PRELIMINARY LAND MANAGEMENT

PROPOSALS FOR THE MENDENHALL RIVER WETLANDS

Submitted By:

Alaska Department of Fish and Game

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ACKNOWLEDGMENT

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INTRODUCTION

During the year 1966, the Alaska Department of Fish and Game has become increasingly concerned over the continual encroachment, development, and changing land uses on the Mendenhall River tidelands. Although the continued land disposal of adjacent uplands has always been a problem and the construction and expansion of the Juneau Municipal Airport has resulted in the loss of valuable wetlands, no period of land development in this area promises to be as destructive to the recreation potentials as the present one. Many proposals have recently been made which could have a combined effect of destroying one of the community's most attractive natural recreation areas.

The Juneau tidelands cover an area of around 6,000 acres and provide recreation and natural product values exceeding 150,000 dollars annually. These tidelands are unique in that they are practically within the confines of a modern city. Other cities have recognized the value of maintaining waterfowl habitat and sanctuaries within the city limits, but probably no other American city has had the opportunity to preserve and offer hunting and other outdoor recreation so close to the center of population. With careful planning Juneau can preserve this recreational asset without interfering with the growth and development of the city.

The preservation of waterfowl habitat in Juneau is not a conflict between people and wildlife. If the habitat deteriorates the birds will go elsewhere, and the net loss will be only to the many people of Juneau who now use the area. These same people will have to do without this recreation or indulge in expensive travel to enjoy the same type of recreational activity. This would constitute an especially keen loss to the younger citizens who have derived many hours of healthful exercise and recreation on the tide flats.

The tidelands today are used by numerous hunters, bird watchers, dog owners, flower pickers, and hikers. As Juneau grows and becomes more urbanized, the demand for this type of recreation will increase. The community should be reminded of similar situations where recreational values or aesthetic values have forced large cities to reclaim valuable lands for public parks. In generations ahead a tidelands park in the center of Juneau may well be the city's most desirable and unique feature.

The Alaska Department of Fish and Game is responsible for the management of Alaska's fish and wildlife and thus is obligated to advise the public and other agencies on matters pertaining to these resources. As the loss of the Juneau wetlands area would result in the loss of valuable waterfowl habitat and

related public recreation, the Department has initiated a study program for the purpose of providing this professional advice and leadership. Because of the importance of accessible flatlands to the community's development, all agencies and organizations have been contacted and efforts made to analyse the individual and combined effects of all proposed land uses. The objective of this preliminary report is to present a recreation evaluation, to present the land use conflicts, to suggest alternate plans, and to propose a system for establishing a complete area land management plan.

PLANNING UNIT DESCRIPTION

Location of Area

The planning area under study (refer to Figure 1 , page 5) is located northwest of Juneau, Alaska. The easterly boundary of the area begins approximately 2-1/2 miles northwest of the Juneau City Limits (near Salmon Creek), continuing along the Glacier Highway to form the northerly border of the unit, this line is then joined by the east shoreline of the Mendenhall Peninsula which constitutes the west boundary, and then crosses Fritz Cove to the North Douglas Highway ending at Falls Creek.

Access

Access to the area is provided by the Glacier Highway, the North Douglas Highway, the Fritz Cove Road, and the Juneau Municipal Airport. Access to the tidelands is presently restricted to private driveways, or by means of the Juneau Municipal Airport, to a few public access points, roadside parking, and by trespass.

Physical Characteristics

Soils

Over 6,000 acres of intertidal flats plus several thousand acres of uplands lie within the planning unit.

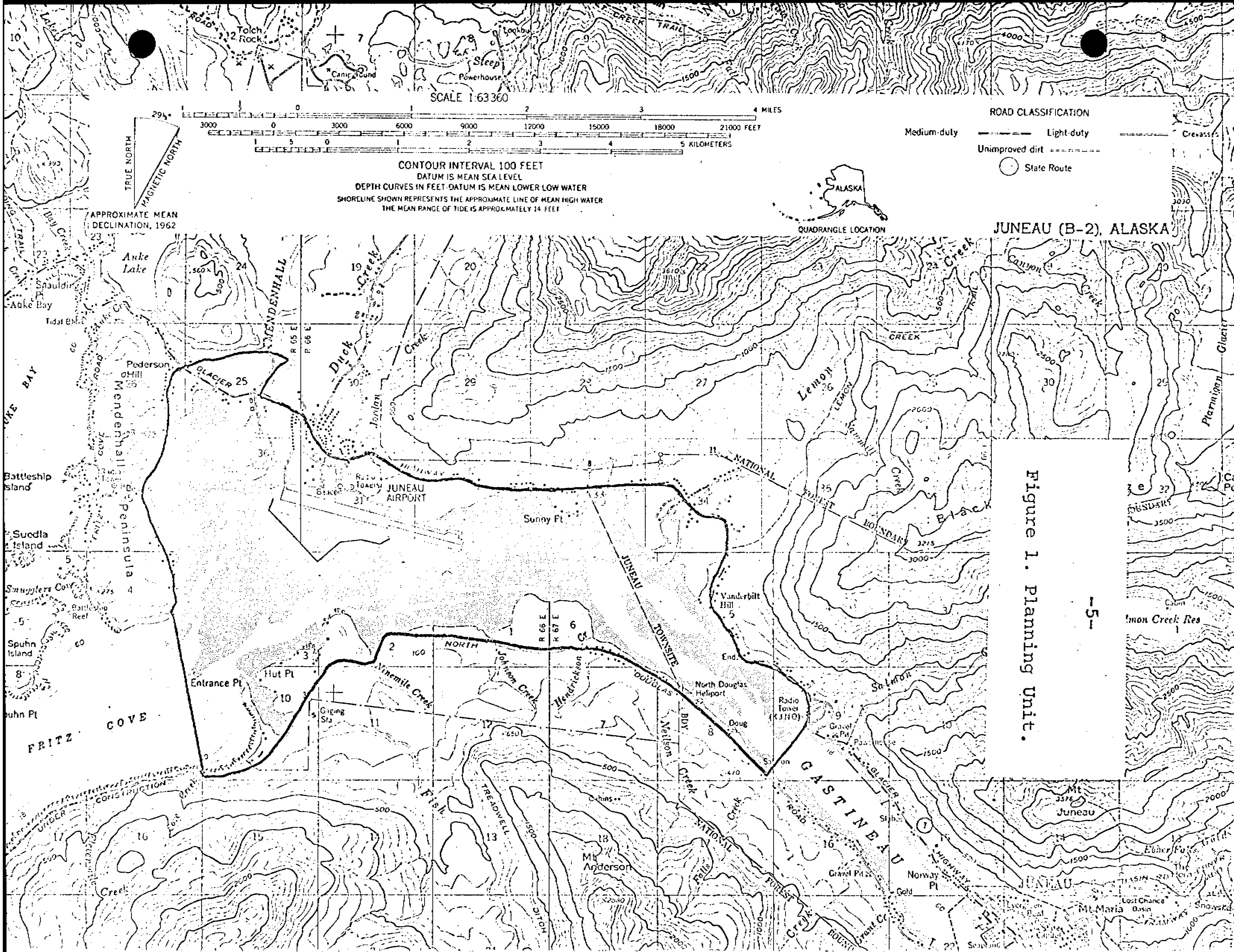

Figure 1. Planning Unit.

This area is covered with an overburden of highly saturated, fine silty soils, largely of glacial origin, overlain with a thin layer of organic matter. Much of the tidal flats are composed of mixed silty sands and sandy gravels, largely near the stream mouths and tidal guts.

Drainages

The largest drainage entering and flowing over the tidal flats is the Mendenhall River which enters Gastineau Channel west of the Juneau Municipal Airport. Other streams entering the flats include Salmon Creek, Jordan Creek, Lemon Creek, Fish Creek, and many small brooks and creeks important to substantial sport fish populations. These streams also have contributed the bulk of the surface soil deposits on the tidelands and to the basic fertility of the area.

Tides

The Juneau tidelands are subject to daily tidal action throughout the planning unit. These tides display a diurnal inequality typical of the Pacific Ocean; that is, of the two high tides within any 24-hour period, one will generally exceed the other by several feet and the same is true of the two low tides.

The mean tide range at Juneau is 14.0 feet; however, the diurnal range (from mean higher high water to mean lower low water) is 16.6 feet. The extreme tidal range is about 26.5 feet, and the extreme high water elevation is 21.1± feet from mean lower low water.

Vegetation and Wildlife

The physical forces and the materials deposited by these means which contributed to the formation of the Juneau tidelands also endowed the area with a high basic fertility. Because of this high fertility, productivity of animal life is many times greater than the uplands. A rich growth of algae and plankton provide food for insects, shellfish, and fish fry. These in turn furnish food for larger species of fish, waterfowl, and for other wildlife.

The vegetation is a basic component of the salt marsh since it forms a protective cover over the soil and prevents erosion, it furnishes shade and concealment to birds and small animals, and it provides seeds, leaves, and roots which are food for migratory birds and other birds. Tidal impoundments are important to small fish that furnish food for birds and mammals. Even in the winter, when nearby uplands are covered with snow, the salt flats produce limited amounts of feed. This is usually

in the form of algae and plankton which are important foods for fish, shellfish, and other tidal creatures.

The intertidal areas provide spawning, nursery, and feeding grounds for many species of fish. Many species do not use the area for spawning or feeding but utilize the stock of fish which are reared on the tide flats.

Vegetative Description

A noticeable characteristic of the Juneau tidelands is the strikingly uniform distribution and community composition of the plant cover. This suggests that conditions favoring the particular stands of vegetation on the flats have been fairly uniform; otherwise the vegetative cover would be of a more mixed composition. The salt marsh plant cover begins at approximately the 10 to 11 foot tide level and extends to the mean higher high tide mark.

The predominant terrestrial plant cover occurring on the tidelands are sedges (Carex lynbeyi, C. aquatilis, and C. spp.). These sedges appear in dense, uniform stands on wet, saturated soils which are inundated daily. Other plant communities of significance to the flats and adjacent uplands include the following: (1) beach rye (Elymus mollis) on sites infrequently

inundated; (2) sedge/spike-rush/fivefinger (Carex spp., Eleocharis sp., Potentilla sp.) on wet locations; (3) sedge/mud/grass (Carex spp., Deschampsia sp.) on frequently inundated sites; (4) arrow grass/fivefinger/sedge (Triglochin sp., Potentilla sp., Carex spp.) daily inundation; and (5) upland mixed stands of beach rye, lupine (Lupinus sp.), fireweed (Epilobium sp.) and many other annual forbs.

