U.S. Army Corps of Engineers

Alaska District

Study Findings and Technical Report

Alaska Baseline Erosion Assessment

Erosion at the community of Emmonak

March 2009

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ABBREVIATIONS

ADOT&PF	Alaska Department of Transportation and Public Facilities
AVETA	Alaska Village Erosion Technical Assistance Program
BEA	Alaska Baseline Erosion Assessment
BIA	U.S. Department of Interior, Bureau of Indian Affairs
Corps	U.S. Army Corps of Engineers
DCCED	Alaska Department of Community Commerce and Economic Development
DCCED-DCRA	Alaska Department of Community Commerce and Economic Development, Division of Community and Regional Affairs
DEA	Detailed Erosion Assessment
EDA	U.S. Department of Commerce, Economic Development Administration
EIP	Erosion Information Paper
EWP	Emergency Watershed Protection
IAWG	Immediate Action Working Group to the Governor's Sub Cabinet on Climate Change
NOAA	U.S. Department of Commerce, National Oceanic and Atmospheric Administration
NRCS	U.S. Department of Agriculture, National Resources Conservation Administration
USDA	U.S. Department of Agriculture
USGS	U.S. Department of Interior, U.S. Geological Survey

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EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers, Alaska District (Corps), has conducted a Baseline Erosion Assessment (BEA) to coordinate, plan, and prioritize appropriate responses to erosion throughout Alaska. The study, begun in April 2005 and completed in March 2009, was specifically funded by the U.S. Congress. After conducting the study, the Corps prepared a technical report intended to help Federal, State, Tribal, and local stakeholders to develop strategies and plans for addressing erosion issues in Alaska.

Summary of Findings

Through a process of stakeholder meetings, review of previous reports, and extensive correspondence with communities,[1] 178 Alaska communities were found to have reported erosion problems. After subsequent investigation, the Corps designated 26 communities "Priority Action Communities"—indicating that they should be considered for immediate action by either initiating an evaluation of potential solutions or continuing with ongoing efforts to manage erosion. Sixty-nine communities where erosion problems are present but not significant enough to require immediate action were designated "Monitor Conditions Communities." Eighty-three communities where minimal erosion-related damages were reported or would not be expected in the foreseeable future were designated "Minimal Erosion Communities."

The 26 Priority Action Communities are identified in Table ES-1.

Table ES-1. Priority Action Communities

Akiak	Emmonak	Newtok
Alakanuk	Golovin	Nunapitchuk
Barrow	Huslia	Port Heiden
Chefornak	Kivalina	Saint Michael
Chevak	Kotlik	Selawik
Clark's Point	Kwigillingok	Shaktoolik
Cordova/Eyak	Lime Village	Shishmaref
Deering	McGrath	Unalakleet
Dillingham	Napakiak	

Each Priority Action Community has reported serious erosion that is threatening the viability of the community, or, in some cases, significant resources are being expended to minimize those threats. The erosion issues in these communities warrant immediate and substantial Federal, State, or other intervention. In some cases, action is needed to continue funding for projects that are underway and funded by Federal, State, Tribal, and/or local entities. For

[1] The term "community" is meant to include both the town and the federally recognized Tribe located near that town. In instances when the intent is to specifically identify the incorporated town/city/village or the federally recognized Tribe, the distinction is made.

others, it is urgent that a team visit the community to assess erosion issues and needs thoroughly.

A topic that arose frequently during the BEA study is that flooding is as great a problem as erosion in some communities. The BEA assesses erosion but includes a conclusion that an assessment of flooding issues in Alaska is needed.

Appropriate Responses

Communities can address erosion issues using various self-initiated activities and by seeking assistance from State and Federal agencies.

The most appropriate response is prevention. Communities and those assisting communities with construction should not build structures within the 50-year erosion hazard zone or 50-year flood hazard zone. If such construction must occur, structures should be designed for ease of relocation, and prior construction in those zones should be retrofitted for the same purpose. These actions can do much to reduce the potential severity of erosion damage.

There are several expedient measures a community can use to construct temporary protection. Measures such as sandbag revetments, sand placement, and use of vegetation can be implemented by using local materials or material that can be brought in by airplane quickly.

Although the State of Alaska has no formal erosion control program, the State has capability to take action in addressing erosion. Through specifically funded projects and coordinated actions such as the Newtok Planning Committee and the Immediate Action Workgroup, the State is a collaborative leader in developing solutions.

The Natural Resources Conservation Service (NRCS) has programs that can provide erosion control assistance. NRCS administers the Watershed and Flood Prevention Program. The Watershed Protection and Flood Prevention Act (PL 83-566) of 1954 authorized NRCS to cooperate with states and local agencies to carry out works of improvement, including projects to prevent erosion damages.

The Corps has several cost-shared programs that communities can utilize for assistance. Section 14 of the U.S. Flood Control Act of 1946 allows the Corps to plan, design, and construct erosion control projects that protect public infrastructure. Section 103 of the U.S. River and Harbor Act 1962 is used for protection against storm waves and hurricanes.

The Corps' authority to construct solutions for erosion control in Alaska has been modified by the repeal in March 2009 of Section 117 of the 2005 Energy and Water Development Appropriations Act. Section 117 had allowed projects constructed under that authority to be funded at full Federal expense, and did not require that those projects be justified by using the traditional benefit-cost ratio test. Under Section 117, the Corps has been able to initiate construction at Kivalina, Newtok, Shishmaref, and Unalakleet. Because of the repeal of Section 117, it is unknown whether these projects can be completed as planned.

1.0 INTRODUCTION

This report presents the results of the Alaska Baseline Erosion Assessment (BEA), a combination of study efforts specifically funded by the U.S. Congress, and describes how those results were attained. The BEA was conducted in response to legislation authorizing the U.S. Army Corps of Engineers (Corps) to coordinate, plan, and prioritize appropriate responses to erosion throughout Alaska.

The report has been prepared with the intent of providing information to Federal, State, Tribal, and local decisionmakers that can assist them in making informed decisions about erosion issues in Alaska and in developing strategies and plans for addressing those issues.

The potential for erosion exists wherever land and water connect. Erosion, as part of a natural process, does not become a problem until it starts to affect something of intrinsic or quantifiable value. In the past, communities simply moved away from erosion sites as necessary. As communities became tied to the land through infrastructure development, it became more difficult to move away from erosion sites, and residents have tried to combat erosion on their own until the problem grew so severe that external assistance was needed.

According to the U.S. Geological Survey (USGS), Geographic Names Information System, Alaska has about 10,000 officially named and thousands of unnamed rivers, creeks, and streams. There are nearly 44,000 miles of tidal shoreline and more than 3 million lakes (USGS, 2009). With this immense amount of water-land connection, the issue of erosion in Alaska is significant.

The term "community" is used liberally throughout the report. In general, this term is meant to include both the town and the federally recognized Tribe located near that town. In instances when the intent is to specifically identify the incorporated town/city/village or the federally recognized Tribe, the distinction is made.

1.1. Study Authority

The BEA was authorized in the Conference Report to Accompany the Fiscal Year 2005 Consolidated Appropriations Act, PL 108-447, Division C, which contains the following language:

> *"The conference finds there is a need for an Alaska erosion baseline study to coordinate and plan the appropriate responses and assistance for Alaska villages in the most need and to provide an overall assessment on the priority of which villages should receive assistance. Therefore, the conference has provided the $2 million for this study."*

In subsequent coordination between the Corps Alaska District and Corps headquarters, it was determined that this work could be done at 100 percent Federal expense, providing that no recommendation for a specific project be made.

1.2. Study Purpose and Objectives

The purpose of the BEA is to coordinate, plan, and prioritize appropriate responses to erosion in Alaska. Significant effort was undertaken to identify communities that have erosion issues and to determine (1) how best to assess the problems within the limits of available funding

and (2) how best to disseminate the information gathered such that Federal, State, Tribal, and local stakeholders have a useful tool at their disposal. To accomplish the purposes of the study, the following tasks were developed:

- Assemble a coordinated team of Federal, State, Tribal, and local stakeholders to assist in identifying problems, developing criteria for assessing those problems, and disseminating the compiled information.
- Create a comprehensive list of Alaska communities that have or are perceived to have an erosion issue.
- Assess the potential for erosion-related damages in those communities.
- Develop ways in which the communities can seek solutions for erosion problems.

This report and its appendices document the accomplishment of these tasks and the results of the assessment.

1.3. Related Reports and Studies

An initial step in conducting the BEA was a review of relevant literature. Reports and studies pertaining to erosion issues in Alaska are too numerous for all to be mentioned in this report; however, there are three reports that readers may wish to reference for additional insight:

- *Alaska Village Erosion Technical Assistance Program.* Prepared by the Corps Alaska District, April 2006. This report examined erosion conditions at seven Alaska communities Bethel, Dillingham, Kaktovik, Kivalina, Newtok, Shishmaref, and Unalakleet. For each location, the report examined the costs of ongoing erosion, the cost to relocate, and the amount of time left before erosion would destroy the community. This study was authorized by the U.S. Congress.
- *Task Force on Erosion Control, Final Report.* Prepared by the Alaska Department of Transportation and Public Facilities (ADOT&PF), January 1984. This report served as a model for the BEA in that it also examined erosion on a statewide scale.
- *Alaska Native Villages, Most Are Affected by Flooding and Erosion, but Few Qualify for Federal Assistance*. U.S. General Accounting Office (GAO) Report Number GAO-04-142, December 2003. This report is cited often for its opening line, "Flooding and erosion affects 184 out of 213, or 86 percent, of Alaska Native villages to some extent." The report concluded that, “Kivalina, Koyukuk, Newtok, and Shishmaref—are in imminent danger from flooding and erosion…”

1.4. Report Organization

In addition to this introduction, the report contains seven sections, one attachment, and nine appendices (appendices are provided in electronic form only, on two CD-ROMs):

- **Section 2.0, Efforts to Manage Erosion,** discusses efforts that have been undertaken by communities, State and Federal agencies, and collaborative groups to manage erosion in Alaska. Examples of projects and other collaborative efforts are included.
- **Section 3.0, Study Development and Community Risk Rating,** describes (1) the coordinated effort conducted among the study team, agencies, and communities; (2) the process used to identify affected communities; and (3) the process used to develop an erosion risk rating for each community under study.
- **Section 4.0, Community Prioritization,** describes the prioritization process and results, identifying erosion-affected communities according to three levels of need: (1) problems are urgent, (2) problems are significant and conditions should be monitored, and (3) problems are minimal. Specific problems in communities with the most urgent need are identified.
- **Section 5.0, Appropriate Responses to Erosion,** identifies appropriate responses for each of the community prioritization designations, specific responses for communities with the most urgent need (Priority Action Communities), interim measures, and State and Federal programs for erosion control assistance
- **Section 6.0, Flooding Risks,** briefly discusses flooding, which often creates or worsens erosion and threatens numerous communities without significant reported erosion problems.
- **Section 7.0, Conclusions,** presents conclusions of the BEA.
- **Section 8.0, References,** lists references used in preparing the report.
- **Attachment 1** contains Erosion Information Papers (EIPs) and Detailed Erosion Assessments (DEAs) for Priority Action Communities.

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2.0 EFFORTS TO MANAGE EROSION

This section discusses recent and ongoing efforts to manage erosion in Alaska communities, including efforts of individual communities (Section 2.1), State agencies (Section 2.2), Federal agencies (Section 2.3), and two collaborative groups, the Newtok Planning Group and the Immediate Action Working Group to the Governor's Sub Cabinet on Climate Change (IAWG). (Section 2.4).

2.1. Individual Communities

In general, communities are resourceful and inventive for temporary measures, but dependent on external assistance for long-term solutions. Individual communities are the first entities to respond to erosion issues. Typically, communities contact State and Federal agencies to draw attention to problem and to try to develop solutions.

In acute situations, communities often take action themselves to slow the erosion, using whatever materials are immediately available. Sandbags, 55-gallon drums, old construction equipment, abandoned cars, and broken heavy machinery have been used to slow erosion. Some coastal communities have limited heavy construction equipment that has been used to push sand up from low-tide areas to help secure a bluff. Some have used armor stone or other construction materials that have been stockpiled at the community as a means of temporary relief from erosion.

2.2. State of Alaska

The State of Alaska does not have a specific erosion control authority or funding program; however, that circumstance has not prevented the State from providing substantial assistance to many communities suffering from the effects of erosion-related damage. The State has a strong history of actively addressing erosion and flooding.

One of the first comprehensive examinations of erosion in Alaska is the *Task Force on Erosion Control, Final Report* (ADOT&PF, 1984). Relying heavily on the insight of local officials and residents, the report identified 31 areas in 30 communities as high-priority areas considered to have critical erosion problems. In rating a site's priority, the report used seven major prioritization categories: public safety, public property, private property, time of projected loss, ability to move, approximate replacement value, and economic value. The report identified nearly $36 million (adjusted for inflation to 2008 dollars) in necessary erosion control projects.

Community relocation was raised in the ADOT&PF report: "One of the directives of the task force was to accumulate an economic profiles (sic) of the communities in order to conduct a cost-effective analysis of the design versus moving the community." The report further stated, "in nearly all cases, community relocation was not a viable option…"

Throughout Alaska, erosion affects much more than the communities. Public facilities such as highways, power facilities, transmission lines, and airports are often subject to erosion damage. Many State agencies that support community infrastructure are now considering erosion and flood risk when repairing or replacing structures, ensuring that structures are safe from damage for at least 30 years.

