Yukon-Kuskokwim Delta

Transportation Plan

Appendices

An Element of the
Alaska Statewide Transportation Plan

Alaska Department of Transportation
and Public Facilities

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Appendices — Introduction

The Y-K Delta Plan Document consists of the Plan, the Summary of the Plan, and the Appendices. Appendices are bound separately from the plan and can be ordered from DOT&PF. They include databases and modeling information used to conduct analyses of transportation systems and system demand (data obtained on socio-economic conditions on a village by village basis. These data appear on websites for the Alaska State Department of Community and Economic Development and the Department of Labor and Workforce Development). Appendices A – I are briefly described here.

Y-K Delta Regional Transportation Plan - Appendices

A.	Population Projections and Review	The 2000 census showed that the cohort analysis in Appendix A, which uses 1990 data plus a combination of information from the Y-K Regional Health Corporation, was on the mark. The results affect many elements of the plan including population-dependent enplanement and mail forecasts.
B.	Air Transportation Passenger Demand Forecast	Analyzes aircraft movements in the region and applies a planning logistics model to forecast future enplanements.
C.	The United States Post Office's Bypass Mail System	This report provides background on the unique fourth-class mail delivery system that provides mail service to remote communities in Alaska. This system has a large influence on transportation operations and passenger fares paid for bush travel.
D.	USPS Mail Demand Forecast	Analyzes and forecasts the demand for air transport of Bypass mail.
E.	USPS Supply Modeling Options	This is a simulation undertaken to understand the implications of growing mail volumes and changing air fleet on mail delivery patterns, including the advantage of more postal hubs and mainline routes.
F.	Yukon-Kuskokwim Delta Coast Regional Port Study	This study reports U.S. Army Corps of Engineers (USACE) findings relative to the benefits and costs of a new regional port along the Bering Sea coast. The results indicate that such a port would not be cost effective using Corps national criteria.
G.	Ruby to McGrath Road Feasibility Study	The city of Ruby commissioned a preliminary study of a potential road alignment from Ruby to McGrath in 1993. With the approval of Ruby, the study, without one set of oversized maps, is provided as background material.

H. Bulk Fuel Distribution and Delivery	This report outlines difficulties barges have accessing some villages, the limited fuel tank storage capacity at many villages, and problems with aging storage tanks.
I. Hovercraft Technology and Its Use	This work provides an assessment of hovercraft, now an operational piece of the transportation system in Bethel. It includes a discussion about the need for docking structures to enhance riverbank operations.

Short Description of the Y-K Delta Transportation Plan Sections and the Summary

Section 1. Introduces the reader to the plan and some of its main issues, outlines the planning processes, and introduces the reader to the land and people of the region.

Section 2. Describes existing transportation facilities and services and outlines conditions that affect transportation operations in the region.

Section 3. Describes the existing aviation system and the models developed to analyze future aviation demand and outlines a development plan for the region's 53 airports, including runway dimensions and construction timelines. The section incorporates the results of continuous discussions held with the FAA, air carriers and others in the aviation community. The analyses in this section confirmed the need for all village airports to meet a 3,300-foot runway standard and indicates those airports that need 4,000- to 4,500-foot runways during the 20-year plan horizon.

Section 4. Describes trail-marking needs for winter trails between villages and from villages to major subsistence areas. It includes a new tripod marker design that is based on local knowledge and elements like signage, locator beacons at tundra villages, and other components needed for an adequate trail marking system. The plan also confirms DOT&PF practice that trails will primarily be located and constructed by people from the villages being served by the trails.

Section 5. Describes road construction opportunities and constraints in the region. The section outlines road corridor analyses requested by villages during public meetings. Overall, intervillage roads in the tundra and coastal areas of the Y-K Delta are not cost effective. This is due primarily to wetlands and soil conditions as well as the absence of nearby construction materials. The section also includes discussion of a road from Ruby to mine developments at Reef Ridge and Donlin Creek with a connection to McGrath. The section concludes with a commitment to do a Benefit/Cost Analysis for the corridor as part of the Northwest Alaska Transportation Plan currently underway.

Section 6. Describes the background and results of the recent U.S. Army Corps of Engineers (USACE) Bering Sea Port study. The section also proposes consideration of inexpensive barge landings for improving river village dockage throughout the area. The section also looks at potential docking facilities for hovercraft delivering mail to villages near Bethel.

Summary. Bound into the plan, the Summary was printed as a separate, stand-alone document useful for briefings and for discussions with legislators, government agencies, and the residents of the region.

Appendix A
Y-K Delta Population Projection Using a Cohort-Survival Model, 1995-2020

Meifu Wang

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Abstract

The DOT&PF study team has undertaken population projections for the study area because the two existing sets of projections—those of the Alaska Department of Labor (ADOL) and those of the University of Alaska Anchorage's Institute of Social and Economic Research (ISER)—were difficult to use: 1) There is a very large spread in their projected future levels. For example, for the Bethel and Wade-Hampton Census Areas combined, for the year 2018, the ADOL high is 40,400, and the ISER low is 27,700. 2) Both projections include some patterns that are a priori difficult to accept without explanation. For example, all the ADOL projections show the population increasing geometrically throughout the projection period. On the other hand the ISER high projections show an unexplained large surge in the 5-year period 2007-2011. 3) The explanations of the projection models used precluded a detailed understanding of the relative significance of their assumptions.

DOT&PF's study team used a cohort-survival model based on 1990 census data to project population by census area in 5-year increments for the period 1995-2020, and allocated the census area totals to the villages. The model is explained in detail in the main text. When compared to Census 2000 counts, the model's results show an overestimate of 5% (low series) to 6% (high series) for Bethel and Wade-Hampton Census Areas combined. (Census 2000: 23,034; DOT&PF projections: 24,246 & 24,448). However, the model's projection of natural increase for the period from 1995 to 2000 was very close to those recorded by Alaska Bureau of Vital Statistics; for Bethel and Wade-Hampton Census Areas combined, the model projected a mere 0.7% or 18 people more natural increase than the BVS's record. This suggests that out-migration may be an important factor in shaping the region's demography.

For planning purposes, keeping in mind the out migration factor, which is largely unknown, the low projection was used.

Y-K Delta Population Projection Using a Cohort-Survival Model, 1995-2020

I. Introduction

The analysis and projection of the Y-K Delta's population, developed for DOT&PF's Yukon-Kuskokwim Delta (Y-K Delta) Transportation Plan, has two purposes: First, it helps improve people's understanding of the planning area, as the characteristics of population are an important element of the Y-K Delta's cultural environment. Second, an understanding of the historical and future trends of population is required for the planning team to develop long-term transportation plans for aviation, port and harbor, road and winter trail infrastructure, and for freight and fuel delivery systems.

Population and economic indicators such as employment and income are commonly used to project future transportation needs. For the Y-K Delta, population is the most important variable for forecasting future transportation needs; employment and income are not suitable due to the region's mixed subsistence and cash economies, including substantial government transfer payments.

DOT&PF's study team used a cohort-survival model to project population by census area in 5-year increments for the period 1995-2020, and allocated the census area totals to the villages. The results differ slightly from the results of three other projections—those of the Alaska Department of Labor, the Institute of Economic and Social Research at the University of Alaska Anchorage, and the Yukon-Kuskokwim Health Corporation.

This Technical Appendix describes in details the Department's cohort-survival model and summarizes the different projections.

II. DOT&PF Cohort-Survival Model

A. Conceptual Structure

A population cohort-survival model was developed to project the population in the Y-K Delta to the year 2020. The cohort-survival model is a standard approach in demographic research. It uses fertility rate, survival rate, and net migration to project populations of different age/sex groups for future years.

In a cohort-survival analysis, the population is desegregated by age-specific cohorts and sex, and projection of future population is based on the concept of survivorship: "During any projection period, the members of any given cohort age enter the succeeding cohort. Thus the population of any cohort at the end of the period is equal to the population in the next younger cohort at the start of that period, less the number who have died. (This temporarily ignores any migration.)" (Ottensmann, John R., 1985. BASIC Microcomputer Programs for Urban Analysis and Planning. Chapman and Hall, New York)

The DOT&PF model is based on the concept described above. The base-year of the model is 1990—the year for which cohorts by sex and age are first desegregated. The census data of this year are used to project population in 1995; the 1995 projections are then used to project population in 2000; this projection continues for 5-year increments to 2020.

The DOT&PF model ignores migration for two reasons. First, there are no actual time series data on net migration in the Y-K Delta to reveal a trend. Second, net migration appears not to be large, thus would not measurably affect the results. This is known because a test run of the model gave 1995 results which, when compared with an actual count reported by the public nurses in the area, showed that the inferred migration was only slightly above one percent over a 5-year period. (Yukon-Kuskokwim Delta Regional Hospital, 1997. Yukon-Kuskokwim Delta Regional Hospital, Future Facility Master Plan)

The population in the Y-K Delta communities is disaggregated by Native/non-Native origin, by sex, and by age; the cohorts are then male and females groups of 0-4 years, 5-9 years, 10-14 years and 85 years and over. There are 16 cohorts for each race/sex group; the oldest age-cohort is open-ended; it contains all age groups older than 85.

In any 5-year projection period, the population of the youngest cohort (0-4 years) is equal to the number of children who were born and survive through that period. To project this cohort's population, two steps are necessary: 1. The number of newborns during the 5-year period is estimated by multiplying the population of women who are at childbearing age—defined as 15-44 years by Alaska Bureau of Vital Statistics—by their fertility rate. 2. The number of newborns is multiplied by their race/sex-specific survival rate—the proportion of a cohort population that survives through the period—to give the population of this cohort at the start of the next period.

During the same projection period, the population of the 5–9 year cohort is equal to the population of the 0-4 year cohort at the start of the period, less the number who died during these five years. Similarly, the population of the 10-14 year cohort is equal to the population of the 5-9 year cohort at the start of the period, less the number who died during these five years. This method is applied to all age-cohorts to project population for the projection period except for the oldest cohort; the surviving member of the oldest cohort remain in that group. These steps are applied to male and female cohorts separately.

Because fertility rates and death rates for Alaska Native and non-Native are significantly different, separate projections are made for these two groups using their respective fertility rates and death rates.

The communities in the Y-K Delta are divided into four sub-groups based primarily on census area. Group 1 consists of the 13 communities in the Wade Hampton Census Area; Group 2 includes all communities in the Bethel Census Area except Bethel City; Group 3 includes 7 communities in the Yukon-Koyukuk Census Area; Group 4 is Bethel City. Altogether, 54 communities are included in this analysis. Telida and Flat, though in the study area, are not included in this analysis as there are no age-cohort census data for these two communities in 1990. See Page 9 for a complete listing of the communities.

The cohort-survival model was run for each group, and population projections were made for each group individually and aggregated to the study area as a whole. The total population of the Y-K Delta is the sum of the populations of the 4 groups. Given the Group 1, Group 2, and Group 3 results, the villages in them were allocated the same proportions of the population as they had according to the 1990 census data.

B. Data

The data required to run the DOT&PF cohort-survival model include cohort data by race, sex, and age; survival rate by race, sex, and age; fertility rate by race.

1990 population data by race, sex, and age for the census areas in the Y-K Delta are available from the U.S. Census Bureau. Survival rates are derived from death rates, which are available in 5-year cohorts by sex and Native/non-Native origin from Alaska Bureau of Vital Statistics. Fertility rate for women aged 15-44 is also available by census area through Alaska Bureau of Vital Statistics.

Death rates are provided by Alaska Bureau of Vital Statistics for statewide Native and non-Native populations by age and sex. The death rates used in this study are based on annual data of 1995-1997, the last years for which data are available.

The fertility rates used in this study are based on annual data of 1995-1997, the last years for which data are available. The three-year annual average is assumed to be typical of the population at the base year.

C. Assumptions

As fertility rates are available only by census area, and both Native and non-Native women contribute to this fertility rate, weighting factors based on relative population of Native and non-Native in a census area are used to derive the race specific fertility rates.

This study first assumed that non-Native women in the Y-K Delta have a fertility rate of 6%, similar to that reported for Mat-Su Census Area. This census area has the highest proportion of White population in the State, about 94% in 1990, which is similar to the characteristics of the non-Native population in the Y-K Delta. The DOT&PF planning team assumed that these populations share similar views about family size.

With this assumption, the non-Native women's contribution to the census-wide fertility rate can be calculated, and fertility rate of Native women in the same census area also becomes known. The results are as the following:

Table 1 Fertility Rates of Native and Non-Native Population in the Y-K Delta, 1995-1997

Census Area	*Wade Hampton*	*Bethel*	*Yukon-Koyukuk*
*Census-Wide**	17.0%	12.3%	8.5%
Native	18%	14%	10%
Non-Native	6%	6%	6%

* Source: Alaska Bureau of Vital Statistics, 1995, 1996, 1997

Two different future fertility rates are used to give two series of projections. In the high series, fertility rates for both Native and non-Native are assumed to remain constant. This assumption is based on the author's conversation with a few health professionals in the area that high fertility rates in the Delta have produced a population boom in the youngest cohorts and there are no obvious reasons to expect a change in the near future. In the low series, Native fertility rates are set to decrease by one percent every 5 years over the projection period. This assumes that the big difference between Native and non-Native fertility rates—10% to 17% vs. 6%—will slowly decline as Native women in future prefer a smaller family for the economic and social reasons that appear to underlie reduced fertility rates in recent years in the U.S. and in numerous other developed nations.

Since death rates are provided by Alaska Bureau of Vital Statistics for statewide Native and non-Native populations by age and sex, this study assumes that these rates are applicable to the Native and non-Native population in the area. The death rates used in this study are based on annual data of 1995-1997. The three-year annual average are assumed to be typical of the population in the first projection period, 1990-1995; furthermore, since the projection period is 5 years, annual survival rates are taken to the fifth power to give the 5-year cumulative survival rates.

Survival rates for all cohorts are assumed to remain constant for the study period; this assumption was made based on data published by Alaska Bureau of Vital Statistics, which show that death rates for the populations in the Y-K Delta have been rather stable in the 1990s (Ref: Alaska Bureau of Vital Statistics, 1997). This assumption is used in both high series and low series projections.

This study also assumes that the community population as a proportion of its sub-group total will remain constant throughout the planning period. This implies that communities in a Census Area will all grow at the same rate and people movement between communities is at equilibrium. Based on this assumption, the communities in each sub-group were allocated the same proportions of the population as they had according to the 1990 census data. DOT&PF planning team recognizes that certain socioeconomic changes may cause individual communities to grow at different pace and inter-community migration may occur. However, 1980 and 1990 census data show that most communities in each sub-group of the study area did grow at similar rates and the assumption described above is adequate for the purpose of regional planning.

D. Computer Routines

1990 cohort data, death rates, and fertility rates were entered into Excel spreadsheets, and the concepts described in the previous sections were translated into mathematical formulas and entered into appropriate Excel cells to calculate cohort populations for the projection periods. To begin this routine, populations for the next projection period based on fertility rate and survival rate are calculated; this is done for male and female cohorts, for Native and non-Native population, and for the 4 area groups defined in the study. It then sums up the group populations to give the area-wide population and calculates annual growth in the projection period. Finally, it derives population of individual communities in each projection period based on the community's relative proportion to the group population in 1990.

This routine is repeated for each projection period from 1995 to 2020 and for the high series and low series. The results are discussed in the next section.

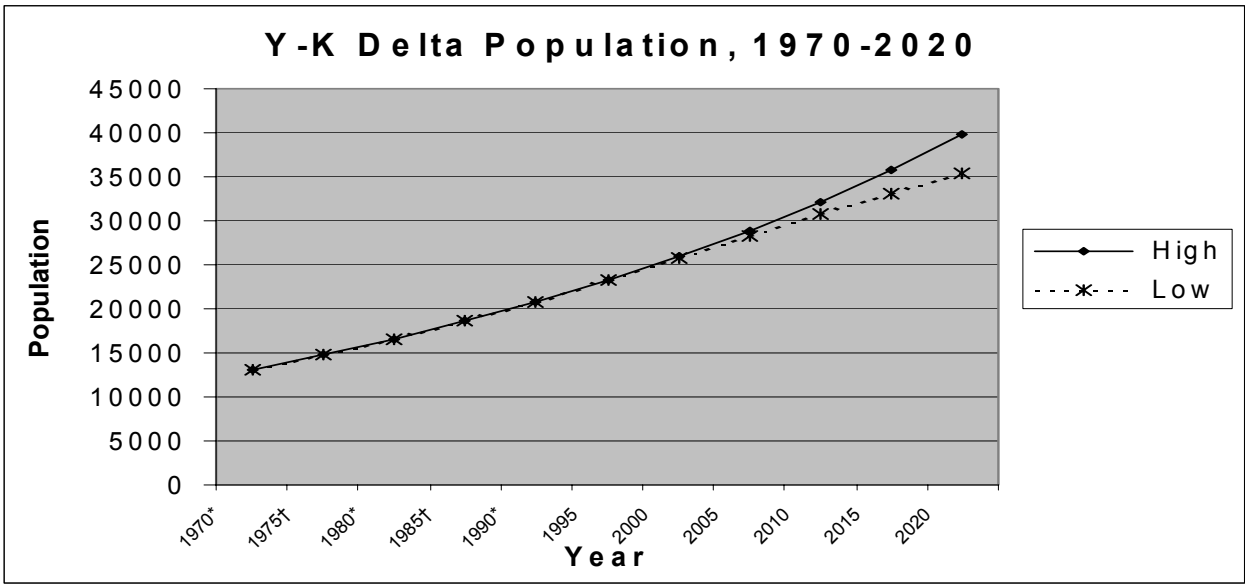
III. DOT&PF Cohort-Survival Model Results

A. Population Projection 1995-2020

1. Y-K Delta area-wide population projection 1995-2020.

Year	1990	1995	2000	2005	2010	2015	2020	Annual Growth
High	20,729	23,245	26,019	29,053	32,463	36,182	40,370	2.25%
	Ann. growth	2.32%	2.28%	2.23%	2.24%	2.19%	2.21%	
Low	20,729	23,245	25,805	28,364	30,967	33,495	35,969	1.85%
	Ann. growth	2.32%	2.11%	1.91%	1.77%	1.58%	1.44%	

The following figure illustrates past population growth and the projected growth.



2. Census Area Population Projection

Group 1 (Wade Hampton Census Area, 13 communities) population projection 1995-2020.

Year	1990	1995	2000	2005	2010	2015	2020	Annual Growth
High	5,780	6,657	7,644	8,779	10,141	11,691	13,462	2.86%
	Ann. growth	2.87%	2.80%	2.81%	2.93%	2.88%	2.86%	
Low	5,780	6,657	7,581	8,570	9,672	10,824	12,007	2.47%
	Ann. growth	2.87%	2.63%	2.48%	2.45%	2.28%	2.10%	

Group 2 (Bethel Census Area excluding Bethel City, 33 communities) population projection 1995-2020:

Year	***1990***	***1995***	***2000***	***2005***	***2010***	***2015***	***2020***	***Annual Growth***
High	8,881	9,863	10,962	12,193	13,564	15,045	16,705	2.13%
	Ann. growth	2.12%	2.14%	2.15%	2.15%	2.09%	2.12%	
Low	8,881	9,863	10,865	11,879	12,884	13,831	14,724	1.70%
	Ann. growth	2.12%	1.95%	1.80%	1.64%	1.43%	1.26%	

Group 3 (Yukon-Koyukuk Census Area, 7 communities) population projection 1995-2020:

Year	***1990***	***1995***	***2000***	***2005***	***2010***	***2015***	***2020***	***Annual Growth***
High	1,381	1,471	1,571	1,667	1,776	1,877	1,984	1.22%
	Ann. growth	1.26%	1.33%	1.20%	1.27%	1.12%	1.12%	
Low	1,381	1,471	1,559	1,630	1,694	1,736	1,779	0.85%
	Ann. growth	1.26%	1.17%	0.90%	0.78%	0.50%	0.48%	

Group 4 (City of Bethel) population projection 1995-2020:

Year	***1990***	***1995***	***2000***	***2005***	***2010***	***2015***	***2020***	***Annual Growth***
High	4,687	5,255	5,842	6,414	6,982	7,569	8,218	1.89%
	Ann. growth	2.31%	2.14%	1.88%	1.71%	1.63%	1.66%	
Low	4,687	5,255	5,800	6,285	6,718	7,105	7,460	1.56%
	Ann. growth	2.31%	2.00%	1.62%	1.34%	1.13%	0.98%	

3. Community Population Projection

High Series

Community	Census	1990	1995	2000	2005	2010	2015	2020
Akiachak	Bet	452	502	558	621	690	766	850
Akiak	Bet	285	317	352	391	435	483	536
Alakanuk	Wad	540	622	714	820	947	1092	1258
Aniak	Bet	529	587	653	726	808	896	995
Anvik	Yuk	78	83	89	94	100	106	112
Atmautluak	Bet	262	291	323	360	400	444	493
Bethel	Bet	4687	5255	5842	6414	6982	7569	8218
Chefornak	Bet	310	344	383	426	473	525	583
Chevak	Wad	597	688	790	907	1047	1207	1390
Chuathbaluk	Bet	99	110	122	136	151	168	186
Crooked Creek	Bet	108	120	133	148	165	183	203
Eek	Bet	264	293	326	362	403	447	497
Emmonak	Wad	610	703	807	926	1070	1234	1421
Goodnews Bay	Bet	232	258	286	319	354	393	436
Grayling	Yuk	217	231	247	262	279	295	312
Holy Cross	Yuk	278	296	316	336	357	378	399
Hooper Bay	Wad	846	974	1119	1285	1484	1711	1970
Kasigluk	Bet	440	489	543	604	672	745	828
Kipnuk	Bet	462	513	570	634	706	783	869
Kongiganak	Bet	313	348	386	430	478	530	589
Kotlik	Wad	462	532	611	702	811	934	1076
Kwethluk	Bet	568	631	701	780	868	962	1068
Kwigillingok	Bet	258	287	318	354	394	437	485
L + U Kalskag	Bet	452	502	558	621	690	766	850
Lime Village	Bet	47	52	58	65	72	80	88
Marshall	Wad	283	326	374	430	497	572	659
McGrath	Yuk	524	558	596	633	674	712	753
Mekoryuk	Bet	168	187	207	231	257	285	316
Mountain Village	Wad	706	813	934	1072	1239	1428	1644
Napakiak	Bet	334	371	412	459	510	566	628
Napaskiak	Bet	326	362	402	448	498	552	613
Newtok	Bet	217	241	268	298	331	368	408
Nightmute	Bet	174	193	215	239	266	295	327
Nikolai	Yuk	113	120	129	136	145	154	162
Nunapitchuk	Bet	385	428	475	529	588	652	724
Oscarville	Bet	44	49	54	60	67	75	83
Pilot Station	Wad	467	538	618	709	819	945	1088
Pitkas Point	Wad	131	151	173	199	230	265	305
Platinum	Bet	67	74	83	92	102	114	126
Quinhagak	Bet	509	565	628	699	777	862	957
Red Devil	Bet	54	60	67	74	82	91	102
Russian Mission	Wad	240	276	317	365	421	485	559
Scammon Bay	Wad	346	399	458	526	607	700	806
Shageluk	Yuk	135	144	154	163	174	183	194
Sheldon Point	Wad	112	129	148	170	197	227	261
Sleetmute	Bet	115	128	142	158	176	195	216
St. Marys	Wad	440	507	582	668	772	890	1025
Stony River	Bet	49	54	60	67	75	83	92
Takotna	Yuk	36	38	41	43	46	49	52
Toksook Bay	Bet	405	450	500	556	619	686	762
Tuluksak	Bet	353	392	436	485	539	598	664
Tuntutuliak	Bet	300	333	370	412	458	508	564
Tununak	Bet	300	333	370	412	458	508	564
Y-K Delta		20729	23245	26019	29053	32463	36182	40370

Low Series

	Census	1990	1995	2000	2005	2010	2015	2020
Akiachak	Bet	452	502	553	605	656	704	749
Akiak	Bet	285	317	349	381	413	444	473
Alakanuk	Wad	540	622	708	801	904	1011	1122
Aniak	Bet	529	587	647	708	767	824	877
Anvik	Yuk	78	83	88	92	96	98	100
Atmautluak	Bet	262	291	321	350	380	408	434
Bethel	Bet	4687	5255	5800	6285	6718	7105	7460
Chefornak	Bet	310	344	379	415	450	483	514
Chevak	Wad	597	688	783	885	999	1118	1240
Chuathbaluk	Bet	99	110	121	132	144	154	164
Crooked Creek	Bet	108	120	132	144	157	168	179
Eek	Bet	264	293	323	353	383	411	438
Emmonak	Wad	610	703	800	904	1021	1142	1267
Goodnews Bay	Bet	232	258	284	310	337	361	385
Grayling	Yuk	217	231	245	256	266	273	280
Holy Cross	Yuk	278	296	314	328	341	350	358
Hooper Bay	Wad	846	974	1110	1254	1416	1584	1757
Kasigluk	Bet	440	489	538	589	638	685	729
Kipnuk	Bet	462	513	565	618	670	719	766
Kongiganak	Bet	313	348	383	419	454	487	519
Kotlik	Wad	462	532	606	685	773	865	960
Kwethluk	Bet	568	631	695	760	824	885	942
Kwigillingok	Bet	258	287	316	345	374	402	428
L + U Kalskag	Bet	452	502	553	605	656	704	749
Lime Village	Bet	47	52	58	63	68	73	78
Marshall	Wad	283	326	371	420	474	530	588
McGrath	Yuk	524	558	591	618	643	659	675
Mekoryuk	Bet	168	187	206	225	244	262	279
MountainVillage	Wad	706	813	926	1047	1181	1322	1467
Napakiak	Bet	334	371	409	447	485	520	554
Napaskiak	Bet	326	362	399	436	473	508	540
Newtok	Bet	217	241	265	290	315	338	360
Nightmute	Bet	174	193	213	233	252	271	288
Nikolai	Yuk	113	120	128	133	139	142	146
Nunapitchuk	Bet	385	428	471	515	559	600	638
Oscarville	Bet	44	49	54	59	64	69	73
Pilot Station	Wad	467	538	613	692	781	875	970
Pitkas Point	Wad	131	151	172	194	219	245	272
Platinum	Bet	67	74	82	90	97	104	111
Quinhagak	Bet	509	565	623	681	738	793	844
Red Devil	Bet	54	60	66	72	78	84	90
Russian Mission	Wad	240	276	315	356	402	449	499
Scammon Bay	Wad	346	399	454	513	579	648	719
Shageluk	Yuk	135	144	152	159	166	170	174
Sheldon Point	Wad	112	129	147	166	187	210	233
Sleetmute	Bet	115	128	141	154	167	179	191
St. Marys	Wad	440	507	577	652	736	824	914
Stony River	Bet	49	54	60	66	71	76	81
Takotna	Yuk	36	38	41	42	44	45	46
Toksook Bay	Bet	405	450	495	542	588	631	671
Tuluksak	Bet	353	392	432	472	512	550	585
Tuntutuliak	Bet	300	333	367	401	435	467	497
Tununak	Bet	300	333	367	401	435	467	497
Y-K Delta		20729	23245	25805	28364	30967	33495	35969

B. Trend and Characteristics Suggested by the Model Results

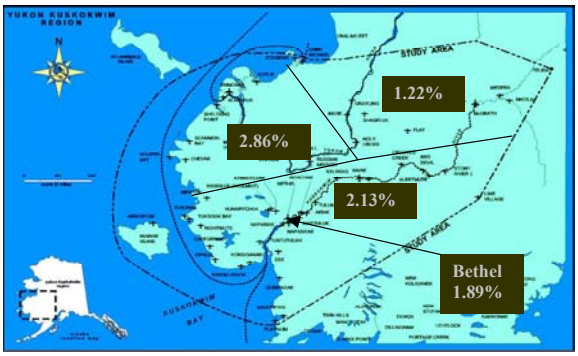
1. Spatial Characteristics

In general, communities in the Wade Hampton Census Area have higher projected population growth rates in the next 20 years than the other Yukon-Kuskokwim Delta communities in the Bethel and Yukon-Koyukuk Census Areas. The age groups projected to increase the most are the youngest and the oldest cohorts. This growth is likely due to high fertility rate and to better medical care for the elderly. The 1995-1997 average fertility rate in Wade Hampton Census Area was 17%, 12.3% in the Bethel Census Area, and 8.5% in the Yukon-Koyukuk Census Area, as compared with 7% statewide and 6% for Mat-Su Census Area.

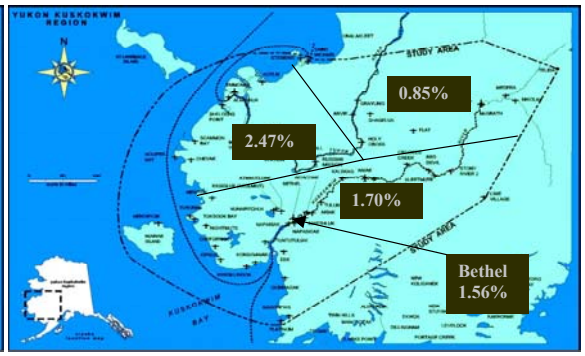
Based on the model results from the high series, the Lower Yukon area, including the coastal communities in the same drainage, will see faster growth at close to 2.9% a year for the next 20 years. The Lower Kuskokwim and Kuskokwim Bay area will also see moderate growth of about 2.1 % a year. These two areas have high proportion of Yupik population, exceeding 90% of the total population. In contrast, the upper Kuskokwim and Yukon above Holy Cross will see slower growth, averaging about 1.2% a year, while in the City of Bethel, the growth is expected to be about 1.9% a year. In these other areas, Native population, Yupik and Athabaskan, makes up about 65% to 75% of the total population.

The results from the low series suggest the same geographic differences in growth, but the growth rates are less for all areas: 2.5%, 1.7%, 0.9% and 1.8% for Lower Yukon, Lower Kuskokwim, Upper Kuskokwim and Yukon, and Bethel City respectively.

The following maps illustrate the geographical differences of the projected population growth, 1990-2020, in the Y-K Delta:



1. Annual Growth — High Series



2. Annual Growth — Low Series

2. Trends

The high annual population growth of 3% to 5% in the Y-K Delta between the 50s and 70s has declined to 2% to 2.5 % in the past 30 years. The high-series' results suggest that growth over the next 20 years will remain at about the level of the last 30 years, and perhaps slowly decrease; for example, the model shows the annual growth rates decreases from 2.24% in year 2000 to 2.16 % in year 2020. This trend of steady and slightly decreasing growth rate is true for all census areas in the Delta. Based on this projection, the population will grow from 20,729 in 1990 to 40,370 in 2020, nearly double in 30 years.

The results of the low series suggest that population growth in the Delta will gradually slow down and the growth rate will be below 2.0% after 2000 and below 1.5% after 2020. The trend of decreasing growth rate is projected for all census areas in the Y-K Delta. Based on this projection, the population will grow from 20,729 in 1990 to about 35,969 in 2020,

If out-migration is considered, the growth might be somewhat less than depicted above. Though there are no actual time series of migration data, anecdotal accounts and cross-section data based on the 1990 census imply greater migration of women than of men from smaller to larger communities. However, 1995-1997 vital statistic data show that these female age-cohorts of child-bearing continue to grow in Wade Hampton Census Area, but not as fast as the general population, about 1.3% vs. 2.7%, whereas their growth is near zero in the Bethel Census Area. If the lower growth in these cohorts in these areas is from net out-migration, as is likely, the size of the migration is likely still too small to affect the projected population levels. Furthermore, continued home-building programs in the communities and better health clinics could influence the out-migration trend for people to return to the smaller communities.

Although the DOT&PF cohort-survival model and other population projections all show rapid population growth in the region, there are of course some unknowns. Fertility rates and migration may be affected by economic and social changes affecting education, employment, income, subsistence, transfer payments, and other factors. The annual growth rates projected by the model's high and low series, however, show a likelihood of sustained population growth in the Y-K Delta over the 20-year planning period.

Technical Appendix A, Population Projection Review, David Marshall

Population Projections: ADOL, DOT&PF, ISER

Introduction

The DOT&PF study team has undertaken population projections for the study region because the two existing sets of projections—those of the Alaska Department of Labor (ADOL) and those of the University of Alaska Anchorage's Institute of Social and Economic Research (ISER)—were unsatisfactory in three ways. First, there is a very large spread in their projected future levels. For example, for the Bethel and Wade-Hampton Census Areas combined, for the year 2018, the ADOL high is 40,400, and the ISER low is 27,700—38 percent lower. Second, both sets include some patterns that are a priori difficult to accept without explanation. For example, all the ADOL projections show the population increasing geometrically throughout the projection period. And, the ISER high projections show an unexplained large surge in the 5-year period 2007-2011, with annual increases during that period of up to 5.5 percent, as compared with less than 2 percent in prior years. Third, their explanation of their projection models' methods and the data they provide preclude a detailed understanding of the relative significance of their assumptions, and thus preclude the use of alternative assumptions or data in rerunning their models, to see what consequences different assumptions or newer data may have.

The basic differences among the three sets we present below are that:

1. The ADOL projections are based on natural increase and migration;
2. The ISER projections are based on natural increase and migration, and are linked to economic projections such as employment and income;
3. The DOT&PF projections are based on natural increase only, and so would for that reason alone tend to be higher than the ADOL and ISER projections, which assume net out-migration from rural areas.

Table A1 and the accompanying figure shows the three sets of population levels projected for the period 1995-2020 in five-year increments for the Bethel and Wade-Hampton census areas combined. They are those of: the Alaska Department of Labor (ADOL); the Alaska Department of Transportation and Public Facilities (DOT&PF); the University of Alaska Anchorage, Institute of Social and Economic Research (ISER). We exclude from this comparison the future population levels for the 7 Yukon-Koyukuk villages in the study area because ADOL and ISER do not project levels for them.

ADOL and ISER project three levels of population: high, medium (or base), and low. DOT&PF projects two: high, low.

All three sets—ADOL, DOT&PF, ISER—project a substantial increase in population in the two census areas over the next 30 years. But—with one exception—they project a future increase less than that of the last 30 years.

Over the period 1960-1990 the population in the two census areas combined more than doubled: from 8,600 in 1960 to 19,300 in 1990, for an increase of 224 percent. The increases

projected for the next 30 year-period 1990-2020 range from a lowest increase of 35 percent (ISER, low) to a highest increase of 221 percent (ADOL, high). The ADOL high is the exception: it projects a rate of growth over the next 30 years at the same level as that recorded over the period 1960-1990.

ADOL

Table A2 and the accompanying figure shows the ADOL projections. They are provided for census areas. The sum of the census areas' projections is constrained by the state control total. Within that constraint, the individual census areas reflect especially trends unique to the census area. (Alaska Department of Labor, 1991. *Alaska population projections, 1991.* Juneau, Alaska*;* Williams G., 1998. *Population projections, Alaska Economic Trends, September-October 1998.* Juneau, Alaska*)*

The ADOL projections for the state as a whole are based on assumptions on the two basic variables natural increase and migration. In turn, these two variables reflect other underlying assumptions. Natural increase reflects assumed rates of fertility and mortality; migration reflects assumptions on economic development in-state and out-of-state, on government spending civilian and military, on state revenues, on growth in the private sector, on employment/population ratios, dependency ratios (non-working-age/working-age population), and so on. The high series, for example, reflects assumptions of low mortality, high fertility, and high net in-migration. Similarly, the low series reflects high mortality, low fertility, and low in-migration. In part, all these assumptions reflect past patterns, which are assumed to stay much the same or to change in important ways.

Whatever the assumptions, the resulting state trends are assumed to be steady annually over the period, with no annual breaks in the trends' continuity. Natural increase is relatively steady; migration is the volatile component in Alaska's population growth. This volatility reflects and is reflected in the relatively young population, which responds more elastically to new job opportunities, and the substantial role of the military in the state. Net in-migration has exceeded natural increase in 10 of the last 50 years. However, its influence on the total is small: net migration has accounted for more than 4 percent of the total state population in only 5 years in the last 50. For purposes of these projections, migration is assumed to reflect the pattern of the 1980s—a decade of relatively low net migration—and then to trend towards zero over the projection period. Fertility and mortality rates are assumed to continue to be different for Alaska Natives and non-Natives. For example, the middle series assumes fertility rates of 3.8 births per Native woman and 2.4 births per White woman in 2010. The state's fertility rates are adapted from, and assumed to continue to be higher than, those of the U.S., i.e., not to converge.

At census level too, the population projections reflect the recent past. And, migration—which is much more volatile the smaller the area—is assumed to reflect the patterns of 1988-1989, with the high and low set at one standard deviation above the mean. Urban Alaska grows through migration especially, and rural Alaska from natural increase especially.

As Table A2 shows, all three ADOL projections show an unconstrained increase in population, with increasing annual average rates of growth, over the period. We believe that a more-moderate option is plausible, involving the twin assumptions of reduced fertility rates and increased net out-migration.

The ADOL do not publish their model, so one cannot test the results that would follow from different assumptions or for using different values for their parameters. And, their model does not specify what part of the future population levels is from natural increase, and what part from net out-migration.

The importance of migration, which is expected to moderate the growth from natural causes alone, is unclear in these projections. The ADOL gives apparently conflicting estimates of historical migration. For example, it shows net out-migration of total population (Natives and non-Natives) between 1980 and 1990 of 444 from the Bethel Census Area, and of 483 from the Wade-Hampton Census Area, but gives a much bigger number of 4,088 net Alaska Native out-migrants from Bethel, Dillingham, Nome, and Wade-Hampton combined. (Williams J. G., 1999. *Alaska population overview, 1998 estimates.* Alaska Department of Labor, Juneau, Alaska. Table 2.3; Page 70)

For these reasons, the DOT&PF study team felt it necessary to undertake its own projections, and to compare the results.

ISER

The ISER population projections appear to reflect economic projections such as employment and to have natural increase and migration components. *(*1. Goldsmith O. S., 1998. *Population, employment, and income projections for Alaska census areas-statewide and regional economic and demographic projections (including Appendix);* 2. Goldsmith O.S., Hill A., 1997. *Alaska's economy and population, 1959-2020; 3.* Goldsmith O. S., 1997. *Economic/demographic projections of selected planning regions of Alaska (including Assumptions).* University of Alaska Anchorage, Institute of Social and Economic Research, Anchorage, Alaska.)

As with ADOL, ISER does not specify its model or the values of its parameters. It does not show what part of its projections reflects natural increase, what part reflects migration, and what part reflects economic projections.

We now summarize the ISER methods and present their results.

"Based on what we know right now, we estimate Alaska's population in 2020 will most likely be about 40 percent larger than it is today, but it could be anywhere from 20 to 80 percent larger." (1, page 1)

"For purposes of analysis, we group Alaska's industries into four sectors: Basic, Infrastructure, Support, and State and Local Government." (1, Appendix, Page 1) (The basic sector sells goods and services to out-of-state markets; the infrastructure sector provides goods and services to other sectors in the state; the support sector sells goods and services mostly to state residents.)

The basic assumptions of the model focus on the oil and gas industry, mining, federal employment, seafood harvesting, tourism, and the Alaska Permanent Fund. (1, page 37). For example, in the high scenario, petroleum taxes stay level, oil litigation brings in $1.8 billion, oil and gas industry employment increases in Cook Inlet and on the North Slope, oil and gas in the Arctic National Wildlife Refuge (ANWR) is developed, and North Slope gas is produced. In mining, jobs rise to 3,300 by 2,000 and 4,200 by 2015 (as compared with the low of 1,900 and 2,000 jobs respectively). Federal military employment increases (but declines in the low scenario). Seafood harvesting employment stays level and processing employment increases (with both declining in the low scenario). Tourism expenditures increase by 7 percent annually to 2000 (versus 4 percent annually in the low scenario), and stay above the low scenario through 2015. The real rate of return of the Alaska Permanent Fund is projected at 6 percent annually (as compared with 4 percent in the low scenario). The Alaska Permanent Fund dividend is cut from 50 percent of earnings to 37.5 percent (but to 12.5 percent in the low scenario.)

These assumptions are the basis for projecting levels of employment and personal income, most of which is the earnings from employment. Population—civilian non-Native, Native, and

military—is projected as the sum of the two components of natural increase--births minus deaths and net migration. It is not clear if the employment and population projections are linked.

The projections are undertaken for the state divided into three regions: Southcentral/Interior, Southeast, and Western Arctic.

Projections of population and employment are allocated from the state control totals to the three regions, which are then further subdivided into projections for census areas and boroughs, using the existing proportions. (3. *Assumptions*, Page 9)

"The Western Arctic region is the least economically developed region in the state and will remain so for the foreseeable future…Most new jobs…will be in the support or government sectors—but growth will be slow because of the budget constraints state and local governments face." (1, page 21) "The Western Arctic region is the least developed of the three [and there] state and local government is especially important…and its very slow projected growth due to fiscal constraints will be reflected in the region's slow employment growth." (1. Appendix, Page 40)

ISER have further provided projections for four regions consisting of aggregates of census areas/boroughs: Copper River; Southeast; Southwest; Yukon-Kuskokwim. The Yukon-Kuskokwim region consists of the Bethel and Wade-Hampton Census Areas, plus the Holy-Cross and McGrath census sub-areas of the Yukon-Koyukuk Census Area.

Unfortunately, ISER published only the historical data it used for the Yukon-Kuskokwim region as a whole and for only one part of the region: the Bethel Census Area. It did not publish the historical data it used for the other two parts of the region: the Wade-Hampton Census Area; the Holy-Cross and McGrath census sub-areas. (3. Pages 98, 127 and 131). Thus, we cannot reproduce the ISER historical data for the two census areas combined—Bethel and /Wade-Hampton—that we are using for purposes of comparison with the ADOL and the DOT&PF projections. We have therefore for Table A1 simply assumed that the ISER data for them in 1990 and 1995 are equal to the data published by the ADOL in 1999. (Alaska Department of Labor, 1999. *Alaska population overview: 1998 estimates.* Juneau, Alaska. Pages 108-109, 138-139*)*

Table A3 and the accompanying figure shows that the ISER high population projection has a sharp upward trend after 2008, which appears to reflect a similarly sharp upward increase in the ISER employment projection. Although less obvious, their baseline and low projections show unexplained discontinuous increases too: between 1999 and 2000, the baseline annual increase doubles from 0.8 to 1.6 percent, and the low projection jumps from an annual increase of 0.4 percent in 1999 to an annual increase of 20 percent in 2002.

DOT&PF

The DOT&PF cohort-analysis model projects natural increase only; it has no migration component and no economic component. The detailed projections are given in the main text of this appendix—*Y-K Delta Population Projection Using a Cohort-Survival Model, 1995-2020* written by Meifu Wang. (YK Population Tech Memo) Thus, assuming that there is net out-migration from the study region, the DOT&PF projections should be higher than those of the ADOL and ISER.

The comparison of the Bethel and Wade-Hampton Census Areas combined, as in Table A1, shows that the DOT&PF projections are slightly higher than the ISER projections: the DOT&PF 2020 high is 38,400 (ISER, 35,600) and the DOT&PF 2020 low is 34,200 (ISER, 27,900). It shows also that the DOT&PF high projection is considerably lower than the nearest ADOL projection: the DOT&PF 2020 high is 38,400 versus an ADOL high of 40,400 in 2018. On the

other hand, the DOT&PF 2020 low of 34,200 is considerably higher than the ADOL low of 30,800 in 2018. In short, the DOT&PF projections are bracketed above and below by the ADOL projections. And, they are slightly higher than the ISER projections, which they should be other things being equal and allowing for the fact that the DOT&PF projections have no reduction from net out-migration, whereas the ISER projections do.

The full details of the DOT&PF model and its results are described in YK Population Tech Memo.

In brief, the DOT&PF model projects two sets of population to 2020. In one set, fertility rates are assumed unchanged throughout the projection period; in the other set, they are assumed to decline by 1 percent every 5 years. The fertility rates are separated for Native women and for non-Native women. The model uses standard 5-year age-cohorts with 1990 Census data as the baseline, and applies cohort-survival rates, and 3-year average annual fertility rates for women of childbearing age for 1995-1997 provided by the Alaska Bureau of Vital Statistics. The model projects population separately for Alaska Natives and non-Natives. For purposes of comparison with ADOL and ISER in this appendix, we have combined them.

Table A1. Population, Bethel And Wade-Hampton Census Areas: 1950-2020. Three Projections

Projection	Year														
	1950	1960	1970	1980	1990	1995	2000	2003	2005	2008	2010	2013	2015	2018	2020
ADOL low	5.21	8.63	12.15	15.36	19.35	21.86	n.a.	24.63	n.a.	26.41	n.a.	28.53	n.a.	30.82	n.a.
ADOL med	5.21	8.63	12.15	15.36	19.35	21.86	n.a.	25.38	n.a.	28.09	n.a.	31.31	n.a.	34.87	n.a.
ADOL high	5.21	8.63	12.15	15.36	19.35	21.86	n.a.	26.51	n.a.	30.46	n.a.	35.08	n.a.	40.35	n.a.
DOT&PF low	5.21	8.63	12.15	15.36	19.35	21.86	24.20	n.a.	26.90	n.a.	29.30	n.a.	31.80	n.a.	34.20
DOT&PF high	5.21	8.63	12.15	15.36	19.35	21.86	24.40	n.a.	27.40	n.a.	30.70	n.a.	34.30	n.a.	38.40
ISER low	5.21	8.63	12.15	15.36	19.35	21.86	22.75	n.a.	24.14	n.a.	25.42	n.a.	26.71	n.a.	27.94
ISER base	5.21	8.63	12.15	15.36	19.35	21.86	22.74	n.a.	24.50	n.a.	26.06	n.a.	27.95	n.a.	29.75
ISER high	5.21	8.63	12.15	15.36	19.35	21.86	22.50	n.a.	24.29	n.a.	29.11	n.a.	32.98	n.a.	35.62

Sources:

1950-1990 U.S. Bureau of the Census

1995 Williams JG. June 1999. Alaska Population Overview: 1998 Estimates. Alaska Department of Labor. Juneau,

2000-2020

ADOL Alaska Department of Labor

DOT&PF

ISER Goldsmith S. January 24, 1998. Population, Employment, And Income For Alaska Census Areas. University of Alaska Anchorage, Institute of Social and Economic Research. Anchorage, Alaska. University of Alaska Anchorage, Institute of Social and Economic Research. Anchorage,

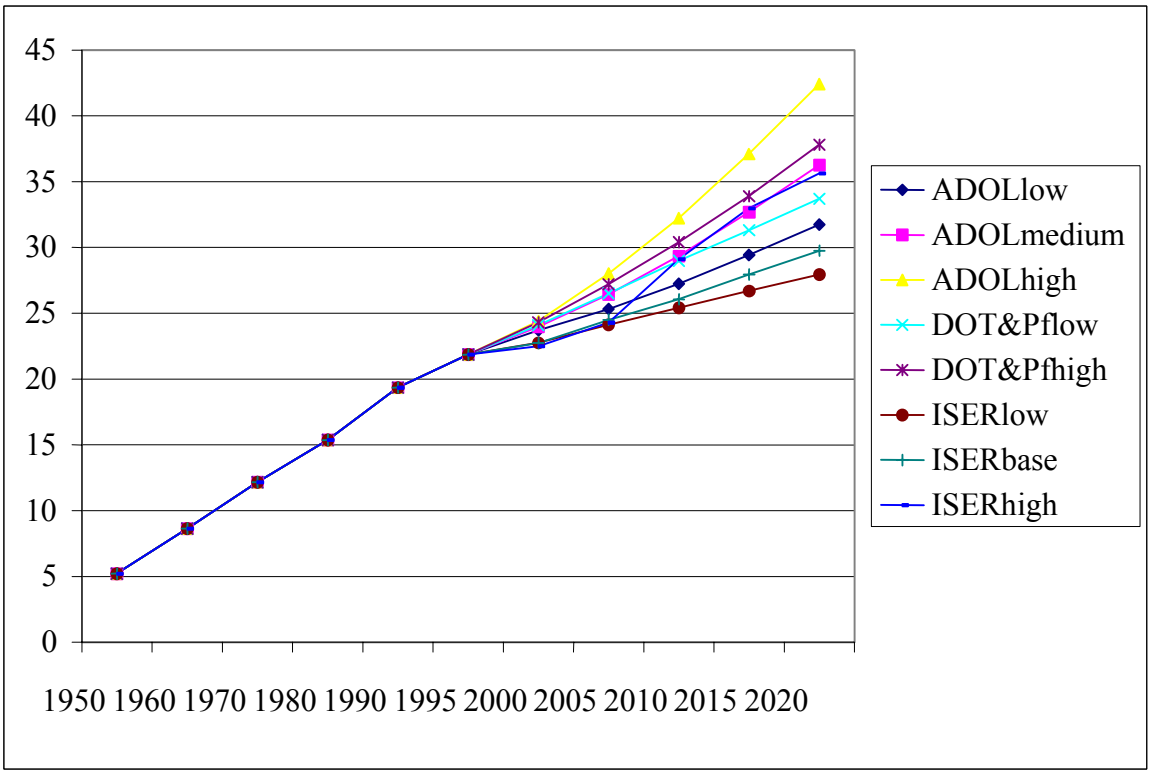
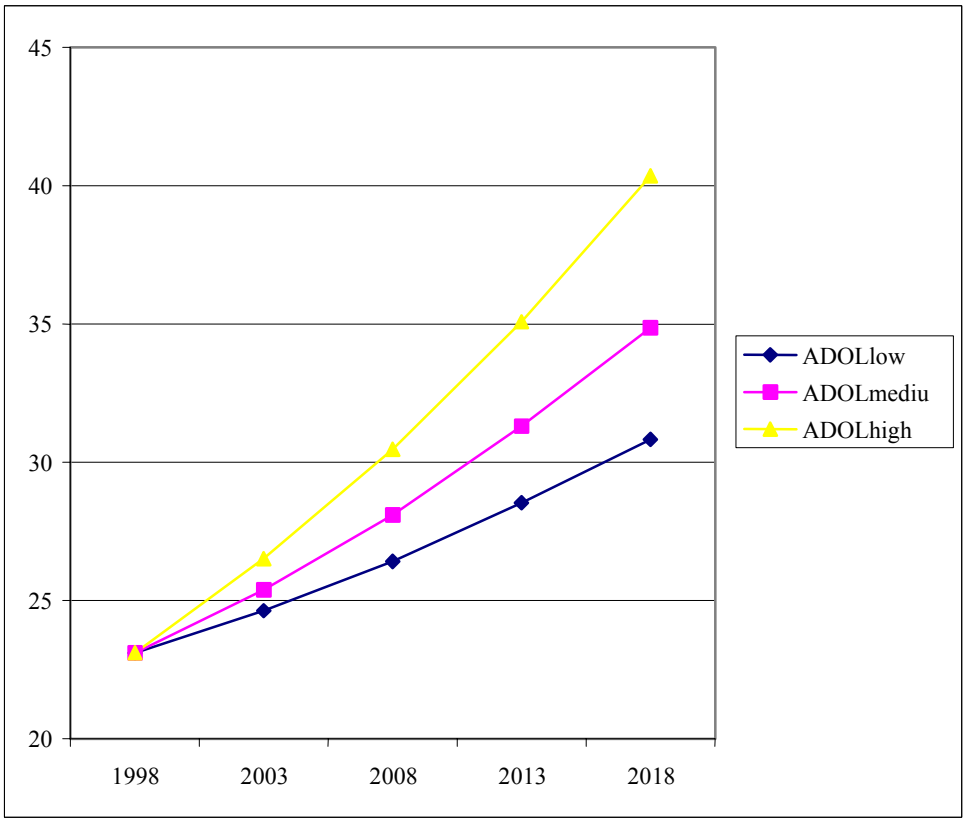


Table A2. ADOL Projections. Bethel and Wade-Hampton Census Areas. 1998 – 2020

Projection	Year				
	1998	2003	2008	2013	2018
ADOLlow	23.1	24.6	26.4	28.5	30.8
ADOLmediu	23.1	25.4	28.1	31.3	34.9
ADOLhigh	23.1	26.5	30.5	35.1	40.4

Source: Alaska Department Of Labor. 1999. Alaska Population Projections 1998-2018. Juneau,

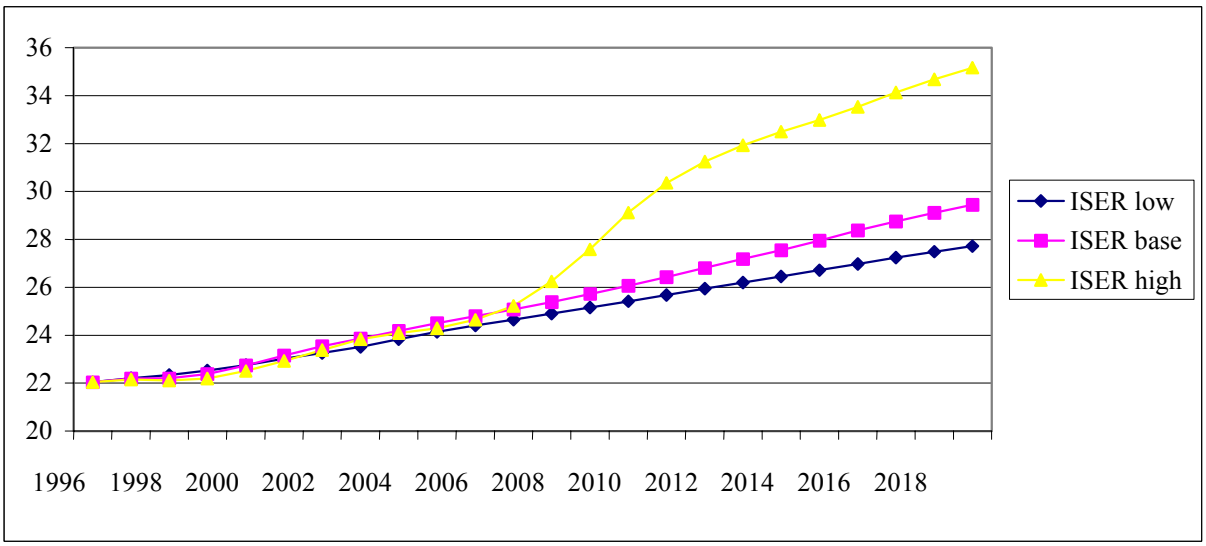


Technical Appendix B — Cohort-Survival Model for the Y-K Delta: Excel Workbook Cohort_YK.xls

Table A3. ISER Population Projections. Bethel and Wade-Hampton Census Areas. 1996-2025

Projection	Year									
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
ISER low	22.0	22.2	22.3	22.5	22.8	23.0	23.3	23.5	23.8	24.1
ISER base	22.0	22.2	22.2	22.4	22.7	23.2	23.5	23.9	24.2	24.5
ISER high	22.0	22.2	22.1	22.2	22.5	22.9	23.4	23.8	24.1	24.3
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ISER low	24.4	24.7	24.9	25.2	25.4	25.7	25.9	26.2	26.5	26.7
ISER base	24.8	25.1	25.4	25.7	26.1	26.4	26.8	27.2	27.6	28.0
ISER high	24.6	25.2	26.3	27.6	29.1	30.4	31.2	31.9	32.5	33.0
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
ISER low	27.0	27.2	27.5	27.7	27.9	28.2	28.5	28.7	28.7	28.6
ISER base	28.4	28.8	29.1	29.4	29.8	30.1	30.4	30.7	31.0	31.3
ISER high	33.5	34.1	34.7	35.2	35.6	36.1	36.5	36.9	37.3	37.7

Source: Goldsmith S. January 24, 1998. Population, Employment, And Income For Alaska Census Areas. University of Alaska Anchorage, Institute of Social and Economic Research. University of Alaska Anchorage, Institute of Social and Economic Research. Anchorage,



Appendix B
Air System Demand Forecast for Y-K Delta Region

By: Sagar Onta,
Purdue University*
January 2000

**This report summarizes the thesis of Sagar Onta in fulfillment of the requirements for the degree of Master of Science in Civil Engineering at Purdue University - Major Professor R. K. Whitford*

Appendix B
Air System Demand Forecast for Y-K Delta Region

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Air System Demand Forecast for Y-K Delta Region

Note that this work was performed using 1997 data and does not reflect changes in the actual plan that was later updated to use 1999 data.

1.0 Introduction

The major goals of this report are:

- To forecast the future passenger travel demand for Y-K Delta Region.
- To examine and understand the present demand for mail, passenger, and cargo freight.

A. General

Yukon-Kuskokwim (Y-K) delta of Alaska is in the southwest of the region, harbored by the Bearing Sea. According to the Alaska Department of Labor [AKDOL, 1998], in 1997 the population of delta was 24,848, living in 61 villages along its rivers and coastlines also known as "bush" communities. About 90% of the population are Alaska Natives, primarily Yup'ik Eskimos. Athabaskan Natives also live in the region, generally in the upper Kuskokwim River region. These natives have inhabited the area for thousands of years. The Yup'ik people proudly point out that their culture is one of the most intact and continuos indigenous culture in the world. According to the analysis by Alaska Department of Transportation and Public Facilities (AKDOT/PF), the coastal villages are growing at about 2.7% a year while the average annual population growth rate for all of the Y-K communities is 2.2% [Wang, 1999]. These growth rates are considerably higher than the state's overall annual growth of 0.7% per year.

The economy of the region substantially depends in the subsistence way of life. In the short summer months, most of the inhabitants devote their time to hunting, fishing and collecting wild plants and fruits. The food is then preserved for the long cold winter and supplemented with trapping and some caribou hunting. The main activities in the winter include cultural ceremonies and social get-togethers. The exchange of goods and services for cash only recently began to develop especially from commercial fishing. Other activities that enhance the cash economy are health care, school, local commerce, state welfare payments, and federal, state and local government jobs. However, subsistence hunting, fishing, and gathering is still important to the Y-K Delta people and it strongly influences their daily transportation needs and patterns. Most of the people travel for subsistence related work, social and cultural responsibilities and health

B. Transportation Need and Uniqueness

Y-K Delta Region is isolated by Alaska's geography and faces some of the harshest climate in the nation. Its high unemployment rate, poverty, and the lack of sanitation systems rival conditions in many Third World countries. An average village has 36.4% of its population below poverty line [DCED, 1990]. The lack of road connections to the region is the result of both an inhospitable topography and geology and a vast physical separation from existing highway systems. Road construction has to be done on top of permafrost, the ice-solid soil that exists over most of the region. The cost of highway construction is very high compared to construction cost of a mile of road in the lower 48. The maintenance cost is also very high due to the freeze-thaw action that takes place every winter and Y-K Delta Region is isolated by Alaska's geography and faces some of the harshest climate in the nation. Its high unemployment rate, poverty, and the lack of sanitation systems rival conditions in many Third World countries. An

average village has 36.4% of its population below poverty line [DCED, 1990]. The Bethel, by far the largest village at 5277 population in 1997, is the main regional hub. It is the center for economic, governmental and social activities. It also has the sixth busiest airport in the state at 108,816 enplanements in 1997 [ACAIS, 1997]. Apart from Bethel, there are four other but less important air hubs in the region, namely, Aniak, Emmonak, McGrath, and St. Mary's. Lack of road connection to the region is the result of both an inhospitable topography and geology and a vast physical separation from existing highway system. Road construction has to be done on top of permafrost, the ice-solid summer, which takes very high toll on the roads and due to the difficulty of snow removal on gravel roads. Due to these reasons, road network is almost negligible in the region except for a poorly maintained 21 mile-road from St. Mary's to Mountain Village.

Alaska has about one mile of road for every 42 square miles of land while the lower 48 has an average of one mile of road for every one square mile of land area. Apart from the road that connects St. Mary's and Mountain Village, most villages achieve internal transportation by dirt tracks or boardwalks over which transportation is predominately achieved by All-Terrain vehicles (ATMs) in summer and snow mobile in winter. Travel is by boat and aircraft in the summer, and by snowmobiles on marked trails and aircraft in the winter. Furthermore, travel on rivers is very circuitous. In the winter, there is also some travel on ice roads fashioned by local governments and residents on the frozen Kuskokwim River. During the two to three month periods of freeze-up in the fall and break-up in the spring, the only travel is by airplane. The spring air travel is often curtailed because of soft runways. Most air travel is by visual flight rules (VFR). Air travel to the villages with their short (usually less than 2500 feet), often unlit, gravel runways is almost always with single piston engine small aircraft, with an occasional twin engine light plane like a Piper Chieftain. With its lack of roads and the existence of numerous remote villages, rural Alaska poses a special problem for transporting people and goods. Stores and business are stocked with goods carried by USPS. Hence, the only year-round transportation mode in the Y-K Delta Region is air transportation.

C. Passengers Demand

Passenger travel demand in Y-K Delta Region is approximately 250,000 enplanements a year. In 1997 an average Y-K delta resident boarded an airplane 9.85 times [ACAIS, 1997 and AKDOL, 1998]. This is compared to 2.39 enplanements per capita made in 1997 by all residents of United States. The high enplanements per capita in the study area is due to the fact that air travel is by far the most feasible way to travel in the delta. Also, since most delta villages do not have health care facilities within the village, they have to travel to bigger villages and hubs to get proper treatment. As mentioned in previous section, air travel is the only year-round mode of transportation. It is the lifeline of the inhabitants of the delta since they use air travel to transport people, for health care and move all their goods as well. Hence, the region experiences much of passenger air travel and negligible people movement by other mode. About 60% of the travel are to Bethel for health, education, and other businesses. Village to village travel is for education, sports, and socioeconomic activities.

D. Scope of Study

This study emphasizes understanding the current transportation needs and then forecasts the future passenger enplanements in the Y-K Delta Region. It examines the relevant variables used in transportation demand forecasting in conventional transportation demand analysis and analyzes their appropriateness in the study area. Based on the forecast of these variables, an enplanement forecast is made to best represent the future travel demand of the region. A forecast has been developed for the each individual village represented by centers. The hubs, namely, Bethel, Aniak, Emmonak, St. Mary's, and McGrath, are forecasted by disaggregating

demand according to the markets served by each hub. According to the resulting enplanement forecast, the operation of the airline fleet and fleet mix for groups of scheduled route is recommended at the end of the study. This study will form a part of the Aviation Plan for the Y-K Delta prepared by Division of Statewide Planning, AKDOT/PF.

E. Methodology of the Study

This thesis concentrates on the air passenger demand in the Y-K delta. Databases used in the analysis and relevancy of conventional analysis techniques to be used in the unique transportation characteristics of the study area are given in Section 2. Section 3 helps to fulfill the goal of the thesis by examining the present demand for mail, passenger, and cargo freight. It provides mail and passenger analysis on air carriers offering service from Bethel to the villages. Section 4 gives the methodology, analysis, and the results of enplanement forecast from now to the horizon/planning year of 2020. A scenario for the forecast of fleet mix change in the study area is briefly developed in Section 5. Section 6 summarizes the study and suggests added work to be done.

2.0 Data Analysis

A. Data Bases Used in Analysis

1. ACAIS

Air Carrier Activity Information System (ACAIS) data are complied by Federal Aviation Administration (FAA) and US Department of Transportation. The database provides data on revenue passengers scheduled and total enplanement, mail, and cargo data for all US airports recognized by FAA. The data can be found in FAA website at http://www.faa.gov/arp/arphome.htm. An eleven-year (1987 – 1997) of total enplanement data from each Y-K village was drawn from this database. Since the data available from this source was aggregate enplanement data, the data did not provide the destinations of the enplanements. Enplanement forecasts for Y-K villages, not hubs, are based on this historic data.

The problem with the data is that it is only from air carriers that are required to submit DOT form 298. Of the total mail delivered to the Y-K delta, only about one half was reported to the FAA in accordance to the ACAIS. Hence, the mail data from this database were not used to analyze mail delivery in the region.

2. BTS 298 Reports

The US-DOT's Bureau of Transportation Statistics (BTS) collects extensive data on transportation related issues. While a vast source for transportation data, the data are often not presented in a form needed for a particular study. The data for Y-K Delta were complied and sorted according to origin, destination, and air carriers. From the complete BTS Form 298- data for six quarters from January 1997 to June 1998 were obtained. Even with only 18 months of data, a number of specific issues were identified. Efforts to get hold more of this data in electronic form were not met on time to be able to use in the analysis. Hence, historical inferences were not possible to make. The data were used to get the detailed example of the type of service provided in the region and the characteristics of the carriers. The reports that were available were:

- A-1 : Scheduled Passenger Airline Operations;

- E-1: Non Scheduled Passenger Enplanements; origin only.
- F-D: Aircraft Operating Expenses and Other Statistics; expenses / block hour.
- T-1: Revenue Traffic by Origin and Destination; by airlines.

The data are broken down by air carrier, type of aircraft, and originating village. Origin and destination are identified for scheduled enplanements as well as mail and cargo. Unscheduled enplanements are recorded but destinations are not known. Some unscheduled or air taxi enplanement may have occurred by carriers not part of the database. These errors seem to be small since the scheduled carriers also provide most of the air taxi service.

3. USPS Mail Delivery Data

The St. Louis records branch of the US Postal Service prepared hard copies of Alaska bush delivery for fiscal year 1997 and 1996 and presented them for this study. The USPS does not reduce the data to electronic form but only hard copy is kept. The data were manually typed in the computer. The data showed all mail delivered giving origin – destination, priority (1st Class) or non-priority (4th Class), air carrier, weight carried and amount paid by USPS to the carrier to carry the mail. These data were used to determine the pounds delivered to each village and total USPS cost for one year in the Y-K delta. These data also were used to verify other sources of data like ACAIS. Although there was not ample data to evaluate historic trend, the full data set for 1997 provides a substantial understanding of the USPS mail operation in the Y-K delta. These data, of course, were not useful in enplanement forecasting but is valuable in indicating the operations at airports.

4. FAA Market Data

The FAA Commuter Air Carrier Activity [FAA, 1996] also called Small Certified Market Data were used to forecast hub enplanement. The data was available in origin-destination pair for the period of 1988-1996 for hubs only and not for every village. This data were used to forecast the hub enplanement in disaggregate markets. The enplanement from “hub-to-Anchorage”, “hub-to-hub” and “hub-to-village” were separated and forecasted independently and combined later to give the total scheduled enplanement forecast for the hub. This allowed for an in-depth analysis of each “hub-to-hub” and “hub-to-village” movement which made the forecast more realistic and reliable since every hub behaves differently. Enplanements destined for outside the Y-K Delta other than to Anchorage, are very small and were omitted for the analysis.

5. Official Airline Guide, OAG

The official airline guide provides the scheduled flights available in all airports in the US. The flight itinerary from OAG was used to find the present seats available in the villages. These data were used to help forecast the fleet mix for the centers.

B. Comparison with Conventional Planning Process

1. Utility Comparison

The utility function, U = f (X, a), takes into account the parameters to define the attributes of the mode. The attributes can be income, population, travel time, travel cost etc. In most urban transportation planning, travel time and cost are the most common attributes used in calculating the utility [Manheim, 1979]. In the case of this study, population, income, and employment were available for each village and were evaluated for the potential to represent the dependent variable, enplanement. Figures 2.1, 2.2, 2.3 show the correlation of these parameters. Due to

the unavailability of income and employment data for 1995, 1990 data were used to compare with the enplanement of 1990 while 1995 population data were used to compare with 1995 enplanement data.

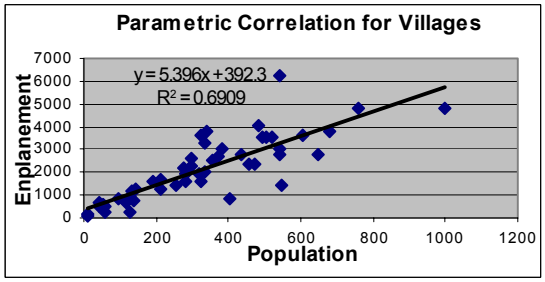


Figure 2.1 Enplanement vs. Population

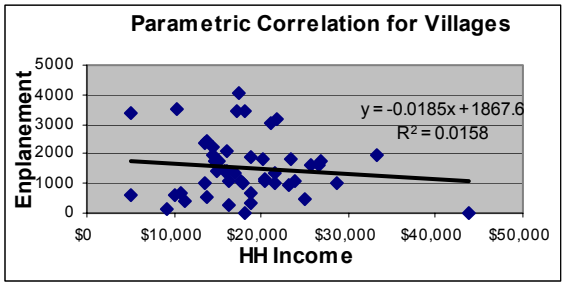


Figure 2.2 Enplanement vs. Median HH Income

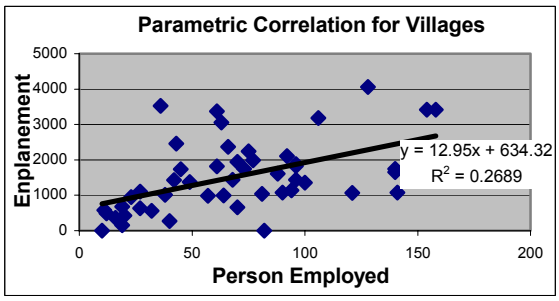


Figure 2.3 Enplanement vs. Total Person Employed

As can be seen, enplanement seem to have highest correlation with population and very little with other parameters. Due to this reason, only population was used as the main independent variable for this study. This fact is not unreasonable considering that subsistence living is still the backbone of most villages. The unemployment rate by traditional measures is very high and increases during the long cold, dark winter.

In utility equation, U = f (X, a), the coefficient a becomes a very important planning number when there is only one variable X like in the present case where X is population. For example, Enplanement = 2.5 * Population, (assuming the coefficient 2.5 is obtained from extensive analysis) is a strong statement especially when forecasting for long-term where the coefficient 2.5 may not be valid after couple of years. Hence, when only one variable is available for analysis, utility function is not reliable to use. Due to this reason, utility theory is discarded in the study.

2. Four-Step Method Comparison

The conventional four-step method has been used in air transportation with obvious modifications [Ashford and Wright, 1992]. For example, zones in conventional four-step method are cities in the case of air transportation, trips are air trips, modal split includes airplane along with automobile and bus, and trip assignment being flight selection involving various combinations of intermediate cities along with direct flights. Dusan Teodorovich in “Airline Operations Research” [Teodorovich, 1988], deals with this issue in detail. Many aspects of air transportation planning and operation are explored. Gravity model presented in the paper is of interest since it uses the same conventional concept but with various modifications.

Even with the modifications mentioned above, four-step method is difficult to implement in the Y-K Delta Region. There are various reasons for this. First, in Step 1, Trip Generation, the use of regression model is questionable when the coefficient of determinant, R-square value is less than 0.3 to obtain the coefficient of the potential parameters like income and employment. See Figures 2.2 and 2.3. In a study by Parsons Brinckerhoff [Brinckerhoff, 1998] for transportation demand model for Y-K delta, 1998, the forecasted enplanement was given by following model;

Airplane Trip Ends for a Given Community = (0.00483)(Income)

Equation 2.1

+ (13.69844)(Population) + (3021.09018)(Jobs per Population)

Though they come up with very high R-square (0.9), in their own words, "… the model developed to forecast enplanements includes population, income, and jobs per person as variables. However, population was the most influential variable in the model so differences in enplanement forecasts can primarily be attributed to differences in population forecast." The importance of population forecast was also realized in our own study as shown by higher R-square in Figure 2.1. Hence, more attention was given to the population forecast.

For Step 2, Trip Distribution, several papers are available that cite the use Gravity Model and Entropy Model, with a much higher inclination to the prior model. The Gravity Model works well with population as attractiveness factor and distance as impedance between two cities. Because no alternative mode of transportation like auto is available to the people, air travel will include travel for business, health, education, personal, etc. However, in case of Y-K Delta, a high portion of air travel is being paid for by the government in terms of civil welfare packages, health insurance, educational events, etc. This hinders the use of Gravity Model since people tend to travel not in accordance to the employment or income figures, but by subsidized travel and, partly, also due to attraction in terms of economic benefits and facilities, available in the destination city. Apart from the main hub, which has obvious attraction criterion such as the presence of the largest health care facility in southwestern Alaska (Y-K Regional Hospital), the trips from a village to a village is difficult to rationalize with population, income, or other parameters as input for the Gravity Model. For this reason, the Gravity model is not used in the study area.

Since in this area air travel is the only viable option, Modal Split model, Step 3, is not useful. Apart from pockets of villages, for example, those very close to Bethel, Emmonak and St. Mary's travel by all terrain vehicles (ATVs) or snowmobiles may be practical during some of periods of the year. Most of the villages can only be assessed by airplane. Hence, only one utility function, i.e. for air transportation, can be formulated which will be useless if there is no other modes to compare with. Hence, modal split models have little application in the Y-K Delta Region.

In the literature for transportation demand modeling, Trip Assignment, the fourth step of four-step model, is used in terms of route selection. In air transportation, trip assignment for a region depends substantially on the market forces that are present in that section of the region. For a specific section of the region, there will be some airlines willing to provide service to the area according to their company's economics. That depends on the market for the air travel, the current service provided in terms of current flight frequency, the operating cost to fly to the region and the technical risk of flying to the region. Keeping all this in mind, each airline comes up with most economical flight itinerary that it believes is competitive. Since these are air carrier's decision, detailed trip assignment route for route is difficult. Thus, the plan attempts to forecast the enplanements for the sections of the market and leave it to the airlines to determine how to best to serve it.

Hence, the use of four-step method is limited in the Y-K delta. Various modifications are needed to suit the nature of travel in the delta. However, with these changes the model will have few

characteristics of the four-step method. One important observation is the high correlation of enplanement and population.

C. AKDOT/PF Population Forecast

Due to the importance of population forecast for the entire transportation analysis of the Y-K Delta Region, the Alaska Department of Transportation and Public Facilities (AKDOT/PF) performed its own population forecast based on the cohort analysis. The details of the forecast can be found in Appendix A. The "Medium" population forecast was used in the analysis. The difference between the high, mid and low forecast is mainly due to the difference in fertility rates, percent of native in the census area and so forth. The population forecast until the year 2020 for the villages used in the enplanement analysis is given in Table 2.1.

Table 2.1 Population Projection for Y-K Delta

Village	*POPULATION PROJECTION*							*% Change 1995-2020*
	1990	*1995*	*2000*	*2005*	*2010*	*2015*	*2020*	
Akiachak	452	502	558	621	690	766	850	2.13
Akiak	285	317	352	391	435	483	536	2.13
Alakanuk	540	617	703	802	922	1055	1206	2.72
Aniak	529	587	653	726	808	896	995	2.13
Anvik	78	83	89	94	100	106	112	1.21
Atmautluak	262	291	323	360	400	444	493	2.13
Bethel	4687	5255	5842	6414	6982	7569	8218	1.80
Chefornak	310	344	383	426	473	525	583	2.13
Chevak	597	682	777	887	1019	1167	1333	2.72
Chuathbaluk	99	110	122	136	151	168	186	2.13
Crooked Creek	108	120	133	148	165	183	203	2.13
Eek	264	293	326	362	403	447	497	2.13
Emmonak	610	697	794	907	1041	1192	1362	2.72
Goodnews Bay	232	258	286	319	354	393	436	2.13
Grayling	217	231	247	262	279	295	312	1.21
Holy Cross	278	296	316	336	357	378	399	1.21
Hooper Bay	846	966	1102	1257	1444	1653	1889	2.72
Kasigluk	440	489	543	604	672	745	828	2.13
Kipnuk	462	513	570	634	706	783	869	2.13
Kongiganak	313	348	386	430	478	530	589	2.13
Kotlik	462	528	602	687	789	903	1032	2.72
Kwethluk	568	631	701	780	868	962	1068	2.13
Kwigillingok	258	287	318	354	394	437	485	2.13
L + U Kalskag	452	502	558	621	690	766	850	2.13
Lime Village	47	52	58	65	72	80	88	2.13
Marshall	283	323	369	421	483	553	632	2.72
McGrath	524	558	596	633	674	712	753	1.21
Mekoryuk	168	187	207	231	257	285	316	2.13
Mountain Village	706	806	919	1049	1205	1380	1576	2.72

Village	POPULATION PROJECTION							% Change 1995-2020
	1990	1995	2000	2005	2010	2015	2020	
Napakiak	334	371	412	459	510	566	628	2.13
Napaskiak	326	362	402	448	498	552	613	2.13
Newtok	217	241	268	298	331	368	408	2.13
Nightmute	174	193	215	239	266	295	327	2.13
Nikolai	113	120	129	136	145	154	162	1.21
Nunapitchuk	385	428	475	529	588	652	724	2.13
Oscarville	44	49	54	60	67	75	83	2.13
Pilot Station	467	533	608	694	797	913	1043	2.72
Pitkas Point	131	150	171	195	224	256	292	2.72
Platinum	67	74	83	92	102	114	126	2.13
Quinhagak	509	565	628	699	777	862	957	2.13
Red Devil	54	60	67	74	82	91	102	2.13
Russian Mission	240	274	313	357	410	469	536	2.72
Scammon Bay	346	395	451	514	591	676	773	2.72
Shageluk	135	144	154	163	174	183	194	1.21
Sheldon Point	112	128	146	166	191	219	250	2.72
Sleetmute	115	128	142	158	176	195	216	2.13
St. Mary's	440	503	573	654	751	860	982	2.72
Stony River	49	54	60	67	75	83	92	2.13
Takotna	36	38	41	43	46	49	52	1.21
Toksook Bay	405	450	500	556	619	686	762	2.13
Tuluksak	353	392	436	485	539	598	664	2.13
Tuntutuliak	300	333	370	412	458	508	564	2.13
Tununak	300	333	370	412	458	508	564	2.13
Y-K Delta	20729	23190	25902	28864	32188	35785	39813	2.19

Source: Wang, Meifu, 1999, "Y-K Delta Population Projection Using a Cohort Survival Method 1995-2020", AKDOT/PF

3.0 Demand Analysis

A. Air Carrier Analysis

To fulfill the goal of understanding and examining the characteristics of air travel in the Y-K Delta Region, the air carriers flying out of Bethel were chosen for analysis. There were ten airlines serving villages out of Bethel according to BTS, 1997 data. The airlines are given in Table 3.1.

Table 3.1 Airlines Serving Villages out of Bethel, BTS Statistics, 1997

Airline Codes	*Airline Names*	*Airline Codes*	*Airline Names*
ASE	Arctic Circle Air Service	PNA	Peninsula Airways Inc
ERA	ERA Aviation Inc.	RYA	RYA Air Services
GRT	Grant Aviation Inc.	VLA	Village Aviation Inc
HAG	Hageland Aviation Services Inc.	YTU	YTU Air Services
LFS	Larry's Flying Service	YUT	Yute Air Inc.

Airline data was acquired from the US DOT's Bureau of Transportation Statistics (BTS) for six quarters from January 1997 to June 1998. The percentage of operation in the study area by the ten airlines that serve from Bethel was analyzed. Any leg of the flight schedule that falls in our region is taken as occurring inside the region. According to the data, around 50% of the operation by the ten airlines are in Y-K Delta Region. The percent varies from 82% for VLA to 10% for PNA. Table 3.2 gives the percent of operation in Y-K Delta Region.

Secondly, the data for enplanement were compared with pounds of mail carried to the same destination with Bethel as origin. The mail weight carried in a quarter was divided by 200 pounds as an estimation of the mail equivalent to one passenger enplanement. The enplanement for the same village in the quarter was divided by this equivalent enplanement. The destination is categorized as small in enplanements if this ratio is less than 0.5, medium if in between 0.5 and 1.5 and large in enplanements if over 1.5.

Table 3.3 gives an example of this data for first quarter of 1997.

Table 3.2 Operation in the Y-K Delta Region, All Quarters, 1997

Air-lines	*Unscheduled Enp Passenger*			*Scheduled Enp. Passenger*			*Cargo – Air freight (lbs.)*			*Mail –Priority & Non-Priority (lbs.)*			*Wt. Average % Inside*
	Inside Stdy ar.	*Outside Stdy ar.*	*% Inside*	*Inside Stdy ar.*	*Outside Stdy ar.*	*% Inside*	*Inside Study ar.*	*Outside Study ar.*	*% Inside*	*Inside Study ar.*	*Outside Study ar.*	*% Inside*	
ASE	2,114	283	88	1,103	1,129	49	3,264,631	330,286	91	6,887,723	1,579,173	81	77
ERA	616	97,205	01	67,250	470,344	13	481,457	3,936,429	11	4,107,449	4,710,517	47	18
GRT	9,905	646	94	40,952	568	99	106,340	55,570	66	4,291,183	2,449,524	64	80
HAG	55,325	10,825	84	87,905	35,543	71	750,566	1,369,886	35	8,307,505	6,775,491	55	61

Table 3.2 Operation in the Y-K Delta Region, All Quarters, 1997

Air-lines	Unscheduled Enp Passenger			Scheduled Enp. Passenger			Cargo – Air freight (lbs.)			Mail –Priority & Non-Priority (lbs.)			Wt. Average % Inside
	Inside Stdy ar.	Outside Stdy ar.	% Inside	Inside Stdy ar.	Outside Stdy ar.	% Inside	Inside Study ar.	Outside Study ar.	% Inside	Inside Study ar.	Outside Study ar.	% Inside	
LFS	664	9,944	06	1,154	16,363	07	10,970	481,308	02	4,924,805	4,235,086	54	17
PNA	2,325	45,490	05	62,431	365,067	15	118,944	3,271,510	04	3,043,289	13,218,686	19	10
RYA	0	0	00	0	0	00	1,964,743	2,282,894	46	7,127,866	8,094,489	47	23
VLA	132	12	92	4,536	200	96	81,477	39,586	67	6,990,797	2,748,972	72	82
YTU	0	0	00	0	0	00	1,065,407	326,377	77	18,316,887	24,090,605	43	30
YUT	19,368	6,829	74	139,376	54,223	72	887,382	602,791	60	6,513,072	5,651,777	54	65

Table 3.3 Example of Categorization

Airline	Origin	Dest.	Pax	Lb of Cargo	Lb of Mail	Eq. Enpl	Pax / Eq. Enpl	Category*
PNA	BET	AKI	18	2	6002	30.0	0.6	M
PNA	BET	AKN	9	0	0	0.1	90.0	L
PNA	BET	ATT	12	692	9735	48.7	0.2	S
PNA	BET	CYF	29	37	33031	165.2	0.2	S
PNA	BET	DLG	27	0	0	0.1	270.0	L
PNA	BET	KKH	15	629	9876	49.4	0.3	S
PNA	BET	KKI	24	1030	14885	74.4	0.3	S
PNA	BET	KPN	25	115	5296	26.5	0.9	M
PNA	BET	KUK	38	1803	17176	85.9	0.4	S
PNA	BET	KWK	28	80	5372	26.9	1.0	M

**Note: S = enp/mail/200 < 0.5, M = 0.5<=enp/mail/200<=1.5, L = enp/mail/200 > 1.5*

The procedure described above was performed on all the data for 4 quarters of 1997. The 'small' category was interpreted as carrying 'All Mail' if there is less than 5 passengers per quarter. If the category was 'small' but more than 5 passengers, it was labeled as 'mail dominated' (Mail Domin). The large category was interpreted as 'all passengers' (All Pax) if there is less than 100 lbs. of mail and as 'passenger dominated' (Pax Domin) if the mail was more than 100-lbs. Medium category was labeled as 'Both.' Table 3.4 gives the result of the procedure.

Table 3.4 Aircraft Operation from Bethel

First Quarter, 1997 (Dec - Feb)

ASE	27/27 Desti	All Mail
LFS	25/25 Desti	All Mail

Second Quarter, 1997 (Mar - May)

ASE	28/28 Desti	All Mail
LFS	25/25 Desti	All Mail

Table 3.4 Aircraft Operation from Bethel

First Quarter, 1997 (Dec - Feb)

RYA	25/25 Desti	All Mail
VLA	25/31 Desti	All Mail
YTU	26/26 Desti	All Mail
ERA	11/17 Desti	Pax domin
	6/17 Desti	Both
GRT	23/27 Desti	All Mail
	4/27 Desti	All Pax
HAG	17/28 Desti	All Mail
	9/28 Desti	Pax domin
	2/28 Desti	Mail domin
PNA	20/20 Desti	Both
YUT	20/34 Desti	Pax domin
	14/35 Desti	Both

Second Quarter, 1997 (Mar - May)

RYA	25/25 Desti	All Mail
VLA	27/27 Desti	All Mail
YTU	27/27 Desti	All Mail
ERA	10/17 Desti	Pax domin
	7/17 Desti	Both
GRT	23/28 Desti	All Mail
	5/28 Desti	All Pax
HAG	15/31 Desti	All Mail
	16/31 Desti	Pax domin
PNA	19/19 Desti	Both
YUT	26/36 Desti	Pax domin
	10/36 Desti	Both

Third Quarter, 1997 (Jun - Aug)

ASE	28/28 Desti	All Mail
LFS	25/25 Desti	All Mail
RYA	25/25 Desti	All Mail
VLA	26/26 Desti	All Mail
YTU	26/26 Desti	All Mail
ERA	9/17 Desti	Both
	8/17 Desti	Pax domin
GRT	20/28 Desti	All Mail
	8/28 Desti	Pax domin
HAG	11/27 Desti	All Mail
	16/27 Desti	Pax domin
PNA	21/21	Both
YUT	28/34 Desti	Pax domin
	6/34 Desti	Both

Fourth Quarter, 1997 (Sep - Nov)

ASE	28/28 Desti	All Mail
LFS	22/22 Desti	All Mail
RYA	20/20 Desti	All Mail
VLA	23/23 Desti	All Mail
YTU	19/19 Desti	All Mail
ERA	11/17 Desti	Pax domin
	6/17 Desti	Both
GRT	15/24 Desti	All Mail
	9/24 Desti	Pax domin
HAG	15/27 Desti	Pax domin
	12/27 Desti	All Mail
PNA	19/19	Both
YUT	25/34 Desti	Pax domin
	9/34 Desti	Both

Note:

PNA serves destinations with all small, medium and large enplanements

Enplanement less than 5 and mail less than 100 lb are ignored as negligible

The following observations are from the results above:

1 Five carriers namely, ASE, LFS, RYA, VLA, and YTU, carry only mail to approximately 25 destinations each.

2 ERA carries primarily passengers to about 10 villages and carries a mixture of mail and passenger to about 7 villages

3 GRT (Grant) seems to fly mainly passengers to the St. Mary's and Emmonak market (Kotlik, Atmautluak, Mountain Village) and carries only mail to the remaining villages it serves.

4 About half of the villages served by HAG (Hageland Airlines) get only mail from the carrier. The other half of its carriage seems to be passenger dominated.

5 PNA (Peninsula Airlines) is the only carrier that seems to have significantly mixed passenger and mail operation to all 19-21 destinations.

6 YUT (Yute Airlines) appears to be passenger dominated.

From this data, we can see that only a few carriers have the balanced mix of passengers and mail carriage (ERA, PNA, and YUT). While some carriers do both, often they serve different markets with mail and passengers. Half of the carriers from the total of ten carriers operating from Bethel carry only mail to about 25 destinations each. Prior to this analysis, the belief was that the law setting up ByPass Mail had the specific intention that mail delivery by air was also to insure that villages had frequent passenger service as a result of mail service. As can be seen, several carriers do not carry passengers at all. Clearly, the issue of the overlap between mail and passenger service, if it ever existed, does not exist any longer. The conclusion is that any reduction or major change in business with USPS in mail delivery may negatively alter these carriers business picture, but it will not necessarily change the passenger service to the villages they serve.

According to the "Equal Tender" contract with each certified carriers, the USPS assigns each carrier to carry the identical weight of mail to each bush villages for which they are certified. Hence, with ten carriers serving a village from Bethel, each carrier will carry 10% of the total mail delivered from Bethel to that village. However, the analysis of BTS data for six quarters of data shows that carriers are carrying anything from 20% to 2% of the mail. Table 3.5 and corresponding Figure 3.1 shows the data for Toksook Bay as an example.

Table 3.5 Mail-Delivery Ratio for Toksook Bay (Origin Bethel)

Airline	Dest.	lb mail(97)		lb mail(97)		lb mail(97)		lb mail(97)		lb mail(98)		Lb mail(98)	
		1st Qtr.	ratio	2nd Qtr.	ratio	3rd Qtr.	ratio	4th Qtr.	ratio	1st Qtr.	ratio	2nd Qtr.	ratio
ASE	OOK	24472	0.12	38328	0.18	14503	0.08	15387	0.07	17981	0.08	47966	0.22
ERA	OOK	36355	0.18	10577	0.05	28687	0.15	23616	0.11	25939	0.12	13863	0.06
GRT	OOK	7873	0.04	16935	0.08	16899	0.09	18531	0.09	28804	0.13	16954	0.08
HAG	OOK	20591	0.1	18722	0.09	10181	0.05	23492	0.11	15158	0.07	9482	0.04
LFS	OOK	10727	0.05	31483	0.15	27394	0.15	11892	0.06	25203	0.12	15287	0.07
PNA	OOK	37239	0.18	28213	0.13	7560	0.04	18055	0.09	17753	0.08	24807	0.11
RYA	OOK	19932	0.1	22019	0.1	22734	0.12	12966	0.06	20513	0.09	8339	0.04
VLA	OOK	21728	0.11	21960	0.1	32109	0.17	35060	0.17	17889	0.08	43324	0.2
YTU	OOK	13056	0.06	18691	0.09	2885	0.02	11140	0.05	20788	0.1	19883	0.09
YUT	OOK	11235	0.06	3844	0.02	24117	0.13	37730	0.18	26042	0.12	20114	0.09
	Total	203208		210772		187069		207869		216070		220019	

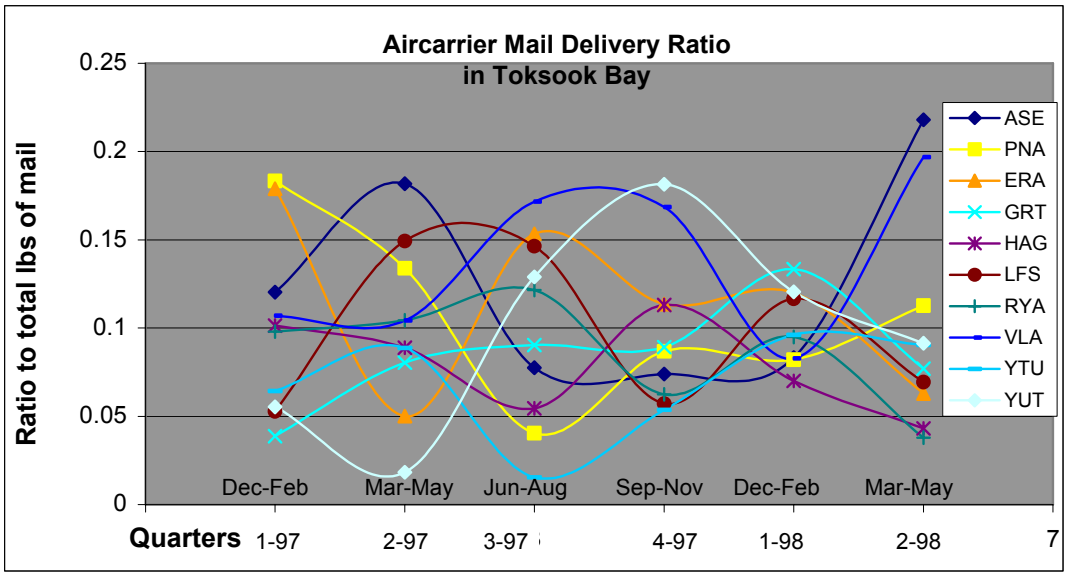


Figure 3.1 Mail-Delivery Ratio for Toksook Bay

It should be noted that the share of Toksook Bay market among the carriers varies significantly during the year. For example, PNA carried 18% of the mail in the first quarter of 1997 but it dropped down to 4% in the third quarter of the same year. The analysis shows that apparently there is no relation as to how much each carrier will carry in a quarter. The USPS says it tries to even it out over a year's time.

B. Passenger Demand Analysis

1. Population Centers or Clusters

With small number of total enplanements in the villages, the small discrepancies in the data often exaggerate the trend. The swings in traffic volume for individual villages can be spectacular to say the least. The variability of separate parts of a larger entity can be expected to be greater than that of the whole. This is a universal statistical principle, which rests on the fact that the variations in the smaller elements tend to cancel each other out when added together. Moreover, the historical data is not extensive enough to give clear indication of the trend. To avoid this handicap, the villages were combined into eleven centers or clusters based on their geographical proximity. The population centers were separated into three areas; 1) Kuskokwim Area 2) Lower Yukon Area 3) Coastal Area. It was believed that with this format, a more reliable and consistent trend might be observed since the villages in a specific area may have similar travel needs and are expected to grow similarly. Figure 3.2 shows the location of the centers.

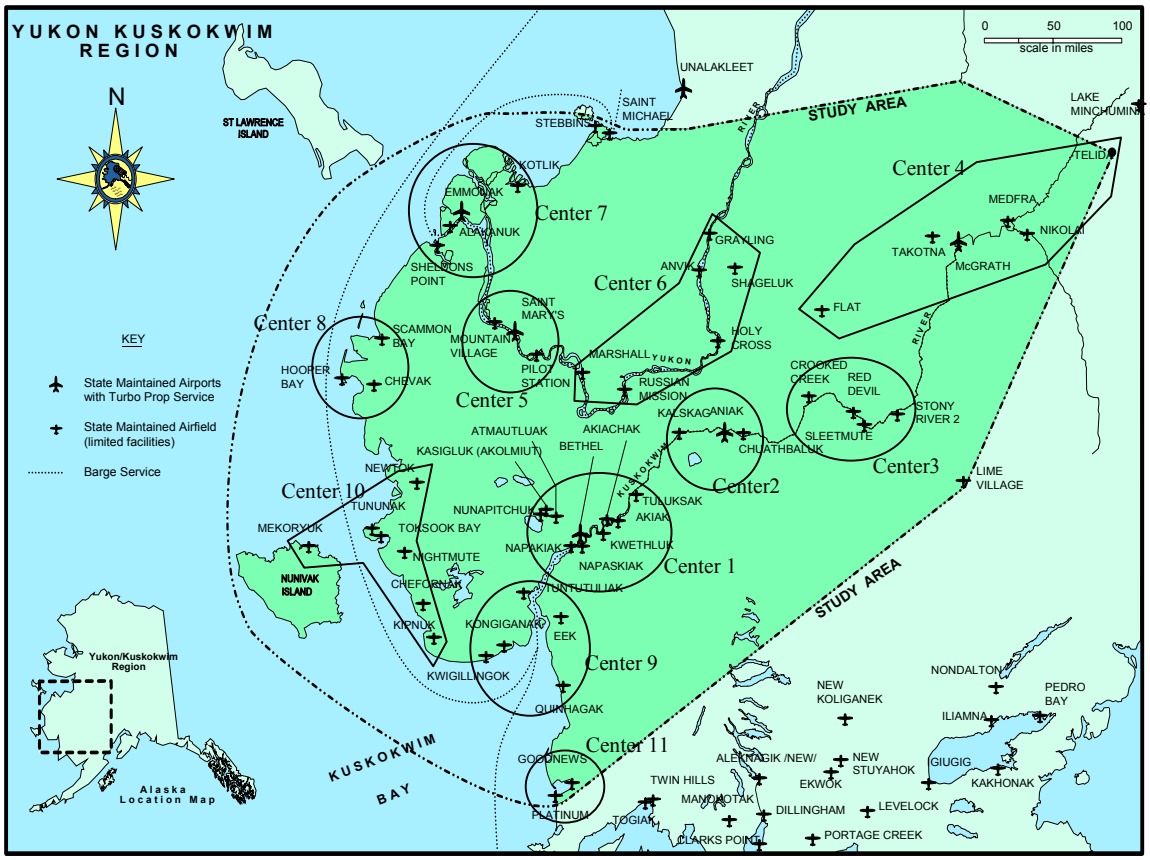


Figure 3.2 Location of Centers in the Study Area

2. Enplanement Data for Villages

a. Time Series Data

The historic time series data used to forecast total enplanement are given in Table 3.6. It must be noted that total enplanement was used and not scheduled enplanement for various reasons. For one, from village to village, and even for a village over time, unscheduled enplanement varies randomly. Secondly, total enplanement is believed to represent the true demand for travel for the village. Unscheduled enplanement is assumed to fill in the latent demand left over that scheduled enplanement was not able to handle or where scheduled flights were simple not available.

b. Regression Results and Problems

The Bethel Airport Master Plan (BAMP) [HDR, 1998] uses the data from FAA terminal area forecast (TAF) as their base data for further forecast. It compares the Bethel enplanement forecast from TAF with Alaska Aviation System Plan Forecasts (AASP) and 1986 Airport Master Plan (MP) forecast. BAMP concluded that the MP forecast significantly overestimated operations and underestimated enplanements. The AASP underestimated both operations and enplanements. The 1996 TAF does appear to be most in line with the recent data. However, their 1997 forecast itself seems to be underestimated. Figure 3.3 shows the BAMP's 1997 Forecast Passenger Enplanement. As can been seen in the figure, the historic data till 1995 tends towards their "high" forecast rather than their moderate forecast which is ultimately adopted. Hence, their moderate forecast of 3.9% annual growth in enplanement is underestimating the actual trend.

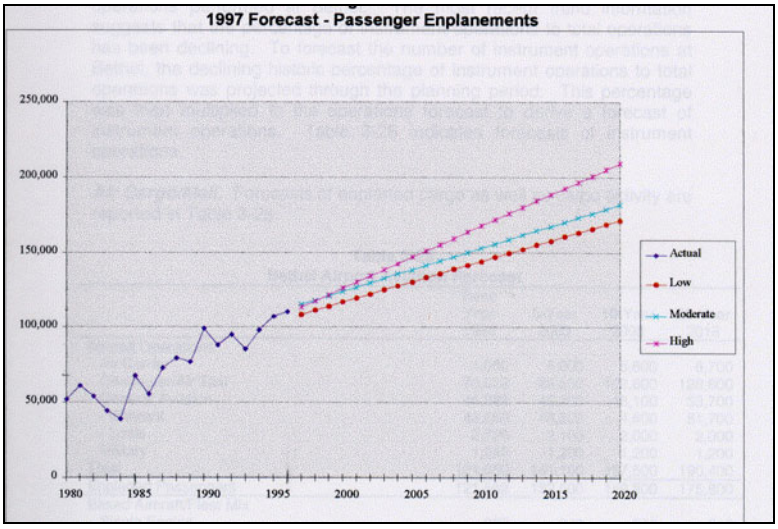


Figure 3.3 BAMP Enplanement Forecast for Bethel

Table 3.5 Population Center Classification

Hubs – 7600

Bethel	5255
St. Mary's	503
Emmonak	697
Aniak	587
McGrath	558

Center 1 – 3832

Akiachak	502
Akiak	317
Atmautluak	291
Kasigluk	489
Kwethluk	631
Napakiak	371
Napaskiak	362
Nunapitchuk	428
Oscarville	49
Tuluksak	392

Center 2 – 612

Chuathbaluk	110
L + U Kalskag	502

Center 3 – 414

Lime Village	52
Sleetmute	128
Red Devil	60
Crooked Creek	120
Stony River	54

Center 4 – 174

Takotna	38
Nikolai	120
Flat	11
Telida	5

Center 5 – 1489

Mountain Village	806
Pilot Station	533
Pitkas Point	150

Center 7 – 1273

Sheldon Point	128
Alakanuk	617
Kotlik	528

Center 8 – 2043

Hooper Bay	966
Chevak	682
Scammon Bay	395

Center 10 – 2261

Kipnuk	513
Chefornak	344
Nightmute	193
Toksook Bay	450
Tununak	333
Mekoryuk	187
Newtok	241

Center 11 – 332

Goodnews Bay	258
Platinum	74

Table 3.6 Historic Enplanement for Y-K Delta Villages

Village	Total Enplanements, ACAIS Database										
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Akiachak	1202	991	832	1080	1276	2806	3041	3523	3037	3089	2107
Akiak	644	745	670	991	960	1739	1834	2393	1968	2115	1322
Alakanuk	1508	1456	1368	1070	905	1089	889	2762	3631	3637	3336
Aniak	15385	11251	11566	11814	11218	11536	12010	13294	13462	14191	15049
Anvik	776	475	538	675	917	775	768	903	837	927	890
Atmautluak	583	1297	897	1436	1359	2434	2132	2552	1944	2645	1789
Bethel	76315	92462	77094	111787	87932	94983	97257	112332	115522	121552	108816
Chefornak	969	2522	2271	1816	2144	2540	2565	2597	2733	3379	2121
Chevak	2850	3163	2999	3417	3546	3245	3234	3706	3802	4027	3483
Chuathbaluk	12		380	557		510	504	656	265	482	302
Crooked cr.					626	746	760	798	738	939	742
Eek	1040	7250	869	3054	1298	1237	1186	1656	1576	1272	1098
Emmonak			2631	1653	1466	1772	1262	4814	1547	5489	5287
Flat	15	66	49	43	51	53	62	13	150	24	29
Goodnews	1380	1674	1527	2366	1406	1770	1711	1734	1458	1501	1858
Grayling	1699	819	961	984	814	943	1051	1285	1276	1265	954
Holy Cross	620	1674	1600	2458	1443	1594	1648	1751	1993		1684
Hooper bay	4007	3275	3372	3418	3548	4225	4198	4920	4828	5264	4113
Kalskag	4389	2920	2995	3523	3079	3359	3094	4174	3574	4119	3681
Kasigluk	665	1804	975	1608	1740	2435	2775	3503	3554	3529	2568
Kipnuk			3215	3376	3586	4299	4704	5909	6253	4506	2816
Kongiganak	36	2712	1810	1941	2190	2973	2882	3131	3312	3509	2404
Kotlik	3046	1315	1136	1140	1254	1531	1454	2608	2814	2797	2825
Kwethluk	2730	2203	1652	2107	1838	2903	3074	3295	2769	3007	2261
Kwigillingok	860	3133	2580	1987	2247	3092	3136	3392	3616	3663	2541
Lime Village	156	191	95	152	134	115	158	177	221	162	648
Marshall	1122	1267	1352	1042	1300	1875	2099	2258	2238	2277	2403
McGrath	7962	5886	8013	6542	7011	5728	5688	7137	6735	6534	6285
Mekoryuk	1710	1532	1838	1735	1562	1746	1611	1586	1660	1818	1658
Mt. Village	1997	1936		1748	1387	2908	2987	4386	4772	197	4791
Napakiak					1327	1930	1725	2020	1625	1959	1241
Napaskiak	877	1645	337	657	536	1115	1111	981	875	1169	817
Newtok	1464	1610	1487	1429	1605	1817	1813	2073	2178	2101	1550
Nightmute	37	1415	1308	1009	1042	1216	1442	1471	1644	1808	1256
Nikolai	63	362	526	424	382	390	356	1078	967	757	574
Nunapitchuk			1500	1359	1539	2113	2619	2908	2400	2579	2129
Pilot Station	166	1574	1426	1437	1826	2908	2844	3314	3559	3741	3210
Platinum	718	1298	842	948	638	858	718	723	652	521	484
Quinhagak			1186	4062	1887	1776	1868	2107	1414	1136	1504
Red Devil	390	450	494	488	3570	347	525	431	509	499	390

Table 3.6 Historic Enplanement for Y-K Delta Villages

Village	Total Enplanements, ACAIS Database										
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Russian Mission	1372	1809	1784	1373	1154	2106	2241	2461	2633	2626	2576
Scammon Bay	1982	1706	1501	1742	1918	2299	2365	2823	2820	3163	2556
Shageluk	1196	1119	905	1106	1001	840	943	1309	1294	1001	974
Sheldon Point	533	437	405	268	239	371	371	982	1213	1314	1177
Sleetmute	624	680	663	630	639	622	680	654	699	821	759
St. Mary's	20829	15659	17351	12785	12512	12661	11156	11503	9732	8401	8499
Stony River	399	523	412	576	498	417	1578	465	491	341	285
Takotna	362	118	284	362	383	471	559	581	606	478	891
Telida	57	73			2	4	52	37	86	44	2
Toksook Bay	2928	3301	2825	3181	3054	3559	3611	4039	4083	5013	3090
Tuluksak	1108	1419	551	1073	1322	2387	3099	3240	2994	2670	2369
Tuntutuliak	589	4469	2469	2245	2554	3951	3537	3883	3797	3450	2542
Tununak	1509	2210	1810	1878	1965	2275	2371	2612	2542	2363	1585
Total	176276	200407	179298	218158	193432	217400	221434	259309	255474	259882	234749

Furthermore, BAMP gives historic data for the rest of the villages in the Y-K delta from the FAA DOT/ACAIS database. However, ACAIS data for Bethel is not used in the forecast for Bethel. The historic enplanement data for Bethel from ACAIS is higher than from TAF. For 1996, the ACAIS enplanement is 11,000 more than TAF. Hence, with ACAIS data the enplanement forecast for Bethel would be higher.

c. Health Related Travel to Bethel

Bethel is a special case mainly due to the presence of Yukon-Kuskokwim Regional Hospital. The hospital attracts more than 50% of enplanements in Bethel. According to the hospital master plan, there is one to two visits to the hospital per person every year from a village. If we take into account that on average one person accompanies the visitor, almost 80% of the enplanement in the villages are due to hospital in Bethel. This is a very significant percentage and shows the importance of hospital in attracting enplanements. And since the government pays for most of this travel in one form or another, it skews the enplanement regression in terms of using income as an independent variable.

3. Difference between Areas

The demand for air travel is different inside various parts of the delta. This is mainly due to the geographic and socioeconomic differences of the areas. According to these parameters, the delta can be classified into three areas; 1) the Lower Yukon 2) Coastal and 3) Kuskokwim.

a. Lower Yukon

The Yukon area includes the major villages of St. Mary's, Pilot Station, Mountain Village, Russian Mission, and Holy Cross. It also includes villages in upper fringes of the portion of Yukon River that lies in the study area namely Anvik, Grayling, Shageluk, and Marshall.

The Yukon area is showing dramatic change mainly due to the loss of St. Mary's as a hub. Since Emmonak became a hub in 1994, bulk of travel from St. Mary's has been diverted to Emmonak. Furthermore, Mountain Village which is bigger in population than St. Mary's seem to prefer to fly directly to Bethel than to St. Mary's probably due to more economic activity in Bethel.

b. Coastal

The Coastal villages include all the villages along the coast even if they are in the lower Yukon or lower Kuskokwim. The villages are spread out over vast area but have similar socioeconomic characteristics due to its vicinity to the sea and propensity for fishing. Hence, the demand for travel for these villages is similar.

The coastal villages of Y-K Delta are the fastest growing in the study area. This is mainly due to the increase in commercial fishing in the region. As a matter of fact, these villages have the most frequent flights from Bethel than any other region. However, the draw back of the region is seen in 1997 when the commercial fishing catch went drastically down and adversely effected the economy of the region. This had a very negative impact on the enplanement for the region which can be seen in the Enp/Pop ratio in Appendix B and C. Table 3.7 gives the data on fishing activity in the delta region according to census area.

Table 3.7 Fishing Data of the Y-K Delta

Census Area		*1995*	*1996*	*1997*
Bethel	Fishers	1,142	1,143	1,118
	Permits	1,308	1,368	1,309
	Pounds (millions)	23.3	22.8	9.8
	Earnings ($ millions)	11.6	9.3	3.6
Wade-Hampton	Fishers	606	601	605
	Permits	647	640	648
	Pounds (millions)	6.8	5.5	5.3
	Earnings ($ millions)	5.9	4.5	5.3
Total	Fishers	1,748	1,744	1,723
	Permits	1,955	2,008	1,957
	Pounds (millions)	30	28	15
	Earnings ($ millions)	18	14	9

Source: Alaska Department of Labor

c. Kuskokwim

There are two distinct regions in the Kuskokwim area. The villages around Bethel, Center 1, are very different from the rest of the Centers in the area. The proximity to the main hub, Bethel, makes the villages in Center 1 more prosperous resulting in a higher tendency to travel. Further, some of the villages also have the recent alternative in hovercraft service (two years) from the Bethel to the outlying villages.

Villages that lie inland and further up the Kuskokwim are very sparsely populated and hence total enplanement from this area is much less than other centers near by. McGrath is the main

hub in the area. However, it experiences less enplanement, which may be because the people in the area may prefer to fly directly to Bethel or Aniak for better facilities. The villages are spread more apart than the villages around Bethel. This makes it difficult to travel between villages. Hence, the greater distance and less population make this area weak in socioeconomic characteristics and thus enplanement is minimal in the area.

4.0 Enplanement Forecast

A. Developing the Forecast

The enplanement forecast focuses on several legs of movement throughout the air network of the Y-K Delta. Each leg was forecasted separately and then the resulting forecasts were aggregated for the final total forecast for the whole region. The legs of the network analyzed are:

- Village to Village
- Village to Hub
- Hub to Village
- Hub to Hub
- Hub to Anchorage

The forecast of enplanement in the study area is divided into two sections; forecast for villages and forecast for hubs. The reason for the distinction is that the villages and the hubs have completely different characteristics. The direct link to Anchorage and the higher socioeconomic activity in the hub makes it a place of major activity. Hence, it experiences much higher per person enplanement than the villages. Furthermore, the importance of hubs and their activities require more detailed analysis. Due to the importance of the hub, their forecast is disaggregated into each network legs. The characteristics of each leg was analyzed in detail and forecasted accordingly. To forecast enplanements for villages, three methods are used, namely, pure trend analysis, Gompertz forecast, and market share. The following sections provide these analysis.

The final aggregate forecast numbers, presented in Chapter 6, were checked in two ways. (1) It followed a reasonable trend from past enplanement and (2) the overall elasticity of demand was conservative at 1.4. It was somewhat below the historic elasticity of 2.5.

B. Forecast for Villages

1. Pure Trend Analysis

The ACAIS historic enplanement data for the bush villages in the Bethel Area Master Plan (BAMP) were used to do the pure trend analysis. The data contains only those villages served by Bethel. For the other villages in the Y-K Delta, data was extracted directly from ACAIS database from FAA internet web page.

The enplanement analysis was done for each of the population Centers, categorized in Section 3. From the data that were available, the percent historic growth of enplanements in each of the centers was obtained as shown in Table 4.1 below. The data show that percent growth can fall in wide range of values. This variability in the growth is an indication of the random enplanement growth pattern in the delta, which makes forecasting a very complex task for the region. Figure 4.1 shows the scatter of growth trend of enplanement taken from

Table 4.1 experienced in the region. While some part of the delta seems to be flourishing like Center 1, others like Center 9 seem to be growing much more slowly. The main culprit for dramatically low growth seems to be specific villages that have gone through some drastic change. For example, with the designation of Emmonak as a hub in 1994, St. Mary's seems to have lost majority of its market and thus the traffic. Its airport was decertified but at one time, it was seen as a hub with several direct flights daily to/from Anchorage. The proximity to Bethel and the relatively small hinterland of St. Mary's seem to be the main reason for its decrease in enplanement.

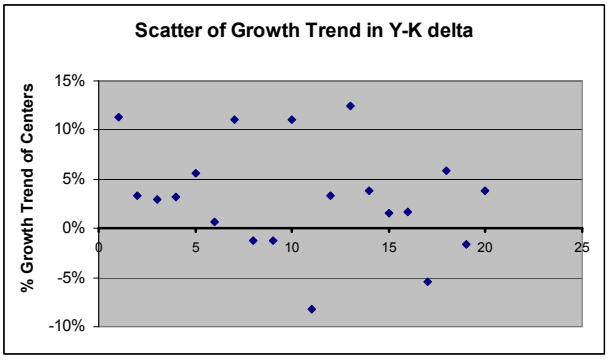


Figure 4.1 Scatter of Growth Trend of Centers and its Components

Table 4.1 Enplanement Trend for the Centers

Center Description		*Remarks and Forecast*	*Trend Growth*
1		Both a linear and exponential curve fit this fast growing center.	11.34 %
2	*(w/ Aniak)*	Growing at either a linear or exponential rate (1987 is not used since its abnormality)	3.28 %
2a	*(w/o Aniak)*	Aniak as a hub is more similar to its villages than other hubs	3.00 %
2b	*(Aniak only)*	75-80% of center's enplanement is from Aniak. Steady and slightly higher growth.	3.18 %
3		Growth has decent R^2 with both linear (0.75) and exponential (0.76) fit.	5.57 %
4	*(w/ McGrath)*	Negligible growth shown as a center with McGrath included.	0.68 %
4a	*(w/o McGrath)*	High growth w/o McGrath and very good correlation too at 0.86 R^2	11.01 %
4b	*(McGrath only)*	Negative to nil growth as a hub. Dominates center, 80-90 %	-1.20 %
5	*(w/ St. Mary's)*	As center without St. Mary's, experiences virtually no growth.	-1.20 %
5a	*(w/o St. Mary's)*	Enplanements are growing at other villages w/o St. Mary's	11.05 %
5b	*(St. Mary's only)*	St. Mary's has witnessed a precipitous decline. 25000 in 1987 to just 8500 in 1997	-8.20 %
6		Growing constantly at linear rate with R^2 at 0.64	3.34 %
7		Vast increase in 1994 to 11000 and growing at 7.3% after 1994. Before 1994, the enplanement was virtually constant at 5000. Emmonak as a hub shows very same growth rate at 12.5%	12.50 %
8		Good linear data. 1997 data is low due to decrease in fishing activities.	3.80 %
9	*(w/ Quinhagak)*	Dip since 1994 but expected to increase overall after 1999. 1987 data excluded.	1.54 %
9a	*(w/o Quinhagak)*	Constant increase w/o Quinhagak except in 1997 when the enplanement drops drastically.	1.73 %

Table 4.1 Enplanement Trend for the Centers

Center Description	*Remarks and Forecast*	*Trend Growth*
9b (Quinhagak only)	Gradual decrease over the years and actually slight increase in 1997. 1990 enplanement is very high.	-5.46 %
10	Linear increase. 1997 data is very low due to decrease in fishing activities.	5.86 %
11	Constant decrease in enplanement for Platinum at –6.19% and slight increase for Goodnews Bay at 0.4%	-1.6 %
Bethel	Fair exponential and linear correlation at 0.62 R^2. Decrease in 1997 enplanement by 10.5% from 1996 (ACAIS).	3.82 %

For long-term forecast, it is not reliable to assume constant percent growth since it tends to give exaggerated enplanements for the horizon year. Due to this reason and the scattered nature of growth trend percentage of the Centers, linear regression was used in the final trend analysis when compared to other methods of forecasting. Linear trend was able to give good comparable results.

2. Gompertz Forecast

Section 3 discussed the comparison of enplanement to population, income, and employment. From the discussion, it was found that population is a relatively reliable indicator of enplanement growth with R^2 of 0.7. This is especially true in the Y-K Delta Region where other forms on socioeconomic data are unreliable and difficult to obtain. Furthermore, Alaska Department Community and Economic Development [DCED, 1999] gives income of villages for 1995 only. With this data, it was attempted to get some relation with the enplanement data for different villages. However, the income and employment data showed no reliable relationship with the enplanement data. Hence, population was taken as the main variable to help forecast enplanement. This conclusion was also reached by Parsons Brinckerhoff in their study [PB, 1998] by of the region's travel demand as mentioned in Section 3.

The historic total enplanement and population data for each villages for a particular center were added to get total historic enplanement and population data. This procedure will help in minimizing the effect of errant data. Hence, this data was used to get total enplanement per capita ratio for the center. It should be taken into account that the enplanements per capita (Enp/Cap) ratio is not expected to grow at the annual growth rate to unprecedented numbers. Figure 4.2 compares the Enp/Cap forecast using linear and Gompertz method with data from Center 5 as an example. It clearly shows that using linear forecasting of Enp/Cap gives very high Enp/Cap ratio, which is not very likely to be achieved in the future. Hence, to make the forecast realistic, a ceiling of 12 Enp/Cap is taken. As this ratio reaches the ceiling, it decreases exponentially. Hence, enplanement can be forecasted accordingly. The enplanement per capita data was forecasted according to the Gompertz forecast with 12 Enp/Cap as absolute limit for most of the centers, except for Center 1 and Center 5 where the upper limit was set at 10 Enp/Cap.

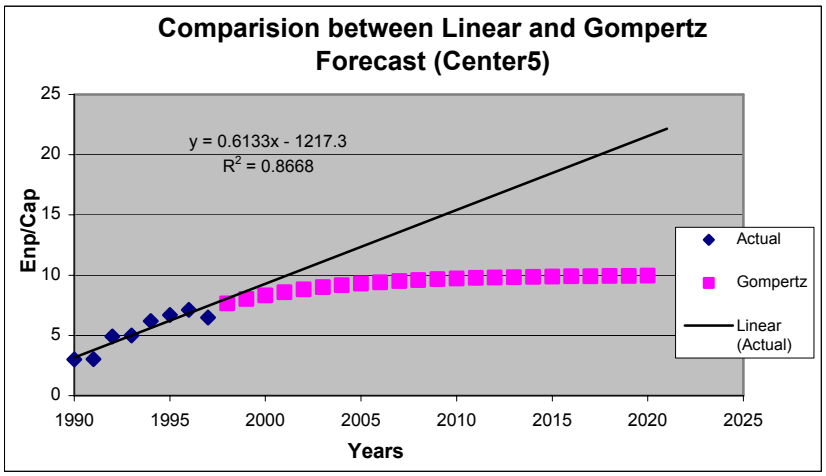


Figure 4.2 Comparison between Linear and Gompertz Forecast

The decision to use 12 enplanements per population was reached through discussion with the planning committee of AKDOT/PF. The reason to use 10 Enp/Cap for Center 1, around Bethel and Center 5, around St. Mary's, is due to the fact that other modes of transportation around these centers are feasible. In the case of Center 1 (around Bethel), there are the options of using the Hovercraft for travel to villages and also the use of snowmobile in winter for the villages that are near. In Center 5, the option is to use the paved, but poorly maintained, road between Mountain Village and St. Mary's. Since these two villages are the biggest in the area, the availability of the land access option does effect the air traffic and thus the Enp/Cap data. The enplanement per capita (enp/cap) ratio for 2020, with and without 1997 data, is shown in Table 4.2. Appendix B shows the detailed calculation for enplanement per capita using the Gompertz method.

Table 4.2 Enplanement per Capita (Enp/Cap) for Centers

	Enp/Cap (2020) w/o 97 data	*Enp/Cap (2020) w/ 97 data*
Center 1*	9.84	8.92
Center 2*	9.71	9.13
Center 3	10.59	9.53
Center 4*	11.61	11.89
Center 5*	9.99	9.95
Center 6	11.25	10.39
Center 7*	11.90	11.78
Center 8	9.05	6.83
Center 9	6.94	2.16
Center 10	11.66	8.95
Center 11	1.07	4.16

*Note: Centers with hubs marked with * does not include hub*

The above data shows enplanements per capita without the hubs for the Centers with hubs. The reason for doing so is that the enplanements in the hubs are very different from the rest of the villages it serves. The hubs function very differently since their socioeconomic characteristics are very different. For example most of the hubs have enplanements at around

20 enplanements per capita range. This high enplanement shows that the activity in the hubs is higher and involves village travelers as well as residents. In addition, the regional hospital in Bethel is a major reason for high enplanement from village to Bethel. Hence, the hubs are analyzed separately and in more detail.

3. Market Share

As an accepted methodology to forecast enplanement by FAA, market share method is widely used in the lower 48. Market share method uses the percent of enplanement the market capture from the national enplanement data. In our case, since the use of national enplanement data is unrealistic, market share for every village is compared with total enplanement data of the Yukon-Kuskokwim region. The analysis consisted of finding whether the market share of a particular center is increasing or decreasing or remaining constant over the years. The market share alternative for enplanement forecast is based on this trend in market share. However, in most cases a constant market share is used. Increasing the market share will compound the enplanement growth since total enplanement that is forecasted to increase. Furthermore, the market share should add up to 100% of the total. This will be hard to maintain if all the markets are increasing their share of the total enplanements. The total enplanements for the region are believed to continue at the present growth of 3.65 %. The ACAIS data analysis gave the market share of each of the centers as shown in Table 4.3.

Table 4.3 Market Share for Centers

	Market Share (%)
Center 1	9.05
Center 2	7.30
Center 3	0.94
Center 4	3.30
Center 5	8.30
Center 6	3.01
Center 7	4.60
Center 8	4.50
Center 9	5.50
Center 10	8.00
Center 11	1.00

Note: Bethel's Market Share is 44.5 %

The three methodologies presented above, namely Pure Trend Analysis, Gompertz, and Market Share, were used to get alternative enplanement forecasts for the Y-K Delta Region. Appendix C shows the total enplanement forecast until 2020 for all the centers. For the final forecast, Gompertz forecast for the villages were chosen. The main advantage of using Gompertz over the other forecasts is that it uses population as an input variable. As mentioned earlier, population is a major parameter that characterizes the socioeconomic activity of the villages and thus the enplanement. Furthermore, Gompertz uses the concept of enplanements per capita ratio, which has objective meaning. It assumes that enplanements per person will not grow forever at constant rate but rather will saturate at an upper limit. This is a realistic assumption since very large number of flights each year by the majority of people in the village seemed unrealistic. Thus, the use of Gompertz forecast for the villages was chosen.

