

Attachment F.1 Benefit Cost Analysis Galena, Alaska

I. Introduction & Overview

The community of Galena, Alaska is located along the Yukon River in central Alaska, 270 miles west of Fairbanks. Galena is only accessible by air or water. Galena has a population of 470 and is a predominantly Inupiat Eskimo community. Residents depend primarily on a subsistence lifestyle supplemented with a limited cash economy. Galena Village, also known as Loudon Village, is a Federally Recognized tribe.

In the spring of 2013, a presidential disaster was declared (DR-4122-AK) when ice jams on the Yukon River caused major flooding in Galena resulting in \$6,000,000 worth of damage.

II. BCA Summary

| Aggregate Benefit Cost Ratios (BCR's) for Proposed Projects | | | |
|--|------------------------------|------------------------|------------|
| Project Description | Quantitative Benefits | Estimated Costs | BCR |
| 1. Dust Control | \$2,583,124 | \$1,121,545 | 2.30 |
| 2. Public Shower House/Laundry Facility | \$6,210,336 | \$466,379 | 13.32 |
| 3. Fire Hall Replacement | \$1,724,440 | \$583,311 | 2.96 |
| 4. Abandoned Building Remediation | \$763,946 | \$636,310 | 1.20 |
| 5. Landfill Compliance and Expansion | n/a | \$815,500 | n/a |
| 6. Land Development and Protection Plan | n/a | \$415,600 | n/a |
| 7. Community Development Planning | n/a | \$196,000 | n/a |
| 8. Early Childhood Development | n/a | \$365,225 | n/a |
| 9. Community Garden Improvement | \$49,740 | \$62,992 | 0.79 |
| 10. Electrical Generation Flood Protection | \$522,880 | \$1,689,520 | 0.31 |
| 11. Alternative Energy/250-kW Wood Gasification System | \$2,682,214 | \$2,161,337 | 1.24 |
| 12. 2.6-mW Solar Array with Grid Scale Battery Storage | \$16,337,674 | \$9,498,762 | 1.72 |

Galena, Alaska
Benefit-Cost Analysis Narrative

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| 13. Water Treatment Plant Mitigation | \$1,066,882 | \$547,668 | 1.95 |
| 14. Galena River Bank Stabilization/Erosion Prevention | \$5,065,713 | \$16,571,922 | 0.31 |
| 15. Tribal Office and Cultural Center | \$1,215,470 | \$890,580 | 1.36 |
| 16. Home Elevation above the Base Flood Elevation | \$10,106,250 | \$6,823,248 | 1.48 |
| 17. Yukon Elder Assisted Living Facility Expansion | \$2,426,289 | \$5,654,180 | 0.43 |
| 18. GILA Biomass Glycol Upgrades | \$4,913,980 | \$3,129,806 | 1.57 |
| 19. Sustainable Energy for Galena Alaska, Inc. (SEGA) | n/a | \$250,000 | n/a |
| Totals: | \$55,668,938 | \$51,879,885 | 1.07 |
| Direct Activity Delivery Cost (20%) | | | |
| Training, travel, grant management, project management, technical assistance, kick-off meetings and other supporting activity implementation | | \$10,375,977 | |
| Total with Direct Activity Delivery Cost | | \$62,255,862 | |

III. Individual Project Narratives

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| <i>Analysis Process Applicable to Multiple Projects</i> |
| Flood Elevation |
| The flood stage in Galena is 124 feet, determined from the National Weather Service Advanced Hydrologic Prediction Service. |
| Determining Flooding Return Interval |
| <p>Maximum monthly high water data for the Yukon River at Galena was obtained from the National Weather Service River Observation Database for approximately 30 years (May 1985 to Sep 2015). River maximums were compared to the Galena Flood Elevation determined previously. Results of the analysis are provided below:</p> <ul style="list-style-type: none"> ○ Flood 0 to 1 feet in depth: 2 events ○ Flood 1 to 2 feet in depth: 1 event ○ Flood 2 to 3 feet in depth: 0 events ○ Flood more than 3 feet in depth: 2 events <p>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 the future flood</p> |

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| event intervals will be evenly spaced for the next 30 years. | | |
| Community Population | | |
| Community Population for Galena is 470 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: Dust Control | | |
| Process for Preparing the BCA | | |
| The Benefit Cost Analysis (BCA) for the Dust Control Project was prepared as follows: | | |
| <u>Costs</u> | | |
| Cost based on engineer's estimate from LeMay Engineering & Consulting, Inc. to chip seal the roadways throughout Galena. | | |
| Operations and Maintenance (O&M) costs are not assumed to increase. The City of Galena already maintains the gravel roadways; this cost will be shifted to maintaining the chip seal roadways. | | |
| <u>Benefits</u> | | |
| Quantified benefits include cost savings related to avoided casualties from persons not being treated for ailments related to dust. Benefits were calculated as follows: | | |
| The doctor at the Galena Clinic, Dr. Tamara Huntington was contacted. Dr. Huntington estimated that between 7 and 10 individuals seek treatment at the Clinic each year for ailments related to dust emanating from the gravel roadways. The FEMA value of \$90,000/patient to treat and release found in Appendix C of the 2009 BCA Reference Guide was used to calculate a yearly benefit of \$630,000 for 7 patients. | | |
| <u>Discount Factor</u> | | |
| 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.1.1. | \$1,121,545 | \$18,500 |
| Description of Current Situation and Problem to be Solved | | |
| Existing gravel roads in Galena lead to excessive dust in dry summer months. Currently, water is applied to roads daily to suppress the dust. This is an expensive, temporary, and time-consuming task. In the summer, the community spends many hours every day outside. The current dust control mitigations do not remove the dust and community members are still affected by dust-related health issues. | | |
| Description of Proposed Project or Program | | |
| This project proposes to apply chip seal to the roadways throughout town. Chip sealing is a process of spraying liquid asphalt on the existing roadway and adding small rocks (chips) to the wet asphalt. | | |
| The life of a chip seal road was determined to be 5 years based on Federal Highway data. | | |

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| Description Risk to the Community if the Proposal is Not Implemented |
| Dust will continue to create health hazards for citizens and increase healthcare costs. |
| List of Benefits and Costs |
| A list of project benefits and costs is provided in Appendix F.1.1. |
| Descriptions of Risks to Ongoing Benefits |
| Chip sealing the roadways will almost completely eliminate dust emanating from the roadways. Minimal maintenance is required for the chip seal. |
| 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 flown 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 Dust Control Project: Resiliency Value: Net increase in life of infrastructure. Environmental Value: Increase quality of life from reduced health risks. Economic Revitalization: Net decrease in maintenance costs. Social Value: Avoided casualties. |

BCA Narrative

Project 2: Public Shower House/Laundry Facility

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Public Shower House/Laundry Facility was prepared as follows:

Costs

Cost based on engineer's estimate from LeMay Engineering & Consulting, Inc. to remodel and elevate the existing public shower house/laundry facility.

Operations and Maintenance (O&M) costs are not assumed to increase. The City of Galena already owns the public shower house/laundry facility which was in operation prior being damaged in the 2013 flood.

Benefits

Quantified benefits include cost savings related to avoided casualties from persons not being treated for ailments related to sanitation. Benefits were calculated as follows:

The doctor at the Galena Clinic, Dr. Tamara Huntington was contacted. Dr. Huntington estimated that between 5 and 10 individuals seek treatment at the Clinic each year for Scabies, a skin parasite related to lack of adequate sanitation. The FEMA value of \$90,000/patient to treat and release, found in Appendix C of the 2009 BCA Reference Guide was used to calculate a yearly benefit of \$450,000 for 5 patients.

