20 June 2001

BARROW, AK
Section 905(b) (WRDA 86) Analysis
Storm Damage Reduction, Flood Reduction, and Navigation Channel

1. STUDY AUTHORITY. This General Investigations study is authorized by the U.S. House of Representatives Public Works Committee Resolution for Rivers and Harbors in Alaska, adopted 2 December 1970. The resolution states in part:

> *Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Rivers and Harbors in Alaska, published as House Document Number 414, 83d Congress, 2d Session; ... Northwestern Alaska, published as House Document Numbered 99, 86th Congress, 1st Session;... and other pertinent reports, with a view to determine whether any modifications of the recommendations contained therein are advisable at the present time.*

2. STUDY PURPOSE. The purpose of this study is to determine the Federal interest in providing storm damage reduction, flood damage reduction and navigation improvements at Barrow, Alaska; to identify a non-federal sponsor willing to share in the cost of the feasibility study; and to develop a Project Management Plan (PMP) for a feasibility-level study.

3. LOCATION OF PROJECT/CONGRESSIONAL DISTRICT.
Barrow, the northern most community in North America and the economic center for the North Slope Borough, is located on the Arctic Ocean about 750 miles north of Anchorage, Alaska. Barrow is a first-class city with about 4,400 residents. The North Slope Borough, which includes almost all of Alaska north of the 68th Parallel, has a population of about 9,600 persons spread over 95,000 square miles, an area about the size of the state of Oregon. The majority of residents are Inupiat Eskimos. Barrow is located on a southwest-northeast coastline of the Chukchi Sea about 10 miles southwest of Point Barrow, the northermost point of land in Alaska (Figure 1). Point Barrow is located on a spit fronting Elson Lagoon and marks the boundary between the Chukchi Sea on the west and the Beaufort Sea on the east.

The study area is located in the Alaska Congressional District, which has the following congressional delegation:

Senator Ted Stevens (R)
Senator Frank Murkowski (R)
Representative Don Young (R)

4. DISCUSSION OF PRIOR STUDIES, REPORTS AND EXISTING WATER PROJECTS.

There are no existing, authorized Corps of Engineers water projects in the Barrow region. The Corps of Engineers has conducted a number of studies considering water resources needs of the Barrow area. These include: studies of beach erosion in 1969 and 1991 (under authority of Section 103 of the 1962 River and Harbor Act) and in 1999 (under Section 14 of the 1946 Flood Control Act); and, studies of small boat harbors in 1979 and 1993 (under Section 107 of the 1960 River and Harbor Act).

The 1969 beach erosion study determined that, due to high alternative costs and insufficient economic benefits, Federal participation in structural measures was not justified. The Corps recommended that Barrow adopt a number of non-structural measures to reduce damage from erosion (i.e., relocate houses, businesses, and utilities and develop/enforce erosion zone ordinances).

The 1979 small boat harbor study looked at five lagoon sites to create a small boat harbor along the coast near Barrow. Sites between Barrow and Browerville (estimated cost $963K) and at Elson Lagoon ($638K) appeared to be economically justified. The report recommended that a Detailed Project Investigation be initiated to determine design feasibility for a small boat harbor.

The 1991 beach erosion study looked at dredging material from an offshore site and transporting the material to the beach. The study determined that such a system (estimated cost $8.6 million) did not appear to be economically justified and thus lacked Federal interest. Subsequently, the North Slope Borough implemented a similar plan.

The 1993 small boat harbor study looked at three basic plans: a boat harbor at the Barrow gravel pit (estimated cost over $10 million), a shallow draft channel in Elson Lagoon ($2.8 million), and a small craft landing and channel from Elson Lagoon into North Salt Lagoon ($1.3 million). The reconnaissance study recommended no further work was warranted since alternatives did not appear to be economically feasible.

The 1999 erosion investigation agreed that there was an erosion problem occurring in front of Barrow and that the landfill and sewage lagoon were vulnerable to overtopping during a severe storm event. However, the cost of potential complete solutions ($20-40 million) greatly exceeded the Federal participation limits ($1 million) of the Section 14 program.

The current study is an effort to carry forward the work begun in the Section 14 study to fully determine whether Federal financial participation in a beach erosion/flood damage reduction and/or navigation project is warranted.

5. PLAN FORMULATION.

a. Existing Conditions.

The economy of Barrow is a combination of subsistence, tourism and transshipment of goods to outlying villages. Due to the existing shallow depths, barges cannot enter Elson lagoon. Since there is no existing harbor near Barrow, goods must be lightered from offshore directly on to the beach. Transshipment is from the beach by small barges to outlying villages. Lost time in the lightering operation is not uncommon due to poor weather conditions and no protected location to unload the barges. In addition, a fleet of approximately 50 boats ranging in size from 16- to 22-feet operates out of Barrow. These vessels are primarily used for subsistence hunting and fishing. Currently the boats are launched using a concrete mat on the beach and small boat trailers. The boats must be removed from the water after each use because there is no protected moorage. Boats left on the beach are subject to developing storms or ice floes pushed upon the beach. Great improvements in efficiency and safety could be obtained if the boats could be moored and transfers could take place in protected waters.

