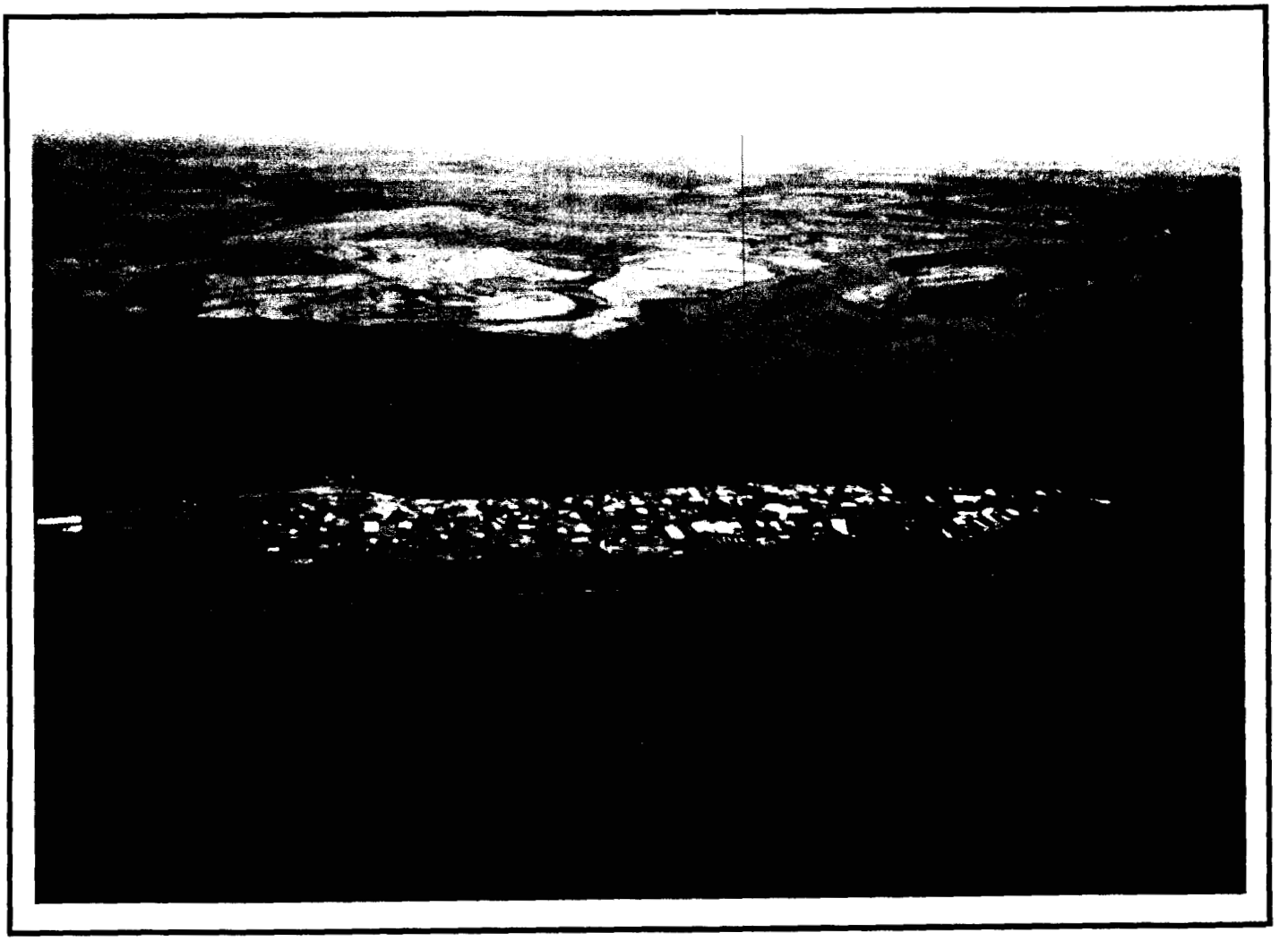
City of Kivalina
Kivalina, Alaska
Relocation Study



DOWL ENGINEERS

A Division of DOWL, Incorporated

City of Kivalina

Relocation Study

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City of Kivalina

Relocation Study
Kivalina, Alaska

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INTRODUCTION

Kivalina is an Inupiaq Eskimo village in the Northwest Arctic Borough of Alaska. The Village of Kivalina (hereafter referred to as the City of Kivalina or the City) is located approximately 80 miles north of the Arctic Circle on a barrier island in the Chukchi Sea. The sand island is generally about 700 feet wide and extends along the coast for approximately five miles. Generally, the island has an elevation of about 10 feet, or less. The City itself is located at the southeast end of the island at the Singauk Entrance to Kivalina Lagoon. The Singauk Entrance is where the Wulik River flows into the Chukchi Sea. The northwest end of the island is bound by the Kivalik Inlet which is the channel formed by flow of the Kivalina River. Barrier islands and peninsulas continue northwest from the Kivalik Inlet. Kivalina Lagoon is formed between the islands and peninsulas and the mainland and is up to 2 miles wide and 10 miles long.

The first recorded history of the community occurred in 1847 when Lt. L. A. Zagoskin of the Imperial Russian Navy recorded the name "Kivualinamut" for a village at the north end of Kivalina Lagoon. The original population of the current City consisted of survivors of aboriginal Kivalinarmiut Society as well as refugees from the Shishmaref area, the Noatak Valley, and the Kotzebue region. The City was founded at its present location when the Federal Government constructed a school on the island in 1905. A settlement grew up around the school when the native children of the area were required to attend school.

The City of Kivalina has developed to its present configuration rapidly. In 1964, there was one log house, ten sod houses, and fourteen frame houses in town. Older residents remember when there were only four wooden structures in town and nearly everyone lived in sod houses. Currently, there are no sod houses in the City. In 1964, most houses were homemade, one-room structures. The houses today are generally two or three bedroom houses with approximately 1,000-square feet of floor space.

The population of Kivalina has increased steadily since 1905. The following table presents the population data:

Year	Population
1920	87
1950	117
1970	188
1990	317

The population is composed almost entirely of Inupiaq Eskimos. The rather dramatic increase in population since 1970 is partially due to better access to medical care and a revival of interest in the community since 1968 when a whale was taken by a Kivalina crew. Kivalina is the only whaling community in the Northwest Arctic Borough.

STUDY

The purpose of this study was to determine the best solution to several problems which exist in Kivalina. All of these problems result from expansion of the City being limited on three sides by water and on the fourth side by the airport. With no room for expansion, and all available space being used for housing or other structures, the City has become very congested. At the time of this study, there were houses where 16 people were living in a 900 square foot home. Since there is no land available to build additional housing, many of the families have three generations living in the same house.

The community has an inadequate sewage system consisting of "honey-buckets" which are emptied by each of the residents into two "bunkers", located near the normal high water line on the Chukchi Sea side of the island. The residents have a relatively poor water system consisting of a half-million gallon, heated tank in the center of town. This tank is filled by stringing a fire hose to a pump station about three miles away upstream on the Wulik River. Many of the buildings in town do not have running water or plumbing. Due to overcrowding and the sanitation conditions, the City of Kivalina has an extremely high instance of communicable diseases and other health problems.

The goal of this study was to evaluate the needs of the people and to determine which relocation option is best for expansion and development of the City. It is believed that relief from overcrowding and an improvement of the sanitation conditions will improve the quality of life and improve the general health of the population.

The City's current location is exposed annually to the threat of damage or destruction by a storm surge from the Chukchi Sea. Generally, these storm surges occur in late summer or fall when a high atmospheric pressure field passes over the area. This is reported to result in a sea level rise of 10 feet or more. When the tidal surge is accompanied by local winds, the storm surge that is generated can become even greater and can be accompanied by waves because these storm surges occur in late summer or early fall they often contain floating ice.