According to the Alaska Department of Community Commerce and Economic Development (DCCED), Division of Community and Regional Affairs (DCRA). Capital Projects Database (2009), several communities have received grants or initiated capital projects to address erosion. Some of these projects have been State-funded, and some have been funded through Federal agencies. In either case, the State has played a substantial role in the success of these projects. The following is a sampling of past erosion efforts the State has undertaken for communities prone to erosion damage.

- **Alakanuk** has had five erosion control projects completed since 1995, according to DCCED. The combined cost totaled just over $200,000. All five projects were funded by DCCED and involved erosion protection and planning for community relocation.
- In **Cordova and Eyak**, the Humpback Creek Hydroelectric Restoration project, which includes erosion repairs, is under construction. The total cost, just over $600,000, is funded by the Denali Commission.
- **Deering** has had one erosion project, conducted under a State emergency erosion protection grant with a local match and completed in 1995. State funding was provided by DCCED, and total project cost was approximately $500,000.
- **Dillingham** has a shoreline emergency bank stabilization project underway in the preliminary stage. This project is funded by DCCED, with an estimated total cost of $1.5 million.
- **Emmonak** has had one erosion control project, for Airport Road and funded by ADOT&PF in 1994.
- **Kivalina** has had nine erosion control projects completed from 1992 to 2007— most dealing with community relocation. All were funded by DCCED, and the combined total cost was approximately $325,000. Kivalina has one project under construction: a shoreline protection project with a total cost of approximately $1.65 million, funded by DCCED. An additional erosion protection project for Kivalina is in the preliminary stage, with a cost of approximately $3.3 million, funded by DCCED.
- There have been three completed erosion control projects in **Kotlik**. All three are being conducted under capital matching grants funded by DCCED, at a total cost of approximately $83,000.
- **McGrath** has had four river erosion control projects completed from 1994 to 2002, at a total cost just over $3 million, funded by DCCED.
- **Napakiak** has had three erosion control projects completed from 1986 through 1997, for a total cost of about $83,000. All three involved community relocation due to erosion at the current community site and were funded by DCCED. An additional residential relocation project is in the construction phase, funded by DCCED at a project cost of approximately $65,000.
- **Newtok** has had one project to address erosion problems, which is listed as preliminary. This project is being conducted under a 2006 construction grant from the U.S. Department of Commerce, Economic Development Administration (EDA), to

relocate the community's barge ramp, dock, and related utilities due to "disastrous erosion." The new site for the community, which will be named "Mertarvik," is on Nelson Island. The estimated cost for this project is $1 million. (Newtok is discussed further in Section 2.4.)

- **Selawik** has had one erosion control capital project, completed in 2003. DCCED funded a $32,632 capital matching grant for boardwalk, bridge repair, and erosion control.

- Three erosion control projects in **Shishmaref** were completed between 1992 and 2002, for a total cost of about $740,000. One was an emergency tanks relocation project funded by the Denali Commission. The second was funded by DCCED under a capital matching grant for facilities relocation, and the third was funded by ADOT&PF for erosion control.

  Two projects have been constructed for erosion control and shoreline protection. Both projects were led by DCCED, with a total cost of approximately $2.5 million. Another erosion project was initiated in 2000 by the U.S. Department of Interior, Bureau of Indian Affairs (BIA), with an estimated cost of $1.2 million. DCCED is the lead agency for a 2009 legislative grant for a Shishmaref beach erosion project, with an estimated cost of $50,000.

- **Unalakleet** has had two erosion projects completed since 2004. Both were led by ADOT&PF and involved repairing and protecting roadways from erosion damage. The total cost of these two projects was approximately $1.8 million. There is also a preliminary-stage Unalakleet erosion protection project underway under a legislative grant. This project is led by DCCED and has an estimated cost of $5 million.

2.3. Federal Agencies

Many Federal agencies are involved in various aspects of erosion management. However, only two Federal agencies have specific missions to provide others with erosion protection projects:

- The U.S. Department of Agriculture (USDA), National Resources Conservation Administration (NRCS), cooperates with states and local agencies to carry out works of improvement for soil conservation and related purposes.

- The Corps has multiple programs that assist communities with coastal and riverine erosion planning, design, and construction.

Other Federal agencies have missions to provide information used in erosion assessment and planning. Some of these agencies construct erosion protection projects occasionally.

- The National Weather Service of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), tracks storms and floods, which often create accelerated erosion rates.

- USGS monitors river flow and has conducted extensive studies on erosion and sediment transport rates in streams and rivers.

- The U.S. Department of Homeland Security (DHS), Federal Emergency Management Agency, responds to assist with disaster recovery after a large, erosion-causing event.
- Other agencies such as the U.S. Department of Interior, Bureau of Land Management; and the USDA, U.S. Forest Service, build small erosion control projects to protect their facilities.

2.3.1. U.S. Army Corps of Engineers

The Corps, with multiple programs to assist communities with coastal and riverine erosion planning, design, and construction, has received dozens of requests over the years for assistance with Alaska erosion problems. The Corps has received approximately 50 requests for action—most during the last 10 years—for river erosion or coastal storm damage.

During the past several years, the U.S. Congress has authorized the Corps to conduct studies related to erosion issues for several communities. In 2003, Congress authorized the Corps to examine the costs of ongoing erosion, the costs to relocate, and the amount of time left before erosion would destroy the communities at Bethel, Dillingham, Galena, Kaktovik, Kivalina, Newtok, Shishmaref, and Unalakleet.[2] Findings of these studies were documented in the *Alaska Village Erosion Technical Assistance (AVETA) Program Report* (Corps, 2006).

The Corps has constructed several projects for erosion control in several communities, including Bethel, Deering, Dillingham, Galena, Homer, Metlakatla, and Talkeetna:

- In **Bethel**, the Corps constructed 8,200 feet of bank protection, which consisted mostly of riprap revetment but included 300 feet of toe protection along the city dock. The pipe-pile bulkhead also was strengthened by installation of steel tieback rods to hold in place the structure along the waterfront. Total cost of this project completed in 1996 was approximately $23 million.
- The Corps completed two revetments for **Deering** in 1997. With a combined length of nearly 1,400 feet, this project cost just over $700,000.
- **Dillingham** has had one project constructed by the Corps and completed in 2000. The Corps constructed a 1,625-sheet pile bulkhead to the east of the city dock. Another 600 feet of sheetpile with riprap was constructed to the east side of the Dillingham Harbor entrance channel. The cost of this two-segment project was about $6.5 million.
- **Galena** has had two projects constructed by the Corps. A 1,590-foot revetment was completed in 1988. A 2,275-foot extension was completed in 2005. The combined cost was about $6 million.
- The Corps completed a 4,830-foot revetment on the **Homer** spit in 1998, at a total cost of approximately $8.6 million.

[2] Consolidated Appropriations Resolution, 2003, PL 108-7, Division D - Energy and Water Development Appropriations, 2003, Conference Report (HR 108-10, page 807), Senate Report (SR 107-220, page 23), and HR 108-357, Section 112, page 10, Conference Report Energy and Water Development Appropriations Bill, 2004.

- At **Metlakatla**, the Corps has installed two revetment projects. The first revetment was 935 feet in length and was installed at the community cemetery. The second was 295 feet in length and located at the community fuel tank farm. Construction of these projects was completed in 1995, at a total cost of approximately $212,000.

- In **Talkeetna**, two Corps projects have been constructed. A brush and natural timber fascine was installed on the southern bank of the Talkeetna River downstream of the railroad bridge. This project was constructed in 1951 at a cost of approximately $24,000. The Corps installed a more permanent project that consisted of a 1,650-foot revetment along the shoreline and a 1,150-foot dike along the shoreward side of the fascine. This project, completed in 1979, had a cost of about $517,000.

Where specific Congressional appropriations are not provided, requirements of the legislative authorities limit the options under which Alaska communities can receive erosion assistance from the Corps. The high cost of rural Alaska projects, which results in lower benefit-cost ratios, is the most common factor preventing approval of community projects in which the Corps can offer assistance. These high costs also hinder project implementation because many communities have little ability to afford the cost-sharing requirement. Other reasons why a potential project may not be eligible for Federal funding include (1) the property at risk is private, (2) project costs exceeded project or program funding limits.

The Corps' authority to assist Alaska communities with erosion issues was expanded for a few years with the enactment of specific legislation in 2005. Section 117 of the 2005 Energy and Water Development Appropriations Act allowed projects constructed under that authority to be funded at full Federal expense and did not require that those projects be justified by using the traditional benefit-cost ratio test.[3] In the 2009 Omnibus Appropriations Act, the U.S. Congress repealed Section 117.[4]

Under Section 117, the Corps was authorized to investigate erosion at Barrow, Bethel, Kaktovik, Kivalina, Koyukuk, Newtok, Point Hope, and Shishmaref. Projects were approved for construction at Kivalina, Newtok, Shishmaref, and Unalakleet. Significant construction has occurred at Kivalina and Shishmaref to provide revetments that are slowing the rates of erosion. Because of the repeal of Section 117, it is unknown whether those projects can be completed as planned.

2.3.2. Natural Resources Conservation Service

NRCS is the only Federal agency other than the Corps that has specific programs to address erosion issues for communities. In recent years, NRCS has had several erosion-related projects in Alaska. The following three items are recent examples:

- **Kongiganak.** Approximately 1,000 linear feet of bank stabilization is being constructed using imported rock riprap. The purpose is to directly protect village

[3] Consolidated Appropriations Act, 2005, PL 108-447, Division C - Energy and Water Development and Related Agencies Appropriations Act, 2005, Section 117.

[4] Omnibus Appropriations Act, 2009, PL 11-8, Division C - Energy and Water Development and Related Agencies Appropriations Act, 2009, General Provisions, Corps of Engineers Civil, Section 117.

infrastructure threatened by erosion. This project, with an estimated cost of $4.6 million, is funded through the Emergency Watershed Protection (EWP) program administered by NRCS.

- **McGrath.** Severe erosion had caused major damage to a portion of the levee that protects a large part of McGrath from flooding. A project repaired the levee and used rock riprap to armor the bank and protect the levee from future damage. Total project length is approximately 1,100 feet. This 2009 project was EWP-funded, at an estimated cost of $4.2 million.

- **Nenana.** In a cooperative effort among the BIA, the Village of Nenana, and NRCS, NRCS designed a series of stream barbs to stabilize approximately 3,000 feet of the Tanana River bank at Nenana. This project was funded by the BIA. The NRCS contribution was technical design and assistance with construction inspection. Although the cost of this 2009 project is not available, NRCS reports the expense was much smaller than for the two examples above.

2.4. Collaborative Efforts to Manage Erosion

A discrete erosion project, such as a revetment, at a single community often is managed by a single agency in partnership with the community. As projects become more complex and expand beyond the scope of one agency's programs, a collaborative approach among several entities is required. Two recent successes of this type are the Newtok Planning Group and the IAWG. In both groups, Federal, State, Tribal, and local officials are working to develop plans to address issues that are beyond the scope of any one agency's mission.

2.4.1. Newtok Planning Group

Members of the Newtok Planning Group, which is chaired by the DCCED Division of Community and Regional Affairs (DCCED-DCRA), include the Corps, ADOT&PF, the Denali Commission, the Newtok Tribal Council, the United States Navy, the United States Marine Corps, and several other entities.

This group is working to develop and implement plans to relocate Newtok because of rapid erosion and flooding. The collaborative approach is allowing the strengths of individual agencies to address certain aspects of the relocation while avoiding cross-purposes and duplication of effort. The Newtok Planning Group has developed a variety of tasks:

- A $1 million project, being conducted under a 2006 EDA construction grant, is relocating the community's barge ramp, dock, and related utilities. ADOT&PF, in conjunction with an Innovative Readiness Training exercise for the Navy and the Marine Corps, is developing a road from the barge landing to the new community site. This road will allow supplies and heavy equipment to be delivered to the new site.

- The Corps is designing an access road and emergency shelter. The access road will start at the barge landing and extend at least to the emergency shelter at the new village location. The shelter is being constructed as a standalone facility for use if quick abandonment of residences at the current site is needed. The shelter also will

serve as a community building as the new site develops, perhaps being used as a temporary school, post office, or other public building.

- Other plans include investigation of alternative energy windmills in conjunction with the Alaska Energy Authority and constructing a new fishing support facility using the Coastal Villages Regional Fund.

2.4.2. Immediate Action Working Group

Most recently, a collaborative effort, a component of which is examining erosion issues, has developed to address climate change and erosion resulting from climate change within Alaska. The IAWG consists of senior leaders from several State and Federal agencies and is co-chaired by the DCCED Deputy Commissioner and the Chief of Engineering Division of the Corps Alaska District.

Primarily focusing on Kivalina, Koyukuk, Newtok, Shaktoolik, Shishmaref, and Unalakleet, IAWG is recommending a series of actions to assist communities with managing the effects of climate change. IAWG will publish a report in April 2009 that will explain its accomplishments and discuss the need for future actions. The report will include accomplishments and plans of ADOT&PF, DHS, DCCED, NOAA, the Corps, and others.

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3.0 STUDY DEVELOPMENT AND COMMUNITY RISK RATING

The BEA was developed in accordance with the requirements of the authorizing legislation. The study focused on the three main activities of coordination, planning, and prioritization, following the authorization framework as follows:

- Significant coordination with Federal, State, Tribal, and local stakeholders to determine which communities are experiencing erosion and the extent of the problems
- Development and implementation of the BEA planning process
- Development of a process to prioritize responses to erosion issues

The BEA team developed a systematic approach to assess erosion issues. The approach included (1) identifying communities with erosion problems, (2) determining how to investigate the problems, (3) documenting the problems, and (4) developing and using a rating system to estimate erosion risk so that the communities could be grouped into categories of priority for receiving assistance.