The bluffs that historically separated Barrow and the lake/tundra lowlands from the Chukchi Sea are higher to the southwest of Barrow than toward the spit. The Southwestern bluffs can be up to 40 feet high (Figure 2) and are interspersed with small ravines and gullies where intermittent streams flow through the bluffs and across the beach. The bluffs are composed of unconsolidated sediments with silt, fine sand, and clay topped with peat and other organics being the prevalent materials observed above sea level. The unconsolidated sediment is cemented by permafrost which, when thawed, leaves them vulnerable to gravity flow failures and extremely vulnerable to wave activity during storm surge events. Bluffs at the southwestern end of Barrow and for a few thousand feet southwest of Barrow contain intermittent pockets of gravel that appear to be the main source of material for the offshore bars and the low beach that extends about 10 miles to the northeast. The gravel and sand found in the bluffs are assumed to be deposits from the Pleistocene glaciation. These gravel areas have probably controlled beach growth and overall bluff recession. Extremely extensive borrow operations have taken place on this critical shoreline. The bluff heights in the gravel rich area have been reduced from approximately 30 feet to less than 10 feet and the gravel sources have been mined shoreward well over a thousand feet. Gravel mining has provided materials for Barrow's airport runway, streets, and other needs. The mined area's close proximity to construction sites has made the area an inexpensive source for prior construction projects. The long-term effect of that borrow operation is that the source of gravel for natural replenishment of the beach material has been removed.

The community infrastructure at risk from storm damage, shoreline erosion and flooding consists of roads, utilidor, sewage lagoon and landfill site. The utilidor stretches more than three linear miles and contains sewage, water, and power lines and communication facilities for the community. The construction cost of the utilidor, when it went into service in 1984, was $270 million (about $16,000 /ft). The cost to relocate the utilidor out of danger would be greater than new construction, but can, at the present time, be assumed to be similar in cost to the original construction. Over one mile of the utilidor is

threatened by beach erosion either through damage or by direct erosion or blocking utilidor entrances or otherwise making access to the utilidor difficult and dangerous.

The sewage lagoon and the landfill (Figure 2) are both separated from the sea by a low-lying beach and a roadway. The separation consists of the natural shoreline extending about 90 feet from the sea to an elevation of about + 6 ft MSL[1] and thence almost vertically to a 30-foot-wide roadway at elevation +9.5 MSL. Landward from the roadway, the beach slopes down for about another hundred feet to the sewage lagoon, whose water surface is perched about elevation +4 ft MSL.

The landfill is adjacent to and northeast of the sewage lagoon. Its setback from the road is similar to that of the sewage lagoon. The North Slope Borough Planning Commission recently selected a site 8 miles southeast of the present landfill as a permanent replacement for the present site. Capping and freezing of the existing landfill has been promoted as a means of stabilizing the landfill for closure. However; capping and stabilization will not prevent the beach from eroding and exposing the landfill to a direct frontal attack by storm waves. The removal of the natural beneficial nourishment source south of Barrow for borrow and the apparent increase in storm activities in the absence of ice cover has made erosion of the low profile beach in front of the landfill an immediate problem. The short distance and low shoreline elevation between the open sea and both the sewage lagoon and the landfill make wave overtopping and breaching from either the lagoon or the shoreside imminent possibilities. Storm surges for the region are severe and reported in the Tekmarine report Bluff and Shoreline Protection Study for Barrow Alaska as:

Return period statistics for storm surge
And nearshore wave heights

Return period (years)	Storm surge elevations Above MSL (ft)	Maximum Wave Height At MSL Shoreline (ft)
100	12.0	9.6
50	10.6	8.5
30	9.5	7.6
20	8.7	7.0
10	7.3	5.8
5	5.7	4.5

The existing roadway at the landfill and sewage lagoon prevents breaching up through about the five-year storm and wave event. Since the roadway is only 30 feet wide, the potential for breaching is imminent. Both the City and the Borough have recognized this potential. Wood, silt/sand filled bags, and other fragile shore protection has been placed in front of the lagoon and landfill in an attempt to provide protection. A beach nourishment program has also been undertaken, using a dredge to pump offshore bottom

[1] Mean Sea Level (MSL) corresponds to the mean tide which is 0.2 feet Mean Lower Low Water (MLLW).

materials onto the beach. However; the dredge used in the nourishment operation, the *Qayuuttaq,* was extensively damaged in mid-August 2000 during a severe summer storm. The dredge was sent to Seattle for repairs. The estimated cost of the needed repairs was about $4-5 million. Consequently, since the Borough put the dredge up for sale in Seattle, it will be unavailable for Barrow beach nourishment activities in the future. The borrow materials that were being dredged offshore for the beach nourishment were high in silt and contained little if any gravel. Any nourishment program will be ineffective unless better material sources for nourishment are found.

Although shoreline processes here are similar to those elsewhere as far as wave movement of sediments, there are exceptional differences such as:

1. The ice pack prevents wave activity on the beach except for a few months in the summer.
2. Permafrost adds some resistance to erosion early in the season after the ice pack retreats. However, when thawed, gravity flows eroding the bank without wave activity are possible.
3. The ice moves sediments onto the shoreline, overtops the beach, and gouges the bluffs and beach.
4. Ice pressure ridges that form offshore can build sufficient depth below sea level to ground on the offshore bar where that bar is present.
5. The ice can also mount the shoreline to elevations 50-ft above water level. This phenomenon is called an ivu. The ice cover normally forms to about a 3-foot depth. When it breaks at the shoreline due to wind pressure it stacks layer upon layer of ice each overriding the underlying layers. The stacking process has been reported to reach heights of 50 feet.

Sediments along the shoreline consist of gravel with sands from Point Barrow to the southwest end of the City of Barrow. From Point Barrow to Plover Point, the eastern tail of the spit, there is a reduction of gravel sizes and the material has a larger composition of coarse sands. As one moves southwest along the beach from the gravel borrow pit southwest of the City, the beach material grades from coarse sand and gravel to fine sand as you proceed southwest.

