SHORELINE SURVEY FOR OIL CONTAMINATION RESULTING FROM THE EXXON VALDEZ OIL SPILL

U. S. Fish and Wildlife Service

Kodiak Island National Wildlife Refuge
Kodiak, Alaska

by

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INTRODUCTION

The primary objective of the subject survey was to identify beaches, administered by the U.S. Fish and Wildlife Service (Service), that remained contaminated by oil as a result of the Exxon Valdez oil spill that occurred on March 24, 1989. A memorandum from Acting Regional Director Rogers to the Office of the Secretary, Regional Environmental Officer, dated April 23, 1990, provided information and guidance to conduct the survey. Responsibilities for the protection and welfare of migratory birds and the sea otter (Enhydra lutris) formed the primary basis for the assessment. Shorelines within the Alaska Maritime, Alaska Peninsula/Becharof and the Kodiak national wildlife refuges were involved.

The subject report contains the results of a survey of beaches administered by the Service as a part of the Kodiak National Wildlife Refuge. It is restricted, however, to Kodiak Island beaches because a separate survey was conducted by other Service personnel on Afognak Island (which contains beaches administered by both the Alaska Maritime and the Kodiak refuges). Both reports should be used in combination for a complete analysis of the nature and extent of oil contamination on Service lands within the Kodiak Archipelago. A separate, independent survey was also conducted on Alaska Peninsula/Becharof National Wildlife Refuge lands.

The original intent of the subject beach survey was to assess all of the shoreline, approximately 550 miles, administered by the Service on Kodiak Island (Figure 1), including lands selected but not conveyed as a part of the Alaska Native Claims Settlement Act (Figure 2). However, as the survey progressed with relatively small amounts of oil contamination discovered on most beaches and as knowledge of the particular types of conditions that entrapped oil was revealed, the survey strategy changed. Succeeding beach segments were selected for survey, in areas with a history of impact from the oil spill, on the basis of terrain with characteristics likely to entrap oil and exposure to wave action conducive to retention of oil contamination. Thus, the extent of the survey was reduced with confidence that the scope and results would not be compromised.

METHODS

A helicopter was used to transport survey personnel to the beach sites and to ferry personnel around inaccessible locations. It was not used to survey for oil contamination because close scrutiny was essential to distinguish oil contaminants from black rock and certain forms of dark-colored algae.

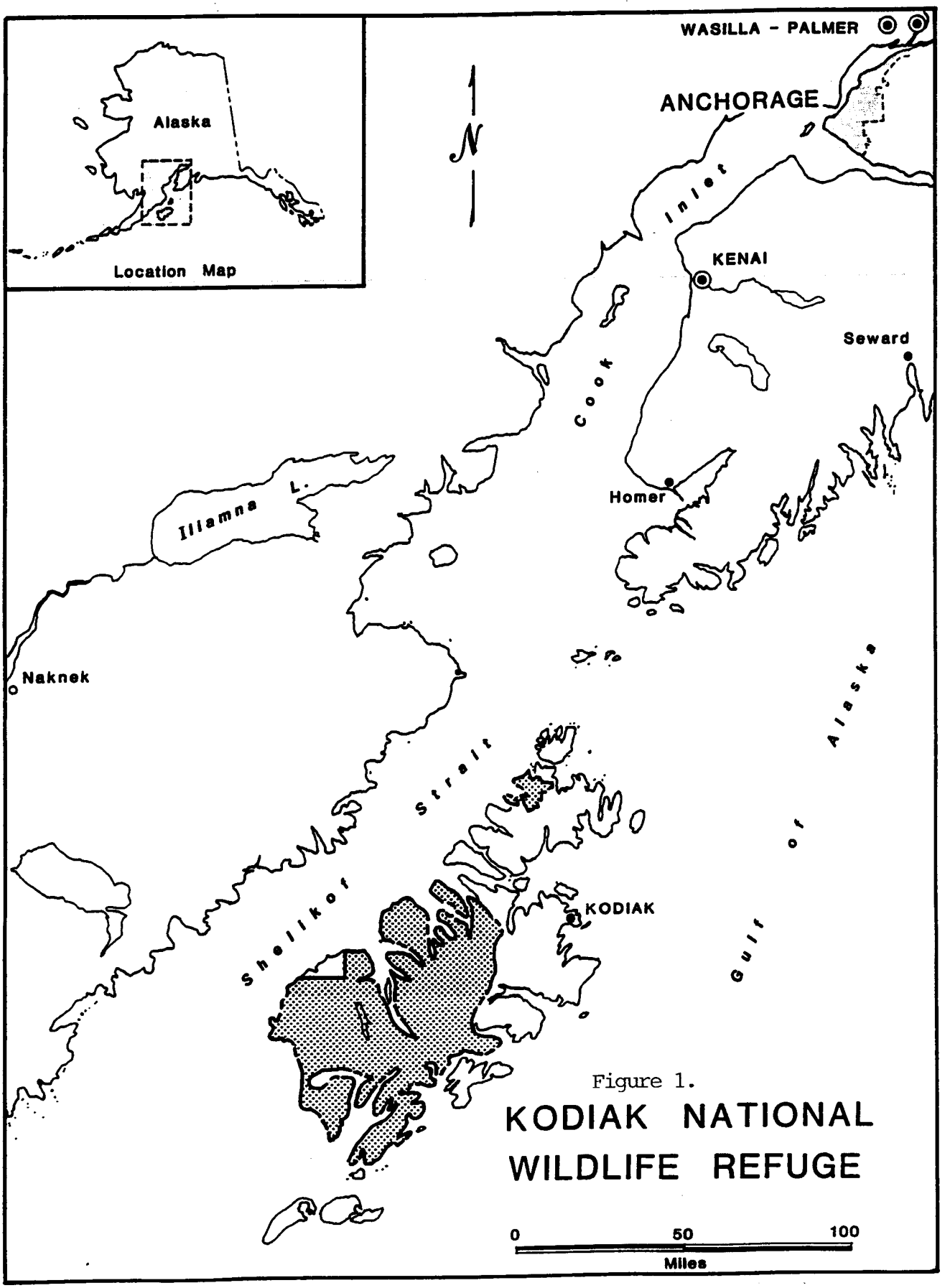
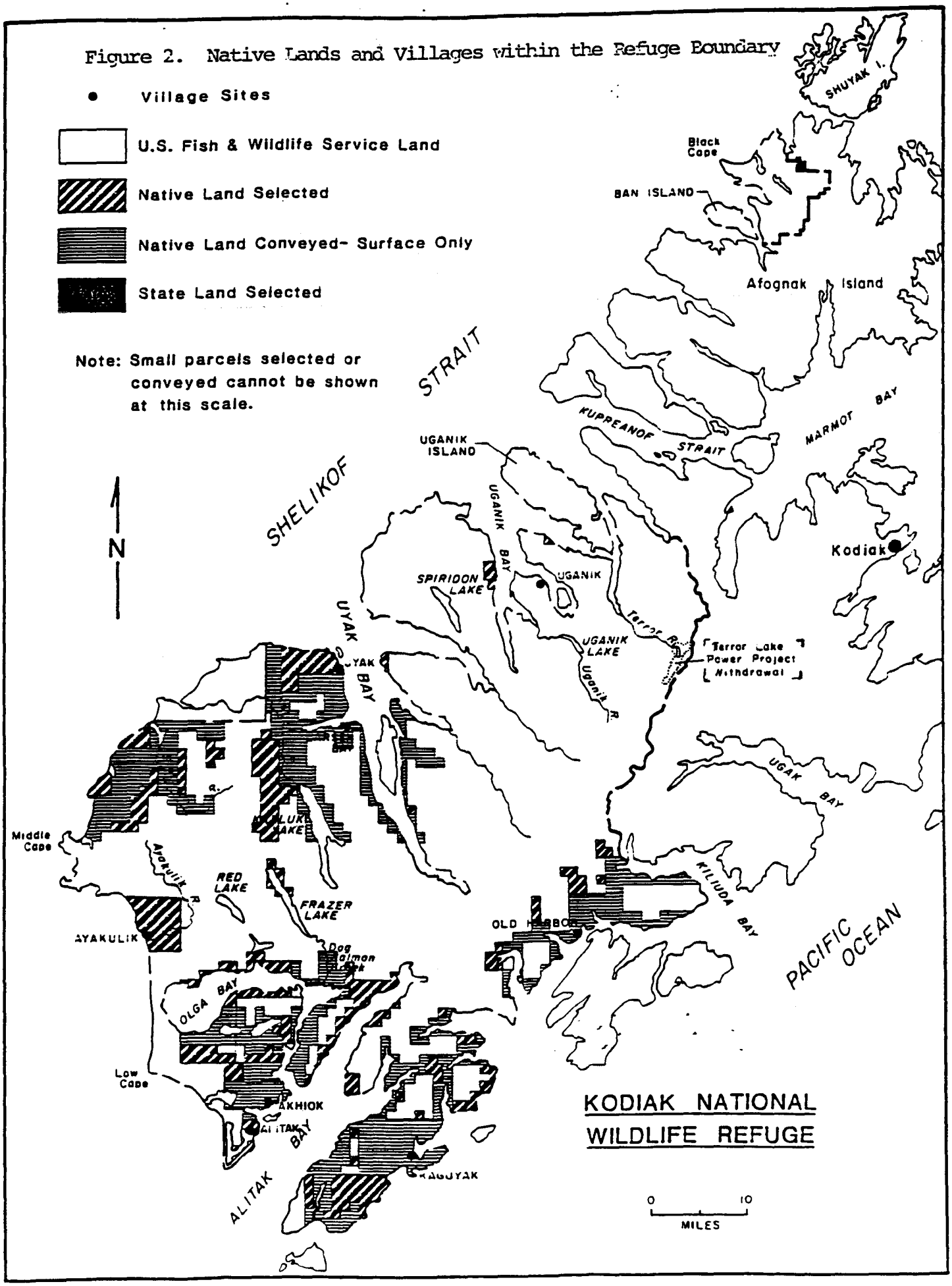


Figure 1.

