

Report of Investigation 2021-3 Alakanuk

EROSION EXPOSURE ASSESSMENT—ALAKANUK

Richard M. Buzard, Mark M. Turner, Katie Y. Miller, Donald C. Antrobus, and Jacquelyn R. Overbeck



Alakanuk, Alaska, in 2021. Photo: Alaska Division of Geological & Geophysical Surveys.



Published by
STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
2021



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State of Alaska
Department of Natural Resources
Division of Geological & Geophysical Surveys

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Suggested citation:

Buzard, R.M., Turner, M.M., Miller, K.Y., Antrobus, D.C., and Overbeck, J.R., 2021, Erosion Exposure Assessment of Infrastructure in Alaska Coastal Communities: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2021-3. <https://doi.org/10.14509/30672>



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EROSION EXPOSURE ASSESSMENT—ALAKANUK

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

ALAKANUK EROSION EXPOSURE ASSESSMENT

This is a summary from an erosion forecast near infrastructure at Alakanuk, 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 (2006) Community Profile Map series.
- Added infrastructure such as roads, water and sanitation facilities, and outbuildings, 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 value based on square or linear footage from Buzard and others (2021).

Alakanuk is built at an intersection of the Yukon River and its branch from the main channel to the Alakanuk Pass Slough (Nakirnepacuar River). Alakanuk is approximately 10 miles upriver from the Bering Sea coast, exposing the community to tides and storm surge. The eastern edge of Alakanuk is on the main channel of the Yukon River where erosion rates range between 1 and 10 feet per year and are linear in trend (Overbeck



and others, 2020). High river flow causes erosion during spring break up and ice-jam floods (U.S. Army Corps of Engineers, 2009).

The Alakanuk Pass Slough both widened and straightened from 1951 to 2015, resulting in non-linear erosion and accretion rates up to 13.8 feet per year (Overbeck and others, 2020). The slough had several meanders that straightened into one larger bend near the current school. In 1951, the slough was approximately 230 feet wide. By 2015, it expanded to 600 feet with as much as 600 feet of erosion or accretion along various bends. The old school and the landfill were undermined by erosion (Alaska Department of Environmental Conservation, 2015). A channel that the river abandoned after the 1950s now has trails, roads, and small structures built in it.

We forecast erosion 60 years from the most recent shoreline (2015) at 20-year intervals to identify the exposure of infrastructure to erosion. Given the complex shoreline history of the Alakanuk Pass Slough, we cannot perform a linear regression erosion forecast. To communicate exposure to erosion, we forecast the mean rate of change of the entire slough. This assumes continued widening of the entire channel. Despite some accretion and stability,

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the slough has an average erosion rate of 1.4 feet per year. The 90 percent confidence interval is 4.4 feet per year. This means any infrastructure within 85 ft of the shoreline is within the 2075 erosion forecast area and uncertainty extends this to any infrastructure within 350 ft. The large uncertainty communicates the distance the river has migrated in the past, as well as limitations of forecasting erosion for a complex system. We include the footprints of past river channels so decision-makers can visualize changes and make their own interpretations. We conduct a standard linear regression erosion forecast for the Yukon River shoreline because it underwent linear erosion over the historical period.

The analysis shows all categories of infrastructure are exposed to erosion through 2075 (table 1). Buildings have the greatest cost of replacement

(\$12.3 million) followed by the barge landing and roads (table 2). There are at least 13 residences within the 2075 erosion forecast area, as well as the retail store and Tribal Hall and Offices (table 3). The total estimated replacement cost of infrastructure exposed to erosion is \$18.2 million (\pm \$5.5 million) through 2075 (table 2; figs. 1 and 2). As previously stated, there is great uncertainty in the forecast timing for Alakanuk due to the non-linear changes along the slough.

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 Alakanuk was not consulted for this report.

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

Quantity of Exposed Infrastructure					
Erosion Forecast Date Range	Power (LF)	Fuel (LF)	Water (LF)	Road (LF)	Buildings (n)
2015 to 2035	40	0	10	530	2
2035 to 2055	1,330	0	280	4,100	4
2055 to 2075	1,680	3	780	1,250	13
Combined Total	3,050	3	1,070	5880	19

Table 2. Replacement cost of infrastructure exposed to erosion per 20-year interval.