B. Forecast for Hubs

As mentioned earlier, enplanement forecasts for the hubs were separated by movement legs. Each leg was analyzed in detail and forecasted separately. There are 5 hubs in the study area, namely, Bethel (BET), Aniak (ANI), Emmonak (EMK), McGrath (MCG) and St. Mary's (KSM). Six movements are analyzed for each of the hubs, namely; 1) to villages served by the hub 2) to Anchorage 3) – 6) to other 4 hubs in the study area.

1. Bethel

Bethel is a very special case even among the hubs. It is the center for business and commerce for the whole Y-K region. Furthermore, with the help of the regional hospital, people not only from Y-K region but also from whole of western Alaska come to Bethel for health checkups and emergencies. As a center, Bethel attracts much of the traffic in the region. Since its population is also much larger than other villages, it also produces much of the traffic that occurs in the region. On the average, from 1990-1997, there were 21 enplanements per capita annually in Bethel. This is much higher than other villages where the average annual enplanements per capita is 7-8 Enp/Cap. The 1997 Enp/Cap data for Bethel is also of suspect since it decreases dramatically and out of line with 5 years of previous trend. Figure 4.3 shows the trend of Enp/Cap ratio for Bethel with and without 1997 data. Without the 1997 data, the correlation of the data is 0.94 with 5.01 % growth. With 1997 data, the correlation drops to 0.53 and growth to 2.97%. Though both these percent growths are high by themselves, they show the effect the 1997 fishing disaster in the delta had on Bethel enplanements. Hence, being a major hub has the tendency to be affected by an economic slowdown in parts of the region that use the airport even though they are not close.

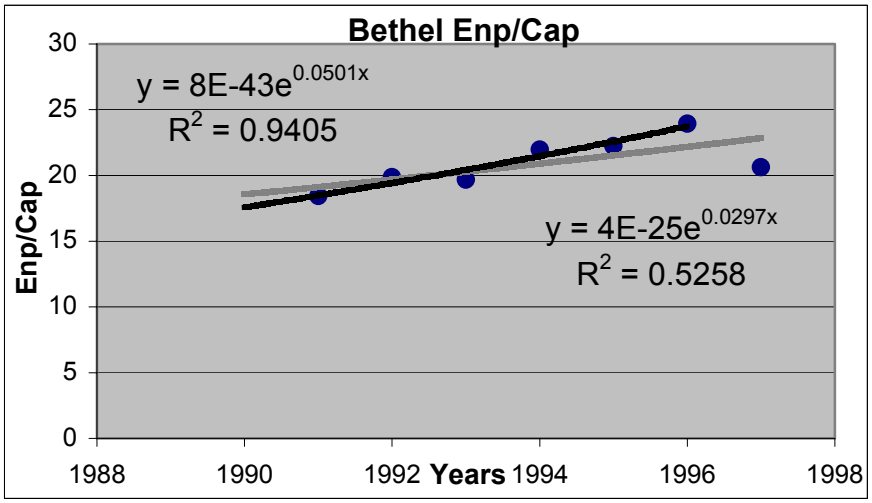


Figure 4.3 Enp/Cap Trend for Bethel with and without 1997 data

a. Bethel Disaggregate Forecast

The characteristics of each of the 6 destinations groups of Bethel were studied in detail. Appendix D gives the number-bulleted comments and analysis on each of the legs. The bullets also try to clarify the procedure used on each leg to get the final enplanement forecast.

Data was taken largely from FAA Small Certified Market data to perform the following analysis. Note: Both small and large certified aircraft enplanement was forecasted for Bethel (BET) to Anchorage (ANC), but only small certified was forecasted for Aniak (ANI) to Anchorage, St. Mary's (KSM) to Anchorage due to the lack of data on large certified carriers for these origin destination pairs.

The sum of the disaggregate enplanement forecast for the 6 legs gave the total scheduled enplanement for Bethel. The increase in scheduled enplanements were 3.13% per year with the 2020 enplanement forecast at around 242,600. This forecast is higher than the high of Bethel Airport Master Plan since it is believed that Bethel will grow faster than what the master plan has projected. Table 4.4 and Figure 4.4 show the enplanement forecast for Bethel.

Table 4.4 Bethel Scheduled Enplanement Forecast

	Bethel Scheduled Enplanement — BETHEL to:						
	KSM	***ANI***	***ANC Large***	***ANC Small***	***EMK***	***Villages***	***TOTAL***
1988	5467	2475		2	105	24408	32456
1989	6650	2300		66	61	27538	36614
1990	4433	2922		0	37	42236	49627
1991	4579	2962	32595	1300	13	41184	82632
1992	3493	2795	31007	3260	13	44263	84830
1993	2963	2704	30190	3698	31	48748	88333
1994	2953	2782	34312	4675	1627	54609	100957
1995	2241	2692	37348	4790	2400	58014	107484
1996	2216	2330		388	2427	57801	65161
1997	1827	2245	41080	5299	2523	62508	115482
1998	1787	2119	42946	5553	2666	65747	120819
1999	1867	2119	44812	5808	2771	68986	126363
2000	1867	2119	46678	6062	2868	72226	131820
2001	1904	2159	48544	6317	2948	75465	137338
2002	1941	2201	50410	6571	3038	78704	142866
2003	1980	2243	52276	6826	3127	81944	148396
2004	2019	2286	54142	7080	3216	85183	153927
2005	2059	2329	56008	7335	3316	88423	159470
2006	2097	2370	57917	7547	3403	91662	164996
2007	2135	2412	59825	7759	3501	94901	170533
2008	2175	2454	61734	7971	3598	98141	176072
2009	2215	2498	63642	8183	3695	101380	181613
2010	2256	2541	65551	8395	3805	104619	187167
2011	2296	2584	67459	8607	3889	107859	192693
2012	2336	2627	69368	8819	3986	111098	198233
2013	2377	2671	71276	9031	4082	114337	203775
2014	2419	2716	73184	9243	4178	117577	209317
2015	2462	2762	75093	9455	4290	120816	214877
2016	2506	2809	77001	9667	4369	124055	220408
2017	2551	2857	78910	9879	4465	127295	225956
2018	2597	2906	80818	10091	4560	130534	231506
2019	2644	2955	82727	10303	4654	133773	237056
2020	2691	3006	84635	10515	4768	137013	242628

Note: Small: Small Certified Carrier; Large: Large Certified Carrier

Source: FAA Commuter Air Carrier Activity, 1988-1996.

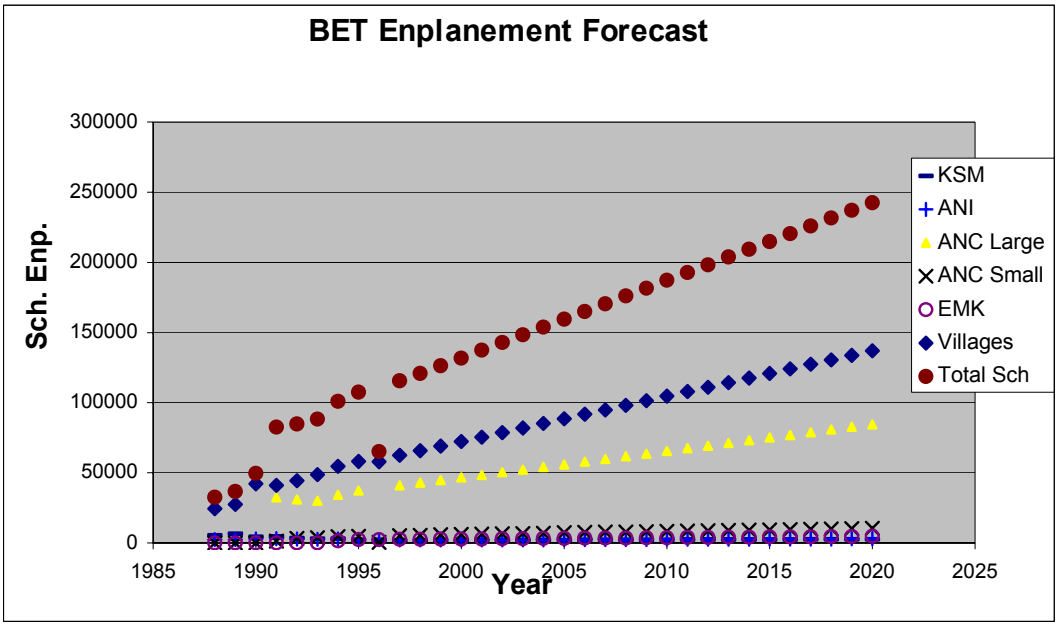


Figure 4.4 Bethel Scheduled Enplanement Forecast

2. Aniak

a. Aniak Trend

The analysis for Aniak showed that it has even higher enplanements per capita than Bethel at an average of 23 enp/cap and growing at the rate of 2.4 %. The Gompertz analysis carried out on the rest of the village data is not valid here; at least with limit of 12 enplanement per capita, since this limit which theoretically cannot be exceeded is already exceeded according to the present data. Hence, either the limit has to be increased to number higher than the current enplanement per capita or some other means of forecasting the enplanement should be adopted specifically for the hubs. This is specially a tricky issue since each hub has unique characteristics that effect its growth. The data on Aniak has been showing constant growth over the past 5 years. However, its proximity to Bethel can be a hindrance in its growth. Hence, its growth depends more on the growth of Bethel than dependence of other hubs on Bethel.

b. Aniak Disaggregate Forecast

Aniak data is not available for 1995 and 1996 in the small-certified market data available to us. Appendix D gives the details of comments and analysis performed on the data. The FAA Small-Certified Market Data showed that there was no scheduled enplanement from Aniak to Emmonak. Hence, analysis on ANI to EMMONAK leg is not available. Table 4.5 and Figure 4.5 shows the disaggregated enplanement forecast for Aniak. The total scheduled enplanement for Aniak is forecasted to grow at 2.17% annually with 2020 enplanement of 21,000.

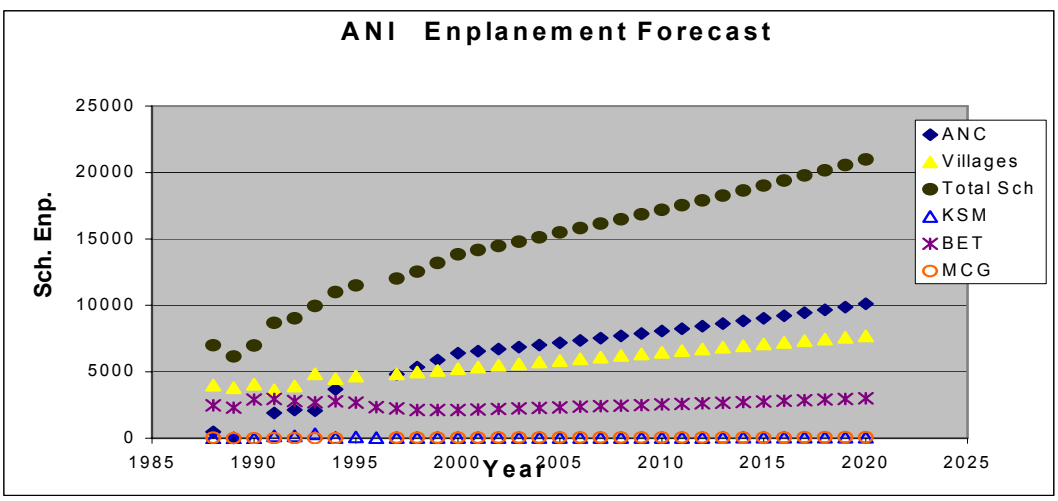


Figure 4.5 Aniak Scheduled Enplanement Forecast

Table 4.5 Aniak Scheduled Enplanement Forecast

	Aniak Scheduled Enplanement — ANIAK to:					
	BET	***ANC***	***KSM***	***MCG***	***Villages***	***TOTAL***
1988	2475	489	13	38	3993	7007
1989	2300	22	27	2	3795	6145
1990	2922		0	0	4060	6982
1991	2962	1905	167	0	3648	8681
1992	2795	2134	166	2	3927	9023
1993	2704	2064	325	8	4857	9957
1994	2782	3687	50	1	4489	11007
1995	2692		89			
1996	2330		31			
1997	2245	4821	50	43	4855	12014
1998	2119	5349	50	44	4979	12541
1999	2119	5877	50	45	5103	13194
2000	2119	6404	50	46	5228	13847
2001	2159	6551	51	47	5352	14161
2002	2201	6702	52	48	5476	14480
2003	2243	6856	54	49	5600	14803
2004	2286	7014	55	51	5725	15130
2005	2329	7195	56	52	5849	15482
2006	2370	7361	58	53	5973	15815
2007	2412	7530	59	54	6097	16153
2008	2454	7703	61	56	6222	16495
2009	2498	7880	62	57	6346	16843
2010	2541	8062	64	58	6470	17195
2011	2584	8247	65	59	6594	17550
2012	2627	8437	67	61	6719	17911
2013	2671	8631	69	62	6843	18276
2014	2716	8829	70	64	6967	18646
2015	2762	9022	72	65	7091	19013
2016	2809	9230	74	66	7216	19395
2017	2857	9442	76	68	7340	19782
2018	2906	9659	77	70	7464	20176
2019	2955	9881	79	71	7588	20575
2020	3006	10115	81	73	7713	20987

Source: FAA Commuter Air Carrier Activity, 1988-1996.

3. St. Mary's

a. St. Mary's Trend

According to the analysis of enplanements per capita, St. Mary's has shown dramatic negative growth since 1990. It is decreasing at the phenomenal rate of –8.6% annually. This is despite the fact that the population is growing at robust 1.9% with strong R^2 of 0.95. This kind of decrease in enplanement is drastic and would strongly effect the economic growth of the village. This can be the reason why Emmonak was designated as a hub in 1994. With Emmonak as hub, St. Mary's need for travel was further reduced. Hence, the future of St. Mary's depends primarily on its own economic characteristics, the village very close to it and the activity not being handled at Emmonak.

b. St. Mary's Disaggregate Forecast

Historical data show that the total enplanements are dropping drastically. In 1994, Emmonak became a hub and this diverted travel from St. Mary's, which is closer to Emmonak than any other hub. The market of St. Mary's was not strong even before 1994 since residents from Marshall and Russian Mission which are close to St. Mary's were traveling to Bethel in large numbers and not to St. Mary's. The largest communities served by St. Mary's, Mountain Village and Pilot Station are close by and have alternatives to travel to St. Mary's e.g. road for Mountain Village and winter trails. However, there is still much travel from Mountain Village to Emmonak and Bethel. Table 4.6 and Figure 4.6 show the disaggregte enplanement forecast for St. Mary's. According to the analysis, St. Mary's enplanements are forecasted to grow at 2.31% from 2000 onwards. The low point in the enplanement forecast is 1997 and then it starts to pick up from 2001 according to the population growth of sum of St. Mary's, Pilot Station, and Bethel. The analysis, explanation and reasoning of the forecast are given in detail in Appendix D. The period between 1997-2001 is considered to be a stabilization period for St. Mary's to rejuvenate its economy and thus the enplanement.

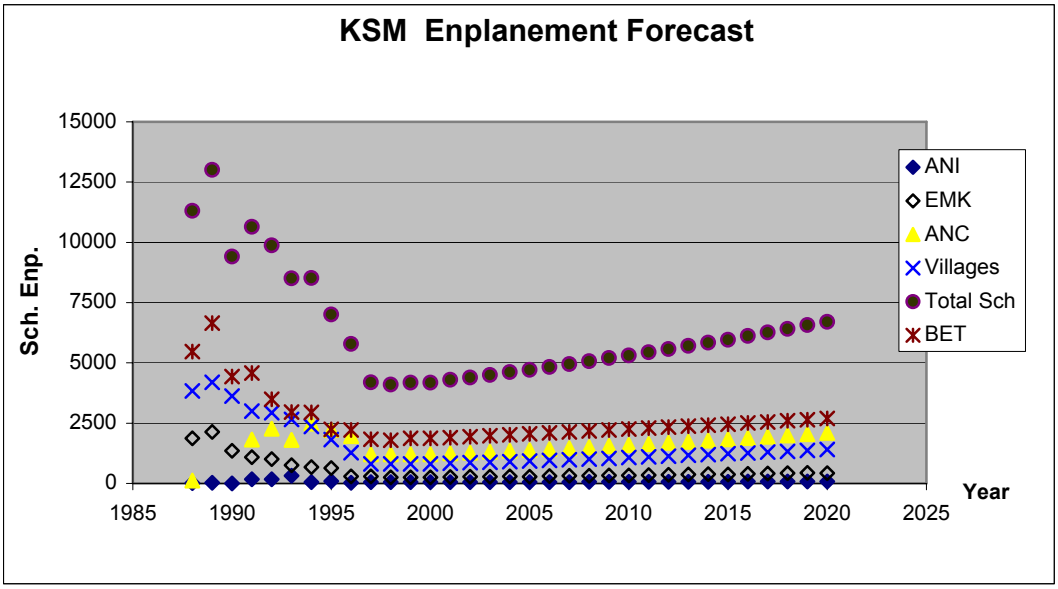


Figure 4.6 St. Mary's Scheduled Enplanement Forecast

Table 4.6 St. Mary's Scheduled Enplanement Forecast

	St. Mary's Scheduled Enplanement — KSM to:					
	BET	***ANI***	***EMK***	***ANC***	***Villages***	***TOTAL***
1988	5467	13	1878	126	3832	11315
1989	6650	27	2142		4195	13013
1990	4433	0	1352		3623	9407
1991	4579	167	1085	1816	3004	10651
1992	3493	166	1010	2270	2939	9877
1993	2963	325	758	1801	2657	8504
1994	2953	50	673	2479	2366	8520
1995	2241	89	632	2220	1825	7005
1996	2216	31	295	1968	1281	5791
1997	1827	50	295	1210	812	4194
1998	1787	50	249	1210	812	4108
1999	1867	50	249	1210	812	4188
1988	5467	13	1878	126	3832	11315
2000	1867	50	249	1210	812	4188
2001	1904	51	265	1243	834	4297
2002	1941	52	272	1277	857	4400
2003	1980	54	280	1312	880	4505
2004	2019	55	287	1347	904	4613
2005	2059	56	284	1384	929	4712
2006	2097	58	304	1424	955	4837
2007	2135	59	312	1465	983	4954
2008	2175	61	321	1506	1011	5074
2009	2215	62	331	1550	1040	5197
2010	2256	64	326	1594	1070	5310
2011	2296	65	350	1639	1100	5449
2012	2336	67	359	1685	1131	5578
2013	2377	69	369	1732	1162	5710
2014	2419	70	380	1781	1195	5845
2015	2462	72	374	1830	1228	5967
2016	2506	74	401	1881	1262	6124
2017	2551	76	412	1933	1297	6269
2018	2597	77	424	1986	1333	6417
2019	2644	79	435	2041	1369	6568
2020	2691	81	427	2097	1407	6703

Source: FAA Commuter Air Carrier Activity, 1988-1996.

4. Emmonak

a. Emmonak Trend

Since it became a hub in 1994, Emmonak's enplanements have increased dramatically. Before 1994, enplanement data show that Emmonak's annual average enplanements were approximately 1500. However, post-1994 data show that enplanements are now about 4000 annually. Figure 4.7 show the enplanement history and forecast for Emmonak. This certainly shows the impact of making Emmonak a hub. Also, since St. Mary's did not show as dramatic decrease in its enplanements in 1994, the increase in enplanements in Emmonak shows its internal potential as a substantial market for business. Its average of about 6.5 enplanements per capita is still very small compared to other hubs where the number hovers around 20 enplanements per capita year by year. Hence, Emmonak should experience some added growth in future.

b. Emmonak Disaggregate Forecast

Small certified air carrier market data is only available only for 1995 and 1996 for Emmonak since it started as a hub since 1994 only. However, there are data for enplanement from other hubs to Emmonak for longer period. This data was used in the forecast. However, according to the data from FAA Small Certified Market Data, there are no scheduled flights from Emmonak to either of Aniak and McGrath. For details on forecast methodologies and analysis refer to Appendix D. According to the disaggregate forecast carried out on Emmonak, it is expected to grow at 2.64% annually from 1998 onwards.

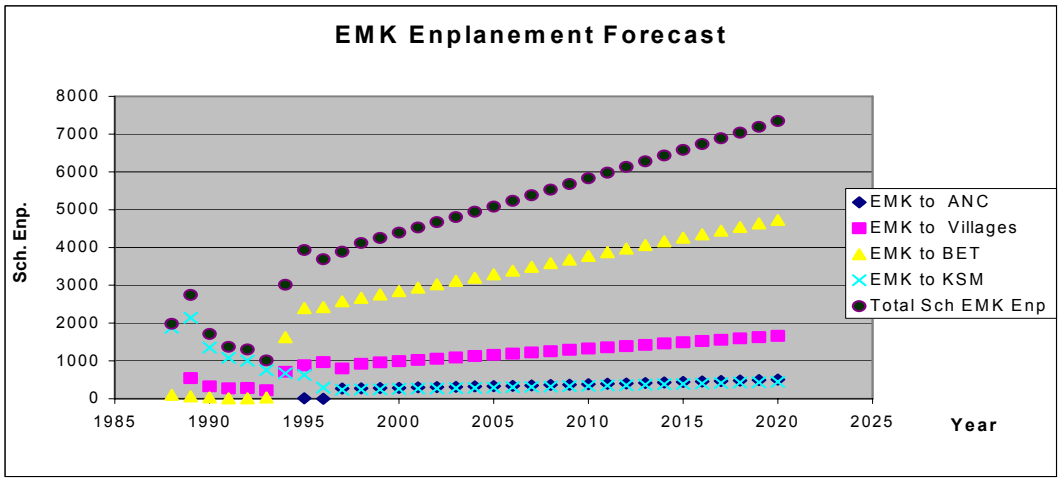


Figure 4.7 Emmonak Scheduled Enplanement Forecast

Table 4.7 Emmonak Scheduled Enplanement Forecast

	Emmonak Scheduled Enplanement — EMK to:				
	ANC	***to BET***	***to KSM***	***Villages***	***TOTAL***
1988		105	1878		1983
1989		61	2142	544	2747
1990		37	1352	325	1713
1991		13	1085	277	1375
1992		13	1010	282	1305
1993		31	758	223	1011
1994		1627	673	715	3015
1995	13	2400	632	888	3932
1996	0	2427	295	967	3689
1997	269	2578	240	800	3887
1998	276	2668	246	926	4117
1999	284	2758	253	959	4254
2000	291	2848	260	993	4392
2001	299	2937	267	1026	4530
2002	307	3026	274	1060	4668
2003	316	3115	282	1093	4806
2004	324	3204	290	1126	4944
2005	333	3293	297	1160	5083
2006	343	3390	306	1193	5232
2007	353	3487	315	1227	5381
2008	363	3584	324	1260	5531
2009	373	3681	333	1294	5681
2010	384	3778	342	1327	5831
2011	395	3874	352	1360	5981
2012	406	3970	362	1394	6131
2013	417	4066	372	1427	6282
2014	429	4161	383	1461	6433
2015	441	4257	393	1494	6585
2016	453	4352	404	1527	6736
2017	465	4447	415	1561	6888
2018	478	4541	427	1594	7041
2019	491	4636	438	1628	7193
2020	505	4729	451	1661	7346

5. McGrath

a. McGrath Trend

Unlike other hubs, McGrath is very far from Bethel and is in the mountainous region. Being farther away, it should have served well as a hub. However, since its hinterland is very small with small population and very poor infrastructure, people in the center seem to prefer to travel to Bethel than to McGrath. The 2.4% growth in enplanement per capita should not be misinterpreted. The growth is due to decrease in population and not increase in enplanement. While the enplanements remain the constant at around 6500 per year, the population is decreasing at the rate of 2.3%. This explains the high growth rate for enplanements per capita. The ability of McGrath to be a hub depends on its ability to sustain growth and act as a real hub of the region. This would mean improving its infrastructure and checking the out-migration of people.

b. McGrath Disaggregate Forecast

McGrath does not act like a true hub due to its limited catchment area. The villages surrounding McGrath are not heavily populated and are not growing substantially. Beside, the villages served by McGrath are few and spread wide apart. Also to McGrath's disadvantage is its lack of scheduled flights to Bethel, Emmonak, and St. Mary's. Table 4.8 and Figure 4.8 show the disaggregate enplanement forecast for McGrath. According to the analysis, the total scheduled enplanement in McGrath is expected to grow at models 1.19% annually.

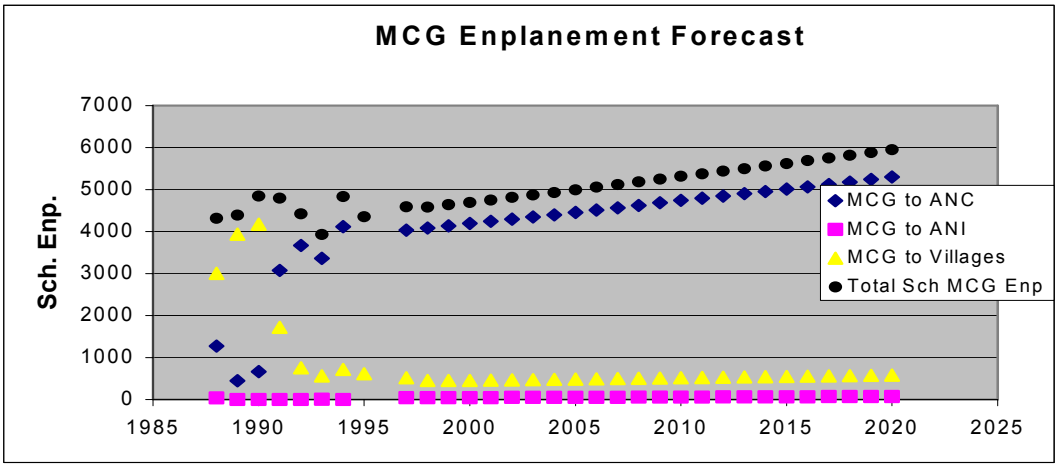


Figure 4. 8 McGrath Scheduled Enplanement Forecast

Table 4.8 McGrath Scheduled Enplanement Forecast

	McGrath Scheduled Enplanement — MCG to:			
	ANC	***ANI***	***Villages***	***TOTAL***
1988	1275	38	3006	4318
1989	449	2	3939	4389
1990	666	0	4178	4843
1991	3074	0	1720	4794
1992	3668	2	755	4424
1993	3362	8	560	3930
1994	4117	1	714	4831
1995			616	4355
1996				
1997	4031	43	519	4593
1998	4084	44	455	4584
1999	4139	45	456	4639
2000	4194	46	456	4695
2001	4244	47	461	4753
2002	4296	48	467	4811
2003	4348	49	473	4870
2004	4401	51	479	4930
2005	4454	52	485	4990
2006	4510	53	491	5054
2007	4567	54	497	5119
2008	4625	56	504	5184
2009	4683	57	510	5250
2010	4742	58	517	5317
2011	4795	59	523	5377
2012	4848	61	529	5437
2013	4901	62	535	5498
2014	4955	64	541	5560
2015	5010	65	547	5622
2016	5066	66	554	5686
2017	5123	68	560	5751
2018	5181	70	567	5817
2019	5239	71	573	5884
2020	5298	73	580	5951

Source: FAA Commuter Air Carrier Activity, 1988-1996.

5.0 Fleet Mix Forecast

A. General

Decisions are to be made on upgrading airports in the study area. In order to assist this decision-making, the size of the aircraft (measured in seats per flight) and number of operations at the airports would be useful. The characteristics of the aircraft determine the runway length and width. Each airport is designed with a “design aircraft” in mind. The increasing demand for passenger and mail will ultimately stretch the 5 and 6 passenger aircraft currently in use beyond the existing fleet capacity. Meeting the demand with more of 5 and 6 passenger aircraft flights is not practical in markets with long stage lengths because it is unprofitable to fly small aircraft on long hauls at high frequency. The first upgrade will be to 9 passenger aircraft and then move to 19 passenger aircraft in the future. With the inclusion of 9 and 19 passenger aircraft in the fleet, the runway length of the airports must be increased to at least 3500 feet. Table 5.1 shows the characteristics of airports in the study area [NOAA, 1999] listed in decreasing runway length. Table 5.1 also shows that most runways are gravel. Some have provisions for seaplanes. Table 5.2 gives runway lengths required for “design aircraft.” Under the present system of chained flights, it will be the airport with the shortest runway in the flight itinerary that will determine the size of aircraft that can be safely used in the flight. Hence, it is necessary that a minimum runway length be set for each itinerary.

Current scheduled operations listed in the Official Airline Guide [OAG 1998], shows that there are peaks of departures and arrivals during 2-hour periods in the morning and the evening. If this temporal distribution remains same in the future, added operations can lead to service shortcomings, which include delay and unrealistic demand on apron space at Bethel. Hence, it is expected departure and arrivals will be spread out over the course of the day as operation increase.

Table 5.3 shows the Official Airline Guide scheduled 1998 enplanement to Bethel from the villages.

Table 5.1 Y-K Delta Airport Data

USPS ID	Village	FAA ID	Length	Width	Number	Surface	Seaplane
BET	Bethel	BET	6398	150	18-36	ASPG	YES
KSM	St. Mary's	KSM	6003	150	16-34	GVL	NO
ANI	Aniak	ANI	6000	150	10-28	ASP	YES
MCG	McGrath	MCG	5435	150	16-34	ASP	YES
RDV	Red Devil	RDV	4750	74	09-27	GVL	NO
EMK	Emmonak	EMM	4400	75	16-34	GVL	NO
FLT	Flat	FLT	4045	114	07-25	TURF-GVL	NO
HCR	Holy Cross	4Z4	4000	100	01-19	GVL	NO
TLJ	Tatalina (AF)	TLJ	3800	150	16-34	GVL	NO
PTU	Platinum	PTU	3640	60	13-31	GVL	NO
HPB	Hooper Bay	HPB	3300	75	17-31	ASP	NO
KLG	Lower Kalskag	KLG	3198	60	06-24	GVL	NO
SLQ	Sleetmute	SLQ	3100	60	14-32	GVL	NO
MY	Mekoryuk	MYU	3070	75	05-23	GVL	NO
PKA	Napaskiak	PKA	3000	60	01-19	GVL	YES
SCM	Scammon Bay	SCM	3000	75	10-28	GVL	YES
ANV	Anvik	ANV	2910	75	17-35	GVL	YES
GNU	Goodnews Bay	GNU	2850	80	05-23	GVL	NO
RSH	Russian Mission	RSH	2700	50	17-35	GVL	YES
VAK	Chevak	VAK	2610	40	14-32	GVL	NO
KWN	Quinhagak	AQH	2600	60	04-22	GVL	YES
SRV	Stony River	SRV	2555	50	18-36	GVL-DRT	NO
MOU	Mountain Village	MOU	2520	60	02-20	GVL	NO
PQS	Pilot Station	AK10	2520	55	07-25	GVL	NO
CYF	Chefornak	CFK	2500	35	16-34	GVL	YES
KWK	Kwigillingok	AK85	2500	35	15-33	GVL	NO
TLT	Tuluksak	TLT	2500	30	02-20	GRV-ERT	NO
NIB	Nikolai	5NI	2350	60	04-22	GVL	NO
KGX	Grayling	KGX	2315	60	15-33	GVL	NO
SHX	Shageluk	SHX	2300	35	16-34	GVL	YES
TLF	Telida	AK52	2270	54	02-20	TURF-ERT	NO
AUK	Alakanuk	AUK	2200	55	18-36	GVL	NO
WWT	Newtok	EWU	2180	35	15-33	GVL	NO
WNA	Napakiak	WNA	2150	50	16-34	GVL	YES
KOT	Kotlik	KOT	2145	20	16-34	GVL	NO
KPN	Kipnuk	IIK	2120	35	15-33	GVL	NO
SXP	Sheldon Point	SXP	2060	50	02-20	GVL	YES
NUP	Nunapitchuk	16A	2040	60	18-36	GVL	YES
TNK	Tununak	AK45	2010	40	08-26	GVL	NO
ATT	Atmautluak	08AK	2000	30	15-33	GVL	NO
CKD	Crooked Creek	CJX	2000	60	13-31	GVL	NO
KUK	Kasigluk	Z09	1950	50	17-35	GVL	NO

Table 5.1 Y-K Delta Airport Data

USPS ID	Village	FAA ID	Length	Width	Number	Surface	Seaplane
MLL	Marshall	MLL	1940	30	11-29	GVL	NO
AKI	Akiak	AKI	1900	38	03-21	GVL	NO
KKH	Kongiganak	DUY	1880	35	18-36	GVL	NO
OOK	Toksook Bay	OOK	1800	55	15-33	GVL	NO
WTL	Tuntutuliak	AK61	1800	28	02-20	GVL	YES
KWT	Kwethluk	KWT	1750	35	06-24	GVL	YES
TCT	Takotna	TCT	1717	65	06-24	GVL	NO
KKI	Akiachak	Z13	1625	50	11-29	GVL	YES
NME	Nightmute	IGT	1600	45	02-20	GVL	NO
CHU	Chuathbaluk	9A3	1560	45	14-32	GVL	NO
LVD	Lime Village	23AK	1475	60	09-27	GVL	NO
EEK	Eek	EEK	1400	35	17-35	GVL	NO

Table 5.2 Design Aircraft for Airport Design

Capacity	Design Aircraft	Runway Length	ARC Design Standards*
6 seats	Cessna 207	1800 feet	A-I
9 seats	Piper Navajo	3400 feet	B-I
19 seats	Beech 1900	3740 feet	B-II
30 seats	SAAB 340	4300 feet	B-II
Hub	DC 6	4500 feet	B-II

** Note: ARC = Airport Reference Code FAA AC 150/5300 - 13*

Table 5.3 OAG 1998 Scheduled Enplanement to Bethel.

Arrival Time	Airline Code	Flight Number		Destinations				Days*	Aircraft
			From	1st Stop	2nd Stop	3rd Stop	4th Stop		
1050	4Y	570	BET	EEK	WTL			X7	CNA
1115	4Y	530	BET	KKH	KWK				CNA
1120	4Y	550	BET	MLL	RSH			X7	CNA
1130	4Y	520	BET	KPN	CYF				CNA
1130	4Y	540	BET	VAK	HPB	SCM		X7	CNA
1145	4Y	754	BET	PQS	MOU			X7	CNA
1230	4Y	560	BET	NME	OOK	TNK	WWT	X7	CNA
1250	4Y	500	BET	WNA	PKA			X7	CNA
1310	4Y	580	ATT	NUP	KUK	BET		X7	CNA
1340	4Y	590	BET	KWT	KKI	AKI	TLT	X7	CNA
1405	4Y	510	BET	EEK	KWN	GNU	PTU	X7	CNA
1415	4Y	701	BET	TOG	DLG			135	CNA
1500	4Y	560	BET	NME	OOK	TNK	WWT	7	CNA
1615	4Y	752	ANI	KLG	BET			X7	CNA

Table 5.3 OAG 1998 Scheduled Enplanement to Bethel.

Arrival Time	Airline Code	Flight Number		Destinations				Days*	Aircraft
			From	1st Stop	2nd Stop	3rd Stop	4th Stop		
1655	4Y	750	BET	KLG	ANI			X7	CNA
1705	4Y	572	BET	WTL	EEK			X7	CNA
1725	4Y	532	BET	KWK	KKH				CNA
1725	4Y	542	BET	SCM	HPB	VAK		X7	CNA
1745	4Y	522	BET	CYF	KPN				CNA
1745	4Y	552	BET	RSH	MLL			X7	CNA
1745	4Y	562	BET	WWT	TNK	OOK	NME	X7	CNA
1805	4Y	754	BET	PQS	MOU			7	CNA
1805	4Y	755	BET	PQS	MOU			X7	CNA
1850	4Y	756	BET	PQS	MOU			7	CNA
1210	4Y*	337	BET	ANC	not listed in Flight Itinerary				SWM
0950	5F	1520	BET	KPN	not listed in Flight Itinerary			X7	CNA
0720	AS	41	BET	ANC	not listed in Flight Itinerary			x7	73M
1510	AS	43	BET	ANC	not listed in Flight Itinerary				73M
1906	AS	45	BET	ANC	not listed in Flight Itinerary			x6	73M
1120	AS*	4863	BET	KPN	KWK	KKH	WTL		DHT
1140	AS*	4862	BET	MYU	OOK	TNK			DHT
1150	AS*	4861	BET	SCM	HPB	VAK			DHT
1405	AS*	4865	BET	CYF	NME	WWT			DHT
1515	AS*	4866	BET	GNU	PTU	KWN	EEK		DHT
1825	AS*	4864	BET	WTL	KKH	KWK	KPN	X67	DHT
1850	AS*	4868	BET	TNK	OOK	CYF		X6	DHT
1910	AS*	4867	BET	VAK	HPB	SCM		X67	DHT
1040	GS	161	EMK	AUK	BET			X67	PAG
1050	GS	281	BET	KPN	CYF			X7	CNA
1100	GS	271	BET	KWT	KKI	AKI	TLT	X7	CNA
1105	GS	251	BET	KWK	KKH	WTL		X7	CNA
1145	GS	291	BET	SCM	HPB	VAK		X67	PAG
1200	GS	261	BET	TNK	OOK	NME	WWT	X7	CNA
1220	GS	203	BET	WNA	PKA			X7	CNA
1235	GS	205	ATT	NUP	KUK	BET		X7	CNA
1250	GS	201	BET	KWN	EEK			X7	CNA
1545	GS	293	BET	SCM	HPB	VAK		67	PAG
1700	GS	163	EMK	SXP	AUK	BET			PAG
1750	GS	282	BET	KPN	CYF			X7	CNA
1800	GS	272	BET	KWT	KKI	AKI	TLT	X7	CNA
1805	GS	252	BET	KWK	KKH	WTL		X7	CNA
1835	GS	262	BET	TNK	OOK	NME		X7	CNA
2015	GS	292	BET	VAK	HPB	SCM		X67	PAG
1040	H6	403	KSM	MOU	PQS	BET		X7	CNA
1048	H6	70	BET	KKI	AKI	KWT		X7	CNA

Table 5.3 OAG 1998 Scheduled Enplanement to Bethel.

Arrival Time	Airline Code	Flight Number		Destinations				Days*	Aircraft
			From	1st Stop	2nd Stop	3rd Stop	4th Stop		
1055	H6	10	ATT	NUP	KUK	BET		X7	CNA
1110	H6	413	BET	PQS	MOU	KSM		7	CNA
1125	H6	614	ANI	KLG	BET			X7	CNA
1430	H6	618	ANI	KLG	BET				CNA
1635	H6	404	KSM	MOU	PQS	BET			CNA
1718	H6	71	BET	KWT	AKI	KKI			CNA
1725	H6	20	BET	KUK	NUP	ATT			CNA
1025	KS	409	ATT	NUP	KUK	BET		X7	PAG
1030	KS	473	BET	PQS	MOU	KSM		X7	PAG
1040	KS	401	BET	WTL	KWN			X7	PAG
1140	KS	421	BET	KWK	KPN	CYF		X7	PAG
1230	KS	435	BET	MLL	not listed in Flight Itinerary			X7	PAG
1300	KS	431	BET	Cape Ramanz not listed in Flt. Itinerary				3	PAG
1535	KS	443	BET	OOK	TNK			X7	PAG
1615	KS	477	KSM	MOU	PQS	BET		X7	PAG
1620	KS	429	BET	VAK	HPB	SCM		X7	PAG
1710	KS	425	BET	MYU	not listed in Flight Itinerary			X7	PAG
1740	KS	465	ATT	NUP	KUK	BET		X7	PAG
1855	KS	449	BET	WTL	KWK	KPN	CYF	X7	PAG
0900	RV	181	BET	ANC	not listed in Flight Itinerary			15	LOM
1825	RV	723	BET	ANC	not listed in Flight Itinerary			X6	72M

* 1=Monday, 2=Tuesday, 3=Wednesday, 4=Thursday, 5=Friday, 6=Saturday, 7=Sunday, X7="not on" Sunday

CNA = Cessna 207 PAG = Piper SWM = Fairchild Metro Merlin
73M = Boeing 737-200C DHT = DeHavilland DHC-6 Twin Otter
LOM = Lockheed L-188 Electra 72M = Boeing 727-100C

B. Fleet Mix Forecast

The forecast for fleet mix is very volatile since the real fleet mix depends on major forces like market economy, individual airline economics and airline goals etc. However with a few assumptions, it is possible to forecast approximately the fleet mix for future years. The assumptions are:

- The general trend of bush air carriers will be the use of larger aircraft for longer stage lengths [AASPU, 1997].
- The airlines will try their best to keep the fleet size the same but might decrease the size by a few aircraft if larger aircraft with adequate frequency can take care of passenger demand.
- The enplanement to/from Bethel from/to the other hubs and villages continue to dictate the aircraft selection for the flight.

- Percent travel from the villages to the hubs especially Bethel, determines the size of the fleet.
- A six flights per week schedule assumption was made on aircraft not in service at the moment.
- Number of aircraft will remain same due to the shortage of new pilots.

6.0 Comments and Conclusion

A. Air Transportation Characteristics of Y-K Delta

From the air carrier analysis, it was found that there are some carriers that carry only mail and some carry only passenger. Hence, the notion that mail delivery supports airlines to make passenger travel cheaper, if it ever was true in the past, is not true anymore. Hence, any reduction or major change in business with USPS in mail delivery may negatively alter the carrier's business picture but it will not necessarily change the passenger service to the villages they serve. Furthermore, the philosophy of equal tender does not enhance market forces to act freely. Since an air carrier is assigned to get their share of mail to be delivered at a fixed price, there is no real initiative in the system to improve the air carrier operation.

Air transportation in the Y-K Delta is highly influenced by the socioeconomic activity of the region. The recent large decrease in fish caught, followed by subsequent reduction in enplanements in those areas hit by the crisis, is clear evidence of its influence. Since air transportation is the lifeline of the villages, any change in economic and social condition of a given village is directly reflected in enplanements.

B Enplanement Forecast

Population is the most important parameter in the enplanement forecast for the region. Other parameters like income and employment failed to show decent correlation with enplanement. Hence, enplanement per capita forecast was taken as the final forecasting method for the study area. An important property of the forecast is that the growth of enplanement is the result of the combination of population growth and the Gompertz forecast of the enplanement per capita ratio. Hence, if the population growth is high but the growth of enplanement per capita ratio is slow, then the resulting enplanement forecast tends to take on a linear property. In the same notion, if population forecast is the dominating factor in the center, the enplanement forecast tends to follow population forecast closely. The same is true if population growth is very mild and enplanement per capita ratio is decreasing at a faster rate, the enplanement forecast tends to be lower than other forecasts. This can be seen in the enplanement forecast of Center 9 and Center 10.

Table 6.1 gives the final total enplanement forecast for the whole Yukon-Kuskokwim Delta Region. The scheduled enplanements for the hubs were converted to total enplanement with the help of ACAIS database. The forecast aggregates all legs of air transportation network in the Y-K Delta region. Each leg was forecasted separately. The resulting final forecast shows that the Y-K Delta Region is forecasted to grow at the rate of 3.03% annually to 560,000 enplanements in the year 2020.

Table 6.1 Total Enplanement Forecast for Y-K Delta Region (in thousands)

Enplanements		*2000*	*2005*	*2010*	*2015*	*2020*
At all of non-hub village airports for non-hub travel (village to village)	46.1	49.5	57.6	67.5	78.9	92.8
At all of non-hub village airports for Bethel travel	58.0	72.2	88.4	104.6	120.8	137.0
At all of non-hub village airports for hubs other than Bethel travel	9.9	9.3	10.4	11.7	12.9	14.1
At Bethel Airport, includes Anchorage, the villages, and the other hubs	118.0	144.7	175.1	205.6	236.0	266.4
At Aniak Airport, includes Anchorage, the villages it serves, Bethel, and the other hubs	13.3	15.9	17.7	19.7	21.8	24.1
At St. Mary's Airport, includes Anchorage, the villages it serves, Bethel, and the other hubs	9.1	5.4	6.1	6.9	7.6	8.7
At McGrath Airport, includes Anchorage, the villages it serves, Bethel, and the other hubs	6.0	6.5	7.0	7.5	7.9	8.5
At Emmonak Airport, includes Anchorage, the villages it serves, Bethel, and the other hubs	4.5	5.0	5.8	6.6	7.5	8.4
Total	**264.9**	**308.5**	**368.1**	**430.1**	**493.4**	**560.0**

The enplanement forecast seems to follow a reasonable trend. With the population growth projected to grow at 2.20% annually according to AKDOT/PF forecast, the elasticity of the enplanement to population is 1.38. This elasticity, while somewhat conservative, is reasonable for a group that must use the air transportation for all their travel. The lower 48 experiences an elasticity with population of about 4, but that is due primarily to the increasing latent demand being satisfied and the growing affluence of Americans.

C. Final Comments and Further Research Potential

In conducting this analysis, it was assumed that all external factors, like welfare structure of the region, health care, etc., remain the same. These factors have the potential to change the enplanement forecast dramatically. This is especially true in areas like Y-K Delta where Native population is very high and government aid makes up the major portion of the financial budget of the villages. The effect of such elements on the forecast is beyond the scope of this thesis. Furthermore, since air transportation plays a major role in the whole economic health of the village, the effect of the enplanement forecast on each of the villages should be studied in detail.

The fleet mix forecast can be extended to include travel from hubs other than Bethel. The aim of the enplanement forecast is to help the planners decide when upgrading of the airports of villages in needed. Fleet mix forecast goes a long way in doing so. However, due to its complex nature, more time and energy is needed to get a reliable fleet mix forecast. The presentation of the Bethel-Chevak-Hooper Bay-Scammon Bay route is an example.

The break down of air carrier operation and final total enplanement forecast for the Y-K Delta Region was successfully performed and reliable results with scientific methodology were obtained.

Appendix C
The United States Post Office's Bypass Mail System
USPS Mail Delivery in Bush Alaska—A Primer[1]

Prepared by R.K. Whitford
March 30, 2000

DISCLAIMER: The information presented in this report, including all references to laws and policies associated with the United States Postal Service, are the author's alone. This document was prepared to improve understanding of the USPS activities as they impact the transportation system in Rural Alaska, with the focus on the Yukon-Kuskokwim Delta region

Abstract

Defining future transportation needs involves understanding the travel demand to, from, and within the planning area. In many parts of rural Alaska, aviation-based mail service is fundamental to the lifestyle of the native peoples and places needs on the transportation system in the bush. This is especially true in the Yukon–Kuskokwim Delta (Y–K Delta) region. While barges deliver fuel and construction materials during the short summer, villages depend on their airstrips for inter-community travel as well as delivery of most of their groceries and other consumer goods.

Established by law (39 USC 5402) the United States Postal Service (USPS) is required to perform their mail delivery mission of "providing universal service at universal rates" in Alaska including the rural/bush communities. Thus the revenue rates paid are the same as in the lower 48, but the USPS costs are significantly higher because of the number of widely dispersed remote communities accessible only by air.

Aircraft are used to deliver over 1700 pounds of dry, perishable and frozen goods per Yukon-Kuskokwim Delta resident (over 45 million pounds per year) as non-priority (parcel post) mail. The wholesalers/shippers in Anchorage ship over 45 million pounds

By special provisions, about 75% of this is By-Pass Mail; so-called because it by-passes the post office facilities as it is packaged by the shipper and transferred, under USPS supervision, to the Air Carrier in Anchorage who assumes responsibility to deliver direct to the addressee.

Because of the limited runway length in most bush villages, often less than 2500 feet, the air carriers are fleets of small, usually single engine piston aircraft. The result is over 65,000 round trips per year carrying mail to the bush villages from the Y-K Delta hubs of Bethel, St. Mary's, Emmonak, Aniak, and McGrath.

With this level of traffic, USPS should play a significant role in future transportation systems in bush Alaska. The ultimate goal is for Alaska's Department of Transportation and Public Facilities, with their responsibility for transportation infrastructure in the bush, to work with the USPS in planning to provide efficient and effective transport linkages in order to enhance the economic well-being and quality of life of rural Alaskans.

1 This report prepared by Robert K. Whitford, Ph.D. in support of the regional Transportation Plan for the Yukon Kuskokwim Delta by Purdue University under contract to the Alaska Department of Transportation and Public Facilities.

1. Introduction

In many parts of rural Alaska, the understanding of the special aviation-based mail service is fundamental to the transportation system. This is especially true in the Yukon–Kuskokwim Delta (Y-K Delta) region. While barges deliver fuel and construction materials during the short summer, villages depend (it is their lifeline) on their airstrips for year-around inter-community travel as well as delivery of most of their groceries and other consumer goods which usually come by fourth class mail.

To aid in the USPS in carrying out its mission to the poor rural communities, special mail provisions were established in the early 1980's as rural Alaska grew and a cash economy began to emerge alongside the subsistence economy already in place. The revenue rates charged by the USPS are the same as in the rest of the United States, but with the air delivery in small planes, the costs are significantly higher than the revenues. The shortfall continues to grow and is about $100 Million per year.

The planning study examines the costs and benefits of having longer runways in some of the villages. Use of more efficient aircraft has the promise of reducing USPS costs and passenger fares as well as enhancing safety.

The USPS will benefit from FAA and AK DOT's investment in runways. Such cross-agency benefits are not unusual, for it is the ubiquitous public road system (developed by FHWA and State DOTs) in the lower 48 that has been essential for the low cost of fourth-class mail delivery as well as just-in-time freight delivery enhances both manufacturing and retailing. Likewise, early in the history of aviation, the Federal Government (U.S. Department of Commerce) pushed the mail contracts with air carriers to help spur the stability and growth of the then fledgling, infant aviation industry.[2]

Defining future transportation needs involves understanding the travel demand to, from, and within the planning area of concern. This paper expands on the general background of the USPS system and presents a brief description of the USPS operation as seen by the author. A short history of mail delivery in Alaska follows. A layman's summary of the legislative background accompanies review of the relevant Civil Aeronautics Board and, its successor, the U.S. Department of Transportation. Some relevant economic considerations are followed with suggestions of some possible ways the transportation system might achieve efficiencies for the USPS system. Attachment 1 gives most of the relevant portions of the Law and Attachment 2 provides a summary of the recommendations of a 1991-2 Special Task Force review of the system.

2. Background

Transportation planning in rural Alaska, particularly in the Yukon-Kuskokwim Delta region, must account for the harsh Arctic climate in a large river delta area heavily dotted with wetlands. The tundra-covered soil on top of often very thick permafrost is not conducive to road construction or maintenance. Alaska has about one mile of road for every 42 square miles of land while the Continental United States (often referred to in Alaska as the lower 48) has an average of one mile of road for every square mile of land area. The Y-K Delta region has one paved road in the delta area, a 21-mile road between St. Mary's and Mountain Village. Most villages have dirt and gravel roads or boardwalks over which transportation is predominately by

2. The book "From Bonfires to Beacons" describes that period in the 1920's and 1930's.

all-terrain vehicles (ATVs) or snow machines in the winter.

Travel is by boat and aircraft in the summer, and by snowmobile on marked trails and aircraft in the winter. In the winter, there is also some travel on ice roads fashioned by local governments and residents on the frozen Kuskokwim River. During the two to three month periods of freeze-up in the fall and break-up in the spring, the only travel is by airplane. Most air travel is by visual flight rules (VFR)[3]. Air travel to the village air strips with their short (usually less than 2500 feet), often unlit, gravel runways) is almost always with single piston engine small aircraft, with an occasional twin engine light plane like a Piper Chieftain.

With its lack of roads and the existence of numerous remote villages, rural Alaska poses a special problem for postal service and consumer goods outlets, such as grocery stores.

In order to meet its mission to deliver mail to all persons in the United States, the United States Postal Service (USPS) uses air mail for both priority (first class) and non-priority (fourth class or standard) mail delivery. The USPS has the authority to deliver non-priority mail at standard non-priority mail rates to remote communities by using airmail. It is not surprising that the cost to deliver the mail by small airplanes to remote villages would exceed the revenue, determined by the least costly ground method available in the lower 48. With the favorable rates (compared to air freight) the shippers naturally are using the USPS to provide distribution of many consumer products to the small stores in the remote parts of Alaska. Thus, the mail service operations in Alaska do not mirror postal service in the rest of the lower 48 states.

Since 1971 when the USPS was set up as a "quasi-government" corporation, it was to operate on a business-like basis. This meant that it charged rates sufficient to break-even with the proviso that each product was required to pay for itself, that is, no price discrimination between products, such as first class versus fourth class mail.

Public policy calls for the USPS *"to provide universal service at universal rates."*[4] The other important items to note is that the parcel post was established to be less expensive than regular mail with lower delivery time standards. So postal rates were established, not only with the least costly surface mode in mind, but there was a delivery time requirement of five days delivery in the same zone, with higher rates and less stringent requirements for longer distance delivery.

In Alaska, not only is air the major mode for parcel post mail, but by virtue of multiple handling, each carrier must get the mail to the next person by midnight the day after they receive it – or hand it off to someone who can. This is weather permitting, of course. The zones in Alaska cover much longer distances than those in the Lower 48. All villages in the Y-K Delta are in Zone 1 from Anchorage, even though some are in excess of 500 miles from Anchorage.

On an average day in the Y-K Delta, there are over 350 flights by small, "bush aircraft."[5] Some flights are as short as a few miles with others traveling 120 to 140 miles. Annually there are about 240,000 enplanements plus the movement of approximately 45 million pounds of mail. About 93% of the mail delivered to the Y-K Delta is fourth class or non-priority mail. Regular air freight is used for things that are prohibited from "by-pass" mail such as

3. Visual flight rules, usually 1000 foot visibilty is required.

4. Letter dated November 15, 1991 to Governor Hickel from Postmaster General Anthony Frank and Alaska's Congressional Delegation.

5. The U.S. Code (39USC5402) defines a bush aircraft as one with a payload of less than 7500 pounds. In reality, most aircraft that operate on the short runways of the Y-K Delta have payloads of 800 to 1200 pounds.

liquid detergents, any materials that weigh more than 70 pounds or that cannot be packaged to meet the "length + girth" requirement of fourth class mail. Overall, regular air freight accounts for about 8% of the flights in the delta. [6]

3. Brief History

Until the 1920's, Alaskan mail was delivered by boat in the summer and by dogsled in the winter. The service, which covered weather emergencies and periods of perilous travel, was defined as "restricted" which could take weeks to be delivered. In the 1920's, following the gains in timely mail delivery in the rest of the United States, the airplane in Alaska emerged as a viable form of improved mail service.

Between 1930 and 1950, regularly scheduled air service developed at a steady pace, with service frequency in rural areas gradually increasing. Between 1950 and 1970, the major air service markets in Western and Northern Alaska were controlled by one or two carriers.

In the late 1970's and early 1980's, the Civil Aeronautics Board (CAB) launched a comprehensive investigation into the unitary rate in use by Wein Air Alaska, then the major mail carrier in Alaska. The result was the establishment of a "two tier - two segment" rate, distinguishing between mainline haul level of operations and that of bush operations. For both tiers, separate rate categories were established for the air mileage segment of operation (cents per ton-mile) and for the terminal handling segments (cents per pound handled).

The "Show Cause Order"[7] issued November 1982[8] defined the rates for non-priority mail. Table 1 shows these rates compared with those established in 1988 and with the 2000 rates.

The USPS began to hire carriers who proved that they could handle the service, by providing an equal amount of freight to each certifiable carrier called "equal tender" on city pair by city pair[9]. Thus, these rates applied to a large number of bush carriers.

Table 1 Comparison of Intra-Alaska Mail Service Rates Over Time

Service	Unit	1981*	1988	2000
Mainline Haul	ton-mile	$0.7999	$0.6385	$0.8518
Mainline Terminal	pound	$0.1536	$0.1966	$0.2165
Bush Haul:	ton mile	$7.5327	$7.0510	$9.9746
Bush Terminal	pound	$0.1435	$0.1349	$0.3591

* Wein and Alaska Air only

The service is provided on a transshipment basis with large quantities (pallet size) carried by larger carriers to "hub" points, like Bethel. The mail is then handed off to small "bush" carriers who travel to bush communities with the freight.

One major change in definition occurred in 1982 when the bush carriers, which had been defined in terms of carrying a 4000 pound payload, were redefined to accommodate a 7000 pound payload. In 1988, the bush payload was expanded to 7500 pounds. In spite of those changes, most bush carriage is on small single

[6] Attachment 3 contains some data on the mail movements in the Y-K Delta.

7. Show cause orders are regulatory documents of proposed rule-making. Any party affected must respond within a specified time limit and in his response show why the regulation would adversely impact his business.

8. USDOT Regulatory Docket #44445 The CAB was sunset as part of the Air Deregulation Legislation of 1978. Its regulatory functions were passed to the U.S. Department of Transportation

9 Air Carriers wishing to carry the mail had to show their ability to do so, by having scheduled service for a given route, say from Bethel to Hooper Bay.

engine aircraft, such as a Cessna 206, with payloads from 800 to 1200 pounds.

A new rate setting process was established beginning in 1986 by the U.S. Department of Transportation (USDOT), who had taken over the remaining economic regulation of the now defunct Civil Aeronautics Board. The rate setting process went through the usual process of legal correction and redefinition until the process was fully agreed upon in 1990. Since then, the USDOT Office of Aviation in the Secretary of Transportation's Office has been incrementally adjusting the rates, based on the carriers reported costs.

Table 2 shows how these rates have escalated from 1988. The regulated rates grew from 1988 to 2000 for mainline air carriage by less than 1% per year and the ground handling about 3% per year. The bush air carriage rates grew by about 2.5% per year, but the terminal handling grew at the rate of 8% each year or 2.5 times in 12 years. The table also indicates that for the movement of one ton from Anchorage to Eek or Tuntutuliak, the cost to the post office is almost $4.30. The revenue, assuming between 40 and 50 pound packages make up the ton, is about $225 or about 50 cents per ton-mile.

Table 2 Costs For 400 Mile Mainline followed by 40 Mile Bush Haul, 1988, 1990 and 2000

400-Mile Mainline Haul

FY	Rate for mileage	Rate for handling	Total	Average Cost per ton-mile
1988	$255.88	$393.20	$649.08	**$1.623**
1990	$343.36	$414.60	$757.96	**$1.895**
2000	$433.00	$340.72	$773.72	**$1.934**

40 Mile Bush Haul

1988	$282.04	$269.80	$551.84	**$13.796**
1990	$258.96	$423.40	$682.36	**$17.059**
2000	$398.98	$718.20	$1,117.18	**$27.93**

Source: Alaska Parcel Post Study, November 15, 1991 and data from USPS.

In the early 1990's, the USPS proposed expanding the number of hubs from 22 to 37 in an attempt to save delivery costs and maintain service. The operation had already been streamlined with creative packaging in Anchorage and carrier responsibility roles that allowed the trans-shipment from the mainline carrier to the bush carrier without going through the usual breakdown and sort in the hub post office. The proposed changes would have reduced the costs by about 10%[10]

10. Dowling, William J., Alaska Parcel Post Study, United States Post Office, Regional Director, Northeast region, November 15, 1990.

In a joint letter from Congress and from the Postmaster General, Governor of Alaska, Walter Hickel, was requested to establish a task force to examine the total situation of parcel post in Alaska. The task force was mandated to review the USPS proposal.

…"There is no question that the Postal Service must control costs and enhance revenue in Alaska as it must do nationwide, but the potential impact in Alaska must be carefully considered in the light of the unique character of the Alaska economy and the geographic challenges of the state."[11]

A task force was established in early 1992 with Mr. Frank Power, the Assistant Postmaster General as chairman with representation from many of the stakeholders. In addition, Price Waterhouse and Diversified Holdings, LTD were hired by the postal service to make an independent analysis of the USPS hub proposal.

The Task Force membership and findings are found in Attachment 2. Generally, they directed the USPS to go slow in implementing any change. They did suggest several experiments that were to be implemented and evaluated. These included adding a hub at Emmonak and evaluating its impact on the system.

While this discussion is about non-priority mail for all of Alaska, the focus of our study is on the Y-K Delta which receives about one third of the statewide volume. Table 3 shows the history of growth in non-priority mail carried statewide plus the 1997 values for the Y-K Delta versus the cost.

Table 3 Growth in Parcel Post Mail in Volume, Revenue and Cost

Fiscal Year	Mainline Volume million lbs	Bush Volume million lbs.	USPS Revenue	USPS Costs*
1986	90.5	36.4	$8M	$31M
1987	96.2	38.5	$8M	$47M
1988	102.3	42.6	$9M	$58M
1989	108.5	47.0	$11M	$62M
1990	113.2	49.8	$10M	$79M
1991	113.7	52.0	$12M	$82M
1992	109.3	52.7	n/a	$76M
1993	111.1	56.0	n/a	$79M
1994	n/a	n/a	n/a	n/a
1995	118.1	57.7	n/a	$87M
1996	123.0	59.8	n/a	$84M
1997	121.0	60.0	n/a	$90M
1998			n/a	
1999			n/a	

n/a: not available from the USPS

Y-K Delta Estimates for 1997

1997	43.5	22.8	n/a	$33M

Source: Before 1992, Alaska Parcel Post Study, November 15, 1991; after 1992, USPS Anchorage

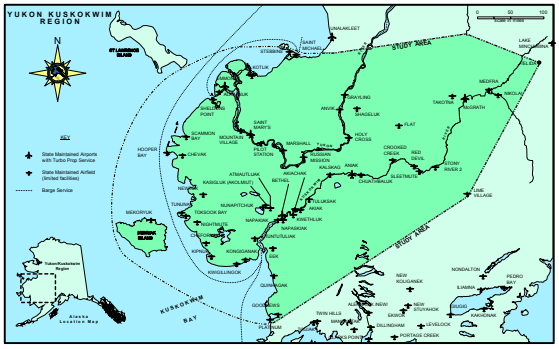
11. ibid.

4. Operational Approach by USPS

There are three levels of mail delivery from Anchorage to each of the hub airports of Bethel, St. Mary's Emmonak, Aniak, and McGrath. First is the regular priority or first class mail that travels by air anywhere in the U.S. This constitutes about 6 to 7% of the mail delivered into, within, and out from the 56 communities that comprise the Y-K Delta planning region. The remainder of the mail is non-priority mail, which travels under the label of fourth-class mail or parcel post. About 25% of this mail receives the treatment of fourth-class mail anywhere, namely it comes into the Post Office in Anchorage or any where and is sent to the hub post office and then to the bush village. The main difference is that it travels by air rather than surface route. The remaining 75% of the non-priority mail goes by "By-pass mail."

By-Pass mail is the result of a special program set up in Alaska to save the GMF (General Mail Facility or Postal Station) from having to accept and handle large parcel shipments in the post office itself. While each package of by-pass mail meets the weight and girth requirements for post office handling, it does not resemble parcel post as is it known in the lower 48 states. By-pass consists of palletized goods, largely foodstuffs, addressed to one or two recipients per pallet. Most often, it takes the form of the movement of goods between the wholesale outlet and the retail store. For example, a single supermarket in Hooper Bay received 30,000 pounds of by-pass mail in one week. A grocery store in Toksook Bay receives 2500 pounds each week.

Figure 1 The Y-K Delta Region



The operation is best described by discussion of the chart of Figure 2. A store in the bush village calls in an order to one of the pre-certified forwarders in Anchorage, like Denali Shipping, distributor for Safeway/Carrs. Each order must be at least 1000 pounds. The shipper-forwarder gathers the food stuffs and other dry goods, sorts and binds them together according to the standard USPS specifications, labels and stamps them according to postal regulations, calls the Postal Service to tell them they have a pallet(s). Standard 40-inch by 48-inch pallets are assembled for a single destination to a height not more than 72 inches. Not all pallets are 1000 pounds. Some have lighter, less dense goods; others more. While each order must be for at least 1000 pounds, within that order could be three types of foods or commodities shipped on separate pallets:

1. Regular goods with long shelf life like canned goods or cereal,
2. Time sensitive or perishable foods like fruits, vegetables, and fresh milk that require cold storage, but cannot be frozen.
3. Frozen goods that need to remain frozen until sale, like ice cream, frozen meats, etc.

The post office tells the shipper which carrier it has chosen for delivery. The shipper meets the USPS representative at the air carrier. The Postal Service accepts

the pallets and transfers them to the air carrier to be transported to the destination.

Figure 2 Bush Mail Delivery Patterns in the Y-K Delta

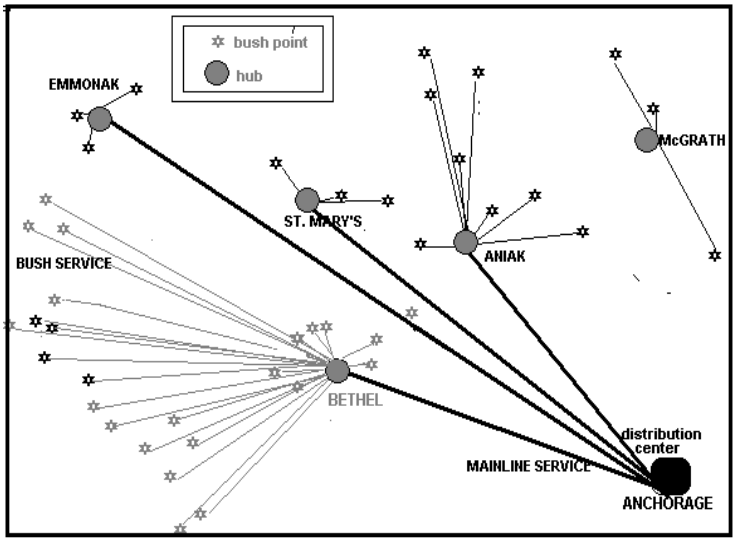


Figure 3. By-pass mail on conveyor after strapping packages together, weighing and stamping by the Shipper

Figure 4. Pallet of Chill Products on pallet for shipment

Figure 5. By-pass Pallet of Chill (perishable) Product, showing how several goods are banded and prepared for shipment

Figure 6 Pallet of Bypass mail after arriving at St. Mary's airport

Figure 7 Loading bypass mail at Emmonak for Kotlik

Figure 8 Stuffing mail for Alakanak in Cessna 206.

Once the air carrier receives the mail, it is their responsibility to deliver it to the destination (store in the bush village) without further involvement by the Postal Service. The carrier in Anchorage transports the mail to the appropriate hub. There it is transferred on an equal tender[12] basis to one of the certified bush carriers. Because of short runways, smaller planes (like a single engine Cessna 206) are used for transport to a bush community for delivery to the consignee. See Figures 6, 7 and 8.

From data gathered by the USPS, there appears a strong similarity to the market distribution. Only 10 shippers account for 91% of the by-pass mail. The consignees are more evenly spread with two chains accounting for about 22% of the deliveries.[13] These stores, like the Safeway in the lower-48, are spread throughout the bush communities. The shipper and consignee would represent a link the distribution network usually accomplished by freight carriers or private trucking in lower 48.

12 . Every carrier that is certified is guarenteed an equal amount of mail based on the market. Called "equal tender".

13. USPS Proposal op. cit. Exhibit II.

5. Legislation and Rate-Setting

The legislation which governs this delivery of mail is found in 39 USC 5402, defining the Postmaster General's role for Alaska mail service and 49 USC 419, defining the Secretary of Transportation's role. The relevant portions of the codes are presented in Attachment 1. The regulatory process has always involved orders that were circulated to the affected parties giving them time to *show cause* why the proposed regulation should not be put into law. Table 4 below summarizes the more relevant show cause orders that apply to Intra-Alaska mail service beginning with the CAB's 1970 and 1977 regulations setting of rates for priority and non-priority mail.

The assessment of the economics begins with the rate setting process. The USDOT assumed the functions formerly identified with the Civil Aeronautics Board. Annually each carrier submits their costs for the preceding year to the Secretary of Transportation (USDOT), Bureau of Transportation Statistics (BTS). The data are used to set fair and compensatory rates to be paid by the USPS to each carrier for carrying mail. The rates are the result of a two level rate process with separate rates. One rate is for the air

transport line-haul, based on mileage, block hours, and fuel expenditures. The other rate is for the terminal process involving the handling of the mail at the hub and performing delivery in the villages. The procedures used by the USDOT have recently become fairly routine since the baseline rates were established in 1988 and 1990.

Table 4 Relevant regulatory dockets from 1970

Docket Number	*Date*	*Purpose*
70-4-9/10	April 1970	Non-priority mail rates
77-12-15	December 1977	Priority and non-priority Domestic Service Mail rate investigation
79-1-137&169	January 1979	Proposes to issue an order for rates applicable to all new inter-Alaska air services
80-9-150	September 1980	Civil Aeronautics Board comprehensive investigation into structure of mail service rates of Wien Air Alaska
80-11-81	November 1980	Defines Bush carriers as having a payload capacity of 4000 pounds or less
80-11-82	November 1980	Proposes establishing the Intra-Alaska Class Service Mail Rates Investigation
80-12-152	December 1980	Expands the definition to 7000 pounds or less
86-10-45	October 1986	Instituted a comprehensive investigation to determine new fair and reasonable intra-Alaska Bush rates
87-3-44	March 197	Carriers to review and correct submissions (298-C Forms)
88-4-27	April 13, 1988	Finalized the temporary rates in effect since October 1986
89-7-51	August 4, 1989	Established new temporary rates
90-10-84	October 22, 1990	Established final mail rates including standard procedures for annually updating them.
95-12-32	December 29, 1995	Eliminate retroactive rate changes
96-2-2	February 5, 1996	Revised schedule for bush rates.
96-12-41	December 1996	Updated Order 90-10-34
97-1-12	January 22, 1997	Established bush rates April 1, 1997 through March 31, 1998
97-9-37	September, 29, 1997	(1)Change the methodology currently used to update Alaska Bush and Mainline nail rates, (2) change frequency of mainline rates to once per year and (3) adjusting procedural schedule for responding to Show Cause Orders
97-11-20	November 1997	Made final tentative conclusions of 97-9-37
98-1-25	January 26, 1998	Sets Bush mail rates for April 1, 1998 through March 31, 1999
98-7-3,	July 1, 1998	Sets Final Mainline rates for October 1, 1998 to September 30, 1999.

INSERT 1

From Order 98-7-3 entitled "Show Cause Order Establishing Final Mainline Service Mail Rates**",** dated July 1, 1998 specified the mainline rates for October 1, 1998 to September 30, 1999 and provided data relative to the baseline 1982 rates.

	through YE 9/30/98	through YE 9/30/99	% Increase
Line -haul charge per billing ton-mile			
Priority	$1.3732	1.4216	3.52%
Non- Priority	$0.8313	$0.8606	3.52%
Terminal Charges per pound originated			
Priority	$0.2381	$0.2360	-0.89%
Non- Priority	$0.2045	$0.2027	-0.89%

Fair and reasonable compensation to be paid according to 49USC41901
Payloads exceeding 7500 pounds.

	Baseline	through YE 9/30/99	% Increase
Line -haul charge per billing ton-mile			
Priority	$1.1969	1.4216	18.77%
Non- Priority	$0..7246	$0.8606	18.77%
Terminal Charges per pound originated			
Priority	$0.1697	$0.2360	39.04%
Non- Priority	$0.1458	$0.2027	39.04%

#82-11-13

INSERT 2

Order 98-1-25 entitled "Order to Show Cause Establishing Final Bush Service Mail Rates"**,** January 26, 1998, provided the Bush rates for April 1, 1998 to March 31, 1999 and data relative to the 1990 baseline rates

	through YE 3/31/98	**through YE 9/30/99**	**% Increase**
Line -haul charge per billing ton-mile			
Non- Priority	$7.8121	$8.4514	8.18%
Terminal Charges per pound originated			
Non- Priority	$0.4065	$0.3805	-6.40%

#97-1-12

Fair and reasonable compensation to be paid according to 49USC41901 for aircraft with payloads of 7500 pounds or less.

	Baseline	**through YE 9/30/99**	**% Increase**
Line -haul charge per billing ton-mile			
Non- Priority	$5.9525	$8.4514	41.98%
Terminal Charges per pound originated			
Non- Priority	$0.2217	$0.3805	71.61%

#90-10-34

INSERT 3

In Order 97-9-37 entitled "Order to Show Cause Intra-Alaska Bush and Mainline Service Mail Rates," dated September 1997, the Secretary of Transportation proposed to replace the current update methodology for bush and mainline rates. The main factors were:

- An update every six months instead of annually
- To separate fuel from non-fuel costs in the rate determination
- To use actual fuel costs without projections
- To base terminal rates on the most recent actual costs
- adjusted forward to new rate period on the basis of most recent ten year moving average of non-fuel costs

Under the present system, regardless of the cost of delivery of mail, the USPS will always sustain a loss. The regulations practiced by the USPS, especially those calling for equal tender, combined with the USDOT approach to set rates on actual expenses plus a fair profit, suggest that the present posture of using the Cessna 206 (or its equivalent) stuffed up to its capacity will continue indefinitely.

There is very little incentive to do more than the minimum amount using the little airplanes (the most expensive approach possible) to garner the most profit. This leads one to ask the question, "What incentives are there in the system for a given carrier to improve service? Or to find ways to lower price?"

The other economic factor appears to be the employment at the Hubs and in the villages of carrier agents. The agent meets the plane, sees that the mail is moved from the airstrip to the destination store and that the mail remains under continuous watch while it sits on the tarmac. The advantage of more hubs will be found in the reduced bush line haul cost.

Terminal costs will go up at the hub with more employment at the new hub. While the same person may serve as agent for more than one airline. The unattended rule for mail on the tarmac creates the need for others from the village to become involved and earn some added income.

The interesting thing is that the system has taken on a posture of its own in the minds of the villagers. Continuing to receive the mail in 206's, 10 to 14 flights per day into most villages, is one more fact that they feel will ensure continuity of air service. They want to retain the capability of their airports which for the most part are serving them well. Any saving that the USPS can obtain will reduce the USPS negative revenue, but will not change the price of goods in the stores. Thus it is hard to get public opinion, at least among the recipients of by-pass mail to be in favor of the increasing the efficiency of delivery.

It is hard to assess or even estimate the impact of rates if they were revenue neutral. One quick calculation would begin with an estimate of average food density say about 50% greater than water. (Canned goods will be more while cereal much less).

Table 5. Cost of Delivering a 50 Pound Non-priority Package to Bush Alaska

Linehaul to Bethel	**400 miles *$0.8608*50/2000**	**$8.61**
Terminal Costs for Mainline	**$0.2027*50#**	**$10.14**
Haul to Bush Village	**80 miles *$8.4514*50/2000**	**$16.90**
Terminal in Bush Village	**$03805*50#**	**$19.05**
	Total	**$54.70**
		(or $1.09 per pound)

Table 6 Differential of transport cost on foods of various weights per pound

Price per pound without transportation	Cost in the bush store	Cost if full charge for delivery were charged	% added charge
$.50	$0.67	$1.59	188%
$1.00	$1.17	$2.09	94%
$2.00	$2.17	$3.09	47%
$3.00	$3.17	$4.09	31%

The cost to ship a 50 pound parcel to the average village from Bethel (80 miles) is The USPS rate sheet (1999)[14] used by Postal Stations throughout the United States suggests that $8.54 be charged for a 50 pound package to zone one. This amounts to about 17 cents per pound. The following chart of Table 5 indicates the increase in cost of goods for several prices per pound. It is clear that the full cost of transportation would not only be inflationary, but it would cripple the villages where unemployment is often over 50% and the foods in the store are more to supplement the subsistence economy of the villages. Even though the distances to the villages along the coast would push the mail to zone 3, the Y-K Delta pays revenue for Zone one delivery.

6. Improving Efficiency of Mail Transport to Rural Alaska

The purpose of this paper was to lay out the scope of the USPS system of mail delivery for an area like the Y-K Delta. Because of the large amount being transported moved there are many flights per day. The USPS demand for transport efficiencies will be important to the overall Y-K plan. Likewise the ability to use new technologies with better runways that are lighted, could improve efficiency. All of the airports in the Y-K Delta are owned and maintained by the State of Alaska, Department of Transportation and Public Facilities..

Clearly the delivery of goods to these remote villages is important to their quality of life. In a similar vein, a part of AKDOT&PF's mission has concerns such as:

- *Improve transportation for Bush Alaska thereby minimizing user cost and improving health safety and quality of life*
- *Partner early with communities, Native organizations, private and commercial organizations, and federal and state agencies to accomplish transportation and economic development projects*
- *Improve access to communities and resources to promote economic development consistent with community, wilderness, subsistence and cultural values*[15]

Further the aviation section of the Policy statement intends that the Department "Give preference to the needs of the approximately 180 off-highway airports." for providing transportation that is efficient Further it is appropriate for the DOT to look at the transportation issues that contribute to the large cost deficit, even if that deficiit is borne by another entity of government, in this case the USPS. However, as the Task Force found, the system is complex with many ramifications. Thus the costs and benefits are not only across agencies, but in this case there is the trade-off between investment costs (FAA/AKDOT) and operational costs (USPS)

Table 7 presents some options that should be explored fully as means of improving efficiency. The USPS will have the opportunity to consider alternative ways of handling the mail. The hovercraft experiment presently underway at Bethel is one such idea.

7. Summary

The Alaska Department of Transportat6ionn and Public Facilities is developing a plan for one to the areas of the state where low-cost mail delivery is not only essential for the economic heath of the village communities, but also where efficiency of the system can be improved by careful consideration of the transportation improvements that might be

14 . Notice 123 Ratefold January 10, 1999

15. Department Policy Statement in "Vision 2020 Update, Statewide Transportation Planning" dated March 1997

made in the next twenty years. This effort has shown that the system as it is presently operated does work.

Table 7 Several Approaches For Possible Change

#	*Approach*	*Impact*
1.	Better airplanes, larger loads within the definition of the bush carriers	Requires paved runways of 4000, apron upgrading,. Requires different PO set-up.
2.	Try new delivery methods such as low speed "drops" similar to that used extensively by the military	
3.	Extensive use of the STOL aircraft such as CASA 212 or VTOL such as helicopter or tilt-rotor aircraft.	Increase payload and permit some trip chaining.
4.	Put into effect a rate structure that will provide incentive for bush carriers to upgrade their fleets, in a way that will reduce costs	Would involve a third rate that would stimulate larger more efficient aircraft
5.	Change the equal tender rules and rate structure to alter the competition	Instill competition with different aircraft capabilities
6	Identify some surface mode of transportation (hovercraft)	All weather use. Bering sea performance questionable.
7.	Better define the commodities allowed in the air system. Use water travel and snow trail delivery when applicable for staples.	
8.	Consider a major hub such as Bethel as the distribution center reducing mainline haul costs to barge rates and bush haul to the lowest cost travel as necessary.	
9.	Apply the lower 48 zone system to increase revenue	

However, as the demand to have more consumer goods increases in the remote villages (as will undoubtedly happen with the high population growth rate and increased cash level of the economy) and the passenger demand increases (as it will), the aviation system will need to undergo changes in the name of efficiency. At one time, the high frequency of the mail delivery to the villages provided a cushion for the airlines as they served the villages. However, the frequency of service for passengers has grown to the place where the cross benefits between passenger travel and mail delivery seems to be limited and small.

One major USPS policy that comes in the study is that of equal tender and rate setting. While the sense of fairness to apply full compensatory rates for any aircraft with a payload of less than 7500 pounds and to give each air competitor an equal share of the mail is certainly laudable, these two principles do not provide for much incentive for air carriers to find new and more efficient aircraft.

Choosing any of the approaches listed in the table or other approaches is entirely up to the USPS and their ability to cause the carriers to behave differently.

AKDOT&PF can only react to the needs as the USPS perceives them and requests AKDOT&PF to implement certain runway improvements that will make for better access. By exploring this area of demand the AKDOT&PF notes the possible need for longer runways with lighting and GPS capability at many of the Y-K delta's villages. Conditions which are being met in the plan to which this Appendix is attached

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14. U. S. Postal Service, ***Intra-Alaska Certified Air Carrier and By-Pass Shipper Instructions***, Handbook PO-508 Draft, January 4 1999.

15. USCODE 39USC Chapter 54 and 49USC Chapter 419

ATTACHMENT 1

RELEVANT SECTIONS OF U.S.CODE

From 39USC Chapter 54 TRANSPORTATION OF MAIL BY AIR

Sec. 5401. Authorization

(a) The Postal Service is authorized to provide for the safe and expeditious transportation of mail by aircraft.

(b) Except as otherwise provided in section 5402 of this title, the Postal Service may make such rules, regulations, and orders consistent with part A of subtitle VII of title 49, or any order, rule, or regulation made by the Secretary of Transportation thereunder, as may be necessary for such transportation.

Sec. 5402. Contracts for transportation of mail by air

(a) The Postal Service may contract with any certificated air carrier, without advertising for bids, in such manner and under such terms and conditions as it deems appropriate, for the transportation of mail by aircraft between any of the points in foreign air transportation between which the carrier is authorized by the Secretary of Transportation to engage in the transportation of mail. Such contracts shall be for the transportation of at least 750 pounds of mail per flight, and no more than 5 percent, based on weight, of the international mail transported under any such contract shall consist of letter mail. Any such contract shall be filed with the Secretary of Transportation not later than 90 days before its effective date. Unless the Secretary of Transportation shall determine otherwise (under criteria prescribed by section 40101(a) of title 49) not later than 10 days prior to the effective date of the contract, such contract shall become effective.

(b) When the Postal Service deems that the transportation of mail by aircraft is required between points in foreign air transportation between which the Secretary of Transportation has not authorized an air carrier or combination of air carriers to engage in the transportation of mail, it may contract with any air carrier in such manner and under such terms and conditions as it may deem appropriate for the transportation of any class or classes of mail. The transportation of mail under contracts entered into under this subsection is not, except for sections 40109(a) and (b). When the Postal Service deems that the transportation of mail provisions of part A of subtitle VII of title 49. The Postal Service shall cancel such contract, in whole or in respect to certain points as the certificate shall require, upon the issuance by the Secretary of Transportation of an authorization under chapters 411 and 413 of title 49 to any air carrier to engage in the transportation of mail by aircraft between any of the points named in the contract, and the inauguration of scheduled service by such carrier.

(c) If the Postal Service determines that service by certificated air carriers or combination of air carriers between any pair or pairs of points in foreign air transportation is not adequate for its purposes, it may contract for a period of not more than 4 years, without advertising for bids, in such manner and under such terms and conditions as it may deem appropriate, with any air taxi operator or combination thereof for such air transportation service. Contracts made under this subsection may be renewed at the existing rate by mutual agreement between the holder and the Postal Service. The Postal Service, with the consent of the air taxi operator, may adjust the compensation under such contracts

for increased or decreased costs occasioned by changed conditions occurring during the contract term. The Postal Service shall cancel such a contract when the Secretary of Transportation authorizes an additional certificated carrier or carriers to provide service between any pair or pairs of points covered by the contract, and such carrier or carriers inaugurate schedules adequate for its purposes.

(d) The Postal Service may determine rates and contract with any air carrier for the transportation of mail by aircraft in interstate air transportation either through negotiations or competitive bidding.

(e) For purposes of this section, the terms "air carrier", "interstate air transportation", and "foreign air transportation" have the meanings given such terms in section 40102(a) of title 49.

*(f) The authority of the Secretary of Transportation and the Postal Service under subsections (a), (b), and (c) of this section shall also apply, and the authority of the Postal Service under subsection (d) shall not apply, to the transportation of mail by aircraft between any two points both of which are within the **State of Alaska** and between which the air carrier is authorized by the Secretary to engage in the transportation of mail.*

(g)

(1) The Postal Service, in selecting carriers of non-priority bypass mail to any point served by more than one carrier in the State of **Alaska**, shall, at a minimum, require that any such carrier shall -

(A) hold a certificate of public convenience and necessity issued under section 41102(a) of title 49;

(B) operate at least 3 scheduled flights each week to such point;

(C) exhibit an adherence to such scheduled flights to the best of the abilities of such carrier; and

(D) have provided scheduled service within the State of **Alaska** for at least 12 consecutive months with aircraft -

(i) up to 7,500 pounds payload capacity before being selected as a carrier of nonpriority bypass mail at an applicable **intra-Alaska bush** service mail rate; and

(ii) over 7,500 pounds payload capacity before being selected as a carrier of nonpriority bypass mail at the **intra-Alaska mainline** service mail rate.

(2) The Postal Service -

(A) may provide direct mainline non-priority bypass mail service to any bush point in the State of **Alaska**, without regard to paragraph (1)(B), if such service is equal to or better than interline service in cost and quality; and

(B) shall deduct the non-priority bypass mail poundage flown on direct mainline flights to bush points within the State of **Alaska** by any carrier, from such carrier's allocation of the total poundage of non-priority bypass mail transported to the nearest appropriate Postal Service hub point in any month.

(3)

(A) The Postal Service shall determine the bypass mail bush points and hub points described under paragraph (2)(B) after consultation with the **State of Alaska** and the affected local communities and air carriers.

(B) Any changes in the determinations of the Postal Service under subparagraph (A) shall be made –

(i) after consultation with the **State of Alaska** and the affected local communities and air carriers; and

(ii) after giving 12 months public notice before any such change takes effect.

Excerpt from PUBLIC LAW 104-52

Sec. 631

(a) Section 5402 of title 39, United States Code, is amended--

(1) in subsection (f) by striking out ``During the period beginning January 1, 1985, and ending January 1, 1999, the'' and inserting in lieu thereof ``The''; and in subsection (g)(1) by amending subparagraph (D) to read as follows:

*(2) `(D) <<NOTE: **Alaska**.>> have provided scheduled service within the **State of Alaska** for at least 12 consecutive months with aircraft-``*

*(i) up to 7,500 pounds payload capacity before being selected as a carrier of nonpriority bypass mail at an applicable **intra-Alaska bush** service mail rate; and*

*(ii) over 7,500 pounds payload capacity before being selected as a carrier of nonpriority **bypass** mail at the intra-Alaska mainline service mail rate.".*

(b.) <<NOTE: Effective date. 39 USC 5402 note.>> Subject to paragraph (2), the amendment made by subsection (a) shall be effective on and after August 1, 1995.

(2) Subparagraph (D) of section 5402(g)(1) title 39, United States Code (as in effect before the amendment made under subsection (a)), shall apply to a carrier, if such carrier--

(A) has an application pending before the Department of Transportation for approval under section 41102 or 41110(e) of title 39, United States Code, before August 1, 1995; and

(B) would meet the requirements of such subparagraph if such application were approved and such certificate were purchased.

(c) Section 41901(g) of title 49, United States Code, is repealed.

Chapter 411 Air Carrier Certificates

41102. General, temporary, and charter air transportation certificates of air carriers

(a) Issuance. - The Secretary of Transportation may issue a certificate of public convenience and necessity to a citizen of the United States authorizing the citizen to provide any part of the following air transportation the citizen has applied for under section 41108 of this title:

(1) air transportation as an air carrier.

(2) temporary air transportation as an air carrier for a limited period.

(3) charter air transportation as a charter air carrier.

(b) Findings Required for Issuance. –

(1) Before issuing a certificate under subsection (a) of this section, the Secretary must find that the citizen is fit, willing, and able to provide the transportation to be authorized by the certificate and to comply with this part and regulations of the Secretary.

(2) In addition to the findings under paragraph (1) of this subsection, the Secretary, before issuing a certificate under subsection (a) of this section for foreign air transportation, must find that the transportation is consistent with the public convenience and necessity.

(c) Temporary Certificates. - The Secretary may issue a certificate under subsection (a) of this section for interstate air transportation (except the transportation of passengers) or foreign air transportation for a temporary period of time (whether the application is for permanent or temporary authority) when the Secretary decides that a test period is desirable

(1) to decide if the projected services, efficiencies, methods, and prices and the projected results will materialize and remain for a sustained period of time; or

(2) to evaluate the new transportation.

(d) Foreign Air Transportation. - The Secretary shall submit each decision authorizing the provision of foreign air transportation to the President under section 41307 of this title.

49USC CHAPTER 419

Sec. 41901. General authority

(a) Title 39. - The United States Postal Service may provide for the transportation of mail by aircraft in interstate air transportation under section 5402(d) and (f) of title 39.

(b) Authority To Prescribe Prices. - **Except as provided in section 5402 of title 39,** on the initiative of the Secretary of Transportation or on petition by the Postal Service or an air carrier, the Secretary shall prescribe and publish -

(1) after notice and an opportunity for a hearing on the record, reasonable prices to be paid by the Postal Service for the transportation of mail by aircraft in foreign air transportation or between places in **Alaska,** the facilities used in and useful for the transportation of mail, and the services related to the transportation of mail for each carrier holding a certificate that authorizes that transportation;

(2) the methods used, whether by aircraft-mile, pound-mile, weight, space, or a combination of those or other methods, to determine the prices for each air carrier or class of air carriers; and he effective date of the prices.

(c) Other Transportation. - In prescribing prices under subsection (b) of this section, the Secretary may include transportation other than by aircraft that is incidental to transportation of mail by aircraft or necessary because of emergency conditions related to aircraft operations.

(d) Authority To Prescribe Different Prices. - Considering conditions peculiar to transportation by aircraft and to particular air carriers or classes of air carriers, the Secretary may **prescribe different prices under this section for different air carriers or classes of air carriers and for different classes of service.** In prescribing a price for a carrier under this section, the Secretary shall consider, among other factors, the following:

(1) the condition that the carrier may hold and operate under a certificate authorizing the transportation of mail only by providing necessary and adequate facilities and service for the transportation of mail.

(2) standards related to the character and quality of service to be provided that are prescribed by or under law.

(e) Statements on Prices. - A petition for prescribing a reasonable price under this section must include a statement of the price the petitioner believes is reasonable.

(f) Statements on Required Services. - The Postal Service shall introduce as part of the record in every proceeding under this section a comprehensive statement of the services to be required of the air carrier and other information the Postal Service has that the Secretary considers material to the proceeding.

Sec. 41902. Schedules for certain transportation of mail

(a) Requirement. - Except as provided in section 41906 of this title and section 5402 of title 39, an air carrier may transport mail by aircraft in foreign air transportation or betweenplaces in **Alaska** only under a schedule designated or required to be established under subsection (c) of this section for the transportation of mail.

(b) Statements on Places and Schedules. - Every air carrier shall file with the Secretary of Transportation and the United States Postal Service a statement showing -

(1) the places between which the carrier is authorized to provide foreign air transportation;

(2) the places between which the carrier is authorized to transport mail in **Alaska**

(3) every schedule of aircraft regularly operated by the carrier between places described in clauses (1) and (2) of this subsection and every change in each schedule; and

(4) for each schedule, the places served by the carrier and the time of arrival at, and departure from, each place.

(c) Designating and Additional Schedules. - The Postal Service may -

(1) designate any schedule of an air carrier filed under subsection (b)(3) of this section for the transportation of mail between the places between which the carrier is authorized by its certificate to transport mail; and

(2) require the carrier to establish additional schedules for the transportation of mail between those places.

(d) Changing Schedules. - A schedule designated or required to be established for the transportation of mail under subsection (c) of this section may be changed only after 10 days' notice of the change is filed as provided in subsection (b)(3) of this section. The Postal Service may disapprove a proposed change in a schedule or amend or modify the schedule or proposed change.

(e) Orders. - An order of the Postal Service under this section may become effective only after 10 days after the order is issued. A person adversely affected by the order may appeal the order to the Secretary before the end of the 10-day period under regulations the Secretary prescribes. If the public convenience and necessity require, the Secretary may amend, modify, suspend, or cancel the order. Pending a decision about the order, the Secretary may postpone the effective date of the order.

(f) Proceedings Preferences. - The Secretary shall give preference to a proceeding under this section over all other proceedings before the Secretary under this subpart.

Sec. 41903. Duty to provide certain transportation of mail

(a) Air Carriers. - Subject to subsection (b) of this section, an air carrier authorized by its certificate to transport mail by aircraft in foreign air transportation or between places in Alaska shall -

(1) provide facilities and services necessary and adequate to provide that transportation; and

(2) transport mail between the places authorized in the certificate for transportation of mail when required, and under regulations prescribed, by the United States Postal Service.

(b) Maximum Mail Load. - The Secretary of Transportation may prescribe the maximum mail load for a schedule or for an aircraft or type of aircraft for the transportation of mail by aircraft in foreign air transportation or between places in **Alaska**. If the Postal Service tenders to an air carrier mail exceeding the maximum load for transportation by the carrier under a schedule designated or required to be established for the transportation of mail under section 41902(c) of this title, the carrier, as nearly in accordance with the schedule as the Secretary decides is possible, shall -

(1) provide facilities sufficient to transport the mail to the extent the Secretary decides the carrier reasonably is able to do so; and

(2) transport that mail.

Sec. 41910. Weighing mail

The United States Postal Service may weigh mail transported by aircraft and make statistical and administrative computations necessary in the interest of mail service. When the Secretary of Transportation decides that additional or more frequent weighings of mail are advisable or necessary to carry out this part, the Postal Service shall provide the weighings, but it is not required to provide them for continuous periods of more than 30 days

ATTACHMENT 2

Specifics of Alaska Parcel Post Task Force
and
Recommendations from Task Force's Final Report

PRELIMINARIES

- USPS report entitled Alaska Parcel Post Study requesting 15 additional hub points in Alaska - November 1990
- Letter from Postmaster Anthony Frank, Senator Ted Stevens, Senator Frank Murkowski, and Representative Dan Young requesting a task force to study the general subject of mail service in Alaska and the USPS report for 15 additional hubs - November 15, 1991
- Congressional Delegation News Release - November 25, 1991
- Meeting of Aviation Industry Participants in Anchorage convened by Senator Stevens December 17, 1991

TASK FORCE MEMBERS

- Mr Frank Power, Assistant Postmaster General (Chairman);
- Mr. Jim Campbell, Alaska Commercial Corp;
- Mr. Robert Silas, Tanana Chiefs Conference;
- Mr. P. R. Steinman Chief of Alaska Field Office U. S. D. O. T.;
- Mr. Richard Romer, Special Assistant for Rural Affairs, Govenor's' Office;
- Dr. Scott Goldsmith, Professor of Economics, University of Alaska, Anchorage;
- Mr. Floyd Pattison Airports Division FAA-Alaskan Region;
- Ms. Helvi Sandvik, Manager Statewide Aviation, Alaska DOT/PF; and
- Mr. Richard Stern, President of Alaska Air Carriers Association.

MEETINGS OF TASK FORCE

Open meeting April 23, 1992 - Juneau

Open meeting July 29, 1992 - Anchorage

Open meeting July 30. 1992 - Bethel (cancelled because of bad weather)

Open meeting October 6, 1992 - Barrow

Open meeting October 7, 1992 - Fairbanks

Closed Meeting November 12, 1992 - to draft report

SUMMARY OF RECOMMENDATIONS

The unanimous recommendations of the Alaska Parcel Post Task Force are summarized as follows:

1. USPS should proceed with the implementation of two new air transportation hubs at Emmonak to serve bush points at Alakanuk, Kotlik, and Sheldon Point; and at Point Hope to serve a bush point at Kivalina. Prior to implementation of the Point Hope hub, a further meeting should be held by USPS with North Slope Borough authorities to review the transition from the present use of Kotzebue as the hub for both Point Hope and Kivalina. Implementation of any of the other thirteen hubs announced in the Federal Register, Volume 56, No. 37, dated February 25, 1991, should be deferred until after the impact of the new hubs at Emmonak and Point Hope has been assessed by USPS. In reviewing possibilities for future hub designations, Bettles should be considered as an alternative to Anaktuvuk Pass.
2. The postal regulations permitting strapping together of two or more packages and mailing them as a single parcel should be retained in their present form.
3. Modification of the "36/24-Hour Rule" regarding the time within which an air carrier must transport non-priority mail from Anchorage or Fairbanks to the hub and bush point should be pursued actively by USPS as a means of reducing air transportation rates in view of air carrier indications that lengthening these delivery times would reduce costs by decreasing overall system capacity requirements.
4. In implementing any lengthening of delivery time by modification of the "36/24-Hour Rule" the Postal Service should maintain its current policies and procedures regarding the handling of perishable matter in the bypass system.
5. USPS should not establish a commodity rate structure for bypass mail.
6. USPS should not change its regulations in order to eliminate freeze and chill items from bypass mail since current regulations adequately address the movement of non-priority mail.
7. The Task Force is unable to recommend either for or against the modification of the zone based rate structure for Alaska parcel post due to the complexity and lack of public input on this proposal. However, the Task Force expressed its clear preference for the implementation of the cost reduction recommendations made in this report prior to the consideration by USPS of modification of the zone rate structure. The Task Force recognizes that the cost reductions recommended in this report will not eliminate the Alaska parcel post deficit and that steps to increase revenues may be necessary in the future. Adequate opportunity for public comment should be provided prior to any such action.
8. USPS should defer changing the maximum weight limits for bypass mail shipments until after it has assessed the impact of any modifications to the "36/24-Hour Rule."
9. USPS should consider elimination of the door-to-door delivery requirement for bypass mail by air carriers only after further study of the cost savings to USPS and the air carriers versus the impact on addressees and the concerns of the Alaska Department of Transportation and Public Facilities over potential liability increases due to increased numbers of persons picking up shipments at airports.
10. The Task Force recommends against having the "Village Agent" be a USPS employee delivering for all air carriers and against replacing air carrier delivery at

bush points by USPS highway contract service unless further study should indicate that such replacement is cost effective for USPS.

11. 'Ihe Task Force endorses the principle that parcel post is intended to be a surface delivery service wherever possible and, therefore, USPS should explore additional surface alternatives to air movement for mail and parcels. The Task Force recommends that USPS implementation planning be continued on the air to surface conversions for Fairbanks to Barrow (via road to Dead Horse and thence via air to Barrow), Nome to Teller (seasonal), Dillingham to Aleknagik, and Anchorage to Fairbanks and return; and that other cost saving opportunities for air to surface conversions continue to be actively pursued.
12. The Task Force also endorses other USPS efforts to reduce costs by change of transportation service and that USPS continue actively to pursue such opportunities as may be feasible and economic.
13. The Task Force recommends the implementation of improved financial and operational data collection and analysis methods to better identify air carrier costs for rate making purposes. In consonance with the purposes for which it was created, the Task Force can only recommend the establishment of geographically based bush mail rates to the extent that such rates reduce total USPS costs.
14. The Task Force recommends that USPS should devote adequate resources to the aggressive review of U.S. Department of Transportation air carrier rate cases.
15. The Task Force recommend that USPS continue to pursue its active revenue protection program to ensure that proper postage is affixed to all individual parcels within each bypass mail shipment and to exclude restricted items from such shipments.

Appendix D
Yukon-Kuskokwim Delta Parcel Post Forecast 2000 – 2020

By: George G Kopcha,
Robert K. Whitford,
Purdue University
May/June 2000

Demand for By-Pass Mail in the Y-K Delta – 2000 to 2020

Abstract

The amount of goods shipped by the United States Postal Service (USPS) clearly requires a large portion of the aviation capability available in the Yukon-Kuskokwim Delta. As such it behooves the Alaska Department of Transportation, in its planning, to attempt to forecast the future of mail movement in the Y-K Delta. The data to be used in the forecast is limited and the analysis difficult because the system is relatively new.

In the past (before 1980), the stores in the bush, for whom the mail system now serves as the distribution agent, depended on barge delivery over the short summer season and on air cargo at much higher rates to manage their inventory. The special fourth class mail system, inaugurated in the early 1980's, has grown rapidly as stores changed their ordering practices and their inventory grew. So the period of the late 1980's and early 1990's saw a very significant growth, as the mail system replaced goods formerly delivered by barge and air cargo became a part of the system and a new inventory.

The initial supplying of inventory is past and the system is in steady-state growth. Without significant changes in the system, the amount of consumption will grow simply from the population growth. The socio-economic shift in various bush villages from a strong subsistence economy to a growing cash economy will also affect the growth. This demand analysis uses a combination of data and models from several sources to try to determine the growth due to other causes. The best estimate is that in per-person consumption will average a growth of about 23 pounds per person per year. Changes in housing and the number of government and education workers will also increase the forecast. The growth for the Y-K delta is estimated to be about 3.5% per year by weight; amounting to handling approximately 100 million pounds in 2020 up from the 54 million pounds in 2000.

1. Introduction

Since the number of operations for the delivery of mail in the Y-K delta is about equal to the number of passenger operations, special effort was undertaken to forecast the amount of mail to be delivered to each village in the future. In lieu of much hard data from the post office, this forecast makes use of other forecasts, notably the BEA forecast for economic activity. And the statewide data relative to mail delivery. Data from post office which outlines operations was also used.

Approximately 25,000 people live in the Yukon-Kuskokwim Delta (Y-K Delta), a

region along the western coast of Alaska that has about 40,000 square miles. The major form of year-round transportation is by air. The goods that are flown to villages in the region generally come from distributors in Anchorage. Two types of goods are flown into the region.

- Mail delivered by the United States Postal Service (USPS): The goods must be non-hazardous and put into boxes that weigh less than 70 pounds each. Construction material is prohibited. The sender pays fourth class rates for zone 1. The mail amounts to over 46 million pounds per year into the Y-K Delta
- Air cargo: Private air carriers may allow hazardous materials, and large and heavy items. The sender pays a higher rate per pound, often as much as 4 to 5 times as much.[1] The estimate of air cargo into the region is about 6 to 7 Million pounds per year

This study evaluates the only the delivery of USPS mail and not the delivery of air cargo.

2. Historic Parcel Post Demand: Basis

Four alternative models were evaluated in an attempt to determine the basis

- Analysis of Statewide Alaska Parcel Post Demand
- Analysis of Data Specific to the Y-K Delta: Village Specific
- Analysis of Data Specific to the Y-K Delta: Aggregate Demand by village type
    - 'Typical Villages'
    - Small Villages
    - Large Villages
    - Hubs Bethel
- Use overall trend data

Each analysis has different statistical models, so that each model sets up a different type of problem for the same data. All of the models are summarized in this section. Generally, the analyses are evaluated according to the average weight of mail consumed per capita in a year. The annual weight of mail per capita varies depending on how the data is prepared. The statewide average is about 1,000 lb/cap, but individual villages can have anywhere between 1,000 lb./cap and 3,000 lb./cap. The average for all of the Y-K Delta is about 1,950 lb./cap.

Three types of analyses support the parcel post forecast. The first is to study the statewide Alaska parcel post demand. The second approach is to study the parcel post demand of individual villages of the Y-K Delta. The third is to study the aggregate demand of mail to each of the five groups of Y-K Delta villages: Bethel, hub villages, large villages, typical villages, and small villages. Finally the aggregate forecast from the first models is compared with a trend forecast using the limited 5 years of data we have.

Linear regression on USPS mail data was used in all approaches since the linear regression models are valuable to explain which factors are influential and roughly what the magnitude of the coefficient is.

3. Analysis of Statewide Alaska Parcel Post Demand

In order to observe a trend in chronological data, it would be preferable to have a great amount of data. The total weight of USPS mail, delivered through the mainline service for statewide Alaska, is known for eleven years (of a twelve-year period).

Additional data available for these twelve years are population and total income. These data are available for Alaska according to census district as well as

1 . Verbal Information from Northern Air Cargo

statewide values. In order to perform calculations with the mail weight data, which is the weight of mail handled by mainline service, the population and total income of those areas that receive mainline service must be determined. These values were estimated by subtracting the population and income of the 'metropolitan communities' of Alaska, that is, those census districts that consist of cities that do not receive mainline service, out of the statewide population and income values.

There are three statistical models for the analysis. These models, and the results of each of them, are:

- Growth of the Total Weight of USPS Mail: The total weight of mail delivered to Alaska grew due to population growth, due to growth of the total income to Alaska, and due to increasing demand over time. A linear regression with three independent variables shows that total mail in Alaska is increasing at 3 mil lb annually. Additional income seems to increase mail by .07 lb/($-income). Population has a negative influence (which is counter-intuitive), at –1780 lb/person.
- Growth of Weight Per Capita: The statewide average weight of USPS mail per capita grew due to increasing demand over time. According to a linear regression the weight per capita increases annually at 14 lb/cap, beginning in 1985 at 800 lb/cap.
- Growth of Weight Per Dollar Income: The statewide average weight of mail per dollar income grew due to increasing demand over time. The weight per dollar income increases annually at just under .001 lb/($-income), beginning in 1985 at .05 lb/$.

Note that the .07 lb/($-income) from the Total Weight model is higher than the .05 to .06 lb/($-income) implied by the Weight Per Dollar model. The negative contribution that population brings to the Total Weight model compensates for the high coefficient value.

The Statewide analysis has eleven years (of a twelve-year period) of historic statewide data, which is enough data to suggest a trend for the demand for parcel post. (Only five years of USPS data specific to the Y-K Delta is available.) The data available for the Statewide analysis are the total weight of mail delivered annually, the population for the year, and the total income received by Alaska residents annually.

The data used for this analysis come from two sources: the Alaska Parcel Post Study, prepared by Price-Waterhouse on contract with the USPS, and the Bureau of Economic Analysis.

The total weight of mail delivered by the USPS at mainline rates in Alaska for each federal fiscal year over the period from 1986 to 1997, with the exception of 1994, is summarized in Table 1

The Bureau of Economic Analysis (BEA, of the US Department of Commerce) publishes (See BEA website) population and total income for each year (presumably, for each calendar year). The aggregate (statewide Alaska) values of these population and income data are published along with data broken down according to Alaskan census district.

The BEA historic data must be prepared before performing the Statewide analysis, since the AKPPS data is the weight of mail delivered to the non-metropolitan communities in Alaska. (The 'metropolitan communities' of Alaska are Anchorage, Fairbanks, Juneau, and their surroundings.) Those census districts that belong to metropolitan communities are identified. Turning to the BEA historic data, the populations of these census districts are subtracted from the statewide population. The calculation is repeated using the total income data.

Table 1. Summary of Statewide USPS Data for Alaska (AKPPS)

Year	Weight (mil lb)		$	
	Mainline	Bush	Revenue	Cost
1986	90.5	36.4	$ 8mil	$31mil
1987	96.2	38.5	$ 8mil	$47mil
1988	102.3	42.6	$ 9mil	$58mil
1989	108.5	47.0	$11mil	$62mil
1990	113.2	49.8	$10mil	$79mil
1991	113.7	52.0	$12mil	$82mil
1992	109.3	52.7	n/a	$76mil
1993	111.1	56.0	n/a	$79mil
1994	n/a	n/a	n/a	n/a
1995	118.1	57.7	n/a	$87mil
1996	123.0	59.8	n/a	$84mil
1997	121.0	60.0	n/a	$90mil
1998	123.3	58.3	n/a	$94mil

n/a: not available
Sources: data for fiscal years 1986 through 1991 The Alaska Parcel Post Study (1991), Price-Waterhouse 1991 and data for fiscal years 1992 through 1999 come from the USPS office in Anchorage.

After adjusting the BEA historic data, the pounds of mail per capita and the pounds of mail per dollar income, for statewide Alaska, is calculated. The pounds per capita of USPS mail delivered in non-metropolitan Alaska went from 779 lb/cap at the start of the period, to a maximum of 975 lb/cap (in year 1996). The pounds per dollar income went from .0512 lb/$ at the start of the period, to a maximum of .0615 lb/$ (1996).

There are three different ways this analysis was conducted using linear regression—two single variable models, and one multiple variable model. The data used for the Statewide analysis and the results are presented in Appendix A. Table 2 summarizes these linear regression analyses.

4. Analysis of Data Specific to the Y-K Delta: Each Village

There are two statistical models for the analysis of typical village data.

- The annual weight of mail per capita for each village is assumed to be dependent on societal factors. As an example, one year a village has a high average family income, but the next year family income goes down. If there is a higher mail-weight per capita for the first year, then we may be able to demonstrate that there is a relationship between average family income and the weight per capita.

Table 2. Summary of Regression on AKUSPS Data

Dependent Variable	Independent Variable	Coefficient
pounds per capita	y-intercept	799
	year (“1986”=1)	14.1
pounds per dollar income	y-intercept	.0497
	year (“1986”=1)	.000838
pounds	y-intercept	$1.72.10^{8}$
	year (“1986”=1)	$2.99.10^{6}$
	total income (dollars)	.0698
	population	-1780

- The growth rate of mail per capita is assumed to be dependent on historic data, such as historic mail per capita, and historic mail per capita growth. As an example, the

population of one village (over the past four years) was down towards 125 people, and the population of a second village was close to 675 people. If the future growth of the weight per capita for the first village is higher than that of the second village, then we may be able to demonstrate that there is a relationship between historic village population and the future growth of weight per capita for that village.

These illustrations are greatly simplified. In order to substantiate such claims, the occurrences that these illustrations depend on must be reasonably frequent.

The first statistical model explains something about the weight of mail delivered to a village in, say, 1998, basing this explanation only on 1998 societal data. If, for example, the annual enplanement per capita for a village is an indicator of the weight per capita for that village, then the weight per capita for 1998 can be (partially) explained by the 1998 enplanement per capita value—the 1997 enplanement per capita value has absolutely no role in explaining the 1998 weight per capita value. (This statistical model is weakened by the unavailability of much societal data on an annual basis.)

The second statistical model explains something about the weight of mail delivered to a village in 1999, basing this explanation on societal data and the weight of mail for the years 1995 through 1998. So that, if annual enplanement is again an indicator of the weight of mail for a village, this second model states that the annual enplanement for the years 1995 through 1998 influences the weight of mail for 1999. The dependent variable of this model is the percent growth of the weight per capita for each village.

MODEL 1 – MAIL FOR EACH VILLAGE USING SOCIO-ECONOMIC DATA

The first typical village model is to evaluate mail-weight per capita for each village based on two types of information. The first type of information is data available annually: year, village population, and enplanement per capita. The second type of information is data that was collected for the 1990 US Census: average family income, average number of people per household, number of federal and state government employees per capita, and village percent poverty. These factors were selected because they have the potential to influence the weight of mail delivered to the villages. The following narratives are conjectures of how these factors influence weight per capita.

- It should be intuitive that the weight per capita increases each year, and that it increases with higher average family income. People are likely to purchase more goods over time, and purchase more goods if they have a higher income.

- Villages with a higher population would seem to have a higher weight per capita. This could be inferred because hub villages and villages with a population greater than 675 people tend to have high mail-weight per capita (Hooper Bay has 1,911 lb./cap, Emmonak has 2,002 lb./cap, and Chevak has 1,914 lb./cap according to fiscal year 1999).

- It might seem intuitive that if people are spending more money for air travel (and the village enplanement per capita is high) then the people have less money to spend on the goods delivered to the village, which could lead to a lower mail-weight per capita.

- Larger numbers of people per household suggest that more people share goods (common goods) within a household, which lowers the per capita mail-weight.

- Government jobs are high-paying and may demand work-related USPS services, and

both reasons should contribute to a higher weight per capita.

- The percent poverty factor could demonstrate that people who have income below a threshold demand a different amount of mail. This may result in significantly less weight per capita because of a low amount of spending money; or, due to food stamp program disbursements, somewhat more weight per capita than otherwise would be expected considering the average family income for the village.

The results of this model show that all independent variables with the exception of average family income are significant (P values under .05), but only when the model is evaluated using specific problem setups. If the problem is set up using only the data available annually over four years (no Census data), then village population is significant. On the other hand, setting the problem up with data collected for the 1990 Census along with average values of population, enplanement, and mail weight, shows that the population is not significant.

MODEL 2 - MAIL USING HISTORIC DATA

The second model of evaluating the data of the typical Y-K Delta villages is to use historic data in order to judge the future growth of mail-weight per capita for a specific village. The first step of this second model is to fit, for each village, a linear trend through the weight per capita over four years (fiscal years 1995 through 1998). This trend is based solely on the independent variable year. From this trend, a projected weight per capita for fiscal year 1999 is calculated—nothing more than the equation of this best fit line evaluated at 1999. There is a difference between this projected weight per capita, and the actual (known) value, for fiscal year 1999. The following is specific information about this method.

- The dependent variable is the percent difference of the actual weight per capita for fiscal year 1999 and the projected weight per capita. Positive (the actual value is higher than the projected value) and negative signs are significant. The percent difference calculation is

- $(w_{actual} - w_{projected}) / w_{projected}$ where w is the weight per capita.

- Historic population, enplanement per capita, and weight per capita (for the four years 1995 to 1998) are independent variables. An average value, not each of the four values, is used for these variables. The averaging calculation is (4x98 + 3x97 + 2x96 + x95) / 10 where x is population, enplanement per capita, or weight per capita.

- Historic rate of growth of population, of enplanement per capita, and of weight per capita (growth over four years, 1995 to 1998) are independent variables. Positive and negative signs are significant. The rate of growth is the slope of the fitted liner regression (of the four years of data), divided by the unweighted average of the four points.

- Two societal factors, average number of people per household and percent poverty, are independent variables.

The findings of the second typical village model show that the historic weight per capita; the historic rate of growth of the weight per capita, population, and enplanement per capita; and the average members per household were significant (P values under .10).

Parcel Post Demand for the Y-K Delta: 'Typical Villages' Aggregate

There are five years of historic data specific to the Y-K Delta. A history of five years is not

suitable in order to evaluate the growth of weight per capita. Two issues became apparent at first looking at the data.

- The weight of USPS mail delivered to each village in the Y-K Delta on a per-capita basis varies from 984 pounds (Napaskiak, 1997) to 2000 pounds (Grayling, 1997). (This statement is based only on the 34 typical villages, which will be defined later in this subsection.) We must explain why a village has a low, medium, or high weight of mail per capita.

- The variability of weight per capita for individual villages in the Y-K Delta is large, and only five years of history are available to observe the growth. A positive annual growth of weight per capita is statistically significant for only 18 of the 51 villages (omitting Flat and Telida: there are 53 villages in the Y-K Delta), according to linear regression analyses performed on each individual village. We must evaluate what influenced the growth of the weight per capita for a village, be it a strong positive growth, a weak positive growth, or stagnant growth.

- There is error inherent to the activity of ordering goods for consumption, factors that may change the weight per capita for a village, but are beyond the scope of this study to identify and evaluate. People do not purchase the precise amount of goods that explanatory variables such as year and income suggest that they should purchase. A degree of variability is expected in the data, but there are two factors that might lessen the accuracy of the weight per capita data and contribute to a greater variability.

- Large mail orders just before or after the turn of the new fiscal year could offset the need to place another large order soon. All the weight of a large order may be counted towards the previous fiscal year, consumed during the current fiscal year, and not offset by a large order before the end of the current fiscal year.

- The population is taken only once each year, on 1st July. The resident population may change significantly over the course of the year, so that this one-time value is unrepresentative of the average population of the village for the year. Additionally, census takers in the Y-K Delta have given the author the 'preliminary indication' that the reported population of most villages is understated by 5% to 25%.

These factors would seem to influence the weight per capita data of smaller villages to a greater extent than the data of larger villages.

The inherent error of the annual weight per capita data and the inaccuracies due to these two additional factors did not strongly influence aggregate data, such as the statewide and Y-K Delta regionwide data. It can be suggested that aggregating the data buffers the variability of the individual villages. This subsection (as well as the following subsection) will analyze the highly variable data of individual villages.

Let us propose that there are different categories of villages, that there are 'typical' villages, and larger and smaller villages, and hub villages—the hub villages other than Bethel, that Bethel is in a category by itself. The data of village weight per capita for each of these five groups behave in a unique manner. For example, the annual weight per capita at hub villages is about 2,400 lb/cap, which is higher than the 1,550 lb/cap at typical villages.

This subsection will evaluate the behavior of typical villages. The next subsection will evaluate the behavior of each of the remaining village groups.

Typical villages are all bush villages that had a population in 1995, 1996, and 1997 of between 125 and 675 people (inclusive). The villages that served as hubs for USPS mail transshipment were omitted. This definition allows 34 of the 48 bush communities in the Y-K Delta to be evaluated. The mail delivered to each of these 34 villages ranges from 202,000 pounds to 1,171,000 pounds per year. These 34 villages make up about 40% of the total weight delivered to the Y-K Delta.

DATA SOURCES FOR VILLAGE ANALYSIS

There are four sources of data that were used for the Villages analysis: the USPS reports, the Alaska Department of Labor (DOL), the Federal Aviation Administration (FAA, of the US Department of Transportation), and the Alaska Department of Community and Economic Development (DCED).

The USPS (offices at St. Louis and Anchorage) provided village-specific information of all mail (priority, nonpriority, and bypass) delivered in the Y-K Delta for five fiscal years, 1995 through 1999. This USPS data consists of, for each fiscal year, the weight of mail delivered by each air carrier for each origin-destination pair statewide. The mail delivered by hovercraft in the Y-K Delta (to eight villages, variously, since fiscal year 1997) is reported by the USPS separately. That weight is recorded onto a form that is completed for every four-week accounting period. These two types of data, air carrier and hovercraft, were examined and put into a composite database (USPS 5-year). The USPS 5-year database has the number of pounds of mail that each village received for each fiscal year.

The population for each village comes from the AkDOL website (AkDOL population). The population data must be modified for this analysis. The 'villages' in the USPS 5-year database actually are airports. Some airports are used by two villages, so the population served by the airport is the sum of the populations of those two villages. This occurs in the following cases: Bethel and Oscarville; Saint Marys and Pitkas Point; and Lower Kalskag and Upper Kalskag.

The FAA receives a report from certain air carriers in the Y-K Delta for every quarter of the year. This report discloses the number of passengers that boarded the air carrier's aircraft at each village the air carrier serves. Reports from all air carriers are compiled to form the Air Carrier Activity Information System report. Sagar Onta, a student at Purdue University (graduated May, 2000) who worked on the demand for air travel in the Y-K Delta, prepared these quarterly ACAIS reports to show the annual number of enplanement for each village.

The DCED website is a source of societal data (DCED societal) for each village in the Y-K Delta. The data from this website that is used in the analysis are the average persons per household, village percent poverty, family income, and the number of people employed by the federal and state government. (The percent Native Alaskan of total village population was not evaluated.) This data comes from the 1990 US Census, and annual changes in the data are not documented

NOTE: The USPS air carrier data for fiscal years 1995, 1996, and 1997; and the hovercraft data for fiscal years 1997, 1998, and 1999 are kept at the AKDOT in Juneau. The air carrier data for fiscal years 1998 and 1999 was made available from the USPS in Anchorage.

The DCED societal data was prepared in various ways.

The family income is reported as the number of families in a village that receive an income less than $10,000 per year, the number that receive between $10,000 and $20,000 per year, and the number that receive income in successive ranges. To convert this to an average family income, the analysis assumes that the average family has an income at the midpoint of the income range—the family has an income of $5,000 or $15,000, for the first two ranges. (For the final category, income greater than $150,000, the analysis assumes the family has an income of $200,000.) The average family income is the average of these assumed family income values for each village. (This is not the average income per capita.)

The number of people employed by the federal and state government is the sum, for each village, of three pieces of information: the number employed by the armed forces, by the state government, and by the federal government.

- The previous two calculations must account for those airports that serve two villages, in

the same way that AKDOL historic population values were adjusted. The number of families in each income range, for those two villages that are served by the same airport, are added together. Government employment data is likewise adjusted.

The independent variables of the Typical Villages analysis are in units per capita, where applicable. Of the societal data, the number of government jobs must be expressed as jobs per capita. The population that the number of jobs was divided into is the average of the five years of population data, from 1995 through 1999. (The population of 1990, reported in the DCED Societal data, was not used.)

The following table summarizes the per capita growth of mail in the Y-K Delta. Note that these figures are much higher than the statewide calculations. The reason probably has more to do with how well the BEA historic data was prepared, than an actual higher weight of mail per capita for the Y-K Delta.

	Pounds Per Capita				
	FY 1995	FY 96	FY 97	FY 98	FY 99
Bethel	3018	3353	3039	3029	3122
Remaining Hubs	2357	2390	2362	2366	2397
All Villages (except hubs)	1407	1485	1487	1526	1564

There are two models for the Typical Village analysis. One model explains how much weight per capita a village has based on societal factors. The other model explains how much a village will increase its weight per capita based on historic data (and these societal factors). These two ways of evaluating the data are performed only on Typical Village data, not on the data of the remaining villages.

The first model was set up in two ways. The first way it was set up uses independent variables that change from one year to the next (these variables are year, population and enplanement per capita), which will be referred to as the Four Year analysis. The second way it was set up uses independent variables for which year-to-year values are not known. These variables are the DCED Societal data with averaged population and enplanement data. The second way to set the problem up will be referred to as the Societal analysis.

