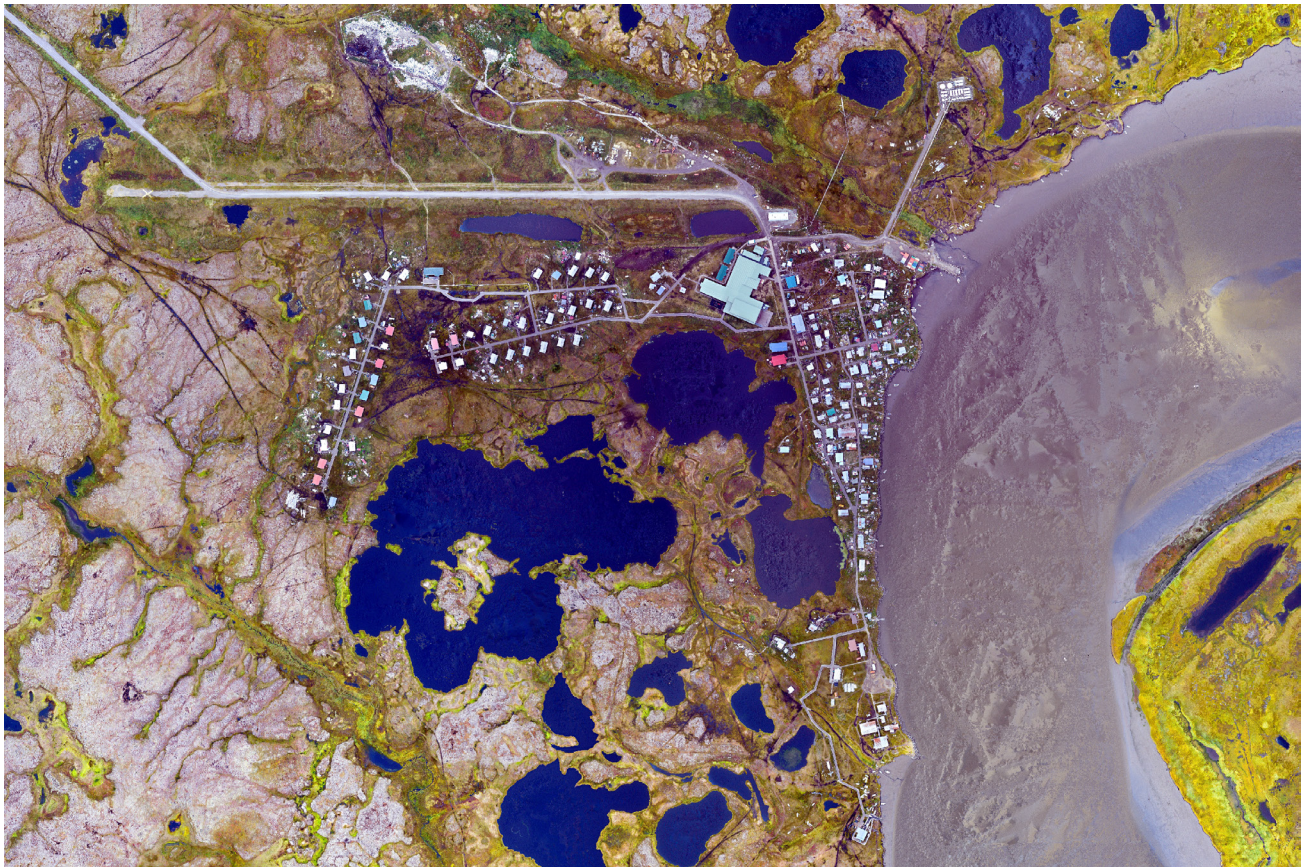


EROSION EXPOSURE ASSESSMENT—CHEFORNAK

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Aerial imagery of Chefnak, Alaska, in 2015. Photo: Overbeck and others, 2016.



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Report of Investigation 2021-3 Chefornak

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EROSION EXPOSURE ASSESSMENT—CHEFORNAK

Richard M. Buzard¹, Mark M. Turner¹, Katie Y. Miller¹, Donald C. Antrobus², and Jacquelyn R. Overbeck¹

CHEFORNAK EROSION EXPOSURE ASSESSMENT

This is a summary of erosion forecast results near infrastructure at Chefnak, Alaska. We conduct a shoreline change analysis, forecast 60 years of erosion, and estimate the replacement cost of infrastructure in the forecast area. Buzard and others (2021) describe the method and guidance for interpreting tables and maps.