Longshore transport has been reported as 10,000 cubic yards per year with dominance to the northeast and about a 10,000 cubic yard per year southerly flow. Northeast transport is then on the average about 20,000 cubic yards per year. It has also been stated that a single storm in 1963 moved at least 200,000 cubic yards of material in a single event to the northeast. The northeast dominance may then greatly exceed the 10,000 cubic yards per year indicated. Beach gradations also indicate that the main source of materials for the spit formation has throughout the centuries come from the gravel borrow area southwest of Barrow.

Shoreline recession based on historic values has varied, but a value of 4 feet per year as reported in Tekmarine's *Bluff and Shoreline Protection Study for Barrow, Alaska,* 1987 at the bluffs does not seem unreasonable. The bluff recession has supplied the sand and gravel needed to sustain the spit. The gravel portion of those bluffs has been diminished

in height by at least 50%. Assuming that adjoining permafrost and other phenomena control the recession rate to the south, this leaves Barrow and locations to the northeast vulnerable to extremely rapid recession unless gravel replenishment and or beach hardening to prevent massive sediment removal by storms is undertaken.

Beach nourishment by the Borough was undertaken in 1999. Materials for the nourishment have come from immediately seaward of the offshore bar formations. Thus far, the borrow material from this source has been about 70% silt and 30% sands with little if any gravel. This nourishment composition is ineffective against major wave activity. Alternative borrow sources with appropriate material have not been developed.

Borrow sources with gravel may be available in the Elson Lagoon, an area about 7 miles north of Barrow. This area, when developed as a borrow source, also could become an unloading site for lightering vessels. A modest amount of dredging in Elson Lagoon to develop a navigation channel would be required.

b. Expected Future Conditions.
Without shoreline improvements, there is about a 30% chance that Barrow will experience a storm in the next 10 years that will breach the sewage lagoon and landfill and damage the utilidor. A breach of the sewage lagoon and landfill will result in the possible release of hazardous and toxic waste and raw sewage into the subsistence hunting grounds of the native population. The utilidor will be severely damaged and to some extent destroyed due to water infiltration. Bluffs will erode and public facilities and housing will be lost to erosion and some flooding damage will occur. The spit will be periodically breached and access to the whale harvest areas near Elson Lagoon will be lost or interrupted.

A lack of navigation improvements at Barrow will continue to cause delays in landing and transshipping goods to and from Barrow. Without navigation improvement vessel damage, loss of goods and delays will continue in the lightering operation. The development and growth of vessel oriented sightseeing/charter sectors cannot be realized without navigation improvements.

c. Planning Objectives.
The local community desires to provide: 1) relief from storm damage and shoreline erosion that threatens homes, shoreline bluffs and infrastructure, 2) protection against flooding and flood damages to critical public and private facilities, and 3) navigation access to a protected harbor site for lighter barge loading and unloading. The flooding, storm damage reduction and shoreline erosion will need to be handled as the same project.

d. Without Federal Project Conditions.
If no Federal project is constructed, the Barrow area will continue to experience erosion and land will continue to be lost to the Arctic Ocean. Storm events in the absence of ice cover will continue to occur and remove large quantities of beach material. The storms

will continue to erode the bluff toe, weaken the bluff and slump onto the beach. The material in the bluffs, which is composed of very fine silt and sand, will then be acted upon by wave action and carried away.

Because of the high cost of a permanent solution to the problem, the borough will most likely continue their current beach nourishment program, dumping sacrificial materials along the seaside of the road. This material provides some protection during moderate storm events but will provide little to no protection from a severe storm event with a high storm surge. Thus, the landfill and sewage lagoon will remain vulnerable to breaching.

In front of the city, the dredge program has been discontinued. In the absence of the dredge, sacrificial material will likely be placed in front of the bluffs by dump trucks. Neither the dredge material nor the dump truck material is likely to be coarse enough to stay in place during a moderate storm event.

e. Alternatives Identified in the Section 14 Study.
The recent Section 14 study considered several different alternatives, but did not select a recommended plan because the estimated costs for all alternatives greatly exceeded the federal cost sharing limits for a project in the Section 14 Program. The alternatives included: (1) groin fields and shore-parallel, detached breakwaters; (2) raising the road (at the Landfill Lagoon) and armoring with concrete block revetment or gravel-filled geotextile bags; and, (3) providing beach nourishment (at Barrow & Browerville) and armoring with concrete blocks or gravel-filled geotextile bags. Because the groin fields and breakwaters were estimated to cost substantially more than the other alternatives and would only address the shore erosion and not the shore bluff recession problem, they were dropped from further consideration in the Section 14 study. The road raise at the Landfill Lagoon and the beach nourishment at Barrow/Browerville would have protected about 2,400 and 4,700 lineal feet of shoreline, respectively, with combined costs ranging from $20 to 30 million. These conceptual plans are further refined in the current 905(b) analysis.

f. General Conceptual Plans. Based on the close proximity of the city, utilidor, sewage lagoon and landfill to the Chukchi Sea, and the elimination of the prime historic coarse sediment sources by the massive borrowing operation, all alternatives considered as solutions for the erosion and flooding problems must include beach nourishment to prevent further beach loss. A partially-hardened, armor-protected shoreline combined with a beach nourishment program appears to be the most likely solution. It is anticipated that the optimum borrow source for nourishment would be located in the Elson lagoon. Dredging operations would be protected in the lagoon, the fleet could overwinter there, and there is potential for harbor development with channel cut material used for beach nourishment. Excavation of borrow material from Elson lagoon would provide a protected moorage area for the existing Barrow small vessel fleet.

