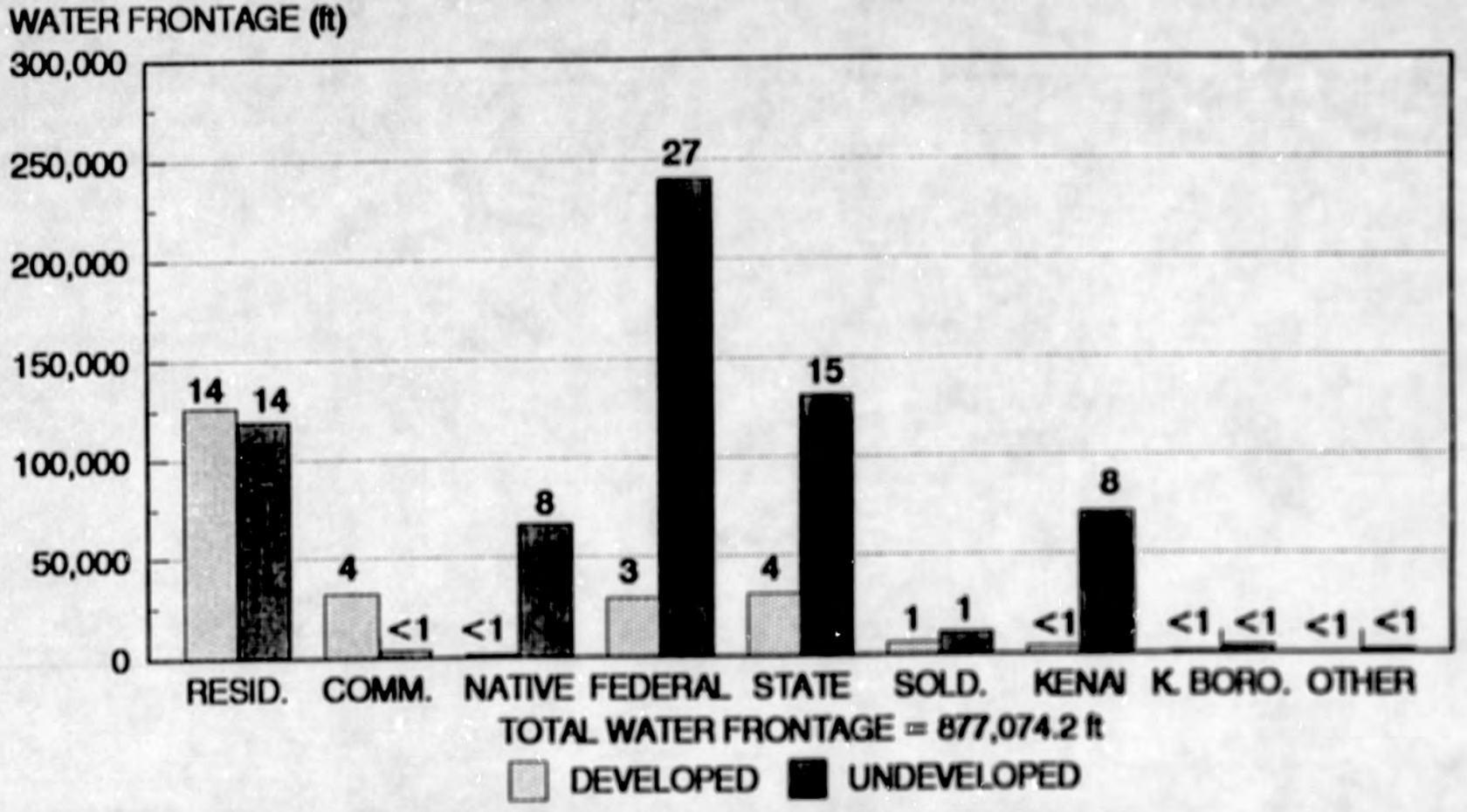


NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

ADF&G 309, 1994

FIG. 9 KENAI RIVER OWNERSHIP CATEGORIES

ALL REACHES COMBINED

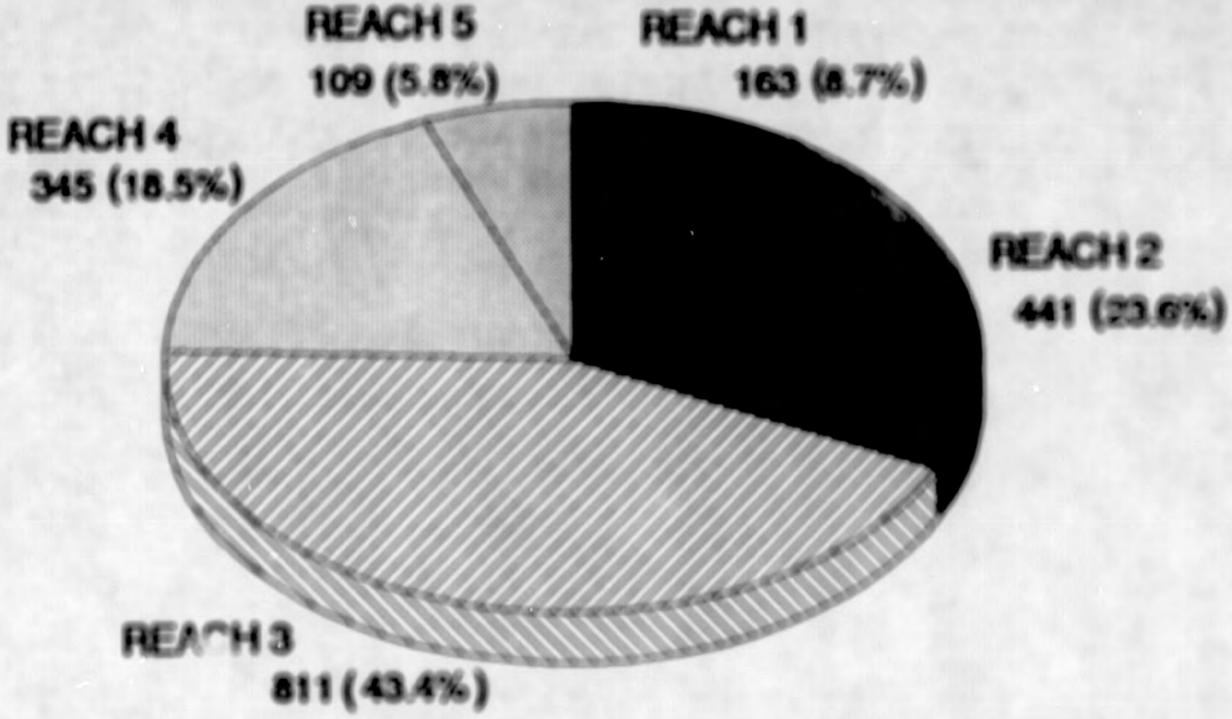


NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

ADF&G 309, 1994

FIG. 10 STRUCTURES ON THE KENAI RIVER

NUMBERS/PERCENTAGES OF ALL STRUCTURES BY REACH



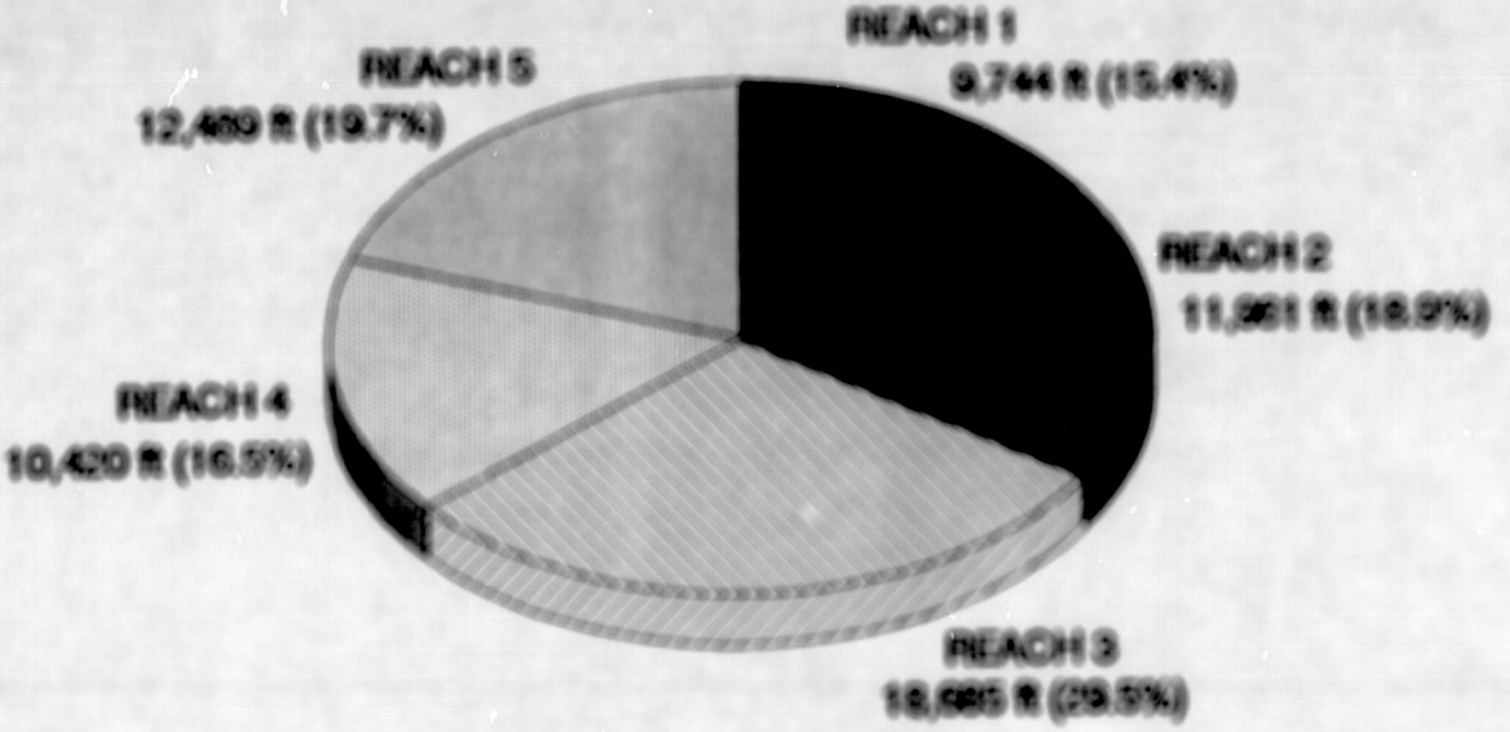
TOTAL = 1869 STRUCTURES ON 639 PARCELS

% = PERCENTAGE OF TOTAL NUMBER OF STRUCTURES FOR THE ENTIRE RIVER MAINSTEM

ADF&G 309, 1994

FIG. 11 STRUCTURES ON THE KENAI RIVER

LENGTHS/PERCENTAGES OF ALL STRUCTURES BY REACH