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.1.2. | \$466,379 | |

Description of Current Situation and Problem to be Solved

Many homes in Galena do not have city water or laundry facilities. Without access to basic sanitation, increased spread of disease is likely.

Description of Proposed Project or Program

The City owned public shower/laundry facility was damaged in the 2013 flood and needs a remodel to repair it and bring it into compliance with ADA standards. The building will also be raised above the base flood elevation.

The life of the shower/laundry house is 50 years, based on the FEMA value in Appendix D of the 2009 BCA Reference Guide.

Description Risk to the Community if the Proposal is Not Implemented

Continued lack of adequate sanitation will perpetuate the spread of disease. Remote communities in Alaska have some of the highest rates of sanitation related diseases in the county.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.1.2.

Descriptions of Risks to Ongoing Benefits

Raising the building above the base flood elevation will protect the building from future flood events.

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 Public Shower House/Laundry Facility Project:

Resiliency Value: Direct effect on local health, improved recovery after events.

Environmental Value: Reduced energy consumption.

Economic Revitalization: Direct effects on local economy, increased revenues.

Social Value: Avoided casualties. Improved living environment, improved social cohesion.

BCA Narrative

Project 3: Fire Hall Replacement

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Fire Hall Replacement was prepared as follows:

Costs

Cost based on engineer's estimate from LeMay Engineering & Consulting, Inc. to replace the fire hall. Operations and Maintenance (O&M) costs are not assumed to increase. The City of Galena already operates a fire hall.

Benefits

Quantified benefits include the cost of a reduction in emergency medical services, fire station services, and the costs of structural damage and displacement. Based on previous flood data and the fire hall's elevation it was determined that the fire hall will be closed for 3 days during a flood which exceeds 11 feet in depth from the NOAA flood state of 124 feet. Benefits were calculated as follows:

The cost of a reduction in emergency medical services is based on information provided in the FEMA Benefit-Cost Analysis Re-engineering (BCAR) 2009 report. This report outlines a method of calculating the increased response time to a cardiac arrest, the corresponding decrease in survival probability and the dollar value of the potential cost in lives.

The cost of a reduction in fire station services is based on information provided in the FEMA BCAR 2009 report. This report outlines a method of calculating the increased response time to a fire, the corresponding increase in fire losses and the dollar value of potential fire losses. The future loss of fire station services was calculated for future flood events based on previous flood events. Additionally the fire station experienced structural damage to the foundation during the 2013 flood which causes difficulty in keeping the building interior above freezing in the winter. Last winter 1 of the 3 fire engines froze to the floor for 2 weeks. It was assumed that this reduced the fire stations effectiveness by 33% and was likely to occur in the future for the same 2 week period.

The cost of property damage is based on three factors: the value of the property which was calculated using the average square foot value of a fire hall from the 2008 RSMeans catalog, the frequency of the flood, and the flood depth. The total cost of the damage to the building was calculated using the Army Corps of Engineers Depth-Damage function, which provides the percentage of the building damaged based on the depth of the flood. It was assumed that the depth-damage functions for residential buildings were going to be less than commercial structures. Therefore, it was a more conservative estimate to use the residential depth-damage functions.

The cost of displacement is based on the information provided in the FEMA BCAR 2009 report. The report gives values for the cost of renting a new space, the cost of displacement and the length of repair time. It was assumed that the city would need to rent a building of the same size as the current fire hall.

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.1.3. | \$583,311 | |

Description of Current Situation and Problem to be Solved

The fire hall has been experiencing severe foundation issues on the north side of the building for almost

10 years, resulting in significant slanting of the concrete floor and gaps along the floor where overhead doors no longer create an airtight seal. As a result of this air gap the water tanker used for firefighting froze to the floor. During the winter months, two of the five bays are unusable. Climate Change has damaged the foundation with the melting of the permafrost. The 2013 Spring Flood further weakened the subsurface under the fire hall, and the north side of the fire hall now clearly appears to be sinking into the ground.

Description of Proposed Project or Program

The proposed project is to replace the existing fire hall with a modern facility. The new facility would be constructed above the base flood elevation and include: floor drains, exhaust ventilation system, indoor tanker truck filling capabilities, and be connected to the power plant recovered heat loop. The foundation will be constructed of 8-inch helical piles drilled to a depth below the active layer. The building will be a pre-engineered metal building with an appropriately-insulated building envelope.

The life of the fire hall is 50 years, based on the FEMA value in Appendix D of the 2009 BCA Reference Guide.

Description Risk to the Community if the Proposal is Not Implemented

In interior Alaska, where winter temperatures are well below freezing, keeping emergency response vehicles in a properly heated space is a priority. Due to the degradation of the existing fire hall, this is increasingly becoming a challenge. Failure of the ambulance to start or having the water tanker frozen to the floor during an emergency could result in the loss of life.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.1.3.

Descriptions of Risks to Ongoing Benefits

Raising the building above the base flood elevation will protect the building from future flood events.

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 Fire Hall Replacement Project:

Resiliency Value: Reduction of % of homes lost from fire.

Environmental Value: Reduced energy consumption.

Economic Revitalization: Direct effects on local economy. Reduces costs from energy efficiency.
Social Value: Improved living environment, improved sense of safety and security.

BCA Narrative

Project 4: Abandoned Building Remediation

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Abandoned Building Remediation was prepared as follows:

Costs

Cost based on engineer's estimate from LeMay Engineering & Consulting, Inc. to remove abandoned buildings.

There are no ongoing operations and maintenance (O&M) costs for this project.

Benefits

A displacement cost was calculated for the cost to residents due to not being able to rebuild their homes until the abandoned homes are removed. Reduction in Expected Displacement Costs due to Future/Repeat Disasters. Displacement Cost = (Disruption Cost x Sq. Ft) + (Rental Cost x Sq. Ft x Displacement Time in Months) as described in the FEMA Benefit-Cost Analysis Re-engineering (BCAR) publication. Rental costs per month based on Table 2 provided in BCAR. Residential Rental Costs based on Single-Family Dwelling: Duplex = \$0.73 per square foot in 2008 dollars. Cost was calculated to be \$0.81 per square foot in 2015 dollars based on US Bureau of Labor and Statistics Inflation Calculator. Disruption Cost (\$/square foot) is provided in Table 2 of BCAR. Residential Disruption Costs based on Single-Family Dwelling: Duplex = \$0.88 per square foot in 2008 dollars. Cost was calculated to be \$0.97 per square foot in 2015 dollars based on US Bureau of Labor and Statistics Inflation Calculator. Recovery Time by Occupancy Type and Flood Depth is provided in Table 3 of BCAR. Assume a 24 month Recovery Time. Rental and Disruption Costs were multiplied by local multiplier developed for Galena, Alaska of 1.65 which was determined using the State Department of Education Geographic Cost Factor. The average area of homes in Galena was determined to be 1,100 square feet based on a report by the Alaska Housing Finance Corporation. Rental and displacements costs were determined based on damage areas multiplied by the Rental and Displacement costs listed above. The total displacement costs were applied to future anticipated flood events over a 2 year recovery time with a discount factor of 7% applied to future benefits.

Qualitative benefits are listed in the BCA table in Appendix F.1.4.

| Full Proposal Cost | Estimated Cost | Other Funding |
|---|-----------------------|----------------------|
| A construction cost estimate is provided in Appendix F.1.4. | \$636,310 | \$525,968 |

Description of Current Situation and Problem to be Solved

During the 2013 flood event a number of properties were damaged beyond repair and have since been abandoned. These properties pose a health and safety risk for the community.