Since the creation of Kivalina in 1905, there have been at least two occurrences when waves have over-topped portions of the island. The normal high water mark on the Chukchi Sea side of the island is clearly visible and appears to be within one to two feet of the elevation of the town.

Although there is very limited information available, it is our opinion that it is only a matter of time until the right combination of natural events occur which will result in over-topping of the City. When this occurs, the wave action will result in damage to the structures and if ice is associated with the storm surge the consequences could be disastrous.

The potential for a disaster created by a storm surge is the major reason for the City considering moving to another, more protected location.

Another natural event that has concerned the residents of Kivalina is the potential for erosion. To evaluate the erosion that is occurring, we studied the available air photography of the island. The review of photographs, back to 1952, does not show conclusive proof that erosion is occurring on the Chukchi Sea side of the island. The beach and the southeast end of the island at the Singauk Entrance are such dynamic systems that at times it is eroding and, at other times, it is adding. With only 40 years of photography available for review, this makes the determination of the long-term trends of erosion or deposition difficult. Our study does indicate there has been substantial erosion of the Kivalina Lagoon side of the island at the Singauk Entrance. This erosion is due to the flow from the Kivalina River some of which flows through the Lagoon and exits at the Singauk Entrance rather than the Kivalik Inlet. The flow channel in the Lagoon near Kivalina is located adjacent to the island and erodes as it rounds the corner into the Singauk Entrance. The erosion and deposition of the beach are so dynamic that the Singauk Entrance has been totally blocked in the past by storm waves, but tends to be reopened by the erosion forces of the Wulik River flowing into the lagoon.

The study focuses on four basic options as discussed below:

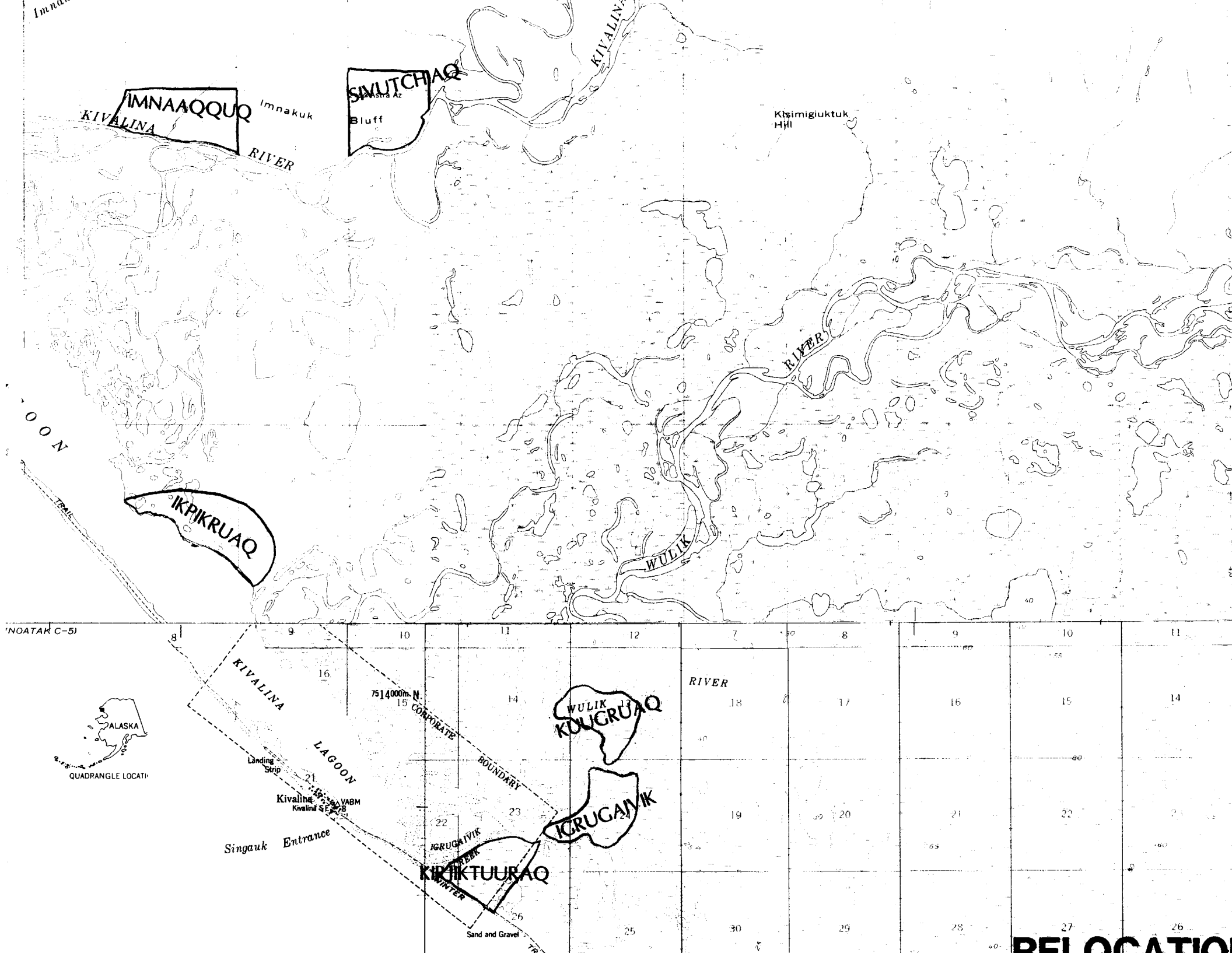
Option 1	Develop the existing airport land and construct a new airport northwest along the island from the existing airport.
Option 2	Fill in a portion of the Kivalina Lagoon adjacent to the City and create new land that could then be developed.
Option 3	Build a bridge across the Singauk Entrance (the Wulik Channel) to the southeast and create access to more land for development along the coast.
Option 4	Move the City to a new location where a planned community could be constructed.

Since the City residents use the area extensively for their subsistence lifestyle and are, therefore, very familiar with the land, they were asked to select the locations they felt should be considered under Option 4, above. A public meeting was held to discuss which sites should be considered. Eight sites were selected for consideration. Of the eight sites selected, some had limited support and others had major support. All sites were considered in this study.

The list below designates each of the sites by its locally known Eskimo name and the map presented as **Figure 1. Relocation Site Map**, shows the general location of each prospective site.

Imnaaqquq
Sivutchiaq
Ikpikrauq
Sivu
Kirjiktuuraq
Ushaq
Igrugaivik
Kuugruaq

Each of the eight sites were visited during the study to perform a visual reconnaissance and make a preliminary evaluation of the soil conditions and topography. Shallow soil samples were obtained to determine the soil consistency. At two locations holes were cut through the ice at thaw lakes near the prospective sites. The water depth was measured and water samples were obtained. These samples were tested to determine if these lakes were saline. The samples tested were not saline. The water has a distinct organic odor and taste and would probably require treatment.


IMNAAQQUQ
Imnakuk
KIVALINA
RIVER
SIVUTCHAQ
Sivutchaq Az
Bluff
Kisimigiuktuk
Hill
KIVALINA
RIVER
IKPIKRUAQ
TRAIL
WULIK
RIVER
WULIK
KUGRUAQ
IGRUGAIVIK
KIPNIKTUURAQ
IGRUGAIVIK
CREEK
WINTER
TRAIL
KIVALINA
LAGOON
CORPORATE
BOUNDARY
7514000m N.
Landing
Strip
Kivalina
Kivalina SE
VABM
Singauk Entrance
Sand and Gravel
ALASKA
QUADRANGLE LOCATI
NOATAK C-5)
RELOCATIO

OPTION EVALUATION CRITERIA

To evaluate each of the expansion options, it was necessary to develop a set of criteria important to the well being of the community of Kivalina. An initial list of criteria were developed and reviewed by the Kivalina City Council. The City's suggestions were incorporated into the evaluation criteria and the research and data gathering began. Some of the criteria are obvious and other criteria are very specific to Kivalina and the subsistence lifestyle of the residents. The agreed upon criteria are listed below with an explanation for each. Based on the criteria's importance to the City, an importance factor of 1 - 5 (5 being the highest) was assigned to each.

