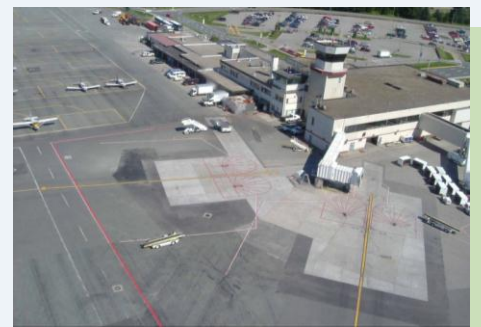




Alaska Aviation System Plan Update

Yukon-Kuskokwim Region Air Versus Roads Access Construction and Maintenance Baseline Cost Comparison

January 2013



**YUKON-KUSKOKWIM REGION
AIR VERSUS ROADS ACCESS
CONSTRUCTION AND MAINTENANCE BASELINE
COST COMPARISON**

ALASKA AVIATION SYSTEM PLAN UPDATE

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APPENDICES

Appendix A	Roadway Cost Estimations
Appendix B	Airport Cost Estimations

LIST OF ACRONYMS

ALP	Airport Layout Plan
ANILCA	Alaska Native Interest Land Claims Act
CSU	Conservation System Unit
DOT&PF	State of Alaska Department of Transportation and Public Facilities
M&O	Maintenance and Operations
SREB	Snow Removal Equipment Building
USGS	United States Geological Survey
WAAPS	Western Alaska Access Planning Study
Y-K	Yukon-Kuskokwim

1.0 INTRODUCTION

The purpose of this study is to compare the costs of constructing and maintaining an airport system in Alaska with the costs of constructing and maintaining a conceptual road system. A subarea of Alaska, the Yukon-Kuskokwim (Y-K) Region, is used to build the comparative case study. The Y-K Region was selected because it contains a large hub community and over 50 villages within relatively close proximity to the hub community of Bethel.

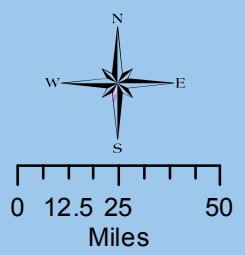
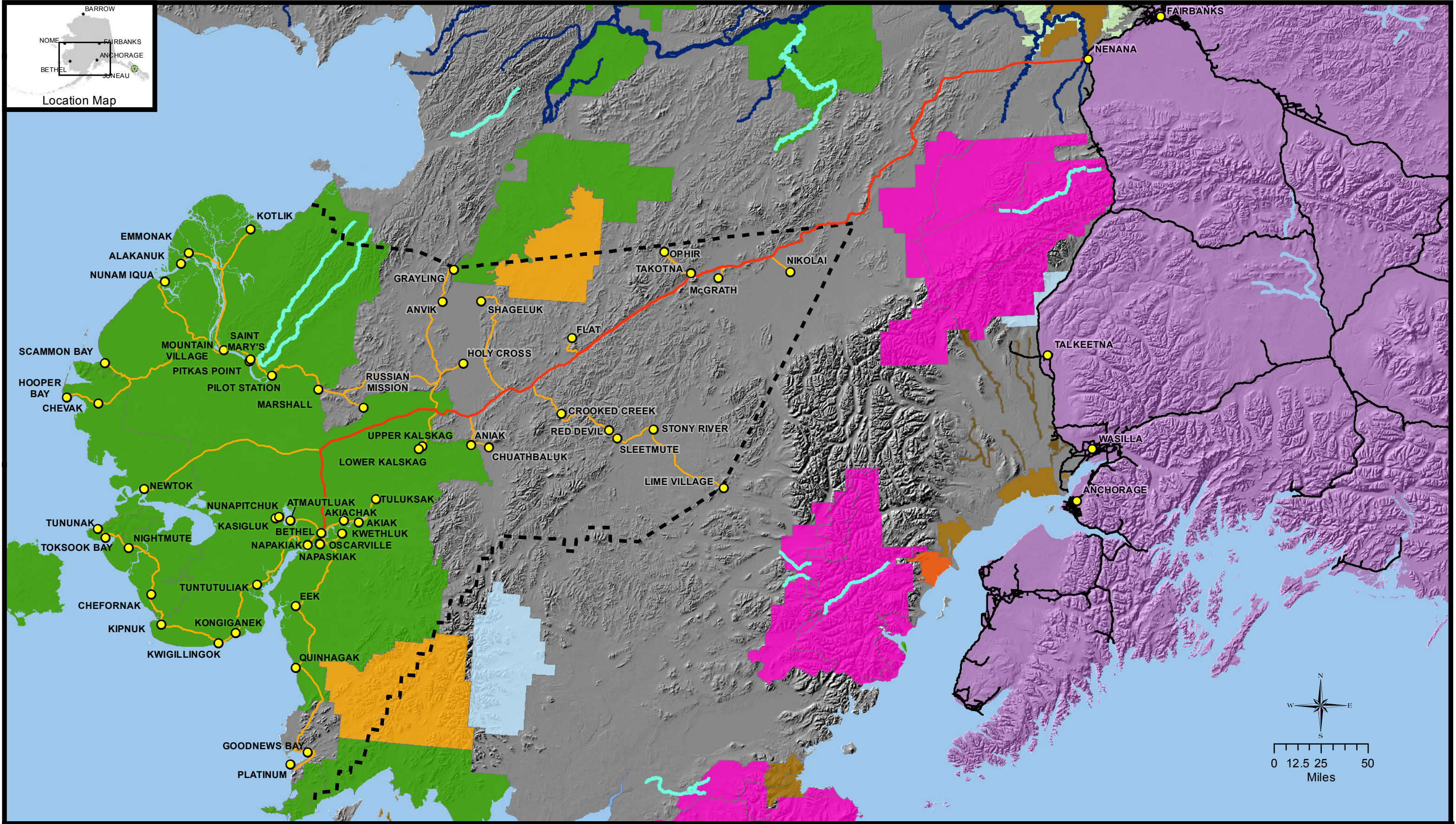
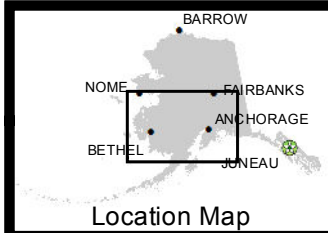
The Y-K Region is approximately the size of the state of Oregon. Located in western Alaska, most communities in the region are located along or near the Yukon and Kuskokwim Rivers. Much of the region is federally protected land in the 19.16-million-acre Yukon Delta National Wildlife Refuge. Daily passenger medevac and cargo transportation to the region is provided by the air transportation system. Road access is primarily limited to short roads within and near communities and some winter ice roads. No communities in the region are connected to the national highway system, nor are any connected by all-season roads.

Air and road access cost estimates were developed for 52 communities in the Y-K Region study area (Figure 1). Communities that are not currently served by an airport and those unreachable by road (i.e., on an island) were excluded for the purpose of this study. Construction estimates for road and airport options do not include costs for pre-construction engineering, environmental permitting, right of way, construction engineering, or overhead. Additional cost comparisons could also be completed, but were not needed for the limited scope of this study. They include costs for public use (costs of airfare versus costs of driving and transporting goods); costs of improving existing airports up to ultimate goals; costs for maintaining airports at a higher level and for longer daily durations; etc. Costs for engineering, land acquisition (right-of-way), permitting Indirect Cost Allocation Plan, overhead, and contingencies, were not included in either cost comparison. Several of these items are listed at the end of this paper for possible future study. All cost estimates are in 2012 dollars.

While this study finds an airport system more economical than a road system in terms of construction and maintenance, some roads in Alaska are not only beneficial but also possibly even cost-effective by providing access for other needs, including natural resource development. However, the overall system of airports represents the most efficient and cost-effective way to

provide year-round access to remote Alaskans. Furthermore, even if a road system were built, airports would continue to be needed to support many of the communities in the Y-K Region.

Yukon-Kuskokwim Region Air versus Roads Access Construction and Maintenance Baseline Cost Comparison study was conducted with a very limited and narrow scope. The intent of this cost comparison was to conduct a baseline cost estimate for comparing construction and maintenance of both air and land transportation links. Costs for roads were compiled using costs and design criteria from existing new road construction studies in areas with similar terrain. To ensure an “apples to apples” comparison, this study focused on the costs to create both air and land transportation links as new construction.



Communities and Placenames	Outside of Project Study Area	National Park	State Park
Existing Roads	Yukon / Kuskokwin Delta Area Trans. Plan Boundary	State Game Refuge/Sanctuary	State Forest
Primary Arterial Corridor		Wildlife Refuge	Fisheries Reserve
Secondary Connector Corridor		Wilderness	Critical Habitat Area
Water		State Recreation Area	Wild & Scenic Rivers

Sources:
 Water: DNR
 Communities and Placenames: DNR
 FCU: DNR
 Existing Roads: ADOT&PF
 Trans. Plan Boundary: ADOT&PF
 Coordinate System: NAD 1983 Alaska Albers

STATE OF ALASKA
 DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
 CENTRAL REGION

BETHEL AREA AIR VS. ROADS ACCESS COST COMPARISON

CONCEPTUAL ROAD CORRIDORS

DATE: July 09, 2012 Figure 1

2.0 ROADS COST ESTIMATE

A conceptual primary arterial road corridor was developed that would access Bethel from the Parks Highway. Bethel was selected as the terminus of the primary arterial corridor due to its function as the hub to surrounding communities. A conceptual network of secondary connection corridors was developed from this primary arterial corridor to access 51 additional communities in the project study area. The project study area, with included communities and the associated conceptual roadway corridors, is shown in Figure 1.

The mountainous terrain of the Alaska Range, along with the development restrictions in Denali National Park and Preserve, precluded developing a cost-effective primary roadway corridor from the southern portion of the Parks Highway. As a result, Nenana was selected as the most practical terminus on the Parks Highway for the primary arterial corridor leading to Bethel. The total length of the primary arterial corridor from Nenana to Bethel is approximately 559 miles. The total length of all secondary connection corridors is approximately 1,458 miles, resulting in a total length of 2,017 miles of conceptual roadway corridors in the project study area.

The conceptual corridors were designed to minimize construction and maintenance costs by avoiding challenging terrain where possible. Corridor alignments were developed based on available aerial photography, satellite imagery, United States Geological Survey (USGS) topographic maps, and federal conservation units. Conceptual corridors were developed based on land status and terrain features without reference to Indian Reservation Roads, historical corridors and trails, or regional transportation plans. Corridor alignments were selected to minimize crossing of steep slopes, wetlands, federally protected lands, and areas assumed to have poor geotechnical conditions. River and stream crossings were minimized when possible to reduce bridge and culvert costs, which comprise a substantial portion of preliminary baseline costs for these corridors. Optimal crossing locations for large rivers were identified using Geographic Information System (GIS) data, USGS maps, and aerial photography to minimize the necessary water crossing structure lengths.

Right-of-way acquisition would be a significant obstacle to constructing a roadway system accessing the Y-K Region. The conceptual roadway corridors primarily cross state-owned and federal lands, including federal Conservation System Units (CSU). Within the project area,

CSUs are primarily National Wildlife Refuges. Crossing federal lands, particularly CSUs, may not be feasible and would require substantial time and costs to complete the land transfer process, including extensive permitting, National Environmental Policy Act documentation, and unified political support. Crossing state-owned lands would reduce time and costs for acquisition of right-of-way.

Acquisition of road right-of-way across lands that have been patented, certified, or selected to Native individuals (Native allotments) would also be particularly challenging. The Alaska Native Interest Land Claims Act (ANILCA) became law in 1980. Section 905 of ANILCA reauthorized all Native allotment applications pursuant to the Act of 1906 that were pending before the Department of Interior on or before December 12, 1971. Section 905 also authorized the state to protest an allotment if the allotment represented the only reasonable access to public lands and waters. Statewide, there are roughly 15,000 proposed or existing allotments, of which little more than half have been certified (rather than patented, since they are managed by the Bureau of Indian Affairs for the allottee and/or his heirs). Access can only be reserved through a Native allotment if use of the easement predates the use and occupancy date of the allottee (many from the early to mid-1900s).