This section discusses coordination efforts and the assessment process, including the estimation of erosion risk in individual communities. The grouping of communities by priority of need resulted in community designations of (1) Priority Action, (2) Monitor Conditions, and (3) Minimal Erosion, as described in Section 4.0.

3.1. Identification of Affected Communities

Most communities in Alaska are adjacent to a body of water and potentially subject to erosion forces. Therefore, the first task of the BEA was to assemble a list of communities with a perceived erosion problem, regardless of magnitude. To accomplish this task, a Technical Committee was formed; many coordination meetings were held; and, during the course of the study, several hundred letters as well as survey questionnaires approved by the Federal Office of Management and Budget were sent to Federal, State, Tribal, and local officials to seek input and obtain project updates.

3.1.1. Technical Committee

The Corps worked with DCCED-DCRA to identify key Federal, State, Tribal, and local entities best suited to sit on the BEA Technical Committee. The role of the committee was to provide input, review, and guidance as the BEA progressed and to bring a statewide perspective to the study process.

DCCED-DCRA is the State agency that oversees floodplain management. This agency has long been a strong supporter and leader in addressing erosion and was chosen to act as the lead non-Federal entity or “sponsor.” Through DCCED-DCRA involvement and its intimate knowledge of erosion and flooding issues in Alaska, the BEA study team gained a strong foundation of knowledge. Representatives from the Alaska Inter-Tribal Council and the Alaska Federation of Natives participated on the Technical Committee to provide Native perspectives on erosion problems.

The Technical Committee's greatest contributions were (1) identifying communities with erosion issues, (2) reviewing study criteria, and (3) ensuring that the concerns of the State, Tribes, and communities and were being heard.

Technical Committee participants included the Corps and the following entities.

DCCED-DCRA

Alaska Department of Military and Veterans Affairs, Division of Homeland Security and Emergency

Alaska Department of Natural Resources

ADOT&PF

Alaska Federation of Natives

Alaska Inter-Tribal Council

Alaska Native Tribal Health Consortium

Alaska State Senate Aides

Denali Commission

Kawerak, Inc.

Inuit Circumpolar Council-Alaska

National Weather Service

U.S. Fish and Wildlife Service

U.S. Geological Survey

U.S. Senate Aides

3.1.2. Regional Outreach, Alaska Native Tribes, and Community Coordination

After formation of the Technical Committee, the next step in identifying communities was to communicate with the Boroughs and regional Native corporations of Alaska by letter. By contacting these groups, the BEA study team gained a regional perspective, identifying additional community erosion issues that were not well known. This approach allowed information and data developed by these organizations to be incorporated into the BEA process. In addition, through enlisting the support and input of regional stakeholders, the Corps gained assurance that all communities were being represented and being treated fairly.

To ensure appropriate coordination with the Alaska Native Tribes and rural communities, various letters were sent to Tribes and communities. An initial letter was sent to each Tribe and community, informing them about the study and asking for input. For many rural communities, a second letter was sent—one to the mayor and another to Tribal leadership. Additional letters were sent on multiple occasions to keep Tribal stakeholders informed of the study's progress. Correspondence included surveys to gather information about erosion.

3.1.3. Identification of Communities with Erosion Issues

The coordinated study effort identified dozens of communities throughout Alaska where erosion was believed to be causing negative impacts. In addition, past project files were reviewed to ensure that any community that had been in contact with the Corps about erosion concerns was on the list. In total, 178 communities were identified as having erosion problems. Table 3-1 lists those communities; Figure 3-1 shows their locations.

Table 3-1. Communities Identified as Having Erosion Issues

Akhiok	Eagle	Koyukuk	Port Alsworth
Akiachak	Eek	Kwethluk	Port Heiden
Akiak	Egegik	Kwigillingok	Port Lions
Alakanuk	Ekuk	Larsen Bay	Portage
Alatna	Ekwok	Levelock	Red Devil

Table 3-1. Communities Identified as Having Erosion Issues

Aleknagik	Elim	Lime Village	Russian Mission
Allakaket	Emmonak	Lower Kalskag	Saint Michael
Ambler	Evansville	Manley Hot Springs	Saint Paul
Anchor Point	Fairbanks	Mary's Igloo	Salcha
Angoon	False Pass	McCarthy	Sand Point
Aniak	Fort Yukon	McGrath	Savoonga
Anvik	Fox	Mekoryuk	Selawik
Atmautluak	Gakona	Metlakatla	Seward
Barrow	Galena	Municipality of Anchorage	Shageluk
Bethel	Gambell	Nanwalek	Shaktoolik
Bettles	Girdwood	Napakiak	Shishmaref
Big Delta	Golovin	Napaskiak	Sitka
Birch Creek	Grayling	Nelson Lagoon	Skagway
Brevig Mission	Gulkana	Nenana	Skwentna
Buckland	Gustavus	New Stuyahok	Sleetmute
Butte	Haines	Newtok	Soldotna
Cantwell	Holy Cross	Nightmute	South Naknek
Central	Homer	Ninilchik	Stebbins
Chalkyitsik	Hooper Bay	Noatak	Susitna
Chefornak	Hughes	Nome	Sutton-Alpine
Chevak	Huslia	Nondalton	Talkeetna
Chignik Bay	Hyder	Noorvik	Tazlina
Chignik Lagoon	Igiugig	Northway	Teller
Chignik Lake	Iliamna	Northway Village	Togiak
Chiniak	Ivanof Bay	Nuiqsut	Toksook Bay
Chistochina	Juneau-Douglas	Nulato	Tuntutuliak
Chitna	Kaktovik	Nunam Iqua	Tununak
Chuathbaluk	Kaltag	Nunapitchuk	Ugashik
Circle	Karluk	Old Harbor	Unalakleet
Circle View- Stampede Estates	Kenai	Oscarville	Upper Chena
Clark's Point	Kiana	Ouzinkie	Upper Kalskag
Coldfoot	King Cove	Palmer	Wainwright
Copper Center	King Island	Pedro Bay	Wasilla
Cordova/Eyak	Kipnuk	Perryville	Wiseman
Council	Kivalina	Pile Bay-Williamsport	Valdez
Crooked Creek	Kokhanok	Pilot Point	Venetie
Deering	Kongiganak	Point Hope	Wales
Delta Junction	Kotlik	Point Lay	Willow
Dillingham	Kotzebue	Port Graham	Yakutat
Diomede	Koyuk		

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Erosion can occur at the interface of land and water.

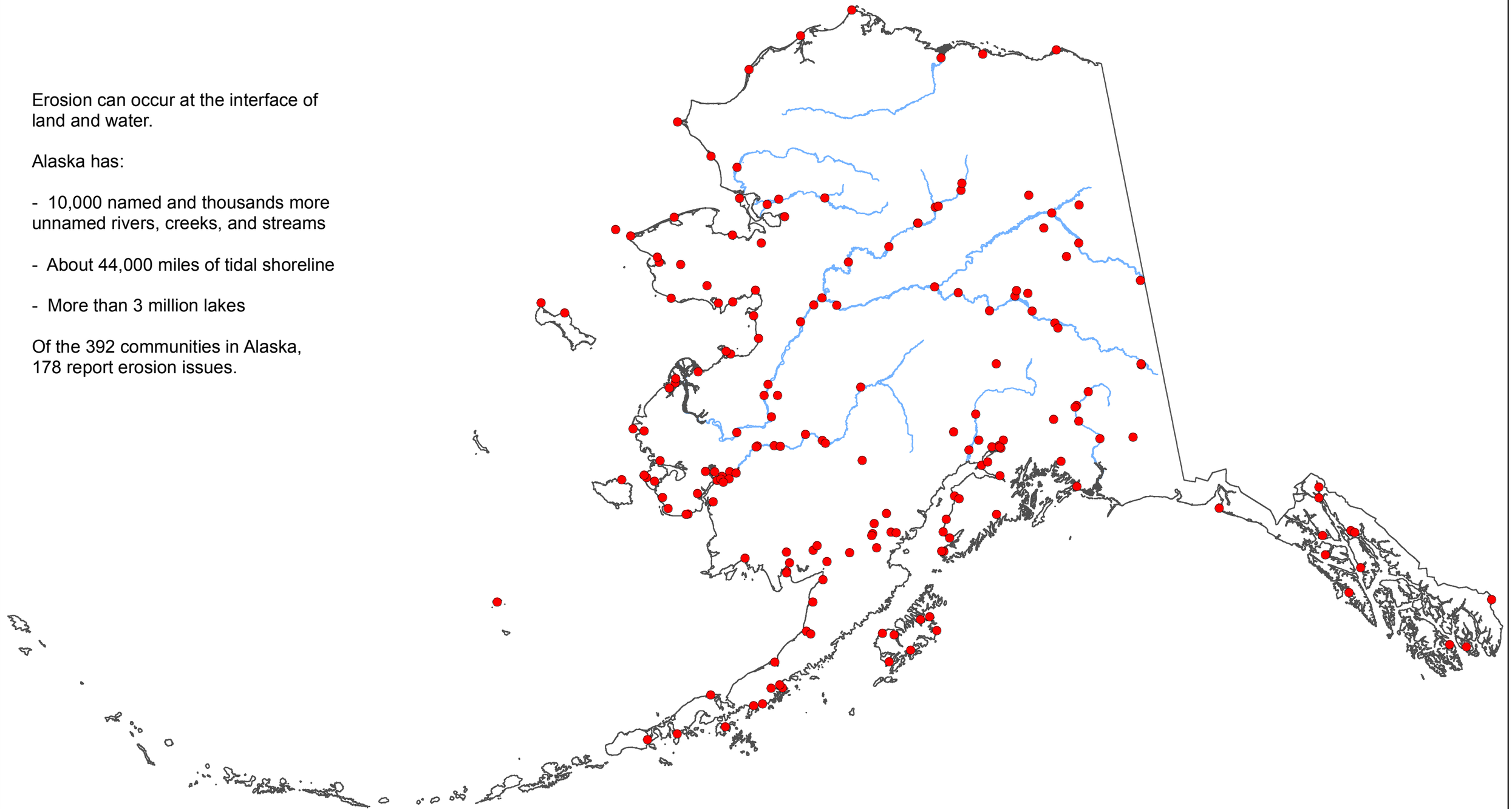
Alaska has:

- 10,000 named and thousands more unnamed rivers, creeks, and streams

- About 44,000 miles of tidal shoreline

- More than 3 million lakes

Of the 392 communities in Alaska, 178 report erosion issues.



Alaska District
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Civil Works Branch

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Date Prepared: March 24, 2009

Figure 3-1

Communities with Erosion Concerns

3.1.4. Findings from Analysis of Community Surveys

Analysis of the surveys used to gather information yielded certain trends and similarities.

- A majority of the communities (68 of the 127 that completed the survey) indicated they experience river or stream erosion. Twenty-two said they experience coastline erosion, while 28 indicated a combination of both kinds of erosion. Most respondents (71 of 96 communities who said they experience river or stream erosion or both river and stream and coastline erosion) indicated that flooding was the major cause of the river or stream erosion in their community, with river flow and ice jams close second.

  Fifty of the 127 communities surveyed indicated that they experience coastline erosion or both coastline and river or stream erosion. Communities experiencing coastline erosion (47 of 48 communities who responded to a secondary question about the causes for their coastline erosion) attributed the cause most often to storm surges. Wind, waves, and high tides were the next-most-frequent erosion cause that was cited.

- Twenty-five percent of the 127 communities surveyed indicated that erosion is gradual and ongoing, as opposed to discrete events (19 percent), and 17 percent said they experience both kinds. Thirty-nine percent of respondents were unable to answer this question, highlighting the difficulty of describing the kinds of problems these communities experience.

  Most communities indicated that they have used some type of fill material to control erosion. Examples mentioned frequently include fill, concrete blocks, 55-gallon drums, dikes, and tree branches. A measure mentioned less frequently was beach nourishment. Few surveyed communities had funding for more permanent structures.

- Forty-four communities indicated that protective measures had been effective. Twenty-three said there had been a failure. However, 14 communities responding that the erosion protection measure had been effective also indicated that there had been a failure. Notes on the surveys indicate that many communities think the erosion protection was beneficial in slowing erosion to some extent, but was not fully effective in stopping it. Several additional communities commented that, where the erosion protection measure had been implemented, it was effective in reducing erosion. However, the protective measure covered an area that was too small to provide adequate protection on a larger scale; therefore, the communities deemed that protection a failure. The causes of failure were not stated explicitly.

A more comprehensive analysis of the survey results is in Appendix A.

3.2. Assessing Community Erosion Issues

This section explains the procedures used to collect erosion information and to document the resulting information in DEAs and EIPs.

3.2.1. Erosion Information Papers and Detailed Erosion Assessments

Two types of reports, DEAs and EIPs, were developed to document erosion problems by community. The team used information in the DEAs and EIPs for assessing the erosion and rating individual community risk. These documents are provided in Attachment 1 and Appendices C through F.

A critical component for good planning is to conduct a detailed, onsite assessment of the erosion problem. From the beginning of the BEA effort, it was apparent that communities with reported erosion problems were too numerous for the study team to investigate each in a detailed manner. However, each community deserved adequate consideration, and the study team developed a process to investigate erosion onsite in many communities and offsite for those that could not be visited. DEAs were prepared for communities the team visited; EIPs were prepared for all other communities.