Source data for this summary include the following:

- Delineated vegetation lines and change assessment by Buzard and others (2021) following the methods of Overbeck and others (2020).
- Infrastructure AutoCAD outlines and metadata from Division of Community & Regional Affairs (2004) Community Profile Map series.
- Added infrastructure such as roads, power distribution lines, and buildings, delineated if visible in the most up-to-date high resolution (≤ 0.66 ft [20 cm] ground sample distance) aerial orthoimagery (Overbeck and others, 2016).
- Computed infrastructure cost of replacement based on square or linear footage from Buzard and others (2021).

Chefnak is located on the south bank of the Kinia River near the southwest coast of the Yukon-Kuskokwim Delta. Erosion rates are typically between 0 and 3.3 feet per year, with the greatest erosion occurring at the riverbend (Overbeck and others, 2020). The community took protective measures to reduce shoreline erosion by placing fabric mats and constructing a jetty with large rocks.



The fabric mats were effective at slowing erosion until they were destroyed (U.S. Army Corps of Engineers, 2008). The jetty itself has not eroded, but its armoring around the barge landing is eroding. Erosion persists in this surrounding area, so we forecast erosion continuing beyond the jetty.

We forecast erosion 60 years from the most recent shoreline (2015) at 20-year intervals to identify the exposure of infrastructure to erosion. Buildings, transportation and utility infrastructure, and the barge landing are exposed to erosion through 2075 (table 1–3). Erosion is forecast to reach the barge landing by 2035 and continue to undermine the entire landing by 2075 (table 1; fig. 1). Five unspecified buildings are exposed to erosion through 2035, but the largest estimated costs are from 2055 to 2075 when multiple residential buildings are exposed (tables 2–3). The total estimated replacement cost of infrastructure exposed to erosion is \$6.2 million (\pm \$1.8 million) by 2075 (table 2; figs. 1 and 2). There are many structures near the riverbank that are beyond the 60-year forecast because historical erosion rates are relatively slow, but recent observations indicate that erosion may be increasing (Trudeau, 2018). Local observations and erosion monitoring can help to identify changes to erosion rates.

¹ Alaska Division of Geological & Geophysical Surveys, 3354 College Rd., Fairbanks, Alaska 99709-3707

² Alaska Native Tribal Health Consortium, 4000 Ambassador Drive, Anchorage, Alaska 99508

Table 1. Quantity of infrastructure with estimated erosion exposure by linear footage (LF), square footage (SF), or count (n).

Quantity of Exposed Infrastructure						
Erosion Forecast Date Range	Buildings & Tank Facilities (n)	Power Lines (LF)	Fuel Lines (LF)	Water Lines (LF)	Roads & Boardwalks (LF)	Barge Landing (SF)
2015 to 2035	5	0	65	0	7	5,969
2035 to 2055	6	0	65	0	7	6,680
2055 to 2075	9	108	149	0	7	6,410
Combined Total	20	108	279	0	21	19,060

Table 2. Replacement cost of infrastructure forecast to erode per 20-year interval.

Cost to Replace Exposed Infrastructure							
Erosion Forecast Date Range	Buildings & Tank Facilities	Power Lines	Fuel Lines	Water Lines	Roads & Boardwalks	Barge Landing	Sum
2015 to 2035	\$0	\$0	\$20,000	\$0	\$75,000	\$0	\$95,000
2035 to 2055	\$400,000	\$0	\$0	\$0	\$0	\$0	\$400,000
2055 to 2075	\$3,115,100	\$50,000	\$0	\$0	\$0	\$2,500,000	\$5,665,100
Combined Total	\$3,515,100	\$50,000	\$20,000	\$0	\$75,000	\$2,500,000	\$6,160,100

Table 3. Cost estimate of erosion exposed to buildings and tank facilities by 20-year interval. The count of impacted residential or unspecified buildings is denoted in parentheses. NCA designates buildings with no cost assigned.

Cost to Replace Exposed Buildings and Tank Facilities		
Erosion Forecast Date Range	Building Type	Replacement Cost
2015 to 2035	Unspecified (5)	NCA
2035 to 2055	Residential (1)	\$400,000
	Unspecified (5)	NCA
2055 to 2075	Residential (6)	\$3,115,000
	Unspecified (3)	NCA