Cost to Replace Exposed Infrastructure							
Erosion Forecast Date Range	Power	Fuel	Water	Road	Barge Landing	Buildings	Sum
2015 to 2035	\$50,000	\$0	\$50,000	\$210,200	\$2,500,000	\$916,200	\$3,726,400
2035 to 2055	\$224,200	\$0	\$63,100	\$1,639,800	\$0	\$1,200,000	\$3,127,100
2055 to 2075	\$335,500	\$20,000	\$311,900	\$499,300	\$0	\$10,168,100	\$11,334,800
Combined Total	\$609,700	\$20,000	\$425,000	\$2,349,300	\$2,500,000	\$12,284,300	\$18,188,300

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

Cost to Replace Exposed Infrastructure		
Erosion Forecast Date Range	Building Type	Cost of Replacement
2015 to 2035	Residential (1)	\$400,000
	Unspecified (1)	\$ 516,200
2035 to 2055	Residential (3)	\$1,200,000
	Unspecified (1)	NCA
2055 to 2075	Residential (9)	\$4,044,000
	Unspecified (2)	\$400,000
	Retail Store	\$500,000
	Tribal Hall & Offices	\$5,224,100

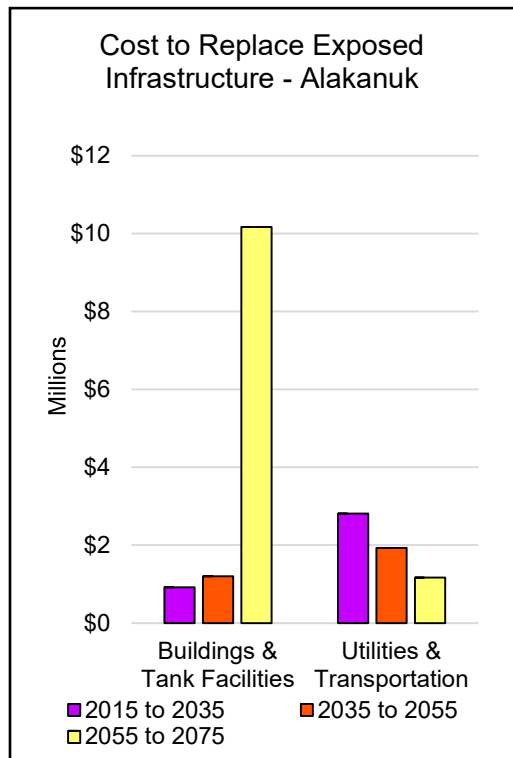


Figure 1. This figure summarizes the replacement cost of all infrastructure in the erosion forecast area. Twenty-year intervals are symbolized by color: purple represents the time interval 2015 to 2035, red represents 2035 to 2055, and yellow represents 2055 to 2075. The bulk of costs are buildings, especially from 2055 to 2075.