Most of the land around Kivalina is owned by the regional native corporation NANA. The exceptions are the tracts of land that are native allotments. Land ownership and land acquisition were not considered when evaluating the expansion options for the City.

Criteria	Description	Importance Factor
Lack of Storm Surge	Used to evaluate each option to determine its susceptibility to flooding during storm surge events.	5
Water Supply	Used to evaluate the distance and difficulty in supplying water to the City.	5
Sewage Disposal	Used to evaluate each option to determine if the area and conditions were adequate to construct a sewage lagoon. A sewage lagoon was considered because it is the predominant method of sewage disposal used in the region.	5
Solid Waste Disposal	Used to evaluate each option to judge the potential for development of a reasonable solid waste disposal facility. (This criteria was not felt to be as important as some others.)	3
Construction Materials Source	Because all options require gravel fill, this was used to evaluate the proximity of potential gravel sources.	5
Soil Conditions	Used to evaluate the probable foundation conditions at each site. Most of the area is underlain with permafrost, much of the permafrost is ice rich and there are massive ice wedges in some areas.	4
Barge Access	Used to evaluate the accessibility of each area to a supply barge. The majority of the supplies for the City arrive by barge.	5
Distance from Current Site	Used to evaluate the distance buildings would have to be moved and the access to the current cemetery and other current facilities.	4

Criteria	Description	Importance Factor
Access to the Ocean	Access to the ocean is critical to the subsistence lifestyle of the City of Kivalina. The people depend on whales, walrus, and seals for much of their game needs. In an average year the City takes about 200,000 pounds of marine mammals.	4
Access to the Wulik River	The average annual harvest of Arctic Char from the Wulik River is about 60,000 pounds. These fish make up most of the City's subsistence fish needs.	4
Access to the Kivalina River	Some of the Arctic Char needs of the City come from the Kivalina River. This river is also an important hunting area for waterfowl.	3
Access to the Kivalina Lagoon	Access to the Kivalina Lagoon is important to the Kivalina lifestyle because this is where many of the Arctic Char are caught and where most of the cod taken by residents are caught.	3
Least Cost	The relative cost of each option was evaluated as a separate item, although cost is also indirectly reflected in many of the other evaluation criteria.	4
Use of the Existing Airport	It was recognized that the use of the existing airport would be less disruptive and would make whatever option was selected easier to implement.	2
Lack of Permit Requirements	Every option being considered will have some permits required. We believe some of the permits required for some of the options will be more difficult to obtain than others.	3
Lack of Community Disruption	All of the options will be disruptive to the community—some will be much more disruptive than others.	4
Availability of Funding Sources	This evaluation criteria was used to perform an estimate of where funds might come from and the relative difficulty of obtaining funds to implement each of the potential options.	4
Potential for a Cross-Wind Runway	Currently, when adverse wind conditions occur, the City of Kivalina is without air service. Since air transportation is the major mode of transportation to and from the City, it would be advantageous to eliminate this problem if a cross-wind runway could be incorporated into the new City layout.	4

EVALUATION OF OPTIONS

Each of the options available to the City were evaluated based on these criteria. Each option was assigned a value of 1 through 5 (with 5 being the best condition) for each of the criteria. Then the importance factor was multiplied by this assigned value and the resulting number was the score for that option for that particular evaluation criteria. After the scores were computed, they were added for each option. The option with the highest total score is, therefore, the best option for the City.

Option 1

MOVING THE RUNWAY TO THE NORTH AND DEVELOPING THE EXISTING RUNWAY AREA

Criteria	Description	Rating Value
Lack of Storm Surge	Danger still exists.	0
Water Supply	Water supply problems are not improved.	1
Sewage Disposal	Design of a sewage disposal system difficult due to the limited space.	1
Solid Waste Disposal	Development of a solid waste disposal site is possible north of the new runway.	3
Construction Materials Source	Material could be obtained up the Wulik River as they were for the airport expansion. However, this will be difficult.	2
Soil Conditions	Soil conditions on the island are relatively good except for the potential of sand erosion.	5
Barge Access	Barge access is good.	5
Distance from Current Site	Essentially the same site.	5
Access to the Ocean	Good access to the ocean.	5
Access to the Wulik River	Access to the Wulik River is good.	5
Access to the Kivalina River	Access is possible through the lagoon.	5
Access to the Kivalina Lagoon	Access to the lagoon is good.	5
Least Cost	Probably requires the least amount of effort and money to implement.	5
Use of the Existing Airport	This plan calls for the replacement of the airport.	0
Lack of Permit Requirements	This plan probably has an average number of permit requirements.	3
Lack of Community Disruption	One of the least disruptive options.	5
Availability of Funding Sources	We believe this option is slightly more acceptable to funding agencies than some of the other options.	4
Potential for a Cross-Wind Runway	A cross-wind runway would be difficult with this option.	1

Option 2

FILL IN A SECTION OF KIVALINA LAGOON TO CREATE LAND

Criteria	Description	Rating Value
Lack of Storm Surge	Does not improve the current situation.	0
Water Supply	There is no improvement to the water supply problem.	1
Sewage Disposal	There is some potential for improved sewage disposal, although it would be difficult.	1
Solid Waste Disposal	The improvement of solid waste disposal was rated average.	3
Construction Materials Source	The availability of construction materials up the Wulik River was assigned a 2 due to the distance and constraints on obtaining the gravel.	2
Soil Conditions	The dumped fill in the lagoon would probably be relatively soft and, although usable, it would be less than desirable	4
Barge Access	Barge access is good.	5
Distance from Current Site	This is an expansion of the current site.	5
Access to the Ocean	Access to the ocean is good.	5
Access to the Wulik River	Access to the Wulik River is good.	5
Access to the Kivalina River	Access to the Kivalina River is good.	5
Access to the Kivalina Lagoon	Access to Kivalina Lagoon is good.	5
Least Cost	This option is one of the more economical.	4
Use of the Existing Airport	Allows continued use of the existing airport.	5
Lack of Permit Requirements	We believe this option would require an average permitting effort.	3
Lack of Community Disruption	Relatively less disruptive to the community than most of the other options.	5
Availability of Funding Sources	Believed to be one of the more acceptable.	4
Potential for a Cross-Wind Runway	With the widening of the island, it would be possible to create land for a cross-wind runway. Although, it would not be a simple design.	2

Option 3

BUILD A BRIDGE TO THE SOUTH ACROSS THE WULIK RIVER INLET AND EXPAND THE CITY TO THE SOUTH

Criteria	Description	Rating Value
Lack of Storm Surge	Potential for storm surge continues.	0
Water Supply	There is no improvement to water supply problem.	1
Sewage Disposal	Developing a sewage disposal system would be difficult with this option.	1
Solid Waste Disposal	Only slightly improved with this option.	3
Construction Materials Source	Obtaining construction materials up the Wulik River would be possible for this option, but because of the distance and other constraints we have rated this criteria as a 2.	2
Soil Conditions	The soil conditions along the beach to the south are relatively good for expansion of the City, but potential problems could develop at the bridge abutments.	4
Barge Access	Barge access is good.	5
Distance from Current Site	Distance is relatively short.	4
Access to the Ocean	Access to the ocean is good.	5
Access to the Wulik River	Access to the Wulik River is good.	5
Access to the Kivalina River	Access to the Kivalina River is good.	5
Access to the Kivalina Lagoon	Access to the Kivalina Lagoon remains good.	5
Least Cost	The cost of constructing a bridge and developing on the south side of the Wulik River channel was believed to be relatively inexpensive in comparison to some options.	4
Use of the Existing Airport	This option allows use of the existing airport.	5
Lack of Permit Requirements	We believe this will require an average permitting effort.	3
Lack of Community Disruption	Minimal disruptive impact on the City.	5
Availability of Funding Sources	We rated this option above average in terms of funding source potential.	4
Potential for a Cross-Wind Runway	The potential for cross-wind runway is below average.	2