For the purposes of this study, the limited protection plan envisioned in the section 14 study (7,100 lineal feet) was expanded to include the entire 25,000 foot-long shoreline under attack, including Barrow, Browerville, and the sewage lagoon/landfill area. The construction of shore protection at the sites shown on figure 3 combined with the placement of nourishment and wave absorption beach fill shown at locations on the same figure should protect the City of Barrow, the sewage lagoon, and the landfill from erosion. Borrow material required for beach nourishment would be taken from Elison Lagoon about seven miles northeast of Barrow and would permit development of a deeper navigation channel in the lagoon from deep water to a sheltered harbor area. This area is presently used as a haul out location for whales when they are harvested.

g. Problems and Challenges.

Solutions to the Barrow beach erosion problem involve several components. Those components are:

1. Identification of an adequate source of gravel and sand for beach nourishment. The source must be capable of supplying up to 4 million cubic yards for initial beach rebuilding and be able to supply enough material for the maintenance nourishment throughout the project life that will be necessary.
2. Development of an affordable method of transporting the materials to the critical beach sections.
3. The project must provide adequate beach depth and height to absorb severe storm and ice conditions. As an alternative, beach hardening could be used in lieu of some of the beach absorption material. The protected area must be continuous and extend somewhat beyond the critical areas of potential damage so as to be able to absorb variations in transport of sediment and intensity of attack.

A source of gravel and sand must be found within an economic transport range of the project site. At present, explorations have concentrated on the zone offshore of the offshore bar. Material thus far excavated has been about 70% silt and 30% fine sand. Neither material is suitable for beach nourishment at this location. Spit growth appears to be a product of sand and gravel transport. Sediment overwash and easterly transport during extreme storm events appears to have formed gravel and sand deposits at the spit terminus. A likely location of extensive gravel deposits appears to be in Elson Lagoon. For purposes of this analysis it is assumed that a source can be developed at this location. Excavation and transport of the material is possible with a pipeline dredge and booster pumps, with a pipeline dredge and truck haul, or with a clamshell dredge with pumpout capability and booster pumps. As many as eight boosters may be required to move the material from the borrow source to the extreme southwest end of the beach.

h. Potential Alternative Projects.

Two solutions were examined for the protection of the critical beach area, from southwest of Barrow to northeast of the landfill (Figure 3) and one option considered for improving

navigation. Both erosion solutions incorporate a raised roadway serving as a last line of defense with beach rebuilding. They differ only in the concept of how best to absorb the energy from extreme storm events. Solution 1 uses only natural materials to widen the beach to absorb storms. Solution 2 uses a hardened concrete mattress protecting half the volume of the initial beach nourishment used in Solution 1. Material dredged from Elson Lagoon would leave channel and harbor areas while serving as part of the material needed for the beach nourishment. Thus the borrow excavation would result in a beneficial use of the borrow area for improved navigation.

SOLUTION ONE: This solution adds 100 feet of beach width to the beach southwest of Barrow to a point about 500 feet northeast of the landfill, a total distance of 25,000 lineal feet. The initial nourishment would require 2 million cubic yards of material. In addition to the beach nourishment, the roadway would be raised to elevation +16 MSL to the same northeast terminus. The roadway would be built with sand and gravel fill from the same source as the beach nourishment. Side slopes on the roadway would be one on three. The roadway top width would be 30 feet. Fill material required for the roadway is estimated to be about 500,000 cubic yards. The annual beach nourishment requirement is estimated to be 10,000 cubic yards per year. Borrow is assumed to be gravel and sand with the same size distribution as the surface beach material located in Elson Lagoon.

Estimated Cost of Solution One:

Beach fill 2,000,000 cu yds @ $33.00/yd.	**$66,000,000**
Raise roadway 500,000 cu. yds. @ $33.00/ yd.	**16,500,000**
Total First cost	**$82,500,000**
Annualized First Cost	**$5,510,000**
Annual Maint. 10,000 cu. yds. @ $33.00	**330,000**
TOTAL ANNUAL COST	**$5,840,000**

SOLUTION TWO: This solution adds 50 feet of beach width to the same length of beach as solution one. The roadway would again be raised to elevation +16 MLLW with one on three side slopes. The annual nourishment requirement is identical to that of solution one. A concrete mattress revetment would be added to the seaward slope of the roadway and bluffs for the total 25,000 feet. The revetment will be underlain with filter cloth and extend from elevation +16 to MSL. Borrow is assumed to be gravel and sand with the same size distribution as the surface beach material in Elson Lagoon.

Estimated Cost of Solution Two

Beach Fill 1,000,000 cu. Yds. @ $33.00	**$33,000,000**
Road Construction 500,000 cu. yds. @ $33.00	**16,500,000**
Filter cloth 1,250,000Sq. ft. @ $2.00	**2,500,000**
Concrete revetment 1,250,000 sq. ft, @ $22.00	**28,000,000**
Total First Cost	**$80,000,000**
Annualized First Cost	**$5,343,000**
Annual Maint. 10,000 cu. yds. @ $33.00	**330,000**
TOTAL ANNUAL COST	**$5,673,000**

NAVIGATION CHANNEL.