Few naturally formed tidal ponds are present on the flats with the exception of the tidal marsh to the west of the Mendenhall River. These ponds are shallow (6-12 inches), brackish, and support stands of pondweeds (Potomogeton spp.), mares tail (Hippuris vulgaris), salt wort (Glaux maritima), widgeon grass (Ruppia sp.), spike rush (Eleocharis spp.), goose-tongue (Plantago maritima), and several other aquatic perenials.

Some of the large man-made ponds in the airport vicinity support extensive stands of the above aquatics plus several species of pondweeds, water milfoil (Myriophyllum sp.), bullrush (Scirpus sp.), and burreed (Sparganium sp.). Distribution of the various species depends largely on the amount of tidal flooding of the ponds and the range of salt tolerance of the vegetation. Nearly all the plants mentioned in this section

have value to wildlife as food. The most important food plants are the pondweeds, widgeon grass, goose-tongue, arrow grass, spike rush, and the sedges.

Wildlife of the Juneau Tidelands

Of the many kinds of wildlife utilizing the Juneau tidelands, waterfowl and fish have the greatest influence on human recreation in the area. Waterfowl are attracted to the tidelands throughout the entire year and projected day use of both ducks and geese exceeds 1,000,000 days (See Appendix, Table 1, page 34). In other words, if we compressed one year's use into 30 days there would be over 30,000 ducks and geese feeding and resting on the tidelands each day for one month. This use is greater than that of many refuges in the other states. Data concerning sport fish numbers and use are not presently available; however, considering the fact that the trout and salmon reared in local streams provide over two-thirds of the freshwater sport fishing in the Juneau-Douglas area, these fish populations must be substantial (Sport Fish Division, Alaska Department of Fish and Game).

Small birds and mammals are common throughout much of the intertidal and upland cover. Bird numbers and species composition vary with the seasons, with the greatest influx of species occurring in the spring and fall. Recreation use of

the tidelands is keyed to these movements and increases measureably with bird abundance. Fur mammals such as coyotes, mink, otter, and muskrats are found fairly commonly in the tidal areas and provide limited recreation.

PUBLIC RECREATION EVALUATION

The study findings suggest that the Juneau tidelands are highly important to many people for recreational, economic, and aesthetic values. The estimated annual economic benefit of this resource to Juneau and its citizens resulting from recreational uses of the tidelands exceeds $150,000. Waterfowl hunting ranks first in total recreational hours and economic return, with sport fishing and other activities contributing the remainder. No one has yet been able to place dollar signs on aesthetic values; however, in this sense the existence of a natural area so close to our state capital deserves recognition for its value to tourism. Tourists do not come to this state to see housing developments and filled-in swamps. They are here to see the things denied them in the populated and highly developed areas of the other less discerning states. Duplication of these undesirable conditions does not seem compatible with the development of an economy keyed to growth of tourism.

Recreational Values of the Waterfowl Resource

An annual harvest of approximately 6,000 ducks and geese is taken on the Juneau tidelands by over 750 local waterfowl hunters. These hunters spend an average of three hours in the

field for at least four to five days during a season of 12 weeks duration. Hunter success is good in comparison with many other heavily utilized waterfowl areas. This success is largely due to the dispersal of hunting pressure over four major units of the tidelands. These units (1, 3, 4, and 5, Figure 2 , page 14) compose about one-half of 6,000 acres of tidelands. However, at present only half of this total acreage is huntable. Hunting pressures on weekends reduce the total acres available per hunter to about 12 acres. This situation is rarely condusive to quality hunting and on an unmanaged area often becomes disastrous to hunter success. Any loss of present usable habitat would crowd hunting populations into smaller acreages, reduce success, and discourage many prospective hunters.

Considering the fact that the present hunting population and the local economy realizes over $125,000 worth of recreational benefits for practically no investment or management expense, it seems logical to safeguard the existing habitat.

Sport Fisheries and the Juneau Tidelands

Over two-thirds of the sport fish caught in the Juneau-Douglas area are provided by several streams which flow across the tideflats. This suggests that several thousand fishermen

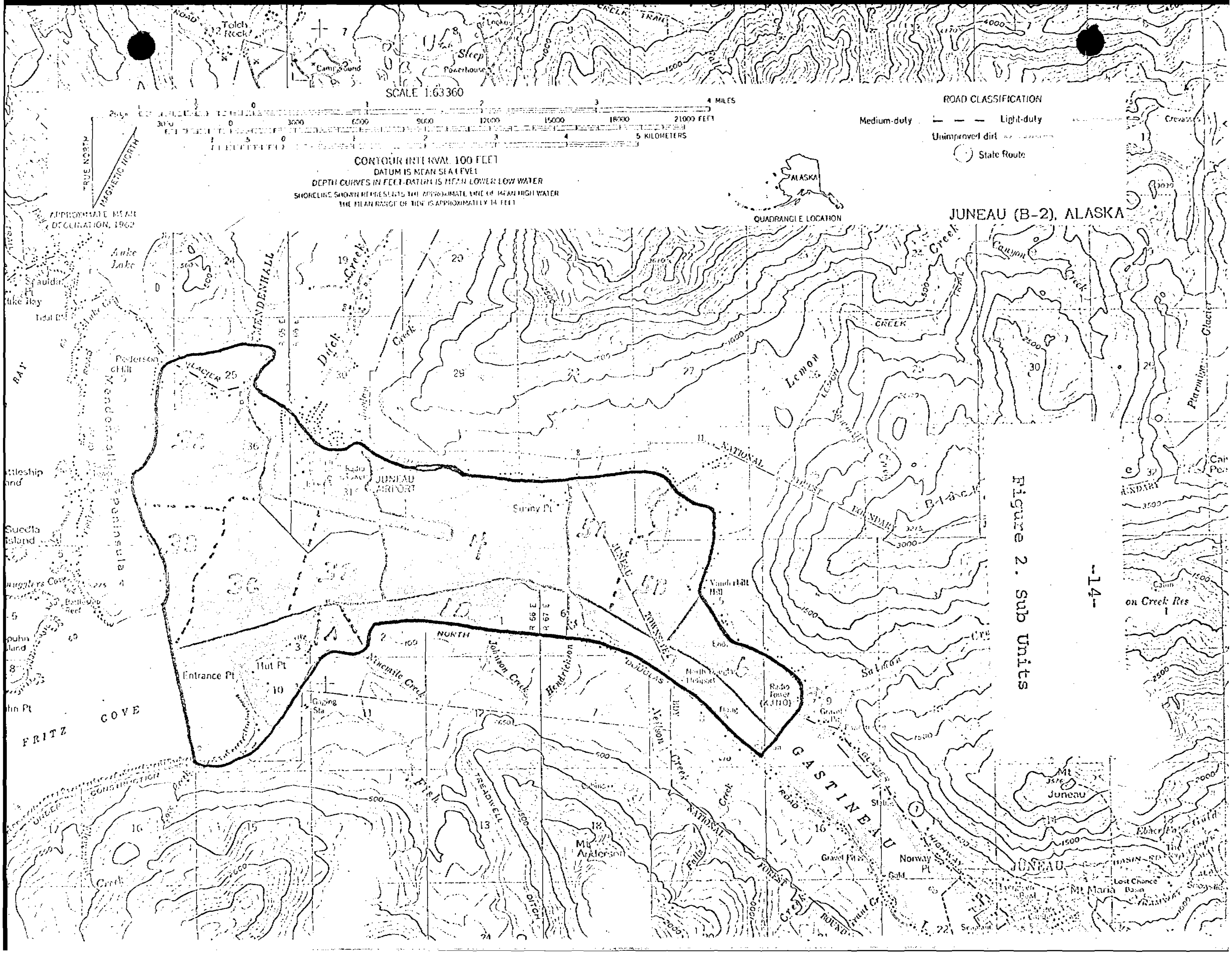

Figure 2. Sub Units

derive recreational benefits from these waters. A conservative estimate of the economic value of this fishery to the local economy would possibly exceed the waterfowl recreation benefit; however, data concerning these values are not available at this time.

Aesthetics and Tourism Values

Bird watchers, hikers, flower pickers, and tourists can, and do, spend many hours on the tidelands. The value of these forms of recreation or their indirect benefits to the community is not possible to measure at present. However, the knowledge that one-quarter of the attraction for tourists is the wildlife of the state suggests that considerable income is derived indirectly through tourism (Buckley, 1957, p. 23).

LAND USE CONFLICTS

Channel Dredging

The public benefits of a deep water navigable channel from Fritz Cove to the Gastineau Channel areeasily recognized because of the heavy water traffic near Juneau and the 15-mile shortcut provided for boats traveling north. Unfortunately, the channel has been insufficient to handle large boats at all tides.

During 1959-60 the U. S. Army Corps of Engineers constructed a navigational channel through the shoal area, but the project was considered semi-permanent due to the continual sloughing of the side slopes.

In 1961 a Committee on Tidal Hydraulics reviewed the shoaling problem and recommended measures which might resolve the problem. The most promising solution was the isolation of the navigational channel by means of a continuous dike. The proposed dike would be open at both ends to allow continual tidal action north of the dike. In response to the Committee's recommendations, a model of the area was constructed in 1965 to study the shoaling effects and effects of various dike locations. The "Status Report on the Gastineau Channel Model Study" is included in the appendix section (page 35).

Construction of the dike (Figure 2, Status Report) would, of course, cover a considerable amount of valuable waterfowl habitat. If the dike were stabilized by seeding, tidal action was not seriously altered north of the dike, the dike was situated as close to the channel as possible, and access was provided to the dike, tidelands adjacent to the dike could possibly be developed to produce more accessible waterfowl hunting. If, however, tidal action is delayed and/or large sediment deposit areas are constructed, the wetland vegetation changes and land surface alterations would most likely make the affected area completely unproductive and unusable in a total management plan.

Airport Expansion

The present Juneau Municipal Airport and adjacent facilities already cover a considerable portion of the tidelands and as the air traffic to the area increases, the airport will undoubtedly expand further. Proper land planning would minimize future expansion costs and also make the project compatible with surrounding land use.

Further airport expansion and other land development in the area must take into consideration the problem of bird-aircraft hazards. Fortunately, the Juneau airport has

experienced little problem in this regard. Proper planning concerned with the location of dump areas will alleviate the greatest problem of sea gull concentrations near the approach and departure zones and similar consideration must be given to minimizing waterfowl movement across and within these areas.

Highway Construction

The newly proposed highway from Norway Point to the Airport will undoubtedly provide quicker, safer, and more efficient service for the community. As in the planning of other highways, however, due consideration should be given not only to construction costs, but to adjacent future land development, aesthetics, recreation, wildlife, and many other social costs. The willingness of our present society to pay additional costs for recreation and aesthetics is illustrated by the "Highway Beautification Programs," federal mitigation and enhancement projects, and special consideration to these natural resources in planning.

