Report of Investigation 2021-3 Emmonak

# EROSION EXPOSURE ASSESSMENT—EMMONAK

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Emmonak, Alaska, in 2014. Photo: ShoreZone, shorezone.org.

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State of Alaska
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Division of Geological & Geophysical Surveys

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# EROSION EXPOSURE ASSESSMENT—EMMONAK

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## EMMONAK EROSION EXPOSURE ASSESSMENT

This is a summary of erosion forecast results near infrastructure at Emmonak, 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, 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).

Emmonak is located on the north bank of Kwiguk Pass near the mouth of the Yukon River, 10 miles upriver from the Bering Sea coast. Kwiguk Pass is subject to storm surge and flooding from ice jams, spring melt, and rainfall runoff, all of which result in riverbank erosion (Overbeck and others, 2018). From 1950 to 2016, erosion rates range between 1 and 7.5 feet per year, with erosion being greatest upstream of the barge landing along the airport access road (Overbeck and others, 2020). Rock revetments installed in front of the fish processing


plant and near the downstream end of the community are continually being damaged and repaired (U.S. Army Corps of Engineers, 2019). Sections of riverbank that are set behind erosion protection infrastructure are not included in this study.

We forecast erosion 60 years from the most recent shoreline (2015) at 20-year intervals to identify the exposure of infrastructure to erosion. The erosion forecast east of the barge landing shows the airport access road is exposed to erosion between 2015 and 2035 (table 1). Further downstream, erosion is forecast to undermine buildings and utility and transportation infrastructure (table 1). Three buildings are exposed to erosion by 2035 with an additional 18 buildings by 2075 (table 3). The greatest cost of erosion exposure is forecast between 2055 and 2075 when multiple residences, public buildings and utility and transportation infrastructure are exposed (table 2; figs. 1 and 2). The total estimated cost of infrastructure replacement is $13.1 million (± $3.9 million) by 2075 (table 2; fig. 1). Buildings located directly across river from Emmonak are within the 2075 erosion forecast area (fig. 3). We did not include the cost of replacement for these facilities in our initial analysis because they were not identified on the community profile map provided by the Division of Community & Regional Affairs (2006).

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**Table 1.** Quantity of infrastructure with estimated erosion exposure by linear footage (LF), 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 (LF)** |
| 2015 to 2035 | 3 | 3,769 | 37 | 27 | 4,279 |
| 2035 to 2055 | 4 | 368 | 37 | 71 | 2,225 |
| 2055 to 2075 | 14 | 637 | 37 | 242 | 1,026 |
| Combined Total | 21 | 4,774 | 111 | 340 | 7,530 |

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

| Cost to Replace Exposed Infrastructure | | | | | | |
|---|---|---|---|---|---|---|
| **Erosion Forecast Date Range** | **Buildings & Tank Facilities** | **Power Lines** | **Fuel Lines** | **Water Lines** | **Roads** | **Sum** |
| 2015 to 2035 | $1,041,000 | $753,800 | $20,000 | $50,000 | $1,711,500 | $3,576,300 |
| 2035 to 2055 | $2,003,400 | $73,600 | $0 | $0 | $889,900 | $2,966,900 |
| 2055 to 2075 | $5,975,100 | $127,300 | $0 | $86,100 | $410,300 | $6,598,800 |
| Combined Total | $9,019,500 | $954,700 | $20,000 | $136,100 | $3,011,700 | $13,142,000 |

**Table 3.** Cost estimate of erosion exposure to buildings and tank facilities by 20-year interval. The count of exposed 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** | **Cost of Replacement** |
| 2015 to 2035 | Residential (1) | $541,000 |
| | Restaurant | $500,000 |
| | Unspecified (1) | NCA |
| 2035 to 2055 | Residential (2) | $1,003,400 |
| | Teacher Housing | $500,000 |
| | Alaska Commercial Co. | $500,000 |
| 2055 to 2075 | Residential (9) | $3,875,100 |
| | ADF&G (3) | $1,200,000 |
| | Church | $500,000 |
| | Unspecified (1) | $400,000 |