For the two solutions identified, the assumption is that the navigation channel and harbor would be created in the borrow area for the beach nourishment project at no additional cost. If a navigation channel were to be constructed independently, it would require initial dredging of 392,000 cubic yards at a unit cost of $33 per cubic yard. Given an interest rate of 6-3/8 percent and a 50-year period of analysis, the annual project cost would be estimated at $864,000. The estimated operation and maintenance cost would be $10,000 a year, with maintenance carried out annually during beach nourishment operations. Therefore, the total annual incremental annual project cost for a navigation channel and harbor would have been estimated at $874,000.

Estimated Cost of Navigation Only Option

Channel Excavation 392,000 cu yds @ $33.00/yd.	**$12,936,000**
Annualized First Cost	**$ 864,000**
Annual Maint. 10,000 cu. yds. @ $33.00	**10,000**
TOTAL ANNUAL COST	**$ 874,000**

Sufficient separable benefits are not anticipated that would justify a separable navigation only project. A navigation project will occur only as an incidental benefit to a storm damage reduction project. Thus, either Solution One or Solution Two may be the vehicle that incidentally includes navigation improvements to form a project addressing both beach erosion/flood damage reduction and navigation needs of the community.

i. Economic Analysis.

(1) Reduction or Elimination of Storm Damage, Erosion and Flood Damages. This would be the primary benefit category and would include potential benefits derived from elimination of a breach to the sewage lagoon, prevention of release of toxic waste from the landfill, and reduction of damage to the utilidor. Average annual benefits, based on the potential need for and cost of replacing the utilidor and the relocation of the sewage lagoon and landfill to a flood free site, are expected to range from $6,000,000 to $8,000,000. Some specific items identified that would be evaluated during the detailed study phase include:

(a) Elimination of a breach to the sewage lagoon
(b) Elimination of the release of toxic waste from the landfill as measured by the cost of removing the toxic substance to a safe, flood-free upland site.
(c) Elimination of damages to the utilidor
(d) Elimination of the destruction of homes and businesses.
(e) Reduction of flood damages to public and private facilities.

*(2) **Harbor Benefits.*** Economic benefits for the harbor would come from reducing delays for barges, reducing environmental risks associated with refueling operations, and increasing the level of subsistence hunting and fishing. The harbor benefits do not appear to be of sufficient magnitude to justify a separable navigation project. However, if the channel and harbor were created incidental to the storm damage reduction project, there would be harbor benefits resulting from project construction. The major benefit categories are discussed in the following paragraphs.

Waterborne Commerce. Reductions in the number of barge delivery delays and in the time spent on lightering operations would result in a decrease in the cost per pound for goods delivered to Barrow and also for those goods transshipped to other communities. A navigation channel able to accommodate fuel barges, along with development of onshore facilities, would minimize the chance of fuel spills, all but eliminate delivery delays lasting more than a few hours, and allow fuel storage facilities to be located at a site offering protection from severe storms. Following excavation of borrow at Elson Lagoon, barges will have a protected area to unload cargo.

Subsistence. Improved vessel access with to the hunting grounds offshore would result in an increase in subsistence hunting and fishing by residents. A decrease in the consumption of imported foods would result, and the level of disposable income within the community would increase. While relatively small in monetary value, these would be direct benefits very important to the community in maintaining their desired subsistence lifestyle.

*(3) **Total Benefits.*** The total storm damage/erosion/flood prevention benefits appear to be greater than the estimated project cost for shore protection. The navigation benefits do not appear greater than the estimated costs for a stand alone navigation project. Navigation benefits are incidental but real and will be included in the total project benefits, as appropriate. The feasibility study will further refine the potential alternatives and fully develop the benefit evaluation.

j. Environmental Considerations.

Based on previous investigations in the general area, the primary environmental factors that should be considered in evaluating any proposed alternatives include possible effects on: wildlife habitats, subsistence, cultural resources, and water quality. The project may provide the opportunity for beneficial use of dredged material. More detailed investigations and preparation of a formal Environmental Assessment or Environmental Impact Statement would be part of a detailed project investigation.

Wildlife Habitats: The Barrow area is one of the remaining areas in Alaska where the threatened Steller's eider and Spectacled eider sea ducks are known to nest. Any action in Barrow would require consultation under Section 7 of the Endangered Species Act with the U.S. Fish and Wildlife Service. Locals report that they used to hunt Steller's eider on Elson Lagoon. Hunting is no longer permitted. Other bird species also nest on the tundra. Elson Lagoon is highly productive for fish and waterfowl. Other marine mammals such as polar bears, seals, walruses, and beluga and bowhead whales are found in nearshore waters at different times of the year. Terrestrial wildlife in the area include large mammals such as caribou, and brown bear; small mammals such as mircrotines and ground squirrel, furbearers such as arctic fox, and arctic hare.

Subsistence: The project may increase the subsistence harvest potential. Carrying capacities of the prey species should be further studied. Care must be taken in the design of the project such that the project does not significantly interfere with existing subsistence activities critical to the community.

Cultural Resources: The Barrow area is one of the few areas of northern Alaska that is relatively well known prehistorically. There are several archaeological sites along Elson Lagoon. Archeological finds continue to be uncovered all over the area. A complete archeological investigation in the project alternatives would be required.

Water quality: Because of the low tidal action, proposed harbor circulation at the proposed dredging sites would have to be analyzed to assure that normal usage would not pollute the harbor. Determination of the suitability of the dredged material for redepositing into the tidal zone would be required, such as tests for contaminant constituents.

Dredging/Beneficial Use : The extensive dredging proposed in the productive Elson Lagoon is of concern. Research into the appropriate timing and location of the dredging would be required. Dredged material could be used beneficially for beach nourishment and eliminate the need for a dredged material disposal site.