KODIAK NATIONAL WILDLIFE REFUGE

Figure 2. Native Lands and Villages within the Refuge Boundary



The survey was usually conducted by two people walking parallel along the shoreline a short distance apart within different tidal zones. Periodically, each person would survey an adjacent tidal zone to sample parts of all intertidal zones within a beach segment. Another survey technique used was to deposit each person separately on adjacent parts of a beach segment and transport them by helicopter in a "leap-frog" method as each person advanced to the location where the other person began. This method was useful to survey narrow beaches, to quickly survey beaches that did not contain oil (or were lightly oiled) and to double the amount of terrain surveyed within a given time frame. Only on rare occasions did a person conduct a survey without the assistance of a co-worker. Personnel on the beach maintained radio contact with the helicopter pilot at all times when out of the pilot's line of sight. This was done for safety reasons, both in terms of personal accidents and for protection from the brown bear (Ursus arctos). All surveys were conducted during low tide cycles throughout the period from June 25 to August 24, 1990.

Beach survey information was recorded on forms identical to those used by the multi-agency, 1990 Spring Shoreline Assessment Team (SSAT). This was done to maintain continuity. The SHORELINE OILING SUMMARY form was used to record basic data for all beach segments. A SKETCH MAP form was used for most of the segments that contained oil. The form was not used when it would be of little value in depicting the location of oil, however, a map to show the approximate location of contamination was used as a substitute. A section map was prepared for each segment to show the extent of the beach segment and that part of the segment that was surveyed.

A deviation from the documentation procedures used by the SSAT did occur with the omission of the SHORELINE ECOLOGICAL SUMMARY form. This form was not included as a part of the documentation process for the following reasons:

1. limited number of personnel and need to devote full time and effort to locating oil contamination,
2. the type of ecological information requested, when applied to long beach segments with a diversity of shoreline organisms, would have provided meaningless information, and
3. the relative paucity of overall oil contamination precluded the relevance of detailed ecological information.

The SHORELINE OILING SUMMARY form contained important data relative to the environmental, geographical, and other factors, including the type and extent of oil contamination, for each surveyed beach segment. The following information was recorded:

OG and BIO - the names of the parties conducting the survey were recorded in the upper left corner following the designations "OG" and "BIO" (the term "OG" was irrelevant, as all survey participants were biologists).

SEGMENT ST/ - the beach segment number was entered. Segment numbers were standard designations specifically used by all participating agencies for Exxon Valdez oil spill purposes. Refer to Figure 3 for unit designation boundaries and Figures 4 through 9 for individual segment boundaries used in the survey.

TIME - the time(s) used to physically survey a beach segment on the date(s) of the survey was recorded. The time was rounded to the nearest fifteen-minute period.

DATE - the date(s) of the survey was recorded.

EST. SUBDIVISION LENGTH - the actual length ,in meters, of the surveyed segment was entered. The designation of "subdivision" was not applicable.

UPLANDS DESCRIPTION - the appropriate box was checked for the upland description.

SURVEYED FROM: - the appropriate box was checked relative to the method used for the survey. The box marked "Helo" was checked only to reference those segments that were not completely surveyed on foot due to inaccessible sections or for other reasons.

WORKING DIRECTION - The appropriate direction of travel along the beach was recorded.

SURFACE SEDIMENTS: - the average percentage of surface sediment types was recorded. Abbreviations were defined as follows:

R - Bedrock	B - Boulder	C - Cobble
P - Pebble	G - Granular	S - Sand
M - Mud/Silt	V - Vegetation	

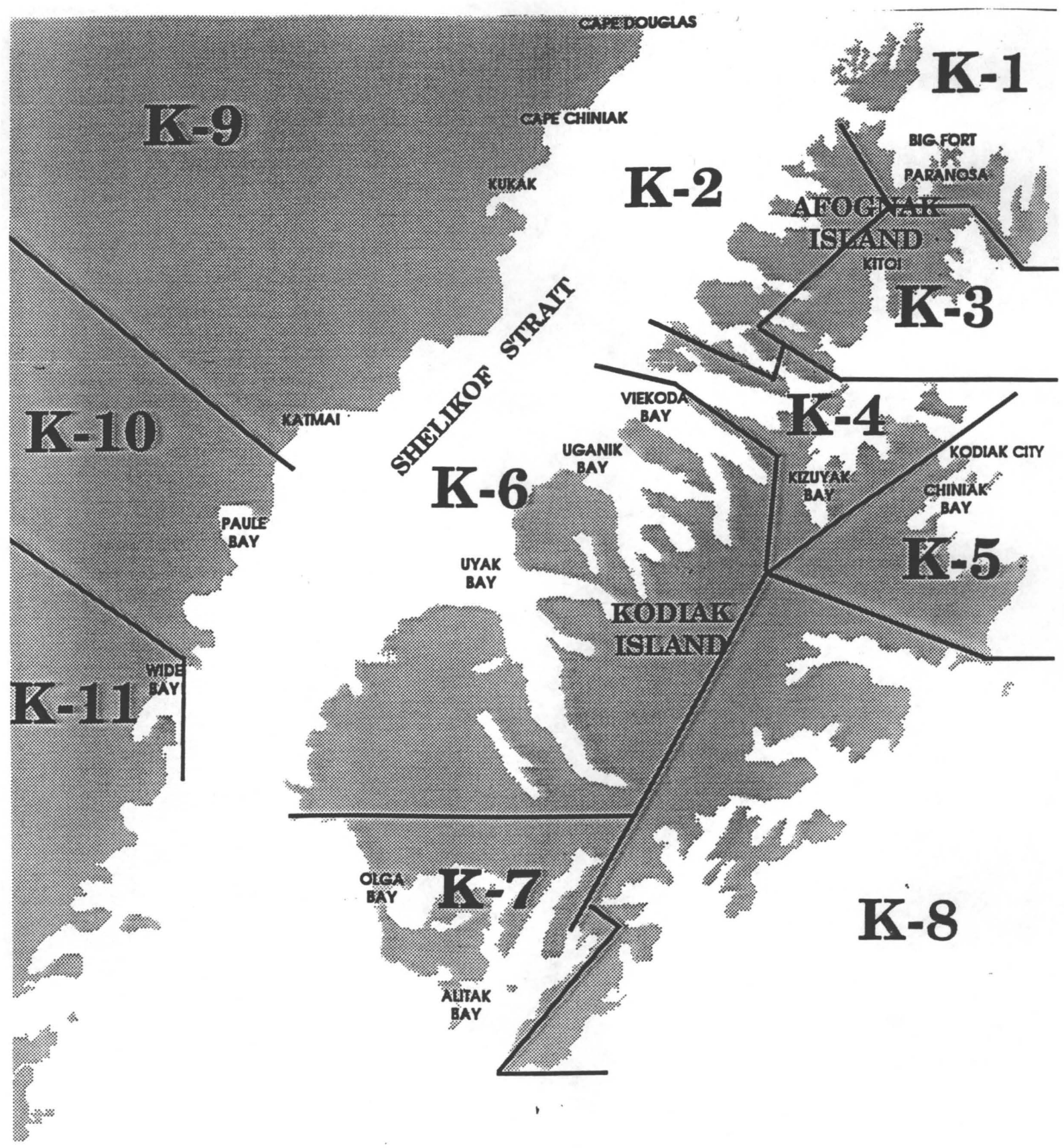


Figure 3. Beach Segment Unit Boundaries.

Kodiak Island to Chignik

SLOPE - the average percentages for slope were recorded. Abbreviations were defined as follows:

LANG - gradually sloping beach
HANG - steeply sloping beach
VERT - vertical bedrock cliffs

WAVE EXPOSURE: - the appropriate box was checked according to the following definitions:

Low - short fetch and/or narrow fetch window
Med - moderate fetch window, and
High - long fetch and/or wide fetch window

OIL CATEGORY LENGTH: - the length, in meters, was recorded according to the following definitions:

W - Wide	>6m and >50% oil cover
M - Medium	>6m and <50% oil cover or >3m to <6m and 10% oil cover
N - Narrow	<3m and >10% oil cover
VL - Very Light	<10% oil cover

SURFACE OIL - appropriate boxes were checked according to the type, distribution and color of the oil contamination and the intertidal zone of impact. Important definitions follow:

POOLED OIL (>1cm thick in rock crevices)
COVER (>1mm thick on sediments or rock)
COAT (<1mm thick; can be scratched off)
STAIN (<0.1mm thick, cannot be scratched off)
MOUSSE - a water-in-oil emulsion, light to medium brown in color, sticky, viscous with consistency of whipped chocolate pudding (may be up to 80% water)

OIL COLOR:

SBL - Shiny Black
DBL - Dull Black
GY - Gray
DBR - Dark Brown
LBR - Light Brown

FILM COLOR:

BR - Brown
RW - Rainbow
SL - Silver
TL - Translucent

TIDAL ZONES:

SU - Supratidal
UI - Upper 1/3 Intertidal Zone
MI - Middle 1/3 Intertidal Zone
LI - Lower 1/3 Intertidal Zone

PATTIES/TARBALLS - the approximate number of bags of oil contaminated materials was entered, based on each bag to contain about 35 pounds of material, including oiled substrate.