Description of Proposed Project or Program

The City of Galena and USDA have determined 20 homes that were damaged and abandoned after the

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| flood need to be demolished. This project would demolish these homes. |
| Description Risk to the Community if the Proposal is Not Implemented |
| Abandoned structures are a risk and liability to the City of Galena. |
| List of Benefits and Costs |
| A list of project benefits and costs is provided in Appendix F.1.4. |
| Descriptions of Risks to Ongoing Benefits |
| Removal of the abandoned buildings mitigates future risks. |
| Assessment of Challenges Faced with Implementing the Proposal |
| There are no unusual challenges anticipated with the demolition of these abandoned structures. |
| Metrics |
| The following metrics will be used to determine the impacts of the Abandoned Building Remediation Project: Resiliency Value: Reduction of displaced costs and expected environmental damages. Quicker response to flood-caused damages in surrounding areas. Environmental Value: Ecosystem returned to natural state. Economic Revitalization: Opportunities for construction with improved energy efficiency. Social Value: Improved living environment, removal of dangerous play areas, better aesthetics, and improved safety. |

| BCA Narrative | | |
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| Project 5: Landfill Compliance and Expansion | | |
| Process for Preparing the BCA | | |
| <p>The Benefit Cost Analysis (BCA) for the Landfill Compliance and Expansion Project was prepared as follows:</p> <p><u>Costs</u></p> <p>Cost based on engineer's estimate from LeMay Engineering & Consulting, Inc. to expand the landfill and recycle flood damaged vehicles.</p> <p>Operations and Maintenance (O&M) costs are not assumed to increase. The City of Galena already operates the landfill.</p> <p><u>Benefits</u></p> <p>Qualitative benefits are listed in the BCA table in Appendix F.1.5.</p> | | |
| Full Proposal Cost | Estimated Cost | Other Funding |
| A construction cost estimate is provided in Appendix F.1.5. | \$815,500 | |
| Description of Current Situation and Problem to be Solved | | |
| <p>After the 2013 flood, debris removal created a problem at the local landfill. The landfill is currently in violation of its permit and is at 90% capacity. An expansion of the landfill and a backhaul to Fairbanks, Alaska for recycling of flood-damaged vehicles is needed.</p> | | |
| Description of Proposed Project or Program | | |
| <p>Increase the size of the landfill by approximately five acres and install new fencing around the entire landfill. Transport 155 flood-damaged vehicles, 30 snow machines, and 15 4-wheelers to Fairbanks, Alaska for recycling.</p> | | |
| Description Risk to the Community if the Proposal is Not Implemented | | |
| <p>Improper disposal of solid waste can cause harm to the environment and human health.</p> | | |
| List of Benefits and Costs | | |
| <p>A list of project benefits and costs is provided in Appendix F.1.5.</p> | | |
| Descriptions of Risks to Ongoing Benefits | | |
| <p>There are currently no risks to the landfill expansion.</p> | | |
| Assessment of Challenges Faced with Implementing the Proposal | | |
| <p>There are no unusual challenges anticipated with the expansion of the land fill or the transportation of flood damaged vehicles for recycling.</p> | | |
| Metrics | | |
| <p>The following metrics will be used to determine the impacts of the Landfill Compliance and Expansion Project:</p> <p>Resiliency Value: A better contained waste area will minimize flood-caused clean-up efforts.</p> <p>Environmental Value: Ecosystem returned to natural state. Minimized vectors and spread of waste.</p> | | |

Economic Revitalization: Value of property increases

Social Value: Proper disposal. Improved living environment. Improved health and safety.

BCA Narrative

Project 6: Land Development and Protection Planning

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Land Development and Protection Planning Project was prepared as follows:

Costs

Cost based on engineer's estimate from LeMay Engineering & Consulting, Inc. for a land development and protection planning study.

There are no operations and maintenance (O&M) costs for this project.

Benefits

Qualitative benefits are listed in the BCA table in Appendix F.1.6.

| Full Proposal Cost | Estimated Cost | Other Funding |
|--|-----------------------|----------------------|
| A cost estimate is provided in Appendix F.1.6. | \$415,600 | |

Description of Current Situation and Problem to be Solved

Currently, the two subdivisions within the city are at capacity. A land plat study is needed to develop a new community subdivision within City limits. The GILA school is protected by a berm which was nearly overtopped in the 2013 flood. A feasibility study is needed to determine how best to protect the GILA school from future floods.

Description of Proposed Project or Program

The land plat study includes a community evaluation to determine land suitable for development; a land survey; plot development; and infrastructure design for water, sewer, and electrical utilities. As a part of the land development planning phase, a feasibility study would be prepared to determine solutions to protect the GILA school property from flooding.

Description Risk to the Community if the Proposal is Not Implemented

The GILA school provided a base of operations for flood recovery in 2013, protecting this infrastructure during future floods is critical.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.1.6.

Descriptions of Risks to Ongoing Benefits

There are currently no risks to these feasibility studies.

Assessment of Challenges Faced with Implementing the Proposal

There are no unique challenges with producing these feasibility studies.

Metrics

The following metrics will be used to determine the impacts of the Land Development and Protection Planning Project:

Resiliency Value: Reduction of expected environmental damages

Environmental Value: Ecosystem returned to natural state.

Economic Revitalization: Value of property increases.

Social Value: Improved living environment.

BCA Narrative

Project 7: Community Development Planning

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Community Development Planning Project was prepared as follows:

Costs

Cost based on engineer's estimate from LeMay Engineering & Consulting, Inc. for a community development planning study.

There are no operations and maintenance (O&M) costs for this project.

Benefits

Qualitative benefits are listed in the BCA table in Appendix F.1.7.

| Full Proposal Cost | Estimated Cost | Other Funding |
|--|-----------------------|----------------------|
| A cost estimate is provided in Appendix F.1.7. | \$196,000 | |

Description of Current Situation and Problem to be Solved

A comprehensive plan for economic development and growth will provide an incentive for individuals, businesses, agencies, and other organizations to invest in Galena with a reasonable expectation of viability and growth

Description of Proposed Project or Program

This project will assess the current structures, land, and resources in Galena to determine a viable plan for economic growth.

Description Risk to the Community if the Proposal is Not Implemented

Future growth may be hampered without a viable development plan.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.1.7.

Descriptions of Risks to Ongoing Benefits

There are currently no risks to this study.

Assessment of Challenges Faced with Implementing the Proposal

There are no unique challenges with producing this study.

Metrics

The following metrics will be used to determine the impacts of the Community Development Planning Project:

Resiliency Value: Reduction of expected environmental damages.

Environmental Value: Ecosystem returned to natural state.

Economic Revitalization: Better planning leads to a more efficient use of economic resources.