Detailed Erosion Assessments

The study team selected a group of communities to be visited, based on relative proximity to each other and because the Corps had not investigated erosion issues in those areas recently. A group of Lower Kuskokwim Delta communities was selected: Akiak, Alakanuk, Aniak, Kalskag, Kipnuk, Kongiganak, Kwethluk, Kwigillingok, Napakiak, Napaskiak, and Tuntutuliak. The Norton Sound community of Shaktoolik was added later, after it was identified as having a serious erosion issue.

In all, 13 detailed assessments were completed in 12 communities (Kalskag was split into two: one for Upper Kalskag and the other for Lower Kalskag).

The DEAs are roughly commensurate with typical Corps reconnaissance investigations. Compared with EIPs, they explain in greater detail the causes of erosion, rates of erosion, potential for damages, and potential solutions. The DEAs include diagrams showing the predicted bank lines for 10, 30, and 50 years in the future. The teams were able to photo-catalog the erosion problems and provide detailed descriptions of the riverine or coastal dynamics that contribute to the erosion. For each DEA, a potential solution was developed that explains what solution(s) might be effective and the potential costs.

The DEAs do not make recommendations for future Corps action; however, they do identify the appropriate programs under which communities can request assistance to address erosion. If the community wishes to use other programs, the DEAs can be used to develop funding strategies.

- DEAs are provided in hardcopy in Attachment 1 (Priority Action Communities only) and electronically in Appendix F (all communities for which DEAs were prepared).

Erosion Information Papers

EIPs were developed for the communities not visited for detailed assessment. The EIP development process was based on (1) telephone interviews that used a survey questionnaire, (2) the DCCED-DCRA Community Profile database, and (3) information in existing Corps files.

An EIP typically consists of two pages of text that describe the community setting, erosion problem, and potential damages. An additional page was added if the community had photos

of the erosion situation. For each EIP, a diagram was created from the most recent aerial photograph to show what the community had reported as the linear extent of erosion.

The EIPs are not intended to provide decisionmakers with enough information to decide whether to implement specific projects. Their purposes are to provide (1) an overall, current picture of a community's erosion problem and (2) an indication of a community's need for further investigation and, in some cases, the need for project construction.

- EIPs for Priority Action Communities are provided in hardcopy in Attachment 1 and electronically in Appendix C. EIPs for Monitor Conditions and Minimal Erosion Communities are provided electronically in Appendices D and E, respectively.

3.3. Rating Community Risk

Section 3.1.4 summarizes trends and commonalities discovered during the analysis of the collected community erosion information. The prioritization discussed in Section 4.0 was based on risk ratings developed for the affected communities. Section 3.3.1 explains the criteria and process used in deriving these risk ratings.

3.3.1. Risk Rating Process

Before prioritization of need could be determined, was necessary to estimate erosion risk for each community. The Corps BEA team worked with representatives from the State of Alaska to develop risk ratings. The study team and DCCED-DCRA staff participated in a workshop to develop risk criteria against which communities would be assessed. This group identified criteria for ranking the relative severity of expected erosion damages across communities.

The selected criteria were Critical Infrastructure, Human Health and Safety, Subsistence and Shoreline Use, Community Setting/Geographic Location, Housing and Population Affected, Housing in Parallel, Environmental Hazard, Cultural Importance, and Commercial/ Non-Residential. In all cases, the criteria were applied to situations that were observed or reported and to situations that reasonably could be expected to occur in the future.

The assessment team used information in the DEAs and EIPs for assessing the erosion issues. Having the most current aerial photograph for each community proved to be the most important feature of the EIPs and DEAs, allowing the team to determine how close critical infrastructure was to the waterline. Estimated erosion rates provided by the communities allowed the team to estimate times until damage could occur.

Each community's risk rating was derived using a mathematical process. That process is outlined here. A more complete description is in Appendix B.

Criteria Weighting Factors

Each of the nine ranking **criteria** was assigned a **weighting factor** representing its relative importance:

- 1 for important
- 2 for more important
- 3 for most important

Calculation of Community Risk Rating

Step 1. For each community, the BEA team assessed erosion information and assigned a **risk ranking** to the community for each criterion:

- 1 for low risk
- 2 for medium risk
- 3 for high risk

Step 2. For each community, the **risk ranking** (**Step 1**) was multiplied by the **weighting factor** for each criterion, and the results for all nine criteria were totaled.

Step 3. For each community, the **total** from **Step 2** was multiplied by a **time factor**:

- 1 if damage is expected to occur no sooner than 20 years in the future
- 2 if damage is expected in 10 and 20 years
- 3 if damage is expected within 10 years

Step 4. Uncertainty factors were applied to the results from **Step 3.**

- If the erosion information was well documented, the uncertainty factor was not applied, and the community score did not change.
- If there was uncertainly about the quality of data, severity of risk, or time when damage might occur, the community score was increased by a statistical factor. As degrees of uncertainly increased, higher statistical factors were used.

Step 5. Each community was assigned a **risk rating** score that was the total of applying **Steps 1 through 4.**

Example

If a community had medium risk (2) for Critical Infrastructure, the community would have an initial **risk ranking** of 2 for that criterion. The 2 would be multiplied by the criteria's **weighting factor**, 3, for a result of 6.

If the **risk ranking** results for the same community for all criteria totaled 30 and damages were expected to occur within the next 10 years, 30 would be multiplied by a **time factor** of 3, for a result of 90.

The cumulative result for that community was subject to an **uncertainty factor**, as described above, and the community was assigned a final **risk rating** score.

A statistical analysis of the community risk ratings showed that they could be grouped in three priority levels, as discussed in Section 4.0.

The following items briefly explain the criteria that were used in the risk rating process:

- **Critical Infrastructure**. Critical infrastructure includes facilities in the community that, if destroyed, would affect the community's ability to survive if not replaced quickly. Examples include schools, power plants, water supply, and airports.

- **Human Health and Safety.** The health and safety criterion focuses on a community's ability to seek emergency services during a storm. For example, if a road exists connecting a community to emergency services, or if the airport is or could be jeopardized, the community ranked high on this criterion. Similarly, if erosion itself would threaten human life during a storm event, the community ranked high on this criterion.
- **Subsistence and Shoreline Use.** This criterion examines whether the community's ability to gather natural resources is jeopardized. For example, if the community has lost the ability to launch boats or the only land available for processing catch, the community ranked high on this criterion.
- **Community Setting/Geographic Location.** This criterion focuses on whether a community has room to retreat from the source of erosion, whether the land is highly susceptible to erosion, and the community's relative importance to surrounding communities. For example, a community situated on a spit of land with no room to retreat was ranked high on this criterion. A community on a bluff with adequate high ground to adjust community layout ranked low. If the community is a hub providing goods and services to other communities, it ranked higher on this criterion.
- **Housing and Population Affected.** The higher the percentage of population that is or could be affected by erosion, the higher the community ranked on this criterion.
- **Housing in Parallel.** This criterion ranked how the community housing is laid out. If the entire community is near the source of the erosion, it ranked high on this criterion. Conversely, a spread-out community with a small percentage of housing subject to erosion did not show risk for this criterion.
- **Environmental Hazard.** This criterion addresses hazardous waste. If a community is in danger of losing a fuel tank, landfill, or something else, the loss of which would cause significant contamination, the community ranked high on this criterion.
- **Cultural Importance.** The majority of communities investigated have an Alaska Native Tribe within the community or nearby. This criterion was included to measure erosion-related impacts to historically and culturally significant sites such as cemeteries and buried artifacts.
- **Commercial/Non-Residential.** This criterion measures the impact of erosion on the commercial services in the community and the ways in which the community would be affected as erosion progresses.

Table 3-2 provides additional detail about the criteria and the relative weights used in the risk ranking process.

Table 3-2. Rating Criteria for Severity of Existing or Potential Erosion Damage in Affected Communities

Criterion	Weight	Impact Level	Multiplier	Ranking Criteria
Critical Infrastructure (for example, school, utilities, transportation)	3	Low	1	One item of critical community infrastructure is at risk. Loss of infrastructure has not resulted in, or would not result in, loss of community sustainability. Damage could be repaired or alternative service restored in less than 1 month.
		Medium	2	More than one item of critical community infrastructure is at risk. Loss of infrastructure has not resulted in, or would not result in, loss of community sustainability. Damage could be repaired or alternative service restored in 1 to 6 months.
		High	3	More than one item of critical community infrastructure is at risk. Loss has affected or could affect community sustainability. Repair or establishment of alternative service would take more than 6 months.
Human Health and Safety	3	Low	1	Situations that are causing or would cause life safety concerns or negatively affect ability to provide emergency services are not likely. Ingress/egress to/from community is not at risk. The community has the ability to mitigate or avoid life safety concerns.
		Medium	2	Only rare events are threatening or would threaten life safety. Access to or from the community by land or airport is threatened. Quick and easy access to emergency services is available.
		High	3	Existing or potential erosion damage is expected to result in human health and safety concerns. Critical health/safety services facility is at risk. Portions or all of the population are or could be cut off from emergency services. Air and/or road access is at great risk or is or could become impassable to all or a portion of community.

Table 3-2. Rating Criteria for Severity of Existing or Potential Erosion Damage

Criterion	Weight	Impact Level	Multiplier	Ranking Criteria
Subsistence and Shoreline Use	2	Low	1	Minor and temporary interruptions exist or could occur that are a nuisance but can be corrected in the same year. Damage can be repaired locally: for example, damage affecting boat launch access each spring. Access is or could be altered, but the alteration is or would not be of substantial consequence or inconvenience.
		Medium	2	Frequent loss or disruption of access to subsistence or damage to important shoreline uses is occurring or could occur. Structural mitigation of risk is a practicable solution but could disrupt high-value traditional use and access areas. Critical habitat and/or use areas are at mild to moderate risk; traditional practices are or could be inconvenienced but not disrupted.
		High	3	Interruptions are or could be severe enough to affect supply on a continual basis. Critical habitat and/or use areas are or could be severely threatened; traditional practices are limited to focusing on survival. Structural mitigation of risk is possible but could eliminate or harm vital subsistence/shoreline use area.
Community Setting/ Geographic Location	1	Low	1	Land is readily available in erosion-free zones for new development or relocations. Soils and hydrology/hydraulic conditions are not conducive to erosion; aggregate resources are available locally if erosion protective measures are needed. Land use controls are in place and/or safe land area between shoreline and development exists.
		Medium	2	Lands in erosion-free zones are limited, precluding new development or relocations into safe areas. Soils and hydrologic/hydraulic conditions are conducive to erosion. There is limited distance between shoreline and development, but safe zones are available and some local resources exist to assist with mitigating the problem.
		High	3	High erosion rates and flooding are occurring or could occur. Poor soils are conducive to erosion; permafrost melt could result in added impact. There are no or limited safe land areas to which structures could be moved; the community is on barrier islands or a spit. The community is a hub of goods/services supporting other communities in the region or subregion.

Table 3-2. Rating Criteria for Severity of Existing or Potential Erosion Damage

Criterion	Weight	Impact Level	Multiplier	Ranking Criteria
Housing and Population	1	Low	1	Less than 10 percent of population/housing is or could be affected. Alternative housing is available.
		Medium	2	10 to 25 percent of population/housing is or could be affected. Alternative housing is available but limited.
		High Impact	3	More than 25% of population/housing is or could be affected. Limited to no alternative housing is available.
Housing in Parallel	2	Low	1	Only a few waterfront structures and limited associated infrastructure are at risk (one-time loss).
		Medium	2	There are multiple rows of structures parallel to the waterfront, and limited associated infrastructure improvements are at risk (expected future recurrence of damages).
		High	3	There are multiple rows of structures parallel to the waterfront, and extensive associated infrastructure improvements are at risk (higher level of expected future recurrence of damages).
Environmental Hazard (for example, landfills, sewer lines, sewage lagoons, fuel tanks)	3	Low	1	A minor issue exists that can be easily addressed at the time of damage. Impact can be addressed locally.
		Medium	2	A moderate environmental effect has occurred or could occur that will require limited intervention by an external agency for a limited period.
		High	3	A large issue exists that will require extensive intervention by one or more external agencies for an extended period. Damage or loss will affect the entire population or a high percentage of the population; for example, contamination of water supply. Erosion is causing environmental impact(s) that is long-term and/or affects other communities or the region (for example, hazardous substances, fuel facilities, or landfills eroding into an anadromous stream).

Table 3-2. Rating Criteria for Severity of Existing or Potential Erosion Damage

Criterion	Weight	Impact Level	Multiplier	Ranking Criteria
Cultural Importance	1	Low	1	There is or could be minor or temporary disruption in cultural/traditional activities, with no lingering negative impacts. There is or could be minimal expected damage to known cultural and historic resources.
		Medium	2	Intervention is or could be required for community to continue with cultural/traditional activities. Some cultural resources are being or could be lost, but rarely without appropriate records being taken to catalog them.
		High	3	Cultural resources are being or could be lost at a high rate, with little or no ability to catalog and record them. Traditional practices are being or could be abandoned to focus solely on life safety and survival.
Commercial/ Non-residential	2	Low	1	Existing or potential impacts have no or little affect on overall community cash flow. There is or would be little and only temporary impact to a community's ability to operate its commercial facilities with minor interruptions. Little or no exterior financial support is or would be necessary to re-establish full capacity.
		Medium	2	Impacts are having or would have moderate impact on overall community cash flow. Impacts to a community's commercial infrastructure require or would require significant external assistance to come back to full capacity. Loss of commercial infrastructure can be handled at an alternative site or location (such as a second local store or other commercial/public dock facility).
		High	3	Impacts are having or would have severe, dramatic effects on the cash flow of a community. The ability to operate the commercial sector for the community is or could be affected severely. Loss of commercial infrastructure is affecting or could affect the entire community (for example, the loss of a single store, with no replacement facilities); or, ability to gather materials or have goods and services brought in is or could be no longer possible (for example, a commercial dock is destroyed with no replacement or alternate facilities).

