

Attachment F.3 Benefit Cost Analysis Emmonak, Alaska

I. Introduction & Overview

The City of Emmonak is located near the mouth of the Yukon River on the coast of Western Alaska, approximately 10 miles from the Bering Sea; bordered on the south by Kwiguk Pass and to the east by Emmonak Slough. Emmonak is predominantly a Yupik Eskimo community of 762 residents. During the Qualified Disaster (DR-AK-4122) from May 17- June 13, 2013, severe ice jams diverted water from the Yukon River into Emmonak and nearby communities.

II. BCA Summary

A summary of Benefits and costs for all projects is provided below. Additional information on individual projects can be found in Section III Project BCA Narratives.

| Aggregate Benefit Cost Ratios (BCR's) for Proposed Projects | | | |
|--|------------------------------|------------------------|------------|
| Project Description | Quantitative Benefits | Estimated Costs | BCR |
| 1. Port Project | \$43,555,155 | \$17,170,551 | 2.54 |
| 2. Flood Protection Pad | \$13,704,572 | \$4,683,000 | 2.93 |
| 3. Airport Project | \$41,178,812 | \$31,900,000 | 1.29 |
| 4. Improved Airport Road with Bypass Project | \$4,245,843 | \$3,161,340 | 1.34 |
| 5. Barge Landing Area Study in Alakanuk Project | n/a | \$145,000 | n/a |
| 6. Water Storage Tank Project | \$10,540,842 | \$8,900,000 | 1.18 |
| Total | \$113,225,224 | \$65,959,891 | 1.72 |
| Direct Activity Delivery Cost (20%) | | | |
| Training, travel, grant management, project management, technical assistance, kick-off meetings and other supporting activity implementation | | \$13,191,978 | |
| Total with Direct Activity Delivery Cost | | \$79,151,869 | |

III. Project BCA Narratives

BCA narratives for individual projects are provided below. Proposed projects focus on infrastructure, housing, and food and economic security.

Analysis calculations applicable to more than one project are summarized under the Analysis Process Applicable to Multiple Projects heading and includes such items as determining the return interval for future disaster events, population, and other similar items.

| <i>Analysis Process Applicable to Multiple Projects</i> |
|--|
| Flood Elevation |
| The flood elevation in Emmonak is 20 feet NGVD 88, determined from the US Army Corps of Engineers (USACE) Public Floodplain Viewer. |
| Determining Flooding Return Interval |
| The flooding return interval for Emmonak was determined from FEMA Disaster Declarations. Emmonak experienced seven flood events in the past 26 years (May 1989 to September 2015). This equates to a flooding interval of eight floods in 30 years. Due to the effects of climate change it is expected that a similar or greater recurrence interval for similar flood events will occur in future years. For benefit analysis purposes it is assumed that future flood event intervals will be evenly spaced for the next 30 years. |
| Community Population |
| Community Population for Emmonak is 762 residents based on information from the 2010 US Census. |
| Project Useful Life |
| Project useful life was determined for each project based on guidance in Appendix D – Project Useful Life Summary provided in the FEMA BCA Reference Guide (June 2009) |

BCA Narrative

Project 1: Emmonak Port Project

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Emmonak Port Project was prepared as follows:

Costs

Cost based on engineer's estimate from Michael L. Foster & Associates, Inc. to construct the Emmonak Port Project (Dropbox: E-1).

Operations and Maintenance (O&M) costs were provided by the City of Emmonak. The City projects that the operations costs of the Port will be offset by the tariffs and lease charges and be an overall net positive cash flow for the City. Cost estimate provided in Appendix F.3.1.

Benefits

Quantified benefits include, increased economic activity from fish processors, increased earnings for fishermen, and a decrease in cost of building an earthen barge landing each year. All calculations and references are provided in Appendix F.3.1.

The value of the decreased shipping costs from having a port facility was given by Kwik’Pak Fisheries LLC. Kwik’Pak shipped 3-4 million pounds of fish last year by barge. The cost of shipping by barge is \$0.25 higher due to lack of port facilities. Kwik’Pak estimates that their business will increase 20% with a port (Dropbox: E-2).

The value of increased earnings from increase sales was from Kwik’Pak Fisheries LLC. Kwik’Pak shipped 3-4 million pounds of fish last year at an average cost of \$2.30 per pound. Kwik’Pak estimates that their business will increase 20% with a port.

The value of decreased costs for constructing an earthen barge ramp and landing barges each year were given by Kwik’Pak Fisheries LLC.

Discount Factor

A discount factor of 7% was applied to all annual costs and benefits to calculate present dollar values of future costs and benefits.

| Full Proposal Cost | Estimated Cost | Other Funding |
|---|-----------------------|----------------------|
| A construction cost estimate is provided in Appendix F.3.1. | \$17,170,551 | \$3,000,000 |

Description of Current Situation and Problem to be Solved

This Yupik Eskimo community is recognized as the most suitable site for a port and dock facility in the lower Yukon region. Emmonak is strategically situated to provide basic shipping and transportation redistribution services to 13 other small communities in the lower Yukon region, serving over 5,500 residents in total.