Social Value: Improved living environments. Better community planning. Cultural preservation.

| BCA Narrative | | |
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| Project 8: Early Childhood Development | | |
| Process for Preparing the BCA | | |
| The Benefit Cost Analysis (BCA) for the Early Childhood Development Project was prepared as follows: | | |
| <u>Costs</u> | | |
| Cost based on engineer's estimate from LeMay Engineering & Consulting, Inc. to develop a daycare and Early Childhood Development Center. | | |
| Operations and maintenance (O&M) costs for this project are based on an engineer's estimate from LeMay Engineering & Consulting, Inc. and are included in Appendix F.1.8. | | |
| <u>Benefits</u> | | |
| Qualitative benefits are listed in the BCA table in Appendix F.1.8. | | |
| Full Proposal Cost | Estimated Cost | Other Funding |
| A construction cost estimate is provided in Appendix F.1.8. | \$365,225 | |
| Description of Current Situation and Problem to be Solved | | |
| There is currently no formal childcare available for children 0-3 years in Galena. Lack of formal childcare hinders parent's ability to work and engage in subsistence hunting and fishing. | | |
| Description of Proposed Project or Program | | |
| This project would complete necessary upgrades to an existing portion of the health clinic which would house the Early Childhood Development Center. The project would also pay for the salaries of 1 teacher and 1 administrator for 3 years. | | |
| Description Risk to the Community if the Proposal is Not Implemented | | |
| Lack of formal childcare reduces parent's ability to work and engage in subsistence hunting and fishing. | | |
| List of Benefits and Costs | | |
| A list of project benefits and costs is provided in Appendix F.1.8. | | |
| Descriptions of Risks to Ongoing Benefits | | |
| The building that will house the Early Childhood Development Center is scheduled to be raised above the base flood elevation in 2016. | | |
| Assessment of Challenges Faced with Implementing the Proposal | | |
| There are no unique challenges opening an Early Childhood Development Center. | | |
| Metrics | | |
| The following metrics will be used to determine the impacts of the Early Childhood Development Project: | | |
| Resiliency Value: Increase in long term education levels. Quicker recovery during event. | | |
| Environmental Value: Improved education of environmental issues leading to increase recycling, reuse and reduction. | | |
| Economic Revitalization: Direct effects on local opportunities and wages. | | |

Social Value: Improved living environment. Improved social cohesion. Decreased unemployment.

| BCA Narrative | | |
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| Project 9: Community Garden | | |
| Process for Preparing the BCA | | |
| <p>The Benefit Cost Analysis (BCA) for the Community Garden Project was prepared as follows:</p> <p><u>Costs</u></p> <p>Cost based on engineer's estimate from LeMay Engineering & Consulting, Inc. to develop a community garden.</p> <p>Operations and Maintenance (O&M) are not expected with a volunteer garden and donated materials.</p> <p><u>Benefits</u></p> <p>Quantified benefits include the market value of the potatoes grown in the community garden. Benefits were calculated as follows:</p> <p>The market value of the food grown in the community garden was determined from the size of the garden, the average per acre yield of potatoes in Alaska, the average wholesale value of potatoes grown in Alaska and the cost of shipping potatoes to Galena from Anchorage.</p> | | |
| Full Proposal Cost | Estimated Cost | Other Funding |
| A construction cost estimate is provided in Appendix F.1.9. | \$62,992 | |
| Description of Current Situation and Problem to be Solved | | |
| <p>Rural Alaskan food prices are considerably higher than the national average and highly dependent on the cost of fuel for shipping. Fresh vegetables are especially rare and expensive. Developing local agriculture makes the community much more resilient to changes in shipping costs and less dependent on outside food in general.</p> | | |
| Description of Proposed Project or Program | | |
| <p>This project would provide fencing, soil, tractor implements, watering hoses, a water tank and garden beds to construct a 100'x100' community garden.</p> | | |
| Description Risk to the Community if the Proposal is Not Implemented | | |
| <p>Lack of access to fresh vegetables is a health concern in rural Alaska.</p> | | |
| List of Benefits and Costs | | |
| <p>A list of project benefits and costs is provided in Appendix F.1.9.</p> | | |
| Descriptions of Risks to Ongoing Benefits | | |
| <p>No risks to ongoing benefits in the community are anticipated if the project is not constructed.</p> | | |
| Assessment of Challenges Faced with Implementing the Proposal | | |
| <p>There are no unique challenges to building a community garden. Galena has had a community garden for many years.</p> | | |
| Metrics | | |
| <p>The following metrics will be used to determine the impacts of the Community Garden Project:</p> <p>Resiliency Value: Reduction of expected environmental damages. Minimizing food shortages leads to quicker recovery.</p> | | |

Environmental Value: Reduced energy use, increased education.

Economic Revitalization: Decrease in grocery bills.

Social Value: Improved living environment, improved social cohesion. Healthier food choices.

BCA Narrative

Project 10: Electrical Generation Flood Protection

Process for Preparing the BCA

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

Costs

Capital cost data was provided by LeMay Engineering & Consulting, Inc. to construct a new pre-engineered metal building and moving all equipment from the existing power plant to the new structure.

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

Benefits

Quantified benefits include, cost savings related to reduction in expected property damage due to future/repeat disasters and reduction in loss of electric service due to future/repeat disasters. Benefits were calculated as follows:

Reduction in property damage is based on three factors: the value of the property which was calculated using the average square foot value of a power plant from the 2008 RSMeans catalog, the frequency of the flood, and the flood depth. The square footage of the existing power plant was measured from aerial maps. The total cost of the damage to the building was calculated using the Army Corps of Engineers Depth-Damage function for residential structures, which provides the percentage of the building damaged based on the depth of the flood. It was assumed that the depth-damage functions for residential buildings were going to be less than commercial structures. Therefore, it was a more conservative estimate to use the residential depth-damage functions.

Reduction in loss of electric service is based on information provided in the FEMA Benefit-Cost Analysis Re-engineering report which outlines methods to calculate benefit values for loss of electric service per capita per day. The total population of Galena, Alaska is from the 2010 U.S. Census, and the duration of the loss of electric service was determined from a phone conversation with the power plant employee.

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.1.10. | \$1,689,520 | |
| Description of Current Situation and Problem to be Solved | | |
| The community of Galena has six diesel-powered generators that power the community. All six generators were impacted by the May 2013 flood event. The power plant is currently within the flood plain and received over two feet of water during the flood. | | |
| Description of Proposed Project or Program | | |
| This project proposes to construct a new pre-engineered metal building on an elevated platform using helical piles drilled to a depth of 35-feet below ground surface. The six existing diesel-powered generators will be moved into the new facility. | | |
| The project useful life for the new power plant facility is 30 years. | | |
| Description Risk to the Community if the Proposal is Not Implemented | | |
| The community is currently dependent on diesel generators to provide power. Existing generators are currently within the flood plain, and are vulnerable to damage from future disaster events. Diesel fuel may not be able to be delivered during disaster events and the community could be at risk to prolonged periods without power if the generators are damaged. | | |
| List of Benefits and Costs | | |
| A list of project benefits and costs is provided in Appendix F.1.10. | | |
| Descriptions of Risks to Ongoing Benefits | | |
| As discussed above, ongoing benefits that are at risk include interruption of electrical service to the community during disaster events. | | |
| Assessment of Challenges Faced with Implementing the Proposal | | |
| Other communities along the Yukon River have had positive results from elevating the power plant on helical piles. No unusual challenges are anticipated for the proposed project. | | |
| Metrics | | |
| The following metrics will be used to determine the impacts of the Electrical Generation Flood Protection Project: Resiliency Value: Reduction of expected environmental damages. Fewer outages directly caused by flood events allows for quicker recovery. | | |

Galena, Alaska
Benefit-Cost Analysis Narrative

Environmental Value: Reduced energy use, improved air quality.

Economic Revitalization: Minimized recurring costs from flooding impacts. Reduced O&M.

Social Value: Improved living environment, improved security, health and safety from reliable power.

BCA Narrative

Project 11: Community Alternative Energy with 250-kW of Wood Gasification and Smart Grid

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Community Alternative Energy with 250-kW of Wood Gasification and Smart Grid Project was prepared as follows:

Costs

Capital cost data was provided by LeMay Engineering & Consulting, Inc. to construct a new wood gasification plant and the installation of a smart grid control system.