The obligation of Federal Aid projects to fish and wildlife considerations was clearly stated in an Instructional Memorandum 21-5-63 of June 12, 1963, issued by the Bureau of Public Roads, U. S. Department of Commerce (Appendix, page 54). Attention is particularly focused on the two paragraphs reading as follows:

"The highway agencies must realize that fish and game are a natural resource belonging to all the people of the country and the preservation of their habitat must be taken into consideration along with other values of public interest to arrive at determinations which are economical for all public interests. Public Roads supports that every effort should be made in the planning, design, and construction of highway projects that cause a minimum of disturbance to and reasonable preservation of the nation's wildlife and related natural resources."

"The Secretary, in exercising his authority to approve projects pursuant to Section 106 of Title 23, United States Code, thereby obligating the Federal Government for the payment of its proportional contribution thereto, will take into account the effects of the proposed construction upon fish and wildlife, and the necessary measures to be incorporated into the project to provide for the protection of these resources."

In the reconnaissance report for the new Norway Point-Airport Road Highway, three alternative routes were presented. Two routes or combinations of each were indicated as preferred (Figure 3). Although the proposed route from Norway Point to Vanderbilt Hill would seriously affect valuable tidelands, the greatest detrimental effects on the total waterfowl management

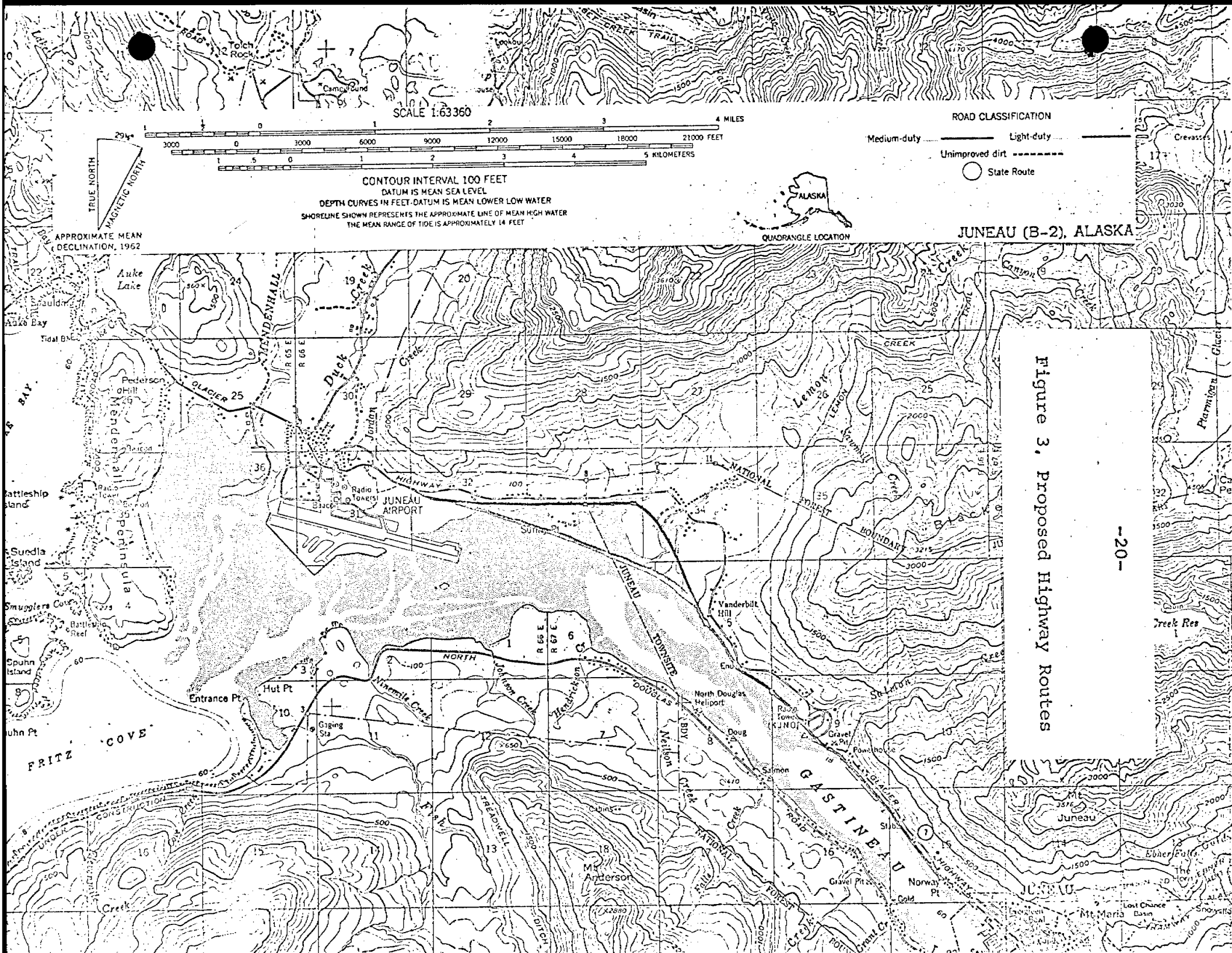

Figure 3, Proposed Highway Routes

program would occur with the selection of the outer (red) route. The route would not only cover valuable wetlands, but would limit access in the areas, cause tidal lags, and result in the eventual loss of the entire tidelands and uplands north of the highway. The inner route would, however, involve a difference of only $42,983.53 in construction costs (Stevens 1965) and would not result in the loss of all the tidelands and uplands and their recreation potentials east of the airport. The related importance of this area to the total planning unit will be discussed in a later section.

Much of the fill required for the project will be taken from the tidal flats which could also affect the aesthetic value, waterfowl production, and the recreation potential of the area. Borrow pit location and design could, however, prove to be beneficial if consideration is given to other land uses. This will also be discussed in greater detail in a following section.

Other Problems

The present Greater Juneau Borough zoning of the area within the planning unit is not generally compatible with long-range recreational land planning and especiall y those related to waterfowl. The present Agriculture-Forestry, Residential, and

Commercial zonings allow for further development and eventual reduction in tidelands and uplands considered essential for waterfowl management. Special land use permits have also been issued which allow further destruction of the area.

PROJECTIONS AND PLANNING

There are two courses of action that can be taken concerning land use of the Juneau wetlands and adjacent uplands: (1) the present deterioration and constriction of the area can continue with eventual loss of the recreation; or (2) the recreation potential can be enhanced and developed to provide increasing recreational opportunities for the growing community. With respect to the second alternative, several things should be considered.

Present land uses such as channel dredging, diking, highway construction, and airport expansion will all result in a restriction in size of the area. Any loss in the existing wetlands will correspondingly decrease the recreational potential. For land planning and a detailed land management plan, it is essential that the present proposed contiguous land unit be considered minimal in size. This is especially true because at present it is impossible to tell at what point development and enhancement projects will be unable to maintain it as a waterfowl recreation area.

The greatest public recreational use of this area is presently associated with the value to migratory waterfowl.

If it is in the best interest of the public to maintain this recreation, the only reasonable approach is to design a long range land management plan which will provide the maximum recreation benefits possible with what existing lands are available.

The construction of a waterfowl orientated land management plan involves many intricate details. Before the actual commitment of funds can be made for area development and enhancement, the tidelands and uplands areas must be secured with maximum guarantees that they will be dedicated for this purpose.

Studies must be initiated to determine precisely what uplands must be purchased, how each section of land should be developed to enhance the present recreational benefits and what developments are most compatible with other land uses in the area.

Tidelands

The most essential land area in this planning unit is the tidelands. The entire waterfowl management plan will depend on the size and condition of this area for the following reasons: (1) the proposed improved production will depend on the nesting areas available; (2) the degree of control of bird

movement within the airport approach and departure zones will depend on the number and size of outer development areas; and (3) plans to provide longer and better waterfowl hunting will depend on the size and attractiveness of the area to waterfowl, the area available for dispersing hunters, and the size and selection of feeding and resting sites. In order that maximum considerations and guarantees are provided the tidelands, the Alaska Department of Fish and Game entered on November 10, 1966 a request for an "Inter-Agency Land Management Transfer" of all the tidelands within the unit (refer to Appendix, page 57).

Purchasing

Once positive guarantees are obtained concerning tideland control, the practicality of purchasing key uplands for development and management purposes can be studied. This would, of course, be necessary for any complete area waterfowl management plan.

The purchasing of lands for the protection and management of waterfowl could be funded through two Federal projects: (1) Wetlands Acquisition Funds provided by Duck Stamp money; and (2) Pittman-Robertson Federal Aid in Wildlife Restoration matching monies. The former would be preferable in that

100 percent of the money would be furnished by the Federal Government. The P. R. funds, on the other hand, are matched on a 75 percent Federal - 25 percent State basis and the State portion would have to be appropriated by the State Legislature. Should the purchasing not qualify under a Wetlands Acquisition program, a proposal for State matching monies would be submitted to the Governor for consideration in his budget.

Development and Enhancement

At present the Juneau tidelands are being heavily utilized for waterfowl hunting. Hunting pressures may soon exceed the limits of space necessary to provide quality waterfowl hunting. Moreover, the number of waterfowl available to hunters is likewise limited due to space , food, and other requirements. Local production of waterfowl is poor due to the lack of sufficient stable impoundments and suitable food for young ducks. All these problems can be resolved, but only through an intensive program of development and enhancement. This program would depend on acquisition of the tidelands and purchase of several upland sites. Once the management control of these areas is in the hands of wildlife management orientated agencies, developmental projects could be initiated.

Many years of waterfowl and game management experience have demonstrated that in order to satisfy all the daily and annual requirements of wildlife one must provide a mixture of habitat types and water areas. This concept is especially true in the case of waterfowl. A large contiguous area of tideland interspersed with several highly developed and managed units would serve this purpose admirably. Field studies conducted by Federal and State game biologists have suggested that there are several key areas necessary for a management unit. These are portions of areas 1, 3, 4, and 5 as shown in Figure 2 , page 14.

Access

A major problem related to waterfowl management will be the establishment of proper access corridors for public use. The necessary dispersal of hunting pressure over the entire area will be directly related not only to the availability of birds, but the parking areas provided and the accessibility of hunting areas.

At present, access to the tidelands is restricted due to private ownership of the uplands and limited routes to the tidelands. A few access points are now available from the Mendenhall Peninsula (Fritz Cove Road), near the Airport

(limited parking), from the Glacier Highway (roadside parking) and the North Douglas Highway (roadside parking). Because of the anticipated waterfowl use due to development projects and related hunter use increases, these access facilities and routes will be highly inadequate. Undoubtedly, monies will have to be spent for leasing and purchasing parking areas and access corridors.