The Four Year analysis has 170 observations. The independent variables are year, population, and enplanement per capita. The variables that have significant P values (less than about .05) are year and population. The multiple R is .3439, the R square is .1183, and the adjusted R square is .0982. These values are very low, most likely because of the awkward problem setup: the model does not distinguish villages.

Omitting the most recent two years of enplanement data will produce a model that has a high t-statistic for enplanement per capita. But to omit the most recent data is unrealistic. This example shows that the model is very sensitive to the data. The analyses of data specific to the Y-K Delta (the Four Year and Societal analyses, and the model using historic data that will be discussed later) were re-performed using two sets of perturbed population values. The (two) perturbed Four Year evaluations had significant P values for year and population, which is the same finding of the unperturbed data.

The Societal analysis has 34 observations. The independent variables are average population, average enplanement per capita, average family income, members per household, federal and state government jobs per capita, and the percent poverty of the village. The variables that have significant P values (less than about .05) are members per household, government jobs per capita, and percent poverty. The R square values of the Societal analysis are

stronger than the Four Year analysis. Perturbing the data does not change which variables have significant P values.

The data and results for the Four Year and the societal analyses are attached in Appendix II. The results of these analyses are summarized in the following table.

Table 3. P Coefficients for Typical Village Analysis

	Independent Variable	Coefficient
Four Year	y-intercept	1480
	year	44.8
	population	-.589
Societal	y-intercept	2830
	members per household	-192
	gov't jobs per capita	-3160
	percent poverty	-757

The second model to perform the Typical Village analysis is to predict how much mail per capita a village will receive based solely on historic data. This model will be referred to as the Weight Growth analysis, because the dependent variable will not be pounds per capita for the village, but rather the percent growth of mail per capita.

The data for this model come from the same sources as the data for the first model. Pounds of mail per capita are taken from the USPS 5-year database. The AKDOL Population database, the ACAIS Enplanement and the DCED Societal sources likewise supplied data used in this model. This model prepares the data more extensively than the first model.

There are 34 observations. The dependent variable is the percent difference between a projected weight per capita and the actual weight per capita for fiscal year 1999. This projected weight per capita for fiscal year 1999 is a projection of the single variable linear regression of four points (fiscal years 1995 through 1998) against year. (If we had only historic annual growth to base our judgment, what would be the best projection for fiscal year 1999 weight per capita?) The percent difference between the actual and the projected weight per capita is the dependent variable (positive and negative signs are significant).

The independent variables are the societal factors members per household, government jobs per capita, and percent poverty; averages of historic population, enplanement per capita, and historic weight per capita; and rate of growth of historic population, enplanement per capita, and weight per capita. The societal data was prepared in the same manner as they were prepared for the first model. Averages were calculated using the equation

$$(4x_{98} + 3x_{97} + 2x_{96} + x_{95}) / 10$$

where x is either population, enplanement per capita, or weight per capita. The rate of growth is calculated as the slope of the single variable linear regression, based on year. This rate of growth further is divided by the arithmetic average of the four years of data.

The variables that have significant P values (less than about .10) are members per household, and rate of growth of historic population, enplanement per capita, and weight per capita. But the two perturbed evaluations show that the average historic weight per capita likewise has significant P values. The data to set up the Weight Growth analysis and the output are attached as Appendix II. The following table summarizes this analysis.

Table 4. P coefficients for independent variable

Independent Variable	Coefficient
members per household	-.0495
average weight per capita	$-6.88.10^{-5}$
rate of population growth	.943
rate of enplanement growth	-.215
rate of weight per capita growth	-.813

Although the rate of growth of the enplanement per capita has a significant P value, it must be

looked at with skepticism. The rate of growth calculation, which looks at the earliest four values of enplanement per capita, will not represent the recent suppressed enplanement activity. Enplanement per capita for 1997 and 1998 are rather consistently lower than the previous ten years for all villages, against the rising trend of the several years prior to 1997. Yet weight per capita continues to be strong, even peaking in fiscal year 1999.

B. Parcel Post Demand for the Y-K Delta: Remaining Villages

The remaining four groups to be evaluated are Bethel, (four) hub villages, (three) large villages, and (eleven) small villages. This subsection will present a short narrative of the problems with the data for each of these groups, and what findings can be obtained from the data. But there is only one statistical model, and that model is performed to each of the four groups. This model is that the aggregate annual weight per capita for a group is evaluated solely according to its annual growth. The only finding for this method is the historic growth of weight per capita. There is no attempt to use societal data to explain the values of weight per capita for these remaining villages. The analysis is not taken any further than the aggregate (group) stage.

Although the weight per capita for Bethel was 3,353 lb/cap for 1996, the other four years show a growth from 3,018 lb/cap to 3,122 lb/cap. The linear regression of the five years of weight per capita for Bethel, an annual loss of 12 lb/cap, has a poor t-statistic. Omitting the 1996 data, the four-year linear regression shows an improved t-statistic with a (positive) growth of 21 lb/cap annually. The four-year result is acceptable if the 1996 data could be considered anomalous—that something is wrong with the data, or that an event took place in 1996 that is not expected to be repeated. Still, the t-statistic for the four-year result is not strong, and zero growth of the weight per capita cannot be ruled out.

The average weight per capita over the five-year history for the aggregate hub villages data is 2,374 lb/cap. The result of the linear regression of this data is an annual increase of 6 lb/cap and weak t-statistics—zero growth of the weight per capita cannot be ruled out.

The aggregate weight per capita data for large villages shows a consistent increase over the five-year history, from 1,652 lb/cap to 1,849 lb/cap. The result of the linear regression for this data is an annual increase of 49 lb/cap. Even the lower 95% value of this coefficient shows a strong 40 lb/cap annual increase over the past five years.

The first four years of the aggregate weight per capita data for small villages varies from a low value of 1,609 lb/cap (in 1998) to a high of 1,699 lb/cap (in 1996). The value for the last year, 1999, is 1,779 lb/cap. The result of the linear regression of this data shows an increase of 22 lb/cap annually; the t-statistic is poor.

The analysis of data specific to the Y-K Delta is performed differently for the remaining villages. These remaining villages are broken down into four groups.

	Number of Villages	Percent of Total Weight
Bethel	1	35%
Hub	4	12%
Large	3	9%
Small	11	2%

These groups behave differently than the Typical Villages. Bethel is the center of activity for the entire region. There are services

provided in Bethel that are not available at any other village in the region: a hospital, state and federal government offices, local government offices, and professional services. The four Hub Villages are a trans-shipment location for USPS mail, air cargo, and people traveling by air. Large Villages, due to their size, suggest that there is a greater variety of services. Small Villages have irregular data, so that data inaccuracies and inherent error cause distortion. Examples of occurrences that affect the weight per capita for small villages is that the population can change over a few months, or that the retail stores have inventory carryover from the previous federal fiscal year (or stocked up inventory just before the close of the current year). These groups were each evaluated in only one manner: the rate of growth of weight per capita over time.

BETHEL

The location of Bethel is near the geographical center of the Y-K Delta. Bethel has 5,535 people out of the total regional population of 24,376 (1999 data), the most populous village in the Y-K Delta. Historically Bethel had significance because it is the farthest inland an ocean-going vessel can travel on the Kuskokwim River. It is now the location of the Y-K Delta Health Center, and Federal and State Government Offices—services that are not available at any other village. And Bethel has an inter-regional airport, a large selection of retail sales businesses, and professional services (education and legal, for example). These activities draw people who live in other villages in the region to visit Bethel. The annual weight of mail per capita becomes a misleading indicator of the consumption of goods in Bethel: residents of other villages are purchasing goods in Bethel, and are receiving services that use goods delivered to Bethel.

An additional problem with the USPS mail data for Bethel is that the calculation of how much mail remains in Bethel is based only on mail arriving from Anchorage or a different hub, and the mail leaving Bethel to bush villages or a different hub. But intra-Alaska mail, specifically mail sent from a bush village to Bethel and then to a different bush village, is a situation where the weight of an actual source of mail (from the first bush village) does not work its way into the calculation of how much mail remains in Bethel. The outgoing mail (to the second bush village) does appear in the calculation. This discrepancy is assumed to be small.

Over the five-year period, Bethel shows an annual decline of 11.72 lb/cap (y-intercept at 3147 lb/cap, “1995”=1 in this and evaluations of all village groups). This has poor t-statistics due to an anomalous 1996 weight per capita value. Omitting the 1996 data, Bethel shows an annual growth of 21.03 lb/cap (y-intercept at 2984 lb/cap) with better t-statistics.

HUB VILLAGES

Hub villages share some of Bethel’s characteristics, in that hub villages tend to offer a larger amount of services than bush villages, which attracts people from nearby bush villages. Further, these villages are USPS mail hubs and the calculation for how much mail remains at their village has the same error as the calculation for how much mail remains at Bethel, which was discussed earlier in this subsection.

The Hub Villages show a growth of 5.59 lb/cap per year (y-intercept at 2358 lb/cap) with weak t-statistics.

LARGE VILLAGES

Large villages, again, offer more services than typical and small villages, but are less likely to attract people from nearby smaller villages. The large villages in the Y-K Delta (Hooper Bay, Mountain Village, and Chevak) do not have airports as well-maintained as those of hub

villages, and air carriers do not use the airports of large villages as transfer points. There are no direct flights to Anchorage from these large villages. Besides, people would prefer to travel just a short distance farther to Bethel or a hub village for a greater selection of services. It seems that large villages do not have the per-capita glitch that Bethel and hub villages suffer.

Large villages do behave differently than typical villages, though. The typical villages analysis shows that population is a significant indicator of weight per capita, that the higher the population, the less the weight per capita. Keep in mind that these are linear regression analyses that are performed on the mail data. The relationship of population to weight per capita is (most likely) non-linear, and the same could be said for all factors that were evaluated using linear regression in this parcel post demand study. It is best to say that for villages with a population between 125 and 675, the annual weight per capita seems to be influenced by village population, and that this influence could be approximated by a first-order equation. Large villages likely violate this relationship between population and annual weight per capita.

Large villages may have a different social structure—local government responsibilities, and employment and recreational activities, for example—that is more likely to be found at hub villages than at typical villages.

The Large Villages show an annual growth of 49.30 lb/cap (y-intercept at 1599 lb/cap) with strong t-statistics.

SMALL VILLAGES

The weight per capita at small villages does not behave in the same manner as the weight per capita for typical villages. Often, these small villages have no retail market. People might inhabit some of these small villages on a seasonal basis, and those that do live in these villages may depend more heavily on a subsistence lifestyle than people who live in typical villages.

To aggravate the problem of evaluating small villages, the villages get very little mail for which to base an evaluation on, even after aggregating the eleven villages. The variances can be extremely large. The value for weight per capita of a small village can be unusually low or unusually high, and the growth in the weight per capita can be unusually high or strongly negative.

The Small Villages show an annual growth of 21.97 lb/cap (y-intercept at 1599 lb/cap) with weak t-statistics. However, if the five strongest villages are grouped together, this subgroup of Small Villages has an annual growth of 79.05 lb/cap (y-intercept at 1268 lb/cap) with strong t-statistics. The villages removed were the two smallest villages (Telida and Flat), three villages that show stagnant or erratic growth (Red Devil, Stony River, and Takotna), and a village that shows negative growth (Nikolai).

V. Parcel Post Demand for the Y-K Delta: Trend for the Region

The trend analysis is conceptually the simplest, however with only five years of data and with the rapid population growth in the region and the recent economic woes due to poorer than normal fishing it may be susceptible to error. It is included for completeness. Note the difference of the 1996 data from a straight line. The lines drawn show a good R2 and the exponential curve indicates an annual growth rate of 2.76%. The 1996 data indicates an anomalous year. If that data is omitted the fit to a straight line is or exponential is very good. The results are presented in Figure 2.1 and Table 2.3

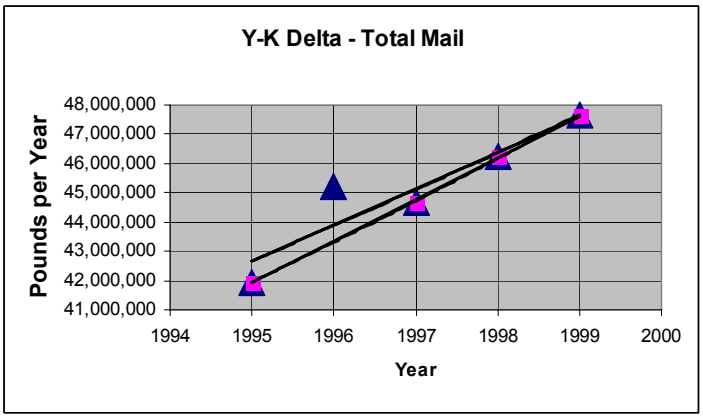
Figure 2.1 Total Mail Volume to Y-K Delta 1995-1999

Table 5. Regression Results on the Total Y-K Delta

	R^2	Annual Increase
St Line All Data	0.8599	1.24 Million lb./yr.
St Line w/o 1996	0.9993	1.42 Million lb./yr.
Exponential All Data	0.8530	2.76%/yr
Exponential w/o 1996	0.9996	3.20%/yr

VI. Forecasting Parcel Post Demand

The analyses of the historic parcel post demand for statewide Alaska and for the Y-K Delta, discussed in the first two sections of this report, are the basis of a forecast of the demand for parcel post in the Y-K Delta. The findings of these analyses seem to contradict each other. For example, the statewide average annual weight per capita is around 1,000 lb/cap, which is half the Y-K Delta regionwide 1,950 lb/cap. Another contradiction is that the weight per capita of large villages is strongly increasing while hub villages, the next category in line, have



stagnant growth. In fact, the weight per capita of individual typical villages can only be partially explained by the societal factors selected for the analysis—this statement is based on the poor R square values of the typical villages analysis.

There is a specific concern with basing a forecast on this historic data. The USPS introduced the bypass mail service in the early 1980s. Prior to the introduction of bypass mail, retail stores in bush villages could place orders to shippers in Anchorage. These shippers would then prepare the order according to USPS postal regulations and take it to a USPS post office. The new thing that bypass mail put forth was omitting the requirement to take the parcels to a post office. Parcels that are sent as bypass mail must still weigh less than 70 pounds each, and each parcel must have address labels and postage. But shippers need only to stack the prepared parcels onto a pallet, shrink wrap the loaded pallet, and deliver the pallet to the designated air carrier; the shipper no longer handles the parcels at the post office. There is no difference in the cost (to the shipper) of sending the goods at fourth class or at bypass postage rates, but the shipper can process the order quicker using the bypass mail service. (The USPS benefits, as well, in that it reduces the workload at the post office.)

The point is that shippers used low postage rates before bypass mail was introduced. The popularity of delivering goods through the USPS grew rapidly after the introduction of bypass mail. The ease of ordering, lower cost and ease of working with individual shippers all contributed to the rapid rise. The twelve years of AKPPS data used in the Statewide analysis goes back to 1986, possibly a time that the growth of the amount of goods delivered by the USPS had lost its initial momentum. The historic data used in these analyses is data of parcel post demand at its infancy, so that long-term consumption patterns cannot be suggested from this data. For example, the weight per capita may rise and fall in cycles, or it may continually increase without an apparent upper limit. Any forecast of the demand for parcel post is highly uncertain.

The method to forecast the demand for parcel post (that will be described in the next two subsections) is based on two beliefs.

- The amount of mail per capita will (generally) increase.
- The findings of the historic analyses will be upheld as much as possible.

There are three steps to forecast the demand for parcel post in the Y-K Delta. The first step is to forecast the demand for parcel post in statewide Alaska, and use this forecast as a basis of region-wide Y-K Delta demand. The next step is to forecast the growth of each group of Y-K Delta villages. Finally, to adjust the forecasts of the groups so that the region-wide forecast will be maintained.

A. First Step of the Forecast Method

Two additional sources are used for the Y-K Delta forecast. The first is a forecast of population and total income published by the BEA. This was downloaded from the BEA website and used in the analysis. (Note that the population and total income values for 1990 and 1995 in the BEA forecast disagree with those values in the BEA historic data that was used in the Statewide historic analysis. This BEA forecast data is statewide and not broken down to the census districts. The second additional source used in the Y-K Delta forecast is a forecast of the population of the villages of the Y-K Delta by Meifu Wang of the Alaska Department of Transportation and Public Facilities (See Appendix A).

The first step is to forecast the demand for parcel post statewide. The belief behind the Statewide forecast is that people will gradually increase how many pounds of mail they demand per dollar earned. This is demonstrated historically by the Statewide historic analysis, but the increase is very gradual. (To project a constant annual increase of 14.1 lb/cap, the best fit single variable linear regression of weight per capita over the years from the Statewide historic analysis, would have no growth of the weight per dollar income, based on BEA forecast data. For this reason, it appears that the annual growth of the weight per capita must be increasing.)

The forecast of statewide mail weight per dollar income is proposed to increase annually, and the increase is to become smaller over the years. The annual increase of mail weight per capita varies over the years. Appendix IV shows the historic and forecast weight per dollar income data.

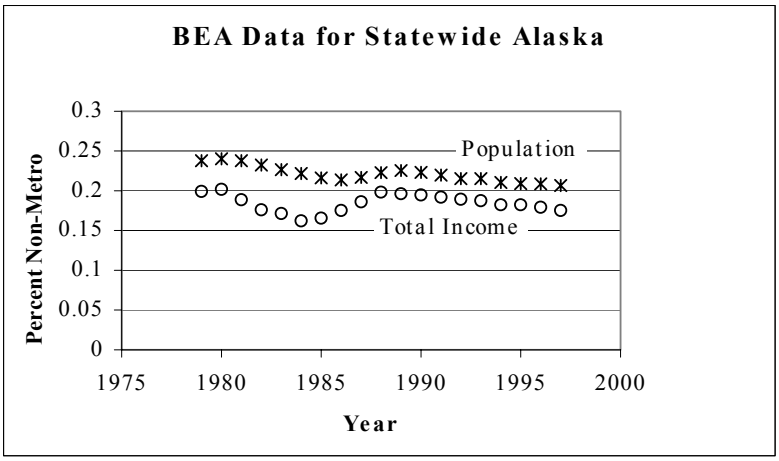
Table 6. Statewide USPS Mail Demand Forecast

	lb./($-income)	lb./cap	annual lb./cap growth
2000	0.0619	1,047	19.2
2005	0.0651	1,154	21.5
2010	0.0683	1,270	23.1
2015	0.0713	1,381	22.3
2020	0.0735 (BEA forecast unavailable)		
2025	0.0759	1,587	20.6

(The weight of mail per capita delivered in the Y-K Delta appears higher than the weight delivered statewide. The Y-K Delta forecast assumes that the regional weight per capita will have equal annual increases as the statewide forecast.)

The previous table is developed from the BTS forecast data. The following discussion explains how this table was prepared.

The BEA forecast data is not broken down into census districts. In order to forecast the growth of non-metropolitan population and total income, this method evaluates the ratio of non-metropolitan population to statewide Alaska population over the period from 1986 to 1997, and the ratio of non-metropolitan total income to statewide Alaska total income over the same period. From these trends, the method draws conclusions about these ratios for the next 25 years.



Source: BEA Data for Alaska

These ratios were trending downwards until a reversal at about 1985. Mike McKinnon of the Alaska Department of Transportation and Public Facilities suggested that the housing crisis in Anchorage and Fairbanks that took place around that time, (a crisis that was caused by state government legislation,) might give the appearance of a greater share of statewide income to non-metropolitan Alaska. The downward trend seems to resume through the 1990s.

The assumption that the Statewide forecast makes about the future of these ratios is that both of them will remain at its low point. (Bad assumption.) In the case of non-metropolitan population to statewide population, the forecast is for the ratio to remain at 20.0:100, just lower than the historic low point. For the income ratio, the forecast is for the ratio to remain at the average of the most recent two years, which is 17.7:100. These ratios are then carried through with the BEA forecast (statewide) data, to calculate the population and total income for non-metropolitan Alaska.

The product of the calculated non-metropolitan total income, and of the proposed weight per dollar income of this Statewide forecast (discussed at the beginning of this section), gives the total amount of non-metropolitan mail. Dividing this total amount of mail by the calculated non-metropolitan population gives the weight per capita. From this the annual increase of pounds per capita, statewide, can be calculated. Appendix IV has the calculations

to perform this analysis. (The findings were summarized in the table near the beginning of this section.) Note that the annual increase of the weight per capita is proposed to be higher (around 20 to 23 lb) than historic weight per capita growth (14.1 lb). Further, the annual increase grows during the first half of the forecast period, peaks around year 2010, and declines later. Keep in mind that the weight per capita always increases over time, and that the weight per dollar income also increases over time.

The weight per capita for the Y-K Delta has been increasing at 23.7 pounds annually according to a best fit linear regression. But the P value is .216, so that it is reasonable to suggest that the actual regional growth is not so high. The following table compares the 95% confidence interval of the Y-K Delta weight per capita growth over the years, to the Statewide analysis.

	Annual lb/cap Growth		
	Best Fit	Lower 95%	Upper 95%
Statewide	14.1	8.1	20.1
Y-K Delta	23.7	-24.6	71.9

The Y-K Delta historic growth cannot be said to have a higher rate than the statewide historic growth with certainty. Proceeding from the assumption that the annual growth of mail in the Y-K Delta behaves somewhat like the Statewide analysis, we can take the proposed future annual growth of weight per capita from the Statewide forecast and apply those values to the Y-K Delta.

The weight per capita for the Y-K Delta for the year 1999 is proposed to be the value of the best fit single variable linear regression model, 1,996 lb/cap, instead of the actual weight per capita, 2,002 lb/cap. The annual increases are based on this proposed weight per capita. Applying the increases gives us the regional weight per capita. Multiplying this weight per capita by the AKDOT&PF population forecast (see Appendix A) gives us the total weight of mail to be delivered to the region.

	Y-K Delta Forecast	
	lb/cap	Total Weight (lb)
2000	2,015	52,440,000
2005	2,118	61,530,000
2010	2,230	72,390,000
2015	2,344	84,790,000
2020	2,452	99,000,000
2025	2,557	(not available)

B. Second and Third Steps of the Forecast Method

The second step of the Y-K Delta forecast is to roughly forecast the growth of individual villages based on village grouping. It is assumed that all villages, regardless of which group they belong to, will increase their weight per capita over time. Generally, the assumption is that if a village over the five-year period from 1995 to 1999 shows consistent growth in the weight per capita, then the forecast weight per capita growth will be high (for the entire 25 year forecast period). If a village over the five-year period shows weak or negative growth, then the forecast weight per capita growth will be low. (Bad assumption.)

But villages have different growth rates depending on which group they belong to. The following table shows that while the annual weight growth for the entire region is forecast to be 20 to 23 pounds per capita over the next 25 years, group averages are lower or higher.

	Number of Villages	Annual Weight Growth Range
Y-K Delta	56	20 to 23 lb./cap
Bethel	1	0 to 20 lb./cap
Other hubs	4	5 to 9 lb./cap
Large Villages	3	30 to 50 lb./cap
Typical Villages	37	25 to 30 lb./cap
Small Villages	11	17 to 19 lb./cap

This table is the result of the third step. The third step is to adjust an initial (undocumented) trial of individual village forecasts (the result of the second step) so that the sum of the weights delivered to individual villages is equal to the final result of the first step of the Y-K Delta forecast. To begin the second step, there must be some suggestion what the ranges (from the above table) are. The suggestion comes from a single variable linear regression performed for each village group, and from the property of consistent growth of individual villages. Bethel was initially proposed to have minimal growth (7 lb/cap annually), but was selected to accept the 'residual weight', that part of the total weight to the Y-K Delta that was not claimed by the other (four) groups. The calculations for this analysis are shown in Appendix IV.

The upper curve comes from the forecast presented here, The lowest curve comes from the liner trend forecast. The middle two curves are from the two exponential trend forecasts. The average annual growth in the detailed forecast is 3.45% per year. This is not unreasonable considering the high average

The other data is the forecast by village as shown in the table below

ffffc

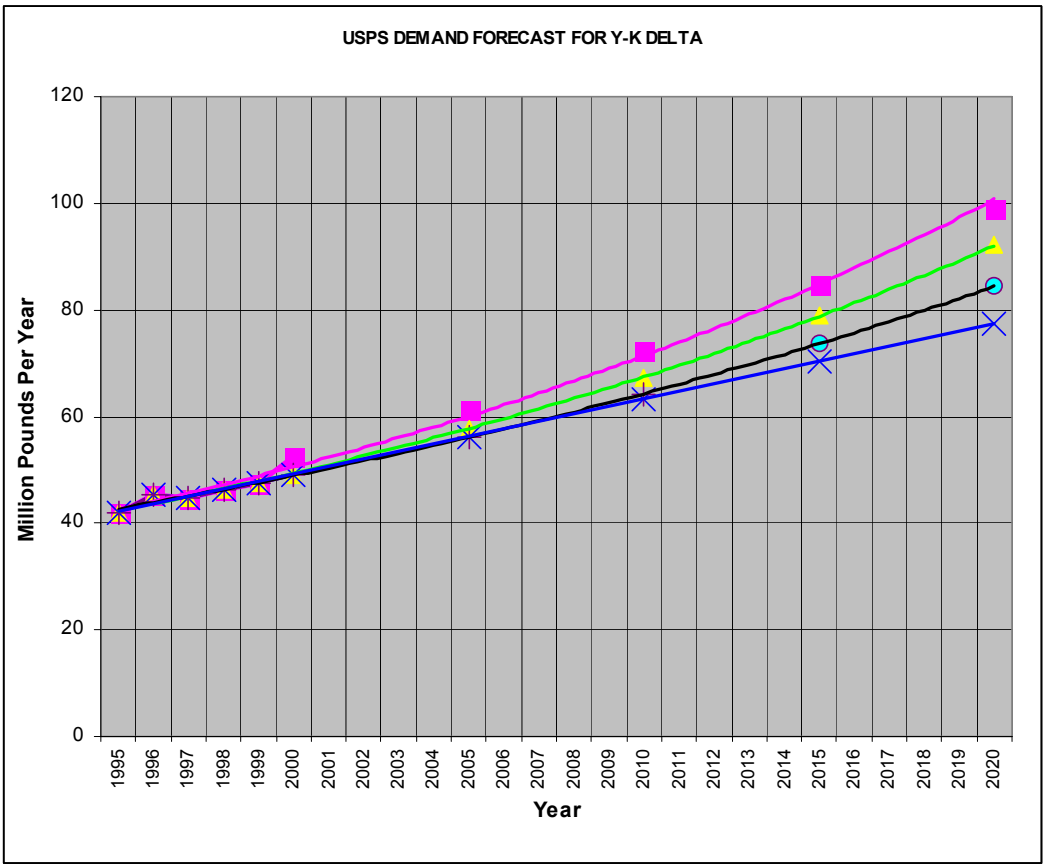


Table 7. Forecast of Fourth-Class Mail by Village

Weight per Capita Growth lpcpy					Weight per Year Lbs.			
Villages	2005	2010	2015	2020	2005	2010	2015	2020
AKIACHAK	1,550	1,678	1,822	1,972	1,058,596	1,284,963	1,560,549	1,894,182
AKIAK	1,400	1,542	1,699	1,860	564,189	696,756	858,658	1,054,206
ALAKANUK	1,800	1,970	2,160	2,352	1,465,966	1,847,717	2,326,486	2,901,994
ANVIK	2,700	2,774	2,864	2,968	313,061	360,691	416,513	484,003
ATMAUTLUAK	1,400	1,542	1,699	1,860	518,439	643,415	796,749	981,590
CHEFORNAK	1,750	1,928	2,124	2,321	803,782	997,801	1,235,415	1,519,227
CHEVAK	2,300	2,472	2,714	2,990	2,059,119	2,548,541	3,213,551	4,055,878
CHUATHBALUK	1,800	1,986	2,174	2,363	246,886	305,427	373,911	455,839
CROOKED CRK	1,850	1,918	2,001	2,092	277,287	322,334	376,127	440,996
EEK	1,600	1,801	2,017	2,231	583,316	739,834	931,211	1,159,126
FLAT	3,000	3,002	3,006	3,011	1,037,740	1,170,192	1,316,828	1,484,513
GOODNEWS BAY	1,950	2,012	2,089	2,174	573,521	663,503	770,520	899,271
GRAYLING	2,050	2,105	2,176	2,255	802,944	924,450	1,068,860	1,242,207
HOLY CROSS	1,950	2,040	2,150	2,268	2,466,856	2,972,058	3,597,020	4,346,703
HOOPER BAY	2,300	2,472	2,714	2,990	1,403,030	1,699,010	2,096,687	2,599,620
KALSKAG	1,600	1,684	1,783	1,887	1,079,364	1,280,050	1,523,203	1,814,125
KASIGLUK	1,600	1,723	1,863	2,009	675,177	819,256	995,563	1,208,161
KIPNUK	1,650	1,768	1,904	2,046	1,138,773	1,405,250	1,737,863	2,139,276
KONGIGANAK	1,450	1,587	1,740	1,897	1,144,073	1,403,985	1,721,732	2,105,083
KOTLIK	2,150	2,266	2,410	2,563	857,893	1,018,806	1,217,784	1,457,441
KWETHLUK	1,450	1,587	1,740	1,897	949,294	1,164,956	1,428,605	1,746,690
KWIGILLINGOK	1,650	1,843	2,053	2,261	97,991	122,723	152,905	188,850
LIME VILLAGE	800	815	830	847	326,968	383,407	448,746	524,413
MARSHALL	2,250	2,312	2,396	2,491	571,618	661,832	770,848	901,871
MEKORYUK	2,150	2,266	2,410	2,563	2,169,456	2,633,239	3,216,064	3,918,039
MOUNTAIN VILLAGE	1,750	1,892	2,071	2,274	786,895	953,809	1,168,022	1,438,041
NAPAKIAK	1,500	1,591	1,695	1,806	695,691	827,362	985,883	1,178,038
NAPASKIAK	1,250	1,357	1,476	1,601	371,390	454,294	555,348	677,890
NEWTOK	1,650	1,768	1,904	2,046	362,348	437,482	529,501	640,316
NIGHTMUTE	1,700	1,814	1,945	2,083	262,015	313,484	375,948	451,527
NIKOLAI	1,400	1,415	1,430	1,448	759,574	864,751	982,837	1,119,458
NUNAPITCHUK	1,500	1,633	1,781	1,934	1,039,740	1,303,580	1,632,648	2,030,943
NUNAM IQUA	1,950	2,097	2,267	2,442	318,210	394,090	489,244	603,716
PILOT STATION	1,650	1,843	2,053	2,261	333,480	428,973	548,745	692,300
PLATINUM	2,100	2,249	2,404	2,565	192,908	232,767	279,653	335,749
QUINHAGAK	1,650	1,731	1,826	1,928	1,186,511	1,402,561	1,662,827	1,975,797

Weight per Capita Growth lpcpy					Weight per Year Lbs.			
Villages	**2005**	**2010**	**2015**	**2020**	**2005**	**2010**	**2015**	**2020**
RED DEVIL	2,700	2,705	2,711	2,718	202,344	227,263	254,762	286,504
SCAMMON BAY	1,700	1,814	1,945	2,083	872,962	1,072,758	1,320,874	1,620,480
SHAGELUK	2,050	2,105	2,176	2,255	402,921	463,894	536,359	623,346
SLEETMUTE	2,100	2,249	2,404	2,565	314,758	377,930	451,876	540,643
STONY RIVER	2,600	2,605	2,612	2,621	187,497	210,663	236,242	265,781
TAKOTNA	2,500	2,506	2,514	2,523	134,331	150,986	169,388	190,648
TELIDA	2,000	2,010	2,021	2,034	31,108	35,053	39,429	44,499
TOKSOOK BAY	1,750	1,859	1,986	2,120	1,054,963	1,262,745	1,516,132	1,821,305
TULUKSAK	1,550	1,759	1,981	2,200	784,632	998,390	1,257,620	1,566,294
TUNTUTULIAK	1,650	1,843	2,053	2,261	710,486	894,198	1,119,486	1,387,456
TUNUNAK	1,550	1,678	1,822	1,972	703,022	857,563	1,046,511	1,274,652
VILLAGE TOTAL					**35,606,207**	**43,055,781**	**52,260,973**	**63,391,871**

Hubs	**2005**	**2010**	**2015**	**2020**	**2005**	**2010**	**2015**	**2020**
BETHEL	2,998	3,114	3,158	3,138	20,188,534	23,104,323	25,737,070	28,157,201
ANIAK	2,698	2,765	2,835	2,906	2,060,193	2,367,288	2,715,162	3,120,797
ST. MARY	2,321	2,291	2,260	2,234	1,532,502	1,741,751	1,973,408	2,234,065
EMMONAK	2,123	2,096	2,068	2,043	2,040,890	2,319,555	2,628,060	2,975,187
McGRATH	2,664	2,852	3,068	3,303	1,988,640	2,387,068	2,872,606	3,467,771
HUB TOTAL					**27,810,759**	**31,919,986**	**35,926,306**	**39,955,021**

REGION TOTAL					**63,416,966**	**74,975,767**	**88,187,279**	**103,346,892**

Appendix E
The Logistics of the USPS Mail Delivery System for the Yukon-Kuskokwim Delta – A Simulation

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Forward

Robert K Whitford, Project Manager
Professor Emeritus, Purdue University
March 2002

The simulation described in this paper was performed to replicate, with simplified assumptions, the delivery of USPS mail in the Y-K Delta. Data from the USPS and from air carriers were used to construct a model of daily mail demand and to evaluate aircraft efficiency. The purpose of simulating the mail delivery system is to evaluate the impact that mail delivery has on the air transportation infrastructure in the Y-K Delta. The results of the simulation can guide transportation planners to determine if building runways to accommodate large aircraft is necessary.

The existing mail regulations were established as part of the U.S. Code (see Appendix C, *The United States Post Office's Bypass Mail System*) not only to provide family goods and food to the people in the Y-K Delta, but also to reinforce essential passenger travel potentially lowering fares with the more effective use of aircraft through the combined delivery of both passengers and mail. Due to increases in mail and changes in the certification of bush aircraft, new regulations are being considered to restore the historic passenger plus mail carriage for delivering mail in rural Alaska.

In this report, the simulation of bypass and fourth-class mail delivery in the Y-K Delta excludes passenger travel. The simulation code is now being revised to simulate flights carrying passengers with mail. Further, the code is being adapted for the Northwest Alaska Planning region. A forthcoming report to the Alaska DOT&PF will describe this revised code.

Abstract

The development of a realistic computer simulation of the bush mail (often referred to as Bypass Mail) delivery in the Y-K Delta is described. The simulation code was developed as a tool to examine the logistics of delivering the very large quantities of USPS mail to the Y-K delta (Over 40 million pounds per year) where air is the only viable delivery mode. The goal of this research project was to determine the impact of the large mail demand on future air system infrastructure requirements. Specifically it was important to evaluate (1) the requirements for longer and wider runways as the aircraft would grow in size to meet the demand, (2) the tradeoffs from using various aircraft in performing the USPS mail delivery mission and (3) the operational effects on the air carriers.

The computer simulation of the mail delivery in the Y-K Delta determines the number of block-hours of flight time to deliver the mail and the load factor of each aircraft leaving the hub(s). The actual Y-K Delta mail delivery system was defined in the simulation code under many different scenarios. The computer simulation creates and handles thousands of these situations in an orderly manner, so that people (computer users) can evaluate the effect of making decisions under a specified scenario. A scenario influences how these situations are created: two different scenarios, for example, are (1) the results for delivery of the current mail and (2) the impacts of forecasted demand for the year 2020. Other scenarios examine changes and constraints in the fleet of aircraft available and the effects of adding new hubs for bush delivery. The hovercraft delivery of mail was also included. The simulation found that as the mail grows the use of the larger aircraft increases the efficiency and reduces the cost. The code is written in Microsoft Visual Basic using MSExcel spreadsheets to provide the data input.

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The USPS Mail Delivery System for the Yukon-Kuskokwim Delta

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I. Introduction

Roughly 24,000 people live in the Yukon-Kuskokwim Delta, a region along the western coast of Alaska containing about 65,000 square miles. There are very few intercity roads. The major form of year-round transportation is by air.

The USPS currently delivers over 46 million pounds of mail to the Y-K Delta each year. Most of this mail is actually food, clothing, and other goods that are to be sold at retail stores in the villages.

The center of the region, Bethel, has over 5,000 people. Bethel joins four other villages (Emmonak, Saint Mary's, Aniak, and McGrath) to serve as hubs for the Y-K Delta—all of the mail for the Y-K Delta is sent from Anchorage to these five hubs by large aircraft, and from there transferred to smaller aircraft for delivery to the 48 bush communities.

The Anchorage-to-hub service is called mainline service, and the hub-to-bush service is called bush service. The USPS pays air carriers for mainline and bush service according to two components: linehaul and terminal costs. The linehaul cost, in units of dollars per ton-mile, is the cost to send one ton of cargo one mile. On a per-pound basis, the linehaul cost increases with the distance to transport the mail. The terminal cost, in units of dollars per pound, is the cost of handling the mail at the airport. The terminal cost does not vary with the distance. The linehaul cost is often referred to as block hour related, and the terminal cost is often referred to as departure related.

The consumer, usually a shipper who wants to send pallets of goods to the Y-K Delta, pays the same rate (standard fourth class) regardless where in the Y-K Delta the goods are delivered. But to the USPS, the rates to deliver goods to different villages in the region vary, depending on the hub to which the goods are sent, and if bush service is required. The bush linehaul cost (about $8.50/tn-mi) is much higher than the mainline linehaul cost (about $.90/tn-mi). Bush linehaul service usually involves a shorter distance (about 10 to 50 miles) than does mainline service (about 400 miles). The bush terminal cost (about $.58/lb) is higher than the mainline terminal cost (about $.20/lb).

Mail that is delivered to retail stores (and residents) in bush villages generates costs from both mainline and bush services, but the mail destined to hub villages avoids the bush delivery cost. In order to show how much the USPS spends to deliver mail in the Y-K Delta, the USPS spends about $.50/lb to deliver a parcel from Anchorage to Bethel, but to deliver that parcel to the bush village Kongiganak, the USPS spends

about $1.20/lb. The customer pays the USPS about $.28/lb to send a 20 pound parcel from Anchorage to either Bethel or Kongiganak. A 70 pound parcel delivered between the same places costs about $.145/lb to the postal customer.

Many alternative methods of delivering mail in the Y-K Delta promise to be more efficient than the current way of delivering mail. Examples of these alternative methods are establishing additional USPS hubs, delivering multiple villages on a route with one vehicle, relaxing delivery time requirements, using larger bush aircraft, and using hovercraft. The purpose of this study is to evaluate potential efficiencies of changes to the air transportation system.

The weight of mail delivered to each village varies greatly from one day to the next. The influence that this daily variability has on the efficiency of the existing delivery system, and on proposed improvements to the system, seems difficult to quantify. If a village frequently receives a low daily weight, say of one or two hundred pounds per day, it would appear that large aircraft with low load factors would prove to be inefficient. Multiple villages on a delivery route may frequently require dispatching a second vehicle on days when one or more villages receive unusually large orders—returning the system to the original hub-and-spoke makeup.

Because of the uncertainty of the variability of daily mail, conventional mathematical models, such as stochastic models, would be difficult to set up. Computer simulation was chosen because the problem setup would explicitly model the physical transportation system. Thus all alternatives to the mail delivery problem are relatively easy to set up.

The computer simulation first creates a situation: an air carrier at Bethel receives 4,300 pounds of mail to deliver to Eek, for example. Then the simulation makes decisions that the air carrier would be expected to make. In our example, the air carrier may decide to fly the 4,300 pounds of mail in two planes: a Cessna 208, and a Cessna 207. Many constraints influence the decision-making. In our example, the air carrier had a Cessna 208 available, but the fleet of Cessna 208s could have been exhausted prior to sending the mail out to Eek. Had that been the case, then our air carrier may send out four trips of Cessna 207s. The computer simulation creates and handles thousands of these situations in an orderly manner, so that people (computer users) can evaluate the effect of making decisions under a specified scenario. A scenario influences how these situations are created: two different scenarios are for the current mail demand, and the demand for mail in the year 2020. But scenarios can also influence decision-making: two different scenarios are having a restricted number (say, four) of Cessna 208s, and having an unlimited number of Cessna 208s.

In order to determine the benefit of a specific alternative, a simulation of mail delivery using that alternative can be compared to a simulation of how the mail is delivered currently. The simulation keeps track of the total block hours (hours of operating) of each vehicle, and the number of departures, for the method of mail delivery.

This report is accompanied by another report, “The Yukon-Kuskokwim Delta Parcel Post Forecast”. That report provides a forecast of the annual weight of USPS mail that each village of the Y-K Delta will receive for the years 2005 through 2020.

This report will first evaluate the daily weight of mail to Y-K Delta villages. The amount of mail a village receives on one day could be as low as almost none, to high values over 10,000 pounds. The variability is very great. The findings of this section to evaluate daily weights will be used in generating the amount of mail that the simulation code will deliver to villages.

This report will next evaluate the cost to operate the aircraft flown in the Y-K Delta. Because the output from the computer simulation is in block hours of aircraft operation, the cost of operating each type of aircraft on a per block hour basis must be known in order to compare costs among the alternatives.

This report then discusses how to use the simulation code, Pando, and how the code operates. The code is written in Microsoft Visual Basic, and is attached as Appendix IV.

The final section of this report shows the results of runs that were performed. The current transportation system and several alternatives were simulated. This section has a short discussion about the merits of each alternative.

II. Evaluation of Daily Bypass Mail

The code to simulate USPS mail delivery to the Y-K Delta must simulate the amount of mail delivered each day to each village in the region. Smaller villages may receive 200,000 pounds of mail annually, and larger villages may receive over 1,000,000 pounds annually.

There are three types of mail delivered to villages in the Y-K Delta. The first type, priority mail (letters and parcel post with first class postage), accounts for a small percent of the total mail delivered to the region: the USPS data reveals that about 7% of the mail belongs to this category. The second type of mail, non-bypass parcel post (fourth class), accounts for about 25% of the total mail to the region, according to Dr. Robert Whitford. The remaining 75% of the mail is bypass mail.

There are a few distinctions between non-bypass parcel post and bypass mail. An order that is to be delivered as bypass mail must weigh at least 1,000 pounds. The order must consist of many individual packages, and each package must conform to USPS regulations.

- Each package must weigh less than 70 pounds.
- The lengths of the three sides of each package must add to 108 inches or less.
- Each package must have a proper address and postage attached.

The sender (usually a shipper) shrink wraps these packages onto large pallets and takes the order directly to the air carrier—the order bypasses the Post Office.

An order that is delivered as non-bypass parcel post can weigh any amount. Non-bypass parcel post must meet the USPS packaging requirements as does bypass mail (packages less than 70 pounds, addressed, and with postage), but the packages must be given to the Post Office for delivery.

It would be logical to suggest that the amount of mail delivered on one day to a village is a random variable, and that this random variable observes a probabilistic distribution. As an example, observe the amount of mail delivered to one of the larger villages for just one day. Based on the expected annual weight of mail (1,000,000 pounds annually) to this village, the village receives an average of 4,000 pounds of mail each day. But for the one day that is under observation, there is a chance that there will be no mail delivered, albeit a very low chance. For this same day, there is a chance that the village receives a low amount of mail, say 1,000 pounds, and a chance that it receives a large amount of mail, say 8,000 pounds.

A probability mass function can be useful to express the amount of mail received by a village on one day. A probability mass function is a discrete distribution that, for each possible amount of daily weight there is an assigned (numerical) probability that the village will receive that much weight. (Note that the probability mass function is discrete, not continuous.) It may be intuitive that the village most likely receives about 4,000 pounds of mail each day, and the probability of receiving weights that are somewhat greater or somewhat less than 4,000 pounds are lower. Following this logic through, it would be most unlikely to receive weights very much greater or very much less than 4,000 pounds. This kind of distribution peaks at the daily average weight, and has lower and upper tails (of near-zero probability). On the other hand, the distribution can be irregular, with multiple peaks. Knowing what probability mass function best describes the daily weight delivered to a village would simplify a computer simulation that generates daily weights.

In an effort to understand what the distribution of daily weights to individual villages looks like, USPS data for bypass mail orders were examined. A rough view of daily activity shows that most villages receive bypass orders on three days (or less) each week. Since the bypass orders must each exceed 1,000 pounds, the village either receives exactly 0 pounds, or more than 1,000 pounds, of bypass mail each day. Many villages receive less than 400,000 pounds annually, over the course of 250 days, and bypass orders tend to break the annual weight into a relatively small number (less than 250) of heavy orders.

The model for total daily weight is the sum of the bypass mail weight and the non-bypass parcel post a village receives on one day. This report evaluates data for bypass mail orders.

A. Size and Occurrence of Bypass Mail Orders

A typical example of how bypass mail is used is that a retail store (grocery store) in a village places a large order (over 1,000 pounds) to a shipping company in Anchorage, Alaska. The shipping company assembles the order into packages under 70 pounds apiece, and addresses and meter stamps each package. The company then stacks the packages onto pallets separated according to perishable, ‘chilled’, and frozen goods. The shipping company then takes these loaded pallets to the air carrier assigned to fly the goods from Anchorage to the hub village. The goods are transferred onto bush aircraft and flown to the recipient’s village.

The data used in this study come from the USPS in Anchorage, Alaska. The data is a record of each bypass order delivered to villages in the Y-K Delta. This is data for 124 days of bypass mail delivery, from 4th January to 1st June, 1999. Each bypass order record of this data consists of the weight of the order, the village and recipient that the order is to be sent to, the date that the order was presented to the air carrier in Anchorage, and identification codes for the mainline and bush air carriers that handled the order. A copy of this data is kept at the Transportation Engineering Department office of the college of Civil Engineering, Purdue University, West Lafayette, Indiana.

The distribution of the weight of a bypass mail order can be directly evaluated from this data. Multiple bypass mail orders can arrive in one day to a village, so the sum of all orders for one day is the amount received at the village.

The model of requesting bypass orders has two steps.

- Someone at the Y-K Delta village places an order, an incident that takes place at a random time. The model states that zero, one, two, or any number of bypass orders arrive at the village on one day.
- That order can weigh any amount greater than 1,000 pounds. The model generates the weight of each order according to the known distribution of bypass order weights.

The villages are divided into large, medium and small according to village population. The distributions of order weights appear to be different for each of these groups. The general shape for each of these groups is that order weights close to 1,000 pounds have the highest probability of occurring, heavier orders (2,500 pounds to 5,000 pounds) occur with a lower probability. Very heavy orders (over 10,000 pounds) are infrequent. The distributions differ among the three groups of villages by how quickly the probability drops as the weight values increase: large villages have a gradual drop with a long tail that can extend beyond 20,000 pounds per order, but small villages have a steep drop with a short tail that does not reach 10,000 pounds per order. This difference influences the average value of the weight per order, so that large villages have the highest average weight, and small villages have the lowest average weight per order.

	Average Weight per Order
Large	4,976 lb/order
Medium	3,031 lb/order
Small	2,773 lb/order

The annual expected weight of bypass mail to be delivered to a village is 75% of the total annual expected weight of mail.

To calculate the expected number of bypass orders received in one year, the annual expected weight of bypass mail for the village is divided by the average order weight of bypass orders for that village's classification. This number of bypass orders for medium villages is usually between 110 and 160 orders, which is less than the 250 days in one

year. Therefore, most of the days have no bypass orders received at the village, many days have one order received, and a few days have two or more orders received.

The occurrences of bypass orders are 'truly random' events if they are not influenced by weekly schedules, by seasonal demand fluctuations, by major events (such as a village-wide festival, or a holiday), and by how recent the previous bypass order occurred. If the occurrences of bypass orders are truly random, then the events follow the Poisson distribution. The Poisson distribution gives the probability that zero occurrences will take place, the probability that one occurrence will take place, that two occurrences will take place—probabilities that any (non-negative integer) number of occurrences will take place on one day. For example, a medium village (that receives 119 orders in one year) may have the following likelihood of number of occurrences on one day.

Occurrences in One Day	Likelihood
0	62.16%
1	29.56%
2	7.03%
3	1.11%
more than 3	0.15%

The likelihood percentages for daily number of occurrences do not change from one day to the next.

The assumptions made as to the uninfluenced nature of the occurrence of a bypass order may not be correct. For example, a store may assign a weekday in which, every week, they place an order for groceries. A chi-square test can demonstrate that these bypass orders do not occur truly randomly. This chi-square test, for 24 medium villages from the USPS Bypass data, shows that five villages have a daily order count distribution that is not truly random, with a five percent error. The 19 villages that passed the chi-square test were not proven to be truly random, but only that they were not disproven (at 95% confidence) to be truly random. It is misleading, though, to use the chi-square test on villages that likely only have zero, one, or two orders per day because the likely outcomes (zero, one, two) are too few, and much more than 124 days of data must be evaluated.

	For 124 Days, the Number of Days for						
	0 Orders	1 Order	2 Orders	3 Orders	4 Orders	Chi-Square	
Akiachak	74 days	37 days	13 days			0.23	
Akiak	95	26	3			0.14	
Atmautluak	85	29	9	1 day		1.30	
Chefornak	85	30	7	2		0.61	
Eek	83	40	1			7.58	fail
Goodnews Bay	97	22	5			0.98	
Kasigluk	77	31	11	5		2.83	
Kipnuk	87	25	11	1		4.68	fail
Kongiganak	83	39	2			5.29	fail
Kwethluk	67	49	7	1		4.73	fail
Kwigillingok	84	36	4			1.73	
Marshall	65	40	15	3	1 day	0.25	
Mekoryuk	92	26	5	1		0.45	
Napakiak	92	28	4			0.07	
Napaskiak	98	26				3.58	
Newtok	93	26	5			0.14	
Nightmute	85	35	4			1.41	
Nunapitchuk	83	36	4	1		1.04	
Quinhagak	68	38	14	4		0.64	
Scammon Bay	68	44	9	3		0.72	
Toksook Bay	88	26	6	3	1	2.71	
Tuluksak	90	33	1			4.13	fail
Tuntutuliak	87	27	10			2.23	
Tununak	79	37	7	1		0.22	

Chi-square values greater than 3.84 (greater than 5.99 for Marshall and Quinhagak) are those bypass order distributions that do not observe the Poisson process (at 95% confidence).

The day of week appears to influence the daily number of bypass mail orders a village receives. Generally, Wednesdays and Thursdays are the days that the village receives a greater than average (>20%) number of bypass orders.

The day-of-week study, for which the following table displays the findings of, omits all orders received on Saturdays—there are 45 Saturday orders of a total 1186 orders. The 124 days of the study include those Saturdays that at least one order was received among these 24 villages, which is 17 Saturdays, and an additional four Saturdays that bypass mail was delivered to Bethel, Hooper Bay, or Chevak, but not to these 24 medium villages.

	Order Count for 124 Days	Percent of Total Orders Monday	Tuesday	Wednesday	Thursday	Friday
Akiachak	63	0.227	0.189	0.205	0.189	0.189
Akiak	32	0.175	0.159	0.254	0.317	0.095
Atmautluak	50	0.044	0.159	0.339	0.239	0.219
Chefornak	50	0.156	0.121	0.402	0.241	0.080
Eek	42	0.055	0.149	0.373	0.298	0.124
Goodnews Bay	32	0.109	0.198	0.033	0.330	0.330
Kasigluk	68	0.095	0.129	0.259	0.280	0.237
Kipnuk	50	0.095	0.129	0.259	0.280	0.237
Kongiganak	43	0.130	0.235	0.306	0.165	0.165
Kwethluk	66	0.178	0.226	0.338	0.129	0.129
Kwigillingok	44	0.080	0.145	0.508	0.145	0.121
Marshall	83	0.188	0.182	0.424	0.121	0.085
Mekoryuk	39	0.000	0.211	0.289	0.368	0.132
Napakiak	36	0.165	0.149	0.358	0.179	0.149
Napaskiak	26	0.167	0.151	0.341	0.151	0.189
Newtok	36	0.000	0.257	0.229	0.257	0.257
Nightmute	43	0.054	0.267	0.291	0.243	0.146
Nunapitchuk	47	0.119	0.236	0.150	0.322	0.172
Quinhagak	78	0.115	0.195	0.325	0.260	0.104
Scammon Bay	71	0.235	0.128	0.213	0.312	0.113
Toksook Bay	51	0.066	0.159	0.537	0.199	0.040
Tuluksak	35	0.229	0.178	0.148	0.267	0.178
Tuntutuliak	47	0.049	0.133	0.398	0.243	0.177
Tununak	54	0.315	0.114	0.247	0.190	0.133
Unweighted Average		0.127	0.175	0.301	0.239	0.158

B. Application of Findings

Two steps simulate the amount of bypass mail delivered to a village on one day: to generate the number of bypass orders received, and to generate the weight of each of those bypass orders. The average number of orders that a village receives on one day, or the arrival rate, must be known to perform the first step. The arrival rate is calculated from the estimated number of orders per year based on the expected annual weight of the village. The average weight per order is known from the order weight distribution.

The daily number of orders follows the Poisson distribution, but instead of an arrival rate that remains constant for the full week, the arrival rate varies according to the unweighted average from the Section II day-of-week study. The calculation for the arrival rate, λ, is

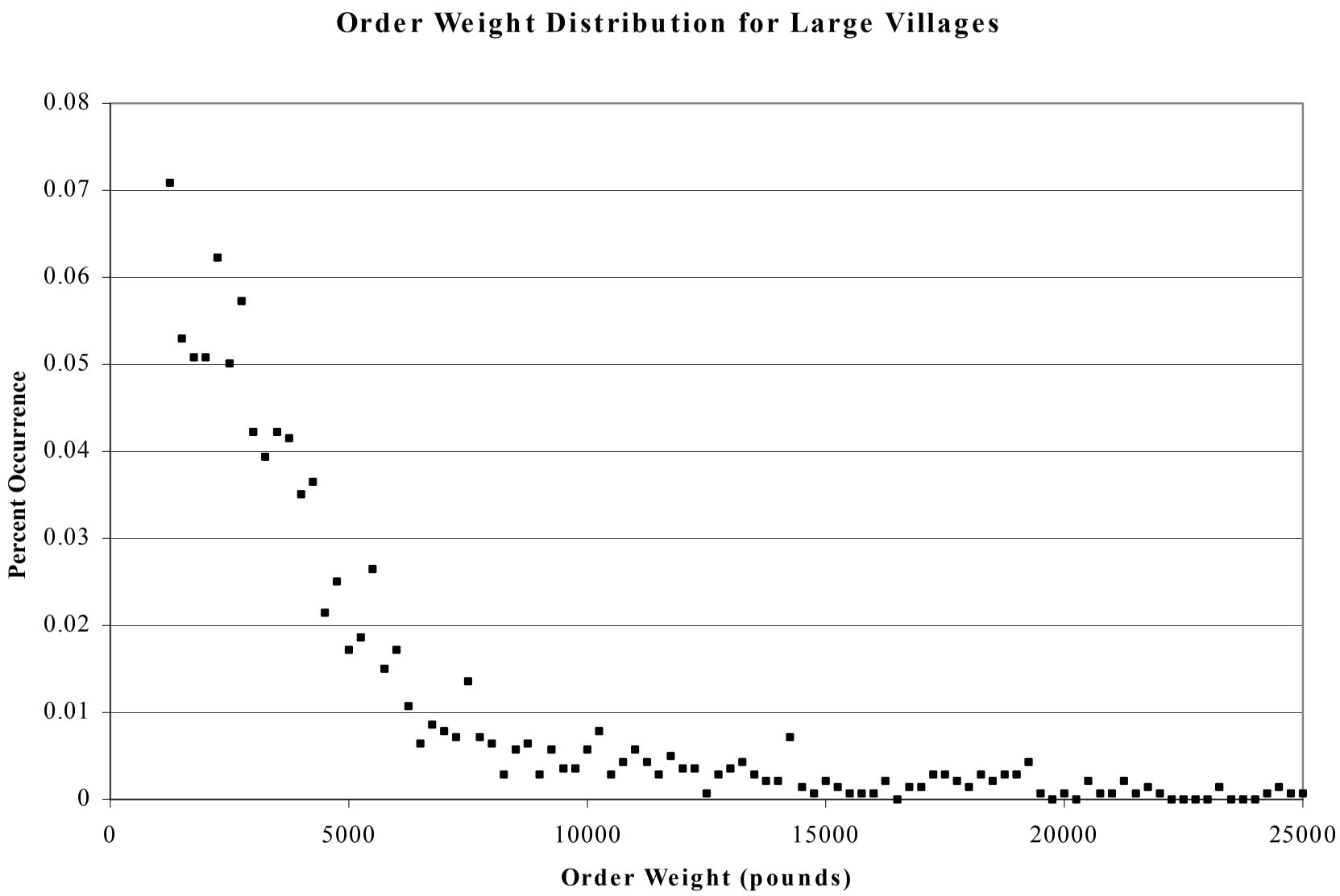
$$\lambda = r\,(\,75\%\ \mathrm{X} / \mu\,) / 50$$

where

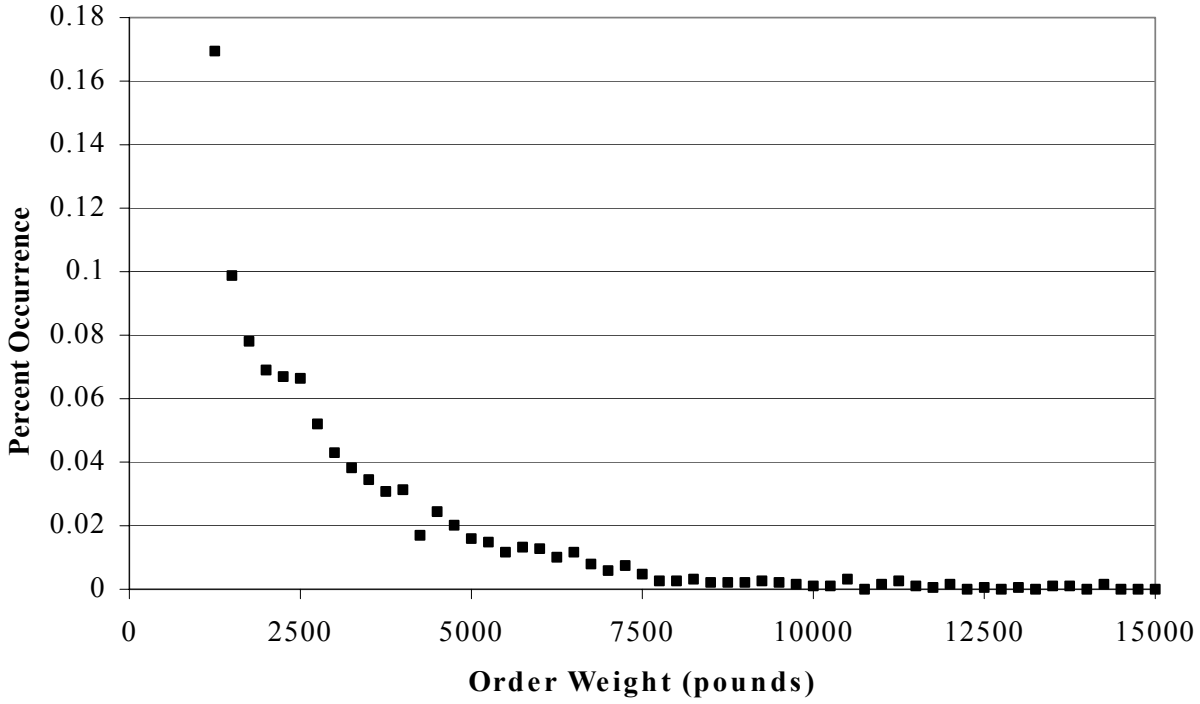
$$r = \frac{\text{number of orders delivered on that day of the week}}{\text{number of orders delivered on all (five) days of the week}}$$

for one year. The variable X is the total annual expected weight for the village, and 75% of X is the annual expected weight of bypass mail for the village. The variable μ is the average weight per order, which varies according to the size (large, medium, or small) of the village. The divisor of 50 is for the 50 weeks of one year.

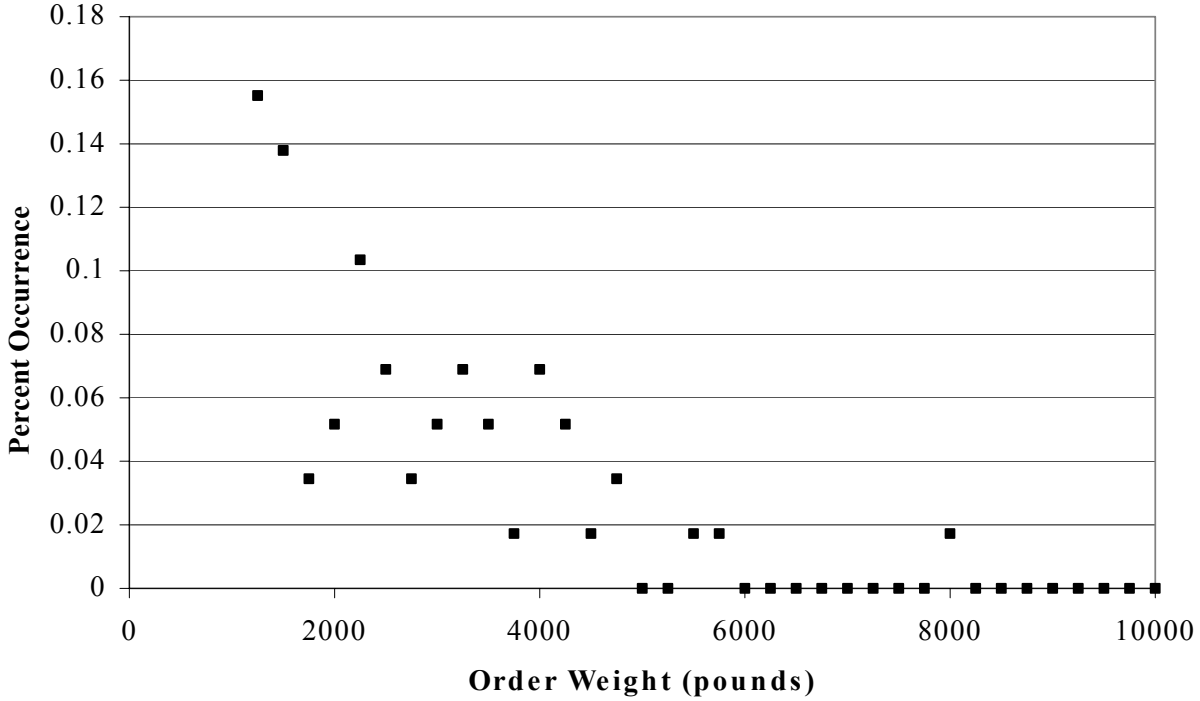
The weight of each order is randomly generated according to the distribution of bypass order weights. The distribution of bypass weights varies according to the size (large, medium, or small) of the village.


Order Weight Distribution for Large Villages
Percent Occurrence
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
5000
10000
15000
20000
25000
Order Weight (pounds)

Order Weight Distribution for Medium Villages



Order Weight Distribution for Small Villages



III. Aircraft Operational Expenses for Delivering USPS Mail

The simulation code produces the block hours of operation and the number of departures for each type of aircraft. The code can evaluate many different delivery systems (scenarios), so that an improvement to the delivery system may lower the block hours of one type of aircraft at the cost of increasing the block hours of a different type of aircraft. The cost of operating a type of aircraft for one block hour, and the cost of operating that type of aircraft on a departure-related basis, are specific to that type of aircraft. The number of block hours of operation, the number of departures, and the cost of operating the aircraft (per-block hour and per-departure) produces the cost to deliver mail systemwide.

The per block hour and per departure costs can be inferred from the rates set by the US Department of Transportation for the USPS to pay air carriers to deliver mail. The air carriers that provide mainline and bush service in Alaska must report operational expenses and terminal handling expenses to the US DOT. From these individual reports, the US DOT determines the total cost to deliver USPS mail statewide. The US DOT takes 90% of this total cost and calculates an average cost to deliver mail per block hour and per departure. This average cost becomes the rate that the USPS will pay air carriers.

This policy is to give incentive to air carriers. Paying the average cost to all air carriers benefits air carriers that deliver mail cost-efficiently. Efficient air carriers receive more money than they spent to deliver the mail. Inefficient air carriers receive less money than they spent to deliver the mail, and they may be forced out of business. In order to break even, an air carrier must perform better than average, since 90% of the total costs are reimbursed.

These rates calculated by the US DOT for the USPS to pay air carriers then seem to be a good indicator of the operational cost to deliver mail.

Further, this report looks at four quarters of those operational costs reported by air carriers to the US DOT. This report uses this data to evaluate the performance of different types of aircraft.

A. Historic Postal Rates

The USPS pays two types of rates to air carriers for the delivery of nonpriority mail.

- **Terminal** rates are in units of dollars per pound. This is the cost of handling the parcels at the airport by the air carrier. These rates are based on departure related expenses reported by air carriers. Terminal rates are the cost to remove the parcels from storage (or from aircraft), to sort the parcels, and to stack the parcels onto aircraft (or to send the parcels to storage or to its recipients).
- **Linehaul** rates are in units of dollars per ton-mile. This is the cost of operating the aircraft to carry one ton of mail for one mile. These rates are based on block hour related expenses reported by air carriers. Linehaul rates are the costs related to fuel, piloting, maintenance, insurance, and depreciation expenditures.

Terminal and linehaul rates differ according to mainline and bush service. Altogether there are four rates—mainline terminal, mainline linehaul, bush terminal, and bush linehaul. These rates are uniformly imposed statewide. Bush service is significantly costlier than mainline, but bush service involves shorter distances. All mail uses mainline service, but only the mail that goes to bush communities use bush service.

People working at Northern Air Cargo in Anchorage, Alaska recorded the historic rates for mainline service. This data is prepared in Appendix I.1. Note that to compare terminal and linehaul rates using common units, the linehaul cost was calculated at 400 miles, the distance from Anchorage to Bethel.

Linehaul rates for mainline service fluctuated over the years. Since 1995, the rates have gone from about $.73/tn-mi up to $.90/tn-mi and then down to $.84/tn-mi.

Terminal rates for mainline service fluctuated over the years. Since 1995, the rates have gone from $.225/lb down to $.167/lb and then up to $.205/lb.

Historic rates for bush service was downloaded from the US DOT website. This data is summarized in Appendix I.2.

Linehaul rates for bush service fluctuated over the years. Since 1995, the rates have gone from $6.51/tn-mi up to $9.14/tn-mi.

Terminal rates for bush service fluctuated over the years. Since 1995, the rates have gone from $.326/lb up to $.407/lb and then down to $.349/lb.

Additionally, Anchorage CPI-U values taken from the Alaska Department of Labor website were entered onto the table in Appendix I.1, in order to express operational costs on a constant dollar basis. What this shows is that the payment rates determined by the US DOT did not increase at a rate equal to the rate that the consumer price index increased. In fact, since 1990 the cost to deliver mail has been decreasing in constant dollars. The drop is especially noticeable in 1994. This reduction may be due to operational and terminal costs being uninfluenced by the CPI, or by air carriers becoming more efficient over time.

B. Reported Operational Expenditures by Aircraft

Air carriers are required to disclose information quarterly to the US Federal Aviation Administration. This information is the number of passengers enplaned, the total weight of air cargo carried, and the total weight of US mail carried for that quarter. Additionally, air carriers report costs to operate: block hour related costs (such as fuel, piloting, and maintenance costs) and departure related costs (such as loading cargo onto aircraft). The FAA compiles this information to create the Air Carrier Activity Information System (ACAIS) report. Sagar Onta, a MS student at Purdue University, summarized four quarters, fiscal year 1997, of this data, which is attached as Appendix II.1.

Although the data summarized by Sagar Onta consists of all costs attributed to block hour of operations, no departure related expenditures were summarized.

The ACAIS data were evaluated to determine average operational costs for each type of vehicle. These average costs along with values for aircraft weight capacity and velocity were attached as Appendix II.2. The capacities and velocities come from two sources. Most aircraft capacity and velocity data came from *The International Directory of Civil Aircraft*, 1999/2000 edition, by Gerard Frawley. The other source, the text, *Airport Operations,* by Norman Ashford and Paul H. Wright (third edition, 1992), provided information especially for the DC-6.

Generally, planes that have lower capacities, and that require one pilot, are the least expensive to operate on a per block hour basis. But the low capacities and relatively low velocities increase the block hours required to send goods to a village. Mail delivered in two trips using small planes may require only one trip using a larger plane. Large planes that require two or more pilots are more expensive to operate, but the heavier load they carry, and the shorter traveling time, could make large aircraft more efficient than small aircraft.

The findings of this analysis are that the Cessna-206 and the Cessna-207, very common planes in the Y-K Delta, are efficient aircraft, despite their small loads. The reported number of block hours of operating Cessna-207s in Alaska is very high, over 55,000 block hours. Most other aircraft have very low number of block hours for the four quarters—16 of the 27 aircraft types reported in the ACAIS report operated fewer than 5,000 block hours over the four quarters. The cost per block hour cannot be calculated with confidence for those aircraft types having a low number of reported block hours.

Aircraft	Capacity lb	Velocity knots	Reported blk-hr	Ops Cost $/blk-hr	Efficiency units
Cessna 207	1,256	144	55,706	$178	.508
Piper Navajo	1,507	218	12,996	$343	.479
Piper Cherokee	1,000	158	12,947	$185	.427
DeHavlnd Twin Otter	2,573	160	12,799	$522	.394
Swearingen Metro III	5,000	250	11,416	$664	.941
Beech 1900	3,996	270	11,397	$464	1.162
Cessna 208 Caravan	3,500	171	10,598	$505	.592

The reported departure related cost of the air carriers is the cost required to handle all air cargo and USPS mail at the terminal. The total weight of air cargo and USPS mail is reported so that a cost per pound of handling parcels at the terminal, regardless if the parcel is USPS mail, is calculated. This cost per pound is then the rate the US DOT applies to deliver USPS mail. The summarized ACAIS data does not have this departure related cost.

C. Fleet Mix of Y-K Delta Aircraft

The types of aircraft in use in Alaska differ from the nationwide US fleet mix. The aircraft in Alaska are older than aircraft nationwide, and tend to run on leaded ‘av-gas’.

The ACAIS data, summarized in Appendix II.2, has the number of block hours that each type of aircraft operated statewide in Alaska for four quarters. The purpose of these flights may be for passenger travel, air cargo, USPS mail, or a different reason, such as

tourism-related flying. Using only those types of aircraft that are flown for bush service, the percent of block hours for each type of aircraft is calculated from the ACAIS data.

Approximately 34% of the operational block hours were expended by Cessna 206/207s. Piper Navajos and Cherokees, deHavilland Twin Otters, Beech 1900s, Cessna 208s, and Fairchild (Swearingen) Metro IIIs each account for 6% to 8% of operational block hours of bush aircraft in Alaska. An aircraft type called 'one engine piston, <450hp' accounted for 7% of operational block hours. Adjusting these operational block hours to the capacities and velocities of the vehicles show that about 13% of operational capacity is accounted to the Cessna 206/207s. Fairchild (Swearingen) Metro IIIs account for 18% of operational capacity, Beech 1900s account for 16%, and deHavilland Dash-8s (which account for about 3% of operational block hours) account for 14% of operational capacity.

A second source of the fleet mix data for Alaska is the *1999 Annual Report of the Regional Airline Association*. This organization publishes the fleet of all registered air carriers in America. The data for air carriers throughout Alaska except for those that fly a fleet that would not be representative of the aircraft flown in the Y-K Delta—such as carriers that operate a significant number of seaplanes, and those that fly solely for tourist purposes—were compiled onto Appendix III.

Approximately 34% of the aircraft (by units) flown in Alaska are Cessna 206/207s. Piper Navajos (about 19%) and Cherokee Sixes (about 12%), and Cessna 208s (Caravans, about 8%) are among the more common types of aircraft. There are ten Cessna 172s among the selected air carriers, and ERA Aviation operates ten deHavilland Twin Otters. Cessna 206/207s account for about 22% of the total aircraft capacity in Alaska. Piper Navajos account for about 15%, and Cessna 208s account for about 14%, of the total aircraft capacity in Alaska.

The future fleet of aircraft in Alaska likely will have larger, more efficient turbo-powered aircraft that do not depend on 'av-gas'. This should contribute to a reduction in the linehaul cost (on a per ton-mile basis) to deliver USPS mail. Larger (or newer) aircraft could also reduce the terminal cost (on a per pound basis).

IV. Input for Pando Simulation Code

This section explains how to enter data into Pando.

In order to execute the simulation code, the user must enter data onto five worksheets—Village, Weight, Vehicle, Tours, and Scenario—in the MSExcel file Pando. Each worksheet requests only one type of data. Other worksheets (Run1, Run2, Output, and Output2) are used only by the simulation code as the code is executing. The Pando code displays error messages on the Run2 worksheet. One worksheet, Output, shows the results of the simulation. Before executing the simulation, the user must clear all data on the Output worksheet.

Sample Village Worksheet

	C	D	E	F	G	H
	Village	Airport	Latitude	=+ min	Longitude	=+ min
9	Anchorage	ANC	61	10.46	149	59.77
10	Fairbanks	FAI	64	48.82	147	51.58
11	Akiak	AKI	60	54.29	161	13.62
12	Aniak	ANI	61	34.9	159	32.58
13	Anvik	ANV	62	38.92	160	11.39
14	Atmautluak	ATT	60	52	162	16.39
15	Alakanuk	AUK	62	40.8	164	39.6
16	Bethel	BET	60	46.79	161	50.28
17	Chuathbaluk	CHU	61	34.99	159	14.16
18	Crooked Creek	CKD	61	52.14	158	8.23
19	Chefornak	CYF	60	8.95	164	17.14
20	Eek	EEK	60	12.95	162	0.34

The user enters onto the Village worksheet the name of the village on column C, and its latitude and longitude coordinates (degrees and minutes) on columns E through H. These coordinates are used to calculate the distances between villages. The airport code is optional and is not used by the computer code. The data must begin at row 9, and no rows can be blank until the end of the list of villages. The spelling of the village name must be consistent among the worksheets Village, Weight, and Tours.

Sample Weight Worksheet

	B	C	D	E	F
		First Year	Second	third	fourth
12	forecast	low			
13	common	1	1	1	1
14	Akiak	302066.7	302067	302067	302067
15	Aniak	1536694	1536694	1536694	1536694
16	Anvik	182137.7	182138	182138	182138
17	Atmautluak	277641.3	277641	277641	277641
18	Alakanuk	1034815	1034815	1034815	1034815
19	Bethel	16150759	16150759	16150759	16150759
20	Chuathbaluk	154555	154555	154555	154555
21	Crooked Creek	235439.3	235439	235439	235439
22	Chefornak	537728.7	537729	537729	537729
23	Eek	372827	372827	372827	372827
24	Emmonak	1556806	1556806	1556806	1556806
25	Flat	44857	44857	44857	44857

The Weight worksheet has weight forecast data for individual villages. One or more tables of forecasts may be stored onto the same worksheet. Multiple forecasts on the worksheet allow the user to set up one run using one forecast, then to quickly reset the

problem (by declaring a different forecast on the Scenario worksheet) without modifying the worksheet. The identifying command 'forecast' in column B (along with an identifying name in column C on the same row as the forecast command) must precede each forecast table on the worksheet, even if there is only one forecast. The first forecast must begin on row 12, and no blank rows are allowed until after the last row of the forecast. Use one blank row between forecasts. The village name belongs in column B, and expected annual weight of mail for the first year (in pounds) is in column C. Columns D onwards are expected annual weight of mail for successive years. A blank column must follow the last year of the forecast. The computer code ignores all information on the row that has the 'common' command (in column B). The common command allows the user to enter a mail growth rate that will be applied to all villages, but the user must define the calculations into all cells for each village.

Sample Vehicle Worksheet

	C	D	E	F	G	H	I
	Vehicle	Velocity	Capacity	Fleet	series		
8				Size	ML air	bush air1	bush air2
9							
10	DC-6	310	22500	100	1	0	0
11	Cessna 207	120	1130	100	0	1	1

The Vehicle worksheet has the name of all types of vehicles in column C beginning at row 10. There should be no blank rows until the end of the list. For each vehicle, the user enters the fleet size (in single units, column F), the vehicle's capacity (in pounds, column E), and its velocity (in miles per hour, column D). The user identifies the 'series' on row 8 beginning at column G. The user must enter a '1' for each type of vehicle that is assigned to the series. If a type of vehicle is assigned to the series, then that vehicle is available when a tour calls for the series—more about this in the next paragraph.

Sample Tours Worksheet

	D	E	F	G	H	I	J
10					case	Original	
11	0	1	1	250	ML air	Anchorage	Bethel
12	0	1	1	250	bush air1	Bethel	Akiak
13	0	1	1	250	bush air1	Bethel	Atmautluak
14	0	1	1	250	bush air1	Bethel	Chefornak
15	0	1	1	250	bush air1	Bethel	Eek
16	0	1	1	250	bush air1	Bethel	Goodnews Bay
17	0	1	1	250	bush air1	Bethel	Hooper Bay
18	0	1	1	250	bush air1	Bethel	Kongiganak
19	0	1	1	250	bush air1	Bethel	Akiachak
20	0	1	1	250	bush air1	Bethel	Kipnuk
21	0	1	1	250	bush air1	Bethel	Kasigluk
22	0	1	1	250	bush air1	Bethel	Kwigillingok

The Tours worksheet distributes the USPS mail weight for the simulation, specifically the geometric setup of the hub and bush delivery system, the type of vehicle to use, the days of the year the delivery pattern is in effect, and the frequency of delivery. The user accomplishes this by defining tours that the simulation code carries out. A tour is a series of villages that defines the path that a vehicle travels.

A set of tours is called a case, and this set of tours should contain sufficient information to account for all the mail to be delivered to a region. Multiple cases may be stored on the worksheet so that the user may run different setups without changing the worksheet. The command 'case' (in column H), followed by an identifying name (in column I on the same row), must precede each set of tours. This is required even when there is only one set on the worksheet. Each row of one case is one tour, and there must be no blank rows within one case.

For each row:

- Column D is the delivery schedule type for the tour. Delivery schedule 0 is for mandatory daily delivery. For cases when delivery occurs on alternate days (as the hovercraft operates), delivery schedules 1 (for odd days) and 2 (even) are used. Delivery schedule 5 is for the mail to be held until the vehicle has full capacity, but the mail is held for no more than five days, which is a proposed policy change.
- Column E is the percent of the total mail destined to the villages on the tour that will be carried on this tour. (If all the mail to these villages must be delivered on this tour, use 1.0; if twenty-five percent of the mail to these villages must be delivered on this tour, use 0.25.) This is useful if the villages on the tour are served by different delivery schedules, or if the mail is separated before being delivered to these villages.
- Columns F and G are the first and the last day of the year that the mail is delivered on this tour. There are 250 days in one year: on none of the days must no mail be delivered, as if they would be weekends or holidays. It is important to specify the first and last days of the year that mail is delivered on the tour because certain modes of delivery are seasonal.
- Column H is the vehicle series from which the tour chooses vehicles. Most evident is that one type of series allows large mainline vehicles, and another allows smaller bush aircraft.
- Column I is the first departing village of the tour. This may be Anchorage, or one of the hub villages.
- Columns J onwards are receiving villages served on the tour. The simulation code will simulate delivering mail from the departing village to the first receiving village, then to the second, and to all successive villages until the last receiving village is served. Then the simulation returns the vehicle to the original village (from column I). If all of the mail cannot be delivered on one aircraft, then the simulation delivers as much mail as possible to the first few villages, returns the vehicle to the original

village, and resumes delivering the mail mid-tour. (The earlier villages are not revisited.)

The simulation code references and matches much of the data from one sheet to the next. For example, the code matches the village name from the Village worksheet to the village name in the Tours worksheet, and to the name in the Weight worksheet. It is important to identically spell the village name on all three worksheets, or the code will produce an error message (onto the Run2 worksheet). The names of vehicle series, weight forecast, and tours case must also agree among the worksheets.

Sample Scenario Worksheet

	C	D	E
	Scenario	Tours	Weight
		case	forecast
11	Case 1	Original	low

The Scenario worksheet is how the user selects which weight forecast and which tours case the simulation code is to run. The code will perform only one scenario for each execution. The user may enter an identifying name for the scenario in cell C11—the simulation code does not use this information. The user specifies in cell D11 which case from the Tours worksheet the simulation code will access. The forecast from the Weight worksheet must be identified in cell E11.

Remember to clear any data on the Output worksheet before executing the code! When the code is finished executing, the user can transfer the code output from the worksheet Output to a separate file.

V. Computer Simulation Procedure

A physical system can be explained as a series of steps that must be followed. For the USPS mail delivery system in the Y-K Delta, these steps are:

- someone in a bush community orders goods;
- a few days later, the goods are put onto aircraft in Anchorage and flown to a hub;
- the goods are transferred to smaller aircraft and flown to the bush village.

A computer simulation follows such a series of steps using random numbers where the physical system has uncertainties, and using reasonable logic where people make decisions.

The advantage that computer simulation has over simplified mathematical models or stochastic models is that when the physical system becomes too complex, the stochastic models become very complex. Computer simulation does not give a precise mathematical explanation of the physical system, but gives us system performance data resulting from defined rules.

Any one village in the Y-K Delta could receive daily mail deliveries that are very low, nearly zero pounds, and that are very high, around 10,000 pounds. The hub-and-spoke system in the Y-K Delta means that planes may be going out with low load factors, or that smaller, inefficient planes must make several trips. The computer simulation Pando keeps track of the number of aircraft departures, the load factor at initial departure, and the operational block hours. These values can be compared to the values of simulations of changes to the system: increased demand for mail, use of larger aircraft, and changes in the holding time policy, for example.

This section discusses the steps the computer code goes through in order to simulate mail delivery in the Y-K Delta. The computer code Pando is attached as Appendix IV. The simulation code has two parts: mail weight simulation and mail delivery simulation. Before simulating anything, though, the code prepares the user-entered data (from the Tours worksheet) so that the simulation may repeatedly and quickly access data.

A. Preparatory Work

The code reviews all the data for spelling errors and input format errors. In the case that an error is found, the code stops executing and an error message is displayed on the Run2 worksheet. The code will not identify errors in logic, such as omitting a village or duplicating a village.

The five worksheets that the user enters data onto are designed to be easy to enter data, but it is time consuming for the code to repeatedly match up village names and vehicle types. In order to improve the performance of the code, the code first prepares the data—specifically, the information on the Tours worksheet is restated onto the Run1 worksheet so that mileages between villages are pre-calculated and that the row numbers from the Weight worksheet are identified. After this preparatory stage, the

code never accesses information from the Tours worksheet (as well as from the Village worksheet).

Sample Run1 Worksheet

	D	E	F	G	H	I	J	K	L	M
1	0	1	1	250	G	1.71186	-1	396.9644	396.9644	5
2	0	1	1	250	H	1.426937	5	152.392	152.392	14
3	0	1	1	250	H	1.378099	5	135.1253	135.1253	49
4	0	1	1	250	H	1.353068	5	143.7095	143.7095	40
5	0	1	1	250	H	1.344865	5	152.9074	152.9074	30
6	0	1	1	250	H	1.308136	5	112.1026	112.1026	34
7	0	1	1	250	H	1.297719	5	116.9622	116.9622	48
8	0	1	1	250	H	1.290318	5	115.101	115.101	12
9	0	1	1	250	H	1.276239	5	94.96865	94.96865	20
10	0	1	1	250	H	1.275576	5	121.4786	121.4786	37
11	0	1	1	250	H	1.262922	5	93.97243	93.97243	8
12	0	1	1	250	H	1.25587	5	94.85286	94.85286	52

As a heuristic to optimizing aircraft selection, the code will choose certain tours for the most efficient planes. These tours have long distances and high expected weights. All tours are assigned a priority number:

$$i = (.8)\ (\ s_t / 500\ ) + (.2)\ (\ w_t / 3{,}000{,}000\ )$$

where s_t is the total length of the tour, w_t is the total annual expected weight of the tour, and i is priority ranking. Higher values of i, which can be greater than 1.0, are assigned to tours that should be served by the most efficient planes. The code will sort all tours according to the priority number (column I), with the tour that has the highest priority number on row 1. The code will simulate the tours in according to the sorted table. Tours with the highest priorities will be simulated first. If the fleet size of the most efficient aircraft is not large enough to deliver all of the mail in the region, then the most efficient aircraft will deliver mail on tours with high priority numbers and the less efficient aircraft will deliver mail on the remaining tours.

The worksheet is sorted according to the priority, column I. The mileage from the first village to the second village is in column K. The second village is identified in column M, so that the number in the column is the row number of the village on the Weight worksheet. The mileages from the previous village to the next village are in columns L, O, and every third column onwards. The mileages from the first village to the *n*th village are in columns K, N, and every third column onwards. Villages on the tour are identified in columns M, P, and every third column onwards. The series of vehicles is identified in column H, the column that the vehicle type is on the Vehicle worksheet. Columns D and E are the delivery schedule code and the percent of mail the tour handles. Columns F and G are the first and last days of simulation of the tour. Column J identifies the hub (the first village) that the mail went to before going to villages in columns M, P, and so forth. This is important so that the code sends the mail from Anchorage to that hub, and then from that hub onto the tour.

B: First Part of Simulation: Forecast of Mail to Each Village

Sample Run2 Worksheet

	A	B	C	D	E	F	G	H
16	335	2417.062	6205	270	916.8183	47511.72	195	150
17	465	16617.41	110	160	4646.326	44611.74	70	300
18	8210	2473.533	3435	3275	3724.651	108416.6	390	235
19	160	1482.226	85	1630	5260.059	65856.87	140	330
20	1995	14582.21	190	315	4709.584	27093.44	50	495
21	210	1449.49	110	175	1131.652	71880.89	95	2370
22	320	3711.259	45	115	2602.368	41645.69	110	215
23	290	4648.262	85	345	8707.423	82752.19	255	215
24	210	2432.394	4890	310	5353.378	34712.13	1435	3030
25	175	1154.063	205	285	896.7924	61416.41	230	250
26	325	1543.611	210	250	11614.57	42741.55	115	135
27	325	6690.88	170	200	1089.027	50680.37	150	240

After checking and preparing the data, the code produces a daily forecast of the weight of mail. This forecast is for the weight of mail that is delivered to each village listed in the selected forecast on the Weight worksheet, for 250 days (one year). The output of this simulation is stored on the Run2 worksheet. Column A records the daily weights for the first village listed in the selected forecast on the Weight worksheet. Successive columns contain daily weights of the successive villages listed in the selected forecast. For example, column F has the daily weights delivered to the sixth listed village. Row 16 contains the weights delivered on the first day to each village. Successive rows have weights delivered on successive days—the final row is row 265.

In order to generate this output, the simulation code performs the steps discussed in this section.

There are two types of mail delivered to each village: bypass and non-bypass parcel post. The code generates the weight of bypass mail for each day first, and then it generates the weight of non-bypass parcel post for each day. The daily weight stored in one cell on the Run2 worksheet is the sum of bypass and non-bypass parcel post for one day.

To generate a weight of bypass mail delivered for one day, the code follows the logic discussed in Section II, “Evaluation of Daily Village Weights”, of this report. The code determines the number of orders arriving to the village for one day, and then generates the weight of each order. The flowchart ‘Simulate Daily Weight of Bypass Mail’ summarizes the steps the computer code takes to produce daily weights of bypass mail for a village.

Flowchart: Simulate Daily Weight of Bypass Mail, *repeated for each village*

For each day,

X = total annual expected weight for the village

$$1: \begin{cases} \textit{if } \mathrm{X} > 1{,}350{,}000 \text{ lb} & \text{village is large} & \mu = 5{,}137 \text{ lb} \\ \textit{if } 240{,}000 \text{ lb} < \mathrm{X} < 1{,}350{,}000 \text{ lb} & \text{village is medium} & \mu = 3{,}014 \text{ lb} \\ \textit{if } \mathrm{X} < 240{,}000 \text{ lb} & \text{village is small} & \mu = 2{,}539 \text{ lb} \end{cases}$$

n = orders per year = 75% X / μ
where 75% of the total annual expected weight is bypass mail

$$2: \begin{cases} \text{Monday} : & r = 13.7\% \text{ of mail} \\ \text{Tuesday} : & r = 17.0\% \text{ of mail} \\ \text{Wednesday} : & r = 30.7\% \text{ of mail} \\ \text{Thursday} : & r = 23.7\% \text{ of mail} \\ \text{Friday} : & r = 14.9\% \text{ of mail} \end{cases}$$

λ = rate of arrival (orders per day) = rn / 50
where 50 weeks are in one year

3: Produce a random number of orders that observes the distribution (Poisson):

$$\begin{cases} \text{zero orders} : & p = e^{-\lambda} \\ \text{one order} : & p = \lambda e^{-\lambda} \\ \text{two orders} : & p = \dfrac{\lambda^2 e^{-\lambda}}{2} \\ \text{three orders} : & p = \dfrac{\lambda^3 e^{-\lambda}}{6} \\ \text{four orders} : & p = \dfrac{\lambda^4 e^{-\lambda}}{24} \\ \Lambda & \end{cases}$$

4: *For each order,*
Produce a weight of the order based on the distribution for the village category.

The following are notes that supply additional information to the flowchart:

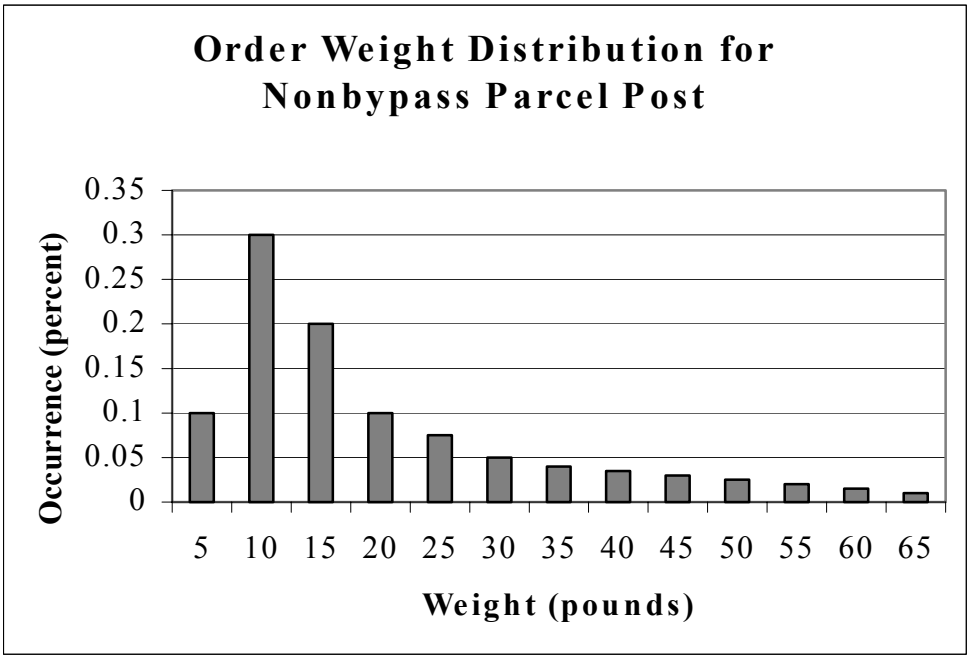
- The village is classified as small, medium, or large. The three classifications have a different distribution of weight per order. These distributions are based on the distributions

of USPS Bypass data. The charts of the distributions used for simulation are at the end of this subsection.

- The amount of mail received on Wednesdays and Thursdays tends to be larger than the amount received on other days. These percents are based on USPS Bypass data.
- The generated number of orders to arrive at the village for one day is based on a Poisson distribution. The USPS Bypass data does not strongly support order arrivals as a Poisson process, but the simulation code assumes that this is true for all cases.

The non-bypass parcel post weight for smaller villages is based on a similar method. The significant differences are:

- The order weight distribution does not exceed 70 pounds. The distribution that the simulation follows is only a conjecture. This study did not use actual non-bypass parcel post data.



- The simulation code assumes that the amount of non-bypass parcel post delivered on one day is independent of the day of the week. The procedure to generate non-bypass parcel post on Wednesdays and Thursdays is no different than that to generate non-bypass parcel post on any of the remaining days.
- For villages that have a non-bypass mail order arrival rate of more than 40 orders per day, the code does not generate individual order weights. Instead, the code generates a total non-bypass parcel post weight based on the normal distribution.

Simulate Daily Weight of Non-bypass Parcel Post, *repeated for each village*

For each day,

X = total annual expected weight for the village

$$1: \begin{cases} if\ \ \mathrm{X} > 797{,}000\ \mathrm{lb} & \text{village is large} \\ if\ \ \mathrm{X} < 797{,}000\ \mathrm{lb} & \text{village is small} \end{cases}$$

If village is **large**, then

2L: Produce the total daily weight of non-bypass parcel post:

2La: μ = average daily weight of non-bypass parcel post = 25% X / 250
where 25% of the total annual expected weight is non-bypass parcel post,
and 250 days are in one year.

2Lb: σ^2 = variance of the daily weight of non-bypass parcel post = 50% μ

2Lc: The total daily weight of non-bypass parcel post is a number based on the normal distribution with the above population parameters.

If the village is **small**, then

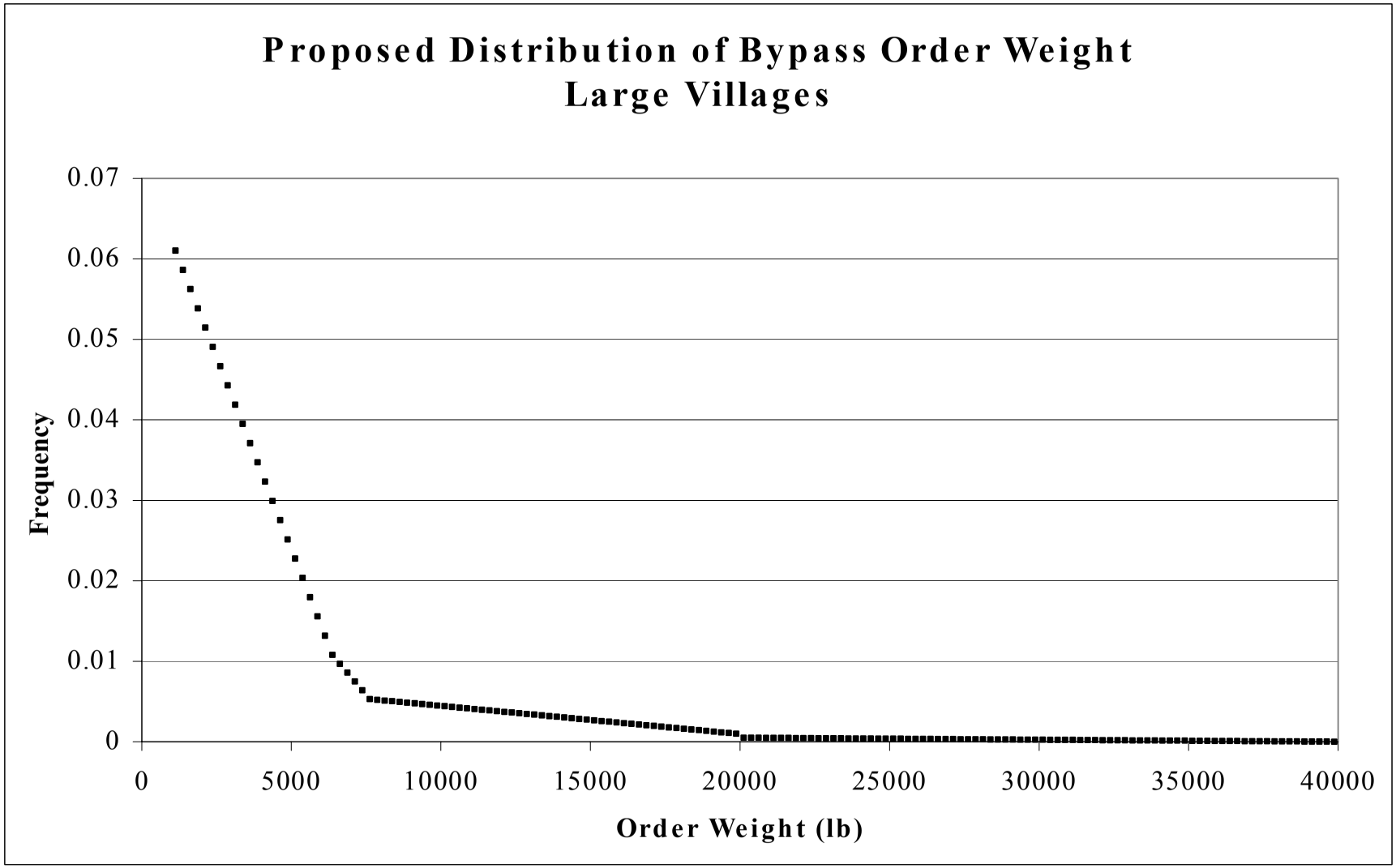
2S: Produce the total daily weight of non-bypass parcel post:

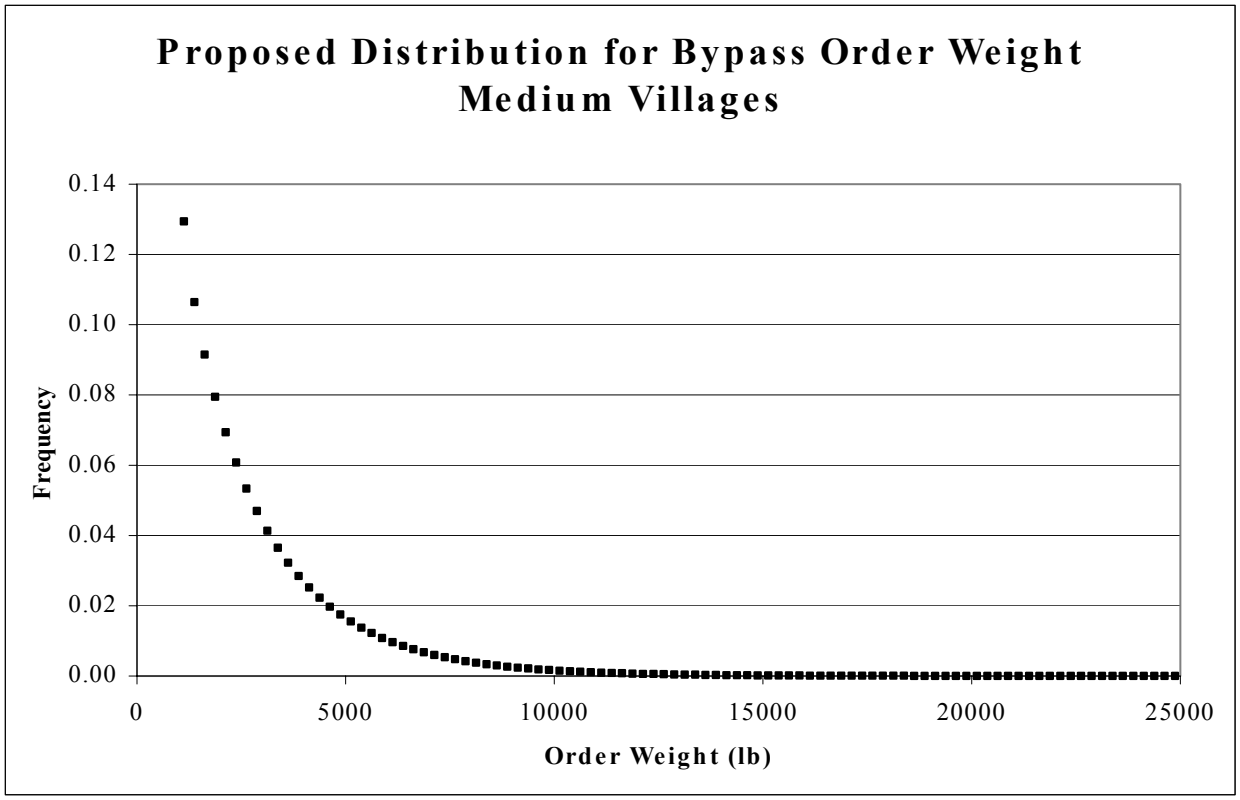
2Sa: n = orders in one year = 25% X / 19.925
where 25% of the total annual expected weight is non-bypass parcel post,
and the average weight per parcel (per order) is 19.925 lb.

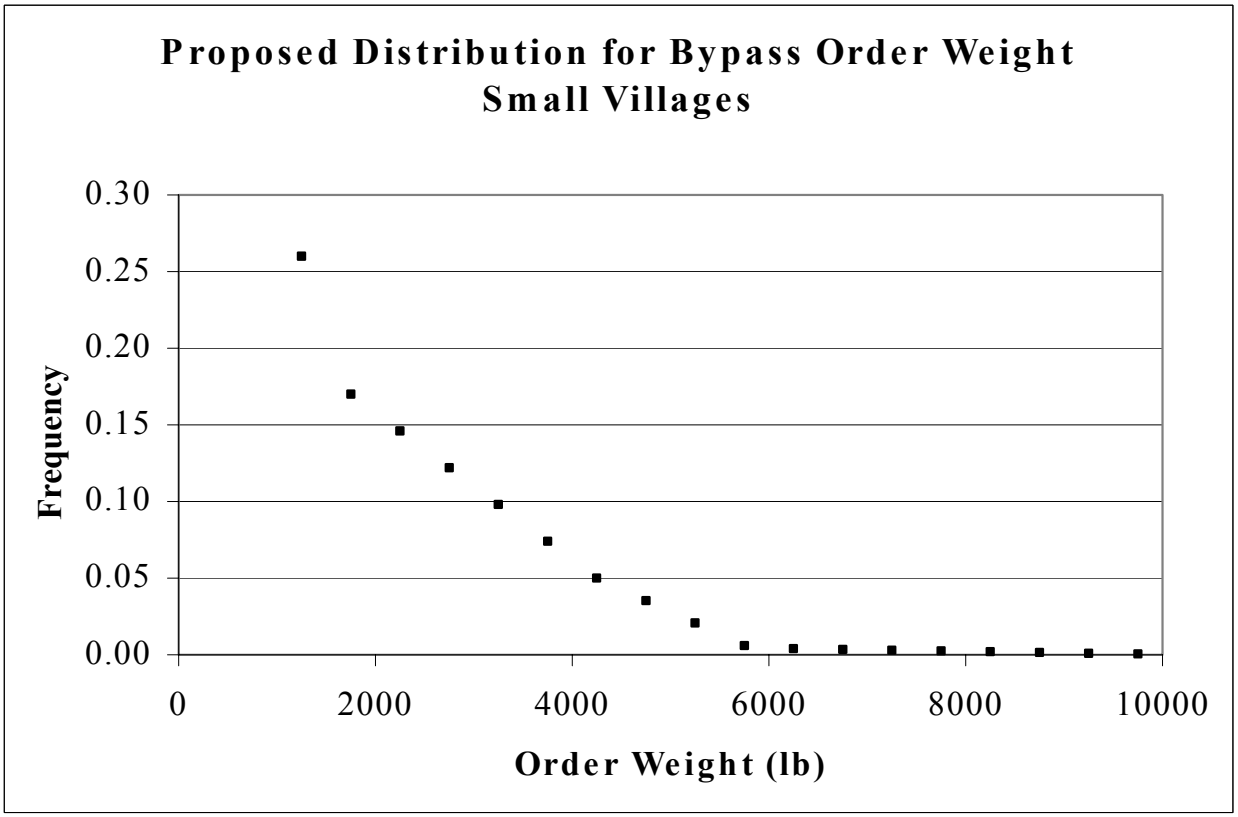
2Sb: λ = rate of arrival (orders per day) = n / 250
where 250 days are in one year.

2Sc: Produce number of daily orders according to Poisson distribution (similar to bypass mail)

2Sd: *For each order,*
Produce a weight per order based on the order weight distribution of non-bypass parcel post.


Proposed Distribution of Bypass Order Weight
Large Villages
Frequency
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
5000
10000
15000
20000
25000
30000
35000
40000
Order Weight (lb)


Proposed Distribution for Bypass Order Weight
Medium Villages
Frequency
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
5000
10000
15000
20000
25000
Order Weight (lb)


Proposed Distribution for Bypass Order Weight
Small Villages
Frequency
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
2000
4000
6000
8000
10000
Order Weight (lb)

C. Second Part of Simulation: Daily Delivery Simulation

The data preparatory step prioritizes the tours, so that the tours that provide the greatest benefit are assigned the most efficient vehicle before the fleet of the most efficient vehicles is depleted. The simulation of the mail delivery begins with the first tour (the highest ranking).

This section discusses what the simulation code performs for tours with daily delivery service (option 0). Alternate day service and holding the mail until a full vehicle are discussed in the next section. All delivery schedule options follow the same steps.

Knowing the total weight that must be delivered on that tour on the first day, the code selects the most efficient vehicles to deliver the mail. The code then calculates and stores the block hours to operate each type of vehicle. (Every time other tours operate the same type of vehicle on the first day of the year, the stored value is incremented by the block hours of other tours. This is done because each vehicle operates six block hours per day—after each unit vehicle of the vehicle type had operated six block hours on the first day, remaining tours for the first day cannot choose that vehicle type.) When the code finishes calculating the block hours of vehicle types for the first day, the code evaluates the weight to be delivered on the first tour for the second day. Again, the code assigns the most efficient vehicles to deliver the mail, and calculates and stores the block hours to operate those vehicles, for the second day. The earlier block-hour values stored on the first day do not affect the vehicle block-hour values for the second day. This method is repeated for each day (250 days) of the year, for the first tour. After the first tour is completed, the code turns to the second tour. The flowchart 'Delivery Simulation' summarizes these steps.

Flowchart: Delivery Simulation, *repeated for each tour,*

1: c_{max} = capacity of the largest vehicle available for the tour
$t_{max,j}$ = block hours the largest vehicle had operated for the *j*th day
A vehicle is available for the tour so long that the vehicle does not exceed six block hours of operation per vehicle. (Usually there are many vehicles in one fleet.)

For each day from the entered first day to the entered last day of the tour,

2: i = village index of the current tour, up to n
g = percent of total weight that the current tour carries
$w_{prim,j}$ = weight to be delivered to the villages of the tour on the *j*th day
$w_{i,j}$ = weight to be delivered to the *i*th village of the tour on the *j*th day

3: $w_{prim,j} = g \cdot w_{1,j}$

4: Check if $w_{prim,j}$ Exceeds Capacity
if $w_{prim,j} > c_{max}$ then
v_{max} = velocity of the largest vehicle
$s_{h,1}$ = distance from hub to first village of the tour
$t_{max,j}$ = block hours the largest vehicle was operated on the *j*th day
$= t_{max,j} + 2s_{h,1} / v_{max}$
$w_{prim,j} = w_{prim,j} - c_{max}$
repeat until $w_{prim,j}$ *is less than* c_{max}

5: *For each tour (other than the current tour) that has the first village of the current tour as a hub (column J of the Run1 worksheet)*

$w_{secd,j}$ = sum of all weight to be delivered to all villages of the (new) tour on the *j*th day

$w_{prim,j} = w_{prim,j} + w_{secd,j}$

6: Check if $w_{prim,j}$ Exceeds Capacity (see step 3)

7: $w_{prim,j} = w_{prim,j} + g \cdot w_{2,j}$

8: Check if $w_{prim,j}$ Exceeds Capacity

if $w_{prim,j} > c_{max}$ then

$s_{1,2}$ = distance from the first village of the tour to the second village

$s_{h,2}$ = distance from the second village of the tour to the hub

$t_{max,j} = t_{max,j} + (\{ s_{h,1} + s_{1,2} \} \{or\} \{ s_{h,2} \} + s_{h,2}) / v_{max}$

9: *For each tour (other than the current tour) that has the second village of the current tour as a hub (column J of the Run1 worksheet)*

$w_{secd,j}$ = sum of all weight to be delivered to all villages of the (new) tour on the *j*th day

$w_{prim,j} = w_{prim,j} + g \cdot w_{secd,j}$

10: Check if $w_{prim,j}$ Exceeds Capacity (see step 8)

Repeat steps 7, 8, 9, and 10 for i = *3, 4, ...,* n

11: Of all available vehicles, select the vehicle of the lowest capacity c_{min} so that

$c_{min} > w_{prim,j}$

This may be the same vehicle as the vehicle with the largest capacity.

12: $t_{min,j} = t_{min,j} + (\{ s_{h,1} + s_{1,2} + ... + s_{h,n} \} \{or\} \{ s_{h,2} + s_{2,3} + ... + s_{h,n} \} \{or\} \{ ... \} \{or\} \{ s_{h,n} \} + s_{h,n}) / v_{min}$

The aircraft selected always follows efficient-use rules. Aircraft with higher capacity are assumed to be more efficient. Of course, using a vehicle with a capacity that greatly exceeds the weight of mail it is to carry is inefficient due to the low load factor. When the delivery of one tour is simulated, those aircraft that are considered are those that do not have exhausted fleets. The availability of vehicle types changes day-to-day. The vehicle with the lowest capacity, but that the capacity exceeds the weight to be delivered, is selected. If the weight of the mail is higher than the vehicle with the largest capacity, then the vehicle with the largest capacity is selected to carry (at 90% load factor) part of the tour's total weight. The remaining weight faces the same decision method as the total weight had faced: the remaining weight is put onto the lowest capacity vehicle that can carry all of it, or is put onto the vehicle with the largest capacity, with yet remaining weight at that point.

Sample Output2 Worksheet

	A	B
1	19.6573	117.8844
2	19.14024	99.39137
3	35.30189	179.7634
4	27.61859	167.7601
5	19.93518	120.8778
6	19.65718	108.2031
7	19.65741	83.82144
8	27.61848	138.106
9	24.54036	193.7188
10	19.6573	92.82949
11	17.09624	103.6667
12	19.6573	95.52883

The availability of aircraft is updated as tours consume block hours of vehicle operation. When a vehicle is selected, the block hours required to perform the tour are calculated. Block hours of aircraft use for the day accumulates on the Output2 worksheet. Column A has daily block hours of operation for the first vehicle listed on the Vehicle worksheet. Successive columns have daily block hours for the remaining vehicles listed. Row 1 has the number of block hours operated on the first day. Successive rows have the number of block hours operated on successive days. (The block hours for the last day of the year are on row 250.) The code allows six block hours for each vehicle in the fleet for one day. After this is exceeded, the fleet is exhausted for that day and the vehicle type will not be assigned to deliver mail. Because the code assigns the most efficient aircraft to a tour, the priority (or ranking) of the tour plays an important role. Tours that are longer (distance) or have heavier weight are the first to use the most efficient aircraft, and may deplete the fleet. The least efficient aircraft could then be the only aircraft available for the low priority villages.

Sample Output Worksheet

	D	E	F	G
8		first year		
9	vehicle	block hour	load factor	departures
10	DC-6	6121.795	4792.963	5454
11	Cessna 20	32415.27	25275.25	55134

The code accumulates annual block hours of operation (in columns E, H, and every third column onwards) and the number of departures (in columns G, J, and every third column onwards) for each vehicle type on the Output worksheet. Additionally, the Output worksheet accumulates a value (in columns F, I, and every third column onwards) that is the product of block hours of operation and load factor for each tour. From this value an average load factor can be calculated: this value divided by the total block hours.

D. Delivery Simulation for Schedules Other than Daily

This section discusses the modifications to the code that allow alternate day delivery (delivery schedule options 1 and 2), and holding onto mail for up to five days to deliver using fully-loaded aircraft (option 5).

Options 1 and 2 perform exactly the same way as daily delivery (option 0), except for the two following modifications.

- Instead of the tour simulation performed for each day, the tour simulation is performed for each odd day (option 1) or for each even day (option 2). No tour simulation occurs on the unassigned days.
- Instead of pulling a single value from worksheet Run2—the weight of mail to deliver to the village in one day—the code pulls two values from the worksheet. The two values correspond to the weight of mail to be delivered on the current day, and the weight to be delivered on the previous day, from the daily delivery procedure. Mainline service must be daily, and mail destined to a village served on alternate days is flown daily mainline. The mail is simulated to be held at the hub.

Option 5 uses new code in order to allow the logic of holding onto mail for multiple days, for a tour that goes to multiple villages. The logic of the new code is:

1. If the capacity of the vehicle is met on the first day by the weight for some of the villages of the tour, then the vehicle goes out to those villages on that day.
2. If the capacity of a second vehicle for the day is met by other villages of the tour, then a second vehicle goes out to those other villages on the first day.
3. This continues until the weight for the remaining villages of the tour for the first day is less than the capacity of the vehicle. That weight is held onto for the next day.
4. If the weight to be delivered to all villages on the first day is less than the capacity of the vehicle, then all the mail is held onto for the next day.
5. If the capacity of the vehicle is met on the second day by the sum of the weight for some of the villages and of the weight carried over from the first day, then the vehicle goes out to those villages on that (the second) day. The mail held onto from the previous day has been delivered, so any mail carried over to the next day is held onto for the first day.
6. If the sum of the weight of mail to all villages for the second day and of the weight carried over from the first day is less than the capacity of the vehicle, then all the mail is carried over to the next day. The mail is held yet for another day.
7. Steps 5 and 6 are repeated.

8. If any of mail is held onto for five days, yet the accumulating mail is less than the capacity of the vehicle, then the vehicle is sent out to all the villages to deliver all the mail. No mail is carried over to the next day.

VI. Executing the Code and Reading the Output

The name of the Excel file is Pando.xls. Previous sections of this report explain how to enter data into the worksheets.

After entering all input and choosing the Tours case and Weight forecast, the computer user must clear the data on the Output worksheet before executing the code. This data is the output from the previous execution. The code does not delete this data because the user may wish to define equations in cells on this worksheet to summarize the output. These equations can remain on the worksheet, but output from the previous run must be deleted. Code output begins at Cell E10. For ten years, output continues to Column AH. Each row is a vehicle type, so that the code output may go to Row 15 or so. Select all these cells, and clear the contents.

In order to execute the code, the code must be on the screen. To get the code on the screen, press Alt-F11, *or* select, from the Tools pull-down menu, the option

Macro > Visual Basic Editor.

The code should appear on the screen. If not, then you must work in the Visual Basic Editor environment to bring it up. The Project Explorer window should be on the left side of the screen. If not, you can get the window to appear by pressing Ctrl-R, *or* by selecting from the View pull-down menu

Project Explorer.

Select the simulation code on the Project Explorer window: this will be project

VBA Project (Pando) ... Modules ... Module1.

If the code still does not appear, then, while Module1 is selected, press F7, *or* select from the View pull-down menu

View Code.

Be sure that the active procedure (selected on the Procedure menu, top right) is test.

After the code appears on the screen then the code can be executed: press the Run button (right-pointing triangle) on the standard toolbar, *or* select Run from the Run pull-down menu, *or* press F5. If the code does nothing, then the code may need to be reset first: press the Reset button (square) on the standard toolbar, *or* select Reset from the Run pull-down menu.

Runs for all the 53 Y-K Delta Villages usually take 45 minutes to an hour. While the code is running, MSExcel will not respond to user's requests (such as requesting a pull-down menu). If the code must be stopped, press the Break key: Ctrl-Break.

When the code is finished running, turn to the Output worksheet. This shows aggregate data for each simulated year. Each row corresponds to one type of vehicle. The row number on the Output worksheet matches the row number for the vehicle on the Vehicle worksheet. For each year, there are three columns of data.

1. The first column is the total block hours of operation for that vehicle for that year.
2. The second column is a value that tells us the average load factor for that vehicle for that year, by dividing it by the value in the first column. The second column is calculated by multiplying the load factor at the beginning of one trip by the block hours required to accomplish that trip.
3. The third column for each year is the total number of departures the vehicle had for that year.

The data in the Output2 worksheet is generated only during the last simulated year: data from calculating previous years were deleted. The code uses this data to verify that the operational block hours of each vehicle type for each day does not exceed the amount of block hours available (six block hours for each vehicle in the fleet for each of the 250 days in a year). Each column corresponds to one vehicle type: Column A corresponds to the vehicle type on Row 10 on the Vehicle worksheet. Each row corresponds to one day in the year.

VII. Y-K Delta Simulation Runs

This section shows the results of simulation runs and suggests what the improvements to the Y-K Delta mail delivery system are. The relative benefits of specific improvements to the USPS mail delivery system are calculated from the output of the Pando computer code. Many different scenarios were set up. For each scenario, the code produces values for the block hours of operation and the number of departures for each type of aircraft. The cost to deliver USPS mail according to each scenario is calculated by multiplying these (simulated) operational block hours by the cost per block hour for each type of aircraft (from Section III.B).

A. Validating the Simulation

The costs for the different scenarios calculated from the simulation code output may not be approximately equal to actual costs for those scenarios. One reason why projected costs differ from actual costs is due to two simplifications the simulation code makes.

1. That short term events such as bad weather do not affect delivery costs, and
2. Use of a simplified heuristics to simulate efficiently loading aircraft, which may not be representative of actual practices.

Another reason why projected costs differ from actual costs is that the calculations of cost per block hour for some aircraft types may be inaccurate (these costs are based on a small dataset).

To address the concern that the costs generated by the simulation code may not be approximately equal to the actual cost, this section follows two techniques. First, scenarios of the actual Y-K Delta delivery system are set up for simulation in order to compare the projected cost to deliver USPS mail to the known cost. The second technique is to evaluate the benefits of improvements as the percent reduction of the cost to deliver USPS mail rather than as the cost (dollar) reduction. This case applies to proposed alternatives to the delivery system. Although a variety of bush aircraft is used the dominant aircraft are Cessna 206/207s. These simulation runs assume fleets of only Cessna 206/207s.

For the first technique: it is estimated that the USPS actually spent $6.11 million (90% of $6.79 million) to deliver the current amount of mail for bush linehaul (based on the USPS FY1997 data). This compares to $5.69 million projected by our Pando runs (from Section VII.B), for the all-Cessna 207 hub-and-spoke—approximately 7% less than the actual data.

In all runs, mainline service was simulated only by DC-6s, and bush service was simulated with an unrestricted fleet of Cessna 206/207s. All runs assume that seven villages are served by hovercraft from Bethel. Some runs in the third set use the forecast for USPS mail for year 2020, but the remaining runs use the current demand for USPS mail (average of the 1995, 1996, and 1997 annual demands).

In order to test the variability of the results, one scenario was set up and performed for five runs, each run having ten replications. The scenario chosen was the five-hub trip-chaining scenario (bush aircraft fleet exclusively Cessna 206/207s, current USPS mail demand). The standard deviation of average annual block hours (mainline, 11 hr out of annual average 6,894 hr; bush, 92 hr out of annual average 29,423 hr) was very small. Ten replications are adequate to calculate average block hours.

B. Additional Hubs

Many bush flights are long distance. A proposed alternative is to add hubs so that existing hubs lose long distance flights to the new hubs. As an example, Emmonak, Alakanuk, Kotlik, and Sheldon Point were long-distance bush flights from Saint Mary's to deliver USPS mail. In 1996 Emmonak became a hub. Emmonak now receives mail directly from Anchorage, and delivers mail to the other three villages, all short flights. The four long distance flights from Saint Mary's to deliver USPS mail are eliminated.

For the second technique, we can evaluate this data so that we can estimate how much of an improvement can be accomplished by using more efficient aircraft, or improving the mail delivery system in a different way. Currently the air carriers at the Y-K Delta are doing a good job optimizing the system. They mix mail and passengers, so as to maintain a high load factor. They visit multiple villages on one trip.

The results of these simulation runs show that adding hubs increases the number of block hours (and departures) of mainline aircraft, but decreases the block hours (and departures) of bush aircraft.

The first set or runs simulated how the mail was delivered before Emmonak was a hub (the 'Original' case) and then poses three system improvements to the Original case:

- adding Emmonak as a hub,
- then adding Hooper Bay as a hub, and
- then adding Toksook Bay as a hub.

These costs are reported in the first four rows of Table VII-1 for current mail delivery and the bottom three rows for the expected amount of mail in 2020. (The demand for USPS mail was forecast in Appendix D, *The Yukon-Kuskokwim Delta Parcel Post Forecast*). Table VII-1 summarizes the advantage of adding hubs. As the number of hubs increases, the bush delivery costs decrease: the bush delivery costs are offset by an increase in mainline delivery costs. Based on the simulation runs using the year 2020 demand for mail, the addition of Hooper Bay as a hub gives a system-wide savings of over $2.75mil. The addition of the hub at Toksook Bay does not show significant savings. Table VII-2 shows additional details for these simulation runs: annual block hours, average load factor, and number of departures.