Operations and Maintenance (O&M) costs include creating a new plant operator position to run and maintain the new facility. The average hourly rate for the plant operator position was determined from the Department of Labor website, which was \$36.00/hour. It was assumed the operator would work 2000 hours/year.

Benefits

Quantified benefits include a reduction in the use of fuel for the City of Galena. Benefits were calculated as follows:

Fuel savings is based on the amount of energy that is generated from the wood gasification system. The energy generated was converted into an equivalent number of gallons of diesel. Based on a published report “Efficiency of Wood Biomass Gasification Report”, a wood gasification system is approximately 25% efficient. Twenty-five percent of 250-kW system would equate to roughly 32,750 gallons of fuel saved per year, which equals \$216,150/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.1.11. | \$2,161,337 | |

Description of Current Situation and Problem to be Solved

The community of Galena is highly dependent on diesel fuel to provide their power needs. Diversifying the methods from which electricity can be generated will help the community be less dependent on importing and storing fuel. Importing fuel via barge service can be difficult to impossible during adverse weather events. A wood gasification plant will decrease utility costs and provide sustainable energy from local renewable resources.

| |
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| Description of Proposed Project or Program |
| <p>This project proposes to construct a new wood gasification system and the installation of a smart grid system. The wood gasification system would provide the community with an alternative source to generate power and reduce the amount of fuel used every year. The smart grid system would tie-in the existing power plant with the wood gasification system, and the future solar array system.</p> <p>The project useful life for the wood gasification system and smart grid is 30 years.</p> |
| Description Risk to the Community if the Proposal is Not Implemented |
| <p>The community is currently dependent on diesel fuel to generate power. Diesel fuel may not be able to be delivered during disaster events and the community could be at risk of prolonged periods without power if fuel tanks are damaged and/or reserves are depleted.</p> <p>The current high cost of electricity will remain and will likely increase as fuel prices increase over time. The wood gasification system lowers the cost to generate power and the reductions in costs are expected to remain relatively steady throughout the life of the project which will help mitigate the high cost of fuel.</p> |
| List of Benefits and Costs |
| <p>A list of project benefits and costs is provided in Appendix F.1.11. Project benefits not included in the BCA include:</p> <ul style="list-style-type: none">• The smart grid system will be programmed to allow the community utility to gain operational efficiencies by automation of the power plant.• Smart grid will ensure that power can be distributed where and when it is needed.• The community will be less dependent on fuel to provide power to the community. The community will receive a social benefit by improved peace of mind from having redundant sources of electricity.• The cost of electricity to the residents of Galena is expected to decrease. The amount of the decrease in cost is unknown at this time and was not quantified. |
| Descriptions of Risks to Ongoing Benefits |
| <p>As discussed above, ongoing benefits that are at risk include high and increasing costs of fuel and the communities growing dependency on diesel fuel.</p> |
| Assessment of Challenges Faced with Implementing the Proposal |
| <p>With an abundance of renewable biomass fuel surrounding Galena, the community will have no problem fueling the wood gasification system. No unusual challenges are anticipated for the proposed project.</p> |
| |

Metrics

The following metrics will be used to determine the impacts of the Community Alternative Energy with 250-kW of Wood Gasification and Smart Grid Project:

Resiliency Value: Reduction of expected environmental damages. Redundant power systems providing quicker recovery during flood events. Wood-based system uses local sources.

Environmental Value: Reduced energy use, use of alternative energy.

Economic Revitalization: Decreased cost of power generating leads to increased income of residents.

Social Value: Improved living environment, more reliable power leads to better health and safety.

BCA Narrative

Project 12: 2.6-Megawatt Solar Array with Grid Scale Battery Storage

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the 2.6-Megawatt Solar Array with Grid Scale Battery Storage Project was prepared as follows:

Costs

Capital cost data was provided by LeMay Engineering & Consulting, Inc. to construct a 2.6-Megawatt Solar Array with Grid Scale Battery Storage.

Operations and Maintenance (O&M) costs were determined from the average value from the National Renewable Energy Laboratory website: http://www.nrel.gov/analysis/tech_lcoe_re_cost_est.html, which provides an O&M cost of \$20/kW*year.

Benefits

Quantified benefits include a reduction in the use of fuel for the City of Galena. Benefits were calculated as follows:

Fuel savings is based on the amount of energy that is generated from the solar array. The energy generated was converted into an equivalent number of gallons of diesel. The estimated amount of energy that would be produced from the solar array was provided by LeMay Engineering and Consulting, Inc. A total of 2,662,998 kWh of energy would be generated from the solar array throughout the year which equates to roughly 199,484 gallons of fuel and \$1,316,594 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.1.12. | \$9,423,316 | |

Description of Current Situation and Problem to be Solved

The community of Galena is highly dependent on diesel fuel to provide their power needs. Diversifying the methods from which electricity can be generated will help the community be less dependent on importing and storing fuel. Importing fuel via barge service can be difficult to impossible during adverse weather events. A solar array with grid scale battery storage will decrease utility costs and provide sustainable energy from renewable resources.

Description of Proposed Project or Program

This project proposes to construct a 2.6 Megawatt solar array with grid scale battery storage. The solar array would provide the community with an alternative source to generate power and reduce the

amount of fuel usage every year.

The project useful life for the solar array is 30 years.

Description Risk to the Community if the Proposal is Not Implemented

The community is currently dependent on diesel fuel to generate power. Diesel fuel may not be able to be delivered during disaster events and the community could be at risk of prolonged periods without power if fuel tanks are damaged and/or reserves are depleted.

The current high cost of electricity will remain and will likely increase as fuel prices increase over time. The solar array will lower the cost to generate power and the reductions in costs are expected to remain relatively steady throughout the life of the project which will help mitigate the high cost of fuel.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.1.12. Project benefits not included in the BCA include:

- The community will be less dependent on fuel to provide power to the community. The community will receive a social benefit by improved peace of mind from having redundant sources of electricity.
- The cost of electricity to the residents of Galena is expected to decrease. The amount of the decrease in cost is unknown at this time and was not quantified.

Descriptions of Risks to Ongoing Benefits

As discussed above, ongoing benefits that are at risk include high and increasing costs of fuel and the communities growing dependency on diesel fuel.

Assessment of Challenges Faced with Implementing the Proposal

Within the community, 40-kW of solar power has already been installed within the last two years. Solar systems have proven to work very well in the spring and summer months in Northern Alaska. No unusual challenges are anticipated for the proposed project.

Metrics

The following metrics will be used to determine the impacts of the 2.6-Megawatt Solar Array with Grid Scale Battery Storage Project:

Resiliency Value: Reduced reliance on imported fossil fuels. Redundant power systems providing quicker recovery during flood events.

Environmental Value: Reduced energy use, use of alternative energy.

Economic Revitalization: Decreased cost of power generating leads to increased income of residents.

Social Value: Improved living environment, more reliable power leads to better health and safety.

BCA Narrative

Project 13: Water Treatment Plant Mitigation

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Water Treatment Plant Mitigation was prepared as follows:

Costs

Capital cost data was provided by LeMay Engineering & Consulting, Inc. to elevate the existing equipment within the water treatment plant and upgrading the water filtration unit.

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

Benefits

Quantified benefits include reduction in expected damage to equipment and reduction in loss of water service due to future/repeat disasters. Benefits were calculated as follows:

Reduction in expected damage to existing equipment within the water treatment plant was determined by identifying all the existing equipment that was damaged from the previous flood event, and calculating the cost of replacement.

