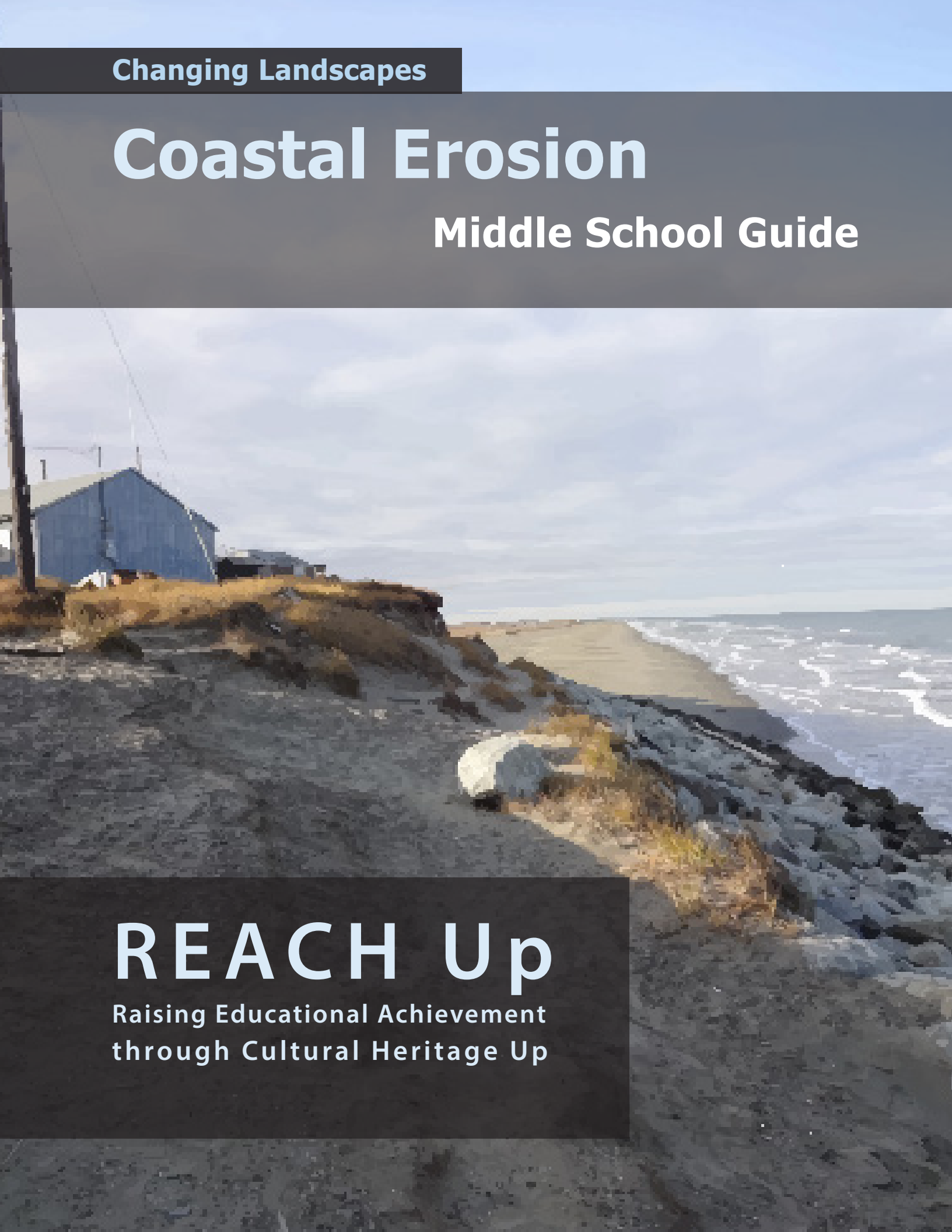
Changing Landscapes

Coastal Erosion

Middle School Guide



REACH Up

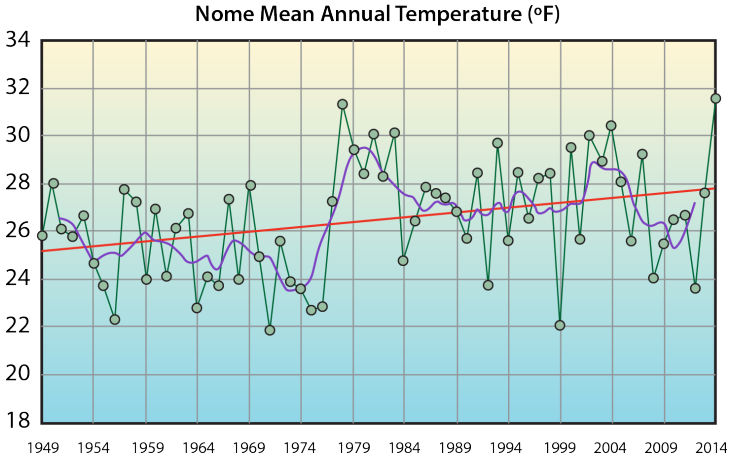
Raising Educational Achievement
through Cultural Heritage Up

Changing Landscapes

How does climate change impact the landscape?

The climate in the Bering Strait region of western Alaska is