NEAR SHORE SHEEN? - the appropriate box was checked according to the presence of sheen observed near shore.

COMMENTS: - comments were entered as appropriate to any aspect of the survey.

The SKETCH MAP form was used to record a rough map of the segment, or portion of the segment, that was contaminated with oil. A "T" was used at the appropriate spot to designate the presence of contamination. An "O" was used to designate non-contaminated portions of the segment. Comments were included to further explain the nature and extent of the contamination.

A map was included for each surveyed segment. Section maps were photocopied from standard topographic maps, scale 1:63. The boundaries for each segment were designated and identified with the appropriate segment number. Portions of beach segments that were surveyed on foot were differentiated from parts that were not surveyed due to inaccessibility or other valid reasons.

A list of all beach segments for Service-administered lands on Kodiak Island is included in the Appendix. It depicts the total miles within each segment and the number of miles for each segment within the refuge. A copy of the data collected for each segment on Kodiak Island refuge lands, including the SSAT survey data, is also included in the Appendix. For ready reference purposes, the SHORELINE OILING SUMMARY form was printed on yellow paper and the SKETCH MAP was printed on beige paper (for the subject survey only). A copy of the SHORELINE OILING SUMMARY EXPLANATION form (green paper), the ABBREVIATIONS/CODES form (pink paper) and the SHORELINE ECOLOGICAL SUMMARY form (blue paper) is also included.

To reach conclusions relative to all Service-administered shoreline on Kodiak Island, extrapolation of survey data was performed in two ways. First, beach areas within segments that were skipped due to impassible terrain, such as cliff faces, were considered as non-contaminated when adjacent sections on both sides of the surveyed beach did not contain oil. In this same vein, some negotiable terrain was bypassed because previous, extensive stretches of surveyed beach were not contaminated. Again, the non-contaminated status was considered only when adjacent sections on either side of the skipped area were not

contaminated. This situation was largely confined to the Viekoda and Uganik bay areas. Second, all remaining non-surveyed refuge beaches were included in the survey on the basis that sample surveys were conducted in areas throughout the island that had a 1989 history of oil contamination. The survey samples were selected on the basis of terrain likely to entrap oil and with characteristics conducive to retention of oil contamination. However, samples did contain the various terrain types from high-energy cliff faces to low-energy sandy beaches. Information from observations and surveys conducted by various agencies and individuals in 1989 was a major consideration as to both the probable extent and location of remaining oil spill contamination. Information from reliable sources was used in selecting the areas that were surveyed. Most of the shoreline areas selected for the 1990 SSAT reviews were also based on a general history of the spill.

RESULTS

The following table depicts the extent of both the subject and the SSAT surveys:

Table 1. Extent of Beach Surveys on Service Lands, Kodiak Island.

	Segments	
	Number	Extent (miles)
Subject Survey	51 (45%)	202 (37.0%)
SSAT Survey	13 (11%)	15 (02.5%)
(not surveyed)	48 (44%)	333 (60.5%)
totals	112 (100%)	550 (100%)

A total of 112 segments were located on refuge beaches on Kodiak Island. The subject survey encompassed all or significant parts of 51 segments (45 percent). Thirteen (11 percent) of the refuge segments were reviewed by SSAT. Combined, the two independent surveys accounted for a total of 64 segments (56 percent). A total of 48 segments (44 percent) were not surveyed.

The total number of miles surveyed depicts a better perspective of coverage than the number of segments. An analysis of Service-administered shoreline on Kodiak Island, by segment, disclosed a figure of approximately 550 miles (excluding lands conveyed under the Alaska Native Claims Settlement Act (ANCSA) but including selected lands not conveyed at the time of the survey). The subject survey encompassed 202 miles (37 percent) and the survey by the SSAT covered about 15 miles (2.5 percent). A total of 217 miles (39.5 percent) of Kodiak Island refuge shoreline was surveyed in 1990 and 333 miles (60.5 percent) were not surveyed.

The six tables that follow (tables 2-7) depict the extent of oil contamination for specific areas on Kodiak Island. Names for the areas were selected on the basis of a prominent location in the vicinity. The figures were converted from meters to miles and rounded to produce the totals that appear in Table 8. With rounding, the integrity of the figures remains intact. The figures in parenthesis indicate a SSAT survey.

Table 2. Viekoda Bay. Oil contamination for the area from the refuge boundary at the mudflats of Viekoda Bay to East Point at the southern head of Uganik Passage. Uganik Island was also included (Figure 4).

Segment Number	Survey Distance (miles)	Extent of Oil Contamination
K6-02	12.0	0
K6-03	18.5	0
K6-04	10.0	0
K6-05	9.5	0
K6-05-UP004	5.5	0
K6-05-UP003	0.5	0
K6-05-UP002	1.5	0
K6-06-UG005	0.5	0
K6-06-NP001	0.5	0
K6-06-NP002*	0.5	0
K6-06-NP003	0.5	0
K6-07-UG050	6.0	0
K6-07-UG051	6.0	0
totals	71.5	0

Table 3. Uganik Bay. Oil contamination for the area from East Point to Broken Point at the southern head of Uganik Bay. It included the Northeast, East, and South arms of Uganik Bay (Figure 5).

Segment Number	Survey Distance (miles)	Extent of Oil Contamination
K6-09	4.0	0
K6-10	20.0	2.8
K6-11	2.5	0
K6-12	12.0	0
K6-13	16.0	0
K6-14	11.0	1.25
K6-15-MP006	2.5	0.25
K6-15-MP005	2.5	0
K6-15-MP004B	3.0	0
totals	73.5	4.30

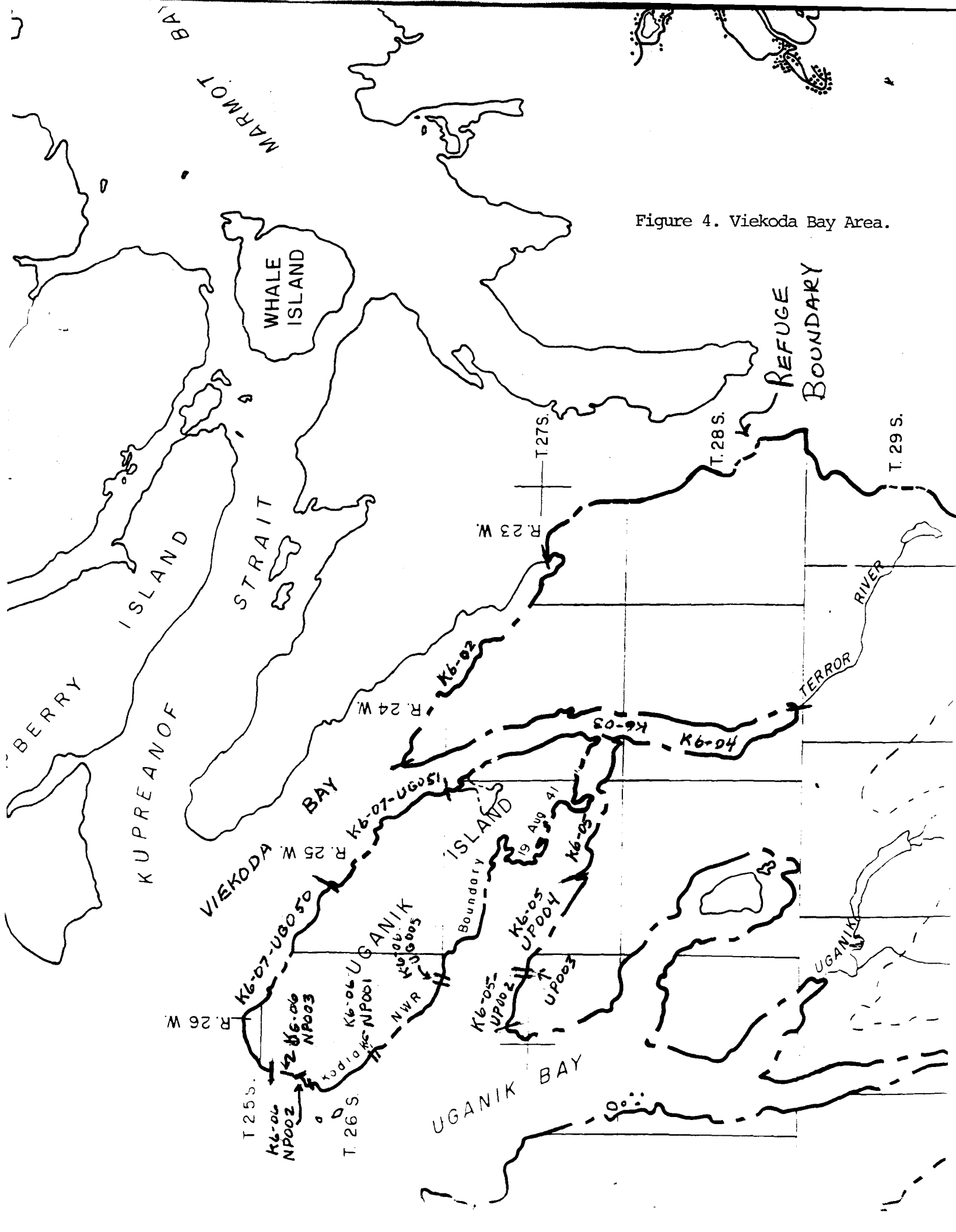


Figure 4. Viekoda Bay Area.