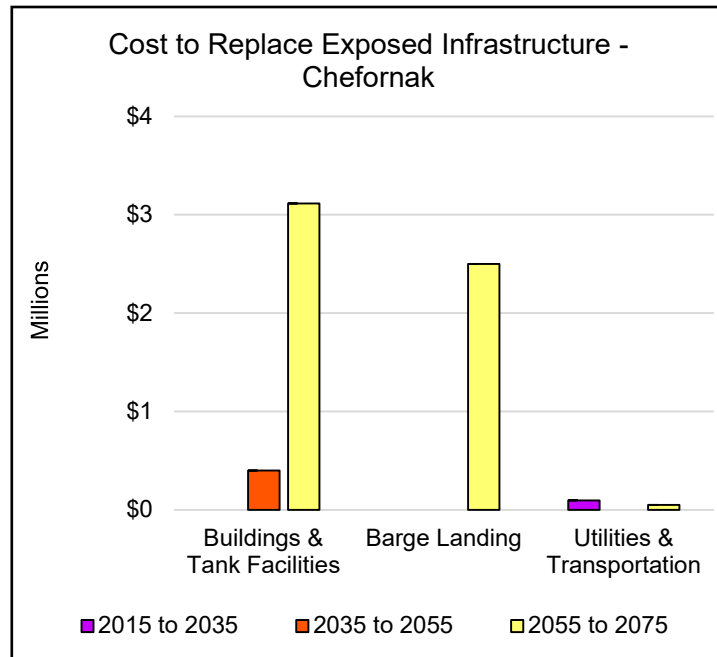


Figure 1. This figure summarizes the replacement cost of infrastructure in the erosion forecast area. 20-year intervals are symbolized by color: purple represents the time interval 2015 to 2035, red represents 2035 to 2055, and yellow represents 2055 to 2075. The bulk of costs occur from 2055 to 2075 when multiple residential buildings are at risk from erosion and the barge landing is fully eroded.

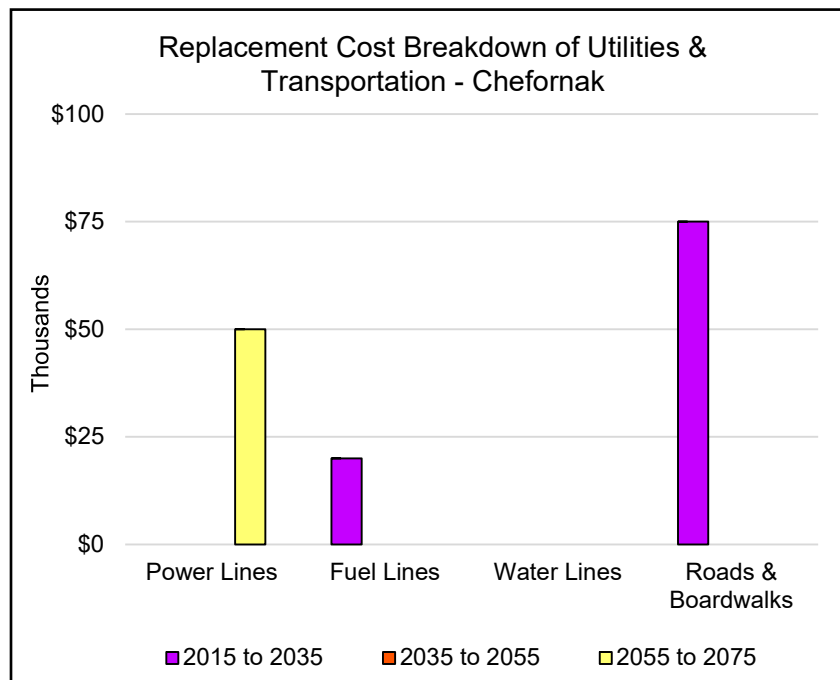


Figure 2. This figure summarizes the replacement cost of utilities and transportation infrastructure in the erosion forecast area. There are no fuel and transportation replacement costs from 2035 to 2075 because a minimum replacement cost is applied to the time interval 2015 to 2035. Power lines are not exposed until 2055 to 2075.