Despite the lack of any port infrastructure in Emmonak, maritime activity has significantly increased in recent years. In 2010, more than 50,000 tons of cargo was shipped through Emmonak; more than triple the cargo delivered in 2002. Today, the lack of infrastructure hinders logistics, damages the riverbank, and delays cargo transport. For example, Kwik’Pak Fisheries, the region’s largest private

employer, must build and maintain earthen barge landings along the riverbank to facilitate port operations. The landings continually wash away and occasionally fail catastrophically, choking the river with sediment and creating a hazardous work environment.

Along the Yukon River, Alakanuk and Emmonak serve as connective ports for ocean and river barges. Emmonak is more commonly used as a hub for this purpose. However, the majority of cargo barges must dock upriver or downriver from the community as the community area itself is not well suited for barge access, even with riverbank maintenance. A barge dock in Emmonak benefits many communities in the Yukon Delta, providing them access to a nearby efficient and robust port. Additional fuel tank capacity would also be valuable.

Emmonak is recognized by local stakeholders, industry operators, and regional planners as the most suitable site for the construction of new maritime infrastructure that would support regional needs. Emmonak is strategically located at the mouth of the Yukon River and accesses the best river channel morphology for ocean barges to maneuver and land safely and efficiently. Emmonak also possesses suitable upland area for cargo staging and storage. The USACE identified Emmonak as one of its 35 priority barge landing facility improvement sites in Western Alaska (Dropbox: E-3-pg. 15). Priority designation is based on the urgency of needed improvements, ease of construction, the frequency of barge deliveries, and the potential impact improvements would have to facility operations. These impacts would include increased operational efficiency, improved worker and environmental safety, and the higher quality of goods and services delivered to the community or region.

Description of Proposed Project or Program

The Lower Yukon River Regional (LYRR) Port project design meets both current demands and anticipated future demand, with the additional benefit of river bank stabilization and erosion control. There are two primary components of the design: 1) a dock portion constructed of sheet-pile cellular bulkheads, anchored by pilings reinforced with armor rock; and 2) a barge landing ramp of poured concrete, stabilized by four sheet-pile cellular bulkheads and including anchor rock protections. The dock structure would allow for barge side tie-up and the crane offloading of smaller cargo, while the ramp will allow for the efficient offload of heavy equipment and large volume rock products. The Emmonak Port Project technical specifications and final drawings are provided by Michael L. Foster & Associates, Inc. (Dropbox: E-15&16). This design configuration has been identified by USACE as ideal for sub-regional redistribution hubs because it allows multiple barges to offload at a time and gives operators several options to maximize efficiency (Dropbox: E-4).

Description Risk to the Community if the Proposal is Not Implemented

High cost of living is a recognized challenge for rural Alaska communities. Geographic isolation pairs with high shipping and transportation costs to make this a particularly significant economic burden for communities such as Emmonak. The average gasoline and heating fuel prices in Western Alaska are the highest in the state (Tables 1 & 2).

Table 1. Gasoline Prices per Gallon across Alaska, January 2014

| | Gulf Coast | Interior | Northern | Northwest | Southeast | Southwest | Western |
|---------|------------|----------|----------|-----------|-----------|-----------|---------|
| High | \$7.60 | \$10.00 | \$9.65 | \$7.99 | \$5.50 | \$8.17 | \$8.03 |
| Low | \$3.92 | \$3.69 | \$4.10 | \$5.25 | \$4.09 | \$4.80 | \$6.18 |
| Average | \$5.07 | \$5.95 | \$6.41 | \$6.76 | \$4.61 | \$6.24 | \$6.90 |

Table 2.#1 Heating Fuel Prices per Gallon across Alaska, January 2014

| | Gulf Coast | Interior | Northern | Northwest | Southeast | Southwest | Western |
|---------|------------|----------|----------|-----------|-----------|-----------|---------|
| High | \$7.22 | \$10.00 | \$3.00 | \$7.22 | \$5.50 | \$8.21 | \$7.32 |
| Low | \$3.80 | \$4.08 | \$1.40 | \$4.85 | \$3.87 | \$4.00 | \$5.28 |
| Average | \$4.79 | \$5.89 | \$1.89 | \$6.19 | \$4.52 | \$5.96 | \$6.51 |

Economic Challenges

Beyond the persistent socioeconomic challenges of poverty, unemployment, low income, and high costs of living, the homogenous economic base of lower Yukon communities is a significant concern for the region. Dependence on unpredictable fish runs and government employment, which is unlikely to increase in the future, inhibits economic growth in Emmonak. Furthermore, it renders them persistently vulnerable to natural disasters that have occurred in the recent past and will likely continue to occur in the future. Federal disaster declarations were issued due to Yukon River Chinook salmon run failures occurring from 2008 through 2012, resulting in Chinook salmon commercial fishing closures throughout the region.

Emmonak shares many of the socioeconomic challenges of neighboring lower Yukon region communities and rural Alaska in general. During a Qualified Disaster, the Department of Transportation, Maintenance and Operations (M&O) flew one load of culvert and materials into Emmonak to help repair the flooded taxiway, and that single flight was \$12,000.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.3.1.

Economic Revitalization:

Ports are the interface of marine-oriented activities such as transportation and fishing and land-based

activities such as manufacturing, resource extraction, and agriculture. At the interface, development is required to support the vessels and landside transportation networks and the goods and material that flow between maritime shipping and landside transportation. This waterfront development can consist of a wide range of activities and businesses ranging from those catering to recreational or small commercial vessel owners and parts and supplies for those vessels, to large warehouses and storage yards to consolidate goods and materials being shipped to or from the port.