TABLE VII-1 Simulation Evaluation of Adding Hubs

		206/7 Aircraft statistics			USPS Relative Annual Linehaul Costs ($Mil.)		
Scenario	**Hubs**	**206/7 (mean)**	**206/7 (median)**	**206/7 (95%)**	**Bush**	**Mainline**	**Total**
		Current Mail Data					
Early	4	*18.7*	*18*	*28*	6.32	10.15	16.47
Add EMN	5	*16.9*	*16*	*26*	5.69	11.03	16.72
Add HPB	6	*11.4*	*11*	*16*	4.18	12.06	16.24
Add OOK	7	*9.7*	*9*	*14*	3.68	13.14	16.82
		Year 2020 Mail Forecast					
5 Hub (with EMN)	5	36.4	34	56	12.53	17.88	30.41
Add HPB	6	*20.9*	*20*	*32*	8.09	19.54	27.63
Add OOK	7	*18.0*	*17*	*27*	7.20	20.02	27.22

Omits the seven villages served by hovercraft; all flights are trip chained

TABLE VII-2 Simulation Results for adding Hubs (Current mail levels only); Line Haul Costs only

	4 hub: Original	4 hub With Hovercraft	5 hub: with EMK	6 hub: with HPB	7 hub: with OOK
Mainline: DC-6					
block hours	6,300	6,340	6,890	7,540	8,210
load factor	78.8%	79.2%	72.6%	69.1%	63.4%
departures	4,590	4,620	4,920	5,150	5,530
estimated line haul cost	$10.15	$10.15	$11.03	$12.06	$13.14
Weight handled (lbs)	45.6M	45.71M	44.63M	44.46M	43.86M
terminal cost	$8.82	$8.84	$8.63	$8.66	$8.47
Total	$18.97	$18.99	$19.66	$20.72	$21.61
% INCREASE			3.53%	5.39%	4.30%
Bush: Cessna-207					
block hours	37,810	35,470	31,940	23,450	20,670
load factor	77.4%	77.4%	76.1%	70.9%	69.9%
departures	57,250	48,780	45,535	42,940	41,120
Line haul cost (millions)	$6.74	$6.32	$5.69	$4.18	$3.68
weight handled (lbs)	21.91M	20.77M	19.05M	16.75M	15.82
Terminal cost (millions)	$8.16	$7.74	$7.10	$6.24	$5.89
Total	$14.90	$14.06	$12.79	$10.42	$9.57
% DECREASE			9.03%	18.53%	8.16%
Total Air Cost (Millions)	$33.87	$33.05	$32.45	$31.14	$31.18
Total with Hovercraft (0.5M)		$33.55	$32.95	$31.64	$31.68
Percent Improvement over previous result		0.95%	1.79%	3.98%	-0.13%

The average mainline terminal rate (for the period 1-July 95 to 30-June 99) used is $0.1934/lb.
The average bush terminal rate (for the period Apr-95 to Mar-99) used is $0.3725/lb.
The line haul costs are based on average block hour costs for the specific aircraft
The hovercraft rate used was 0.43606 cents per pound.

C. Unlimited Cessna 208s and Trip Chaining

Two alternative methods of delivering the mail are a strict hub-and-spoke, when aircraft flies to one village and returns to the hub, and trip-chaining, when aircraft visit multiple villages before returning to the hub. Passenger routes are flown in the trip-chaining manner. For example, one trip-chaining route is to fly from Bethel to Chevak, to Hooper Bay, to Scammon Bay, and then return to Bethel. Simulation runs to compare trip-chaining to hub-and-spoke were first performed using an unlimited fleet of Cessna 206/207s. These same runs were re-executed using a mixed fleet of unlimited Cessna 208s and Cessna 206/207s. All these runs used the current demand for USPS mail, and the five-hub system. When Cessna 208s are available, then they are filled and flown out as much as possible: Cessna 206/207s are used only when the amount of mail on one flight is small enough that all the mail fits on one Cessna 206/207 (that is, the mail weighs less than 1,100 pounds). The results of these simulation runs are summarized in Table VII-3.

Table VII-3 Results comparing Bush Aircraft Costs between Hub-and-Spoke and Trip-Chaining

	Hub-and-Spoke		Trip-Chaining	
	Only 207s	207s & 208s	Only 207s	207s & 208s
Bush: Cessna-207				
block hours	31,940	8,910	29,450	8,590
load factor	76.1%	36.1%	85.8%	83.3%
departures	45,540	13,320	43,060	12,310
Bush: Cessna-208				
block hours		6,980		6,910
load factor		81.8%		77.2%
departures		11,560		13,140
Bush Aircraft:				
cost (millions)	$5.69	$5.12	$5.25	$5.02

There is a 10.1% reduction of total bush aircraft cost using Cessna 208s, for the hub-and-spoke system. Or, using no Cessna 208s but using a trip-chaining system, there is a 7.8% cost savings. The savings due to the combined effect of adding an unrestricted fleet of Cessna 208s and of changing to a trip-chaining system is 11.7%. The load factor is the amount of mail put on the plane at the hub divided by the capacity of the aircraft—this is the load factor as the plane departs from the hub, and not an average load factor for the entire flight. Trip-chaining load factors are higher than hub-and-spoke load factors. (Note especially the poor Cessna 207 load factor for the hub-and-spoke system.) Trip-chaining departures are higher, yet the block hours are roughly the same as hub-and-spoke block hours. Cessna 206/207s are used more efficiently in the trip-chaining system.

D. Restricted Mixed Fleet

In reality, a restricted mix of aircraft provides bush air service in the Y-K Delta. Air carriers must choose among available aircraft how best to transport their mail allotment. The Cessna 206/207 is frequently used. Adding several aircraft of a different type, aircraft types that are more efficient than the Cessna 206/207, will improve the efficiency of the system. The three types of aircraft that were examined are the Cessna 208, the Piper Navajo, and the Beech 1900. The Cessna 208 is readily available for purchase (to be purchased as used aircraft from the lower 48 states) and does not require a long runway. The Beech 1900 is a much more efficient type of aircraft, but requires a longer runway than most villages in the Y-K Delta currently have. The Piper Navajo is more efficient than the Cessna 208 but has a lower capacity and needs a slightly longer runway than the Cessna 208.

An aircraft type's efficiency value is defined as $X_{eff}=cv/e$, where c is the vehicle capacity (lb), v is the vehicle velocity (knot), and e is the expense to operate the vehicle ($/blk-hr). (These values are normalized to roughly fall in the range of 0.5 to 1.5.) The units of efficiency values are pound-miles of USPS mail per dollar cost (lb-mi/$). Higher efficiency values indicate higher aircraft efficiency. The Cessna 207 (which costs $178.20/blk-hr to operate) has an efficiency value of 0.370. The Table below shows the relationship of these efficiencies.

Table VII-4 Comparison of aircraft effectiveness

Aircraft	Cost per block-hour	Relative Efficiency
Cessna 207	$178.20	0.370
Cessna 208	$505.50	0.519
Piper Navajo	$342.60	0.573
Beech 1900	$464.30	1.346

Table VII-4 shows that the Beech 1900 should deliver a greater amount of mail at a lower cost than any of the other aircraft. One of the benefits of simulation is that the suitability of various aircraft can be evaluated in different situations. Unfortunately, Pando's logic assumes that planes with lower capacities are less expensive to fly on a per-mile basis. Since actual aircraft operations costs are not entered into the simulation code, the code does not (and cannot) select the most cost-efficient aircraft. The code, instead, selects aircraft to maximize aircraft load factor. The code produces a number of block hours of operations for each aircraft type, and the user must hand calculate the cost. The Beech 1900 has a higher capacity and a lower cost (per mile) than the Cessna 208. The computer code believes that flying out a Cessna 208 with a high load factor is preferable to flying out a Beech 1900 with a modest load factor. In reality, an air carrier in the same situation would choose the Beech 1900—that is the cheaper alternative. Of course the runway length of the bush village may prohibit selecting the Beech 1900, a factor addressed by these runs by declaring different vehicle series for tours with restrictive runway lengths.

For all of the following simulation runs, the supply of Cessna 207s is unlimited, and trip chaining is used. The following simulations were first conducted using the current demand for USPS mail, and were repeated using the forecast demand for USPS mail for the year 2020.

The first set (of three sets) of simulation runs shows the effects due to acquiring a limited number of Cessna 208s. In this set of runs, the fleet of Cessna 208s is first restricted to zero aircraft. Successive runs increment the number of Cessna 208s available for bush service—to one aircraft, then two, then three, and so forth—until the addition of one Cessna 208 no longer gives further cost savings. (Essentially there is an unlimited supply of Cessna 208s at this point.) There are no Piper Navajos or Beech 1900s in these simulation runs.

The second set of simulation runs shows the effects due to acquiring a limited number of Piper Navajos. This set of runs is performed in the same manner as the first set of runs, but it is the fleet of Piper Navajos that is incremented until the greatest cost savings is achieved. There are no Cessna 208s or Beech 1900s in these simulation runs.

The third set of simulation runs shows the effects due to acquiring a limited number of Beech 1900s. Again, this set of runs is performed in the same manner as the first two

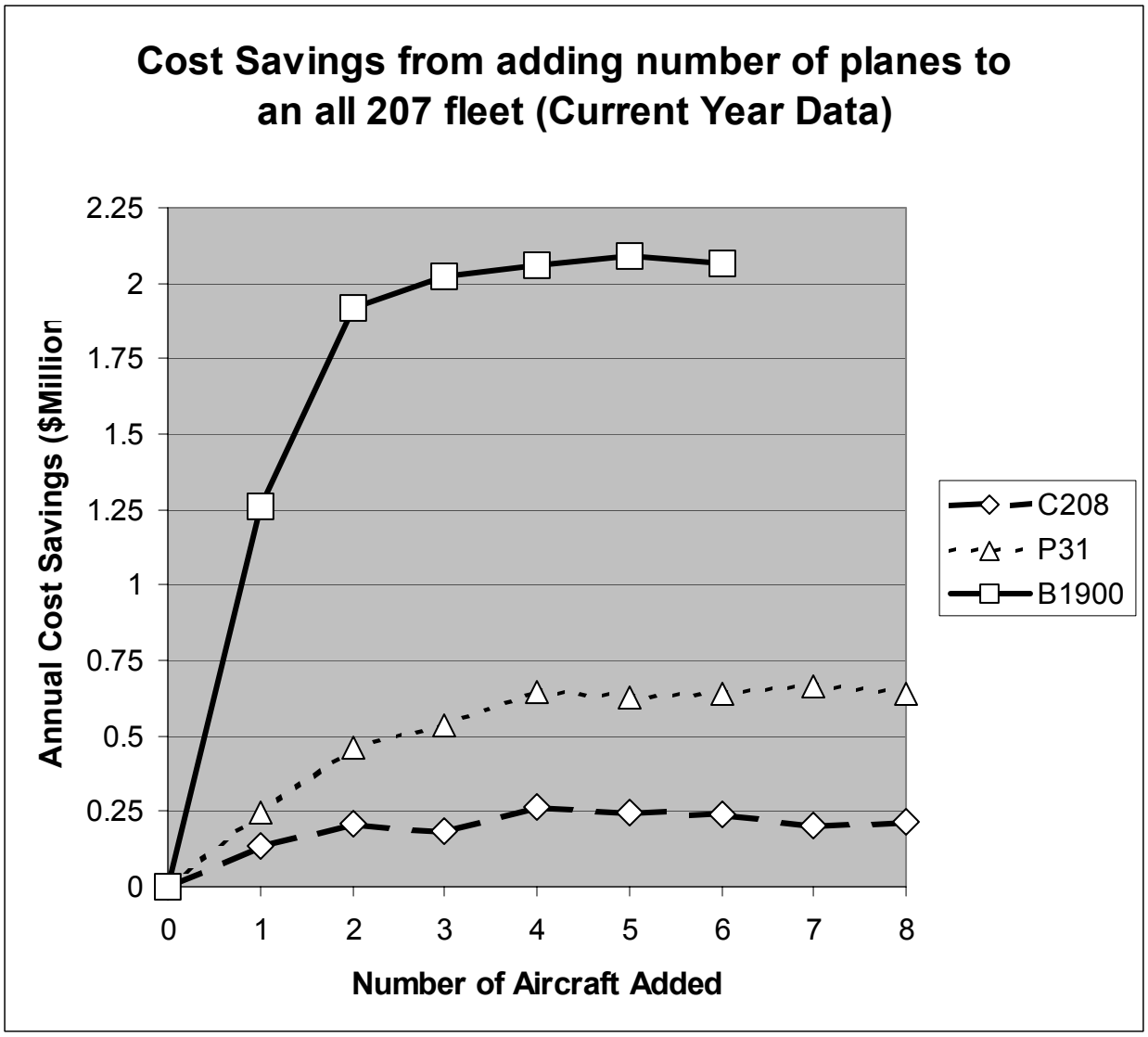
sets, but it is the fleet of Beech 1900s that is incremented until the greatest cost savings is achieved. There are no Cessna 208s or Piper Navajos in these simulation runs.

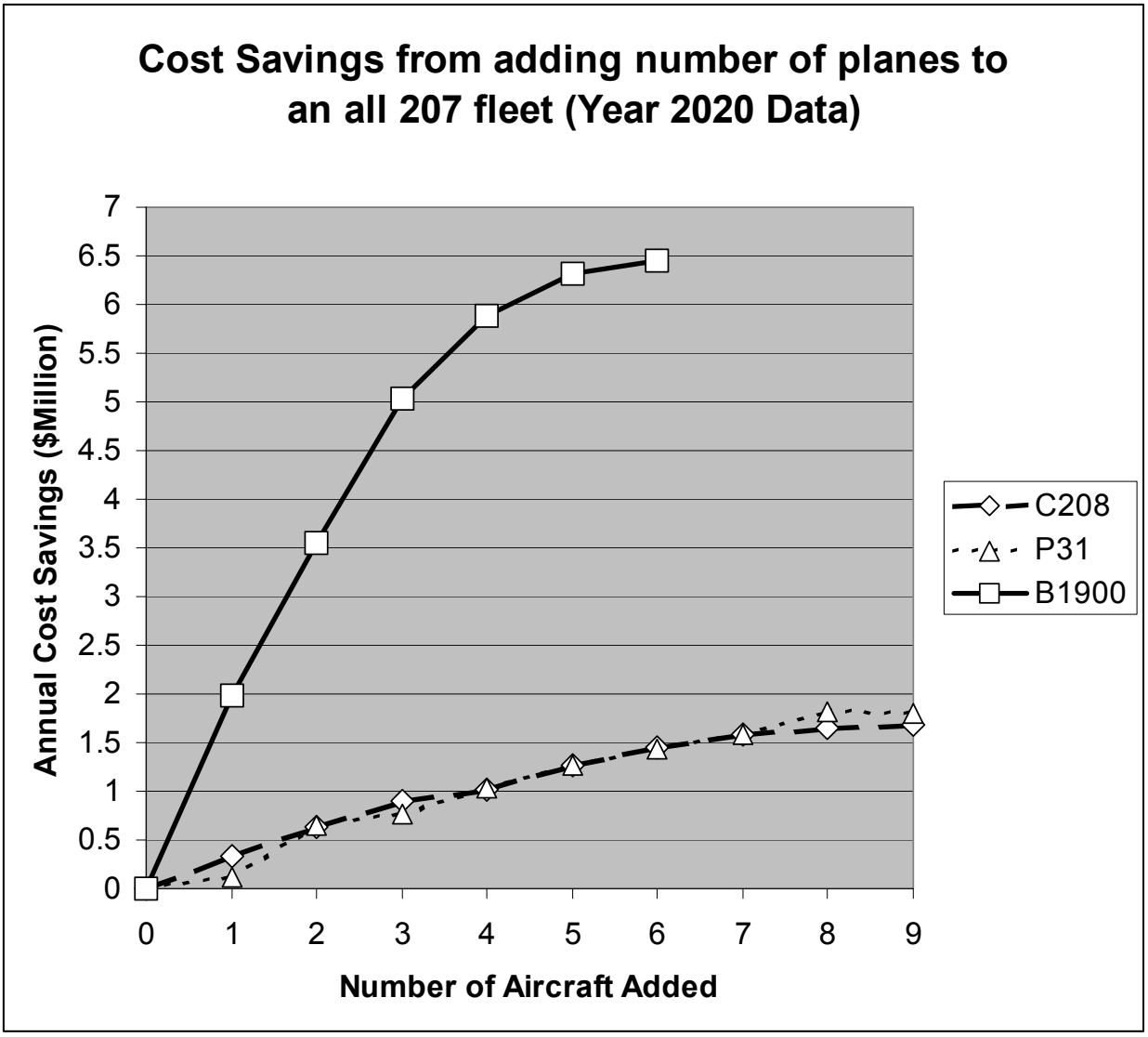
Table VII-5 For 2020 Mail (All trip-chaining)

		206/7 Statistics			Other Bush Aircraft Mix			USPS Relative Costs in $Mil.		
Scenario	**Hubs**	**206/7 (average)**	**206/7 (median)**	**206/7 (95%)**	**Cessna 208**	**Navajo**	**Beech 1900**	**Bush**	**Mainline**	**Total**
				Current Mail Data						
Baseline	5	*15.4*	*15*	*25*				5.25	11.13	16.38
+2 C208s	5	*8.5*	*8*	*16*	2	0	0	5.08	11.07	16.14
+4 C208s	5	*5.5*	*5*	*12*	4	0	0	5.07	11.08	16.15
+2 Navajo	5	*9.9*	*9*	*18*	0	2	0	4.85	11.08	15.93
+4 Navajo	5	*8.3*	*8*	*15*	0	4	0	4.76	11.06	15.82
+1 B1900	5	*9*	*8*	*16*	0	0	1	4.10	11.11	15.20
+2 B1900	5	*8.4*	*8*	*15*	0	0	2	3.99	11.05	15.03
Mix	5	*4.4*	*4*	*10*	2	2	2	4.06	11.10	15.17
				Year 2020 Mail Forecast with Hooper Bay Hub						
Baseline	6	*20.9*	*20*	*32*				8.07	21.97	30.04
+2 C208s	6	*13.3*	*12*	*23*	2	0	0	7.61	21.79	29.40
+4 C208s	6	*7.4*	*6*	*17*	4	0	0	7.38	21.90	29.28
+6 C208s	6	*5.3*	*5*	*11*	6	0	0	7.30	21.92	29.22
+2 Navajo	6	*14.6*	*14*	*26*	0	2	0	7.56	21.92	29.48
+4 Navajo	6	*10.8*	*10*	*19*	0	4	0	7.32	21.89	29.21
+8 Navajo	6	*9.8*	*9*	*17*	0	8	0	7.25	21.97	29.21
+2 B1900	6	*13.4*	*13*	*21*	0	0	2	6.35	21.91	28.26
+3 B1900	6	*13.4*	*13*	*21*	0	0	3	6.35	21.93	28.29
+4 B1900	6	*13.4*	*13*	*22*	0	0	4	6.38	22.02	28.40
Mix 0	6	*5.9*	*5*	*13*	3	0	3	6.44	21.88	28.33
Mix 1	6	*4.7*	*4*	*10*	4	1	3	6.26	21.85	28.12
Mix 2	6	*4.6*	*4*	*10*	5	2	3	6.26	21.96	28.22
Mix 3	6	*4.7*	*4*	*11*	5	2	4	6.30	21.90	28.20

Omits the seven villages served by hovercraft; all flights are trip chained

The two curves below show that, as expected, the advantage of adding more and more aircraft diminishes as more aircraft are added. There is little difference between Piper Navajos and Cessna 208s (Caravans). The Beech 1900 shows a much greater cost savings.


Cost Savings from adding number of planes to an all 207 fleet (Current Year Data)
Annual Cost Savings ($Million
2.25
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
0
1
2
3
4
5
6
7
8
Number of Aircraft Added
C208
P31
B1900


Cost Savings from adding number of planes to an all 207 fleet (Year 2020 Data)
Annual Cost Savings ($Million)
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
1
2
3
4
5
6
7
8
9
Number of Aircraft Added
C208
P31
B1900

Appendix I.1 Mainline Rates

Appendix I.2 Rates set by the US DOT

Appendix II.1 Direct Aircraft Expense, Qtrs 1-4, 1997

Appendix II.2 ACAIS data

Appendix III Aircraft Fleet of Selected Alaskan Air Carriers

Appendix IV Pando Code / The Pando Code is a Microsoft® Excel file available on the cd

Appendix E - Appendix I.1 Mainline Rates

Rates (mainline) set by the US DOT for the USPS to pay air carriers to deliver mail in Alaska

Compiled by people at Northern Air Cargo

	Date	Linehaul	Terminal		ANC-BET cost		Anchorage		ANC-BET cost
	Equivalent	$/(lb-400mi)	$/lb		$/lb		CPI-U		1983$/lb
1st 3/4 of '98	98.5	0.1676	0.2045		0.3721		146.8		0.2603
2nd 1/2 of '97	97.75	0.1815	0.1938		0.3753		145.4		0.2651
1st 1/2 of '97	97.25	0.1793	0.1836		0.3629		144.1		0.2586
2nd 1/2 of '96	96.75	0.1591	0.1667		0.3258		143.7		0.2329
1st 1/2 of '96	96.25	0.1602	0.1776		0.3378		141.8		0.2446
2nd 1/2 of '95	95.75	0.1465	0.2249		0.3714		139.5		0.2734
1st 1/2 of '95	95.25	0.1444	0.2061		0.3505		138.2		0.2604
2nd 1/2 of '94	94.75	0.1565	0.2154		0.3719		135.8		0.2812
1st 1/2 of '94	94.25	0.1799	0.2292		0.4091		134.3		0.3129
2nd 1/2 of '93	93.75	0.1722	0.2260		0.3982		132.8		0.3079
1st 1/2 of '93	93.25	0.1489	0.2326		0.3815		131.5		0.2979
2nd 1/2 of '92	92.75	0.1620	0.2018		0.3638		129.1		0.2894
1st 1/2 of '92	92.25	0.1800	0.1938		0.3738		127.3		0.3016
2nd 1/2 of '91	91.75	0.1828	0.2033		0.3861		124.7		0.3180
2nd 1/4 of '91	91.375	0.1689	0.1851		0.3540		123.3		0.2949
1st 1/4 of '91	91.125	0.1793	0.1851		0.3644		121.9		0.3070
4th 1/4 of '90	90.875	0.1958	0.2024		0.3982		120.4		0.3397
3rd 1/4 of '90	90.625	0.1730	0.2024		0.3754		118.9		0.3243
1st 1/2 of '90	90.25	0.1717	0.2073		0.3790		116.9		0.3329
2nd 1/2 of '89	89.75	0.1572	0.1900		0.3472		112.5		0.3169
1st 1/2 of '89	89.25	0.1391	0.1722		0.3113		110.9		0.2883
2nd 1/2 of '88	88.75	0.1482	0.1671		0.3153		108.9		0.2973
1st 1/2 of '88	88.25	0.1563	0.1750		0.3313		108.4		0.3139
2nd 1/2 of '87	87.75	0.1478	0.1882		0.3360		108.1		0.3193
1st 1/2 of '87	87.25	0.1273	0.1518		0.2791		108.3		0.2647
2nd 1/2 of '86	86.75	0.1580	0.1369		0.2949		107.4		0.2820
1st 1/2 of '86	86.25	0.1448	0.1639		0.3087		108.3		0.2928
2nd 1/2 of '85	85.75	0.1323	0.1890		0.3213		106.9		0.3087
1st 1/2 of '85	85.25	0.1477	0.1816		0.3293		104.7		0.3230
2nd 1/2 of '84	84.75	0.1243	0.1227		0.2470		103.9		0.2441
1st 1/2 of '84	84.25	0.1507	0.1645		0.3152		102.7		0.3152
2nd 1/2 of '83	83.75	0.1493	0.1566		0.3059				

This is identical to the values taken from the US DOT website, but the NAC compilation goes farther in history.
The $.1676 to deliver one pound 400 miles reported by NAC does not agree with the US DOT website value, $.1663.
The values for Anchorage CPI-U were taken from the AK DOL website.
The CPI-U value for the 1st 3/4 of '98 is an average of CPI-U values taken from the AK DOL website.

Rates set by the US DOT for the USPS to pay air carriers to deliver mail in Alaska

Bush (DOT Docket 405)									
Effective Period		Date	Linehaul	Terminal			60 mi haul	Anchrge	60 mi haul
From	To	Equivlnt	$/tn-mi	$/lb	Source		total $/lb	CPI-U	1983$/lb
1-Apr 94	31-Mar 95	94.75	7.4478	0.3142	Order 95-6-14		0.5376	136.6	0.4042
1-Apr 95	31-Mar 96	95.75	6.5091	0.3260	Order 95-7-30		0.5213	140.3	0.3816
* 1-Apr 96	31-Mar 97	96.75	7.2406	0.3770	Order 96-2-2		0.5942	143.7	0.4248
1-Apr 97	31-Mar 98	97.75	7.8121	0.4065	Order 97-1-12		0.6409	145.8	0.4514
1-Apr 98	31-Mar 99	98.75	8.4514	0.3805	Order 98-3-28		0.6340	147.6	0.4411
12-Apr 99	31-Mar 00	99.75	9.1442	0.3486	Order 99-4-11		0.6229		
Mainline (DOT Docket 429)									
Effective Period		Date	Linehaul	Terminal			400 mi haul	Anchrge	400 mi haul
From	To	Equivlnt	$/tn-mi	$/lb	Source		total $/lb	CPI-U	1983$/lb
1-Jan 91	31-Mar 91	91.125	0.8966	0.1851	Order 92-7-37		0.3644	123.3	0.3035
1-Apr 91	30-Jun 91	91.375	0.8447	0.1851	Order 92-7-37		0.3540	123.3	0.2949
1-Jul 91	31-Dec 91	91.75	0.9142	0.2033	Order 93-1-19		0.3861	124.7	0.3180
1-Jan 92	30-Jun 92	92.25	0.9001	0.1938	Order 93-1-19		0.3738	127.3	0.3016
1-Jul 92	31-Dec 92	92.75	0.8102	0.2018	Order 93-2-26		0.3638	129.1	0.2894
1-Jan 93	30-Jun 93	93.25	0.7445	0.2326	Order 93-5-9		0.3815	131.5	0.2979
1-Jul 93	31-Dec 93	93.75	0.8610	0.2260	Order 94-12-25		0.3982	132.8	0.3079
1-Jan 94	30-Jun 94	94.25	0.8997	0.2292	Order 94-12-25		0.4091	134.3	0.3129
1-Jul 94	31-Dec 94	94.75	0.7823	0.2154	Order 95-7-51		0.3719	135.8	0.2812
1-Jan 95	30-Jun 95	95.25	0.7218	0.2061	Order 95-7-51		0.3505	138.2	0.2604
1-Jul 95	31-Dec 95	95.75	0.7324	0.2249	Order 95-8-43		0.3714	139.5	0.2734
5-Feb 96	30-Jun 96	96.25	0.8008	0.1776	Order 96-2-3		0.3378	141.8	0.2446
30-Jul 96	31-Dec 96	96.75	0.7956	0.1667	Order 96-7-41		0.3258	143.7	0.2329
1-Jan 97	30-Jun 97	97.25	0.8963	0.1836	Order 96-12-43		0.3629	144.1	0.2586
18-Jul 97	31-Dec 97	97.75	0.9076	0.1938	Order 97-7-17		0.3753	145.4	0.2651
15-Jan 98	30-Sep 98	98.375	0.8313	0.2045	Order 98-1-9		0.3708	146.8	0.2594
1-Oct 98	30-Sep 99	99.25	0.8606	0.2027	Order 98-9-28		0.3748	148.1	0.2599
1-Oct 99	30-Sep 00	100.25	0.8518	0.2165	Order 99-9-13		0.3869		

All final rates published on the US DOT website are on this worksheet.
Bush costs for the period 1-Apr 96 through 31-Mar 97 are not final rates, but published rates for comments.
All costs are for nonpriority mail delivery.
Anchorage CPI-U values were downloaded from the AK DOL website.
CPI-U values were averaged for cases when multiple CPI-U values are applicable for one effective period.

Direct Aircraft Expense
1st Quarter, 1997

Airline	Quarter Ending	Aircraft Code	Pilot & Co-Pilot	Aircraft Fuel & Oil	Other Flying Ops Expense	Mainte-nance	Rentals & Deprecia-tion	Total Block hours	Total Depar-ture	Total gal fuel issued
ASE	3/1/1997	95	45,890	31,396	9,319	108,394	31,350	840	1,548	15,617
ASE	3/1/1997	125	16,599	16,700	4,888	25,559	44,750	259	277	9,926
ASE	3/1/1997	416	14,646	17,330	6,500	34,271	40,523	215	354	10,885
ASE	3/1/1997	486	20,504	35,186	10,781	87,184	61,367	260	352	21,296
		Total	97,639	100,612	31,488	255,408	177,990	1,574	2,531	57,724
ERA	3/1/1997	406	52,973	18,439	10,109	45,230	43,783	207	78	18,280
ERA	3/1/1997	430	359,606	600,404	54,113	1,035,255	18,763	1,293	890	369,666
ERA	3/1/1997	483	222,223	253,846	41,008	702,901	192,148	1,212	1,884	181,890
ERA	3/1/1997	485	377,734	280,950	65,925	620,293	206,558	2,834	4,601	216,909
ERA	3/1/1997	663	130,990	81,609	13,535	112,406	85,188	334	91	88,920
ERA	3/1/1997	902	0	0	13,405	44,514	20,170	0	0	0
		Total	1,143,526	1,235,248	198,095	2,560,599	566,610	5,880	7,544	875,665
GRT	3/1/1997	35	69,202	57,808	11,004	69,278	29,361	1,124	2,284	19,997
GRT	3/1/1997	36	1,775	750	963	6,061	3,000	28	57	270
GRT	3/1/1997	110	16,285	15,518	3,003	18,908	4,540	102	122	5,142
GRT	3/1/1997	194	48,971	80,085	8,617	54,253	29,180	620	1,010	27,602
		Total	136,233	154,161	23,587	148,500	66,081	1,874	3,473	53,011
HAG	3/1/1997	33	0	0	2,000	0	0	0	0	0
HAG	3/1/1997	35	269,294	154,905	27,469	262,461	174,781	3,852	9,239	57,788
HAG	3/1/1997	36	9,578	3,288	375	6,288	6,000	137	566	1,233
HAG	3/1/1997	110	489	875	1,875	1,285	0	7	19	350
HAG	3/1/1997	125	41,107	51,156	13,761	107,957	56,810	588	1,467	20,579
HAG	3/1/1997	416	43,484	73,489	16,250	99,924	130,392	622	1,365	34,210
		Total	363,952	283,713	61,730	477,915	367,983	5,206	12,656	114,160
LFS	3/1/1997	35	30,866	17,098	6,788	40,245	0	456	963	7,992
LFS	3/1/1997	36	9,428	812	2,104	24,529	4,000	55	156	432
LFS	3/1/1997	79	27,934	20,840	8,500	53,871	16,900	549	649	9,741
LFS	3/1/1997	131	21,875	11,422	2,563	28,318	2,700	117	165	5,347
LFS	3/1/1997	194	46,666	81,911	8,675	124,639	19,370	974	1,158	38,342
LFS	3/1/1997	416	14,296	8,290	0	0	3,535	78	46	7,536
		Total	151,065	140,373	28,630	271,602	46,505	2,229	3,137	69,390
PNA	3/1/1997	33	11,428	2,374	5	7,997	2,250	55	47	992
PNA	3/1/1997	35	9,763	2,602	0	8,157	0	84	215	1,514
PNA	3/1/1997	79	188,629	80,747	618	173,177	16,063	2,187	5,807	39,371
PNA	3/1/1997	170	51,823	30,566	16,374	119,867	24,788	362	877	18,075
PNA	3/1/1997	172	13,878	6,638	1,013	10,447	11,688	105	310	3,138
PNA	3/1/1997	194	117,589	98,135	6,762	190,527	24,946	967	1,883	41,569
PNA	3/1/1997	416	76,704	57,181	28,686	97,119	87,774	650	1,754	25,980
PNA	3/1/1997	418	86,563	37,730	16,402	71,378	1,590	344	240	24,066
PNA	3/1/1997	456	51,426	41,335	1,845	95,502	95,940	325	180	43,821
PNA	3/1/1997	467	402,154	383,648	135,426	710,835	344,608	3,051	2,108	274,590
PNA	3/1/1997	478	17,894	13,893	1,700	35,606	20,500	191	180	13,377
		Total	1,027,851	754,849	208,831	1,520,612	630,147	8,321	13,601	486,493

Direct Aircraft Expense
1st Quarter, 1997

Airline	Quarter Ending	Aircraft Code	Pilot & Co-Pilot	Aircraft Fuel & Oil	Other Flying Ops Expense	Mainte-nance	Rentals & Deprecia-tion	Total Block hours	Total Depar-ture	Total gal fuel issued
RYA	3/1/1997	35	74,660	66,161	26,725	120,865	67,940	1,589	3,012	27,005
RYA	3/1/1997	110	13,740	18,881	5,173	30,030	11,591	148	165	7,706
RYA	3/1/1997	125	14,053	19,313	4,310	22,973	4,627	216	252	7,351
RYA	3/1/1997	416	19,695	25,210	50,001	26,292	20,090	303	486	15,756
		Total	122,148	129,565	86,209	200,160	104,248	2,256	3,915	57,818
VLA	3/1/1997	95	75,338	53,439	3,562	89,243	34,800	1,719	3,535	27,223
		Total	75,338	53,439	3,562	89,243	34,800	1,719	3,535	27,223
YTU	3/1/1997	35	17,214	15,521	6,130	23,048	2,849	349	654	5,690
YTU	3/1/1997	405	137,063	307,119	95,873	267,562	68,541	2,031	1,400	224,039
		Total	154,277	322,640	102,003	290,610	71,390	2,380	2,054	229,729
YUT	3/1/1997	35	225,202	171,038	61,023	268,325	66,724	4,686	8,947	70,286
YUT	3/1/1997	36	20,487	8,166	11,664	23,860	4,686	413	794	3,301
YUT	3/1/1997	79	10,857	8,702	2,441	13,225	8,806	255	580	4,083
YUT	3/1/1997	194	27,658	48,088	12,689	64,819	3,090	542	814	20,600
YUT	3/1/1997	416	13,314	21,232	11,803	17,916	52,205	194	327	11,667
		Total	297,518	257,226	99,620	388,145	135,511	6,090	11,462	109,937

Direct Aircraft Expense
2nd Quarter, 1997

Airline	Quarter Ending	Aircraft Code	Pilot & Co-Pilot	Aircraft Fuel & Oil	Other Flying Ops Expense	Mainte-nance	Rentals & Deprecia-tion	Total Block hours	Total Depar-ture	Total gal fuel issued
ASE	6/1/1997	95	43,967	34,500	9,319	114,199	31,350	1,099	1,979	20,268
ASE	6/1/1997	125	14,949	21,098	4,888	33,853	43,893	325	352	12,388
ASE	6/1/1997	416	15,828	22,104	9,705	21,084	34,638	293	513	15,200
ASE	6/1/1997	486	13,190	27,017	10,781	76,924	26,972	229	344	18,880
		Total	87,934	104,719	34,693	246,060	136,853	1,946	3,188	66,736
ERA	6/1/1997	406	53,094	22,640	11,018	52,788	43,863	214	78	19,210
ERA	6/1/1997	430	329,932	639,158	38,097	958,602	18,797	1,556	1,491	440,352
ERA	6/1/1997	483	217,498	245,073	39,168	359,998	192,498	1,338	2,224	195,660
ERA	6/1/1997	485	457,161	315,400	61,258	469,494	194,381	3,063	4,736	233,739
ERA	6/1/1997	663	139,082	77,171	15,327	179,356	64,215	359	108	95,070
ERA	6/1/1997	902	9,287	18,450	13,758	40,668	20,207	99	33	8,090
		Total	1,206,054	1,317,892	178,626	2,060,906	533,961	6,629	8,670	992,121
GRT	6/1/1997	35	68,587	63,097	13,313	88,209	10,218	1,285	2,534	22,877
GRT	6/1/1997	36	3,151	1,830	1,390	9,211	3,000	69	144	664
GRT	6/1/1997	110	12,990	15,081	3,511	23,261	7,155	109	201	5,468
GRT	6/1/1997	194	45,149	72,391	9,532	63,153	51,808	589	1,103	26,248
		Total	129,877	152,399	27,746	183,834	72,181	2,052	3,982	55,257
HAG	6/1/1997	33	0	0	1,050	0	0	0	0	0
HAG	6/1/1997	35	280,017	178,531	30,808	233,816	195,429	4,746	10,920	71,192
HAG	6/1/1997	36	17,756	7,224	394	9,891	6,000	301	1,175	2,709
HAG	6/1/1997	110	2,066	4,379	3,281	4,604	0	35	71	1,752
HAG	6/1/1997	125	52,232	77,844	13,781	115,584	57,762	885	2,018	30,990
HAG	6/1/1997	410	2,102	16,834	1,286	8,626	10,000	36	89	5,907
HAG	6/1/1997	416	38,326	94,834	21,369	74,722	113,389	650	1,178	37,934
		Total	392,499	379,646	71,969	447,243	382,580	6,653	15,451	150,484
LFS	6/1/1997	35	38,280	24,616	6,700	57,196	14,091	626	1,229	10,991
LFS	6/1/1997	36	1,780	560	2,104	35,697	4,000	38	93	285
LFS	6/1/1997	79	50,234	37,096	8,500	80,290	4,308	1,020	925	16,572
LFS	6/1/1997	131	4,060	2,175	2,563	36,180	5,366	26	29	973
LFS	6/1/1997	194	51,768	97,243	11,300	169,198	33,554	1,099	1,191	43,483
LFS	6/1/1997	416	13,920	8,540	0	0	29,599	99	47	7,764
		Total	160,042	170,230	31,167	378,561	90,918	2,908	3,514	80,068
PNA	6/1/1997	30	897	392	0	5,614	0	23	116	409
PNA	6/1/1997	33	8,399	3,067	1,883	3,090	2,250	117	297	2,097
PNA	6/1/1997	35	13,831	6,271	925	7,616	0	179	418	3,227
PNA	6/1/1997	79	240,165	128,211	1,803	187,871	19,811	3,085	9,983	61,249
PNA	6/1/1997	170	55,741	44,282	25,005	88,422	29,891	414	1,119	22,985
PNA	6/1/1997	172	11,312	2,831	1,033	11,122	69,386	239	629	7,176
PNA	6/1/1997	194	113,642	118,152	8,724	198,920	20,680	1,221	2,455	53,396
PNA	6/1/1997	416	90,631	125,798	34,271	142,151	87,774	1,129	3,422	45,168
PNA	6/1/1997	418	72,362	22,610	15,270	64,425	11,770	222	129	15,568
PNA	6/1/1997	456	176,866	176,746	51,627	392,345	291,231	1,126	865	151,970
PNA	6/1/1997	467	352,653	321,921	183,984	629,799	438,991	3,069	2,181	276,183
PNA	6/1/1997	478	21,572	11,514	0	17,407	20,500	167	108	11,718
		Total	1,158,071	961,795	324,525	1,748,782	992,284	10,991	21,722	651,146

Direct Aircraft Expense
2nd Quarter, 1997

Airline	Quarter Ending	Aircraft Code	Pilot & Co-Pilot	Aircraft Fuel & Oil	Other Flying Ops Expense	Mainte-nance	Rentals & Deprecia-tion	Total Block hours	Total Depar-ture	Total gal fuel issued
RYA	6/1/1997	35	74,636	53,006	27,125	92,330	5,274	1,588	3,086	26,996
RYA	6/1/1997	110	25,979	31,222	5,250	36,287	9,139	306	338	15,902
RYA	6/1/1997	125	3,913	4,019	4,375	19,736	0	60	71	2,047
RYA	6/1/1997	416	26,826	42,137	50,751	56,229	87,476	413	781	21,460
		Total	131,354	130,384	87,501	204,582	101,889	2,367	4,276	66,405
VLA	6/1/1997	95	78,628	54,469	5,311	100,965	34,800	1,751	3,321	28,002
YTU	6/1/1997	35	24,868	25,018	5,644	17,365	11,996	557	1,049	9,283
YTU	6/1/1997	405	212,556	422,021	97,909	401,757	103,256	2,745	1,951	316,368
		Total	237,424	447,039	103,553	419,122	115,252	3,302	3,000	325,651
YUT	6/1/1997	35	277,816	189,050	45,221	324,130	83,647	6,154	12,072	92,311
YUT	6/1/1997	36	47,223	17,561	7,513	32,654	4,686	1,004	2,360	8,035
YUT	6/1/1997	79	16,074	11,329	2,650	15,596	10,572	350	941	5,604
YUT	6/1/1997	194	27,942	36,469	23,047	54,059	3,090	428	650	16,258
YUT	6/1/1997	416	16,902	36,575	11,857	10,766	52,082	307	498	18,414
		Total	385,957	290,984	90,288	437,205	154,077	8,243	16,521	140,622

Airline	Quarter Ending	Aircraft Code	Pilot & Co-Pilot	Aircraft Fuel & Oil	Other Flying Ops Expense	Mainte-nance	Rentals & Deprecia-tion	Total Block hours	Total Depar-ture	Total gal fuel issued
ASE	9/1/1997	95	53,613	48,282	10,518	82,132	60,851	1,197	1,990	21,953
ASE	9/1/1997	125	17,156	24,388	5,156	27,775	30,941	306	304	11,610
ASE	9/1/1997	416	15,012	19,984	8,409	32,886	49,276	272	458	13,690
ASE	9/1/1997	486	21,445	48,927	14,522	106,078	59,755	333	475	34,400
		Total	107,226	141,581	38,605	248,871	200,823	2,108	3,227	81,653
ERA	9/1/1997	406	59,236	21,511	10,979	66,178	43,857	227	83	19,720
ERA	9/1/1997	430	411,976	679,782	34,627	1,388,169	34,911	2,192	2,281	603,141
ERA	9/1/1997	483	225,182	209,041	39,168	343,577	192,470	1,434	2,042	212,796
ERA	9/1/1997	485	460,232	318,082	66,399	1,036,762	193,603	3,982	6,009	304,533
ERA	9/1/1997	663	143,548	84,222	15,013	137,118	64,772	338	110	88,410
ERA	9/1/1997	902	27,264	53,523	13,934	36,094	20,204	292	193	25,810
		Total	1,327,438	1,366,161	180,120	3,007,898	549,817	8,465	10,718	1,254,410
GRT	9/1/1997	35	82,297	68,870	17,816	70,360	10,218	1,342	2,763	23,879
GRT	9/1/1997	36	2,053	2,516	1,979	7,814	3,000	91	281	872
GRT	9/1/1997	110	7,369	16,394	4,526	17,872	7,155	113	132	5,684
GRT	9/1/1997	194	38,545	95,054	13,625	53,808	51,808	740	1,387	32,958
GRT	9/1/1997	406	30,832	45,836	6,601	26,070	40,750	215	119	20,387
		Total	161,096	228,670	44,547	175,924	112,931	2,501	4,682	83,780
HAG	9/1/1997	33	1,839	1,392	888	1,605	0	32	26	416
HAG	9/1/1997	35	281,092	219,182	28,750	212,520	207,629	4,907	10,684	73,685
HAG	9/1/1997	36	9,284	4,086	394	5,760	6,000	162	672	1,459
HAG	9/1/1997	110	3,077	7,279	1,968	7,637	0	54	117	2,686
HAG	9/1/1997	125	53,218	88,402	14,422	132,078	45,199	929	2,176	32,518
HAG	9/1/1997	410	2,284	14,991	5,844	5,668	36,765	40	124	5,838
HAG	9/1/1997	416	75,327	197,037	26,265	163,582	209,342	1,316	2,472	76,454
		Total	426,121	532,369	78,531	528,850	504,935	7,440	16,271	193,056
LFS	9/1/1997	35	28,040	31,298	7,950	58,966	43,431	777	1,358	13,209
LFS	9/1/1997	36	1,209	305	2,104	9,388	4,000	21	40	147
LFS	9/1/1997	79	42,467	28,797	8,500	84,536	6,308	884	974	12,116
LFS	9/1/1997	131	8,934	15,376	2,563	42,094	5,366	171	244	6,498
LFS	9/1/1997	194	50,447	98,283	12,550	177,881	19,317	1,008	1,169	41,534
LFS	9/1/1997	416	1,430	1,888	0	0	8,332	29	37	1,716
		Total	132,527	175,947	33,667	372,865	86,754	2,890	3,822	75,220
PNA	9/1/1997	30	5,100	1,290	0	1,462	0	81	126	1,454
PNA	9/1/1997	33	12,561	4,951	595	4,624	750	132	241	2,380
PNA	9/1/1997	35	12,350	7,168	0	13,706	0	195	420	3,501
PNA	9/1/1997	79	223,433	131,805	1,228	170,006	24,077	3,438	9,233	61,886
PNA	9/1/1997	170	55,337	54,692	18,403	117,572	40,098	517	1,274	25,860
PNA	9/1/1997	172	25,601	14,665	999	29,163	24,183	294	730	8,811
PNA	9/1/1997	194	137,133	150,300	10,997	140,755	20,680	1,580	2,883	68,857
PNA	9/1/1997	416	88,723	92,084	42,297	129,652	208,774	1,111	2,894	44,428
PNA	9/1/1997	418	86,439	31,456	16,373	93,847	35,185	307	203	21,455
PNA	9/1/1997	456	155,393	193,559	96,316	636,044	308,121	1,259	926	169,938
PNA	9/1/1997	467	353,153	330,950	233,205	603,513	409,620	3,218	2,244	289,611
PNA	9/1/1997	478	16,338	29,746	1,961	15,389	20,500	185	137	12,929
		Total	1,171,561	1,042,666	422,374	1,955,733	1,091,988	12,317	21,311	711,110

Airline	Quarter Ending	Aircraft Code	Pilot & Co-Pilot	Aircraft Fuel & Oil	Other Flying Ops Expense	Mainte-nance	Rentals & Deprecia-tion	Total Block hours	Total Depar-ture	Total gal fuel issued
RYA	9/1/1997	125	17,167	19,732	4,375	17,913	2,219	264	299	8,979
RYA	9/1/1997	416	35,126	61,752	50,751	71,076	92,265	540	948	28,101
		Total	52,293	81,484	55,126	88,989	94,484	804	1,247	37,080
VLA	9/1/1997	95	94,708	71,630	5,311	109,070	26,426	1,932	3,681	31,606
		Total	94,708	71,630	5,311	109,070	26,426	1,932	3,681	31,606
YTU	9/1/1997	35	19,717	26,848	5,309	37,874	5,354	557	1,307	9,641
YTU	9/1/1997	405	204,351	438,244	138,470	539,789	133,005	3,161	2,113	342,548
		Total	224,068	465,092	143,779	577,663	138,359	3,718	3,420	352,189
YUT	9/1/1997	35	304,537	193,128	32,723	355,564	93,595	6,647	12,564	99,708
YUT	9/1/1997	36	41,238	14,290	4,252	35,525	4,686	878	2,008	7,026
YUT	9/1/1997	79	15,901	10,872	1,578	16,762	10,834	364	891	5,826
YUT	9/1/1997	194	31,757	33,323	9,727	62,064	3,090	486	742	18,460
YUT	9/1/1997	416	19,368	29,130	11,432	17,404	55,305	283	474	16,953
		Total	412,801	280,743	59,712	487,319	167,510	8,658	16,679	147,973

Direct Aircraft Expense
4th Quarter, 1997

Airline	Quarter Ending	Aircraft Code	Pilot & Co-Pilot	Aircraft Fuel & Oil	Other Flying Ops Expense	Mainte-nance	Rentals & Deprecia-tion	Total Block hours	Total Depar-ture	Total gal fuel issued
ASE	12/1/1997	95	42,690	39,784	18,373	104,008	56,400	965	1,972	17,791
ASE	12/1/1997	125	18,143	28,809	8,050	33,709	25,500	350	387	12,683
ASE	12/1/1997	416	13,874	18,047	11,927	47,985	39,900	249	513	12,425
ASE	12/1/1997	486	32,017	72,186	16,610	122,257	45,420	498	794	50,360
		Total	106,724	158,826	54,960	307,959	167,220	2,062	3,666	93,259
ERA	12/1/1997	406	60,837	18,082	9,610	40,421	43,161	182	82	15,500
ERA	12/1/1997	430	371,653	373,853	39,762	121,551	217,375	1,398	1,533	386,694
ERA	12/1/1997	483	238,038	159,398	35,230	538,497	189,415	1,192	1,909	176,310
ERA	12/1/1997	485	392,320	243,863	53,937	675,895	193,721	2,920	4,530	227,664
ERA	12/1/1997	663	150,683	67,776	13,380	221,242	134,124	302	77	80,670
ERA	12/1/1997	902	0	512	6,638	14,710	19,883	3	3	710
		Total	1,213,531	863,484	158,557	1,612,316	797,679	5,997	8,134	887,548
GRT	12/1/1997	35	69,346	66,713	20,089	55,911	13,793	1,331	2,923	23,682
GRT	12/1/1997	36	2,223	318	1,290	3,591	3,000	12	47	113
GRT	12/1/1997	110	0	0	3,527	9,815	7,155	0	0	0
GRT	12/1/1997	194	50,557	103,038	15,096	42,015	51,808	821	1,882	36,576
GRT	12/1/1997	406	16,873	44,144	7,020	19,539	40,750	237	158	22,477
		Total	138,999	214,213	47,022	130,871	116,506	2,401	5,010	82,848
HAG	12/1/1997	33	0	0	888	0	0	0	0	0
HAG	12/1/1997	35	275,911	193,331	28,128	202,012	206,342	4,366	10,322	69,793
HAG	12/1/1997	36	11,595	4,627	394	7,241	6,000	184	804	1,652
HAG	12/1/1997	110	935	2,005	1,968	2,336	0	15	39	740
HAG	12/1/1997	125	55,484	83,551	14,422	138,596	67,197	878	2,025	30,737
HAG	12/1/1997	410	0	0	4,186	0	10,000	0	0	0
HAG	12/1/1997	416	84,728	202,136	44,018	185,189	221,319	1,341	2,595	78,404
		Total	428,653	485,650	94,004	535,374	510,858	6,784	15,785	181,326
LFS	12/1/1997	35	42,706	34,933	7,005	52,981	22,710	939	1,567	17,345
LFS	12/1/1997	36	12,637	3,350	1,773	8,830	4,000	89	208	1,810
LFS	12/1/1997	79	23,140	27,546	9,912	70,642	6,308	726	1,024	15,566
LFS	12/1/1997	131	0	0	2,563	35,321	5,366	0	0	0
LFS	12/1/1997	194	48,512	106,300	15,438	176,604	39,815	1,082	1,320	52,645
		Total	126,995	172,129	36,691	344,378	78,199	2,836	4,119	87,366
PNA	12/1/1997	30	0	0	0	729	7,434	0	0	0
PNA	12/1/1997	33	7,853	2,278	1,443	3,034	0	94	210	1,697
PNA	12/1/1997	35	0	0	1,443	26,863	0	0	0	0
PNA	12/1/1997	79	227,616	108,896	20,516	273,155	22,698	2,832	6,870	50,972
PNA	12/1/1997	170	49,510	38,161	28,225	85,143	41,439	360	901	18,000
PNA	12/1/1997	172	18,938	10,338	7,612	49,422	13,500	213	512	6,387
PNA	12/1/1997	194	125,991	127,991	27,551	154,557	20,680	1,126	2,544	48,742
PNA	12/1/1997	416	91,440	78,125	40,198	128,035	117,243	955	2,229	38,188
PNA	12/1/1997	418	67,554	14,440	21,051	85,214	35,431	99	57	6,958
PNA	12/1/1997	456	184,433	177,092	141,225	421,213	381,548	1,190	782	160,623
PNA	12/1/1997	467	301,771	229,861	256,518	592,074	367,981	2,078	1,558	187,020
PNA	12/1/1997	478	19,882	15,783	9,805	49,213	20,500	150	128	10,472
		Total	1,094,988	802,965	555,587	1,868,652	1,028,454	9,097	15,791	529,059

Direct Aircraft Expense
4th Quarter, 1997

Airline	Quarter Ending	Aircraft Code	Pilot & Co-Pilot	Aircraft Fuel & Oil	Other Flying Ops Expense	Mainte-nance	Rentals & Deprecia-tion	Total Block hours	Total Depar-ture	Total gal fuel issued
RYA	12/1/1997	35	72,314	73,640	26,627	90,029	9,810	1,539	2,737	26,156
RYA	12/1/1997	110	26,377	21,199	5,788	16,359	9,139	145	165	7,530
RYA	12/1/1997	125	16,374	24,113	4,631	30,483	2,219	252	307	8,565
RYA	12/1/1997	412	10,193	14,697	27,785	66,589	0	74	44	7,440
RYA	12/1/1997	416	22,451	35,479	50,938	60,508	48,000	345	623	17,961
		Total	147,709	169,128	115,769	263,968	69,168	2,355	3,876	67,652
VLA	12/1/1997	95	85,505	56,925	17,993	122,238	17,483	1,603	2,995	24,365
		Total	85,505	56,925	17,993	122,238	17,483	1,603	2,995	24,365
YTU	12/1/1997	35	24,595	29,875	7,792	63,223	6,371	647	1,488	11,631
YTU	12/1/1997	405	231,247	558,432	138,006	645,361	151,233	3,460	3,185	398,344
		Total	255,842	588,307	145,798	708,584	157,604	4,107	4,673	409,975
YUT	12/1/1997	35	239,227	171,098	26,281	228,234	76,646	5,519	10,633	82,780
YUT	12/1/1997	36	35,926	13,303	1,762	38,545	4,686	865	2,152	6,917
YUT	12/1/1997	79	7,351	5,570	633	10,387	11,012	180	466	2,894
YUT	12/1/1997	194	12,411	25,580	5,937	54,356	3,090	290	418	11,029
YUT	12/1/1997	416	11,863	24,006	10,934	5,691	54,566	288	491	17,282
		Total	306,778	239,557	45,547	337,213	150,000	7,142	14,160	120,902

Aircraft Code	Total blk-hr	Fuel Cost $/blk-hr	Comments
30	104	16.17	two observations 15.93 17.04
33	430	32.70	five observations 24.23 26.21 37.51 43.16 43.50
35	56,041	38.20	26 observations, 15 in the range 29.1-41.6, 11 in the range 44.3-51.4
36	4,347	19.09	16 observations, seven in the range 14.5-19.8, eight in the range 24.0-27.7, one high point 37.64
79	15,870	37.83	12 observations 29.87 minimum 41.56 maximum
95	11,106	35.15	eight observations 31.09 minimum 41.23 maximum
110	1,034	128.47	ten observations, six in the range 125.0-134.8, at 138.4, three in the range 145.1-152.1
125	5,312	86.43	12 observations, three around 65.0, at 74.7, five in the range 79.7-89.4, three around 95.3
131	314	92.27	three observations 83.65 89.92 97.62
170	1,653	101.45	four observations, three around 106.1, one low point 84.44
172	851	40.51	four observations 11.85 48.54 49.88 63.22
194	13,573	101.11	16 observations, ten in the range 84.1-101.5, at 113.7, four in the range 122.9-129.2, one low point 68.57
405	11,397	151.43	four observations 138.64 minimum 161.40 maximum
406	1,282	133.11	six observations, four in the range 89.1-105.8, two high points 186.26 213.19
410	76	418.75	two observations 374.78 467.61
412	74	198.61	only (one) observation
416	11,682	110.63	23 observations, ten in the range 72.5-88.0, nine in the range 102.0-119.1, three in the range 145.9-150.7, one low point 65.10
418	972	109.30	four observations 101.85 102.46 109.68 145.86
430	6,439	356.14	four observations 267.42 310.12 410.77 464.35
456	3,900	150.96	four observations 127.18 minimum 156.97 maximum
467	11,416	110.93	four observations 102.84 minimum 125.75 maximum
478	693	102.36	four observations 68.95 72.74 105.22 160.79
483	5,176	167.57	four observations 133.72 145.77 183.16 209.44
485	12,799	90.50	four observations 79.88 minimum 102.97 maximum
486	1,320	138.88	four observations 117.98 minimum 146.93 maximum
663	1,333	233.14	four observations 214.96 minimum 249.18 maximum
902	394	183.97	three observations 170.67 183.30 186.36

Aircraft	Total	Fuel Use	
Code	blk-hr	gal/blk-hr	Comments
30	104	17.91	two observations
33	398	18.01	four observations, omitting outlying 13.00
35	56,041	15.74	26 observations 15.00 minimum 18.47 maximum
36	4,258	8.25	15 observations, using 7.00 minimum, 9.64 maximum, omitting outlying 20.34
79	15,870	18.01	12 observations 13.71 minimum 21.44 maximum
95	11,106	16.82	eight observations 15.20 minimum 18.59 maximum
110	1,034	51.22	ten observations
125	5,312	35.46	12 observations 33.99 minimum 38.32 maximum
131	314	40.82	three observations 37.42 38.00 45.70
170	1,653	51.37	four observations, three around 50.0, and at 55.52
172	851	29.98	four observations
194	13,573	42.61	16 observations 37.98 minimum 48.66 maximum
405	11,397	112.42	four observations
406	1,282	90.15	six observations 85.16 minimum 94.84 maximum
410	76	154.54	two observations 145.95 164.08
412	74	100.54	only (one) observation
416	7,660	55.94	17 observations, omitting outlying 39.97 39.99 39.99 40.01 78.42 96.62 using 49.90 minimum, 60.14 maximum
418	972	70.01	four observations
430	6,439	279.52	four observations
456	3,900	134.96	four observations
467	11,416	90.00	four observations
478	693	69.98	four observations
483	5,176	148.12	four observations
485	12,799	76.79	four observations
486	1,320	94.65	four observations, two around 82.2, two around 102.2
663	1,333	264.87	four observations
902	391	86.70	two observations, omitting outlying 236.67

Aircraft Code	Total blk-hr	Pilot $/blk-hr	Comments
30	104	57.66	two observations 39.00 62.96
33	430	97.86	five observations 57.47 71.79 83.54 95.16 207.78 and omitting 77.26816 116.22619
35	55,778	52.04	24 observations, three in the range 35.4-38.0, 12 in the range 43.4-53.4, seven in the range 57.3-63.3, two high points 67.69 69.91 {above}
36	4,100	49.02	12 observations, five in the range 45.7-49.6, five in the range 57.3-63.4, two outside points 41.53 69.91 and omitting 22.56 141.99 171.42 185.25
79	7,040	56.00	eight observations, seven in the range 40.8-50.9, one high point 64.99 and omitting 31.87 77.85 80.37 86.25
95	11,106	46.85	eight observations, five in the range 40.0-44.9, three high points 49.02 53.34 54.63
110	678	79.14	seven observations, five in the range 57.0-69.9, two high points 84.90 92.84 and omitting 119.17 159.66 181.91
125	5,312	60.32	12 observations, three in the range 56.1-59.0, seven in the range 64.1-69.9, two low points 46.00 51.84
131	314	111.05	three observations 52.25 156.15 186.97
170	1,136	138.27	three observations, omitting outlying 107.03
172	851	81.94	four observations 47.33 87.08 88.91 132.17
194	10,108	66.31	12 observations, five in the range 47.1-52.0, three in the range 61.6-65.3, four in the range 76.7-93.1, omitting outlying 42.80 44.84 111.89 121.60
405	11,397	68.90	four observations, three in the range 64.7-67.5, one high point 77.43
406	830	272.46	four observations, three in the range 248.1-261.0, one high point 334.27 and omitting 71.19 143.40
410	76	57.71	two observations
412	74	137.74	only (one) observation
416	9,612	66.14	18 observations, 15 in the range 54.0-69.9, two around 80.0, one low point 49.31 and omitting 41.19 95.75 118.01 140.61 183.28
418	873	281.06	three observations 251.64 281.56 325.95 and omitting 682.36
430	6,439	228.79	four observations 187.95 212.04 265.85 278.12
456	3,900	145.67	four observations, three in the range 155.0-158.2, one low point 123.43
467	11,416	123.49	four observations 109.74 minimum 145.22 maximum
478	693	109.22	four observations 88.31 93.69 129.17 132.55
483	5,176	174.45	four observations 157.03 minimum 199.70 maximum
485	12,799	131.84	four observations 115.58 133.29 134.36 149.25
486	1,320	66.03	four observations 57.60 64.29 64.40 78.86
663	1,333	423.33	four observations 387.42 minimum 498.95 maximum
902	391	93.48	two observations

Aircraft Code	Total blk-hr	Maintnce $/blk-hr	Comments
30	104	68.04	two observations 18.05 244.09
33	375	32.94	four observations, three in the range 26.4-35.0, one high poi 50.16 and omitting 145.40
35	55,484	54.74	25 observations, 41.35 minimum, 97.72 maximum, omitting 31.18
36	4,347	60.94	16 observations, ten in the range 32.5-99.2, and 133.49 216.46 299.25 445.98 447.05 939.39
79	15,870	72.43	12 observations, four in the range 44.6-51.9, at 57.7, at 60.9, two at about 79.0, four in the range 95.6-98.1
95	11,106	74.76	eight observations 51.92 56.45 57.66 68.61 76.26 103.91 107.78 129.04
110	1,034	153.36	ten observations, six in the range 112.8-158.2, high points 183.57 185.37 202.91 213.40
125	5,312	132.95	12 observations, five in the range 90.8-106.4, five in the range 121.0-183.6, and outside points 67.85 328.93
131	288	244.49	two observations, omitting outlying 1391.54
170	1,291	225.51	three observations 213.58 227.41 236.51 and omitting 331.12
172	851	117.69	four observations 46.54 99.19 99.50 232.03
194	13,573	131.26	16 observations, four in the range 51.2-89.9, at 107.2, five in the range 119.6-137.3, six in the range 154.0-197.0
405	11,397	162.72	four observations 131.74 minimum 186.52 maximum
406	1,282	195.18	six observations 82.44 121.26 218.50 222.09 246.67 291.53
410	76	188.08	two observations 141.70 239.61
412	74	899.85	only (one) observation
416	11,476	123.95	20 observations, four in the range 61.5-96.8, nine in the range 115.0-138.1, five in the range 149.4-192.7, two low points 19.76 35.07
418	972	323.93	four observations 207.49 290.20 305.69 860.75
430	6,439	544.12	four observations 86.95 616.07 633.29 800.66
456	3,900	396.18	four observations 293.85 348.44 353.96 505.20
467	11,416	222.16	four observations 187.54 minimum 284.92 maximum
478	693	169.72	four observations 83.18 104.23 186.42 328.09
483	5,176	375.77	four observations 239.59 269.06 451.76 579.95
485	12,799	218.96	four observations 153.28 218.88 231.47 260.36
486	1,320	297.31	four observations 245.50 318.55 335.32 335.91
663	1,333	487.71	four observations 336.54 405.67 499.60 732.59
902	394	232.16	three observations 123.61 410.79 4903.33

Aircraft Code	Total blk-hr	Deprectn $/blk-hr	Comments
30			no observations
33	304	17.27	three observations 5.68 19.23 40.91
35	55,127	24.64	22 observations, 12 in the range 3.3-14.2, four in the range 17.3-26.1, five in the range 41.2-47.3, one high point 55.90
36	4,347	16.27	16 observations, three at about 5.0, eight in the range 11.4-44.9, at 72.7, two around 106.5, two high points 190.48 250.00
79	15,870	9.94	12 observations, seven in the range 4.2-8.7, four in the range 29.8-34.6, one high point 61.18
95	11,106	26.42	eight observations, four in the range 10.9-20.2, at 28.5, at 37.2, two high points 50.84 58.45
110	923	52.78	six observations 29.87 minimum 78.32 maximum
125	5,252	72.57	11 observations, two at about 8.6, at 21.4, at 48.7, five in the range 65.3-101.1, two high p 135.06 172.78
131	314	42.78	three observations 23.08 31.38 206.38
170	1,653	82.41	four observations 68.48 72.20 77.56 115.11
172	851	139.55	four observations 63.38 82.26 111.31 290.32
194	13,573	29.18	16 observations, five in the range 5.7-13.1, seven in the range 16.9-36.8, at 47.0, three in the range 63.1-88.0
405	11,397	40.01	four observations 33.75 minimum 43.71 maximum
406	1,282	199.82	six observations 171.94 minimum 237.15 maximum
410	76	615.33	two observations 277.78 919.13
412			no observations
416	11,682	157.83	23 observations, three in the range 45.3-77.7, 17 in the range 118.22-211.8, three in the range 269.1-299.0
418	972	86.40	four observations 4.62 53.02 114.61 357.89
430	6,439	45.01	four observations, three in the range 12.1-15.9, one high point 155.49
456	3,900	276.11	four observations 244.73 minimum 320.63 maximum
467	11,416	136.76	four observations 112.95 minimum 177.08 maximum
478	693	118.33	four observations 107.33 minimum 136.67 maximum
483	5,176	148.09	four observations 134.22 minimum 158.91 maximum
485	12,799	61.59	four observations 48.62 minimum 72.89 maximum
486	1,320	146.60	four observations 91.20 117.78 179.44 236.03
663	1,333	261.29	four observations 178.87 191.63 255.05 444.12
902	394	153.03	three observations 69.19 204.11 6627.67

Aircraft Code	Total blk-hr	Other $/blk-hr	Comments
30			no observations
33	375	12.82	four observations 4.51 15.35 16.09 27.75
35	55,762	8.56	24 observations 4.76 minimum 17.56 maximum
36	4,314	8.59	14 observations, seven between 1.31--7.48, four between 19.92--28.24, 34.39 38.25 55.37 , omitting two around 105
79	7,160	8.83	nine observations 3.52 4.34 , five between 7.24--9.62, 13.65 15.48
95	11,106	7.18	eight observations, three around 2.50, two around 8.50, two around 11.15, and 19.04
110	977	29.91	seven observatior 17.16 , six between 29.44--40.05, omitting 93.74 131.20 267.86
125	5,252	17.65	11 observations, six around 16.00, three around 19.00, two around 23.00, omitting 72.92
131	288	17.80	two observations, 14.99 21.91 , omitting 98.58
170	1,293	46.24	three observations 35.60 45.23 60.40 , omitting 78.40
172	851	12.52	four observations, two around 4.0, 9.65 35.74
194	13,573	14.75	16 observations, three around 7.00, five between 8.91--14.27, 16.18 , six between 18.39--24.47, 53.85
405	11,397	41.26	four observations, between 35.67--47.20
406	1,282	43.16	six observations, two around 30.00, four around 50.00
410	76	93.82	two observations, 35.72 146.10
412	74	375.47	one observation 122.8838 147.64638 165.0198
416	11,476	46.91	20 observations, one low point 19.96 seven between 26.13 and 33.12, seven between 37.97 and 47.90, 60.84 93.98 and three high points {above}
418	972	71.09	four observations, 47.68 53.33 68.78 212.64
430	6,439	25.87	four observations, 15.80 24.48 28.44 41.85
456	3,575	80.89	three observations 45.85 76.50 118.68 , omitting 5.68
467	11,416	70.88	four observations, 44.39 59.95 72.47 123.44
478	526	25.60	three observations 8.90 10.60 65.37
483	5,176	29.86	four observations between 27.31--33.83
485	12,799	19.34	four observations between 16.67--23.26
486	1,320	39.92	four observations, 33.35 41.47 43.61 47.08
663	1,333	42.95	four observations between 40.52--44.42
902	391	70.82	two observations, 47.72 138.97

Appendix E - Appendix II2

Aircraft		Reported	Cost Per Block Hour						Capacity	Velocity	Perform	
Code	Type	blk-hr	Fuel	Pilot	Maintnce	Deprectn	Other	Total	lb	mi/hr	units	Type
30	Cessna 180	69	16.17	57.66	68.04			141.88				Cessna 180
33	Cessna 185	385	32.70	97.86	32.94	17.27	12.82	193.60	864	140	0.312	Cessna 185
35	Cessna 206/207	55,706	38.20	52.04	54.74	24.64	8.56	178.18	1,256	144	0.508	Cessna 206/207
36	Cessna 172	4,286	19.09	49.02	60.94	16.27	8.59	153.92	587	123	0.235	Cessna 172
79	Piper Cherokee	12,947	37.83	56.00	72.43	9.94	8.83	185.04	1,000	158	0.427	Piper Cherokee
95	1-engine piston, <450hp	11,106	35.15	46.85	74.76	26.42	7.18	190.36				1-engine piston, <450hp
110	Beech 18	947	128.47	79.14	153.36	52.78	29.91	443.66	2,450	222	0.613	Beech 18
125	Cessna 402	5,292	86.43	60.32	132.95	72.57	17.65	369.91	1,823	214	0.527	Cessna 402
131	Brittain Norman Islander	305	92.27	111.05	244.49	42.78	17.80	508.38	1,533	133	0.201	Brittain Norman Islander
170	Grumman Goose	1,447	101.45	138.27	225.51	82.41	46.24	593.88	1,462	166	0.204	Grumman Goose
172	Grumman Widgeon	851	40.51	81.94	117.69	139.55	12.52	392.21	735	113	0.106	Grumman Widgeon
194	Piper Navajo	12,996	101.11	66.31	131.26	29.18	14.75	342.61	1,507	218	0.479	Piper Navajo
405	Beech 1900	11,397	151.43	68.90	162.72	40.01	41.26	464.31	3,996	270	1.162	Beech 1900
406	Beech 200 Super Kingair	1,207	133.11	272.46	195.18	199.82	43.16	843.74	2,500	235	0.348	Beech 200 Super Kingair
410	Rockwell Turbo Commander	76	418.75	57.71	188.08	615.33	93.82	1373.68				Rockwell Turbo Commander
412	CASA 212	62	198.61	137.74	899.85		375.47	1611.68	5,950	170	0.314	CASA 212
416	Cessna 208 Caravan	10,598	110.63	66.14	123.95	157.83	46.91	505.46	2,330	171	0.394	Cessna 208 Caravan
418	Cessna 441	956	109.30	281.06	323.93	86.40	71.09	871.77				Cessna 441
430	Convair 580	6,439	356.14	228.79	544.12	45.01	25.87	1199.94	12,300	260	1.333	Convair 580
456	Saab-Fairchild 340	3,846	150.96	145.67	396.18	276.11	80.89	1049.81	7,000	260	0.867	Saab-Fairchild 340
467	Swearingen Metro III	11,416	110.93	123.49	222.16	136.76	70.88	664.21	5,000	250	0.941	Swearingen Metro III
478	Piper T-1040	665	102.36	109.22	169.72	118.33	25.60	525.22	2,372	280	0.632	Piper T-1040
483	DeHavilland Dash-8	5,176	167.57	174.45	375.77	148.09	29.86	895.75	7,960	270	1.200	DeHavilland Dash-8
485	DeHavilland Twin Otter	12,799	90.50	131.84	218.96	61.59	19.34	522.23	2,573	160	0.394	DeHavilland Twin Otter
486	Short Skyvan	1,320	138.88	66.03	297.31	146.60	39.92	688.73	2,457	168	0.300	Short Skyvan
663		1,333	233.14	423.33	487.71	261.29	42.95	1448.43				
902		393	183.97	93.48	232.16	153.03	70.82	733.47				

Sources for capacity and velocity values are various
Performance value is (capacity * velocity) / (total cost)
Higher performance values are more efficient aircraft

	Arctic Circle Air Service	Arctic Transportation Services	Alaska Central Express	Baker Aviation	Bering Air	Cape Smythe Air	ERA Aviation	Frontier Flying Service	FS Air Service	Grant Aviation	Hageland Aviation	Hyannis Air	Larry's Flying Service	Olson Air Service	Peninsula Airways	Tanana Air	Tatonduk Outfitters	Village Aviation	Warbelow's Air Ventures	Wright Air Service	Yute Air Alaska
Cessna Conquest															2						
Cessna 172										2			2					3			3
Cessna 185						1						1									
Cessna 206	1			1				1			1	1					2	1	1	1	1
Cessna 207	7	10	3		3	7		1		10	12	2	2	1				3	2	2	14
Cessna 208 (Caravan)	1			2	4						4	1			6		2				2
Cessna 402	2	1									1			1							
Piper Lance													1			5					
Piper Navajo				2	6	2		7	2	5		1	6		6	1			10	4	1
Piper Cherokee Lance	1																4				
Piper Cherokee Six													1			4					1
Piper Cheyenne II						1															
Piper Saratoga													3		13						
Piper T1040						3									1						
deHavilland Dash 8							2														
deHavilland Twin Otter							10														
Beech 99						3		1													
Beech 1300								2													
Beech 1900			5					3													
Beech Turbo 18									2												
Beech Baron												1									
Beech King Air						1				1											

	Arctic Circle Air Service	Arctic Transportation Services	Alaska Central Express	Baker Aviation	Bering Air	Cape Smythe Air	ERA Aviation	Frontier Flying Service	FS Air Service	Grant Aviation	Hageland Aviation	Hyannis Air	Larry's Flying Service	Olson Air Service	Peninsula Airways	Tanana Air	Tatonduk Outfitters	Village Aviation	Warbelow's Air Ventures	Wright Air Service	Yute Air Alaska
Grumman Goose															4						
Grumman Widgeon															2						
Saab 340															2						
Britten Norman Islander													1								
Convair 580							5														
Shorts Skyvan	3																				
CASA 212		2			1				1												
Catpass 250					2																
Fairchild Metro									1						5						
DC-3								1													
DC-6																	6				

Alaska Central Express carries no passengers

Fleet of Bush Aircraft of Selected Alaskan Air Carriers

			Percent of Total	
		Number	Number	Capacity
Cessna 172		10	3.61%	1.16%
Grumman Widgeon		2	0.72%	0.29%
Cessna 185		2	0.72%	0.34%
Piper Cherokee Six		33	11.91%	6.53%
Cessna 207		93	33.57%	22.81%
Grumman Goose		4	1.44%	1.16%
Piper Navajo		54	19.49%	16.11%
Britten Norman Islander		1	0.36%	0.30%
Cessna 402		5	1.81%	1.80%
Cessna 208 (Caravan)		22	7.94%	10.15%
Piper T1040		4	1.44%	1.88%
Beech Turbo 18		2	0.72%	0.97%
Shorts Skyvan		3	1.08%	1.46%
Beech King Air		2	0.72%	0.99%
deHavilland Twin Otter		10	3.61%	5.09%
Beech 99		4	1.44%	2.30%
Beech 1900		8	2.89%	6.33%
Catpass 250		4	1.44%	3.74%
Fairchild Metro		6	2.17%	5.94%
CASA 212		4	1.44%	4.71%
Saab 340		2	0.72%	2.77%
deHavilland Dash 8		2	0.72%	3.15%

Appendix IV Pando Code / The Pando Code is a Microsoft® Excel file available on the cd

Appendix F
Yukon-Kuskokwim Delta Coast Regional Port Study

TETRA TECH INC.

1925 Post Alley, Suite 4, Seattle, WA 98101
PHONE (206) 728-9655 • FAX (206) 728-9670

To: Bob Sanders
Study Manager
U.S. Army Corps of Engineers
Alaska District
PO Box 898
Anchorage, Alaska 99506

From: Ridge Robinson

Date: 19 July 2001

Subject: Yukon-Kuskokwim Delta Coast Regional Port Study
Final Report

Bob,

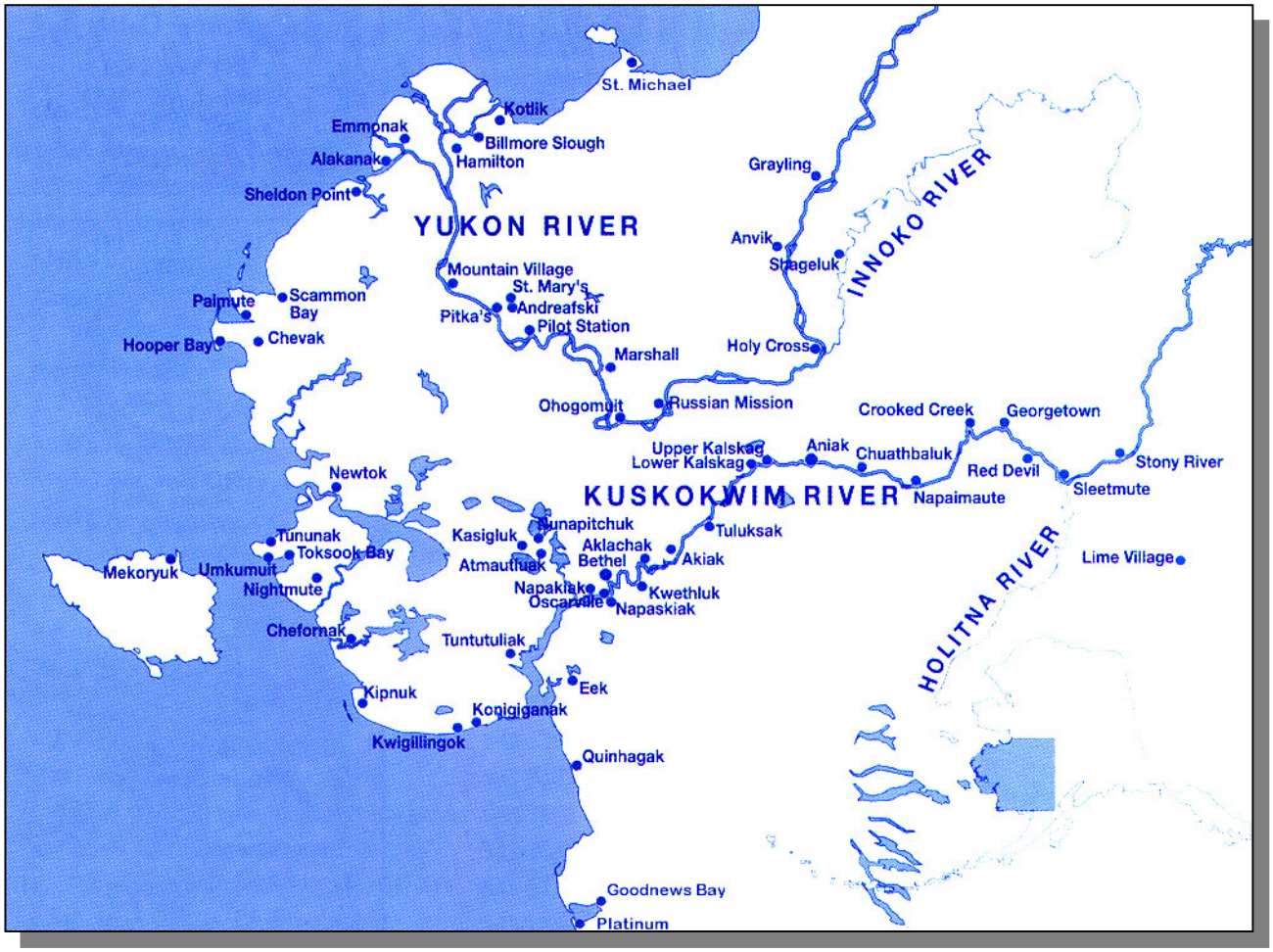
Please find enclosed Tetra Tech's final report submittal for the Yukon-Kuskokwim Delta Coast Regional Port Study. As identified in our scope of work, we have provided twenty hard copies and one electronic copy of the final report. The electronic copy is in Microsoft Word format and has been saved to a 3¼" compact disk.

I would like to thank Alaska District and your sponsors, the Alaska Department of Transportation and the Coastal Villages Region Fund, for the opportunity to work with you on this interesting project.

Sincerely,

Ridge Robinson
Program Manager

YUKON-KUSKOKWIM DELTA COAST REGIONAL PORT STUDY



JULY 2001

YUKON-KUSKOKWIM DELTA COAST REGIONAL PORT STUDY

prepared for
U.S. Army Engineer District, Alaska
(Contract No. DACA85-00-D-001, D07)

in coordination with
Alaska Department of Transportation, and
Coastal Villages Region Fund

prepared by
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JULY 2001

YUKON-KUSKOKWIM DELTA COAST REGIONAL PORT STUDY

EXECUTIVE SUMMARY

The purpose of this study was to examine regional economic and environmental issues related to development of a regional port in western Alaska in the coastal region extending from Goodnews Bay to the south to Saint Michael to the north. The regional port would serve primarily as a distribution center for general cargo and fuel that is transported to the region by mainline ocean barges and then transferred to villages within the region by shallow-draft coastal and river barges. If economically justified, the port would include mooring and dock facilities for ocean and lightering barges, onshore storage for general cargo and bulk fuel, and dock and onshore space for other uses such as fish processing facilities. Currently, the only such ports in the region are at Bethel, which serves Kuskokwim River villages, and Nenana, which serves Yukon River villages. Regional fuel distribution is provided form Bethel and St. Michael. A summary of key findings is provided below.

- The study area encompasses the Yukon-Kuskokwim Delta, including inland villages that are served by waterborne carriers that serve coastal villages. This area includes a total of 50 communities with a total population of about 25,000. The largest community is Bethel with a population of 5,500. The study found that as many as 16 coastal villages with a total population of about 6,500 might be served from a centrally located regional port located on the coast.

- Analysis of general cargo movements shows that general cargo is moved to and within the region by mainline, coastal and river barges by a single common carrier and a number of contract waterborne carriers and by air. Air shipments of general cargo are primarily through the bypass mail program of the U.S. Postal Service and could account for as much as one-half of total general cargo shipments. Lightering barges that transfer cargo from ocean barges that anchor in Goodnews Bay provide common carrier barge service to coastal villages. Large volumes of general cargo required for major construction projects are typically transported by contract barges and are delivered directly to the village where the construction project is located, typically with the assistance of one or more lightering barges. Estimates of annual shipments of general cargo to coastal villages range from as little as 10 to 1,000 tons each, depending on the village and the basis for the estimate.

- Comparison of bypass mail and barge rates for general cargo shows that the rate for bypass mail is less than one-half the barge rate. This is possible because the Federal government heavily subsidizes bypass mail. Analysis of barge rates (costs) indicates that rates are primarily a function of local conditions (mooring and unloading) rather than distance. Thus, aggregate NED benefits would be larger for improving local conditions than for reducing transportation distances through development of a new regional port.

- Analysis of fuel movements shows that a single waterborne carrier transports essentially all of the fuel that is delivered to the region. Yukon River villages, including those near the coast, are served from Nenana. Coastal villages are served by lightering barges operating from an ocean barge anchored in the vicinity of Eek Island. Kuskokwim River villages are served by river barges that operate from Bethel. Regional fuel storage facilities are located at

Bethel (service to Kuskokwim River villages) and at Saint Michael (service to Yukon River villages).

- The regional fishery that impacts coastal villages includes two major components that utilize fish allocated to coastal communities through the community development quota program as follows: an at-sea fishery for groundfish and other species and a local fishery that targets primarily salmon, herring and halibut. Investments by the CVRF to support the local fishery are directed at establishing fishing as an economic activity in each of its member communities.

- Analysis of the need for (and potential NED benefits that would result from) development of a regional port shows the following:

    - There is insufficient volume of waterborne general cargo and fuel to justify the cost of developing a regional port. Furthermore, use of a regional port for transfer of general cargo and fuel from ocean barges to coastal villages would increase the cost of these deliveries because of handling and moorage costs that would be imposed at the port.
    - Analysis of barge rates for a sampling of 18 of the 50 villages in the study area shows that differences in barge transportation costs (rates) among the villages are largely determined by local conditions rather than distance.
    - Development of a regional port at Nunivak Island for the purpose of exporting rock and gravel cannot be justified because there are adequate resources at other locations within the study area that can meet all potential future needs of these resources at the same or lower cost.
    - As much as one-half of all general cargo is diverted from barge carriers to air transportation because of the U.S. Postal Service's bypass mail program.
    - Airport expansion will have no effect on the volume of air and barge transported general cargo.
    - Analysis of potential NED benefits shows that there are no significant quantifiable benefits that would be realized by constructing a regional port.

- Analysis of navigation problems shows there is a need for the following types of improvements in the region:

    - Dredging the Kuskokwim River at the Oscarville Crossing (Johnson bar) to reduce delays and the need for light-loading of mainline general cargo and fuel barges and sand, gravel and rock barges. Shippers indicated that the channel would need to be deepened by about three feet for a distance of about one-half mile to obtain a channel depth of 15 feet during low water conditions that occur late in the shipping season.
    - Development of minimum mooring and unloading facilities for river barges at all coastal and Kuskokwim River and Yukon River villages.

YUKON-KUSKOKWIM DELTA COAST REGIONAL PORT STUDY

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YUKON-KUSKOKWIM DELTA COAST REGIONAL PORT STUDY

1.0 Introduction

During the mid-1990s a pre-feasibility study of development of a port at Mekoryuk was conducted. The report entitled, "Mekoryuk Port Pre-Feasibility Study and Development Plan, December 1997," includes information on the results of an analysis of four categories of potential national economic development benefits—transportation cost savings for fuel and cargo; transportation savings for sand, gravel and rock; enhancement of commercial fishing; and, harbor of refuge. The analysis was based on the assumption that all cargo, fuel and sand, gravel and rock are transshipped to coastal communities from Bethel. The finding of the study was that only transportation cost savings for deliveries of fuel, cargo and sand, gravel and rock to communities located more proximally to Mekoryuk than to Bethel "…would be expected to result in significant national economic development benefits." The report pointed out that additional economic benefits might be possible from provision of a harbor-of-refuge. The comparison of costs and benefits for a port at Mekoryuk resulted in a benefit-cost ratio of 0.8:1. A benefit-cost ratio of at least 1:1 is required before a local sponsor of the project can receive Federal financial assistance through the U.S. Army Corps of Engineers.

2.0 Purpose

This report was prepared to provide information needed to determine the potential feasibility of development of a coastal port in the Yukon-Kuskokwim Delta region of Western Alaska. The purpose of the study was essentially two-fold: first, identify and examine alternative port sites; and, second, determine potential national economic benefits that would accrue to a new port. To accomplish the purpose of the study, the following goals were established:

- Determine potential national economic benefits a new port might generate in the region.
- Examine alternative port sites to determine the most economically sound location for a new regional port.
- Discuss existing problems moving goods and services to Western Alaska and the Y-K Delta.
- Discuss how a new port would impact existing ports and coastal communities in the Y-K Delta and Western Alaska.

3.0 Organization of the Report

The study addresses the following tasks as specified in the scope of work:

- Evaluate Health, Education and Transportation Agency Plans
- Evaluate Construction Contractor Plans
- Evaluate Bulk Fuel Movement
- Evaluate General Cargo Movement
- Evaluate Community Development Quota Fisheries in the Bering Sea
- Evaluate Fish Processing and Transshipment
- Outline Potential Concerns

- Incorporate Local Knowledge into the Study Process
- Develop a Conceptual Port Schematic
- Prepare a Report

In addition to the tasks that were specified in the scope of work, in order to establish a framework for the study and analysis of potential NED benefits to alternative regional port sites, the study area was divided into sub-regions. Also, socio-economic data for each of the communities in the study area was developed and is presented in the report as that basis for the analysis.

The report is organized to sequentially address each study task. However, discussions of the study tasks included in the scope of work are preceded by a description of the study area, identification of sub-regions and socio-economic indicators for each village. The information developed during the study is presented on a sub-regional basis because the various activities that the study addresses are impacted differently by the existing waterborne commerce system that serves the study area. The study area was divided into sub-regions on the basis of commonality of geographic area, e.g. coastal and river, and their proximity to existing and potential new regional ports. The information included in the report is presented on the basis of the sub-regions and communities. Construction plans of the health, education and transportation agencies and contractors are addressed in a single section but the remaining tasks are addressed in separate sections.

4.0 Study Area

The study area extends from Goodnews Bay to the south to Saint Michael to the north and up the Kuskokwim and Yukon Rivers to Nikolai and Holy Cross, respectively. The present economic center for much of the region is Bethel, located at the mouth of the Kuskokwim River 40 miles inland from the Bering Sea. Nome, located on the Seward Peninsula to the north of the study area, and Nenana, located on the Tanana River to the east of the study area, are also important as transshipment points for fuel and general cargo to some communities in the region. Although there is currently some uncertainty as to whether inland communities located along the Kuskokwim and Yukon Rivers and their tributaries that receive fuel and general cargo from the coast should be included, the study has been defined to include all of the villages from Goodnews to Saint Michael along the coast and up the Kuskokwim and Yukon Rivers. The reason for including the villages located on the rivers is that they either currently receive freight and fuel shipments or could receive them from coastal ports. Thus, information for 50 communities was obtained and evaluated for the study. A list of the communities, including their location and points-of-contact is shown in Appendix A.

5.0 Sub-Regional Divisions

To facilitate the analysis and to add clarity to the results, the study area was divided into seven sub-regions based on commonality of location and principle origin of fuel and freight shipments. The sub-regions, beginning at the southern limit of the study area and continuing toward the northern limit are as follows:

- Coast North to Kuskokwim River—Three villages
- Kuskokwim River, Mouth to Bethel—Seven villages
- Bethel—The community of Bethel
- Kuskokwim River, Bethel to Nikolai—Fourteen villages
- Coast & Yukon Mouth--Kuskokwim River to Emmonak—Fifteen villages
- Coast & Yukon Mouth-- Kotlik to Saint Michael—Three villages
- Yukon River, Mountain to Holy Cross—Seven villages

6.0 Sub-Regional and Community Socio-Economic Indicators

Selected socio-economic data are presented to establish a basis for determining the best location for a regional port, developing estimates of fuel and freight shipments and developing estimates of potential national economic development benefits. The information was taken primarily from the Alaska Community Database, Alaska Department of Community and Economic Development. The data was extracted from the database during November 2000. The database was last updated in October 2000. According to this data, the study area as a whole had an estimated population of 25,563 in 1999, with Bethel, the economic hub of the region, accounting for about 21 percent of the total.

6.1 Coast, North to Kuskokwim River

The sub-region, Coast, North to Kuskokwim River, extends from Goodnews Bay to the south to the Kuskokwim River to the north and includes the communities of Goodnews Bay, Platinum and Quinhagak. The sub-region extends a total of about 69 miles from village to village and had a population of 894 in 1999, about 3 percent of the total population of the study area. From 1970 through 1999 the sub-region had an annual population growth rate of about 2.8 percent. Fishing is an important economic activity with an estimated 144 residents holding commercial fishing permits, primarily for salmon and herring roe. Assuming there is one permit per household, about 67 percent of the households engage in commercial fishing, compared with about 38 percent for the study area. Socio-economic data for the sub-region and its communities are shown in Table 1.

Table 1. Socio-Economic Indicators, Coast North to Kuskokwim River

Village	Population				Growth	*Housing Units (no.)*			Employ-	Com Fish
	1999 1/	1990	1980	1970	Rate 2/	Occupied	Vacant	Total	Ment 4/	Permits
Goodnews Bay 3/	256	241	168	0	2.1%	66	6	72	66	42
Platinum	43	64	55	55	-0.8%	22	23	45	23	7
Quinhagak	595	501	412	340	1.9%	127	9	136	128	95
Totals	894	806	635	395	2.8%	215	38	253	217	144

Source: Alaska Community Database, Alaska Department of Community and Economic Development.
1/ Estimate made by the State, certified or not. All other data are from the 1990 US Census.
2/ Population growth rate, 1970 – 1999.
3/ Population growth rate, 1980 – 1999.
4/ Number of jobs.

6.2 Kuskokwim River, Mouth to Bethel

The sub-region, Kuskokwim River, Mouth to Bethel, extends from Kuskokwim Bay upriver to, but not including Bethel. Communities included in this sub-region are Eek, Tuntutuliak, Napakiak, Napaskiak and Oscarville. The sub-region extends a total of about 108 miles from village to village and had a population of 2,463 in 1999. This represents an annual growth rate of about 1.3 percent since1970. Fishing is an important economic activity with an estimated 275 residents holding commercial fishing permits, primarily for salmon and herring roe. Assuming there is one permit per household, about 56 percent of the households engage in commercial

fishing, compared with about 38 percent for the study area. Socio-economic data for the sub-region and its communities are shown in Table 2.

Table 2. Socio-Economic Indicators, Kuskokwim River, Mouth to Bethel

Village	*Population*				Growth	Housing Units (no.)			Employ-	Com Fish
	1999 1/	1990	1980	1970	Rate 2/	Occupied	Vacant	Total	ment 5/	Permits
Eek	281	254	228	186	1.4%	72	8	80	63	45
Tuntutuliak	350	300	216	158	2.7%	70	6	76	75	47
Nunapitchuk	471	378	299	526	-0.4%	87	10	97	100	51
Kasigluk	528	425	342	293	2.0%	89	16	105	88	46
Napakiak 4/	363	318	262	226	1.6%	81	24	105	82	44
Napaskiak	406	328	244	259	1.5%	74	25	99	70	41
Oscarville	64	57	56	41	1.5%	15	6	21	11	1
Totals	2,463	2,060	1,647	1,689	1.3%	488	95	583	489	275

Source: Alaska Community Database, Alaska Department of Community and Economic Development.
1/ Estimate made by the State—certified or not. All other data are from the 1990 US Census.
2/ Population growth rate, 1970 – 1999.
4/ 1970 population is estimated as the mean of the population of 1960 and 1980.
5/ Number of jobs.

6.3 Bethel

Bethel is the economic hub of the region and dominates it in terms of population and economic activity. In addition, it is the principle port from which fuel and water-borne freight are transshipped to most of the other communities in the region. The most significant exception is the communities of Stebbins and Saint Michael, located on the south side of Norton Sound and the communities along the Yukon River from Kotlik to Holy Cross. In 1999, Bethel had an estimated population of 5,471. Since 1970, population has grown at an annual rate of about 2.8 percent. While commercial fishing is an important economic activity, it is much less significant than in the other communities, with only an estimated 205 residents holding commercial fishing permits, primarily for salmon and herring roe. Assuming there is one permit per household, only about 14 percent of the households engage in commercial fishing, compared with about 38 percent for the study area. Socio-economic data for Bethel are shown in Table 3.

Table 3. Socio-Economic Indicators, Bethel

Village	*Population*				Growth	Housing Units (no.)			Employ-	Com Fish
	1999 1/	1990	1980	1970	Rate 2/	Occupied	Vacant	Total	Ment 3/	Permits
Bethel	5,471	4,674	3,576	2,416	2.8%	1,432	192	1,624	2,021	205

Source: Alaska Community Database, Alaska Department of Community and Economic Development.
1/ Estimate made by the State—certified or not. All other data are from the 1990 US Census.
2/ Population growth rate, 1970 – 1999.
3/ Number of jobs.

6.4 Kuskokwim River, Bethel to Nikolai

The sub-region upstream from Bethel on the Kuskokwim River includes 14 communities: Kwethluk, Akiachak, Akiak, Tuluksak, Lower Kalskag, Upper Kalskag, Aniak, Napaimiut, Crooked Creek, Red Devil, Sleetmute, Stony River, McGrath and Nikolai. The sub-region extends a total of about 470 miles from village to village and had a population of 4,077 in 1999. Since1970, population has grown at an annual rate of about 1.9 percent. Commercial fishing, primarily for salmon, is an important economic activity in the lower portion of the sub-region. An estimated 215 residents hold commercial fishing permits. Assuming there is one permit per household, about 22 percent of the households engage in commercial fishing, compared with about 38 percent for the study area. Socio-economic data for the Kuskokwim River, Bethel to Nikolai sub-region is shown in Table 4.

Table 4. Socio-Economic Indicators, Kuskokwim River, Bethel to Nikolai

Village	Population				Growth	Housing Units (no.)			Employ-	Com Fish
	1999 1/	1990	1980	1970	Rate 2/	Occupied	Vacant	Total	ment 3/	Permits
Kwethluk	714	558	454	408	1.9%	127	11	138	92	61
Akiachak	560	481	438	312	2.0%	112	17	129	141	73
Akiak	338	285	198	171	2.3%	67	13	80	64	27
Tuluksak	443	358	236	195	2.8%	74	16	90	90	29
Lower Kalskag	310	291	246	183	1.8%	67	6	73	36	7
Upper Kalskag	261	172	129	122	2.6%	48	3	51	35	3
Aniak	604	540	341	205	3.7%	159	16	175	215	14
Napaimiut	4	3	4	0	0.0%	9	1	10	0	0
Crooked Creek	137	106	108	59	1.2%	33	16	49	24	0
Red Devil	44	53	31	81	1.8%	18	6	24	12	0
Sleetmute	103	106	107	109	-0.2%	33	5	38	27	1
Stony River	35	51	62	74	-2.8%	19	8	27	11	0
McGrath	423	528	355	279	0.9%	175	32	207	219	0
Nikolai	101	109	91	112	0.5%	40	3	43	20	0
Totals	4,077	3,641	2,800	2,310	1.9%	981	153	1,134	986	215

Source: Alaska Community Database, Alaska Department of Community and Economic Development.
1/ Estimate made by the State—certified or not. All other data are from the 1990 US Census.
2/ Population growth rate, 1970 – 1999.
3/ Number of jobs.

6.5 Coast & Yukon Mouth, Kuskokwim River to Emmonak

The Coast and Yukon River Mouth—Kuskokwim River to Emmonak sub-region extends north along the coast from the mouth of the Kuskokwim River to the village of Emmonak on the central discharge channel of the Yukon River and includes Mekoryuk on Nunivak Island. The sub-region includes 15 communities: Kongiganak, Kwigillingok, Kipnuk, Chefornak, Toksook Bay, Nightmute, Tununak, Mekoryuk, Newtok, Hooper Bay, Chevak, Scammon Bay, Nunam Iqua, Alakanuk and Emmonak. The sub-region extends a total of about 470 miles from village to village and had an estimated population of 7,192 in 1999. Since1970 population has grown at an annual rate of about 2.2 percent. Commercial fishing, primarily for salmon, is an important economic activity with an estimated 816 residents holding commercial fishing permits. Assuming

there is one permit per household, about 62 percent of the households engage in commercial fishing, compared with about 38 percent for the study area. Socio-economic data for the Kuskokwim River to Emmonak sub-region is shown in Table 5.

Table 5. Socio-Economic Indicators, Kuskokwim River to Emmonak

Village	Population				Growth	Housing Units (no.)			Employ-	Com Fish
	1999 1/	1990	1980	1970	Rate 2/	Occupied	Vacant	Total	ment 3/	Permits
Kongiganak	359	294	239	190	2.1%	60	7	67	70	30
Kwigillingok	360	278	354	148	3.0%	62	16	78	77	39
Kipnuk	573	470	371	325	1.9%	99	29	128	61	150
Chefornak	416	320	230	146	3.6%	64	15	79	61	32
Toksook Bay	513	420	333	257	2.3%	88	15	103	106	89
Nightmute	230	153	119	127	2.0%	29	7	36	38	34
Tununak	331	316	298	274	0.6%	78	14	92	96	52
Mekoryuk	193	177	160	249	-0.8%	63	4	67	45	52
Newtok	284	207	131	114	3.1%	42	3	45	42	22
Hooper Bay	1028	845	627	490	2.5%	190	13	203	158	47
Chevak	763	598	466	387	2.3%	147	17	164	154	17
Scammon Bay	484	343	250	166	3.6%	85	14	99	73	48
Nunam Iqua	181	119	103	125	1.2%	27	6	33	40	25
Alakanuk	659	544	522	265	3.1%	121	19	140	121	77
Emmonak	818	642	567	439	2.1%	161	11	172	140	102
Totals	7,192	5,726	4,770	3,702	2.2%	1,316	190	1,506	1,282	816

Source: Alaska Community Database, Alaska Department of Community and Economic Development.
1/ Estimate made by the State—certified or not. All other data are from the 1990 US Census.
2/ Population growth rate, 1970 – 1999.
3/ Number of jobs.

6.6 Coast & Yukon Mouth, Kotlik to Saint Michael

The Coast and Yukon Mouth—Kotlik to Saint Michael sub-region is located on Norton Sound and is relatively economically unrelated to the other sub-regions of the study area, as the economic hub of the area appears to be Nome rather than Bethel. The sub-region consists of just three communities—Kotlik, Stebbins and Saint Michael. The sub-region is small and extends a total of only about 60 miles from village to village. The estimated population for the sub-region in 1999 was 1,503. Since1970, population has grown at an annual rate of about 2.8 percent. Commercial fishing, primarily for salmon, is an important economic activity with an estimated 108 residents holding commercial fishing permits. Assuming there is one permit per household, about 42 percent of the households engage in commercial fishing, compared with 38 percent for the study area. Socio-economic data for the Coast and Yukon Mouth—Kotlik to Saint Michael sub-region is shown in Table 6.

Table 6. Socio-Economic Indicators, Coast & Yukon Mouth—Kotlik to Saint Michael

Village	Population				Growth	Housing Units (no.)			Employ-	Com Fish
	1999 1/	1990	1980	1970	Rate 2/	Occupied	Vacant	Total	ment 3/	Permits
Kotlik	579	461	293	228	3.2%	101	8	109	94	80
Stebbins	543	400	331	231	2.9%	86	1	87	96	19
St. Michael	381	295	239	207	2.1%	69	9	78	74	9
Totals	1,503	1,156	863	666	2.8%	256	18	274	264	108

Source: Alaska Community Database, Alaska Department of Community and Economic Development.
1/ Estimate made by the State—certified or not. All other data are from the 1990 US Census.
2/ Population growth rate, 1970 – 1999.
3/ Number of jobs.

6.7 Yukon River to Holy Cross

The Yukon River to Holy Cross sub-region extends from Mountain Village on the Lower Yukon River to Holy Cross. As is the case with the Coast & Yukon Mouth—Kotlik to Saint Michael sub-region, this sub-region appears to be relatively unrelated economically to the rest of the study area, as commerce is primarily with Nenana or Nome, rather than Bethel. The sub-region consists of seven communities—Mountain Village, Pitkas Point, Saint Mary's/Andreafsky, Pilot Station, Marshall, Russian Mission and Holy Cross. The sub-region extends along the Yukon River for a distance of 210 miles from village to village. The estimated population for the sub-region in 1999 was 3,249. Since1970 population has grown at an annual rate of about 2.2 percent. Commercial fishing, primarily for salmon, is an important economic activity throughout the sub-region with an estimated 266 residents holding commercial fishing permits. Assuming there is one permit per household, about 43 percent of the households engage in commercial fishing, compared with 38 percent for study area. Socio-economic data for the Yukon River to Holy Cross sub-region is shown in Table 7.

Table 7. Socio-Economic Indicators, Yukon River to Holy Cross

Village	Population				Growth	Housing Units (no.)			Employ-	Com Fish
	1999 1/	1990	1980	1970	Rate 2/	Occupied	Vacant	Total	Ment 3/	Permits
Mountain Village	766	674	583	419	2.0%	148	43	191	140	94
Pitkas Point	146	135	88	70	2.5%	37	10	47	37	1
St. Mary's/ Andreafsky	917	851	489	384	2.9%	118	36	154	151	65
Pilot Station	544	463	325	290	2.1%	100	23	123	96	54
Marshall	318	273	262	175	2.0%	70	13	83	81	33
Russian Mission	311	246	169	146	2.6%	56	2	58	49	12
Holy Cross	247	277	241	199	0.7%	86	7	93	43	7
Totals	3,249	2,919	2,157	1,683	2.2%	615	134	749	597	266

Source: Alaska Community Database, Alaska Department of Community and Economic Development.
1/ Estimate made by the State—certified or not. All other data are from the 1990 US Census.
2/ Population growth rate, 1970 – 1999.
3/ Number of jobs.

7.0 Health, Education, Transportation and Other Construction Plans (Tasks 3.1 and 3.2)

7.1 Planned and Funded Construction Projects

7.1.1 Sources of Information

Because of the centralization of data on publicly funded construction projects in the study in a single database (see sources of information below), assessments of construction plans of health, education and transportation and other state and Federal agencies were combined into a single assessment. The sources of information used in the assessment included the central database and personal communication with representatives of state and Federal agencies.

The State Department of Community and Economic Development tracks public construction activity within the state through a database system called RAPIDS (Rural Alaska Project Identification and Delivery System). Although originally designed to track construction projects in rural communities, the database has since been expanded to include all Alaska communities. The system currently contains descriptions, funding levels and status information on over 8,000 capital projects. According the manager of the system, "RAPIDS is designed to encompass all capital projects, by any agency, state or federal, including entities like the Denali commission. Our participation rate is fairly good, so I would say RAPIDS includes "virtually" all capital projects underway or envisioned for a given community."[1] The primary source of information on the construction projects in the study area was RAPIDS. Agency representatives were contacted to confirm that their construction plans are included in RAPIDS and to obtain information on any projects that were not included. Interviews with agency representatives and representatives of the construction industry also obtained information about sources of sand, gravel and rock; logistical problems associated with the current waterborne commerce system; potential sites for a new regional port; and, potential benefits to a new regional port.

7.1.2 Planned and Funded Construction Projects

Through RAPIDS and with supplemental information obtained from agency representatives, a total of 170 construction projects with an estimated value of over $250 million were identified in the study area. The projects consist of buildings (new buildings and renovation of existing buildings), water and sewer systems, bulk fuel storage facilities, boardwalks, roads and airports. Projects identified and included in this report are those that are either funded or planned (RAPIDS also includes a large number of potential projects that have no estimated costs or implementation schedule). The implementation schedule for the projects extends from 2000 to 2006. Most of the projects in the system are those that are funded for implementation in 2000. This should not, however, be viewed as an indication of a decreasing construction workload following 2000. It is simply an indication that more information is known (and made public) about projects as they approach implementation. Construction plans for each sub-region are discussed and projects are identified in the following paragraphs.

[1] Email from Michael Cushing, Department of Community and Economic Development, dated 4 October 2000.

7.1.2.1 Coast—Goodnews Bay to Kuskokwim River

A total of six planned and funded construction projects were identified in the Coast—Goodnews Bay to Kuskokwim River sub-region with an estimated cost of nearly $3.5 million. The majority of planned and funded construction is for sewer system improvements. Construction projects that were identified are listed in Table 8.

Table 8. Construction Projects, 2000 and Beyond—Coast, Goodnews Bay to Kuskokwim River

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
Goodnews Bay	None	na	na	na	na
Platinum	Bulk fuel facilities	2000	AEA	Funded	25,000
	Bulk fuel facilities	2001	DCED	Funded	59,339
Quinhagak	Road construction	2000	DOT&PF	Funded	100,000
	Building design	2000	DCED	Funded	25,000
	Sewer system improvement	2000	DEC	Funded	1,950,000
	Sewer system improvement	2001	DEC	Funded	1,333,476
Total number of projects & cost		6			3,492,815

Source: Alaska Community Database (RAPIDS), Alaska Department of Community and Economic Development and agencies.
1/ Agencies that participate in RAPIDS are listed (along with agency abbreviations) in Appendix 1.

7.1.2.2 Kuskokwim River, Mouth to Bethel

A total of 24 planned and funded construction projects were identified in the Kuskokwim River—Mouth to Bethel sub-region with an estimated cost of over $22.6 million. Although transportation improvements constitute a significant portion of the construction work, improvements to other facilities constitute the majority of the work. Construction projects that were identified are listed in Table 9.

Table 9. Construction Projects, 2000 and Beyond--Kuskokwim River, Mouth to Bethel

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
Eek	Water & sewer improvements	2000	DEC	Funded	1,369,000
Tuntutuliak	Bulk fuel tank farm	2000	AEA	Funded	1,804,000
	Powerhouse upgrade	2001	AEA	Funded	1,180,500
	Flush-haul system improvements	2000	DEC	Funded	1,249,100
	Tank haul units	2001	DEC	Funded	517,600
	Road construction	2004	DOT&PF	Planned	150,000
	Road construction	2005	DOT&PF	Planned	850,000
Nunapitchuk	Boardwalk improvements	2000	DOT&PF	Funded	2,100,000
	Sewer system improvement	2000	DEC	Funded	950,000
	Sewer system improvement	2001	DEC	Funded	950,000
	Water system improvements	2001	DEC	Funded	800,000
	Road improvements	2006	DOT&PF	Planned	250,000
	Road improvements 6/	2000+	BIA	Planned	1,500,000

Table 9. Construction Projects, 2000 and Beyond--Kuskokwim River, Mouth to Bethel

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
Kasigluk	Boardwalk improvements	2000	DOT&PF	Funded	350,000
	Boardwalk improvements	2003	DOT&PF	Planned	1,300,000
Napakiak	Washateria upgrade	2000	DEC	Funded	1,249,100
	Sewer system improvements	2001	DEC	Funded	517,600
	Road improvements	2004	DOT&PF	Planned	150,000
	Road construction	2005	DOT&PF	Planned	850,000
Napaskiak	Bulk fuel facilities	2000	AEA	Funded	1,406,164
	Housing improvements	2000	DEC	Funded	1,000,000
	Bulk fuel consolidation	1999	Denali	Planned	700,000
	Boardwalk improvements	2003	DOT&PF	Planned	200,000
	Boardwalk improvements	2004	DOT&PF	Planned	1,210,000
Oscarville	None	na	na	na	na
Total number of projects & cost		24			22,603,064

Source: Alaska Community Database (RAPIDS), Alaska Department of Community and Economic Development and agencies.
1/ Agencies that participate in RAPIDS are listed (along with agency abbreviations) in Appendix 1.

7.1.2.3 Bethel

A total of 14 planned and funded construction projects were identified for the Bethel sub-region with an estimated cost of over $33.5 million. The majority of the projects are for road improvements. Construction projects that were identified are listed in Table 10.

Table 10. Construction Projects, 2000 and Beyond—Bethel

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
Bethel	Road improvements	2000	DOT&PF	Funded	150,000
	Airport improvements	2000	DOT&PF	Funded	1,000,000
	Boardwalk improvements	2000	DOT&PF	Funded	750,000
	Building renovation	2000	DCED	Funded	112,700
	Water & sewer improvements	2000	DEC	Funded	3,000,000
	Navigation improvements	2001	COE	Planned	225,000
	Road improvements	2001	DOT&PF	Planned	1,955,000
	Road improvements	2002	DOT&PF	Planned	500,000
	Road improvements	2002	DOT&PF	Planned	1,210,000
	Road improvements	2003	DOT&PF	Planned	4,315,000
	Road improvements	2004	DOT&PF	Planned	1,990,000
	Road improvements	2005	DOT&PF	Planned	9,360,000
	Regional medical clinic 2/	2001	YKHC	Funded	4,000,000
	Medical staff quarters 2/	2001	YKHC	Funded	5,000,000
Total number of projects & cost		14			33,567,700

Source: Alaska Community Database (RAPIDS), AK Dept. of Community and Economic Development & agencies.
1/ Agencies that participate in RAPIDS are listed (along with agency abbreviations) in Appendix 1.
2/ Information obtained from the agency.

7.1.2.4 Kuskokwim River, Bethel to Nikolai

A total of 39 planned and funded construction projects were identified in the Kuskokwim River—Bethel to Nikolai sub-region with an estimated cost of over $22.9 million. Construction projects will provide for significant improvements to transportation, sewer and water systems and other facilities, with transportation projects being the most significant in terms of costs. Construction projects that were identified are listed in Table 11.

Table 11. Construction Projects, 2000 and Beyond--Kuskokwim River, Bethel to Nicholai

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
Kwethluk	Playground improvements	2000	DCED	Funded	25,000
	Road improvements	2000	DOT&PF	Funded	200,000
	Airport relocation	2000	DOT&PF	Funded	4,500,000
	Road improvements 2/	2000+	BIA	Planned	1,500,000
Akiachak	Road improvements	2000	DOT&PF	Funded	450,000
	Trash bin construction	2000	DCED	Funded	26,369
	Water & sewer improvements	2000	DEC	Funded	2,000,000
Akiak	Sewer system improvement	2000	DEC	Funded	978,000
Tuluksak	None	na	na	na	na
Lower Kalskag	Water system improvements	2000	DCED	Funded	25,196
	Bulk fuel facilities	2000	AEA	Funded	1,026,500
	Water & sewer improvements	2000	DEC	Funded	150,000
	Medical clinic 2/	2000	YKHC	Funded	415,000
Upper Kalskag	Bulk fuel facilities	2000	AEA	Funded	796,500
	Road improvements	2004	DOT&PF	Planned	30,000
	Road improvements	2005	DOT&PF	Planned	300,000
Aniak	Road improvements	2005	DOT&PF	Planned	50,000
Napaimiut	None	na	na	na	-
Crooked Creek	Roads	2000	DOT&PF	Funded	500,000
	Fire-hall building	2000	DCED	Funded	26,314
	Bulk fuel facilities	2000	AEA	Funded	600,000
	Water & sewer improvements	2000	DEC	Funded	75,000
	Erosion repair	2001	DCED	Funded	26,138
	Housing improvements	1999+	HUD/CGP	Planned	225,000
	Medical clinic 2/	2000	YKHC	Funded	335,000
Red Devil	Bulk fuel facilities	2000	AEA	Funded	622,727
	Multiple purpose building	2000	DCED	Funded	26,351
	Community facilities	2001	DCED	Funded	26,317
Sleetmute	Building improvements	2000	DCED	Funded	28,853
	Bulk fuel facilities	2000	AEA	Funded	25,000
	Building improvements	2001	DCED	Funded	26,136
Stony River	None	na	na	na	-
McGrath	Water plant upgrade	2000	DCED	Funded	25,000
	Airport improvements	2000	DOT&PF	Funded	1,000,000
	Water system improvements	2000	DCED	Funded	23,122
	Water system improvements	2000	DEC	Funded	192,500
	Water system improvements	2001	DCED	Funded	26,316

Table 11. Construction Projects, 2000 and Beyond--Kuskokwim River, Bethel to Nicholai

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
	Road improvements	2005	DOT&PF	Planned	106,000
	Road improvements	2006	DOT&PF	Planned	1,367,000
Nikolai	Airport improvements	2000	DOT&PF	Funded	4,500,000
	Bulk fuel facilities	2000	AEA	Funded	622,727
	Bulk fuel & generator	2201	DCED	Funded	26,316
Total number of projects & cost		39			22,904,382

Source: Alaska Community Database (RAPIDS), Alaska Department of Community and Economic Development and agencies.
1/ Agencies that participate in RAPIDS are listed (along with agency abbreviations) in Appendix 1.
2/ Information obtained from the agency.

7.1.2.5 Coast & Yukon Mouth—Kuskokwim River to Emmonak

A total of 52 planned and funded construction projects were identified in the Coast & Yukon Mouth—Kuskokwim River to Emmonak sub-region with an estimated cost of over $128.3 million. Construction projects will provide for significant improvements to transportation, sewer and water systems and other facilities, with transportation projects being the most significant in terms of costs. Construction projects that were identified are listed in Table 12.

Table 12. Construction Projects, 2000 and Beyond, Coast & Yukon Mouth—Kuskokwim River to Emmonak

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
Kongiganak	Boardwalk improvements	2000	DCED	Funded	26,700
	Bulk fuel facilities	2000	AEA	Funded	1,600,000
	Washateria	2000	DEC	Funded	1,300,000
	Road improvements 2/	2000+	BIA	Planned	1,500,000
Kwigillingok	Clinic building	2000	DCED	Funded	26,340
	Boardwalk improvements	2005	DOT&PF	Planned	100,000
	Medical clinic 2/	2000	YKHC	Funded	415,000
Kipnuk	Airport improvements	2000	DOT&PF	Funded	4,560,000
	Road improvements	2000	DCED	Funded	26,340
	Washateria, waste disposal	2000	DEC	Funded	1,832,000
	Boardwalk improvements	2002	DOT&PF	Planned	50,000
	Boardwalk improvements	2003	DOT&PF	Planned	2,900,000
Chefornak	Airport improvements	2000	DOT&PF	Funded	5,300,000
	Boardwalk improvements	2000	DOT&PF	Funded	2,200,000
Toksook Bay	Seawall construction	2000	DCED	Funded	25,000
	Airport improvements	2000	DOT&PF	Funded	5,000,000
	Bulk fuel facilities	2000	AEA	Funded	1,800,000
	Sub-regional medical clinic 2/	2003	YKHC	Planned	4,200,000
Nightmute	Airport improvements	2000	DOT&PF	Funded	6,400,000
	Medical clinic 2/	2001	YKHC	Funded	415,000
Tununak	Airport improvements	2000	DOT&PF	Funded	900,000

Table 12. Construction Projects, 2000 and Beyond, Coast & Yukon Mouth—Kuskokwim River to Emmonak

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
	Sewer system improvement	2000	DEC	Funded	815,000
	Washeteria, etc.	2001	DEC	Funded	834,388
	Road improvements 2/	2000+	BIA	Planned	1,500,000
Mekoryuk	None	na	na	na	na
Newtok	Community hall improvements	2000	DCED	Funded	26,316
	Sewer system improvement	2000	DEC	Funded	275,000
	Electrial system upgrades	2000	AEA	Funded	405,000
	Boardwalk improvements	2001	DCED	Funded	27,789
Hooper Bay	Water & sewer improvements	2001	DEC	Funded	2,450,000
	School renovation/addition 2/	2003	LYSD	Planned	21,000,000
Chevak	Water & sewer improvements	2000	DEC	Funded	3,400,000
	Building improvements	2001	DCED	Funded	52,632
Scammon Bay	Building improvements	2000	DCED	Funded	25,000
	Sewer system improvement	2001	DCED	Funded	28,145
	School renovation/addition 2/	2002	LYSD	Planned	16,000,000
	Portable classroom 2/	2001	LYSD	Planned	500,000
Nunam Iqua 5/	Building improvements	2000	DCED	Funded	10,000
	Sewer & solid waste improvements	2000	DCED	Funded	15,000
	Utilities improvements	2000	DEC	Funded	1,311,500
	Water & sewer improvements	2000	DCED	Funded	26,313
	School renovation/addition 2/	2002	LYSD	Planned	8,000,000
Alakanuk	Airport improvements	2000	DOT&PF	Funded	7,000,000
	Medical clinic 2/	2000	YKHC	Funded	350,000
	Heating/elec sys upgrade 2/	2003	LYSD	Planned	1,000,000
Emmonak	Airport improvements	2000	DOT&PF	Funded	6,000,000
	Bulk fuel facilities	2000	AEA	Funded	2,240,000
	Road improvements	2002	DOT&PF	Planned	175,000
	Road improvements	2003	DOT&PF	Planned	134,000
	Road improvements	2004	DOT&PF	Planned	1,370,000
	School renovation/addition 2/	2004	LYSD	Planned	12,000,000
	Mechanical/elec sys upgrade 2/	2004	LYSD	Planned	750,000
Total number of projects & cost		52			128,297,463

Source: Alaska Community Database (RAPIDS), Alaska Department of Community and Economic Development and agencies.
1/ Agencies that participate in RAPIDS are listed (along with agency abbreviations) in Appendix 1.
2/ Information obtained from the agency.

7.1.2.6 Coast & Yukon Mouth—Kotlik to Saint Michael

A total of 13 planned and funded construction projects were identified in the Coast & Yukon Mouth—Kotlik to Saint Michael sub-region with an estimated cost of over$24.9 million. Construction projects will provide for significant improvements to bulk fuel storage and sewer

and water facilities in Kotlik, housing and other building improvements in Stebbins and road improvements in Saint Michael. Construction projects that were identified are listed in Table 13.

Table 13. Construction Projects, 2000 and Beyond, Coast & Yukon Mouth—Kuskokwim River to Emmonak

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
Kotlik	Erosion control	2000	DCED	Funded	25,000
	Water & PH upgrades	2000	AEA	Funded	850,000
	Bulk fuel facilities	2000	AEA	Funded	2,100,000
	Sewer & water improvements	2001	DEC	Funded	1,396,000
	Sidewalk repair	2001	DCED	Funded	10,526
	New school 2/	2001	LYSD	Funded	17,000,000
Stebbins	Road improvements	2000	DCED	Funded	25,000
	Bulk fuel facilities	2000	AEA	Funded	25,000
	Community facilities	2001	DCED	Funded	26,326
St. Michael	Building improvements	2000	DCED	Funded	25,000
	Housing improvements	2001	AHFC	Funded	1,915,201
	Building improvements	2001	DCED	Funded	26,316
	Road 2/	2000+	BIA	Planned	1,500,000
Total number of projects & cost		13			24,924,369

Source: Alaska Community Database (RAPIDS), Alaska Department of Community and Economic Development and agencies.
1/ Agencies that participate in RAPIDS are listed (along with agency abbreviations) in Appendix 1.
2/ Information obtained from the agency.

7.1.2.7 Yukon River, Mountain Village to Holy Cross

A total of 12 planned and funded construction projects were identified in the Coast & Yukon Mouth—Kotlik to Saint Michael sub-region with an estimated cost of over$7.9 million. Construction projects will provide for significant improvements to bulk fuel storage and sewer and water facilities in Kotlik, housing and other building improvements in Stebbins and road improvements in Saint Michael. Construction projects that were identified are listed in Table 14.