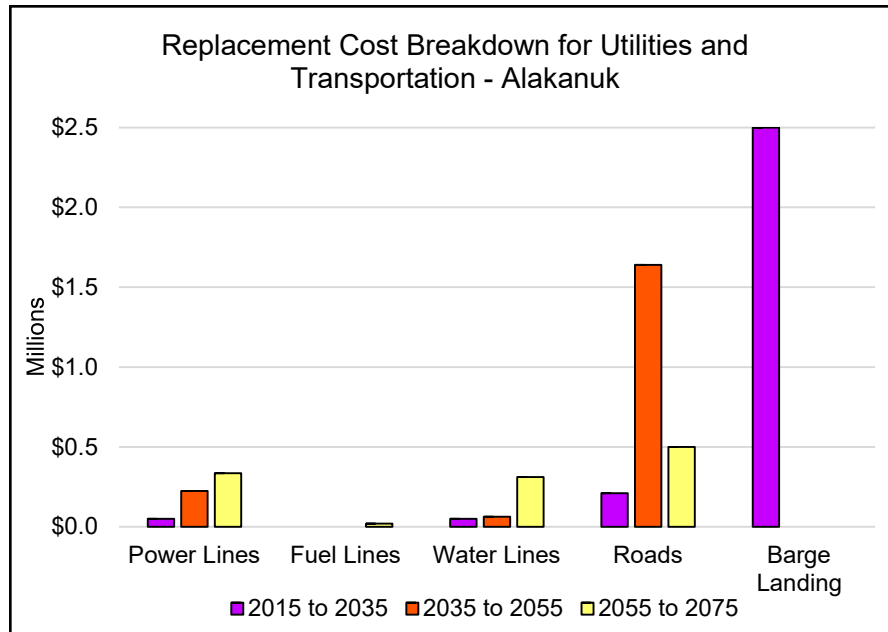


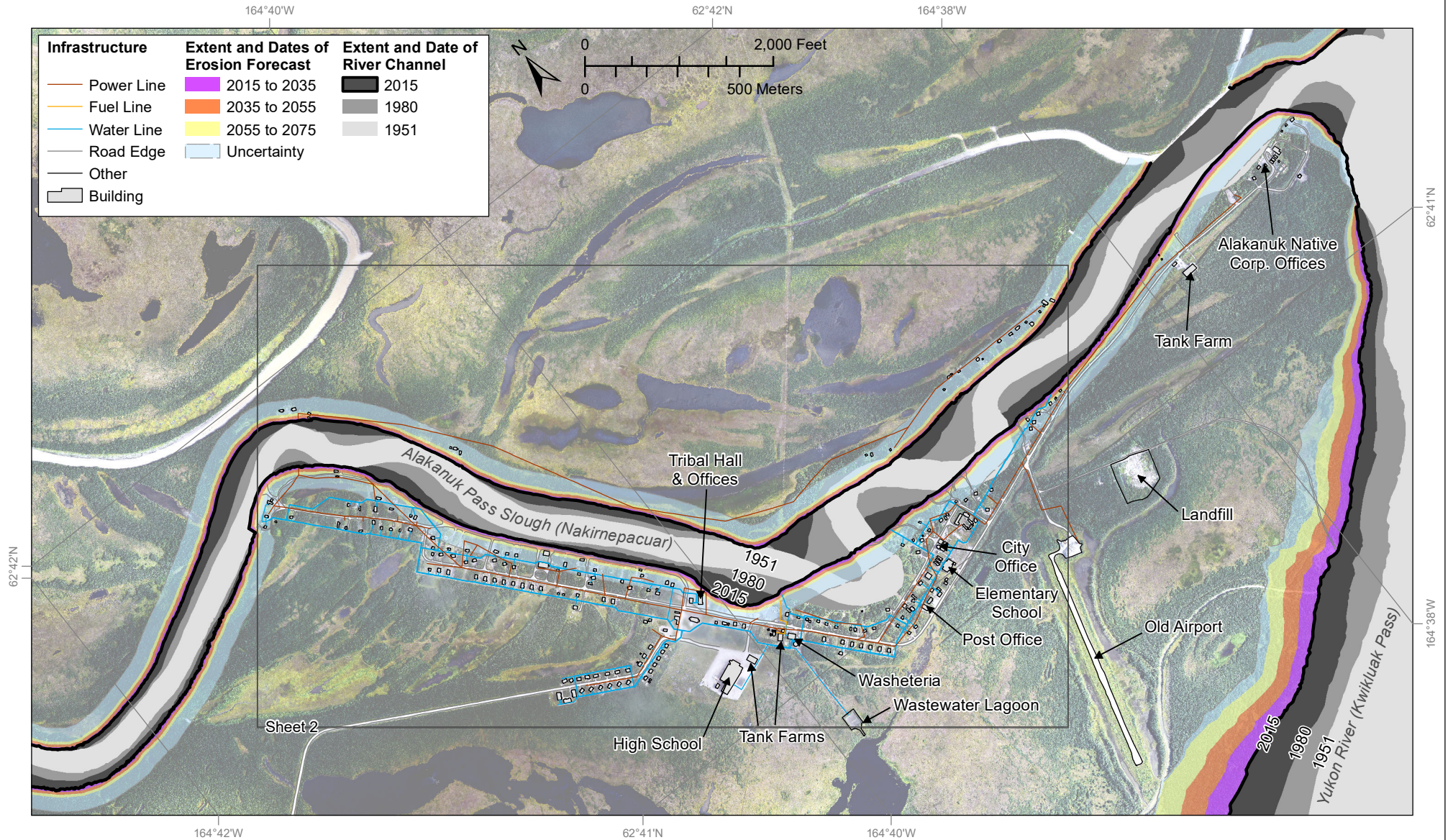
Figure 2. This figure breaks down the replacement cost of all utilities and transportation infrastructure in the erosion forecast area. The greatest cost is the barge landing, followed by erosion of roads from 2035 to 2055.

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Erosion Forecast Alakanuk, 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 shorelines (river areas shown in grayscale and labeled by year). The long-term (1951 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 Alakanuk, refer to the Alakanuk erosion exposure assessment report.