Reduction in loss of water service is based on information provided in the FEMA Benefit-Cost Analysis Re-engineering report which outlines methods to calculate benefit values for loss of water service per capita per day. The total population data for Galena, Alaska is from the 2010 U.S. Census data, and the duration of the loss of water service was determined from a phone conversation with the water treatment plant employee.

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.1.13. | \$547,668 | |

Description of Current Situation and Problem to be Solved

The water treatment plant for the City of Galena produces 24 gallons per minute with a total daily output of 34,560 gallons per day. As a result, each resident receives an average of 63 gallons per day. Most piped systems in Alaska provide up to 100 gallons per person per day. Additionally, the existing equipment within the water treatment plant is below the 136.5 foot elevation recommended for protection in the FEMA flood zone. All of the equipment was damaged and needed to be replaced after the last flood event.

Description of Proposed Project or Program

This project proposes to upgrade the filtration system and elevate the existing equipment within the water treatment plant. Upgrading the filtration system will produce up to 70 gallons per minute compared to 24 gallons per minute. Elevating the existing equipment within the water treatment plant

will eliminate the risk of damaging the equipment in the next flood event.

The project useful life for the filtration system and elevating the equipment is 30 years.

Description Risk to the Community if the Proposal is Not Implemented

Currently, the electrical equipment and pumps are two feet below the 136.5 foot recommended building elevation. During the last flood event, all equipment was damaged and had to be replaced. The electrical equipment and pumps are still within the flood elevation and could be damaged in the next flood event. In addition, not upgrading the filtration unit could result in lack of clean drinking water for the community.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.1.13.

Descriptions of Risks to Ongoing Benefits

As discussed above, ongoing benefits that are at risk include the loss of water service for the community and providing sufficient amount of clean drinking water during high demands.

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 Water Treatment Plant Mitigation Project:

Resiliency Value: Reduced loss of potable water during flood events leads to quicker recovery and reduced health impacts.

Environmental Value: Reduced energy use.

Economic Revitalization: Reduced O&M leads to decreased fees for residents.

Social Value: Improved living environment. More reliable water supply.

BCA Narrative

Project 14: Galena River Bank Stabilization/Erosion Prevention

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Galena River Bank Stabilization/Erosion Prevention was prepared as follows:

Costs

Capital cost data was provided by LeMay Engineering & Consulting, Inc. to install rip-rap material along the Galena coastline. Four zones were identified that are in need of the rip-rap installation. Only one of the zones is included in the BCA.

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

Benefits

Quantified benefits include; reduction in loss of land, expected property damage, expected road damage, displacement cost, cost of treatment of psychological issues, and cost of lost productive hours due to psychological issues due to future/repeat disasters. Benefits were calculated as follows:

Reduction in loss of land was calculated based on the current erosion rates projected into the future. The value of land per acre was from the Erosion Control in Riparian Areas outlined in FEMA Final Sustainability Benefits Methodology Report, which is \$11,447.30 per acre. The total area was calculated by projecting the existing coastline by 10 feet/year. A value of 10 feet/year was used for the area with more aggressive erosion.

Reduction in expected property damage was calculated based on the projection of the coastline eroding at a rate of 10 feet/year. For the properties that were determined to be in the erosion zone, the FEMA value for acquiring the property outlined in the Memorandum for Cost Effectiveness Determinations for Acquisitions and Elevations in Special Flood Hazard Areas Using Pre-Calculated Benefits was used. The property damage benefits were claimed in the year the property was determined to be effected.

Reduction in expected road damage was calculated based on the projection of the coastline eroding at a rate of 10 feet/year. It was assumed that the same length of roadway that would be washed away would have to be reconstructed. The cost of rebuilding the roadway was determined from a similar road project planned by the Alaska Department of Transportation in Galena. The cost for the proposed project was divided by the total length of the proposed road to calculate the cost per feet of new road. The benefits for reduction in road damage were claimed in the year the roadway was projected to be effected.

Reduction in displacement costs were calculated based on the methods outlined in the FEMA Benefit-Cost Analysis Re-engineering (BCAR). It was assumed that the rental space was equivalent to the existing building area. The building area is an average area of several structures that were located along in "Old Town" Galena and long the coastline. The recovery time was determined from Table 3: Recovery Time by Occupancy Type and Flood Depth in BCAR. It was assumed the minimum recovery period would be 12

months.

Reduction in Cost of Treatment of Psychological Issues from Future/Repeat Disasters

- Total cost for mental health treatment for severe and mild/moderate illnesses with effect of prevalence and course determined from Table 6 in FSBMR. Cost of \$2,443.10 per person who is at risk of losing a home due to erosion, per traumatic event was provided.
- Calculation assumes that traumatic event occurs annually when erosion removes more and more of the shoreline.
- Cost of psychological treatment (\$2,443.10 x Number of residents at risk of losing homes) was calculated for each year.
- The total psychological treatment costs were applied to future anticipated erosion events over a 50 year design life of the project with a discount factor of 7% applied to future benefits.

Reduction in Cost of Lost Productive Hours due to Psychological Issues from Future/Repeat Disasters.

- Total cost for productivity loss due to severe mental illness determined from Table 7 in FSBMR. Cost of \$8,736 per productive person in household, per traumatic event was provided.
- 2010 US Census data lists 291 homes with an average household size of 1.65 people. Based on average household size it is assumed that 1 productive person live in each home.
- Calculation assumes that traumatic event occurs annually when erosion removes a little more of the shoreline.
- Cost of lost productivity (\$8,736 x 81 productive persons) was calculated for each year the residents could potentially lose their home.

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.1.14. | \$16,571,922 | |

Description of Current Situation and Problem to be Solved

The City of Galena is situated on a cut bank of the Yukon River. A levy was built in the 1940’s by the Air Force, but the “Old Town” of Galena is outside of the levy and susceptible to erosion. Hundreds of feet of land, including several roads, have been lost to erosion since Galena was established in the 1920’s. Approximately 1.8 miles of rip-rap has been placed along the riverbank of Galena, successfully preventing further erosion. There are additional areas that have not been stabilized by rip-rap that are in need of erosion protection.

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| Description of Proposed Project or Program |
| Zone 3 of the riverbank is in need of erosion protection via rip-rap addition: Zone 3 - Crow Creek (2,700 feet). The project useful life for the rip-rap stabilization is 50 years. |
| Description Risk to the Community if the Proposal is Not Implemented |
| Areas with no rip-rap stabilization will continue to erode away by the Yukon River. Continued erosion will damage both roads and property. |
| List of Benefits and Costs |
| A list of project benefits and costs is provided in Appendix F.1.14. Project benefits not included in the BCA include: Galena is situated on the cut bank side of the Yukon River since it was first established in the 1920's. Based on elder accounts, photos, and maps, the river bank has lost hundreds of feet of land, including several roads. A century's worth of tradition and culture is slowly being washed away by the Yukon River. By installing the rip-rap along the coastline, Galena will be able to preserve their land and traditions to pass on to future generations. |
| Descriptions of Risks to Ongoing Benefits |
| As discussed above, ongoing benefits that are at risk include the loss of land, property damage, and damage to roadways. |
| Assessment of Challenges Faced with Implementing the Proposal |
| Portions of the Galena coastline have already been stabilized with rip-rap material. Considering previous efforts have had success, no unusual challenges are anticipated for the proposed project. |
| Metrics |
| The following metrics will be used to determine the impacts of the Galena Riverbank Stabilization/Erosion Protection Project: Resiliency Value: Reduction of expected environmental damages. Quicker response time during flood events. Environmental Value: Minimizes pollution from damaged structures and erosion. Reduced clean-up efforts during flooding events. Economic Revitalization: Reduced insurance claims, increased investment in protected areas. Social Value: Improved living environment, improved health and safety. |

BCA Narrative

Project 15: Tribal Office and Cultural Center

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Tribal Office and Cultural Center was prepared as follows:

Costs

Capital cost data was provided by LeMay Engineering & Consulting, Inc. to demolish the old building and to construct a new Tribal Office and Cultural Center.