Option 4
RELOCATION OF THE CITY

To evaluate this option, it was necessary to evaluate each of the eight relocation sites individually. These evaluations are presented below:

Move the City to Imnaaqquq

This site is located in Section 20, Township 28N, Range 26W, Kateel River Meridian. The site is on the north side of the Kivalina River, about three miles upstream from the mouth. The site has a gradual slope to the south and is on a bluff about 50 feet higher than the Kivalina River.

Criteria	Description	Rating Value
Lack of Storm Surge	This site has no potential for storm surge events.	5
Water Supply	The site is adjacent to the Kivalina River which could be used as a water source.	5
Sewage Disposal	Sewage disposal would be relatively easy to develop at this site.	5
Solid Waste Disposal	Solid waste disposal at this site is relatively easy to provide.	4
Construction Materials Source	Gravel is available along the sides of the Kivalina River and weathered rock is available from the site and adjacent areas.	5
Soil Conditions	This site has a surface layer of silt which lies above highly weathered rock.	5
Barge Access	To have access to a barge it would be necessary to construct a road from this site to a location at the north end of Kivalina Lagoon.	2
Distance from Current Site	This site is an appreciable distance from the current City.	2
Access to the Ocean	Again, a road would have to be constructed to the coast (about 3 miles) to allow access to the ocean because the Kivalina River is not always navigable, even with a small skiff.	2
Access to the Wulik River	Access to the Wulik River from this site is more difficult than for some of the other options.	2
Access to the Kivalina River	The Kivalina River is adjacent to this site.	5
Access to the Kivalina Lagoon	Access to Kivalina Lagoon would require a road since the river itself is not navigable during low water periods.	2
Least Cost	To relocate to this site would probably be more expensive than average due to the distance and terrain.	2

Criteria	Description	Rating Value
Use of the Existing Airport	Relocation to this site eliminates use of the existing airport.	0
Lack of Permit Requirements	Since this site is on a highland area we believe the permits required will be limited.	5
Lack of Community Disruption	The move to this site would be quite disruptive.	1
Availability of Funding Sources	We believe funding agencies will be available, but somewhat limited.	3
Potential for a Cross-Wind Runway	Although a runway location has not been selected, we believe there is an average chance a cross-wind runway could be constructed. The presence of the mountains to the north will make the runway location selection process more difficult.	3

Move the City to Sivutchiaq

This potential relocation site is located in Section 22, Township 28N, Range 26W, Kateel River Meridian. The site is located about five miles up the Kivalina River on the north side of the River. The site rises from about elevation 20 near the river to a high ridge in the north which is about elevation 215. The steep slope to the south will make this site relatively difficult to develop. Below we have summarized the ratings assigned to each evaluation criteria for relocation to this site.

Criteria	Description	Rating Value
Lack of Storm Surge	No potential for storm surge event.	5
Water Supply	The Kivalina River could be used as a water supply, although pumping requirements may be more than other sites due to the elevation difference. We also understand the Kivalina River may freeze to the bottom during cold years.	3
Sewage Disposal	Sewage disposal is possible at this site, but the steep slopes will make the design of the system more difficult than for a level site.	4
Solid Waste Disposal	The opportunities for solid waste disposal at this site are better than average.	4
Construction Materials Source	Construction materials are available from the gravel areas along the Kivalina River and weathered rock is available from the site.	5
Soil Conditions	The soils at the site consist of a thin silt surface layer above highly weathered rock.	5
Barge Access	A road would be required from the site to the coast to allow access to barge transportation.	1
Distance from Current Site	This site is a substantial distance from the current site.	1
Access to the Ocean	Access to the ocean will require a road.	1
Access to the Wulik River	Access to the Wulik River would be difficult.	1
Access to the Kivalina River	While the site is adjacent to the Kivalina River, it is about five miles upstream where the river is relatively shallow.	4
Access to the Kivalina Lagoon	Because of the shallow water in the Kivalina River, we rated this criteria low.	2
Least Cost	Moving to this location would be relatively expensive compared to other sites.	2
Use of the Existing Airport	No potential for use of the existing airport.	0
Lack of Permit Requirements	Requires a minimum of permits.	5
Lack of Community Disruption	The move from the current City location to this site would be quite disruptive.	1
Availability of Funding Sources	Funding availability for this site is average.	3
Potential for a Cross-Wind Runway	The potential for a cross-wind runway at this site is no better than average due to the steep slopes on the site itself.	3

Move the City to Ikpikrauq

This potential relocation site is located in Sections 5, 6, and 8 of Township 27N, Range 26W, Kateel River Meridian. The site is located about three miles northeast of the present City on the north side of Kivalina Lagoon between the Kivalina River and the Wulik River.

Criteria	Description	Rating Value
Lack of Storm Surge	The site is adjacent to the Kivalina Lagoon and is susceptible to storm surge events.	0
Water Supply	Probably from the Wulik River, although a thaw pond northwest of the site was investigated. The pond was six to seven feet deep and the water had a brownish color and an organic odor. Tests were performed on the water to determine if it was saline. The test results indicated the pond has fresh water. We rated this criteria a 2 because of the distance to a water source and the water treatment that would be necessary.	2
Sewage Disposal	Possible at this location, but due to the permafrost conditions we believe it would be difficult to design a reliable system.	2
Solid Waste Disposal	The opportunity for developing a solid waste disposal site is average.	3
Construction Materials Source	The most probable source of construction materials is from the area up the Wulik River. Obtaining and transporting this material would be somewhat difficult.	2
Soil Conditions	The soils at this site consist of ice rich permafrost with frozen silt and organics. It is obvious there are many massive ice wedges.	1
Barge Access	Since the site is adjacent to the Lagoon, barge access is possible. The Lagoon becomes shallow north and east of the current City site. It may be necessary to dredge an area to allow barge access.	4
Distance from Current Site	This potential relocation site is an average distance from the current site.	3
Access to the Ocean	Access to the ocean is relatively good.	5
Access to the Wulik River	Access to the Wulik River is good.	5
Access to the Kivalina River	Access to the Kivalina River is relatively good.	5
Access to the Kivalina Lagoon	The site is adjacent to the Lagoon.	5
Least Cost	Development of this site would be relatively expensive because of the poor soil conditions, the distance to a water source and the probable dredging that would be required in the Lagoon to allow barge access.	1

Criteria	Description	Rating Value
Use of the Existing Airport	The existing airport would be inaccessible during parts of the year and would not be usable.	0
Lack of Permit Requirements	We believe this site will require an average amount of permitting effort.	3
Lack of Community Disruption	As with any relocation plan, the disruption to the community would be extensive.	1
Availability of Funding Sources	We feel the availability of funding sources to move the community to this site is average.	3
Potential for a Cross-Wind Runway	There is a potential for a cross-wind runway, but because of the soil conditions it may be more difficult to design and construct, as well as maintain.	4

Move the City to Sivu

This potential relocation site is located in Sections 23 and 26 of Township 28N, Range 24W, Kateel River Meridian. The site is located about 15 miles up the Wulik River on the north bank at a large bend in the river about four miles east of Avenak Mountain. The site is a low, relatively flat gravel area about eight feet above normal water level in the Wulik River. The site is covered with a thick stand of willows. Below, we have summarized the ratings assigned each evaluation criteria for relocation to this site.