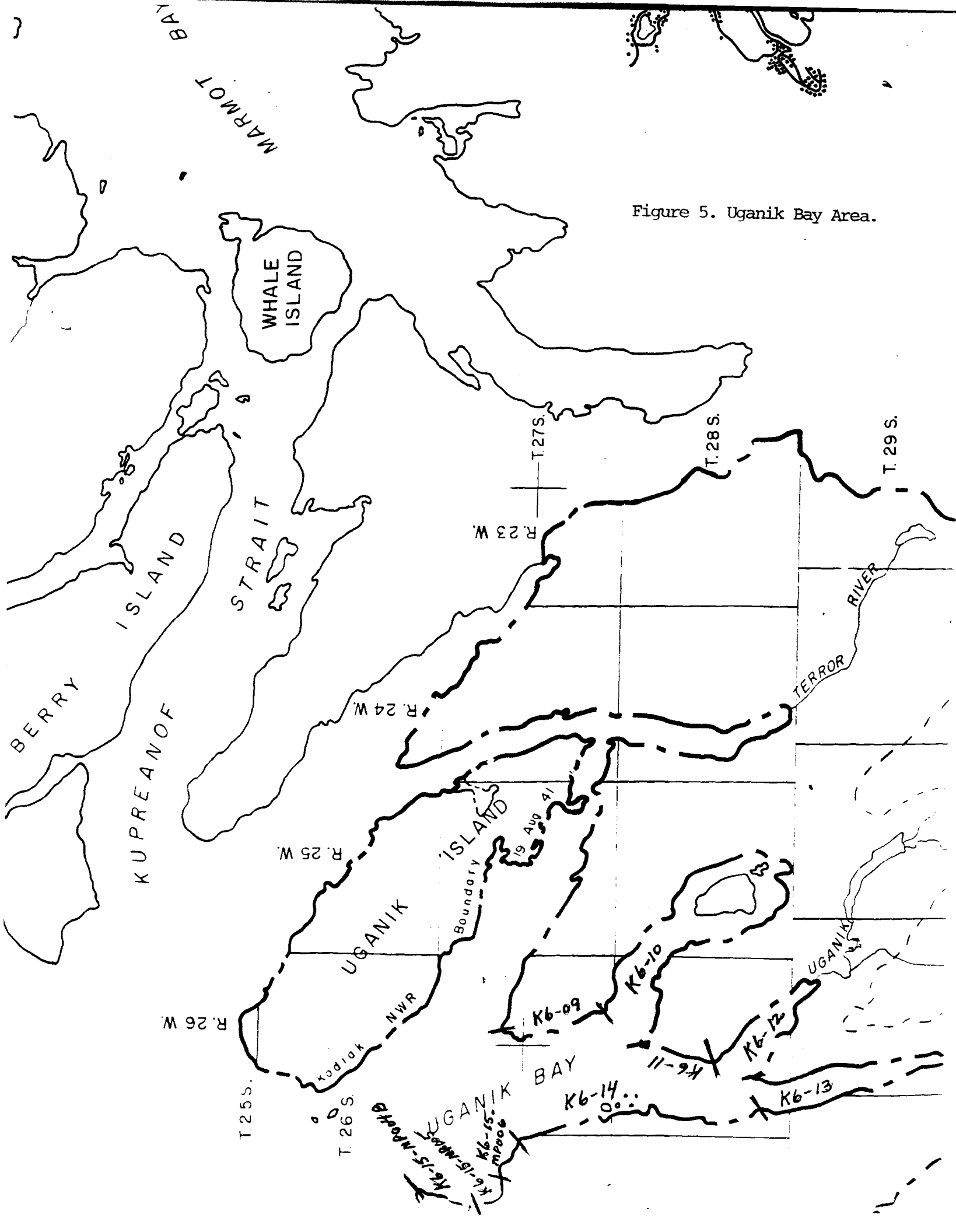


Figure 5. Uganik Bay Area.

Table 4. Spiridon Peninsula. Oil contamination for the Spiridon Peninsula from Broken Point to Hook Point on the north side of Spiridon Bay (Figure 6).

Segment Number	Survey Distance (miles)	Extent of Oil Contamination
K6-16-MP004A	3.00	0
K6-16-MP003	0.50	0
K6-16-MP002	3.25	0
K6-16-MP001	1.00	0.06
K6-17-MP007	7.00	0
K6-18-TC901	6.00	0
K6-19-CK001*	0.50	0
K6-19-CK002	0.75	0
K6-19-CK003*	2.00	0
K6-19-CK004	2.00	1.50
K6-19-SB006*	0.50	0.12
K6-19-CK005*	2.00	1.86
K6-20-SB010	0.50	0.16
K6-20-SB005*	2.50	1.49
K6-20-SB004	1.00	0.24
K6-20-SB007	1.00	0.06
K6-20-SB003*	0.50	0.03
K6-20-SB002*	0.25	0.05
K6-20-SB001*	0.25	0.15
K6-20-SB011	1.50	0.50
totals	36.00	6.22

Table 5. Karluk. Oil contamination for the area from Seven Mile Beach at the southern head of Uyak Bay to Cape Ikolik (Figure 7).

Segment Number	Survey Distance (miles)	Extent of Oil Contamination
K6-31-SM032	0.5	0.08
K6-31-SM001	0.5	trace
K6-32-RP001	1.0	0
K6-33	1.0	0
K6-34-SL015*	1.5	0.05
K6-34-SL016*	1.0	0
K6-34-SL017*	1.0	0
K6-34	2.5	0
K6-35	3.0	0
K6-36	1.0	0
totals	13.0	0.13

Figure 6. Spiridon Peninsula Area.

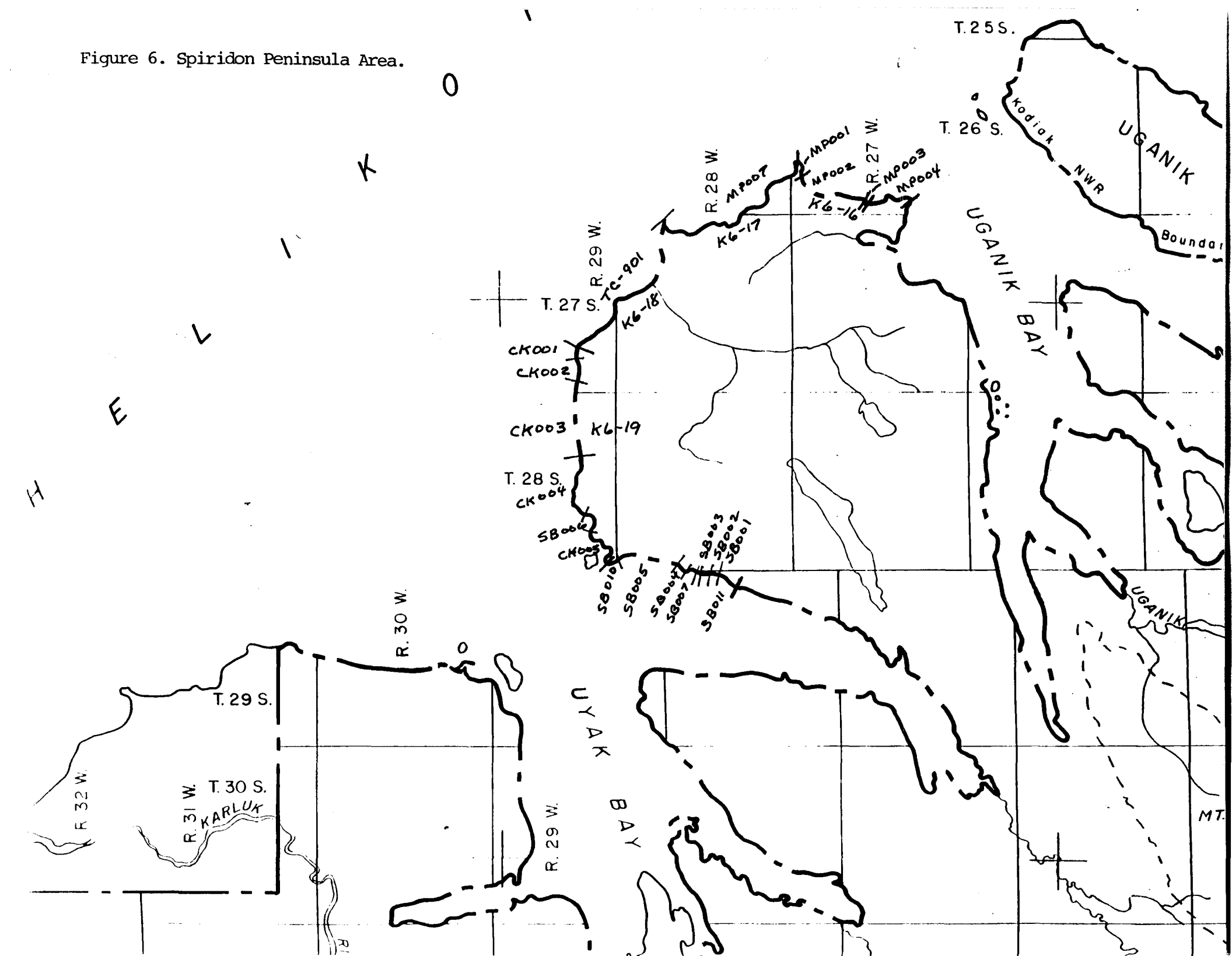


Figure 7. Karluk Area.