It is assumed that there are Native allotments within the study area, including both restricted and unrestricted allotments. Procedures for acquiring right-of-way across unrestricted Native allotments are cumbersome at best, requiring extensive survey, appraisal, and Bureau of Indian Affairs coordination. Right-of-way cannot be acquired across restricted Native allotments. Given these facts it is recommended that once a preferred route has been identified it be designed so that the alignment does not require acquisition from any Native allotment lands.

Due to the uncertainties present in this concept-only study, land acquisition and associated permitting costs were not included, though it is acknowledged that land acquisition costs could potentially increase the total roadway costs substantially from the values reported.

2.1 Design Criteria

The design criteria, assumptions, and unit costs used for this study were derived from the Ambler Mining District Access Study (Ambler) and Western Alaska Access Planning Study (WAAPS). The Ambler and WAAPS projects used published guidelines from the American Association of

State Highway and Transportation Officials in the design of roads. Additional design criteria were developed from the State of Alaska Department of Transportation and Public Facilities (DOT&PF) bridge designers, private bridge fabricators, professionals with heavy-haul design experience, and past planning reports on similar DOT&PF road and bridge projects. Design criteria and assumptions were compared to recent and proposed construction projects within the Y-K Region as a check that assumptions and unit costs are reasonable.

The proposed road cross-section is a two-lane gravel road that would accommodate two-way traffic and place minimal restrictions on passenger and freight vehicles travelling the corridors. Given the high cost of construction, a single-lane roadway is included as a phasing option that would provide all-season road access at a lower initial construction cost. This single-lane interim phase would require strict operational controls while additional resources are allocated to complete construction of the two-lane road.

The design criteria, comparison data, and criteria source or rationale used to develop conceptual cost estimates for single-lane and two-lane roadway corridors are summarized in Appendix A.

2.2 Roadway Unit Costs and Assumptions

2.2.1 Roadway Unit Costs

A base value of \$2.29 million per mile was estimated for two-lane roads and a value of \$1.82 million per mile for single-lane roads. Factoring in costs associated with river and stream crossings (bridges and culverts), maintenance camps, and turnouts, the average construction cost per mile is \$3.39 million for two-lane roads and \$3.01 million for single-lane roads. To evaluate whether these costs are reasonable for the Y-K Region, costs were compared to several smaller ongoing roadway projects in the area. Construction unit costs for these projects ranged from \$1.66 million to \$4.94 million per mile of roadway, with an average value of \$2.93 million per mile. Cost varied primarily due to the proximity of material sites and existing soil conditions. Based on these values, the assumed values for evaluating the conceptual roadway corridors to Bethel and the surrounding communities are considered reasonable. Unit costs for representative projects in the Y-K Region are compared to assumed unit costs used in this study in Table 1.

Table 1: Roadway Unit Costs Comparison Summary

Conceptual Roadway Project/Study	Costs Per Mile (million \$)	
	Two-Lane Road	Single-Lane Road
Nelson Island Sub-regional Transportation Plan (2003*)	\$1.67	-
Nelson Island Road Project (2006*)	\$2.19	-
WAAPS (2010*)	\$2.27	-
Yukon River to Kuskokwim River Engineering Study (2009*)	\$2.93	-
Road between Nunapitchuk and Kasigluk (2005*)	\$4.94	-
Baseline Construction Cost per Mile	\$2.29	\$1.82
Total Construction Cost per Mile**	\$3.39	\$3.01

*All costs adjusted to 2012 dollars

**Includes bridges, culverts, maintenance camps, etc.

2.2.2 Roadway Cost Assumptions

Roadway cost estimates were prepared for two-lane and single-lane alternatives. This study uses the roadway construction costs developed for the Cape Darby Corridor as part of the Ambler project. The majority of roadway construction costs are associated with embankment fill, the requirements for which are largely dependent on permafrost and soil conditions. Over 90% of conceptual roadway corridors in the Y-K Region cross upland and lowland areas underlain by moderately thick to thin permafrost, similar to the Cape Darby Corridor. The Cape Darby Corridor also crosses a similar range of upland regions (Darby Mountains, Selawik Hills) and lowland/wetland regions (Kobuk Lowlands, Selawik Lowlands), providing the most realistic example without geotechnical studies. As a result, the average 7-foot-deep roadway embankment assumed for the bulk of the Cape Darby Corridor is applicable to the conceptual roadway corridors in the Y-K Region project study area.

The unit cost per mile of roadway assumes that the roadway surface layer would be aggregate surface course, reducing construction costs relative to asphalt pavement. The two-lane option would have a total top width of 32 feet, including two 12-foot lanes and 4-foot shoulders, while the single-lane option would have a total top width of 20 feet, including a single 12-foot lane and 4-foot shoulders. It is assumed that much of the traffic will be heavy haul vehicles used for shipping freight and goods to the rural communities in the project area. The typical sections used to evaluate roadway construction costs are based on sections developed as part of the Ambler Mining District Access Study. These roadway sections are very similar to the section developed for the WAAPS and are reasonable for the geological and climatic conditions present

in the Y-K Region. Roadway construction costs were estimated based on the following assumptions and limitations:

- Quantity estimates used to develop roadway construction unit costs are based on costs for clearing, surface, and embankment material.
- Due to the breadth of the project study area and lack of detailed geotechnical data, material sites available for roadway construction were not investigated or identified as part of this study. The lack of available material sites in lowland regions, typical in the western portion of the project study, will likely result in longer haul distances and increased construction costs over these lowland areas.
- Roadway turnouts are included. Only one turnout is necessary per 10 miles for a two-lane roadway, while a minimum of 4 turnouts are necessary per mile for a single-lane roadway. The estimated construction cost is \$21,000 per turnout.

The construction costs of the single-lane alternative are not half the construction costs of the two-lane alternative for numerous reasons, including:

- Single-lane roads have an increased need for turnouts based on available sight distance to safely accommodate two-way traffic.
- Two-lane bridge widths are necessary to increase safety at river crossings where passing vehicles do not have the option to pull over or use turnouts.
- A 20-foot typical section (versus 32 feet for two-lane roadway) is necessary to provide sufficient roadway shoulders to safely accommodate large freight and maintenance vehicles.

2.2.3 Drainage Unit Costs and Assumptions

Drainage structures are a significant portion of the overall construction cost for the conceptual corridors. On average, bridge and culvert costs account for \$1.02 million per mile for two-lane roadways and \$0.98 million per mile for single-lane roadways. Much of the eastern portion of the conceptual roadway network passes through mountainous and rugged terrain with numerous small tributary streams. The corridors often follow stream valleys to pass through these rugged areas. Further to the west, the project area consists of wetlands with many ponds, lakes, and

sloughs around the Yukon River and Kuskokwim River deltas. The number and type of stream crossings along the corridors was estimated using aerial photography, USGS topographic maps, and satellite imagery. Structure sizes are based on measurements taken from aerial imagery and are estimated based on the perceived need to provide floodplain transport. Cost estimates for drainage structures are based on the Ambler project and include the following unit costs and structure breakdown:

- \$18,000 per minor drainage culvert (36-inch diameter)
- \$91,000 per small culvert (4- to 10-foot diameter)
- \$200,000 per large culvert (>10- to 20-foot diameter)
- \$430,000 per small bridge (less than 50-foot total length)
- \$1,130,000 per medium bridge (50- to 140-foot total length)
- \$11,400 per linear foot for large bridges (greater than 140-foot total length)

Unit bridge costs were developed under consultation with the DOT&PF bridge design group for the Ambler project based on conceptual designs for pre-cast concrete bulb tee bridges, steel girder with pre-cast concrete deck bridges, and prefabricated modular steel bridges. Unit costs for drainage structures were compared to recent DOT&PF projects in the project study area and found to be reasonably representative of construction costs in the Y-K Region.

Based on recent DOT&PF projects in the study area, 10 minor drainage culverts were assumed per mile of roadway for upland areas and 20 minor drainage culverts were assumed per mile of roadway for lowland and wetland areas. These numbers are reasonable compared to other DOT&PF projects in the area and assumptions developed for the WAAPS and Ambler projects. The frequency of small and large culvert crossings along the conceptual corridors was estimated based on two representative roadway segments, representing upland regions and lowland regions. The frequency and size of culvert crossings were estimated from USGS topographic maps and satellite imagery. All roadway corridors were divided into the two categories based on overall terrain features for the purpose of estimating small and large culvert costs. Descriptions of the representative roadway segments are as follows:

- A segment along the conceptual primary arterial corridor between the Nikolai spur road and the Crooked Creek spur road was selected as a representative section of rugged,

upland terrain. The roadway segment is approximately 152 miles long and had, on average, the need for 3 small culverts per 10 miles and 2 large culverts per 10 miles.

- The conceptual Newtok spur road, between the primary arterial corridor and Newtok, was selected as a representative section of lowland and wetland areas. The roadway segment is approximately 105 miles long and had, on average, the need for 5 small culverts per 10 miles and 3 large culverts per 10 miles.

2.3 Maintenance Unit Costs and Assumptions

Annual maintenance costs for the conceptual roadway corridors include costs for maintaining the roadways and road maintenance camps. The current DOT&PF Central Region annual maintenance cost of \$8,730 per foot lane mile is assumed for the roadways to cover costs associated with grading, plowing, dust control, minor repairs, and similar activities necessary to keep the roads safe and operational. These costs are agreeable with costs assumed for other DOT&PF projects in the Y-K Region and the WAAPS project. Estimated annual maintenance per camp is \$422,000, developed for the Ambler project based on data provided by the DOT&PF Dalton Highway maintenance section, and includes costs associated with fuel (for heating and generators), staffing camps, and minor repairs. Assumed maintenance costs do not include major upgrades or renovations.

Additional construction costs were added to each roadway corridor for initial construction of the road maintenance camps. Conceptual maintenance camp locations were determined under the assumption that each camp would be able to service approximately 60 miles.. The initial construction cost for each maintenance camp is estimated at \$13.50 million, as developed for WAAPS and includes infrastructure such as housing, shops, power generators, utilities, and fencing.

2.4 Total Roadway Corridor Costs

The total estimated construction cost for the conceptual roadway network to and within the Y-K Region is approximately \$6.84 billion for the two-lane alternative and \$6.08 billion for the single-lane alternative. Annual maintenance costs for both the two-lane and single-lane alternatives are approximately \$60.46 million and \$42.85 million, respectively. The total construction costs and annual maintenance costs for the roadway alternatives are shown in Table

2. Both the two-lane and single-lane alternatives include a total of 2,017 miles of conceptual roadway, including a 559-mile primary arterial corridor and 1,458 miles of secondary connector corridors.

Table 2: Roadway Corridor Construction and Maintenance Cost Summary

Component	Costs (million \$)	
	Single-Lane Road (2,017 miles)	Two-Lane Road (2,017 miles)
Baseline Cost per Mile	\$1.82	\$2.29
Water Crossings Cost per Mile	\$0.98	\$1.02
Turnout Construction Costs	\$168.27	\$4.20
Maintenance Camp Costs	\$432.00	\$432.00
Total Cost per Mile	\$3.01	\$3.39
Total Corridor Construction Cost	\$6,078.27	\$6,844.20
Annual Maintenance	\$42.85	\$60.46

There are cost savings associated with single-lane roadways (compared to two-lane roadways) however these savings may not justify the increased safety hazards and operational challenges associated with long distance single-lane roadways. To safely accommodate vehicles passing in opposite directions, single-lane roadways require turnouts to be constructed at intervals frequent enough to allow adequate visibility for opposing traffic as well as reduced design speeds to provide adequate stopping sight distance. Fog, blowing snow, and other weather conditions can also dramatically reduce visibility and reduce safety on single-lane roadways. Single-lane roadways also present additional maintenance challenges, such as where grading and snow plowing operations hinder traffic and create unsafe driving conditions due to the inability to pass around maintenance vehicles. For these reasons, the single-lane roadway system is not recommended despite the potential savings in construction costs relative to the two-lane system.

3.0 AIRPORTS COST ESTIMATE

Whereas the road system considered by this study is conceptual, the airports are the existing transportation system in the Y-K Region. For purposes of providing a baseline cost comparison, this study estimated the aviation system replacement cost using ultimate Airport Layout Plan (ALP) runway lengths.