Note: The weights and multipliers in this table were used to calculate risk rankings for each community for each criterion, deriving values that were then used to develop an overall erosion risk rating for each community and to prioritize the communities in three groups according to severity of risk.

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4.0 COMMUNITY PRIORITIZATON

This section documents the process used to prioritize affected communities according to the level of erosion concern or risk. Results of the prioritization are provided in Sections 4.2, 4.3, and 4.4. Specific problems are identified for Priority Action Communities.

4.1. Priority Category Development

After establishing risk ratings for the 162 communities as discussed in Section 3.3.1, the BEA team grouped them in three categories, according to the level of erosion concern or risk being experienced or expected in the future. The categories were designed to allow decisionmakers to determine where resources should be focused and were defined as follows:

- **Priority Action.** Erosion is threatening the viability of the community, significant resources are being expended to minimize such threats, or both conditions are present.
- **Monitor Conditions.** There are significant impacts related to erosion, but those impacts are not likely to affect the viability of the community.
- **Minimal Erosion.** In general, erosion impacts are not serious and are not affecting the viability of the community.

To develop these categories, a statistical analysis was conducted on the list of community risk ratings to determine the mean and the standard deviation. Ratings approximately one deviation above the mean showed a tendency to increase quickly. Conversely, at about one deviation below the mean, the decrease in ratings was flattened. The breakpoints at about one deviation above and one deviation below the mean became the points of differentiation among the three prioritization categories.

The prioritization categories also were used to group the EIPs and DEAs provided in Attachment 1 and Appendices C through F:

- **Attachment 1 –** EIPs and DEAs for Priority Action Communities
- **Appendix C –** EIPs for Priority Action Communities
- **Appendix D –** EIPs for Monitor Conditions Communities
- **Appendix E –** EIPs for Minimal Erosion Communities
- **Appendix F –** DEAs

4.2. Priority Action Communities

A Priority Action Community has reported erosion threatening community viability, significant resources are being expended to minimize the threats, or both conditions are present. The erosion issue likely warrants immediate and substantial Federal, State, or other intervention. Priority Action Communities should be considered for immediate action in either initiating an investigation or continuing with ongoing efforts to manage erosion.

The 26 communities designated “Priority Action” are identified in Table 4-1. Figure 4-1 shows their locations.

- DEAs and EIPs for the respective communities are provided in hardcopy in Attachment 1 and electronically in Appendix C (Priority Action Communities for which EIPs were developed) or Appendix F (communities for which DEAs were developed).

Table 4-1. Priority Action Communities (26 Communities)

Akiak[a]	Dillingham	Newtok
Alakanuk[a]	Golovin	Nunapitchuk
Barrow	Huslia	Port Heiden
Chefornak	Kivalina	Saint Michael
Chevak	Kotlik	Selawik
Clark's Point	Kwigillingok[a]	Shaktoolik[a]
Cordova/Eyak	Lime Village	Shishmaref
Emmonak	McGrath	Unalakleet
Deering	Napakiak[a]	

[a]Community for which a Detailed Erosion Assessment was developed (Appendix F).

The following items summarize erosion conditions in Priority Action Communities.

- **Akiak** is subject to erosion from the Kuskokwim River. Concerns are associated mostly with erosion at the upstream end of the community, affecting the cemetery and old, adjacent fuel tanks. Ongoing erosion has increased the risk of fuel tanks falling into the river and polluting the waterway. At least six homes are near the bank in the fastest-eroding area.
- **Alakanuk** is at the entrance to Alakanuk Pass, a major southern channel for the Yukon River. The most serious erosion problems are at a large scour hole along the riverbank at the midpoint of the community. Too deep to fill, the scour area threatens several homes, community buildings, and a wide range of utilities. The community received grants to relocate residences: 14 were relocated in 1999 and 6 in 2006.
- **Barrow** experiences coastline erosion from the Chukchi Sea. Erosion averages just above 1 foot per year, but a single storm can cause more extensive losses up to 35 feet inland. Erosion has been aggravated by harvesting of beach materials, and by coastal ice forming later in recent years than it had in the past—historically, coastal ice has acted as natural erosion protection, and the community is now more susceptible to erosion from storms for a longer period. The main road along the coast and archeological sites are the areas of greatest erosion concern. Coastal flooding is also a significant issue. Many erosion protection measures are being implemented at great expense. If these measures were not being taken, many structures and critical infrastructure would incur damages within the next 10 years.

A Priority Action Community has reported erosion threatening the viability of the community and/or significant resources are being expended to minimize threats to the community's viability. The erosion issue likely warrants immediate and substantial Federal, State, or other intervention. Priority Action Communities should be considered for immediate action in either initiating an investigation or continuing with ongoing efforts to manage erosion issues.

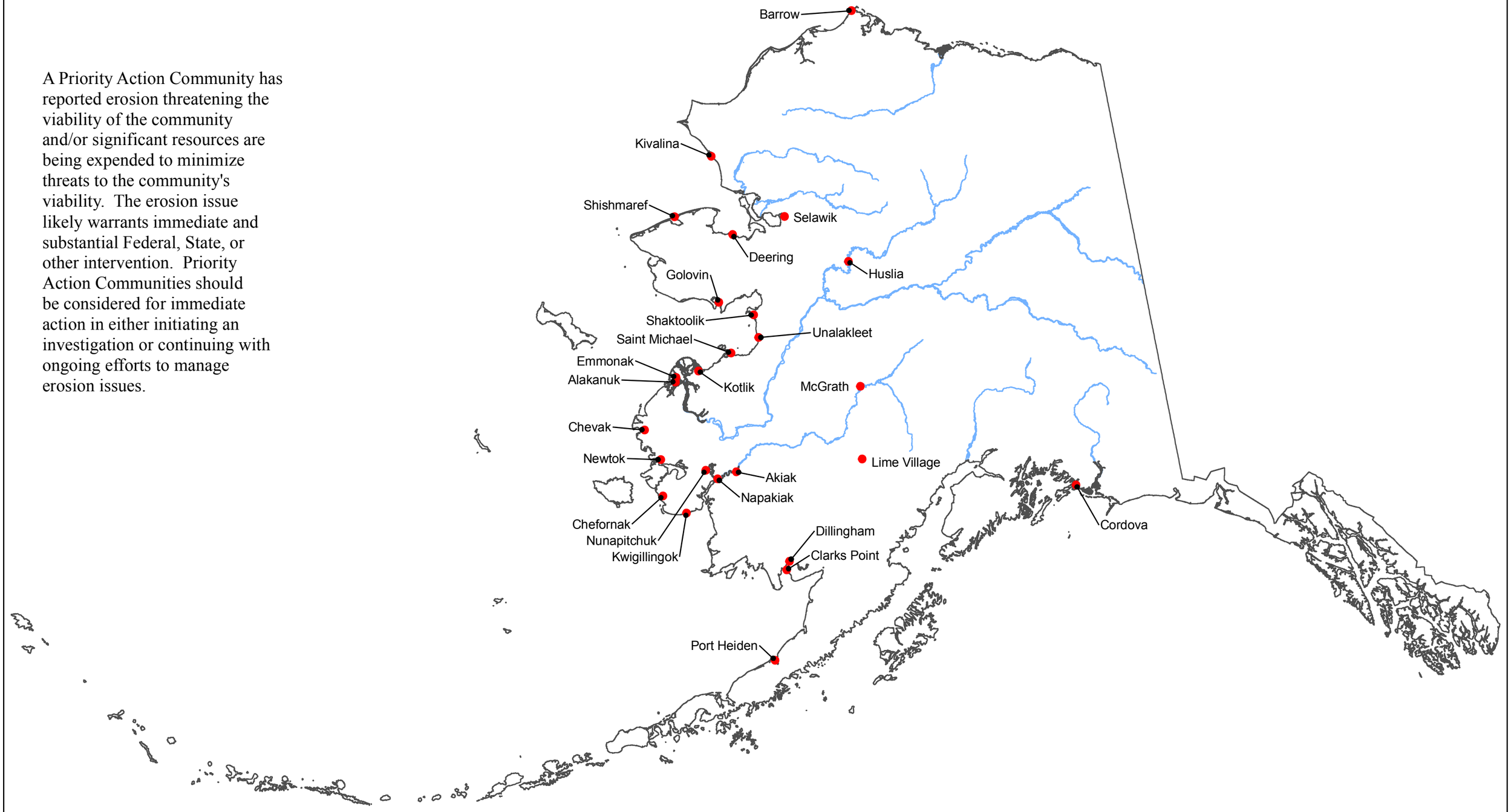

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Figure 4-1

Priority Action Communities

- **Chefornak** experiences coastal and riverine erosion, with the shoreline eroding at 2 to 6 feet per year along a length of approximately 200 linear feet. The community considers risk to structures critical. Structures at risk include homes, fuel tanks, the road, utility poles and lines, and the school. The primary cause of erosion appears to be removal of fine-grained materials from the riverbank through groundwater discharge into the river. Once these materials are lost, tundra collapses, jeopardizing any structure supported. Protection measures have been implemented with some success, but damage is expected in less than 10 years.

- At **Chevak,** riverine erosion averages 5 to 10 feet per year, threatening several structures, including residences, utility lines, the barge landing, and a road that links the village to the barge landing. Damage is expected in less than 10 years.

- Coastal and riverine processes along Nushagak Bay and Nushagak River are the cause of erosion in **Clark's Point**. Contributing conditions include flooding, spring breakup, high tides, and wind and wave action from the north, west, and south. South-southwest waves can reach approximately 14 feet in height. The older portion of Clark's Point, situated on a gravel spit, is particularly vulnerable to storms with intense southwest winds. Long-term erosion has been estimated at 2 to 4 feet per year.

- Persistent flooding and erosion in **Cordova/Eyak** is caused by inflows of Scott River into Eyak River. In recent years, the Scott River has moved across its delta toward and into the Eyak River at two breaches within 600 feet of each other, about 1.5 miles downstream of the Copper River Highway. Residences, outbuildings and sheds, water tanks and lines, fuel tanks, food storage, drying racks, smoke houses, boat launches, sewer lines, cultural and archeological sites, the Eyak Lake airport, and the city's solid waste processor are threatened.

- **Deering** experiences coastal and riverine erosion aggravated by its location on a sand and gravel spit. Approximately 3,000 feet of shoreline is affected at a rate of 3 feet per year. Structures at risk include homes, water tanks/lines, roads, utility poles, the school, a clinic, and a church, among others—with some structures within 50 feet of the eroding bank. Some protection measures have been implemented, but damage is expected within 10 to 20 years.

- **Dillingham** experiences riverine erosion aggravated by storm activity. Protection measures are in place and some relocation efforts have occurred. Erosion is considered contained, with the exception of areas by the harbor that are experiencing 10 feet of erosion per year. The viability of the small boat harbor and a regional fuel depot are threatened.

- **Emmonak** suffers from coastal and riverine erosion, typically in discrete, major events associated with spring flooding. Erosion rates are 2 to 25 feet per year, with the main road to the airport, utility lines, landfill, and other structures at risk. An offshore island that provides some protection from erosion is eroding—if that island disintegrates, the erosion rate in Emmonak is expected to increase.

- **Golovin** experiences coastal and riverine erosion at an average annual rate of 2 to 4 feet along 2,400 linear feet of shoreline. Erosion is gradual and ongoing, and at-risk structures include a retail store, road, boat launch, utility poles, and others. Some protection measures have been implemented, but damage is expected within the next 10 years.

- **Huslia** experiences riverine erosion that undercuts the foundation upon which the community sits. Multiple structures including homes, water and power supply, and the sewage lagoon are expected to be affected in less than 10 years. The community has relocated several structures and implemented other protection measures, which subsequently failed.

- **Kivalina's** coastal erosion is aggravated by coastal ice forming later in recent years than it had in the past—historically, coastal ice has acted as natural erosion protection, and the community is now more susceptible to erosion from storms for a longer period. Structures lost to erosion include teacher housing and drain fields for the school and washeteria. Multiple protection measures have been implemented, but residential, commercial, and community infrastructure are still at risk. Extreme damage is expected within 10 years. The most current protection constructed by the borough is failing in multiple locations.

- **Kotlik** experiences riverine erosion at 3 feet per year. Structures at risk include several homes, a church, and a retail store that are a few feet from the eroding bank. The riverside boardwalk, which functions as the village road system, has been moved inland 3 times in the last 5 years to prevent its being eroded away. An estimated 60 percent of village structures are at risk. Protection measures have failed and erosion continues to worsen.

- Erosion at **Kwigillingok** is episodic, occurring primarily during fall storms. The failure mode of Kwigillingok River banks is caused mainly by pore pressure failure in soils. As the soil becomes saturated, it loses strength and cannot support the weight of the soil above it, leaving shallow slopes. Permafrost thaw may also be a factor. Erosion is affecting several residential and fishery structures and the barge landing.