6. FEDERAL INTEREST. The alternatives considered during this investigation appear to demonstrate a Federal interest in conducting a feasibility study considering storm damage reduction, flood damage reduction, and navigation. Benefits to the Nation potentially include: reduction of erosion damage, reduction in flood damage, elimination of the risk for an imminent release of landfilled material and human sewage, and incidental navigation benefits. Based on the alternatives developed for this analysis, an erosion protection system, that incidentally may create navigation improvements, appears to be technically possible, economically feasible, and environmentally acceptable.

7. PRELIMINARY FINANCIAL ANALYSIS. The North Slope Borough has agreed to sponsor the feasibility study. The sponsor is aware of the 50-percent study cost-sharing requirement. The sponsor is also aware of the responsibility for sharing the implementation costs. The sponsor can provide the necessary funding to initiate the feasibility study, as stated in the enclosed letter, and is willing to share the cost of construction.

8. SUMMARY OF FEASIBILITY STUDY ASSUMPTIONS. The major assumption involved in the alternative solution identified at this time is that a suitable gravel source of a sufficient size will be found within an economically feasible transportation range for beach nourishment. If such a gravel source is not found, the scope of the study and possible alternative measures could change, with a potential additional cost needed to complete the study. The estimated total feasibility phase costs are based on an Environmental Impact Statement (EIS) being prepared, rather than an Environmental Assessment (EA). The area appears to have enough species of concern that an EA would not be adequate.

9. FEASIBILITY PHASE MILESTONES. The following table provides a list of significant Feasibility Phase Milestones.

Sponsor endorses 905(b) Analysis	24 April 2001
Begin preparation of Project Study Plan	May 2001
Sign Feasibility Cost Sharing Agreement	Oct 2001
Feasibility Scoping Meeting	Oct 2003
Alternative Formulation Briefing	Nov 2004
Draft Feasibility Report/EIS to Public	Jul 2005
Final Feasibility Report/EIS to Congress	Dec 2005

10. FEASIBILITY PHASE COST ESTIMATE. The Feasibility Phase of this study is estimated to cost $3 million. These costs may be apportioned as shown in the following table. The local sponsor has indicated a desire to provide part of its cost share with in-kind services. The exact amount of these in-kind services will be determined as the Project Management Plan is developed.

Type of Work Item	Estimated Cost
Project Management	$200,000
Plan Formulation	$300,000
Hydraulic Analyses and Design	$700,000
Economic Analyses	$300,000
Cost Engineering	$ 60,000
Geotechnical Investigations	$600,000
Environmental Analyses & EIS	$500,000
Real Estate Investigations	$ 50,000
Review & Revision of Report	$ 40,000
Support for Washington Level Review	$ 50,000
Contingency	$200,000
TOTAL ESTIMATED COST	$3,000,000

11. RECOMMENDATIONS.

I recommend further study to determine the feasibility of providing storm damage reduction, flood reduction, and navigation improvements for Barrow, Alaska. The total cost of the feasibility study is estimated at about $3 million, which includes contingency. The study is scheduled for completion in 2005.

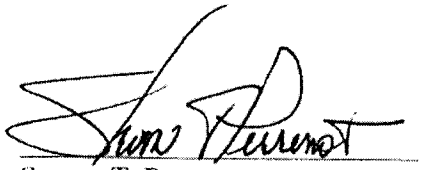
The recommendations contained herein reflect the policies governing formulation of individual projects and the information available at this time. They do not necessarily reflect program and budget priorities inherent in the local and State programs, or the formulation of a national Civil Works water resources program. Consequently, the recommendations may be modified at higher levels within the executive branch before they are used to support funding. However, prior to initiating the feasibility study, the local sponsor will be advised of any such modifications and will be afforded an opportunity to comment further.

12. POTENTIAL ISSUES AFFECTING INITIATION OF FEASIBLITY PHASE. None.

13. VIEWS OF OTHER RESOURCE AGENCIES. The views of other resources agencies are not known at this time. The alternatives have not been discussed with the resource agencies, but will be once the Feasibility Phase begins. It is anticipated that the National Marine Fisheries Service, the U.S. Fish and Wildlife Service and other resource agencies will be very interested in this study.

14. FIGURES.

1.Location Map
2.Detailed Map of Project Sites-existing conditions
3.Detailed Map of Project Sites-segment locations