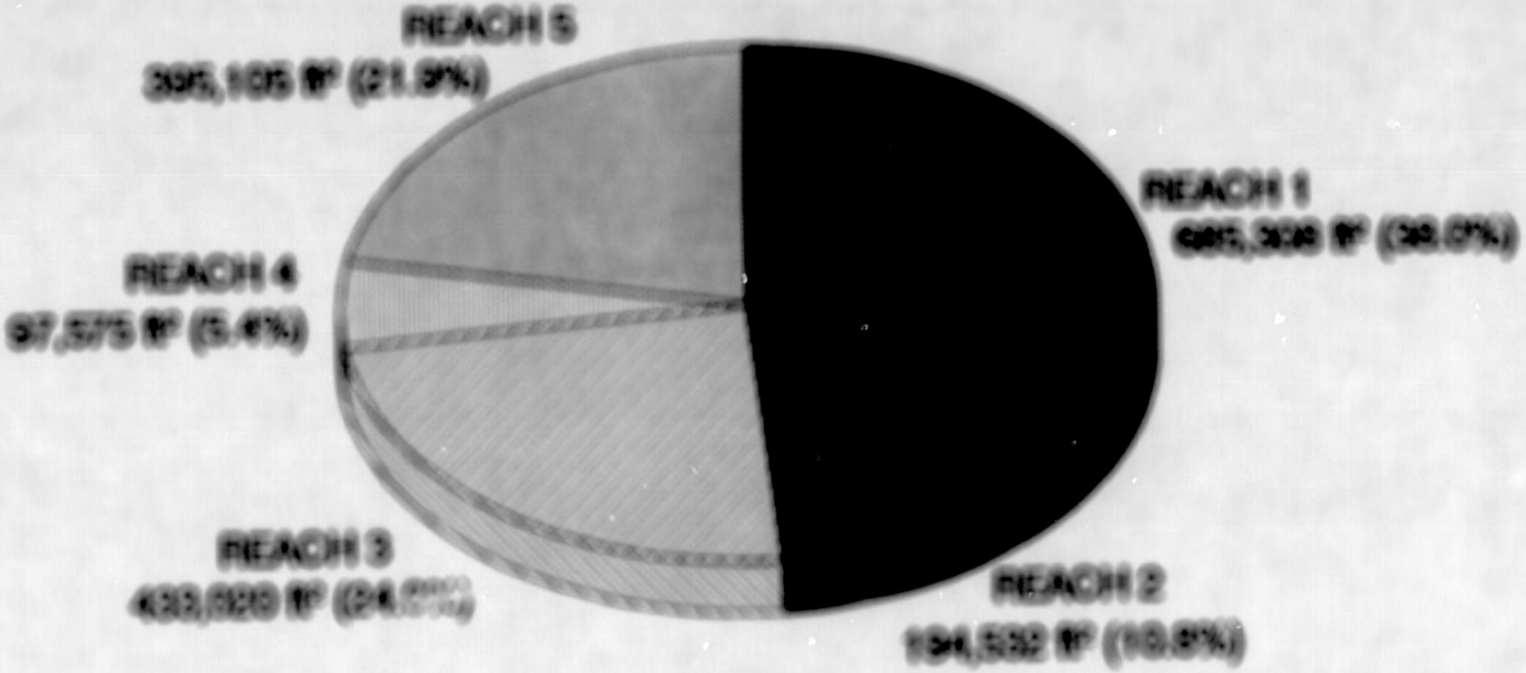
TOTAL = 63,299 ft

% = PERCENTAGE OF TOTAL STRUCTURE LENGTHS FOR THE ENTIRE RIVER MAINSTEM

ADF&G 369, 1984

FIG. 12 STRUCTURES ON THE KENAI RIVER

AREAS/PERCENTAGES OF ALL STRUCTURES BY REACH

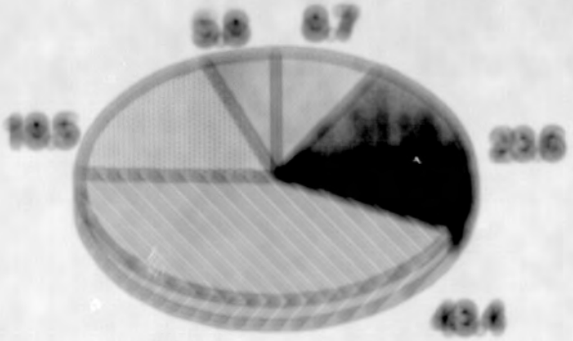


TOTAL AREA AFFECTED BY STRUCTURES = 1,805,540 ft²
= 34.2% OF TOTAL STUDY AREA

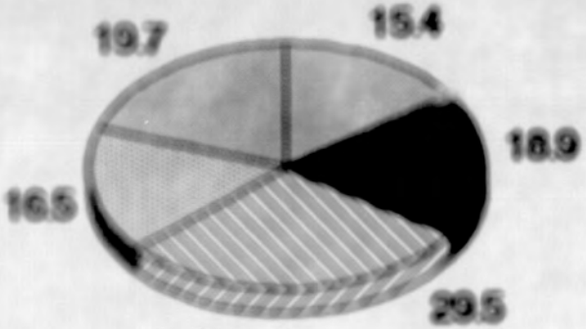
% = PERCENTAGE OF TOTAL STRUCTURE AREA FOR THE ENTIRE MAINSTEM

ADF&G 3/93, 1994

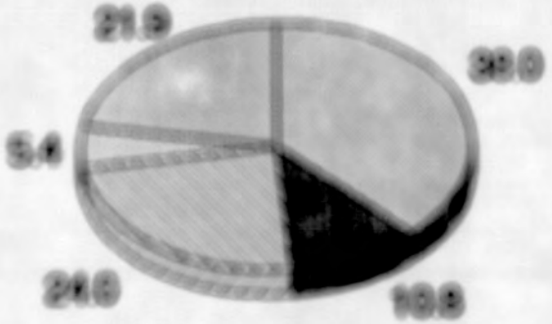
FIG. 13 SUMMARY OF KENAI RIVER WATERFRONT LENGTHS AND STRUCTURES



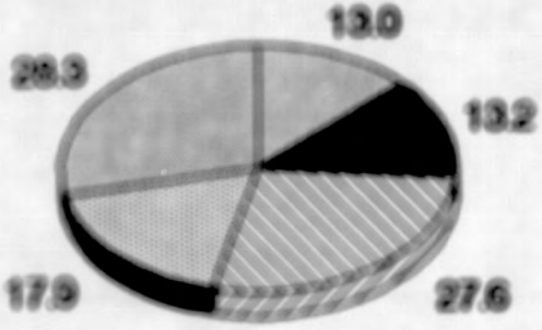