- **Lime Village** suffers primarily from erosion caused by flooding related to Stony River ice jams. Flooding typically occurs during spring breakup, when jams push water and ice into the airport area, leading to erosion. An estimated 8 major erosion events have occurred in the last 20 years, with damage to the airport access road, apron and runway, and airport maintenance building. Fixed-wing aircraft were unable to land until the facility was repaired. Fuel tanks and lines are also in danger. Damage is expected within 10 years.

- **McGrath** experiences riverine erosion caused by flooding, ice jams, spring breakup, boat traffic, and river migration. Multiple residences, commercial buildings, and public structures are within 100 feet of the eroding bank. Damage is expected in less than 10 years.

- Erosion at **Napakiak** generally occurs in fall, when storms with high south winds create wave activity on the river. Spring breakup flooding is a second, less severe

cause of erosion. Since Napakiak lies downstream of Bethel, wake from frequent barge traffic delivering supplies also causes erosion. Rapid erosion threatens a wide variety of structures and several have had to be relocated.

- **Newtok's** riverine erosion on the Ninglick River is aggravated by wave action and thermal degradation of the ice-rich riverbank. The long-term, average erosion rate is 71 feet per year, with peak erosion of approximately 113 feet in a single year. The community is experiencing almost annual flooding and has a water supply contaminated by flood-driven sewage spills. Severe damage is expected within 10 years. The community is actively involved in relocating and is pursuing several projects to relocate as quickly as possible.

- **Nunapitchuk** experiences riverine erosion from factors such as spring breakup, melting permafrost, and human activities. The average erosion rate is 1 foot per year across the length of the community. Protection measures have been implemented but have not been fully successful. Some infrastructure has been relocated and erosion has caused some damage. Many structures and public facilities are 100 feet or less from the eroding bank. Damage is expected in 10 to 20 years.

- **Port Heiden** experiences coastline erosion along Bristol Bay, caused by fall storms with high tides, storm surges, and wind and wave action. Annual erosion ranges from 15 to 40 feet, with erosion rates in the upper end of that range in recent years. Several buildings and the cemetery have been relocated, but multiple structures remain at risk, including homes, fuel tanks, the cemetery, and roads. Damage is expected within 10 years.

- At **Saint Michael,** coastal erosion is caused by high tides, storm surges, wind and waves, melting permafrost, and coastal ice forming later in recent years than it had in the past—historically, coastal ice has acted as natural erosion protection, and the community is now more susceptible to erosion from storms for a longer period. The average annual erosion rate is 3 feet inland, in an area 1 to 2 miles in length. Several structures have been relocated and additional protection measures have been taken. However, many other structures and facilities remain at risk and are less than 100 feet from the erosion area. Damage is expected in less than 10 years.

- **Selawik** suffers from riverine and shoreline erosion from Selawik River and Lake. The primary erosion area is in the center of the community, where eroded banks measure 800 feet horizontally and 6 feet vertically. Structures at risk include homes, a road, and utility poles and lines—some within 100 feet of the eroding area. Damage is expected in 10 to 20 years.

- **Shaktoolik** experiences riverine and coastal erosion due to its location on a sand and gravel spit bounded by the Tagoomenik River and Norton Sound. Natural protection has eroded considerably in recent years from storms, leaving the community vulnerable to further storm damage. Risk includes isolation of the community if a narrow spit that connects Shaktoolik to the mainland becomes eroded, which also would cut the community off from its source of fresh water. Damage is expected in less than 10 years.

- At **Shishmaref,** coastal erosion is aggravated by the natural icepack protection forming later in winter and melting earlier in spring. Protection measures have had limited success. The Corps, BIA, State, and City of Shishmaref recently constructed a riprap revetment for protection along significant portions of the coast fronting the community, but about a third of the community—the airport and the entire lagoon side of the island—is still exposed. Multiple structures at risk include residential structures, commercial and public buildings, and infrastructure. Severe damage is expected within 10 years.
- **Unalakleet** experiences riverine and coastline erosion because of its location on Norton Sound at the mouth of the Unalakleet River. Storm activity aggravates erosion. Multiple protection measures have been implemented. The Corps has a proposed project to install a revetment for a large portion of frontage, but erosion will still threaten multiple residential structures, commercial and public buildings, and infrastructure. Damage is expected within 10 years.

4.3. Monitor Conditions Communities

A Monitor Conditions Community generally has reported significant impacts related to erosion but the impacts are not likely to affect the viability of the community. The erosion issue may warrant Federal, State, or other intervention. A Monitor Conditions Community should be watched. Taking action in a Monitor Conditions Community to prevent a problem from becoming worse would be prudent.

The 69 communities designated "Monitor Conditions" are identified in Table 4-2. Figure 4-2 shows their locations.

- EIPs and DEAs for the respective communities are provided electronically in Appendix D (Monitor Conditions Communities for which EIPs were developed) or Appendix F (communities for which DEAs were developed).

Table 4-2. Monitor Conditions Communities (69 Communities)

Alatna	Galena	Noatak
Aleknagik	Gulkana	Nome
Aniak[a]	Haines	Nuiqsut
Atmautluak	Homer	Old Harbor
Bethel	Hooper Bay	Oscarville
Big Delta	Hughes	Ouzinkie
Brevig Mission	Igiugig	Pile Bay-Williamsport
Buckland	Iliamna	Pilot Point
Butte	Kaktovik	Point Hope
Central	Kenai	Port Graham
Chignik Lagoon	Kipnuk[a]	Russian Mission
Chiniak	Kongiganak[a]	Savoonga
Circle	Kotzebue	Seward
Circle View-Stampede Estates	Koyukuk	Shageluk
Delta Junction	Kwethluk[a]	Soldotna
Diomede	Levelock	South Naknek
Eagle	Lower Kalskag[a]	Sutton-Alpine
Eek	McCarthy	Tununak
Egegik	Mekoryuk	Tuntutuliak[a]
Elim	Nanwalek	Upper Kalskag[a]
Evansville	Nelson Lagoon	Valdez
False Pass	Nenana	Venetie
Fort Yukon	Nightmute	Wales

[a]Community for which a Detailed Erosion Assessment was developed (Appendix F).

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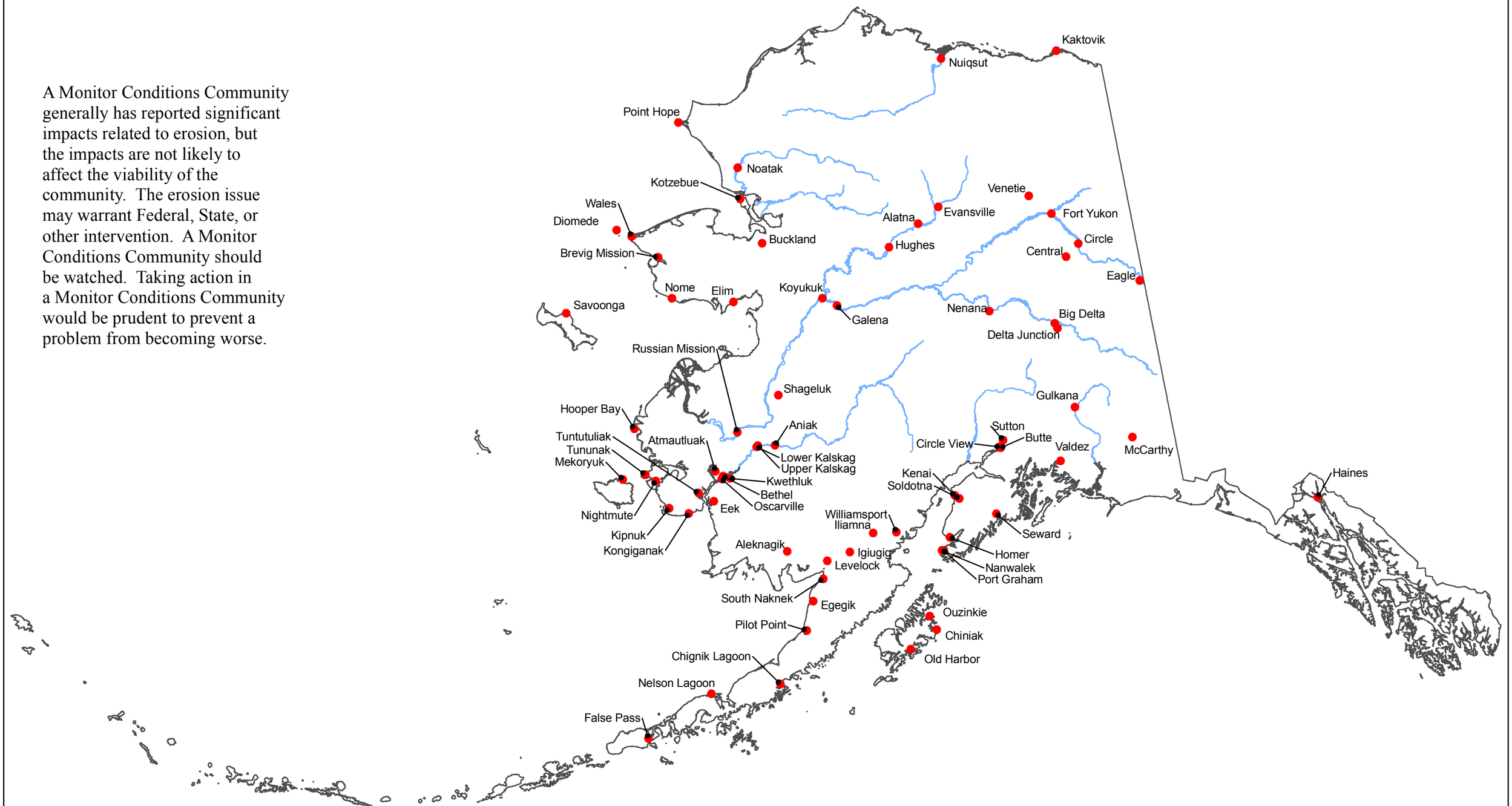
A Monitor Conditions Community generally has reported significant impacts related to erosion, but the impacts are not likely to affect the viability of the community. The erosion issue may warrant Federal, State, or other intervention. A Monitor Conditions Community should be watched. Taking action in a Monitor Conditions Community would be prudent to prevent a problem from becoming worse.



Alaska District
Corps of Engineers
Civil Works Branch

Alaska Baseline Erosion

Date Prepared: March 24, 2009

Figure 4-2

Monitor Conditions Communities

4.4. Minimal Erosion Communities

In general, a Minimal Erosion Community has reported erosion impacts that are not serious and are not affecting the viability of the community. At this time, erosion does not appear to warrant Federal, State, or other intervention.

The 83 communities designated "Monitor Conditions" are identified in Table 4-3. Figure 4-3 shows their locations.

- EIPs for these communities are provided electronically in Appendix E. The exception is Napaskiak, for which a DEA was developed (Appendix F).

Table 4-3. Minimal Erosion Communities (83 Communities)

Akhiok	Gustavus	Perryville
Akiachak	Holy Cross	Point Lay
Allakaket	Hyder	Port Alsworth
Ambler	Ivanof Bay	Port Lions
Anchor Point	Juneau-Douglas	Portage
Angoon	Kaltag	Red Devil
Anvik	Karluk	Salcha
Bettles	Kiana	Sand Point
Birch Creek	King Cove	Saint Paul
Cantwell	King Island	Sitka
Chalkyitsik	Kokhanok	Skagway
Chignik Bay	Koyuk	Skwentna
Chignik Lake	Larsen Bay	Sleetmute
Chistochina	Manley Hot Springs	Stebbins
Chitna	Mary's Igloo	Susitna
Chuathbaluk	Metlakatla	Talkeetna
Coldfoot	Municipality of Anchorage	Tazlina
Copper Center	Napaskiak[a]	Teller
Council	New Stuyahok	Togiak
Crooked Creek	Ninilchik	Toksook Bay
Ekuk	Nondalton	Ugashik
Ekwok	Noorvik	Upper Chena
Fairbanks	Northway	Wainwright
Fox	Northway Village	Wasilla
Gakona	Nulato	Willow
Gambell	Nunam Iqua	Wiseman
Girdwood	Palmer	Yakutat
Grayling	Pedro Bay	

[a]Community for which a Detailed Erosion Assessment has been developed (Appendix F).