warming. Increasing temperatures change the landscape in a variety of ways. Landscape changes impact local ecosystems and ways of life for local residents. What are these changes? What processes cause them? How do these changes impact Bering Strait communities?

Bering Strait, Alaska



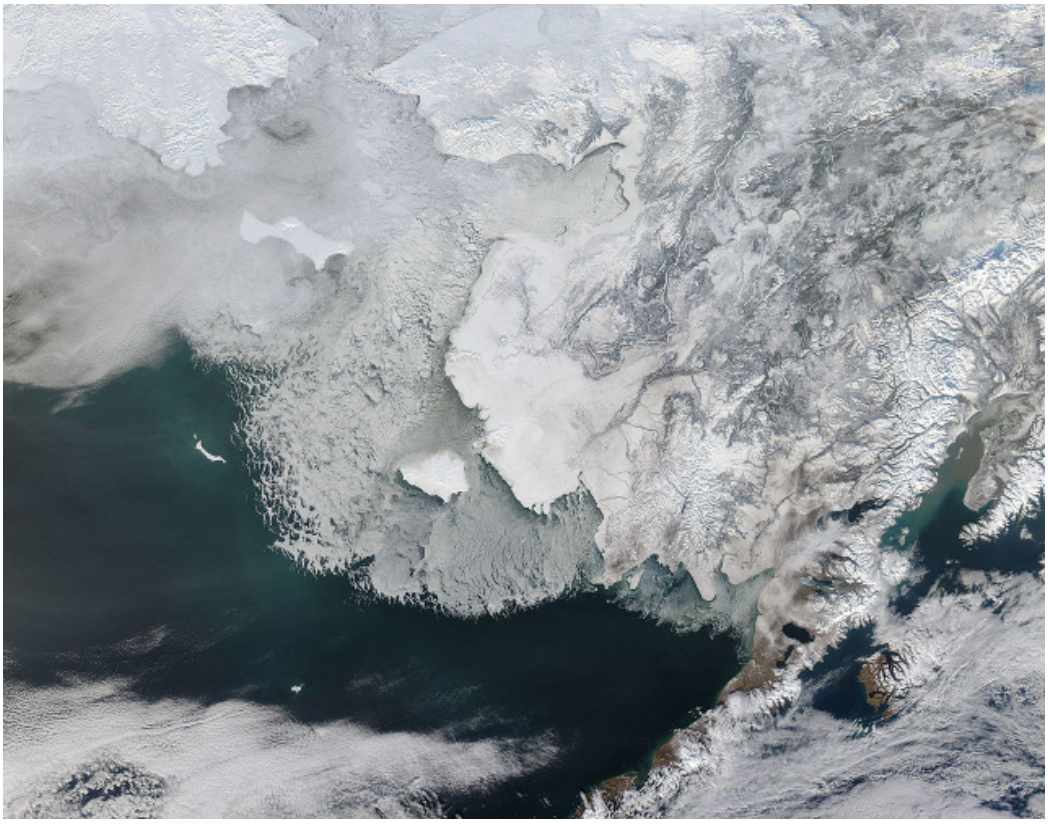
What is coastal erosion?

