

**Community Erosion Assessment
Shaktoolik, Alaska
11 March 2009**

1. Community: Shaktoolik, Alaska



Figure 1. Location of Shaktoolik

2. Community Profile Summary

Shaktoolik, (shock-TOO-lick), is located on the east shore of Norton Sound 125 miles east of Nome and 33 miles north of Unalakleet in the Cape Nome Recording District in the Unorganized Borough. It lies at approximately 64.33 degrees North Latitude and -161.15 degrees West Longitude. (Sec. 23, T013S, R013W, Kateel River Meridian.) The community spans 1.1 square miles of land and 0.0 square miles of water. Shaktoolik experiences a sub-arctic climate with maritime influences when Norton Sound is ice-free, (generally May to October). Temperatures range from -50 to 87 degrees Fahrenheit. The sale or importation of alcohol is banned in the village.

Shaktoolik is situated on a gravel and sand spit, bounded by the Tagoomenik River and the coast of Norton Sound. The Tagoomenik and Shaktoolik Rivers converge at Shaktoolik Bay and empty into Norton Sound about two miles northwest of the community. The Shaktoolik River extends 60 aerial miles to the northeast, with its headwaters located in the hills that separate the coastal drainage from the Yukon River.

3. Concise Description of Erosion Problem:

The proximity to both fresh and saltwater leaves the community vulnerable to erosion when fall storms hit the sand and gravel spit upon which the community resides. There is no breakwater to protect the community from destructive waves from Norton Sound when storms come from the south. The beaches have historically been susceptible to damage and erosion from storm conditions, tidal surges, and from sea ice conditions. Several areas along the coastline used by the people in Shaktoolik are vulnerable to erosion and flooding during the storm season. Considerable coastline erosion in the community occurred during recent storms in 2003, 2004, and 2005. The spit of land once used as the airport in the “old site” is now just a few hundred feet from erosion advancing from the Tagoomenik River. It is reported that most of Shaktoolik lies within the 100-year floodplain.

For this study the area was divided into three reaches. Reach 1 is a 9,600-foot portion of coastline that fronts the community and is eroding at a rate of 2.0 feet per year. Reach 2 is a 3,900-foot portion of coastline south of Reach 1 and is eroding at a rate of 1 foot per year. Reach 3 is a 4,700-foot portion of coastline south of Reach 2 and is eroding at 3.0 feet per year.