Restaurants and businesses catering to cruise ship passengers or visitors taking a day cruise are now found in many ports. Charter boats are found in many harbors, and fish processing plants provide increased economic activity in the communities where they are located. Smaller and remote communities may not see large cruise ships or even day-cruise boats, but the interface is still there and economic activity can be found around the port or harbor, albeit on a smaller scale.

The presence of a port contributes to the total economic activity in a community. This contribution extends beyond the activities and businesses that are located on the waterfront and extends to businesses located elsewhere in the community and the local government(s) that are present. Other businesses, defined as those that are not located on the waterfront, can receive additional revenue from the expenditures by vessel owners and crew, and their families, in grocery stores and other commercial entities. Employees at the seafood processing plant will spend money in the community and the owner of the plant purchases goods and services from local vendors. Visitors to the community will purchase goods and services at local businesses, including charter fishing firms, restaurants, hotels, etc. In addition to this spending, further expenditures by other business owners, their families, and employees will round out the multiplier effect to increase the level of economic activity in the community. The web of interconnected expenditures emanating from this port project is wide and pervasive.

The LYRR Port project would directly benefit the shipping and construction industries operating in Western Alaska by facilitating more efficient and cost effective operations. These companies are invested in the area, but are persistently challenged by geographical hardships and a lack of proper infrastructure and management.

A new port facility in Emmonak would also directly support the Kwik'Pak Fisheries seafood processing facility and other Yukon Delta Fisheries Development Association (YDFDA) subsidiary businesses. The cost-effective transport of frozen fish products out of Emmonak is a major issue for Kwik'Pak fisheries, as limitations ultimately impact local commercial fishermen who sell their catch to Kwik'Pak. In past years, salmon harvesting and processing activities have been forced to shut down due to limited fish product transport capacity out of Emmonak. Improved barge landing facilities in Emmonak would be attractive to marine shipping companies possibly interested in long-term investments that would stabilize product distribution and encourage continued economic growth in the region through Kwik'Pak Fisheries.

The continued growth of local businesses like Kwik'Pak Fisheries and other private sector industries in Emmonak is critical to long-term economic development in the region. The activity of these

businesses diversifies and strengthens the economic base of the region and reduces reliance on government employment and unpredictable fish returns. This diversification is critical to the long-term sustainability of communities in the lower Yukon region that are subject to significant socioeconomic challenges and frequent natural disaster scenarios.

Resiliency Value:

The 2011 *Planning for Alaska's Regional Ports and Harbors: Final Report* commissioned by USACE, identifies Emmonak as the best investment opportunity in the lower Yukon region (Dropbox: E-3-pg 15). With well-organized management, the proposed LYRR Port project would alleviate congestion and allow for ordered regulation and efficient barge delivery operations into Emmonak. It is anticipated that this directed maritime infrastructure improvement could reduce the costs of delivering cargo to the lower Yukon region. Shipping companies may then be able to improve service and reduce cost of goods delivered to local residents and businesses. The high cost of fuel in the lower Yukon region is the product of high fuel costs statewide and the difficulty associated with delivering fuel to the region. The primary way to reduce fuel costs to Western Alaska is to maximize the efficiency of fuel delivery operations.

Port construction in Emmonak will support efficient fuel shipment and delivery that facilitate less costly offloading operations. With proper management and coordination, these capacity improvements may allow Emmonak to receive and redistribute fuel at economies of scale that could reduce gasoline, propane, and heating fuel costs across the region. Increased maritime industry capacity in Emmonak could also allow the region to become involved in several large-scale industry development opportunities.

Many of Alaska's rural communities are dependent on resupply trips carried out by barges. The fuel and other goods that are delivered by marine transport allow rural Alaskans to continue their subsistence lifestyle, which is among the most highly valued aspects of the Alaska Native culture and an important part of the economy of these rural communities.

No other state in the continental U.S. depends on water transportation to the extent Alaska does. Access to water was a critical factor in the development of the state and often dictated the location of communities. Today, Alaska's ports and harbors remain an essential element of the state's economy. They are critical for the import and export of goods as well as bulk commodities. Alaska waterways provide the transportation corridors for the movement of the majority of the cargo delivered to Alaska, as well as the majority of exports, including all of the state's oil and gas exports and much of the seafood and minerals. Alaska's dependence on waterborne commerce is the result of its geography and isolation from the rest of the nation. Alaska's 33,900 miles of coastline is far greater than that of the continental U.S.

Social Value:

The regional hub model of marine shipping and transportation is particularly applicable in Alaska. Limited funding is available for maritime infrastructure projects in remote Alaskan communities, so

strategic projects that serve multiple communities through efficient redistribution operations maximize the impact of targeted investments.

Regional hubs play an important role in the marine transportation system and the resupply of rural communities by providing storage capacity that is sufficient to take a large fuel barge and hold the fuel while it is delivered over time with multiple trips to local communities. Similarly, they have large storage yards sufficient to hold multiple containers and other material from barges, which may require several trips on smaller vessels to the final destination. Regional hubs generally have large equipment for efficiently offloading and loading containers as well as heavy and bulky construction materials. These attributes reduce costs for residents of the hub communities as well as residents of outlying communities.