Table 14. Construction Projects, 2000 and Beyond, Yukon River, Mountain Village to Holy Cross

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
Mountain Village	Building improvements	2000	DCED	Funded	25,000
	Building improvements	2001	DCED	Funded	26,316
	Road improvements	2003	DOT&PF	Planned	365,000
	Road improvements	2004	DOT&PF	Planned	200,000
	Road improvements	2005	DOT&PF	Planned	3,000,000
Pitkas Point	Building improvements	2000	DCED	Funded	26,352
St. Mary's/Andreafsky	Building improvements	2000	DCED	Funded	25,000
	Sewer system improvement	2000	DEC	Funded	152,000
	Building improvements	2001	DCED	Funded	26,316
	Road improvements	2003	DOT&PF	Planned	3,200,000

Table 14. Construction Projects, 2000 and Beyond, Yukon River, Mountain Village to Holy Cross

Village	Description	Fiscal Year	Lead Agency 1/	Status	Cost
Pilot Station	Water & sewer improvements	2000	DEC	Funded	1,351,000
	Water & sewer improvements	2001	DEC	Funded	1,443,052
Marshall	Building improvements	2000	DCED	Funded	25,000
	Water & sewer improvements	2001	DEC	Funded	1,000,000
Russian Mission	Road improvements	2000	DCED	Funded	25,259
	Airport improvements	2000	DOT&PF	Funded	2,300,000
	Building improvements	2001	DCED	Funded	15,789
	Road improvements	2002	DOT&PF	Planned	50,000
	Road improvements	2003	DOT&PF	Planned	420,000
Holy Cross	Building improvements	2000	DOT&PF	Funded	650,000
	Building improvements	2000	DCED	Funded	28,399
	Medical clinic 2/	2000	YKHC	Funded	350,000
Total number of projects & cost		22			14,704,483

Source: Alaska Community Database (RAPIDS), Alaska Department of Community and Economic Development and agencies.
1/ Agencies that participate in RAPIDS are listed (along with agency abbreviations) in Appendix 1.
2/ Information obtained from the agency.

7.2 Sources of Sand, Gravel and Rock

In general, sand, gravel and rock needed for construction projects are available from sources within the study area. Calista, the native regional corporation, owns essentially all of the land in the study area that is outside the boundaries of the native village corporations. At present, there are a number of extraction sites that are available for use for projects within the study area. Knik Construction Company of Seattle operates all of the existing sites in a joint venture with Calista, except the gravel operation at Saint Mary's. In terms of quality, rock from Nome is the best in the region; rock from Goodnews Bay is high and is generally acceptable for all State projects but not for Corps of Engineers projects; rock from Kalskag and Saint Mary's is of average quality but is usually allowed on State projects. Rock from Dillingham, Saint Paul and Saint George is also acceptable for most projects. Existing and potential sources of sand, gravel and rock in the study area are listed in Table 15.

Table 15. Existing and Potential Sources of Sand, Gravel and Rock

Source/Sub-Region	Sand	Gravel	Rock
Existing Sources in the Study Area			
Goodnews Bay/Coast—Goodnews Bay to Kuskokwim River			X
Platinum/Coast—Goodnews Bay to Kuskokwim River		X	
Bethel/Bethel	X		
Kalskag/Kuskokwim River—Bethel to Nikolai			X
Aniak/Kuskokwim River, Bethel to Nikolai	X	X	
Saint Mary's/Yukon River—Mountain Village to Holy Cross		X	
Existing Sources Outside the Study Area			
Nome	X	X	X
Dillingham	X	X	X
Saint Paul			X
Saint George			X

Potential Sources			
Mekoryuk	X		X
Hooper Bay	X		

7.3 Most Likely Sources of Sand, Gravel and Rock for Future Construction Projects

Existing sources have substantial reserves that are more than adequate to meet the region's needs for the foreseeable future.[2] This conclusion differs from that contained in a report, "Mekoryuk Port Pre-Feasibility Study and Development Plan," which states "…in the area between Platinum (to the south) and Nome (to the north), four quarries (excluding Mekoryuk) were estimated as capable of partially supplying the gravel, rock and sand needs in the region." On the basis of current information and the assessment that resources are adequate to meet the region's future needs, the most likely sources of materials for projects within each of the sub-regions were identified. The findings of this assessment are shown in Table 16.

Table 16. Most Likely Sources of Sand, Gravel and Rock for Future Construction Projects

	Most Likely Source		
Sub-Region	**Sand**	**Gravel**	**Rock**
Coast--Goodnews Bay to Kuskokwim River	Bethel	Platinum	Goodnews B.
Kuskokwim River, Mouth to Bethel	Bethel	Aniak	Kalskag
Bethel	Bethel	Aniak	Kalskag
Kuskokwim River, Bethel to Nikolai	Aniak	Aniak	Kalskag
Coast & Yukon Mouth--Kuskokwim River to Emmonak 1/	Bethel	Platinum	Goodnews B.
Coast & Yukon Mouth--Kuskokwim River to Emmonak 2/	Local	Nome	Nome
Coast & Yukon Mouth--Kotlik to St. Michael	Local	Local	Nome
Yukon River--Mountain Village to Holy Cross	Local	Local	St. Mary's/local

Notes:
1/ From Scammon Bay south.
2/ North of Scammon Bay.

7.4 Sand, Gravel and Rock Transportation Practices, Problems, and Potential Benefits

Kink Construction Company transports sand, gravel and rock with equipment designed to for the conditions that exist in western Alaska. This means that the company has large equipment where water depths are not restrictive and smaller equipment that can be used in shallow water locations. Frequently, both large and small equipment is used in tandem to make deliveries of materials. The type of equipment used and its capacity are shown in Table 17.

Table 17. Sand, Gravel, and Rock Transport Equipment

Equipment	Draft	Tonnage Capacity
Large		
Tug	8	Not applicable
Barge (8 to 14 feet of draft)	14	4,500
	12	3,750
	10	3,000
	8	2,500
Small		
Tug	3	Not applicable
Barge (down to 3 feet of draft)	4	400
	3	300

Except at Platinum, where gravel is loaded with a conveyor system, materials are loaded using earth moving equipment and ramps from the barge to shore. Materials are off-loaded at sites with

[2] Telephone conversation with Steve Jansen, Knik Construction Co., Seattle, 1 November 2000.

adequate water depth in the same manner. To off-load materials at locations where water depths are expected to be less than eight feet, large and small tug and barge equipment is operated in tandem, with the large tug and barge transporting the materials and towing the small tug and barge as far as water depths will allow. At that point the smaller equipment is used to transship the materials to the site. To off-load the materials onshore, the barge is pushed as close to the bank as possible and ramps are placed from the barge to the shore. At coastal sites where tide is a factor, if the barge cannot be moved close enough to shore to off-load to dry ground, the barge is pushed in as far as possible during high tide and then is off-loaded in the dry at low tide.

Construction of a new regional port would not reduce transportation costs for sand, gravel and rock, as there are no regional-port related problems associated with transport of these materials. Further, development of a quarry at Mekoryuk would be done in competition with existing quarries. The only comparative advantage that a quarry at Mekoryuk would have would be its proximity to some locations. This finding agrees with the finding reported in the Mekoryuk Port Pre-Feasibility Study. The potential magnitude of these transportation cost savings are discussed in the section of this report entitled, Summary of Potential NED Benefits.

7.5 Regional Demand for Sand, Gravel and Rock

The largest component of demand for sand, gravel and rock is construction of airport and road improvements. Based on an assessment of the Alaska Department of Transportation and Public Facilities' draft Statewide Transportation Improvement Program and Alaska Airport Improvement Program, the Mekoryuk Port Study concluded that annual demand would average about 20,000 tons per village for the 11 communities where Mekoryuk might have a comparative transportation advantage. Analysis of data obtained for this study from RAPIDS and other sources indicates that this estimate is probably too high, largely because road and airport improvements are not made on an annual basis at any one village. Estimates developed in the Mekoryuk Port Study were made on the basis of assumptions that the typical airport and road projects require 17,500 tons and 6,000 tons of "aggregate," respectively. Analyses done for this study indicate that the typical airport project requires only about 12,000 tons of surfacing material. This estimate is, as are the estimates made in the Mekoryuk Port Study, based on the use of transported materials only for surfacing, with the sub-grade being constructed of local materials. Airport runways are currently typically being built to a length of 3,400 feet with a landing surface of crushed rock of 75 feet in width. The thickness of the landing surface varies from 9 to 18 inches but averages about 10 inches. Estimates of crushed rock requirements for airports were developed for this study on the basis of the following specific assumptions:

- Over the next 10 years all gravel runways that are less than 3,000 feet in length will be lengthened to 3,400 feet
- Local materials will be used for the sub-grade
- Crushed rock will be used for the landing surface
- The landing surface will be 75 feet in width
- The surfacing rock will be placed to an average depth of 10 inches
- Maintenance of both gravel and asphalt runways will require resurfacing with crushed rock to a depth of four inches once every 10 years
- Airports will not be constructed at the four villages that currently do not have an airport because these villages are all located near village with existing airports (These villages, followed by the location of the nearby airport, are as follows; Oscarville/Bethel, Napaimiute/Chuathbaluk, Pitka's Point/Saint Mary's and Kwigillingok/Kongignak.)

The result of these estimates is that throughout the study area, on average, there will be about eight airport expansion or maintenance projects (about three expansion and five maintenance projects annually). This number could actually decrease following completion of the lengthening of existing runways to 3,400 feet. However, average annual demand for crushed rock was not reduced to account for this. This is something that would need to be considered if more detailed studies of port development in the study area are undertaken.

The only information available about road construction and maintenance that was available for this study was the number of projects currently included in RAPIDS (38) and the cost of these projects ($41.3 million). To arrive at an estimate of the demand for crushed rock for roadwork for this study, the following assumption was made: the percent of the cost of crushed rock for a road project is the same as it is for an airport project.

On the basis of this assumption, the quantity of rock for a road project is simply the ratio of the cost of a road project to the cost of an airport project times the quantity of rock required for the airport project. The estimate of demand for crushed rock for road projects was made on the basis of the average cost and quantities for all airport projects in RAPIDS (12) and the average cost of all road projects (38). This analysis resulted in a finding that the average road project costs about 30 percent as much as the average airport project. Thus, for this study, the demand for crushed rock for roads is estimated to be 30 percent of the estimated demand for airport projects for the study area as a whole.

To estimate the crushed rock demand for roads for each sub-region, the total demand was allocated to the sub-regions on the basis of population. In the absence of data to support an analysis of the demand for sand, gravel and rock for other uses, this demand was estimated to be equal to the demand for road construction. The resulting estimates of demand for each sub-region for airport, road and other projects are shown in Table 18.

Table 18. Estimated Demand for Sand, Gravel and Rock

Sub-Region	Airport	Roads	Other	Total
Coast--Goodnews Bay to Kuskokwim River	3,800	700	700	5,200
Kuskokwim River, Mouth to Bethel	9,900	1,800	1,800	13,500
Bethel	900	4,100	4,100	9,100
Kuskokwim River, Bethel to Nikolai	16,300	3,000	3,000	22,300
Coast & Yukon Mouth--Kuskokwim R. to Emmonak	19,700	5,300	5,300	30,300
Coast & Yukon Mouth--Kotlik to St. Michael	2,600	1,100	1,100	4,800
Yukon River, Mountain Village to Holy Cross	8,000	2,400	2,400	12,800
Totals	61,200	18,400	18,400	98,000

7.6 Navigation Problems and Needed Improvements

7.6.1 Navigation Problems

Materials for construction of projects on the Yukon River would come from Saint Mary's or other sources upstream, depending on the location of the job. All of the villages around Norton Sound have local sources of materials. On the basis of cost and other information obtained from a representative of Knik Construction and other sources, materials for projects on the Kuskokwim above Bethel would come from Kalskag; materials for projects from Goodnews Bay to about

Scammon Bay would most likely come from Platinum/Goodnews Bay; and, materials for projects north of Scammon Bay would come from Nome. There are no significant navigation problems associated with any of these sources of materials. At Platinum, gravel is loaded using a conveyor system. At the other coastal sites (Goodnews Bay and Nome--includes Cape Nome) the water is deep enough to allow the ocean barges to get close enough to shore to load form shore using ramps. Although docking facilities at the sites on the Yukon and Kuskokwim Rivers would be nice to have, river barges can be loaded from shore at each of the sites with use of ramps.

The only problem that the representative of Kink Construction reported encountering is the relatively shallow depth of water over the Johnson Bar or Oscarville Crossing on the Kuskokwim River. The bar is located at the confluence of the Johnson and Kuskokwim Rivers about six miles downstream from Bethel. During low water conditions, typically late in the season as temperatures cool and the melt rate of glaciers that feed the river decrease, the depth of water over the bar is reduced to about 12 feet. It is not uncommon for barges to go aground on the bar but doing so is not a significant problem because the bottom consists of soft material that does not cause any damages. Since ocean barges typically have a loaded draft of 14 feet, during low water conditions barges must be light-loaded going into Bethel or enough of the cargo must be lightered to reduce draft to the point where the bar can be crossed.

7.6.2 Need for a New Regional Port

According to a representative of Knik Construction, a new regional port is not needed for transporting sand, gravel and rock within the Yukon-Kuskokwim Delta region. Because sand, gravel and rock can be loaded directly from shore, using a port facility for loading the material would actually increase costs. A case in point is the fact that Kink Construction does not now use the port facilities in Bethel. However, a port would need to be constructed at Mekoryuk in order to export sand, gravel and rock from Nunivak Island because the depth of the water is not sufficient to allow ocean barges to be loaded from shore. According to a representative of Knik Construction, including the cost of a port in the cost of sand, gravel and rock that might be exported from Nunivak Island would make such exports uneconomical. In addition, Mekoryuk enjoys a transportation advantage with a relatively small portion of the region's population and, finally, adverse weather conditions around Nunivak Island are a significant impediment to ocean and lighterage barge operations.

7.6.3 Need for Other Navigation Improvements

The following navigation improvements that would benefit transport of sand, gravel and rock were identified:

- Construction of minimal docking facilities at communities along the Yukon and Kuskokwim Rivers—This would reduce the time required to dock and unload and would reduce damages to barge and unloading equipment.
- Dredging the Johnson Bar to a depth of about three feet for approximately one-half mile to maintain a minimum channel depth during the shipping season of 14 feet—This would reduce delays and eliminate the need for light loading and the lightering during low water conditions.

7.7 Potential NED Benefits of a New Regional Port

7.7.1. Potential NED Benefits to Construction Companies

Construction materials, except sand, gravel and rock, are shipped to the region on contact barges or on scheduled line-haul barge general cargo transportation services provided by Northland Services, Inc. Currently, construction materials shipped by contract barges are delivered as directly as possible to the village where the construction project or projects is/are located. Contract barge shipments to communities on the Kuskokwim River are delivered to Bethel for transshipment and there are no potential new regional port sites that would offer a comparative advantage to these communities as compared with the Port of Bethel. Contact barge shipments to communities on the Yukon River are typically delivered downriver from Nenana. The ocean barge typically delivers contract barge shipments to the vicinity of the destination village where it is met by lightering barges that transship the materials from the ocean barge to the village. Occasionally lightering operations are delayed by weather but the cost of the delays are minimal compared with the savings that is afforded by using the ocean barge as a regional port as opposed to using a new land-based regional port. Accordingly, there are no identifiable NED benefits of a new regional port to construction projects in the region.

7.7.2 Potential NED Benefits to Shipments of Sand, Gravel and Rock

Sand, gravel and rock are typically produced and shipped in the region on the basis of orders received for construction projects. As with all others in the region construction companies must plan well in advance for their need for sand, gravel and rock. Given this condition, sand, gravel and rock is produced and shipped to construction sites on as needed basis. Therefore, there is no need for a new regional port to serve this industry. Accordingly, there are no identifiable NED benefits of a new regional port to construction projects in the region.

7.8 Potential NED Benefits of Navigation Improvements on the Kuskokwim River

As noted above, navigation improvements on the Kuskokwim River in the form of dredging the Johnson bar and installing navigation aids is needed. These improvements would benefit both shippers of general construction materials (the estimated volume of these shipments is included with estimates of general cargo shipments) and sand, gravel and rock. Categories of potential benefits are as follows:

- Reduced cost of pilot services
- Reduced cost of delays
- Reduced costs of light loading (more efficient use of equipment)
- Reduced cost of lightering

Analysis of these benefits is beyond the scope of this study but should be given priority for future study.

8.0 Analysis of Bulk Fuel Movement (Task 3.3)

8.1 Waterborne Commerce

8.1.1 Shippers

During 2000, Yukon Fuels, a Northland company, shipped fuel to the Yukon-Kuskokwim Delta region including the lower Yukon River. In addition, Crowley made deliveries to Kuskokwim River communities from fuel supplies stored at the tank farm in Bethel. According to a representative of Crowley, it is probable that once those supplies are exhausted, the company will no longer provide fuel service to the Yukon-Kuskokwim Delta region.[3]

During the shipping season of 2000, Yukon Fuels' three line-haul tanker barges made a total of 16 trips to Western Alaska with an estimated total of about 151,000 tons of fuel. The company operated two larger barges and a smaller one. The first trip of each of the three line-haul barges is from Seattle but the remaining trips are from Nikiski. The region served by the three vessels extends from Bristol Bay to the south to Kotzebue to the north. The larger barges serve three fuel distribution centers in Western Alaska—Bethel, Saint Michael and Nome. The smaller barge services the coastal communities with the assistance of lightering barges that operate from Nenana down the Yukon River. A summary of information about the line-haul barges is shown in Table 19.

Table 19. Summary Information About Line-Haul Fuel Barges

	----------Capacity----------			No.	Total
Type of Barge	**Barrels**	**Gallons**	**Tons**	**Trips**	**Tons**
Line-Haul (large)	70,000	2,940,000	11,025	6	66,150
Line-Haul (large)	70,000	2,940,000	11,025	5	55,125
Line-Haul (small)	38,000	1,596,000	5,985	5	29,925
Total Shipments					151,200

Since the line-haul barges can only get into two communities in the Yukon-Kuskokwim Delta--Bethel and Saint Michael—fuel deliveries to all but these two communities are made with lightering barges that have drafts of not more than four feet. Yutana, a Northland Company, owns and operates all six lightering barges. Three of the lightering barges make deliveries to coastal communities and three barges made deliveries to communities on the Kuskokwim and Yukon Rivers. Approximately 28 percent of fuel shipments are lightered directly to final destination villages from the ocean barge (the smaller Yukon Fuels barge). During direct lightering operations, the ocean barge typically anchors on the lee side of Eek Island in the mouth of the Kuskokwim River. The lightering barges then load from the ocean barge and deliver to the communities from Goodnews Bay to Scammon Bay. During times when the water level in the Kuskokwim is too low for the larger line-haul barges to get into Bethel fully loaded (14 feet draft), the lightering barges will load from those as well to lighten the load until they can cross the Johnson bar.

Fuel stored at Bethel at a tank farm with a total capacity of about 9.4 million gallons is used to supply communities on the Kuskokwim River from Eek at the mouth to Nikolai. The fuel stored at the Saint Michael tank farm with an estimated capacity of 1.3 million gallons is used to supply Yukon River and Norton Sound communities. For operational reasons Yukon Fuels/Yutana does

[3] Source: Telephone conversation with Jerry Galliart, Bethel manager for Crowley, on 9 October 2000.

not mix "blue and brown water equipment." This means that all coastal communities are served by a set of three lightering barges that operate on the ocean and Kuskokwim and Yukon River communities are served by the set of three lightering barges that operate on the rivers, regardless of the fact that some "coastal" river communities may be physically closer to the ocean barge than they are to the tank farms in Saint Michael or Bethel.

8.1.2 Volume of Fuel Moved by Barge by Origin and Destination

As stated above, Yukon Fuels, the only supplier to the Yukon-Kuskokwim Delta region, delivered a total of about 151,200 tons of fuel to Western Alaska[4] during the 2000 shipping season. Historical information on the actual distribution of fuel within the Yukon-Kuskokwim Delta region is not readily available. In fact, the only official data available to the public is the data compiled by the Corps of Engineers and reported in Waterborne Commerce of the United States Part 4—Waterways and Harbors Pacific Coast, Alaska and Hawaii. This data, however, is of limited use and reliability for this study because of the small volumes of the total tonnage moved in the Yukon-Kuskokwim Delta region. The only port in the region with sufficient tonnage to be included in the report is Bethel. Although the reliability of the results must be considered with suspicion, estimates of village, sub-regional and regional fuel use were developed for this study using Waterborne Commerce data. Because of the potential unreliability of the estimates developed from Waterborne Commerce data, estimates of fuel use in the region were also made using data from the Mekoryuk Study (1997), the volume of fuel storage at each village in the region and data provided by Yukon Fuels on fuel deliveries made during 2000. The derivation of the four estimates is described as follows:

- **Waterborne Commerce Based Estimate (WCBE)—**This estimate was developed from fuel shipment data for Bethel, on the basis of the same assumption that was used in the Mekoryuk study: i.e., fuel delivered to the region from Goodnews Bay to Scammon Bay, including all of the Kuskokwim River is shipped first to Bethel and is then transshipped from there to Kuskokwim River and coastal villages. The volume of fuel shipped to each village was estimated by computing the per capita volume for the region described above using 1990 population (15,048) and the average of 1995 through 1998 Waterborne Commerce data for fuel shipments to Bethel (33,000 tons). This per capita value was then applied to applied to estimated 1999 population for each village in the region to obtain fuel use for each village, sub-region and for the region. The estimates are likely to be somewhat high (assuming all fuel shipments through the Port of Bethel were reported) because data for the port includes inbound and outbound shipments. This means that cargo that was actually transshipped from Bethel to the other communities may have been counted twice. This analysis resulted in an estimate of fuel use in the region of nearly 2.2 tons (about 600 gallons) per capita and a total of nearly 53,400 tons (about 14.2 million gallons) for the entire study area. Estimates by village, sub-region and the study area are shown in Table 20. The origin of fuel shipments is also shown.

- **Mekoryuk Study Based Estimate (MSBE)—**The estimate of fuel use developed for the Mekoryuk Study and presented in the Mekoryuk Port Pre-Feasibility Study and Development Plan, December 1997 was developed from information obtained from Crowley for 15 communities which are closer to Mekoryuk than they are to Bethel. This estimate was used to compute an average per capita estimate using 1990 population

[4] Source: Telephone conversations with Howard Elliot, Port Director, Bethel on 9 October 2000 and with Shane Tarter, Yukon Fuels, Anchorage on 8 November 2000.

estimates for the 15 communities included in the study. The resulting per capita use estimate was then applied to 1999 population estimates for all of the communities in the region to obtain total estimates of fuel use for each village, sub-region and the study area. The analysis resulted in an estimate of fuel shipments and use within the region that was very nearly the same as that obtained using Waterborne Commerce data at about 2.2 tons per capita (about 600 gallons) and a total tonnage of slightly more than 52,800 tons (about 14.1 million gallons) for the entire study area. Estimates of fuel tonnage by village, sub-region and the study area along with information on the origin of fuel shipments are shown in Table 20.

- **Fuel Storage Based Estimate (FSBE)—**The shipping season for waterborne commerce within the Yukon-Kuskokwim Delta region extends from about mid-June through mid-October because the rivers freeze over by about mid-October and do not reopen for navigation until about mid-June. Breakup actually usually occurs somewhat earlier but it is usually mid-June before fuel shipments from either storage facilities at Bethel and Saint Michael or the first line-haul barge fuel shipment of the year can reach communities within region. Thus, between mid-October and mid-June, communities generally must rely on stored fuel. On this basis, if total fuel storage and the amount of stored fuel that is used during the winter months are known, fuel use at each village can be estimated.

  Data on fuel storage facilities is compiled by the Alaska Department of Economic and Village Development and reported in its Alaska Village Database. Fuel storage information was obtained from the database and was used as the basis for making the FSBE estimate of fuel use within the region. Total fuel storage in the region amounts to slightly more than 23.5 million gallons. To make the estimate of per capita use, an assumption that storage includes a reserve of 10 percent regionally. Thus, estimated use during the 8 months when waterborne fuel deliveries are not possible amounts to a total of about 21.2 million gallons. Because of missing information on fuel storage for Napaimiut (population of 6) and Oscarville (population of 64) the population of these to communities was excluded from the computation of per capita fuel storage for the region. This adjustment increased estimated per capita fuel storage from 946 (based on the region's total population) to 949 gallons (excluding the population of Oscarville and Napaimiut).

  To obtain an estimate of the amount of fuel use per capita, the assumed reserve of 10 percent was deducted from total storage. This adjustment resulted in an estimate of per capita use of 854 gallons. The adjusted value represents the estimated amount of fuel that is used during the winter (8 months), on a per capita basis. Summer use of fuel is assumed to occur at the same level as in the winter, with summer activities such as fishing offsetting the decrease in fuel use for heating. Thus, annual per capita use was estimated to be 1,284 gallons (854 gallons/(8 months/12 months)). This estimate was applied to 1999 population estimates for each village to obtain estimated total fuel use for each village, sub-region and the region. The analysis resulted in an estimate of fuel use for the region of 31.8 million gallons or about 119,300 tons. Estimates of fuel tonnage by village, sub-region and the study area along with information on the origin of fuel shipments are shown in Table 20.

- **Carrier Interview Based Estimate (CIBE)—**Because significant changes have occurred in the composition of barge service to the region over the past two to three years, an estimate of the volume of fuel shipments based on information provided by Northland Services, Inc. (Yukon Fuels and Yutana Barge Lines) was developed. The data used in making the estimate was total fuel shipments to the region (see Table 19) and estimated

1999 population of villages in Western Alaska from Port Moller to Kotzebue. This data was used to estimate per capita use which was then applied to 1999 population estimates for each village in the study are to obtain estimates of use at each village and for the entire Yukon/Kuskokwim Delta region. The analysis resulted in an estimate of bulk fuel shipments and use within the region of slightly more than 2.8 tons per capita (about 754 gallons) and a total tonnage of slightly less than 70,300 tons (about 18.7 million gallons) for the entire study area. Estimates of fuel tonnage by village, sub-region and the study area are shown in Table 20.

8.2 Navigation Problems and Needed Improvements

8.2.1 Navigation Problems

As stated previously, fuel deliveries to coastal communities from Goodnews Bay to Scammon Bay are made by lightering barges from a line-haul ocean barge that is anchored in the protection of Eek Island in the Kuskokwim estuary. Generally, river barges make fuel deliveries to Yukon River communities from a tank farm located at Saint Michael. Lightering barges also make deliveries to villages on the Kuskokwim River from the bulk storage tank farm in Bethel.

The only problem related to the issue of a regional port that Yukon Fuels and Yutana Barge Lines reported encountering is the relatively shallow depth of water over the Johnson Bar or Oscarville Crossing on the Kuskokwim River. As is the case with line-haul barges used to ship sand, gravel and rock and other construction materials, line-haul barges with a loaded draft of 14 feet experience navigation problems during low water conditions when the depth of water over the bar is reduced to about 12 feet. During low water conditions, line-haul tanker barges must be light-loaded going into Bethel or enough fuel must be lightered to reduce draft to the point where the bar can be crossed.

Table 20. Yukon-Kuskokwim Delta Coast Regional Economics--Origin, Destination and Estimated Volume of Waterborne Fuel

Village/Destination	Population 1999	Origin	Transshipment Point	Estimates of Volume of Fuel WCBE 1/ (tons)	MSBE 2/ (tons)		FSBE 6/ (tons)	CIBE 3/ (tons)	Year 2000 Data Volume (tons)	Carrier
Coast--Goodnews Bay to Kuskokwim River										
Goodnews Bay 3/	256	Seattle/Anchorage	Eek Island Ocean Lighter	561	572	5/	1,229	724		
Platinum	43	Seattle/Anchorage	Eek Island Ocean Lighter	94	96	5/	206	122		
Quinhagak	595	Seattle/Anchorage	Eek Island Ocean Lighter	1,305	750	4/	2,857	1,683		
Totals	894			1,961	1,419		4,293	2,529		
Kuskokwim River, Mouth to Bethel										
Eek	281	Seattle/Anchorage	Eek Island Ocean Lighter	616	750	4/	1,349	795		
Tuntutuliak	350	Seattle/Anchorage	Eek Island Ocean Lighter	768	750	4/	1,681	990		
Nunapitchuk	471	Seattle/Anchorage	Bethel	1,033	1,053	5/	2,262	1,332		
Kasigluk	528	Seattle/Anchorage	Bethel	1,158	1,181	5/	2,536	1,493		
Napakiak 4/	363	Seattle/Anchorage	Bethel	796	750	4/	1,743	1,027		
Napaskiak	406	Seattle/Anchorage	Bethel	890	908	5/	1,950	1,148		
Oscarville	64	Seattle/Anchorage	Bethel	140	143	5/	307	181		
Totals	2,463			5,401	5,535		11,828	6,967		
Bethel										
Bethel	5,471	Seattle/Anchorage	None	11,998	12,234	5/	26,273	15,475		
Kuskokwim River, Bethel to Nikolai										
Kwethluk	714	Seattle/Anchorage	Bethel	1,566	1,597	5/	3,429	2,020		
Akiachak	560	Seattle/Anchorage	Bethel	1,228	1,252	5/	2,689	1,584		
Akiak	338	Seattle/Anchorage	Bethel	741	756	5/	1,623	956		
Tuluksak	443	Seattle/Anchorage	Bethel	971	991	5/	2,127	1,253		
Lower Kalskag	310	Seattle/Anchorage	Bethel	680	693	5/	1,489	877		
Upper Kalskag	261	Seattle/Anchorage	Bethel	572	584	5/	1,253	738		
Aniak	604	Seattle/Anchorage	Bethel	1,325	1,351	5/	2,901	1,708		
Napaimiut	4	Seattle/Anchorage	Bethel	9	9	5/	19	11		
Crooked Creek	137	Seattle/Anchorage	Bethel	300	306	5/	658	388		
Red Devil	44	Seattle/Anchorage	Bethel	96	98	5/	211	124		

Table 20. Yukon-Kuskokwim Delta Coast Regional Economics--Origin, Destination and Estimated Volume of Waterborne Fuel

Village/Destination	Population 1999	Origin	Transshipment Point	Estimates of Volume of Fuel WCBE 1/ (tons)	MSBE 2/ (tons)		FSBE 6/ (tons)	CIBE 3/ (tons)	Year 2000 Data Volume (tons)	Carrier
Sleetmute	103	Seattle/Anchorage	Bethel	226	230	5/	495	291		
Stony River	35	Seattle/Anchorage	Bethel	77	78	5/	168	99		
McGrath	423	Seattle/Anchorage	Bethel	928	946	5/	2,031	1,196		
Nikolai	101	Seattle/Anchorage	Bethel	221	226	5/	485	286		
Totals	4,077			1,857	9,117		19,579	11,532		
Coast & Yukon Mouth--Kuskokwim River to Emmonak										
Kongiganak	359	Seattle/Anchorage	Eek Island Ocean Lighter	787	803	5/	1,724	1,015		
Kwigillingok	360	Seattle/Anchorage	Eek Island Ocean Lighter	789	750	4/	1,729	1,018		
Kipnuk	573	Seattle/Anchorage	Eek Island Ocean Lighter	1,257	750	4/	2,752	1,621		
Chefornak	416	Seattle/Anchorage	Eek Island Ocean Lighter	912	750	4/	1,998	1,177		
Toksook Bay	513	Seattle/Anchorage	Eek Island Ocean Lighter	1,125	1,147	5/	2,464	1,451		
Umkumiut	-	No service	No service	-	750	4/	-	-		
Nightmute	230	Seattle/Anchorage	Eek Island Ocean Lighter	504	750	4/	1,105	651		
Tununak	331	Seattle/Anchorage	Eek Island Ocean Lighter	726	750	4/	1,590	936		
Mekoryuk	193	Seattle/Anchorage	Eek Island Ocean Lighter	423	750	4/	927	546		
Newtok	284	Seattle/Anchorage	Eek Island Ocean Lighter	623	750	4/	1,364	803		
Hooper Bay	1,028	Seattle/Anchorage	Eek Island Ocean Lighter	2,254	750	4/	4,937	2,908		
Chevak	763	Seattle/Anchorage	Eek Island Ocean Lighter	1,673	750	4/	3,664	2,158		
Scammon Bay	484	Seattle/Anchorage	Eek Island Ocean Lighter	1,061	750	4/	2,324	1,369		
Nunam Iqua	181	Seattle/Anchorage	St Michael	397	405	5/	869	512		
Alakanuk	659	Seattle/Anchorage	St Michael	1,445	1,474	5/	3,165	1,864		
Emmonak	818	Seattle/Anchorage	St Michael	1,794	1,829	5/	3,928	2,314		
Totals	7,192			9,248	13,907		34,537	20,343		
Coast & Yukon Mouth--Kotlik to St Michael										
Kotlik	579	Seattle/Anchorage	St Michael	1,270	1,295	5/	2,780	1,638		
Stebbins	543	Seattle/Anchorage	St Michael	1,191	1,214	5/	2,608	1,536		
St Michael	381	Seattle/Anchorage	St Michael	836	852	5/	1,830	1,078		
Totals	1,503			15,783	3,361		7,218	4,251		

Table 20. Yukon-Kuskokwim Delta Coast Regional Economics--Origin, Destination and Estimated Volume of Waterborne Fuel

Village/Destination	Population 1999	Origin	Transshipment Point	Estimates of Volume of Fuel WCBE 1/ (tons)	MSBE 2/ (tons)		FSBE 6/ (tons)	CIBE 3/ (tons)	Year 2000 Data Volume (tons)	Carrier
Yukon River--Mountain Village to Holy Cross										
Mountain Village	766	Seattle/Anchorage	St Michael	1,680	1,713	5/	3,678	2,167		
Pitkas Point	146	Seattle/Anchorage	St Michael	320	326	5/	701	413		
St. Marys/Andreafsky	917	Seattle/Anchorage	St Michael	2,011	2,051	5/	4,404	2,594		
Pilot Station	544	Seattle/Anchorage	St Michael	1,193	1,216	5/	2,612	1,539		
Marshall	318	Seattle/Anchorage	St Michael	697	711	5/	1,527	899		
Russian Mission	311	Seattle/Anchorage	St Michael	682	695	5/	1,493	880		
Holy Cross	247	Seattle/Anchorage	St Michael	542	552	5/	1,186	699		
Totals	3,249			7,125	7,265		15,602	9,190		
Grand Totals	**24,849**			53,373	52,838		119,329	70,286		
Total Gallons				14,232,749	14,090,042		31,821,196	18,742,911		

Notes:

1/ WCBE = Waterborne Commerce Based Estimate

2/ MSE = Mekoryuk Study Estimate; assumes two trips per year of 40 tons each.

3/ CIBE = Carrier Interview Based Estimate

4/ Estimate is from the report, "Mekoryuk Port Pre-Feasibility Study and Development Plan, December 1997.

5/ Estitmate is based on the average per capita (1990 population) estimate from the Mekoryuk Study and 1999 population--
(Volume = Average per capita volume times 1999 population).

6/ FSBE = Fuel Storage Based Estimate

MSE Per Capita Volume Calculation			
Tons	11,250		
Total Pop	5,031		
Tons/cap	2.236135957	Gallons/capita	596.302922

Assumes two trips of 100,000 gallons to each community and that fuel weighs 7.5 pounds/gallon.

Table 20. Yukon-Kuskokwim Delta Coast Regional Economics--Origin, Destination and Estimated Volume of Waterborne Fuel

Village/Destination	Population 1999	Origin	Transshipment Point	Estimates of Volume of Fuel WCBE 1/ (tons)	MSBE 2/ (tons)	FSBE 6/ (tons)	CIBE 3/ (tons)	Year 2000 Data Volume (tons)	Carrier
WCBE Per Capita Volume Calculation									
Tons		33,000							
Total Pop		15,048							
Tons/cap		2.192982456							
Assumes commerce at Port of Bethel serves Bethel and the Kuskokwim River, excluding Eek and Tuntutuliak.									
FSBE per capita tons									
Population		15,048	(Excludes Oscarville & Napaimiute because fuel storage data was not available.						
Total Storage (gals)		23,506,753							
Reserve (10%)		2,350,675							
Capacity Less Reserve		21,156,078							
Winter Use (Gals/cap)		854							
Annual Use (Gals/cap)		1,281							
Tons/cap		4.80							
Assumes that storage includes a reserve capacity of 10 percent (on average) and that fuel is consumed at the same rate throughout the year.									
CIBE per capita tons									
Tons		115,200	Drft Rpt Table 19						
Total populaton		40,728	Bristol Bay to Kotzebue						
Tons/cap		2.828520919							
Gallons/cap		754.2722451							

8.2.2 Need for a New Regional Port

According to representatives of Yukon Fuels and Yutana Barge Lines, a new regional port is not needed for transporting fuel within the Yukon-Kuskokwim Delta region. The current use of line-haul tanker barges as a regional transshipment center for fuel deliveries to coastal communities is considered to be efficient and significantly lower in cost than a new regional port would be. Accordingly, it is unlikely that Yukon Fuels would use a regional port for distribution of fuel to coastal communities if one were to be constructed.

8.2.3 Need for Other Navigation Improvements

Navigation improvements that would reduce the cost of distributing fuel within the region are essentially the same as those identified for shipment of sand, gravel and rock. These improvements are reiterated as follows:

- Construction of minimal docking facilities at communities along the Yukon and Kuskokwim Rivers—This would reduce the time required to dock and unload fuel but cost savings would likely be less significant than those for sand, gravel and rock shipments because it is not necessary to get the barge as close to the bank as is required for sand, gravel and rock barges.
- Dredging the Johnson Bar to a depth of about three feet for approximately one-half mile to maintain a minimum channel depth during the shipping season of 14 feet—This would reduce delays and eliminate the need for light loading and the lightering during low water conditions.

8.3 Potential NED Benefits of a New Regional Port

Based on the information obtained during the course of this study, a new regional port would not result in any measurable NED benefits to shippers of fuel.

8.4 Potential NED Benefits of Navigation Improvements on the Kuskokwim River

As noted above, navigation improvements on the Kuskokwim River in the form of dredging the Johnson bar and installing navigation aids is needed. As with shippers of general construction materials and sand, gravel and rock, these improvements would benefit fuel shippers as follows:

- Reduced cost of pilot services
- Reduced cost of delays
- Reduced costs of light loading (more efficient use of equipment)
- Reduced cost of lightering

Analysis of these benefits is beyond the scope of this study but should be given priority for future study.

9.0 Analysis of General Cargo Movement (Task 3.4)

9.1 Waterborne Commerce

9.1.1 Shippers

A single common carrier and a number of contract carriers and construction companies that own and operate their own barges to supply construction projects make waterborne shipments to the study area. The single common carrier—a carrier that offers scheduled general cargo transportation service—is Northland Services, Inc. Since 1977 Northland has been providing contract and common carrier service between Seattle, Alaska and Russia. Principle commodities carried to Alaska include supplies for the fishing and construction industries, as well as general re-supply items such as groceries, hardware and vehicles.[5] Northland operates as two separate companies to provide ocean and river barge transportation to the Yukon-Kuskokwim delta. Northland Services provides line-haul ocean barge service to coastal communities and Bethel and Yutana Barge Lines provides river barge service to communities on the Yukon River. Other companies that provide sub-contract lightering services to Northland and contract transportation services are Bowhead Transportation, Kelly Ryan, Kuskokwim Lighterage & Trucking, Bering Marine Corporation and Bryce Construction. A search of the AOL (America On Line) yellow pages, under the category "barges and barge lines" for selected cities in Western Alaska, Nenana, Anchorage and Seattle resulted in 45 listings for 34 different companies, all of which do or could provide barge transportation services to the study area on a contract basis. A summary of the number of listings and companies is shown in Table 21.

Table 21. Number of Barge Company Listings and Companies for Selected Cities

City	No. of Listings	No. of Companies
Anchorage	18	12
Bethel	2	2
Dillingham	4	3
Nenana	2	2
Nome	4	2
Seattle	15	13
Total	45	34

Transportation services offered by Northland Services are provided on a point-to-point delivery basis but the line-haul ocean barges that serve Western Alaska, including the regional port of Bethel, are only able to deliver cargo to Bethel. General cargo is delivered to final destinations, except Bethel, by lightering companies that Northland contracts with. In general, Northland provides freight transport services to coastal communities in the study area from Goodnews Bay to the south to Scammon Bay to the north and up the Kuskokwim River to Eek and Tuntutuliak via direct lightering of freight from the line-haul ocean barges to the villages. During these operations, the line-haul barges effectively serve as a regional port. Typically the ocean barge is anchored in Goodnews Bay for about two weeks and lightering barges transship cargo from there to the villages. The ocean barge is not moved up the coast as cargo is lightered to the communities because of the cost of keeping the ocean tug with the barge. Typically there is other work for the tug to do while the barge is being unloaded. Lightering services to coastal communities are sub-contracted by Northland primarily to, Kelly Ryan, Inc. and Yutana. The volume of cargo delivered by Northland to the coastal communities amounts to between 4,000

[5] Source: Home page of Northland Services' website (northlandservices.com).

and 5,000 tons annually. Scheduled service is provided to the coastal communities twice each year by barges leaving Seattle in May and August.

General cargo destined for communities on the Kuskokwim River upstream from Eek and Tuntutuliak is barged to Bethel by line-haul ocean barges and transshipped from there to final destinations by river lightering barges. Lightering services to Kuskokwim River communities are sub-contracted by Northland, primarily to Kuskokwim Lighterage and Trucking, Inc. Barge service to communities along the Yukon River is provided by ocean barge to Anchorage (for cargo originating in Seattle), by truck from Anchorage to Nenana and from Nenana to the lower Yukon River communities by river barge. Scheduled barge service on the Yukon River is provided by Yutana Barge Lines.

Schedules for general cargo shipments to the region during 2000 are shown in Table 22 for all of the communities located in the study area. The schedules shown are the combined schedules for shipments by ocean directly to Western Alaska by Northland Services and shipments through Nenana to communities located on the lower Yukon River by Yutana Barge Lines.

Table 22. Yukon-Kuskokwim Delta Coast Regional Economics--Scheduled Barge Service (2000) 1/

Sub-region/Village	Voyages											
Coast--Goodnews Bay to Kuskokwim River (3)												
	Origin 2/	**0001**	**0002**	**0003**	**0004**	**0005**	**0006**	**0007**	**0008**	**0009**	**0010**	**0011**
Goodnews Bay 3/	Western			X							X	
Platinum	Western			X							X	
Quinhagak	Western			X		X					X	
Kuskokwim River, Mouth to Bethel (7)												
	Origin	**0001**	**0002**	**0003**	**0004**	**0005**	**0006**	**0007**	**0008**	**0009**	**0010**	**0011**
Eek	Western			X							X	
Tuntutuliak	Western			X							X	
Nunapitchuk	Western			X		X		X	X	X	X	
Kasigluk	Western			X		X		X	X	X	X	
Napakiak 4/	Western			X		X		X	X	X	X	
Napaskiak	Western			X		X		X	X	X	X	
Oscarville	Western			X		X		X	X	X	X	
Bethel (1)												
	Origin	**0001**	**0002**	**0003**	**0004**	**0005**	**0006**	**0007**	**0008**	**0009**	**0010**	**0011**
Bethel	Western			X		X			X	X	X	X
Kuskokwim River, Bethel to Nikolai (14)												
	Origin	**0001**	**0002**	**0003**	**0004**	**0005**	**0006**	**0007**	**0008**	**0009**	**0010**	**0011**
Kwethluk	Western			X		X		X	X	X	X	
Akiachak	Western			X		X		X	X	X	X	
Akiak	Western			X		X		X	X	X	X	
Tuluksak	Western			X		X		X	X	X	X	
Lower Kalskag	Western			X		X		X	X	X	X	
Upper Kalskag	Western			X		X		X	X	X	X	
Aniak	Western			X		X			X	X	X	
Napaimiut	Western			X		X		X	X	X	X	
Crooked Creek	Western			X		X		X	X	X	X	

Table 22. Yukon-Kuskokwim Delta Coast Regional Economics--Scheduled Barge Service (2000) 1/

Sub-region/Village		**Voyages**										
Red Devil	Western			X		X		X	X	X	X	
Sleetmute	Western			X		X		X	X	X	X	
Stony River	Western			X		X		X	X			
McGrath	Western			X		X		X	X			
Nikolai	Western			X								
Coast & Yukon Mouth--Kuskokwim River to Emmonak (15)												
	Origin	**0001**	**0002**	**0003**	**0004**	**0005**	**0006**	**0007**	**0008**	**0009**	**0010**	**0011**
Kongiganak	Western			X							X	
Kwigillingok	Western			X							X	
Kipnuk	Western			X							X	
Chefornak	Western			X							X	
Toksook Bay	Western			X							X	
Nightmute	Western			X							X	
Tununak	Western			X							X	
Mekoryuk	Western			X							X	
Newtok	Western			X							X	
Hooper Bay	Western			X							X	
Chevak	Western			X							X	
Scammon Bay	**Western**			**X**							**X**	
	Origin	**0806**	**0807**	**0006**	**0808**	**0008**	**0809**	**0009**	**0010**			
Nunam Iqua	Yukon	X	X	X	X	X	X	X	X			
Alakanuk	Yukon	X	X	X	X	X	X	X	X			
Emmonak	Yukon	X	X	X	X	X	X	X	X			
Coast & Yukon Mouth--Kotlik to Saint Michael (3)												
	Origin	**0806**	**0807**	**0006**	**0808**	**0008**	**0809**	**0009**	**0010**			
Kotlik	Yukon	X	X	X	X	X	X	X	X			
	Origin	**0001**	**0002**	**0003**	**0004**	**0005**	**0006**	**0007**	**0008**	**0009**	**0010**	**0011**
Stebbins	Western			X						X		
St. Michael	Western			X						X		
Yukon River--Mountain Village to Holy Cross (7)												
	Origin	**0806**	**0807**	**0006**	**0808**	**0008**	**0809**	**0009**	**0010**			
Mountain Village	Yukon	X	X	X	X	X	X	X	X			
Pitkas Point	Yukon	*(service provided through St. Mary's/Andreafsky)*										
St. Marys/Andreafsky	Yukon	X	X	X	X	X	X	X	X			
Pilot Station	Yukon	X	X	X	X	X	X	X	X			
Marshall	Yukon	X	X	X	X	X	X	X	X			
Russian Mission	Yukon	X	X	X	X	X	X	X	X			
Holy Cross	Yukon	X	X					X	X			

Notes: Source: Northland Services' website (northlandservices.com).
1/ Service provided by Northland Services, Seattle (includes Yutana Barge Lines).
2/ All sailings originate in Seattle. Western indicates shipments directly to western Alaska and Yukon indicates shipments made on the Yukon River from Nenana.
Western--first sailing is May 01 and the last is Sep 12
Yukon, Lower Yukon--first trip is May 08 and the last is Jul 31; Yukon, Innoko River--first trip is May 08 and the last is Aug 16

9.1.2 Types of General Cargo Moved by Barge

General cargo transported by barge to the Yukon-Kuskokwim Delta region consists primarily of building materials, vehicles and machinery. In addition, they transport a minor amount of groceries. The amount of groceries and general supplies for village stores such as clothing and household goods (except large items that cannot be packaged with a combined length and girth dimension of the package of no greater than 108 inches) has decreased to almost nothing since establishment of intra-bulk mail center parcel post rates for rural Alaska and the bypass mail program. The bypass mail program provides a relatively inexpensive and very fast (airmail) transportation for much of the "grocery" and small household type goods that are used in the region. The bypass mail program is discussed in a following section of the report.

9.1.3 Volume of General Cargo Moved by Barge by Origin and Destination

As was the case with fuel shipments and use in the region, there was no single reliable source of data on which to base an estimate of general cargo shipments and use. For this reason, three different estimates were made with the belief that the three estimates should establish a range within which actual shipments and use lie. The sources of information that was used to develop the estimate are as follows:

- Waterborne Commerce of the United States (Calendar Years 1995 thru 1998) Part 4—Waterways and Harbors Pacific Coast, Alaska and Hawaii, U.S. Army Corps of Engineers.
- Mekoryuk Port Pre-Feasibility Study and Development Plan, Preatrovich, Nottingham & Drage, Inc.
- Interviews with representatives of ocean and river barge transportation companies.

The report, Waterborne Commerce of the United States, is the official source of data on waterborne commerce for the United States. The data is collected by the Corps of Engineers under the authority of Section 11 of the Rivers and Harbors Appropriation Act of 1922 (42 Stat. 1043), as amended and codified in 33 U.S.C. 555. The statement of the legal authority of the Corps of Engineers to collect data on waterborne commerce is as follows:

> *"Owners, agents, masters, and clerks of vessels and other craft plying upon the navigable waters of the United States, and all individuals and corporations engaged in transporting their goods upon the navigable waters of the United States, shall furnish such statements relative to vessels, passengers, freight and tonnage as may be required by the Secretary of the Army: Provided. That this provision shall not apply to rafting logs, except upon a direct request upon the owner to furnish specific information.*
>
> *Every person or persons offending against the provisions of this section shall, for each and every offense, be liable to a fine of not more than $5,000 or imprisonment not exceeding two months, to be enforced in any district court of the United States within whose territorial jurisdiction such offense may have been committed. In addition, the Secretary may assess a civil penalty of up to $2,500 per violation against any person or entity, that fails to provide timely, accurate statements required to be submitted pursuant to this section by the Secretary."*

Even though waterborne commerce data must be reported, there are instances where carriers fail to report. This appears to be particularly true of contract carriers. However, this is not the case for

Northland companies.[6] Waterborne commerce available in Part 4-- Waterways and Harbors Pacific Coast, Alaska and Hawaii for the Yukon-Kuskokwim delta region is limited to the port of Bethel. Information for all ports (communities) is available from the database maintained by Corps' Waterborne Commerce Statistics Center Database Detail Cargo File. This data was not analyzed for this study because the level of effort required to extract the data was beyond the scope of the study.

From the information available in the three sources listed above, three estimates of the annual volume of barge shipments to the Yukon-Kuskokwim Delta region were developed. The estimates were derived as follows:

- **Waterborne Commerce Based Estimate (WCBE)—**This estimate was developed from data for Bethel, on the basis of the same assumption that was used in the Mekoryuk study: i.e., general cargo delivered to the region from Goodnews Bay to Scammon Bay, including all of the Kuskokwim River is shipped first to Bethel and is then transshipped from there to Kuskokwim River and coastal villages. The estimate of the volume of cargo to each village was computed by computing the per capita volume for the communities that are assumed to be served from Bethel (and including Bethel) and applying that value to the estimated 1999 population for each village in the entire study area. The estimates are likely to be somewhat high (assuming all shipments through the Port of Bethel were reported) because data for the port includes inbound and outbound shipments. This means that cargo that was actually transshipped from Bethel to the other communities was counted twice. The volume of tonnage at Bethel that was used was the average tonnage for the years 1995 through 1998. The analysis resulted in an estimate of general cargo shipments within the region of nearly 3.4 tons per capita and a total of nearly 82,000 tons for the entire study area. Estimates by village, sub-region and the study area along with origin/destination information are shown in Table 24.

- **Mekoryuk Study Based Estimate (MSBE)—**The estimate of general cargo shipments developed for the Mekoryuk Study and presented in the Mekoryuk Port Pre-Feasibility Study and Development Plan (Dec. 1997) was developed from information obtained from Crowley for 15 communities that are closer to Mekoryuk than they are to Bethel. These estimates were used together with 1990 population estimates to compute an average per capita estimate of general cargo movement and use. The per capita estimate was then applied to the 1999 population estimate for each village in the region to obtain total estimates of general cargo tonnage for each village, the sub-regions and the study area. The analysis resulted in an estimate of general cargo shipments and use within the region of slightly less than 0.24 tons per capita and a total tonnage of slightly more than 5,900 tons for the entire study area. Estimates of general cargo tonnage by village, sub-region and the study area along with origin/destination information are shown in Table 24.

- **Carrier Interview Based Estimate (CIBE)—**Because significant changes have occurred in the composition of barge service to the region over the past two to three years, an estimate of the volume of general cargo shipments based on information provided by Northland Services, Inc. was developed. Because the data provided by Northland was for coastal communities (4,000 to 5,000 tons), the estimates for sub-regions were made on the basis of the per capita shipments to the coastal communities. Per capita estimates were made using the mid-point (4,500 tons) of the range of general cargo shipments

[6]Source: Personal interview with Mike Clevenger, Vice President of Operations, Northland Services, Inc. on 6 November 2000.

estimated by Northland Services, Inc. for 2000 and estimated 1999 population. The analysis resulted in an estimate of general cargo shipments within the region of slightly more than 0.5 tons per capita and a total tonnage of about 10,600 tons for the entire study area. By contrast, Yutana reported total shipments of about 20,000 tons to the lower Yukon River or about 3.6 tons per capita. Additional information is needed to determine the appropriate estimate on which to base a final estimate of general cargo shipments to the region. Pending receipt of additional information from Northland and Yutana, estimates of general cargo tonnage shipped to the region, based on reported shipments to coastal villages during 2000, by village, sub-region and the study area along with origin/destination information are shown in Table 24.

Table 24. Yukon-Kuskokwim Delta Coast Regional Economics--Origin, Destination and Volume of Waterborne General Cargo

Village/Destination	Pop 1999	Origin	Transshipment Point	Estimates of Volume WCBE 1/ (tons)	MSE 2/ (tons)		CIBE 3/ (tons)
Coast--Goodnews Bay to Kuskokwim River							
Goodnews Bay 3/	256	Seattle/Anchorage	Goodnews Bay Ocean Lighter	561	61	5/	139
Platinum	43	Seattle/Anchorage	Goodnews Bay Ocean Lighter	94	10	5/	23
Quinhagak	595	Seattle/Anchorage	Goodnews Bay Ocean Lighter	1,305	142	4/	324
Totals	894			1,961	213		487
Kuskokwim River, Mouth to Bethel							
Eek	281	Seattle/Anchorage	Goodnews Bay Ocean Lighter	616	67	4/	153
Tuntutuliak	350	Seattle/Anchorage	Goodnews Bay Ocean Lighter	768	83	4/	191
Nunapitchuk	471	Seattle/Anchorage	Bethel	1,033	112	5/	257
Kasigluk	528	Seattle/Anchorage	Bethel	1,158	126	5/	288
Napakiak 4/	363	Seattle/Anchorage	Bethel	796	80	4/	198
Napaskiak	406	Seattle/Anchorage	Bethel	890	97	5/	221
Oscarville	64	Seattle/Anchorage	Bethel	140	15	5/	35
Totals	2,463			5,401	581		1,342
Bethel							
Bethel	5,471	Seattle/Anchorage	None	11,998	1,305	5/	
Kuskokwim River, Bethel to Nikolai							
Kwethluk	714	Seattle/Anchorage	Bethel	1,566	170	5/	389
Akiachak	560	Seattle/Anchorage	Bethel	1,228	134	5/	305
Akiak	338	Seattle/Anchorage	Bethel	741	81	5/	184
Tuluksak	443	Seattle/Anchorage	Bethel	971	106	5/	241
Lower Kalskag	310	Seattle/Anchorage	Bethel	680	74	5/	169
Upper Kalskag	261	Seattle/Anchorage	Bethel	572	62	5/	142
Aniak	604	Seattle/Anchorage	Bethel	1,325	144	5/	329
Napaimiut	4	Seattle/Anchorage	Bethel	9	1	5/	2
Crooked Creek	137	Seattle/Anchorage	Bethel	300	33	5/	75
Red Devil	44	Seattle/Anchorage	Bethel	96	10	5/	24
Sleetmute	103	Seattle/Anchorage	Bethel	226	25	5/	56
Stony River	35	Seattle/Anchorage	Bethel	77	8	5/	19
McGrath	423	Seattle/Anchorage	Bethel	928	101	5/	230
Nikolai	101	Seattle/Anchorage	Bethel	221	24	5/	55
Totals	**4,077**			**1,857**	**972**		**2,221**

Table 24. Yukon-Kuskokwim Delta Coast Regional Economics--Origin, Destination and Volume of Waterborne General Cargo

Village/Destination	Pop 1999	Origin	Transshipment Point	Estimates of Volume WCBE 1/ (tons)	MSE 2/ (tons)		CIBE 3/ (tons)
Coast & Yukon Mouth--Kuskokwim River to Emmonak							
Kongiganak	359	Seattle/Anchorage	Goodnews Bay Ocean Lighter	787	86	5/	196
Kwigillingok	360	Seattle/Anchorage	Goodnews Bay Ocean Lighter	789	86	4/	196
Kipnuk	573	Seattle/Anchorage	Goodnews Bay Ocean Lighter	1,257	137	4/	312
Chefornak	416	Seattle/Anchorage	Goodnews Bay Ocean Lighter	912	99	4/	227
Toksook Bay	513	Seattle/Anchorage	Goodnews Bay Ocean Lighter	1,125	122	5/	279
Umkumiut	-	No service	No service	-	-	4/	-
Nightmute	230	Seattle/Anchorage	Goodnews Bay Ocean Lighter	504	55	4/	125
Tununak	331	Seattle/Anchorage	Goodnews Bay Ocean Lighter	726	79	4/	180
Mekoryuk	193	Seattle/Anchorage	Goodnews Bay Ocean Lighter	423	46	4/	105
Newtok	284	Seattle/Anchorage	Goodnews Bay Ocean Lighter	623	68	4/	155
Hooper Bay	1,028	Seattle/Anchorage	Goodnews Bay Ocean Lighter	2,254	245	4/	560
Chevak	763	Seattle/Anchorage	Goodnews Bay Ocean Lighter	1,673	182	4/	416
Scammon Bay	484	Seattle/Anchorage	Goodnews Bay Ocean Lighter	1,061	115	4/	264
Nunam Iqua	181	Seattle/Anchorage	Nenana	397	43	5/	99
Alakanuk	659	Seattle/Anchorage	Nenana	1,445	157	5/	359
Emmonak	818	Seattle/Anchorage	Nenana	1,794	195	5/	446
Totals	**7,192**			**9,248**	**1,715**		**3,918**
Coast & Yukon Mouth--Kotlik to Saint Michael							
Kotlik	579	Seattle/Anchorage	Nenana	1,270	138	5/	315
Stebbins	543	Seattle/Anchorage	St. Michael Ocean Lighter	1,191	130	5/	296
St. Michael	381	Seattle/Anchorage	St. Michael Ocean Lighter	836	91	5/	208
Totals	**1,503**			**15,783**	**358**		**819**
Yukon River--Mountain Village to Holy Cross							
Mountain Village	766	Seattle/Anchorage	Nenana	1,680	183	5/	417
Pitkas Point	146	Seattle/Anchorage	Nenana	320	35	5/	80
St. Marys/Andreafsky	917	Seattle/Anchorage	Nenana	2,011	219	5/	500
Pilot Station	544	Seattle/Anchorage	Nenana	1,193	130	5/	296
Marshall	318	Seattle/Anchorage	Nenana	697	76	5/	173
Russian Mission	311	Seattle/Anchorage	Nenana	682	74	5/	169
Holy Cross	247	Seattle/Anchorage	Nenana	542	59	5/	135
Totals	**3,249**			**7,125**	**775**		**1,770**
Grand Totals	**24,849**			**53,373**	**5,920**		**10,557**

Notes:
1/ WCBE = Waterborne Commerce Based Estimate
2/ MSE = Mekoryuk Study Estimate; assumes two trips per year of 40 tons each.
3/ CIBE = Carrier Interview Based Estimate
4/ Estimate is from the report, "Mekoryuk Port Pre-Feasibility Study and Development Plan, December 1997.
5/ Estimate is based on the average per capita (1990 population) estimate from the Mekoryuk Study.
Average per capita volume times 1999 population.

9.1.4 General Cargo Shipping Rates

In general, NED analyses by the Corps use rates as the basis for estimating transportation costs. The exception to this general rule is that reconstructed costs are to be used if it can be demonstrated that rates are not set in a competitive market and are significantly different than costs. The current presence of a single common waterborne carrier of general cargo in the region would suggest that the use of rates might not be appropriate. However, the presence of a relatively large number of contract waterborne carries suggests that there is a basis for competition in the region for shipping general cargo. Also, the recent withdrawal of Crowley from the region as a general cargo carrier suggests that the market might actually be highly competitive. On the basis of the withdrawal of Crowley and the presence of contract general cargo carriers, for this study, rates are assumed to be representative of costs. Accordingly, general cargo shipping rates for selected communities were obtained from Northland Services and are used as the basis for determining potential savings that might result from construction of a new regional port. The rates are shown in Table 25.

As shown in Table 25, the same rates apply to a number of villages that are located in different sub-regions and are at substantially different distances from each other and any common regional point, such as a regional port. The commonality of rates is therefore not only a function of distance but also, and primarily, due to local navigation and moorage/unloading conditions. This strongly suggests that marginal differences in the cost of shipping general cargo to and within the Yukon-Kuskokwim Delta region is determined largely by local rather than regional port facilities. Thus, a greater marginal savings in the cost of shipping general cargo to a specific village could be obtained by improving navigation and port facilities at that village than in constructing a new port.

To illustrate the point that shipping costs appear to be largely a function of local conditions rather than the availability of a regional port, Table 26 was prepared to show the aggregations of the villages according to shipping rates together with sub-regional locations, distances from Bethel (used only as a common point) and a cost index. The cost index was computed by dividing the rate for Lumb1 for each village by the rate for Lumb1 for Bethel. As shown in Table 26, there is a somewhat unrelated mix of locations and distances from Bethel within each of the aggregations.

Table 25. Yukon-Kuskokwim Delta Coast Regional Economics--General Cargo Shipping Rates for Selected Villages

	**********	**********	**********	**********	Transportation Rates	**********	**********	**********	**********	**********	
Sub-Region/Village	**Lumb1**	**Lumb2**	**BuildM1**	**BuildM2**	**Panels**	**Mach1**	**Mach2**	**Mach3**	**Mach4**	**Vehicles**	**Fuel**
Coast--Goodnews Bay to Kuskokwim River											
Goodnews Bay	30.80	28.73	73.16	45.40	83.00	51.80	54.35	70.45	87.31	435.00	38.53
Quinhagak	38.50	36.19	80.62	50.05	86.80	59.19	63.56	83.50	93.19	469.00	48.10
Kuskokwim River, Mouth to Bethel											
Eek	27.89	25.79	67.33	41.52	74.80	46.53	49.08	65.18	82.04	392.00	35.68
Nunapitchuk	23.11	20.96	57.76	35.14	63.54	38.26	40.81	56.91	73.77	326.00	31.54
Bethel											
Bethel (shipping) 1/	12.19	10.69	36.41	23.20	na	na	na	na	na	na	na
Wharf age (per cwt)	0.26	0.26	0.39	0.39	na	na	na	na	na	na	na
Handling (per flat)	173.25	173.25	173.25	173.25	na	na	na	na	na	na	na
Kuskokwim River, Bethel to Nikolai											
Lower Kalskag	23.11	20.96	57.76	35.14	63.54	38.26	40.81	56.91	73.77	326.00	31.54
Aniak	23.11	20.96	57.76	35.14	63.54	38.26	40.81	56.91	73.77	326.00	31.54
Sleetmute	27.89	25.79	67.33	41.52	74.80	46.53	49.08	65.18	82.04	392.00	35.68
McGrath	30.80	28.73	73.16	45.40	83.00	51.80	54.35	70.45	87.31	435.00	38.53
Coast & Yukon Mouth--Kuskokwim River to Emmonak											
Chefornak	38.50	36.19	80.62	50.05	86.80	59.19	63.56	83.50	93.19	469.00	48.10
Toksook Bay	30.80	28.73	73.16	45.40	83.00	51.80	54.35	70.45	87.31	435.00	38.53
Mekoryuk	30.80	28.73	73.16	45.40	83.00	51.80	54.35	70.45	87.31	435.00	38.53
Hooper Bay	38.50	36.19	80.62	50.05	86.80	59.19	63.56	83.50	93.19	469.00	48.10
Scammon Bay	38.50	36.19	80.62	50.05	86.80	59.19	63.56	83.50	93.19	469.00	48.10
Emmonak	38.50	36.19	80.62	50.05	86.80	59.19	63.56	83.50	93.19	469.00	48.10
Coast & Yukon Mouth--Kotlik to Saint Michael											
St. Michael	na	na	na	na	na	na	na	na	na	na	na
Yukon River--Mountain Village to Holy Cross											
St. Marys/Andreafsky	38.50	36.19	80.62	50.05	86.80	59.19	63.56	83.50	93.19	469.00	48.10
Holy Cross	na	na	na	na	na	na	na	na	na	na	na

Table 25. Yukon-Kuskokwim Delta Coast Regional Economics--General Cargo Shipping Rates for Selected Villages

Source: Northland Services (Kerri Hokoda, khakoda@northlandservicesinc.com), 14 Nov 00

Notes:

Lumb1 = Lumber and misc. building materials loaded onto platforms with 30,000 lb minimum per flat (per cwt)

Lumb2 = Lumber and misc. building materials loaded onto platforms with 36,000 lb minimum per flat (per cwt)

BuildM1 = Building materials loaded into closed containers, 10,000 lb min per container (per cwt)

(Same rate is to be used for groceries, household goods and ATVS, etc.)

BuildM2 = Building materials loaded into closed containers, 18,000 lb min per container (per cwt)

(Same rate is to be used for groceries, household goods and ATVS, etc.)

Panels = Insulated building materials loaded onto flats (per cwt)

Mach1 = Machinery weighing from 15,000 to 21,999 pounds (per sq. ft.)

Mach2 = Machinery weighing from 22,000 to 39,999 pounds (per sq. ft.)

Mach3 = Machinery weighing from 40,000 to 49,999 pounds (per sq. ft.)

Mach4 = Machinery weighing 50,000 pounds and over (per sq. ft.)

Vehicles = All passenger and transportation vehicles (per lin. Ft.)

Fuel = Oil and petroleum products in drums with a minimum of 20,000 lbs per container

1/ Rate for BuildM2 is for a minimum of 16,000 lbs per container. Rates for minimums of 24,000 and 34,000 lbs are 15.76 and 12.24, respectively.

Table 26. Aggregations of Villages with Common General Cargo Shipping Rates (Costs) and Distances To Bethel

Aggregation/Village	Sub-Region	Distance to Bethel 1/	Cost Index 2/
First Aggregation			
Nunapitchuk	Kuskokwim River, Mouth to Bethel	46	1.90
Lower Kalskag	Kuskokwim R, Bethel to Nikolai	96	1.90
Aniak	Kuskokwim R, Bethel to Nikolai	127	1.90
Second Aggregation			
Eek	Kuskokwim R, Mouth to Bethel	80	2.29
Sleetmute	Kuskokwim R, Bethel to Nikolai	236	2.29
Third Aggregation			
Goodnews Bay	Coast--Goodnews Bay to Kuskokwim R	164	2.53
McGrath	Kuskokwim R, Bethel to Nikolai	388	2.53
Toksook Bay	Coast & Yukon Mouth--Kuskokwim R to Emmonak	200	2.53
Mekoryuk	Coast & Yukon Mouth--Kuskokwim R to Emmonak	229	2.53
Fourth Aggregation			
Quinhagak	Coast--Goodnews Bay to Kuskokwim R	94	3.16
Chefornak	Coast & Yukon Mouth--Kuskokwim R to Emmonak	182	3.16
Hooper Bay	Coast & Yukon Mouth--Kuskokwim R to Emmonak	291	3.16
Scammon Bay	Coast & Yukon Mouth--Kuskokwim R to Emmonak	330	3.16
Emmonak	Coast & Yukon Mouth--Kuskokwim R to Emmonak	385	3.16
St. Mary's	Yukon R--Mountain Village to Holy Cross	473	3.16
Fifth Aggregation			
Bethel	Bethel	-	1.00

Notes:

1/ River/water miles calculated using Microsoft Streets 2001.

2/ Ratio of rate for Lumb1for each aggregation to the rate for Bethel, excluding wharfage and handling.

9.2 Navigation Problems and Needed Improvements

9.2.1 Navigation Problems

To summarize what has been stated previously, general cargo is shipped to coastal communities in the Yukon-Kuskokwim Delta region by line-haul ocean barges in combination with lightering barges. The ocean barge is typically anchored in Goodnews Bay and the lightering barges transship the cargo from that location to coastal communities north to and including Scammon Bay. General cargo destined for Kuskokwim River communities in taken by the line-haul ocean barges to Bethel from where it is transshipped to the rest of the communities from the mouth of the river, excluding Eek and Tuntutuliak, to Nikolai. General cargo destined for communities on the lower Yukon River is typically trucked from Anchorage to Nenana from where it is barged down river.

As with fuel shipments, general cargo shipments to the coastal communities utilize the ocean barge as a regional port. The Port of Bethel (Kuskokwim River) and Nenana (Tanana River) serve the rest of the region. According to representatives of Northland Services, use of a new regional port to transship general cargo to coastal communities would increase transportation costs. For example, the cargo would have to be handled one more time to reload it to the lightering barges at

the port. The only problem related to the issue of a regional port that Northland Services reported encountering is the relatively shallow depth of water over the Johnson Bar or Oscarville Crossing on the Kuskokwim River. The loaded draft of the line-haul cargo barges is 14 feet, the same as the other types of barges previously discussed. During low water conditions when the depth of water over the bar is reduced to about 12 feet, line-haul cargo barges must be light-loaded going into Bethel or enough cargo must be lightered to reduce draft to the point where the bar can be crossed.

9.2.2 Need for a New Regional Port

According to representatives of Northland Services, a new regional port is not needed for transporting general cargo within the Yukon-Kuskokwim Delta region. The current use of line-haul cargo barges as a regional transshipment center for general cargo deliveries to coastal communities is considered to be efficient and significantly lower in cost than a new regional port would be. Also, shipping rates show that local conditions are a more significant factor than distance from Bethel, the existing regional port. Accordingly, it is unlikely that Northland Services would use a new regional port for distribution of general cargo to coastal communities if one were to be constructed.

9.2.3 Need for Other Navigation Improvements

Navigation improvements that would reduce the cost of distributing general cargo within the region are the same as those identified for shipment of sand, gravel and rock and fuel. These improvements are reiterated as follows:

- Construction of minimal docking facilities at communities along the Yukon and Kuskokwim Rivers—This would reduce the time required to dock and unload cargo and it would reduce the cost of unloading equipment that now if often operated in relatively rough conditions, causing excessive wear and maintenance.
- Dredging the Johnson Bar to a depth of about three feet for approximately one-half mile to maintain a minimum channel depth during the shipping season of 14 feet—This would reduce delays and eliminate the need for light loading and the lightering during low water conditions.

9.3 Potential NED Benefits of a New Regional Port

Based on the information obtained during the course of this study, a new regional port would not result in any measurable NED benefits to shippers of general cargo, except at the site of the new port where rates could be expected to be about the same as current rates at Bethel.

9.4 Potential NED Benefits of Navigation Improvements on the Kuskokwim River

As noted above, navigation improvements on the Kuskokwim River in the form of dredging the Johnson bar and installing navigation aids is needed. As with shippers of commodities, these improvements would benefit general cargo shippers as follows:

- Reduced cost of pilot services
- Reduced cost of delays

- Reduced costs of light loading (more efficient use of equipment)
- Reduced cost of lightering

Analysis of these benefits is beyond the scope of this study but should be given priority for future study.

9.5 By-Pass Mail

9.5.1 Definition and Current Rates

Bypass mail is defined as bulk Standard Mail that is prepared so as not to require handling in a postal facility. The bypass mail program was established to alleviate congestion of mail in processing centers by creating bypass acceptance points. Qualified air carriers deliver the mail. The rate of payment to the carriers is based on the class of mail (priority or non-priority) and the payload capacity of the aircraft used to transport the mail (Mainline or Bush). The correct postage must be affixed to each piece of mail and an individual piece may not exceed 108 inches (combined length and girth) or weigh more than 70 pounds. Pieces of mail must be palletized and the weight of each pallet cannot exceed 2,500 pounds. To be eligible for acceptance in the bypass program, a shipment to a single addressee must weigh a minimum of 1,000 pounds. Neither hazardous nor building and construction materials can be shipped as bypass mail. The postal rate for this type of mail is $7.28 for a parcel weighing 70 pounds ($0.104 per pound or $208.00 per ton). Because bypass mail is heavily used to re-supply stores in rural Alaska and because of the minimum shipment requirement, it is assumed that essentially all bypass mail is shipped at this rate. The complete schedule of rates for local and intra-BMC/ASF parcel post is shown in Table 27. The rates that apply to rural Alaska are those for zones 1&2.

Table 27. Parcel Post Rates Used for Bypass Mail

Rates - Standard Mail (B) 5.3 Local and Intra-BMC/ASF Parcel Post

Weight not over (pounds)	Zone A/, B/, C/				
	Local	1 & 2	3	4	5
2	$2.67	$2.80	$2.80	$2.80	$2.80
3	2.87	3.17	3.26	3.27	3.29
4	3.04	3.32	3.57	3.58	4.14
5	3.19	3.45	3.85	3.88	4.63
6	3.28	3.58	4.13	4.15	5.08
7	3.35	3.69	4.37	4.40	5.50
8	3.43	3.82	4.59	4.63	5.90
9	3.50	3.91	4.77	4.86	6.27
10	3.58	4.03	5.01	5.08	6.62
11	3.64	4.12	5.18	5.27	6.94
12	3.71	4.23	5.33	5.47	7.26
13	3.78	4.32	5.46	5.65	7.54

Weight not over (pounds)	Zone A/, B/, C/				
	Local	1 & 2	3	4	5
14	3.84	4.41	5.55	5.83	7.82
15	3.90	4.49	5.68	5.99	8.08
16	3.97	4.56	5.81	6.15	8.33
17	4.02	4.65	5.93	6.31	8.56
18	4.07	4.72	6.05	6.45	8.80
19	4.12	4.81	6.16	6.59	9.01
20	4.19	4.88	6.27	6.74	9.21
21	4.23	4.94	6.38	6.87	9.41
22	4.28	5.02	6.47	7.00	9.60
23	4.33	5.08	6.59	7.13	9.79
24	4.38	5.14	6.68	7.24	9.96
25	4.43	5.20	6.77	7.36	10.13
26	4.47	5.27	6.86	7.47	10.29
27	4.52	5.33	6.96	7.58	10.44
28	4.56	5.38	7.05	7.69	10.59
29	4.62	5.45	7.14	7.80	10.74
30	4.67	5.50	7.22	7.89	10.89
31	4.71	5.56	7.28	7.99	11.02
32	4.75	5.62	7.37	8.09	11.15
33	4.80	5.67	7.45	8.19	11.29
34	4.84	5.72	7.51	8.27	11.40
35	4.88	5.77	7.59	8.37	11.52
36	4.91	5.82	7.66	8.46	11.65
37	4.95	5.88	7.72	8.54	11.76
38	4.99	5.93	7.80	8.62	11.87
39	5.04	5.98	7.87	8.71	11.97
40	5.08	6.02	7.93	8.78	12.08
41	5.12	6.08	8.01	8.87	12.18
42	5.16	6.12	8.06	8.94	12.27
43	5.20	6.16	8.13	9.02	12.38
44	5.25	6.21	8.18	9.10	12.46
45	5.28	6.25	8.24	9.16	12.56
46	5.32	6.31	8.31	9.24	12.64
47	5.36	6.36	8.36	9.30	12.73
48	5.40	6.40	8.42	9.38	12.83

Weight not over (pounds)	Zone A/, B/, C/				
	Local	1 & 2	3	4	5
49	5.43	6.44	8.48	9.44	12.90
50	5.47	6.47	8.53	9.51	12.99
51	5.51	6.53	8.58	9.57	13.06
52	5.54	6.57	8.65	9.64	13.14
53	5.58	6.60	8.70	9.70	13.21
54	5.62	6.64	8.75	9.76	13.29
55	5.66	6.68	8.79	9.82	13.36
56	5.69	6.73	8.85	9.89	13.42
57	5.72	6.77	8.91	9.94	13.50
58	5.76	6.81	8.94	9.99	13.57
59	5.80	6.85	9.00	10.06	13.63
60	5.82	6.89	9.05	10.11	13.70
61	5.88	6.94	9.10	10.17	13.77
62	5.90	6.98	9.14	10.22	13.82
63	5.94	7.01	9.19	10.28	13.88
64	5.97	7.05	9.23	10.33	13.95
65	6.01	7.09	9.28	10.38	14.00
66	6.03	7.14	9.33	10.44	14.07
67	6.08	7.18	9.37	10.49	14.12
68	6.11	7.20	9.41	10.54	14.17
69	6.15	7.24	9.45	10.59	14.23
70	6.18	7.28	9.52	10.64	14.28
Oversized	19.43	28.42	28.42	28.42	28.42

Notes:
A/ For barcoded discount, deduct $0.03 per piece (machinable parcels only).
B/ Pieces that measure more than 108 inches (but not more than 130 inches) in combined length and girth pay the oversized rate, regardless of the actual weight of the piece.
C/ Parcels that weigh less than 15 pounds but measure more than 84 inches (but not more than 108 inches) in combined length and girth are charged the applicable rate for a 15-pound parcel.

9.5.2 Comparison of Bypass Mail and General Cargo Rates

On the basis of the assumption that villagers in the Yukon-Kuskokwim Delta Region take full advantage of the bypass mail program and, in general, insure that this mail is shipped at the lowest cost per pound, the average cost of shipping general cargo via bypass mail rather than by barge would be $10.40 per cwt compared with a range of from $23.20 (excluding wharfage and handling) at Bethel and $50.05 at several other villages (see Table 25). On the basis of this comparison, it is not surprising that Northland Services does not have a specific shipping rate for

groceries and household goods. It is also not surprising that rural Alaskans throughout the state rely heavily on bypass mail when shipping general cargo that meets program specifications.

9.5.3 Volume of Bypass Mail

Data on the volume of parcel post bypass mail in Alaska has been requested through the Post Office's national information center and through the Post Office in Anchorage. The only response that has been received to date is notification that the request through the national information center has been referred to the Post Office in Anchorage for response. The data is needed as the basis for estimating the potential volume of general cargo that has been diverted away from waterborne carriers. Absent this data, and assuming that "smaller" items are shipped by air and "larger" items are shipped by barge, as much as one-half of all general cargo moved within the region could be moved as bypass mail.[7]

9.6 Effects of Airport Expansion on General Cargo Movement

Shipping is a service that, like all other goods and services in a free market economy, is chosen largely on the basis of price. In the case of the Yukon-Kuskokwim Delta Region (and the rest of rural Alaska) competition in the general cargo shipping market is provided by alternative choices of carriers and rates, including the heavily subsidized rates of the bypass mail program. As shown above in the assessment of the bypass mail program, rates for shipping qualified general cargo via bypass mail ranges from just 45 to 21 percent of the cost of shipping by barge. In addition, delivery service of the bypass mail is much superior to that of barge shipments. With bypass mail, orders need only be placed about one day in advance while orders to be shipped by barge must be placed months in advance and there is typically only about two potential shipping dates.

Because of the extreme current cost advantage offered by air shipments of qualified general cargo via the bypass mail program over barge shipments it must be assumed that all general cargo that can be shipped by air is currently being shipped by this mode. Therefore, it is unlikely that airport expansion would have any effect on the movement of general cargo that qualifies for the bypass mail program to the region. However, to the extent that airports are expanded to accommodate large transport aircraft such as the C-130 Hercules, there could be some diversion of vehicles and equipment away from barge shipment. Because of the higher cost of air transport of machinery and heavy equipment, such diversion should be minimal and should be expected to occur as a result of the urgency of the need for the equipment rather than a general shift from barge shipment to air shipment.

To the extent that airport extensions allow the use of more efficient aircraft for transport of bypass mail, they could result in a decrease in the Federal subsidy to the program but not rates or the volume of bypass mail.

[7] This assumption is made on the basis of personal knowledge of shipments of bypass mail to the Village of Venetie and responses to the CVRF questionnaire (see Assessment of Local Knowledge in a following section of the report).

10.0 Analysis of Fish Movement (Task 3.5)

10.1 Description of Fisheries

10.1.1 Community Develop Quota Program (CDQ)

The Western Alaska ocean fishery targets groundfish, halibut, crab and species for which commercial harvest is generally prohibited. The basis for the fishery is the Western Alaska Community Development Quota (CDQ) Program that was established in 1992 and is administered by the National Marine Fisheries Service (NMFS) and the State of Alaska. The CDQ program allocates a percentage of all Bering Sea and Aleutian Islands quotas for groundfish, prohibited species, halibut, and crab to eligible communities. The purpose of the CDQ Program is to provide the means for starting or supporting commercial fisheries business activities that will result in an ongoing, regionally based, fisheries-related economy in Western Alaska. The study area includes all or portions of three CDQ Groups—Coastal Villages Regional Fund (CVRF), Yukon Delta Fisheries Development Association (YDFDA) and Norton Sound Economic Development Corporation (NSEDC). The CVRF group includes the entire southern portion of the study area from Platinum to the south to Scammon Bay to the north. The YDFDA group includes all of the Yukon River Delta communities from Nunam Iqua to the south to Kotlik to the north and upriver to Mountain Village and Grayling. The remaining two coastal communities in the study area, Stebbins and Saint Michael, are included in the NSEDC group. In all, 27 of the study area's 50 communities representing about 48 percent of the population of the study area participate in the CDQ fishery. The CDQ groups and communities are listed in Table 28.

Table 28. Yukon-Kuskokwim Delta Coast Regional Economics--CDQ Groups and Communities

CDQ Group/Village	1999 Pop	CDQ Group/Village	1999 Pop
Coastal Villages Fund		**Yukon Delta Fisheries Development Association**	
Goodnews Bay	256	Nunam Iqua	181
Platinum	43	Alakanuk	659
Quinhagak	595	Emmonak	818
Eek	281	Mountain Village	766
Tuntutuliak	350	Kotlik	579
Napakiak	363	**Total 1/**	**3,003**
Napaskiak	406	**Total 2/**	**3,190**
Oscarville	64	**Norton Sound Development Corporation**	
Kongiganak	359	Stebbins	543
Kwigillingok	360	St. Michael	381
Kipnuk	573	**Total**	**924**
Chefornak	416	**Grand Total 3/**	**11,819**
Toksook Bay	513	**Percent of Study Area**	**48%**
Nightmute	230		
Tununak	331		
Mekoryuk	193		
Newtok	284		
Hooper Bay	1,028		
Chevak	763		
Scammon Bay	484		
Total	**7,892**		

Note:
1/ YDFDA also includes Grayling, population 187.
2/ Includes Grayling.
3/ Excludes Grayling.

10.1.2 CDQ Target Species

Species targeted in the CDQ fishery include essentially all of the commercial species of the Bering Sea. Species and the portion of the total CDQ fishery allocation by NMFS for 2000 are shown in Table 29 for each of the three CDQ groups included in the study area.

Table 29. Yukon-Kuskokwim Delta Coast Regional Economics—CDQ Fishery Allocation: 2000

Category	Total Allocation(mtons)	Share of Allocation 1/ CVFR 2/(%)	YDFDA 2/(%)	Study Area Share (%)	Amount (mtons)
CDQ Reserve Category					
BS FG Sablefish	147.0	0	25	25	36.8
AI FG Sablefish	364.0	30	15	45	163.8
BS Sablefish	55.0	17	19	36	19.8
AI Sablefish	45.0	17	19	36	16.2
BS Pollock	113,900.0	22	14	36	41,004.0
AI Pollock	200.0	22	14	36	72.0
Bogoslof Pollock	100.0	22	14	36	36.0
Pacific Cod	14,475.0	17	19	36	5,211.0
WAI Atka Mackerel	2,227.0	17	20	37	824.0
CAI Atka Mackerel	1,852.0	17	20	37	685.2
EAI/BS Atka Mackerel	1,230.0	17	20	37	455.1
Yellofin Sole	9,244.0	5	28	33	3,050.5
Rock Sole	10,107.0	20	20	40	4,042.8
BS Greenland Turbot	467.0	1	24	25	116.8
AI Greenland Turbot	230.0	14	19	33	75.9
Arrowtooth Flounder	9,825.0	16	20	36	3,537.0
Flathead Sole	3,948.0	15	20	35	1,381.8
Other Flatfish	6,285.0	15	20	35	2,199.8
BS Pacific Ocean Perch	195.0	17	20	37	72.2
AI Pacific Ocean Perch	425.0	17	20	37	157.3
CAI Pacific Ocean Perch	263.0	17	20	37	97.3
EAI Pacific Ocean Perch	234.0	17	20	37	86.6
BS Other Red Rockfish	14.0	17	20	37	5.2
AI Sharpchin/Northern Rockfish	386.0	17	20	37	142.8
AI Shortraker/Rougheye Rockfish	66.0	17	19	36	23.8
BS Other Rockfish	27.0	18	19	37	10.0
AI Other Rockfish	51.0	18	19	37	18.9
Squid	147.0	22	14	36	52.9
Other Species	2,352.0	14	21	35	823.2
PSQ Reserve Category	**Allocation**	**(%)**	**(%)**		
Zone 1 Red King Crab	7,275.0	15	21	36	2,619.0
Zone 1 Bairdi Tanner Crab	62,250.0	9	26	35	21,787.5
Zone 2 Bairdi Tanner Crab	189,000.0	9	26	35	66,150.0

Table 29. Yukon-Kuskokwim Delta Coast Regional Economics—CDQ Fishery Allocation: 2000

Category	Total Allocation(mtons)	Share of Allocation 1/ CVFR 2/(%)	YDFDA 2/(%)	Study Area Share (%)	Amount (mtons)
Opilio Tanner Crab	326,250.0	8	26	34	110,925.0
Pacific Halibut	343.0	13	23	36	123.5
Chinook Salmon	3,600.0	22	14	36	1,296.0
Non-Chinook Salmon	3,150.0	22	14	36	1,134.0
Totals	**770,729**			**35%**	**268,453**

Source: Nat'l Marine Fisheries Service Alaska Regional Office, MS CDQ/PSQ Annual Allocation Matrix 2000.

Notes:
1/ Excludes Stebbins and St. Michael that are both in the Norton Sound Economic Development Corp.
2/ CVFR = Coastal Villages Region Fund. YDFDA = Yukon Delta Fisheries Development Assoc.

In terms of significance, four species dominate the CDQ allocation for the study area, excluding Stebbins and Saint Michael, with Opilio Tanner crab, Zone 2 Bairdi Tanner crab, Bering Sea Pollock and Zone 1 Bairdi Tanner crab making up 41.3 percent, 24.6 percent, 15.3 percent and 8.1 percent, respectively of the total allocation. Taken together these four species account for 89.3 of the total allocation.

10.1.3 Harvest and Processing

Based on the information available for this study, it appears that catcher/processors and catchers that fish for a mother ship or deliver to shore based processing plants (located at Saint Paul) harvest all of the CDQ allocation in the study area, except halibut. Typically catcher/processor and catcher vessels operate out of Seattle and do not call at any ports in Western Alaska. Data currently available on the NMFS website on fishing vessels and processing facilities for the CDQ fishery is limited to the years 1999 and 2000 and was only available for the combined CDQ area. Available information is summarized in Table 30. As shown in Table 28, from 1999 to 2000 trawl vessels decreased from a total of 39 to a total of 26 and HAL (hook and line) vessels increased from 23 to 26. In addition, 9 pot vessels entered the fishery in 2000. However, overall there was a net decrease in vessels and processing facilities of one from 1999 to 2000.

Table 30. Yukon-Kuskokwim Delta Coast Regional Economics--Number of Vessels and Processors

Year/Type	Pollock Trawl	Other Trawl	HAL	Pot	Total
2000					
Catcher/Processors	11	6	11	-	28
Catcher Vessels	7	-	11	6	24
Motherships	1	-	-	-	1
Shoreplants	1	-	4	3	8
Totals	20	6	26	9	61
1999					
Catcher/Processors	10	7	14	-	31
Catcher Vessels	17	-	7	-	24
Motherships	1	-	-	-	1
Shoreplants	4	-	2	-	6
Totals	**32**	**7**	**23**	**-**	**62**

Source: Source: National Marine Fisheries Service, Alaska Regional Office.
Note: HAL = Hook and Line

10.1.4 Harvest Trends in the Fisheries

10.1.4.1 Groundfish

The Bering Sea fishery is highly regulated with catch quotas being set annually by the North Pacific Fisheries Management Council (Council) of the National Marine Fisheries Service. The Council has jurisdiction over the 900,000 square mile Exclusive Economic Zone (EEZ) off Alaska. The Council has primary responsibility for groundfish management in the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI), including cod, pollock, flatfish, mackerel, sablefish, and rockfish species harvested mainly by trawlers, hook and line longliners and pot fishermen. The fisheries are managed to a harvest level of optimum yield, which has been defined as 85 percent of the maximum sustainable yield for groundfish, for example. The present level of harvest effort is determined by the annual allocation set by the Council. In general, the industry is fully capable of harvesting the entire allowable catch. Accordingly, provided that stock assessments are accurate, there is virtually no possibility for increased harvest of Bering Sea stocks of commercial fish in the future. Instead, total harvest can be expected to remain at about the current level. The Sustainable Fisheries Act sets the CDQ share of the total harvest at 7.5 percent of total harvest of each fishery. Although harvest is now at optimum sustained yield, CDQ harvest could increase because of increased efficiency of fishing effort. The potential for increased harvest is shown in Table 31 in which the combined CDQ allocation, catch, remaining allocation and percent of allocation remaining are shown for 1998, 1999 and 2000. As shown in Table 31, the combined CDQ fishery failed to harvest 92.4 percent of its allocation in 1998. Since then, the percent of allocation remaining has been decreased to 25.5 percent in 2000. Thus, the combined CDQ fishery could increase by an estimated 45,000 metric tons. Data for earlier years (the CDQ fishery began in 1992) was not available for this study.

Table 31. Yukon-Kuskokwim Delta Coast Regional Economics--Catch For All CDQ Groups Combined

Year	Amount Available (mtons)	Catch To Date (mtons)	Amount Remaining (mtons)	Percent Remaining
1998 1/	64.272.5	4,871.9	59,400.7	92.4
1999 1/	173,052.0	121,785.5	51,266.5	29.6
2000 1/	177,012.0	131,937.6	45,074.8	25.5

Source: National Marine Fisheries Service, Alaska Regional Office, MS CDQ/PSQ Catch To Date For All CDQ Groups Combined.
Notes:
1/ Excludes PSQ Reserve Category

In addition to a potential for some increase in the CDQ fishery because of improved harvest efficiency (i.e., catch a higher percentage of the allocation), CDQ groups compete annually for shares of the total allocation. For 2001-2002, for example, the CVRF has requested a significant increase in its share of every fishery. The largest increase is proposed for Tanner Crab where the CVRF requests that its share be increased from about 9 percent to 25 percent. At the same time the YDFDA is requesting that their Pollock allocation be increased from 14 to 17 percent and that their halibut allocation be increased from 26 to 40 percent, with allocations for the other species to remain at 2000 levels. Obviously, fisheries managers cannot meet these competing requests. From a national perspective, increases in shares of the total allocation of fisheries to the CDQ groups represent reallocation of the resource among the CDQ groups and does not represent an

increase in harvest or national economic efficiency. Data required to evaluate the comparative advantages of the six CDQ groups and potential increases in economic efficiencies that may result from reallocating the fisheries among them is not currently available. Furthermore, analysis of this issue is beyond the scope of this study. Therefore, for the purpose of this study the assumption is that there will be no increase in harvest in the Bering Sea fisheries and that the allocation of the resources will continue at 2000 levels.

10.1.4.2 Halibut and Sablefish

The CDQ halibut fishery in the study area consists of Areas 4D and 4E. Area 4E is adjacent the coast and extends westward to 168 degrees west longitude, southward to 52 degrees 20 minutes north latitude and northward to 65 degrees 34 minutes north latitude. Area 4D lies to the west of Area 4E, excluding a conservation area around the Pribilof Islands and extends westward to the US/Russian boundary. Area 4D is fished exclusively by large ocean-going vessels, whereas Area 4E is fished heavily by small vessels that are based in CDQ communities in Western Alaska. CDQ catch and allocation data for halibut Areas 4D and 4E and Bering Sea sablefish is shown in Table 29. As shown in Table 32, halibut catch in Area 4D has consistently about equal to the allocation. However, catch in Area 4E has decreased from a landing rate of about 100 percent during 1995 through 1997 to only about 60 percent in 1998 and 70 percent in 1999. There is no explanation of the decrease. Data for from the National Marine Fisheries Service for 2000 shows that the landing rate was slightly more that 92 percent as of 4 December 2000.

Table 32. Halibut and Sablefish CDQ Landings and Catch, 1995-1999

Area	Species	Vessel Landings	Total Catch (lbs)	Allocation (lbs)	Remaining (lbs)	Percent (lbs)
1995						
4D	halibut	115	229,279	231,000	1,721	99.3
4E	halibut	383	125,630	120,000	(5,630)	104.7
	Total	498	354,909	351,000	(3,909)	101.1
BS	sablefish	12	117,130	352,800	235,670	33.2
1996						
4D	halibut	248	229,426	231,000	1,574	99.3
4E	halibut	526	121,241	120,000	(1,241)	101.0
	Total	774	350,667	351,000	333	99.9
BS	sablefish	11	107,479	242,506	135,027	44.3
1997						
4D	halibut	1,269	349,863	348,000	(1,863)	100.5
4E	halibut	1,357	256,911	260,000	3,089	98.8
	Total	2,626	606,774	608,000	1,226	99.8
BS	sablefish	4	164,342	242,506	78,164	67.8
1998						
4D	halibut	79	469,396	477,000	7,604	98.4
4E	halibut	834	191,213	320,000	128,787	59.8
	Total	913	660,609	797,000	136,391	82.9
BS	sablefish	10	93,166	286,598	193,432	32.5
1999						
4D	halibut	26	603,018	609,000	5,982	99.0
4E	halibut	1,293	272,650	390,000	117,350	69.9
	Total	1,319	875,668	999,000	123,332	87.7
BS	sablefish	na	na	na	na	na

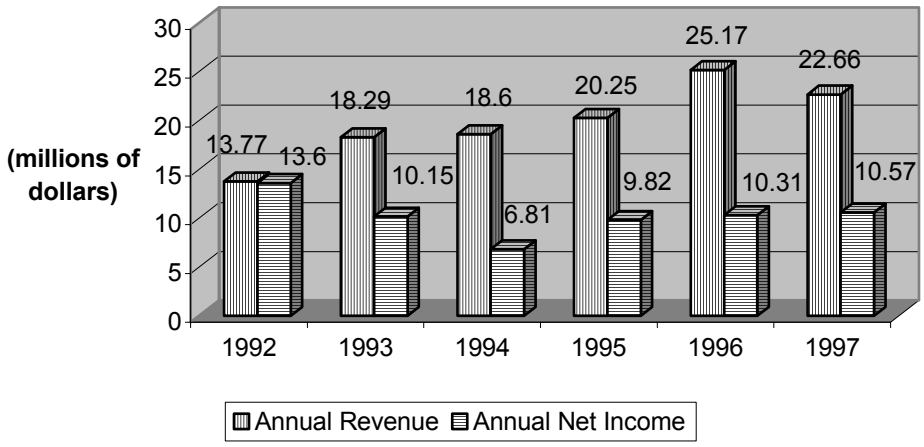
Source: Individual Fishing Quota (IFQ)/Community Development (CDQ) Halibut Program Reports, National Marine Fisheries Service, Alaska Regional Office.

10.2 Community Development Quota (CDQ) Plans for Infrastructure Development

10.2.1 Sources of Investment Revenue

The primary source of revenue for CDQ groups is royalties from the sale of CDQ allocations of Bering Sea fish resources to commercial fishing interests. A secondary source is return on investments that the groups have made, primarily in the commercial fishing industry. Annual revenue to all of the CDQ groups increased from 13.77 million in 1992 to 25.17 million in 1996 and declined somewhat to $22.86 million in 1997. CDQ revenues and net income for the period, 1992-1997 are shown in Figure 1.

Figure 1. CDQ Revenue and Net Income, 1992-1997



10.2.2 Active and Proposed CDQ Investment Projects

Since the Community Development Quota program (CDQ) was developed to enable residents of rural fishing communities in western Alaska to participate in the groundfish fishery off their shores in a way that will bring significant economic development to the Bering Sea region, each of the CDQ groups is required to develop and submit a Community Development Plan (CDP) to the Alaska Department of Community and Economic Development (DCED). The CDPs are reviewed and evaluated by the DCED to determine if the CDP will directly benefit the communities and individuals within the village. Proposed investments are evaluated to determine if are likely to yield a reasonable rate of return. The CDP provides the basis for each CDQ's request for allocations of the Bering Sea fishery resources. This section of the report presents a summary listing of the active and proposed investment projects included in the CDP's submitted by the CVRF and the YDFDA for the 2001-2002 CDQ allocation.

10.2.2.1 Coastal Villages Region Fund

Following is a summary listing of proposed and active investment projects included in CVRF's allocation request for 2001-20002. The summary excludes scholarship and other training programs and community development projects that do not represent direct investment in the fishing industry.

- Proposed Projects

  - 2001/2002 Investigate investment opportunities in groundfish vessels.
  - 2001/2002 Invest in a second crab vessel.
  - 2001/2002 Initiate halibut buying operations in Hooper Bay.
  - 2001/2002 Purchase one or more tender vessels to support the shore-side processing projects.
  - 2001/2002 Start one or businesses that support the Inshore Program (e.g., gear suppliers, construction contractors, repair services).
  - 2001-2002 Pursue development of a regional port facility.

- Active Projects

  - 2001/2002 Groundfish vessels—CVRF has an investment interest in the Ocean Prowler.
  - 2001/2002 Crab vessels—CVRF has an investment interest in a crab vessel.
  - 2001/2002 Pollock vessels—Analyses will be done to determine if the 20 percent interest in American Seafoods should be increased.
  - 2001/2002 Kuskokwim Salmon—Determine the salmon program should be extended into the mainstem of the river. Some processing now occurs at Goodnews Bay and Quinhagak.
  - 2001/2002 Halibut—Have all plants operating by June 1 (Toksook Bay, Tununak, Mekoryuk and Chefornak (added in 2000)) and purchase at least 200,000 pounds of halibut.

10.2.2.2 Yukon Delta Fisheries Development Association

Following is a summary listing of proposed and active investment projects in included in CVRF's allocation request for 2001-20002. The summary excludes scholarship and other training programs and community development projects that do not represent direct investment in the fishing industry.

- Proposed Projects

  - Consider investment in catcher vessels that deliver or could deliver fish to the M/V Golden Alaska.
  - Purchase up to cap limits in sablefish and halibut IFQ shares.
  - Acquire up to a 50 percent equity interest in a crab vessel(s).
  - Acquire up to a 50 percent equity interest in a cod catcher/processor that will participate in both the open access and CDQ allocations.
  - Construct a skiff and sled production facility in a Yukon Delta village.

- Active Projects

  - YDFDA has equity in the M/V Golden Alaska processor ship and two catcher vessels.
  - YDFDA owns the 78-foot combination vessel Lisa Marie that participates in both CDQ and open access Pacific cod, sablefish, turbot and halibut fisheries.

- YDFDA has provided funding to the Kotlik Fisheries Cooperative for development of a small value-added plant in Kotlik. The plant is expected to operate in 2001 as a heading, gutting, icing and shipping facility for fresh salmon.

10.2.3 Effect of a Regional Port on CDQ Development Plans

10.2.3.1 Coastal Villages Region Fund

Development of a new regional port, preferably on Nunivak Island near Mekoryuk, is an integral part of the CVRF's CDP. The CVRF believes that the port would support an expanded fish processing operation and lower transportation costs for fuel and general cargo destined to CVRF member communities. Although the CDP includes development of a regional port, the success of existing and proposed investments is not dependent on the existence of a new regional port. In addition, the CDP does not include any investments whose economic viability is dependent upon the existence of a new regional port.

10.2.3.2 Yukon Delta Fisheries Development Association

The YDFDA's CDP does not include any active or proposed investment projects that would directly benefit from development of a new regional port in western Alaska. The focus of the groundfish fishery is on ocean processing and the focus of the salmon and halibut fisheries is on the fresh market that requires air transport of product.

10.2.3.3 Current Navigation Problems in the Fishery

Based on information obtained in public involvement efforts conducted by the CVRF, the most frequently mentioned problems related to the commercial fishery include the following:

- Lack of safe port facilities for loading supplies and unloading fish
- Lack of harbor facilities for moorage during storms and when not fishing at most villages and the lack of a full-tide harbor at Mekoryuk

10.3 Effect of a Regional Port on CDQ Harvest, Processing, Marketing and Transportation

10.3.1 Groundfish

Since groundfish resources are harvested and processed at sea, development of a regional port would not have an effect on these activities. It is possible that a regional port would have a favorable effect on marketing and transportation provided that the product could be concentrated at port facilities and marketed and transported in larger volumes and with greater efficiency. If there were significant economic advantages to such a strategy, these functions could be accomplished at either or both of the existing regional ports at Nome and Bethel. Economic justification of a regional port would require concentration of economic activity, especially in the Bering Sea fishery, at a regional hub where a port could be located. Such concentration of activity appears to be contrary to current CDPs for both the CVRF and the YDFDA in which emphasis seems to be on strengthening the local economies of member villages.

The only potential for significant NED benefits from the groundfish fishery that might accrue to a regional port would be from development of shore-side processing facilities in conjunction with development of the port, such as at Saint Paul. However, there are currently no such plans and, according the National Marine Fisheries Service, it is unlikely that shore-side processing facilities for groundfish in the Yukon-Kuskokwim Delta Region would be economically feasible. The bulk of the groundfish harvest is taken well south of this area and there is already an over-supply of adequate processing capacity available closer to the main fishing grounds.

10.3.2 Halibut and Salmon

As stated above, proposed investments in halibut and salmon fisheries appear to be directed at strengthening the economies of member communities of the CDQ groups in the study area rather than in concentrating economic activity at a regional hub. In addition, both halibut and salmon fisheries appear to be targeted at the fresh market. This requires an infrastructure strategy that focuses on timeliness and flexibility in marketing and transportation arrangements. To a point, these are best accomplished at the village level where processing facilities can be kept relatively small, where the catch can be delivered to maximize quality (freshness) and where air transport services are readily available. This appears to the direction that CDQ investment by both the CVRF and the YDFDA is directed.

10.4 Potential Regional Port NED Benefits

No significant measurable potential NED benefits to a regional port have been identified for the QDC fishery. However, if a port were constructed it would provide a limited amount of benefits to the village at which it were located. Due the relatively small magnitude of these potential benefits an attempt to quantify them was not been made.

11.0 Assessment of Local Knowledge, Regional Input (Task 3.7)

11.1 Public Invovlement

An important goal of the regional economics study was to solicit and incorporate local knowledge of economic, environmental, and social issues in the region. This local input was provided by interviews with representatives of communities, agencies, construction contractors, commercial shippers, and citizens from throughout the region. Agencies representatives, shipping companies, and construction contractors were identified and interviewed by phone. An opportunity for agencies and citizens to provide input to the process was provided during the annual CVRF (Coastal Villages Region Fund) Funding Summit, November 2-3, 2000 in Bethel. A special session was held from 6:30pm to 9:30pm on November 2 to discuss the regional economics study and to offer the public an opportunity to ask questions and provide input into the study process.

A questionnaire was developed and implemented by CVRF to obtain input from citizens of local communities on issues of interest to the study. These issues included:

- preferred port locations
- climate conditions at identified locations
- required port features and facilities
- existing problems with fuel and cargo shipments
- commercial fishing

- subsistence fishing
- natural resource extraction
- tourism
- community development
- environmental concerns
- social concerns

The questionnaire was explained and distributed at the workshop and workshop attendees were grouped by their communities to collectively discuss the issues and provide input to the study. Participants left with handout copies of the questionnaire to take back to their communities to provide opportunities for other citizens to provide input. CVRF provided additional copies of the handout to interested individuals who could not attend the Summit. A separate set of questions was developed for local government and tribal entities to answer and interviews were conducted by CVRF. Questions for entities included:

- real estate ownership data for recommended port sites
- fuel and cargo shipments to communities
- fuel storage capacities at communities
- regional fisheries
- fish delivery destinations
- fish processing practices
- natural resource extraction
- home construction rates
- tourism
- planned capital construction projects
- environmental and social concerns

The questionnaire given to representatives of village representatives and the tabulation of responses is included in this report as Appendix B. The questionnaire given to individuals and the tabulation of responses is included in the report as Appendix C.

11.2 Summary of Information Obtained From Village Representatives

Information obtained from representatives of coastal villages in the study area focused on eight main areas, including: respondent information; desired port locations and features, existing fuel and cargo shipments, fisheries industry issues, resource extraction industry issues, future community development issues, environmental concerns, and social issues and concerns. Brief summaries of the information obtained in each of these areas are presented below.

- *Respondent Information:* Information was provided by 11 representatives of Mararmuit, LKSD, Napakiak Corporation, Native Village of Kwinhagak, Newtok Traditional Council, Indian Reorganization Act Council (Mekoryuk), City of Mekoryuk, Tununak Traditional Council, Tununrmiut Rinit Corporation, Native Village of Goodnews Bay and City of Scammon Bay.

- *Port Location And Features:* Representatives of each of the organizations expressed the view that their village would be a suitable site for a new regional port. Accordingly, no conclusions could be reached on the basis of the information provided that would help in selecting a preferred port site. Land at each of these locations in native owned. Several respondents noted that pressure ridges in winter ice and spring breakup of sea ice would

be a problem at each location. Desired improvements and facilities related to port development that were identified are summarized in Table 33.

Table 33. Minimum Improvements And Types Of Facilities That Would Be Needed

1/	Breakwater	Dredging of Entry	Dredging of Harbor	Floats	Dock	Boat Ramp	Upland Parking Facilities	Upland Service Facilities
1	X	X	X	X	X	X	X	X
2	X			X	X	X	X	X
3	X	X	X		X	X	X	X
4		X	X	X	X	X	X	X
5								
6	X		X		X	X	X	X
7	X		X		X	X	X	X
8	X		X		X	X	X	X
9	X	X			X	X	X	X
10	X	X	X	X	X	X	X	X
11	X	X	X	X	X	X	X	X

Note: 1/ Rows in the table are responses from each of the 11 respondents. It is noted that one respondent (#5) did not indicate that any improvements would be needed.

- *Existing Fuel And Cargo Shipments:* In general, the information provided confirmed information obtained from other sources during the course of the study. However, in some cases the information provided indicates that residents of the region may not be very knowledgeable about how fuel and general cargo actually is moved into and within the region. Specifically, the responses indicated that (1) fuel is shipped by barge to each of the villages from outside the region; (2) large general cargo items are shipped by barge and smaller items are shipped by air; (3) except for villages close to Bethel, deliveries of both fuel and general cargo are made difficult by local conditions, including weather and water depths; (4) Crowley, Wave Fuels, Inc., Yukon Fuels and the BIA were identified as being fuel suppliers; (5) principal carriers of general cargo were identified as Crowley Maritime (Crowley Marine--no longer services the region), Wave and "coastal barges"; (6) generally, fuel shortages that occur as often as every year during the winter months occur only as a result of a failure to go into the winter with storage tanks full; (7) the cost of fuel and general cargo transportation service would be reduced by a regional port by eliminating landing delays (at the site of the port) and reducing transport distances to other villages; and finally, (8) estimates of general cargo shipments to the villages range from 10 to 100 tons each.

- *Fisheries Industry:* Information provided on the fishing industry confirms the finding that the industry is focused on community-based harvest and processing of relatively high value species, namely salmon, herring and halibut. Responses provided the following general information: (1) target species are salmon, halibut and herring; (2) fish are delivered to tenders or processing plants located not more than about 30 miles from the fishing site; (3) fish are processed at both at-sea and on-shore processing facilities; (4) the principal benefit of a new port facility is generally viewed as being better protection and operating conditions for fishing boats (benefits consistent with harbor, rather than port facilities); and, (5) fishing vessels operated from various locations within the region during the fishing season.

- *Resource Extraction Industry:* Respondents indicated that existing and potential resources that are now are could be exploited include fish (salmon, herring, halibut and shellfish), reindeer and sand, gravel and rock.

- *Future Community Development:* On this topic, respondents indicated that (1) up to about five homes are built each year in each village; (2) tourism is a potentially important source of income and the industry could be enhanced by construction of a new regional port by eliminating difficulties in landing small cruise ships that operate in the region; and, other future construction projects that were identified confirmed information obtained from the Alaska Department of Community and Economic Development's RAPIDS database.

- *Environmental Concerns:* On this topic, respondents indicated that (1) with the exception of minor oil spills there are no significant environmental concerns related to current deliveries of fuel and general cargo; (2) a new regional port might result in implementation of higher safety standards for fuel and general cargo deliveries that could reduce potential environmental damage; (3) a number of measures were identified that could reduce environmental risks, if implemented; (4) and, the existence of a new regional port should not have any significant adverse environmental effects, if operated properly. No specific concerns were expressed in response to a question about critical habitat issues.

- *Social Issues And Concerns:* On this topic, responses indicated that (1) potential increased marine traffic should not result in an increase in drug or alcohol problems; (2) crew members of shipping and other vessels could be screened to insure that they do not try to bring drugs or alcohol ashore; (3) there should be no increased risk of introduction of illnesses and diseases; and, (4) all except one village has existing crime prevention and safety enforcement programs in place.

11.3 Summary of Information Obtained From Individuals

A total of 27 individuals completed questionnaires that were given to attendees at the Costal Villages funding workshop. These individuals represented about 17 coastal villages and Bethel (one respondent). Brief summaries of information obtained from the completed questionnaires are presented following.

- *Preferences for Location of a regional port:* The overwhelming choice of location for a regional port is Nunivak Island (Mekoryuk), with 17 of 26 votes. The next favored location was Goodnews Bay with three votes, followed by Quinhagak and Toksook Bay each with two votes each. Bethel and a site northeast of Cape Vancouver were also mentioned as possible regional port sites.

- *Needed Improvements and Minimum Facilities for a Regional Port:* Improvements and facilities that would be needed are shown in Table 34. Dredging was not generally considered necessary at Nunivak Island and Toksook Bay.

Table 34. Improvements and minimum facilities that would be needed at a regional port.

	Breakwater	Dredging of Entry	Dredging of Harbor	Floats	Dock	Boat Ramp	Upland Parking Facilities	Upland Service Facilities
1	X			X	X	X		X
2	X			X	X	X	X	X
3		X	X	X	X	X	X	
4		X	X	X	X	X	X	
5	X	X	X		X	X		X
6		X	X			X	X	
7	X			X	X	X	X	X
8		X			X		X	X
9	X			X	X	X		X
10	X			X	X			
11	X	X	X				X	X
12	X			X	X	X	X	X
13	X			X	X	X		X
14	X		X	X	X	X	X	X
15	X		X		X		X	X
16	X			X		X	X	X
17					X	X	X	X
18	X			X	X	X	X	X
19	X			X	X	X	X	X
20				X	X	X		X
21	X	X	X	X	X	X	X	X
22					X		X	
23	X		X	X	X	X		
24	X				X	X		
25	X		X	X	X	X	X	X
26	X	X			X	X	X	
27				X	X	X	X	

- *Wind, Wave, Tide and Ice Conditions:* Information on wind, wave, tide and ice conditions at the most preferred sites is summarized in Table 35. Values shown are the average of the values reported.

Table 35. Wind, Wave, Tide and Ice Conditions at Potential Port Sites

Condition	Nunivak Isl.	Goodnews Bay	Quinhagak	Toksook Bay
Prevailing Summer Wind Direction	S/SW	E/ S	SE-SW	SW
Max Summer Wind Velocity	20-40 nm/hr	na	50-70 mph	30-40 mph
Winter Wind Direction	N/NW	na	N-NE	NW
Max Winter Wind Velocity	40-60 nm/hr	50-60 nm/hr	25-55	30-40 mph
Max Wave heights (summer/fall storms)	6 - 14 ft	6 – 9 ft	4 – 5 ft	4 – 5 ft
Height of Tides	8 - 12 ft	4 – 5 ft	6 – 10 ft	6 ft
Site affected by winter ice	Yes	Yes-Beach	Yes	Rarely
Duration of Sea Ice	Nov/May	Oct/Apr	Nov/May	Jan/Apr
Thickness of winter ice at site	7 – 10 ft	3 – 4 ft	6 – 8 ft	2 – 4 ft

- *Other Port Site Concerns:* The only significant other concern expressed about the preferred port sites is a concern about sea ice at Nunivak. Although this site is the preferred location, there is some concern that ice flows and pressures be thoroughly studied before a port is constructed.

- *Current Problems with General Cargo Shipments to Preferred Port Sites:* Current problems at Nunivak Island (Mekoryuk) consist principally of high costs and delays caused by shallow water—barges must wait for high tide to land. No problems were identified for Goodnews Bay and Toksook Bay (Newtok). The only problem identified for Quinhagak was the high cost and high time associated with cargo being transported to Bethel before being transferred to its final destination.

- *Effect of a Regional Port on Commercial Fishing:* The perception expressed in the comments about the effect of a regional port on commercial fishing indicates a belief that the port would primarily provide better protection for boats and easier access in and out of the harbor (port). These characteristics are characteristics of a harbor rather than a port.

- *Target Species if a Regional Port Were to Enhance Commercial Fishing Opportunities:* Assuming that a regional port would enhance fishing opportunities, respondents indicated that they would primarily target the following species, listed in order of the number of times mentioned in the responses (most to least): halibut, herring, salmon and crab. Generally, the area that would be fished is the area adjacent to the port. For example, respondents favoring a port at Goodnews Bay would fish in that area while those favoring a port on Nunivak Island would fish that area. The fishing season generally extends from May through August. Respondents also expressed the view that a port would give them the option of shipping large quantities of frozen fish by barge.

- *Subsistence Fishing Issues:* Most respondents indicated that they fish for subsistence, primarily using skiff. A number of species (e.g., herring, salmon, halibut and bottomfish) are targeted and several types of gear (e.g., gill net, trawl, dipnet, hoopnet, long-line and rod and reel) are used. Respondents expressed the view that a new port—comments were directed primarily at a port on Nunivak Island—would result in increased catch, would reduce loading and unloading time and would entice more fishers to fish from Nunivak Island.

- *Natural Resources That Could be Exploited With a New Port:* Respondents expressed the view that with a new port increased amounts of fish (primarily halibut, herring, salmon and shellfish) could be exploited for export and, with a port at Nunivak Island, rock, gravel and sand and reindeer could be exploited as export commodities. In addition, one respondent indicated that marine mammals such as bearded seal, otter, mink and beaver could be exploited.

- *Impact of a New Port on Tourism:* Respondents indicated there is not a consensus about potential benefits of a new port to tourism or even if encouraging tourism is desirable. Several respondents indicated that tourism should be discouraged or that their villages was not interested in attracting tourists. Nevertheless, the presence of a port would make that village (where the port is located) more attractive to the cruise ship industry because access would not be a problem. Also, one respondent indicated that the cruise industry should be contacted to see they would be interested in calling at Mekoryuk if there were a port.

- *Impact of a New Port on Existing Environmental Problems:* Generally, respondents agreed that the presence of a new port would reduce environmental problems and risks associated with current barge operations at the site of the new port, e.g., Nunivak Island. Specifically, there is a belief that the risk of oil spills would be reduced. However, respondents recognize that a regional port could increase the risk of environmental damage from large oil spills because of the increased volume of fuel that would be moved through the regional port.

- *Control of Potential Social Problems Related to a New Port (drugs and alcohol):* Generally, respondents do not believe that a new port would result in a significant problem with the importation of illegal drugs and alcohol. If a problem were to arise, several respondents expressed the view that it would be dealt with by monitoring marine passengers and crew and by enforcing applicable laws.

12.0 Analysis of Potential Regional Port Sites (Task 3.8)

12.1 Typical Regional Port Facilities

A regional port serves primarily as a distribution center for general cargo and fuel that is transported to the region by mainline ocean barges and then transferred to villages within the region by shallow-draft coastal and river barges. A regional port typically would include:

- mooring and dock facilities for ocean and lightering barges
- transient dock
- boat ramp
- onshore storage for general cargo and bulk fuel
- other upland facilities as needed (parking, service, fish processing)

12.2 Identification of Potential Regional Port Sites

Potential port sites were identified through interviews with local government, agency and industry representatives while obtaining data for the study and through the interview of village leaders and individuals conducted by the Coastal Village Region Fund. In addition, information on potential sites was solicited and obtained from representatives of Federal and state agencies and representatives of regional organizations.

The potential port sites that were identified are shown below together with a brief commentary on the site and significant issues. The sites are listed in order of local preferences as expressed in the interviews of village leaders and other interested individuals during the course of the study.

- Mekoryuk (Nunivak Island):

  - Interviews of coastal village representatives and individuals who attended the Coastal Villages Region Fund funding summit (held in Bethel on 2 – 3 November 2000) shows an overwhelming preference for development of a port at Nunivak Island, compared with other potential sites in the Yukon-Kuskokwim Delta region.
  - This site has the advantage of being centrally located in the Yukon-Kuskokwim Delta coastal region.
  - Sea ice, with an estimated maximum thickness of from about 7 to 10 feet, is a significant design consideration. In addition, the effect of the prevailing northerly winds that have a

sustained storm velocity in the range of from 40 to 60 nautical miles per hour on sea ice during the winter months is a significant design consideration.

- During the summer months the prevailing wind is from a southerly direction and a port developed on the northern side of the island near Mekoryuk, as proposed in a study by Peratrovich, Nottingham and Drage, Inc., December 1997 (PND study), would be largely protected from waves that have an estimated maximum height of from 6 to 14 feet. Maximum sustained wind velocity during the summer months is in the range of from 20 to 40 nautical miles per hour.
- Examination of navigation charts and review the PND study indicates that there is adequate depth for port development without the need to dredge an entrance channel along the northern shore of the island approximately 13 miles west of Mekoryuk. The preliminary design in the PND study included dredging of the mooring area adjacent to the dock.
- Compared with the other potential sites, this site is subject to much more severe weather and winter ice conditions. Because of the relatively severe weather conditions around Nunivak Island, even during the summer months, there would be a higher risk of weather related delays in transferring general cargo and fuel to other villages.
- Because of relatively severe sea ice conditions during the winter months port development costs related to protecting port facilities from ice damage would be significantly higher than at Toksook Bay or Goodnews Bay.
- Representatives of Northland Services, Inc., the region's sole waterborne common carrier, stated the company could not support development of a regional port on Nunivak Island largely because of the relatively severe weather conditions at the site. In addition, they noted that the volume of general cargo and fuel is not sufficient to justify development of a regional port.

- *Goodnews Bay/Platinum:*

  - Residents of Goodnews Bay appear to be the only people that support development of a port at Goodnews Bay.
  - Sea ice would apparently be a relatively minor design consideration because ice from the Bering Sea does not enter the bay. According to the responses, ice forms only along the beach.
  - The entrance to the bay faces west and is, therefore, protected from both winter and summer storms.
  - A significant disadvantage of this site is that is not centrally located to the Yukon-Kuskokwim Delta coastal region.
  - According to the responses, dredging would be required for both the entrance channel and mooring area adjacent to the dock.
  - Northland Services, Inc. currently uses the bay as a regional water-based port for transfer of general cargo to coastal villages from Platinum to Scammon Bay.

- *Quinhagak:*

  - Two respondents supported development of a port at Quinhagak.
  - The site is located where it is relatively exposed to summer winds from the south and winter winds from the north.
  - Sea ice conditions at the site could be expected to be similar but not quite so severe as at Nunivak Island.

- Although the site is more centrally located in the Yukon-Kuskokwim Delta coastal region, it is not a well located as either Nunivak Island or Toksook Bay.
- Respondents indicated that dredging would be required for an entrance channel and mooring area at the dock. Bathometric data needed to determine the extent of dredging that would be required is not available for this report.

- *Toksook Bay:*

  - Based on bathometric data shown on navigation charts, a port could be developed on the north side of the bay without significant dredging.
  - The site is centrally located to the region and is relatively well protected from storm generated sea waves.
  - Based on information provided by respondents, the site is subject to the same winds as Nunivak Island is but velocities are somewhat less. Also, wave heights are somewhat less than at Nunivak Island.
  - Based on responses to the CVRF interview questions, ice conditions are significantly less severe than conditions at Nunivak Island.
  - Representatives of Northland Services, Inc. have expressed the view that a port at this location would be preferable to one at Nunivak Island. However, they do not believe that a port could be economically justified at this time.

12.3 Typical Regional Port Design

As part of the study, a typical regional port design and cost estimate was developed. Because of the diversity in physical conditions at each site evaluated, no one design could be applied to all sites. The design developed for this study was an adaptation of the design previously developed in the PND study for Nunivak Island. Nunivak Island was selected based upon its relative feasibility as compared with the other sites and its level of support as identified in the CVRF interviews.