This estimate of costs to construct the Y-K Region aviation system is based on actual costs of airports constructed in the Y-K Region in the past 10 years, adjusted for inflation (Table 3). This estimate is based on constructing airports to their recommended ALP ultimate length or a minimum of 3,300 feet. Airports were divided into three main classes: the Bethel hub, sub-regional hubs, and community airports. Community airports were then divided into sub-classes to represent unique airports, airports with 4,000-foot runways, and airports with 3,300-foot runways. These groups define the size and role of the airport and are listed in Table 4. Maintenance costs were obtained from DOT&PF maintenance contract records and DOT&PF data for state maintained airports.

Table 3: New Airports Constructed in or around the Study Area, 2002-2012

Location	Most Recent Grant Year	Airport Construction Cost (million \$)	Inflation Adjusted Cost (million \$)
Akiachak	2010	\$17.99	\$18.56
Chefornak	2010	\$20.09	\$20.73
Kipnuk	2010	\$15.19	\$15.67
Takotna	2009	\$12.46	\$13.06
Tuluksak	2009	\$12.25	\$12.84
Tuntutuliak	2006	\$16.24	\$18.12
Tununak	Estimated 2012	\$17.50	\$17.50
Kotzebue	Feasibility study in 2007	\$659.50	\$724.00
Bethel (single asphalt runway)	2009	\$8.40	\$8.98

Table 4: Class of Airports

Class of Airport		Number of Airports
Regional Hub		
Bethel		1
Sub-Regional Airports		
Aniak	5,400-foot runway	1
McGrath	5,936-foot and 2,000-foot runways	1
St. Mary's	6,000-foot and 1,500-foot runways	1
Emmonak	6,000-foot and 1,500-foot runways	1
Community Airports		
Akiachak	5,000-foot runway	1
Red Devil	4,500-foot runway	1
Kotlik	4,400-foot runway	1
Community Airports	4,000-foot runway	17
Community Airports	3,300-foot runway	27

3.1 Design Criteria

Airport cost estimates in this study were developed using square foot costs due to the varying widths/lengths of runways, whereas roadway estimates were developed using per mile estimates. The recently constructed/estimated airport costs in Table 3 were used to estimate a \$37-per-square-foot cost for gravel and \$47-per-square-foot cost for asphalt construction. These per-square-foot costs include other airfield infrastructure (runway safety areas, lighting, etc.) resulting in a significant increase when compared to the per-square-foot cost for roads. The current DOT&PF Spending Plan was also examined to determine cost to construct a snow removal equipment building (SREB). The cost to construct a single bay building is approximately \$800,000. This cost doubles when a second bay is added. Most airports have a single- or double-bay SREB.

Appendix B details airport class, dimensions, and cost estimates for each airport included in the study. For a community class airport, cost estimates were created by assuming a standard airport including one runway, one taxiway, one apron, and a one-mile access road. Runway lengths were determined from current ALP ultimate design standards and grouped into three categories; 3,300 feet, 4,000 feet, and unique airports. A minimum runway length of 3,300 feet has been the historical standard used by DOT&PF for safety and planning standards. Airports with a runway length of 3,300 feet were assumed to be 60 feet wide. Airports with a runway 4,000 feet or longer were assumed to be 75 feet wide. A common apron and taxiway size were assumed with 100,000 square feet of apron space and 80,000 square feet of taxiway. Cost to construct a single-

lane gravel road was calculated during the road cost estimation portion of this study and is used again for the airport access road.

Sub-regional class airports have varying airfield qualities and dimensions; therefore each airport’s cost was calculated individually. Bethel is also unique, serving as the regional hub, and was also estimated individually. All assumptions are detailed below in Table 5.

Table 5: Airport Dimension and Cost Assumptions

Airport Element	Assumption
Community Class Runway	3,300 feet by 60 feet >4,000 feet by 75 feet
Community Class Apron	100,000 square feet
Community Class Taxiway	80,000 square feet
Snow Removal Equipment Building	\$800,000 per bay
Gravel Surface	\$37 per square feet
Asphalt Surface	\$47 per square feet
Single-lane gravel access road	\$1.82 million per mile
Two-lane asphalt access road	\$4.60 million per mile

Bethel, which serves as the region’s hub, is a much larger facility than other airports in the region. Kotzebue, an airport located in the northern region of Alaska, has similar construction material scarcity issues as the Y-K Region and was used as the most recent cost estimate to construct a new regional sized airport in the state*. Kotzebue, however, has only one paved runway and one gravel runway, seven taxiways, and one apron. In comparison, Bethel has two paved runways, one gravel runway, twelve taxiways, and three aprons. To account for these differences, Kotzebue’s cost was increased by calculating the additional square footage needed to construct additional runways, taxiways, and aprons. Kotzebue was estimated to cost \$724,100,000 with an additional cost of \$20,600,000 for maintenance and operations (M&O) facilities. Bethel’s additional pavement for aprons (2,864,760 square feet) and taxiways (1,105,677 square feet) was included for an additional \$186,600,000 in cost. Bethel is currently served by a paved two-lane access road, which adds an additional \$4.60 million to the replacement cost. The total estimated replacement cost for Bethel is \$936.00 million.

Table 6 details the cost for each class of airport and the number of airports in the region. The cost to construct all 52 airports is approximately \$2.19 billion.

* *Kotzebue Airport Relocation Feasibility Study*, January 2008, DOT&PF. Prepared by PDC Inc. Engineers.

Table 6: Class of Airports with Cost Estimates

Class of Airport		Number of Airports	Cost to Construct Per Airport
Regional Hub - Bethel Airport		1	\$936,000,000
Sub-Regional Airports		4	--
McGrath Airport	5,936-foot and 2,000-foot runways		\$92,900,000
Aniak Airport	5,400-foot runway		\$79,300,000
Saint Mary's Airport	6,000-foot and 1,500-foot runways		\$64,100,000
Emmonak Airport	6,000-foot and 1,500-foot runways		\$53,900,000
Community Airports		3	--
Akiachak Airport	5,000-foot runway		\$22,400,000
Red Devil Airport	4,500-foot runway		\$21,000,000
Kotlik Airport	4,400-foot runway		\$21,000,000
Community Airports	4,000-foot runway	17	\$19,600,000
Community Airports	3,300-foot runway	27	\$15,800,000
Total Cost			\$2,050,400,000

3.2 Maintenance Costs and Assumptions

Roads and airports are generally maintained by the same crew in rural villages, making it difficult to separate airport maintenance costs from road maintenance costs. Furthermore, many airports are currently maintained by rural subcontractors, and these contract costs do not adequately reflect total maintenance costs in ways applicable to this study. Airport deferred maintenance also complicates maintenance estimates.

Based on DOT&PF records, routine annual maintenance costs for rural airports in the region can cost up to \$500,000 per airport. An estimated average annual cost of \$200,000 per airport is assumed. Due to the difficulty in accounting for the rural airport M&O costs, this estimate was applied to all airports with the exception of Bethel. Bethel Airport's maintenance costs are accounted for on a regular basis and are approximately \$2.50 million a year. Combining Bethel's and all other airport estimates, an estimated maintenance cost of \$12.70 million a year was used for all 52 airports in the Y-K Region.

3.3 Total Airport System Costs

The estimate to construct the airport system at the 52 communities in the Y-K Region is \$2.05 billion (in 2012 dollars). Annual routine system maintenance costs are estimated at \$12.70 million per year.

4.0 CONCLUSION

This analysis compares the construction of a road versus air transportation system in the Y-K Region, as an indicator of costs for rural Alaska. Construction of a road transportation system accessing the study area is estimated at \$6.08 billion for a single-lane road system and \$6.84 billion for a two-lane road system. Construction of an air transportation system meeting the ultimate runway length in the ALPs was estimated to cost \$2.05 billion.

Table 7: Cost Comparisons

	Construction Cost Comparison		M&O Comparison (per year)	
	Single-lane	Two-Lane	Single-lane	Two-Lane
Road System	\$6.08 billion	\$6.84 billion	\$42.85 million	\$60.46 million
Airport System	\$2.05 billion		\$12.70 million	

The analysis has tended to underestimate the cost of the road system and overestimate the cost of the aviation system to be sure the analysis does not overstate the cost-effectiveness of constructing and maintaining the aviation system.

This report does not expound on the qualitative challenges of building and maintaining a road system in rural Alaska. It is worth mentioning the considerable difficulties of construction in Alaska’s rugged terrain and wetlands, harsh climate, and brief construction season. Further, keeping roads operational during flooding seasons, spring thaw, winter storm, and the continuous deterioration in such severe remote conditions presents significant costs and efforts. Even if roads were built to these communities, most would still need an airport because of long distances and travel times to provide medevac access and other services.

Based on this study’s findings, the cost to construct a road to Bethel and the 51 Y-K Region communities included in this study far outweighs the cost to construct an airport system by a factor of nearly three, and maintenance costs for the road network are nearly five times as much as for the airports.

This study does not attempt to estimate the following:

- Operating costs for use of roads versus runways - the comparative costs to transport people and goods by road versus air.
- Cost to bring existing airport system up to construction goals set in ALPs/Master Plans/Regional Plans and maintain it at a prescribed level of service.

5.0 FOLLOW ON STUDIES

The scope of this study was narrowly focused on a preliminary baseline comparison of costs to construct, from new, an airport system with the costs to construct a road system to provide access to the same locations. There are many methods that could be utilized to conduct future additions to this study, including the following concepts or a combination of these concepts:

1. Compare construction costs for upgrading existing aviation infrastructure with the construction of a new road.
2. Compare the costs for the operation, maintenance and upgrades to roads versus airports, including capital reconstruction and heavy maintenance costs.
3. Comparison of actual costs of transporting goods and people on each mode of transportation, including a comparison of construction and maintenance costs for airports and roads.
4. Assuming road is built, the need and costs for at least a partial aviation system. Even with road access, there would remain a compelling need to have an airport for medical and other emergencies requiring faster response and/or evacuation.
5. Develop a hub and spoke system that would use Bethel and possibly other large communities as the hub and connect the local smaller villages by road to the hub. This concept would not tie this system to the contiguous national highway system. The costs for moving people and goods could then be compared to all the options.
6. Develop costs and considerations for a partial road or road segments. This would compare costs of constructing and operating short connector roads between certain villages that are in close proximity and closing an airport or airports, to the costs of maintaining an airport in each community. This study would also need to identify all impacts (medivacs, convenience, and other transportation costs and considerations) from each option.
7. Explore the possibility of resource development that could be used to either offset or justify the cost of an access road that is tied to the contiguous highway system or a port.
8. Compare the costs of a rail link with the road options.

9. Include life cycle costs in a comparison of the costs associated with airport improvements versus road improvements.
10. Complete a cost comparison of the long-term benefit and costs of operating the road with the projected costs of the airports. Examine if a road system would help the long-term economic viability of the villages over an airport system.
11. Conduct a cost study analysis to determine the costs to operate the road as a toll road and the costs of a public transportation fare in comparison to an airfare.
12. Conduct a cost-benefit study for single-lane, one-way versus single-lane, two-way traffic and comparison of operational and maintenance costs.
13. Additional geotechnical studies to identify construction material type and availability.