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

Benefits

Quantified benefits include reduction in expected property damage and reduction in expected displacement costs due to future/repeat disasters. Benefits were calculated as follows:

Reduction in property damage is based on three factors: the value of the property which was calculated using the average square foot value of a community center from the 2008 RSMeans catalog, the frequency of the flood, and the flood depth. The total cost of the damage to the building was calculated using the Army Corps of Engineers Depth-Damage function, which provides the percentage of the building damaged based on the depth of the flood. It was assumed that the depth-damage functions for residential buildings were going to be less than commercial structures. Therefore, it was a more conservative estimate to use the residential depth-damage functions.

Reduction in displacement costs were calculated based on the methods outlined in the FEMA Benefit-Cost Analysis Re-engineering (BCAR). It was assumed that the rental space was equivalent to the existing building area. The recovery time was determined from Table 3: Recovery Time by Occupancy Type and Flood Depth in BCAR.

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.1.15. | \$890,580 | |

Description of Current Situation and Problem to be Solved

The Louden Tribal Council building is used for community and cultural meetings, workshops, tribal member services, and storing files. The Louden Tribal Council serves 259 tribal members living in Galena, and a total of 773 members in Alaska. As a result of the 2013 flooding, the Louden Tribal Council building was severely damaged and condemned. Currently, the Louden Tribal Council lacks a safe facility to provide services to the community of Galena.

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| Description of Proposed Project or Program |
| <p>The project proposes to demolish the existing facility, and to construct a 3,000 square-foot, two stories Tribal Office and Cultural Center. The building would include ADA access throughout and contain energy-efficient building materials.</p> <p>The project useful life for the new Tribal Office and Cultural Center is 50 years.</p> |
| Description Risk to the Community if the Proposal is Not Implemented |
| <p>The existing Louden Tribal building was severely damaged during the 2013 flood. Since the building is located near the river, it received a large amount of water, which damaged the building beyond repair. Currently, the Louden Tribal Council is renting a temporary facility. The Louden Tribal Council office is vital to 259 tribal members that live in Galena. The council will have to continue to rent a temporary facility until they can get funding to construct a new facility.</p> |
| List of Benefits and Costs |
| <p>A list of project benefits and costs is provided in Appendix F.1.15.</p> |
| Descriptions of Risks to Ongoing Benefits |
| <p>As discussed above, ongoing benefits that are at risk include property damage, and ongoing displacement cost.</p> |
| Assessment of Challenges Faced with Implementing the Proposal |
| <p>No unusual challenges anticipated for the proposed project.</p> |
| Metrics |
| <p>The following metrics will be used to determine the impacts of the Tribal Office and Cultural Center Project:</p> <p>Resiliency Value: Direct effect on local health Environmental Value: Reduced energy consumption. Economic Revitalization: Direct effects on local economy through increased job opportunities and wages. Social Value: Improved living environment, improved social cohesion.</p> |

BCA Narrative

Project 16: Home Elevation Above the Base Flood Elevation

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Home Elevation Above the Base Flood Elevation Project was prepared as follows:

Costs

Capital cost data was provided by LeMay Engineering & Consulting, Inc. to elevate 35 homes using helical pile foundation system.

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

Benefits

Quantified benefits include a reduction in expected property damage due to future/repeat disasters. Benefits were calculated as follows:

Reduction in expected property damage was calculated using the FEMA pre-calculated value for elevating structures from the Memorandum Cost Effectiveness Determinations for Acquisitions and Elevations in Special Flood Hazard Areas Using Pre-Calculated Benefits. For each elevation of a structure, FEMA states that the benefits are worth \$175,000. The value was multiplied by 1.65, which is the local multiplier for Galena, Alaska.

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.1.16. | \$6,823,248 | |

Description of Current Situation and Problem to be Solved

Many houses in Galena were built below the Base Flood Elevation (BFE). During flooding in 2013, 95% of homes in Galena were impacted by floodwaters. Through a partnership between FEMA and the State of Alaska, 51 homes out of 130 homes have been raised above the BFE. Currently, 79 homes are still below the BFE, and are vulnerable to future flood damages.

The City of Galena sits on permafrost, which is susceptible to frost-jacking without an appropriate foundation.

Description of Proposed Project or Program

This project proposes to raise 35 homes and add a foundation design consisting of 8-inch pipe piles with

18-inch helices. This system was designed for structures built on permafrost.

The project useful life for elevated building foundations is 30 years.

Description Risk to the Community if the Proposal is Not Implemented

The majority of the homes in Galena are within the flood plain. Future floods will continue to damage the existing structure and destroy personal belongings. Over time, the structures will become severely damaged from repeating flood events, and become unstable.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.1.16. Project benefits not included in the BCA include:

- Residents will no longer have to worry about their homes and belongings being damaged from future flood events.

Descriptions of Risks to Ongoing Benefits

As discussed above, ongoing benefits that are at risk include damage to property and personal belongings.

Assessment of Challenges Faced with Implementing the Proposal

During the 2014 summer construction season, 41 elevated home foundations were constructed, and another ten were constructed in 2015. No unusual challenges are anticipated for the proposed project.

Metrics

The following metrics will be used to determine the impacts of the Home Elevation Above the Base Flood Elevation Project:

Resiliency Value: Reduction of expected damages during a flood leading to quicker recovery.

Environmental Value: Reduced debris and pollution from flood events.

Economic Revitalization: Reduction in flood insurance premiums, more investment.

Social Value: Improved living environment, improved health, safety and security.

BCA Narrative

Project 17: Yukon Elder Assisted Living Facility Expansion

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Yukon Elder Assisted Living Facility Expansion Project was prepared as follows:

Costs

Capital cost data was provided by LeMay Engineering & Consulting, Inc. to expand the current assisted living facility from 9 units to 20 units.

Operations and Maintenance (O&M) costs include creating three new nursing assistance positions to accommodate eleven additional elderly residents. The average hourly rate for the nursing assistant position was determined from the Alaska Department of Labor website, which was \$17.10/hour. It was assumed the nursing assistants would work 2000 hours/year. The number of new hires was determined after speaking with the assisted living facility director.

Benefits

Quantified benefits include reduction in expected displacement costs due to future/repeat disasters, and reduction in cost of elderly assistance. Benefits were calculated as follows:

Reduction in displacement costs were calculated based on the methods outlined in the FEMA Benefit-Cost Analysis Re-engineering (BCAR). It was assumed the rental space would be 22% larger than the existing facility to accommodate the 11 new elderly residents. The recovery time was determined from Table 3: Recovery Time by Occupancy Type and Flood Depth in BCAR.

Reduction in cost of elderly assistance was calculated by determining what the cost of home care minus the cost of assisted living was per month. It was assumed that there would be full time home care service of 2000 hours per year at \$25/hour. In addition to cost of home care service, the average cost for living per month was added to the total home care cost, since the family would need to provide food and shelter for the elderly. The average cost for living of \$1,226.67 per month is the poverty level for Alaska.