Types of Development

Developmental projects will be geared to satisfy the following objectives: (1) to disperse hunting pressure over a much broader area; (2) to provide more nesting habitat; (3) to create more attractive feeding and resting areas for migrant waterfowl away from airport approach and departure zones; and (4) to protect resident sport fish stocks. Dispersal of hunting pressure is possible through development of adequate access routes, providing a well-dispersed supply of birds (objective 3), and if necessary, management of hunting pressure. A major goal, however, is to avoid any semblance of artificiality when attaining this goal. Waterfowl production may be increased by creation of many small impoundments to supplement the present shortage of brood habitat. These impoundments can be created by several methods: (1) low dams across tidal guts equipped

with proper tidal gates, and (2) digging of small, shallow ponds by bulldozer or dragline. Local plants of high waterfowl value will be introduced in the ponds for food and cover. A system of brood ponds and some deep larger ponds as provided by planned placement of borrow pits is considered sufficient to attract and hold migrants in each waterfowl management unit. Placement of these units will be in the best interests of hunter convenience and for dispersal of birds away from the Juneau Municipal Airport approach and departure corridors. Several closed areas near highway systems are contemplated in the developmental planning. At least one of these areas could be suitable for roadside viewing of ducks and geese.

Projections of Use Demands and Management Benefits

In this growing community we expect hunter use of the tidelands will double in the next ten-year period. This increase would be especially noticeable if accompanied by a successful habitat enhancement problem. Planning of the management units will be based on satisfying the demands of a much larger hunting population.

The present production of waterfowl on the Juneau tidelands is nearly negligible. However, a sound management plan

could increase this production many times. Such production would in turn increase the harvestable portion of birds and add to the overall value of the planning unit.

Creation of more and better quality habitat will no doubt increase the attractiveness of the tidelands to migrant waterfowl. Abundant food and cover will hold these birds for longer periods, thus providing more hunting opportunities.

Other Recreation Potentials

As it has been pointed out, the primary recreational use within the planning unit has been related to waterfowl, although sport fishing plays a major role as well as bird watching, photography and hiking. The dedication of this area to these primary uses does not mean that other recreational possibilities do not exist. Because of the increasing community population and the associated demand for diversified outdoor recreation, it seems feasible to study the possibilities of developing other compatible recreational uses.

Many matching Federal funds are available for community planning of which recreation is a primary consideration. In addition, the Alaska Department of Natural Resources is staffed with personnel qualified in public recreation planning. A combined effort of all agencies concerned could undoubtedly create additional public benefits in outdoor recreation.

RECOMMENDATIONS

1. That the management responsibilities for the Juneau tidelands be transferred to the Alaska Department of Fish and Game by means of an "Inter-Agency Land Management Transfer."
2. That studies be initiated by the U. S. Fish and Wildlife Service and Alaska Department of Fish and Game to determine exactly what waterfowl habitat development projects are most feasible and what uplands will be required.
3. That the Greater Juneau Borough and the Alaska Department of Natural Resources initiate studies designed to determine other recreational needs of the community and the compatible recreational opportunities that exist within this planning unit. Many Federal matching funds are available for these types of studies.
4. That the Juneau Municipal Airport expansion plans be considered and incorporated in a long range waterfowl habitat management plan.
5. That studies be initiated by the Alaska Department of Fish and Game, the U. S. Fish and Wildlife Service and the Federal Aviation Agency to determine how the area can be developed and by which methods to assure that bird-aircraft problems will be kept at a minimum.

6. That the proposed U. S. Army Corps of Engineers' Gastineau Channel dike be situated as close to the channel as possible, and that the dike be stabilized and seeded.

7. That no complete or partial blockage of the flats to normal tidal action be allowed.

8. That the northern highway route from Vanderbilt Hill to the Airport road be selected for construction.

9. That the selection and design of borrow pits on the Mendenhall Flats be planned and coordinated with the waterfowl management plan.

10. That selected pull-outs and access corridors be established for public use.

11. That Federal funds be utilized for purchasing of key upland areas determined by the studies as being essential in a recreation management plan.

12. That the Greater Juneau Borough create and establish a Public Recreation zoning for the unit.

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Table 1. NUMBER OF DAY USE BY WATERFOWL, MENDENHALL FLATS 1/

Species	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	TOTAL
Swan										7,500	3,500		11,000
Canada geese	7,500	7,500	7,500	7,500	1,000	1,000	1,000	7,500	1,000	1,000	1,000	3,500	47,000
Snow geese					10								10
W.F. geese					30								30
Total geese													47,040
Mallard	15,500	15,500	15,500	15,500	30,000	3,000	3,000	5,000	10,000	16,500	15,500	15,500	300,000
Pintail					30,000			1,000	10,000	10,000			51,000
Widgeon					15,000			1,000	1,000	10,000			27,000
Shoveler					1,000			500	500	2,000			4,000
Teal					15,000			15,000	15,000	30,000	15,000		90,000
Total dabblers													472,000
Scaup	3,000	3,000	3,000	3,000	10,000	1,000	1,000	1,000	3,000	3,000	3,000	3,000	37,000
Canvasback					200				200				400
Ringneck					50				100				150
Goldeneye	12,000	12,000	12,000	12,000	25,000	6,000	6,000	6,000	12,000	12,000	12,000	12,000	139,000
Bufflehead	3,000	3,000	3,000	3,000	6,000	1,000	1,000	1,000	3,000	3,000	3,000	3,000	33,000
Scoter	27,000	27,000	27,000	27,000	40,000	10,000	10,000	10,000	40,000	27,000	27,000	27,000	299,000
Total divers	68,000	68,000	68,000	68,000	173,290	22,000	22,000	48,000	95,800	122,000	66,500	64,000	508,550
Merganser	300	300	300	3,000	300	300	300	300	3,000	3,000	300	300	11,700
GRAND TOTAL	68,300	68,300	68,300	71,000	173,590	22,300	22,300	48,300	98,800	125,000	66,800	67,000	1,060,290

1/ Data supplied by U. S. Bureau of Sport Fisheries and Wildlife, Juneau, Alaska

STATUS REPORT ON THE GASTINEAU CHANNEL MODEL STUDY

by

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ABSTRACT

The paper describes the testing program currently underway (August 1966) at the U. S. Army Engineer Waterways Experiment Station concerning improvement of the navigation channel in Gastineau Channel, Alaska. At the present time, hydraulic adjustment and verification of the model have been completed and the shoaling verification of the model is underway.

The paper also describes the purpose of the model study, the existing prototype conditions, the model and its appurtenances, model testing procedures, and the proposed testing program.

STATUS REPORT ON THE GASTINEAU CHANNEL MODEL STUDY

The Prototype

Gastineau Channel (fig. 1) is a narrow strait about 16 miles long separating Douglas Island from the mainland of southeastern Alaska. It connects Stephens Passage on the east with Fritz Cove on the west. Juneau, Alaska, is located on the mainland side of the channel at about its mid-point. East of Juneau the channel is fairly uniform with the width varying from 4,000 ft to 6,000 ft. A naturally deep channel, with controlling depth of about -45 ft mllw, exists in this portion of Gastineau Channel. West of Juneau the width varies from about 2,000 ft near Juneau to about 10,000 ft near the western end of the channel.

The channel is subject to tidal action at both ends. The tides display a diurnal inequality typical of the Pacific Ocean. The mean tide range at Juneau is 14.0 ft; however, the diurnal range (from mean higher high water to mean lower low water) is 16.6 ft. The extreme tidal range is about 26.5 ft, and the extreme high water elevation is +21.1 ft mllw.

There are several freshwater streams entering the channel. The largest of these is the Mendenhall River, which enters the channel at its extreme western end near the Juneau Airport. The mean and maximum discharges of this stream are 1,100 cfs and 10,000 cfs, respectively. Other streams entering the system include Sheep Creek, Gold Creek, Salmon Creek, and Lemon Creek.

History of the Navigation Project

The western 5.5 miles of the channel has been described as a giant shoal with a general elevation of +10 to +15 ft mllw. The shoal is roughly centered on the meeting point of the tides which enter the opposite ends of the channel. Since the tides are very closely equal in range and phase, tidal velocities in this area are almost zero. It is, therefore, not surprising that sediments carried into the area by tributary streams are not moved out of the shoal area. The shoal consists primarily of glacial till with the surface layers being mainly fine to coarse sands covered by a thin layer of organic muck.

Gastineau Channel provides a 15 mile shortcut for boats traveling north from Juneau. However, in the past the controlling depth across the shoal area was about +15 ft mllw, so that it could only be navigated by small boats and only at high tide. In 1945, Congress authorized construction of a navigation channel through the shoal area of the channel with a bottom width of 75 ft, a depth of 0 ft mllw, and 1 on 3 sideslopes. The project was actually constructed during 1959-60 to a depth of -4 ft mllw, including 2 ft of overdepth dredging and 2 ft of advance maintenance dredging.

Subsequent to construction of the navigation channel, rapid shoaling within the limits of the project has occurred. The primary reasons for this rapid shoaling appear to be twofold. First, it has been determined that, under the influence of tidal action, the natural sideslopes are from 1 on 6 to 1 on 10, rather than 1 on 3 as constructed. Therefore, extensive

sloughing of the sideslopes was experienced during the first year subsequent to construction of the project. Second, the navigation channel produced a dredge cut which was as much as 15 ft below the surrounding tidal flats, thus creating a drainage canal for the tidal flats. This situation increased the hydraulic gradients of the natural channels across the shoal area, thus producing higher velocities which are capable of moving large quantities of sediment into the canal. The result of this is especially evident at the mouths of the tributary streams and sloughs entering the navigation channel. Due primarily to the fact that no dredges are available in Alaska, no maintenance dredging has been undertaken.

The Juneau Airport and seaplane basin are located on the edge of the tidal flats north of the navigation channel. When the navigation channel was first dredged, there was a sizable breach in the east end of the seaplane basin dike. Under this condition, almost the entire volume of the seaplane basin drained into Jordan Creek during ebb tide phases, resulting in the flushing of large amounts of sediment out of Jordan Creek into the navigation channel. The breach in the dike was subsequently repaired, and it appears that navigation channel shoaling in the vicinity of Jordan Creek has been significantly reduced.

Purpose of the Model Study

In June 1961, the U. S. Army Engineer District, Alaska, requested that the Corps of Engineers, Committee on Tidal Hydraulics review the shoaling problem and recommend measures which might resolve the problem. At that time

the Committee recommended that more extensive field surveys be made in order to study the problem in more detail and made several generalized recommendations for reducing channel shoaling.