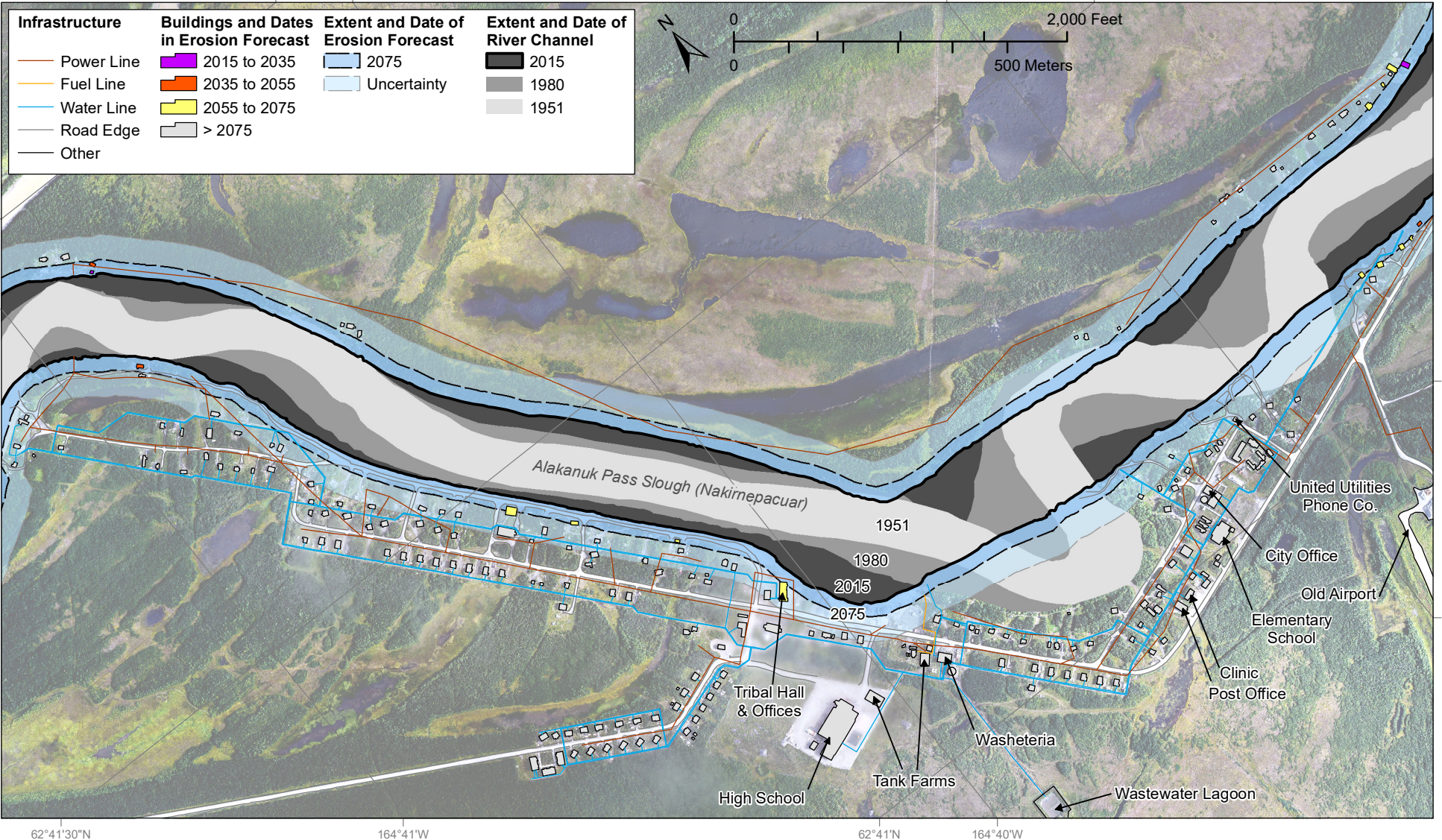
This work is part of the Coastal Infrastructure Erosion Vulnerability Assessment project funded by the Denali Commission Environmentally Threatened Communities Grant Program. Components of this map were prepared by the Alaska Department of Commerce, Community, and Economic Development (DCCED) using funding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



Erosion Exposure Alakanuk, Alaska

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Alakanuk, Sheet 2 of 2

62°42'N 164°40'W 164°39'W 62°41'30"N



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