Erosion occurs when forces of nature move sand, soil, and rock. Wind, water, ice, and gravity all contribute to erosion. Coastal erosion occurs where land meets sea. Climate change is causing increased coastal erosion in many Bering Strait communities.

Eroding shoreline beneath the village of Shishmaref. Photo by P. Clark

How does the warming climate increase coastal erosion?

A warming climate reduces sea ice, increases storm frequency and intensity, and thaws permafrost. All of these factors contribute to coastal erosion.



NASA image of sea ice in Western Alaska on February 4, 2014

Sea Ice

Sea ice is ice that forms when seawater freezes. It is forming later and melting earlier throughout the Arctic. Elders and scientists report that it is thinner than it has been in the past. Ice that is anchored to the shore does not form until later in the season. This shore ice reduces coastal erosion by providing a barrier to waves. Distant sea ice also is important to coastal erosion because it has a damping effect on the ocean waves that reach the shore. Less ice means that waves can travel greater distances uninterrupted. Uninterrupted waves tend to surge higher and inundate further inland when they reach the coast.

Feedback Cycle

Less sea ice is both a symptom and a cause of warmer water. Ice is more reflective than open water. When ice blankets the ocean it reduces the amount of solar radiation that the ocean can absorb. Less ice means more solar radiation is absorbed and the water temperature rises. Warmer water takes longer to freeze, creating a feedback cycle. Warmer water is also more effective at thawing frozen soil and scooping it away from the Arctic shore.

Storms

Western Alaska is experiencing more frequent and severe storms. Storms form more readily over open water, so as sea ice diminishes, storms that send wind-driven waves at the coastline, or "storm surges", increase in number and intensity. Depending on the season, these storms can also deliver heavy rainfall to coastal areas. The surges and precipitation cause erosion and flooding in coastal communities.

A 2011 storm flooded the community of Golovin. Photo by John Peterson.

Permafrost Thaw

The coastline along the Bering and Chukchi Seas is dominated by soil rich with permafrost. Permafrost is soil that has remained frozen for at least two years. Most of this soil has been frozen since the last Ice Age. Stable permafrost is very hardy and is similar to a rocky bluff in its ability to withstand the wind, wave, and water actions that cause erosion. Unfortunately, the average annual temperature in the Arctic has risen more than 3 degrees Fahrenheit over the past century, and permafrost has begun to thaw. Thawed permafrost is very fragile. It often resembles soupy mud and erodes even faster than sand.

Thawing permafrost leaves behind loose soil and mud that is easily eroded.
Photo credit: Matthew Whitley

Activity

Ask an Expert

1. Watch the REACH Up *Coastal Erosion* video available at www.k12reach.org/videos.php
2. Conduct your own interview with an elder or cultural knowledge bearer.

   Some questions you may want to ask:

   - How do the people in our community make use of the nearby coastlines and beaches?
   - Are the coastlines or beaches changing? If so, how?
   - Can you tell me about changes to the sea ice?
   - How are current changes to the coast and ice conditions impacting our community? If the coast and ice conditions have not changed, how may future coastal erosion or decreased ice impact our community?
3. If the person you interview speaks an Alaska Native language, ask them what language and dialect(s) they are familiar with. Ask them to please translate the following words:

   - ice
   - sea ice
   - shore ice
   - coast
   - storm
   - waves

   Compare your words with the translations on the following page. Are any of the terms the same or similar?

Bessi Sinnok of Shishmaref discusses the changes that she has observed on the island. Photo credit: P. Clark

Coastal Erosion Vocabulary

Would you like to know Alaska Native language terms related to climate change?

Work with your classmates to practice coastal environment vocabulary words in English and the indigenous language of your community. Your teacher will give you vocabulary cards with the English word and an illustration on one side. Write the corresponding indigenous term on the blank line on the back of each card. Use the words that you learned from a local elder or cultural knowledge bearer, or choose the translation below that is closest to your community.