Environmental Value:

Persistent riverbank erosion and flooding pose a significant threat to the existing physical infrastructure of local maritime industry businesses. It also makes it difficult to bring in heavy equipment after a disaster to help rebuild the community.

Descriptions of Risks to Ongoing Benefits

Constructing and maintaining infrastructure projects across Alaska is expensive, particularly in rural areas. For example, the cost of constructing buildings in remote areas is on the order of twice as much per square foot as in Anchorage. The higher construction costs in rural Alaska are due to a combination of higher input costs. Construction aggregate, such as crushed rock or gravel, are often barged to the construction site because they are difficult to source locally. Transportation of building materials is expensive; limited road and rail networks mean that goods must be barged or flow in. Additional challenges include a limited supply of specialty labor (mechanical, electrical); challenging foundation conditions—including areas with abundant permafrost; weather delays; remote logistics; and the high cost of fuel. Moreover, the harsh winter climate of Alaska significantly shortens both the construction season and the useful life of roads and other infrastructure.

Assessment of Challenges Faced with Implementing the Proposal

This facility would directly support barge delivery services and maritime industry growth in Emmonak by addressing two current operational challenges:

- Overcrowding
 - The current unimproved condition of the barge landing facility and inefficient offloading operations create periods of significant overcrowding and barge backup.
- Port Regulations
 - Local oversight and regulations of cargo deliveries into Emmonak is extremely limited. Inconsistent local management and disorganized operations significantly impact the reliability of current cargo and fuel delivery and redistribution through Emmonak.

Several key people active in the shipping industry in the lower Yukon region expressed serious

concerns about local management capacity. They described the lack of training and management disorganization in Emmonak could prevent efficient shipping and fuel distribution. These inefficiencies drive up costs and stifle industry activity in the area. Additionally, ongoing difficulties in the current fuel storage and distribution system, combined with lack of training gave rise to concerns of long-term reliability of operating in Emmonak.

In the face of these existing difficulties, the LYRR Port project may be viewed as an opportunity to develop local infrastructure and workforce management capacity. Investments in additional physical infrastructure will not produce any positive economic impacts for a community when the underlying management capacity to operate the facilities is unreliable. Investment in training, management capacity building, industry coordination, and development must occur in concert with infrastructure improvements to produce the potential economic impacts. Specifically, this may include coordination with state or other municipal maritime industry regulatory authorities, hiring outside consultants to assist in planning and drafting of regulatory documents, and close cooperation with local industry partners. Several significant challenges limit maritime industry growth in Emmonak. The construction and organized management of the LYRR Port project should specifically address these issues.

Metrics

The following metrics will be used to determine the impacts of the Emmonak Port:

- Resiliency Value: Intermodal transportation linkage occurs
- Environmental Value: Net reduction in erosion
- Economic Revitalization: Net increase of workforce development program participants enrolled
- Social Value: Infrastructure investment directly affecting the Region

BCA Narrative

Project 2: Flood Protection Pad Project

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Flood Protection Pad Project was prepared as follows:

Costs

Capital cost data was provided by DOWL to construct the Flood Protection Pad (Dropbox: E-5). There will be no additional operations and maintenance (O&M) costs associated with the project.

Benefits

Quantified benefits include reduction in expected damage to personal property due to future/repeat disasters. All calculations and references are provided in Appendix F.3.2. Benefits were calculated as follows:

The primary modes of transportation in Emmonak, Alaska are ATV’s and snowmobiles. Based on the U.S. Census data, there are approximately 232 housing units in Emmonak. It was assumed each household owned at least one ATV and one snowmobile for transportation in the summer and winter seasons, and that they would need to be replaced from flood damages after each major flood event. The average values used for the calculations for an ATV was \$5,500 and \$11,429 for a snowmobile.

Discount Factor

A discount factor of 7% was applied to all annual costs and benefits to calculate present dollar values of future costs and benefits.

| Full Proposal Cost | Estimated Cost | Other Funding |
|---|----------------|---------------|
| A construction cost estimate is provided in Appendix F.3.2. | \$4,683,000 | |

Description of Current Situation and Problem to be Solved

The City of Emmonak is located near the mouth of the Yukon River on the coast of Western Alaska, approximately 10 miles from the Bering Sea. It is bordered on the south by Kwiguk Pass and to the east by Emmonak Slough. The majority of the city is below the base flood elevation (BFE). Severe flooding has occurred twice in the past 6 years (2009 & 2013) and has caused widespread damage and significant personal property loss. This investment could reduce public and private property damage after a future flood event.

Description of Proposed Project or Program

The City of Emmonak proposes to build a flood protection pad for the storage and staging of equipment and materials. The pad will be constructed near the city docks on 8.9 acres of scrub-shrub wetlands. The pad will be used by the future Port of Emmonak as a staging and material handling area when construction on the regional port is finished. The Flood Protection Pad will also provide a safe staging

area for people, animals, critical life-sustaining supplies, and high-value equipment above the historic flood level elevation.

The project useful life for the flood protection pad is 50 years.