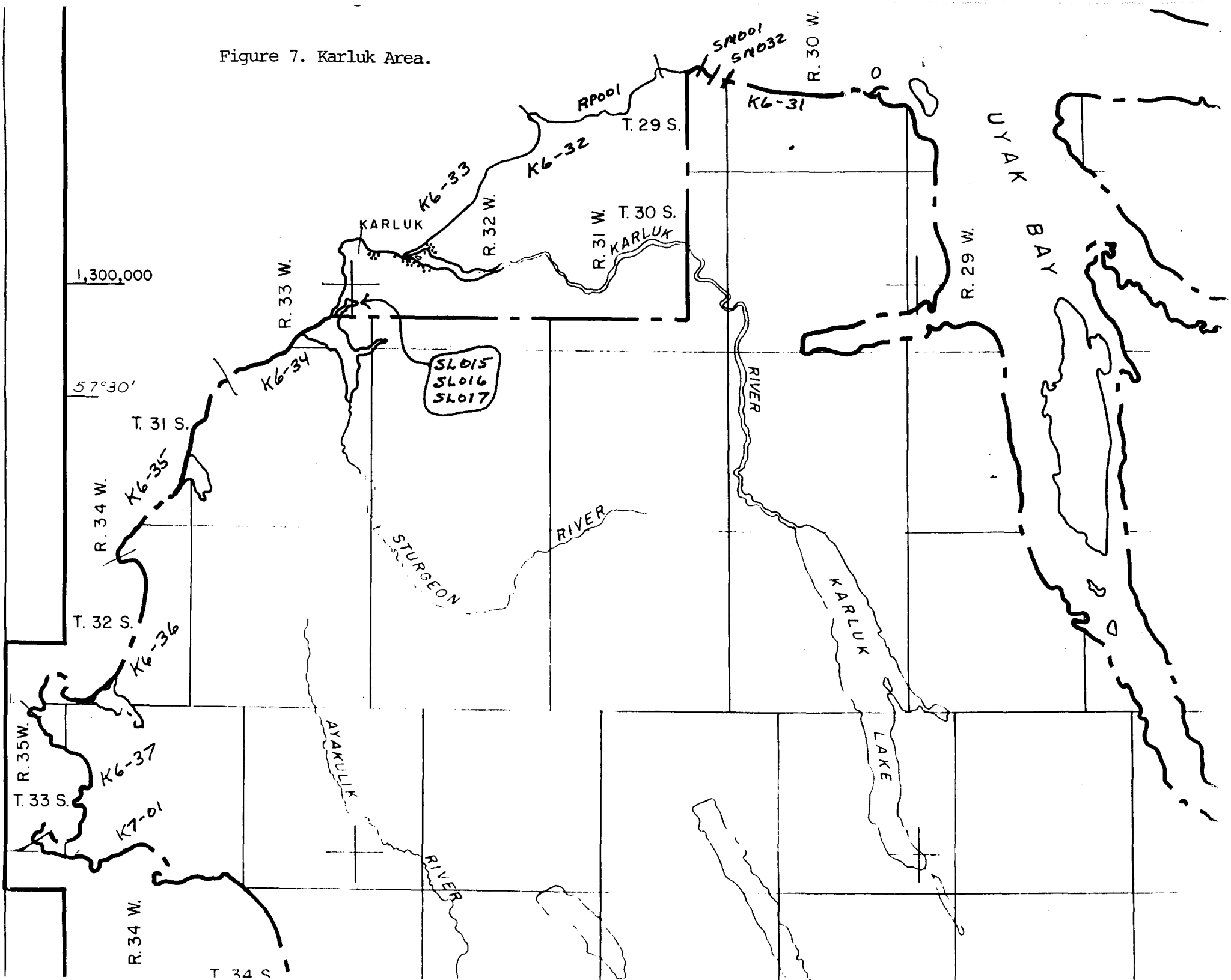


Table 6. Alitak Bay. Oil contamination from Cape Ikolik to Cape Trinity (Figure 8).

Segment Number	Survey Distance (miles)	Extent of Oil Contamination
K7-03-LC005*	2.5	0
K7-03-LC007	1.0	0.06
K7-04	1.0	0.05
K7-09-AL105	1.0	0
K7-12-AL100	5.0	1.74
totals	10.5	1.85

Table 7. Old Harbor. Oil contamination from Cape Trinity north along the southeast part of Kodiak Island to the southern head of Kiliuda Bay (Figure 9).

Segment Number	Survey Distance (miles)	Extent of Oil Contamination
K8-26	1.0	0
K8-17	2.0	0
K8-16	1.5	0
K8-13	3.0	0
K8-12	2.0	0
totals	9.5	0

Table 8. Summary of Oil Contamination for All Areas (expressed in miles).

Area	Survey Distance	Extent of Oil Contamination	No Oil
Viekoda Bay	71.5	0	71.50
Uganik Bay	73.5	4.30	69.20
Spiridon Peninsula	36.0	6.22	29.78
Karluk	13.0	0.13	12.87
Alitak Bay	10.5	1.85	8.65
Old Harbor	9.5	0	17.50
totals	222.0	12.50	209.50

Oil contamination was found on a total of 12.5 miles of Service lands on Kodiak Island that were accessed by both the subject and the SSAT surveys. No oil contamination was located on 209.5 miles.

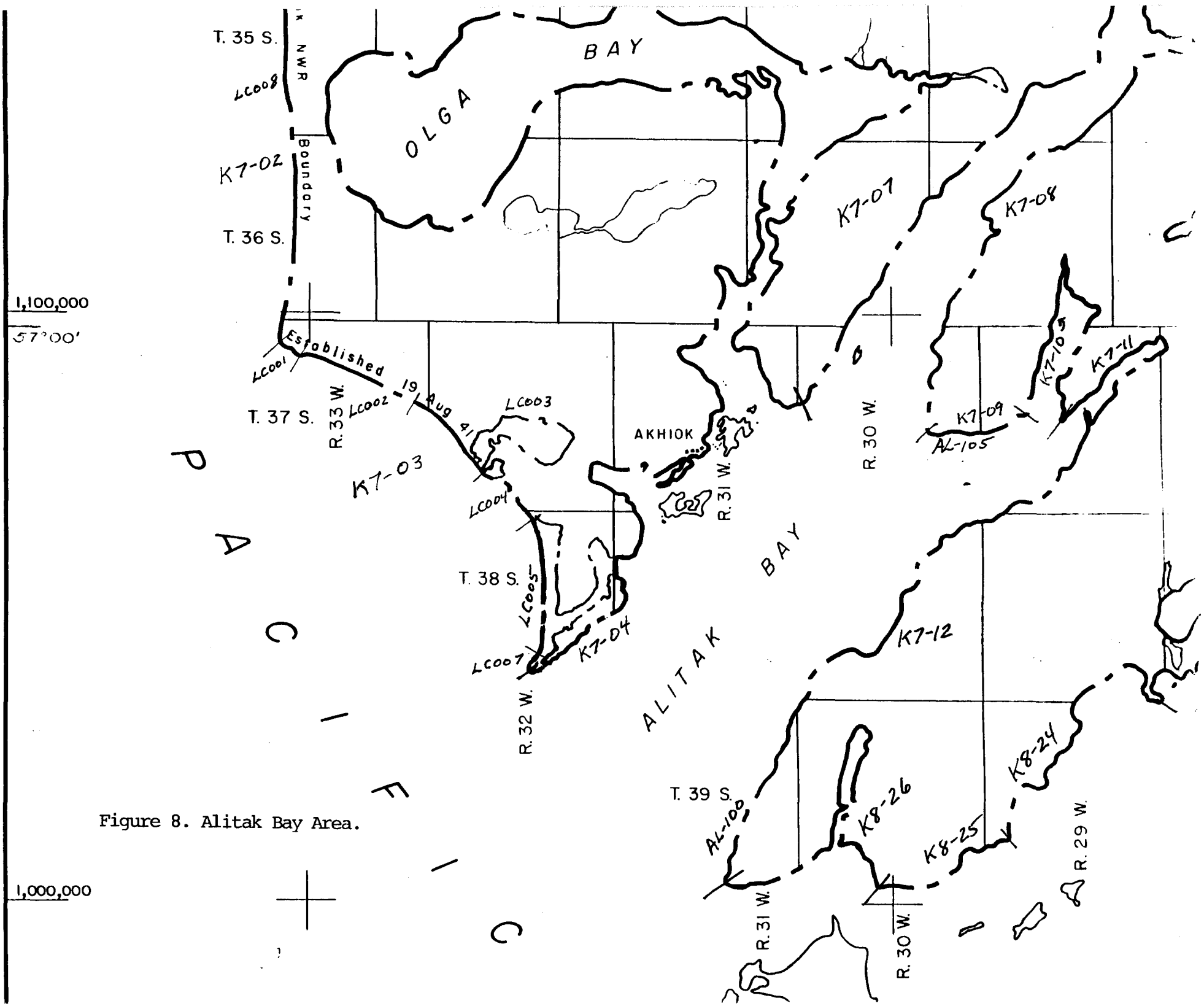


Figure 8. Alitak Bay Area.