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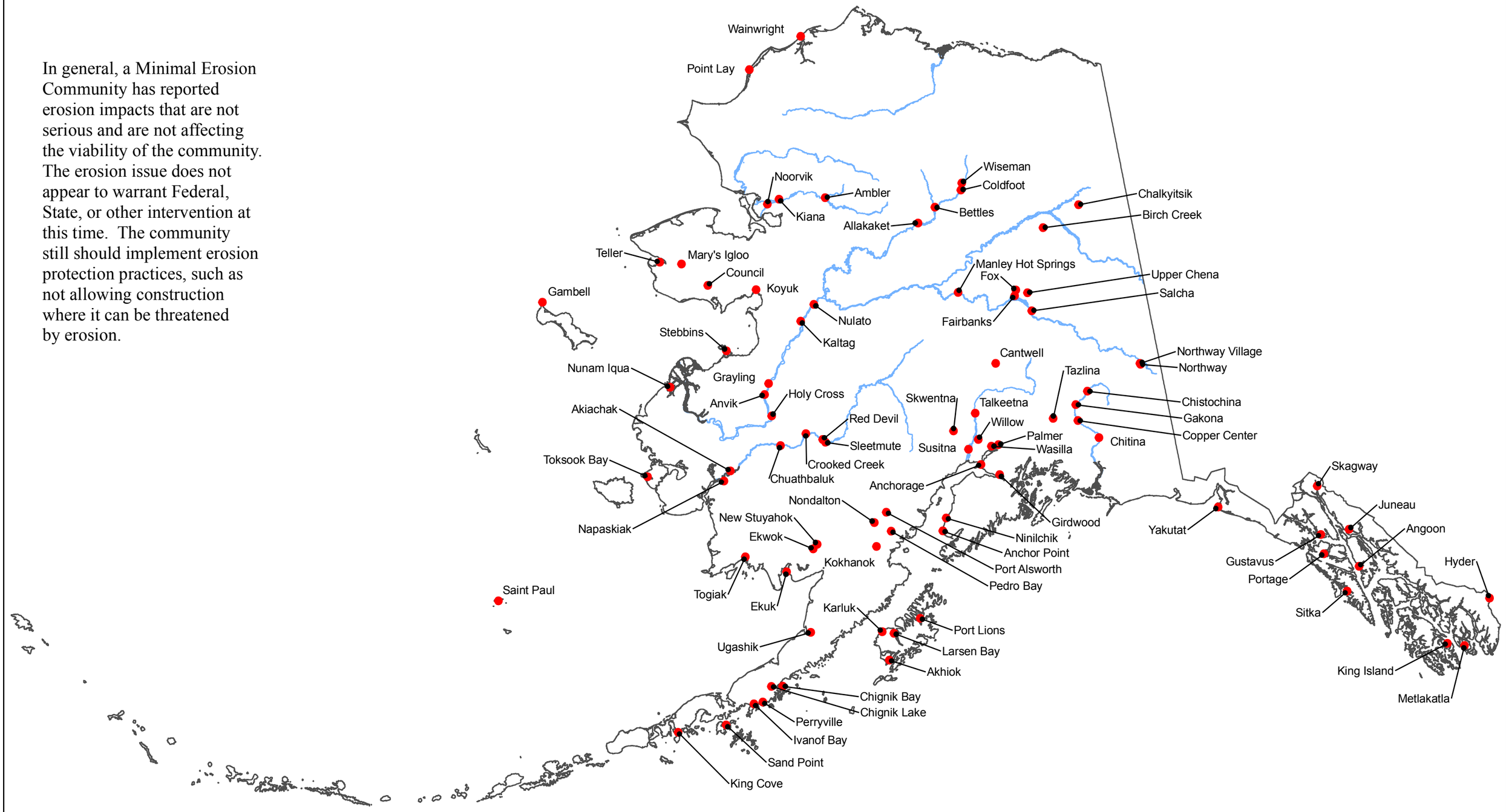
In general, a Minimal Erosion Community has reported erosion impacts that are not serious and are not affecting the viability of the community. The erosion issue does not appear to warrant Federal, State, or other intervention at this time. The community still should implement erosion protection practices, such as not allowing construction where it can be threatened by erosion.



Alaska District
Corps of Engineers
Civil Works Branch

Alaska Baseline Erosion

Date Prepared: March 24, 2009

Figure 4-3

Minimal Erosion Communities

5.0 APPROPRIATE RESPONSES TO EROSION

This section provides information about appropriate responses for each of the three community prioritization designations (Section 5.1), interim measures (Section 5.2), and State and Federal programs for erosion control assistance (Section 5.3). The discussion of appropriate responses for Priority Action Communities includes specific actions by community.

The authorizing language for this study included the requirement to "plan the appropriate responses and assistance for Alaska villages in the most need." The communities in most need are those with the "Priority Action" designation. However, Monitor Conditions Communities or Minimal Erosion Communities should not be precluded from receiving assistance for their erosion problems. A "Monitor Conditions" or "Minimal Erosion" designation means that, barring further information, intervention for the erosion issue may not be warranted at this time.

Although the discussion of appropriate responses focuses on Corps capabilities, various actions could be undertaken by other Federal, State, or local stakeholders who may have the necessary resources to complete these actions.

The most appropriate response, of course, is prevention. Communities and those assisting communities with construction should not build structures within the 50-year erosion hazard zone or 50-year flood hazard zone. If construction must be done within these zones, structures should be designed for ease of relocation, with prior construction retrofitted for the same purpose. These actions alone can do much to alleviate erosion damages that may occur in the future.

5.1. Summary of Appropriate Responses by Priority Designation

This section summarizes appropriate responses for each of the three community designations. For each designation, there are a variety of appropriate responses, depending on the severity of the erosion and the actions that have been taken.

Specific suggestions for next steps are provided for Priority Action Communities. For Monitor Conditions and Minimal Erosion Communities, only general descriptions of next steps are included. While various entities can conduct planning, design, and construction to address erosion, the following discussions include scenarios with Corps participation. Regardless of which entity is the lead agency, all such work is best done in a collaborative manner.

5.1.1. Priority Action Communities

Appropriate responses to erosion in Priority Action Communities are actions needed to decrease erosion-related risks and impacts to acceptable levels. In some cases, the action is relocation of structures; in others, a structural fix is more reasonable. In some communities, not enough is known about the situation to justify suggesting anything other than sending a team to the community for further investigation.

Types of Appropriate Responses

The following items discuss three types of appropriate responses for Priority Action Communities.

Initiate Planning

For several Priority Action Communities, the next appropriate step is to initiate a planning study. Each such study typically begins by determining whether there is a problem the Corps can assist with and then developing the scope for studies necessary to get approval for construction. Typically, the cost for this action is approximately $100,000 and is at full Federal expense. This effort could be started by the community through a written request to the Corps for assistance under one of the Corps programs listed in Section 5.3.2.

- Priority Action Communities best suited for this response are **Chevak, Clark's Point, Cordova/Eyak, Deering, Emmonak, Golovin, Huslia, Lime Village, Nunapitchuk, Port Heiden, Saint Michael,** and **Selawik**.
- Some other villages need to have studies initiated, although the need for a Corps study has been determined. These communities are **Akiak, Alakanuk, Kwigillingok,** and **Napakiak**, which were visited during the BEA.

Continue Planning and Design Efforts

Each of the Priority Action Communities of **Barrow, Chefornak, Dillingham, Kivalina, McGrath, Newtok, Shaktoolik, Shishmaref,** and **Unalakleet** has initiated a study under an existing Corps program. Some of these studies and projects will be affected by the repeal of Section 117 of the 2005 Energy and Water Development Appropriations Act, but for the most part will be able to continue as long as the local sponsor can provide the non-Federal matching funds. The estimated needs for funding vary greatly for each community, ranging from $200,000 to $1 million.

Continue Construction

The Priority Action Communities of **Kivalina, Newtok, Shishmaref,** and **Unalakleet** have approved projects, have signed Project Partnership Agreements, and in some cases have substantially initiated construction. The funding needs for these communities vary from $10 million to $30 million per community. Although a significant portion of the funding for these projects has been appropriated, the repeal of Section 117 authority may greatly affect the Corps' ability to use these funds.

Specific Appropriate Responses by Community

The following items summarize specific responses that are underway or would be reasonable next steps for Priority Action Communities. Cost-sharing requirements for the suggested responses would be determined under the funding programs that provide assistance.

- A detailed assessment of erosion at **Akiak** was developed, and it would be appropriate for the community to pursue a 275-foot bank stabilization to protect the cemetery and fuel tanks from erosion-related damages. Approximately $100,000 would be required for initiating the planning phase.

- A detailed assessment of erosion at **Alakanuk** was developed, identifying a serious erosion problem in the center of the community at the site of a large scour hole. Because estimates to fill this hole exceed $50 million, a more feasible solution would be to relocate affected structures rather than protecting them. Approximately $100,000 would be required for initiating the planning phase.

- The Corps has prepared a technical report evaluating alternative plans for an erosion and storm damage reduction project at **Barrow**. This action was funded through the Corps' budgetary process in partnership with the North Slope Arctic Borough. The cost-sharing is 50 percent Federal, 50 percent non-Federal, with the North Slope Arctic Borough as the non-Federal sponsor.

- The Corps is investigating **Chefornak** under the Emergency Streambank Protection Authority (Section 14 of the U.S. Flood Control Act of 1946), but the solution will likely be well beyond the scope of that program. Approximately $300,000 would be required for continuing the planning phase.

- For **Chevak**, a detailed assessment of erosion is necessary, and, potentially, solutions will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000; cost-sharing would depend on the funding source.

- A detailed assessment of erosion at **Cordova** is necessary, and, potentially, solutions will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- A detailed assessment of erosion is necessary for **Clark's Point**, and, potentially, solutions will need to be developed. Because this community was not visited, it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- For **Deering**, the need for a Section 14 Emergency Streambank Protection project is under investigation by the Corps, but that investigation addresses only public structures in harm's way. A local sponsor that can cost-share has not been identified. An estimated $300,000 would be required for continuing the planning phase.

- The Corps is preparing for a project to construct shoreline protection in **Dillingham**. Approximately $18 million of the total estimated cost ($20 million) is needed for this project to be constructed. This project is authorized at full Federal expense.

- For **Emmonak**, a detailed assessment of erosion is necessary, and, potentially, solutions will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- For **Golovin**, a detailed assessment of erosion is necessary, and, potentially, solutions will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- For **Huslia,** a detailed assessment of erosion is necessary, and, potentially, solutions will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- Implementation of interim shoreline protection at **Kivalina** is ongoing. To date, 400 feet of revetment has been completed, with the final, 1,200-foot segment being constructed by the Corps in 2009. The estimated cost for the 1,200-foot segment is $8.5 million. Another segment, 400 feet in length, is needed. This project is authorized at full Federal expense. However, with the Corps authority of Section 117 having been repealed, the project's future is uncertain. The community's goal is to relocate eventually. The AVETA report (Corps, 2006) estimated the cost to relocate Kivalina at between $95 million and $125 million.

- For **Kotlik,** a detailed assessment of erosion is necessary, and, potentially, solutions will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- The investigation of erosion at **Kwigillingok** identified a significant erosion problem along most of the river frontage. Because there is little room for the community to retreat or relocate structures, a shoreline protection project seems to be a reasonable solution, although the cost could be in the range of $20 million to $30 million. Approximately $100,000 would be required for initiating the planning phase.

- For **Lime Village,** a detailed assessment of erosion is necessary, and, potentially, solutions will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- At **McGrath,** the Corps is investigating the need for an erosion protection project. NRCS is installing a temporary project for erosion control in 2009. That project has an expected life of 10 years. The Corps study is funded through Fiscal year 2009, but additional funds will be needed to continue with planning, design, and eventual construction. Additional funding needs are estimated at $400,000. A recommended plan has not yet been developed. The study is funded at full Federal expense; however, with Section 117 having been repealed, the study cost-sharing may revert to the standard 50 percent Federal, 50 percent non-Federal.

- The detailed assessment of erosion problems in **Napakiak** demonstrated that the community is experiencing severe and fast-moving erosion. Although much of the community has moved structures out of harm's way, a significant number of structures are susceptible to erosion damages within 10 years. Shoreline stabilization would cost nearly $90 million and likely would not be an effective solution. The most

reasonable approach appears to be retreat and relocation of structures to the areas recently developed outside the area of erosion risk. Approximately $100,000 would be required for initiating the planning phase.

- **Newtok** is actively relocating. The AVETA report estimated the cost to relocate Newtok at between $80 million and $130 million (Corps, 2006). Design and preconstruction activities for an emergency evacuation shelter at the new community site continue by the Corps, State, and others. This work will include a barge landing and road between the shelter and the landing. The estimated project cost is $20 million. This project is authorized at full Federal expense, but with the Corps authority of Section 117 having been repealed, the project's future is uncertain. The Corps' role is to provide technical support and to collaborate with other agencies on the relocation process.

- For **Nunapitchuk,** a detailed assessment of erosion is necessary, and, potentially, solutions will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- For **Port Heiden,** a detailed assessment of erosion is necessary, and, potentially, solutions will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- For **Saint Michael**, a detailed assessment of erosion is necessary, and, potentially, a solution will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- For **Selawik,** a detailed assessment of erosion is necessary, and, potentially, solutions will need to be developed. This community was not visited, and it is important to send a team there to assess the issue firsthand. That effort is estimated to cost $100,000.

- The Corps is investigating erosion at **Shaktoolik** under a combination of funding through the BEA and under the Hurricane and Storm Damage Reduction Program, Section 103 of the 1962 River and Harbor Act. The Section 103 program has a per-project limit of $3 million; therefore, the scope of any potential assistance under this program will be limited. Studies are estimated to cost $500,000.

  The community's long-term goal is to relocate. Kawerak, Inc., and the Denali Commission have developed a reconnaissance plan for a road to the new site. Construction of the 14.6-mile road is estimated to cost $33.4 million. The next step for the road project is to undertake a planning and design effort. The scope of this effort has not yet been estimated.

  At **Shishmaref,** the Corps is undertaking a project to construct 2,200 feet of rock revetment to provide interim protection to the shoreline, as Shishmaref plans to relocate. Phase I is 625 feet and has been constructed; Phase II is 750 feet and is

estimated to cost $7.5 million. Construction is scheduled to begin in July 2009. Phase III is 550 feet, and Phase IV is 1,225 feet. Phase IV will increase the height of existing revetments installed by others. The combined cost for Phases III and IV is estimated at $15 million. All these efforts have been approved at 100 percent Federal funding, but with the Corps authority under Section 117 having been repealed, the future of these projects is uncertain.