In June 1962, the Alaska District again requested that the Committee review the Gastineau Channel problem. With the more detailed information the Alaska District was able to furnish at that time, the Committee published a report entitled "Navigation Project in Gastineau Channel, Alaska" which listed several specific alternate solutions to the problem as follows: (a) redredge the channel periodically, (b) reduce velocities over the shoal areas with dikes or by reshaping natural contours, (c) localize scouring velocities to paved or enrocked areas so that no bed movement occurs, (d) construct settling basins to trap the sediments, (e) divert tributary streams and sloughs away from the navigation channel, and (f) isolate the navigation channel from the tidal flats.

Of these possible solutions, the Committee recommended isolation of the navigation channel by means of a continuous dike as being the only one giving promise of a permanent improvement. The dike proposed by the Committee (fig. 2) would be open at both ends in order to preserve the tidal conditions north of the dike. It is probable that rather sizable volumes of sediment will be carried out of the tide flats past the ends of the dike; however, due to the abrupt termination of the shoal at both ends, it is not believed that the sediments will be transported around the ends of the dike and into the navigation channel. Much of the material required for construction of the dike would logically be obtained by deepening and widening the navigation channel. This would lead to increased navigation

benefits from the project and satisfy requests of local interests for an enlarged channel. It was felt that an additional benefit, which might be realized from this plan, was the reclamation of land for future development. Several alternate dike alignments are also presented in fig. 2.

The Committee further recommended that a hydraulic model study of the problem be undertaken with the following purposes: (a) to study the present current patterns over the shoal area as a guide to laying out improvement works; (b) to determine the velocities associated with any proposed dike construction, weir construction, or channel diversion; and (c) to study dike closure procedures in the event that a land reclamation project is considered in the improvement program.

The Model

Description

The Gastineau Channel model was constructed at the U. S. Army Engineer Waterways Experiment Station in 1965. The model reproduces about seven miles of Gastineau Channel from Fritz Cove to about one mile north of Juneau, Alaska (fig. 3). Each end of the model terminates in a headbay of suitable area and depth for installation and operation of a tide generator.

The model is constructed to linear scale ratios, model to prototype, of 1:500 horizontally and 1:100 vertically. From these basic ratios the following scale relations were computed according to the Froudian

relations: velocity, 1:10; time, 1:50; discharge, 1:500,000; volume, 1:25,000,000; and slope, 1:5.

The model is approximately 95 ft long, covers an area of about 1,600 sq ft, and is of fixed-bed construction. The navigation channel is molded in removable blocks so that desired alterations can readily be made if it is necessary to investigate changes in channel dimensions.

Appurtenances

The model is equipped with the necessary appurtenances to reproduce and measure all pertinent phenomena, such as tidal elevations, current velocities, freshwater inflow, dispersion characteristics, and shoaling distribution. Apparatus used in connection with the reproduction and measurement of these phenomena include two primary tide generators and recorders, tide gages, current velocity meters, freshwater inflow measuring weirs, skimming and measuring weirs, dye injection and measurement equipment, and shoaling injection and recovery apparatus.

Prototype Data

Prototype data collected for verification of the model included: (a) continuously recorded tidal elevations at four locations (fig. 3); (b) current velocity, current direction, and salinity observations at three depths on each of four stations in the navigation channel (fig. 3); (c) hydrographs of freshwater tributaries in the problem area; and (d) hydrographic and topographic surveys. The field data for items a, b, and c were gathered in September 1965 by the Juneau, Alaska, office of the U. S. Geological Survey. These prototype data were obtained over a

two-week period during which the tides varied from spring tides to slightly-less-than-mean tides. Freshwater inflows during the metering period were somewhat higher than the average annual high discharge.

Prototype salinity data were reviewed, and it was determined that there was no appreciable salinity gradient, surface to bottom, during the flood phase of the tide. During the later stages of the ebb tide, surface salinities are considerably lower than bottom salinities in the navigation channel. During these stages of the ebb tide, almost the entire tidal prism of the area is confined to the navigation channel. Since fresh water from tributary streams enters the navigation channel, and since current velocities are not sufficient to create appreciable vertical mixing, it is not surprising that this salinity gradient exists during the ebb flows. It is believed that the density effects resulting from vertical salinity differences are not significant to hydraulic or shoaling phenomena in the problem area.

Verification of the Model

The accurate reproduction of hydraulic, salinity, and shoaling phenomena in an estuary model is an important phase in the preparation of the model for its ultimate use in evaluating the effects of proposed improvement works. In this instance, it was decided that salinity effects played an insignificant role in the shoaling problem; therefore, salinity was not reproduced in this model. Verification of hydraulic phenomena for one spring tide and one mean tide required a series of elaborate tests extending over a period of four months. Shoaling verification of the model had been underway for about two months at the time this paper was prepared.

It should be emphasized that the worth of any model study is wholly dependent upon the proven ability of the model to produce with a reasonable degree of accuracy the results which can be expected to occur in the prototype under given conditions. It is essential, therefore, before any model tests are undertaken of proposed improvement plans, that the required similitude first be established between the model and prototype and that all scale relationships between the two be determined.

Hydraulic Verification

The first step in the hydraulic verification of the model involved reproduction of the prototype tidal phenomena throughout the model, by means of adjusting the tide generators and metal roughness strips in the model. The second step in the hydraulic verification involved reproduction of prototype current velocities. Since the tidal flats are exposed throughout the major portion of the tidal cycle, current velocities were measured only in the navigation channel. During this step of the model verification, it was necessary to insure that model velocities from surface to bottom at the four metering stations were in agreement with those observed in the prototype. This was accomplished by making minor adjustments to the model roughness.

Shoaling Verification

The model shoaling verification involves the reproduction of the prototype shoaling distribution pattern throughout the length of the dredged navigation channel. Unfortunately, the only data available consist of three sets of 16 cross sections across the channel surveyed immediately

after completion of dredging (1960) and also in 1961 and 1962, and one comprehensive hydrographic survey of the area made in 1963. The volume of shoaling within the navigation channel between cross sections was determined on an end-area basis and converted to a percent of the total shoaling in the channel in order to determine the shoaling distribution pattern.

The basic objective of the model shoaling verification is to identify a synthetic sediment which will move and deposit under the influence of the model forces in the same manner that natural sediments move and deposit under the influence of natural forces. In the process of identifying a suitable sediment for use in the model, there are a great number of variables involved and each must be resolved by trial and error in the model. A list of the most significant variables includes: (a) shape, size, gradation, and specific gravity of the artificial sediment; (b) method, location, duration, and quantity of artificial sediment injection; (c) rate of freshwater discharge; (d) magnitude of tide; (e) length of model operation; and (f) readjustment of model roughness. Model water temperature must be closely monitored, since similar shoaling tests run with different water temperatures often give significantly different results.

Current Status of Model Study

The initial phase of the model testing program was the determination of the dispersion characteristics of the freshwater flows of Mendenhall River and Lemon Creek. This was accomplished by introducing dye with the

discharge of each stream and observing its spread throughout the model for several tidal cycles. In this manner it was possible to determine the areas affected by any suspended sediments carried by these streams. Dye diffusion patterns were recorded photographically at times of high- and low-water slacks for conditions of mean and high freshwater discharges. These tests indicated that only a very small portion of the Mendenhall River discharge eventually makes its way into the navigation channel. On the other hand, the Lemon Creek discharge rapidly dispersed throughout the entire length of the navigation channel.

As mentioned previously, shoaling verification of the model was in progress at the time this paper was being prepared (August 1966). At that time it appeared that a successful reproduction of the prototype shoaling distribution pattern could be accomplished. Fig. 4 shows the navigation channel alignment and the location of the cross sections which were used for computing the shoaling rate, while fig. 5 shows the prototype shoaling distribution pattern for the period 1961-1963. By 1961 the sideslopes of the navigation channel had become relatively stable, so that the shoaling represented in fig. 5 includes only a minor amount of side sloughing. For the purpose of the model shoaling verification, the navigation channel in the model was molded to conform to 1961 conditions.

Discussion of Prototype Shoaling

Examination of the available shoaling data indicates that heavy shoaling occurred during the first year after dredging (1960-1961) at four locations (fig. 4) as follows:

(a) Sta 20 - This shoaling near the eastern end of the channel is believed to have been caused by severe side sloughing.

(b) Sta 76-96 - Switzer and Lemon Creeks enter the channel in this reach. Severe erosion (not sloughing) of the sideslopes was observed in this area. The heaviest shoaling was observed in the northerly portion of the channel, with the deep water in the channel shifting south.

(c) Sta 152-188 - Jordan Creek enters the channel in this reach. Severe erosion and sloughing of the sideslopes were observed. The breach in the seaplane basin dike at the Juneau Airport accentuated this shoaling, and a tidal slough entering the channel from the south between sta 152 and sta 172 may have increased shoaling at the eastern end of this reach.

(d) Sta 234-248 - Several tidal sloughs enter the channel in this reach. Severe sloughing and erosion of the sideslopes were observed. The dredge spoil disposal areas in this area were closer to the channel than for the rest of the project; therefore, it is possible that this shoaling was accentuated by the return of dredged material to the channel.

Subsequent to 1961, the shoaling pattern has changed to the following:

(a) Sta 20 - Very light shoaling, probably attributable to stabilization of the sideslopes.

(b) Sta 76-96 - Very light shoaling in the vicinity of the main freshwater inflow (sta 94). Moderate to heavy shoaling shifting as far east as sta 40 and as far west as sta 108.

(c) Sta 152-188 - Very light shoaling in the vicinity of the mouth of Jordan Creek (sta 180). The breach in the seaplane dike was repaired in November 1962, thus reducing the shoaling rate in this area. Heavy shoaling as far east as sta 152 and as far west as sta 234. Erosion of sideslopes still occurring, but not sloughing.

(d) Sta 234-248 - Very light shoaling, probably attributable to stabilization of sideslopes.

Future Testing Program

Following completion of the model shoaling verification, the navigation channel in the model will be converted to the original design channel, and a shoaling base test will be run using exactly the same technique developed for the shoaling verification. In this manner it will be possible to determine the shoaling rate in the design navigation channel without the effects of side sloughing. Detailed measurements of tidal elevations and current velocities and photographs of surface and bottom current patterns will be made throughout the model to establish in detail the hydraulic regimen under existing conditions. Proposed improvement plans will then be installed in the model and tested. For each plan tested, the hydraulic regimen and shoaling distribution pattern will be determined. The effects of these plans will then be determined by comparing the results of these tests with the test results for existing conditions.