APPENDIX A

Roadway Cost Estimations

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Category	Two-Lane Alternative	Single-Lane Alternative	Criteria Source/Rationale
General Project Information			
Project Overview	Road from Yukon-Kuskokwim Region to Interior Alaska	No change	Scope of Services
Project Type	New Construction	No change	Scope of Services
Purpose	To connect communities within the isolated Yukon-Kuskokwim Region to the contiguous Interior highway system to facilitate community and resource development in the region.	No change	Scope of Services
Road Design Criteria and Assumptions			
Life Cycle	20 years	No change	Scope of Services
Functional Classification(s)	Rural Other Principal Arterial Very Low-Volume Local Road	No change	AASHTO GDVLVLR
Projected AADT	≤ 400	No change	2007-2009 Annual Daily Traffic Report, Northern Region for Dalton Highway
Number of Lanes	2	1	Scope of Services
Minimum Traveled Way Width	32 feet	20 feet	GDVLVLR, page 18 Exhibit 1
Lane	12 feet	12 feet	Page 19 discretion
Shoulder	4 feet	4 feet	
Maximum Design Speed	50 mph	30 mph	AASHTO, Page 415 and GDVLVLR, page 52 The speed will be dependent on the terrain.
Grade Limitations	50 mph - Level, 0-4% 40 mph - Rolling, 4-7% 40 mph -Mountainous, 7-9% 40 mph -Mountainous, 9-12%	30 mph - Level, 0-7% 30 mph - Rolling, 7-10% 30 mph -Mountainous, 10-14%	American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, 5th Edition, 2004, (AASHTO) page 235& 409, 414. AASHTO, page 446 (Steeper grades may necessitate lower design speeds)
Clear Zone	6 ft Recommended (4H:1V sides slopes) 0 ft Allowed (Can be 3:1 or steeper, slope stability dependent)	6 ft Recommended (4H:1V sides slopes) 0 ft Allowed (Can be 3:1 or steeper, slope stability dependent)	GDVLVLR, page 48 and 50.
Surfacing, Lanes	Unpaved	Unpaved	GDVLVLR, page 6
Road Construction Unit Costs			
Base construction cost per mile	\$2.29 million	\$1.82 million	Cape Darby Corridor, Ambler Mining District Access, Draft Single-Lane Corridor Analysis Report, FY10
Turnouts	\$21,000 each	No change	Cape Darby Corridor, Ambler Mining District Access, Draft Single-Lane Corridor Analysis Report, FY10
Turnouts per mile	0.1	4	Cape Darby Corridor, Ambler Mining District Access, Draft Single-Lane Corridor Analysis Report, FY10

Alaska Aviation System Plan
Yukon-Kuskokwim Region Air vs. Roads Access
Construction Maintenance Baseline Cost Comparison

Category	Two-Lane Alternative	Single-Lane Alternative	Criteria Source/Rationale
Bridge/Culvert Criteria and Assumptions			
Design Flood	50-year recurrence interval (2% exceedance probability)	No change	Alaska Highway Preconstruction Manual (HPM) and Alaska Highway Drainage Manual (HDM)
Bridge Live Load	AASHTO HL-93	AASHTO HL-93	HPM
Minor Culverts (36" diameter) per mile	10 per mile in upland terrain 20 per mile in wetland/lowland terrain	No change	2003 Nelson Island Subregional Transportation Plan
Small Culverts (4' to 10' diameter) per mile	3 per 10 miles in upland terrain 5 per 10 miles in wetland/lowland terrain	No change	Estimated as part of this study.
Large Culverts (>10' to 20' diameter) per mile	2 per 10 miles in upland terrain 3 per 10 miles in wetland/lowland terrain	No change	Estimated as part of this study.
Bridge/Culvert Unit Costs			
Minor Culverts (36" diameter)	\$21,000 per culvert (80' long)	\$19,000 per culvert (68' long)	Developed for Ambler Mining District Access, Baseline Cost Memorandum, FY11
Small Culverts (4' to 10' diameter)	\$103,000 per culvert (95' long)	\$94,000 per culvert (83' long)	Developed for Ambler Mining District Access, Baseline Cost Memorandum, FY11
Large Culverts (>10' to 20' diameter)	\$230,000 per culvert (95' long)	\$207,000 per culvert (83' long)	Developed for Ambler Mining District Access, Baseline Cost Memorandum, FY11
Small Bridge (20' to 50' span)	\$430,000 per crossing	No change	Developed for Ambler Mining District Access, Baseline Cost Memorandum, FY11
Medium Bridge (>50' to 140' span)	\$1,080,000 per crossing	No change	Developed for Ambler Mining District Access, Baseline Cost Memorandum, FY11
Large Bridge (>140' span)	\$11,400 per linear foot	No change	Developed for Ambler Mining District Access, Baseline Cost Memorandum, FY11
Maintenance and Operations Assumptions			
Annual routine road maintenance costs	\$8,730 per (12-ft) lane mile	No change	Data provided by DOT&PF's Dalton Highway Maintenance Section for FY10.
New maintenance camp construction	\$13.5 million per camp to construct	No change	Western Alaska Access Planning Study M&O Assumptions
Annual facilities maintenance per camp	\$422,000	No change	Data provided by DOT&PF's Dalton Highway Maintenance Section for FY10.

Two Lane Corridor Baseline Cost Estimate Summary								
Corridors	Length	Road Construction						Maintenance
	Miles	Baseline Cost/mile (million/mile)	Water Crossing Cost/mile (million/mile)	Total Cost Per Mile (million/mile)	Turnout Costs per Corridor (in millions)	Maintenance Camp Cost (in millions)	Total Corridor Cost (in millions)	Annual Maintenance Cost (in millions)
Primary Arterial (Bethel)	559	\$2.29	\$0.50	\$3.10	\$1.18	\$148.50	\$1,711.18	\$17.65
Secondary Connectors	1458	\$2.29	\$1.22	\$3.70	\$3.02	\$283.50	\$5,393.02	\$42.80
Individual Secondary Connectors								
Nikolai	13	\$2.29	\$1.23	\$3.80	\$0.021000	\$0.00	\$50.02	\$0.00
McGrath	9	\$2.29	\$2.04	\$4.70	\$0.000000	\$0.00	\$40.00	\$0.00
Takotna	3	\$2.29	\$2.18	\$3.40	\$0.042000	\$0.00	\$10.04	\$0.00
Ophir	21	\$2.29	\$0.72	\$2.80	\$0.042000	\$0.00	\$60.04	\$0.00
Flat	16	\$2.29	\$0.54	\$2.60	\$0.042000	\$0.00	\$40.04	\$0.00
Crooked Creek	24	\$2.29	\$0.73	\$2.90	\$0.063000	\$13.50	\$70.06	\$2.04
Red Devil	33	\$2.29	\$1.22	\$3.60	\$0.021000	\$0.00	\$120.02	\$0.00
Sleetmute	7	\$2.29	\$3.29	\$6.10	\$0.063000	\$0.00	\$40.06	\$0.00
Stony River	25	\$2.29	\$0.99	\$3.20	\$0.126000	\$13.50	\$80.13	\$2.04
Lime Village	55	\$2.29	\$0.86	\$3.10	\$0.147000	\$0.00	\$170.15	\$0.00
Shageluk	68	\$2.29	\$0.44	\$2.80	\$0.042000	\$13.50	\$190.04	\$2.04
Aniak	17	\$2.29	\$2.23	\$4.70	\$0.021000	\$0.00	\$80.02	\$0.00
Chuathbaluk	9	\$2.29	\$0.69	\$3.20	\$0.084000	\$0.00	\$30.08	\$0.00
Holy Cross	36	\$2.29	\$1.56	\$3.90	\$0.084000	\$0.00	\$140.08	\$0.00
Anvik	44	\$2.29	\$0.76	\$3.00	\$0.042000	\$13.50	\$130.04	\$2.04
Grayling	22	\$2.29	\$1.23	\$3.60	\$0.147000	\$0.00	\$80.15	\$0.00
Russian Mission	71	\$2.29	\$0.37	\$2.70	\$0.021000	\$13.50	\$190.02	\$2.04
Marshall	14	\$2.29	\$0.33	\$2.80	\$0.105000	\$0.00	\$40.11	\$0.00

Two Lane Corridor Baseline Cost Estimate Summary								
Corridors	Length	Road Construction					Maintenance	
	Miles	Baseline Cost/mile (million/mile)	Water Crossing Cost/mile (million/mile)	Total Cost Per Mile (million/mile)	Turnout Costs per Corridor (in millions)	Maintenance Camp Cost (in millions)	Total Corridor Cost (in millions)	Annual Maintenance Cost (in millions)
Pilot Station	45	\$2.29	\$1.40	\$3.80	\$0.021000	\$0.00	\$170.02	\$0.00
St. Marys	14	\$2.29	\$2.17	\$4.40	\$0.042000	\$13.50	\$60.04	\$2.04
Mountain Village	23	\$2.29	\$0.29	\$2.70	\$0.063000	\$13.50	\$60.06	\$2.04
Kotlik	27	\$2.29	\$3.61	\$6.00	\$0.147000	\$0.00	\$160.15	\$0.00
Emmonak	69	\$2.29	\$1.79	\$4.10	\$0.021000	\$13.50	\$280.02	\$2.04
Alakanuk	8	\$2.29	\$4.39	\$6.10	\$0.126000	\$0.00	\$50.13	\$0.00
Sheldon Point	63	\$2.29	\$2.01	\$4.30	\$0.126000	\$13.50	\$270.13	\$2.04
Scammon Bay	65	\$2.29	\$1.03	\$3.40	\$0.042000	\$13.50	\$220.04	\$2.04
Chevak	24	\$2.29	\$1.48	\$3.70	\$0.042000	\$13.50	\$90.04	\$2.04
Hooper Bay	19	\$2.29	\$0.81	\$3.20	\$0.210000	\$0.00	\$60.21	\$0.00
Newtok	104	\$2.29	\$0.83	\$3.10	\$0.042000	\$27.00	\$320.04	\$4.08
Atmautluak	20	\$2.29	\$1.23	\$3.50	\$0.021000	\$0.00	\$70.02	\$0.00
Nunapitchuk	8	\$2.29	\$2.26	\$4.80	\$0.000000	\$0.00	\$40.00	\$0.00
Kasigluk	4	\$2.29	\$2.52	\$5.20	\$0.021000	\$0.00	\$20.02	\$0.00
Napaskiak	8	\$2.29	\$5.07	\$7.50	\$0.021000	\$0.00	\$60.02	\$0.00
Kwethluk	11	\$2.29	\$1.85	\$3.80	\$0.105000	\$13.50	\$40.11	\$2.04
Eek	49	\$2.29	\$1.09	\$3.50	\$0.084000	\$13.50	\$170.08	\$2.04
Quinhagak	42	\$2.29	\$1.18	\$3.60	\$0.147000	\$0.00	\$150.15	\$0.00
Goodnews Bay	66	\$2.29	\$0.64	\$2.90	\$0.042000	\$13.50	\$190.04	\$2.04
Platinum	23	\$2.29	\$0.90	\$3.00	\$0.021000	\$0.00	\$70.02	\$0.00
Napakiak	7	\$2.29	\$1.18	\$4.00	\$0.105000	\$13.50	\$30.11	\$2.04

Two Lane Corridor Baseline Cost Estimate Summary								
Corridors	Length	Road Construction					Maintenance	
	Miles	Baseline Cost/mile (million/mile)	Water Crossing Cost/mile (million/mile)	Total Cost Per Mile (million/mile)	Turnout Costs per Corridor (in millions)	Maintenance Camp Cost (in millions)	Total Corridor Cost (in millions)	Annual Maintenance Cost (in millions)
Tuntutuliak	47	\$2.29	\$1.35	\$3.60	\$0.063000	\$0.00	\$170.06	\$0.00
Kongiganek	34	\$2.29	\$1.29	\$3.60	\$0.021000	\$13.50	\$120.02	\$2.04
Kwigillignok	13	\$2.29	\$1.47	\$3.90	\$0.063000	\$0.00	\$50.06	\$0.00
Kipnuk	34	\$2.29	\$1.04	\$3.30	\$0.042000	\$13.50	\$110.04	\$2.04
Chefornak	22	\$2.29	\$1.67	\$4.10	\$0.084000	\$0.00	\$90.08	\$0.00
Nightmute	40	\$2.29	\$1.58	\$3.80	\$0.042000	\$13.50	\$150.04	\$2.04
Toksook Bay	18	\$2.29	\$0.64	\$2.80	\$0.021000	\$0.00	\$50.02	\$0.00
Tununak	6	\$2.29	\$0.40	\$3.50	\$0.042000	\$0.00	\$20.04	\$0.00
Upper Kalskag	22	\$2.29	\$0.42	\$2.80	\$0.021000	\$0.00	\$60.02	\$0.00
Akiachak	14	\$2.29	\$1.39	\$3.50	\$0.021000	\$13.50	\$50.02	\$2.04
Akiak	8	\$2.29	\$0.97	\$3.80	\$0.042000	\$0.00	\$30.04	\$0.00
Tuluksak	17	\$2.29	\$2.89	\$5.20	\$0.000000	\$0.00	\$90.00	\$0.00
Total (All Corridors)	2017	\$2.29	\$1.02	\$3.39	\$4.20	\$432.00	\$6,844.20	\$60.46