Steven T. Perrenot
Colonel, Corps of Engineers
District Engineer

29 JUN 2001

Date

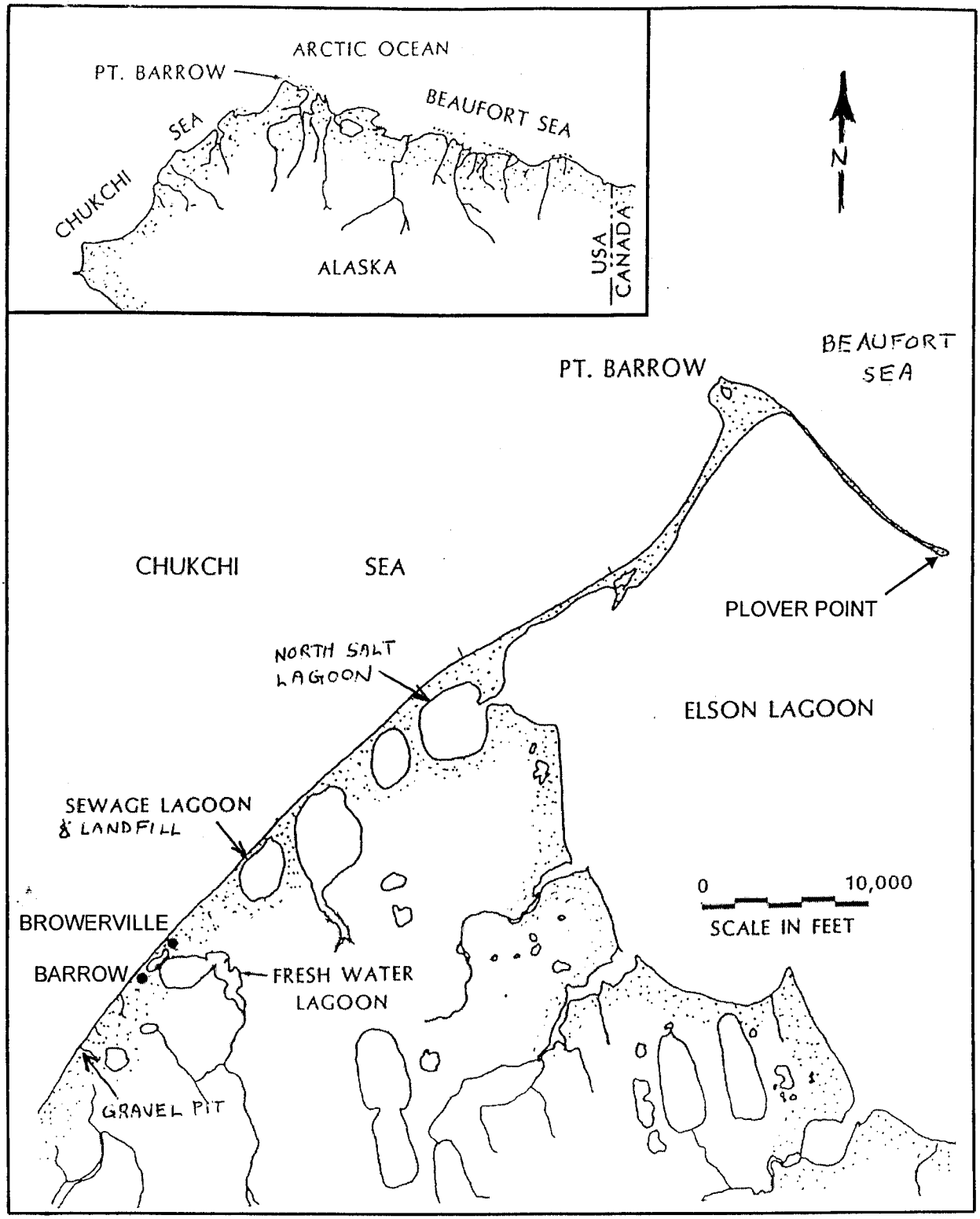


FIGURE 1. LOCATION MAP

From Tekmarine bluff and shoreline protection study for Barrow, Alaska 1987

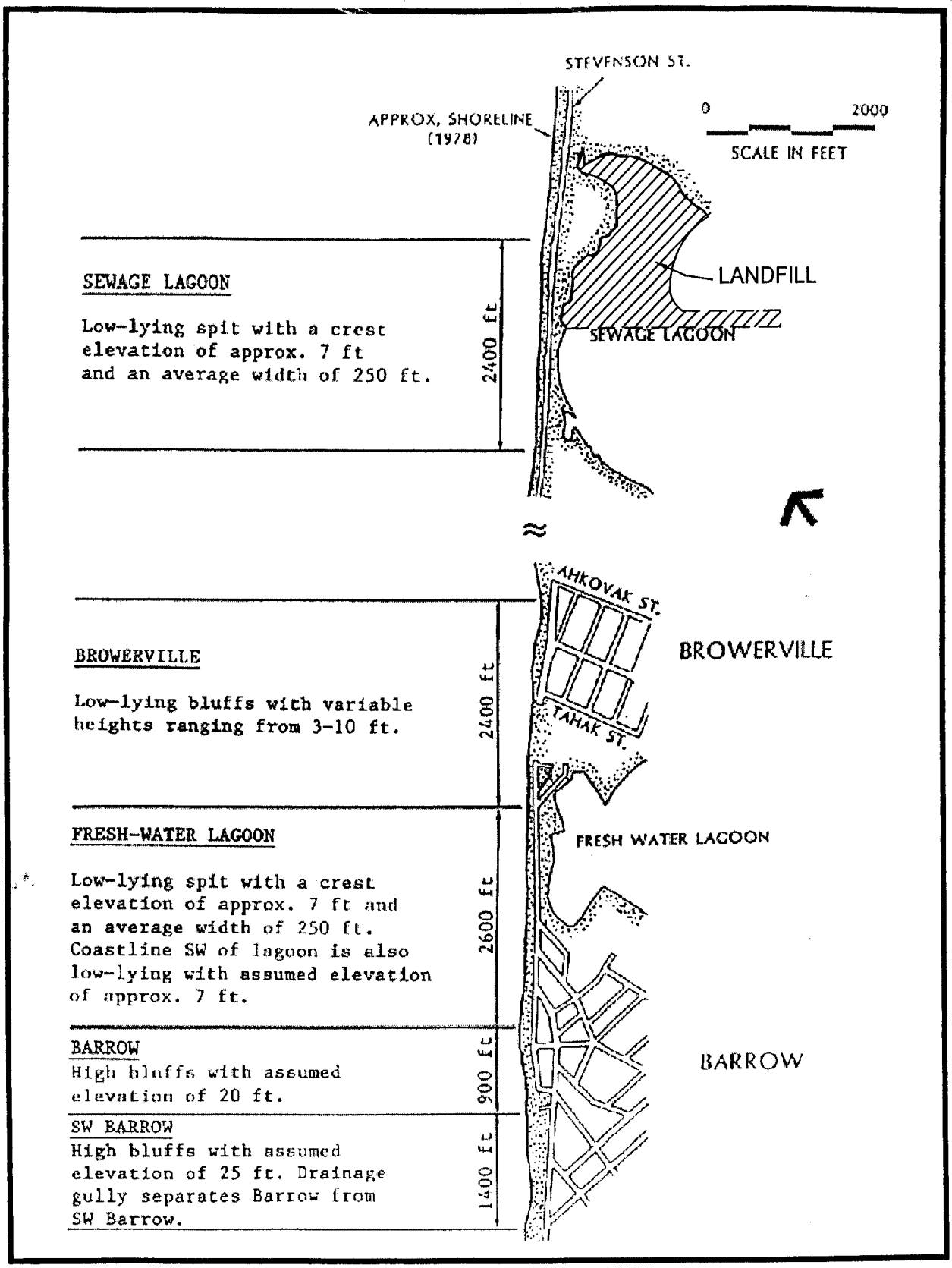