ACKNOWLEDGMENTS

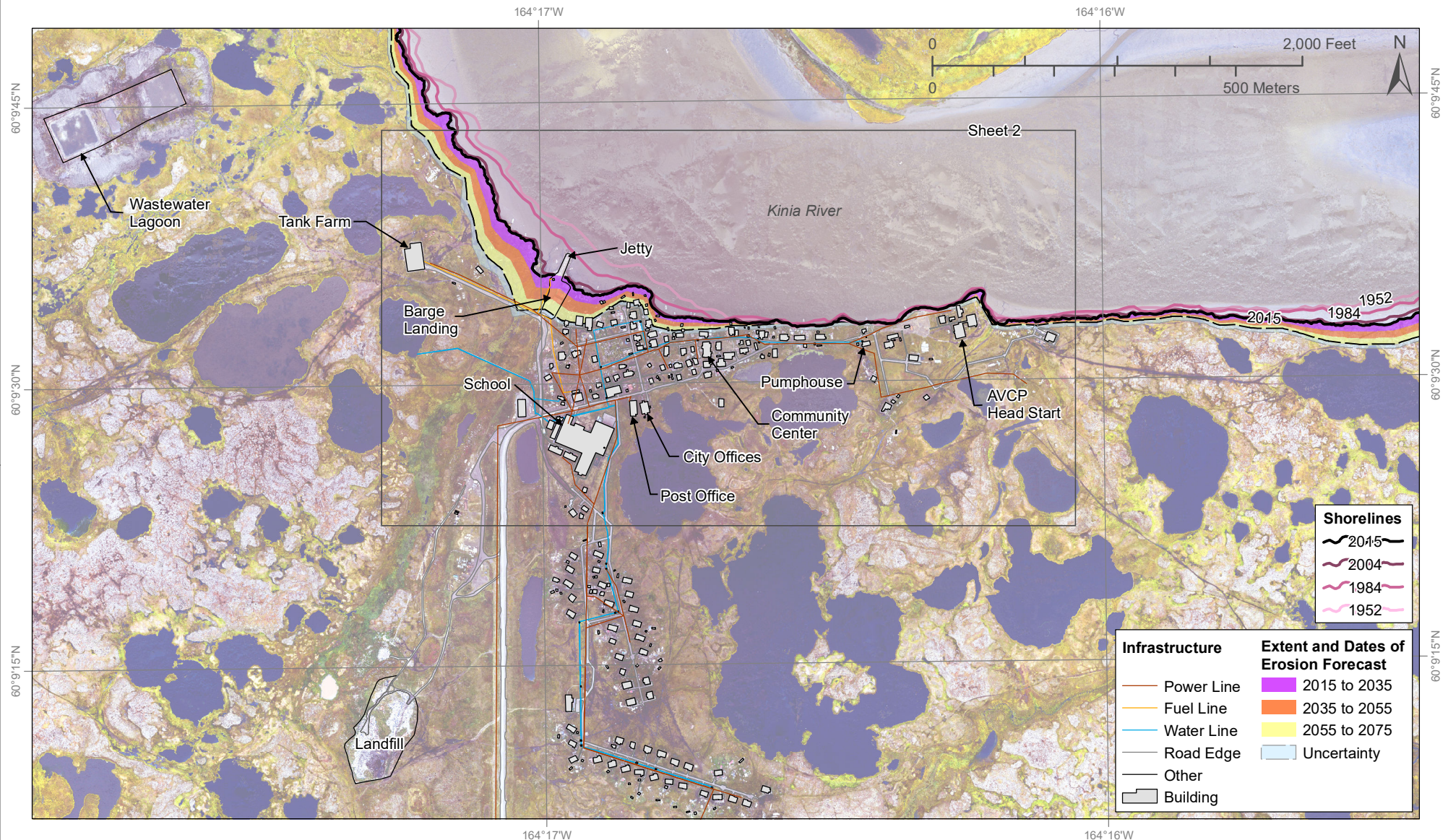
This work was funded by the Denali Commission Village Infrastructure Protection Program through the project “Systematic Approach to Assessing the Vulnerability of Alaska’s Coastal Infrastructure to Erosion.” The community of Chefnak was not consulted for this report.

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Erosion Forecast Chefornak, Alaska

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Projection: NAD83 UTM Zone 3N. Orthoimagery year: 2015. Orthoimagery available from elevation.alaska.gov