NUMBERS OF STRUCTURES
TOTAL = 1,869



LENGTHS OF STRUCTURES
TOTAL = 63,299 ft



AREAS OF STRUCTURES
TOTAL = 1,805,540 ft²

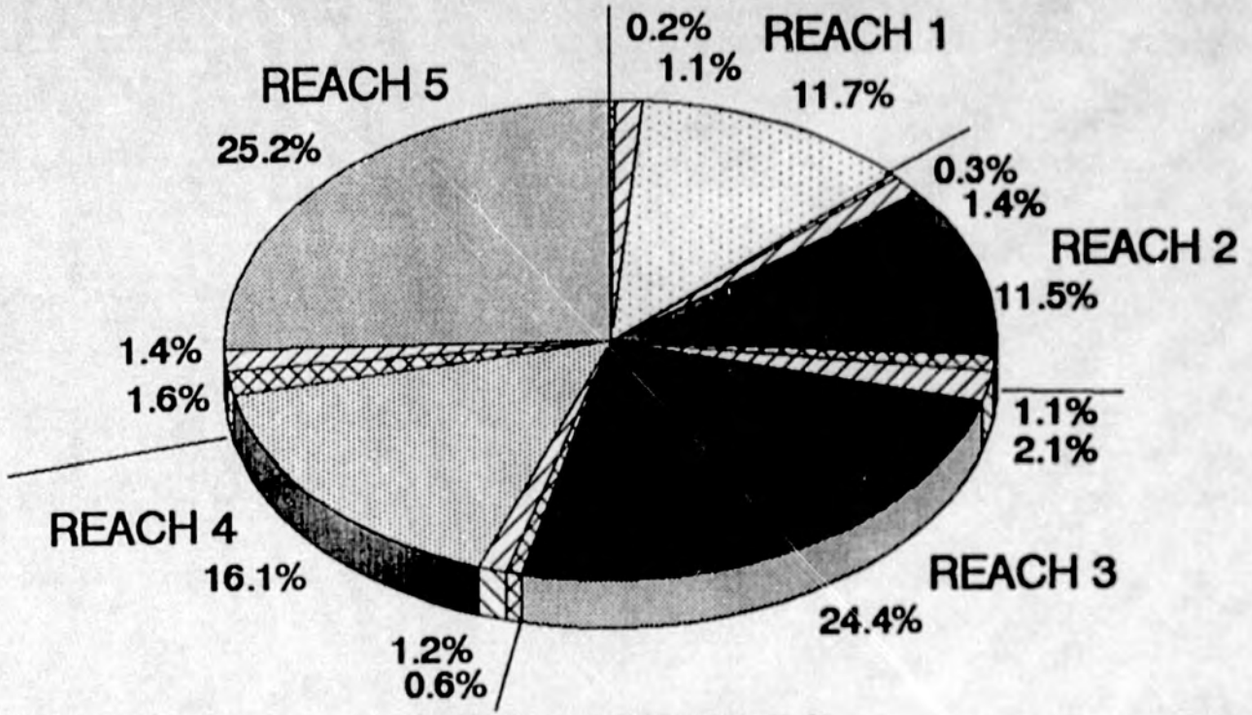


WATER FRONTAGE PER REACH
TOTAL = 877,074.2 ft

REACH 1 REACH 2 REACH 3 REACH 4 REACH 5

ADF&G 309, 196

FIG. 14 KENAI RIVER WATER FRONTAGE ALTERATIONS
FOR EACH REACH AT ORDINARY HIGH WATER

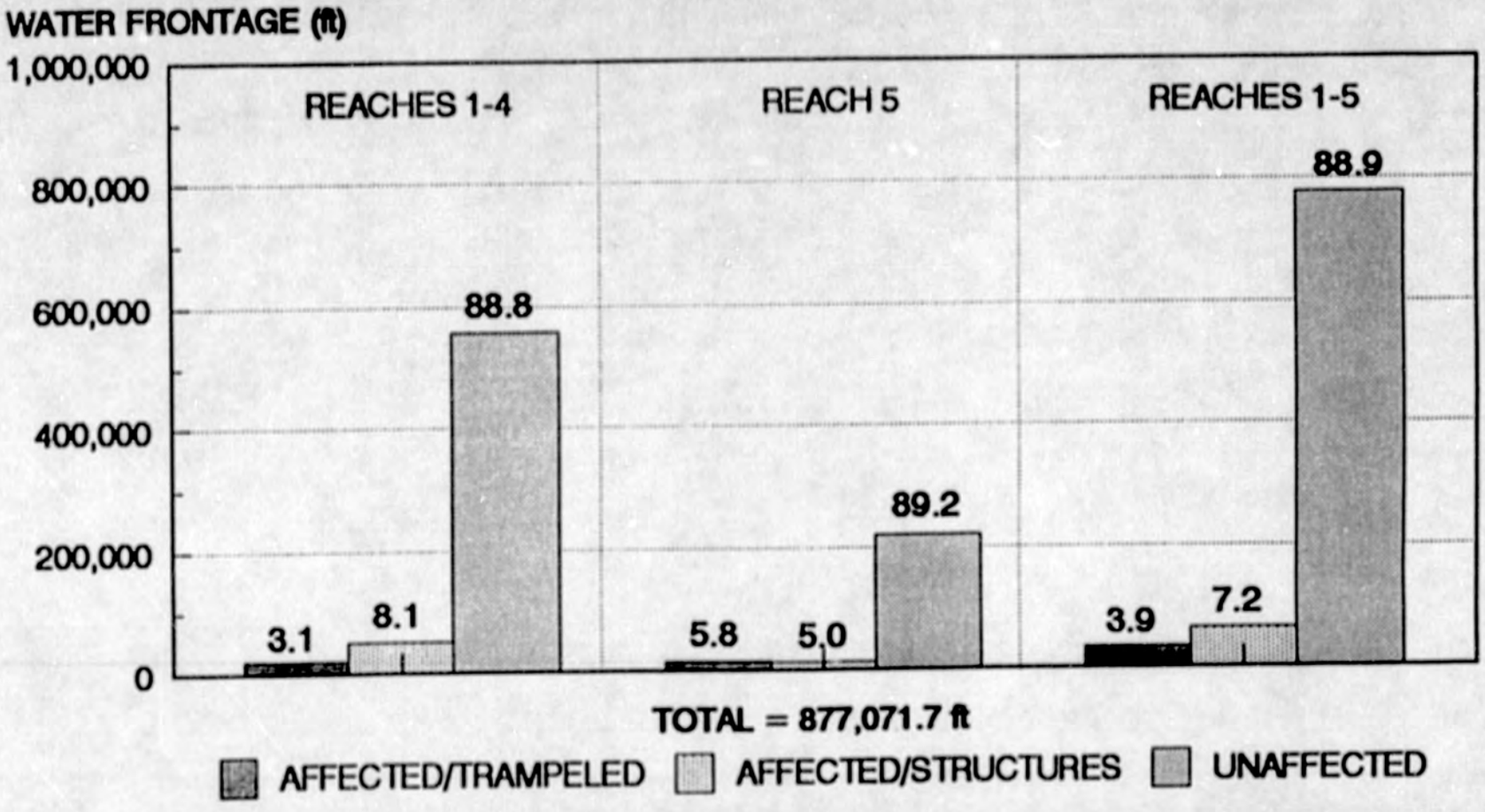


% = PERCENT OF TOTAL WATER FRONTAGE FOR THE ENTIRE RIVER MAINSTEM

ADF&G 309, 1994

FIG. 15 KENAI RIVER WATER FRONTAGE ALTERATIONS

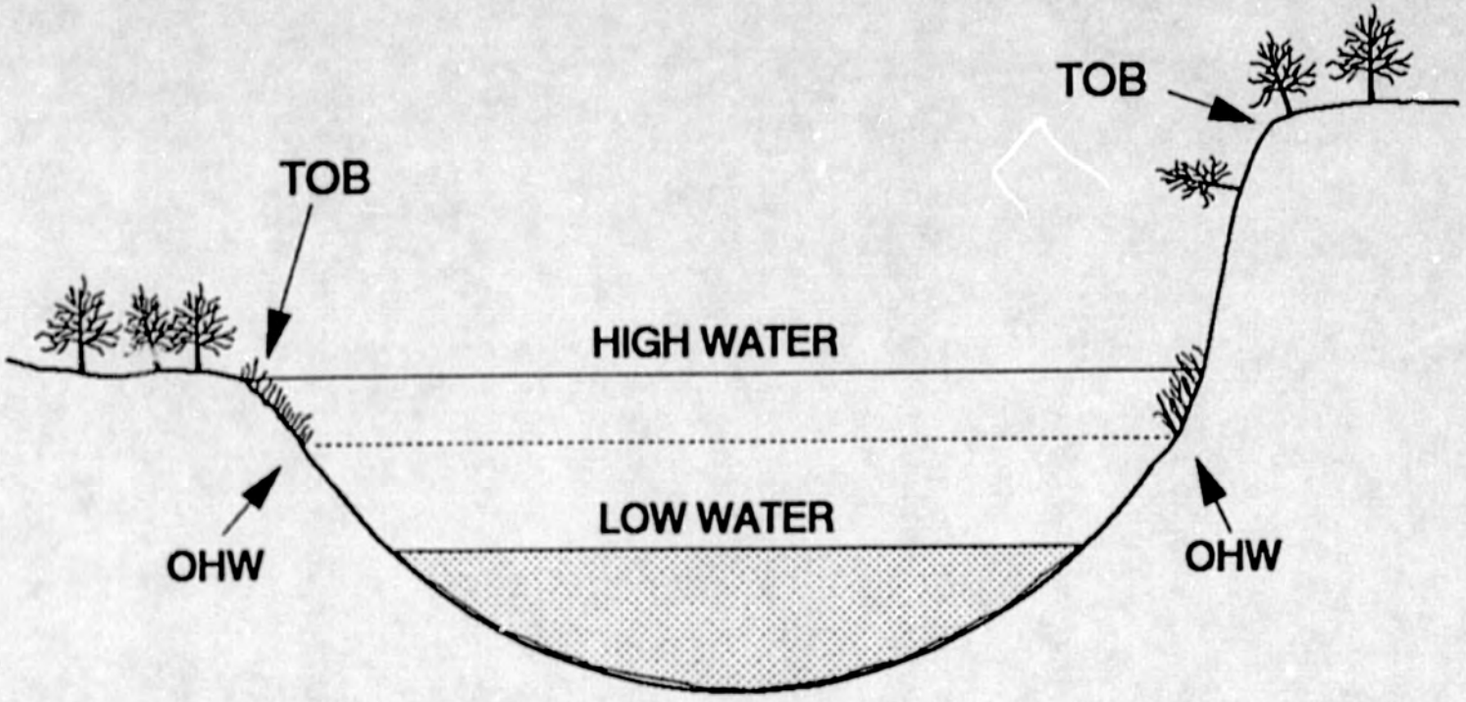
FOR COMBINED REACHES AT ORDINARY HIGH WATER