Criteria	Description	Rating Value
Lack of Storm Surge	This site is at about elevation 90 and has no potential for storm surge events.	5
Water Supply	This site is adjacent to the Wulik River where water could be obtained.	5
Sewage Disposal	The materials and area are available to construct a sewage lagoon.	5
Solid Waste Disposal	This site has a better than average ability to accommodate a solid waste disposal area.	4
Construction Materials Source	Gravel is available all along the Wulik River in the area of the site.	5
Soil Conditions	Located on a sandbar and the soils appear to consist of gravel with occasional cobbles.	5
Barge Access	Barge access to this site is impossible.	0
Distance from Current Site	This potential site is the greatest distance from the current site.	0
Access to the Ocean	Access to the ocean from this site would be limited by the season and the water level in the Wulik River.	0
Access to the Wulik River	Adjacent to the Wulik River so access is always available, but much of the subsistence activities of the City take place at the mouth of the River which is 15 miles down- stream.	4
Access to the Kivalina River	Access to the Kivalina River would be very limited from this site due to the distances.	0
Access to the Kivalina Lagoon	Access to Kivalina Lagoon is limited by distance and the season.	1
Least Cost	It would be costly to move to this site because of the distances involved.	1
Use of the Existing Airport	Use of the existing airport is not possible.	0
Lack of Permit Requirements	We believe that relocation to this site would require relatively few permits.	5
Lack of Community Disruption	Relocation to this site will cause extensive disruption to the community.	1
Availability of Funding Sources	Funding sources should be about average.	3
Potential for a Cross-Wind Runway	The area is available and the construction materials appear to be available to construct a cross-wind runway at this site.	5

Move the City to Kirjiktuuraq

This potential relocation site is located in Sections 23 and 26 of Township 27N, Range 26W, Kateel River Meridian. The site is located about 1.5 miles southeast of the current City on the southeast side of Igrugaivik Creek. The site is adjacent to the old dump site and is at an elevation of 10 to 15. Below we have summarized the ratings assigned each evaluation criteria for relocation of the City to this site.

Criteria	Description	Rating Value
Lack of Storm Surge	This site will be exposed to the problems associated with storm surges.	1
Water Supply	The water supply for this site would probably come from upstream in the Wulik River, although there are some small thaw ponds nearby. We believe the thaw ponds probably freeze to the bottom in winter.	3
Sewage Disposal	There is room to develop a sewage lagoon at this site and material sources are not far away, but due to the ice rich permafrost and massive ice wedges, the lagoon design would require special considerations.	4
Solid Waste Disposal	A solid waste disposal site could be developed at the site.	4
Construction Materials Source	The most probable place to obtain construction materials is along the beach southeast of the current City. The material is generally sand with some gravel. It would also be possible to obtain construction materials from areas up the Wulik River.	4
Soil Conditions	The soil conditions are poor at this site. The soils consist of ice rich silts with as much as 50 percent ice and frequent ice wedges which were observed to be 15 feet or more in width.	2
Barge Access	From current, local knowledge, we believe this site can be accessed with a barge.	5
Distance from Current Site	This site is about an average distance from the current site.	3
Access to the Ocean	Access to the ocean from this site is easy.	5
Access to the Wulik River	Access to the Wulik River would be relatively simple from this potential relocation site.	5
Access to the Kivalina River	Access to the Kivalina River is good.	5
Access to the Kivalina Lagoon	The access to Kivalina Lagoon is good.	5
Least Cost	We believe the relative cost to relocate the City to this location is higher than average.	2
Use of the Existing Airport	The existing airport would not be usable from this site.	0
Lack of Permit Requirements	We believe the permitting requirements would be average for this site.	3

Criteria	Description	Rating Value
Lack of Community Disruption	Moving the community to this location would be relatively disruptive.	1
Availability of Funding Sources	We think the availability of funding sources for a move to this location is average.	3
Potential for a Cross-Wind Runway	There is land available, but the fill requirements will be substantial due to the poor soil conditions at this site.	4

Move the City to Ushaq

This potential relocation site is located in Section 36, Township 27N, Range 26W, Kateel River Meridian. The site is on the northwest end of Imikruk Lagoon. The site is at an elevation of about 15 feet and the area is flat and wet. Imikruk Lagoon has no outlet, although outlets have formed in the past. Below we have summarized the ratings assigned each evaluation criteria for relocation to this site.

Criteria	Description	Rating Value
Lack of Storm Surge	No known flooding due to storm surge was reported by the Kivalina residents. Because of the site location and elevation it appears to have some potential for impact by a storm surge.	3
Water Supply	There is a large thaw lake northeast of this site that potentially could be used as a water supply. The water was tested and it is not saline, although the water is tea colored and has an organic odor and taste. The depth of the lake was measured at two locations and was about seven feet deep. It is not known if the lake freezes to the bottom in winter. The Wulik River could also be used as the water supply although the River is quite a distance away. We assigned a rating of 0 to this criteria because of the uncertainty involved in obtaining a water supply.	0
Sewage Disposal	Land is available to construct a sewage lagoon.	4
Solid Waste Disposal	Opportunity to create a solid waste disposal site.	4
Construction Materials Source	Construction materials for this site would probably have to be obtained from the beach. Extraction of sand from the beach may result in erosion.	3
Soil Conditions	The soil conditions at this site are relatively poor with most of the site being underlain with ice rich permafrost consisting of frozen silt which are generally high in organics.	2
Barge Access	Barge access would be to the beach which would require that the wave action be limited. This would prevent access with a barge during storms or on-shore winds.	3
Distance from Current Site	This site is located about 3.5 miles along the coast from the current City site.	3
Access to the Ocean	Access to the ocean is good from this site.	5
Access to the Wulik River	Access to the Wulik River would require about 3.5 miles of travel by 4-wheeler or boat.	3

Criteria	Description	Rating Value
Access to the Kivalina River	Access to the Kivalina River is possible, but will require more travel from this site.	3
Access to the Kivalina Lagoon	Access to the Lagoon requires 3.5 miles of travel.	3
Least Cost	Higher than average for this site.	2
Use of the Existing Airport	Use of the existing airport is not possible.	0
Lack of Permit Requirements	About average for this site.	3
Lack of Community Disruption	As with any relocation plan, the disruption to the community will be substantial.	1
Availability of Funding Sources	Funding availability for this site is average.	3
Potential for a Cross-Wind Runway	Plenty of area to develop a cross-wind runway.	5

Move the City to Igrugaivik

This potential relocation site is located in Section 24, Township 26N, Range 26W, Kateel River Meridian. The site is located about two miles directly east of Kivalina on the east side of Igrugaivik Creek. The land is low, relatively flat ice rich permafrost with ice polygons in most areas. Below we summarized the ratings that have been assigned to each of the evaluation criteria for relocation to this site.