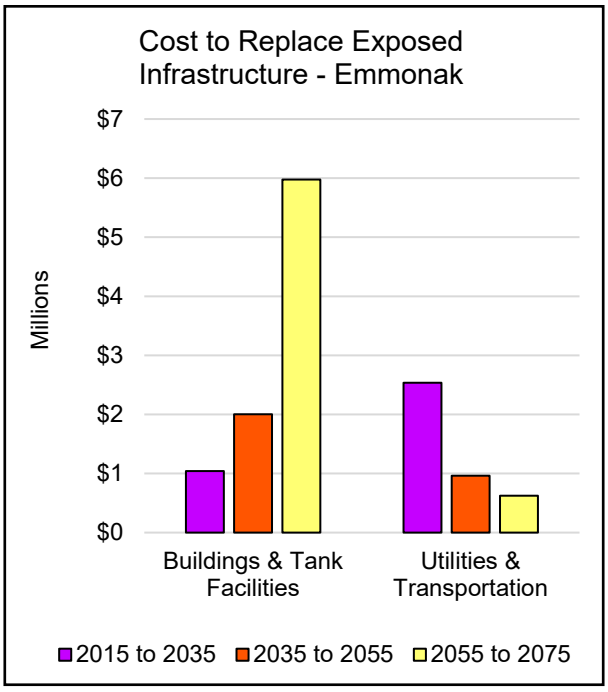


**Figure 1.** This figure summarizes the replacement cost of infrastructure in the erosion forecast area. Twenty-year intervals are symbolized by color: purple represents the time interval 2015 to 2035, red represents 2035 to 2055, and yellow represents 2055 to 2075. Bulk of costs occur from 2055 to 2075 when 14 buildings are at risk from erosion.

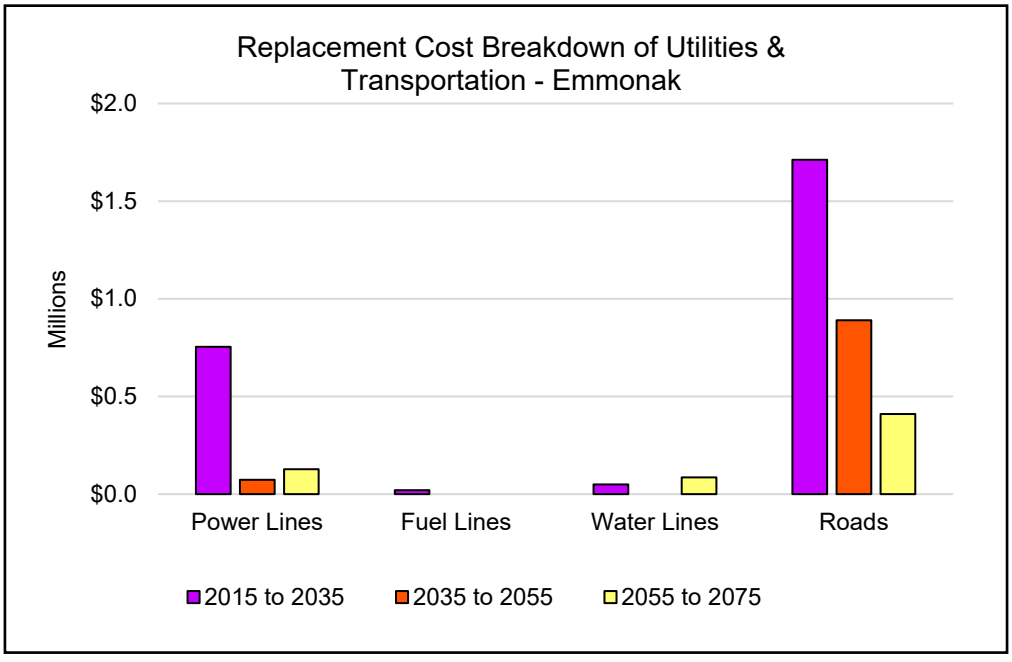


**Figure 2.** This figure summarizes the replacement cost of utilities and transportation infrastructure that are exposed to erosion per 20-year interval.