NUMBERS ABOVE BARS REFLECT % OF TOTAL WATER FRONTAGE FOR EACH SET OF REACHES

ADF&G 309, 1994

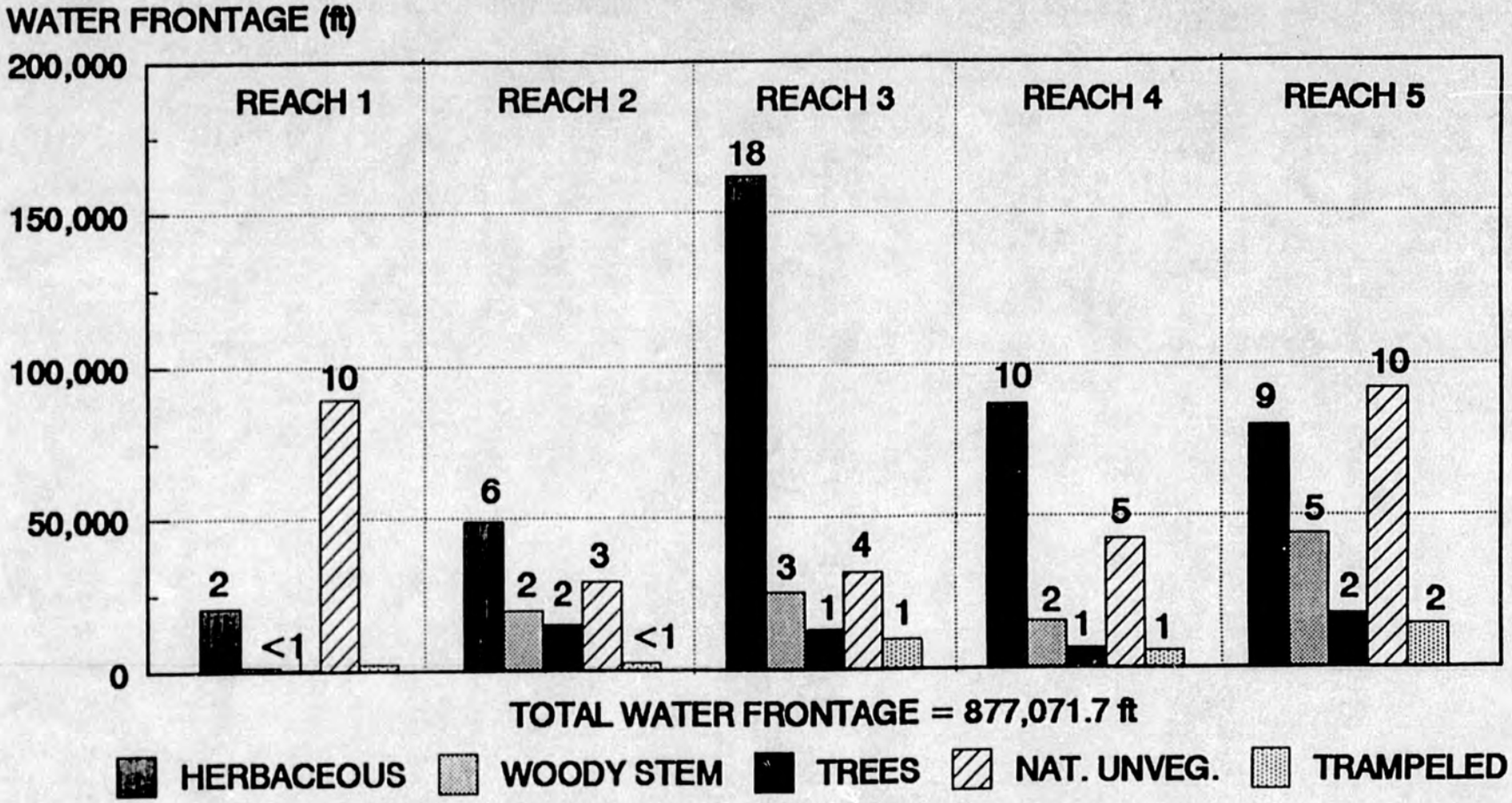
FIG. 16 WATER LEVEL AND BANK LOCATION DEFINITIONS