Description Risk to the Community if the Proposal is Not Implemented

As mentioned above, the majority of Emmonak is below the BFE. Without a sufficient storage area above the BFE, personal property such as ATV's, snowmobiles, and other valuable items are at risk from getting damaged due to future/repeat disasters.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.3.2. Project benefits not included in the BCA include:

- The pad will immediately serve as a safe storage area for personal items that would otherwise be damaged from future flood events. Additionally, the pad will serve as a staging area for the future port.

Descriptions of Risks to Ongoing Benefits

As discussed above, ongoing benefits that are at risk include damage to personal belongings and damage to the community's primary mode of transportation.

Assessment of Challenges Faced with Implementing the Proposal

The City of Emmonak has already applied for the USACE Individual Permit Application and has been approved. They have also received approval from the State of Alaska, Department of Environmental Conservation, Division of Water, Wastewater Discharge Authorization Program (Dropbox: E-6).

No unusual challenges are anticipated for the proposed project.

Metrics

The following metrics will be used to determine the impacts of the Flood Protection Pad:

- Resiliency Value: Net decrease in loss of equipment
- Environmental Value: Net increase of ground stabilization
- Economic Revitalization: No net loss of residential and commercial vehicles and equipment
- Social Value: Reduced cost to community residents for personal transportation

BCA Narrative

Project 3: Airport Project

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Airport Project was prepared as follows:

Costs

Capital cost data was provided by the Alaska Department of Transportation to lengthen the Emmonak airport runway by approximately 1,600 feet (Dropbox: E-7).

There will be no additional operations and maintenance (O&M) costs associated with the project.

Benefits

Quantified benefits include a reduction in expected loss of air freight service in the near future, a reduction in expected increase in cost of shipping via air service, and improved air quality. All calculations and references are provided in Appendix F.3.3. Benefits were calculated as follows:

Benefits for the airport were calculated assuming the current DC-6 aircraft that is used to fly shipments to Emmonak would be obsolete in the next five years. This assumption is based on EPA's issuing of the Federal Register document published July 1, 2015 on Advance Notice of Proposed Rulemaking to reduce greenhouse gas emissions from certain classes of engines used in aircrafts. Additionally, the production of DC-6 aircraft has been discontinued for almost 50 years. Many airlines including Northern Air Cargo (NAC) have stopped flying DC-6 aircrafts due to high operations and maintenance cost and low efficiency rate (Dropbox: E-8).

Reduction in expected loss of air freight service was calculated based on a meeting with the Kwik'Pak Fisheries, LLC manager. Kwik'Pak fisheries currently ship out fish valued at \$2.30 - \$2.50/pound; \$2.30/pound was used as a conservative estimate. According to a letter from Kwik'Pak to the Department of Transportation, Kwik'Pak normally flies out between 850,000 pounds and 1.42 million pounds of fishery products from Emmonak during a typical season; 850,000 pounds was used as a conservative estimate (Dropbox: E-2).

Reduction in expected increase in cost of shipping via air service was calculated by figuring out how much extra per pound the community would have to pay for shipping once the DC-6 aircraft was discontinued. Jet engine transport aircraft currently cannot fly into Emmonak. The shipping rate to fly from Anchorage to Emmonak via a jet engine aircraft was found by interpolating NAC's rate to ship from Anchorage to St. Mary's and from Anchorage to Nome. Since Emmonak is located approximately half way between Nome and St. Mary's, the average value of the two rates was used, which came out to \$0.79/pound. Since jet engine aircraft are not currently able to fly into Emmonak, shipments would first need to be transferred onto another aircraft. It was assumed that shipments from Anchorage would get shipped to St. Mary's first, and then transferred onto a smaller aircraft owned by Ryan Air. Finally, the additional cost per pound was calculated by adding the cost from Anchorage to St. Mary's and from St. Mary's to Emmonak, minus the previously calculated value of \$0.79/pound. The current DC-6 aircraft has a maximum capacity of 28,188 pounds. According to Everts Air Cargo, there is a cargo plane flying

into Emmonak a minimum of 3 times per week every week for the whole year. The total shipment delivered to Emmonak was calculated assuming the planes are 75% full each flight.

Savings from carbon emissions is based on information provided in the FEMA Final Sustainability Methodology report which outlines methods to calculate benefit values for carbon emissions from vehicles. A similar process was utilized for carbon emissions from aircraft. A value of 0.01018 metric tons of carbon per gallon of diesel fuel was provided in the report. A value for the Social Cost of Carbon of \$36.00 per metric ton is multiplied by 154,092 gallons of fuel saved per year.

Discount Factor

A discount factor of 7% was applied to all annual costs and benefits to calculate present dollar values of future costs and benefits.

| Full Proposal Cost | Estimated Cost | Other Funding |
|---|----------------|---------------|
| A construction cost estimate is provided in Appendix F.3.3. | \$31,900,000 | \$2,900,000 |

Description of Current Situation and Problem to be Solved

Aviation provides a vital link to everyday goods and services in rural Alaska. Alaska’s vast size, harsh terrain, extreme climate and large percentage of federally protected land make airports often the only mode of transportation serving the rural population. Creating a taxiway/runway that can withstand disasters and climate change is critical to this hub community. In terms of investment for rural access, there is simply no near term possibility of achieving a fully connective road system.