Two Lane Corridor Maintenance Cost Estimate Summary								
Corridors	Length	Annual Road Maintenance			Annual Camp Maintenance			Annual Maintenance Cost (in millions)
	Miles	Cost per lane mile (\$/mi)	Lanes	Total Cost	Cost per Camp (ea/yr)	Camps	Total (\$/yr)	
Primary Arterial (Bethel)	559	\$8,730	2.67	\$13,010,261	\$422,000	11	\$4,642,000	\$17.65
Secondary Connectors (All)	1458	\$8,730	2.67	\$33,942,240	\$422,000	21	\$8,862,000	\$42.80
Total (All Corridors)	2017	\$8,730	2.67	\$46,952,501	\$422,000	\$32	\$13,504,000	\$60.46

Corridors	Length	Maintenance Camp Construction		
	Miles	Cost per Camp (ea, in millions)	Each	Construction Cost (in millions)
Primary Arterial (Bethel)	559	\$13.50	11	\$148.50
Secondary Connectors (All)	1458	\$13.50	21	\$283.50
Total (All Corridors)	2017	\$13.50	21	\$432.00

Yukon-Kuskokwim Region Air vs. Roads Access

Construction Maintenance Baseline Cost Comparison

Two Lane Corridor Turnout Costs per Corridor					
Corridors	Length	Turnouts			
	Miles	Turnouts (per mile)	Turnouts	Turnout Costs (ea)	Turnout Costs per Corridor
Primary Arterial (Bethel)	559	0.1	56	\$21,000	\$1,176,000
Nikolai	13	0.1	1	\$21,000	\$21,000
McGrath	9	0.1	1	\$21,000	\$21,000
Takotna	3	0.1	0	\$21,000	\$0
Ophir	21	0.1	2	\$21,000	\$42,000
Flat	16	0.1	2	\$21,000	\$42,000
Crooked Creek	24	0.1	2	\$21,000	\$42,000
Red Devil	33	0.1	3	\$21,000	\$63,000
Sleetmute	7	0.1	1	\$21,000	\$21,000
Stony River	25	0.1	3	\$21,000	\$63,000
Lime Village	55	0.1	6	\$21,000	\$126,000
Shageluk	68	0.1	7	\$21,000	\$147,000
Aniak	17	0.1	2	\$21,000	\$42,000
Chuathbaluk	9	0.1	1	\$21,000	\$21,000
Holy Cross	36	0.1	4	\$21,000	\$84,000
Anvik	44	0.1	4	\$21,000	\$84,000
Grayling	22	0.1	2	\$21,000	\$42,000
Russian Mission	71	0.1	7	\$21,000	\$147,000
Marshall	14	0.1	1	\$21,000	\$21,000

Yukon-Kuskokwim Region Air vs. Roads Access

Construction Maintenance Baseline Cost Comparison

Two Lane Corridor Turnout Costs per Corridor					
Corridors	Length	Turnouts			
	Miles	Turnouts (per mile)	Turnouts	Turnout Costs (ea)	Turnout Costs per Corridor
Pilot Station	45	0.1	5	\$21,000	\$105,000
St. Marys	14	0.1	1	\$21,000	\$21,000
Mountain Village	23	0.1	2	\$21,000	\$42,000
Kotlik	27	0.1	3	\$21,000	\$63,000
Emmonak	69	0.1	7	\$21,000	\$147,000
Alakanuk	8	0.1	1	\$21,000	\$21,000
Sheldon Point	63	0.1	6	\$21,000	\$126,000
Scammon Bay	65	0.1	6	\$21,000	\$126,000
Chevak	24	0.1	2	\$21,000	\$42,000
Hooper Bay	19	0.1	2	\$21,000	\$42,000
Newtok	104	0.1	10	\$21,000	\$210,000
Atmautluak	20	0.1	2	\$21,000	\$42,000
Nunapitchuk	8	0.1	1	\$21,000	\$21,000
Kasigluk	4	0.1	0	\$21,000	\$0
Napaskiak	8	0.1	1	\$21,000	\$21,000
Kwethluk	11	0.1	1	\$21,000	\$21,000
Eek	49	0.1	5	\$21,000	\$105,000
Quinhagak	42	0.1	4	\$21,000	\$84,000
Goodnews Bay	66	0.1	7	\$21,000	\$147,000

Yukon-Kuskokwim Region Air vs. Roads Access

Construction Maintenance Baseline Cost Comparison

Two Lane Corridor Turnout Costs per Corridor					
Corridors	Length	Turnouts			
	Miles	Turnouts (per mile)	Turnouts	Turnout Costs (ea)	Turnout Costs per Corridor
Platinum	23	0.1	2	\$21,000	\$42,000
Napakiak	7	0.1	1	\$21,000	\$21,000
Tuntutuliak	47	0.1	5	\$21,000	\$105,000
Kongiganek	34	0.1	3	\$21,000	\$63,000
Kwigillignok	13	0.1	1	\$21,000	\$21,000
Kipnuk	34	0.1	3	\$21,000	\$63,000
Chefornak	22	0.1	2	\$21,000	\$42,000
Nightmute	40	0.1	4	\$21,000	\$84,000
Toksook Bay	18	0.1	2	\$21,000	\$42,000
Tununak	6	0.1	1	\$21,000	\$21,000
Upper Kalskag	22	0.1	2	\$21,000	\$42,000
Akiachak	14	0.1	1	\$21,000	\$21,000
Akiak	8	0.1	1	\$21,000	\$21,000
Tuluksak	17	0.1	2	\$21,000	\$42,000

Two Lane Corridor Water Crossing Summary Per Corridor			
Corridors	Length	Roadway	
	Miles	Total Cost (in millions)	Per Mile Cost (in millions)
Primary Arterial (Bethel)	559	\$281.00	\$0.50
Nikolai	13	\$16.28	\$1.23
McGrath	9	\$17.40	\$2.04
Takotna	3	\$6.52	\$2.18
Ophir	21	\$15.36	\$0.72
Flat	16	\$8.42	\$0.54
Crooked Creek	24	\$17.60	\$0.73
Red Devil	33	\$40.50	\$1.22
Sleetmute	7	\$21.77	\$3.29
Stony River	25	\$24.67	\$0.99
Lime Village	55	\$47.73	\$0.86
Shageluk	68	\$30.29	\$0.44
Aniak	17	\$37.89	\$2.23
Chuathbaluk	9	\$6.45	\$0.69
Holy Cross	36	\$55.85	\$1.56
Anvik	44	\$33.56	\$0.76
Grayling	22	\$27.19	\$1.23
Russian Mission	71	\$26.21	\$0.37
Marshall	14	\$4.62	\$0.33

Two Lane Corridor Water Crossing Summary Per Corridor			
Corridors	Length	Roadway	
	Miles	Total Cost (in millions)	Per Mile Cost (in millions)
Pilot Station	45	\$63.14	\$1.40
St. Marys	14	\$29.88	\$2.17
Mountain Village	23	\$6.62	\$0.29
Kotlik	27	\$95.86	\$3.61
Emmonak	69	\$122.86	\$1.79
Alakanuk	8	\$35.81	\$4.39
Sheldon Point	63	\$126.09	\$2.01
Scammon Bay	65	\$67.09	\$1.03
Chevak	24	\$36.09	\$1.48
Hooper Bay	19	\$15.23	\$0.81
Newtok	104	\$86.39	\$0.83
Atmautluak	20	\$24.66	\$1.23
Nunapitchuk	8	\$18.81	\$2.26
Kasigluk	4	\$9.71	\$2.52
Napaskiak	8	\$40.78	\$5.07
Kwethluk	11	\$19.39	\$1.85
Eek	49	\$53.88	\$1.09
Quinhagak	42	\$49.73	\$1.18
Goodnews Bay	66	\$41.89	\$0.64

Two Lane Corridor Water Crossing Summary Per Corridor			
Corridors	Length	Roadway	
	Miles	Total Cost (in millions)	Per Mile Cost (in millions)
Platinum	23	\$20.79	\$0.90
Napakiak	7	\$8.81	\$1.18
Tuntutuliak	47	\$63.59	\$1.35
Kongiganek	34	\$43.47	\$1.29
Kwigillignok	13	\$18.68	\$1.47
Kipnuk	34	\$34.85	\$1.04
Chefornak	22	\$37.02	\$1.67
Nightmute	40	\$62.68	\$1.58
Toksook Bay	18	\$11.41	\$0.64
Tununak	6	\$2.31	\$0.40
Upper Kalskag	22	\$9.10	\$0.42
Akiachak	14	\$19.76	\$1.39
Akiak	8	\$7.59	\$0.97
Tuluksak	17	\$50.06	\$2.89

Two Lane Corridor Roadway Water Crossing Summary													
Corridors	Culverts						Bridges						Total
	Minor Culverts (<4')		Culvert Small (4' to 10')		Culvert Large (>10' to 20')		Bridge Small (<50')		Bridge Medium (50' to 140')		Bridge Large (>140')		
	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	COST (in millions)
Primary Arterial (Bethel)	5,589	\$21,000	168	\$103,000	112	\$230,000	33	\$430,000	33	\$1,130,000	6060	\$11,400	\$281.00
Nikolai	133	\$21,000	4	\$103,000	3	\$230,000	1	\$430,000	2	\$1,130,000	850	\$11,400	\$16.28
McGrath	86	\$21,000	3	\$103,000	2	\$230,000	0	\$430,000	0	\$1,130,000	1300	\$11,400	\$17.40
Takotna	30	\$21,000	1	\$103,000	1	\$230,000	1	\$430,000	0	\$1,130,000	450	\$11,400	\$6.52
Ophir	212	\$21,000	7	\$103,000	5	\$230,000	2	\$430,000	3	\$1,130,000	420	\$11,400	\$15.36
Flat	156	\$21,000	5	\$103,000	4	\$230,000	2	\$430,000	0	\$1,130,000	250	\$11,400	\$8.42
Crooked Creek	240	\$21,000	8	\$103,000	5	\$230,000	0	\$430,000	2	\$1,130,000	730	\$11,400	\$17.60
Red Devil	334	\$21,000	10	\$103,000	7	\$230,000	2	\$430,000	0	\$1,130,000	2630	\$11,400	\$40.50
Sleetmute	67	\$21,000	2	\$103,000	2	\$230,000	1	\$430,000	0	\$1,130,000	1690	\$11,400	\$21.77
Stony River	250	\$21,000	8	\$103,000	5	\$230,000	4	\$430,000	1	\$1,130,000	1280	\$11,400	\$24.67
Lime Village	555	\$21,000	17	\$103,000	12	\$230,000	4	\$430,000	2	\$1,130,000	2420	\$11,400	\$47.73
Shageluk	685	\$21,000	21	\$103,000	14	\$230,000	6	\$430,000	4	\$1,130,000	300	\$11,400	\$30.29
Aniak	170	\$21,000	6	\$103,000	4	\$230,000	2	\$430,000	0	\$1,130,000	2800	\$11,400	\$37.89
Chuathbaluk	94	\$21,000	3	\$103,000	2	\$230,000	2	\$430,000	0	\$1,130,000	250	\$11,400	\$6.45
Holy Cross	360	\$21,000	11	\$103,000	8	\$230,000	2	\$430,000	0	\$1,130,000	3900	\$11,400	\$55.85
Anvik	441	\$21,000	14	\$103,000	9	\$230,000	3	\$430,000	0	\$1,130,000	1710	\$11,400	\$33.56
Grayling	222	\$21,000	7	\$103,000	5	\$230,000	3	\$430,000	1	\$1,130,000	1600	\$11,400	\$27.19
Russian Mission	707	\$21,000	22	\$103,000	15	\$230,000	6	\$430,000	1	\$1,130,000	170	\$11,400	\$26.21
Marshall	142	\$21,000	5	\$103,000	3	\$230,000	1	\$430,000	0	\$1,130,000	0	\$11,400	\$4.62