FIGURE 2. DETAILED MAP OF PROJECT SITES

From Tekmarine Bluff and Shoreline Protection study for Barrow, Alaska 1987.

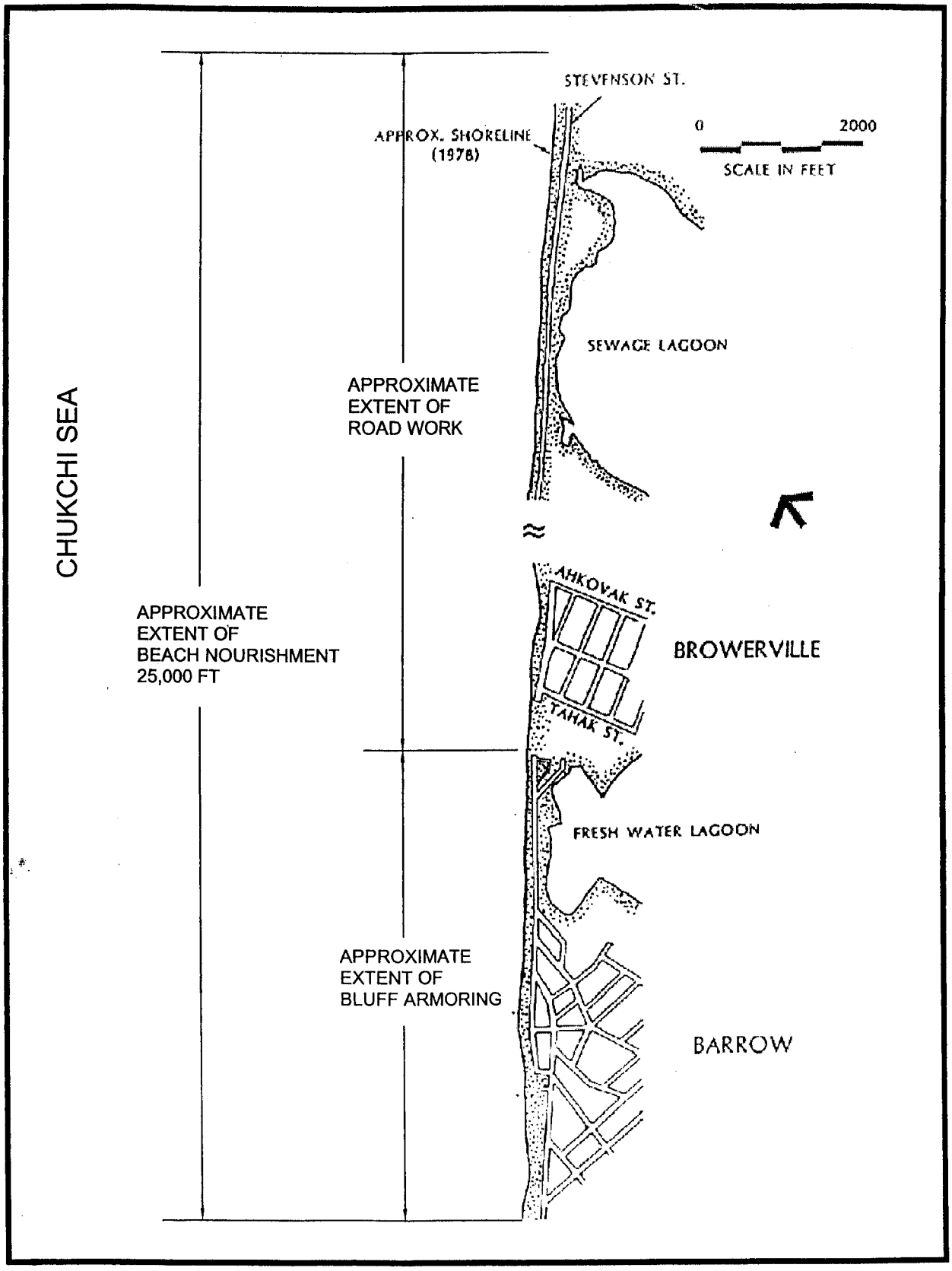


FIGURE 3. DETAILED MAP OF PROJECT SITES

From Tekmarine Bluff and Shoreline Protection Study for Barrow, Alaska 1987.