Criteria	Description	Rating Value
Lack of Storm Surge	This site is adjacent to the waters of Igrugaivik Creek in the tidal zone.	2
Water Supply	Water is available from the Wulik River, not far away.	4
Sewage Disposal	Sewage disposal would be possible at this site by constructing a sewage lagoon, although the construction materials must be imported from up the Wulik River.	4
Solid Waste Disposal	This site has the land area and a solid waste disposal area could be developed at this site.	4
Construction Materials Source	Construction materials are available a short distance upstream along the Wulik River.	4
Soil Conditions	The soils consist of ice rich permafrost with ice wedges.	2
Barge Access	Barge access to this site is good, according to local knowledge.	5
Distance from Current Site	On a relative basis, this is one of the closest relocation sites.	4
Access to the Ocean	Access to the ocean from this site is good.	5
Access to the Wulik River	Access to the Wulik River is good.	5
Access to the Kivalina River	Access to the Kivalina River is good.	5
Access to the Kivalina Lagoon	Access to Kivalina Lagoon is good.	5
Least Cost	Because of the relatively poor soil conditions at this site, we rated this site below average.	2
Use of the Existing Airport	The existing airport will not be usable if the City is relocated to this site.	0
Lack of Permit Requirements	We felt that an average permitting effort would be required for relocation to this site.	3
Lack of Community Disruption	As with any relocation, moving to this site would be very disruptive to the community.	1
Availability of Funding Sources	We felt that an average number of funding sources would be available for moving to this site.	3
Potential for a Cross-Wind Runway	The land area and construction materials are available for a cross-wind runway.	5

Move the City to Kuugrauq

This potential relocation site is located in Section 13, Township 27N, Range 26W, Kateel River Meridian. This site lies 2.5 miles east-northeast of the current City. It is directly across the Wulik River from the water intake building which is currently used by the community. The site is bounded on the west by the Wulik River and on the east by what appears to be an intermittent river channel. A portion of the area is covered with a heavy stand of willow bushes. Approximately half of the area has gravel exposed at the surface. The other portion of the site probably has soil conditions consisting of ice rich permafrost with ice wedges. Below we have summarized the ratings assigned to each evaluation criteria for relocation to this site.

Criteria	Description	Rating Value
Lack of Storm Surge	This site is located at the limit of normal tidal influence and is far enough inland to be relatively safe from storm surge.	5
Water Supply	This site is directly across the Wulik River from the location where the City currently takes its water from the River.	5
Sewage Disposal	The land area and construction materials are available to construct a sewage disposal system.	5
Solid Waste Disposal	A solid waste disposal site could be developed at this location.	4
Construction Materials Source	Gravel could be obtained from this site or from adjacent areas along the River. This area probably has the best supply of gravel in the general area.	5
Soil Conditions	The soil conditions at this location are relatively good and with construction materials being so readily available, any poor areas could be improved.	5
Barge Access	It is not known if the barge could reach this site, but we believe the barge can get at least half way from the Lagoon to the site depending on the River stage. A relatively short road could be constructed to a barge landing site or because local boats can navigate the River, they could be used to transport goods from the barge to the City. For fuel transport, a line could be installed from the barge landing to the fuel storage area in the relocated community. We believe there are workable solutions for obtaining goods by barge.	5
Distance from Current Site	This site is about average as far as distance from the current site is concerned.	3
Access to the Ocean	The access from the site to the ocean is good.	5

Criteria	Description	Rating Value
Access to the Wulik River	Access to the Wulik River is excellent.	5
Access to the Kivalina River	Access to the Kivalina River is good, but it is slightly further.	4
Access to the Kivalina Lagoon	Kivalina Lagoon can be easily accessed from this site.	5
Least Cost	The distance from the current site, the relatively good soil conditions and the availability of construction materials score this criteria average.	3
Use of the Existing Airport	The existing airport cannot be used if the City is relocated to this site.	0
Lack of Permit Requirements	A slightly less than average permitting effort will be required for relocation of the City to this location.	4
Lack of Community Disruption	As with any relocation, moving the City to this location would be very disruptive.	1
Availability of Funding Sources	We believe there are an average number of funding sources available, on a relative basis, for relocation to this site.	3
Potential for a Cross-Wind Runway	The area is available and construction materials are available to construct a cross-wind runway at this site.	5

Table 1. Evaluation Criteria (following page) summarizes this information presented previously. The table also presents the product of the rating of each evaluation criteria times the importance factor and the sums of these products. The sum of the products is presented at the bottom of each column as the total score.

Table 1. City of Kivalina—Evaluation Criteria Summary

	Options Rating (1-5)																					
tance	Move	Score	Fill	Score	Build a	Score	Move to	Score	Move to	Score	Move to	Score	Move to	Score	Move to	Score	Move to	Score	Move to	Score	Move to	Score
tor	Airport		Lagoon		Bridge		Imnaaqquq		Sivutchiaq		Ikpikrauq		Sivu		Kirjiktuuraq		Ushaq		Igrugaivik		Kuugruaq	
5)					South																	
	0	0	0	0	0	0	5	25	5	25	0	0	5	25	1	5	3	15	2	10	5	25
	1	5	1	5	1	5	4	20	3	15	2	10	5	25	3	15	0	0	4	20	5	25
	1	5	1	5	1	5	5	25	4	20	2	10	5	25	4	20	4	20	4	20	5	25
	3	9	3	9	3	9	4	12	4	12	3	9	4	12	4	12	4	12	4	12	4	12
	2	10	2	10	2	10	5	25	5	25	2	10	5	25	4	20	3	15	4	20	5	25
	5	20	4	16	4	16	5	20	5	20	1	4	5	20	2	8	2	8	2	8	5	20
	5	25	5	25	5	25	2	10	1	5	4	20	0	0	5	25	3	15	5	25	5	25
	5	20	5	20	4	16	2	8	1	4	3	12	0	0	3	12	3	12	4	16	3	12
	5	20	5	20	5	20	2	8	1	4	5	20	0	0	5	20	5	20	5	20	5	20
	5	20	5	20	5	20	2	8	1	4	5	20	4	16	5	20	3	15	5	20	5	20
	5	15	5	15	5	15	5	15	4	12	5	15	0	0	5	15	3	9	5	15	4	12
	5	15	5	15	5	15	2	6	2	6	5	15	1	3	5	15	3	9	5	15	5	15
	5	20	4	16	4	16	2	8	2	8	1	4	1	4	2	8	2	8	2	8	3	12
	0	0	5	10	5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	9	3	9	3	9	5	15	5	15	3	9	5	15	3	9	3	9	3	9	4	12
	5	20	5	20	5	20	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4
	4	16	4	16	4	16	3	12	3	12	3	12	3	12	3	12	3	12	3	12	3	12
	1	3	2	6	2	6	3	9	3	9	4	12	5	15	4	12	5	15	5	15	5	15
		232		237		233		230		200		186		201		232		198		249		291

By reviewing the table it can be seen that, based on our evaluation criteria and the importance factor for each criteria, the best option for improving the living conditions in the City of Kivalina is to **relocate the City to Kuugruaq**.

We estimate that the Kuugruaq site has about 100 acres of usable land. The current City occupies an area of about 27 acres excluding the airport property. We think that a new City layout will cover an area of about 40 acres and other areas should be set aside for future expansion.

During the Spring of 1993 when the Wulik River was at flood stage from spring runoff, we received a call saying that the Kuugruaq site was flooded. We flew to Kotzebue, chartered an aircraft, and flew over the site several times to evaluate the extent of the flooding. Our observations indicated that about half of the site was flooded (still leaving about 100 acres of usable area). It appears that the areas which are heavily vegetated with willows are susceptible to flooding.

In the early summer of 1994, we performed a "rough" survey of the Kuugruaq site. Using GPS, we set control at the site and surveyed around what was visually identified as the high water mark. We also performed a survey and established a cross section for the Wulik River near the northwest area of the Kuugrauq site. From this information, the flow rate was calculated to be about 2,700 CFS and it was estimated that the channel has a capacity of about 10,300 CFS. We know from published data that the Wulik River does exceed a flow rate of 10,000 CFS during breakup some years. The biggest unknown is the number of abandoned river channels that carry water during flooding, but are dry the remainder of the year. It should also be noted that during flooding extensive areas are inundated, but it is suspected the water is only inches deep over large areas.