The population of rural Alaska is primarily Native Alaskan. The remote, starkly beautiful land that we refer to as “rural Alaska” is simply “home” to the people who have inhabited the state for thousands of years. While subsistence living (the customary and traditional use of wild and natural resources) still plays a major role in the lives of Alaska’s rural residents; many basic, everyday needs must be met by delivery of goods and services. There is no road network connecting villages to each other or to the highway system enjoyed by the continental U.S. The isolated villages dotting Alaska’s landscape are all connected to each other and to the rest of the world by their airports. Aviation provides a fundamental link for access to necessities such as food, mail, healthcare, education, and travel but at a high financial cost. Gasoline and heating oil currently sell for about \$6 per gallon in Emmonak and more in the outlying villages.

Emmonak is a primary airport and has a thriving fish processing business that needs adequate transportation of product to market. The current runway is too short to allow for cargo jet service. Jets flying into Emmonak need a minimum of 6000 feet to land and take off safely.

Description of Proposed Project or Program

This project would extend the runway to 6000 feet (approximately 1600 feet of additional runway). The project will also extend the runway safety area to meet FAA C-III standards by placing embankment stabilization material for the runway, and improving drainage and lighting.

The project useful life for the extended runway is 50 years.

Description Risk to the Community if the Proposal is Not Implemented

In 2008 Northern Air Cargo (NAC) transitioned its fleet from Douglas DC-6 aircraft to Boeing 737-200 jets. With its new all-cargo 737's, NAC continued to provide service to all scheduled markets except Emmonak, due to its runway limitations. Currently Everts Air Cargo is the only provider to Emmonak, and they fly DC-6s which will be retired within 5 years due to future FAA regulations. When Everts Air Cargo upgrades their fleet there will be no air freight to Emmonak unless the runway is expanded to 6000 ft (Dropbox: E-9).

Currently it costs \$26,000 to charter a DC-6 to fly 28,000 pounds of fish to Anchorage. If the runway was extended to 6000 ft. so jets could land, it would cost \$14,000 to charter a 737 to fly 25,000 pounds of fish to Anchorage which is a savings of \$0.37/pound.

Kwik'Pak fisheries estimate that with the extended runway, fish production will increase between 20-40%. Kwik'Pak currently buys about 4.5 million pounds of fish per year from the locals. If fish cannot be shipped out, fishermen have to stop fishing due to limited storage space in Emmonak. Last year Kwik'Pak lost out on 500,000 pounds of fish because of the inability to transport fish.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.3.3.

Descriptions of Risks to Ongoing Benefits

As discussed above, ongoing benefits that are at risk include the loss air service and revenue for the community of Emmonak and increased emission of greenhouse gases generated from older aircrafts.

Assessment of Challenges Faced with Implementing the Proposal

No unusual challenges are anticipated for the proposed project.

Metrics

The following metrics will be used to determine the impacts of the Airport Project:

- Resiliency Value: Intermodal transportation linkage occurs
- Environmental Value: Net reduction in erosion
- Economic Revitalization: Reduction of fuel prices
- Social Value: Infrastructure investment directly affecting the Region

BCA Narrative

Project 4: Improved Airport Road with Bypass Project

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Improved Airport Road with Bypass Project was prepared as follows:

Costs

Cost based on engineer's estimate from CRW Engineering Group, LLC. to construct the Improved Airport Road with Bypass Project (Dropbox: E-17).

The operation and maintenance costs (O&M) are not expected to increase; the City of Emmonak already maintains the roads in town.

Benefits

Quantified benefits include cost savings related to the loss of air freight. All calculations and references are provided in Appendix F.3.4.

Kwik’Pak Fisheries LLC shipped 1.135 million pounds of fish from Emmonak Airport last year. The fish had a value of \$2.40 per pound. Based on previous flood events and erosion rates it was determined that the next major flood in 3 years will erode Frontage Road causing the loss of revenue and trigger the construction of the bypass road (Dropbox: E-2).

Discount Factor

A discount factor of 7% was applied to all annual costs and benefits to calculate present dollar values of future costs and benefits.

| Full Proposal Cost | Estimated Cost | Other Funding |
|---|----------------|---------------|
| A construction cost estimate is provided in Appendix F.3.4. | \$3,161,340 | |

Description of Current Situation and Problem to be Solved

A 1994 USACE Trip Report estimated that historic erosion rates along the city’s waterfront ranged from 2 to 25 feet per year (Dropbox: E-10). Erosion is closest to the road at the old landfill, with a vertical cut bank of about 10 to 15 feet high. Frontage Road is in this area. At the estimated rate of erosion, the next flood will take parts of this road out. To armor Frontage Road the estimate is roughly \$100M. This is not a long term resilient solution. Frontage Road is vital to the community because it is the only road that the tractor trailers can haul fish to the airport to be flown out. The other existing road to the airport, Airport Road, has a tight corner that tractor trailers cannot make. Also, a utility power line is too low for a tractor trailer to go under. In addition to constructing this new section of road, Airport Road will require improvements. During the 2013 flood events, the Airport Road was washed out in multiple places, leaving residents without access to the airport.

Description of Proposed Project or Program

Improvements to Airport Road will include elevating the road and installing culverts at existing drainages. The new bypass road will be constructed on City owned property and will connect the industrial waterfront to the existing Airport Road. The new bypass road will be built to accommodate tractor trailers.