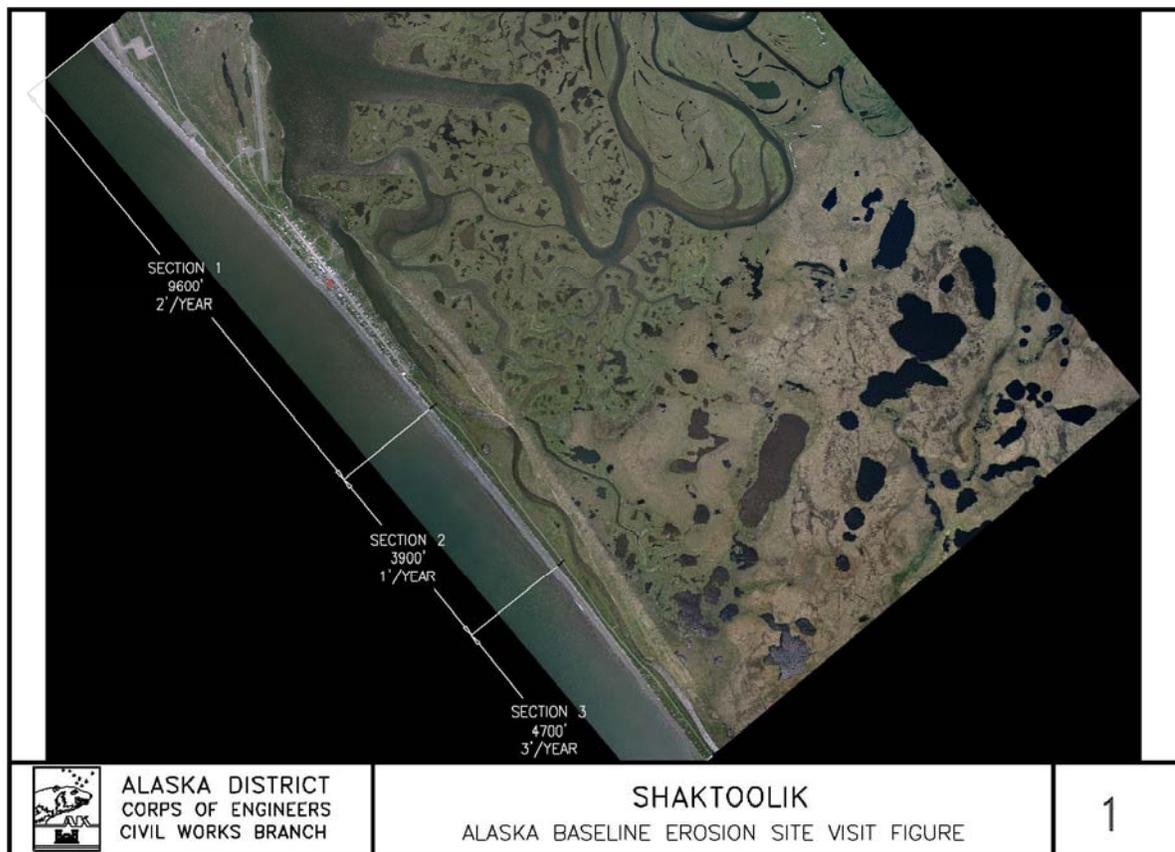


Figure 2. Shaktoolik Erosion Map

4. Potential Erosion Damages

Using the projected erosion interval lines on the aerial photograph, the economic damages were developed for the 50-year period of analysis and broken down into the sub-intervals of 0-10 years, 11-30 years and 31-50 years. Breaking down the economic damages into these sub-intervals allows us to determine when the greatest economic impact is expected to occur. Determining when the greatest economic impact could occur is important so that timely decisions can be made when an erosion retarding measure needs to be taken. For the purposes of this report, damages were assessed by time interval rather than attempting to estimate the exact year that the damage occurs. The analysis was completed in this manner to try and account for two types of uncertainty:

- 1.) That which is associated with predicting erosion which is progressing at varying rates over time (including episodic events); and
- 2.) That which exists when performing a surface analysis as opposed to doing an in depth investigation such as soils exploration and expensive modeling efforts.

Damage Categories

The approach used to determine potential erosion damages is based on several assumptions as they pertain to the damage categories of residential, commercial, and public structures, as well as infrastructure, land values, and environmental concerns. This evaluation relies on previous reports and information gathered during site visits to determine appropriate values where data was unavailable. Assumptions used for the various damage categories are described more fully in the following discussion of future damages.

Damages caused by erosion in Shaktoolik fall into six damage categories: land, residential structures, commercial structures, public structures, infrastructure, and environmental hazards. Approximately 14 percent of the expected damages in Shaktoolik are expected to occur in the first 10 years of the examined period.

Expected Damages

The period of analysis for this evaluation is 50 years and all damage categories have net present values calculated based on the federal fiscal year 2009 discount rate of 4 5/8 percent. The sections below detail expected losses with a summary provided in Table 1.

Shaktoolik is losing approximately 38,300 square feet of land per year (0.88 acres). Estimated land losses for River Reach 1 are 23.42 acres with land losses for River Reach 2 expected to be 3.86 acres and land losses in Reach 3 of 17.56 acres. It is expected that 44.84 acres will be lost over the 50-year period of analysis. Land is valued at approximately \$10,000 per acre giving the land loss has a total value of \$448,000 with a net present value of \$179,000 and an annual average value of \$9,200.

Expected residential damages in Shaktoolik are widely dispersed throughout the community. At-risk structures include 14 outbuildings and 18 residences. All of the residences and outbuildings are located in Reach 1. There are abandoned structures present in Reach 3. These structures are not counted as they are in an advanced state of disrepair and have minimal value.

Three commercial buildings are estimated to be subject to damages including two tank farms and a retail store. The classification of these structures is based on on-site analysis and aerial photographs.

Four public buildings are at risk in Shaktoolik including the school and various outbuildings. The septic tanks servicing the school will be lost at some point prior to the school being lost. It is estimated that the school will not have water or septic for some period of time prior to the building itself being lost.

Building damages in Shaktoolik are expected to total \$9.8 million with a net present value of \$2.4 million and an average annual cost of \$121,700.

Infrastructure that lies within the 50-year erosion profile includes: approximately 5,000 feet of roads, 1,400 feet of sewer lines, 275,000 gallons of bulk fuel tank storage, 848,000 gallons of water storage, and 10,000 feet of water lines due to compromising of the fresh water source. The power plant is expected to be lost in the 30 to 50-year timeframe but the corresponding fuel tank farm could be lost up to 10 years earlier than the plant itself.

The tank farm on the south side of town and the retail store located nearby will be lost prior to year 10. Three other commercial outbuildings will be lost in years 40-50. Our estimates likely understate the commercial damages. Were these structures to be lost, it would compromise the income earning opportunities for the businesses and the residents they employ. It is expected that relocation efforts would impact these facilities as well.