This typical design includes the following features:

- barge dock to accommodate the 425' ocean-going cargo barges that currently deliver to Bethel,
- transient moorage dock,
- upland regional fuel storage tank farm,
- upland general cargo storage area,
- port office facility,
- boat ramp,
- mooring basin dredged to 18' (10,000 cubic yards)
- fuel pumping system
- breakwater with access road

The design assumes that adequate real estate would be made available for required upland facilities (no real estate costs are in the cost estimate). The original PND design was modified to accommodate 425' rather than 300' barges. Because no plans or support were identified for a floating processor, the processor and finger piers were removed from the PND design (an upland processing site could be developed if desired). Added to the PND design were a transient dock to accommodate up to 80' vessels and an upland storage area for general cargo. The fuel tank farm

was kept at the 500,000 gallon capacity specified in the PND design although this storage capacity is significantly lower than typical regional tank farm facilities in the region. For example, the regional tank farm at Bethel has storage capacity of 9,000,000 gallons and the facility at St. Michael has storage capacity of 1,300,000 gallons.

A preliminary design drawing is provided at the rear of the report as Plate A.

12. 4 Typical Regional Port Cost Estimate

The preliminary estimated cost of the typical regional port design amounted to $8.4 million. A breakdown of the cost is provided in Table 36.

Table 36. Typical Regional Port Construction Cost Estimate

Item	Quantity	Cost
Gravel Access Road	2 miles	$0.5
Breakwater	900’	$3.5
Sheet Pile Barge Dock	300’	$1.5
Sheet Pile Transient Dock	65’	$0.3
Dredging	10,000 CY	$0.2
Ramp/Boat Launch	1 Ea.	$0.1
Fuel Storage, Lines & Building	500,000 gallon capacity	$0.6
Engineering, Admin & Contingency	25%	$1.7
Total		**$8.4**

Due to the unique physical characteristics of each site, the cost for regional port development would vary from site to site. The primary factors of cost variation include:

- Amount and difficulty of dredging required
- Length of breakwater required (amount of rock required)
- Ice conditions at site
- Real estate costs

13.0 Overview of Potential Environmental Issues (Task 3.6)

13.1 Potential Environmental Issues and Mitigation Measures

Potential environmental issues and mitigation measures related to port development in the Yukon-Kuskokwim Delta Region are expected to be similar to those experienced at Nome and Saint Paul. Environmental impacts would result from construction of breakwaters; dredging of entrance channels and mooring areas; construction of dock facilities; periodic maintenance of the breakwaters, entrance channel and berthing areas; and, use of the facility. In general, potential environmental impacts resulting from construction and maintenance are minimal because the affected habitat would probably already be in a somewhat disturbed condition because of sea ice effects (ice flows dragging bottom in the relatively shallow water) and because of storm wave action. However, adverse effects of construction and maintenance are unavoidable. The most significant impacts can be expected to result from the actual operation of the port. The general types of environmental impacts associated with these potential causes together with potential mitigation measures are summarized below in Table 37.

Table 37. Potential Environmental Issues and Mitigation Measures Associated with Development of a Regional Port

Potential Cause/Impact	Potential Mitigation Measures
Breakwaters	
Loss of aquatic habitat	▪ Unavoidable impact but can be minimized through site selection to avoid areas with high biological productivity
Entrance Channel/Berthing Area	
Alteration of aquatic habitat	▪ Unavoidable but can be minimized by site selection to minimize length of entrance channel and dredging required for berthing
Disposal of Dredge Material	
Temporary decrease in the quality of aquatic habitat	▪ Unavoidable temporary impact
Loss of marine life	▪ Unavoidable decrease in biological productivity of affected area
Port Facilities	
Loss of inter-tidal habitat	▪ Unavoidable impact that can be minimized through site selection
Periodic Maintenance	
Temporary loss of marine life and alteration of habitat	▪ Unavoidable temporary impact
Port Operations	
Fuel Storage	▪ Construction of containment barriers
Fuel Transfer	▪ Formal procedures and emergency plans
Vessel Ballast Water	
Port Icing	▪ Formal procedures and monitoring system
Introduction of Pests (e.g., rats and dogs)	▪ Facility design that will prevent environmental damage ▪ Formal procedures and use of barriers between vessels and the dock together with continuous monitoring

13.2 Potential Threatened and Endangered Species

Listings of threatened and endangered species by the U.S. Fish and Wildlife Service shows that 12 animals and one plant listed for the region. These listed species are shown in Table 38 together with their listing status and their impacted habitat range. Feasibility analysis, construction and operation of a new regional port in the Yukon-Kuskokwim Delta Region would have to include assessment of potential impacts of the project on threatened and endangered species and measures would needed to be taken, if necessary, to ensure their protection.

Table 38. Summary Listing of Threatened and Endangered Species and Habitat Ranges

Status	Species and Habitat Range
	Animals (11)
E	Albatross, short-tailed (*Phoebastria albatrus*) Entire range--AK, CA, HI, OR, WA; Northern Pacific Ocean,Japan and U.S.S.R
E	Curlew, Eskimo (*Numenius borealis*) Entire range--Alaska and northern Canada to Argentina
T	Eider, spectacled (*Somateria fischeri*) Entire range--U.S.A. (AK), Russia
T	Eider, Steller's (AK breeding pop.) (*Polysticta stelleri*) Alaska breeding population
T	Goose, Aleutian Canada (*Branta canadensis leucopareia*) Entire range--AK, CA, OR, WA; Japan, Mexico
E	Sea turtle, leatherback (*Dermochelys coriacea*) Entire range—Alaska and numerous other locations
E	Sea-lion, Steller (western pop.) (*Eumetopias jubatus*) West of 144 degrees longitude—Alaska and Russia
T	Sea-lion, Steller (eastern pop.) (*Eumetopias jubatus*) West of 144 degrees longitude—Alaska and Russia
E	Whale, bowhead (*Balaena mysticetus*) Oceanic north latitudes of Alaska
E	Whale, finback (*Balaenoptera physalus*) Entire range—Alaska and numerous other locations
E	Whale, humpback (*Megaptera novaeangliae* Entire range—Alaska and numerous other locations
	Plants (1)
E	Fern, Aleutian shield (*Polystichum aleuticum*) Entire range—Alaska

Source: U.S. Fish and Wildlife Service (website, state listings), December 2000

13.3 Potential Agency Environmental Coordination Requirements

Formal environmental coordination requirements are expected to be similar to those for the study of navigation improvements at Nome (July 1998) that were as follows, including an indication of the purpose of the coordination:

- U.S. Fish and Wildlife Service: Coordination Act Report
- *U.S. Environmental Protection Agency:* Review and approval of disposal areas for dredged materials
- *State Historic Preservation Office:* Review of potential impacts on historic sites that are eligible for inclusion in the National Register of Historic Places
- *U.S. National Marine Fisheries Service:* Review of potential impacts on marine resources, including endangered species
- *Alaska Department of Fish and Game:* General review of potential environmental impacts
- *Alaska Department of Environmental Conservation:* Review of compliance of the project with the requirements of Section 401 of the Federal Clean Water Act and provisions of the Alaska Water Quality Standards and issuance of a Certificate of Reasonable Assurance [that the proposed project is in compliance
- *State of Alaska, Office of the Governor:* Review of the proposed project and certification that it is consistent with the Alaska Coastal Management Program

In addition, to the above required formal coordination it is probable that a feasibility study would need to be informally coordinated with a number of other Federal and State agencies and Native organizations to obtain data needed to site, evaluate and design a proposed project. Specific entities that would be involved would depend on the type of data that is needed but would certainly include the Bureau of Indian Affairs, Coastal Villages Region Fund, Alaska Department of Transportation, Yukon Delta National Wildlife Refuge and residents of the region through a public involvement program.

13.4 Assessment of Need Environmental Compliance Studies

Almost all of the study area, including the Nunivak Island—a potential port site, is included in the Yukon Delta Wildlife Refuge. For this reason, the study area must be considered as having a relatively high value for fish and wildlife resources. In addition, there are a number of threatened or endangered animal and plant species in the region that could be potentially impacted by the project. As with all Federal actions, an assessment of potential environmental impacts will need to be conducted. This will include assessments of fish and wildlife resources, with special emphasis on threatened or endangered species. Depending on the location of a new regional port, it could also require assessment of terrestrial plant communities to determine the presence of the Aleutian Shield Fern because it is endangered.

If the assessment of environmental resources and potential impacts of the project on them determines that there would be no or only insignificant impacts, preparation of the full environmental impact statement would not be required. If a new port were to be developed in an area that has already been subjected to significant human activity it possible that the environmental assessment and a finding of no significant impact would be sufficient, as was the case for the study of navigation improvements at Nome that was completed in 1998.

APPENDICES

YUKON-KUSKOKWIM DELTA COAST REGIONAL ECONOMICS

APPENDIX A – LOCAL CONTACTS

YUKON-KUSKOKWIM DELTA COAST REGIONAL PORT STUDY
VILLAGES, GENERAL LOCATIONS & POINTS OF CONTACT, GOODNEWS BAY TO ST. MICHAEL[8]

The study area consists of the coastal and inland areas of the Yukon-Kuskokwim delta from Goodnews Bay to the south to St. Michael to the north. Communities in the area are listed in the following table from south to north and from downstream to upstream.

Name	Location	Point of Contact
Coast--Goodnews Bay to Kuskokwim River (3)		
Goodnews Bay	Coast (160 mi. S Bethel)	Mary Brown, Administrator (907-967-8614)
Platinum	Coast (150 mi. S Bethel)	Moses Echuck, Mayor or David Walters, Administrator (907-979-8144)
Quinhagak	Coast (71 mi. SW Bethel)	Sophie Evan, Mayor (907-556-8202)
Kuskokwim River, Mouth to Bethel (7)		
Eek	Kuskokwim R. (35 air mi. S Bethel)	Fritz Petluska (907-536-5129)
Tuntutuliak	Kuskokwim R. (40 mi. S Bethel)	Robert Enoch, General Manager (907-256-2529)
Nunapitchuk	Johnson R (22 mi. NW Bethel)	Robert Nick, Mayor (907-527-5327)
Kasigluk	Johnson R., (26 mi. NW Bethel)	Levi Hooper, Chairman (907-447-6113)
Napakiak	Kuskokwim R. (15 SW Bethel)	Crowley: Oliana Kameroff, Administrator (907-589-2611)
Napaskiak	Kuskokwim R. (7 mi. SE Bethel)	James Paul, Mayor (907-737-7626)
Oscarville	Kuskokwim R. (6 mi SW Bethel)	Ignati Jacob, Chairman (907-543-2066)
Bethel (1)		
Bethel	Kuskokwim R. (n)	Robert Heron, Manager (907-543-2047)
Kuskokwim River, Bethel to Nikolai (14)		
Kwethluk	Kwethluk/Kuskokwim R. (17 mi. upstream Bethel)	Boris Epchook, Mayor (907-757-6022)
Akiachak	Kuskokwim R. (23 mi upstream Bethel)	Philip Peter, Chief (907-825-4626)
Akiak	Kuskokwim R. (35 mi. upstream Bethel)	Lillian Lliaban, Mayor (907-765-7411); Ivan Ivan, Administrator (907-765-7411)
Tuluksak	Tuluksak/Kuskokwim R. (51 mi upstream Bethel)	Joseph Alexie, President Tuluksak Native Community (907-695-6420)
Lower Kalskag	Kuskokwim R. (92 mi. upstrem Bethel)	Mezak Kameroff, Mayor (907-471-2228)
Upper Kalskag	Kuskokwim R. (95 upstream Bethel)	Racheal Wise, Administrator (907-471-2220)
Aniak	Kuskokwim R. (127 mi. upstream Bethel)	Travis Page, Manager (907-675-4486)
Napaimiut	Kuskokwim R (158 mi. upstream Bethel)	Marcie Sherer, President (907-471-2325)
Crooked Creek	Kuskokwim R. (194 mi. upstream Bethel)	Madrona Sakar, President (907-432-2200)
Red Devil	Kuskokwim R (229 mi. upstream Bethel)	Ellen Brewer, President (907-447-3213)

[8] Sources:
Alaska Natives and the Land (Figure III-44), Federal Field Committee for Development Planning in Alaska, 1968.
Alaska Community Database, Alaska Department of Community and Economic Development, 2000.

Name	Location	Point of Contact
Steelmute	Kuskokwim R. (236 mi. upstream Bethel)	Moxie Alexie, President (907-449-4205)
Stony River	Kuskokwim R. (261 mi. upstream Bethel)	Andrew Gusty, Sr., President (907-537-3209)
McGrath	Kuskokwim R. (388 mi. upstream Bethel	Paula Harris, Mayor (907-524-2825) ksnow@mcgrathalaska.com
Nicolai	Kuskokwim R. trib. (475 mi. upstream Bethel)	Peter Tony, Mayor (907-293-2113)
Coast & Yukon Mouth--Kuskokwim River to Emmonak (15)		
Kongiganak	Coast (70 mi SW Bethel)	Tommy Philip, Sr., President, Kongiganak Native Village
Kwigillingok	Coast (77 mi SW Bethel)	George David, Director, Kwik, Inc. (907-588-8112)
Kipnuk	Coast/Kugkaktlik R. (85 air mi. SW Bethel)	Paul Kiuna, Sr., President, Kipnuk Traditional Council
Chefornak	Coast/ Kinia R. (98 air mi. SW Bethel)	Rosalie Mathew, Administrator (907-867-8528)
Toksook Bay	Nelson Isl. (115 mi NW Bethel)	Lawrence John, Mayor (9907-427-7613)
Nightmute	Nelson Isl. (100 m W Bethel)	Paul Joe, Administrator or Simeon Agnus, Mayor (907-647-6426)
Tununak	Nelson Isl. (115 mi NW Bethel)	George Hooper, Sr., President (907-652-6527)
Umkumiut	Nelson Isl.(adjacent to Toksook bay, 41 mi to Mekoryuk)	Summer fishing camp for residents of Toksook Bay. No year-round population.
Mekoryuk	Nunivak Isl. (149 air mi. W Bethel—breakwater protects shore)	Chester Wesley, Mayor (907-827-8314)
Newtok	Baird Inlet--Kealavik R. N Nelson Isl. (94 mi NW Bethel	David Kasaiuli, Chairman (907-237-2512)
Hooper Bay	Coast (25 mi S Scammon Bay)	Ole Lake, Administrator or Lucille Green, Mayor (907-758-4311)
Chevak	Niglikfak R. (17 mi E Hooper Bay)	Peter Boyscout, Mayor or Greg Aloralrea, Administrator (907-858-7128)
Scammon Bay	Kun R. (1 mi. Bering Sea)	Paul Ulak, Mayor or Frank Aguchak, Manager (907-558-5529)
Nunam Iqua	Yukon R. trib. (9 mi S Alakanak)	Formerly Sheldon's Point—Isidore Shelton, Mayor or Frank Camille, Administrator (907-498-4226)
Alakanuk	Yukon R. (15 mi. Bering Sea)	Ragnar Alstrom, Mayor or Joshephine Stern, Administrator (907-238-3313)
Emmonak	Yukon R. (10 mi. Bering Sea, 120 air mi. Bethel)	Douglas Redfox, Mayor or Martin Moore, Manager (907-949-1227)
Coast & Yukon Mouth--Kotlik to St Michael (3)		
Kotlik (Calista most northern)	Kotlik Slough, Yukon R. (35 mi NE Emmonak)	Martin Okitkum, Mayor or Jack Okitkum, Jr., Manager (907-899-4313)
Bill Moore's Slough	Apoon Pass, Yukon Delta	Summer fish camp for residents of Kotlik
Hamilton	Apoon Pass, Yukon Delta	Summer fish camp for residents of Kotlik
Stebbins	NW Coast St. Michael Island, Norton Sound	Tony Southall, Mayor (907-934-3451)
St. Michael	E Coast St. Michael Island, Norton Sound	Carl Otten, Mayor or Virginia Washington, Administrator

Name	Location	Point of Contact
Yukon River to Holy Cross (7)		
Mountain Village	Yukon R. (20 mi. W St. Marys)	Joyce Brown-Rivers, Mayor or Vincent Beans, Manager (907-591-2920)
Pitkas Point	Yukon/Andreafshy R. (5 mi NW St Mary's)	Scott Riley, President (907-438-2833)
St. Marys & Andreafsky	Andreafsky R. (5 mi. Yukon R.)	Andrew Paukan, Mayor or Walton Smith, Manager (907-438-2515)
Pilot Station	Yukon R. (11 mi. E St Mary's)	John Evan, Mayor (907-549-3211)
Marshall	Polte Slough, Yukon R.	Raymond Alstrom, Sr., Mayor (907-679-6215)
Ohogamiut	Yukon R. (n)	Summer fish camp with no permanent facilities or population.
Russian Mission (Calista most upstream)	Yukon R. (25 mi. SE Marshall, 70 air mi. NE Bethel)	Olga Changsak, Mayor (907-584-5111)
Holy Cross (most upstream)	Ghost Crk Slough,Yukon R.	Sandra Demientieff, Mayor (907-476-7139)

APPENDIX B – PUBLIC INPUT (VILLAGES)

YUKON-KUSKOKWIM DELTA COAST REGIONAL PORT STUDY
SUMMARY OF RESPONSES TO QUESTIONNAIRE
COMPLETED BY VILLAGE REPRESENTATIVES

PART 1. RESPONDENT INFORMATION

Reference	Date	Entity	Name	Street	City
1	11.2.00	Mararmuit			
2	11.17.00	LKSD		Box 49	TNK
3	11.3.00	City of Napakiak, Napakiak Corporation	Daniel Nelson	POB 34030	Napakiak
4	11.17.00	Native Village of Kwinhagak		POB 149	Quinhagak
5	11.17.00	Newtok Traditional Council	Phillip Kusayak	POB 5545	Newtok
6	11.16.00	Indian Reorganization Act Council		POB 66	Mekoryuk
7	11.16.00	City of Mekoryuk		POB 29	Mekoryuk
8	11.16.00	Tununak Traditional Council	Peter Pitka, Harry Lincoln, and Elders	POB 97	Tununak
9	11.16.00	Tununrmiut Rinit Corporation	Phillip James	POB 89	Tununak
10	11.3.00	Native Village of Goodnews Bay	Carl Evon	POB 138	Goodnews Bay
11	11.2.00	CURF/TC/CITY - Scammon Bay	Byron Ulak		Scammon Bay

PART 2. ECONOMIC AND ENGINEERING CONCERNS

A. Port Location and Features

Q1. Check the types of facilities that would be needed at the port at a minimum

	Breakwater	Dredging of Entry	Dredging of Harbor	Floats	Dock	Boat Ramp	Upland Parking Facilities	Upland Service Facilities
1	x	x	x	x	x	x	x	x
2	x			x	x	x	x	x
3	x	x	x		x	x	x	x
4		x	x	x	x	x	x	x
5								
6	x		x		x	x	x	x
7	x		x		x	x	x	x
8	x		x		x	x	x	x
9	x	x			x	x	x	x
10	x	x	x	x	x	x	x	x
11	x	x	x	x	x	x	x	x

Q2. Who owns the land that would be needed for port development at that location?

1. ANSCA Village Corporation
2. NIMA
3. Mekoryuk Corporation and USFWS
4. Quinhagak Native Corporation
5. Nunivak Islanders
6. Nima Corporation, could be annexed to city after the port is built
7. Nima Corporation, could be annexed to city after the port is built
8. NIMA Corporation
9. Tununak Traditional Council
10. Kuitsarak, Inc. POB 150 Goodnews Bay, AK 99589
11. Native Corporation

Q3. Please provide any additional comments/concerns regarding port location not addressed by the above questions

1. Ideal location
2. (No answer given)
3. Port location will serve 100% coastal usage Yukon and Norton Sound.
4. Local port exists but needs expansion
5. No comment
6. There could be pressure ridge problem during winter season, and spring ice break-up (moving ice)
7. There could be pressure ridge problem during winter season, and spring ice break-up (moving ice)
8. No road, bridge or airport
9. Spring ice breakups would result damages to port locations
10. Goodnews Bay has a salmon and herring fishery that many southwest fishermen use during the course of the summer
11. (No answer given)

PART 2. ECONOMIC AND ENGINEERING CONCERNS

B. Existing Fuel and Cargo Shipments

Q4. Describe how waterborne fuel shipments are currently routed from their origin to your community.

1. Shipments made from Seattle, Nome, Bethel, and Anchorage
2. Barge
3. Seattle - Bethel and to villages
4. Seattle to Bethel then to small communities including Quinhagak
5. Through barge
6. Tug and barge
7. Tug and barge
8. ? See Questionnaire from Tununrmiut Rinit Corporation
9. During high tides, calm waters - barges pier on the beach to deliver cargo.
10. By Barge
11. Usually from Seattle, Anchorage, Bethel, then village ...(illegible)

Q5. Describe how waterborne shipments of general cargo are currently routed from their origin to your community.

1 Shipments made from Seattle, Nome, Bethel, and Anchorage
2 Barge
3 Seattle - Bethel to Napakiak
4 Same as A4
5 Barge routes to reach certain villages
6 Air, large items by barge
7 Air, large items by barge
8 ? See Questionnaire from Tununrmiut Rinit Corporation
9 Summer time - fuel barge deliveries
10 By barge
11 Same as Q4

Q6. What problems are experienced with the way fuel and general cargo are currently shipped to your community?

1 Very limited and high costs are experienced. They are also delayed because bad weather and distances.
2 Tidal flats
3 There isn't too much problem, our community is close to Bethel. Other problems are for other villages and coastal villages.
4 Further damage, delays and misses the flooded river after break-up and our high, high tides
5 Weather, low level of water
6 Inconsistency
7 Inconsistency
8 Bad weather and low tides
9 Fall deliveries are usually the problem each year due to high winds
10 No docking facility only open beach, subject to wind, weather, and waves
11 Takes too long, weather delays, usually one delivery for fuel and cargo

Q7. Who are the suppliers of fuel for your community?

1 1. Crowley/Wave 2. Yukon Fuel Co.
2 Yukon Fuel North land
3 WAVE Fuels Inc.
4 WAVE Fuels Inc.
5 WAVE Fuels Inc.
6 WAVE Fuels Inc., Crowley
7 WAVE Fuels Inc., Crowley
8 See Questionnaire from Tununrmiut Rinit Corporation
9 Wave Fuel and transportation - d.b.a. Northstar gas
10 BIA, Yukon Fuel, WAVE
11 Crowley, Wave, Yukon Fuels

Q8. What companies ship waterborne freight to your community and what is their area of operation?

1 Practically all service/barge lines.
2 Coastal tug and barge
3 Crowley Maritime and others from Seattle
4 Ocean freighters unload to Bethel, then coastal tug and barge (Crowley) go and deliver to small communities
5 Northerly Land
6 Crowley, Wave, coastal tug and barge
7 Crowley, Wave, coastal tug and barge
8 See Questionnaire from Tununrmiut Rinit Corporation
9 Mother ships usually around Bethel, they would load them smaller barges and deliver cargo
10 Ocean going or coastal tugs and barges or freighters to major destinations of local communities
11 Crowley fuel, Yukon fuel - Freight/barge lines.

Q9. What is the capacity of bulk fuel storage facilities in your community?

1 1. 155,000 gallons at Scammon Bay 2. 500,000 gallons at Hopper Bay 3. 400,000 gallons at Chevak.
2 ~80,000 gallons/ gas plus #1 fuel
3 55,000 village, about 60,000 LKSD
4 20,000 gals per bulk tank
5 30,000 gal
6 383,184 gals
7 383,184 gals
8 See Questionnaire from Tununrmiut Rinit Corporation
9 For heating fuel - 62,000 gal est. Unleaded gas - 42,000 gal.
10 Gasoline - 42,000 gals. S/O - 49,000 gals. AVEC 40,000 gals approximate. School 35,000 gals approximate.
11 200K gal - Sam. 400K gal - Chevak. 600K gal - Itby

Q10. What problems are experienced with the current fuel distribution system in your community?

1 1. Tanks containers need to be upgraded. 2. Old and inoperable equipments. 3. More tank containers.
2 They run out
3 None at this time
4 Confusion of how much gallons of fuel/gas to distribute between ...(illegible) IRA, LKSD, AVEC, because their brought in one bulk
5 None
6 Unknown
7 Unknown
8 See Questionnaire from Tununrmiut Rinit Corporation
9 Fuel shortages
10 Barges must come in at the highest tide
11 Tank erosion, (illegible), need upgrades

Q11. Has your community ever experienced a fuel shortage? When/how often?

1 Every year in all 3 villages mentioned above (Q10).
2 Every year
3 Rarely
4 March or April every year
5 None
6 Yes, not every year, There was not enough storage bulk tanks available
7 Yes, not every year, There was not enough storage bulk tanks available
8 See Questionnaire from Tununrmiut Rinit Corporation
9 (No answer given)
10 No
11 Yes, recently installed/upgraded tank ...(illegible)

Q12. If your community has ever experienced a fuel shortage, in your opinion, what was the cause of the shortage?

1 1. Lack of fuel containers. 2. Lack of record keeping. 3. More gas engines ownerships. 4. More consumers.
2 Don't maintain and watch level of the fuel
3 Winter ice - road not maintained or too much snow for traffic to Bethel
4 Barges arriving late and sometimes not delivering the capacity we ordered
5 NA
6 When there was no top off delivery
7 When there was no top off delivery
8 Growing number of snow machines, ATVs, outboard motors, generators. Surrounding villages coming during activities and getting gas, especially during winter.
9 Other community comes to purchase fuel.
10 NA
11 Not enough holding tanks, miscalculations of fuel distribution/sales, more consumers

Q13. What problems are experienced with the current system of shipping general cargo to your community?

1 1. High prices/high costs. 2. Long system of delivery which at times are over far longer times.
2 Tidal flats
3 Not too much problem
4 Mostly damaged or arriving late and make our projects delayed.
5 Low water level and weather
6 Barges and tugs have to wait for high tide to enter Mekoryuk Bay
7 Barges and tugs have to wait for high tide to enter Mekoryuk Bay
8 Delivery barges trying to come very late in Fall
9 Late deliveries
10 Off loading of freight
11 High prices, delays from weather

Q14. In your opinion, how would a regional port reduce the cost of shipping general cargo and fuel to your community?

1 1. Reduce delays and distance therefore reduce the prices incurred than current system.
2 Costs would be less
3 No stops to Bethel for additional costs charged
4 Make one stop to communities instead of unloading in Bethel first, would reduce barge ...(illegible).
5 Delivery and land cost would reduce
6 Probably by mass purchase
7 Probably by mass purchase
8 Regional port would raise the cost of material and equipment, storage, portage and shipping and handling
9 Shipment are in one time in summer
10 Reduce turn time for barge delivering by not waiting for tide
11 Shorter distance would lead to lower prices (?)

Q15. Approximately how many gallons of fuel are shipped to your community each year?

1 See Q9.
2 80,000 gallons a year
3 About 115,000 bty fuel, 20,000 gasoline
4 (No answer given)
5 30,000
6 Est. 100,000 gals
7 Est. 100,000 gals
8 See Tununrmiut Rinit Corporation Questionnaire.
9 40,000 gal > 62,000 each year
10 166,000 gals
11 200K gal - Sam. 400K gal - Chevak. 600K gal - Itby

Q16. Approximately how many tons of general cargo is shipped to your community each year?

1 1. 30 tons to Scammon Bay. 2. 60 tons to Chevak. 3. 100 tons to Hooper Bay.
2 lots and lots and lots
3 For community projects only, ei; housing, etc.
4 50-90 tons estimate
5 10-15 tons
6 Est. 50 tons
7 Est. 50 tons
8 See Tununrmiut Rinit Corporation Questionnaire.
9 Varies
10 10-15 tons
11 30 tons in Sc, 60 tons in Ch, 100 tons in Itby

Q17. Please provide any additional comments/concerns regarding fuel and cargo shipments not addressed by the above questions.

1 Would the cost of shipping be lowered regardless where des…. Point is? Example Nome, Mekoryuk, 10 Villages
2 (No answer given)
3 We have not experienced any problems as stated, our community is close to Bethel.
4 (No answer given)
5 No comment
6 (No answer given)
7 (No answer given)
8 None
9 (No answer given)
10 Many surrounding villages utilize Goodnews Bay Fisheries (salmon and herring)
11 (No answer given)

PART 2. ECONOMIC AND ENGINEERING CONCERNS

C. Fishing Industry

Q18. What species of fish do fisherman from your community currently commercially harvest?

1	Herring, King Salmon, and Chum
2	Halibut, herring
3	Coho, chum, red salmon
4	King, sockeye, chum, coho, and halibut
5	Herring, halibut
6	Halibut, herring
7	Halibut, herring
8	Herring, halibut
9	Herring, halibut
10	Salmon, herring, halibut
11	Herring, salmon

Q19. Where are commercially caught fish currently delivered for sale or processing? How far do fisherman travel to deliver fish for processing?

1	Herring to processing ships or vessels/ Salmon to Y-1
2	Herring to tenders to processor boats beyond 3 mile limit are locally processed.
3	Bethel is about 15 miles, most sell to tenders
4	In the river dock or tender boats anchored as far out as 5 miles from land.
5	Herring, halibut, within fishing tenders
6	3 to 30 miles delivery to fish plant
7	3 to 30 miles delivery to fish plant
8	Herring delivered to offshore tenders. Fisher tenders are usually close by to boats. Halibut delivered to inshore plants.
9	6 miles to port
10	Bethel and Bristol Bay
11	Herring - (illegible). Salmon - (illegible)

Q20. Where are commercially caught fish currently processed?

1	Mother ships
2	(No answer given)
3	Salmon, more of coho
4	Quinhagak Fish Plant

5	In processing ...(illegible)
6	Off shore of Nunivak
7	Off shore of Nunivak
8	Halibut processed at inshore fish plant
9	(No answer given)
10	Bethel, Bristol Bay and Quinhagak AK
11	Herring - (illegible). Salmon - (illegible).

Q21. Briefly describe how commercial fish are currently caught, handled, processed, and shipped to market.

1	1. For herring by gillnet, to tender boats and to processor mother ships. 2. Salmon, gillnet, processor.
2	(No answer given)
3	Drift setting by 50 nets, fish are sold as whole to tenders or brought to Bethel.
4	Drift net, iced with slush bags, gilled, slimed, gutted, freezed, and shipped out by air.
5	Halibut through fish processing facility in Tununak
6	Longline skates, jigging, headed, gutted, slimed, shipped out by air
7	Longline skates, jigging, headed, gutted, slimed, shipped out by air
8	Herring are caught by set net. Halibut by jigging and longline and shipped by commercial airlines.
9	Fish cleaned by fishermen, processed by local employment, each week ship by air to market
10	Salmon and Herring with Gillnet. Halibut with Longline. Tender from fish companies
11	Herring - gillnet, tender boat, mother ship. Salmon - gillnet, tender boat, processing plant.

Q22. In your opinion, how would a regional port enhance the ability of commercial fisherman from your community increase their catch?

1	None
2	Better equipment available, shipping as one shipment rather than smaller boats
3	No problems at this time
4	If the river is dredged and the channel is deeper, more fish would be in the channel and increase the fishermen's catch.
5	Yes
6	Better port facility where fisherman don't have to wait for high tide to float their boats
7	Better port facility where fisherman don't have to wait for high tide to float their boats
8	No opinion.
9	Have a tender be stand by around fishermen
10	Safe port in inclement weather and moorage when not fishing.
11	None

Q23. What port do commercial fishing boats operate from the fish the area that is, or could be, commercially fished by fishermen from your community?

1	Tendered
2	TNK, OOK, MKY
3	Bethel
4	No port except a dock for fuel and cargo and tender boat parking
5	Tununak, Toksook, Mekoryuk
6	Village breakwater
7	Village breakwater
8	?
9	Both subsistence/ commercial fishermen
10	Togiak, Platinum, Quinhagak, Mekoryuk, Eek, Napagkiak
11	(Illegible)

Q24. Where do these vessels currently deliver their catch?

1 Mother ships and to processing plants.
2 Locally
3 Bethel
4 Tender boat tied at dock or processors 5 miles out
5 To fish processing plants
6 Local processing plant, delivered to plant by truck
7 Local processing plant, delivered to plant by truck
8 See Q19
9 Inland plants
10 Tenders in the bay
11 Mother ship via tender boat. Processing plant.

Q25. Please provide any additional comments/concerns regarding the fishing industry not addressed by the above questions.

1 Because of land based fishing entities there is no other fisheries other than herring and salmon.
2 (No answer given)
3 Increase halibut fishing to coastal villages tender near villages involved area possible, other processing plant at port, capacity size.
4 (No answer given)
5 None
6 Off loading of catch will be faster using dock not using truck
7 Off loading of catch will be faster using dock not using truck
8 None
9 (No answer given)
10 Many nearby villages utilize the herring and salmon fishery in Goodnews Bay
11 Lack of facilities, no commercial land based plants.

PART 2. ECONOMIC AND ENGINEERING CONCERNS

D. Resource Extraction Industry

Q26. What natural resources are there in the vicinity of your community that might be developed and exported if there was a regional port in the area?

1 1. Gravel/rocks 2. Natural waters 3. Sand 4. Crabs 5. Halibut 6. Shellfish
2 Fish, reindeer
3 Salmon is only natural resource
4 Halibut, salmon, and caribou
5 ?
6 Blue king crab, herring, salmon
7 Blue king crab, herring, salmon
8 No comments.
9 (No answer given)
10 Gravel sales to surrounding villages
11 Gravel, rocks, crab, halibut, clams

Q27. Please provide any additional comments/concerns regarding the resource extraction industry not addressed by the above questions.

1 More research in our immediate waters for natural resources/renewable resources.
2 (No answer given)
3 NK
4 (No answer given)
5 None
6 Varies year to year
7 Varies year to year
8 No comments
9 (No answer given)
10 No docking or port facility for on loading of gravel
11 More research requested

PART 2. ECONOMIC AND ENGINEERING CONCERNS
E. Future Community Development

Q28. Approximately how many new homes are constructed in your community each year?

1 1. Five in Scammon Bay 2. Five in Chevak 3. Five in Hooper Bay
2 0
3 About up to five homes
4 4 to 6
5 10
6 (No answer given)
7 (No answer given)
8 Once per year
9 One so far, this year, hopefully 3 more would be for next year
10 5-7 hours
11 Call AVCPHO. 5 per year

Q29. In your opinion, would the presence of a regional port enhance tourism in your community? If so, please describe how tourism would benefit.

1 Yes. Tourist will bring in cash.
2 Yes, visitors could come and see the village environment
3 NK
4 Only sport fishermen now, would probably have tourists coming and provide more jobs for people
5 NA
6 The port would accommodate small cruise ships, village artists would sell artifacts, carvings, grass baskets, etc.
7 The port would accommodate small cruise ships, village artists would sell artifacts, carvings, grass baskets, etc.
8 No opinion or comment
9 Local residents would benefit from tourism by selling their arts and crafts
10 Yes, greatly many rafters (100-150) float the Goodnews River
11 Yes $

Q30. Please list significant future construction projects that are planned for your community within the next five to ten years.

1 Processing plant, vocational facilities, airports, new schools, tank farms.
2 Boardwalks, runway renovation, PO, TTC building
3 Possible road to Bethel, village relocation
4 Headstart, elder complexes, recreational center, hotel/restaurant, bunk house
5 Public facility, pre-school
6 Possibly a multipurpose community building which would include a small museum
7 Possibly a multipurpose community building which would include a small museum
8 New airport extension, new roads to new dumpsite, water and sewer systems, new community hall building
9 Maybe - new community hall, airport, dumpsite, renovation of sidewalks - perhaps expand ... (illegible)
10 BIA road plan and at least two small suspension bridges
11 (No answer given)

Q31. Please provide any additional comments/concerns regarding future community development not addressed by the above questions.

1 Will answer in future.
2 Cooperation between DRA/TTC
3 Possible mini port if road to Bethel is reality
4 (No answer given)
5 None
6 (No answer given)
7 (No answer given)
8 Board walk, piped water and sewer system, seawall and community office building
9 (illegible)... Roads
10 Possible aluminum boat construction
11 (No answer given)

PART 3. ENVIRONMENTAL CONCERNS

Q32. Briefly describe environmental problems related to how fuel and general cargo are delivered and handled in your community.

1 At risk
2 Tidal flats
3 None at this time
4 No problems
5 Pumped from
6 There would be oil spill problem where the village gather fish and other sea life for food
7 There would be oil spill problem where the village gather fish and other sea life for food
8 Bad weather, ice formation during winter
9 (No answer given)
10 Deep holes from tug-boat propeller wash
11 At KPSK

Q33. Briefly describe how the existence of a regional port would reduce or eliminate environmental problems associated with delivery and handling of fuel and general cargo in your community?

1 Upgrades and compliances.
2 NA
3 All fuel and cargo operate with plans with EAP and coast guard
4 No problems
5 None
6 The facilities would be US Coast Guard and environmentally inspected for proper use
7 The facilities would be US Coast Guard and environmentally inspected for proper use
8 Make an airport
9 (No answer given)
10 Reduction of A32
11 Upgrades and compliance with C6

Q34. Briefly describe any measures for controlling potential problems with pest infestation, hazardous materials and improperly disposed pollutants.

1 Separate disposal sites, immerging response teams for oil spills, etc.
2 NA
3 None
4 Dikes are in place, pollutants are properly disposed of, our gas operators are trained in case of oil spill.
5 Oil spill prevention
6 There would be proper facilities for hazardous material
7 There would be proper facilities for hazardous material
8 Watch very closely with oil leaks and make dice to prevent leaks. Make or complete building that would hold and prevent the spread of pollution
9 Ship out ...(illegible)... In containers each year.
10 Harbor patrol and river ranger patrol
11 No plans

Q35. Briefly describe how the existence of a regional port may impact the natural or renewable resources associated with pollutants in your community.

1 Don't know at this period.
2 If there is an oil spill things will be impacted
3 NK
4 If properly handled no problems are foreseen.
5 Prevention of oil spill
6 No study has been available
7 No study has been available
8 Incompetent workers
9 (No answer given)
10 Reduce human and mechanical (oil and gas) waste in the Bay
11 Don't know

Q36. Briefly describe ESA Critical Habitat Issues in your community and your community's plans to address those issues.

1 No plans currently.
2 (No answer given)
3 NK
4 No comment
5 Marine manual
6 (No answer given)
7 (No answer given)
8 ?
9 (No answer given)
10 River ranger patrol, land use permits (includes restrictions on trash and waste for certain areas)
11 No plans

Q37. Please provide any additional comments/concerns regarding environmental quality issues not addressed by the above questions.

1 Romanoff restoration site.
2 (No answer given)
3 Plans may be assessed as how and what will be involved at pot, then work with EAP and coast guard to meet the needs
4 (No answer given)
5 None
6 (No answer given)
7 (No answer given)
8 None
9 (No answer given)
10 None
11 Cape ... (illegible) Restoration.

PART 4. SOCIAL ISSUES AND CONCERNS

Q38. Briefly describe how your community may alleviate social problems related to the potential influx of drug and alcohol importation via marine transportation.

1 It would be the same with when it used to be transported by air.
2 Troopers/ fish and game involvement
3 None, it can be handled same as sale and importation laws
4 No drug or alcohol have been imported thru marine transportation, no additional social problems expected
5 With restriction enforcement
6 Visitors to village possibly can be screened also, villages can be screened after visiting boats
7 Visitors to village possibly can be screened also, villages can be screened after visiting boats
8 Zero toleration of importation of alcohol and drugs
9 Having local help through public police
10 Harbor patrol
11 (No answer given)

Q39. Briefly describe what precautions are currently in place to protect against illnesses and diseases that originate outside of region.

1	YK k/c
2	NA
3	NK
4	Water is drawn from water treatment plant where is treated with chlorine.
5	No comment
6	(No answer given)
7	(No answer given)
8	?
9	?
10	None
11	YKHC

Q40. Briefly describe what existing crime prevention and safety enforcement programs are currently in place.

1	State/federal laws.
2	None
3	AMA, Police Dept. accident prevention and environmental plans with, sewage, trash, gas and food
4	Tribal ordinances, tribal court and tribal police
5	Law enforcements local cops
6	There is VPSO and VPO employed within city State Troopers can be called to investigate
7	There is VPSO and VPO employed within city State Troopers can be called to investigate
8	Local banishment of importation of alcohol and drugs
9	TTC/IRA would answer
10	UPSO, OHSA, VPO
11	UPSO ...(illegible)

Q41. Please provide any additional comments/concerns regarding social issues not addressed by the above questions.

1	None
2	(No answer given)
3	NA
4	(No answer given)
5	No comment
6	(No answer given)
7	(No answer given)
8	None
9	(No answer given)
10	None
11	(No answer given)

APPENDIX C – PUBLIC INVOLVEMENT (INDIVIDUALS)

YUKON-KUSKOKWIM DELTA COAST REGIONAL PORT STUDY
SUMMARY OF RESPONSES BY INDIVIDUALS

Q1—Respondent Information

Reference	Date	Name	Organization	Address
1	11.15.00	Elsie Tommy	Newtok Traditional Council	Newtok, AK 99559
2	11.17.00		LKSD	Box 49, TNK
3	11.16.00	Joseph T. Brown	CVRF thru TVC	
4	11.16.00	John James	CVRF thru TVC	
5	11.2.00	Bernard Murran	Coastal Villages Region Fund	POB 289 Hooper Bay, AK 99604
6	11.3.00	Jack M. Stewart Jr.	AVCP/CVRF	POB 004 Goodnews Bay, AK 99589
7	11.3.00	Byron Ulak	CVRF	POB 101
8	11.14.00	Fred Anaver	Kipnuk Traditional Council	POB 57 Kipnuk, AK 99614
9	11.3.00	Walter Hill	City Council/ NVK Joint Members	POB 149 Quinhagak, AK 99655
10	11.3.00	George B. Hooper, Sr.	Tununak IRA Council	POB 48 Tununak, AK 99681
11	11.3.00	Lucille Cleveland	Native Village of Kwinhagak	POB 149 Quinhagak, AK 99655
12	(None)	Tom Amos	Indian Reorganization Act Council	POB 66 Mekoryuk, AK 99630
13	11.1.00	Lena Mathlaw	Coastal Villages	POB 272 Bethel, AK 99559
14	11.16.00	Group of Elders	Tununak Traditional Elders Council	POB 97 Tununak, AK 99681
15	11.2.00	Ray Therchick	City of Toksook Bay	POB 37008 Toksook Bay, AK 99637
16	11.2.00	Peter John	CVRF Board	POB 5544 Newtok, AK 99559
17	11.2.00	Oscar Wassillie	CVRF	POB 75 Chefornak, AK 99561
18	11.2.00	Howard T. Amos	CVRF	POB 47 Mecoryuk, AK 99630
19	11.1.00	Dale T. Smith, Sr.	City of Mekoryuk	POB 29 Mekoryuk, AK 99630
20	11.2.00	Clifford A. Kaganak, Sr.	CVRF	209 Hillside St. Box 33 Scammon Bay, AK 99662
21	11.1.00	Fred K. Phillips	CVRF	
22	11.2.00	Dick Lincoln	TTC	Box 97 Tununak, Ak 99681
23	11.2.00	Viola Smith		
24	11.2.00	Oscar L. Evon	Native Village of Kwigillingok	POB 49 Kwigillingok, AK 99622
25	11.2.00	Paul Tulik		POB 90016 Nightmute, AK 99690
26	11.2.00	Simeon John		
27	11.2.00	Chrisopher A. Tulik	Chinuruk Incorporated	POB 90009 Nightmute, AK 99690

Q1-- In your opinion, what is the best location for a port to serve communities located in the Yukon-Kuskokwin delta region (Goodnews Bay to Saint Michael, including Nunivak Island)?

1 Nunivak Island
2 (No answer given)
3 The upper side of the airport (Goodnews Bay), close to the hanger
4 The upper side of the airport (Goodnews Bay), close to the hanger
5 Nunivak Island because of its deeper waters, and away from more environmental sensitive areas.
6 Maybe at the 1st lake, or behind the airport.
7 Mekoryuk
8 Nunivak Island
9 My opinion for the best location for a port would be in Quinhagak.
10 Nelson Island and Nunivak Island, Toksook Bay, Tununak
11 Quinhagak
12 Nunivak Island
13 Unknown, possibly Nunivak or Bethel
14 Kaugbagaluq - Northeast of cape Vancouver
15 Nunivak Island
16 Nelson Island - good location that can reach shore even at low tide. Between Toksook and Tununak.
17 Nunivak Island
18 Nunivak Island is centrally located within this region.
19 Nunivak is a central area where the barge lines are going North and South
20 Nunivak Island - I would surely like to have a port at Cape Romanoff but the water is never high enough for a barge to come in.
21 Mekoryuk
22 Nunivak Island
23 Nunivak Island
24 Nunivak Island
25 Nunivak Island
26 Nunivak Island/Nelson Island
27 Nunivak Island - Primary. Nelson Island - Alternate

Q2--Check the types of facilities that would be needed at the port at a minimum.

	Breakwater	Dredging of Entry	Dredging of Harbor	Floats	Dock	Boat Ramp	Upland Parking Facilities	Upland Service Facilities
1	x			x	x	x		x
2	x			x	x	x	x	x
3		x	x	x	x	x	x	
4		x	x	x	x	x	x	
5	x	x	x		x	x		x
6		x	x			x	x	
7	x			x	x	x	x	x
8		x			x		x	x
9	x			x	x	x		x
10	x			x	x			
11	x	x	x				x	x
12	x			x	x	x	x	x
13	x			x	x	x		x

Q2--Check the types of facilities that would be needed at the port at a minimum.

	Breakwater	Dredging of Entry	Dredging of Harbor	Floats	Dock	Boat Ramp	Upland Parking Facilities	Upland Service Facilities
14	x		x	x	x	x	x	x
15	x		x		x		x	x
16	x			x		x	x	x
17					x	x	x	x
18	x			x	x	x	x	x
19	x			x	x	x	x	x
20				x	x	x		x
21	x	x	x	x	x	x	x	x
22					x		x	
23	x		x	x	x	x		
24	x				x	x		
25	x		x	x	x	x	x	x
26	x	x			x	x	x	
27				x	x	x	x	

Q3--What is the prevailing wind direction and maximum wind speeds in the summer and winter months at the location?

1 N- very windy/cold. More windy in the east. NE - 50 to 60 mi/hr. Dangerous when windy from SW. Stronger winds from N or NE.
2 Summer North/East 20 knots. Winter North 20 knots.
3 East and south southwest and south
4 South and east.
5 Stronger winds come from south than any other directions.
6 East and south summer and winter winds at 50 to 60 knots
7 South, North. I'm guessing since I'm not from there based on my living in coastal village.
8 Summer - south. Winter - north.
9 Southeast to southwest wind speeds in August is about 70 to 75 miles per hr. Winter month North and Northeast 35 to 50 miles.
10 NE, NW - summer and winter, 47 at weather one month October. Wind up 50 mile hours from NE and NW.
11 Summer south 15-55 gust. Winter variable 15-55 gust
12 Summer time from all directions. Winter time North winds.
13 North, south-summer
14 East and northeast at 25-35 knots.
15 N to NW from 15-70 kts (winter) ?
16 Summer - NW and SW, 30-40. Winter - NW and SW, 30-40.
17 North winds. Summer 10-15. Fall 40-50. Winter 40-50.
18 Northerly 55 mph (fall). Summer 10-25 mph. Winter 40-50. Spring 10-15/30.
19 Summer weather is from any direction, starting Dec are northerly till end of May
20 Don't know the weather at Nunivak. But at Cape Romanoff winds can get up to 20-40 miles in the winter. Wind directions North and South.
21 Don't know
22 North to northwest - 15 to 20 knots
23 Summer south 10-25 mph. Winter north 10-50 mph.
24 North/South. Summer 35 knots. Winter 55-60 knots.
25 North/ West in winter 40/60
26 Summer S-SE 0-20 mph. Winter N-NW-W 0-30.
27 Summer SE and W 0-20. Winter W and N.

Q4--What are the average and maximum wave heights and prevailing directions during the summer and winter months at the location?

1 Fall time, creates tall waves. Cannot travel while there are N and NE winds.
2 Summer 4'. Winter ice.
3 About 5 to 10 ft
4 When the wind blows the waves are at least 7 to 10 ft. None during winter.
5 Probably 25 or less miles an hour.
6 5 to 6 ft. out of the east and south
7 Don't know.
8 South in summer averaging 4-5 max 16 ft. Winter from North averaging 5-10 ft max to 24 ft.
9 Average wave height in summer when windy is about 4 feet. Don't know winter month. But have high and low tides.
10 On summer time, wind 15-20 from NW, month of March
11 High winds about 4-5 ft chops = summer. Winter = depending on cold conditions ice flow extends to about 10-15 miles out.
12 Summer time 0-10 ft. Fall 0-18 ft. Winter time frozen.
13 Summer - south, don't know - 5/10. Winter -
14 6-8 feet high north northeast direction
15 ?
16 Summer SW, W, NW, 4'-5'. 0 winter - frozen.
17 Summer 0-10. Fall 0-18. Winter 0.
18 Spring 0-5, summer 0-10, fall 0-16, winter 0.
19 Waves in summer are from 5-10 - 0 to 18 till freeze-up.
20 Summer approx 10-12 ft. high. Winter - ocean is frozen at Cape Romanoff
21 Don't know.
22 4-8'
23 Summer 3-5 ft (bad weather 6-10 ft). Winter ?
24 Don't know. A-3 - A-9
25 ?
26 Summer 2-6 Winter 2-8
27 Summer 5-8' at SE and W. Winter 0-5' at W and N.

Q5--What is the tidal range (high and low tide) at the location?

1 Extremely high tide when super windy.
2 8'
3 4 to 5 ft
4 High 3 to 4 ft
5 Probably 5 ft.
6 No answer given.
7 Don't know.
8 High tidal ranges from 5'-10'. Low tidal ranges 0-5'.
9 Tidal range - high.
10 On month May these is high tide over 4-5 feet
11 High tide up to 10 ft. Low tide up to 6 ft.
12 About 12'. Low 8'
13 High
14 4-6 feet rise high tide, low tide unsurveyed
15 ? 10-15 ft
16 Low tide ~ 100-200 feet. High tide ~ 6 feet water.
17 High tide 12 ft. Low tide 8 ft.
18 High tide 12 ft. Low tide 8 ft.

Q5--What is the tidal range (high and low tide) at the location?

19 At least 12'
20 Very low at Cape Romanoff during the fall. High water during spring.
21 Don't know.
22 ?
23 ?
24 (No answer given)
25 ?
26 10-15 ft
27 high - low -

Q6--Is the port affected by ice?

1 Yes
2 Yes
3 The beach side only
4 If its by the airport it won't be affected.
5 The less there is a break water.
6 Not if the port is located behind the airport
7 In winter months.
8 Nunivak is affected by ice in month of Oct-May
9 Yes
10 On month May there is ice in sea. Every wind from Northwest. Same time 20 miles 25 miles, Fr NW - Ice still there ...(illegible).
11 In extreme cold winter months ice thickness goes up to 7-9 ft.
12 Yes
13 Yes - winter
14 Yes
15 Yes, the ice flows or moves constantly in Bering Sea with the wind and currents.
16 Rarely. Jan and Feb is time it gets minimal ice.
17 Yes
18 Yes
19 Yes
20 Wouldn't know about Nunivak Island
21 Yes
22 Yes
23 Yes
24 (No answer given)
25 Yes
26 Yes
27 Yes

Q7-- If the port location is affected by ice, what are the approximate dates for freeze-up and break-up?

1 May/June break-up. Freezes in Nov/Dec.
2 Nov - May
3 Down on the beach. Sometime in September, breakup April May
4 Down on the beach only.
5 Nov/Dec to March
6 NA
7 Nov - April
8 Freeze in Nunivak is in first of Oct and clears up in month of April.

Q7-- If the port location is affected by ice, what are the approximate dates for freeze-up and break-up?

9 December
10 Ice break-up month May April. Freeze-up around month of Oct, Nov.
11 Freeze up around between Oct and Dec. Break up between Apr and May.
12 Nov to May
13 Unknown
14 January freeze-up, an the break-up begins mid to late in the month of May. The break-up varies, some times early and sometimes a little early.
15 November - May
16 Jan/Feb - freeze up between March (mid-winter) and April
17 November to May
18 November - May
19 From Dec till end of May
20 Probably break-up would be early May and freeze up would be 1st week of November
21 Nov - May
22 Dec. Jan. Feb. March. April
23 Dec to May
24 (No answer given)
25 Jan-Feb
26 Yes, Nov freeze - May break
27 November - May

Q8-- If the port location is affected by ice, what is the approximate thickness of the ice during average and extreme conditions?

1 (No answer given)
2 4' - 6'
3 2 to 3 ft someplaces thicker
4 4 to 6 ft in some places
5 2 ft thick
6 2' to 4'
7 5-10 ft.
8 Thickness of ice ranges less than 1" to 3' in Oct-April
9 4 - 6 feet
10 (Illegible)
11 See Q6
12 8-10'
13 Unknown
14 4-5 feet thick, averaging 4.5 feet
15 ? 10 ft or below
16 2-3 feet, 4 feet at most
17 8 - 12 ft.
18 8-12 feet
19 thickness of the ice est 8-12 feet
20 Wouldn't know - because I'm not from Nunivak Island.
21 Don't know.
22 Approx 10 ft.
23 4-6 ft.
24 (No answer given)
25 10-15 ft.
26 10'

Q8-- If the port location is affected by ice, what is the approximate thickness of the ice during average and extreme conditions?

27 10-15ft.

Q9-- Please provide any additional comments/concerns regarding port location not addressed by the above questions.

1 No traveling takes place when windy and scary. Area floods when very windy. December is month when ice is very thick.
2 (No answer given)
3 NA
4 Right now the beach is where we keep the boats.
5 It would be the only one more feasible than other villages in the region.
6 (No answer given)
7 (No answer given)
8 The Traditional Council supports the Nunivak port for Bethel Port is not accessible at Oct-April dates.
9 No comment
10 (No answer given)
11 (No answer given)
12 Moving ice during freeze up.
13 (No answer given)
14 None
15 Have the forces of ice flow be studied and see what degrees the port will effect the seawater environment and ecology.
16 Need professional survey at location where ice develops to thoroughly evaluate strength of ice pressure.
17 It is a good staging area.
18 Ice pressure ridges are sometimes evident.
19 Moving ice before freeze-up
20 The reason I picked Nunivak Island is that the people from that region think that it is the best place to have the port at Nunivak Island.
21 (No answer given)
22 Good location
23 Does Goodnews Bay and St. Michaels know that they are possibly listed for a regional port? Who coordinated this survey and is it part of the phases that need to be done?
24 (No answer given)
25 I think the location of Nunivak Island is a great place. The fisherman that go out fishing at that area would have a closer place to get fuel and off load fish.
26 (No answer given)
27 What is the velocity of the current.

Q10--What problems are experienced with the current system of shipping general cargo to your community?

1 Low tide, very shallow.
2 Tidal flats.
3 None
4 None right now we order enough fuel during the summer.
5 We have to wait for certain times and wait for it to arrive.
6 No current problems.
7 Distance and time (relatively once per year). High cost of shipping.
8 Today Bethel port consumes time and distance. Kuskokwin River route is limited due to shallow channels. Shuttling back and forth from Bethel port to village takes too much time.
9 NA
10 Arrival around month June 1-15 to last part June

Q10--What problems are experienced with the current system of shipping general cargo to your community?

11 Limited full is transported and we experience shortage of gas and fuel oil come spring including surrounding villages. Incoming cargo is taken to Bethel first or delayed due to various incidents such as breakdown, high winds, they have to be transported to Bethel for repairs by other barges

12 Low tick-barges wait for high tide to come in to off load fuel and cargo.

13 Space availability, or flights - cargo plane approximately 2/3 a summer for barge service

14 Freight delayed at Bethel port by days or weeks even by a month, or to a point of spoilage, ruining and even damage to a point of unusable or inedible.

15 Shipping prices are getting too high.

16 No problems with Newtok service.

17 Lowtide is the only problem, got to wait until hightide to get in.

18 Barge wait for high tide to deliver fuel or cargo. Different fuel delivery pipelines.

19 Low tides - barges waiting at deeper waters

20 Don't know. Maybe price of fuel going high okay, due to shipping fuel far away.

21 At best it is the communities that do business with community.

22 30 miles

23 Barge (summer time) air for goods.

24 Barged all the way up to Kuskokwin River and then barged all the way back down to coastal communities, time consuming.

25 The fuel that is shipped out to our village. NME, comes once a year for heating and gas. Sometimes the barge comes in late. Like close to freeze up time. Also during the winter and spring we have shortage.

26 Dropped off in Bethel, additional cost to ship to other villages.

27 Constant delays and danger of freeze up.

Q11--Please provide any additional comments/concerns regarding fuel and cargo shipments not addressed by the above questions.

1 Currently there are erosion problems in Newtok. Sand bags will help prevent.

2 (No answer given)

3 NA

4 NA

5 It can be more affordable in the area.

6 (No answer given)

7 (No answer given)

8 Kipnuk Traditional Council supports Nunivak Port project for it will reduce costs of cargo shipping.

9 (No answer given)

10 To July 00 yr.

11 (No answer given)

12 (No answer given)

13 Cost of items

14 NA

15 (No answer given)

16 No comment

17 None

18 (No answer given)

19 Fuel barges waiting in deeper water to come in, wait for high water to come out.

20 (No answer given)

21 Is there adequate land to establish storage facilities?

22 (No answer given)

23 (No answer given)

24 Fall fuel shipping may be affected by early Kuskokwin River freeze up.

25 ?

Q11--Please provide any additional comments/concerns regarding fuel and cargo shipments not addressed by the above questions.

26 (No answer given)

27 (No answer given)

Q12-- In your opinion, how would a regional port enhance the ability of commercial fishermen from your community to increase their catch?

1 More opportunity to fish more and to catch a variety of species. Currently, fish caught are few.

2 Freezer storage; large out shipments.

3 The port would help by not letting boats and gear sink during a bad storm.

4 Keep the boats from sinking during a storm.

5 There can be a safer place of delivery of fish and more fish to deliver in the future.

6 It would make it easier for people who fisherman to get ice/unload, etc.

7 Don't know if it would increase catch but could be used as receiving/distributing center, if facilities are installed.

8 In the long run commercial fisherman would benefit feasibly.

9 (Illegible)

10 On herring fishing season may last ...(illegible) for commercial fishing.

11 I believe if the channel is dredged, more salmon coming in the river would be caught if more fisherman fish in the channel. Easier to deliver and fish for more.

12 Not waiting for high tide to go out fishing.

13 If there is fish available and closeness of delivery of fish.

14 In halibut it would increase in poundage and size, it would also make it closer to deliver the catches. Herring would be no difference.

15 Providing fuel to fisherman harvesting around their port.

16 It will become efficient and increase cash flow with added catch.

17 Could park right on the port, and deliver my fish a lot faster.

18 A fish processing facility/value added products.

19 Not waiting for high tide to go fishing.

20 I don't think that I would be affected because I fish and sell my catch to Bering Sea fisheries.

21 Other fishers from near by communities could stay at port during fishing season.

22 90%

23 Eh? If there's fish.

24 Buyers, processors can have a faster turnaround time to unload and return to fishing grounds.

25 Fishing gear will be more affordable and available to fishermen.

26 Easier access to fishing grounds.

27 Better place to harbor and closer to halibut fishing grounds.

Q13--If the regional port would enhance the ability of fisherman from your community to increase their catch, what species would they harvest?

	salmon	herring	whitefish	pike	halibut	lush	pollock	cod	flounder	shellfish	crab
1		x	x	x		x					
2					x						
3	x	x									
4	x										
5					x		x			x	x
6											
7	x	x			x						
8		x			x				x		
9	x										
10											
11	x										
12					x						x

	salmon	herring	whitefish	pike	halibut	lush	pollock	cod	flounder	shellfish	crab
13		x			x			x			
14											
15					x			x			
16		x			x			x			
17					x						x
18					x						x
19											x
20	x										
21		x			x						x
22											
23	x				x			x	x		
24		x			x						
25					x						
26		x			x						
27					x						

Q13 (cont.)--If the regional port would enhance the ability of fisherman from your community to increase their catch, what species would they harvest?

	Other Species
1	na
2	na
3	na
4	na
5	feasible resources from Bering Sea
6	all species
7	na
8	tomcod, blackfish, smelt for subsistence
9	kings, chums, reds, silver
10	Herring fishing last may until harvest for all fish like herring and salmon
11	king, coho, chum
12	na
13	na
14	this depends on the high low fish run.
15	na
16	na
17	blue king crab
18	blue king crab
19	blue king crab
20	kings and chums
21	na
22	yes
23	na
24	na
25	na
26	na
27	na

Q14--If the regional port would enhance the ability of fisherman from your community to increase their catch, what areas would they fish?

1 Near the mountains, Cakcaaq, Nunivak, Nanvaruk. Families must camp out for weeks to catch the fish, Beird Inlet.
2 Nunivak area
3 W 5
4 W 5
5 Within the Nunivak Island area
6 Only the Goodnews Bay area
7 (No answer given)
8 Cape Avinoff - Kipnuk River - Kuskowin River General area of Kipnuk for subsistence.
9 (Illegible)
10 (No answer given)
11 Goodnews Bay, Quinhagak, Kuskokwin River
12 Area 4E
13 Nunivak area
14 As usual Area 4E
15 Deeper water of the Nelson Nunivak waters.
16 Akuluraq
17 Area 4E. All of CVRF Villages; Scammon to Platinum
18 Area 4E - CVRF area
19 Area 4E - CVRF area
20 Don't know
21 Help would be from local fishers ie: Mekoryuk residents.
22 halibut area - triangle
23 Bering Sea
24 Cape Avinoff, and offshore locally.
25 4E CVRF Region
26 Yes
27 Near the port

Q15--If a regional port would enhance the ability of fisherman from your community to increase their catch, what is the fishing season for each species that would be harvested?

1 Every season. Spring, winter.
2 June - Aug
3 May- herring, June through August - salmon
4 Herring in May, and salmon from June to August.
5 May/June for herring roe.
6 Herring and salmon season
7 (No answer given)
8 Herring - end of May to first of June. Halibut - June -Sept. Blackfish, smelt, tomcod - Aug- May for subsistence.
9 Kings, sockeyes, silver seasons. Start at first week of June for kings.
10 No enough harvested. Not enough fish, some fish small, we need biggers
11 May - June Kings. June - Sep chums. July - Sept coho.
12 Halibut June to Sept.
13 Halibut - see A13, summer generally
14 Herring middle of May to early part of June. Halibut from June to September or until the quota is caught.
15 June - August
16 June - July
17 Halibut June through September.
18 Halibut - June/September, King Crab - during King Crab season.

Q15--If a regional port would enhance the ability of fisherman from your community to increase their catch, what is the fishing season for each species that would be harvested?

19 From June till September
20 First week of June and late August for fall chum.
21 All summer. Which is a very short fishing season.
22 May to Sept.
23 Seasons A and B, summer June/July
24 Herring in May, Halibut May to June.
25 June - August Halibut
26 Herring, halibut
27 June - August

Q16--Briefly describe how ocean subsistence fishing is currently done.

1 Travel by boar and catch with net, black fish traps and other types of nets/traps.
2 Gill net; jigging
3 NA
4 As of right now we don't fish in the ocean.
5 We use skiffs to fish for herring, salmon, tomcod, flounders, etc.
6 Don't fish in the ocean.
7 Gillnets, longline, jigging.
8 Gill net, trawl, dipnet, hoopnet, long-line, rod and reel, jigging w/hooks, ugtag.
9 When the tide is coming in, you set net and wait how long you catch fish and move to another spot if you're not catching.
10 Aug to Oct.
11 Drift or set net and with rod and reel further out in the ocean (10 miles) for halibut.
12 Area 4E are currently allowed to keep non-commercial size halibut for subsistence.
13 Longline, rod and reel
14 Set net, Drift net, Jigging and Long line.
15 Jigging, gillnetting, and longlining.
16 Land boat to ocean and rivers
17 Rod and reel
18 Rod and reel
19 None commercial size fish. Using long line and reel.
20 Set net.
21 Small boats - LUND - regular aluminum boats
22 Long line - mech. rod and reel.
23 Longline; jigging
24 In small boat skiffs 16-24 ft in length
25 In the spring most villages that live on the coast hunt seal in the ocean. When break up comes we start fishing w/ small skiffs for herring, kings, red, etc.
26 Herring, halibut, seals
27 Longlines and jig

Q17--Briefly describe how a regional port would enhance ocean subsistence opportunities, if at all.

1 (No answer given)
2 NA
3 Easier to off load and load catch
4 Easier to load and off load catch and gear.
5 None
6 Make it easier for local people to unload their fish.

Q17--Briefly describe how a regional port would enhance ocean subsistence opportunities, if at all.

7 No effects
8 Nunivak port will help provide cheaper fuel, consolidate our equipment needs.
9 It would help lots of people, ... (illegible)
10 Subsistence, all year round
11 See Q12
12 See Q16. The port would allow subsistence to fisherman to use port to travel along North prevailing winds.
13 Delivery
14 It would enhance the storage for future needs, or future use.
15 ?
16 After catching ocean going foods, bring and offload at port.
17 It would make it a lot safer, with the port being there, due to big waves.
18 Currently subsistence fishers wait good weather to go around Cape Efolin to go to southside of Nunivak Island
19 See A16
20 Don't know.
21 (No answer given)
22 Deliver my catch to Mekoryak
23 Maybe some other villages can come to Nunivak and fish for halibut.
24 NA
25 ?
26 Safety
27 ?

Q18--Please provide any additional comments/concerns regarding the fishing industry not addressed by the above questions.

1 (No answer given)
2 (No answer given)
3 NA
4 NA
5 A good port can provide use services and make passable to enhance development of pressing plants, etc.
6 (No answer given)
7 (No answer given)
8 Increase the commercial buying of any commercial catches.
9 Need longer fishing periods and higher fish prices.
10 For subsistence - open all weather and summer
11 Since Quinhagak commercial fish is open longer I believe more Kuskokwin fisherman come out in increasing numbers, if they are able to make it in the river easier and a facility available to deliver more fish.
12 (No answer given)
13 Over harvesting
14 NA
15 ?
16 0
17 None
18 (No answer given)
19 (No answer given)
20 I think that it would have been a great idea having a port nearby. That way we can fly out fish or barge the frozen fish in a big quantity.
21 Quality could be better.
22 (No answer given)
23 (No answer given)

Q18--Please provide any additional comments/concerns regarding the fishing industry not addressed by the above questions.

24 (No answer given)
25 ?
26 (No answer given)
27 (No answer given)

Q19--What natural resources are there in the vicinity of your community that might be developed and exported if there was a regional port in the area?

1 Bearded seal, otter, minks, seal oil, beaver, tusks
2 Fish, reindeer
3 Halibut, herring, and salmon
4 Halibut, trout, salmon, and others
5 Herring roe, saffar cod, salmon special (pink), shellfish, crabs, halibut, sea cucumbers
6 Mostly fishing - seasonally
7 Gravel/rocks, shellfish, other fish species, cod, pink
8 Tomcod, smelts, blackfish, weaving salt grass, sand, local clay mud, special, salmonberries, blackberries, wild spinach, reeds, Labrador tea
9 Halibut, herring
10 We have natural resources ...(illegible) at village
11 Salmon
12 Blue king crab. Pacific cod, herring.
13 Gravel/rock
14 (No answer given)
15 Shrimp, yellow fin and other abundant fish
16 Seafood
17 Herring, crabs, halibut, cod
18 Herring, crab, halibut, gray cod, saffron cod
19 Blue king crab, cod fish, herring, tomcods
20 Gravel - rocks.
21 (No answer given)
22 Halibut, herring, gravel
23 Mining, gravel, fish
24 Renewable seafood resources, herring, halibut, tomcod
25 ?
26 Gravel - Reindeer raw product
27 ?

Q20--Please provide any additional comments/concerns regarding the resource extraction industry not addressed by the above questions.

1 (No answer given)
2 (No answer given)
3 NA
4 NA
5 Some of the above species need to be developed first by researching those resources.
6 (No answer given)
7 (No answer given)
8 Supports the extraction of local resource from area for export
9 Herring fishing.
10 At Nelson Island area need bigger boat.
11 (No answer given)

Q20--Please provide any additional comments/concerns regarding the resource extraction industry not addressed by the above questions.

12 (No answer given)
13 (No answer given)
14 (No answer given)
15 (No answer given)
16 0
17 None
18 (No answer given)
19 (No answer given)
20 (No answer given)
21 sand/gravel sales
22 Gravel is a much needed resource that may not be readily available in other villages
23 (No answer given)
24 (No answer given)
25 ?
26 (No answer given)
27 ?

Q21--In your opinion, would the presence of a regional port enhance tourism at your community? If so, please describe how tourism would benefit?

1 Newtok is not interested in tourism.
2 Cruise ships
3 Less moving of equipment to the present point, closer.
4 It would make getting to boats easier and off loading of passengers
5 Not necessarily if compared with airport.
6 Easier to off load and load equipment and be closer to the air strip.
7 Not sure.
8 Tourism is out of place. Tourism will affect local in negative way.
9 Maybe more tourism would come with port and ...(illegible) when to catch the fish.
10 We need benefit, for fisherman.
11 We already have a high number of sport fisherman coming in every summer. Perhaps our native corporation can create a tourism business in addition to guiding and transporting and bring in more revenue and employment.
12 Yes, cruise lines, passing thru going North.
13 Yes - additional boat dock; service - visitors hunting and fishing (arts, grafts, guides, etc.)
14 (No answer given)
15 Yes, the tourist would definitely be interested in native artwork.
16 Discourage tourism
17 Arts and crafts. Guides for the wilderness. $
18 Cruisers stopover, hiring local entrepreneurs and regional.
19 Yes
20 Don't know
21 Not > bird watching
22 Since we currently don't get tourists now, I don't think they will benefit much if the port is there.
23 Bird watching; basic village tourism; "I've been on Nunivak Island in Alaska Bay out in the Bering Sea"
24 No
25 Yes. There would be interest in our communities to see our subsistence way of life.
26 Yes, ferry's would be able to dock
27 No

Q22--Please provide any additional comments/concerns regarding future community development not addressed by the above questions.

1 Outsiders will not enter our community to dictate our lifestyle, only we can dictate ourselves.
2 (No answer given)
3 NA
4 NA
5 Need to develop fish plants when the resources are identified and port is in place.
6 NA
7 (No answer given)
8 Community development is here already and we are already moving towards flushing toilet, water system, anything that is positive to our community is already planned.
9 Need bigger fish plant.
10 At Nelson Island, we need higher price, little too low. Fisherman need good gear. Like very good boat get more fish, next season.
11 (No answer given)
12 (No answer given)
13 Tank farm to store fuel, constructional equipment storage, enlarge community water source and sewer, science inform/research, larger public jail facilities
14 (No answer given)
15 There would be convenient places be built for tourist to accompany their stay and place to eat. These would promote jobs.
16 0
17 Heavy equipment storage.
18 Heavy equipment storage.
19 Supply point, warehouse storage, fuel depot
20 I think that having a port nearby we can have our nature people work.
21 (No answer given)
22 (No answer given)
23 Sometimes, cruise tourism ships go all the way out to Nunivak Island; contact Princess Tours; Major cruise lines to see if they are interested in coming out to Nunivak. Market this adventure opportunity for outdoor adventurists around the world.
24 (No answer given)
25 ?
26 (No answer given)
27 ?

Q23--Briefly describe how the existence of a regional port would reduce or eliminate environmental problems associated with delivery and handling of fuel and general cargo in your community?

1 Get gas directly from the barge.
2 NA
3 Less oil and gas spills
4 Oil, and gas spills would be minimized
5 The more sensitive environment from our immediate would be avoided and place to a more safer area to Nunivak Island.
6 There would be no spills going into the bay.
7 Don't know if it would.
8 Port of Nunivak will reduce damages of personal items. Nunivak Port will reduce burning of barge and cargo fields, it will reduce the potential fuel spillages
9 It would be probably be faster to pump fuel and unload cargo in the port.
10 Gas price little too high. Fuel motor oil are high now.
11 If you hire natural resourcists and find their cause its possible to control or reduce the environmental problems.
12 They would be Coast Guard, EPA inspected facilities.
13 Large fuel spills near village, line spills on beach in front of village breakwater.

Q23--Briefly describe how the existence of a regional port would reduce or eliminate environmental problems associated with delivery and handling of fuel and general cargo in your community?

14 Drugs and alcohol will not be tolerated. All freight should be carefully checked before they delivered.
15 ?
16 Fuel spills and other catastrophes will prevent natural resources from recycling or get renewed.
17 EPA and Coast Guard regulations.
18 Coast Guard inspectors.
19 They would pass coast guard inspection facilities.
20 Having a port close by would reduce the price of fuel.
21 It could mean more timely delivery of fuel and general cargo.
22 If complete care is put into the transportation and transfer of fuel/goods, things may go well. To our understanding, transferring fuel doesn't take place unless when there are problems or deficiencies.
23 Fuel leaks
24 No comment
25 The fuel that is transported to our villages would be closer.
26 Costwise, things would be cheaper.
27 It will eliminate mother fuel barges from anchoring that present potential fuel spill.

Q24--Briefly describe how the existence of a regional port may impact the natural or renewable resources associated with pollutants in your community.

1 (No answer given)
2 NA
3 Easier to transport catch out of village
4 NA
5 Possible spills of fuel can be avoided in terms of volume.
6 NA
7 Will it affect the "usual route" of the different fish species that pass near port?
8 No comment.
9 In the port, ... (illegible) can take away the pollution from ...(illegible) village.
10 (No answer given)
11 Our natural and renewable resources are already impacted by natural causes, such as global warming and will continue to decline, in my opinion, whether we try different methods of interventions or not.
12 Fish plant would feed small fish around the port.
13 Waste, fisher-halibut, air, garbage.
14 Watch carefully the leaking and disposal of hazardous substance and liquids
15 ?
16 Will hurt the cycle of renewable resources.
17 It would be a place for scientific studies, for different sea species.
18 Staging port for scientific vessels.
19 (No answer given)
20 Would have ...(illegible) all year around.
21 It could possibly affect herring and halibut fishing.
22 If fuel is spilled in Nunivak, the impact will be felt on Nelson Island and will impact herring, the herring eggs, etc. currently available on or near the island.
23 Noise from transfers.
24 No impact.
25 ?
26 If there was a spill, it would effect our food source.
27 ?

Q25--Please provide any additional comments/concerns regarding environmental

quality issues not addressed by the above questions.

1 (No answer given)
2 (No answer given)
3 NA
4 NA
5 See Q24
6 NA
7 (No answer given)
8 (No answer given)
9 Need good agreement with sport fisherman about their trash and ...(illegible) buckets. I think sport fishing need better ...(illegible) bucket ...(illegible).
10 (No answer given)
11 (No answer given)
12 (No answer given)
13 (No answer given)
14 Disposal of hazardous material, be it liquid or solid waste and human waste. Proper storage facilities, and proper handling should be enforced.
15 ?
16 0
17 None
18 (No answer given)
19 (No answer given)
20 None
21 Oil spill - boats running aground could prove disastrous.
22 Waterfowl and their eggs that hatch in the area may be impacted if pollutants occur.
23 (No answer given)
24 (No answer given)
25 ?
26 (No answer given)
27 (No answer given)

Q26--Briefly describe how your community may alleviate social problems related to the potential influx of drug and alcohol importation via marine transportation.

1 (No answer given)
2 Get troopers involved/ fish and game.
3 Cops can keep an eye on boaters.
4 Easier for the local cops to keep an eye on boaters.
5 Not associated.
6 Don't think it would be a problem, cause, baggages are checked when people come from out of town.
7 Currently don't know if any drug/alcohol coming in via barge.
8 (No answer given)
9 NA
10 1) Fuel transportation, needs fisherman, fuel-motor/oil. 2) Tununak VPO and funding. 3) Needs repair buildings, public safety building.
11 Drug and alcohol importation has and will always exist although laws and law enforcers try to eliminate those problems.
12 Screen potential visitors to village by use of UPSO.
13 It wouldn't be able to handle the change unless it is funded; Education, AA-increase meetings, ...(illegible) w/ YKHC
14 Answer same as above.
15 ?
16 Need a "police" or guardian to ensure that visitors don't import such things.
17 Public safety issue, leave it to the LAW enforcements.

Q26--Briefly describe how your community may alleviate social problems related to the potential influx of drug and alcohol importation via marine transportation.

18 Increase public safety officers
19 Public safety.
20 Having a job would keep anybody away from drugs and alcohol. I know I would.
21 (No answer given)
22 Policies need to be developed that requires incoming vessels to refrain from selling, importing, or distributing drugs and alcohol.
23 Have a guard at the gate; "only employee" sign should be posted. Border shop should be on site for natives to sell native arts and crafts to barge/ships.
24 No comment
25 ?
26 Unless its 0 tolerances and monitored very closely, it will definitely affect us in this area.
27 Importation of drug and alcohol will probably increase.

Q27--Please provide any additional comments/concerns regarding social issues not addressed by the above questions.

1 (No answer given)
2 (No answer given)
3 NA
4 NA
5 Negative social impacts would not result of the port but positive ones can.
6 NA
7 (No answer given)
8 (No answer given)
9 Need mighty voices and understanding judgment.
10 1) Tununak need community hall need completed building. 2) Public safety building needs repair. 3) Need water sewer..(illegible).
11 If our new airport is completed, we are told our tribal police will search everyone coming in.
12 Increase training of village police officers and UPSO's.
13 (No answer given)
14 None
15 ?
16 0
17 None
18 Need to strengthen public safety training.
19 Increase training police forces in village
20 (No answer given)
21 Jobs Jobs Jobs = $ $ $
22 Parents often are not concerned of children who may abuse as a result of importation. Mental and physical burden will be on parents. Refrain from these becoming issues at any level as possible.
23 (No answer given)
24 (No answer given)
25 ?
26 (No answer given)
27 (No answer given)

Appendix G
Ruby to McGrath Road Feasibility Study

Manley Land Surveyors, Inc.

P.O. BOX 69 MANLEY HOT SPRINGS, ALASKA 99766 (907) 672-3632

November 29, 1993

Linda Snow
City of McGrath
McGrath, Alaska 99627

Dear Linda Snow:

Transmitted herewith is a copy of the "Ruby to McGrath Road Feasibility Study". This document consolidates much of the existing baseline data relevant to the Highway Development Process, identifies some of the potential roadway corridors., and takes a first cut at project development costs. This information was presented to the communities of Ruby, Takotna and McGrath during our final series of public meetings this fall. Jacques Boutet and Jim Sawhill, of Lounsbury and Assoc,, and I also presented this Feasibility Study Report to the officials of the Northern Regional Office of the Alaska Department of Transportation and Public Facilities on September 20th. and answered their questions.

Copies of this report are also being sent to the following councils, agencies, communities, or individuals:

City of Ruby
Takotna Community Association
Takotna Village Council
McGrath Native Village Council
MTNT Limited
Ruby Village Council
Dineega Corporation
Tanana Chiefs Conference
Fairbanks, McGrath, and Galena
Doyon Limited
Alaska Department of Transportation & Public Facilities
Jack Coghill, Lieutenant Governor, State of Alaska
Alaska Department of Community and Regional Affairs

Thank you very much for your input and cooperation with the preparation of this study. If you have any questions or require any additional information, please do not hesitate to call.

Very truly yours,

Manley Land Surveyors, Inc.
Elaine M. Gray, P.L.S.

Manlev Land Surveyors, Inc.

P.O. Box 69 MANLEY HOT SPRINGS, ALASKA 99756 (907) 672-3632

November 15, 1993

Hon. Donald V. Honea, Sr., Mayor
City of Ruby
P.O. Box 90
Ruby, Alaska 99768

Subject: Ruby to McGrath Road Feasibility Study Report
FINAL

Dear Don:

As you and other residents of the communities and mining districts between the Yukon and Kuskokwim are keenly aware, transportation throughout interior Alaska is costly, weather-dependent and often inadequate. Many argue that Alaska's limited transportation system restricts the growth and productivity of its resource-based economic sectors and sustains the high cost of living in rural communities.

Development of a roadway to move people, goods, forest products and minerals products between Ruby and McGrath appears to offer many benefits to its potential users. However, a road will effect changes in social, economic, and environmental conditions all along its corridor. It will be important to comprehensively describe these changes and balance their costs and benefits. Additionally, this project will compete for funding with many other proposed transportation improvements throughout the State and thus must demonstrate a strong contribution to Alaska's social and economic development.

The attached Feasibility Study Report for a Ruby to McGrath road consolidates much of the existing baseline data relevant to the Highway Development Process in a single document, identifies some of the potential roadway corridors, and takes a *first* cut at project development costs. The quality of data currently available are neither sufficient to make a judgement on the extent of these impacts, nor do they point to the best corridor for a road between Ruby and McGrath. Should the Ruby-McGrath Road advance into the Highway Development Process, a clearer picture of these issues can be drawn.

As always, we appreciate the opportunity to be of service to the City of Ruby.

Sincerely,

Elaine M. Gray, R.L.S.
Project Manager

RUBY TO MCGRATH ROAD

FEASIBILITY STUDY REPORT

NOVERMBER 1993

PREPARED FOR:

CITY OF RUBY
P.O. BOX 90
RUBY, ALASKA 99768

PREPARED BY:

Manley Land Surveyors, Inc.
Lond Surveying ond Civil Engineering
P.O. Box 69, Manley Hot Springs, AK 99756
(907) 672-3632

IN ASSOCIATION WITH:

LOUNSBURY & ASSOCIATES, INC.
ENGINEERS-PLANNERS-SURVEYORS
723 W. 6th AM. ANCHORAGE, ALASKA 99501
(907) 272-5451

AND DUANE MILLER, P.E.

NOTICE TO USERS

This Feasibility Study Report reflects a limited review of existing data and field conditions as of September, 1993 and a conceptual-level effort at identifying potential corridors for a road between Ruby and McGrath. Because changes in conditions, availability of data, and thinking frequently occur during the highway development process, users of this report should confirm current project status with the appropriate transportation' agencies.

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LIST OF ACRONYMS

Acronym	Reference
	Agencies
AASHTO	American Association of State Highway and Transportation Officials
ADOT&PF	Alaska Department of Transportation and Public Facilities
ARC	Alaska Road Commission
B.L.M.	'Bureau of Land Management
D.N.R.	Alaska Department of Natural Resources
FHWA	Federal Highway Administration
MTNT	McGrath, Takotna, Nikolai and Telida
U.S.	United States
USDA	United States Department of Agriculture
USGS	United States Geological Survey
	Documents
ANCSA	Alaska Native Claims Settlement Act
FSR	Feasibility Study Report
HPM	ADOT&PF Highway Preconstruction Manual
M-UTCD	Manual of Uniform Traffic Control Devices
	Terms
ADT	Average Daily Traffic
B-40	Single Unit Vehicle with 40-foot Wheel Base
CY	Cubic Yard
FAS	Federal Aid System
ft^2	Square feet
I.C.	Interim Conveyance
LF	Linear Feet
K.R.M.	Kateel River Meridian
R.O.W.	Right-of-Way
RS	Revised Statute
SY	Square Yard
T.A.	Tentative Approval
U.S.C.	United States Code

1.0 EXECUTIVE SUMMARY

This document reports the findings of a *feasibility* ***study*** to identify potential corridors for a proposed highway between the communities of Ruby and McGrath, Alaska. Ruby is located on the south bank of the Yukon River and McGrath is located on the south bank of the Kuskokwim River, approximately 125 air miles south of Ruby. Figure 1 locates Ruby, McGrath, the Yukon and Kuskokwim Rivers, and the general corridor within Alaska.

The general patterns of land ownership and status were investigated for the Ruby to McGrath corridor. The accompanying land status map shows a general indication of the land ownership and the permitted uses. Numerous historical and currently-utilized trails connect the' communities of Ruby and McGrath. Portions of the proposed route, ***the Ruby-Poorman Road*** and ***the Sterling Landing-Ophir Road*** have existing documented public rights-of-way. Additionally, the. majority of the land between Poorman and Ophir is owned by the State of Alaska, so the majority of any required right-of-way should be available. Existing land rights due to U.S. Federal mining claims, U.S. Mineral Surveys, State mining claims, Native Allotments, ANCSA Regional and Village Corporation lands, and some privately-held lands all exist within the study area.

There has been extensive mining activity in the area for the past ninety years. Many Federal mining claims are still valid and are generally clustered in the Long, Poorman and Ophir areas. State of Alaska mining claims are generally clustered in the Long to Poorman area and near Folger and Ophir. The mining activity is important in two ways: 1) subsequent project phases such as environmental or location studies are likely to identify mining activity as significant in establishing the purpose and need for the project, and 2) mining equipment and activities will affect the design of the road.

Within the scope of this study and available data, several alternative corridors are available. Where possible, this document suggests following existing corridors including the Ruby-Poorman Road and the Sterling Landing-Ophir Road. Currently, ADOT&PF and road users maintain the Sterling Landing-Ophir Road to within a short distance of Ophir and the Ruby-Poorman Road as far south as Monument Creek.

Between Poorman and the existing Sterling Landing-Ophir Road, three general alternative corridors are analyzed: ***the Innoko Corridor, the Folger Corridor,*** and the ***Susulatna Corridor.*** From the existing ***Sterling Landing-Ophir Road*** to McGrath, two general alternative corridors ***are*** analyzed: ***the Porcupine Corridor,*** and ***the Roundabout Corridor.*** Within each of these

general alternative corridors, various subsidiary alternatives are discussed.

The three corridors, Innoko, Susulatna, and Folger are representative of varying topography. The Innoko Corridor follows lowlands which provides advantages including ease of meeting roadway geometric standards and gentle grades. Disadvantages of the Innoko Corridor include an increased likelihood of expense due to wetland impact mitigation, fording drainages, lack of suitable material sources, and permafrost. The Susulatna Corridor follows higher, rolling to mountainous terrain, which limits the disadvantages associated with the Innoko Corridor. The disadvantage of the higher terrain is difficulty in creating a road with good geometrics such as large-radius horizontal curves, long vertical curves and gentle grades. The Folger Corridor strikes a balance between the advantages of the Innoko Corridor and the Susulatna Corridor. It follows higher ground than the Innoko Corridor, which should tend to limit permafrost problems, promote finding material sources along the route, and mitigate wetland impacts. Additionally, with limited exceptions while crossing mountain passes, the terrain of the Folger Corridor is more accomodating than the Susulatna Corridor which should tend to promote better roadway geometrics.

Rough cost estimates for the various alternatives are included in section 13. As described in section 3.4, the estimated cost per mile was rounded to $1 ,OOO,OOO per mile, not inclusive of bridges, which were estimated at $250,000 to $2 million each. Because the quality of available data was not sufficient for each corridor to develop more refined costs, the $1,000,000 per mile estimate was applied equally to all corridors assuming even distribution of expense for the project area. Therefore, any apparent cost advantage for a corridor is based only on its estimated length relative to other alternatives. Realistically, only the high and low costs derived from this analysis should be considered and only then as boundary values for a cost range.

To summarize, the Innoko Corridor via the Porcupine Option is approximately 180 miles and is estimated at $23 1 ,OOO,OOO. Using the Roundabout Option, the Innoko Corridor is approximately 185 miles and is estimated at $240,000,000.

The Folger Corridor via the Porcupine Option is approximately 175 miles and is estimated to cost $226,000,000. Using the Roundabout Option, the Folger Corridor is approximately 180 miles and is estimated at $234,000,000.

The Susulatna Corridor via the Porcupine Option is approximately 165 miles and is estimated to cost $212,000,000. Using the Roundabout Option, the Susulatna Corridor is approximately 170 miles and is estimated at $220,000,000.

2.0 INTRODUCTION

2.1 Purpose of the Feasibility Study Report

This document reports the findings of a *feasibility study* of a proposed highway between the communities of Ruby and McGrath, Alaska. The primary goal of this feasibility study was to identify potential corridors for such a highway. Two secondary goals were also adopted:

- The compilation and synthesis of existing data for these potential corridors; and
- Provision of a basis for Location Study and Environmental Documentation of these corridors.

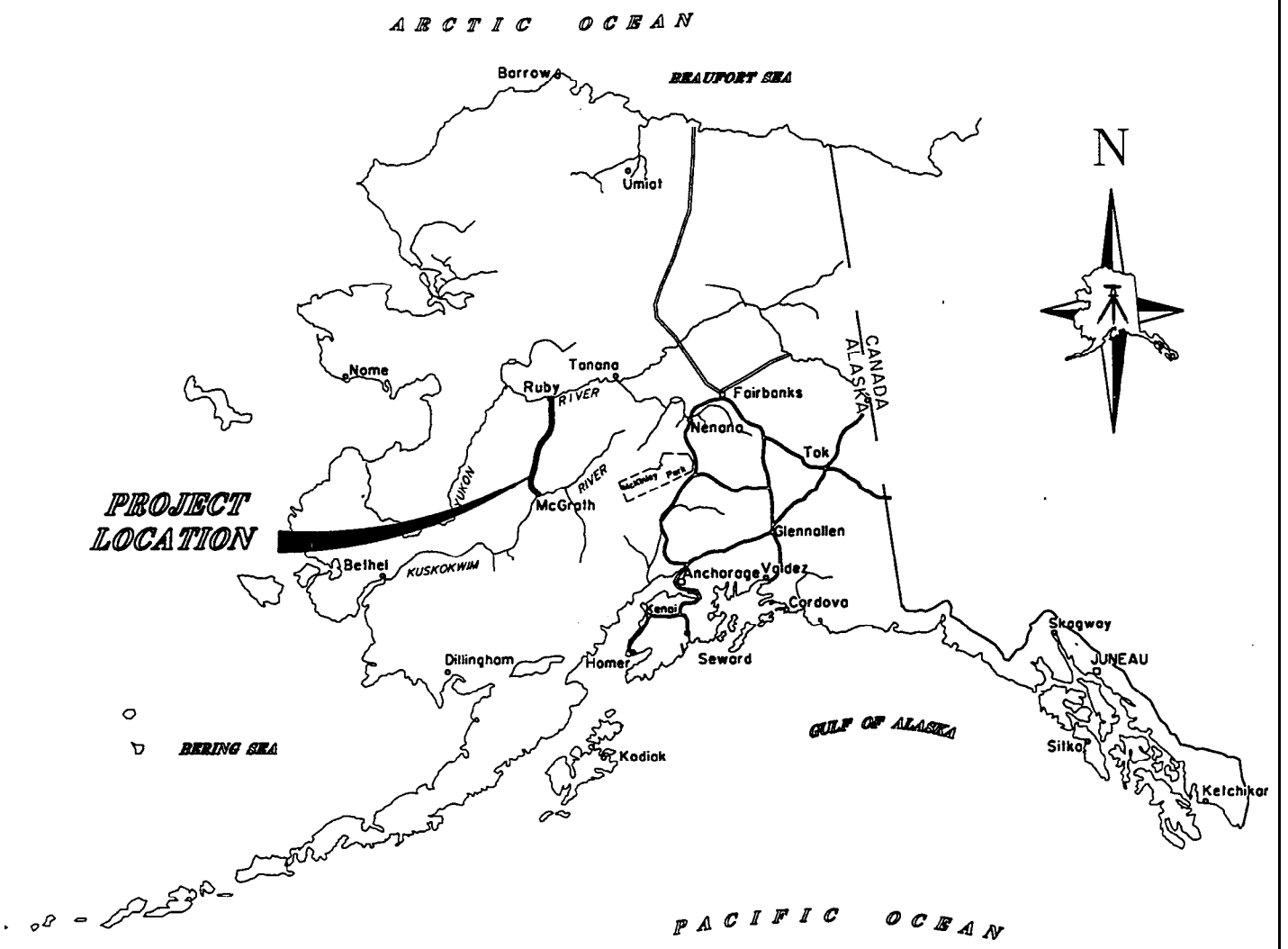
This feasibility study was supported by a Municipal Grant from the State of Alaska Department of Administration to the City of Ruby. It was prepared by Manley Land Surveyors, Inc. in association with Lounsbury & Associates, Inc. and Duane Miller, P.E.

Although a formal Highway Project Development Process has not been initiated for a Ruby-McGrath road, the study recognizes that the Alaska Department of Natural Resources has nominated two of the routes considered in this study for certification as rights-of-way under 43 U.S.C. 932, Revised Statute (RS) 2477 and moreover that the Alaska Department of Transportation and Public Facilities has tentatively scheduled a Location Phase in its 1999 State Transportation Improvement Program.

2.2 Project Location

The project is located 'in the Upper Yukon-Kuskokwim Region of Alaska. Ruby is located in the Kilbuck-Kuskokwim Mountains, on the south bank of the Yukon River approximately 50 air miles east of Galena and 230 air miles west of Fairbanks. McGrath is located on the south bank of the Kuskokwim River, approximately 125 air miles south of Ruby. Figure 1 locates Ruby, McGrath, the Yukon and Kuskokwim Rivers, and the general corridor within Alaska.

This document suggests following existing corridors beginning with the ***Ruby-Poorman*** Road Corridor. From Poorman south to the existing ***Sterling Landing-Ophir Road,*** three general alternative corridors are analyzed: ***the Innoko Corridor, the Folger Corridor,*** and the ***Susulatna Corridor.*** From the existing ***Sterling Landing-Ophir Road*** to McGrath, two general alternative corridors are analyzed: the ***Porcupine Corridor,*** and the ***Roundabout Corridor.*** Within each of these general alternative corridors, various subsidiary alternatives are discussed.



RUBY TO MCGRATH ROAD STUDY	LOUNSBURY & ASSOCIATES, INC. ENGINEERS-PLANNERS-SURVEYORS 723 W. 6th AVE. ANCHORAGE, ALASKA 99501 (907) 272-5451
FEASIBILITY STUDY REPORT	SCALE: NO SCALE
	DATE: SEP 1993
LOCATION MAP	DRAWN: CJH
	CHKD: JMB
	FIGURE: I

2.3 Background to the Project

Except for aboriginal travel routes, for which there is little documentation, most trails in the Kuskokwim area were developed as a result of mineral exploration and production. Prospectors began exploration of the Kuskokwim Valley in 1889, but did not find enough gold to warrant staying in the region. Commercial quantities of gold were discovered in 1906 and by the spring of 1907 many hundreds of prospectors had entered the area from Nome and Fairbanks, with the major prospecting occurring on Ganes, Little, Spruce, and Ophir creeks. At that time, primary access into the region was via steamer along the Kuskokwim and Yukon rivers. Although there were a few trails in 1907, water transportation was the predominate mode.

In 1908, the Alaska Road Commission conducted a reconnaissance for a trail between Seward and Nome that passed through the Kuskokwim area, noting potential route locations. In the same year, geologist A.G. Maddren performed a survey of the region which resulted in the recommendation for a route connecting the Kuskokwim drainage with the town of Ophir. Meanwhile, new mining towns were established: Flat, on the east bank of Otter Creek 16 miles above its confluence with the Iditarod River, Takotna Station, 20 miles from Ophir, and others.

Area mining flourished in the ensuing years. Thousands of miners and prospectors entered the region, with lode mining development at Cripple, Nixons Fork and dredging operations southwest of McGrath providing the impetus for road and trail development. Between 1920 and 1930 mining companies and the Alaska Road Commission constructed hundreds of miles of permanent and seasonal roads in the Upper Yukon-Kuskokwim mining districts. Brief histories of routes relevant to the Ruby-McGrath corridor are presented in the later discussion of specific alignments provided in this report. Mining activity in the region halted during the Second World War and road and trail construction came to a virtual standstill. During the 1950's, minor maintenance was performed on some of the area's roads and trails.

With statehood, Alaska received easements for two highways in the project area., the Sterling Landing-Ophir route (Federal Aid System Route #261) and the Ruby-Poorman route (Federal Aid System Route #271). These so-called "omnibus" roads are further discussed in Section 5.0. Additionally, responsibility for the planning, design, construction, and maintenance of access routes in the region passed to the State Department of Highways (now renamed the Department of Transportation and Public Facilities or ADOT&PF).

In 1965, the State, in cooperation with the U.S. Bureau of Public Roads, proposed a network of 34 roads in Alaska, three of which were the McGrath-Dillingham, Lignite-McGrath, and

Talkeetna-McGrath Scenic roads. A decade later the Bureau of Land Management proposed 40 multimodal transportation and utility corridor systems for Alaska, including a route between Ruby and McGrath via Ophir. None of these proposals were realized, however, probably because of the enormous cost involved in planning, construction, and maintenance. The 1974 Alaska Existing Trail System inventory by the Alaska Department of Transportation attempted to identify important trails and roads in Alaska. In 1985, Alaska Department of Natural Resources compiled a similar inventory. Both are being used in the current state program to protect and/or acquire rights-of-way to historic roads, trails, and access routes.

In June, 1993, the Alaska Department of Natural Resources advertised its nomination of both the winter and summer Poorman-Ophir Trails for certification as RS 2477 rights-of-way and is currently compiling its supporting documentation.

Currently, ADOT&PF and road users maintain the Sterling Landing-Ophir Road to within a short distance of Ophir and the Ruby-Poor-man Road as far south as Monument Creek. Both roads provide access to community landfills, hunting/fishing areas, and mining districts. The road between Sterling Landing and Takotna provides Takotna residents with access to the Tatalina Air Base and its employment opportunities and the Kuskokwim River, with its barge traffic and subsistence areas. Because both roads are founded on native soils and have minimal drainage systems, traversability during spring break-up and rain/snow storms is marginal.

2.4 Study Methodolow

This study employed four (4) phases of activity, described below.

Phase 1: Data Collection

Data Collection was accomplished with the following activities:

- Compilation and review of relevant planning, geological, demographic, economic, and transportation studies of the project area.

- Interviews and discussions with local area residents, as well as planners, geologists, biologists, engineers, and managers with the following agencies and private enterprises:

  Organized Cities
  City of Ruby
  City of McGrath

Takotna Community Association

Village Councils
Ruby Village Council
Takotna Village Council
McGrath Native Village Council

Regional and Village Corporations
Doyon, Limited
Tanana Chiefs Conference
MTNT Limited (McGrath, Takotna, Nikolai and Telida)
Dineega Corporation

Federal Agencies
U.S. Bureau of Mines
U.S. Geological Survey - Alaska Branch
U.S. Bureau of Land Management
U.S.D.A. Soil Conservation Service
U.S. Fish and Wildlife Service

State of Alaska Agencies
Alaska Department of Transportation and Public Facilities
- Northern Region Planning
- Northern Region Right-of-Way
- Northern Region Materials

Alaska Department of Natural Resources
- Division of Land
- Division of Geological and Geophysical Surveys
- Division of Mining

Alaska Department of Fish and Game

- Compilation and interpretation of high-altitude infra-red photography acquired by U-2 overflights of the project area.

- Presentation of the project concept at a series of public meetings held in Ruby, Takotna, and McGrath during November, 1992, during which public input was solicited and received.

- Engineering field investigations consisting of walking inspections, site

photography acquisition, and interviews with users and maintenance personnel.

Phase 2: Analysis and Formulation of Alternative Corridors

The data collected in Phase 1 was compiled and evaluated as described in the sections below. Further refinement of these data developed an array of alternative corridors, combinations of which provide possible routes for a highway between Ruby and McGrath. Major elements of these corridors, such as Right-of-Way status, geology, and environmental conditions, were investigated through research of existing studies.

Phase 3: Public Involvement

The project was presented to residents of the project area in two (2) series of public meetings held in Ruby, Takotna, and McGrath.

The first series of meetings initiated the project and discussed the following project elements:

- Typical Highway Development Process Flowchart
- Project Timeline
- Typical Rural Highway Cross-section

Additionally, public questions, comments, and other input were solicited.

The second series of meetings, held after the completion of a preliminary draft Feasibility Study Report (FSR), presented the alternative corridors developed in the FSR, provided discussion of the various elements of each corridor analyzed in the FSR, and solicited public input.

Phase 4: Documentation

This phase consists of the development of this FSR. The FSR compiles and presents the results of Phases 1, 2, and 3 without identifying a Preferred Corridor or making specific recommendations as to route location. Completion of the FSR will complete this project.

3.0 DESIGN STANDARDS AND PROJECT COSTS

3.1 Functional Classification

A highway's ***functional classification*** defines both its purpose and the type of service it is expected to provide. The Ruby-McGrath road will have a combination of functions and special considerations that do not lend themselves to typical rural highway design controls:

- The route will probably be isolated, that is not linked to the State highway system;
- Design year and near-term traffic volumes for trucks and automobiles will be low;
- A significant proportion of the traffic stream will be all-terrain vehicles (four-wheelers and snowmachines);
- Heavy construction equipment associated with area mining operations will operate on the highway;
- Available funding for construction and maintenance will not support development of a highway to typical standards.

In many respects, the Ruby-McGrath road operational characteristics and requirements will be comparable to the resource development (such as mining or logging) or recreational (park access) roads located throughout the United States. National and state design policies recognize these conditions as characteristic of so-called **Special Purpose Roads** and have developed separate, specialized design criteria.

3.2 Design Criteria

In its Highway Preconstruction Manual (HPM, Part II, Section 11-20.00) the Alaska Department of Transportation and Public Facilities develops a design classification for ***Non-contiguous Rural Collectors.*** By definition, these, roads serve less than 400 vehicles per day, link adjoining properties and rights-of-way with one or more communities, and are isolated from the State highway system.

The following table presents **the minimum** and **desirable** design criteria for non-contiguous rural collectors:

Ruby-McGrath Road	DESIGN CRITERIA	
Design Element	Minimum Value	Desirable Value
Design Vehicle	Single-Unit Truck	AASHTO WB-40
Design Speed	**20** MPH	**40** MPH
Bridges	H 15	HS 20
Lane Width	9 feet	10 feet
Shoulder Width	**2** feet	**2** feet
Clear Zone Distance	**7** feet	10 feet
Design Flood Frequency (culverts)	10 years	**50 years**
Design Flood Frequency (bridges)	**50 years**	100 years
Stopping Sight Distance	125 feet	**325** feet
Passing Sight Distance	800 feet	1500 feet
Horizontal Curve Radius	125 feet	**750** feet

3.3 Typical Section

Application of the minimum standards established by the design criteria presented above yields a Typical Section for the roadway as depicted in Figure 2, which is presented in Section 4.0.

3.4 Construction Costs

The limited road construction history in the project area complicates development of construction costs for the Ruby-McGrath road, even at a conceptual level. The ADOT&PF's database for highway and aviation projects in the Upper Yukon-Kuskokwim region for the twelve-year period, 1980-1992 was reviewed and average unit costs for major construction

items extracted. Construction quantities for representative projects were also analyzed for typical requirements of road construction in similar terrain conditions. The following table summarizes the results of this analysis and estimates a cost-per-mile value for road construction which was adopted for this study.

Construction Item	unit	Quant/mile	unit cost	Total Cost
Mobilization	L.S.	All Required	10% of Total Cost	$90,600
Clearing and Grubbing	Acre	10.5	$2,000	$21,000
Unusable Excavation	CY	57,500	$6	$345,000
Usable Excavation	CY	35,000	$6	$210,000
Classified Fill and Backfill	CY	18,125	$8	$145,000
Crushed Aggregate Surfacing	CY	2,000	$35	$70,000
Culvert	LF	500	$70	$35,000
Rip Rap	CY	2,500	$10	$25,000
Geotextile	SY	27,500	$2	$55,000
TOTAL COST /MILE				$996,600

The estimated cost per mile was rounded to $1,000,000 per mile, not inclusive of bridges, which were estimated at $250,000 to $2 million each.

This estimated cost per mile assumes an even distribution of the range of topographic and geotechnical conditions identified for the project area. All corridors were found to have a variable mix of these conditions. However, the quality of available data was not sufficient to develop more refined costs for each corridor. Consequently the unit cost was applied equally to all alternatives. Therefore, any apparent cost advantage for a corridor is based only on its estimated length relative to other alternatives. Realistically, only the high and low costs derived from this analysis should be considered and only then as boundary values for a cost range.

4.0 ENGINEERING GEOLOGY

4.1 Terrain Unit Mapping

A general assessment of geotechnical conditions along the proposed routes was developed from existing geologic reports from the region (reference Appendix A) and a three day field trip (August 30 to September 1, 1993) which included driving existing roads and flying over selected alignments. Using these data sources and a preliminary review of available high altitude, stereo photographs, the expected geotechnical units for possible routes were mapped. The map units along the possible routes are summarized in the following table:

Summary of Map Units

Map Unit	General Description	Typical Thermal Condition
Modem ALLUVIUM	Stratified silt, sand, and gravel; includes mining tailings.	Unfrozen or thaw stable.
Older TERRACES and FANS	Sorted sand and gravel; mantled by loess, colluvium, and vegetation.	Frozen, thaw stable material overlain by surface silt which may be ice-rich.
SWAMP and PEAT BOG	Organic-rich alluvial and lacustrine silt; may include peat layers to 5-foot depth.	Unfrozen or ice-rich.
COLLUVIUM	Unconsolidated silt and bedrock rubble deposits; may include some loess.	Frozen; may be ice-rich.
UNDIFFERENTIATED Surface SOILS	May include terrace, colluvial and loess deposits	Frozen; varies from thaw stable to ice-rich.
BEDROCK	Primarily metamorphic rocks north of Poorman, Sedimentary rocks to the south, with igneous domes between Ophir and McGrath. May include thin loess and colluvial cover.	Unfrozen or thaw stable.

Corridor Landform Mapping developed for the proposed corridors depicting the approximate boundaries of the above-described units is presented in a pull-out map provided at the end of this document.

4.2 Foundation Considerations

The geotechnical design of the road will be strongly influenced by the landforms it traverses.

The principal geotechnical factors affecting design include the following:

- Drainage;
- Stability of the embankment;
- Difficulty of excavation; and
- Material sources.

Drainage

Because of the presence of permafrost, drainage will complicate roadway design over all landform units except bedrock (typically associated with drier upland areas) and alluvium deposits. The permafrost will not permit infiltration and thus trap runoff and surface water in the upper level of the subgrade. In upland areas, cross-drainage will partially relieve this condition. In the flatter, lowland areas water movement will slow and possibly stagnate although the use of cross-culverts, structural fill with low frost susceptibility, and soil separation fabric will mitigate roadway degradation.

Stability of Embankment

The stability of the embankment will be most affected by the presence of permafrost along the route. Where the roadway crosses frozen soil, the increased heat gain in the summer from the presence of the roadway will cause the permafrost to thaw. Preventing thaw by insulating the embankment is generally not a cost effective alternative in the interior of Alaska because of the warm ground temperatures. Insulation in the embankment will slow but not stop the thaw of the permafrost. Therefore the roadway should be designed assuming that underlying frozen soils will degrade after construction.

Thaw settlement will be largest where ice-rich permafrost occurs. When the ice-rich soil thaws, the embankment will settle, shoulders will crack and spread, and cut sections will slump. Ice-rich permafrost is expected to be most common in areas underlain by peat bogs, colluvium and wind-blown silt (loess). Site specific data is needed to avoid the deposits of massive ice which will have the most adverse effect on the roadway.

The alluvium is expected to generally consist of sand and gravel, and if frozen, the material will generally be thaw stable so that settlements will be small. Exceptions will be localized thick pockets of frozen organic soil and silt overlying the alluvium. The older terraces and fans that border much of the modem alluvium are also expected to be underlain by thaw stable sand and gravel. Where surface silts overlie these older granular soils, the silt is probably ice-rich.

In the areas mapped as "undifferentiated", both thaw stable and ice-rich soils are expected. The lower levels of the undifferentiated landforms are more likely to be underlain by thaw stable soils associated with fans and terraces. At greater distances from the modern streams, the thickness of colluvium and silt in the undifferentiated unit is expected to increase, and the risk of crossing ice-rich permafrost is greater.

Bedrock areas could be underlain by permafrost, but the permafrost will be thaw stable. However, bedrock areas commonly have the most topographic relief so quantities of cut and fill will be greater than in the gentler terrain along the lower drainages.

Difficulty of Excavation

Excavation should be avoided in permafrost areas to mitigate thaw instability and degradation, and thus significant portions of all corridors will not be affected by the difficulty of excavation. However these segments will have a consequent increase in required quantities of borrow material for thaw' protection.

The unfrozen or thaw stable alluvium deposits can be excavated to accommodate alignment criteria or material mass balance requirements. Excavation will be primarily complicated by thermal conditions in the active layer, a factor of the time of year excavation is performed.

The excavation of bedrock can be more difficult than in areas underlain by soil, and blasting will be required in some locations. This complicating factor is somewhat offset by the stability and reduced structural fill requirements typically encountered in bedrock areas.

Material Sources

Material sources for constructing the embankment are expected to be available throughout the project corridor. Numerous developed material sites exist along the Ruby-Poorman and Sterling Landing-Ophir roads. The landform units expected to provide the best structural materials are areas of modern alluvium, old terraces and fans, and bedrock.

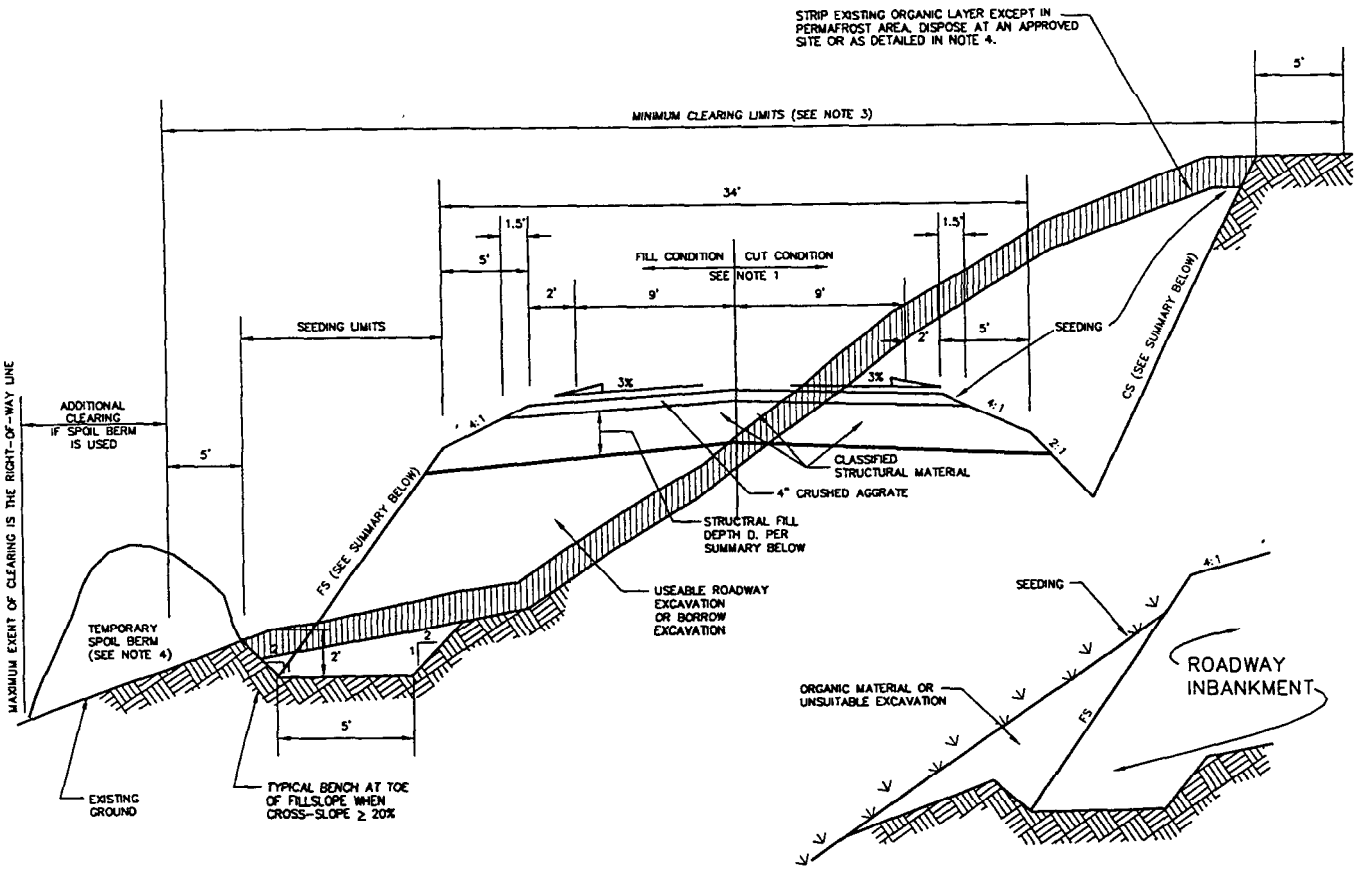
4.3 Foundation Recommendations

For preliminary planning purposes the surface of the roadway embankment is expected to be at least three feet above the existing grade. Side slopes of 1.5 horizontal to 1 vertical (1.5H:1V) can be assumed for embankments constructed over most of the landforms. Cut slopes of 1.5H:1V can be used for estimating quantities in the alluvium and old fans and

terraces. Similar slopes will be appropriate through the colluvium on the higher slopes of the mountains. However, where the colluviurn is thick and ice-rich, the cut slopes should be designed with a wide ditch at their toe to allow space for thawing soils to slump and be removed by maintenance crews. Allowable cut slopes in bedrock will vary widely depending on rock type, jointing and degree of weathering, but an average slope of 1 H: 1 V should be used for preliminary planning. Figure 2 presents a Typical Section for the roadway, depicting the application of these recommendations for various design conditions.

Stream crossings can be accomplished using culverts and bridges. Bridges will be founded on either pile foundations driven into the alluvium or on bin-type walls bearing on the alluvium and protected from scour by slope protection.

The design of'the roadway alignments through this complex terrain will require geotechnical reconnaissance level surveys and detailed site specific explorations to develop a cost effective design.



SPOIL EMBANKMENT DETAIL

NOT TO SCALE

NOTES

1. THE PORTION OF THE TYPICAL SECTION TO THE LEFT OF THE CENTERLINE INDICATES A FILL CONDITION, WHEREAS THE PORTION TO THE RIGHT OF THE CENTERLINE INDICATES A CUT SITUATION.

2. THE CUTSLOPE (CS) FOR SILT OR SILT GRAVEL DESIGN CONDITIONS IS 1.5: 1 FOR CUTS UP TO 10 FEET HIGH OR 1: 1 FOR CUTS OVER 10 FEET HIGH.

3. THE CLEARING LIMITS SHOULD BE AT LEAST 40 FEET EACH SIDE OF THE CENTERLINE.. CLEARING IN PERMAFROST AREAS SHOULD BE LIMITED TO CUTTING TREES AND BRUSH TO GROUND LEVEL

4. UNSUITABLE EXCAVATION AND ORGANIC MATERIAL SHOULD BE TEMPORARILY STOCKPILED BEYOND THE TOE OF FILLSLOPE ON THE DOWNHILL SIDE. UPON COMPLETION OF ROADWAY PRISM. THE ORGANIC AND UNSUITABLE MATERIAL SHOULD BE SLOPED, SHAPED AND SEEDED TO A NEAT CONDITION AS SHOWN IN THE SPOIL EMBANKMENT DETAIL.

TYPICAL SECTION DESIGN CONDITION – SUMMARY			
CUT SLOPE (CS)•	FILL SLOPE (FS)	STRUCTURAL FILL DEPTH(D)	DESIGN CONDITION
SEE NOTE 2	1.5:1	36"	SILT OR SILTY GRAVEL
SEE NOTE 2	1.5:1	36"	PERMAFROST
1:1	1.5:1	36"	BEDROCK

RUBY TO MCGRATH ROAD STUDY	LOUNSBURY & ASSOCIATES. INC ENGINEERS-PLANNERS-SURVEYORS 7220 W 6th AVE. ANCHORAGE ALASKA 99501 (907) 272-5451
FEASIBILITY STUDY REPORT	SCALE: NO SCALE
	DATE: SEP 1993
TYPICAL SECTION	DRAWN: CJH
	CHKD: JME?
	FIGURE: 2

to individuals or to the State of Alaska. The area shown as containing Federal mining claims is very approximate. The exact locations and dimensions of the claims were not investigated.

The State of Alaska has classified land for mineral activities and many mining claims have been issued. The mining claims currently shown on the D.N.R. status plats or mineral estate maps as of June, 1993 have been drawn on the land status map. As with the Federal mining claims, these locations are approximate. The claims are generally clustered in the Long to Poorman area and near Folger and Ophir. The state-issued water rights permits are not shown.

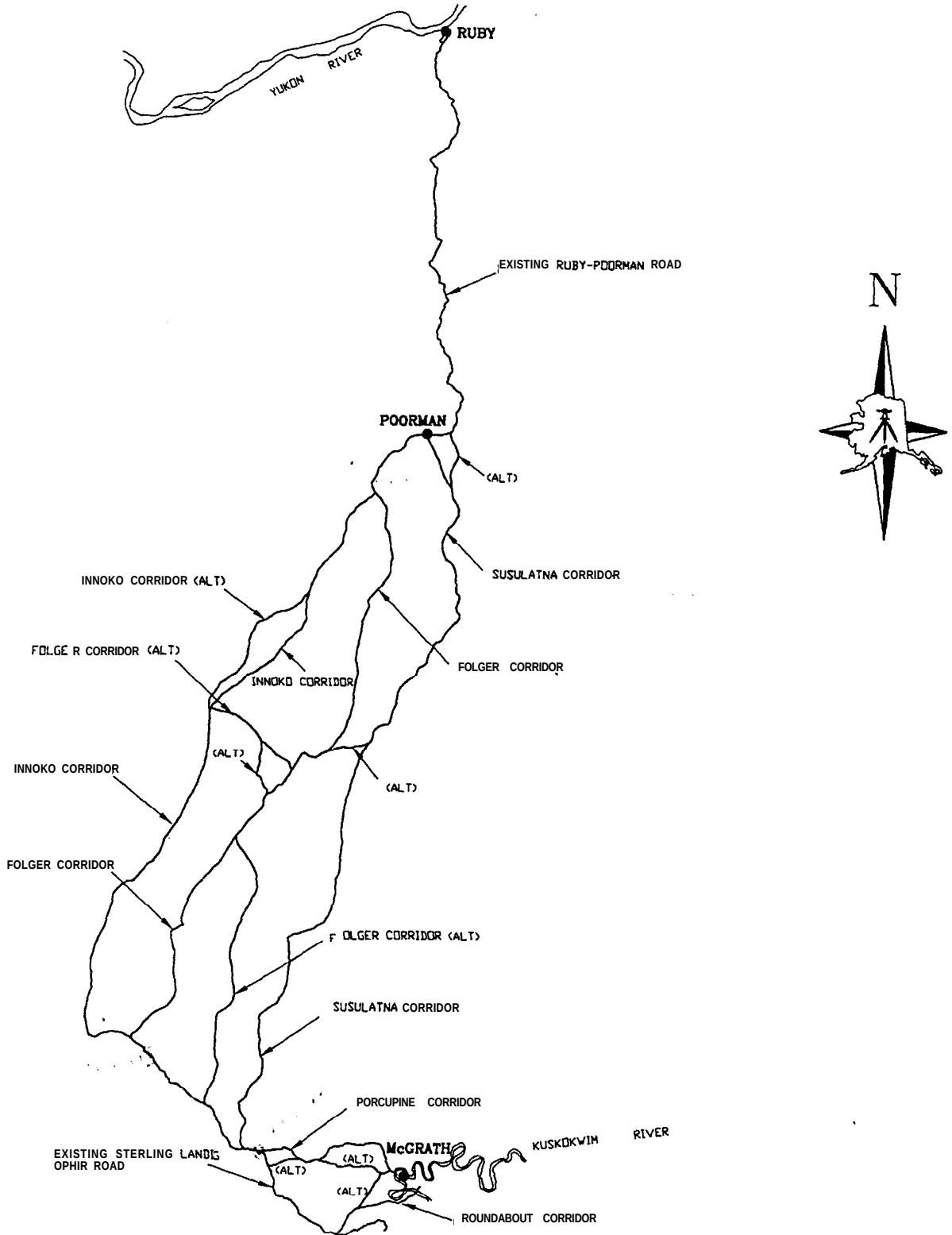
5.3 Native Allotments, Regional and Village Corporation Lands

Many Native Allotments exist within the study area. They are generally located in the northern and southern sections of the study area in the vicinity of communities but some are also located near Cripple Landing. The Native Allotment program allowed individual Natives to obtain title from the Federal government to lands that they used and occupied. Most of the allotments shown have been surveyed.