TOB = TOP OF BANK
OHW = ORDINARY HIGH WATER

ADF&G 309, 1994

FIG. 17 KENAI RIVER BANK VEGETATION TYPES
AT ORDINARY HIGH WATER

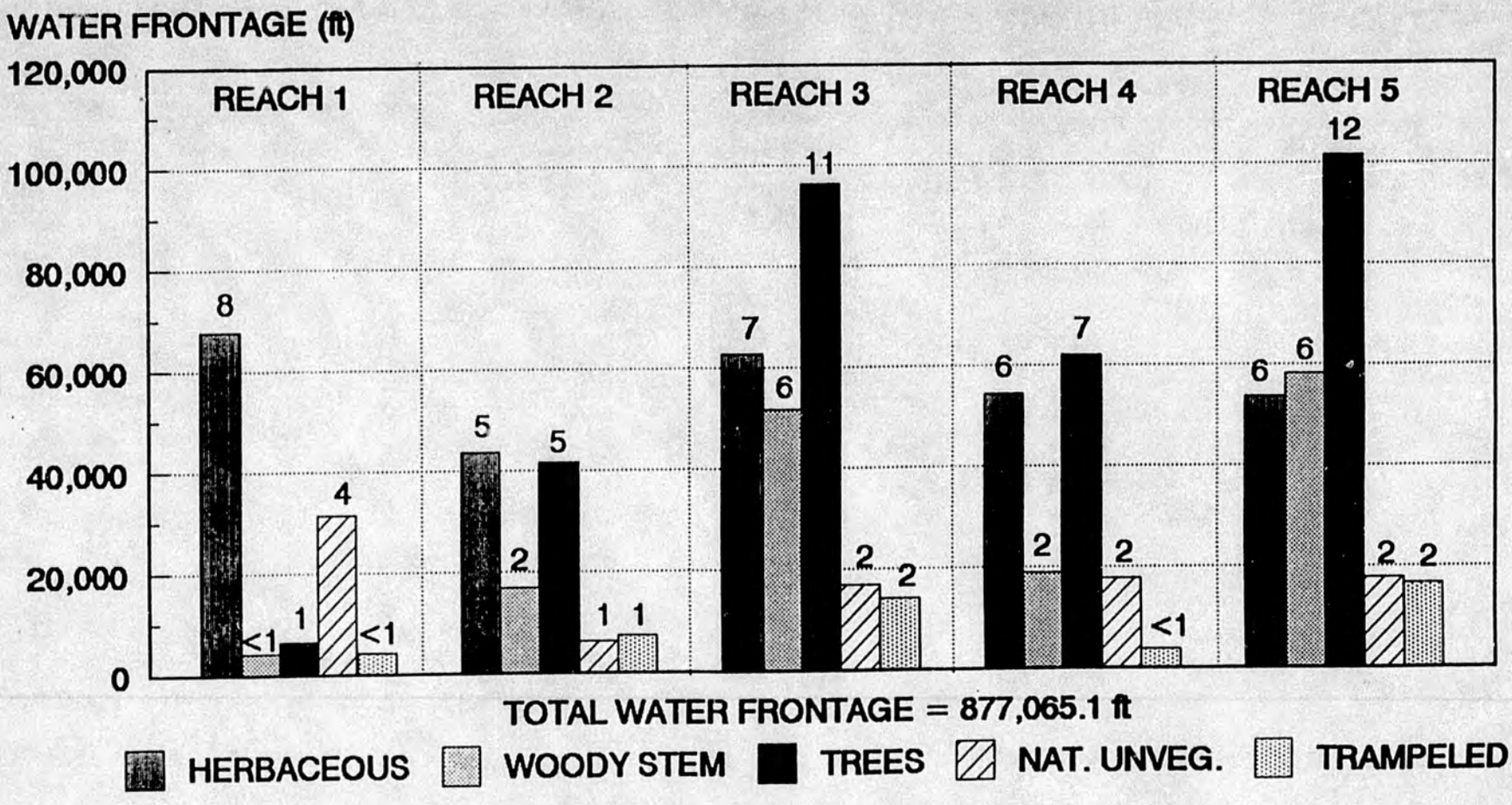


NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

ADF&G 309, 1994

FIG. 18 KENAI RIVER BANK VEGETATION TYPES

AT TOP OF BANK

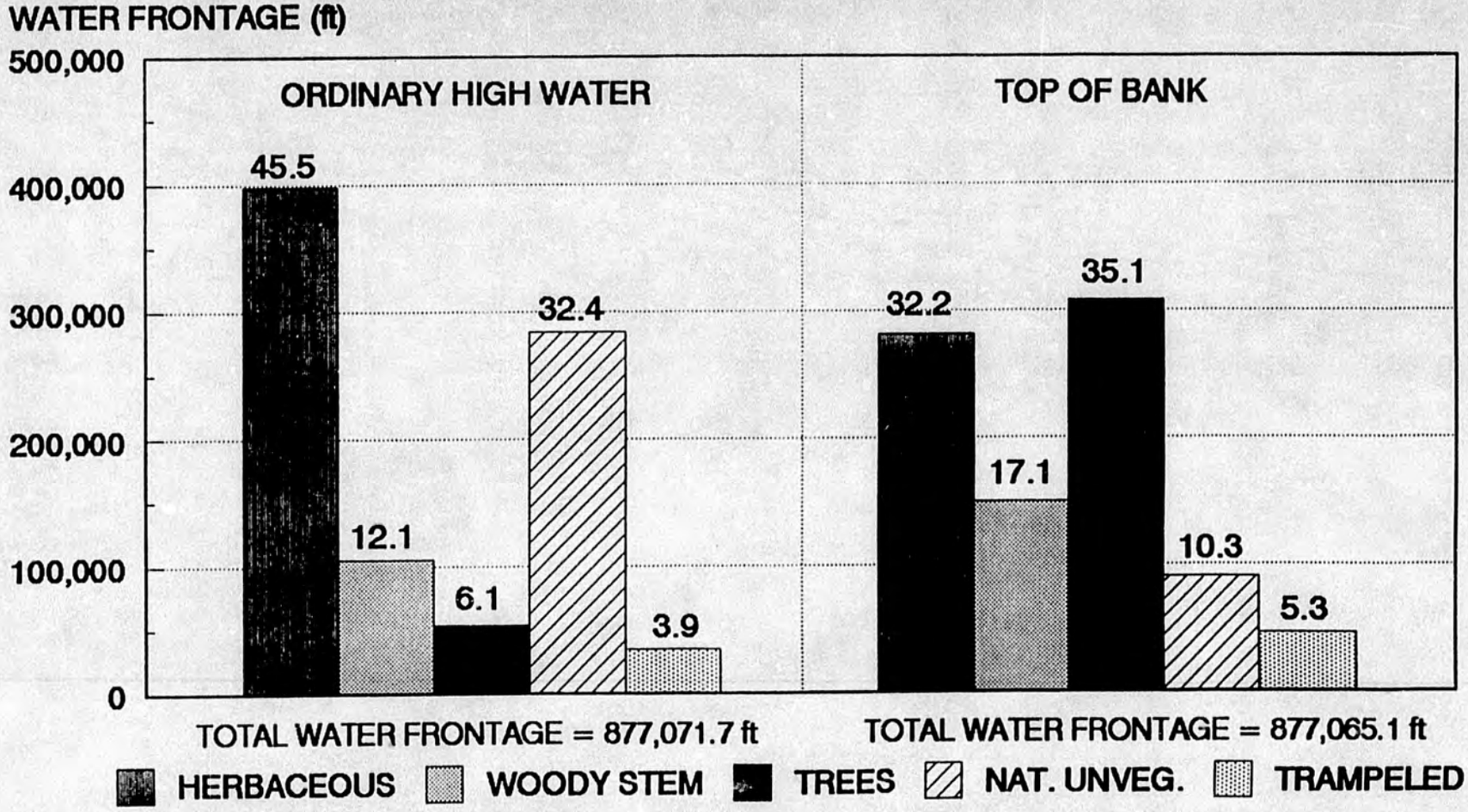


NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

ADF&G 309, 1994

FIG. 19 KENAI RIVER BANK VEGETATION

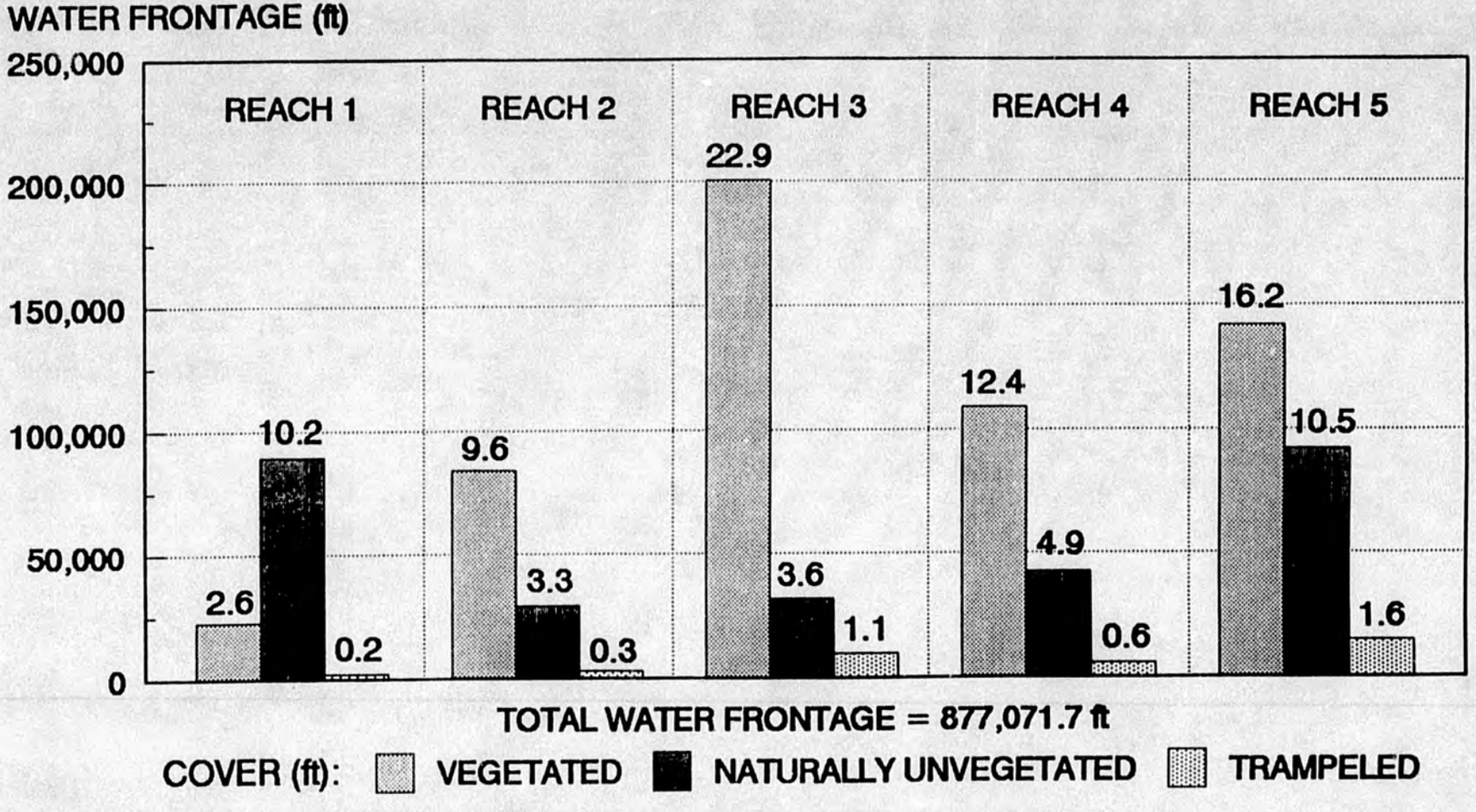
ALL REACHES COMBINED



NUMBERS ABOVE BARS REFLECT % OF TOTAL WATER FRONTAGE FOR OHW OR TOB

ADF&G 309, 1994

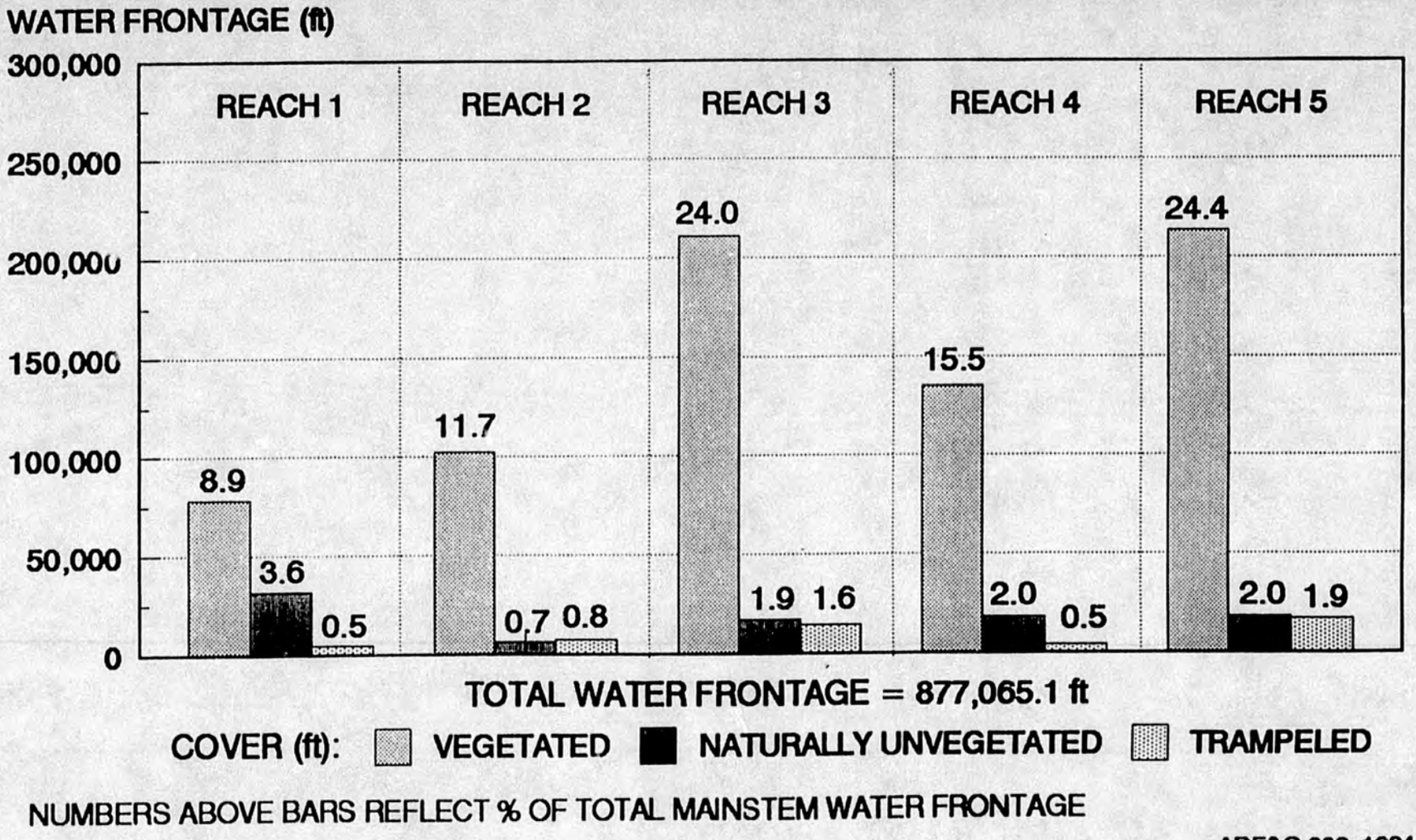
FIG. 20 KENAI RIVER BANK VEGETATION FOR ALL REACHES
AT ORDINARY HIGH WATER



NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

ADF&G 309, 1994

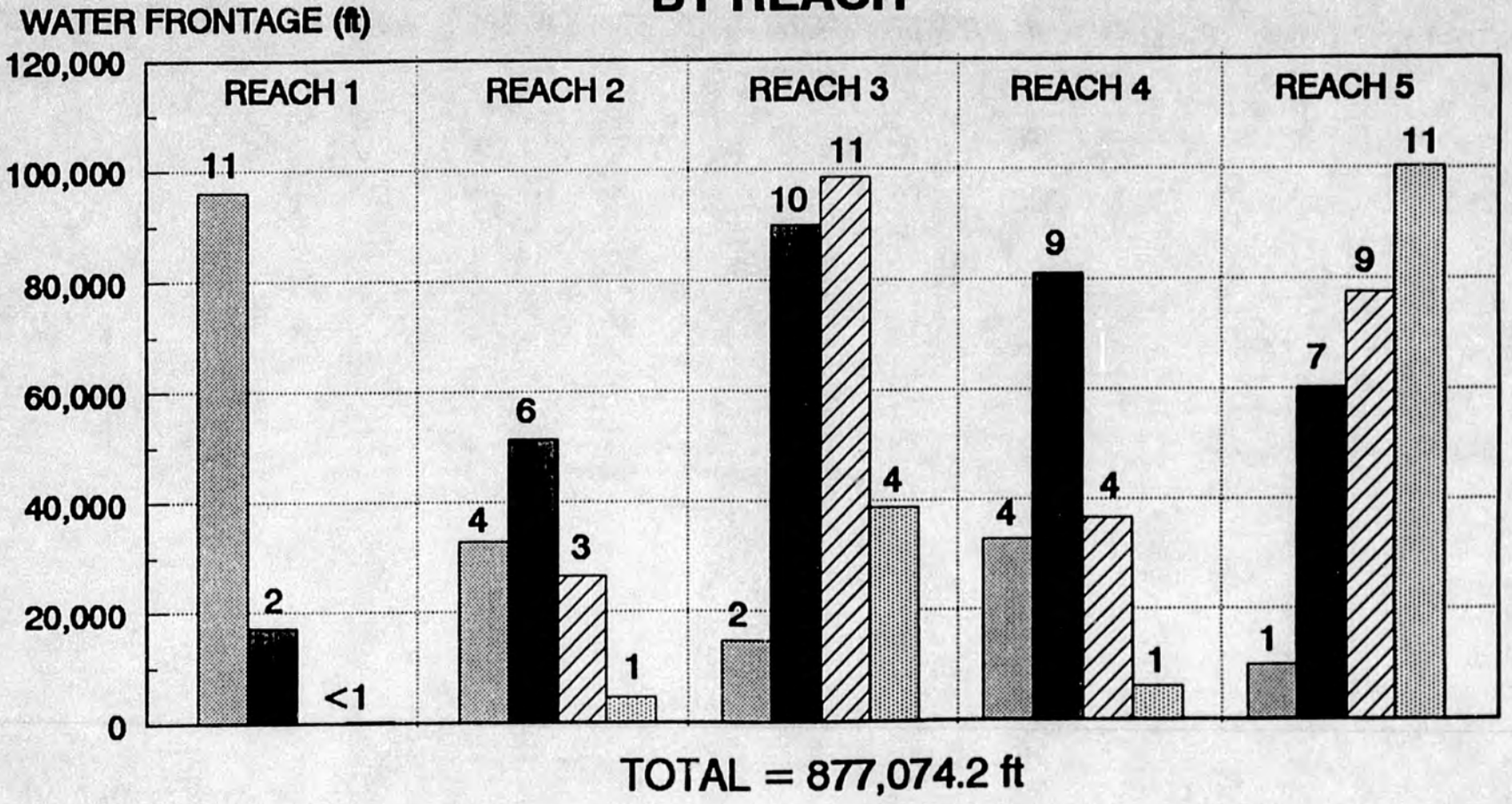
FIG. 21 KENAI RIVER BANK VEGETATION FOR ALL REACHES
AT TOP OF BANK



NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

ADF&G 309, 1994

FIG. 22 KENAI RIVER NEARSHORE SUBSTRATES BY REACH



TOTAL = 877,074.2 ft

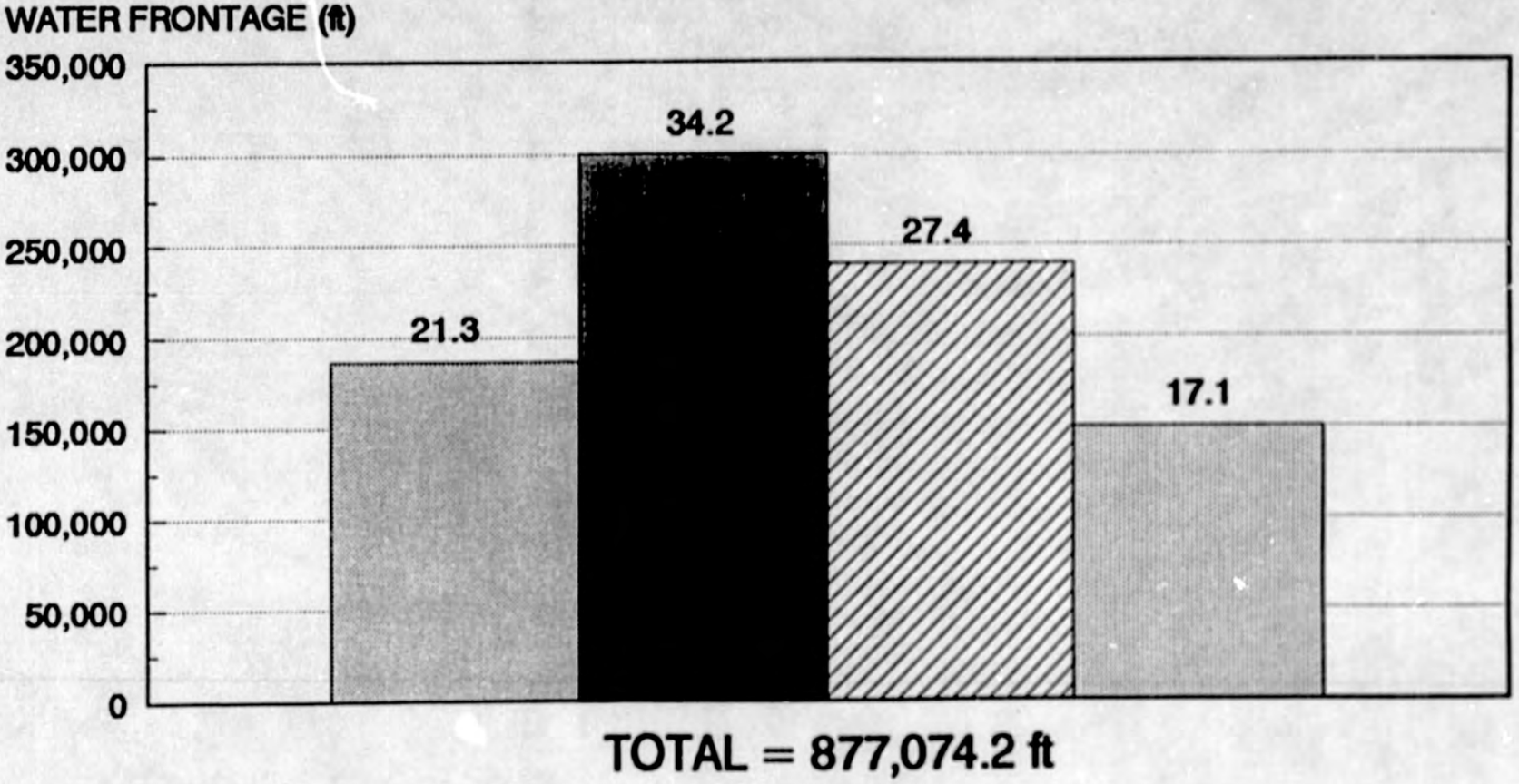
MUD/SAND/SILT (<.5 in.) GRAVEL (.5-3 in.) COBBLE (3-5 in.) RUBBLE (>5 in.)

NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

ADF&G 309, 1994

FIG. 23 KENAI RIVER NEARSHORE SUBSTRATES

ALL REACHES COMBINED



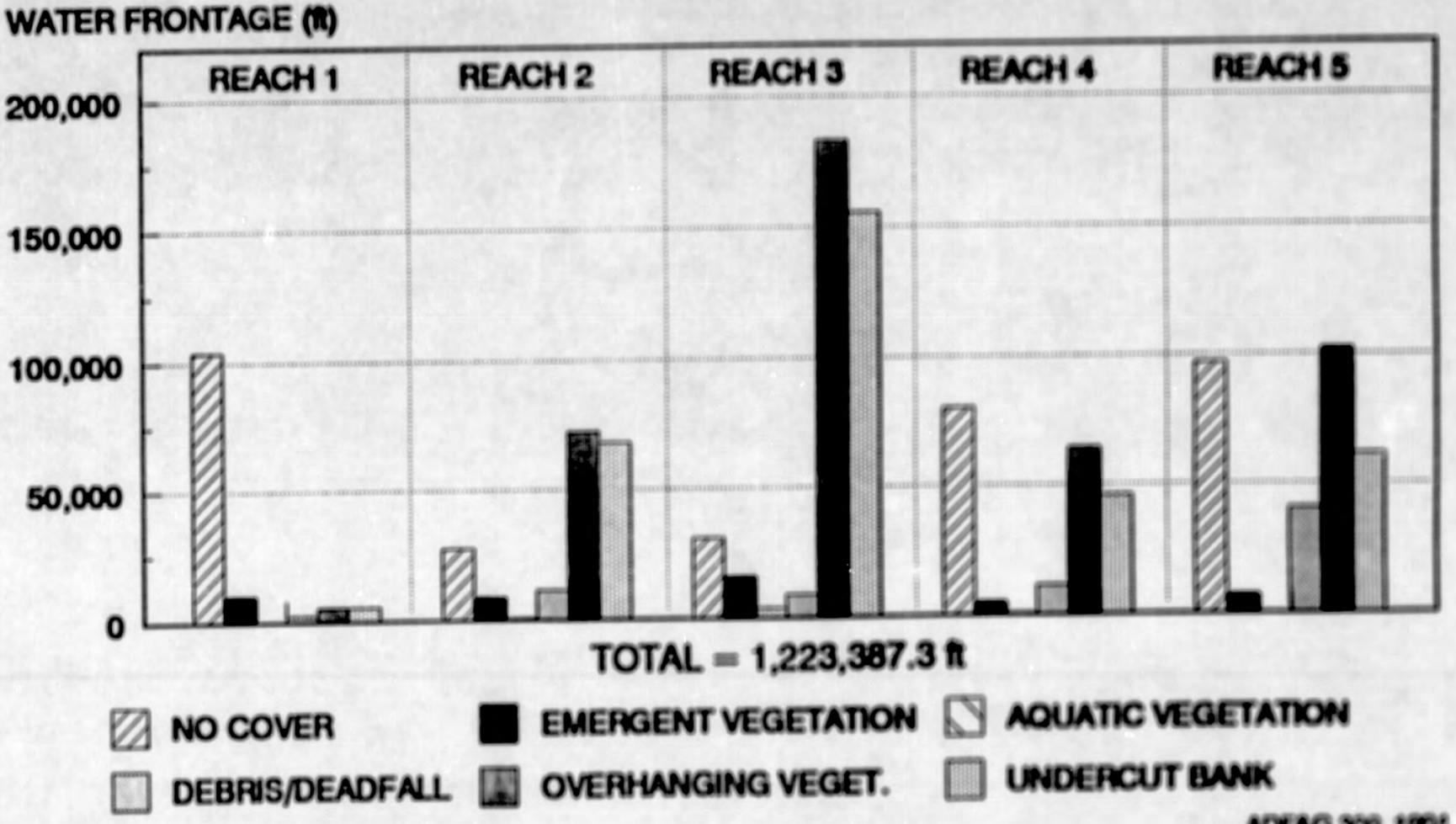
TOTAL = 877,074.2 ft

MUD/SAND/SILT (<.5 in.) GRAVEL (.5-3 in.) COBBLE (3-5 in.) RUBBLE (>5 in.)