The community's goal is to relocate. The AVETA report estimated the cost of relocation at between $100 million and $200 million (Corps, 2006).

- At **Unalakleet,** the Corps is undertaking a project to construct a 1,500-foot rock revetment over the existing NRCS gabion revetment. The NRCS revetment has experienced damage that eventually will lead to its failure. The cost of the Corps project is estimated at $28 million, for which funding has been received. A construction contract was awarded in February 2009 for part of the project. However, with the Corps authority of Section 117 having been repealed, the project's future is uncertain.

5.1.2. Monitor Conditions Communities

Because Monitor Conditions Communities have erosion problems (not of extreme magnitude), these communities should monitor erosion actively and bring new information to the attention of local, State, or Federal officials if the situation warrants. A good methodology is to measure to the top of the riverbank or shoreline bluff from points set throughout the community. Ideal locations for the points are corners of buildings or other steadfast infrastructure. By using this process, if the community experiences an increase in the rate of erosion or if slow moving erosion eventually approaches pieces of community infrastructure, local officials will have good information to pass along to agencies for assistance in erosion abatement efforts.

Having digital photography of new or developing problems would aid significantly in ongoing monitoring of erosion. If there is a new, perceived problem, having the both erosion rate from the top-of-bank measurements and the digital photography of points of concern will help State and Federal agencies to provide timely assistance.

If an erosion problem does worsen in a Monitor Conditions Community, addressing that problem should not be dismissed simply because of the less urgent designation. In many cases, a small project to arrest erosion progression will provide greater benefits than could be achieved when addressing the situation after it becomes worse.

Other natural hazards such as flooding may be causing problems. Such hazards should be managed lest they affect the rate of erosion and cause additional problems for the community.

5.1.3. Minimal Erosion Communities

A Minimal Erosion Community has little threat of erosion-related damages. Unless the situation were to change significantly, no action is deemed necessary for this community to address erosion. The community, however, may be experiencing problems from other natural hazards, such as flooding, that could lead to erosion problems in the future.

5.2. Interim Measures

State and Federal agencies will require significant time and effort to plan, design, permit, and construct comprehensive solutions for many of the problems identified in this study. Communities can do much to manage erosion and implement immediate remedies to carry them through to a more permanent solution.

Through measuring the progression of erosion, controlling boat wakes, or moving structures, many communities have demonstrated the wherewithal to mitigate erosion impacts successfully on their own. Ideally, there would be no development within the 50-year erosion hazard zone or 50-year flood hazard zone. If construction must be done within these zones, structures should be designed for ease of relocation, and prior construction in those zones should be retrofitted for the same purpose.

As with any protection project, risks and uncertainties attend the use of these interim measures. Professional engineering assistance in their development is important. Even if properly constructed, many interim structures are sacrificial—the structures themselves are intended to be damaged or destroyed in defense of the shoreline. Therefore, if a community installs an interim project, the community should be prepared to perform significant rehabilitation over time, seek the development of a more permanent solution such as those offered through State and Federal programs, or both.

Sections 5.2.1 and 5.2.2 discuss some engineering and construction techniques that communities may be able to implement on their own or with limited assistance. The Corps has developed reports about riverine and coastal interim measures (Appendices G and H, respectively) that communities can use for assistance with their efforts. The measures described in the riverine and coastal reports could be implemented using local materials or materials that can be flown in within a short timeframe. Although such measures are sometimes expensive, a major cost factor is labor, to which the community could consider contributing. In addition, emergency response funds available through the State and the Federal agencies could be used to implement these measures and assist in short-term protection projects.

5.2.1. Riverine Expedient Measures

Expedient erosion control measures for rivers are described in Appendix G. Appendix G is intended to describe some low-cost erosion protection alternatives for Alaska communities located on riverbanks that experience erosion. Riprap and quarry stone revetments are the tried-and-true methods for stream bank protection, but they are costly to install and require significant planning to gather resources to produce a successful project. Expedient riverine measures use locally available materials as much as possible and require a minimum amount of skilled labor and heavy machinery. While these methods are not as effective as riprap or quarry stone revetments, they can be constructed on a faster schedule, buying time to gather resources to implement a more permanent solution.

5.2.2. Coastal Expedient Measures

Expedient shoreline protection measures for coastal areas are described in Appendix H. Such measures include (1) engineered geotextile sandbag revetment, (2) beach nourishment, and (3) modified geotextile wrap revetment. Significant investments are required to achieve the

durability needed to resist even the smallest wave climate. These methods are only suggestions and should be carried forward after considering all available options.

Any method of shore protection, if properly implemented, is expensive. In some instances, constructing a shoreline protection structure or hardening the shoreline can exacerbate erosion problems rather than mitigate them. Erosion problems are often caused by failure to recognize that shorelines have always been areas of continuous and sometimes dramatic change. This lack of understanding of shoreline processes has been catastrophic for many property owners, both private and public.

5.3. Programs for Erosion Control Assistance

The State and Federal governments respond to erosion issues in many different ways. This section describes how communities can get assistance through the various agencies.

5.3.1. State of Alaska

While the State of Alaska has no formal erosion control program, many agencies are actively involved in addressing erosion issues. As discussed in Section 2.2, the State is actively leading many activities. Questions about erosion control at State-owned facilities are best directed to the agency responsible for the item in question. Highways, airport, and other transportation infrastructure concerns can best be addressed by ADOT&PF. Concerns related to ongoing erosion in communities can be directed to DCCED-DCRA. Queries related to actions needed in response to natural disasters can be submitted to the Alaska Division of Homeland Security and Emergency Management.

5.3.2. U.S. Army Corps of Engineers

The following items summarize programs and authorities that allow the Corps to provide erosion assistance to Alaska communities.

- **Section 14, Emergency Streambank Restoration.** Section 14 of the U.S. Flood Control Act of 1946 allows the Corps to plan, design, and construct erosion control projects that protect public infrastructure. Section 14 has been used traditionally on rivers, but there have been instances when Section 14 has been used on coastline. The first $100,000 of the assessment is at full Federal expense, with the remainder of the studies cost-shared at 50 percent Federal, 50 percent non-Federal. The per-project limit is $1.5 million, with construction cost-sharing of 65 percent Federal, 35 percent non-Federal. Projects are justified on a least-cost basis. This program works well for small erosion protection projects in front of a school, power plant, or other public facility.
- **Section 22, Planning Assistance to States.** Section 22 of the U.S. Water Resources Development Act of 1974 is a study-only authority that allows the Corps to conduct almost any type of water resource study, as long as it does not include detailed design or plans and specifications. The cost-sharing is 50 percent Federal, 50 percent non-Federal, and there is a per-state or per-tribe limit of $2 million per year. The Section 22 authority is useful for a community that is trying to develop a plan to address erosion or any other water resources issue.

- **Section 103, Hurricane and Storm Damage Reduction.** Section 103 of the U.S. River and Harbor Act of 1962 is similar to Section 14 of the U.S. Flood Control Act. However, it has a $3 million per-project limit and is used exclusively for protection against storm waves and hurricanes. Therefore, Section 103 is used most often in coastal areas only. This authority requires benefits to outweigh costs and has a 65 percent Federal, 35 percent non-Federal cost-share. The program would be most useful for coastal communities seeking a solution to coastal storm damage.

- **Public Law 84-99, Flood and Coastal Storm Emergencies.** The Corps may provide disaster response and support under PL 84-99. PL 84-99 is a Corps-unique authority with missions and authorities that include disaster preparedness through all hazards planning, advance measures, emergency operations during and after events, rehabilitation of flood control works threatened or destroyed by flood, protection or repair of federally authorized shore protective works threatened or damaged by coastal storm, and provision of emergency water due to drought or contaminated source.

- **Specifically Authorized Program.** When a solution for a problem exceeds the authorized monetary limits of other Corps programs, the Specifically Authorized Program is used. For erosion problems, the U.S. Congress must specifically authorize the Corps to examine the erosion before studies can begin. Projects are authorized by Congress based on findings of the Corps study, and construction typically is cost-shared, with 65 percent Federal and 35 percent non-Federal contributions.

5.3.3. Natural Resources Conservation Service

NRCS administers the Watershed and Flood Prevention Program. The U.S. Watershed Protection and Flood Prevention Act (PL 83-566) of August 4, 1954, as amended, authorized NRCS to cooperate with states and local agencies to carry out works of improvement for soil conservation and for other purposes including flood prevention; conservation, development, use and disposal of water; and conservation and proper use of land. This program is divided into three parts: Watershed Surveys and Planning, Watershed Operations, and Watershed Flood Prevention.

- **Watershed Surveys and Planning.** NRCS cooperates with other Federal, State, and local agencies in making investigations and surveys of river basins as a basis for development of coordinated water resource programs, floodplain management studies, and flood insurance studies. NRCS also assists public sponsors in development of watershed plans to mitigate flood damages; conservation, development, use, and disposal of water; and conservation and proper use of land. The focus of these plans is to identify solutions that use conservation practices, including nonstructural measures, to solve problems.

- **Watershed Operations.** Watershed Operations is a voluntary program that provides assistance to sponsoring local organizations of authorized watershed projects planned and approved under the authority of the PL 83-566 and the U.S. Flood Control Act of 1944 (PL 78-534). NRCS provides technical and financial assistance to States, Tribes, and local governments (project sponsors) to implement authorized watershed project plans for the purpose of watershed protection; flood mitigation; water quality

improvements; soil erosion reduction; rural, municipal, and industrial water supply; irrigation water management; sediment control; fish and wildlife enhancement; and wetlands and wetland function creation and restoration.

- **Watershed Flood Prevention.** The NRCS installs watershed improvement measures to reduce flood, sedimentation, and erosion damages; to promote the conservation, development, use and disposal of water; and to promote conservation and proper use of land.

6.0 FLOODING RISKS

Many BEA communities reported flooding as the primary cause of erosion; therefore, the question of how to address flooding was raised several times. Since the authorizing language identified erosion as the focus of the assessment, communities with flooding concerns were not singled out. According to the Alaska Division of Homeland Security and Emergency Management, 21 Alaska communities had 3 or more flood disaster declarations during the last 30 years (1978-2008). Table 6-1 identifies those communities: all but two were studied during the BEA. The table illustrates that numerous communities with erosion problems less urgent than those of Priority Action Communities also experience severe flooding. The study team concluded that communities with erosion problems may have other water hazards issues that need to be investigated.

Table 6-1. Comparison of Flood Risk Communities

Community	Number of Flood Disaster Declarations	Years
Priority Action Communities		
Alakanuk	6	1984, 1991, 1995, 2002, 2005, 2006
Cordova	6	1983, 1985, 1986, 1995, 2000, 2006
Dillingham	3	1980, 2000, 2005
Emmonak	7	1984, 1985, 1991, 1995, 2002, 2005, 2006
McGrath	6	1985, 1990, 1991, 1993, 2002, 2005
Napakiak	4	1986, 1988, 1990, 2005
Shishmaref	5	1988, 1997, 2001, 2002, 2005
Monitor Conditions Communities		
Aniak	5	1983, 1987, 1991, 1995, 2002
Bethel	4	1985, 1990, 1995, 2006
Delta Junction	3	1994, 2000, 2006
Galena	3	1991, 1992, 1994
Haines	4	1985, 1988, 1998, 2005
Kwethluk	3	1995, 2002, 2006
Sleetmute	3	1985, 1987, 2002
Minimal Erosion Communities		
Crooked Creek	3	1985, 1988, 2002
Fairbanks	7	1989, 1991, 1992, 1997, 2000, 2002, 2008
Juneau-Douglas	3	1984, 1998, 2005
Red Devil	3	1985, 1991, 2002
Communities not Included in Baseline Erosion Assessment		
Copper River	3	1985, 1997, 2006
Kodiak	6	1980, 1991, 1992, 2000, 2002, 2003

Source: Alaska Division of Homeland Security and Emergency Management, 2008

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7.0 CONCLUSIONS

There are 178 Alaska communities that expressed an erosion problem of some type. The BEA identified 26 Priority Action, 69 Monitor Conditions, and 83 Minimal Erosion designations, indicating the level of erosion concern the community is experiencing.

Severe weather events were the most commonly reported causes of both riverine and coastal erosion. The most commonly reported impacts were to roads and houses, with most of the affected communities reporting that the erosion is less than 100 feet from a facility or structure of importance. With coastal and riverine flooding a primary indicator of erosion, an analysis similar to the BEA that incorporates flooding is needed.

Communities and those assisting communities with construction should not build structures within the 50-year erosion hazard zone or 50-year flood hazard zone. If construction must be done within these zones, structures should be designed for ease of relocation, and prior construction in those zones should be retrofitted for the same purpose. These actions alone can do much to alleviate erosion damages that may occur in the future.

The first line of defense for erosion impacts is the communities themselves. Managing shoreline usage, constructing small erosion prevention projects that use local materials, or relocating movable structures out of harm's way are all ways in which communities throughout Alaska have taken action. Encouragement and support of these practices could be a cost-effective way to address many erosion issues, especially for those communities that appear to have lower risk.

Several plans to address erosion issues are underway for the Priority Action Communities by the Corps and many other State and Federal agencies. However, the Corps authority to construct solutions for erosion control in Alaska has been modified by the repeal of Section 117 of the 2005 Energy and Water Development Appropriations Act. Regardless of this setback, continued support and collaboration for these projects is essential, and the Corps will continue to provide assistance through traditional programs.

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