Concluding Remarks

Since the present state of knowledge in the field of tidal hydraulics has not developed to the point where complex problems involving sedimentation can be solved analytically, the hydraulic model is a very valuable

tool for the design engineer. It is not capable, however, of providing all the quantitative information necessary for the design of major projects and is, therefore, not suggested as a substitute for analytical design or the collection and analysis of field data. In the hands of experienced laboratory personnel who are thoroughly familiar with the capabilities and limitations of hydraulic models, the cost and effort invested in the model study are usually returned with dividends in terms of lower costs and improved performance of the project in the field. The model may indicate that the best design will have either a lower or higher cost of construction than that of the proposed design; however, savings should result from improved efficiency of the design and lower maintenance costs.

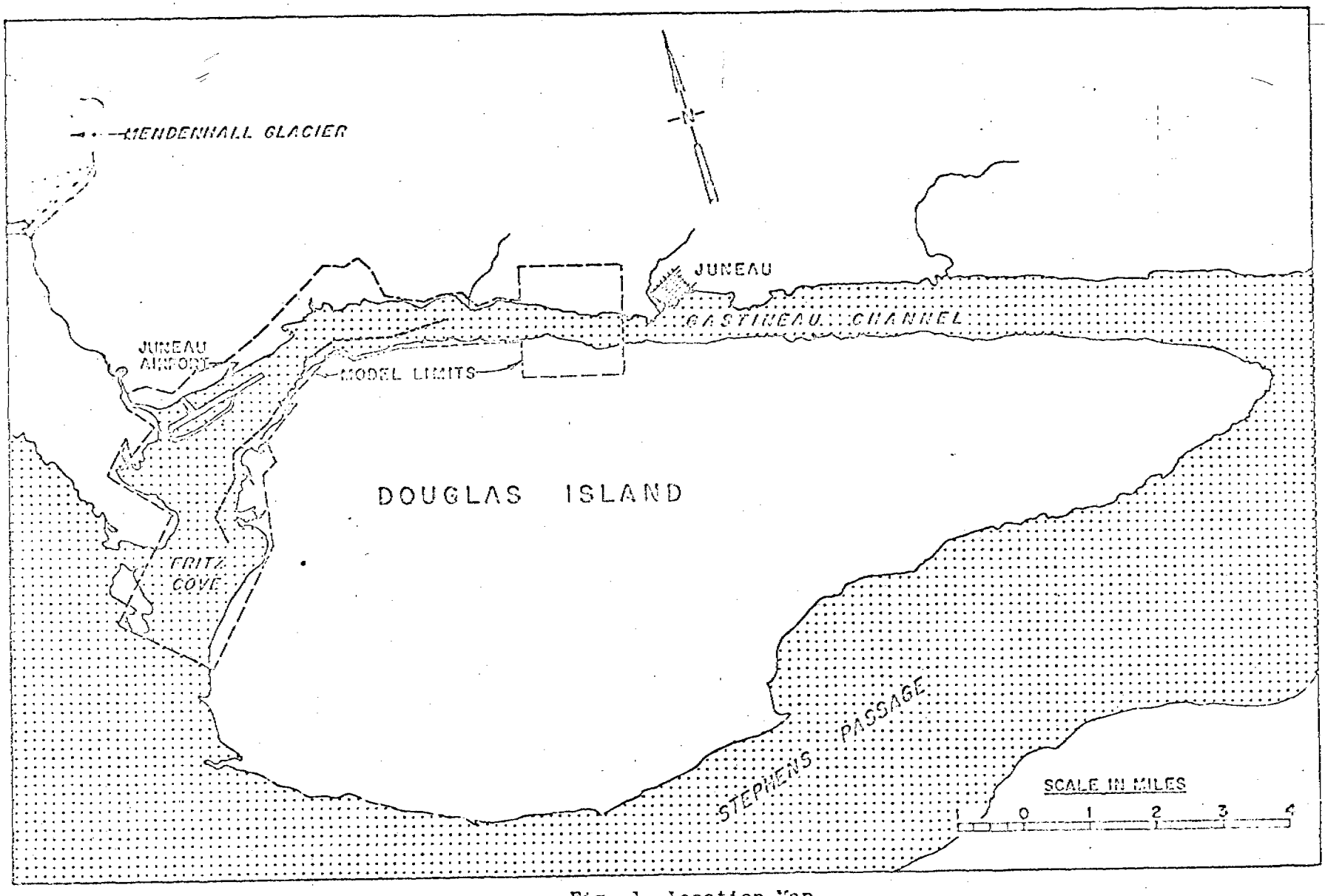

Fig. 1 Location Map

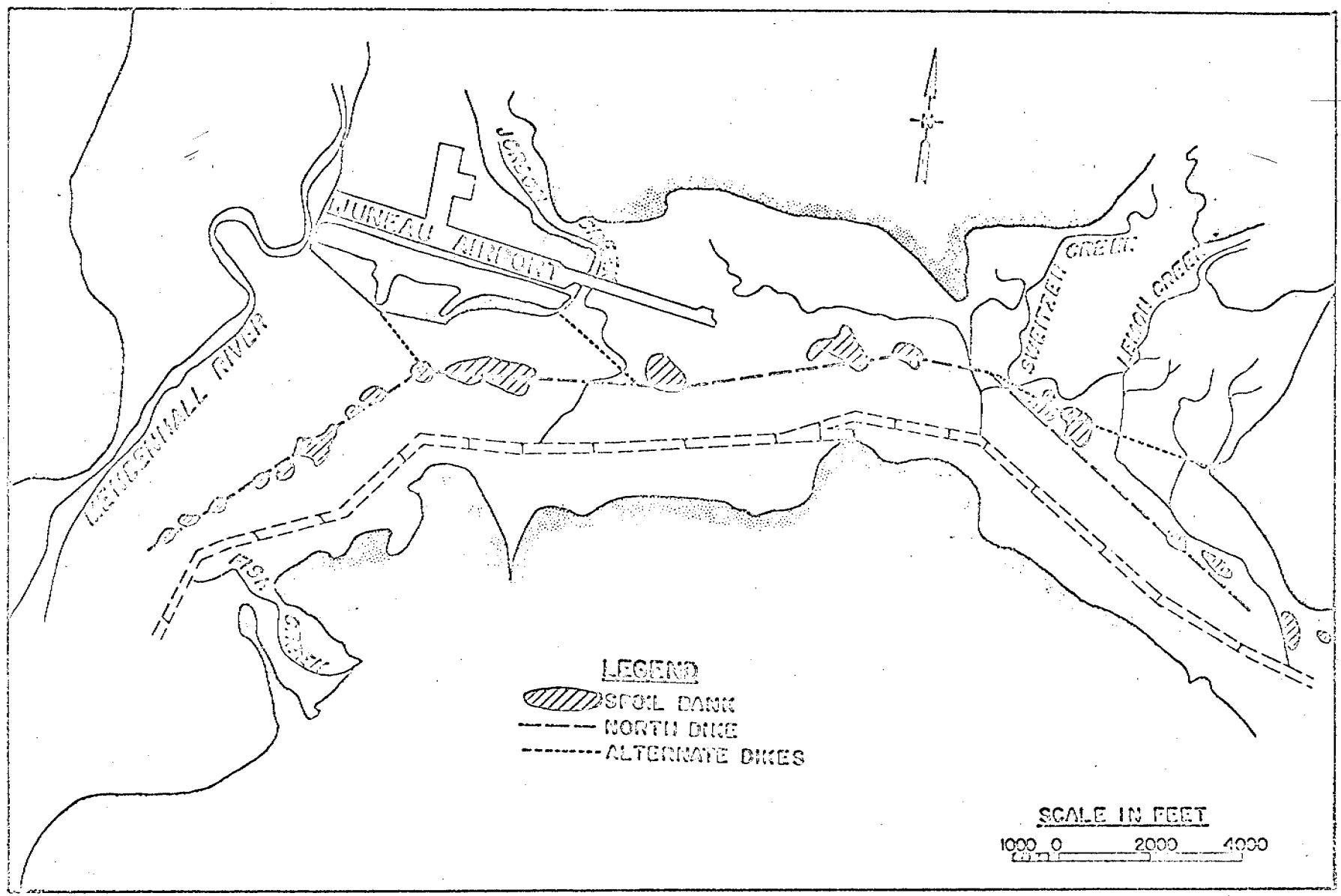

Fig. 2 Proposed Dike Locations

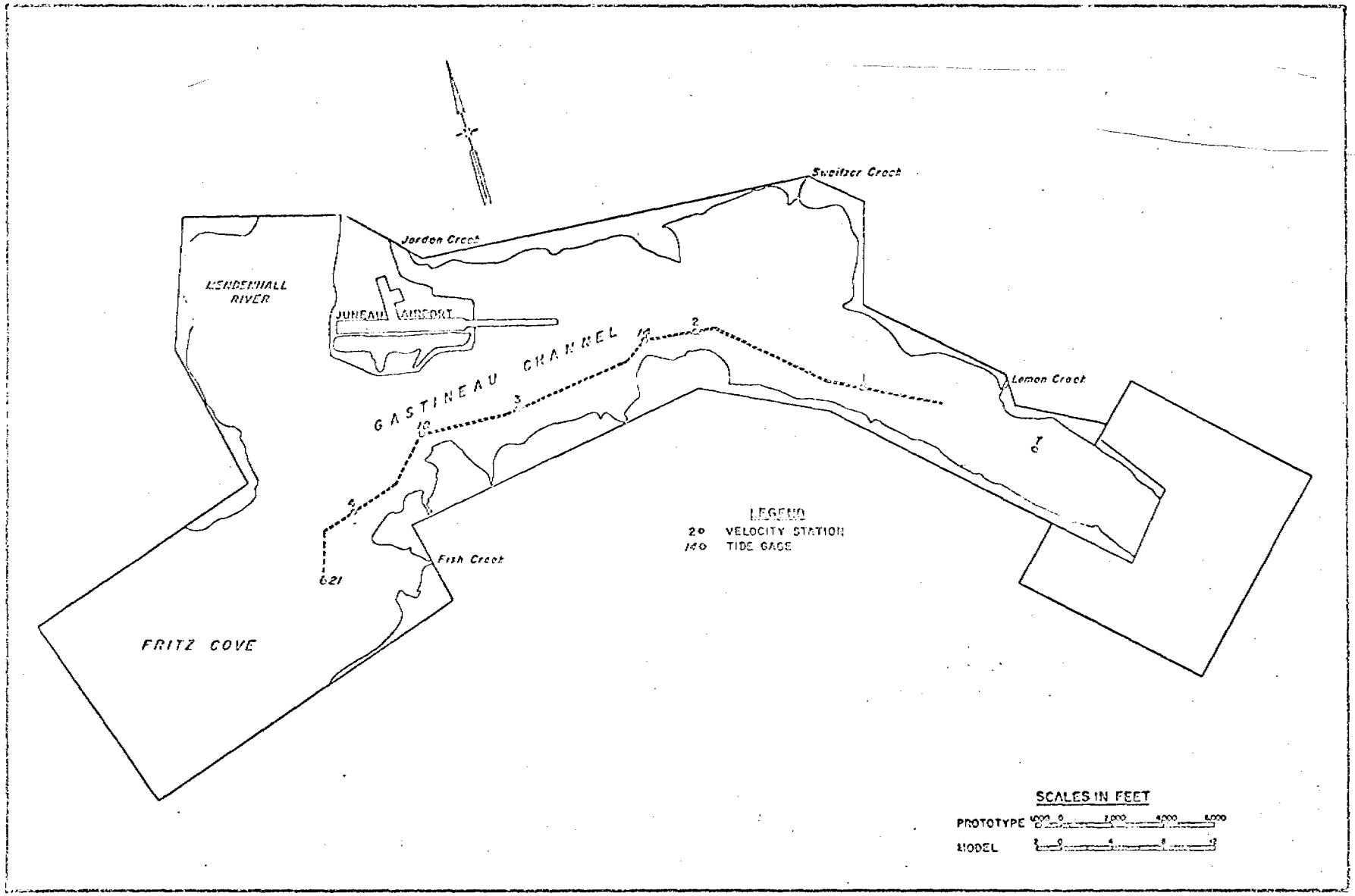

Fig. 3 Model Layout

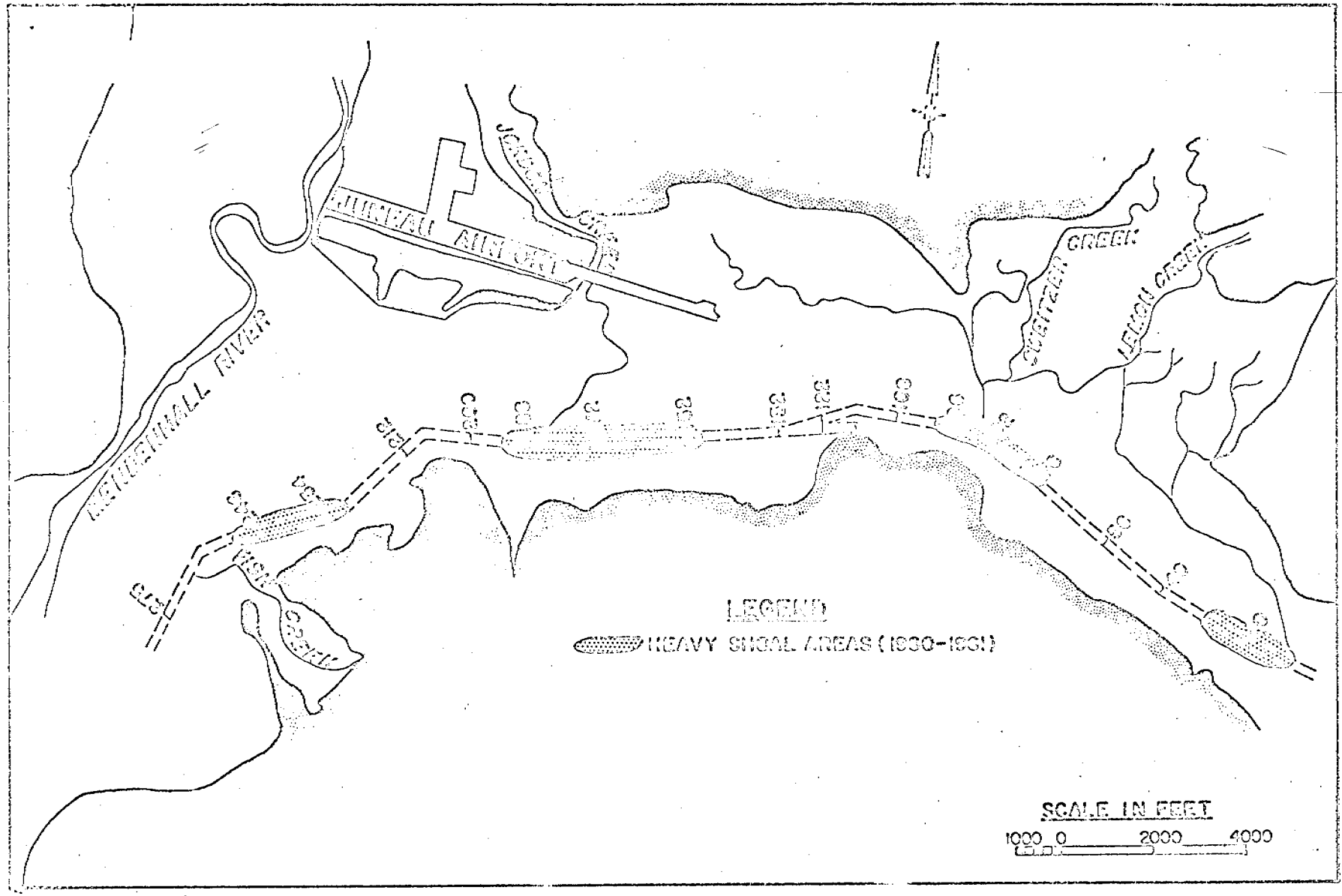

Fig. 4 Areas of Major Shoaling with the Navigation Channel

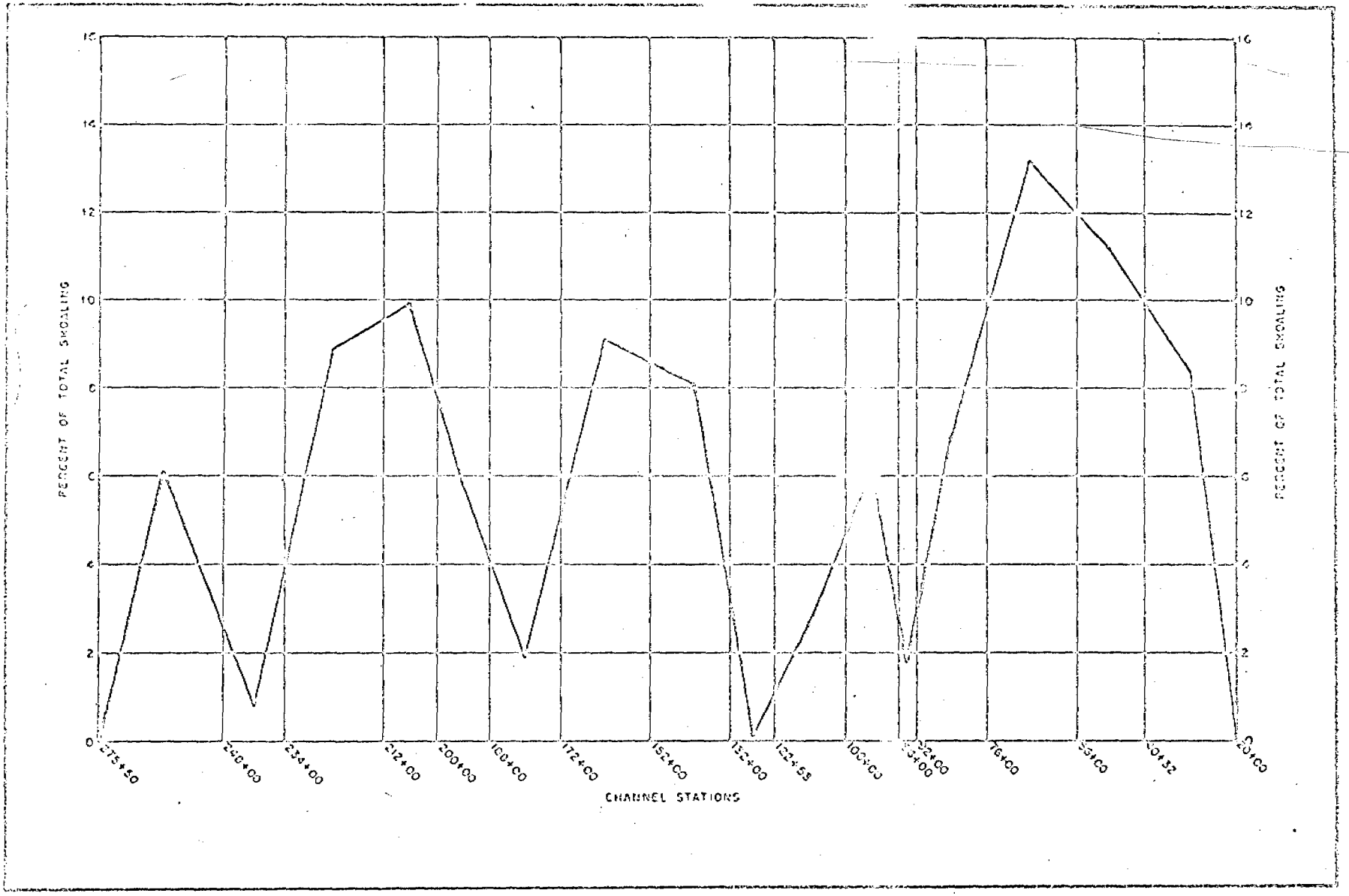

Fig. 5 Shoaling Distribution Pattern

U.S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
Washington 25, D.C.

June 12, 1963

INSTRUCTIONAL MEMORANDUM 21-5-63

32-01

SUBJECT: Coordination of public interests of highway improvements with those of fish and wildlife resources

The information received in reply to our memorandum of January 17, 1963, to regional engineers revealed a degree of coordination between the State highway departments and the State fish and game departments ranging from formal agreements establishing close liaison in the planning, location, and design stages of highway projects to relatively nonexistent communication between the agencies.

Several State highway departments have formal agreements with the State fish and game departments which among other things provide that proposed highway construction projects will be reviewed by the conservation agency for possible effects on fish and game resources, and establish and encourage close liaison between the field offices of both departments.

The highway agencies must realize that fish and game are a natural resource belonging to all the people of the country and the preservation of their habitat must be taken into consideration along with other values of public interest to arrive at determinations which are economical for all public interests. Public Roads supports that every effort should be made in the planning, design, and construction of highway projects that cause a minimum of disturbance to and reasonable preservation of the nation's wildlife and related natural resources.