Two Lane Corridor Roadway Water Crossing Summary													
Corridors	Culverts						Bridges						Total
	Minor Culverts (<4')		Culvert Small (4' to 10')		Culvert Large (>10' to 20')		Bridge Small (<50')		Bridge Medium (50' to 140')		Bridge Large (>140')		COST (in millions)
	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	
Pilot Station	901	\$21,000	23	\$103,000	14	\$230,000	0	\$430,000	2	\$1,130,000	3190	\$11,400	\$63.14
St. Marys	276	\$21,000	7	\$103,000	5	\$230,000	0	\$430,000	2	\$1,130,000	1750	\$11,400	\$29.88
Mountain Village	226	\$21,000	7	\$103,000	5	\$230,000	0	\$430,000	0	\$1,130,000	0	\$11,400	\$6.62
Kotlik	532	\$21,000	14	\$103,000	8	\$230,000	1	\$430,000	8	\$1,130,000	6310	\$11,400	\$95.86
Emmonak	1372	\$21,000	35	\$103,000	21	\$230,000	0	\$430,000	0	\$1,130,000	7510	\$11,400	\$122.86
Alakanuk	164	\$21,000	5	\$103,000	3	\$230,000	2	\$430,000	2	\$1,130,000	2460	\$11,400	\$35.81
Sheldon Point	1254	\$21,000	32	\$103,000	19	\$230,000	3	\$430,000	6	\$1,130,000	7370	\$11,400	\$126.09
Scammon Bay	1299	\$21,000	33	\$103,000	20	\$230,000	3	\$430,000	3	\$1,130,000	2380	\$11,400	\$67.09
Chevak	488	\$21,000	13	\$103,000	8	\$230,000	4	\$430,000	3	\$1,130,000	1540	\$11,400	\$36.09
Hooper Bay	377	\$21,000	10	\$103,000	6	\$230,000	4	\$430,000	1	\$1,130,000	180	\$11,400	\$15.23
Newtok	2077	\$21,000	52	\$103,000	32	\$230,000	10	\$430,000	12	\$1,130,000	1070	\$11,400	\$86.39
Atmautluak	401	\$21,000	11	\$103,000	7	\$230,000	1	\$430,000	4	\$1,130,000	750	\$11,400	\$24.66
Nunapitchuk	167	\$21,000	5	\$103,000	3	\$230,000	1	\$430,000	1	\$1,130,000	1100	\$11,400	\$18.81
Kasigluk	78	\$21,000	2	\$103,000	2	\$230,000	0	\$430,000	0	\$1,130,000	650	\$11,400	\$9.71
Napaskiak	161	\$21,000	5	\$103,000	3	\$230,000	2	\$430,000	1	\$1,130,000	3000	\$11,400	\$40.78
Kwethluk	211	\$21,000	6	\$103,000	4	\$230,000	0	\$430,000	3	\$1,130,000	880	\$11,400	\$19.39
Eek	985	\$21,000	25	\$103,000	15	\$230,000	13	\$430,000	8	\$1,130,000	1100	\$11,400	\$53.88
Quinhagak	842	\$21,000	22	\$103,000	13	\$230,000	9	\$430,000	11	\$1,130,000	920	\$11,400	\$49.73
Goodnews Bay	656	\$21,000	20	\$103,000	14	\$230,000	7	\$430,000	1	\$1,130,000	1640	\$11,400	\$41.89

Two Lane Corridor Roadway Water Crossing Summary													
Corridors	Culverts						Bridges						Total
	Minor Culverts (<4')		Culvert Small (4' to 10')		Culvert Large (>10' to 20')		Bridge Small (<50')		Bridge Medium (50' to 140')		Bridge Large (>140')		
	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	COST (in millions)
Platinum	231	\$21,000	7	\$103,000	5	\$230,000	1	\$430,000	4	\$1,130,000	800	\$11,400	\$20.79
Napakiak	150	\$21,000	4	\$103,000	3	\$230,000	0	\$430,000	0	\$1,130,000	400	\$11,400	\$8.81
Tuntutuliak	942	\$21,000	24	\$103,000	15	\$230,000	10	\$430,000	4	\$1,130,000	2550	\$11,400	\$63.59
Kongiganek	673	\$21,000	17	\$103,000	11	\$230,000	5	\$430,000	1	\$1,130,000	1910	\$11,400	\$43.47
Kwigillignok	255	\$21,000	7	\$103,000	4	\$230,000	2	\$430,000	1	\$1,130,000	850	\$11,400	\$18.68
Kipnuk	671	\$21,000	17	\$103,000	11	\$230,000	4	\$430,000	6	\$1,130,000	700	\$11,400	\$34.85
Chefornak	443	\$21,000	12	\$103,000	7	\$230,000	7	\$430,000	3	\$1,130,000	1620	\$11,400	\$37.02
Nightmute	795	\$21,000	20	\$103,000	12	\$230,000	3	\$430,000	3	\$1,130,000	3200	\$11,400	\$62.68
Toksook Bay	359	\$21,000	9	\$103,000	6	\$230,000	1	\$430,000	1	\$1,130,000	0	\$11,400	\$11.41
Tununak	58	\$21,000	2	\$103,000	2	\$230,000	1	\$430,000	0	\$1,130,000	0	\$11,400	\$2.31
Upper Kalskag	216	\$21,000	7	\$103,000	5	\$230,000	1	\$430,000	2	\$1,130,000	0	\$11,400	\$9.10
Akiachak	284	\$21,000	8	\$103,000	5	\$230,000	0	\$430,000	3	\$1,130,000	740	\$11,400	\$19.76
Akiak	157	\$21,000	4	\$103,000	3	\$230,000	0	\$430,000	0	\$1,130,000	280	\$11,400	\$7.59
Tuluksak	346	\$21,000	9	\$103,000	6	\$230,000	3	\$430,000	2	\$1,130,000	3240	\$11,400	\$50.06

Single Lane Corridor Baseline Cost Estimate Summary								
Corridors	Length	Road Construction						Maintenance
	Miles	Baseline Cost/mile (million/mile)	Water Crossing Cost/mile (million/mile)	Total Cost Per Mile (million/mile)	Turnout Costs per Corridor (in millions)	Maintenance Camp Cost (in millions)	Total Corridor Cost (in millions)	Annual Maintenance Cost (in millions)
Primary Arterial (Bethel)	559	\$1.82	\$0.48	\$2.70	\$46.94	\$148.50	\$1,526.94	\$12.77
Secondary Connectors	1458	\$1.82	\$1.17	\$3.40	\$121.34	\$283.50	\$4,891.34	\$30.08
Individual Secondary Connectors								
Nikolai	13	\$1.82	\$1.20	\$3.10	\$0.71	\$0.00	\$40.71	\$0.00
McGrath	9	\$1.82	\$2.01	\$3.50	\$0.25	\$0.00	\$30.25	\$0.00
Takotna	3	\$1.82	\$2.15	\$3.90	\$1.79	\$0.00	\$11.79	\$0.00
Ophir	21	\$1.82	\$0.70	\$2.40	\$1.30	\$0.00	\$51.30	\$0.00
Flat	16	\$1.82	\$0.51	\$2.70	\$2.02	\$0.00	\$42.02	\$0.00
Crooked Creek	24	\$1.82	\$0.71	\$2.60	\$2.79	\$13.50	\$62.79	\$1.43
Red Devil	33	\$1.82	\$1.19	\$3.00	\$0.55	\$0.00	\$100.55	\$0.00
Sleetmute	7	\$1.82	\$3.26	\$6.40	\$2.10	\$0.00	\$42.10	\$0.00
Stony River	25	\$1.82	\$0.96	\$3.00	\$4.66	\$13.50	\$74.66	\$1.43
Lime Village	55	\$1.82	\$0.83	\$2.80	\$5.75	\$0.00	\$155.75	\$0.00
Shageluk	68	\$1.82	\$0.41	\$2.20	\$1.43	\$13.50	\$151.43	\$1.43
Aniak	17	\$1.82	\$2.20	\$4.20	\$0.80	\$0.00	\$70.80	\$0.00
Chuathbaluk	9	\$1.82	\$0.66	\$3.50	\$3.02	\$0.00	\$33.02	\$0.00
Holy Cross	36	\$1.82	\$1.53	\$3.40	\$3.70	\$0.00	\$123.70	\$0.00
Anvik	44	\$1.82	\$0.73	\$2.50	\$1.85	\$13.50	\$111.85	\$1.43
Grayling	22	\$1.82	\$1.20	\$3.40	\$5.94	\$0.00	\$75.94	\$0.00
Russian Mission	71	\$1.82	\$0.34	\$2.10	\$1.20	\$13.50	\$151.20	\$1.43
Marshall	14	\$1.82	\$0.30	\$2.40	\$3.78	\$0.00	\$33.78	\$0.00

Single Lane Corridor Baseline Cost Estimate Summary								
Corridors	Length	Road Construction						Maintenance
	Miles	Baseline Cost/mile (million/mile)	Water Crossing Cost/mile (million/mile)	Total Cost Per Mile (million/mile)	Turnout Costs per Corridor (in millions)	Maintenance Camp Cost (in millions)	Total Corridor Cost (in millions)	Annual Maintenance Cost (in millions)
Pilot Station	45	\$1.82	\$1.35	\$3.10	\$1.16	\$0.00	\$141.16	\$0.00
St. Marys	14	\$1.82	\$2.11	\$4.50	\$1.89	\$13.50	\$61.89	\$1.43
Mountain Village	23	\$1.82	\$0.27	\$2.30	\$2.23	\$13.50	\$52.23	\$1.43
Kotlik	27	\$1.82	\$3.56	\$5.90	\$5.75	\$0.00	\$155.75	\$0.00
Emmonak	69	\$1.82	\$1.74	\$3.50	\$0.69	\$13.50	\$240.69	\$1.43
Alakanuk	8	\$1.82	\$4.33	\$8.00	\$5.27	\$0.00	\$65.27	\$0.00
Sheldon Point	63	\$1.82	\$1.96	\$3.90	\$5.46	\$13.50	\$245.46	\$1.43
Scammon Bay	65	\$1.82	\$0.98	\$2.80	\$2.06	\$13.50	\$182.06	\$1.43
Chevak	24	\$1.82	\$1.43	\$3.30	\$1.58	\$13.50	\$81.58	\$1.43
Hooper Bay	19	\$1.82	\$0.76	\$3.60	\$8.72	\$0.00	\$68.72	\$0.00
Newtok	104	\$1.82	\$0.78	\$2.60	\$1.68	\$27.00	\$271.68	\$2.86
Atmautluak	20	\$1.82	\$1.18	\$3.00	\$0.69	\$0.00	\$60.69	\$0.00
Nunapitchuk	8	\$1.82	\$2.20	\$3.60	\$0.32	\$0.00	\$30.32	\$0.00
Kasigluk	4	\$1.82	\$2.46	\$5.40	\$0.67	\$0.00	\$20.67	\$0.00
Napaskiak	8	\$1.82	\$5.01	\$7.60	\$0.88	\$0.00	\$60.88	\$0.00
Kwethluk	11	\$1.82	\$1.79	\$4.20	\$4.14	\$13.50	\$44.14	\$1.43
Eek	49	\$1.82	\$1.04	\$2.90	\$3.53	\$13.50	\$143.53	\$1.43
Quinhagak	42	\$1.82	\$1.13	\$3.20	\$5.50	\$0.00	\$135.50	\$0.00
Goodnews Bay	66	\$1.82	\$0.61	\$2.50	\$1.93	\$13.50	\$161.93	\$1.43
Platinum	23	\$1.82	\$0.88	\$2.60	\$0.63	\$0.00	\$60.63	\$0.00
Napakiak	7	\$1.82	\$1.12	\$4.50	\$3.95	\$13.50	\$33.95	\$1.43