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| Description Risk to the Community if the Proposal is Not Implemented |
| At the current rate of erosion the next flood will take out parts of Frontage Road. The previous flood washed out portions of both Frontage Road and Airport Road cutting off Emmonak from the airport during the qualifying disaster. When Frontage Road is eroded the loss of the ability to truck fish to the airport will cause severe negative impacts to the economic activity of Emmonak. |
| List of Benefits and Costs |
| A list of project benefits and costs is provided in Appendix F.3.4. |
| Descriptions of Risks to Ongoing Benefits |
| Improvements to Airport Road will include elevating the road and installing culverts at existing drainages. The road will still be subject to impacts from seasonal flooding; however, the elevated surface and the addition of culverts will minimize overtopping and associated erosion. |
| Assessment of Challenges Faced with Implementing the Proposal |
| Constructing and maintaining infrastructure projects across Alaska is expensive, particularly in rural areas. For example, the cost of constructing buildings in remote areas is on the order of twice as much per square foot as in Anchorage. The higher construction costs in rural Alaska are due to a combination of higher input costs. Construction aggregate, such as crushed rock or gravel, are often barged to the construction site because they are difficult to source locally. Transportation of building materials is expensive; limited road and rail networks mean that goods must be barged or flow in. Additional challenges include a limited supply of specialty labor (mechanical, electrical); challenging foundation conditions—including areas with abundant permafrost; weather delays; remote logistics; and the high cost of fuel. Moreover, the harsh winter climate of Alaska significantly shortens both the construction season and the useful life of roads and other infrastructure. |
| Metrics |
| The following metrics will be used to determine the impacts of the Improved Airport Road with Bypass Project: <ul style="list-style-type: none">• Resiliency Value: Net reduction in erosion and washout• Environmental Value: Reduced erosion of river bank and avoided destruction of natural habit• Social Value: Increased safety and security gauged via survey• Economic Value: Increased revenue to resident fisherman for shipping more fish. |

BCA Narrative

Project 5: Barge Landing Area Study in Alakanuk Project

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Barge Landing Area Study in Alakanuk is based on qualitative benefits as determined in conversations with community representatives.

Costs

Cost estimate from CRW Engineering Group, LLC for the Barge Landing Area Study in Alakanuk based on previous study that was conducted in Emmonak.

Full Proposal Cost

Estimated Cost

Other Funding

A construction cost estimate is provided in Appendix F.3.5.

\$145,000

Description of Current Situation and Problem to be Solved

Currently, the barge dock in Alakanuk is located near where most of the erosion is occurring. When barges are at the existing landing site, an extensive amount of forward thrust is needed to keep the barge in place during offloading. This creates a massive amount of water movement near the bank which in turn creates or accelerates the erosion of the shoreline. Ten homes, the tribal building, and the high voltage inter-tie power line from Emmonak are threatened by the erosion problem related to the current barges landing operations. Additionally, barges delivering goods to the community previously landed on the Yukon River side of Alakanuk. However, due to changing river patterns, this site requires dredging.

Description of Proposed Project or Program

This project would allocate funds for an erosion control study to evaluate approximately two miles of the Kulupuk Slough running through the middle of the City of Alakanuk and conduct a feasibility study for a deep draft barge landing site where it will not impact the community's infrastructure nor be impacted by continuing erosion.

Description Risk to the Community if the Proposal is Not Implemented

Not conducting the study would further delay the potential to construct a stable barge landing for the community of Alakanuk. Without any actions, the Yukon River will continue to erode away vital land and infrastructure for the community.

List of Benefits and Costs

Due to the difficulty in quantifying the benefits for a barge landing area study, a BCR was not calculated for this project. Qualitative benefits for this project include:

- Normally when other communities such as Emmonak, Nunam Iqua (formerly known as Sheldon Point), and Kotlik get flooded, Alakanuk does not flood, and becomes a hub for recovery for the neighboring communities. Alakanuk is only seven nautical miles from Emmonak and provides a

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|--|
| <p>good location for a secondary barge landing site.</p> <ul style="list-style-type: none">• A future barge landing site in Alakanuk would help to prevent further erosion of the coastline. |
| Descriptions of Risks to Ongoing Benefits |
| <p>As discussed above, ongoing benefits that are at risk include further loss of land and structures if the barge landing site is not constructed.</p> |
| Assessment of Challenges Faced with Implementing the Proposal |
| <p>No unusual challenges are anticipated for the proposed project.</p> |
| Metrics |
| <p>The following metrics will be used to determine the impacts of the Barge Landing Study in Alakanuk:</p> <ul style="list-style-type: none">• Resiliency Value: Quicker recovery during an event• Environmental Value: Reduced erosion of river bank and avoided destruction of natural habit• Social Value: Cultural preservation improvements, improved health and safety• Economic Value: Improved facilities can result in opportunities for economic growth |

BCA Narrative

Project 6: Emmonak Water Tank Storage

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Emmonak Water Tank Storage Project was prepared as follows:

Costs

Cost based on engineer's estimate from CE2 Engineers, Inc. to construct the Emmonak Water Tank Storage Project (Dropbox: E-11).