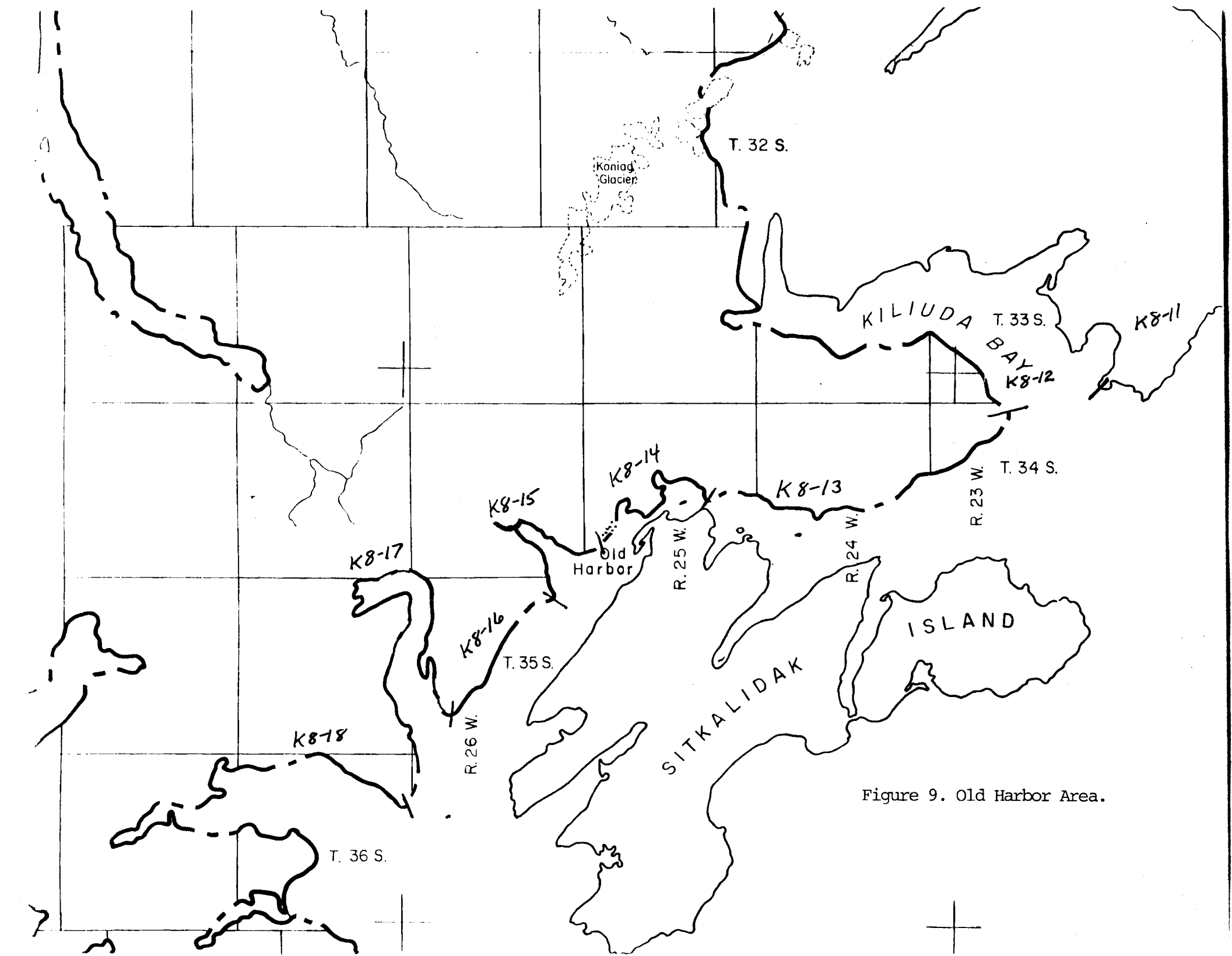


Figure 9. Old Harbor Area.

The following table depicts the extent of oil contamination in terms of category length. Refer to the definitions for Category Length in the METHODS section. The figures are expressed in miles:

Table 9. Extent of Oil Contamination by Category Length

	Oil Contamination by Category Length				Survey
	moderate	narrow	very light	none	Distance
Subject Survey	0.05	0.20	8.50	193.25	202
SSAT Survey	0	0	3.75	11.25	15
totals	0.05	0.20	12.25	204.50	217

Fifteen of the beach segments surveyed by the subject project contained oil contamination which amounted to the equivalent of 8.75 total miles. All but approximately 0.25-mile was placed in the "very light" category. The remaining 193.25 miles were not contaminated. The SSAT survey revealed that 3.75 miles of Kodiak Island refuge shorelines were contaminated and the remaining 11.25 miles were free of contamination. Thus, approximately 204.5 miles of shoreline were not contaminated while about 12.25 miles did contain "light" contamination. Oil contamination on 2 miles reported by the SSAT survey was removed, however, in June 1990, decreasing the contaminated figure to 10.5 miles and increasing the non-contaminated figure to 206.5 miles.

Table 10 is a summary of the 1990 surveys conducted by both the subject and the SSAT surveys. It takes into account the 2 miles of Service-administered shoreline that was cleaned in 1990 following the SSAT surveys.

Table 10. Summary of 1990 Surveys (expressed in miles).

	Distance Surveyed	Extent of Oil Contamination	No Oil
Totals	217	10.5	206.5

The table that follows (Table 11) shows mileage differences between surveyed and non-surveyed shorelines from the Viekoda Bay boundary on the west to the eastern boundary at Kiliuda Bay. Refer to Figure 10 for a map that shows the described areas.

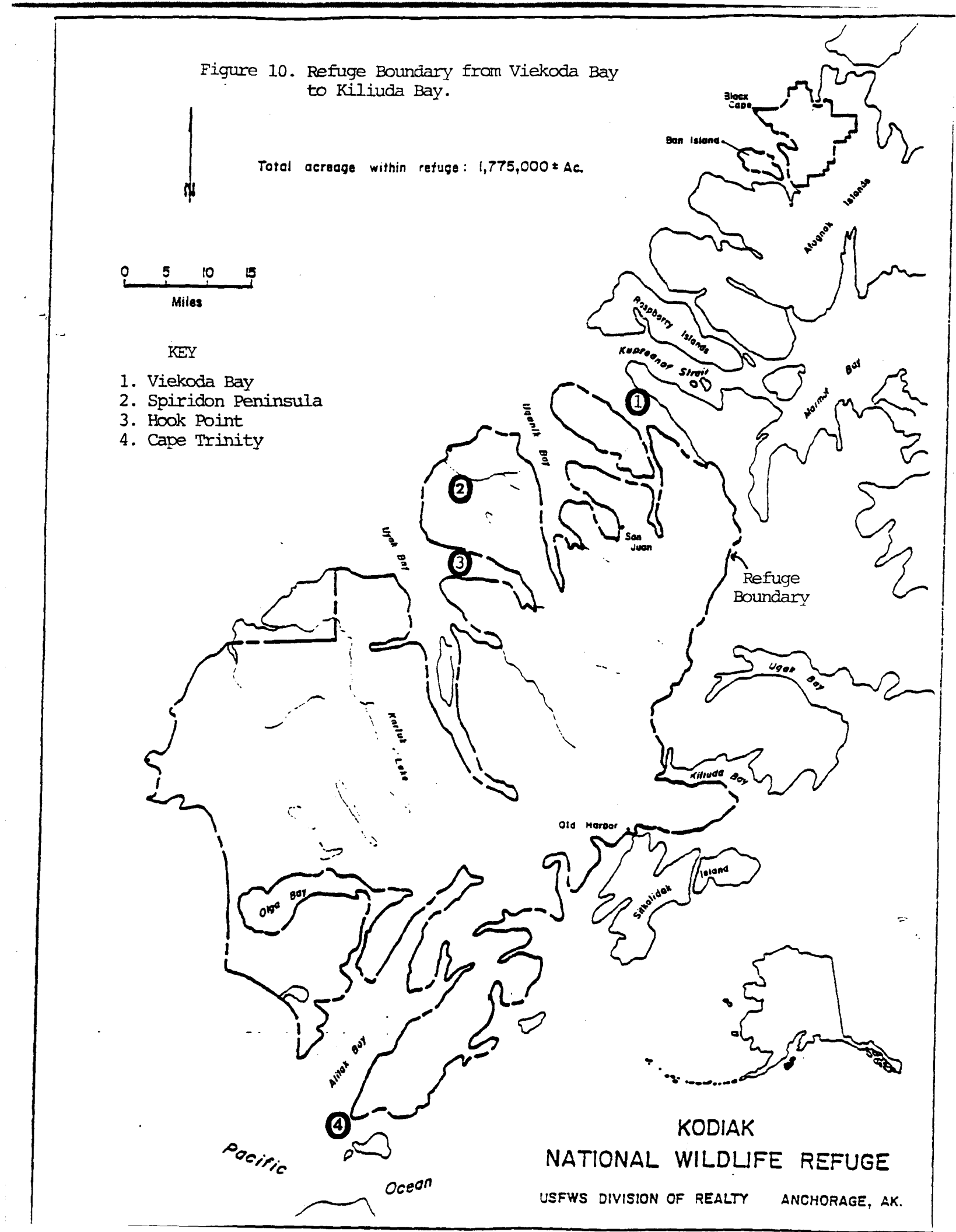
Table 11. Difference (in miles) between Surveyed and Non-Surveyed Refuge Lands on Kodiak Island From Viekoda Bay to Kiliuda Bay.