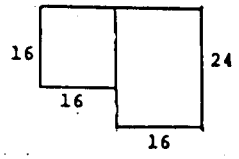
We believe that more investigation into the flooding is warranted and it may be necessary to build dikes or diversion structures along the east side of the site. More flood information would also be valuable in determining what elevation the site should be raised to in order to prevent spring flooding.

EXISTING STRUCTURE INVENTORY

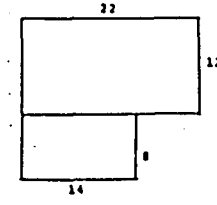
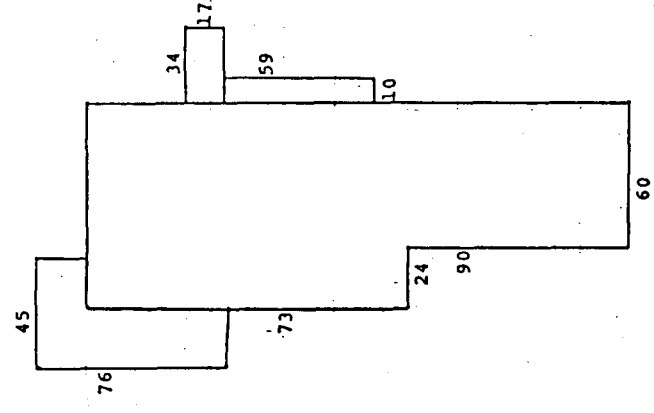
We performed an inventory of the existing structures in Kivalina. The purpose of the inventory was to determine what currently exists, the type of construction, and an opinion regarding the movability of each structure. Sheds, small out buildings, and entryways were ignored during our inventory. If a building was constructed with a floor frame resting on large carrying members, we assumed it could be moved. The assigned building numbers are shown on the following map, **Figure 2** (aerial photograph of Kivalina). **Table 2. Existing Structure Inventory**, which follows the map, lists each structure.

Building Number	Length Feet	Width Feet	Clear Height Above Ground Feet	Skirted	Moveable	Comments
20	40	26	1.6	No	Yes	BIA, about 1972
21	74.5	24	1.3	No	Yes	BIA 1972 +/- low next to ground, height to .5 feet to siding
22a	30'	16	.8	No	?	Two houses connected by hallway
22b	22'	16	.8	No	?	Same as above
23	42	24	3.5	No	Yes	New, HUD
24	30	20	0	No	No	Plywood
25	35	30	0	No	No	Sitting on ground, 30 years old
26	42	24.5	3.5	No	Yes	New, HUD
27	28	16.5	2.7	No	Yes	Jail
28	36	24	2.0	No	?	City Storage, Concrete slabs on Deck
29	41	23	1.5	No	Yes	City Hall, 2-story
30	34	24	1.3	No	?	
31	32	18	0	No	No	Built 1970
32	36.6	24.5	3.0	No	Yes	New, HUD
33	54	9	2.0	Yes	Yes	Post Office (skid mounted)
34	31	24.6	3.4	No	Yes	New, HUD
35	30	20.5	3.3	No	Yes	1970'ish ASHA
36	30	10.5	2.0	No	Yes	1970'ish ASHA
37	42	24.5	4.3	No	Yes	New, HUD
38	36	24.5	4.0	No	Yes	New, HUD
39	32	16	0	—	?	
40	36	26.6	1.5	Yes	?	BIA, 1976 (?)
41	28	16	1.5	Yes	?	BIA, 1976
41a	24	16	0	—	?	Metal roof beside 1941 installation
42	72	22	2.0	Yes	?	Church
43	25	16	0	—	No	
44	30	20.5	1.8	No	Yes	ASHA
45	30.5	24.4	4.5	No	Yes	New, HUD
46	62	41.5	35	No	Yes	New Community Center
47	64	41	2.0			Old Community Center

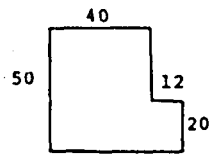
EXISTING STRUCTURE INVENTORY

Building Number	Length Feet	Width Feet	Clear Height Above Ground Feet	Skirted	Moveable	Comments
47a	37	16	4.5	No	Yes	Generator shop building and an 11 x 30 metal skid mounted generator building plus numerous tanks
48	40	26	1.5	No	Yes	Single Family
49	20	20	2.5	No	Yes	Fire Hall
50a	60	20	3.7	No	Yes	Armory East 1/2, connected to west half & all skid mounted
50b	41	30	1	No	Yes	Armory, west 1/2
51	28	20	2.0	No	Yes	Telephone Building
52	42	24	4.0	No	Yes	HUD-type, single family
53	36	28	2.0	Yes	Yes	Clinic
53a	40	24	0.5	No	Yes	New Church
54a	28.5	17	1.5	Yes	?	East BIA, Single Family
54b	31.5	14.3	0	—	?	West Addition on Building #54a
55	42	16	0	—	No	
56	24	20	1.5	Yes	?	2-story, Single Family
57	20	19	2.0	No	Yes	Single Family, Rental
58	32	16	0.5	—	No	Single Family
59	50 dia.	—	0	—	No	Water Tank
60			1	No	No	Water Treatment, see diagram 
61	42	24	2.5	No	Yes	Single Family, HUD Type

EXISTING STRUCTURE INVENTORY

Building Number	Length Feet	Width Feet	Clear Height Above Ground Feet	Skirted	Moveable	Comments
61a			.5	No	No	Single family, see diagram 
62	20	12	1.0	No	Yes?	Water System Building
63	24	21	0.5	—	No	Single Family
64	24	16	1.0	—	No	Single Family
65	36	24	4.0	No	Yes	HUD-type, single family
66	36	22	1.0	No	No	Single Family
67	30	30	0.5	Yes	No	Single Family
68	28	23	0.5	—	No	Single Family, not used
68a	16	12	1.0	No	?	Single Family
69	28	20	1.0	Yes	?	Single Family
70			4.5	No	No	School — See Diagram 

EXISTING STRUCTURE INVENTORY

Building Number	Length Feet	Width Feet	Clear Height Above Ground Feet	Skirted	Moveable	Comments
71	40	28	1.0	Yes	?	Single Family
72	28	16	0.5	Yes	No	Old Mission House - not occupied
73	42	22	1.0	Yes	?	Single Family
74	36	24	1.0	Yes	?	HUD, Single Family
75	28	24	1.0	Yes	?	BIA Single Family
76	30	24	4.0	No	Yes	HUD
77	30	20	20	No	Yes	BIA Old Rental, not occupied
78	30	20	2.0	No	Yes	BIA Single Family
79	48	24	2.0	No	Yes	HUD-type, Single Family
80	75	16	0	—	No	Store Warehouse - many additions, occupied
81	28	24	0	—	No	Store Warehouse
82	50	40	3.0	Yes	No	Store, see diagram 
83	30	20	2.5	Yes	Yes	Single Family
84	36	24	2.8	No	Yes	HUD-type, Single Family
85	38	24	0.5	No	?	Single Family
86	30	20	1.5	Yes	Yes	Single Family
87	36	24	3.0	No	Yes	HUD-type, Single Family
88	56	14	4.0	Yes	Yes	New Modular Unit - Teacher's Quarters
89	52	20	3.0	No	Yes	School Warehouse
90	60	12	2.0	Yes	Yes	Modular Unit - Teacher's Quarters
91	56	14	3.5	Yes	Yes	New Modular Housing Unit for Teachers
92	65	14	2.0	Yes	Yes	Modular Unit for Teacher's Housing
93	29	18	2.0	Yes	Yes	Old Modular Housing Unit, used as school warehouse
94	42	29	2.0	Yes	Yes	Modular Teacher House
95	50	24	2.0	Yes	Yes	Modular Housing Unit, not used

EXISTING STRUCTURE INVENTORY

A review of our inventory shows that most of the residential structures are movable. The inventory also indicates that the major infrastructure buildings are probably not movable. We are not an authority on moving buildings, and as this project progresses, it will be necessary to have a professional building mover look at each of the structures and determine if they are, in fact, movable.