Miriam Toolie
Savoonga, AK
Siberian Yupik
St. Lawrence Island Yupik dialect

ice - siku
sea ice - qelughtaaq
shore ice - uughhun
coast - tapghaa
storm - eslalluuk
waves - nengulghat

Annie Conger
Nome, AK (from Brevig Mission)
Seward Peninsula Iñupiaq
Bering Strait dialect

ice - siku
sea ice - siku
shore ice - siku sinaani
coast - taġium sinaa
storm - piqsiq
waves - qailiq

Luci Washington
St. Michael, AK
Yup'ik
Unaliq dialect

ice - ciku
sea ice - imarpik ciku
shore ice - ceńa ciku
coast - ceńa
storm - pircir
waves - qaiq

Jolene Nanouk
Unalakleet, AK
Seward Peninsula Iñupiaq
Qawiaraq dialect

ice - siku
sea ice - siku
shore ice - sinaasiku
coast - taġium sinaa
storm - piqsiq
waves - qailiq

How is coastal erosion impacting Bering Strait communities?

Most communities in the Bering Strait region are situated on the coast. This provides access to vital subsistence resources as well as commercial fishing opportunities and ports for incoming community supplies. Coastal erosion is threatening community lifestyles and infrastructure. Fresh water resources can become inundated with salt water. Homes and other buildings near the coast can be washed away or flooded during storm surges. Areas of the coast traditionally used for drying seal meat or gathering edible plants are disappearing. Coastal bird habitats are changing. Important cultural sites such as cemeteries are threated by erosion. Waste treatment facilities can be damaged.

Communities are forming action plans to address erosion concerns. Some opt to reinforce coastal embankments with imported rock or other resources. Others have voted to relocate the entire community. Solutions are costly, time consuming, and take an emotional and cultural toll on residents facing these challenges.

The community of Shishmaref is facing relocation as a result of coastal erosion.
Photo credit: Ned Rozell

Community Shorelines

Scientists have created maps that show historic and predicted shorelines for Alaska communities. These maps can help us understand how the shoreline is changing. Work with a partner and use the maps on the following pages to discover how shorelines are changing in Unalakleet, Wales, and Shishmaref. Use a ruler, the map key, and the scale on the map to help you answer the questions about each community. Hint: On these maps, 1 cm = 20 meters.

Unalakleet

Legend

- 1951 Shoreline
- 2012 Measured Shoreline
- 2030 Projected Shoreline
- 2030 Uncertainty

Image courtesy of the Division of Geological & Geophysical Surveys and available at http://maps.dggs.alaska.gov/shoreline/

- What is the average annual rate of shoreline change from 1951 – 2012? Hint: Choose a location and measure the distance between the purple and pink lines. Divide this distance by the number of years between 1951 and 2012.
- Is the shoreline getting closer to the school or farther away?
- What will be the closest distance between the school and the projected shoreline in 2030?