Area	Refuge Lands (miles) In Unit	Surveyed	Not Surveyed
Viekoda Bay to Hook Point	195.5	181.0	14.5
Hook Point to Cape Trinity	304.5	26.5	278.0
Cape Trinity to Kiliuda Bay	50.0	9.5	40.5
totals	550.0	217.0	333.0

The most extensively surveyed part of Service-administered beaches on Kodiak Island occurred from the refuge boundary at Viekoda Bay to Hook Point in Spiridon Bay (figures 4 through 6). A total of about 181 miles were surveyed out of a total of 195.5 miles in that area. From Hook Point to Cape Trinity, however, a total of only 26.5 miles was surveyed out of a total of 304.5 miles of refuge shoreline (figures 7 and 8). The remaining 278 miles were not surveyed. From Cape Trinity to Kiliuda Bay, only 9.5 miles was surveyed out of 50 miles of refuge shoreline (Figure 9). The remaining 40.5 miles were not surveyed. Based on sample surveys of shoreline types most likely to retain oil contamination within areas with a known oil spill history, survey conclusions were extrapolated to include the non-surveyed beaches.

In summary, with extrapolation, the results from 217 miles of surveyed beaches indicated that a total of approximately 10.5 miles of shoreline remained contaminated out of about 550 miles of Service-administered beaches on Kodiak Island.

Figure 10. Refuge Boundary from Viekoda Bay to Kiliuda Bay.



DISCUSSION

Oil contamination, from the Exxon Valdez spill, that remained on refuge-administered beaches on Kodiak Island in 1990 was found mainly in rocky crevices and adjacent sand or gravel areas that were sheltered from storm tides. The first prerequisite for remaining oil contamination appeared to be a protected area, usually in one of the upper tidal zones, that received the oil on a high tide. The oil settled in cracks, crevices and interstices of rocks, or in sand or gravel, that was protected from the influence of storm tides. There it remained, while other oil contamination was either flushed by storm tides or buried in sand or gravel. One of the visible clues used by the survey team to locate contamination was the presence of coat and/or stain on rock surfaces in protected areas of the beach, usually confined to the upper tidal zones.

The area from Viekoda Bay to Hook Point in Spiridon Bay received the most survey attention because of its history of contamination in 1989. The Spiridon Peninsula was particularly hard hit and the 1990 survey results substantiated that fact. Remaining oil contamination amounted to a total of 6.22 miles; 17 percent of the total distance of 36 miles of beach. The beaches consisted of rocky, protected areas particularly conducive to the retention of oil contamination. The second hardest hit area was Uganik Bay, including Uganik Island. The total area consisted of 73.5 miles with a total of about 4.3 miles (6 percent) of oil contamination remaining. Again, protected rocky areas were present along the coastline, although not as numerous as those on the Spiridon Peninsula. The 71.5 miles within Viekoda Bay did not have any contamination.

Except for Sturgeon Lagoon, the Karluk area was not hard hit by oil. Most of the 73 miles of beach, from the western head of Uyak Bay at Harvester Island to Gurney Bay, consisted of high energy, rocky cliff faces with relatively few protected areas for the retention of oil contamination. Sample surveys along a total area of 13 miles disclosed less than 0.2-mile of remaining contamination on Service-administered lands.

The shoreline from Cape Ikolik to Cape Alitak was comprised largely of 42 miles of cobble, pebble and sandy beaches that contained few protected areas for the retention of oil contamination. The only areas with an oil spill history were the rocky, protected beaches that were intermingled with the high energy cliff faces at Cape Alitak. Sample surveys at the cape disclosed that a trace of oil contamination was still present.

The Alitak Bay area, from Cape Alitak to Cape Trinity, contained a total of 76 miles of Service-administered coastlands, excluding the 28 miles of isolated, sheltered refuge lands within Olga Bay. Within the area, only Cape Trinity had an oil spill history. The 5-mile stretch of refuge coastline contained ideal conditions for the retention of oil contamination with numerous rocky areas protected from storm tides at the upper tidal levels. Remaining oil contamination was found throughout the surveyed length of Cape Trinity and amounted to a total of almost 2 miles.

The 42 miles of refuge shoreline on the southeastern section of Kodiak Island, from the refuge boundary an Kiliuda Bay to Cape Trinity, had no history of contamination from the oil spill. However, 9.5 miles of refuge lands within the section were surveyed. The survey samples consisted of rocky coastline and adjacent sandy areas that were conducive to the retention of oil contamination. No oil contamination was found.

The results of both the subject and the SSAT surveys disclosed that a total of approximately 10.5 miles of refuge-administered beaches on Kodiak Island remained contaminated with oil as of the end of August, 1990. Contamination amounted to about 5 percent of the 217 miles of surveyed shoreline on Kodiak Island. Virtually all of the remaining oil contamination was in the "very light" category. The survey conclusions have a basis for application to all Service-administered coastline on Kodiak Island. With extrapolation, based on the information presented, a total of approximately 10.5 miles (less than 2 percent) remain contaminated out of about 550 miles of refuge shoreline.

In general terms, marine shoreline organisms appeared to be little affected by the remaining oil contamination. Various species of barnacles, mussels, snails, limpets, sculpin and other marine life were observed in pools that contained mousse and other forms of oil contamination. In terms of populations, they appeared to be healthy and unaffected by the presence of the oil. Only a few individual barnacles, mussels and snails appeared to have died as a result of the oil contamination. The overall healthy status of the observed marine populations was attributed to the paucity of oil contamination in pools and the fact that only a small fraction of the available pools were contaminated.

Migratory birds and sea otters observed on and near beaches throughout the survey period appeared healthy. There were no bird or sea otter carcasses observed or reported from Kodiak Island that could be attributed to oil contamination resulting from the Exxon Valdez oil spill. Therefore, in conclusion, a relatively insignificant amount of oil contamination was found on refuge-administered shorelines on Kodiak Island, as of September 1990,

to jeopardize the health and welfare of either marine flora and fauna or migratory birds and the sea otter.

ACKNOWLEDGEMENTS

The survey would not have been possible without the hard work, dedication and effort of Otto Florschutz. His contribution is especially appreciated. Other significant survey contributors were Dick Wydoski and Bill Jones. At the conclusion of the survey, Bill Jones' assistance with the sheen survey was outstanding. The success of the study and with writing the report is attributed to Bill's efforts. Appreciation is expressed to the Kodiak National Wildlife Refuge staff, especially to Refuge Manager Jay Bellinger and Assistant Manager Dick Munoz. While their support took many forms, it all added up as a major contribution to both the contamination survey and the sheen study.

SHEENING STUDY

A sheening study was conducted in mid-August 1990 to assess potential oiling problems to migratory birds and the Sea Otter, (Enhydra lutris). Seventeen areas were originally identified as potential candidate sites to assess the degree and magnitude of sheening. The sites were selected and arranged in priority order based on both the magnitude of oil contamination and the degree of wildlife resource values. However, a study of three of the top five sites disclosed sufficient information to draw conclusions and the remaining sites were not surveyed. The top five sites were Tugidak Island (K07-13-TI001), Perevalnie Cove (K01-10-SI003) on Shuyak Island, Chief Cove (K06-20-SB005) on Kodiak Island, Foul Bay (K02-04-FB003) on Afognak Island, and the south beach of Little Fort Island (K01-01-SI011A) off the east coast of Shuyak Island. Except for the Tugidak Island location, the sites were heavily contaminated with oil in 1989. Oil contamination was removed from all of the sites in 1989 and an additional cleaning operation was conducted at the Perevalnie Cove and Little Fort Island areas during the last week of July 1990. Although most of the recoverable oil contamination was removed, significant amounts of nonrecoverable oil, in the form of coat, stain and mousse, remained on rocks and in crevices and interstices of rocks.