The increased operation and maintenance costs (O&M) are expected to be offset by the rates charged by the water utility.

Benefits

Quantified benefits include cost savings related to the cost of loss of water service. All calculations and references are provided in Appendix F.3.6.

The cost of loss of water service was calculated from the methodology outlined in the FEMA Benefit Cost Analysis Re-engineering Report (BCAR) 2009 (Appendix F. Reference). Emmonak currently has a potable water storage capacity of 300,000 gallons. Emmonak residents use approximately 40 gallons per person per day as reported by CE2 Engineers Inc. The life of the water tanks was determined to be 50 years from the FEMA BAC Reference Guide 2009, Appendix D.

Discount Factor

A discount factor of 7% was applied to all annual costs and benefits to calculate present dollar values of future costs and benefits.

| Full Proposal Cost | Estimated Cost | Other Funding |
|---|----------------|---------------|
| A construction cost estimate is provided in Appendix F.3.6. | \$8,900,000 | |

Description of Current Situation and Problem to be Solved

During the spring ice breakup and the fall freeze up, Emmonak is unable to extract water from the river for 14 days. Based on Emmonak's current population, water usage and the current capacity of 300,000 gallons, Emmonak will run out of potable water in 9.8 days. During the summer months the community fish processing plant uses large quantities of water to meet USDA standards. During the height of the 2014 season the processor had to suspend operations due to lack of water costing local fishermen \$48,000 per day.

The City of Emmonak has experienced a steady growth in population, with the resulting need for increasing amounts of safe, potable water for its residents. Increasing population, as well as higher water consumption by the community cooperative fish processing operation, has now taxed the existing water storage tanks to the limit. The local population and the fish processing plant are very interdependent, as the seasonal fishery jobs support the local population with income that in turn supports the Emmonak water and sewer utility.

Over the past 50 years, Alaska has warmed at more than twice the rate of the rest of the U. S.' average. Its annual average temperature has increased 3.4°F, while winters have warmed even more, by 6.3°F. As a result, climate change impacts are much more pronounced than in other regions of the

U.S. The higher temperatures are already contributing to earlier spring snowmelt, reduced sea ice, widespread glacier retreat, and permafrost warming (Dropbox: E-12-pg 139-143).

For the present and for a 20 year design horizon, the existing water storage system will not be adequate to support the community. The current water storage tanks cannot supply the community needs with the potable water during the two week periods of spring breakup and fall freeze-up, when the Yukon River water source is unavailable. During this time the river is too clogged full of ice, debris and extremely silt-laden water to be pumped for treatment.

Description of Proposed Project or Program

By adding two additional water tanks we can address this issue and solve the problem of inadequate potable water for the community. The two existing water storage tanks, totaling 300,000 gallons, are not figured into this plan, as they are almost 30 years old and are not expected to be usable in the 20-year design horizon. However, they will be used as reserve tankage for the rest of their useful lives.

Due to the fact that Emmonak is subject to serious flooding at times, a foundation with adequate ground clearance and resistance to ice damage and ice erosion is necessary. An 80 x 180 ft. long pile-supported deck would provide a safe platform for the two new 428,000 gallon water tanks.

Description Risk to the Community if the Proposal is Not Implemented

The Kwik’pak Fisheries processing plant suspended operation in June 2014 when there was not enough water to allow operations. The closure came at the height of the commercial chum salmon season, when fishermen were catching between 10,000-15,000 fish each day. With no ability to process the fish, fisherman had to avoid fishing until the next day when the plant reopened. This temporary closure had a financial impact on the 450 families that depend on fishing as their primary source of income in the community of Emmonak. This one day closing cost roughly \$48,000 total in lost revenue to these 450 fishing families. Kwik’Pak pays the fishermen \$0.60/chum and \$0.70/coho per pound. An average chum salmon weighs 8 lbs. and an average coho weighs 12 lbs. (Dropbox: E-13&14).

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.3.6.

Descriptions of Risks to Ongoing Benefits

The water tanks and treatment plant will be constructed on a pile foundation protecting them from future floods.

Assessment of Challenges Faced with Implementing the Proposal

Constructing and maintaining infrastructure projects across Alaska is expensive, particularly in rural areas. For example, the cost of constructing buildings in remote areas is on the order of twice as much per square foot as in Anchorage. The higher construction costs in rural Alaska are due to a combination of higher input costs. Construction aggregate, such as crushed rock or gravel, are often barged to the construction site because they are difficult to source locally. Transportation of building materials is expensive; limited road and rail networks mean that goods must be barged or flow in. Additional challenges include a limited supply of specialty labor (mechanical, electrical); challenging foundation conditions—including areas with abundant permafrost; weather delays; remote logistics; and the high cost of fuel. Moreover, the harsh winter climate of Alaska significantly shortens both the construction season and the useful life of roads and other infrastructure.

Metrics

The following metrics will be used to determine the impacts of the Emmonak Water Tank Storage:

- Resiliency Value: Net reduction in water shortage
- Environmental Value: Net increase in water quality
- Economic Revitalization: Net reduction in loss days of fishing
- Social Value: Reduced risk to community

Appendices

Benefit-Cost Analyses for each project are provided in Appendices F.3.1 through F.3.6. Please also see the **Attachment F. Reference** for general reference information that is applicable to multiple projects.