Shaktoolik has approximately \$10.6 million of infrastructure at risk due to erosion. The combined net present value of these items is \$3.6 million. The average annual loss of infrastructure is valued at \$185,000.

Environmental concerns in Shaktoolik include damage to two fuel farms, sewage spillage, and loss of fresh water source. The tanks located in both farms are still in use. The surrounding soils may be contaminated and will pose a threat to the local ecosystem and related fish stocks when eroded away. Decommission and closure of the facility is essential to avoid these harmful effects. Based on the above assumptions, the south tank farm will need decommissioning in the next ten years and the north tank farm will need decommissioning in the 11 to 30-year timeframe. Utilizing values from previous studies, including the Shishmaref Relocation Study, it is estimated that these processes have a combined cost of \$2.3 million with a net present value of \$1.3 million and an average annual cost is \$68,500.

Damages to sewer lines would cause sewage and related materials to enter Norton Sound. While it is unknown how significant the effects will be, it is possible that these harmful contaminants could pose significant damage to local fish stocks and their related environment as well as pose a threat to human health.

Summary

Total erosion damages in Shaktoolik over the 50-year period of analysis are \$20.6 million with a net present value of \$7.1 million and an average annual value of \$367,400. Table 1 summarizes the expected damages by category.

Table 1. Total Expected Damages.

Damage Category	Quantity	Time Span (Years)			Total value (50 years)	Net present value (\$)	Average Annual Value
		0-10	11-30	31-50			
Land (acres)	44.84	\$ 97,000	\$ 176,000	\$ 176,000	\$ 448,000	\$ 179,000	\$ 9,200
Residential	18	2,000	421,000	3,343,000	3,766,000	673,000	34,700
Commercial	4	521,000	-	695,000	1,216,000	450,000	23,300
Public buildings	4	-	4,191,000	616,000	4,807,000	1,234,000	63,700
Infrastructure	--	1,212,000	5,716,000	3,633,000	10,561,000	3,583,000	185,000
Environmental	--	1,495,000	-	823,000	2,318,000	1,326,000	68,500
Total damages	--	\$ 3,327,000	\$ 10,504,000	\$ 9,286,000	\$ 23,117,000	\$ 7,445,000	\$ 384,400

5. Potential Solutions:

Non-structural solutions include relocation of threatened buildings and infrastructure, specifically the threatened fresh water intake; construction of an evacuation route to give the community access to refuge during storm events, and village relocation. As costs of village relocation may be prohibitive and a consortium of entities including the State of Alaska, the Denali Commission, and Kawerak Corporation are working to construct an evacuation route the most feasible non-structural solution is relocation of the fresh water intake.

Structural solutions include: constructing a 4,500-foot revetment that would protect the entire community at a cost of \$29.2 million or approximately \$6,500 per linear foot, constructing a 3,350-foot revetment to protect the community's fresh water intake at a cost of \$18.6 million or approximately \$5,600 per linear foot, constructing a groin field to trap sand that is migrating parallel to the shore, causing accretion on the beach itself at a cost of \$30.8 million, and conducting beach nourishment at a cost of \$36.5 million.

6. Conclusion:

Shaktoolik has a definite erosion problem that is affecting the community over the next 50 years. The community has the potential to have over \$23 million in damages.

Shaktoolik will likely require some sort of assistance to stop the erosion from causing significant future damages as they are unable to solve their own erosion problems due to limited financial resources.

7. Community Photos:



Photo 1: Shaktoolik tank farm threatened by wave-driven driftwood and erosion



N 64° 21.059' W 161° 11.407'

Shaktoolik

RIMG0206

Photo 2: Woody debris piles exceed 6 feet in height near the community



Photo 3: Shaktoolik Water Intake Structure

8. Additional Information:

This assessment, as well as those for other communities, can be accessed on the internet at www.AlaskaErosion.com. The web site also contains additional information on addressing erosion issues, educational materials, and contact information.



	<p>Alaska District Corps of Engineers Civil Works Branch</p>	<p>Predicted and Historical Shorelines</p> <p>Legend</p> <table border="0"> <tr> <td></td> <td>1980</td> <td></td> <td>2004</td> <td></td> <td>2037</td> </tr> <tr> <td></td> <td>1994</td> <td></td> <td>2017</td> <td></td> <td>2057</td> </tr> </table>		1980		2004		2037		1994		2017		2057		<p>0 190 380 760 Feet</p> <p>0 55 110 220 Meters</p> <p>1 inch equals 300 feet Image dated June 2004</p>	<p>Alaska Baseline Erosion Shaktolik, Alaska</p>	
	1980		2004		2037													
	1994		2017		2057													