The type of oil present with the highest potential to contribute significant sheen was lightly weathered mousse. Localized areas at the three sites that contained the heavier amounts of mousse were selected for observation. The specific objectives were to determine the degree and magnitude of sheening and to see if sheen produced in localized areas would coalesce and form a broader continuous band along the water-shoreline interface in amounts significant to adversely affect wildlife.

Because of ideal weather conditions to produce sheen at Perevalnie Cove, Chief Cove and Little Fort Island (August 19, 25 and 26, respectively) observations at these three areas represented the worst case scenario. Both the Chief Cove and Little Fort Island sites had a southwest exposure and received maximum sun and warming during the tidal slack. At Little Fort Island, temperature at the ground surface (measured on the surface of dark colored rock) was 88 degrees F., ambient air temperature was 73 degrees F. and surface water temperature (measured at low tide at the water-shoreline interface) was 66 degrees F. Similar temperatures existed at both Perevalnie and Chief coves. At Little Fort Island, oozing of mousse and the smell of oil was evident. Conditions were ideal for observation. All areas were protected from prevailing winds so that rising

tide flushes were gentle and produced no foam. During the observation period there was full direct sunlight.

Observations at the three sites were as follows:

1. Small, permanent, intertidal pools that contained mousse had a rainbow sheen. The sheen on small pools (such as those less than a few square inches in area) completely covered the surface while only partial coverage was noted on larger pools. Coverage in one pool (1M x 3M) was estimated at 10 percent.

2. The initial flush of water and subsequent flushing events (those immediately prior to complete inundation of the mousse) produced sheening.

3. The form of the sheen produced varied from small irregular patches on the flush that changed to trailing fingers on the ebb.

4. The areal extent of sheening was minor. Generally with the initial flush, a small sheen was produced and the sheen vacillated with the flush/ebb cycle. With tidal flushing the sheen moved toward shore and with the tidal ebb moved outward. The greatest distance sheen was observed to move was about 4 feet (from end of flush to end of ebb). However, in most instances mousse produced a sheen covering an area of less than 1 square foot.

5. When mousse was completely inundated and not affected by flushing action, sheening ceased. With higher water levels, the sheen produced during flushing disappeared.

6. Sheen produced from localized areas did not coalesce or intermingle to form a continuous band of sheen along the water-shoreline interface.

7. The location of the oiled contamination was at the upper end of the lower intertidal zone and the middle intertidal zone. Some contamination also occurred in the upper and supratidal levels at the Perevalnie site.

While not present during the observation period, four species of shorebirds typically inhabited the rocky shoreline habitat prevalent at the sites. The four species were the Black Oystercatcher (Haematopus bachmani), Wandering Tattler (Heteroscelus incanus), Black Turnstone (Arenaria melanocephala), and Rock Sandpiper (Calidris ptilocnemis). Each of the four species was common during the spring and summer months (with the

exception that the Rock Sandpiper was uncommon in the summer). Observations of the four species along numerous beach segments throughout the spring and summer months disclosed that each of the species frequented the rocky areas covered with fucus within the lower intertidal zone. This observation was significant to the point that the oil contamination that produced sheen at the study sites and in other areas was located immediately above the tidal line inhabited by the fucus. Thus, individuals of the four species would appear to have limited direct contact with sheen produced within the intertidal pools at beach levels higher than they frequented. Other species of shorebirds that appeared along the beaches as migrants also were observed to occupy habitats below the zones where the sheen occurred. Snails (Nucella sp.) and sculpins (Oligocottus sp.) were noted in the tidal pools where sheen occurred. They did not appear to be adversly affected by the oil contamination. Sea otters were not present at or near the sites during the observation period.

Based on the above observations, as well as those made at several cleanup monitoring sites, sheening was minute and dissipated so rapidly with the large volumes of sea water that it was not viewed as a hazard to birds or the Sea Otter. Furthermore, shorebirds frequented intertidal areas below the oil contaminated zones, thus decreasing the likelihood of contact with sheen.

Observations for sheen were dismissed at both Foul Bay and Tugidak Island because oil contamination was not evident at the Foul Bay site and reduced to only one weathered mousse patty at the Tugidak Island site.

APPENDIX

U.S. FISH AND WILDLIFE SERVICE LANDS

KODIAK ISLAND BEACH SEGMENT LIST

Segment No.	Location	Unit Extent (miles) Total	Refuge*
K5-04-SP903	WOMANS BAY	6.0	6.0
K5-05-SP904	HOLIDAY BAY	3.0	3.0
K6-02	ROLLING POINT	12.0	12.0
K6-03	SEAPLANE	18.5	18.5
K6-04	TERROR BAY	10.0	10.0
K6-05			
K6-05-UP001			
K6-05-UP002			
K6-05-UP003			
K6-05-UP004	EAST POINT	17.0	17.0
K6-06-NP001			
K6-06-NP002			
K6-06-NP003			
K6-06-NP004			
K6-06-NP005			
K6-06-UG001			
K6-06-UG002			
K6-06-UG003			
K6-06-UG004			
K6-06-UG005			
K6-06-UG006			
K6-06-UG007			
K6-06-UG008			
K6-06-UG009	E UGANIK ISLAND	21.0	21.0
K6-07-UG050			
K6-07-UG051			
K6-07-UG052	W UGANIK ISLAND	18.0	18.0

* includes lands selected, but not conveyed, under the Alaska Native Claims Settlement Act and also tideland responsibilities

Segment No.	Location	Unit Extent Total (miles)	Refuge
K6-08	TWO CONE POINT	0.0	0.0
K6-09	MESA ROCKS	4.0	4.0
K6-10	NORTHEAST	20.0	20.0
K6-11	ROCK POINT	2.5	2.5
K6-12	EAST ARM	12.0	12.0
K6-13	SOUTH ARM	16.0	16.0
K6-14	VILLAGE ISLAND	11.0	11.0
K6-15-MP004B K6-15-MP005 K6-15-MP006	CAMPBELL LAGOON	8.0	8.0
K6-16-MP001 K6-16-MP002 K6-16-MP003 K6-16-MP004A	MINERS POINT	4.5	4.5
K6-17-MP007	CAPE UGAT	7.0	7.0
K6-18-TC901	TWO CONE POINT	6.0	6.0
K6-19-CK001 K6-19-CK002 K6-19-CK003 K6-19-CK004 K6-19-CK005 K6-19-SB006 K6-19-SB100	CHIEF POINT	8.0	8.0
K6-20-SB001 K6-20-SB002 K6-20-SB003 K6-20-SB004 K6-20-SB005 K6-20-SB007 K6-20-SB008 K6-20-SB009 K6-20-SB010 K6-20-SB011 K6-20-SB012	HOOK POINT	19.0	19.0

Segment No.	Location	Unit Extent (miles) Total	Refuge
K6-21	ANGUK ISLAND	19.0	19.0
K6-22	CANNERY	13.0	13.0
K6-23	CARLESON POINT	10.0	4.0
K6-25	AMOOK BAY	8.0	3.0
K6-26	UYAK BAY	29.0	21.0
K6-30	HARVESTER	13.0	4.5
K6-31-SM001 K6-31-SM032	SEVENMILE BEACH	8.5	8.5
K6-32-RP001	ROCK POINT	24.0	24.0
K6-33	KARLUK	19.0	19.0
K6-34-SL013 K6-34-SL015 K6-34-SL016 K6-34-SL017	STURGEON LAGOON	13.0	6.0
K6-35	GRANT LAGOON	4.0	3.0
K6-36	HALIBUT BAY	15.0	5.0
K6-37	GURNEY BAY	8.0	8.0
K7-01-LC012 K7-01-LC013	BUMBLE BAY	7.0	7.0
K7-02-LC001 K7-02-LC008 K7-02-LC009 K7-02-LC010 K7-02-LC011	AYAKULIK	22.0	20.0
K7-03-LC001 K7-03-LC002 K7-03-LC003 K7-03-LC004 K7-03-LC005 K7-03-LC006 K7-03-LC007	SUKHOI LAGOON	15.0	15.0

Segment No.	Location	Unit Extent (miles) Total	Refuge
K7-04-LB001	LAZY BAY	22.0	22.0
K7-05-AL101	ALITAK BAY	22.0	2.0
K7-06	MOSER BAY	78.0	28.0
K7-07	BRUIN REEF	19.0	19.0
K7-08	IVOR COVE	21.0	21.0
K7-09	CAPE HEPBURN	3.5	3.5
K7-10	SULUA BAY	10.0	3.0
K7-12-AL100	SHAG BLUFF	23.0	6.0
K8-12-KL004	KILIUDA BAY	45.5	2.0
K8-13-SX001	GHOST ROCKS	12.5	3.0
K8-16	BARCLAY	6.0	1.5
K8-17	THREE SAINTS BAY	21.0	7.0
K8-18	KAIUGNAK BAY	22.0	8.0
K8-19-KX001	CAPE KIAVAK	6.0	3.0
K8-20-KA002 K8-20-KO001	KNOLL BAY	5.5	5.5
K8-21	JAP BAY	10.5	2.5
K8-24	BOOT POINT	10.0	6.0
K8-25	ALIULIK PENISULA	5.0	1.0
K8-26	RUSSIAN HARBOR	6.5	2.5
	TOTALS	800.0	550.0