Single Lane Corridor Baseline Cost Estimate Summary								
Corridors	Length	Road Construction						Maintenance
	Miles	Baseline Cost/mile (million/mile)	Water Crossing Cost/mile (million/mile)	Total Cost Per Mile (million/mile)	Turnout Costs per Corridor (in millions)	Maintenance Camp Cost (in millions)	Total Corridor Cost (in millions)	Annual Maintenance Cost (in millions)
Tuntutuliak	47	\$1.82	\$1.30	\$3.20	\$2.81	\$0.00	\$152.81	\$0.00
Kongiganek	34	\$1.82	\$1.24	\$3.00	\$1.07	\$13.50	\$101.07	\$1.43
Kwigillignok	13	\$1.82	\$1.42	\$3.40	\$2.81	\$0.00	\$42.81	\$0.00
Kipnuk	34	\$1.82	\$0.99	\$3.00	\$1.85	\$13.50	\$101.85	\$1.43
Chefornak	22	\$1.82	\$1.62	\$3.80	\$3.34	\$0.00	\$83.34	\$0.00
Nightmute	40	\$1.82	\$1.53	\$3.30	\$1.51	\$13.50	\$131.51	\$1.43
Toksook Bay	18	\$1.82	\$0.58	\$2.30	\$0.48	\$0.00	\$40.48	\$0.00
Tununak	6	\$1.82	\$0.37	\$2.10	\$1.81	\$0.00	\$11.81	\$0.00
Upper Kalskag	22	\$1.82	\$0.39	\$2.40	\$1.20	\$0.00	\$51.20	\$0.00
Akiachak	14	\$1.82	\$1.34	\$3.60	\$0.65	\$13.50	\$50.65	\$1.43
Akiak	8	\$1.82	\$0.92	\$2.70	\$1.45	\$0.00	\$21.45	\$0.00
Tuluksak	17	\$1.82	\$2.84	\$4.60	\$0.00	\$0.00	\$80.00	\$0.00
Total (All Corridors)	2017	\$1.82	\$0.98	\$3.01	\$168.27	\$432.00	\$6,078.27	\$42.85

Single Lane Corridor Maintenance Cost Estimate Summary								
Corridors	Length	Annual Road Maintenance			Annual Camp Maintenance			Annual Maintenance Cost (in millions)
	Miles	Cost per lane mile (\$/mi)	Lanes	Total Cost	Cost per Camp (ea/yr)	Camps	Total (\$/yr)	
Primary Arterial (Bethel)	559	\$8,730	1.67	\$8,131,413	\$422,000	11	\$4,642,000	\$12.77
Secondary Connectors (All)	1458	\$8,730	1.67	\$21,213,900	\$422,000	21	\$8,862,000	\$30.08
Total (All Corridors)	2017	\$8,730	1.67	\$29,345,313	\$422,000	\$32	\$13,504,000	\$42.85

Corridors	Length	Maintenance Camp Construction		
	Miles	Cost per Camp (ea, in millions)	Each	Construction Cost (in millions)
Primary Arterial (Bethel)	559	\$13.50	11	\$148.50
Secondary Connectors (All)	1458	\$13.50	21	\$283.50
Total (All Corridors)	2017	\$13.50	21	\$432.00

Yukon-Kuskokwim Region Air vs. Roads Access
Construction Maintenance Baseline Cost Comparison

Single Lane Corridor Turnout Costs per Corridor					
Corridors	Length	Turnouts			
	Miles	Turnouts (per mile)	Turnouts	Turnout Costs (ea)	Turnout Costs per Corridor
Primary Arterial (Bethel)	559	4	2,235	\$21,000	\$46,935,000
Nikolai	13	4	53	\$21,000	\$1,113,000
McGrath	9	4	34	\$21,000	\$714,000
Takotna	3	4	12	\$21,000	\$252,000
Ophir	21	4	85	\$21,000	\$1,785,000
Flat	16	4	62	\$21,000	\$1,302,000
Crooked Creek	24	4	96	\$21,000	\$2,016,000
Red Devil	33	4	133	\$21,000	\$2,793,000
Sleetmute	7	4	26	\$21,000	\$546,000
Stony River	25	4	100	\$21,000	\$2,100,000
Lime Village	55	4	222	\$21,000	\$4,662,000
Shageluk	68	4	274	\$21,000	\$5,754,000
Aniak	17	4	68	\$21,000	\$1,428,000
Chuathbaluk	9	4	38	\$21,000	\$798,000
Holy Cross	36	4	144	\$21,000	\$3,024,000
Anvik	44	4	176	\$21,000	\$3,696,000
Grayling	22	4	88	\$21,000	\$1,848,000
Russian Mission	71	4	283	\$21,000	\$5,943,000
Marshall	14	4	57	\$21,000	\$1,197,000

Yukon-Kuskokwim Region Air vs. Roads Access
Construction Maintenance Baseline Cost Comparison

Single Lane Corridor Turnout Costs per Corridor					
Corridors	Length	Turnouts			
	Miles	Turnouts (per mile)	Turnouts	Turnout Costs (ea)	Turnout Costs per Corridor
Pilot Station	45	4	180	\$21,000	\$3,780,000
St. Marys	14	4	55	\$21,000	\$1,155,000
Mountain Village	23	4	90	\$21,000	\$1,890,000
Kotlik	27	4	106	\$21,000	\$2,226,000
Emmonak	69	4	274	\$21,000	\$5,754,000
Alakanuk	8	4	33	\$21,000	\$693,000
Sheldon Point	63	4	251	\$21,000	\$5,271,000
Scammon Bay	65	4	260	\$21,000	\$5,460,000
Chevak	24	4	98	\$21,000	\$2,058,000
Hooper Bay	19	4	75	\$21,000	\$1,575,000
Newtok	104	4	415	\$21,000	\$8,715,000
Atmautluak	20	4	80	\$21,000	\$1,680,000
Nunapitchuk	8	4	33	\$21,000	\$693,000
Kasigluk	4	4	15	\$21,000	\$315,000
Napaskiak	8	4	32	\$21,000	\$672,000
Kwethluk	11	4	42	\$21,000	\$882,000
Eek	49	4	197	\$21,000	\$4,137,000
Quinhagak	42	4	168	\$21,000	\$3,528,000
Goodnews Bay	66	4	262	\$21,000	\$5,502,000

Yukon-Kuskokwim Region Air vs. Roads Access
Construction Maintenance Baseline Cost Comparison

Single Lane Corridor Turnout Costs per Corridor					
Corridors	Length	Turnouts			
	Miles	Turnouts (per mile)	Turnouts	Turnout Costs (ea)	Turnout Costs per Corridor
Platinum	23	4	92	\$21,000	\$1,932,000
Napakiak	7	4	30	\$21,000	\$630,000
Tuntutuliak	47	4	188	\$21,000	\$3,948,000
Kongiganek	34	4	134	\$21,000	\$2,814,000
Kwigillignok	13	4	51	\$21,000	\$1,071,000
Kipnuk	34	4	134	\$21,000	\$2,814,000
Chefornak	22	4	88	\$21,000	\$1,848,000
Nightmute	40	4	159	\$21,000	\$3,339,000
Toksook Bay	18	4	72	\$21,000	\$1,512,000
Tununak	6	4	23	\$21,000	\$483,000
Upper Kalskag	22	4	86	\$21,000	\$1,806,000
Akiachak	14	4	57	\$21,000	\$1,197,000
Akiak	8	4	31	\$21,000	\$651,000
Tuluksak	17	4	69	\$21,000	\$1,449,000

Yukon-Kuskokwim Region Air vs. Roads Access
Construction Maintenance Baseline Cost Comparison

Single Lane Corridor Water Crossing Summary Per Corridor			
Corridors	Length	Roadway	
	Miles	Total Cost (in millions)	Per Mile Cost (in millions)
Primary Arterial (Bethel)	559	\$265.73	\$0.48
Nikolai	13	\$15.90	\$1.20
McGrath	9	\$17.15	\$2.01
Takotna	3	\$6.43	\$2.15
Ophir	21	\$14.76	\$0.70
Flat	16	\$7.97	\$0.51
Crooked Creek	24	\$16.93	\$0.71
Red Devil	33	\$39.58	\$1.19
Sleetmute	7	\$21.57	\$3.26
Stony River	25	\$23.98	\$0.96
Lime Village	55	\$46.20	\$0.83
Shageluk	68	\$28.41	\$0.41
Aniak	17	\$37.40	\$2.20
Chuathbaluk	9	\$6.19	\$0.66
Holy Cross	36	\$54.85	\$1.53
Anvik	44	\$32.34	\$0.73
Grayling	22	\$26.57	\$1.20
Russian Mission	71	\$24.25	\$0.34
Marshall	14	\$4.22	\$0.30

Yukon-Kuskokwim Region Air vs. Roads Access
Construction Maintenance Baseline Cost Comparison

Single Lane Corridor Water Crossing Summary Per Corridor			
Corridors	Length	Roadway	
	Miles	Total Cost (in millions)	Per Mile Cost (in millions)
Pilot Station	45	\$60.81	\$1.35
St. Marys	14	\$29.15	\$2.11
Mountain Village	23	\$5.99	\$0.27
Kotlik	27	\$94.48	\$3.56
Emmonak	69	\$119.32	\$1.74
Alakanuk	8	\$35.37	\$4.33
Sheldon Point	63	\$122.86	\$1.96
Scammon Bay	65	\$63.74	\$0.98
Chevak	24	\$34.82	\$1.43
Hooper Bay	19	\$14.25	\$0.76
Newtok	104	\$81.03	\$0.78
Atmautluak	20	\$23.60	\$1.18
Nunapitchuk	8	\$18.36	\$2.20
Kasigluk	4	\$9.49	\$2.46
Napaskiak	8	\$40.34	\$5.01
Kwethluk	11	\$18.82	\$1.79
Eek	49	\$51.34	\$1.04
Quinhagak	42	\$47.55	\$1.13
Goodnews Bay	66	\$40.08	\$0.61

Yukon-Kuskokwim Region Air vs. Roads Access
Construction Maintenance Baseline Cost Comparison

Single Lane Corridor Water Crossing Summary Per Corridor			
Corridors	Length	Roadway	
	Miles	Total Cost (in millions)	Per Mile Cost (in millions)
Platinum	23	\$20.15	\$0.88
Napakiak	7	\$8.41	\$1.12
Tuntutuliak	47	\$61.15	\$1.30
Kongiganek	34	\$41.72	\$1.24
Kwigillignok	13	\$18.01	\$1.42
Kipnuk	34	\$33.10	\$0.99
Chefornak	22	\$35.86	\$1.62
Nightmute	40	\$60.63	\$1.53
Toksook Bay	18	\$10.47	\$0.58
Tununak	6	\$2.13	\$0.37
Upper Kalskag	22	\$8.49	\$0.39
Akiachak	14	\$19.01	\$1.34
Akiak	8	\$7.17	\$0.92
Tuluksak	17	\$49.15	\$2.84