NUMBERS ABOVE BARS REFLECT % OF TOTAL MAINSTEM WATER FRONTAGE

ADF&G 309, 1994

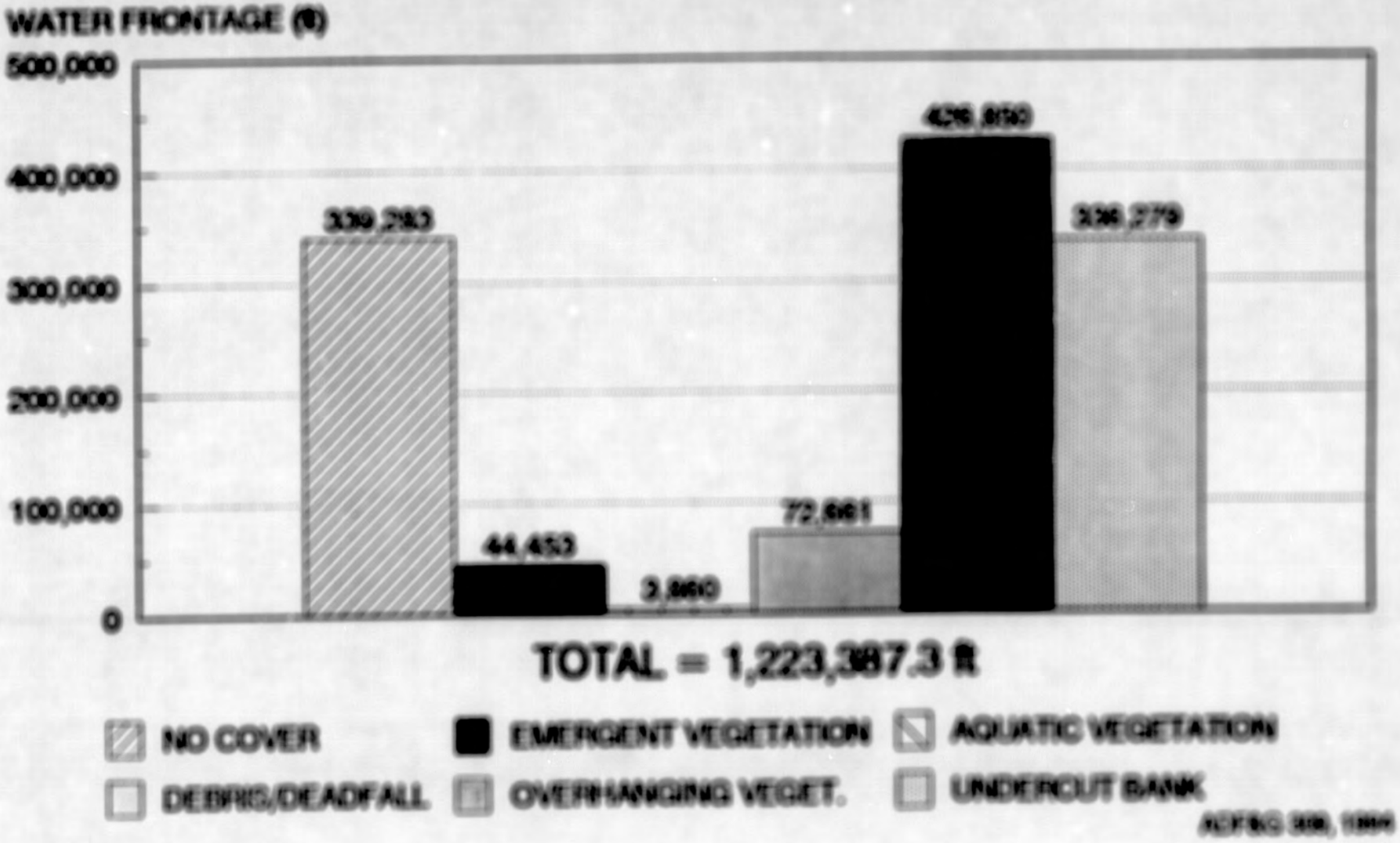
FIG. 24 KENAI RIVER FISH COVER
BY REACH



ADF&G 309, 1991

FIG. 25 KENAI RIVER FISH COVER

ALL REACHES COMBINED



HEP FORMULA

$$\text{HABITAT COMPONENT (AREA)} \times \text{HABITAT SUITABILITY INDEX (HSI)} = \text{HABITAT UNITS (HU's)}$$

$$\text{HSI} = \frac{\text{SUM OF ALL HABITAT COMPONENT VARIABLES}}{\text{\# OF VARIABLES}}$$