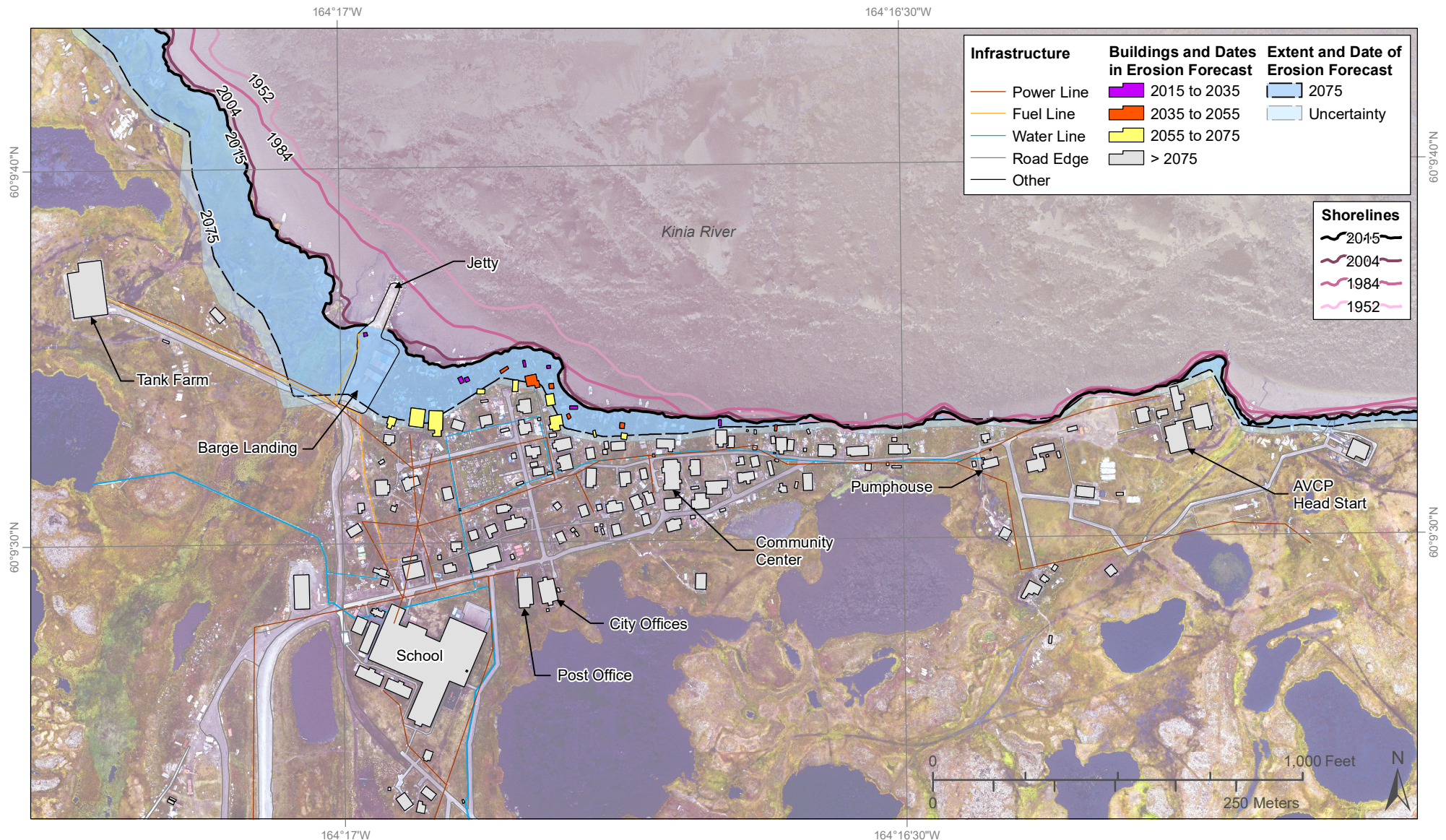
Erosion and accretion of coasts and rivers result in shoreline change. These rates of shoreline change at Alaska communities are calculated from historical and modern shorelines (shorelines shown as lines in pinkscale and labeled by year). The long-term (1952 to 2015) shoreline change rate is used to forecast where erosion could impact community infrastructure. Erosion is forecast to reach the colored areas by specified time intervals: 2015 to 2035 (purple), 2035 to 2055 (orange), and 2055 to 2075 (yellow). The area of uncertainty of the 2075 shoreline at a 90 percent confidence interval is light blue. Areas that are not colored by time interval are not forecast to erode by 2075 based on the historical shoreline change rate. For more detailed information about the impacts to infrastructure from erosion at Chefornak, refer to the Chefornak erosion exposure assessment report.

This work is part of the Coastal Infrastructure Erosion Vulnerability Assessment project funded by the Denali Commission Environmentally Threatened Communities Grant Program. Components of this map were prepared by the Alaska Department of Commerce, Community, and Economic Development (DCCED) using funding from multiple municipal, state, federal, and tribal partners. The original AutoCAD drawing of the infrastructure data layers was converted to ArcGIS.



Erosion Exposure Chefnak, Alaska

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Erosion and accretion of coasts and rivers result in shoreline change. These rates of shoreline change at Alaska communities are calculated from historical and modern shoreslines (shoreslines shown as lines in pinkscale and labeled by year). The long-term (1952 to 2015) shoreline change rate is used to forecast where erosion could impact community infrastructure. Erosion is forecast to year 2075 (dark blue) with a 90 percent confidence interval area of uncertainty (light blue). Buildings forecast to be impacted by erosion are colored by the range of years when the impact is forecast to occur: 2015 to 2035 (purple), 2035 to 2055 (orange), 2055 to 2075 (yellow), and no impacts expected by 2075 (gray). For more detailed information about the impacts to infrastructure from erosion at Chefnak, refer to the Chefnak erosion exposure assessment report.

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