Activity

Wales

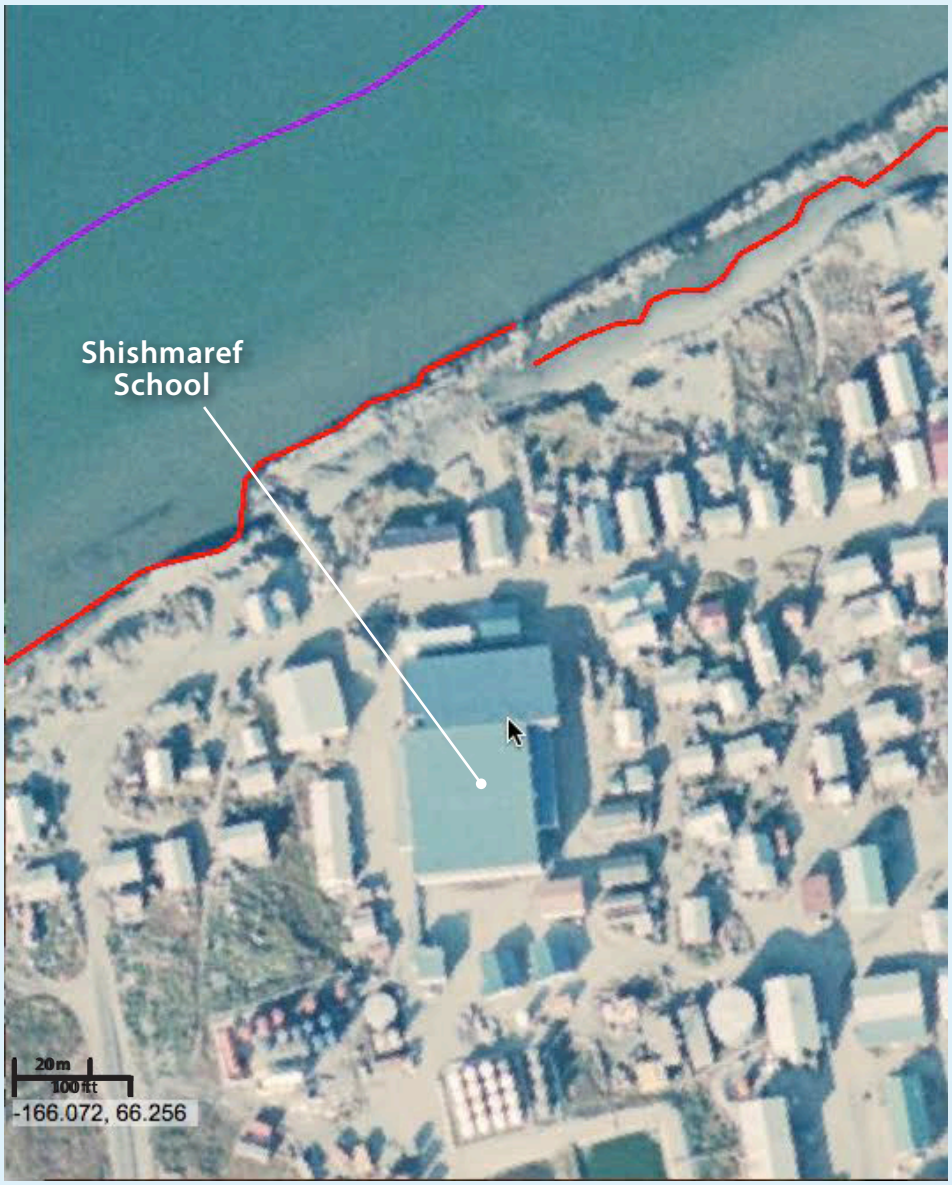
Legend

- 1950 Shoreline
- 2011 Measured Shoreline
- 2035 Projected Shoreline
- 2035 Uncertainty

Image courtesy of the Division of Geological & Geophysical Surveys and available at http://maps.dggs.alaska.gov/shoreline/

- What is the closest distance from the water tank to the 2011 shoreline?
- What is the annual rate of shoreline change from 1950 to 2011 near the water storage tanks?
- Is the shoreline getting closer to town or farther away?
- Is the water storage tank in a safe place from coastal erosion? Why or why not?
- How far will teacher housing be from the projected shoreline in 2035?

Shishmaref



Legend

- 1950 Shoreline
- 2003 Shoreline

Image courtesy of the Division of Geological & Geophysical Surveys and available at http://maps.dggs.alaska.gov/shoreline/

- Is the shoreline getting closer to the village or farther away?
- What is the closest distance from the school to the 2003 shoreline?
- What is the annual rate of shoreline erosion from 1950 to 2003?
    - Based on this rate, about how many more years will it be before the shoreline is at the edge of the school? Do you think the school is in a safe location from coastal erosion? Why or why not?

Conclusions — Discuss with your classmates:

- Is the rate of shoreline change in all villages the same?
- What village has the greatest rate of shoreline change?
- Why is monitoring shoreline change important to Alaska's coastal villages?

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