Under existing statutes, the Secretary, before approving Federal-Aid projects submitted to him in accord with Section 106 of Title 23, United States Code, is required by Section 109 to consider the particular needs of each locality affected by the project. These needs may include the preservation of the fish and wildlife resources of the State or area through which a Federal-aid highway is planned for construction. In order that the Secretary may properly discharge his duties in this regard he should receive proper assurances from each State highway department submitting projects for approval that it has had sufficient opportunity to study the needs of the locality in terms of the preservation or protection of fish and wildlife; that such needs have been evaluated and considered in locating and designing the particular highway project, and that

all feasible measures will be taken to avoid damage to fish and wildlife and their natural habitats in the construction of the project.

To accomplish this purpose, the State highway department of every State shall adopt, in a timely manner, a procedure to be followed in the locating, planning, design, and construction of Federal-aid highway projects so as to afford protection of fish and wildlife resources. This procedure shall contain provision for suitable coordination between the activities of the State highway department and the activities of the appropriate State agency charged with the responsibility for the conservation of fish and wildlife. To accomplish the desired coordination, this procedure, as a minimum, should provide that the State highway department shall (a) submit programs of proposed Federal-aid highway projects to the State fish and game agencies at an early stage with a request that the fish and game agencies indicate those projects of interest; (b) furnish notice of public hearings, where required by Section 128 of Title 23, United States Code, to the fish and game agencies; and (c) adopt such other methods as will afford the State fish and game agency full opportunity to study and make recommendations to the State highway department concerning the proposed project prior to its submission by the State to the Secretary.

As soon as possible, but not later than January 1, 1964, submission of surveys, plans, specifications, and estimates for each proposed Federal-Aid project included in an approved program pursuant to Section 106 of Title 23, United States Code, shall contain a statement that the State highway department has considered all facts presented by the State fish and game agency and the effect the proposed construction may have on fish and wildlife resources. The statement should contain (1) a description of the measures planned as project expenditures to minimize the effect of the proposed construction on fish and wildlife resources; (2) a description of any measures proposed by the State fish and wildlife agency to accomplish this purpose, which differ from those proposed by the State highway department; and (3) to the extent that measures proposed by the State highway department and State fish and game agency differ, an explanation of the factors considered by the State highway department in arriving at its proposal.

The Secretary, in exercising his authority to approve projects pursuant to Section 106 of Title 23, United States Code, thereby obligating the Federal Government for the payment of its proportional contribution thereto, will take into account the effects of the proposed construction upon fish and wildlife, and the necessary measures to be incorporated into the project to provide for the protection of these resources.

The general principles of the foregoing procedures shall be followed by the States for Secondary Road projects undertaken pursuant to Section 117 of Title 23, United States Code, and the certified statements submitted by the States as required thereunder shall so provide.

To be certain that these objectives will be a part of the Federal-aid highway program, each division engineer is to require that the State highway department furnish Public Roads with record of agreement or memorandum of understanding between the State highway departments and the State game and fish agency as to the procedures for cooperation and coordination between such agencies in adopting plans for construction of highway projects which affect fish and wildlife resources. A copy of such record is to be forwarded to the Office of Engineering and Operations, Washington, D. C.

Each division engineer is to require that the State highway department, if operating under the Secondary Road Plan, submit an amending statement to its presently approved Plan advising that the procedures as outlined herein will be made applicable to Federal-aid secondary projects undertaken after date of understanding with the State agency charged with the responsibility for the conservation of fish and wildlife resources, which date shall not be later than January 1, 1964. Such amendatory statements are to be forwarded to the Office of Engineering and Operations for processing for approval and establishment of effective date as set forth in Paragraph 4g of PPM 20-5.

/s/ Rex M. Whitton
Federal Highway Administator

DL-25

ALASKA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF LANDS
344 Sixth Avenue
Anchorage, Alaska

ADL_____

INTERAGENCY LAND MANAGEMENT TRANSFER

The Division of Lands, Department of Natural Resources of the State of Alaska transfers and assigns to the Alaska Department of Fish and Game
1018 International Airport Road, Anchorage, Alaska
or its successors in function, hereinafter called Assignee, jurisdiction and management of the following described lands, including uplands, shorelands, tidelands or submerged lands, located in the State of Alaska, to-wit:

Parcel of tideland located in Greater Juneau Borough, T40 & 41S, R65, 66, and 67E, Copper River Meridian, being more specifically described as follows:

Beginning at U.S.C.G.S. Triangulation Station "Salmon" located on the northeastern shore of Douglas Island; thence, northeasterly across Gastineau Channel approximately .5 miles to U.S.C.G.S. Triangulation Station "Creek", said station being on the shore of Gastineau Channel, 200 feet south of Salmon Creek; thence northwesterly along the line of mean high water approximately 14.5 miles to U.S.C.G.S. Triangulation Station "Glacier", on the southerly tip of Mendenhall Peninsula; thence, in a southeasterly direction across Gastineau Channel approximately 1.3 miles to mouth of Cove Creek; thence in a general easterly direction along the line of mean high water of Douglas Island approximately 9 miles to U.S.C.G.S. Triangulation Station "Salmon", the true point of beginning for this description.

Containing approximately 5973.33 acres.

said jurisdiction and management being limited to the surface and so much of the subsurface as may be required in order to make use of the land for public purposes within the jurisdiction of the Assignee, and for so long as required for said public purposes. The right

to construct, maintain or improve and remove buildings, roads, airports and works of any description, and to use or remove sand, gravel, timber, or other materials on or near the surface is expressly granted when such action is necessary in order to make use of the land for any public purposes within the jurisdiction of the Assignee. The Division of Lands expressly reserves jurisdiction and management of all other minerals including oil and gas in the above described land, provided, however, that the Division of Lands will not permit surface entry for the purpose of mineral or oil and gas exploration or development without the consent of the Assignee.

Dated at Anchorage, State of Alaska, this _____ day of _____, 19_____.

_____
Director, Division of Lands
Department of Natural Resources

UNITED STATES OF AMERICA)
STATE OF ALASKA) ss.

This certifies that on the _____ day of _____, 19____ before me a notary public in and for the State of Alaska, duly commissioned and sworn, personally appeared _____, to me known and known to me to be the person described in and who executed and acknowledged the foregoing instrument on behalf of the State of Alaska, as Director of the Division of Lands, Department of Natural Resources. The said _____, after being duly sworn according to law, stated to me under oath that he is the Director of the Division of Lands, Department of Natural Resources and has authority pursuant to law to execute and acknowledge the foregoing instrument as such Director on behalf of the State of Alaska, acting through the Division of Lands, Department of Natural Resources and that he executed and acknowledged the same freely and voluntarily as the free and voluntary act and deed of the said State of Alaska and for the Division of Lands, Department of Natural Resources.

WITNESS my hand and official seal the day and year in this certificate first above written.

_____
Notary Public in and for the State of Alaska.
My commission expires _____

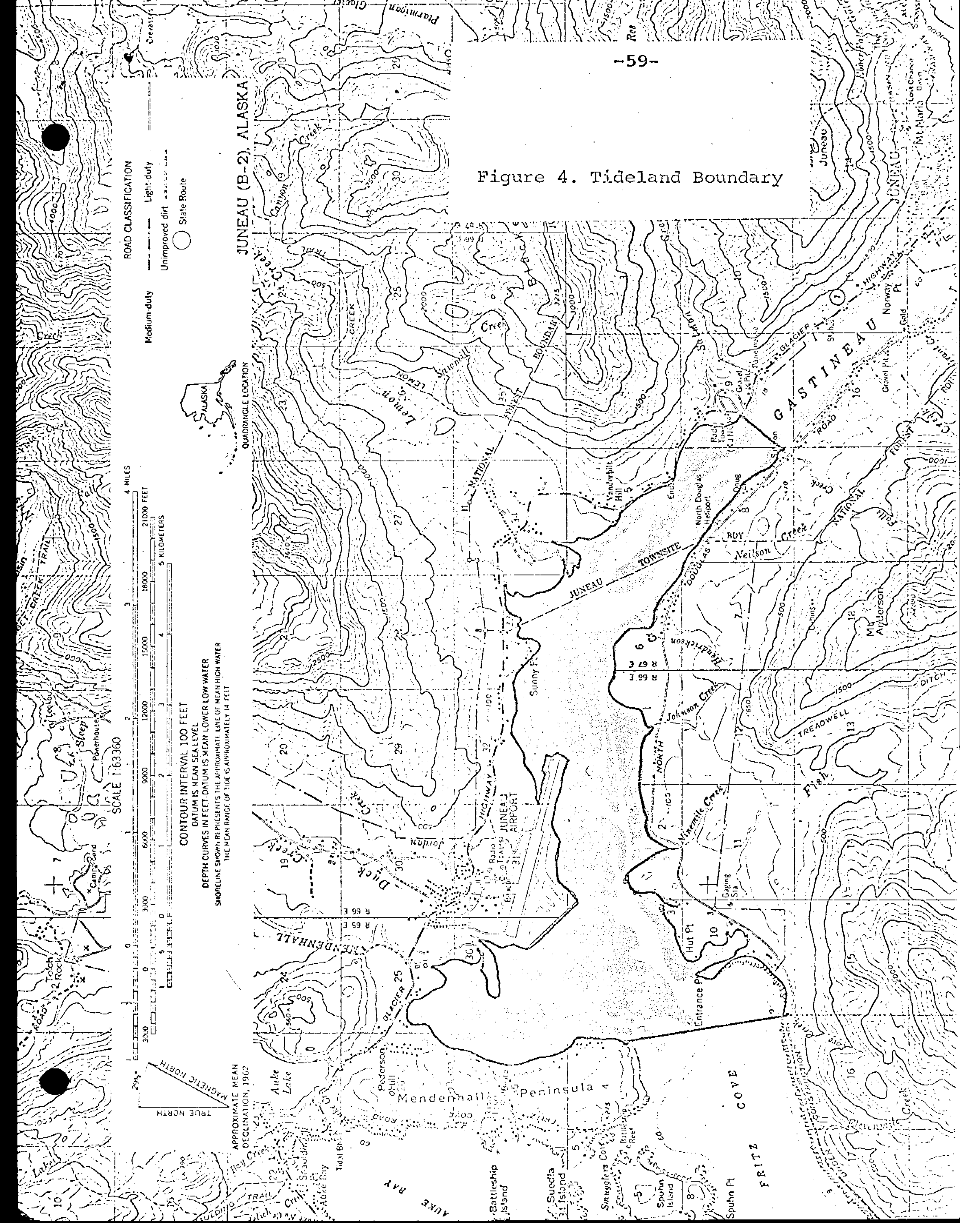

Figure 4. Tideland Boundary