FINDINGS

Early in 1994, a public meeting was held in Kivalina. The purpose of the meeting was to publicly review a draft of this report and to reaffirm that the residents wanted to move ahead with expansion plans and that they wanted to pursue the findings of this report. The results of the votes taken during the public meeting were that the community wants to continue to try to relocate and the Kuugrauq site was the relocation site of choice.

During this study, land ownership was not a consideration in the relocation process. This decision was based on conversations during City Council meetings. But, during the late fall of 1994, it became evident that a resolution to the land ownership problems at the Kuugrauq site could not be reached.

At meetings held to discuss the land ownership problems, it was decided that the land area directly east of the Kuugrauq site should be considered as part of the Kuugrauq site. An aerial survey of the site was performed to define its location and to better understand the characteristics of the site. From the observations made, it can be concluded that the site may be acceptable for use. It appears that the Native Allotment that presented problems on the Kuugrauq site also extends onto the area to the east. This allotment also blocks access to the gravel source which was available for use south of the Kuugrauq site. The Allotment may also make access to the Wulik River difficult.

It is our opinion that if the Kuugrauq site cannot be used because of land issues, then the next highest ranked site should be considered. This is the Igrugaivik site. We recommend that another public meeting be held to discuss the issues and to determine if the community wants to pursue moving to Igrugaivik. Possibly before the meeting it would be advisable to check on the land status to determine if potential land status issues could also be a problem with this site.

PRELIMINARY COSTS

While there are many uncertainties about the move, there are some items which have costs associated with them. A new school facility will probably be required and we have been told that a reasonable

estimate for construction of a new school is about $15 million. Another item is the airport which we have been told will require about 400 acres if a cross-wind runway is developed and an estimate of about $10 million has been quoted by Alaska Department of Transportation & Public Facilities (ADOT&PF) personnel. A third big ticket item is housing. If we just assume that the existing houses are not moved, and all new housing is built, we estimate that about 90 houses would be required and if we assume something on the order $120,000 per unit, that results in about $11 million.

These estimates total $36 million and they do not include a water system, sewer system, community center, armory, City Hall, jail, and other infrastructure. A rough estimate of $50 million for relocation of the Village seems to be appropriate.

EXISTING COMMUNITY

A discussion was held at the public meeting in early 1994 regarding what would be done with the old City after relocation. It was evident that many of the residents want to retain ownership and access to the property. A commitment was made at the meeting that the old City site would remain in the hands of the current owners and the right to access the area would be maintained.

There are several questions regarding remediation of the area which must be answered. The sewage bunkers should be abandoned and buried. The dump should be covered with soil after a study to ensure that materials are not present which would be potentially harmful to the environment. There are at least three large fuel storage areas in town (school, AVEC generator area, and store) which must be evaluated before they can be abandoned. If cleanup is necessary, it should be performed.

FUTURE WORK

For the relocation of the City of Kivalina to proceed it will be necessary for more work to be performed. At the time this study was undertaken there was nearly unanimous support for expansion or relocation of the City to alleviate the overcrowding, poor sanitation, and associated illness. The commitment should be confirmed before proceeding. A public meeting should be held to discuss the conditions surrounding the inability to acquire the Kuugrauq site and to determine if the second choice (Igruguavik) should be pursued. It would be prudent to determine if any obstacles exist to the acquisition of the Igruquavik site.

First, it must be decided where the boundaries for the new property will be and these boundaries must be staked. The current City occupies about 27 acres excluding the airport. We recommend the new City site be at least 60 acres to allow for future development. The ADOT&PF has stated that if it constructs a

new airport with a cross-wind runway, it will require about 400 acres of land. As a relocation site is pursued, discussions with ADOT&PF should be held to determine the actual needs for an airport.

If the Igruguavik site is to be pursued as a relocation site, it will be necessary to perform some basic survey work. It may be possible to use gravel from the island between Igruguavik and Kuugrauq, which we previously investigated. We estimate that there is approximately 50,000 cubic yards of gravel available. It would be advisable to also perform a reconnaissance of the area and investigate any other potential borrow sites.

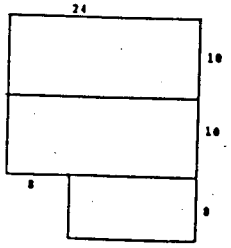
The process should then begin to plan the new City layout. This will require the involvement of the school district, the U.S. Postal Service, Public Health Service, Village Safe Water, Alaska Village Electric Cooperative, the housing authority, the people involved in the native store, people from the churches and the National Guard, as well as others. As part of the planning process, further study of the flooding potential of the relocation site should be undertaken so any flood protection can be incorporated in the design. The final product of this planning process should be a plat that could be filed once the land transfer process and final survey is complete.

As part of the planning process, it will be necessary to work with the housing authority and a house mover to determine if it will be more economic to move houses or to build new ones. At the same time, the other more major structures in town should be evaluated to determine if they are moveable and to estimate the cost for moving those structures.

The Kivalina City Council must also enact an ordinance which will allow the City to transfer land ownership from the City to residents. This will be necessary because the land will be transferred from NANA to the City and the mechanism must be in place in order to transfer land to the individuals. The Alaska Department of Community and Regional Affairs can help with this process.

After the planning process is complete, detailed estimates for the relocation will be required. At this time any estimate of the relocation costs is only a guess because it is not known if it is more economical to try to relocate some of the major structures or to build new ones. Our current guess is that the relocation will cost on the order of $50 million.

As this process progresses, which could require five years, or more, it would be prudent to explore what funding is available for relocation of the City. Personnel from the Northwest Arctic Borough working with the Alaska Department of Community and Regional Affairs should be able to assist in this effort.

Building Number	Length Feet	Width Feet	Clear Height Above Ground Feet	Skirted	Moveable	Comments
1	28.2	24	0	No	Yes	2-12' x 28' on skids - DOT for terminal and baggage - not used
2	96.2	48.2	0	No	No	Airport Maintenance Building - City used for equipment storage - on grade
3	42.8	24.4	4	No	Yes	New, HUD
4	32	24.6	3	No	Yes	New, HUD
5	30	24.6	3.5	No	Yes	New, HUD
6	27	24	1.3	Yes	?	Shelf-built home
7	24.6	31	3.3	No	Yes	New, HUD
8	24.8	36.6	3.6	No	Yes	New, HUD
9	30	24.6	3.2	No	Yes	New, HUD
10	27	24.6	4.0	No	Yes	New, HUD
11	67	27	2.0	Yes	?	Church, Missionary Housing, Multi Unit
12	36	24.6	3.0	No	Yes	New, HUD
13	28	24	1.3	Partial	?	See Diagram 
14	42	24	1.3	Yes	?	1976 HUD House, Missionary House
15	42	24.6	3.2	No	Yes	New, HUD
16	30	24.6	3.7	No	Yes	New, HUD
17	32	32	3	Yes	Historic	Abandoned (old store)
18	39	25	1.1	Yes	No	Separable at 8'
19	36.5	24.5	3.7	No	Yes	New HUD, Height measument to bottom of T-111 siding

EXISTING STRUCTURE INVENTORY