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.1.17. | \$4,238,223 | |

Description of Current Situation and Problem to be Solved

The Yukon Elder Assisted Living Facility (YEALF) currently provides assisted living care to nine residents, and is at capacity. There is a growing need for additional assisted living care in Galena. The YEALF also

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| <p>provides a forum in which youth and elders interact. At least three times a week, students from the Galena boarding school spend time with the elders.</p> |
| <p>Description of Proposed Project or Program</p> |
| <p>The proposed project would add 11 units, a 1,200 square-foot area for youth/elder interaction, a library, and staff training for YEALF.</p> <p>The project useful life for the new addition is 50 years.</p> |
| <p>Description Risk to the Community if the Proposal is Not Implemented</p> |
| <p>The level of care that elders need is getting progressively higher with health issues such as dementia (80% of residents have this diagnosis), diabetes, rheumatoid arthritis, and various cancers. Since the flood of 2013 as well as other disasters, an increase of post-traumatic stress disorder, depression, and respiratory diseases are being seen. Without additional space to house the elderly, they are often left to fend for themselves.</p> |
| <p>List of Benefits and Costs</p> |
| <p>A list of project benefits and costs is provided in Appendix F.1.17. Project benefits not included in the BCA include:</p> <ul style="list-style-type: none">• Yukon Elder Assisted Living Facility not only provides assisted living care for at risk elders, but it has proven to be a valuable employment opportunity for locals who often would not be able to find employment otherwise. |
| <p>Descriptions of Risks to Ongoing Benefits</p> |
| <p>As discussed above, ongoing benefits that are at risk include additional cost for elderly care by families and displacement costs.</p> |
| <p>Assessment of Challenges Faced with Implementing the Proposal</p> |
| <p>No unusual challenges are anticipated for the proposed project.</p> |
| <p>Metrics</p> |
| <p>The following metrics will be used to determine the impacts of the Yukon Elder Assisted Living Expansion Project:</p> <p>Resiliency Value: Direct effect on local health and quicker recovery.</p> <p>Environmental Value: Reduced energy consumption.</p> <p>Economic Revitalization: Direct effects on local economy, job opportunities and better wages. Reduced cost of elderly assistance.</p> <p>Social Value: Improved living environment, health and safety. Improved community across generations and cultures. Cultural preservation.</p> |

BCA Narrative

Project 18: Galena Interior Learning Academy Biomass Glycol Upgrades

Process for Preparing the BCA

The Benefit Cost Analysis (BCA) for the Galena Interior Learning Academy Biomass Glycol Upgrades Project was prepared as follows:

Costs

Capital cost data was provided by LeMay Engineering & Consulting, Inc. to replace the existing utilidor within the school.

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

Benefits

Quantified benefits include a reduction in the use of fuel for the City of Galena. Benefits were calculated as follows:

Fuel savings are based on the amount of heat that would be saved every year from upgrading the existing utilidor. A recent engineering study indicated that the utilidor system wastes heat equivalent to about 60,000 gallons of diesel fuel 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.1.18. | \$3,129,806 | |

Description of Current Situation and Problem to be Solved

The Galena Interior Learning Academy is a boarding school operated by the Galena City School District (GCSD) that provides education to approximately 230 high school students. Heat for all of the school buildings is provided by a central steam plant and underground steam distribution system (the utilidor) which connects the low pressure steam boilers to the buildings, including classrooms, dormitories, a dining hall, an onsite water plant, and maintenance facilities. A recent engineering study indicated that the utilidor system wastes heat equivalent to about 60,000 gallons of diesel fuel per year, and that it is very likely to fail catastrophically within the next ten years.

Description of Proposed Project or Program

The State of Alaska has approved a grant to replace the boiler portion of the heating system with a wood chip boiler. This replacement cannot be implemented without first replacing the heat distribution

pipes in the utilidor. The proposed utilidor system will provide increased thermal efficiency, lower maintenance costs, extend operating life, and improve reliability. The combination of the wood chip boiler and the new utilidor is expected to reduce diesel fuel consumption for GILA by about 200,000 gallons per year.

The project useful life for the new utilidor is 30 years.

Description Risk to the Community if the Proposal is Not Implemented

The central heating system is critical to the school’s operation during the cold Alaskan winter. A major failure of the current steam heating system would jeopardize the entire school operations. In addition, the school would continue to spend on heating that is being wasted every year.

List of Benefits and Costs

A list of project benefits and costs is provided in Appendix F.1.18.

Descriptions of Risks to Ongoing Benefits

As discussed above, ongoing benefits that are at risk include continuously wasting heat and energy that could otherwise be preserved and used for other causes.

Assessment of Challenges Faced with Implementing the Proposal

Design is currently underway and no unusual challenges are anticipated for the proposed project.

Metrics

The following metrics will be used to determine the impacts of the Galena Interior Learning Academy Biomass Glycol Upgrades Project:

Resiliency Value: Reduction of expected environmental damages leading to quicker recovery. Reduced fuel prices.

Environmental Value: Reduced energy consumption.

Economic Revitalization: Direct effects on local economy from decreased fuel needs.

Social Value: Improved living environment, health and safety.

| BCA Narrative | | |
|---|-----------------------|----------------------|
| Project 19: Sustainable Energy for Galena Alaska, Inc. (SEGA) | | |
| Process for Preparing the BCA | | |
| <p>The Benefit Cost Analysis (BCA) for the Sustainable Energy for Galena Alaska, Inc. (SEGA) Project was prepared as follows:</p> <p><u>Costs</u></p> <p>Cost based on engineer's estimate from LeMay Engineering & Consulting, Inc. to fund the Sustainable Energy for Galena Alaska Project.</p> <p>Operations and maintenance (O&M) costs are expected to be covered by the revenue from sale of wood.</p> <p><u>Benefits</u></p> <p>Qualitative benefits are listed in the BCA table in Appendix F.1.19.</p> | | |
| Full Proposal Cost | Estimated Cost | Other Funding |
| A construction cost estimate is provided in Appendix F.1.19. | \$250,000 | \$647,000 |
| Description of Current Situation and Problem to be Solved | | |
| The planned wood boiler system requires a steady supply of wood for fuel. | | |
| Description of Proposed Project or Program | | |
| This project would provide capital to bridge the transition between using diesel fired boilers and the wood fired boilers. | | |
| Description Risk to the Community if the Proposal is Not Implemented | | |
| Installing and running wood fired boilers in the school and town will reduce the community's dependence on expensive imported diesel fuel. | | |
| List of Benefits and Costs | | |
| A list of project benefits and costs is provided in Appendix F.1.19. | | |
| Descriptions of Risks to Ongoing Benefits | | |
| There are no risks to the ongoing benefits. | | |
| Assessment of Challenges Faced with Implementing the Proposal | | |
| There are no unique challenges to building a supporting the wood harvesting plan. | | |
| Metrics | | |
| <p>The following metrics will be used to determine the impacts of the Sustainable Energy for Galena Alaska, Inc. (SEGA) Project:</p> <p>Resiliency Value: Reduction of expected environmental damages and more reliable power, leading to quicker recovery.</p> <p>Environmental Value: Reduced energy consumption, reduced fossil fuels.</p> <p>Economic Revitalization: Direct effects on local economy through increased jobs and energy savings.</p> <p>Social Value: Improved living environment, health and safety.</p> | | |

Appendices

Benefit-Cost Analyses for each project are provided in Appendices F.1.1 through F.1.19. Please also see the **Attachment F.Reference** for general reference information that is applicable to multiple projects.