Doyon, Ltd. is the regional corporation for the entire study area. Dineega Corporation is the village corporation for the Ruby area. Village corporations only receive title to the surface estate of their lands and the regional corporation receives the subsurface estate of these village lands. Dineega and Doyon have received Interim Conveyance (a patent will later be issued) to portions of three townships along the northern portion of the Ruby to Poorman Road. Doyon has also received I.C. to the surface and subsurface of a portion of T.l 1S., R.17E., K.R.M. Doyon and Dineega have selected additional lands in this area.

MTNT, Limited is the consolidation of the four village corporations formerly located in McGrath, Takotna, Nikolai, and Telida. MTNT and Doyon have received interim conveyance or have selected the majority of the land in the southern portion of the study area. The State of Alaska has also received tentative approval to portions of five townships in this same *area* creating a patchwork of ownership. Most of the remaining land has been selected by both the State of Alaska and by MTNT and Doyon.

Interim conveyances are subject to valid and existing rights and contain 17(b) easements. The purpose of 17(b) easements is to guarantee public access to publicly owned lands, major waterways, or other public uses. These easements are specified in each I.C.



RUBY TO MCGRATH ROAD STUDY	LOUNSBURY & ASSOCIATES, INC ENGINEERS PLANNERS SURVEYORS 723 W. 6TH AVE/10 (907) 272-5451 ANCHORAGE, ALASKA 99501
FEASIBILITY STUDY REPORT	SCALE: NO SCALE DATE: SEP 1993
CORRIDOR LOCATION	DRAWN: CJH CHKD: JMB FIGURE: 3

6.0 RUBY-POORMAN CORRIDOR

This corridor consists of the existing Ruby to Poorman Road, a dedicated right-of-way approximately 53.5 miles long that is owned by the State of Alaska and administered by the ADOT&PF. A 1:250,000-scale map of the corridor overlain on topography and cadastral/political boundary mapping prepared by the U.S. Geological Survey appears on the **ALTERNATIVE CORRIDORS WITH TOPOGRAPHIC BASE MAPPING** plan attached to the end of this document.

6.1 Historical Background

Gold was discovered at Ruby Creek in 1907, but the settlement at Ruby was not founded until a strike at Long Creek in 1911. Subsequently the area population quickly grew to over 1,000. A trail between Ruby and Long was established shortly thereafter and additional discoveries to the south fueled public interest in extending this trail. The Alaska Road Commission's Map of the Kuskokwim District for 1926 depicts a wagon road between Ruby and Monument Creek (located 10 miles south of Long), continuing as a pack trail through Poorman and on south to several communities along the Kuskokwim River.

Although the Second World War brought a general decline in mining in the area, there are currently several mines in operation. The demand for vehicular access between these mines and Ruby has kept the road maintained as far south as Monument Creek although the route has not been upgraded and remains a low-speed seasonal road.

6.2 Alignment and Maior Structures

Existing Conditions

The existing road is apparently passable to Monument Creek, at which there is reportedly no bridge structure. Efforts to drive to Monument Creek during the August, 1993 field trip were frustrated two or three miles short of the river by the poor condition of the road-bed following a storm. Because it was constructed of native materials containing silts and clays, the existing roadway is only traversable with all-wheel drive vehicles during spring break-up and rain storms. That portion of the route that was driven was generally between 15 and 18 feet wide, with rolling grades, and containing only short segments of grades in excess of 10%.

The route was field-engineered as a wagon trail long before highway design standards were established. In consequence, horizontal and vertical curvature is irregular and traveling speeds

are often restricted. As the existing roadway does not meet current design standards and does not have suitable foundation materials, it should be completely reconstructed at an appropriate phase in the Ruby-McGrath road construction period.

General Alignment

Bearing south from Ruby (elevation 200 feet), the route climbs, connecting a series of drainage branches, to Hub Hill (approx. elevation 1200 feet). Following the 1000-foot contour, the road reaches Long and then descends to Monument Creek (approx. elevation 400 feet) where the crossing is currently impassable. From Monument Creek's opposite bank, the route continues on the 400-foot contour to the Sulatna Crossing and climbs for the remaining 12 miles to Poorman (elevation 600 feet).

Major Structures

The road has numerous creek crossings, including Monument Creek and the Sulatna River, for which major drainage structures are required.

6.3 R.O.W. Analysis

As discussed above, rights-of-way for the Ruby-Poorman corridor have been granted by the Federal government through various public land orders. The road was later designated as FAS Route No. 271 and described as being "From Poorman northward through Long to Ruby on the Yukon River" in the Alaska Omnibus Act. The 1959 Omnibus Act transferred by quitclaim deed interest in the road from the Federal government to the State of Alaska. The easement is one hundred feet each side of the centerline and the mileage noted is 56.5 miles.

The ownership of the land in this corridor south of the City of Ruby is a combination of State tentative approval, interim conveyance to Dineega and Doyon, individual Native Allotments, and Federal and State mining claims. The interim conveyance document to Dineega specifically states that it is subject to the Omnibus Act right-of-way.

6.4 Engineering Geology

The existing road from Ruby to Poor-man is primarily built on landforms mapped as bedrock and colluvium. The road follows the higher ridges and in general is well drained. The colluvium is probably thin over much of the route and is commonly blanketed by wind-deposited silt deposits (loess). Massive ice is reported to be encountered under some of the silt mantled hills. The road also crosses the modem alluvium at Sulatna Crossing. The

following table indicates the mile-point locations of the terrain units boundaries identified in Section 4.0 above.

RUBY-POORMAN ROAD			
MILE POST	LANDFORM LEAVING	LANDFORM ENTERING	COMMENTS
0			Village of Ruby located wholly in BEDROCK area
0.5	BEDROCK	COLLWIUM	0.5 Miles in COLLUVIUM
2.2	COLLWIUM	BEDROCK	1.7 Miles in BEDROCK
4.0	BEDROCK	COLLWlUM	1.8 Miles in COLLWIUM
4.8	COLLWIUM	BEDROCK	0.8 Miles in BEDROCK
10.7	BEDROCK	COLLWIUM	5.9 Miles in COLLUVIUM
12.5	COLLWIUM	BEDROCK	1.8 Miles in BEDROCK
25.0	BEDROCK	ALLWIUM	12.5 Miles in ALLUVIUM
25.3	ALLUVIUM	BEDROCK	0.3 Miles in BEDROCK
28.0	BEDROCK	COLLWIUM	2.7 Miles in COLLUVIUM
29.7	COLLWIUM	BEDROCK	1.7 Miles in BEDROCK
37.7	BEDROCK	COLLUVIUM	8 Miles in COLLUVIUM
38.6	COLLUVIUM	BEDROCK	0.9 Miles in BEDROCK
39.9	BEDROCK .	COLLWIUM	1.3 Miles in COLLWIUM
41.0	COLLWIUM	BEDROCK	1.1 Miles in BEDROCK
41.9	BEDROCK	COLLWIUM	0.9 Miles in COLLUVIUM
42.1	COLLUVIUM	BEDROCK	0.2 Miles in BEDROCK
42.3	BEDROCK	COLLUVIUM	0.2 Miles in COLLUVIUM
43.5	COLLUVIUM	ALLUVIUM	1.2 Miles in ALLWIUM
46.4	ALLUVIUM	COLLWIUM	2.9 Miles in COLLUVIUM
46.8	COLLUVIUM	BEDROCK	0.4 Miles in BEDROCK
53.5			Village of Poorman located wholly in BEDROCK

6.5 Environmental Conditions

Social and Economic

Residents in Ruby are the most likely of the three communities (Ruby, Takotna, and McGrath) to experience major socioeconomic impacts stemming from development of a road between Ruby and McGrath.

Although Ruby has yet to regain its gold rush population, the city continues to grow. Between 1980 and 1988, population increased from 197 to 243 people. Current projections call for the community to reach 300 people by the year 2005.

A questionnaire returned by Ruby's City Clerk in 1989 listed the community's major sources of income as municipal employment, mining, commercial fishing, and trapping. An Alaska Department of Labor employment estimate placed current employment level at 46 jobs (exclusive of subsistence), distributed as follows:

Employment Sector	Jobs
Government	24
Trades and Services	6
Basic Industries	16

Although mining operations along the Ruby-Poorman Road provide some job opportunities and cash flow into the area, no major economic development projects are currently planned. Consequently, while total population is expected to gradually increase over time, the number of jobs in the community will likely decrease without significant changes in the local economy. Consequently, Ruby will become even more dependent on transfer payments from State and Federal sources.

Natural Resources

Other than natural resource surveys of the Nowitna National Wildlife Refuge which lies 15 miles east of the corridor, little investigation of environmental conditions has been made of this area. In 1933, the U.S. Geological Survey performed a reconnaissance of the general geology and mineral deposits in the area. As current and historic mining activity indicates, there are gold, silver, and tin deposits throughout the corridor.

7.0 INNOKO CORRIDOR

The Innoko Corridor proposes an alignment between Poor-man and Ophir which generally follows the winter trail established by miners in the second decade of this century. As its name suggests, most of the corridor lies within the Irmoko drainage, intersecting the river at Cripple Landing and following it upstream to Ophir. A 1:250,000-scale map of the corridor overlain on topography and cadastral/political boundary mapping prepared by the U.S. Geological Survey appears on the **ALTERNATIVE CORRIDORS WITH TOPOGRAPHIC BASE MAPPING** plan attached to the end of this document.

7.1 Historical background

The discovery of gold in commercial quantities on Ganes Creek, a headwater tributary of the Innoko River, brought stampeders from both the Kuskokwim and Yukon mining districts. By 1908 winter trails had been established linking Ganes Creek with both the Kuskokwim (via Ophir) and Yukon Rivers.

In 1922, the Alaska Road Commission conducted a winter and summer reconnaissance for the continuation of a winter mail trail up the Innoko River to Ophir, and in the winter of 1923 a small amount of work was done on the trail. This trail was known as route-38C and in 1924 two bridges were built and tripoding performed, and in the following year a bridge was erected over Caribou Creek at Cripple. The trail was reported as suitable for dog sleds and received periodic maintenance throughout the Innoko gold rush.

The decline of mining activity in the 1930's brought an end to mail service and maintenance along the route. A 1949 Alaska Road Commission report for the region no longer listed this trail in their system. Today the trail between Ophir and Cripple landing is used by cat trains to resupply mining operations. The Iditarod Dog Race has also revived winter traffic along the route.

7.2 Alignment and Maior Structures

Existing Conditions

As a winter-only trail, the corridor currently has only minimal evidence of development. Development of a permanent road on this route will be entirely new construction.

General Alignment

From the southern terminus of the Ruby-Poorman Road, the corridor follows an established trail southwest along Poorman Creek approximately 9 miles to Placerville (elevation 400 feet). From Placerville, the corridor turns slightly south to avoid the wet musket of the North Fork Innoko River, but eventually crosses this river near its confluence with Tango Creek and follows Tango Creek towards Hunch Mountain into Hunch Creek, finally reaching the Innoko River at Cripple Landing (elevation 250 feet). For the next 20 to 22 miles, the route parallels the Innoko on its right bank, gradually rising to about the 400-foot contour.

Near Fourmile Creek, the corridor crosses the Innoko to avoid mountains abutting its right bank and rejoins the traditional winter trail. Following the left bank up south and then east, the corridor again crosses the Innoko near Beaver Creek, following the winter trail into Ophir (elevation 600 feet).

This route has an estimated length of 87.5 miles. As the estimated elevations of communities and mining areas along the corridor indicate, the vertical alignment is essentially a flat-to-gently rising grade. Although it is possible that a similarly smooth horizontal alignment can be developed, the presence of numerous water bodies and muskeg areas suggest the need for a frequent use of curves to avoid areas with inadequate foundation conditions,

Major Drainages

The 1:250,000 topographic mapping of this corridor indicates over 30 river and creek crossings. It is believed that most of these crossings can be accomplished with drainage pipes. As many as four (4) bridges may be required for crossing the Innoko River.

7.3 R.O.W. Analysis

The Innoko corridor begins at Poorman and travels southwesterly toward Cripple Landing and then follows the Innoko River drainage to Ophir. The northern portion of the route near Poorman and the southern portion of the route near Ophir are active mining areas and the corridor crosses Federal and State mining claims and a few U.S. Mineral Surveys. There are three Native Allotments at Cripple Landing. The State of Alaska has tentative approval or patent to the majority of the land along this corridor. The State has issued a few trapping cabin permits along the middle of the corridor but most development is at either end of the route.

The Innoko corridor follows the historical winter trail from Poorman to Ophir for the majority

of its length. The trail is documented in newspaper articles, Alaska Road Commission reports, and other publications. The Iditarod Trail also follows portions of this corridor. This trail has been designated as RST 19 by the State of Alaska, Division of Land and DNR has nominated this trail for certification as a RS 2477 right-of-way.

7.4 Engineering Geology

The limited geologic data suggests that virtually all landforms discussed in Section 4.0 above are located along the corridor. Based on review of high-altitude photography and a brief overflight that was diverted by poor aviation weather, the primary landforms along the route are anticipated to be Alluvium and Colluvium. The shallow gradient for the Innoko riverbed suggests that poorly-drained ground with shallow permafrost occurs throughout the corridor, although the presence of sand and gravel may create a thaw-stable subgrade condition.

The following table indicates the mile-point locations of the terrain units boundaries identified in Section 4.0 above.

INNOKO CORRIDOR			
MILE POST	SOIL TYPE LEAVING	SOIL TYPE ENTERING	COMMENT
0.0			Mile Post 0 located in BEDROCK
0.8	BEDROCK	COLLUVIUM	0.8 Miles in COLLUVIUM
5.1	COLLUVIUM	ALLUVIUM	4.3 Miles in ALLUVIUM
6.4	ALLUVIUM	COLLUVIUM	1.3 Miles in COLLUVIUM
6.8	COLLUVIUM	BEDROCK	0.4 Miles in BEDROCK
7.6	BEDROCK	COLLUVIUM	0.8 Miles in COLLWIUM
9.3	COLLUVIUM	ALLUVIUM	1.7 Miles in ALLUVIUM
9.6	ALLUVIUM	COLLUVIUM	0.3 Miles in COLLWIUM
11.0	COLLUVIUM	UNDIFFERENTIATED	1.4 Miles in UNDIFFERENTIATED
12.8	UNDIFFERENTIATED	COLLUVIUM	1.8 Miles in COLLUVIUM
16.7	COLLUVIUM	UNDIFFERENTIATED	3.9 Miles in UNDIFFERENTIATED
18.8	UNDIFFERENTIATED	COLLUVIUM	2.1 Miles in COLLWIUM
19.6	COLLWIUM	BEDROCK	0.8 Miles in BEDROCK
22.7	BEDROCK	UNDIFFERENTIATED	3.1 Miles in UNDIFFERENTIATED
38.8	UNDIFFERENTIATED	ALLUVIUM	16.1 Miles in ALLWIUM
39.1	ALLUVIUM	UNDIFFERENTIATED	0.3 Miles in UNDIFFERENTIATED
45.6	UNDIFFERENTIATED	COLLUVIUM	6.5 Miles in COLLWIUM
51.8	COLLUVIUM	ALLUVIUM	6.2 Miles in ALLUVIUM
52.4	ALLUVIUM	UNDIFFERENTIATED	0.6 Miles in UNDIFFERENTIATED
53.1	UNDIFFERENTIATED	COLLUVIUM	0.7 Miles in COLLWIUM
53.6	COLLWIUM	BEDROCK	0.5 Miles in BEDROCK
54.4	BEDROCK	COLLUVIUM	0.8 Miles in COLLWIUM
57.3	COLLWIUM	BEDROCK	2.9 Miles in BEDROCK
62.1	BEDROCK	ALLUVIUM	4.8 Miles in ALLUVIUM
64.1	ALLUVIUM	UNDIFFERENTIATED	2.0 Miles in UNDIFFERENTIATED
69.0	UNDIFFERENTIATED	COLLUVIUM	4.9 Miles in COLLWIUM
70.0	COLLWIUM	ALLUVIUM	1.0 Miles in ALLWIUM
70.7	ALLWIUM	COLLUVIUM	0.7 Miles in COLLWIUM
71.5	COLLWIUM	ALLUVIUM	0.8 Miles in ALLUVIUM
72.4	ALLUVIUM	COLLWIUM	0.9 Miles in COLLWIUM

73.7	COLLUVIUM	ALLUVIUM	1.3	Miles in	ALLUVIUM
77.4	ALLUVIUM	BEDROCK	3.7	Miles in	BEDROCK
82.9	BEDROCK	ALLUVIUM	5.5	Miles in	ALLUVIUM
83.4	ALLUVIUM	BEDROCK	0.5	Miles in	BEDROCK
84.6	BEDROCK	ALLUVIUM	I.2	Miles in	ALLUVIUM
85.0	ALLUVIUM	COLLUVIUM	0.4	Miles in	COLLWIUM
86.5	COLLWIUM	BEDROCK	1.5	Miles in	BEDROCK
87.5			Mile Post 87.5 located in BEDROCK		

7.5 Environmental Conditions

Social and Economic Conditions

The corridor is believed to have few, if any, permanent residents. However, there are numerous mining claims (primarily searching for gold) along the corridor, many of which are currently active. Additionally exploration is underway at locations northwest of the Innoko basin.

Natural Resources

The Innoko Corridor was extensively evaluated in the Alaska Department of Natural Resource's Kuskokwim Management Plan, primarily in the Innoko River sub-unit of the Innoko River Management Unit. The following table generally summarizes this report's conclusions regarding resource potential for the area.

INNOKO CORRIDOR			
Resource	Upper Segment	Middle Segment	Lower Segment
Agriculture	Low Potential at Hunch Creek	Unsuitable	Unsuitable
Energy	Very Low (some coal in adjacent units)	Very Low (some coal in adjacent units)	Very Low (some coal in adjacent units)
Fish	Salmon and resident fish	Salmon and resident fish	Salmon and resident fish
Forestry	High-Moderate along Innoko & Hunch Cr.	High-Moderate along Innoko	High-Moderate along Innoko
Mineral	Moderate (numerous mining claims)	Low	Moderate (numerous mining claims)
Oil & Gas	unknown	unknown	unknown
Recreation	Low (isolated) except Iditarod Trail	Low (isolated) except Iditarod Trail	Low (isolated) except Iditarod Trail
Wildlife	Special-High Value Habitat Areas Moose winter range, bear, waterfowl	Special-High Value Habitat Areas Moose winter range, bear, waterfowl	Special-High Value Habitat Areas Moose winter range, bear, waterfowl

8.0 SUSULATNA CORRIDOR

The Susulatna Corridor proposes to avoid much of the wet, lowland soils associated with the Innoko and Folger Corridors by following a rolling-to-mountainous alignment located well east of and 300 to 500 above the Innoko drainage. The corridor provides a more direct link between Poor-man and Takotna, but would, require spur roads to access mines and settlements in the Placerville, Cripple, Folger and Warner Creek areas.

Moreover the improved foundation conditions will be somewhat (if not entirely) offset by complex horizontal and vertical alignment requirements. Although an aerial overflight of the area in November, 1993 determined that the ridgelines that generally comprise this alignment are actively used as transportation corridors by heavy equipment, it is noted that the operational capabilities (and characteristics) of these vehicles are significantly different than those of the traffic for which roadways are designed.

A 1:250,000-scale map of the corridor overlain on topography and cadastral/political boundary mapping prepared by the U.S. Geological Survey appears on the **ALTERNATIVE CORRIDORS WITH TOPOGRAPHIC BASE MAPPING** plan attached to the end of this document.

8.1 Historical Background

A review of the Alaska Road Commission's maps of the Kuskokwim District for' 1923 and 1950 found record of a summer trail between Poorman and Folger which used the northern one-third of this alignment. As subsequent discussion in Section 8.3 below will detail, this trail is well-documented and of interest to the State of Alaska. Topographic mapping prepared by the U.S.G.S. in the 1960's also showed segments of the Poorman-Folger trail as open.

8.2 Alignment and Maior Structures

Existing Conditions

As indicated above, there is currently an extensive system of "cat trails" along the Susulatna Corridor's ridgelines. Miners in both Ruby and McGrath indicate they are using these trails and that foundation conditions are more favorable than are found in lower-lying corridors to the west. All road improvements on this alignment will be new construction.

General Alignment

This route bears south-southeast from Poorman, paralleling Timber Creek and climbing over 400 vertical feet in its first six miles. Once reaching the 1200-foot contour, the alignment tries to hold this elevation, but must contend with substantial physical relief which imposes severe climbing and descending grades. Approximately 17 miles south of Poorman the route joins the South Fork Sulatna River and an "active" trail indicated in USGS mapping. This trail is

followed for another 20 miles along a southwest direction, approaching the Susulatna drainage. **At** this point, however, the mapped trail veers west into the Cripple Creek Mountains and the Folger mining district, whereas the Susulatna Corridor parallels the left bank of its namesake, temporarily leaving the mountainous terrain and bearing towards Fossil Mountain along the 1200-foot contour. Immediately south of Fossil Mountain, the route uses a narrow gap to pass west into the South Fork Folger Creek basin. However, from here the alignment climbs to over 2000 feet along the west side of Cloudy Mountain, finding the Roberts Creek drainage and descending to intersect the Sterling Landing-Ophir Road just west of Takotna at 1000 feet.

The estimated distance between Poorman and Takotna along this route is 92 miles. As the above narrative and the topographic base mapping suggest, the route has severe topographic conditions and is of questionable feasibility.

Major Structures

The route is anticipated to cross less than a dozen drainages, none of which is believed to require a bridge.

8.3 R.O.W. Analysis

The Susulatna Corridor begins east of or at Poorman on the Ruby to Poorman Road and travels south through State of Alaska patented or tentatively approved land mainly following the historic summer trail from Poorman to Ophir. This trail is documented in. newspaper articles, Alaska Road Commission reports, and other publications. The trail has been designated as RST 13 by the State of Alaska, Division of Land and DNR has nominated this trail for certification as a RS 2477 right-of-way.

West of Folger, the Susulatna corridor branches off of RST 13 and follows the Susulatna River drainage south to the Fossil Mountain area. South of Fossil Mountain it follows a tributary of Folger Creek to the area between Twin Mountain and Cloudy Mountain. The land in this area is State patented and few permits have been granted except for a trapping cabin and two mining claims in the area northwest of Cloudy Mountain. This section of the Susulatna Corridor at times follows trails identified on the 1974 Existing Trail System Inventory Map prepared by the Alaska Department of Highways.

The corridor then continues south in State land along the Roberts Creek drainage and into MTNT and Doyon land. It continues through MTNT and Doyon land to the Innoko River and then south along Canadian Creek, through a small section of State selected land, to the Ophir-Sterling Landing Road just west of Takotna. Portions of this section are also shown on the 1974 Existing Trail System Inventory Maps.

8.4 Engineering Geology

The limited geologic data and high-altitude aerial photography suggests that the Bedrock and

Colluvium landforms discussed in Section 4.0 above predominate in this corridor. Although the presence of permafrost is indicated for both landforms, particularly the Colluvium areas, absent massive deposits of massive ice, the soil should be thaw stable. The bedrock areas will pose the greatest difficulties in excavation and likely require larger quantities of cut and fill because of the steeper relief.

The following table indicates the mile-point locations of the terrain units boundaries identified in Section 4.0 above.

SUSULATNA CORRIDOR					
MILE POST	LANDFORM LEAVING	LANDFORM ENTERING	COMMENTS		
0.0			Mile Post 0 located in BEDROCK		
1.2	BEDROCK	ALLUVIUM	1.2	Miles in	ALLUVIUM
1.5	ALLUVIUM	BEDROCK	0.3	Miles in	BEDROCK
2.1	BEDROCK	COLLUVIUM	0.6	Miles in	COLLUVIUM
2.6	COLLUVIUM	BEDROCK	0.5	Miles in	BEDROCK
6.1	BEDROCK	COLLUVIUM	3.5	Miles in	COLLUVIUM
6.6	COLLUVIUM	BEDROCK	0.5	Miles in	BEDROCK
16.9	BEDROCK	COLLUVIUM	10.3	Miles in	COLLUVIUM
18.7	COLLUVIUM	BEDROCK	1.8	Miles in	BEDROCK
36.2	BEDROCK	COLLUVIUM	17.5	Miles in	COLLUVIUM
37.0	COLLUVIUM	BEDROCK	0.8	Miles in	BEDROCK
41.2	BEDROCK	COLLUVIUM	4.2	Miles in	COLLUVIUM
43.3	COLLUVIUM	BEDROCK	2.1	Miles in	BEDROCK
45.2	BEDROCK	COLLUVIUM	1.9	Miles in	COLLUVIUM
47.1	COLLUVIUM	BEDROCK	1.9	Miles in	BEDROCK
48.8	BEDROCK	COLLUVIUM	1.7	Miles in	COLLUVIUM
57.4	COLLUVIUM	BEDROCK	8.6	Miles in	BEDROCK
63.0	BEDROCK	COLLUVIUM	5.6	Miles in	COLLUVIUM
64.9	COLLUVIUM	BEDROCK	1.9	Miles in	BEDROCK
66.6	BEDROCK	COLLUVIUM	1.7	Miles in	COLLUVIUM
67.5	COLLUVIUM	BEDROCK	0.9	Miles in	BEDROCK
68.3	BEDROCK	COLLUVIUM	0.8	Miles in	COLLUVIUM
71.7	COLLUVIUM	BEDROCK	3.4	Miles in	BEDROCK

81.6	BEDROCK	COLLUVIUM	9.9	Miles in	COLLUVIUM
83.3	COLLUVIUM	BEDROCK	1.7	Miles in	BEDROCK
84.5	BEDROCK	COLLUVIUM	1.2	Miles in	COLLUVIUM
85.4	COLLUVIUM	BEDROCK	0.9	Miles in	BEDROCK
87.7	BEDROCK	COLLUVIUM	2.3	Miles in	COLLUVIUM
88.9	COLLUVIUM	BEDROCK	1.2	Miles in	BEDROCK
89.8	BEDROCK	COLLUVIUM	0.9	Miles in	COLLUVIUM
90.0			Mile Post 90.0 located in COLLUVIUM		

8.5 Environmental Conditions

Social and Economic Conditions

The corridor is believed to have few, if any, permanent residents. However, there are numerous mining claims (primarily for gold) along the corridor, many of which are currently active.

Natural Resources

The southern two-thirds of this corridor was extensively evaluated in the Alaska Department of Natural Resource's Kuskokwim Management Plan as the Hinterlands sub-unit of the Innoko River Management Unit. The following table generally summarizes this report's conclusions regarding resource potential for the area.

	SUSULATNA CORRIDOR		
Resource	Upper Segment	Middle Segment	Lower Segment
Agriculture	Unsuitable	Unsuitable	Unsuitable
Energy	Very Low (some coal in adjacent units)	Very Low (some coal in adjacent units)	Very Low (some coal in adjacent units)
Fish	Resident fish	Resident fish	Resident fish, salmon in Irmoko
Forestry	Low potential	Low potential	High potential on upper Innoko
Mineral	Very High (numerous mining claims)	Moderate	Moderate
(Xl & Gas	unknown	unknown	unknown
Recreation	Low (isolated)	Low (isolated)	Low (isolated)
Wildlife	Low Value Habitat Area Bear, moose	Low Value Habitat Bear, moose	Moderate Value Habitat Bear, moose

9.0 FOLGER CORRIDOR

The Folger Corridor is generally aligned upland of the Innoko drainage, although it uses tributary drainages of the Innoko to avoid mountainous relief. One of the oldest trails in the region, this route accesses almost all of the active and historic mining areas between Poorman and Ophir.

A 1:250,000-scale map of the corridor overlain on topography and cadastral/political boundary mapping prepared by the U.S. Geological Survey appears on the **ALTERNATIVE CORRIDORS WITH TOPOGRAPHIC BASE MAPPING** plan attached to the end of this document.

9.1 Historical Background

A review of tlie Alaska Road Commission's maps of the Kuskokwim District for 1923 and 1950 found record of a summer trail between Folger and Ophir which used this alignment. As subsequent discussion in Section 8.3 below will detail, this trail is well-documented and of interest to the State of Alaska. Topographic mapping prepared by the U.S.G.S. in the 1960's also showed the trails from Ophir up Warner Creek and from Folger south to Folger Creek as open. The segment which follows Dominion Creek has been used to resupply mining operations. Spur roads from these two main north-south trails which are still used by miners access Tolstoi, Esperato creek, Mastodon Creek, Colorado Creek and other drainages around Folger.

9.2 Alignment and Maior Structures

Existing Conditions

As discussed above, at least 25 miles of this alignment is actively used as summer trail although accessibility is likely restricted to all-terrain vehicles. Consequently, all road improvements on this alignment are anticipated to be new construction.

General Alignment

This corridor heads southwest from Poorman to Placerville on the same alignment as the Innoko Corridor. However, from Poorman the route turns south climbing to the l,OOO-foot contour, crossing Our Creek and eventually the North Fork Innoko River near its headwaters. Continuing south, the route intercepts the summer trail from Poorman approximately 8 miles west of Folger. and follows it into the Folger mining area. From Folger, the alignment follows another trail southwest along the Quartz and Butte drainages, crossing Folger Creek (where the existing trail is indicated to end), and moving along the Dominion Creek to the northern terminus of the Warner Creek summer trail. This summer trail continues southwest for

approximately 20 miles and connects to the road at Ophir.

The terrain is generally rolling-to-mountainous, although route rarely exceeds 1000 feet in elevation. Because the alignment relies on creek beds for passage between mountains, extensive side-hill cuts and benches should be expected. Horizontal alignment will also be somewhat restricted where drainages have cut only a narrow canyon through the mountains.

The Folger Corridor has an estimated length of 74 miles.

Major Structures

Because the alignment is generally upland of the Innoko Basin, less river and creek crossings than encountered on the Innoko Corridor are expected. Current 1:250,000-scale mapping indicates less than two dozen creek crossings for this route. Given the typically upland location of these fords, no bridges are anticipated.

9.3 R.O.W. Analysis

The Folger Corridor begins south of Placerville along the Innoko Corridor. The Placerville area is an active mining area with State and Federal mining claims. The Folger Corridor travels south through State patented land to the active Folger and Colorado Creek mining areas. This area is lined with State mining claims. East of the Colorado Creek mining area the Folger Corridor begins following the historic summer trail from Poor-man to Ophir. The Folger corridor generally follows this historic summer trail southwesterly through State patented and tentatively approved land to Ophir. The historic summer trail from Poorman to Ophir has been designated as RST 13 by the State of Alaska, Division of Land and DNR has nominated this trail for certification as a RS 2477 right-of-way.

The Folger Corridor has an alternative alignment running from Cripple Landing to the Folger and Colorado Creek mining areas. This alignment is-through State land and it follows trails shown on the 1974 Existing Trail System Inventory Map. A second alternative alignment is shown branching off of the historic summer trail south of Folger, traveling south, and following the Folger Creek drainage. This second alternative alignment then travels west of Twin Mountain and continues south to the Ophir - Sterling Landing Road. All but the southern section of this alignment is in State ownership with permits granted for trapping cabins and mining claims.

9.4 Engineering Geology

The limited geologic data suggests that virtually all landforms discussed in Section 4.0 above are located along the corridor. Based on review of high-altitude photography and a brief overflight that was diverted by poor aviation weather, the primary landforms along the route are anticipated to be Alluvium and Colluvium. The Innoko and Warner drainages's shallow gradients suggest that poorly-drained ground with shallow permafrost occurs throughout the

corridor, although the presence of sand and gravel may create a thaw-stable subgrade condition. The following table indicates the mile-point locations of the terrain units boundaries identified in Section 4.0 above.

FOLGER CORRIDOR

MILE POST	LANDFORM LEAVING	LANDFORM ENTERING	COMMENTS		
0.0			Mile Post 0 located in COLLUVIUM		
1.4	COLLUVIUM	BEDROCK	1.4	Miles in	BEDROCK
3.2	BEDROCK	COLLUVIUM	1.8	Miles in	COLLUVIUM
3.5	COLLUVIUM	BEDROCK	0.3	Miles in	BEDROCK
5.0	BEDROCK	COLLUVIUM	1.5	Miles in	COLLUVIUM
5.5	COLLUVIUM	BEDROCK	0.5	Miles in	BEDROCK
13.7	BEDROCK	UNDIFFERENTIATED	8.2	Miles in	UNDIFFERENTIATED
14.5	UNDIFFERENTIATED	COLLUVIUM	0.8	Miles in	COLLUVIUM
16.7	COLLUVIUM	BEDROCK	2.2	Miles in	BEDROCK
23.4	BEDROCK	COLLUVIUM	6.7	Miles in	COLLUVIUM
26.6	COLLUVIUM	BEDROCK	3.2	Miles in	BEDROCK
33.6	BEDROCK	COLLUVIUM	7	Miles in	COLLUVIUM
37.0	COLLUVIUM	BEDROCK	3.4	Miles in	BEDROCK
42.3	BEDROCK	COLLUVIUM	5.3	Miles in	COLLUVIUM
46.9	COLLUVIUM	ALLUVIUM	4.6	Miles in	ALLUVIUM
53.6	ALLUVIUM	COLLUVIUM	6.7	Miles in	COLLUVIUM
55.9	COLLUVIUM	BEDROCK	2.3	Miles in	BEDROCK
58.2	BEDROCK	COLLUVIUM	2.3	Miles in	COLLUVIUM
58.5	COLLUVIUM	BEDROCK	0.3	Miles in	BEDROCK
64.0	BEDROCK	COLLUVIUM	5.5	Miles in	COLLUVIUM
64.4	COLLUVIUM	BEDROCK	0.4	Miles in	BEDROCK
66.1	BEDROCK	ALLUVIUM	1.7	Miles in	ALLUVIUM
66.5	ALLUVIUM	COLLUVIUM	0.4	Miles in	COLLUVIUM

68.1	COLLUVIUM	ALLUVIUM	1.6 Miles in ALLUVIUM
69.0	ALLUVIUM	COLLUVIUM	0.9 Miles in COLLUVIUM
73.1			Mile Post 73.1 located in COLLWIUM

9.5 Environmental Conditions

Social and Economic Conditions

The corridor is believed to have few, if any, permanent residents. However, there are numerous mining claims (primarily gold) along the corridor, many of which are currently active.

Natural Resources

The southern two-thirds 'of this corridor was extensively evaluated in the Alaska Department of Natural Resource's Kuskokwim Management Plan as the Innoko River Uplands and Hinterlands sub-units of the Innoko River Management Unit. The following table generally summarizes this report's conclusions regarding resource potential for the area.

FOLGER CORRIDOR			
Resource	Upper Segment	Middle Segment	Lower Segment
Agriculture	Unsuitable	Unsuitable	Unsuitable
Energy	Very Low (some coal in adjacent units)	Very Low (some coal in adjacent units)	Very Low (some coal in adjacent units)
Fish	Resident fish	Resident fish	Resident fish
Forestry	Low potential	Low potential	Low Potential
Mineral	Very High (numerous mining claims)	Moderate	High-Moderate
Oil & Gas	Unknown	Unknown	Unknown
Recreation	Low (isolated) except Iditarod Trail	Low (isolated) except Iditarod Trail	Low (isolated) except Iditarod Trail
Wildlife	Low Value Habitat Area	Low Value Habitat	Low Value Habitat
	Bear, moose	Bear, moose	Bear, moose

10.0 STERLING LANDING CORRIDOR

This corridor consists of the existing Sterling Landing to Ophir Road, a dedicated right-of-way approximately 38 miles long that is owned by the State of Alaska and administered by the ADOT&PF. A 1:250,000-scale map of the corridor overlain on topography and cadastral/political boundary mapping prepared by the U.S. Geological Survey appears on the **ALTERNATIVE CORRIDORS WITH TOPOGRAPHIC BASE MAPPING** plan attached to the end of this document. This surface link connects the Kuskokwim River with the Tatalina Air Force Base, Takotna, and mining operations around Ophir and plays a critical role in providing employment, reducing freight costs, and maintaining access to the important hub city of McGrath.

10.1 Historical Background

Construction of a 23-1/2 mile wagon road between Takotna and Ophir was a cooperative venture between the Alaska Road Commission and the Territory of Alaska. Construction began in 1921, but because of deep permafrost, progress was slow. Nonetheless, it maintained a high priority because it served about 100 miners operating in the Upper Innoko River, and also formed a portage between the Kuskokwim and Innoko Rivers.

By 1927, the road had been advanced 21 1/4 miles from Takotna. The road was completed in 1928 and was suitable for motor traffic along all but one mile of the route. Minor maintenance as performed on this road in 1930-32, after which ARC reports do not refer to this road.

Another 25 mile wagon road, which served as an alternate winter route to the Ophir-Takotna summer road, was located and work was begun on it in 1921-22. In 1922, a bridge was constructed over Ganes Creek to complete the trail. The road was maintained and improved until 1929 after which ARC reports do not refer to it.

Today, miners use the secondary road between Sterling Landing, on the Kuskokwim River, and Ophir to transport heavy equipment and fuel. They also use roads on Yankee, Independence and Canadian creeks in the Ganes Creek area. In winter the Takotna-Ophir road is drifted-in in the vicinity of Ganes Creek and a parallel trail is utilized.

10.2 Alignment and Maior Structures

Existing Conditions

The existing road is generally passable to Spruce Creek, after which the road narrows considerably and appears unmaintained. The roadway was driven between Takotna and Spruce Creek in late August, 1993 during a period intermittent rain. Because it was constructed of native materials containing silts and clays, the existing roadway is only traversable with all-wheel drive vehicles during spring break-up and rain storms. That portion of the route that was driven was generally between 15 and 18 feet wide, with rolling grades, and containing only short segments of grades in excess of 10%.

General Alignment

The route was field-engineered as a wagon trail long before highway design standards were established. In consequence, horizontal and vertical curvature is irregular and traveling speeds are often restricted. As the existing roadway does not meet current design standards and does not have suitable foundation materials or drainage systems, it should be completely reconstructed at an appropriate phase in the Ruby-McGrath road construction period.

Major Structures

There are several existing bridges along this road, most of which could be replaced with drainage pipe. The bridge at the Takotna River, located two miles southwest of Takotna was found to be near the end of its service life and should be replaced with any major upgrades to this road.

10.3 R.O. W. Analysis

The Ophir - Sterling Landing Corridor has a similar history as the Ruby - Poor-man Corridor. It also was extensively developed during the mining activity of the teens and twenties. The 1923 Alaska Road Commission map of the Kuskokwim District calls Sterling Landing, Candle Landing, and shows a wagon road from the landing to the dredge at Candle Creek. A dog sled and pack trail is shown from the dredge to Takotna and a wagon road is again shown from Takotna to Ophir. The road was designated as FAS Route No. 261 and described as being "From Sterling Landing on the Kuskokwim River northwest to Ophir Landing Field" in the Alaska Omnibus Act. The 1959 Omnibus Act transferred by quitclaim deed interest in the road from the Federal government to the State of Alaska. The easement is one hundred feet each side of the centerline and the mileage noted is 47 miles.

The land near Ophir is an active mining area with the State T.A.'d land subject to Federal and State mining claims and several U.S. Mineral Surveys. From Ganes Creek ***to*** Takotna, MTNT and Doyon have received interim conveyance to the land subject to existing rights, existing U.S. Surveys in private ownership, and individual Native Allotments. The Interim Conveyance document specifically states that it is subject to the Omnibus Act right-of-way. From Takotna to Sterling Landing the majority of the land is either MTNT and Doyon I.C.'d, State T.A.'d, or selected by both the State of Alaska and MTNT and Doyon. This corridor also passes through the Tatalina Air Force Base.

10.4 Engineering Geology

The road from Ophir to Tatalina primarily crosses landforms mapped as colluvium, older, terraces and fans and bedrock. The road crosses many drainages, and ditches along the upslope side of the road are poorly developed with many needing maintenance. In addition to crossing short sections of alluvium associated with small streams draining into the Irmoko River, the route crosses the alluvium deposited by the Takotna River.

The following table indicates the mile-point locations of the terrain units boundaries identified in Section 4.0 above.

EXISTING STERLING LANDING - OPHIR ROAD					
MILE POST	SOIL TYPE LEAVING	SOIL TYPE ENTERING		COMMENTS	
0.0			Mile Post 0 located in BEDROCK		
1.0	BEDROCK	ALLUVIUM	1	Miles in	ALLUVIUM
5.6	ALLUVIUM	TERRACES & FANS	4.6	Miles in	TERRACES & FANS
6.4	TERRACES & FANS	BEDROCK	0.8	Miles in	BEDROCK
8.0	BEDROCK	COLLUVIUM	1.6	Miles in	COLLUVIUM
8.3	COLLUVIUM	TERRACES & FANS	0.3	Miles in	TERRACES & FANS
9.6	TERRACES & FANS	ALLUVIUM	1.3	Miles in	ALLUVIUM
10.7	ALLUVIUM	TERRACES & FANS	1.1	Miles in	TERRACES & FANS

11.2	TERRACES & FANS	COLLUVIUM	0.5	Miles in	COLLUVIUM
12.6	COLLUVIUM	BEDROCK	1.4	Miles in	BEDROCK
16.2	BEDROCK	COLLUVIUM	3.6	Miles in	COLLUVIUM
19.2	COLLUVIUM	BEDROCK	3	Miles in	BEDROCK
19.7	BEDROCK	TERRACES & FANS	0.5	Miles in	TERRACES & FANS
20.1	TERRACES & FANS	ALLUVIUM	0.4	Miles in	ALLUVIUM
21.6	ALLUVIUM	COLLUVIUM	1.5	Miles in	COLLUVIUM
22.1	COLLUVIUM	BEDROCK	0.5	Miles in	BEDROCK
26.3	BEDROCK	COLLUVIUM	4.2	Miles in	COLLUVIUM
27.7	COLLUVIUM	ALLUVIUM	1.4	Miles in	ALLUVIUM
28.7	ALLUVIUM	COLLUVIUM	1	Miles in	COLLUVIUM
29.2	COLLUVIUM	ALLUVIUM	0.5	Miles in	ALLUVIUM
29.5	ALLUVIUM	TERRACES & FANS	0.3	Miles in	TERRACES & FANS
30.3	TERRACES & FANS	COLLUVIUM	0.8	Miles in	COLLUVIUM
31.2	COLLUVIUM	BEDROCK	0.9	Miles in	BEDROCK
34.4	BEDROCK	COLLUVIUM	3.2	Miles in	COLLUVIUM
37.8	COLLUVIUM	BEDROCK	3.4	Miles in	BEDROCK
39.3	BEDROCK	COLLUVIUM	1.5	Miles in	COLLUVIUM
40.6	COLLUVIUM	TERRACES & FANS	1.3	Miles in	TERRACES & FANS
40.7			Mile Post 40.7 located in TERRACES & FANS		

10.5 Environmental Conditions

Social and Economic Conditions

With the exception of Takotna, the corridor is believed to have few, if any, permanent

residents. However, there are numerous mining claims (primarily searching for gold) along the corridor, many of which are currently active.

The community of Takotna is likely to experience some socioeconomic impacts stemming from development of a road between Ruby and McGrath.

Takotna was a traditional settlement and seasonal camp before the old mining era. Both McGrath and Takotna were well positioned to serve as support bases for nearby gold mining activities.

Takotna has a stable population of slightly less than 50 people, roughly equal numbers of Alaska Native and non-Native residents. Most residents were born elsewhere, mostly (about 60%) outside Alaska. Even so, long-term residents form a substantial core (over 40 percent) of the population.

Takotna is characterized by smaller, less crowded households, with more one-person households and, unusual for small rural communities, a majority of renter-occupied dwellings.

The region is endowed with limited exportable natural resources. Their commercial development is handicapped by disadvantageous transportation, energy and labor costs, plus remoteness from consumer markets. Historic and potential export commodities mainly include the region's lode and placer gold deposits; wood products; and furs. The region's salmon stocks do not support a commercial fishery, but are important for subsistence purposes. The region has provided sites for minor defense installations, in particular the Tatalina Air Force Station near Takotna.

Apart from the prospect of some shrinkage in state and local governmental employment, there are no pending events that imply major changes in economic conditions or population levels in the study communities.

Natural Resources

This corridor was extensively evaluated in the Alaska Department of Natural Resource's Kuskokwim Management Plan as the Takotna, Ophir-Folger-Madison-Twin Mountains, 4th of July Creek-Little Waldren Fork, and Upper Takotna River sub-units of the Innoko River Management Unit. The following table generally summarizes this report's conclusions regarding resource potential for the area.

	STERLING	LANDING	CORRIDOR
Resource	Upper Segment	Middle Segment	Lower Segment
Agriculture	Unsuitable	Unsuitable	Unsuitable
Energy	Very Low (some peat in area)	Very Low (some peat in area)	Very Low (some peat in area)
Fish	Resident fish	Resident fish	Resident fish
Forestry	Unsuitable-low potential	Unsuitable-low potential	Unsuitable-low potential
Mineral	Moderate-very low	Moderate-very low	Moderate-very low
Oil & Gas	unknown	unknown	unknown
Recreation	High use near Takotna	Low	Low
Wildlife	Low Value Habitat Area Bear, moose, caribou	Low Value Habitat Bear, moose, caribou	Moderate Value Habitat Bear, moose, caribou

11.0 PORCUPINE CORRIDOR

The Porcupine Corridor is one of two alignments investigated as a possible link between the Sterling Landing-Ophir Road and McGrath. This corridor is approximately 19 miles long. A 1:250,000-scale map of the corridor overlain on topography and cadastral/political boundary mapping prepared by the U.S. Geological Survey appears on the **ALTERNATIVE CORRIDORS WITH TOPOGRAPHIC BASE MAPPING** plan attached to the end of this document.

11.1 Historical Background

A winter trail from McGrath to Takotna was constructed in 1923 as part of the through trail from Nenana to Flat. In 1928 a 78-foot span suspension bridge was constructed over the Tatalina River. In 1924, the ARC constructed a 5-mile summer trail that connected McGrath and Takotna via the McGrath-Candle Creek winter trail and the Candle Creek-Takotna summer trail.

Today the trails between Takotna and McGrath are still used by McGrath miners to transport equipment into the Ophir area. The trail is also frequently used by residents of Takotna and McGrath as a transportation route between the two communities.

11.2 Alignment and Maior Structures

Existing Conditions

USGS mapping depicts an active trail which bears east from Takotna, skirts the north side of the Porcupine Ridge, and terminates as it approaches the Kuskokwim River. Because it is an undeveloped trail, all improvements along this alignment will require new road construction.

General Alignment

A route along the Porcupine Corridor would likely leave the Sterling Landing-Ophir Road at Takotna and bear east, crossing the Takotna River at a new location. Leaving the Takotna riverbed, the road would rise to the base of the Porcupine Ridge and follow the 600-foot contour northeasterly until the ridge begins to descend into the Kuskokwim river valley. At this point, the route is north-northwest of McGrath and thus must turn sharply and approach the Kuskokwim River. The crossing into McGrath would be just west of the airport.

Major Structures

In addition to the Takotna River, other creek crossings will be required. A bridge across the Kuskokwim will be a monumental structure. Given the low traffic volumes the route is likely to experience during the first decade of service, a barge service in lieu of a bridge should be investigated for cost effectiveness.

11.3 R.O.W. Analysis

The Porcupine Corridor travels easterly from Takotna to McGrath. The land is a combination of private, individual Native Allotments, MTNT and Doyon I.C., State T.A., and land selected by both MTNT and the State of Alaska. Two alternative alignments of the corridor are shown, Both alignments generally follow trails shown on the 1974 Existing Trail system Inventory Maps. A twenty-five foot 17(b) easement (EIN 20 Cl, C3, D9) also exists on the southern alignment. ANCSA 17(b) easements are reserved in the I.C. document to insure access to publicly owned lands and use is restricted. The Iditarod Trail also appears to follow portions of this corridor.

11.4 Engineering Geology

The limited geologic data suggests that virtually all landforms discussed in Section 4.0 above are located along the corridor. Based on review of high-altitude photography and a brief overflight that was diverted by poor aviation weather, the primary landforms along the route are anticipated to be Alluvium and Colluvium. The Kuskokwim River's shallow gradient suggest that poorly-drained ground with shallow permafrost occurs throughout the corridor (except along the river banks), although the presence of sand and gravel may create a thaw-stable subgrade condition.

The following table indicates the mile-point locations of the terrain units boundaries identified in Section 4.0 above.

PORCUPINE CORRIDOR					
MILE POST	SOIL TYF'E LEAVING	SOIL TYPE ENTERING	COMMENTS		
0.0			Mile Post 0 located in COLLWIUM		
0.3	COLLWIUM	BEDROCK	0.3	Miles in	BEDROCK
2.2	BEDROCK	TERRACES & FANS	1.9	Miles in	TERRACES & FANS
2.6	TERRACES & FANS	COLLUVIUM	0.4	Miles in	COLLUVIUM
3.4	COLLWIUM	ALLUVIUM	0.8	Miles in	ALLWIUM
5.1	ALLWIUM	TERRACES & FANS	2.3	Miles in	TERRACES & FANS
6.4	TERRACES & FANS	SWAMP/PEAT BOG	0.7	Miles in	SWAMP/PEAT BOG
7.0	SWAMP/PEAT BOG	TERRACES & FANS	0.6	Miles in	TERRACES & FANS
8.1	TERRACES & FANS	BEDROCK	1.1	Miles in	BEDROCK
9.3	BEDROCK	TERRACES & FANS	1.2	Miles in	TERRACES & FANS
10.0	TERRACES & FANS	COLLUVIUM	0.7	Miles in	COLLWIUM
10.9	COLLWIUM	ALLUVIUM	0.9	Miles in	ALLUVIUM
12.6	ALLUVIUM	COLLUVIUM	1.7	Miles in	COLLWIUM
16.0	COLLWIUM	ALLUVIUM	3.4	Miles in	ALLWIUM
18.4			Mile Post 18.4 located in ALLUVIUM'		

11.5 Environmental Conditions

Social and Economic Conditions

With the exception of McGrath, the corridor is believed to have few, if any, permanent residents. Residents in McGrath are least likely of the three communities (Ruby, Takotna, and McGrath) to experience major socioeconomic impacts stemming from development of a road between Ruby and McGrath.

McGrath was a traditional settlement and seasonal camp before the old mining era. Both McGrath and Takotna were well positioned to serve as support bases for nearby gold mining activities. McGrath's population grew to over 500 during the 1970's and then stabilized and, declined during the 1980's, falling below 400 people.

McGrath has roughly equal numbers of Alaska Native and non-Native residents, most of which were born elsewhere, mostly (about 60%) outside Alaska. Even so, long-term residents form a substantial core (over 40 percent) of the town's population.

The region is endowed with limited exportable natural resources. Their commercial development is handicapped by disadvantageous transportation, energy and labor costs, plus remoteness from consumer markets. Historic and potential export commodities mainly include the region's lode and placer gold deposits; wood products; and furs. The region's salmon stocks do not support a commercial fishery, but are important for subsistence purposes. The region has provided sites for minor defense installations, first an auxiliary airfield at McGrath during World War II, later the Tatalina Air Force Station near Takotna. As state petroleum revenues boosted state and local government programs after the mid-1970's, public employment became the mainstay of the local wage economy, especially at McGrath, whose role as subregional center for transportation and governmental services has boosted its economy.

The Iditarod Area School District, with administrative headquarters in McGrath for nine village schools, is a major local employer. McGrath is also subregional center for a modest assortment of small-scale mining, trade, transportation, construction and other private sector services.

Also headquartered in McGrath is MTNT, Ltd., a private Native corporation formed in 1976 by merger of the ANCSA village corporations for McGrath, Takotna, Nikolai and Telida to pool their land and financial assets. MTNT has invested in several local enterprises, including an electric utility, fuel supply and rental housing. The communities fall within Doyon, Ltd.'s ANCSA regional corporate boundaries.

Apart from the prospect of some shrinkage in state and local governmental employment, there are no pending events that imply major changes in economic conditions or population levels in the study communities.

The Upper Kuskokwim region's subsistence food resources are not abundant. This circumstance partly accounts for the region's historic and contemporary low population levels, but also underscores the importance to many area residents of the limited subsistence food resources available for their livelihood.

Natural Resources

This corridor was extensively evaluated in the Alaska Department of Natural Resource's Kuskokwim Management Plan as the 4th of July Creek-Little Waldern Fork, Takotna, Upper Moore, and Upper Takotna River sub-units of the Innoko River Management Unit. The following table generally snrnmarizes this report's conclusions regarding resource potential for the area.

PORCUPINE CORRIDOR			
Resource	Upper Segment	Middle Segment	Lower Segment
Agriculture	Unsuitable	Unsuitable	Unsuitable
Energy	Very Low (some peat in area)	Very Low (some peat in area)	Very Low (some peat in area)
Fish	Resident fish	Resident fish	Resident fish
Forestry	Unsuitable-low potential	Unsuitable-low potential	Unsuitable-low potential
Mineral	Moderate-very low	Moderate-very low	Moderate-very low
Oil & Gas	unknown	unknown	unknown
Recreation	High use near Takotna	Low	Low
Wildlife	Low Value Habitat Area	Low Value Habitat	Moderate Value Habitat
	Bear, moose, caribou	Bear, moose, caribou	Bear, moose, caribou

12.0 ROUNDABOUT CORRIDOR

The Roundabout Corridor is one of two alignments investigated as a possible link between the Sterling Landing-Ophir Road and McGrath. This corridor is approximately 27 miles long, with approximately 15 miles on the Sterling Landing-Ophir Road and approximately 12 miles from the existing road to McGrath. A 1:250,000-scale map of the corridor overlain on topography and cadastral/political boundary mapping prepared by the U.S. Geological Survey appears on **the ALTERNATIVE CORRIDORS WITH TOPOGRAPHIC BASE MAPPING** plan attached to the end of this document.

12.1 Historical Background

Please refer to Section 11.1 above.

12.2 Alignment and Maior Structures

Existing Conditions

Two trails which parallel either side of Candle Creek currently connect the Sterling Landing-Ophir Road to the Kuskokwim River east and southeast of McGrath. Because they are undeveloped trails, all improvements along this alignment will require new road construction.

General Alignment

This corridor leaves the Sterling Land-Ophir Road at the Candle Creek stub-out and bears northeast for approximately three miles where the two existing trails fork. The route will probably use the right fork and remain on the higher ground at the base of the Roundabout Mountains for about seven miles, finally reaching the Kuskokwim River almost due south of McGrath. Crossing the Kuskokwim River, the corridor intersects the existing Nor Hill Road approximately two miles south of McGrath's town center.

Major Structures

North of the Kuskokwim River, only crossings at Candle and Cash Creeks are anticipated. A bridge across the Kuskokwim will be a monumental structure. Given the low traffic volumes the route is likely to experience during the first decade of service, a barge service in lieu of a bridge should be investigated for cost effectiveness.

12.3 R.O.W. Analysis

The Roundabout Corridor begins on the Ophir - Sterling Landing Road in the Roundabout Mountains near Candle Creek, follows the Candle Creek drainage northeasterly, and then travels east to the Kuskokwim River south of McGrath. An alternative alignment continues down the Candle Creek drainage to the Porcupine Corridor. MTNT and Doyon have received I.C. for the land near the Ophir - Sterling Landing Road and to the land near the Kuskokwim River and McGrath. The State has received. T.A. for the remaining land. A majority of these two alignments are trails shown on the 1974 Existing Trail System Inventory Map.

12.4 Engineering Geolow

The limited geologic data suggests that virtually all landforms discussed in Section 4.0 above are located along the corridor. Based on review of high-altitude photography and a brief overflight that was diverted by poor aviation weather, the primary landforms along the route are anticipated to be Alluvium and Colluvium. The Kuskokwim River's shallow gradient suggest that poorly-drained ground with shallow permafrost occurs throughout the corridor (except along the river banks), although the presence of sand and gravel may create a thaw-stable subgrade condition.

The following table indicates the mile-point locations of the terrain units boundaries identified in Section 4.0 above.

	ROUNDABOUT	CORRIDOR			
MILE POST	LANDFORM LEAVING	LANDFORM ENTERING	COMMENTS		
0.0			Mile Post 0 located in BEDROCK		
0.7	BEDROCK	COLLUVIUM	0.7	Miles in	COLLUVIUM
2.7	COLLUVIUM	ALLUVIUM	2	Miles in	ALLUVIUM
3.0	ALLUVIUM	COLLUVIUM	0.3	Miles in	COLLUVIUM
3.8	COLLUVIUM	TERRACES & FANS	0.8	Miles in	TERRACES & FANS
3.9	TERRACES & FANS	ALLUVIUM	0.1	Miles in	ALLUVIUM
4.1	ALLUVIUM	TERRACES & FANS	0.2	Miles in	TERRACES & FANS
5.1	TERRACES & FANS	BEDROCK	1	Miles in	BEDROCK
5.9	BEDROCK	ALLUVIUM	0.8	Miles in	ALLUVIUM
11.7			Mile Post 11.7 located in ALLUVIUM		

12.5 Environmental Conditions

Social and Economic Conditions

Please reference the discussion in Section 11.5 above.

Natural Resource Conditions

This corridor was extensively evaluated in the Alaska Department of Natural Resource's Kuskokwim Management Plan as the Upper Moore sub-unit of the Innoko River Management Unit. The following table generally summarizes this report's conclusions regarding resource potential for the area.

ROUNDABOUT CORRIDOR	
Resource	Entire Segment
Agriculture	Unsuitable
Energy	Very Low (some peat in area)
Fish	Resident fish and salmon
Forestry	Unsuitable-low potential
Mineral	Moderate-very low
Oil & Gas	unknown

13.0 COMPARISON OF CORRIDOR DEVELOPMENT COSTS

Design and construction costs were estimated for three possible routes between Ruby and McGrath which used combinations of the corridors discussed in the sections above. Each of the three routes considered both the Porcupine and Roundabout Corridors for access to McGrath. For a discussion of the basis of construction cost estimates, please refer to Section 3.4 above.

The immense scope of constructing a corridor between Ruby and McGrath will require that the project be phased. The phasing plans presented below were not developed for use in construction planning, but rather to reference the preceding corridor discussions and indicate the sections in which the respective segments were presented.

13.1 Innoko Corridor

The following table summarizes estimated project development costs for the Innoko Corridor:

PROJECT DEVELOPMENT COST ESTIMATES							
INNOKO CORRIDOR							
Porcupine Option							
Phase	Segment	Mileage	Design	Road Construction	Bridge Construction	Construction Management	Total cost
1	Ruby-Poorman	53.5	$5,400,000	$53,500,000	$500,000	$8,100,000	$67,500,000
2	Innoko	87.5	$8,900,000	$87,500,000	$1,500,000	$13~50,000	$111,250,000
3	Sterling-Ophir	18.8	$1,880,000	$18,800,000	$0	$2,820,000	$23,500,000
4-A	Porcupine	19.3	$2,330,000	$19,300,000	$4,000,000	$3,495,000	$29,125,000
Totals		179.1	$18.510.000	$179.100.000	$6.000.000	$27.765.000	$231.375.000
Roundabout Option							
Phase	Segment	Mileage	Design	Road Construction	Bridge Construction	Construction Management	Total cost
1	Ruby-Poorman	53.5	$5,400,000	$53,500,000	$500,000	$8,100,000	$67,500,000
2	Innoko	87.5	$8,900,000	$87,500,000	$1,500,000	$13,350,000	$111,250,000
3	Sterling-Ophir	18.8	$1,880,000	$18,800,000	$0	$2,820,000	$23,500,000
4-B	Roundabout	26.6	$3,010,000	$26,600,000	$3,500,000	$4,5 15,000	$37,625,000
Totals		186.4	$19,190,000	$186,400,000	$5,500,000	$28,785,000	$239,875,000

13.2 Folger Corridor

The following table summarizes estimated project development costs for the Folger Corridor:

PROJECT DEVELOPMENT COST ESTIMATES							
FOLGER CORRIDOR							
Porcupine Option							
Phase	Segment	Mileage	Design	Road Construction	Bridge Construction	Construction Management	Total Cost
1	Ruby-Poorman	53.5	$5,400,000	$53,500,000	$500,000	$8,100,000	$67,500,000
2	Innoko	9.8	$980,000	$9,800,000	$0	$1,470,000	$12,250,000
2	Folger	73.6	$7,410,000	$73,600,000	$500,000	$11,115,000	$92,625,000
3	Sterling-Ophir	18.8	$1,930,000	$18,800,000	$500,000	$2,895,000	$24,125,000
4-A	Porcupine	19.3	$2,330,000	$19,300,000	$4,000,000	$3,495,000	$29,125,000
Totals		175	$18,050,000	$175,000,000	$5,500,000	$27,075,000	$225,625,000
Roundabout Option							
Phase	Segment	Mileage	Design	Road Construction	Bridge Construction	Construction Management	Total Cost
1	Ruby-Poorman	53.5	$5,400,000	$53,500,000	$500,000	$8,100,000	$67,500,000
2	Innoko	9.8	$980,000	$9,800,000	$0	$1,470,000	$12,250,000
2	Folger	73.6	$7,410,000	$73,600,000	$500,000	$11,115,000	$92,625,000
3	Sterling-Ophir	18.8	$1,930,000	$18,800,000	$500,000	$2,895,000	$24,125,000
4-B	Roundabout	26.6	$3,010,000	$26,600,000	$3,500,000	$4,515,000	$37,625,000
Totals		182.3	$18,730,000	$182,300,000	$5,000,000	$28,095,000	$234,125,000

13.3 Susulatna Corridor

The following table summarizes estimated project development costs for the Susulatna Corridor:

PROJECT DEVELOPMENT COST ESTIMATES							
SUSULATNA CORRIDOR							
Porcupine option							
Phase	Segment	Mileage	Design	Road Construction	Bridge Construction	Construction Management	Total cost
1	Ruby-Poorman	53.5	$5,400,000	$53,500,000	$500,000	$8,100,000	$67,500,000
2	Susulatna	90	$9,050,000	$90,000,000	$500,000	$13,575,000	$113,125,000
3	Sterling-Ophir	1.7	$170,000	$1,700,000	$0	$255,000	$2,125,000
4-A	Porcupine	19.3	$2,330,000	$19,300,000	$4,000,000	$3,495,000	$29,125,000
Totals		164.5	$16,950,000	$164,500,000	$5,000,000	$25,425,000	$211,875,000
Roundabout Option							
Phase	Segment	Mileage	Design	Road Construction	Bridge Construction	Construction Management	Total cost
1	Ruby-Poorman	53.5	$5,400,000	$53,500,000	$500,000	$8,100,000	$67,500,000
2	Susulama	90	$9,050,000	$90,000,000	$500,000	$13,575,000	$113,125,000
3	Sterling-Ophii	1.7	$170,000	$1,700,000	$0	$255,000	$2,125,000
4-B	Roundabout	26.6	$3,010,000	$26,600,000	$3,500,000	$4,515,000	$37,625,000
Totals		171.8	$17,630,000	$171,800,000	$4,500,000	$26,445,000	$220,375,000

APPENDIX A

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Appendix H
Bulk Fuel Distribution and Delivery

Methods

The analytical framework of this study includes 4 major parts:

- Demand For Bulk Fuel
- Supply of Bulk Fuel
- Government Policies
- Technology

Figure 1 shows this framework.

The demand for bulk fuel is a derived quantity; it is derived from the demands of various users. The major users are schools, utilities, etc., and their demand is also a derived quantity. It reflects the size of the population and consumption per capita. These numbers determine the size of the schools, the size of the light plants, the number of homes, and so on. These major users provided much of the demand data for this study.

The supply of bulk fuel is provided to meet the demand. Two characteristics of the supply are of interest in this study: how much fuel and what kind of fuel; how the fuel is supplied-by air, land, or water.

By definition, demand and supply are equal--what is actually bought is actually sold. We are interested in whether or not there is an imbalance or an inequality between the amounts of bulk fuel people would like to have and the amounts they have. Are there bottlenecks or roadblocks in the transport system that bring about an imbalance? If so, what are they, and can they be overcome as part of a transportation plan?

Imbalance may show itself in many ways. For example, although a rural household has a much smaller consumption of electricity than an urban household does, there may be a pent-up demand for more diesel fuel if the rural household could afford the amount the urban household enjoyed. Hence, we are required to look at things that affect this.

Two kinds of things affect this demand. One kind is government policies and associated programs. For example, Alaska has a government policy to try to provide rural electricity at rates more in line with the rates enjoyed by urban households. The program used for this is the Power Cost Equalization Program, which subsidizes rural electric utilities so that the monthly light bill is lower for rural residents. The other kind is technology. For example, bulk fuel tanks are a vital part of the fuel distribution system; they are needed to permit continuous functioning of fuel dependent in villages where fuel supply can be only intermittent. Hence, this study investigates both government policies and technology; the latter includes the more general topic of storage capacity.

We mention these two as examples because they are central to the continued functioning of rural households. The cost of electricity is a big budget item for the households. Most tank farms must be upgraded. We therefore discuss both of these examples at some length

We find that the villages have plenty of fuel storage capacity but much of it is in bad shape, we also note that the newly-created Denali Commission will play a critical role in upgrading bulk fuel tanks, as the single biggest provider of funds for that purpose.

Given the crucial role of bulk fuel tanks, it is inevitable that it becomes a major focus of the study. Therefore, this study at some length compared the demand for fuel storage capacity, as measured by the fuel flowing through the villages, with the supply of such capacity, as measured by the actual capacity of the fuel tanks in place. This comparative study could be done because for the first time we have collected reliable data on actual fuel purchases. With these data at hand, we can compare throughput--amounts of fuel flowing--with fuel tank storage capacity--amounts of fuel potentially able to be handled.

On the face of it, the capacity is there in ample amounts. If all capacity is added together in each village, there is plenty. The problem is that it is not distributed proportionately; for example, the schools have far more than they need, whereas numerous village corporations are bumping up against capacity.

Seeing this, we therefore raise what we believe to be a central engineering and economic question: Is the surplus capacity of the schools (say) in sufficiently good shape that it can be transferred in amounts and quality to other users of storage capacity? Furthermore, can this be done in ways that will appreciably reduce the cost of fuel-tank upgrading? This cost is estimated at present to be enormous on the assumption that all defective capacity should be upgraded.

This study does not attempt to answer this question. It depends not only on engineering and cost data (which are increasingly being collected by AVEC and DCRA/DOE), but also on administrative issues such as ownership and responsibility, lease-purchases or gifts, and the like. These topics are beyond the scope of this study.

Nevertheless, our data show that this is not a pointless question. The new reliable data on fuel use constitute a benchmark against which one can measure the adequacy of the existing capacity, at least in quantitative terms. If answered, it would have important implications for planning the transport of bulk fuel in the study region.

Findings

We find that the villages have plenty of fuel storage capacity, if all capacity is added together in each village, there is plenty. The problem is that it is not distributed proportionately; for example, the schools have far more than they need, whereas numerous village corporations are bumping up against capacity. In addition, many of the storage tanks are in bad shape.

We also note that the newly created Denali Commission will play a critical role in upgrading bulk fuel tanks, as the single biggest provider of funds for that purpose.

It appears that most communities and fuel distributors perceive the fuel demand-and-supply system as working well.

Base on population projection done by the planning team, we predict that XX communities will have insufficient storage in year 2010 and YY communities will encounter the problem in 2020. In Table 5.1, we listed the communities where the exiting fuel storage capacity will be insufficient for the projected fuel consumption in 2010 and 2020. The insufficient amount for each community is also listed in this Table.

A comparative study of the fuel cost by barge and by air is underway. However, due to the limited response so far from the air carriers to our request for data and cost estimates, this analysis is yet to be completed.

Recommendations

1. Consolidate fuel tanks where feasible.
2. Upgrade/construct fuel tanks in the community which has insufficient storage capacity.
3. Add storage capacity to meet future demand. This should be planned for the communities where barging fuel in is the only cost effective transport mode. A schedule for new tank farm construction is developed based on the projected population growth in each community.
4. Extend airport runways in the communities where the cost of flying fuel in may be comparable to barging fuel in. In these communities, only selected fuel tanks need to be upgraded.

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I. Introduction and Summary

Figure 1 shows the analytical framework for this report. It has 4 major parts (boxes with rounded corners):

- Demand for bulk fuel;
- Supply of bulk fuel;
- Government policies (affecting the demand for and supply of bulk fuel);
- Technology (affecting the supply of and demand for bulk fuel).

The demand for bulk fuel is a derived demand: it is derived from the demands of the various users. We have listed the major users: schools, utilities, etc. At bottom, their demand too is derived. It reflects the size of the population, and consumption per capita, which determines the size of the schools, the size of the light plants, the number of homes, and so on. We got much of the demand data by asking the major users.

The supply of bulk fuel is provided to meet the demand. We are interested especially in two characteristics of the supply: how much of what kind of fuel; how it is supplied—by what mode, air, land, water.

By definition, demand and supply are equal: what is actually bought is actually sold. We are interested in whether or not there is an imbalance—an inequality—between the amounts of bulk fuel people would like to have and the amounts they have. Are there bottlenecks or roadblocks in the transport system that bring about an imbalance? If so, what are they, and can they be overcome as part of a transport plan?

Imbalance may show itself in many ways-for example, in a much smaller consumption of electricity in a rural household (than in an urban household), and so a pent-up demand for more diesel fuel that would be needed if the rural household could afford the amount the urban household enjoyed. Hence, we are required to look at things that affect this.

Two kinds of things affect this. One kind is government policies and associated programs. For example, Alaska has a government policy to try to provide rural electricity at rates more in line with the rates enjoyed by urban households. The program used for this is the Power Cost Equalization Program, which subsidizes rural electric utilities, so that the monthly light bill is lower for rural residents. Hence, we list and discuss that. The other kind is technology. For example, bulk fuel tanks are a vital part of the fuel distribution system: they are needed to permit continuous functioning of fuel-dependent in villages where fuel supply can be only intermittent. Hence, we list and discuss them, and the more-general topic of storage capacity.

We mention these two as examples because they are central to the continued functioning of rural households. The cost of electricity is a big budget item for the households. Most tank farms must be upgraded. We therefore discuss both of these examples at some length

We find that the villages have plenty of capacity, but that much of it is in bad shape, and note that the newly-created Denali Commission will play a critical role in upgrading bulk fuel tanks, as the single-biggest provider of funds for that purpose.

Given the crucial role of bulk fuel tanks, we have focused above all on them. More precisely, we have at some length compared the *demand* for fuel storage capacity as measured by the fuel flowing through the villages, with the *supply* of such capacity, as measured by the actual capacity of the fuel tanks in place. We have been able to do so because for the first time we have collected reliable data on actual fuel purchases. Therefore, we can compare throughput (amounts of fuel flowing) with fuel tank storage capacity (amounts of fuel potentially able to be

handled).On the face of it, the capacity is there in ample amounts. If all capacity is added together in each village, there is plenty. The problem is that it is not distributed proportionately: for example, the schools have far more than they need; numerous village corporations are bumping up against capacity.

We therefore raise what we believe to be a central engineering and economic question: Is the surplus capacity of the schools (say) in such good shape that it can be transferred in amounts and quality to other users of storage capacity in ways that will reduce appreciably the enormous cost of upgrading estimated at present on the assumption that all defective capacity should be upgraded?

We cannot answer the question in this report. It depends not only on engineering and cost data (which are increasingly being collected by AVEC and DCRA/DOE), but also on administrative issues—ownership and responsibility, lease-purchases or gifts, and the like.

Nevertheless, our data show that the question can be raised, because the new reliable data on fuel use constitute a benchmark against which to measure the adequacy of the existing capacity, at least in quantitative terms.

If answered, it would have important implications for planning the transport of bulk fuel in the study region.

II. How the Fuel Flows

Figure 2 shows the region and the villages supplied.

The fuel supplied is of three main types: aviation gasoline; diesel/heating fuel; unleaded gasoline. Aviation gasoline and jetA50—a different name for diesel fuel # 2—are used in planes. Diesel fuel—mostly #1, but with # 2 mixed in during cold weather—is used to run diesel engines (in boats, electric light plants, and trucks) and for heating of buildings (homes, other private and public buildings); unleaded gasoline is used by internal combustion engines (other than for planes and diesels).

About 22 million gallons enter the study region: heating fuel, 9 million; diesel fuel, 7 million; unleaded gasoline, 4 million; aviation gasoline, 2 million.

II.I To the Villages

II.I.I The Bargelines

Almost all the fuel is barged into and distributed within the region by three companies. Very little fuel is flown in. The three major suppliers are: Crowley Marine Services (CMS); Delta Western (DW); Yutana Barge Lines/Yukon Fuel Company (YBL/YFC). All three supply rural Alaska as a whole, and the villages of the different parts of the region: the Kuskokwim-Yukon Coast; the Kuskokwim River; the Yukon River.

They use line-haul (oceangoing) fuel barges loaded mostly at Alaska refineries in the Gulf of Alaska (Anchorage) and Prince William Sound (Valdez), which deliver to the Y-K region via large tank farms in Dutch Harbor, Bethel, and Saint Michael especially, with some off-loading to smaller barges along the coast. They also use smaller barges.

Bethel is the regional hub, on the Kuskokwim River, and accounts for about half the total amount of fuel. Fuel reaches there on line-haul barges, which can navigate the Kuskokwim River with the help of river pilots. From Bethel, the fuel is either consumed there, or stored, and later shipped by smaller barges, and trucked, to villages up and down the Kuskokwim River.

Line-haul barges cannot navigate the Yukon River: it is too shallow, and there are no river pilots. The villages of the Yukon River are supplied from the ocean side and from upriver. From the ocean, they are supplied by smaller barges that have off-loaded from the line-haul barges at the mouth, or that have loaded up at the Saint Michael tank farm. Saint Michael is in the Norton Sound, close to the lower Yukon River. From Saint Michael, line-haul barges ship to the villages of the lower Yukon. The Yukon villages supplied from the ocean are those of the lower Yukon, up to Saint Mary's from time to time. But most of the fuel to the Yukon River villages—especially those upriver from the mouth—is supplied by YBL/YF's smaller barges that carry the fuel downriver from Nenana, a village on a tributary of the upper Yukon.

Some fuel is from time to time barged from Nome's tank farms to some villages along the coast nearby—Chevak, Hooper Bay, and Scammon Bay, for example—and to the lower Yukon villages.

Smaller barges carry the fuel to the villages. They supply the villages of the Kuskokwim River from the Bethel tank farm. They supply the villages of the lower Yukon River from the tank farm in Saint Michael, and from the oceangoing barges they meet off the mouth of the Yukon. In addition, smaller barges from Nenana on the Tanana River—a tributary of the upper Yukon—deliver most of the fuel to the Yukon River villages down to Saint Mary's and even beyond, to the villages at the mouth. Nenana is linked by road and rail to the two refineries at North Pole, near Fairbanks. Today, only the road link appears to be used: 1996 was the last year that Alaska Railroad carried fuel—and then only jet fuel/HF #2 (703,500 gallons)—in two shipments, in July and in August.

YBL/YFC now dominates in the region. It delivers the bulk of the fuel on the Kuskokwim: both the amount barged to Bethel, and the fuel trans-shipped from Bethel to the villages up- and down-river. (It was not a player on the Kuskokwim until 1996; before then, CMS and DW were the only suppliers.)

On the Yukon, YBL/YFC dominates deliveries downriver from Nenana. (CMS, which collaborated with YBL/YFC, severed its ties with YBL/YFC in 1996.) In 1998, YBL/YFC scheduled 21 voyages from Nenana between mid-May and mid-September. Ten of these 21 voyages were timed to carry freight brought to Nenana by train and truck from Anchorage, reached by Northland Services Inc's (NSI) scheduled freight barges from Seattle. This mixed freight/fuel service reflects vertical integration by the two companies YBL/YF and NSI, which were recently bought by Gillette.

Over the 3-year period 1990-1992, YBL/YFC shipped annually from Nenana an average of 5.5 million gallons (22,000 tons*250 gallons/ton) of fuel, of which 90 percent—5 million gallons—was heating fuel. CMS and DW also carry freight and fuel downriver from Nenana, but their operations are small relative to those of YBL/YFC.

There is an area of overlap on the lower Yukon—villages that get part of their fuel downriver from Nenana by YBL/YFC and part upriver from linehaul barges via Crowley. They are the villages from and including Saint Mary's on down. In that area, the lower price of fuel delivered to Nenana as compared with the price at the tank farm in Saint Michael in the Norton Sound is more-or-less offset by the longer distance from Nenana. For example, Saint Mary's is about 800 miles from Nenana but only about 150 miles from Saint Michael.

II.I.II The Airlines

Fuel is flown in only in emergencies, because it costs much more than fuel barged in—from Bethel to Chevak, for one recent example, at three times the summer barge price per gallon.

Emergencies occur when, for example, a supplier has contracted to provide a certain amount by a certain date and an upriver barge is prevented from arriving then by mechanical or navigational problems, or when a community runs out of fuel in the spring before breakup.

Lime Village is the only village in the region supplied by air only. It is on the western slopes of the Alaska Range, and is unreachable by water: the Stony River is not navigable except by skiffs. (A few intrepid residents will from time-to-time take one or two drums upriver from the village of Stony River.)

II.I.III Trucks and Others

When the big three bargelines have delivered the fuel to the villages, several villages have feeder operations. The most significant example of this is Hoffman Fuel Sales, in Bethel, which trucks fuel in winter by ice-road to villages close to Bethel that have bought fuel from Bethel Fuel Sales. On the Kuskokwim, some residents of villages close (and even not so close) to Bethel, travel to Bethel Fuel Sales' tanks on the riverbank—by boat in summer; by all-terrain-vehicle (ATV) and by skidoos in winter—to buy fuel. On the Yukon, some residents of villages close (and even not so close) to Saint Mary's travel to YBL/YF's tanks close to the riverbank—by boat in summer; by all-terrain-vehicle and by snowmachine in winter—to buy fuel. There is occasional and sometimes steady inter-village trafficking, depending on the weather, fuel use, and the ratio of storage capacity to amounts supplied: for examples, Kwethluk on the Kuskokwim is visited by residents of Akiachak and other nearby villages; Chevak on the coast is visited by residents of Hooper Bay and Scammon Bay. There are numerous other examples of inter-village sharing of this kind, in winter and spring especially, as shortages (and rationing) appear.

II.II In the Villages

In the villages, the fuel is pumped into tanks owned by village corporations and stores that distribute it, and into tanks owned by institutions that use it themselves: city administration; schools; utilities. In a few villages—Kipnuk, for example—the BIA/Coolbarge program pumps at the beach into individually-owned tanks with a capacity of 1,000 or more gallons, that are permanently located there. In the past, some barges pumped directly into rows of 55-gallon drums placed on the riverbank by households, but this practice has ended with the introduction of tighter environmental controls by state and federal agencies. Once in the tanks there, the fuel is distributed in different ways. Diesel fuel tanks are hooked up to the diesel light plants. Heating fuel for the schools and other public buildings is trucked to day tanks. Heating fuel for homes is mostly picked up by residents using a variety of modes: ATV's and sleds; boats; dog-teams and sleds; skidoos and sleds; trucks.

III. How the System is Perceived and Works — More Detail

III.I By Community Residents

The system is by all respondents we contacted—buyers and sellers in the 13 large villages and in the sample of 23 smaller villages; representatives of barge lines—perceived as working because it is working. Most of the fuel arrives in the villages in bulk when and where it is needed, at prices set by the suppliers high enough to support their operations, but low enough so that they can be absorbed by the ultimate consumer.

Some communities have from time to time had to fly fuel in during emergencies, or to ration fuel, or to turn buyers away. This happens from interruption of supply and/or from unexpected increase in demand. Supply is interrupted when, for example, low water in fall, or early ice, prevents final delivery before freezeup. Demand increases with prolonged cold spells.

Under these conditions, villages ration fuel, by, for example, giving elders a priority on dwindling supplies of heating oil. Or, they may borrow fuel reciprocally—for example, the city's borrowing from the Alaska Village Electric Cooperative (AVEC), or AVEC's borrowing from the school.

In extreme circumstances, they may fly fuel in. For example, Anvik's Ingalik Incorporated, faced with a cold spell this winter and spring, flew heating oil in with Everett Air: 2,000 gallons in December, and 2,000 gallons in April. This is almost double the 5,000 gallons it bought last summer, which came by barge.

Small villages may be more vulnerable to interrupted supply. For example, Chefornak's Chefarnrmute Incorporated reported in February that—although it has had to fly fuel in only twice in the memory of the respondent—it may run out of gasoline this spring, because the barge line would not deliver last fall the supplementary amount the company wanted, since it was less than the 10,000-gallon minimum the barge line requires.

In addition, some villages may bump up against capacity in part because of their good management, coupled with inadequate capacity in neighboring villages, whose residents come to the one with surplus capacity. For example, Chevak's Chevak Company Corporation saves its fuel revenues in the winter in order to prepay the suppliers, thus keeping the price down. Its prices are slightly lower than in the two neighboring villages Hooper Bay and Scammon Bay, some of whose residents travel to Chevak to buy fuel. Their added demand, plus the increase in demand placed on capacity by Chevak residents, has led to a shortage of capacity that will need to be remedied soon. In the winter of 1997/1998, Chevak had to ration fuel because the barge arrived only once in the summer of 1997, and had to fly gasoline in during the spring of 1998. Arctic Air supplied it from Bethel at $3 per gallon, as compared with just over $1 per gallon off the barge. The company is putting a tank loan program package together that will increase its capacity by about 20 percent: adding 40,000 gallons of capacity—20,000 gallons each for gasoline and heating oil—to its 196,000 gallons of existing capacity.

Village corporations especially report that their capacity is inadequate in amount and quality. The widespread reporting of a quality problem—the need to upgrade tanks—is consistent with the findings of the Alaska Department of Community and Regional Affairs, Division of Energy (DCRA/doe). (see Chapter 7.) Almost all village corporations reported that their capacity is in need of upgrading, and many reported that it was inadequate in amount—not so much at present (although some wanted more capacity as soon as they could afford it), but certainly in the near future.

Respondents in numerous villages—even in those villages that had no upgrading underway—were aware of the DCRA/doe's role in upgrading bulk fuel tanks. Respondents in numerous other villages knew nothing of the DCRA/doe's role.

Almost all village corporations—the usual suppliers of heating oil and gasoline to residents—reported that the demand for both kinds of fuel is increasing. The demand for heating oil is increasing, with growth in population and in the number of new or recent HUD homes with oil stoves. New water/sewer systems were always mentioned as needing substantial increases in heating fuel, by those villages that had installed them or were planning to install them. The demand for gasoline is increasing region-wide, with growing population and with increasing ownership of machines—autos and trucks, all-terrain vehicles, boat engines, snowmachines.

III.II By The Barge Lines

III.II.I Yutana Barge Lines Inc/Yukon Fuel Company (YBL/YFC)

1. Scope of Operations

YBL/YFC is emerging as the major fuel supplier in the region—growing relative to the other two barge lines Crowley and Delta Western. This relative growth reflects, in part, vertical integration between this company and one of its former competitors which was the major freight barge line. Northland Holdings recently acquired ownership of Northland Services and Yutana Barge Lines (of which Yukon Fuel is a subsidiary).

Laurence G. Shelver, President, summarized his company's operations and offered his opinions, in an interview with the author on September 1, 1998:

2. Logistics

- YBL/YFC barges 75-90 million gallons of fuel annually to rural Alaska—to every village in the Y-K region, and to many outside it—and arranges to fly fuel to one Y-K community (Lime Village).
- we supply 100 percent of Kuskokwim fuel, and 60-70 percent of Yukon fuel;
- we barge fuel to the big regional tank farms in Bethel, Nome, and Saint Michael by oceangoing barges mostly from Alaska refineries (Anchorage and Kenai especially);
- we distribute it in smaller barges from there to villages up and down the Kuskokwim, along the coast, and up the Yukon partway;
- we barge fuel partway down the Yukon from Nenana, from the Mapco and Petrostar refineries near Fairbanks;
- we supply 100 percent of the fuel of the big Bethel distributor—Bethel Fuel Sales, which has its own tank farm there;
- we own tank farms in the Y-K region in Hooper Bay and Saint Mary's, and also outside it in Galena, Nenana, Fort Yukon, and Saint Michael;
- our barges' capacities range from 500,000 to 2,800,000 gallons.

3. Costs of Operations

In addition to our own costs, we (and our competitors) pay transport fees: transfer fees; city taxes; pilotage. The City of Bethel charges an 8c/gallon transfer fee. The City of Nome charges an 8c/gallon city fee. Pilotage fees on the Kuskokwim are $20,000 per barge load. No pilot is required on the Yukon.

4. Costs Reflecting Government Policies

Six government policies especially have had and will have the most effect on the cost of our operations: the by-pass mail system; the building of village airport runways; fuel tank regulations; fuel spill monitoring; fuel barge hull requirements.

- **By-Pass Mail**

The government biases rural transport in favor of air carriers by subsidizing them but not barges: through the by-pass mail system, and by building the infrastructure (runways, lighting, etc.), which waterborne carriers have to pay for.

Over time, by subsidizing airfreight costs, by-pass mail has siphoned off much of YBL/YFC's deck freight: less than 10 percent of historic levels remain. The history of the company is that we originally used barges to carry both freight and fuel combined, to regional hubs especially. By-pass mail reduced airfreight costs. And, now that all villages have runways, planes carry most of the freight. The by-pass mail system has had unintended cost consequences. The ≥1,000 pound limit that triggers it means that as few as four individuals can order enough to qualify. This has reduced the ability of village stores to compete: they offer less variety than they were able to offer when barges were competitive, and the costs of what they do offer is higher. Intended especially to help in the transport of perishables, the system has been abused; it is used to carry large quantities of non-perishables—building materials, for example.

- **Fuel Tanks**

YBL/YFC spent $5 million in the last 4 years on inspections and upgrading of our tank farms, to comply with the Alaska Department of Environmental Conservation (DEC) regulations. But many of our competitors have not upgraded theirs. Thus, we have incurred tank maintenance costs local tank owners have to date escaped. DEC needs to be even-handed in applying its regulations. It has been suggested to the state that they levy a tax on local tank owners not in compliance, and lift it when they comply. This would put in place an incentive for everybody to upgrade/maintain their tanks.

For small communities the costs of regulation are substantial. For example, recouping the fuel-tank cost of DEC regulations adds 30c/gallon to the price of barged fuel in Fort Yukon, and so adds $175,500 to the cost of its 585,000 gallons of fuel. [Author's note: The price of the fuel in Fort Yukon is unknown. For purposes of comparison, AVEC paid $1.0996 per gallon for diesel fuel, in the village closest to Fort Yukon that it serves. This one-fuel, one-place, one-year, one tank-farm comparison suggests that the regulations may add about 30 percent ($0.30/$1.0996) to the price of fuel supplied by companies that upgrade their own tank farms. This provides a perverse disincentive: not to upgrade until forced to—particularly when competitors, such as cities and/or village corporations—are heavily-subsidized by the state.]

Village bulk fuel storage is adequate in terms of quantity, and there have been few spills. It is inadequate in terms of quality. The problem is the villages don't have funds for upgrading. DCRA's revolving loan fund needs more funds and should be expanded. [Author's note: Senator Stevens announcement of the Denali Commission was 7 weeks off-October 22.] Scarce village SS can be saved by incinolets instead of sewer pipes, and by back-hauling compacted garbage on barges. (YBL/YFC brings batteries back free and takes lube oil back to Nenana.)

- **Modal Bias**

The government biases the transport of bulk fuel in rural Alaska in favor of air carriers by applying to them less stringent requirements, i.e., standards are applied to barge operators but not to air carriers. For example, barge fuel supply operations are closely monitored, by DEC especially, but air carriers are not. Airport spills are not monitored systematically by DEC, by the

Environmental Protection Agency (EPA), or by the Federal Aviation Administration (FAA), but barge spills and operations are. Poor training is implicated in spills too. Barge crews are required to have lots of training. But aviation crews are not; they even drag tanks on the frozen ground.

- **Barges and Hulls**

The requirement that new fuel barges and single-hulled barges ≥10,000 barrels be double-hulled over the period 2007-2010 will add 35 percent to the cost of barges. [Author's notes: single-hulled barges < 10,000 barrels are permanently exempt; data to support the statement would need to be obtained—costs of retrofitting, new barges, and the relationship between capital costs of barge upgrading on the one hand and the price of fuel on the other.]

- **Dyeing**

The requirement that non federally taxed fuel be dyed increases our cost because tanks carrying dyed fuel cannot be used to carry undyed fuel (avgas, for example) for fear of contamination. The cost of contamination—if and when it occurs—is great.

- **Planes**

FAA regulation 175.320 stipulates that fuel may not be flown into a community if there is another method of supplying the community. This regulation is ignored.

Even with the regulatory bias in favor of air carriers, the price of delivering fuel by plane will increase too, for technological reasons: the old planes of choice (C46s, 2,200 gallons; D6s, 5,000 gallons) are not now being built, and no new ones have been built since the 1950s; the new planes (C130 Hercules, 7,000-9,000 gallons) cost $10 million each.

The spread between air and barge is substantial- overall, planes, 67 cents/gallon: barges, 6-7 cents/gallon; The ratio is 6:1 for the C130 and about 3:1 for the DC6 ($1/gallon versus 30 cents/gallon).

5. Solutions

Solutions to these problems require:

- designated landing areas at consolidated tank farms centrally located, with common pipelines to the communities;
- public assistance $$ to AVEC, not to individual village utilities **[Author's note: single-village utilities.]**
- the design and use of a tax incentive system to keep tanks upgraded/maintained;
- levelling the playing field—air carriers versus waterborne carriers, and across waterborne companies;
- simplifying standards for approval of bulk fuel tank farms.

III.II.II Crowley Marine Services, Inc. (CMS)

Sean Hochanadel, Senior Account Executive, summarized his company's operations and offered his opinions, in an interview with the author on September 1, 1998. (He is now no longer with Crowley.)

1. Logistics

- CMS supplies fuel to most of the villages of rural Alaska, including the YK region;
- our line-haul barges load up with fuel in Alaska especially;
- they deliver to our tank farm in Dutch Harbor, and to the tank farms owned by other companies in Nome and Kotzebue. They reach Bethel on the Kuskokwim, but are met at the mouth of the shallower Yukon by our lighterage barges, which carry freight and fuel;
- on the Yukon, we operate on the lower Yukon only-we severed our YBL ties two years ago;
- Northland is our freight competitor. Gillette has bought Northland and Yutana;
- our barges don't winter in Alaska-they may load up in the lower 48 on their first spring trip;

  - **Contracts And Prices**

- we have the Rural Alaska Utilities contract—Bethel, Dillingham, Kotzebue, Naknek, Nome;
- AVEC puts out an RFP using an OPUS-indexed price (average pricing). Sometimes we lock in a price as of the date ordered, rather than indexed. Gasoline prices increase in the summer and decline in the winter; heating prices the reverse.

2. Cost Considerations

By the Oil Pollution Act of 1990, fuel must be carried in double-hulled vessels.

III.II.III Delta Western Fuel and Lube (DW)

Mike Poston, Contract Manger, summarized his company's operations and offered his opinions, in an interview with the author on October 15, 1998.

1. Logistics

- DW has tank farms in Dillingham, Dutch Harbor, Haines, Juneau, Naknek, Seldovia, Wrangell, Yakutat;
- the two relevant for the Yukon-Kuskokwim region are the large tank farm in Dutch Harbor, with from 8-13 million gallons capacity and the Dillingham tank farm with 1.5-2.0 million gallons capacity;
- we totally rebuilt the Dillingham tank farm 1996-1998.
- we buy about 80 percent of our fuel from Alaska refineries, with purchases from the lower 48 during periods of peak demand especially;
- we have 2 line-haul barges, which carry about 2 million gallons each, and 1 dedicated charter barge, to carry the fuel from the refineries to our tank farms, and from our tank farms to others' tank farms in regional hubs like Bethel;
- we have 3 lighterage barges, which carry 100,000-500,000 gallons, and 2 dedicated charter barges, to redistribute from the tank farms in the regional hubs to the villages, and to redistribute from the line-haul barges to some coastal villages direct.
- our owned and dedicated charters carry 80 percent of the fuel we supply; we spot-charter the rest;

- we share the distribution of all three fuel types with two other companies especially: Crowley; Yutana Barge Lines/Yukon Fuel. What proportion each of delivers changes from year to year. In the 1990s, we probably have supplied about one-third of the total;
- we fly fuel in occasionally, if a barge doesn't make it to a village before freezeup, and if we have contracted to supply an amount by a date. Maybe we fly 5 percent into the YK region;
- geography also plays a role in this, as well as barge-timing. For example, we sometimes fly from Fairbanks to Medfra and Nikolai, **[Author's note: 250 miles]** because it is competitive at the margin with barging from Prince William Sound, through the Aleutians, across Bristol Bay, and all the way up the Kuskokwim;
- enlarging runways would help a community fly fuel in if it needed to, and would also increase the proportion of freight flown in rather than barged in.

2. Fuel Types

The distribution of fuel in the YK region is (about) as follows: diesel/heating, 75 percent; gasoline, 20 percent; avgas, 5 percent. We supply about the same proportions. The regional hubs may skew to a higher proportion of gasoline.

3. Contracts

On some of our contracts we require payment up-front, on others at delivery, in some we have an escape clause, in others we don't.

4. Economic Comments

The return on invested capital in rural fuel supply is limited. This reflects especially new environmental requirements—tank farms and barges, for example.

It is costly to upgrade tank farms, and duplication of capacity creates higher cost per unit capacity. For example, there are 3 tank farms in Dillingham: Alliance Fuel; Bristol Fuel; Delta Western

Barges will have to be double-hulled instead of single-hulled (OPA 1990). A barge that already cost $4-5 million will have to be retrofitted—reconfigured, and with new piping and other plumbing—at an added cost of $3.5-4.0 million.

5. General Thoughts on Cost Possibilities

- better weather information—more detailed and more up-to-date—would help reduce the cost of shipping by any mode. Local TV monitors hooked to the internet is one way.
- dredging and better information on river bottoms (for example) would reduce the cost of line-haul barging, and is needed in two-thirds of the waterways where line-haul barges go;
- a road from Glenn Highway to McGrath may pay its way;
- some economic efficiencies may be available from consolidation of tank farms in a community;
- lower costs may be achievable by utilities which own their own tank farms: Nome Utilities does; Bethel Utilities doesn't.

6. Regulation

Although our tank farms were built in the 1940s we've had no spills, but we are still cutting up tanks, and putting liners and double bottoms in them. A recent incident cost us $100,000: in 1998 one of our barges ran up on a sandbar and we reported an unintentional grounding to the

Coastguard as required. We would have pumped fuel from the front to the back of the barge and pulled it off. But the Coastguard said we had to have a diver inspect for hull damage, and pay a competitor to pump out into their barge. There was no damage, and the competitor charged top dollar.

III.II.IV Calista Corporation/WAVE

Andrew Guy, Counsel, summarized his company's operations and offered his opinions, in an interview with the author on October 15, 1998.

- the Calista Corporation started Western Alaska Village Enterprises (WAVE) in the early 1990s;
- WAVE then had two parts: WAVE Wholesale Company (WWC); WAVE Stores Cooperative (WSC);
- WWC buys building supplies, clothing, groceries, housewares, skidoos, etc. from suppliers (Anchorage, Seattle, wherever) at the lowest prices it can, and gets low prices because it orders in bulk;
- WWC buys what WSC orders;
- WSC is retail outlets in the villages, which set their own prices;
- WSC has 49 members: individual buyers, school districts, village councils, village for-profit corporations;
- in 1998 Calista created a third entity: WAVE Fuels and Transportation (WFT);
- WFT buys fuel in bulk at the lowest prices it can, gets low prices because it orders in bulk, and sells the fuel through WSC;
- it solicits fuel bids, and buys from the lowest bidder, which has been Crowley to date;
- the contract with Crowley commits Crowley to delivering a specified amount of fuel at a specified price by a specified time. (Crowley had to fly fuel to one community at the specified price after its barge couldn't get there.);
- WFT has bought a Bethel fuel supply retail outlet and a Kotzebue sports machines retail outlet;
- WFT is exploring the possibility of buying (building?) a bulk fuel tank facility;

WFT has extensive baseline data on the fuel demand of the 49 WSC members.

1. Not for Attribution

- Alaska Department of Environmental Conservation (DEC) especially monitors barge fuel supply, but not air carriers, and airport spills are not monitored systematically by DEC, by the Environmental Protection Agency (EPA), or by the Federal Aviation Administration (FAA);
- DEC's tank farm limit of 420,000 gallons has cost implications: within some upper limit, it is cheaper per gallon to upgrade tank farms the bigger the farm; limiting the permitted amount increases the cost by precluding economies of scale;
- it is not clear that upgrading of tanks is needed—this observer has never seen a tank failure; rather, the leaks are from hoses, pipes, and valves;
- DEC's Aboveground Manual 1992 is too complicated;
- the asymmetry in inspection of fuel delivery subsidies and inspections—barges versus planes—exists also with training, which is also implicated in spills: barge crews are required to have lots of training, but aviation crews are not; they drag tanks on the ground;
- the DEC, which has jurisdiction over barge plans to 700 miles upriver, does not apply its jurisdiction even-handedly: when a competitor (bargeline) hit an obstacle on the [river] and spilled oil, they got an accommodation; a competitor (bargeline) is allowed to load at a dangerous crossing; a competitor (bargeline) was not required to advertise its shipping rates;
- In general, the agencies adopt a role of adversarial environmental watchdog.

IV. How Much Fuel Flows

Table DOTYK1 shows that 21.7 million gallons of fuel entered the study region annually in the late 1990s, by community, for the four major fuel types: aviation gasoline; diesel fuel; heating fuel; unleaded gasoline. (In Chapter 5 we explain how we got the 21.7 million gallons, and why we give it not for any one year such as 1998 but for a representative "year in the late 1990s.")

IV.I Bethel

Bethel is by far the biggest community, and so is by far the biggest consumer of fuel—it alone accounted for 10.2 million gallons, or almost half the total fuel entering the region. and so we summarize its amounts. **(The data are from: Bethel Fuel Sales; Bethel Port Authority; Bethel Utilities; City of Bethel; Hoffman Fuel; Lower Kuskokwim School District; Yukon-Kuskokwim Health Corporation.)**

All told, Bethel consumed 10,186,000 gallons of fuel in 1998. The single biggest amount was 4,101,000 gallons of *heating fuel* (HF1). This was about equally shared by three types of consumers: homes for heating (1,359,000 gallons); public buildings (1,525,000); airplanes, for which HF1 is sold as jet A50 (1,217,000). The next biggest amount was 3,588,000 gallons of *diesel fuel (HF2).* Bethel Utilities—the electric power plant—was by far the biggest consumer of HF2. It alone accounted about three-quarters of the diesel fuel. The remaining diesel fuel was bought by boats and trucks. *Unleaded gas* amounted to 1,286,000 gallons. Almost all was sold through the gas stations, but a small amount was sold directly to customers at Bethel Fuel Sales' tanks. Finally, airplanes consumed 1,211,000 gallons of *avgas*—just about the same amount as their jetA50. One notable feature of Bethel's fuel picture is that Bethel Utilities supplies waste heat from the jackets of its diesel engines to 18 public buildings including the largest. In this way, Bethel uses less heating oil than it otherwise would. The 18 buildings are: Yukon-Kuskokwim Health Corporation, 9 (including the hospital and adjacent living quarters in part); City, 5 (including City Hall, the Court, and others); Kuskokwim Community College, 2; State of Alaska, 2.

This 10,186,000 gallons of fuel includes a relatively small amount—not more than 100,000 gallons of HF1 and unleaded combined—that was consumed not by Bethel but by neighboring villages: Akiak, Akiachak, Kwethluk, Napakiak, Napaskiak, Oscarville, Tuluksak. This is in winter especially, when residents of these villages use the ice road to go to Bethel and buy from Bethel Fuel Sales direct, and Hoffman Fuel Sales in Bethel trucks fuel to them. And, there is some personal boat traffic in fuel in summer. Otherwise, barges supply the bulk of these villages' fuel, in summer.

The amount of fuel entering Bethel in 1998 was greater than the 10,186,000 gallons distributed in Bethel, for two reasons. First, Bethel Fuel Sales bought some fuel that added to its inventory. Second, the three barge lines (CMS, DW, YBL/YF)) bought some fuel that they stored in Bethel Fuel Sales' tanks until they were ready to pump it out again and barge it to other communities up and down the Kuskokwim.

Combined, these two reasons (inventory; trans-shipment) add 6,213,000 gallons to the 10,186,000. The bulk of this 6,213,000 gallons is the transshipped amount: the average annual amount of fuel that the barge lines stored temporarily in Bethel Fuel Sales tanks was 5,392,000 gallons over the 5-year period 1994-1998.

IV.II The Other Communities

We cannot give as much detail for the other communities as we could for Bethel, for two reasons. First, we don't always have as much detail for them. Second, even when we do, we

cannot always give it, because we have to avoid publishing information that would disclose the operations of individual companies in the private sector—the village for-profit corporations, for example. In Bethel, there are many buyers and sellers of fuel; in most villages, there are few.

Table DOTYK1 shows that we have arranged the 56 villages of the study region into four groups: large tundra; large wood; small tundra; small wood.

We did so in order to see if there are any patterns that distinguish large from small villages, or tundra villages from upriver villages. For example: How many big villages account for how much of the fuel use? Do the residents of the big villages use more fuel per person than residents of the small villages? Do the residents of the upriver villages use less heating fuel because at breakup they can more easily snag trees for wood heating than residents of the coastal villages, and because they can cut wood close to the village? If we can answer these and other similar questions, we can think more clearly about planning fuel delivery systems.

Table DOTYK1 shows that we defined the large villages as all those with a population of 500 or more in 1997. There are 13: tundra, 5; wood, 8. (We have included Alakanuk and Emmonak at the mouth of the Yukon in the large wood group because many trees at breakup float down to the lowest reaches of the Yukon River; we have not included lower Kuskokwim villages in the large wood group because most of the trees at breakup on that river are snagged before they get there.)

The 13 largest villages of the 56 villages account for just over half the population: 13,189 (tundra, 8,144; wood, 5,045) out of a total population of 23,782, or 55 percent. They consume an even higher proportion of the fuel—three quarters of it: 16,288,000 gallons (tundra, 11,981,000; wood, 4,307,000 wood) out of a total of 21,713,000 gallons, i.e., exactly 75 percent.

The 13 largest villages consume a much higher proportion of the fuel largely because they include the one regional hub Bethel and the two subregional hubs Aniak and Saint Mary's. All three have much higher total fuel consumption per capita—between 1,500 and 2,000 gallons a year—than any other villages. (Note the three exceptions—three small villages that also have large consumption per capita. Two of the three exceptions are two of the smallest of the 56 villages: Takotna and Telida. The third is McGrath which, even though much smaller than Aniak and Saint Mary's, may also be regarded as a subregional hub: it has a school district and other government offices, and is the entrepot for the neighboring mining communities.) If the three hubs are removed, the gallons of fuel per capita fall greatly: from 1,471 to 626 (a 57 percent reduction) in the large tundra villages; from 854 to 589 (a 30 percent reduction) in the large wood villages.

In general, bigger communities, especially hubs, consume more *heating fuel* because they have more public buildings per capita.

The big per capita *diesel fuel* usage in Bethel—by far the biggest except for tiny Telida—is explained largely by the fact that Bethel Utilities provides the electricity to Napakiak and Oscarville, and part of Napaskiak's electricity as well. It is not because Bethel Utilities is inefficient: its gallons/kwh are about average for the region's utilities.

The higher per capita use of *gasoline* in the big villages reflects above all the fact that the big villages have more households with higher incomes and therefore more vehicles, and more miles of roads to drive around on.

We have the bulk of the *aviation gasoline*: firm data on *aviation gasoline* consumption in Aniak, Bethel, and Saint Mary's from the suppliers there, supplemented by partial data from the airlines. Table 1 does not include aviation gasoline consumption in the other villages, but we believe the amounts involved are small: the planes fuel up in the three big communities especially, with enough fuel for their round trips to all the other villages. Using airline travel data, we estimate total airplane fuel use in the study region of the 10 major airlines at 3,003,000

gallons in 1997. This is a very close match with our total of 2,428,000 gallons: 1,211,000 aviation gas; 1,217,000 jetA50 (HF1). We expect to narrow the small difference between these two sources of data as we collect more-detailed data from the individual airlines on their purchases (if any) in the smaller villages. (The airline travel data are from the Alaska Air Carriers Association: gallons of fuel issued in 1997, by member airlines operating in the study region.)

We note that Aniak has the highest per capita fuel use of all the villages. This is in part because the total is overstated: some of it was not consumed in Aniak, but shipped out to mining projects along the Kuskokwim River. (We must report the total amount that arrived in Aniak, because we are interested in the balance between the supply of and demand for fuel—for example, in the issue of if communities have storage capacity adequate for the amounts of fuel entering them, even if some of that fuel then leaves them.) The amount shipped out of Aniak is proprietary information; we can say it was less than 500,000 gallons of HF#2, some of which was used as diesel fuel by the mining operations, that we have included in the heating fuel category.

In the smaller villages, the small wood villages consumer a little more fuel per capita than the small tundra villages—about 20 percent more: 596 gallons per capita, versus 458. They use more fuel in all four major types of fuel. We had expected that they might use less heating fuel than the tundra villages because they can more easily get wood for heating. But this is not so. They use slightly more: 239 gallons per capita versus 217 gallons per capita. There may be several reasons for this. The most-likely reason is that it is colder upriver in Interior than downriver. And/or, the winter of 1998/1999 may have been colder than normal in the wood villages upriver but not in the tundra villages. And/or, wood may not be an important enough source of heat in the wood villages to make much difference to oil consumption overall. In the wood villages, new homes and Toyo stoves, which are very fuel efficient, may be making wood increasingly the supplementary rather than primary source of home heating. We would like to collect and analyze data on wood use in villages, to compare the costs and benefits of oil heating versus wood heating in those villages where our research to date shows that wood is widely used, even if only as a supplement: on the Yukon River, from Mountain Village upriver; on the Kuskokwim River, from Akiachak upriver.

Seven villages do not consume *diesel fuel* for light plants: Kalskag Upper; Kasigluk; Napakiak; Oscarville; Flat; Lime Village; Pitka's Point. Five of them are served by other communities' light plants: Kalskag Upper is served by Kalskag Lower; Kasigluk is served by Nunapitchuk; Napakiak and Oscarville are served by Bethel; Pitka's Point is served by Saint Mary's. Lime Village residents have individually-owned generators. We have not yet examined Flat's electric power services.

V. How We Got the Data on Flows of Fuel

We got most of the data of **Table DOTYK1** by asking the major buyers and sellers in the 13 large communities and in the sample of 13 out of the 43 smaller communities how much they bought and sold. We defined the larger communities as those with a population of 500 or more in 1997. We selected the 13 of the 43 smaller villages at random: 7 of the 20 small tundra villages; 6 of the 23 small wood villages. Some of it we got from archival data sources. Some of it we got from special data requests we made to government agencies. Some of it we got by estimating.

Most of the *heating fuel* heats schools and homes; some heats other public buildings. We got data from the six school districts on how much heating fuel they bought in 1998: Iditarod; Kushunamiut (Chevak); Kuspuk; Lower Kuskokwim; Lower Yukon; Yupiit. To get home heating fuel use, and how much is bought to heat public buildings other than schools, we phoned and then wrote followup letters to the village corporations in half the communities—the 13 large communities and the sample of 13 small communities—asking them how much heating fuel they bought/sold. In some of the 26 villages the city or the tribal council was the distributor, not the village corporation. In those cases, we phoned and then wrote followup letters to them, asking them how much heating fuel they bought/sold.

The *diesel fuel numbers* are the 1996 gallons by electric utility by community in the statistical report of the Power Cost Equalization Program for Fiscal Year 1996, published in 1998 by the Division of Energy, Alaska Department of Community and Regional Affairs.

We got the data for *unleaded gasoline* by asking the village corporations, city councils, and tribal councils in the same 26 villages.

We got the *aviation gasoline* numbers for three communities from the distributors in Aniak, Bethel, and Saint Mary's, with minor supplementary data from schools and city or tribal councils, and compared their numbers with airline fuel use data.

We interviewed and collected detailed data from major individual users in the three hub communities Aniak, Bethel, and Saint Mary's because of their size: Bethel Utilities; City of Bethel; City of Saint Mary's; Port of Bethel. And, we collected and analyzed the data of Bethel Fuel Supply (for Bethel) and Yukon Fuel (for Hooper Bay and Saint Mary's). We supplemented the community data with data from two other government agencies. The Alaska Department of Public Safety provided data on aviation gasoline used by fish and game personnel. The Defense Energy Office, U.S. Department of Defense provided data on aviation gasoline, heating fuel and unleaded gasoline ordered by two kinds of users: some federal agency facilities in Bethel; orders from some communities through the Coolbarge program. The amounts ordered by the federal facilities in Bethel through the Department of Defense amounted to 738,000 gallons. The bulk of this was heating fuel for the hospital; other amounts were for the Federal Aviation Administration and the Yukon Delta National Wildlife Refuge. The coolbarge fuel deliveries amounted in 1998 to 307,164 gallons of heating/diesel fuel ordered by 8 of the 56 villages, and 190,764 gallons of unleaded gasoline order by 7 of the same 8 villages. Of the 307,164 gallons of heating/diesel fuel, the bulk was home heating fuel ordered by individuals in 7 villages through the Bureau of Indian Affairs. They bought 274,138 gallons, or 89 percent. The other purchasers of the 307,164 gallons of heating/diesel fuel through the coolbarge program were the Federal Aviation Administration (McGrath) and the Public Health Service (Eek).

The only estimates we made were of heating fuel for public buildings and homes, and of unleaded gasoline, in the 30 smaller communities that we did not contact directly. In them we already had major amounts of two kinds of fuel use from the archives and special runs: diesel fuel used by the light plants; heating fuel bought for the schools. We estimated their

consumption of heating fuel for public buildings and homes, and of unleaded gasoline, by assuming they consumed the same amounts per capita as the sampled villages.

The estimate had four stages. First, we combined across the sampled villages their corporations' purchases of heating fuel and unleaded gasoline. For example, we added together the gallons of heating fuel purchased by the village corporations in the 7 sample small tundra villages. They are marked (a) in Table DOTYK1. Second, we added the 7 villages' populations. Third, we calculated their per capita consumption by dividing their consumption by their population. Fourth, we multiplied their per capita consumption by the population of the non-sampled villages to get consumption in the non-sampled villages. (Algebraically, hfcnstv1=hfcastv/pastv*pnstv1 where: hfcnstv1=heating fuel consumed in non-sampled tundra village # 1; hfcastv=heating fuel consumed by all sampled tundra villages; pastv=population of all sampled tundra villages; pnstv1=population of non-sampled tundra village #1.)

These estimates were small relative to the total gallons of fuel already known. They added 1,516,000 gallons to the 20,197,000 known gallons, for the total of 21,713,000 gallons of Table DOTYK1, i.e., 7 percent. The 1,516,000 gallons added were: 660,000 gallons to the 6,463,000 gallons of the 20 small tundra villages (10 percent); 856,000 gallons to the 2,463,000 gallons of the small wood villages (35 percent).

Once we had the amounts known and the amounts estimated, we were able to compare the results for selected villages—all those villages upriver from Bethel and some of those villages downriver from Bethel—with a known control total: the amount of fuel stored temporarily in Bethel Fuel Sales tanks, and then shipped by the three barge lines in 1998 from Bethel to villages upriver and downriver. Our known and estimated data were a close match to the Bethel Fuel Sales (barge lines') control total.

The comparison involved three steps. First, we had to determine which villages are served by barge from Bethel. The upriver villages are known. From conversations with barge line employees and other fuel intermediary suppliers, we concluded that the downriver villages whose fuel is supplied in part from Bethel extend to Quinhagak on the south and Newtok on the north, plus Mekoryuk. (The fuel to villages north of Newtok is supplied from Nome and/or from Tanana. The fuel to communities south of Quinhagak is supplied from Goodnews Bay.) Second, we combined our fuel data for all these villages. Third, we compared our total with the bargelines' control total, of about 5,000,000 gallons. Our known fuel consumption in these villages (from the data their buyers gave us and our estimates for the non-sampled villages) was about 500,000 gallons more than the control. This small difference confirmed the accuracy of our archival and collected data for these villages: they consume somewhat more than what is barged from Bethel. For example, the downriver villages Eek, Kipnuk, Mekoryuk, Newtok, and Toksook Bay were supplied in 1998 (and in 1996 and 1997) in part by the Coolbarge program, which pumps directly into containers of 1,000 or more gallons on the waterfront. Further, the upriver and downriver villages close to Bethel buy fuel from Bethel Fuel Sales in winter, i.e., outside the barge deliveries between May and September.

VI. Fuel Flows and Capacity

Is there enough fuel storage capacity? In all communities, there is more than enough storage capacity for the amount of fuel entering them, comparing total capacity and gallons of fuel consumed annually. This assumes that the data on reported capacity are reliable, and that the tanks reported on can be used. The pattern of ownership is not optimal: in some communities the village corporations are bumping up against capacity limits, even though the tanks of all owners combined are more than adequate for foreseeable needs.

Table DOTYK2 shows the capacity by major owners, and compares it with total gallons consumed. This already suggests that capacity as a whole is more than adequate. Table DOTYK3 gives more detail on capacity by major owners and their fuel consumed, and shows their ratios of capacity to consumption.

Table DOTYK2 showed that the 56 communities have a total capacity of 24,273,000 gallons, as compared with 21,791,000 gallons of fuel consumed. This is a ratio of capacity to consumption of 1.1: for every one gallon of fuel consumed, the study region has slightly more than one gallon of capacity. This fact alone suggests overcapacity. This amount of capacity—an amount equalling consumption—is needed if there is only one delivery a year. Then, the tanks are filled, and drawn down during the year until the next delivery next year. A year's worth of capacity—capacity equal to a year's worth of fuel—is needed under those circumstances. But those are not the circumstances of the Yukon-Kuskokwim region. We explained earlier that, with only one exception, the 56 villages are supplied by barge twice a year: in spring after breakup and in fall before freezeup. (Lime Village, way up the Stony River, is the exception: its fuel is flown in.)

How much capacity—what ratio of capacity to consumption—is needed? At the least, it is necessary to have a ratio of 0.50, i.e., to have at least one gallon of capacity for every two gallons consumed. But this is too low a lower limit: it is too small to allow for possible problems with delivery at either (or both) of the two delivery times spring and fall. This ratio of 0.50 is too small also because it does not allow for the fact that more fuel is consumed in winter than in summer. More than half of the total fuel has to be delivered at one time in the fall, so a capacity of more than half the annual fuel consumption is needed for that reason alone.

A higher lower limit than 0.5 is therefore needed. The case of Bethel Fuel Sales is instructive. It has a ratio of between 0.50 and 0.60. (We cannot give more precise numbers, because to do so would disclose details of the company's operations.) It has total throughput of between 15 and 20 million gallons a year, and capacity of between 6 and 12 million gallons. (Bethel Fuel Sales' throughput differs from the amount of fuel consumed in Bethel, as shown in Table DOTYK1 and Table DOTYK2, for two reasons. First, not all of its purchases in 1998 were consumed—the company added to its inventory. Second, a substantial proportion of its throughput—between 25 and 35 percent—was fuel it did not purchase but instead fuel it stored for the barge lines until they were ready to pump it out again for delivery to the upriver and downriver villages.) But a ratio of less than 0.60, although tolerable for Bethel Fuel Sales, is still too low for the villages as a whole: Bethel is reliably supplied by oceangoing barges up a river that provides adequate passage between breakup and freezeup. The other villages—particularly those upriver from Bethel—are not as reliably supplied. Sometimes the smaller barges are stretched too thin at fuel demand periods, and/or face unexpected river conditions—for example, low water during the summer, late ice in the spring, early ice in the fall.

We believe that a ratio of 1:1, or 1.00, i.e. one gallon of capacity for every gallon of fuel consumed, is adequate, *provided the tanks work and meet code.*

From this perspective, **Table DOTYK2** suggests that the study region has adequate capacity. It shows the distribution of capacity across different owners.

Bethel's capacity dominates, with 9.7 million of the 24.3 million gallons of total capacity. Its 9.7 million gallons of capacity is almost the same size as its own consumption of fuel, 10.2 million gallons. Bethel Fuel Sales predominates. Its tanks account for well over 80 percent of the total capacity in Bethel, meet code, and can meet the needs of the city, and the numerous villages supplied from its tanks, into the foreseeable future. Its capacity means that Bethel end-users do not need their own fuel tanks. For example, even Bethel Utilities, which consumes 3.67 million gallons annually, is supplied daily to its tanks on-site, that have a capacity of only 51,000 gallons, and the school facilities have small day tanks.

In descending order, and excluding Bethel, the schools have the most capacity (3,715,000 gallons), then the electric utilities (3,691,000), then the village corporations (3,149,000 gallons), followed by the city and tribal councils (1,874,000 gallons), and the non-Native private sector companies (1,805,000 gallons).

Without Bethel, the capacity ratio for the other 55 communities is 1.3: there are 14,577,000 gallons of capacity, and 11,605,000 gallons consumed, or 1.3 gallons of tank capacity for every 1 gallon consumed in the other 55 communities. In and of itself, this means that the 55 communities as a group and on the whole are well supplied with capacity. This should be even more clearly true when allowance is made for the fact that several communities close to Bethel can get fuel from Bethel by truck in winter. Thus, in principle, these communities should need less capacity, because they can get fuel more-or-less year-round. But, in practice, the proximity to Bethel alone is not a major factor in the allocation of purchases by those nearby villages, as between summer and winter. The more-important variables are two: the fuel-storage capacity of the individual buyers (as distinct from the community as a whole); the limited price differential. Kwethluk—more precisely, the village for-profit corporation—is the biggest and therefore the best example of this. Kwethluk Incorporated buys far more fuel in winter than any other community whose residents are also served to some extent from Bethel in winter. It does so because it does not have enough capacity. It buys 220,000 gallons of fuel (70,000 gallons of heating oil; 95,000 gallons of diesel fuel; 55,000 gallons of gasoline), but has capacity of only 133,500, i.e., a capacity/throughput ratio of 0.65. As a consequence, Kwethluk Incorporated's Manager reports (as quoted by the author) **"You always fill up your tanks [in the fall] from the barges. Even so, every year you find yourself running out of stove oil."**

But if and when Kwethluk Incorporated increases its capacity, will it then still avail itself of its proximity to Bethel, and buy some fuel from Bethel in the winter, because such fuel, even though higher-priced than barge fuel in summer, is not so much more expensive as to offset the savings implicit in not having to tie up capital in one-time (or two-time) big purchases from the summer barges? Without more research, we cannot answer this question. What we do not know is the opportunity cost of the capital tied up in this way—what alternative rates of return the monies might bring if not tied up by having been spent on fuel. Nor do we know how the barge lines would react to attempts to shift to more winter purchases. It may be assumed that the barge lines can estimate precisely what Kwethluk Incorporated (for example) pays for winter fuel: the price at Bethel Fuel Sales' tanks, plus the Hoffman Fuel Sales transport fee per gallon from Bethel- Kwethluk. Then, it may further be assumed that the barge lines will set prices slightly below that estimate.

But these questions can in principle be answered by detailed empirical economic analysis which has not been undertaken. The purpose of such an analysis would be to estimate the least-cost method of transporting fuel to the villages, from an inter-modal (barge versus ice-road) perspective. This inter-modal perspective must take into account the central role played by three kinds of costs: of bulk fuel storage capacity; of subsidizing purchases of fuel by truck; of building and maintaining ice-roads. Given them, the least-cost method—whatever it is—will of course reflect also another perspective: the state (Federal and State government) versus the community. From the perspective of the state, the least-cost method includes the cost of the tanks, of subsidizing purchases by truck, and of the ice-roads. But from the community's

perspective it does not, because the tanks, the subsidies, and the ice-road are paid for by the state.

Thus, in microcosm, the Kwethluk case clarifies the analytical framework needed for a thorough analysis and understanding of the delivery of bulk fuel in the study region.

Apart from the Kwethluk case, the amounts trucked from Bethel to other nearby communities in winter are not large, relatively speaking: of the order of another 40,000 gallons, on top of Kwethluk's 60,000 gallons. There is in addition the amounts bought in winter in Bethel by residents from communities near and far. These amounts may be relatively small in the aggregate, but are likely to be involve very important cost-savings. For example, a resident of Eek—about 60 miles by river—can easily reach Bethel on a snowmachine with one 6-gallon tank of gas. There s/he can buy a 55-gallon drum of heating oil for $66.50, saving $43.50—given the price of a drum in Eek of $110, $2 a gallon—or saving $87 with a sturdy sled capable of carrying two drums. Assuming 20 drums over the winter, maybe slightly more, this is a saving of up to $1,000. Such a saving is a substantial amount, particularly when—as is the case—the opportunity cost of the travel time involved is negligible (the travel time is not sacrificed for work-for-pay time, for example), and may even be positive (if the Eek resident has relatives and friends in Bethel)!