Single Lane Corridor Roadway Water Crossing Summary													
Corridors	Culverts						Bridges						Total
	Minor Culverts (<4')		Culvert Small (4' to 10')		Culvert Large (>10' to 20')		Bridge Small (<50')		Bridge Medium (50' to 140')		Bridge Large (>140')		COST (in millions)
	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	
Primary Arterial (Bethel)	5,589	\$19,000	168	\$94,000	112	\$207,000	33	\$430,000	33	\$1,130,000	6060	\$11,400	\$265.73
Nikolai	133	\$19,000	4	\$94,000	3	\$207,000	1	\$430,000	2	\$1,130,000	850	\$11,400	\$15.90
McGrath	86	\$19,000	3	\$94,000	2	\$207,000	0	\$430,000	0	\$1,130,000	1300	\$11,400	\$17.15
Takotna	30	\$19,000	1	\$94,000	1	\$207,000	1	\$430,000	0	\$1,130,000	450	\$11,400	\$6.43
Ophir	212	\$19,000	7	\$94,000	5	\$207,000	2	\$430,000	3	\$1,130,000	420	\$11,400	\$14.76
Flat	156	\$19,000	5	\$94,000	4	\$207,000	2	\$430,000	0	\$1,130,000	250	\$11,400	\$7.97
Crooked Creek	240	\$19,000	8	\$94,000	5	\$207,000	0	\$430,000	2	\$1,130,000	730	\$11,400	\$16.93
Red Devil	334	\$19,000	10	\$94,000	7	\$207,000	2	\$430,000	0	\$1,130,000	2630	\$11,400	\$39.58
Sleetmute	67	\$19,000	2	\$94,000	2	\$207,000	1	\$430,000	0	\$1,130,000	1690	\$11,400	\$21.57
Stony River	250	\$19,000	8	\$94,000	5	\$207,000	4	\$430,000	1	\$1,130,000	1280	\$11,400	\$23.98
Lime Village	555	\$19,000	17	\$94,000	12	\$207,000	4	\$430,000	2	\$1,130,000	2420	\$11,400	\$46.20
Shageluk	685	\$19,000	21	\$94,000	14	\$207,000	6	\$430,000	4	\$1,130,000	300	\$11,400	\$28.41
Aniak	170	\$19,000	6	\$94,000	4	\$207,000	2	\$430,000	0	\$1,130,000	2800	\$11,400	\$37.40
Chuathbaluk	94	\$19,000	3	\$94,000	2	\$207,000	2	\$430,000	0	\$1,130,000	250	\$11,400	\$6.19
Holy Cross	360	\$19,000	11	\$94,000	8	\$207,000	2	\$430,000	0	\$1,130,000	3900	\$11,400	\$54.85
Anvik	441	\$19,000	14	\$94,000	9	\$207,000	3	\$430,000	0	\$1,130,000	1710	\$11,400	\$32.34
Grayling	222	\$19,000	7	\$94,000	5	\$207,000	3	\$430,000	1	\$1,130,000	1600	\$11,400	\$26.57
Russian Mission	707	\$19,000	22	\$94,000	15	\$207,000	6	\$430,000	1	\$1,130,000	170	\$11,400	\$24.25
Marshall	142	\$19,000	5	\$94,000	3	\$207,000	1	\$430,000	0	\$1,130,000	0	\$11,400	\$4.22

Single Lane Corridor Roadway Water Crossing Summary													
Corridors	Culverts						Bridges						Total
	Minor Culverts (<4')		Culvert Small (4' to 10')		Culvert Large (>10' to 20')		Bridge Small (<50')		Bridge Medium (50' to 140')		Bridge Large (>140')		COST (in millions)
	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	
Pilot Station	901	\$19,000	23	\$94,000	14	\$207,000	0	\$430,000	2	\$1,130,000	3190	\$11,400	\$60.81
St. Marys	276	\$19,000	7	\$94,000	5	\$207,000	0	\$430,000	2	\$1,130,000	1750	\$11,400	\$29.15
Mountain Village	226	\$19,000	7	\$94,000	5	\$207,000	0	\$430,000	0	\$1,130,000	0	\$11,400	\$5.99
Kotlik	532	\$19,000	14	\$94,000	8	\$207,000	1	\$430,000	8	\$1,130,000	6310	\$11,400	\$94.48
Emmonak	1372	\$19,000	35	\$94,000	21	\$207,000	0	\$430,000	0	\$1,130,000	7510	\$11,400	\$119.32
Alakanuk	164	\$19,000	5	\$94,000	3	\$207,000	2	\$430,000	2	\$1,130,000	2460	\$11,400	\$35.37
Sheldon Point	1254	\$19,000	32	\$94,000	19	\$207,000	3	\$430,000	6	\$1,130,000	7370	\$11,400	\$122.86
Scammon Bay	1299	\$19,000	33	\$94,000	20	\$207,000	3	\$430,000	3	\$1,130,000	2380	\$11,400	\$63.74
Chevak	488	\$19,000	13	\$94,000	8	\$207,000	4	\$430,000	3	\$1,130,000	1540	\$11,400	\$34.82
Hooper Bay	377	\$19,000	10	\$94,000	6	\$207,000	4	\$430,000	1	\$1,130,000	180	\$11,400	\$14.25
Newtok	2077	\$19,000	52	\$94,000	32	\$207,000	10	\$430,000	12	\$1,130,000	1070	\$11,400	\$81.03
Atmautluak	401	\$19,000	11	\$94,000	7	\$207,000	1	\$430,000	4	\$1,130,000	750	\$11,400	\$23.60
Nunapitchuk	167	\$19,000	5	\$94,000	3	\$207,000	1	\$430,000	1	\$1,130,000	1100	\$11,400	\$18.36
Kasigluk	78	\$19,000	2	\$94,000	2	\$207,000	0	\$430,000	0	\$1,130,000	650	\$11,400	\$9.49
Napaskiak	161	\$19,000	5	\$94,000	3	\$207,000	2	\$430,000	1	\$1,130,000	3000	\$11,400	\$40.34
Kwethluk	211	\$19,000	6	\$94,000	4	\$207,000	0	\$430,000	3	\$1,130,000	880	\$11,400	\$18.82
Eek	985	\$19,000	25	\$94,000	15	\$207,000	13	\$430,000	8	\$1,130,000	1100	\$11,400	\$51.34
Quinhagak	842	\$19,000	22	\$94,000	13	\$207,000	9	\$430,000	11	\$1,130,000	920	\$11,400	\$47.55
Goodnews Bay	656	\$19,000	20	\$94,000	14	\$207,000	7	\$430,000	1	\$1,130,000	1640	\$11,400	\$40.08

Single Lane Corridor Roadway Water Crossing Summary													
Corridors	Culverts						Bridges						Total
	Minor Culverts (<4')		Culvert Small (4' to 10')		Culvert Large (>10' to 20')		Bridge Small (<50')		Bridge Medium (50' to 140')		Bridge Large (>140')		
	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	Quantity (ea)	Unit Cost (ea)	COST (in millions)
Platinum	231	\$19,000	7	\$94,000	5	\$207,000	1	\$430,000	4	\$1,130,000	800	\$11,400	\$20.15
Napakiak	150	\$19,000	4	\$94,000	3	\$207,000	0	\$430,000	0	\$1,130,000	400	\$11,400	\$8.41
Tuntutuliak	942	\$19,000	24	\$94,000	15	\$207,000	10	\$430,000	4	\$1,130,000	2550	\$11,400	\$61.15
Kongiganek	673	\$19,000	17	\$94,000	11	\$207,000	5	\$430,000	1	\$1,130,000	1910	\$11,400	\$41.72
Kwigillignok	255	\$19,000	7	\$94,000	4	\$207,000	2	\$430,000	1	\$1,130,000	850	\$11,400	\$18.01
Kipnuk	671	\$19,000	17	\$94,000	11	\$207,000	4	\$430,000	6	\$1,130,000	700	\$11,400	\$33.10
Chefornak	443	\$19,000	12	\$94,000	7	\$207,000	7	\$430,000	3	\$1,130,000	1620	\$11,400	\$35.86
Nightmute	795	\$19,000	20	\$94,000	12	\$207,000	3	\$430,000	3	\$1,130,000	3200	\$11,400	\$60.63
Toksook Bay	359	\$19,000	9	\$94,000	6	\$207,000	1	\$430,000	1	\$1,130,000	0	\$11,400	\$10.47
Tununak	58	\$19,000	2	\$94,000	2	\$207,000	1	\$430,000	0	\$1,130,000	0	\$11,400	\$2.13
Upper Kalskag	216	\$19,000	7	\$94,000	5	\$207,000	1	\$430,000	2	\$1,130,000	0	\$11,400	\$8.49
Akiachak	284	\$19,000	8	\$94,000	5	\$207,000	0	\$430,000	3	\$1,130,000	740	\$11,400	\$19.01
Akiak	157	\$19,000	4	\$94,000	3	\$207,000	0	\$430,000	0	\$1,130,000	280	\$11,400	\$7.17
Tuluksak	346	\$19,000	9	\$94,000	6	\$207,000	3	\$430,000	2	\$1,130,000	3240	\$11,400	\$49.15

APPENDIX B

Airport Cost Estimations

Airport Cost Estimates

Community	Class of Airport	Surface	Runway Length	Runway Width	Total Runway	Total Taxiway & Apron		Road Cost	Total Cost
			Assumed	Assumed	Square Footage	Square Footage			
Bethel	Hub	Asphalt	6400	150					
		Asphalt	4000	75					
		Gravel	3200	60	1,452,000	4,940,000	\$ 4,600,000	\$ 936,000,000	
McGrath	Sub-Regional	Asphalt	2000	60	565,200	1,185,500	\$ 1,274,000	\$ 92,900,000	
Aniak	Sub-Regional	Asphalt	5400	75	405,000	810,500	\$ 728,000	\$ 79,300,000	
		Gravel	6000	150					
St. Marys	Sub-Regional	Gravel	1500	60	990,000	610,000	\$ 3,276,000	\$ 64,100,000	
		Gravel	6000	150					
Emmonak	Sub-Regional	Gravel	1500	60	990,000	699,500	\$ 3,458,000	\$ 53,900,000	
Akiachak	Community	Gravel	5000	75	375,000	180,000	\$ 1,820,000	\$ 22,400,000	
Red Devil	Community	Gravel	4500	75	337,500	180,000	\$ 1,820,000	\$ 21,000,000	
Kotlik	Community	Gravel	4400	75	330,000	180,000	\$ 1,820,000	\$ 21,000,000	
Alakanuk	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Anvik	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Grayling	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Holy Cross	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Kipnuk	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Lower Kalskag	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Nikolai	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Quinhagak	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Russian Mission	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Scammon Bay	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Shageluk	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Sheldon Point	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Takotna	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Chuathbaluk	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Crooked Creek	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Flat	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Mountain Village	Community	Gravel	4000	75	300,000	180,000	\$ 1,820,000	\$ 19,600,000	
Atmautluak	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Chefornak	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Chevak	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Eek	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Goodnews Bay	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Hooper Bay	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Kasigluk	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Kongiganak	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Kwethluk	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Kwigillingok	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Marshall	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Napakiak	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Napaskiak	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Newtok	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Nightmute	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Nunapitchuk	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Ophir	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Sleetmute	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Stony River	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Toksook Bay	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Tuluksak	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Tuntutuliak	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Tununak	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Akiak	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Lime Village	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Pilot Station	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Platinum	Community	Gravel	3300	60	198,000	180,000	\$ 1,820,000	\$ 15,800,000	
Total								\$ 2,050,400,000	

Sub-Regional Airport Cost Estimations

<u>Community</u>	<u>Surface</u>	<u>ALP Ultimate Runway Length</u>	<u>Runway width</u>	<u>Taxiway</u>	<u>Apron</u>	<u>Total Sq Footage</u>	<u>SREB (mil)</u>	<u>Total Cost</u>
Aniak	Asphalt	5400	150	115,500	695,000	1,620,500	\$ 2.40	\$ 78,563,500.00
	Asphalt	5936	100					
McGrath	Asphalt	2000	60	160,000	1,025,500	1,899,100	\$ 2.40	\$ 91,657,700.00
Emmonak	Gravel	6200	100	65,750	633,750	1,319,500	\$ 1.60	\$ 50,421,500.00
	Gravel	6000	150					
St. Marys	Gravel	1500	60	90,000	520,000	1,600,000	\$ 1.60	\$ 60,800,000.00

Assumptions

- \$800,000 per SREB bay
- \$37 sq ft wet areas gravel
- \$47 sq ft asphalt
- \$1.82 million pone lane gravel road (per roads section) for access road

**Regional Airport Cost Estimations
Bethel Airport**

Kotzebue Airfield Cost Estimate ¹	\$	724,135,720.21
Kotzebue M&O Facilities ² Cost Estimate	\$	20,600,000.00
Additional Pavement ³ Cost at Bethel	\$	186,610,539.00
2-Lane Paved Access Road ⁴ at Bethel	\$	4,600,000.00
TOTAL BETHEL COST ESTIMATE	\$	935,946,259.21

¹ Kotzebue's proposed runway (Kotzebue Airport Relocation Feasibility Study, 2008) square footage is comparable to Bethel's current square footage

² Kotzebue's M&O Facility is comparable to Bethel's

³ 3,970,437 additional square feet of pavement to be added to Kotzebue's cost at \$47 per square foot (2,864,760 sq ft of apron & 1,105,677 sq ft of taxiway)

⁴ 1.2 mile two-lane road at 3.83 million per mile