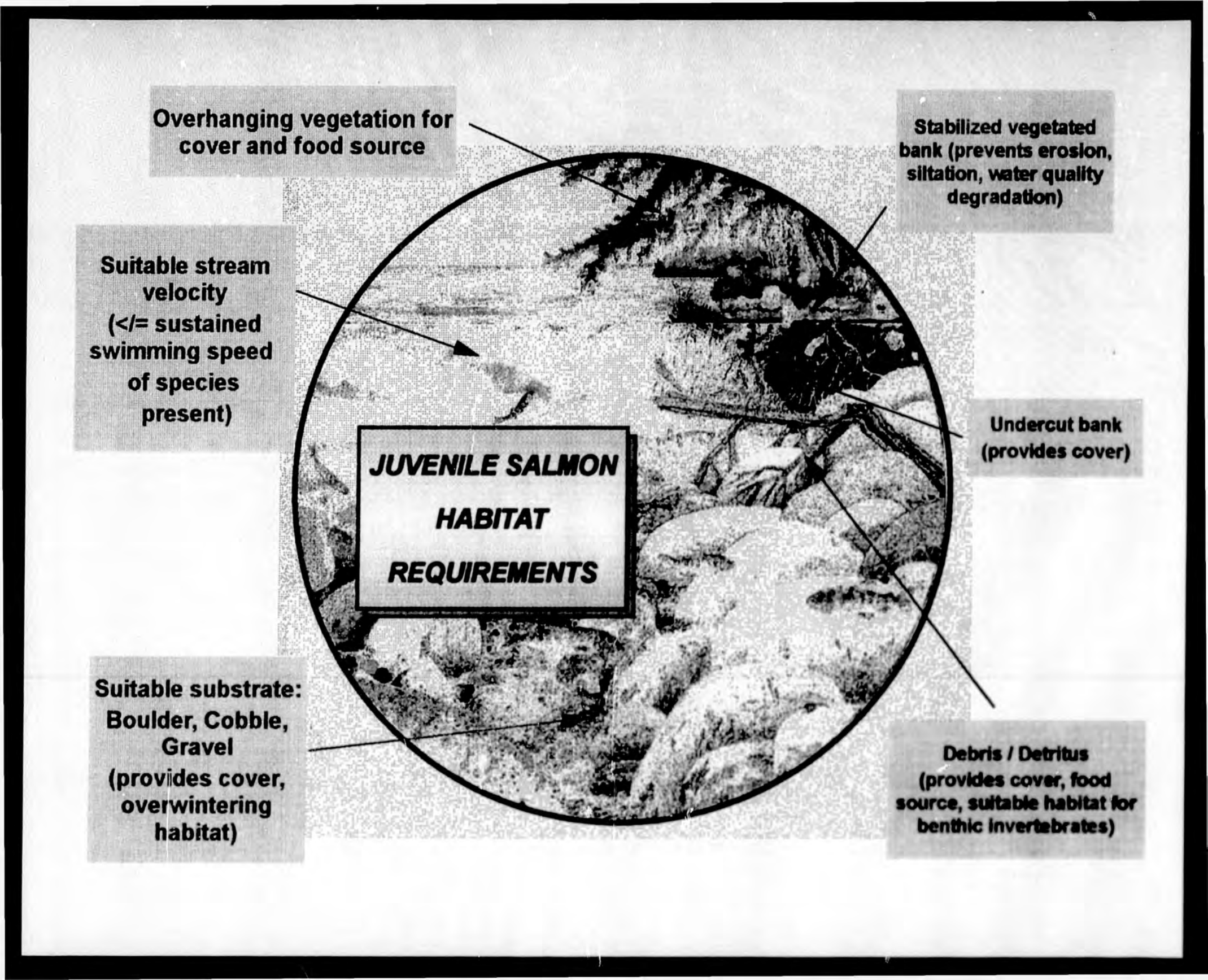
KENAI RIVER HABITAT EVALUATION PROCEDURES (HEP) IMPACT ANALYSIS CATEGORIES

UNDEVELOPED HABITAT CATEGORIES

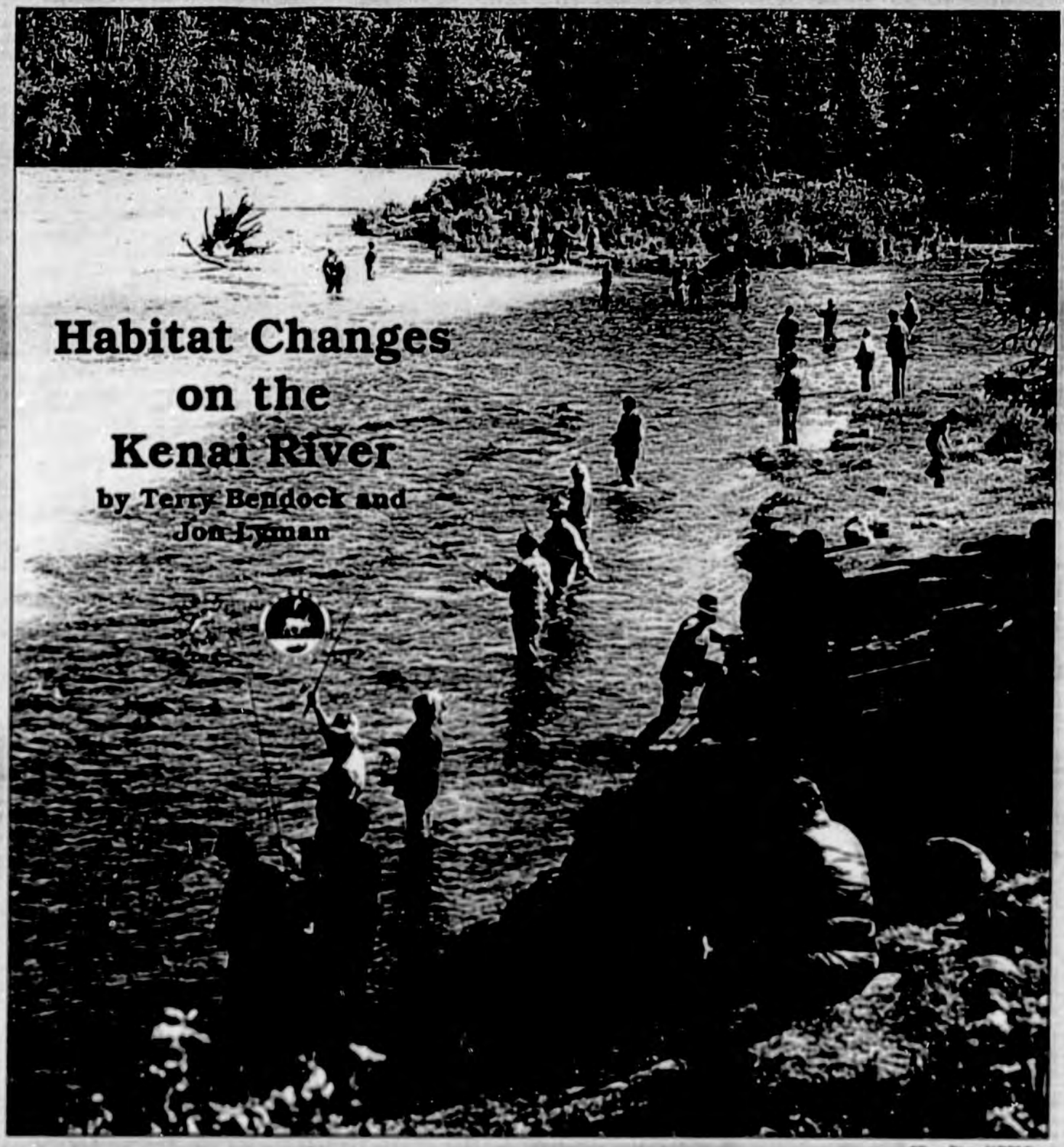
- IDEAL JUVENILE CHINOOK REARING HABITAT
- VEGETATED, UNDEVELOPED SHORELINE AND BANK
- VEGETATED, SLIGHTLY DEGRADED SHORELINE AND BANK
- HEAVILY DEGRADED SHORELINE AND BANK CONDITION
- NON-ERODING/STABLE GRAVEL BANKS
- EROSIONAL BANKS

DEVELOPED SHORELINE CATEGORIES

- BOAT LAUNCHES
- DOCKS, DECKS AND PILE SUPPORTED STRUCTURES
- BANK PROTECTION MEASURES
- BULKHEADS
- JETTIES AND GROINS
- OTHER DEVELOPMENT CONDITIONS


Overhanging vegetation for cover and food source
Stabilized vegetated bank (prevents erosion, siltation, water quality degradation)
Suitable stream velocity (</= sustained swimming speed of species present)
JUVENILE SALMON HABITAT REQUIREMENTS
Undercut bank (provides cover)
Suitable substrate: Boulder, Cobble, Gravel (provides cover, overwintering habitat)
Debris / Detritus (provides cover, food source, suitable habitat for benthic invertebrates)

THE FOLLOWING DOCUMENT
HAS NOT BEEN FILMED
BUT IS AVAILABLE IN THE
ORIGINAL FILE

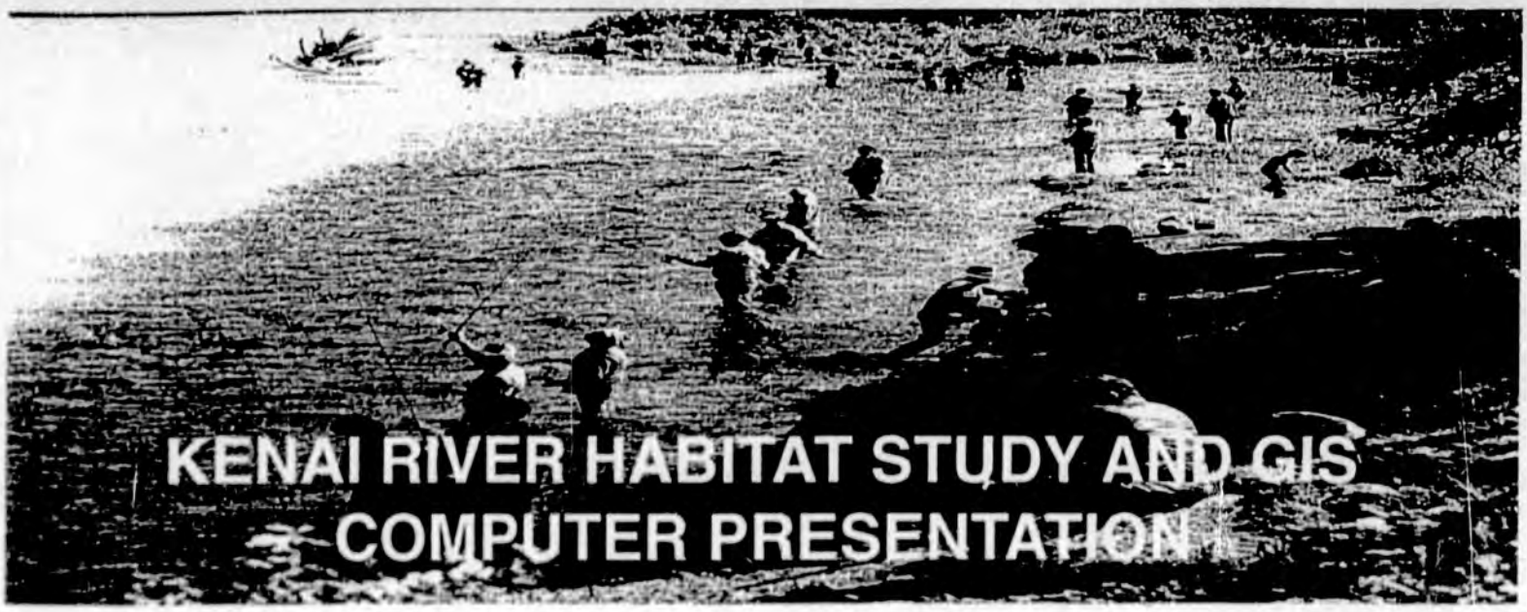


Habitat Changes on the Kenai River

by Terry Bendock and Jon Lyman

©Russ Dunn/ADF&G

The survival of the Kenai River's world famous salmon depends upon water flows of less than one foot per second. Although adult fish have little trouble swimming against swift flows, the young require reduced water velocity and cover provided by naturally vegetated banks to survive. Each spring, young chinook and coho salmon migrate from upriver areas where they were hatched to the rich feeding grounds along the mainstream. Each fall, they must return to overwinter in Skilak, Kenai, and other lakes. Streambank vegetation slows flow speed and provides cover--both are



KENAI RIVER HABITAT STUDY AND GIS COMPUTER PRESENTATION

Kenai River habitat degradation and the need to maintain the river's world class fishery have both received much attention lately -- and for good reason. A 1994 study showed roughly 12% of the river's salmon rearing habitat has been shown to be degraded by trampling, vegetation removal and development. This study has already begun to serve as a valuable management and planning tool and was integrated into a computer-based geographic information system (GIS).

On March 6, Fish and Game **Habitat Biologist Gary Leipitz** will make three presentations to describe the genesis and results of the study, plus demonstrate the GIS computer mapping capabilities the State has gained through this study. An agenda is attached for your information. **The March 6 presentations are scheduled for:**

(1) **11:30 am - 12:30 pm**, ADF&G Commissioners Conference Rm

(2) **3:15 - 4:15 pm**, ADF&G Commissioners Conference Rm

(3) **5:00 - 7:00 pm**, before the House Fisheries Committee

This will be an excellent education and discussion opportunity, so please share this notice with anyone you think would be interested.

To ensure that we have enough seating in sessions (1) and (2), please call **Becky Abbott (465-4105) by close of business on** Thursday March 2 **to sign up** for either of those sessions. Please indicate name, phone number, and preferred session. We will try to ensure that legislative employees get their preference of session.