Returning to the central theme, we note that the total capacity/consumption ratio of 1.3 shown in Table DOTYK2 is adequate as a basis for the preceding discussion on a plausible ratio for the region as a whole. But it is necessary to provide more detail, in order to analyze the prospects for reducing capacity to an acceptable ratio of 1.0 or 1.1. Even such an apparently small reduction implies a reduction of 3.5 million gallons of capacity: tanks of that amount that would not need to be upgraded because they are redundant. At an average of $5 per gallon for upgrade, this alone implies a cost saving of $17.5 million. (We arrived at this estimate of a reduction of 3.5 million gallons as follows: 11,605,000 gallons * (1.3-1.0) = 11,605,000 gallons*0.3 = 3,481,500 gallons.)

Table DOTYK3 provides the detail needed. It shows the fuel consumption, capacity, and capacity/consumption ratios for three major consumers: schools; utilities; Native corporations/cities/tribes. We have lumped together Native corporations/cities/tribes to avoid disclosure.

The most striking feature of this table is the large surplus capacity of the biggest single purchaser of fuel in the communities: the schools. Their capacity/consumption ratio is 2.4. That is, the schools have almost two-and-a-half gallons of tank space for every gallon of fuel they pump in, annually. It is below 2.0 in the schools only 15 of the 56 communities. It is below 1.0 in the schools in only one community: Kalskag Lower. (Even there, the available archival capacity data may be an anomaly; we will establish the school's true capacity in the near future. We suspect that the relevant measure is the combined capacity for the two Kalskags, which are served by a common school. If so, their ratio is 2.0: 65,000 gallons of fuel capacity/32,000 gallons of fuel.)

The next most striking feature is that the other two groups—the utilities, and the composite of village corporations and city and tribal councils—also have adequate capacity. With ratios of 1.1 they too are at or above the ratio of 1.0 we argue above is adequate.

What this means is that, in principle, the schools have just over 2 million gallons of surplus capacity that they could make available to the communities they are in—2,161,000 gallons of surplus capacity=3,755,000 gallons of capacity minus 1,594,000 gallons of fuel purchased—and still have a ratio of 1.0.

The importance of this surplus is that it may enable every community to upgrade its tanks at lower cost than would be possible without the surplus. If capacity and consumption were equal (and if they needed to be equal) all tanks that were below standards would need to be

upgraded. But if, as we see, there are tanks that are surplus to capacity, the surplus capacity could in principle be considered a pool of replacement tanks: replacement for defective tanks used by the utilities, the village corporations, and the city and tribal councils. (In this discussion, we are deliberately leaving out the capacity of the "other private sector". Table DOTYK2 showed that this was concentrated in only five communities: Aniak; Bethel; Hooper Bay; McGrath; Saint Mary's. The owners of this capacity are the major intermediaries—buyers of fuel for resale—in their communities. They have established capacity adequate for their needs as *suppliers*. Thus, they do not have the surplus capacity typical of *demanders*—for example, the schools.)

For example, if the schools' surplus capacity of 2 million gallons were also transferable in principle (the remaining school fuel capacity did not need to be upgraded) and useable as is (the surplus capacity itself did not need to be upgraded), it would be a huge addition to the options available to the other two consumers shown in Table DOTYK3. For example, it would increase the capacity available to the utilities by 58 percent: 1.58=(3,742,000 gallons of existing capacity + 2,161,000 gallons of school surplus capacity)/3,742,000 gallons of existing capacity. Similarly, it would increase the capacity available to the village corporations/cities/tribes by 42 percent: 1.42=(5,158,000 gallons of existing capacity + 2,161,000 gallons of school surplus capacity)/5,158,000 gallons of existing capacity. Similarly, it would add 24 percent—almost one-quarter–to the capacity of the other two combined: 1.24=(5,158+3,742+2,161)/(5,158+3,742).

At this point, the tanks—all the tanks—have long since been bought and paid for. Thus, the least-cost solution to providing capacity adequate in amount and quality (i.e. that meets safety standards) is in principle easy to estimate. It is to: 1, assume that all tanks in a community are part of a common pool; calculate the total capacity of the pool; 2, establish which are defective; 3, estimate how close the capacity of the non-defective tanks is to the desired minimum capacity (assuming for now a working ratio of capacity to consumption of 1:1); 4, establish the least-cost method of upgrading the defective tanks to the point where their addition to the non-defective tanks achieves the desired ratio of 1:1; transfer ownership/operation of the non-defective tanks so that all parties have a ratio of at least 1:1.

With reliable data, calculation of the least-cost method is a straightforward linear-programming exercise. Three sets of data are needed: capacity; the proportion of capacity that is defective; a range of costs/gallon for upgrading.

VII. Government Policies and Programs

Government policies and related programs affect the bulk fuel distribution system in rural Alaska in several ways.

Environmental protection policies add to the cost of fuel: for example, bulk fuel tanks and double-hulled barges. Subsidies and loans reduce the cost of fuel: for example, the power cost equalization program subsidy, the bulk fuel revolving loan fund. Capital projects in the form of grants affect the ways in which fuel is distributed: for example, the building and extending of airport runways, and the hovercraft idea discussed elsewhere in this report.

The costs involved are so great that, without government involvement, the bulk fuel distribution system—how much fuel is distributed, and how—would be very different. We summarize the major programs, under three headings:

1. capacity and upgrading;
2. upgrade of electric utilities;
3. fuel flows and money flows.

VII.I Capacity and Upgrading

In most villages, many fuel tanks are in poor condition, and must by law be upgraded. A 1992 report by the Alaska Energy Authority (AEA) summarized the results of its survey of 325 tank farms in 44 communities. **"Over 98% of the facilities studied had significant code and/or regulation violations that constitute a formidable threat to public safety and the environment." (Alaska Energy Authority. March, 1992. Rural Alaska bulk fuel assessment program. Anchorage?, Alaska. page 1)** It estimated the costs of repair of the tank farms in 32 of the communities at $46.9 million, and noted that the costs of cleanup **"... may far exceed repair costs." (page 2)**

The AEA report included suggestions on how to reduce the costs associated with bulk fuel tanks that involved issues of consolidation, location, pooling of resources. "Combining fuel storage for multiple users into a single consolidated facility [and from there to users by pipeline or truck] has tremendous potential... Facilities should be located outside of the known flood plain...All tank farm owners within a given community should pool their spill response resources..." (pages 24, 26, and 27) It also referred to the possibility of reductions in fuel use from alternative energy—non-fossil-fuel-based—systems.

Four government agencies share jurisdiction over the problem: the DEC, over facilities of more than 420,000 gallons capacity; the Alaska Department of Public Safety (DOPS), over above-ground tanks publicly and privately owned; the U.S. Coastguard, over facilities receiving oil from vessels with a capacity of ≥10,500 gallons; the EPA, over above-ground tanks of ≥660 gallons. All four agencies require the owners of facilities to have oil-spill prevention and contingency plans and/or operating manuals specific to their requirements: engineering standards; inspecting; lighting; maintenance; proximity; notification procedures; security measures; spill containment; testing, and training.

Of the 32 communities reported on in the 1992 AEA report, 18 are in the Y-K region.

Table DOTYK4 shows that the cost of repairing the tank farms in these 18 communities—with a combined capacity in 1992 of 6.1 million gallons—was estimated in 1992 at $32 million. The cost per gallon for all 18 villages combined averaged $5, but ranged from $3 to $11. There is no obvious trend in costs—for example, that the cost of repair per gallon declines as the size of the tanks increases.

We can estimate a rough upper limit to the cost today of upgrading fuel tanks for all villages in the study region by multiplying $5 a gallon by the total capacity of 23 million gallons in Table DOTYK2: about $115 million. This is too big for several reasons, the most important reason being that several were not substandard in 1992 or have been upgraded since 1992. The biggest tank farm—that of Bethel Fuel Sales, with 9 million gallons, can be removed: it was not defective in 1992. The biggest tank farms in three other of the 13 biggest communities can also be removed: Aniak; Hooper Bay: Saint Mary's. In these three villages, the (non-village-corporation) private sector predominates, with 2,265,000 gallons combined. Their owners have already brought them up to code, working closely with the Coastguard, with DEC, and with the EPA.

Table DOTYK5 and Table DOTYK6 show the communities some of whose capacity has been upgraded in recent years by the agency taking the lead in this: the Alaska Department of Community and Regional Affairs, Division of Energy (DCRA/doe).

VII.I.I Alaska Department of Community and Regional Affairs, Division of Energy (DCRA/DOE)

Describing itself, the DCRA/DOE "[is] the lead State agency for the repair, upgrade, and replacement of bulk fuel storage and electric power systems in rural Alaska." (DCRA/doe. April, 1999? Rural energy plan. Bulk fuel storage, electric utilities, alternative energy. (page ?) Anchorage, Alaska) Its role is central because it has statutory authority to do so, has been doing so for many years, and so has a staff experienced in all aspects of running upgrading programs, and has evolved a pattern of upgrading that has two additional key elements: consolidation of funding sources; force accounting. For example, it consolidated funding packages for the $3.74 million fuel tank upgrading projects scheduled for completion in 1999 from the following sources: Alaska Department of Education (DOE); DCRA, Division of Community Development (DCRA/dcd)—Community Development Block Grants; DCRA/doe—its own budget requests and Alaska State Legislature capital appropriations; U.S. Environmental Protection Agency; U.S. Department of Housing and Urban Development-Indian Community Development Block Grants. The purpose of force accounting is to hire community residents especially—in this case in bulk fuel construction projects. With this method of managing projects, workers are brought in only if and when they have skills not available locally—for example, project foremen, and highly-skilled welders. DCRA/doe issues a grant for the project to the community—typically, the city council. In turn, the grantee designates DCRA/doe as Project Manager, which includes managing the funds. The grantee has greater flexibility in hiring than the DCRA/doe, which must follow state procedures on competitive bidding, contracting, and personnel.

Table DOTYK5 shows DCRA/DOE upgrading of bulk fuel tanks completed in 7 communities at a cost of just over $5 million. In two of them, the capacity of several owners was upgraded: city, school, and village corporation. In one, the city and the village corporation's tanks were upgraded. In one, the city and the electric utility's tanks were upgraded. In one, only the electric utility was upgraded. In the other two, only the city's tanks were upgraded. These 7 add another 600,000 gallons of upgraded capacity: 550,000 gallons known; the other 50,00 gallons we have estimated. (This appears to have been a relatively expensive group: about $8 a gallon.)

Table DOTYK5 also shows 5 more communities, for which upgrading is to be undertaken in 1999 at a cost of just under $4 million. Their upgraded capacity is 1,284,000 gallons, at $4 per gallon.

Finally, **Table DOTYK5** shows 11 more communities, for which upgrading is scheduled for completion in 1999, at a cost of $9 million. Their upgraded capacity is 3,005,000 gallons, for $3 per gallon.

Thus, of the 23 million gallons total, we can already deduct 7,154,000 (2,265,000+600,000+1,284,000+3,005,000) for a reduced total of about 15 million gallons, or about one-third less.

If the cost is correspondingly reduced, the reduction of costs of upgrading fuel tanks beyond this group of 23 villages already completed or underway (plus the 3 villages with large private sector ownership already upgraded by them independently of DCRA/doe) is appreciable: from $115 million to $77 million. This may be a useful ballpark figure, although it is likely to be something of an underestimate of true future costs of upgrading tanks in the region, for two reasons: inflation; more-precise cost estimates. DCRA/doe remarks thus on its preliminary estimates, given in **Table DOTYK5**: **"…some of the estimates…are preliminary and are intended only to show the expected general magnitude of project cost."**

But, whatever this cost estimate is, it is still too high if—as we suggested above—surplus capacity exists. If, for example, the actual capacity is twice what is needed, the actual cost of upgrading may not be $100 million, but $50 million. It may even be less, if the tanks for upgrading are "high-graded"—only the best chosen to be retained in the inventory of working capacity. This may in practice be too ambitious an ideal: selecting what to discard from surplus capacity—i.e., consolidating—involves issues of ownership and engineering. On ownership, the DCRA notes that "The main obstacle to tank farm consolidation is getting local institutions and tank farm owners…to agree on how the consolidated tank farm is to be set up in terms of ownership, operations and financial management, and physical configuration." (Alaska Department of Community and Regional Affairs. February, 1999. Rural Energy Plan: Bulk Fuel Storage; Electric Utilities; Alternative Energy. Division Of Energy. Anchorage, Alaska. Page 8.) On engineering, good tanks owned by the school, for example, may be adjudged by engineering economists as too distant from the light plant to be cost-effective.

DCRA/doe uses 7 criteria in establishing priorities for upgrading tank farms—which to do first: electrical; foundations; life, health and safety; piping; secondary containment; site location; tanks. Each of these 7 has subsets. For example**, "life, health, and safety"** has 5 subsets, ranging from **"code compliant"** to **"potential for loss of life"**. The procedure includes two weighting procedures. The first is that of assigning different points within each of the 7 criteria: for example, 0 for "code compliant", 40 for "potential loss of life". The second is to weight the 7 criteria relative to each other, so that, for example, a village project with 320 points after the first weighting procedure has 64.94 after the second (i.e., final) weighting procedure. DCRA/does not describe this second step in quantitative terms, so that one cannot tell how the final points are calculated. It refers to the following variables as being used for weighting in this second step: community capability; community contribution and commitment; community income-level; community-specific funding opportunities; community cost per capita (the higher it is, the lower the ranking, other things being equal); critical individual tank farm conditions (masked by averages); owners' tax delinquency; private/public ownership; propinquity (villages close together); other (past experiences working in the community, unusual conditions or costs). This list of variables used at the second stage of ranking is so extensive and has so many subjective components that it would be difficult for a community to understand the basis for the final ranking it received.

However that may be, using these 7 criteria, DCRA/doe is well along in creating the database needed to set the priorities: it has in the last three years examined the tank farms in 161 of the 193 villages. As a result, it now has a list of 142 villages with tank farms' weighted average points. **(Alaska Department of Community and Regional Affairs. February, 1999. Rural Energy Plan: Bulk Fuel Storage; Electric Utilities; Alternative Energy. Division Of Energy. Anchorage, Alaska. Attachment 3.)**

At this point, it appears that the procedure of the DCRA/doe results in the following decision-rule: the worse the tank farm, the higher the ranking. But in a world of surplus capacity this decision rule may result in a suboptimal order of priorities, and a misallocation of limited funds.

With surplus capacity, the worst tanks in a farm may be dropped from consideration altogether, rather than placed at the top of the list for upgrading, and the money thus saved spent on other village projects.

Whatever the priorities, the role of the Denali Commission will be central in funding future upgrades.

Until this year, the bulk of the monies for upgrading fuel tanks has come from legislative appropriations routed through the Alaska Department of Community and Regional Affairs, Division of Energy (DCRA/DOE). Beginning in 1999, the bulk is expected in future to come from the Denali Commission—again routed through DCRA/DOE. The Commission is expected to have the money.

VII.I.II Denali Commission

Section 329(a) of the Omnibus Appropriations Bill of 1998 established the Denali Commission and required it to develop with the Coastguard a program for the remediation of above-ground bulk fuel storage tanks in Alaska not in compliance with federal or state law. It transfers to the Commission for that purpose the interest—$16 million annually—on the $170 million balance remaining in the Trans Alaska Pipeline Liability Fund. In addition, the U.S. Environmental Protection Agency is making a grant of $3 million to the State for the same purpose.

The newly-created body will **"…coordinate federal funding for rural utilities and other projects recommended by the Commission." (Ted Stevens, United States Senator for Alaska. October 22, 1998. Omnibus [Appropriations] Bill includes authorization for Denali Commission. Press Release. Washington, D.C.)** The 7-member board consists of: two co-chairs, one designated by the Governor, the other by the Secretary of Commerce; the presidents of the Alaska Federation of Natives, the Alaska Municipal League, the Associated General Contractors of Alaska, the state AFL-CIO, and the University of Alaska.) Its plan is based on project proposals submitted by local governments and other entities. **(Ted Stevens. Press releases October 21 and 22, 1998. United States Senator. Washington, D.C; P.L. Section 329(a); P.L. 101-380 Section 8102(a)(2)(B)(i))** At its first public meeting, in Anchorage in early April, the Executive Director announced it had two village priorities: bulk fuel tanks; water and sewer systems.

A recent unpublished table from DCRA/doe shows the central role of the Denali commission's funds in future. The table increases the cost of 7 of the 16 projects shown in **Table DOTYYK6**: from $8,454,000 to $9,880,000. Of this increased total, the share of the Denali Commission is $6,300,000, i.e., 64 percent.

VII.II Upgrade of Electric Utilities

DCRA/doe upgrades electric utilities. The 193 villages are served by 99 electric utilities in the private sector; 105 villages are served by 11 utilities; the other 88 villages have individual utilities. The single biggest utility is the Alaska Village Electric Cooperative (AVEC), which serves 50 villages, of which 24 are in the study region.

The utilities too need to be upgraded: DCRA/doe notes that **"For most of these utilities, the power plant and distribution system do not meet accepted utility standards for safety, reliability, and environmental protection." (Alaska Department of Community and Regional Affairs. February, 1999. Rural Energy Plan: Bulk Fuel Storage; Electric Utilities; Alternative Energy. Division Of Energy. Anchorage, Alaska. Page 12.)** In 1995, DCRA/doe established a database on conditions in a large sample—52 of the 88 single-village utilities. Of those 52, the powerhouse was defective in 29 (56 percent) and the distribution system was defective in 34 (65 percent). There was also extensive fuel contamination around the

powerhouse in 20 (39 percent). DCRA/doe's Energy Plan (its Attachment 9) estimates the cost of upgrade of the utilities in these 52 villages at $14.9 million: $9.6 million, powerhouse; $5.3 million, distribution system.

Table DOTYK6 shows that 19 of the 52 are in the study region, and that the cost of upgrading them is estimated at $6.9 million: $4.5 million, powerhouse; $2.4 million, distribution system. (**DLM WHYTHREECOSTZERO?)**

Table DOTYK7 shows the distribution of the utilities in the 56 villages of the study region. AVEC serves 23 communities; MKEC serves 5; Bethel Utilities serves 3; the remaining 25 are single-village utilities, most owned by the village corporations.

AVEC, which now has 50 member villages, started in 1968. It is financed by loans from the U.S. Department of Agriculture, Rural Utilities Service, and its customers have the same Power Cost Equalization subsidy as the customers of all the other rural utilities. (see below). AVEC has not yet established a database on its utilities comparable to the DCRA/doe database for the 52 single-village utilities.

DCRA/doe and AVEC are working cooperatively to establish a comprehensive and consistent database on fuel tanks, and on upgrading. DCRA/doe's ranking survey on bulk fuel tanks includes all except two of AVEC's 23 tank farms in the villages of the study area. Of the 23 villages in Table DOTYK5 noted for tank farm consolidation, AVEC owns the utility in 11 of them, of which 7 will be included in the consolidation. And, AVEC is offering to owners of consolidated facilities to undertake contract work managing and operating tank farms, based on its 30 years of experience in such management, and is proposing to establish a service subsidiary for that purpose. **(AVEC. March, 1999. Tank Farm Management Concept. Anchorage, Alaska.)** AVEC proposes also a consolidation of management functions via the rural regional hubs, to take advantage of economies of scale that can then be applied to the 80 or single-service utilities which **"…have no hope of ever being self-sufficient [economically, and whose management] is often erratic with unpredictable federal/state funding."**

DCRA/doe notes that **"Unlike the bulk fuel storage consolidation projects, the Division of Energy has not been able to acquire alternative sources of funding for electric utility upgrade projects for a number of years."** Its current proposal lists such projects in 8 communities (none in the study area) for a total of $5.3 million, of which it is proposed that the Denali Commission supply $5.0 million.

While it now appears that the funds needed for upgrading fuel tanks will be forthcoming in the amounts needed—from the Denali Commission especially—it is not as clear to what extent other funds needed, which are just as important, but that are not funds for capital projects, will be forthcoming. The next section discusses these continuing (rather than one-time) funding programs:

- Power Cost Equalization Program;
- Loan Programs (bulk fuel loans; power project loans).

VII.III Fuel Flows and Money Flows

VII.III.I Power Cost Equalization Program

Under the Power Cost Equalization Program (PCE), the state has since 1985 paid rural electric utilities a subsidy monthly to help keep the cost of diesel-powered electricity for their customers at about the same levels as those paid by urban residents. (The PCE was preceded by the Power Production Assistance Program, 1980, and the Power Cost Assistance Program, 1981.)

This program is of central importance in the flow of bulk fuel in rural Alaska and in the study region. Table DOTYK1 showed that diesel fuel for the light plants of the study region amounted to 7 million gallons in 1998—32 percent of the total fuel.

At present, the subsidy is paid to utilities serving 190 communities, and has averaged about $17.5 million a year since inception. The future of the program is at present unclear. In 1993, the legislature announced its intent to fund the program at $17 million annually through 2013 **(Chapter 18, SLA 1993, Sec. 1)**, and established a capital fund of $66.9 million. But this fund was inadequate for the purpose—the annual payments were from it exclusively—and the Governor established a Blue Ribbon Committee in 1998 to recommend ways to continue to reduce the cost of electricity to residents of rural Alaska. **(Alaska Department of Community and Regional Affairs, Division of Energy/Alaska Public Utilities Commission. July, 1997. Power Cost Equalization Program Manual. Anchorage, Alaska; Alaska Rural Electric Cooperative Association, Inc. 1996. Rural issues forum report. Anchorage, Alaska; Alaska Governor's Blue Ribbon Committee. February 1, 1999. Power Cost Equalization-report and recommendations. Anchorage, Alaska.)** FY96 was the fifth successive year with a shortfall, which is dealt with by an across-the-board reduction. For example, in FY96 payment was at 95.7 percent of the full PCE formula amount.

The importance of this program for residents of villages is that it reduces their bill by about $50 a month: **"At the present time, the average PCE benefit per residential customer is about $550 per year." Alaska Governor's Blue Ribbon Committee. February 1, 1999. Power Cost Equalization-report and recommendations. Anchorage, Alaska. page 7)** A $50-a-month increase would be significant for residents of rural villages where, as we showed in T**able DOTYK9**, 62 percent of the households in the study region had median 1989 household incomes of less than $20,000.

Because it costs much more to produce electricity in rural Alaska, customers pay more even with the PCE program. For example, the cost in Anchorage is $0.10 per kwh, but $0.42 per kwh in the typical PCE community. Thus, the rural residential customer pays on the average $0.20 per kwh—about twice what the Anchorage resident pays. Partly as a consequence, the rural residential customer uses less electricity: 3,921 kwh per year, or about half the consumption of the Anchorage resident.

The options reflect the structure of the program. The subsidy is confined to utilities most of whose power is from diesel light plants, and whose costs are above 9.5 cents/kwh. It pays 95 percent of the costs between 9.5 and 52.5 cents/kwh. It does not pay any part of the costs above 52.5 cents/kwh. It is paid for four classes of customers: commercial; community facilities; schools; residential. The eligible costs are: fuel costs; non-fuel costs (insurance, parts and supplies, salaries, etc.) The fuel cost component is the mechanism by which the PCE seeks to induce efficiency: fuel costs are paid on the kwh produced rather than on the fuel used, and assume the utility achieves 8 kwh/gallon. The commercial customer is limited to a subsidy on only the first 700 kwh per month. This excludes most commercial purchases, because few commercial enterprises use as little as 700 kwh/month. The limit on community facilities is 70 kwh/month/person * # of people. The residential limit is 700 kwh/month. Most households qualify, because few use over 700 kwh/month.

The options include:

- changing eligibility by customer class—for example, removing commercial customers;
- redefining eligibility within a class—for example confining community facilities to those affecting health and safety, i.e. removing schools;
- shifting the ceiling—for example, reducing the monthly cap from 700 kwh;
- shifting the floor—increasing it from 9.5 cents per kwh;

- making across-the-board cuts in entitlement;
- establishing an adequately-capitalized service fund;
- finding alternative/supplementary sources of funds—for example, federal sources, surcharges on Alaska customers of other utilities.

For the time being, the 1999 legislature agreed to fund the program at $15.7 million, using two recurring sources of funds: the recent National Petroleum Reserve-A oil and gas lease-sale; the Four Dam Pool. **(Senator Al Adams. Power cost equalization changes. June 3, 1999. Juneau, Alaska.)** The structure of the program was changed in two ways. The floor was raised: equalization begins not at 9.9 cents/kwh, but at 12 cents/kwh. And, the ceiling was lowered: from 700 per month kwh to 500 kwh, above which residents pay full rates.

VII.III.II Loan Programs

The DCRA/doe has two loan programs extant that influence the demand for bulk fuel:

- Bulk Fuel Revolving Loan Fund (BFRLF), under **AS 42.45.250**
- Power Project Loan Fund (PPLF), under **AS 42.45.010**

1. Bulk Fuel Revolving Loan Fund (BFRLF)

The BFRLF has a maximum limit of $100,000 per applicant, the loan amount may not exceed 90 percent of the wholesale price of the fuel being purchased, and the loan must be repaid within one year. The first loan is interest-free; the second (to the same applicant) is at 5 percent, and loans thereafter are based on the average weekly bond rate. Loans may be made to an organized municipality, or an unincorporated village with fewer than 2,000 residents, or a private individual with a written endorsement from the local governing body. The PPLF sets no upper loan limit, the loan term depends on the life of the project, and the interest rate is the lesser of two rates—one that will allow the project to be financially feasible, or the average weekly yield of municipal bonds. Loans may be made to local utilities, local governments, or independent power producers for the development or upgrade of electric power utilities, including bulk fuel storage. The fund has $1.2 million, which is fully lent (and returned) annually. **(AS 42.45.250; DCRA/doe. Bulk Fuel Revolving Loan Fund. Loan Application.)**

Table DOTYK8 shows the amounts disbursed in the study region by these three programs combined this decade.

They disbursed almost $10 million—$9,571,300—to 38 of the 56 villages of the study region, i.e., 70 percent. Of the 38 villages, the top 12 accounted for two-thirds of the total: $6,314,000. We may assume that any amounts over $100,000 in any one year are PPLF and/or RERLF funds, and that amounts of ≤ $100,000 are BFRLF. Thus, the bulk of the loan funds—$9,433,000 of the $9,571,300, i.e., 99 percent—was BFRLF. Making three other assumptions—that the bulk of the fuel was heating fuel, that the average cost per gallon of heating fuel in the region was the same as diesel fuel, and that the average FY 94 diesel fuel price data of the Power Cost Equalization Program adequately represent the 1990s—we may estimate the average price of heating fuel in the region bought with the BFRLF monies at $0.97 a gallon. This means that the BFRLF of $9,433,000 over the decade bought—at least initially—9,724,742 gallons over the 10-year period, i.e., 972,474 gallons a year, or about 1 million gallons a year rounded up, shared by 35 villages. Since this was almost certainly heating oil, the BFRLF program is and was in the 1990s a vital part of the bulk fuel distribution system in the region: it enabled the purveyors of heating oil to buy the fuel needed to supply the homes in more than two-thirds of the region's villages, until they could recover their costs as they sold the fuel.

Whether or not this pattern of distribution of the BFRLF monies over the decade was optimal—or even why it was distributed in this way—is unknown. An optimal pattern would arguably reflect a functional relationship between income and loans: poorer communities would need the loans more and would therefore get more of the loans, proportionately. To see if this was the pattern, we look to see if the communities that had the bulk of the loans were the poorest, in terms of median household income in 1989 (the latest year for which we have community-specific Census data).

Table DOTYK9 shows that the poorer communities—those in the lowest median household income bracket—did not get a disproportionate share of the loan funds. The 27.28 percent of the households that were poorest, in the sense that they had median household incomes of below $15,000, had almost the same percent of the loans—28.2 percent. In this sense, the pattern of distribution of the loan funds was arguably suboptimal. We do not know what economic or other criteria may be used by the DCRA/doe to allocate the limited funds. It is likely that the pattern of distribution reflects, above all, differences among villages in their knowledge of the existence of the loan programs and how to apply for funds under them. This is suggested by, for example, the fact that half of the 37 recipient villages in Table DOTYK8 had loans in at least 5 of the 10 years, and by Nikolai's consistent receipt of relatively large amounts of loan monies—surprising for such a small village.

The recipients of BFRLF loans benefit greatly. The interest-free or 5 percent interest rate should be compared with 18 percent rates charged by fuel suppliers, or with 12 percent charged by banks. Some communities may even make a slight profit over the period between receipt of the funds and their disbursement: by investing the proceeds at 8 percent (say), versus borrowing at 5 percent.

2. Power Project Loan Fund (PPLF)

(AS 42.45.010; DCRA/doe. Power Project Fund. Loan Application Instructions.)

VII.III.III ACKNOWLEDGEMENTS

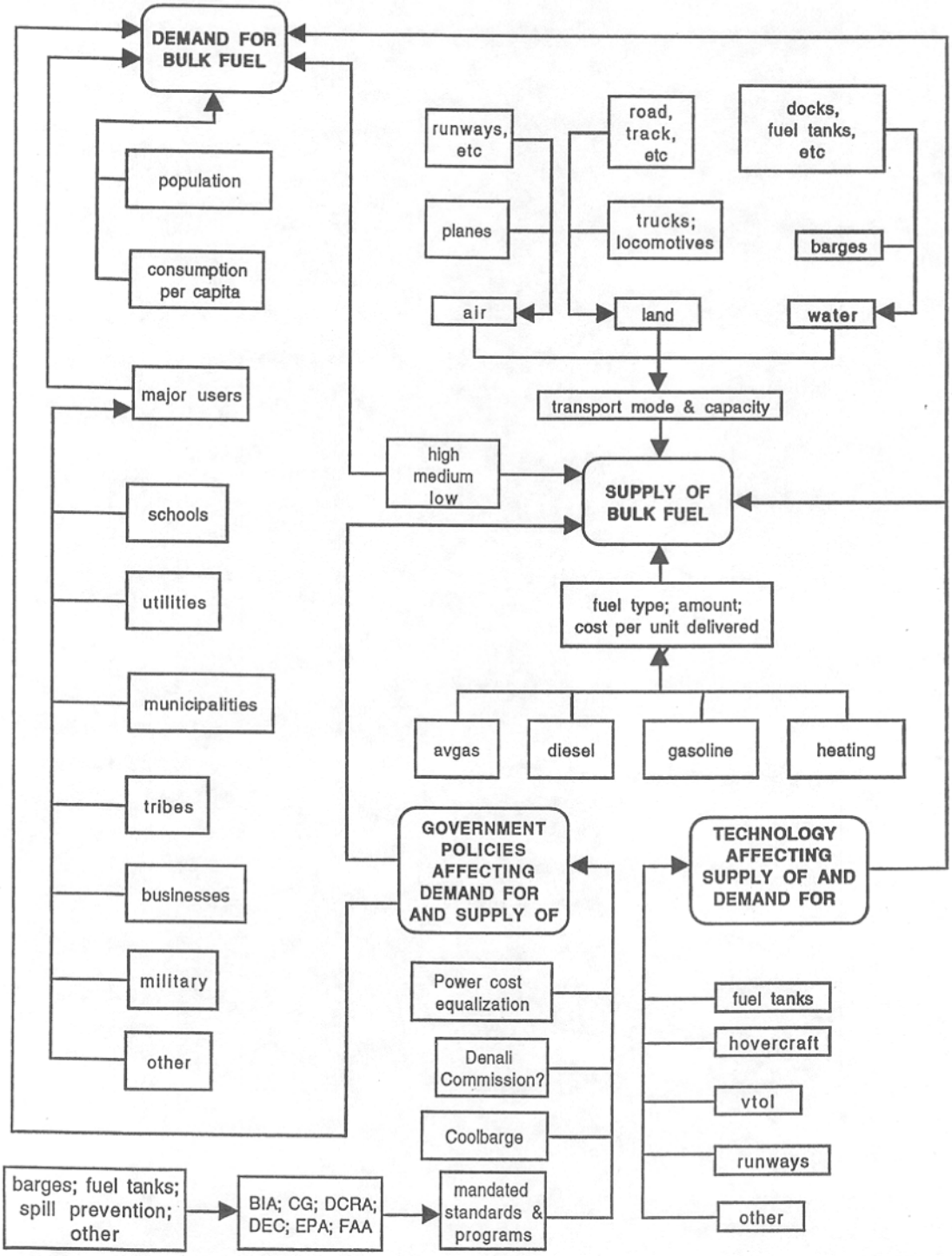
I wish to acknowledge the help of the numerous individual residents of the villages of the study area, who fielded phone questions on the distribution of bulk fuel in their communities, who agreed to read and correct my followup letters summarizing their answers, who did so, and who did all this with good humor, a passion for accuracy, in some cases in several conversations extending over a period of months. Without their local knowledge, their insights, and their willingness to share their data and their contacts, I could not have completed this study.

Paul Bruner of Bethel Fuel Sales made sure I understood the details of his operation in Bethel, and how his operation fits into the bigger picture of fuel distribution along the Kuskokwim. Since his operation handles more than half the total fuel on the region, I had from him a great building-block: baseline data on fuel by category, over time, and to some extent across space, against which to compare the fuel purchases data I collected from dozens of key informants.

Ray Kelly of the Lower Kuskokwim School District and Gary Epperson of the Lower Yukon School District gave me vital data on heating fuel purchases in their villages.

Walton Smith.

Figure 1. Y-K Region Bulk Fuel Supply: Analytical Framework



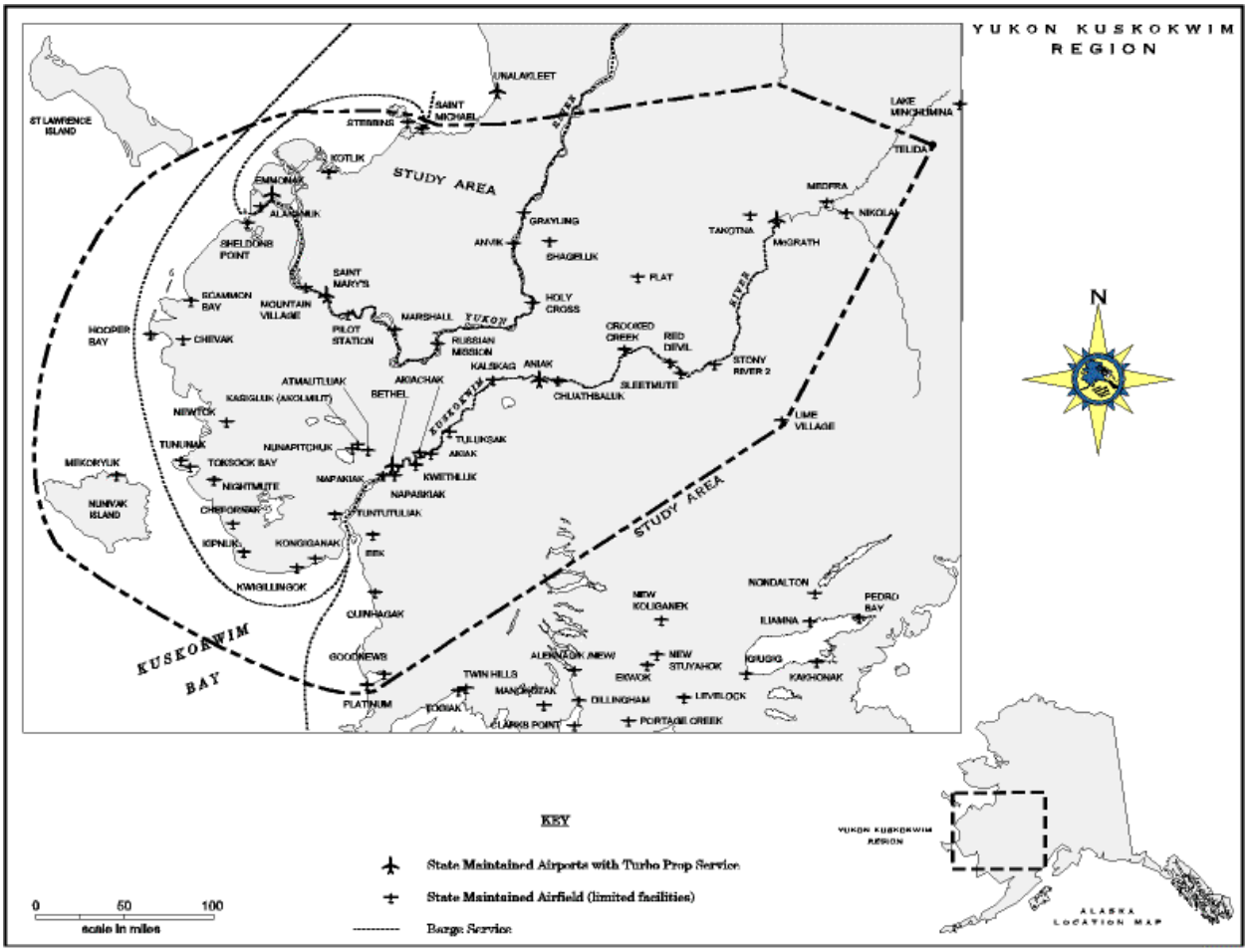


Figure 2 YK Study Area

Table DOTYK1. Annual Fuel Consumption In The Yukon-Kuskokwim Region. Late 1990s. By Village And Type Of Fuel. (1,000 Gallons)

VILLAGE TYPE	VILLAGE	FUEL TYPE (1,000 GALLONS)					POPULATION	FUEL PER CAPITA (GALLONS)				
		AVIATION GASOLINE	DIESEL FUEL	HEATING FUEL	UNLEADED GASOLINE	TOTAL		AVIATION GASOLINE	DIESEL FUEL	HEATING FUEL	UNLEADED GASOLINE	TOTAL
largetundra	Bethel	1,211	3,588	4,101	1,286	10,186	5,277	229	680	777	244	1,930
largetundra	Hooper Bay	0	150	330	190	670	1,012	0	148	326	188	662
largetundra	Chevak	0	110	189	95	394	721	0	153	262	131	546
largetundra	Kipnuk	0	100	265	91	456	567	0	176	468	160	805
largetundra	Quinhagak	0	87	98	90	275	567	0	153	173	159	485
subtotal		1,211	4,035	4,983	1,752	11,981	8,144	149	495	612	215	1,471
largewood	Emmonak	0	183	223	215	621	798	0	229	279	269	778
largewood	Mountain Village	0	182	125	185	492	738	0	247	169	251	667
largewood	Kwethluk	0	93	107	55	255	669	0	139	160	82	381
largewood	Alakanuk	0	87	90	148	325	651	0	134	138	227	499
largewood	Aniak	203	182	489	264	1,138	578	351	315	846	457	1,969
largewood	Akiachak	0	67	211	80	358	560	0	120	377	143	639
largewood	Pilot Station	0	91	81	111	283	547	0	166	148	203	517
largewood	Saint Mary's	236	215	229	155	835	504	468	427	454	308	1,657
subtotal		439	1,100	1,555	1,213	4,307	5,045	87	218	308	240	854
smalltundra	Chefornak(a)	0	48	88	30	166	405	0	119	217	74	410
smalltundra	Kongiganak(a)	0	45	87	60	192	349	0	129	249	172	550
smalltundra	Napaskiak(a)	0	53	69	31	153	399	0	133	173	78	383
smalltundra	Nightmute(a)	0	31	43	25	99	206	0	150	209	121	481
smalltundra	Scammon Bay(a)	0	69	85	55	209	459	0	150	185	120	455
smalltundra	Tununak(a)	0	59	87	30	176	330	0	179	264	91	533
smalltundra	Tuntutuliak(a)	0	54	54	36	144	*351*	0	154	154	103	410
smalltundra	Atmautluak	0	44	63	27	134	292	0	151	216	94	459
smalltundra	Eek	0	44	48	26	118	277	0	159	172	94	425
smalltundra	Goodnews Bay	0	44	46	26	116	263	0	167	176	99	442
smalltundra	Kasigluk	0	0	94	48	142	514	0	0	182	94	276
smalltundra	Kwigillingok	0	42	72	31	145	333	0	126	216	94	436
smalltundra	Mekoryuk	0	57	74	37	168	192	0	297	385	193	875
smalltundra	Napakiak	0	0	96	30	126	354	0	0	271	85	356
smalltundra	Newtok	0	28	90	39	157	269	0	104	335	145	584
smalltundra	Nunapitchuk	0	181	90	46	317	489	0	370	184	94	648
smalltundra	Oscarville	0	0	28	6	34	59	0	0	475	94	569
smalltundra	Platinum	0	7	10	4	21	41	0	171	236	94	501
smalltundra	Toksook Bay	0	80	108	49	237	496	0	161	218	99	478
smalltundra	Tuluksak	0	32	114	36	182	385	0	83	296	94	473
subtotal		0	918	1,445	673	3,035	6,463	0	142	224	104	470
smallwood	Anvik (a)	0	29	29	9	67	*141*	0	206	206	64	475
smallwood	Grayling(a)	0	42	47	36	125	186	0	226	253	194	672
smallwood	Kalskag Upper(a)	0	0	49	15	64	195	0	0	251	77	328
smallwood	Nikolai(a)	0	28	53	16	97	108	0	259	491	148	898
smallwood	Russian Mission(a)	0	46	46	26	118	295	0	156	156	88	400
smallwood	Takotna(a)	0	16	31	16	63	63	0	254	492	254	1,000
smallwood	Aklak	0	66	96	42	204	327	0	202	294	127	624
smallwood	Chuathbaluk	0	17	20	23	60	115	0	148	172	197	522
smallwood	Crooked Creek	0	22	24	27	73	138	0	159	172	192	529
smallwood	Flat	0	0	2	2	4	13	0	0	172	127	299
smallwood	Holy Cross	0	53	57	33	143	260	0	204	218	127	550
smallwood	Kalskag Lower	0	75	30	49	154	278	0	270	108	176	554
smallwood	Kotlik	0	90	138	69	297	543	0	166	255	127	547
smallwood	Lime Village	0	0	16	6	22	47	0	0	342	127	468
smallwood	Marshall	0	58	64	40	162	318	0	182	200	127	509
smallwood	McGrath	5	245	116	58	424	456	11	537	255	127	930
smallwood	Pitka's Point	0	0	46	20	66	154	0	0	302	127	429
smallwood	Red Devil	0	16	8	9	34	49	0	327	172	188	694
smallwood	Shageluk	0	26	37	19	82	145	0	179	255	134	566
smallwood	Sheldon Point	0	36	51	19	106	150	0	240	339	127	707
smallwood	Sleetmute	0	22	18	20	59	102	0	216	172	196	578
smallwood	Stony River	0	15	7	8	30	42	0	357	172	198	714
smallwood	Telida	0	7	6	1	14	5	0	1,400	172	127	2,800
subtotal		5	909	992	562	2,468	4,130	1	220	239	136	596
Total		1,655	6,962	8,970	4,199	21,796	23,782	70	293	377	177	917

Sources: see text
(a)=sampled villages

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Table DOTYK2. Total Fuel Storage Capacity Versus Annual Consumption. (1,000 gallons)

#	Village	Capacity By Major Owners (1,000 gallons)							Gallons Of Fuel Consumed Annually (1,000)	Ratio Of Capacity To Gallons Consumed Annually
		Schools	Electric Utilities	Native Corporations	Cities/ Tribes	Other Private	Other Government	Total		
1	Akiachak	169	77	68	27	0	0	341	358	1.0
2	Akiak	79	58	58	0	0	0	195	204	1.0
3	Alakanuk	132	117	124	4	0	40	417	325	1.3
4	Aniak	142	195	0	2	467	4	810	1,138	0.7
5	Auvik	21	54	29	7	27	0	138	67	2.1
6	Atmautluak	65	54	58	0	0	0	177	134	1.3
7	Bethel	0	51	0	0	9,601	44	9,696	10,186	1.0
8	Chefornak	119	43	86	49	8	4	309	166	1.9
9	Chevak	119	137	242	53	31	3	585	394	1.5
10	Chuathbaluk	34	15	0	38	0	0	87	60	1.5
11	Crooked Creek	25	17	0	6	54	0	102	73	1.4
12	Eek	45	71	68	8	0	0	192	118	1.6
13	Emmonak	168	172	132	421	153	0	1,046	621	1.7
14	Flat	0	0	0	0	0	0	0	4	0.0
15	Goodnews Bay	43	67	113	17	10	2	252	116	2.2
16	Grayling	35	70	35	36	0	0	176	125	1.4
17	Holy Cross	28	81	178	14	0	0	301	143	2.1
18	Hooper Bay	145	161	0	20	228	8	562	670	0.8
19	Kalskag Lower	16	104	0	75	0	0	195	154	1.3
20	Kalskag Upper	49	0	37	39	2	0	127	64	2.0
21	Kasigluk	95	0	117	15	0	0	227	142	1.6
22	Kipnuk	72	44	54	0	0	0	170	456	0.4
23	Kongiganak	74	53	52	0	13	30	222	192	1.2
24	Kotlik	49	50	220	18	15	0	352	297	1.2
25	Kwethluk	95	55	40	104	0	0	294	255	1.2
26	Kwigillingok	113	30	109	3	0	0	255	145	1.8
27	Lime Village	10	0	0	5	0	0	15	22	0.7
28	Marshall	46	76	95	14	0	0	231	162	1.4
29	McGrath	75	221	0	36	298	45	675	424	1.6
30	Mekoryuk	90	85	95	35	16	3	324	168	1.9
31	Mountain Village	206	195	194	34	1	0	630	492	1.3
32	Napakiak	73	0	62	0	3	3	141	126	1.1
33	Napaskiak	107	40	0	0	0	0	147	153	1.0
34	Newtok	121	56	52	0	7	3	239	157	1.5
35	Nightmute	28	90	40	0	5	3	166	99	1.7
36	Nikolai	97	25	0	70	0	0	192	97	2.0
37	Nunapitchuk	85	168	101	16	0	3	373	317	1.2
38	Oscarville	40	0	0	0	0	0	0	34	0.0
39	Pilot Station	48	96	102	17	0	0	263	283	0.9
40	Pitka's Point	22	0	0	15	0	0	37	66	0.6
41	Platinum	7	5	67	6	0	0	85	21	4.1
42	Quinhagak	101	99	80	32	24	8	344	275	1.3
43	Red Devil	18	15	43	0	15	0	91	34	2.7
44	Russian Mission	30	59	45	0	0	12	146	118	1.2
45	Saint Mary's	47	214	0	275	415	60	1,011	835	1.2
46	Scammon Bay	60	81	0	144	1	3	289	209	1.4
47	Shageluk	44	55	0	30	12	0	141	82	1.7
48	Sheldon Point	67	32	0	0	0	98	197	106	1.9
49	Sleetmute	30	17	0	26	0	0	73	59	1.2
50	Stony River	26	24	0	23	0	0	73	30	2.4
51	Takotna	30	14	0	0	0	0	44	63	0.7
52	Telida	10	6	0	0	0	0	16	14	1.1
53	Toksook Bay	35	147	120	26	0	5	333	237	1.4
54	Tuluksak	130	21	50	39	0	0	240	182	1.3
55	Tuntutuliak	70	45	63	59	0	0	237	144	1.6
56	Tununak	70	80	120	16	0	6	292	176	1.7
	Total	3,755	3,742	3,149	1,874	11,406	387	24,273	21,791	1.1
	Total Without Bethel	3,755	3,691	3,149	1,874	1,805	343	14,577	11,605	1.3

Sources:
Alaska Department of Community And Regional Affairs; bulk fuel tanks spreadsheet
Alaska Department of Community And Regional Affairs; Community Information Summaries. October 1995
Alaska Village Electric Cooperative
tank owners

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Table DOTYK3. Fuel Storage Capacity Versus Annual Consumption. (1,000 gallons). Capacity, Consumption, And Ratios. Major Users

Village	Schools			Utilities			Native Corporations/Cities/Tribes		
	Gallons Of Fuel Consumed Annually (1,000)	Capacity (1,000 gallons)	Ratio Of Capacity To Gallons Consumed Annually	Gallons Of Fuel Consumed Annually (1,000)	Capacity (1,000 gallons)	Ratio Of Capacity To Gallons Consumed Annually	Gallons Of Fuel Consumed Annually (1,000)	Capacity (1,000 gallons)	Ratio Of Capacity To Gallons Consumed Annually
Akiachak	110	169	1.5	67	77	1.1	181	95	0.5
Akiak	40	79	2.0	66	58	0.9	98	58	0.6
Alakanuk	73	132	1.8	87	117	1.3	165	128	0.8
Aniak	53	142	2.7	182	195	1.1	0	2	0.0
Anvik	12	21	1.8	29	54	1.9	26	36	1.4
Atmautluak	28	65	2.3	44	54	1.2	60	58	1.0
Bethel	0	0	0.0	0	51	0.0	0	0	0.0
Chefornak	48	119	2.5	48	43	0.0	70	135	1.9
Chevak	60	119	2.0	110	137	1.2	183	295	1.6
Chuathbaluk	8	34	4.3	17	15	0.9	35	38	1.1
Crooked Creek	9	25	2.8	22	17	0.8	42	60	1.4
Eek	16	45	2.8	44	71	1.6	58	76	1.3
Emmonak	70	168	2.4	183	172	0.9	368	553	1.5
Flat	0	0	0.0	0	0	0.0	0	0	0.0
Goodnews Bay	11	43	3.9	44	67	1.5	55	130	2.4
Grayling	10	35	3.5	42	70	1.7	73	71	1.0
Holy Cross	12	28	2.3	53	81	1.5	78	192	2.5
Hooper Bay	57	145	2.5	150	161	1.1	313	20	0.1
Kalskag Lower	19	16	0.8	75	104	1.4	60	75	1.3
Kalskag Upper	13	49	3.8	0	0	0.0	51	76	1.5
Kasigluk	35	95	2.7	0	0	0.0	107	132	1.2
Kipnuk	35	72	2.1	100	44	0.4	300	54	0.2
Kongiganak	37	74	2.0	45	53	1.2	110	52	0.5
Kotlik	45	49	1.1	90	50	0.6	162	238	1.5
Kwethluk	37	95	2.6	93	55	0.6	125	144	1.2
Kwigillingok	34	113	3.3	42	30	0.7	69	112	1.6
Lime Village	8	10	1.3	0	0	0.0	14	5	0.4
Marshall	9	46	5.1	58	76	1.3	95	109	1.1
McGrath	38	75	2.0	245	221	0.9	0	36	0.0
Mekoryuk	30	90	3.0	57	85	1.5	40	130	3.3
Mountain Villag	60	206	3.4	182	195	1.1	250	228	0.9
Napakiak	51	73	1.4	0	0	0.0	75	62	0.8
Napaskiak	24	107	4.5	53	40	0.8	3	5	1.7
Newtok	43	121	2.8	28	56	2.0	56	94	1.7
Nightmute	13	28	2.2	31	90	2.9	55	40	0.7
Nikolai	8	97	12.1	28	25	0.9	61	70	1.1
Nunapitchuk	34	85	2.5	181	168	0.9	102	117	1.1
Oscarville	21	40	1.9	0	0	0.0	13	0	0.0
Pilot Station	36	48	1.3	91	96	1.1	156	119	0.8
Pitka's Point	20	22	1.1	0	0	0.0	46	37	0.8
Platinum	5	7	1.4	7	5	0.7	9	73	8.1
Quinhagak	38	101	2.7	87	99	1.1	150	112	0.7
Red Devil	3	18	6.0	16	15	0.0	14	43	3.1
Russian Mission	20	30	1.5	46	59	1.3	52	45	0.9
Saint Mary's	25	47	1.9	215	214	1.0	0	275	0.0
Scammon Bay	20	60	3.0	69	81	1.2	110	144	1.3
Shageluk	13	44	3.4	26	55	2.1	43	42	1.0
Sheldon Point	25	67	2.7	36	32	0.9	45	0	0.0
Sleetmute	7	30	4.3	22	17	0.8	31	26	0.8
Stony River	3	26	8.7	15	24	1.6	12	23	1.9
Takotna	15	30	2.0	16	14	0.9	32	0	0.0
Telida	5	10	2.0	7	6	0.9	2	0	0.0
Toksook Bay	34	35	1.0	80	147	1.8	104	146	1.4
Tuluksak	70	130	1.9	32	21	0.7	80	89	1.1
Tuntutuliak	17	70	4.1	54	45	0.8	72	122	1.7
Tununak	27	70	2.6	59	80	1.4	90	136	1.5
	1,594	3,755	2.4	3,374	3,742	1.1	4,601	5,158	1.1

Sources: Table DOTYK1; Table DOTYK2

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Table DOTYK4. Estimated Cost In1992 Of Fuel Tank UpGrades. By Ownership Category. ($1,000)

Village	Cost Of Upgrade By Major Owner ($1,000)							Capacity (1,000 Gallons)	Cost/ Gallon ($1)
	Native Corporation	School	Electric Utility	City/ Village	Other Gov't	Other Private	Total		
Aniak	0	848	436	996	737	2,808	5,825	853	7
Atmautluak	236	241	165	0	0	0	642	187	3
Chefornak	319	396	158	66	43	82	1,064	242	4
Chevak	790	431	483	260	73	120	2,157	451	5
Crooked Creek	0	154	51	40	0	316	561	103	5
Hooper Bay	1,315	472	601	381	80	0	2,849	531	5
Kalskag Upper	239	422	0	146	0	340	1,147	127	9
Kasigluk	379	460	0	160	0	0	999	221	5
Kongiganak	621	346	160	51	34	100	1,312	222	6
Mekoryuk	466	162	305	170	42	77	1,222	327	4
Nightmute	257	144	397	0	35	30	863	167	5
Nunapitchuk	370	390	426	132	13	0	1,331	376	4
Quinhagak	454	375	340	254	61	195	1,679	343	5
Red Devil	226	374	0	0	0	238	838	76	11
Saint Mary's	197	222	1,032	780	344	3,959	6,534	1,366	5
Scammon Bay	569	445	462	255	188	0	1,919	267	7
Sleetmute	126	30	83	0	0	0	239	73	3
Tuntutuliak	277	233	181	56	0	0	747	192	4
Total	6,841	6,145	5,280	3,747	1,650	8,265	31,928	6,124	5

Source:

Alaska Energy Authority. March 1992. Rural Alaska Bulk Fuel Assessment Program.
Rural Alaska Bulk Fuel Assessment Program

(Table 3.1; Table 3.2.) Anchorage, Alaska

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Table DOTYK5. Fuel Tank Upgrades By DCRA Division Of Energy:
Completed 1996-1998; Planning 1999; Completion 1999.
By Village. By Major Owner

Village	Completed 1996-1998				
	City(4)	School	Village Corporation(5)	Electric Utility	Project Cost ($1,000)
Atmautluak	y	y	y	n	1,400
Grayling	y	y	y	n	1,100
Kwigillingok	y	n	n	n	1,000
Marshall	y	n	y	n	600
McGrath	n	n	n	y	205
Quinhagak	y	n	n	n	290
Sheldon Point	y	n	n	n	600
Total	n.a.	n.a.	n.a.	n.a.	5,195
Village	Planning 1999				
	City(4)	School	Village Corporation(5)	Electric Utility	Project Cost ($1,000)
Akiak	y	y	y	y	1,155
Anvik	y	y	y	y	700
Chefornak	y	y	y	y	1,340
Nunapitchuk (1)	y	y	y	y	320
Shageluk(2)	n.a.	y	y	y	225
subtotal	n.a.	n.a.	n.a.	n.a.	3,740
Village	Completion 1999				
	City(4)	School	Village Corporation(5)	Electric Utility	Project Cost ($1,000)
Chuathbaluk(1)	y	y		y	267
Emmonak	y	y	y		1,600
Kalskag Lower	y	y		y	1,100
Kalskag Upper (3)	y	y	y	n.a.	700
Kongiganak(1)	y	y	y		370
Mekoryuk(1)	y	y	y	y	360
Napaskiak	y	y	y	y	660
Nightmute(1)	y	y	y		150
Takotna(1)	y		y		550
Toksook Bay	y	y	y	y	1,700
Tuntutuliak		y	y	y	1,539
subtotal	n.a.	n.a.	n.a.	n.a.	8,996

n.a.=not applicable
(1) school only
(2) pipe only
(3) electric utility is AVEC, in Kalskag Lower
(4) includes tribal council, depending on the village
(5) includes other private and public sector operations, depending on the village
Sources:
Alaska Department Of Community And Regional Affairs (DCRA), Division Of Energy.
Rural Energy Plan. February 1999. Anchorage, Alaska
letter to David L. Marshall. May 11, 1999

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Table DOTYK6. Upgrade Costs Of 18 Single-Village Utilities. ($1,000)

Village	Upgrade Cost Estimate ($1,000)		
	Powerhouse	Distribution System	Total
Akiachak	402.8	60.0	462.8
Akiak	0.0	257.0	257.0
Atmautluak	0.0	322.0	322.0
Chefornak	338.8	81.0	419.8
Kipnuk	0.0	0.0	0.0
Kongiganak	450.9	0.0	450.9
Kotlik	482.8	280.0	762.8
Kwethluk	468.8	63.0	531.8
Kwigillingok	227.5	66.0	293.5
Napakiak	311.8	216.0	527.8
Napaskiak	0.0	0.0	0.0
Newtok	198.8	334.0	532.8
Nightmute	358.8	57.0	415.8
Nikolai	0.0	0.0	0.0
Sheldon Point	158.3	57.0	215.3
Takotna	164.7	186.0	350.7
Telida	59.4	192.0	251.4
Tuluksak	391.0	84.0	475.0
Tuntutuliak	460.7	210.0	670.7
Total	4,475.1	2,465.0	6,940.1

n.a.=not applicable

Source: Alaska Department Of Community And Regional Affairs (DCRA) Division Of Energy (doe).

February 1999. Rural Energy Plan. Anchorage, Alaska

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Table DOTYK7. Ownership Of Electric Utilities

#	Village	Ownership		
		AVEC (1)	MKEC (2)	Single-Village Utility
1	Akiachak			y
2	Akiak			y
3	Alakanuk	y		
4	Aniak			y
5	Anvik	y		
6	Atmautluak			y
7	Bethel			y
8	Chefornak (Naterkaq)			y
9	Chevak	y		
10	Chuathbaluk		y	
11	Crooked Creek		y	
12	Eek	y		
13	Emmonak	y		
14	Flat	n.a.	n.a.	n.a.
15	Goodnews Bay	y		
16	Grayling	y		
17	Holy Cross	y		
18	Hooper Bay	y		
19	Kalskag Lower	y		
20	Kalskag Upper (via Lower)	y		
21	Kasigluk (via Nunapitchuk)	y		
22	Kipnuk			y
23	Kongiganak (Puvurnaq)			y
24	Kotlik			y
25	Kwethluk			y
26	Kwigillingok			y
27	Lime Village	n.a.	n.a.	n.a.
28	Marshall	y		
29	McGrath			y
30	Mekoryuk	y		
31	Mountain Village	y		
32	Napakiak (via Bethel)			
33	Napaskiak			y
34	Newtok (Unqusraq)			y
35	Nightmute			y
36	Nikolai			y
37	Nunapitchuk	y		
38	Oscarville (via Bethel)			
39	Pilot Station	y		
40	Pitka's Point (via Saint Mary's)	y		
41	Platinum			y
42	Quinhagak	y		
43	Red Devil		y	
44	Russian Mission	y		
45	Saint Mary's	y		
46	Scammon Bay	y		
47	Shageluk	y		
48	Sheldon Point			y
49	Sleetmute		y	
50	Stony River		y	
51	Takotna			y
52	Telida			y
53	Toksook Bay	y		
54	Tuluksak			y
55	Tuntutuliak			y
56	Tununak	y		

(1)=Alaska Village Electric Cooperative
(2) MKEC=Mid-Kuskokwim Electric Cooperative
Sources:
Alaska Department of Community And Regional Affairs, Division Of Energy Statistical Report Of The Power Cost Equalization Program. FY1996 Anchorage, Alaska.
Alaska Village Electric Cooperative. 1997. Loyd M. Hodson. Village Phoenix. Anchorage, Alaska.

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Table DOTYK8. Villages Borrowing Loan Fund Monies. FY90-FY99. ($1, 000)

#	Village	Year											Cumulative Total FY90-FY99	Percent Share Of Cumulative Total FY90-FY99
		FY90	FY91	FY92	FY93	FY94	FY95	FY96	FY97	FY98	FY99	Total FY90-FY99		
1	Emmonak	50.0	50.0	50.0	100.0	100.0	150.0	150.0	50.0	150.0	100.0	950.0	950.0	9.9
2	Akiak	38.2	136.3	97.2	100.0	95.0	99.8	0.0	46.0	65.5	76.1	754.1	1,704.1	17.8
3	Kotlik	50.0	0.0	50.0	100.0	100.0	50.0	50.0	110.0	110.0	110.0	730.0	2,434.1	25.4
4	Nikolai	50.0	50.0	50.0	50.0	112.0	100.0	100.0	100.0	100.0	0.0	712.0	3,146.1	32.9
5	Chefornak	41.7	50.0	50.0	50.0	112.0	70.0	70.0	0.0	70.0	70.0	583.7	3,729.8	39.0
6	Mountain Village	0.0	10.2	0.0	25.0	50.0	150.0	48.0	148.0	44.0	0.0	475.2	4,205.0	43.9
7	Akiachak	0.0	0.0	94.6	50.0	83.8	23.8	80.1	60.0	0.0	28.0	420.3	4,625.3	48.3
8	Toksook Bay	50.0	50.0	0.0	0.0	0.0	100.0	0.0	100.0	100.0	0.0	400.0	5,025.3	52.5
9	Atmautluak	48.1	43.2	0.0	38.1	41.6	46.8	44.2	34.8	43.2	32.9	372.9	5,398.2	56.4
10	Napakiak	45.0	0.0	0.0	50.0	45.0	47.6	62.0	0.0	56.7	51.3	357.6	5,755.8	60.1
11	Kongiganak	47.8	50.0	10.8	0.0	0.0	100.0	0.0	40.0	40.0	0.0	288.6	6,044.4	63.2
12	Kwigillingok	19.6	50.0	50.0	50.0	0.0	0.0	50.0	0.0	50.0	0.0	269.6	6,314.0	66.0
13	Takotna	28.0	21.7	30.0	30.0	30.0	30.0	35.0	0.0	28.3	35.0	268.0	6,582.0	68.8
14	Alakanuk	13.9	0.0	25.0	25.0	25.0	25.0	25.0	25.0	47.9	45.2	257.0	6,839.0	71.5
15	Tuluksak	23.6	46.4	50.0	0.0	0.0	50.0	0.0	50.0	0.0	28.6	248.6	7,087.6	74.1
16	Red Devil	37.6	40.0	45.0	10.0	0.0	20.0	20.0	20.0	20.0	20.0	232.6	7,320.2	76.5
17	Kalskag Lower	21.1	21.8	15.2	0.0	0.0	0.0	0.0	0.0	100.0	62.4	220.5	7,540.7	78.8
18	Kalskag Upper	22.6	41.2	47.2	50.0	0.0	0.0	0.0	55.6	0.0	0.0	216.6	7,757.3	81.0
19	Sheldon Point	0.0	0.0	35.4	50.0	50.0	40.0	40.0	0.0	0.0	0.0	215.4	7,972.7	83.3
20	Chuathbaluk	47.0	43.6	0.0	10.0	0.0	20.0	20.0	20.0	20.0	20.0	200.6	8,173.3	85.4
21	Crooked Creek	28.8	28.6	0.0	10.0	0.0	20.0	20.0	20.0	20.0	20.0	167.4	8,340.7	87.1
22	Stony River	0.0	0.0	13.0	50.0	0.0	20.0	20.0	20.0	20.0	20.0	163.0	8,503.7	88.8
23	Kipnuk	0.0	0.0	50.0	0.0	0.0	50.0	0.0	56.5	0.0	0.0	156.5	8,660.2	90.5
24	Scammon Bay	10.2	9.7	16.0	0.0	50.0	60.0	0.0	0.0	0.0	0.0	145.9	8,806.1	92.0
25	Sleetmute	0.0	0.0	10.0	0.0	0.0	20.0	20.0	20.0	20.0	20.0	110.0	8,916.1	93.2
26	Kasigluk	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	9,016.1	94.2
27	Saint Mary's	0.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	9,116.1	95.2
28	Grayling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.4	81.4	9,197.5	96.1
29	Anvik	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	50.0	0.0	80.0	9,277.5	96.9
30	Hooper Bay	11.6	0.0	42.9	0.0	10.6	0.0	0.0	0.0	0.0	0.0	65.1	9,342.6	97.6
31	Aniak	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	9,392.6	98.1
32	Tununak	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	9,442.6	98.7
33	Mekoryuk	0.0	0.0	29.4	0.0	9.6	0.0	0.0	0.0	0.0	0.0	39.0	9,481.6	99.1
34	Pitka's Point	0.0	0.0	10.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	30.0	9,511.6	99.4
35	Marshall	0.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	9,531.6	99.6
36	Platinum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.7	0.0	18.7	9,550.3	99.8
37	Chevak	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	15.0	9,565.3	99.9
38	Pilot Station	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	6.0	9,571.3	100.0
39	Bethel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
40	Eek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
41	Flat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
42	Goodnews Bay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
43	Holy Cross	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
44	Kwethluk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
45	Lime Village	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
46	McGrath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
47	Napaskiak	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
48	Newtok	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
49	Nightmute	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
50	Nunapitchuk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
51	Oscarville	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
52	Quinhagak	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
53	Russian Mission	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
54	Shageluk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
55	Telida	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
56	Tuntutuliak	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Total		784.8	852.7	931.7	898.1	914.6	1,293.0	875.3	1,025.9	1,174.3	820.9	9,571.3		

Source: Alaska Department Of Community And RegionalAffairs, Division Of Energy
Bulk Fuel Loans. Spreadsheet provided to the author

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Table DOTYK9. Distribution Of Revolving Loan Funds Across Villages
By Median Household Income Bracket

#	Village	Median Household Income 1989	Median Household 1989 Income Bracket	Percent Of Households In Bracket	Percent Of Loans Received
1	Emmonak	$25,625	<$5,000	1.82	1.6
2	Akiak	$13,571	$5,000-$9,999	3.64	1.7
3	Kotlik	$20,417	$10,000-$14,999	21.82	24.9
4	Nikolai	$11,250	$15,000-$19,999	34.55	22.6
5	Chefornak	$20,278	$20,000-$24,999	16.36	25.9
6	Mountain Village	$26,750	$25,000-$29,999	12.73	19.6
7	Akiachak	$23,750	$30,000-$34,999	3.64	3.54
8	Toksook Bay	$21,875	$35,000-$39,999	1.82	0
9	Atmautluak	$15,833	$40,000-$44,999	3.64	0
10	Napakiak	$18,125			
11	Kongiganak	$33,250	Total	100.00	100.00
12	Kwigillingok	$14,500			
13	Takotna	$18,750			
14	Alakanuk	$17,708			
15	Tuluksak	$20,446			
16	Red Devil	$25,000			
17	Kalskag Lower	$10,357			
18	Upper Kalskag	$16,250			
19	Sheldon Point	$16,250			
20	Chuathbaluk	$13,750			
21	Crooked Creek	$16,250			
22	Stony River	$5,156			
23	Kipnuk	$4,999			
24	Scammon Bay	$15,179			
25	Sleetmute	$10,000			
26	Kasigluk	$26,563			
27	Saint Mary's	$28,542			
28	Grayling	$21,641			
29	Anvik	$10,694			
30	Hooper Bay	$18,125			
31	Aniak	$32,841			
32	Tununak	$18,750			
33	Mekoryuk	$14,792			
34	Pitka's Point	$17,813			
35	Marshall	$28,750			
36	Platinum	$23,056			
37	Chevak	$17,222			
38	Pilot Station	$16,000			
39	Bethel	$42,232			
40	Eek	$21,000			
41	Flat	n.a.			
42	Goodnews Bay	$13,523			
43	Holy Cross	$13,750			
44	Kwethluk	$16,000			
45	Lime Village	$9,257			
46	McGrath	$36,250			
47	Napaskiak	$18,750			
48	Newtok	$14,844			
49	Nightmute	$17,813			
50	Nunapitchuk	$17,083			
51	Oscarville	$26,250			
52	Quinhagak	$17,500			
53	Russian Mission	$21,667			
54	Shageluk	$16,250			
55	Telida	$43,750			
56	Tuntutuliak	$14,444			

n.a.=not applicable
Sources:
Median Household Income. 1990 Census. U.S.Department of Commerce. Bureau of the Census. Standard Tape File 3A

Percent Of Loans Received. Table DOTYK9

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Appendix I
Hovercraft Technology and Its Use

Hovercraft for the Y-K Delta — A Brief Technology Assessment

Robert K. Whitford[1]

Executive Summary

Note: This brief description is included because of two factors: (1) to present the technology in light of the testing undertaken by the United States Post Office for use in delivery of mail near Bethel, Alaska and (2) to describe in broad terms the unique potential that the Hovercraft could have in remote rural locations where the terrain or river bed supports its use. Most of the data included here comes from its present use by the Post Office under contract with Hovercraft/JV, a division of Lynden Transport Inc., to transport mail to Kuskokwim villages near Bethel. In addition, it occasionally transports cargo, moves people when necessary, and can be a major help in search and rescue missions. This report touches the surface and as such lacks the depth of a complete technology assessment. It has been reviewed by Dr Paul Valihura of Volpe and Mr Glen VanValen of Hovercraft/JV2

Ever since the United States Postal Service (USPS) entered into a "demonstration" contract with Alaska Hovercraft JV (Subsidiary of Lynden Freight Company) with deliver the fourth class mail to seven villages near Bethel using the AP-188 Air Cushion Vehicle (ACV), there has been controversy. The concern raised about the vehicle centered about its noise and most importantly its potential impact on the subsistence lifestyle of native Yu'pik Eskimos living in the villages being served. In addition, avoiding the expectation of destroying the Tundra and harming the wildlife that live in the Tundra, the operation of the craft was restricted to the rivers.

> "The purpose of the demonstration is: The mission of the USPS is to provide prompt, reliable, and efficient postal services to all Americans, regardless of where they live. This commitment extends to providing service at the highest level of quality and at the lowest possible cost. Sound business practices require the USPS to explore alternative means of service delivery which will reduce the cost burden while maintaining service quality. The purpose of the Alaska Hovercraft two-year demonstration project is to determine the technical, economic and environmental feasibility of hovercraft technology for the transport of mail for regularly scheduled service."3

Most locations within the State of Alaska lack road and highway systems connecting cities and villages. These cities and villages are dependent on air carriers to meet transportation needs as well to provide the primary means of transporting freight and mail. In an effort to meet established service standards and provide reliable mail delivery, the USPS must move surface

1. Dr. Whitford is Professor of Transportation Engineering at Purdue University and is a member of the AKDOT&PF planning team for the Yukon Kuskokwim Delta Regional Transportation Plan

2 . Dr Paul Valihura is the Project Manager for the Volpe study in support of the USPS. Over the three years of study the team thoroughly researched many of the problem identified for the Hovercraft. Mr. Glenn VanValen has been the Alaska Hovercraft JV Project Manager in Bethel for the operation of the Hovercraft. He is intimately familiar with the AP1-88 and has been involved in making it work in the Bethel environment.

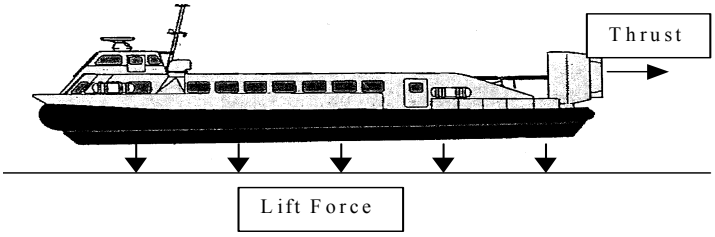
3. See the Environmental Assessment prepared by the USPS.

mail via air carriers. Providing mail service to citizens of Alaska is costly and reliability is sometimes impacted by severe weather conditions. The USPS is exploring hovercraft technology as a reliable mode of surface transportation that could offer the required level of service at more competitive prices. The USPS regularly pays carriers to deliver the fourth class mail at about ten times the revenue that the postal rates permit them to charge [4].

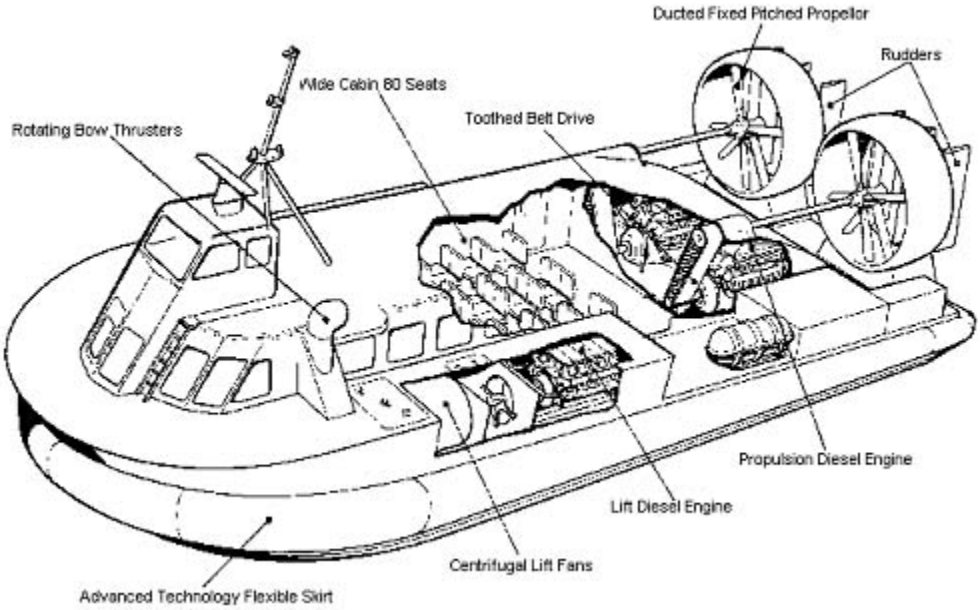
This paper occurs about the time that the two-year experiment is about to be completed. It is not intended to evaluate the USPS experiment with the hovercraft but to examine the ACV potential as a transportation mode in this unique area of rural Alaska, where there are no road and a harsh climate. For expediency the study deals with the AP1-88 craft, although other hovercraft might be used. This Executive Summary is organized around frequently asked questions with the author's answer.

WHAT IS AN AIR CUSHION VEHICLE?

The hovercraft is one of a class of air cushion vehicles, also often called skimmers. It is a vehicle that rides above the surface of the earth or water, supported by air pressure created by fans pushing air downward. Likewise the rearward facing fans propel it forward. It can be thought of as an airplane without wings (it never gets more than 24 to 30 inches off the ground). Its skirt maintains that air under the vehicle and defines the height it rides above the surface.



Cut away of the AP1-88



4. The seven times is an estimate when it was considered that in 1991 the USPS spent approximately $82 million to deliver mail for which it received revenue of $12 million.

Figure 1 AP1-88 Hovercraft –Side and Rear view

Photo by R.K.Whitford

WHAT IS AP1-88 HOVERCRAFT PERFORMANCE?

The ACV, since at its operating speed it does not displace water, is capable of relatively high speeds over water in the 45 to 60 mile per hour (MPH) range. It will be operated above its inherent "hump-speed" (about 12 knots or 13.7 MPH) The speed and height above the surface depend on the vehicle's weight, thrust fans and lift fans capability and skirt length. Its payload is also variable. The higher the payload the more thrust from the engines is required for both lift and forward speed. The maximum payload of freight and passengers on the AP 1-88, specified by the U.S. Coast Guard is 12,500 pounds. Its length of operating time is limited by the fuel load, which can often be increased by reducing the payload. The AP1-88 can operate for four hours while carrying 10,000 pounds of payload (freight and/or passengers).

WHAT IS ITS RELATIVE COST?

The rate paid by the USPS for the hovercraft delivery is $0.43606 per pound. For the estimated carriage of 65,000 pound per week of USPS mail, the air carriers received revenue of $10.9002 per ton mile plus 0.3614 per pound for a total of about $32,347 assuming a weighted average of about 25 miles for the flights. The hovercraft, on the other hand, is charging USPS about $28,350 or about 87.6% of the price for hauling . The employment in the bush villages would not change with Alaska Hovercraft/JV retaining at least one of agents employed previously by the air carriers. Some of the air carriers will still need an agent to handle the priority mail which would still be delivered by the air carrier. The rate above includes the "Hovercraft JV" agents in each village who meet the hovercraft and transport the mailto its destination; whether an AC store, the school, the post office or other.

DOESN'T THE HOVERCRAFT CREATE A MAJOR DISTURBANCE/WAKE IN THE WATER?

Actually when operating at a speed above 10 to 12 knots (called the hump speed) the Hovercraft skims along the surface of the water creating a wake that is more than the typical small motorboat (skiff) used in the Kuskokwim River and its tributaries. When operating below hump speed, which occurs on or near the port, a spray is generated and there is considerably more displacement of water. Overall the Hovercraft wake is less than the fuel barges that make trips to each of the villages.

THE HOVERCRAFT TRAVELS ON THE WATER; DOESN'T THAT AFFECT THE FISH?

Fishing is a major portion of the subsistence living of the Yu'pik natives. There are several possible impacts on the fish from the AVC passage, which occurs two times per day every other day. Since sound propagates much better in air than in water, noise it is not a likely impact. Since there is little wake except during periods of startup (below hump speed) and no displacement of the water it would seem that there should be minimal, if any, impact on the fish. The recent study by the USPS for the Environmental Assessment and the AGRA Earth and Environmental Inc. [AGRA, 1998] commissioned by the Calista Elders Council (hereafter referred to as CEC) indicate as much. To avoid stranding fry in pools created by the hovercraft near port, the hovercraft operation can be adjusted to minimize any effect.

WHEN THE HOVERCRAFT TRAVELS CLOSE TO SHORE WHAT IS ITS EFFECT?

Bank erosion is a common phenomenon along rivers. With or without the Hovercraft, significant erosion will continue to occur along the rivers in the delta. The wave action by motor boats and

fuel barges will hasten erosion. While the hovercraft above hump speed generates virtually no wake.

WHAT EFFECT DOES THE HOVERCRAFT HAVE ON WILDLIFE THAT FEED NEAR THE RIVER?

According to a very quick study AGRA the proximity of hovercraft passage seemed to coincide with decreased presence of mammal scat, tracks and plant utilization along the shore. However, twice every other day passage was only one possible influence on such a finding. Both scat and tracks increased with distance from the hovercraft route. While the abundance of wildlife seems lower in the impacted area than other river areas, the diversity of species does not appear to be affected since tracks of shore bird, raven, gull, crane, fox, muskrat and porcupine were all found in the impact area as well as the control area. Note: the AGRA study seemed to lack the research methodology to clearly ascertain if this result was due to hovercraft passage. (There is no before data with which to compare habitat along the routes)

DOES THE NOISE THAT HOVERCRAFT MAKES HAVE A DELETERIOUS EFFECT?

The noise emitted by the hovercraft, largely due to its diesel engines and the propellers, represents the largest negative both for its impact on birds and animals but also for its disturbance factor to humans. The noise is classed as relative noise depending on the distance one is from the hovercraft. The usual process of noise calculation based on the FAA's approach for airports was used. Since this integrates the effects over a peak day with only two passes, the impact is different and was considered to have virtually no impact with that day-night methodology applied. The noise or sound pressure averaged over the two passes a day leaves a sound pressure equivalent to 101 dB at 200 feet. That level drops by ½ at 630 feet and by another ½ at 2000 feet. However the noise might still be considered significant at 4000 feet where 84 dBa instantaneous sound has been measured [numbers from 1997 report] The table below defines the noise levels in terms of other noise sources of which we are familiar.

Table 1 Sound pressure at various distances from the Hovercraft route

Hovercraft	Sound Pressure	Equivalent source
	110 dB	Rock band @ 15 ft
	106 dB	Jet fly over @ 1000 ft
@200 ft.	101 dB	
	96 dB	Snowmobile engine @ 3 ft
@630 ft	95 dB	
@2000 ft	88 dB	Diesel truck @ 50 feet
@ 4000 ft	84 dB	
	70 dB	Snowmobile @ 100 feet

Source: VNTSC/ETC 1997 and Chen [1995]

WHAT ABOUT THE INTERIM REPORT BY THE USPS OF "NO SIGNIFICANT IMPACT"?

The interim report of No Significant Impact (FONSI) was submitted by the USPS on the basis of an agreement with the U.S. Department of Transportation's Volpe National Transportation Systems Center (VNTSC) in Cambridge MA. The VNTSC hired reputable Environmental Transportation Consultants Daniel, Mann, Johnson & Mendenhall (DMJM) CH2M Hill and Woodward-Cycle Federal Services who followed accepted testing and evaluation techniques in preparing the Environmental Assessment.[ETC 1977] They made extensive survey of the area examining potential impact on fish, waterfowl and wildlife for the proposed track on the rivers. Noise measurements indicated that based on the accepted federal Noise Standards that the noise would be within acceptable limits. There would be some loss of revenue felt by the air

carriers now serving the villages to be served by the hovercraft, but because they fly to other villages there would be little impact in terms of job loss and displacement.

WHY HAS THE HOVERCRAFT OPERATION BEEN CONSTRAINED TO THE WATER?

Since the state owns the waterways and the remainder of land in largely in a Wildlife Refuge, the constraint of operating only on the rivers, has permitted the Hovercraft to operate on the FONSI developed from an Environmental Assessment. Incidentally, provided there were no large step differentials in the contour of the land, the ACV would work just fine on land. One city, Amauthulak, was on the original route agreed to by the USPS and the Lyndeon JV. Amauthulak is just 5 air miles from Kasigluk. However sticking to the rivers caused the distance to increase to over 25 miles due to the circuitry of the river, between the two villages. Thus the cost and time for delivery to Amauthulak created an extreme inefficiency and hovercraft service to Amathulak was stopped. To have attempted the route overland may have brought the Hovercraft assessment into the more formal EIS.

IS THE HOVERCRAFT TRULY ALL WEATHER?

Although, it can operate in all weather, there are periods at freeze-up and breakup covering about 4 weeks per yea when ACV operation was deemed to not be in the best interest of the population and the hovercraft suspended operation during those periods,. Since the natural action of the hovercraft is to be an icebreaker (In many places in the world the ACV finds a major application as an icebreaker used to extend the seasons of conventional shipping) The formation of the ice road between Eek and Anaik on the Kuskokwim is a major reason for suspending operation during freeze up. During the spring thaw, the ice gets thin and the hovercraft does not want to influence the natural course of break-up. However, it is interesting to note that some villages have requested the Hovercraft in the spring to break up the ice to facilitate river access by their motor boats.

IS THE EVERY OTHER DAY DELIVERY SATISFACTORY?

Yes, the Post Office delivery specification in the lower-48 for ground modes is five days. The 36-hour requirement for airlines delivering bush mail does not apply. In fact because it can operate in all weather conditions, the Hovercraft is expected to be more consistent in delivery than the aircraft who are subject to the delivery constraint and inclement weather.

WHAT HAS BEEN THE VIEW OF HOVERCRAFT BY THE COMMUNITIES?

There is no impact that has been observed by AGARE&E that can with certainty be identified to occur as result of the hovercraft operation over the 18 months of operation. Not surprisingly they suggest that more study is required. The problem may not be the actual disturbance by the hovercraft but the perceived disturbance to the local residents. The clear problem is that there is not any before data with which to compare the present data. One possible deterrent is simply the size of the hovercraft. The hovercraft represents change, which is not all that easy. There is no particular benefit that the villagers see. The main beneficiary is the USPS who can deliver the mail at a lower rate.

WHAT ARE THE BENEFITS OF HOVERCRAFT?

- The hovercraft offers an acceptable alternative mode for the delivery of mail.
- It is an all weather vehicle, increasing the reliability of delivery over aircraft.
- It can carry passengers when aircraft cannot fly. (2 hour ride compared to 30 minute flight)
- It has proven to be a valuable resource in effecting search and rescue.
- For the close-in villages the cost of the Hovercraft is less than the equivalent cost for Aircraft
- Because it is a single company delivering all the non-priority mail, it provides for better freight handling and less damage.
- During spring the icebreaking capability can be a benefit by speeding up the ice breakup and improving the flow out to sea. This can be especially important, because during the spring some airports become too soft to permit regular operations. *See dysbenefit*.
- It is a natural vehicle for the severe conditions of the western bush areas with the large number of wetlands. (This benefit is not observed because operation now does not allow crossing the tundra/wetland areas, most of which are federal Wildlife Refuge Lands.)

WHAT ARE THE DYSBENEFITS OF HOVERCRAFT?

- Because of its natural icebreaking capability, there is a period when it is kept off the ice during freeze up, to allow for a homogeneous ice build up.
- While its integrated noise effect is much less than that generated by aircraft, it still emits a substantial sound pulse as it passes a given point.
- It cannot climb very steep inclines, depending on its skirt length

IN SUMMARY, WHAT ARE THE RECOMMENDATIONS? *(These are the author's ideas and do not represent official Alaska DOT and PF policy)*

1. The work of the hovercraft has been a significant event in bush Alaska. In spite of the fact that it is not universally appreciated by a number of natives, it has high potential for future transportation throughout the bush. In fact, if confined to particular trails across the tundra/wetlands it could efficiently serve to transport goods and people. When held to the river the following recommendations can be made:
2. The Hovercraft technology was found to be appropriate for the Kuskokwim River area of Alaska. It can operate in the winter and during times of inclement weather found during summer months. It is a safe alternative mode of transport for the area.
3. The delivery of mail in the Bethel area by Hovercraft is continuing through 2006 with the private sector company Alaska Hovercraft/JV. providing the service.
4. The bank erosion should be carefully monitored as well as the other potential effects
5. The experiment should be widened with one short overland route (six or seven miles) from Kasigluk to Atmauthluak

6. Work should begun on a long range environmental review process to cover that short distance to serve Atmauthluak

7. Research should be initiated to develop means of reducing the noise. Perhaps the Federal Government Labs (NASA) instrumental in engine noise reduction technology for aircraft power plants could become involved In noise reduction research for the Hovercraft. VNTSC should continue to monitor the effects.

8. A youth involvement in hovercraft design and home building could be initiated in the villages, with perhaps the schools involved in a contest. This would hasten familiarity and acceptance.

9. Similar to village roads and landing fields, designated landing areas should be constructed along with gravel roads back to the villages to facilitate movement of freight, mail and passengers.

10. Initial investigations should be considered that would consider winter access across the frozen tundra for the Hovercraft.

11. Initial investigations should take place to select several short alternative Hovercraft routes across the tundra that would help determine potential impact. These routes should be identified with help from the local resource agencies and Native Alaskans.

Hovercraft for the Y-K Delta

Chapter I Introduction

This paper presents a brief technology assessment of the hovercraft with a focus on the possible uses of the craft in areas where there are no roads, due to the sparse villages and the existence of many lakes, tundra and permafrost. The existence of a network of roads in the area is not likely due to the heavy expense of construction and of maintenance, especially to keep them open during winter. From a technological point of view the hovercraft must be studied because it more than any other craft provides the potential of year-around travel in all kinds of weather and on water and land. The hovercraft can be used in weather conditions that airplanes cannot fly. The Hovercraft or air cushion vehicles due to their unique ability to traverse a wide variety of reasonably level ground surfaces, offer the potential to provide a new and reliable ground transportation option to the residents of the delta region. The potential of these craft lies in their ability to provide service in difficult weather conditions and at a lower cost. It is the purpose of this document to evaluate the hovercraft to improve the mobility of the residents of the Y-K delta region.

A technology assessment (TA) is a social/economic/technical study of the particular technology as it is or may be applied to a particular problem. It assesses the state of the art of the technology in the application at hand, examines its potential risks (such as safety and noise), identifies particular relationships to the environment and examines it economics.

Basically it attempts to layout the full range of complex issues surrounding the application of the specific technology in a specific end-use; addressing complex - and often conflicting - social, economic, resource issues, political claims. It should address the intricate array of technical realities and uncertainties, scientific knowledge and tradeoffs social values and perceptions of risk, equity, and political judgements.

The two major categories of TA involve (1) an assessment of an already developed technology as it is applied to a specific set of operating conditions or on specific missions (assessing the potential of bringing high-speed rail already in operation in Japan, France and Germany to the United States) and (2) the assessment of an emerging technology usually applied to a broad set of socio-economic areas (evaluating the potential impact of electric cars). This study of the hovercraft in Alaska is concerned with the use of a proven, accepted technology in a use where its efficacy has not been proven.

No other technology offers the potential of year-around mobility enhancement in the Yukon-Kuskokwim river delta area, as does the hovercraft. Its use to deliver the mail near Bethel is only one application. The large amount of federally protected land make its use for across land applications highly unlikely. This assessment is a part of the Long-range transportation plan being developed for the Yukon-Kuskokwim River delta area by the Alaska Department of Transportation and Public Facilities. A plan which attempts to address the personal mobility issues and “resources for living” distribution in this special region populated by about 25,000 Alaskans, mostly Yup'-ik Eskimos with a number of Athabascan natives in the more inland areas. The map of Figure 2 sketches the planning area.

Figure 2 Yukon-Kuskokwim Delta Study Area

Thus this assessment has the following sections.

- Review of the hovercraft including its principle of operation
- Indication of present uses (called by some the state of the art)
- Range of Specifications (Performance Measures) that it can satisfy.
- Critical Technology Issues
- Critical Environmental Issues and Potential Impacts
- Critical Social Issues
- Alternative patterns of use in rural Alaska
- Costs and potential benefits
- Alternatives to its use.
- Recommendations as to ways to proceed

For the most part this assessment will be focused on the AP1-88 Hovercraft operating in an experimental mode in the Y-K Delta. Under recommendations there will be a note on other hovercraft or air cushion vehicles.

Chapter II Principles of Operation

Air cushion vehicle principles were noticed in the mid-eighteen hundreds. Real development, however, didn't occur until 1950 when a more efficient design was invented by Christopher Cockeral. With high potential for military applications and operations in difficult areas, considerable progress was made towards what we call modern day hovercraft. Most notably, the invention of the inflatable skirt by Charles J. Fletcher dramatically changed hovercraft design and made them practical.[5] Today there are many hovercrafts designed for a variety of uses and new advancements are constantly being made.

The Hovercraft Experience for the Bethel/Kuskokwim area begins as early as 1970. At that time the Air Cushion Vehicle (ACV) Technology was just coming to a point of initial operational usage.[6] Even at that time the ACV or Hovercraft was not new to Alaska. The ACV has operated in such widely varying areas as the Cook Inlet (1966)[7] and on the North Slope near Barrow (1972). Further, there were several tests going on in the cold regions of Canada even at that time.[8] Interest in Hovercraft reemerged in 1982 when the two different Hovercraft one Passenger and one freight were tested in the Bethel region. It was one of the technologies evaluated in the Knik Arm crossing to Anchorage[9].

The other revelation to this writer was the extent to which Hovercraft have invaded the personal transportation market. There are a number of places where hovercraft are home-built as a hobby.[10] There are clubs throughout the United States[11] and several annual meets or rallys[12].

When examining the terrain and the difficulty presented by travel condition the Hovercraft presents one possible mode of year around ground/water/snow travel for an environment such as the YK delta. This is not a new idea, but if it can lower the cost of living in the Bush without sizeable impact to the environment, it may well be an idea whose time may have come. For example, Universal Hovercraft in their advertisement in the web states

> "High speed Hovercrafts and Air Cushion Vehicles for all seasons.
> Up to 80 mph on land, water, ice, or snow."

The Hovercraft as the name implies has the advantage of riding above the earth either land or water. It is a craft that in various forms is in operation in a number of Arctic applications. It

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5 Stews description

6 Routes in the United States like the Oakland Port Demonstration Project of the U.S. Department of Housing and Urban Development (Later the Urban Mass Transportation Administration of the USDOT (UMTA). The demonstration took place in 1970 employing the British Hovercraft Corporation Models SR-N5 and SR-N6.

7 Alaska Transportation Commission; Hearing Docket #70-34, Skimmers.

8 Tests were conducted in 1966 at MacKenzie Delta with the 40 foot long (SR-N5) and in Manatoba with the 48 foot long SR-N6.

9 State Legislature letter from Senator J. Coghill Senate Transportation Committee to the committee, September 22, 1987 with attachments.

10 All aspects of hovercraft design for recreational use are presented in the book, "Hovercrafting as a Hobby", by James Perozzo. Available from Twin Peaks Publishing; 30455 Kent-Blk Diamond Rd., Auburn, WA 98092.

11 Hoverclubs in the world include Australian Hovercraft Federation, Hovercraft Club of Canada, Hoverclub of America, Hoverclub of South Africa, Belgian Hoverclub, RHONE ALPES AEROGLISSEURS, Hoverclub von Deutschland, Hoverclub of Great Britain, The Netherlands Hovercraft Club, Japanese Hovercraft Association, Hovercraft Club of New Zealand, Wellington and Wairarapa (New Zealand) Hover Club and Swedish Hoverclub. Most of them publish a bi-monthly newsletter. For example the newsletter of Hoverclub of America's publication 'HoverNews' is distributed every two months. Subscription/ membership in the club is $30/yr. See (Http://www.hoverclubofamerica.org/)

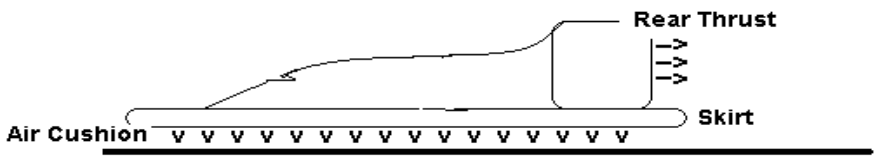
12 Several rallies scheduled for 1998 are the 23rd National Annual Hove Rally/June 12,13, & 14/Troy, OH; 1998West Coast Hover-In and Cruise/July/Long View WA; The U.S. National Cruise on the Wisconsin River/August/Muscoda, WI; Scioto River Hover-In & Cruise/August/ Chillicothe, OH; Tennessee Hover-in/October/Big Spring, Tennessee; Texas Hover-In/October/Dallas/Ft.Worth TX,

certainly offers a lower cost alternative providing new economic value to the bush communities. It offers the potential for more regular, less weather dependant operation than the present air service. The hovercraft has the potential for operation over a series of “tundra/river” roads that could form the appropriate paths for travel between communities.

There are two types of air cushion vehicles: the integrated system and the non-integrated system. Both systems develop sufficient lift to raise the craft off either land or water. The integrated system uses the same propulsion system to drive fans providing both lift and forward motion as depicted in Figure 1. Generally, the integrated system is used for recreational hovercrafts while the non-integrated system is used for recreational, commercial, and cargo carrying hovercrafts. Air cushion vehicles are very useful as commercial vehicles. They can be used as ice breakers, ferrying or lightering watercraft, hauling vehicles, buoy tenders, and even rescue craft.

In the integrated system about one third of the thrust is taken from the thrust fan using an air splitter directly behind the propeller and routed underneath the hovercraft to the air chamber. The integrated system uses the self-supporting ‘pleated skirt’ rather than the inflated bag skirt of the non-integrated system. The pleated skirt is self supporting with the pressure of the air chamber used to maintain its shape.

Figure 3 Lift and Thrust Diagram - Side View



The non-integrated system uses two separate engines and fans, one for lift, the other for forward thrust. The air created by the lift fan is contained under the craft by an air chamber. The chamber is formed on all four sides by the skirt, on the top by the craft, with the surface of the land or water being the other surface. The skirt which lines the perimeter is expanded when the air from the lift fan is blown underneath the craft It is further inflated with higher pressurized air. The pressure then builds up until it is so great that it pushes the craft up from the surface.

A hovercraft can only hover as high as the air chamber is tall so the size of the skirt controls the height above the surface. Also, the gap between the ground surface and the skirt is usually between one and four centimeters. Since air is constantly escaping through the gap, the lift fan is sized to maintain sufficient air flow to maintain the gap. The gap between the ground surface and the craft is important since it reduces surface contact friction and thereby affects the efficiency of the hovercraft In operation, the Hovercraft encounters changes in wind, surface conditions and direction that causes brief contact of the skirt. Thus, depending on these many changing conditions the skirt does touch down occasionally.

The forward speed of the craft is governed by a separate thrust engine. There is a critical speed for each craft since when the critical speed is reached between 50 kilometers per hour(kph) and 100 kph when more air escapes from the air chamber (through a larger hover gap) thereby depleting the craft's ability to lift.

Control of a hovercraft is achieved by activating air rudders located behind the thrust fan much like an airboat. When a hovercraft is on water it presses the water underneath it downwards 2 to 3 centimeters because of the high lift pressure. This creates a wake. The wake forms at about 10 to 15 kph For a craft to go faster 15 kph, it must have enough thrust power to push itself over the wake.

Chapter III The State of Development

Some Commercial Uses[13]

"In Canada, hovercraft built by Bell Aerosystems are used between Montreal and Beauharnois to crack ice up to forty inches thick. Conventional ships are more expensive to run and take up to twice the time to crack the same amount of ice. Also, hovercrafts clear twice the amount of space and use less fuel than heavy conventional icebreakers. A hovercraft uses shock waves to break the ice instead of ramming. Since the ice is hard, it is unbendable. When the hovercraft goes between fifteen and thirty miles per hour it creates a wake in water, and the same forces are applied to ice. When the hovercraft moves over the ice it bends the ice in waves to try to make a wake, and since the ice won't bend, it shatters. Also, because hovercrafts use waves to break up the ice, the waves travel and break up a path about twice as wide as the craft itself. Hovercrafts are much more efficient than ships, have much better maneuverability, and can also break ice in shallow waters far better than ice breaking ships."

Hovercrafts are becoming increasingly popular as ferries for people and their belongings. Hovercrafts are used in England as ferries across the English Channel and also Oresund Sound. The AP-l88 Hovercraft, used to cross Oresund Sound, was built by British Hovercraft and can carry one hundred people a trip. The ferrying service started in 1984 and was intended to draw more business to the travel industry. The AP-188 uses four, four hundred and fifty horsepower diesel engines for lift and thrust using the non-integrated system. Due to the success of the AP-l88, British Hovercraft is considering the building of larger hovercrafts to also use as ferries.

Often, hovercrafts are used as search and rescue vehicles. Small air cushion vehicles are well suited for rescue purposes because they can hover over deep and shallow water and ice. They are especially good for saving flood and drowning victims. In 1989 the North Muskegon Fire Department, Michigan, used a modified SCAT hovercraft to save a fisherman. The fisherman was stuck in the middle of a flooded area and the current was too fast for him to swim, so a hovercraft was used to rescue the fisherman.

One of the primary uses of commercial hovercrafts is hauling. In some conditions a hovercraft can be used instead of an ocean liner or a barge. Hovercrafts can turn easier than large ships and can also go in shallow water and marshes. Air cushion vehicles provide a good alternative to large ships in many instances. However, hovercraft are too expensive and impractical for long term hauling. Compared to today's super tankers and extremely large ships, hovercrafts can't carry nearly as much cargo to make a long distance trip efficient. Hovercrafts also generally don't perform well on rough seas and easily get blown off course. While air cushion vehicles would work well as commercial craft on rivers and small bodies of water, they aren't efficient or practical enough for long-term hauls over the oceans or very far up and down the coast.

[13] Stews

Military Uses[14]

Hovercrafts can also be used militarily as assault and landing craft. Air cushion vehicles are useful is assault craft especially on rivers because of their speed, agility, and ability to hover over swamps and land. From 1966-1969, six modified Bell Aerosystems commercial hovercrafts were used to patrol rivers in Vietnam. Each hovercraft had two machine gun turrets and was equipped with radar. Hovercrafts were good for patrolling, but they had disadvantages. As ARMY magazine said, " Their mobility was well suited to the task, but maintenance problems and high noise levels left unresolved the question of whether they were better than helicopters in tactical roles."

Air cushion vehicles are now becoming more predominant in the military as landing craft to transport troops and vehicles such as tanks and jeeps from a ship directly to shore. These amphibious landings are far better accomplished by a hovercraft than by a ship because a hovercraft can move from the water directly to the land so the cargo doesn't have to get wet. The US Navy's LCAC hovercraft is an assault, landing, and transport hovercraft which can carry more than sixty tons. The LCAC can carry an M1A1 tank, troops, equipment, and / or supplies. The LCAV-3O US Army hovercraft has a thirty ton payload limit and is used both as a cargo transport and as a landing craft. The LCAV-30 went out of US Army active service in 1993.

Chapter IV Specifications

Since it is the AP.1-88 that is of concern, its specifications and operating characteristics are:

- **Size: 70 feet (21.33 meters) long, beam 36 feet (11.5 meters)**
- Height on Landing pads 26 feet; Hovering - 29.2 feet
- Welded Aluminum Alloy Construction
- Thrust engines: Two Deutz BF12L413FC 500 horsepower marine diesel engines
- Lift engines Two Deutz BF10L413FC 390 horsepower marine diesel engines
- Propulsion: 2 x 2.74 m (9.0 ft) diameter shrouded propellers
- Fans: 8 x 0.84 m (2.75 ft) diameter centrifugal type
- Cowlings to reduce the noise
- 18 inch skirt
- Cruising speed 30 knots
- Maximum Operating Weight 74,000 pounds
- Payload 12,500 pounds (Including Passengers)
- Could seat up to 80 passengers (Seats for Twenty passengers)
- Crew of 3

[14] Ibid

- Maximum fuel 720 U.S. Gallons
- Fuel Consumption rate provides 12 hours of operation

Operating

- Cruising speed limited to 30 knots on the rivers
- Payload 10,000 pounds (Including Passengers)
- Twenty passengers
- Reduced speeds when operating in heavy traffic or very inclimate weather

Energy Intensity

The energy costs of the hovercraft are much higher than those of the truck carrying similar amounts of freight. The hovercraft uses significantly more fuel because fuel is providing both forward thrust and lift. However the BTU's required per ton mile of carriage make it competitive with other forms of carriage in terms of it usage of fuel. The fully loaded ACV with a higher rated payload operating at max speed can move about 11 Ton at 57.5 MPH. So in one hour it can move 632 Ton Miles. During that hour it will consume about 430 liters or 110 gallons of diesel fuel @ 140,000 BTU/gallon resulting in an Energy Intensity of about 24,300 BTU per TM.

This ACV can move about 6.5 Ton at 30 mph. At the fuel rate of 60 gallons/per hour this would result in an energy intensity of about 43,100 BTU/TM.

A fully loaded semi-van truck that carries about 25 tons, consumes about 13 gallons per hour travelling at 55 mph. It has an Energy Intensity of about 1400 BTU per TM. This gives a disparity of over 15 times when comparing the energy use of these two forms of transportation.

The fact that there are no roads, suggests that we should compare the Energy Intensity with Air. The Cessna 206 can carry a payload of about 1000 pounds and uses about 16 gallons per block hour. Since it travels about 120 mph it will make two 30 mile round trips in an hour. Thus it will carry 60 TM/hour using about 16 Gallons of AVGAS yielding an Energy Intensity of 32,000 BTU/TM. Larger Aircraft will provide a better Energy Intensity, but the villages that the Hovercraft is serving are generally served by Cessna 206 and 207's

The hovercraft is expensive to purchase and to operate and maintain. It requires a crew of three to operate the craft. With its speeds of over 50 knots it can cover considerable space in a short time. In that regard it is equivalent to any truck. On the other hand, since its operation in the Delta area is confined to the river, it must go longer distance than air miles due to the river's circuity

Chapter V Some Critical Technology Issues

If there are any critical issues related to the use of the Hovercraft in the Y-K delta region it would be operating reliability in the harsh environment and noise. The hovercraft came to Alaska from Florida and many of the problems that were encountered in the first year of operation were temperature related. Once those problems were solved the hovercraft has operated

successfully in temperatures to and including minus 40 degrees F.[15] Several minor modification were made to the machine

- Combustion air intakes had to be re-routed to avoid snow-buildup that cutoff the air supply.
- A new source of prop pitch actuators had to be found in the U.S. as the existing actuators were no longer being manufactured.
- New prop pitch controllers had to designed and installed.
- New governors on the prop. engines had to be fitted. (built in U.S.A.).
- A new manual governor for proper. engine cooling was developed and installed.
- The end cones were modified for better lift.

While the noise can be shown to be somewhat less than the integrated effect of a number of single engine aircraft or several snowmobiles or ATV's and boats, all of which occur daily (depending on the season) at every village. It is, nevertheless, a much stronger noise sound that is short lived when it occurs. Such occurrence have seemed to be offensive to the native community. The ETC study used the integrated noise model that the FAA uses, which uses the integrated effect of noise producers than focusing on an individual occurrence. While there is some thought that the level of noise is responsible for the flushing of ducks and for some possible migration of wildlife away from the hovercraft track site, there is no proof of that concern. The real problems are not with the technology, but with the history and bad name that the craft has received from the native community.

The new AP1-88 which this author rode in Vancouver Canada (October 15, 2000), is much quieter. Both fan design improved ducting seem to account for much of the noise reduction. One could stand out on the back of the craft as it was moving without significant discomfort from the noise. So should the vehicle be replaced, or perhaps just the fans replaced, the AP1-88 will be less obtrusive, noise-wise,

Chapter VI Environmental Issues

There are a number of environmental issues that need to be confronted if the hovercraft is to receive any major acceptance in the Y-K delta. Several studies have been performed to address these issues. The best of the studies is found in 3 reports prepared for the USPS by Volpe National Transportation Center and Environmental Engineering Solutions;

1. "Supplemental Environmental Assessment – Hovercraft Transport of Alaska Bypass Mail," July 1997
2. "Supplemental Environmental Assessment – Hovercraft Transport of Alaska Bypass Mail," June 2000
3. "Ecological Monitoring Summary Report - Hovercraft Transport of Alaska Bypass Mail," March 2000

For purposes of distinguishing between the efforts there were comprehensive studies by the U.S.P.S. through the Volpe National Transportation Systems Center (VNTSC) in Cambridge,

[15] These data are from Glen VanValen, Project Manager for the hovercraft in Bethel.

MA covering approximately 36 months and a much less comprehensive study sponsored by the Calista Elders Council, performed by AGRA Earth and Environmental, Inc., covering one to two weeks of observations.

The USPS Studies

The USPS had completed an Environmental Assessment of the 2-year demonstration program (this was increased to three years to ensure adequate test results), an in-depth ecological study, and a Supplemental Assessment that considered the permanent transport of By-pass mail to eight villages.

The most significant elements of the USPS ecological monitoring were:

1. Methods and results were peer reviewed,
2. Public and local regulatory agency review took place over several years with many observations;
3. Incorporated comments by local people who had traditional knowledge of the area
4. Adjusted the measurement program (choice of best places to monitor) as result of village meetings
5. Monitoring program adjusted to reflect their concerns.

The hovercraft was confined to operate only on the rivers and a contractor was retained by the United States Postal Service (USPS) to perform the Environmental Assessment. That contract, with concern over its relationship with the native communities, went to a Government Think Tank, the Volpe National Transportation Systems Center of the U.S. Department of Transportation. Volpe was given sufficient resources to conduct these studies using noted experts in the field from Daniel, Mann, Johnson, & Mendenhall, CH2M Hill, and Woodward-Clyde Federal Services. *[Note: The Volpe staff has conducted noise studies for transportation beginning in 1974. Its staff has a unique (author's opinion) noise data gathering and analysis capability. It also has developed noise models in use by the transportation community]* These studies were conducted in three phases. The first, begun in spring 1995, was to be an Environmental Assessment EA in support of a two year experiment to occur from July 1997 to July 1999. During the study there was considerable public involvement with the Native communities that would be affected. The experiment would use the AP1-88 Hovercraft on the rivers around Bethel to transport the large quantities of mail to seven villages. The final EA was released in July of 1997 with a "Finding of No Significant Impact (FONSI)." However, the study continued with in-depth measurements taken over the next three years. The final report was issued in June 2000 and is titled "United States Postal Service; Supplemental Environmental Assessment – Hovercraft Transport of Alaska Bypass Mail." It delineates the research conducted and the results leading to the FONSI.

The level of study and the results are much more than can be accommodated here. The author has attempted to summarize them in some of the critical environmental areas. Studied were Fish and Wildlife (includes birds, especially shore birds), Aquatic resources, Noise, Air Quality and Subsistence activities and Commercial Fishing. The study also addressed a range of socio-economic issues, which are reported elsewhere in this study. The reader of this assessment is encouraged to obtain a copy of the Postal Service study to examine the details of their findings and for a bibliography of related studies and papers.

Fish

The Kuskokwim River is an important fish habitat. It serves as both a migration path for anadromous species; mostly all varieties of salmon and a year-around habitat for other fish notably sheefish, blackfish and whitefish. The areas of concern around the hovercraft operation included spawning, adult fish mortality, juvenile fish (fry) in shallow water areas.

Stranded Fish

From Hovercraft wake	Investigation found that there was no significant difference water motion or intensity between the hovercraft and a medium sized motorboat commonly used on those rivers. Some 13,000 yards of beach were checked for stranded fish, with no being found attributable to the hovercraft.
At Landing sites	Chum salmon fry during the four week period when they were most present show that those stranded during this period were about 2.5 per landing. The percentage compared to the estimated population of over 1 million is insignificant. In addition juvenile whitefish stranding was observed over the period from mid- April to mid October. Here again the 369 whitefish fry would be a negligible fraction of the total population. Other sources of depletion of whitefish during the time of maturing having nothing to do with the hovercraft way out weigh this loss.
From operating in shallow water and near shore	The problem here is the potential stranding after the hovercraft passes especially near low gradient beaches. Over the month tests concluded that most of the fish stranded by such action were whitefish with a stranding rate of about 1 fish for every 250 yards of beach. Again compared to the of whitefish fry this amount is negligible.

Mammals

As the result of the scoping meetings with the resource agencies, the USPS study never investigated the effect of the hovercraft on mammals. According to the agencies, a kill zone pretty much exists along the Kuskokwim and Johnson Rivers caused by the local subsistence hunters. Large mammals are easily avoided if direct contact appears likely, although no caribou or moose were encountered during the experimental phase. Noise and other disturbances may impact those mammals that would feed near the shore, however many of them are relatively used to the disturbances on the river from boats in summer and snow-machines in winter.

Birds

Bird habitat included those birds that nest near the riverbank, migratory birds and those that breed near the water. Control transects were established along with those in affected areas and the bird activity closely monitored. The results indicated that no significant additional activity in bird patterns existed beyond that already present with other boats on the river. The results are summarized below.

Flushing from river banks	Waterfowl were noticed moving from their riverside habitat during the passing of the skiffs, motorboats and the hovercraft. The gulls, ducks and shorebirds often landed a short distance away. (p 46-47)
Use of the river habitat	Experimental effort identified transects on several rivers involving both control and hovercraft route areas. No specific differences attributable to the hovercraft were found. Bird abundance along the rivers seemed to be more impacted by the quality of the habitat than by any boat or hovercraft traffic on the rivers. (p 47-50)
Breeding waterfowl	Aerial surveys of the areas along the three rivers involved indicated no statistical difference between transects involving the hovercraft and the control areas. (p 51)

The following note from one of the progress reports indicates the type of study the team from Volpe conducted:

"Mr. Christopher Roof of the Safety and Environmental Technology Division, along with Mr. David Read of W. T. Chen and Mr. John Burgess, a biologist with CH2M Hill (both Volpe Center contractors), visited Bethel, Alaska, in order to perform noise measurements of the hovercraft and to study blackfish behavior near the small village of Kasigluk. Blackfish are a primary food source for the local population. The measurements were conducted while the Johnson River was covered with ice in order to evaluate the effects of ice on the underwater noise. In addition to conventional acoustic instrumentation, the team used hydrophones to measure underwater noise levels and specialized video equipment to monitor blackfish behavior. The team also monitored other environmental conditions, and interviewed local fishermen to obtain their day-to-day accounts.

Mr. Roof and his team accomplished their tasks despite numerous obstacles including making the 30-mile trip each way every day to Kasigluk via snowmobiles. Sleds were used to transport more than 500 pounds of support equipment, including acoustic instrumentation for measurement in water and air, as well as meteorological and video instruments.

The winter underwater noise monitoring and visual observations showed that the hovercraft had little impact on blackfish subsistence gathering and that, after careful observation and repeated testing performed by Volpe staff over the past three years, the hovercraft has had little impact on waterfowl and only a few dead, injured, or stranded fish have been found. "

A hydrophone measures noise levels under the ice on Johnson River (Photo by Roof)

Source: Volpe National Transportation Center and Environmental Engineering Solutions

The Calista Study

The Elder's Council of the Calista Corporation conducted their own study. They contracted with AGRA Earth and Environmental Inc. to examine the impacts of the Hovercraft on fish and wildlife. The methods used by AGRA did not receive any known peer review nor to the author's knowledge were they presented for public comment and/or reviewed by local regulatory agencies. All work was completed over a one to two week time period with very limited observations. (The seasonal changes that occur over an extended period cannot be adequately observed in such a short period.) The major impacts that the AGRAE&E study identified were:

Fish disturbance when the craft is traveling below hump speed. There is no doubt that below hump speed the ACV displaces water and increases turbidity, however the craft is run above hump-speed over 90 percent of its operating time. The effect on fish either from noise or turbidity or from displacement has been observed to be minimal. The AGRAE&E report "For fish, impacts by the hovercraft seem to be negligible on a population level." [*The suggestion by this study that the hovercraft affects the water column in a manner to cause the fish to dart into deeper water has been examined in detail by the USPS study and not confirmed. The USPS study further indicated that the hovercraft has no part in the shortage of fish in the areas in the 1999-2001 seasons*].

The AGRAE&E study suggested that hovercraft noise was involved in flushing of waterfowl and possible migration of wildlife that occupy the land near the shore. The major problem with the study is that there is no "before" data. Thus the study uses a pristine area nearby as its control area. The differences between the use of an area not affected by the tides (the control area) to one that has significant tide effects, namely the Kuskokwim and Johnson Rivers, may have as much to do with the results as the hovercraft. Also, salt-water invasion will certainly affect pH, turbidity, and conductivity. While the AGARE&E finds these results to be statistically significant, the results cannot be in any way attributed to the hovercraft.

The effect on local wildlife that normally would be found near the water banks. Along the Kuskokwim River and the Johnson River, the proximity of hovercraft passage coincided with decreased presence of mammal scat along the shore. But remember, the local residents suggested that a kill zone exists along the Kuskokwim and Johnson Rivers because of the local subsistence hunters. Thus it is not surprising that scat increased with distance from the river. Similar findings were found in comparing the Johnson River with the control area. The study concludes "While the results indicate that the abundance of wildlife is lower in the impacted area, species diversity does not appear to be affected: Tracks of shore bird, raven, gull, crane, fox, muskrat and porcupine were found in the impact area."

The areas tested were found to be vastly different in bird droppings and scat and in the plant utilization along the water banks. This only suggests to this author that, "the subsistence resources differ between the two rivers."

There is no impact that has been observed by AGRAE&E that can with certainty be identified to occur as result of the hovercraft operation over the 18 months of operation. Not surprisingly they suggest that more study is required. The problem may not be the actual disturbance by the hovercraft but the perceived disturbance to the local residents. The clear problem is that there is not any "before" data with which to compare the present data and the choice of a control area, which the contractor used to compare results, leaves much to be desired. Unlike the USPS study, the Calista study seemed more politically oriented. It received no known peer review. As suggested, some of their results are suspect due to the very short time of data collection and/or the use of several skeptical data collection approaches.

Chapter VII Social Issues

The major social issue is that the use of the hovercraft has replaced several flights by small planes formally used to deliver non-priority mail. In fact it is estimated that the ACV replaced some 250 flights per week carrying mail. Its every other day delivery fits the USPS mail service standards for by-pass mail. The present displacement would involve at least 50 pilots, all of whom would live in Bethel. Air terminal employees and village agents have not changed, since the same agents are now working to move the hovercraft delivered mail, although they are doing it every other day instead of every day.

The pilot displacement is not a problem since other parts of the Delta are requiring increased flights and there is a pilot shortage.

To the extent that the hovercraft could affect animal and fish and their habitat, it could also affect the subsistence living approach of the natives. The full three-year study by the USPS did not identify any real impact on subsistence species or activities. There exist several perceptions, often with second-hand statements, as to the negative impact of the hovercraft on fish and game; the claims, however, were not observed during the three-year study.

Chapter VIII Alternative Patterns of Use in Rural Alaska

- There are a myriad of other uses that the hovercraft, with its unique ability to travel over land and water, might satisfy in Alaska.
- The Canadian Coast Guard has found the hovercraft to reduce the cost of tending buoys — not only can it get to the buoy faster, the size of the crew needed is much reduced.
- The hovercraft is being used in the Prudhoe Bay area to provide service to their offshore oilrigs. Its ability to travel over water or ice makes it an ideal service vehicle.
- The Canadian government is using the hovercraft to expedite their Search and Rescue operations in the Vancouver area
- The hovercraft is being used in an icebreaking role to extend the commercial season in some ports on the St. Lawrence Seaway.
- It has been used in the Bering Sea to lighter some goods from larger ships to shore facilities
- It is a competent vehicle for carrying passengers.

Chapter Ix Costs and Potential Benefits

The post office can see an immediate benefit. The hovercraft is equivalent to the ground system with which they deliver mail in the Lower-48. Rules that they are used to apply. Finally for them it is somewhat cheaper than the air equivalent, although certainly as the energy intensity comparison indicates, it is much more expensive than truck. The intangibles such as its use in search and rescue provide a high value intangible when lives are saved.

Finally what can be said about the economics of its operation? I have only a small bit of data on which to base it. In addition I include the investment cost amortized over 30 years. The craft that is used in the Y-K Delta was purchased used, and is about 25 years old. Certain things have been learned from the operation in the clod climate to improve its availability and reliability.

The following weekly costs are estimated by the author

Labor (includes 50% overhead)			$ 15,000
	Operators	3	
	Added Unloading and loading personnel	1	
	Added Maintenance Personnel	2	
Fuel		(300*6)	$ 2,700
Maintenance			$ 2,500
Insurance			$ 200
Investment		($7 Million 30 years @6%)	$ 10,200
Other Cost (G&A, profit, etc			$ 4,000
			$ 34,000

This little exercise indicates that moving the mail is about even between the aircraft and the hovercraft, if there is a cost item to depreciate the craft. Since these craft were bought as surplus, the cost can be about $10,000 lower, which makes it a way for the USPS to lower their costs for mail.

That is an expensive operation for one week. The Post Office moves about 65,000 pounds each week.

EXCURSIS

In July 2001, Alaska Hovercraft/JV began the second five years of delivering the mail to the seven villages around Bethel The costs to the USPS are such that they find it an important way of reducing their costs. The only thing in the way of infrastructure that would help maintain a higher level of product acceptance in the villages would be to give the Hovercraft a better landing area, free from the muddy shore that is being used today and often times makes delivery difficult. It is interesting, when one considered that the Kuskokwim Ice Road is plowed in the winter, village roads constructed and maintained, village airfields constructed and maintained, and winter trails marked for snowmachine safety, that the Hovercraft seems like the step-child. The lack of permanent Hovercraft landing facilities or gravel access roads to the landing sites often means that the goods are moved on the mud with instances noted where they had to be left uncovered on a skid in a muddy area.

Chapter X Recommendations

The Hovercraft technology was found to be appropriate for the Kuskokwim River area of Alaska. It can operate in the winter and during times of inclement weather found during summer months. It is a safe alternative mode of transport for the area. The key recommendation is to find a way to achieve some acceptance of Air Cushion Vehicles among the native community. Some elders have gone on record during public meetings in support of the Hovercraft, while others have stated their opposition. Accommodation may take several years. The hovercraft offers year

around transportation and mobility and can be used in a variety of operational modes. Residents of this region are no longer dependent on the summer months to move large amounts of freight with the help of the Hovercraft. It can always be used as the Postal Service is using it now for the delivery of the large amounts of mail to the bush villages. It could do that more efficiently if it were not constrained to the circuitous rivers. The original service included Atmauthulak, but because of being constrained to the river the time from Kasigluk to Atmauthulak over the Johnson and Pikmiktalik Rivers was over an added 90 minutes, the service to Atmauthluak was stopped. It is interesting to note that the trip between Kasigluk and Atmauthluak is only six miles across the land and wetlands between the two.

It is not inconceivable where short distances exist that tundra routes could be defined, with the help of the regulatory agencies and local Alaskan Natives, and the Hovercraft kept on them just as a car is kept on the highway. This could minimize any widespread damage. In addition, several alternative routes could be planned for in the event impact is needed to be minimized. Furthermore, winter crossing of the frozen tundra should be considered as an alternative route for the Hovercraft. Similar to the ice roads constructed for tracked vehicles, the Hovercraft could possibly use pre-approved routes over the snow-covered tundra during the winter months with negligible impact.

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