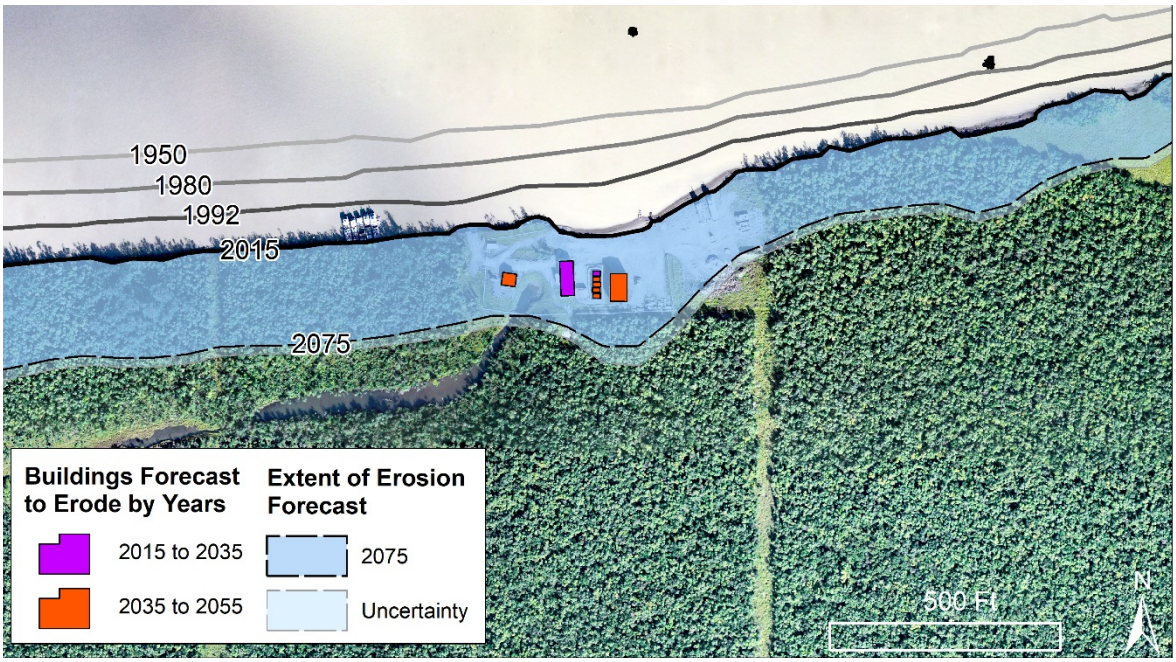


**Figure 3.** Buildings across river from Emmonak exposed to erosion between 2015 and 2055. Cost of erosion exposure is not included in this analysis because the buildings are not identified on the Emmonak community profile map provided by the Division of Community & Regional Affairs (2006).

## 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 Emmonak was not consulted for this report.

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# Erosion Forecast
## Emmonak, Alaska

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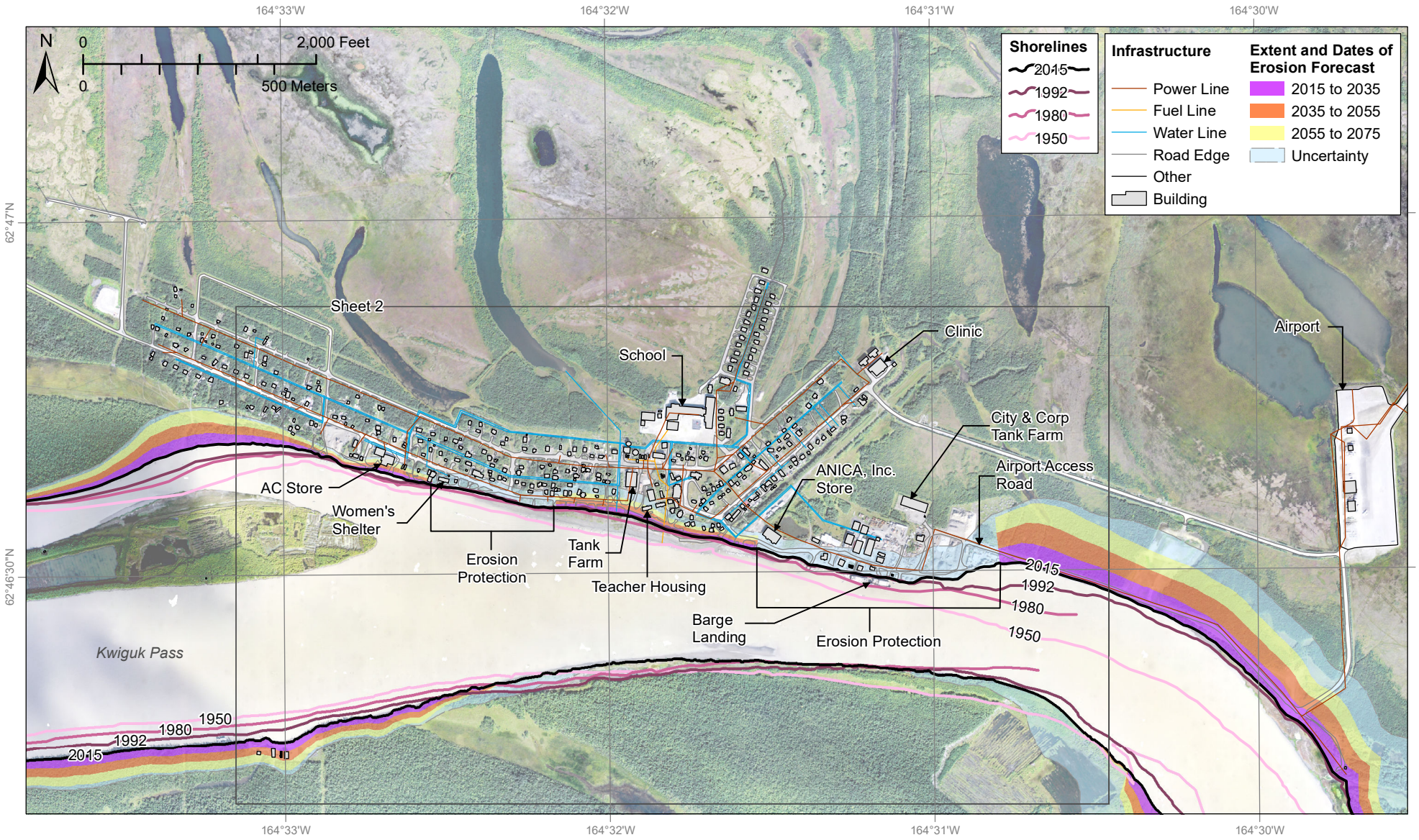
Emmonak, Sheet 1 of 2

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website: dggs.alaska.gov

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 (1950 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 Emmonak, refer to the Emmonak 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
## Emmonak, Alaska

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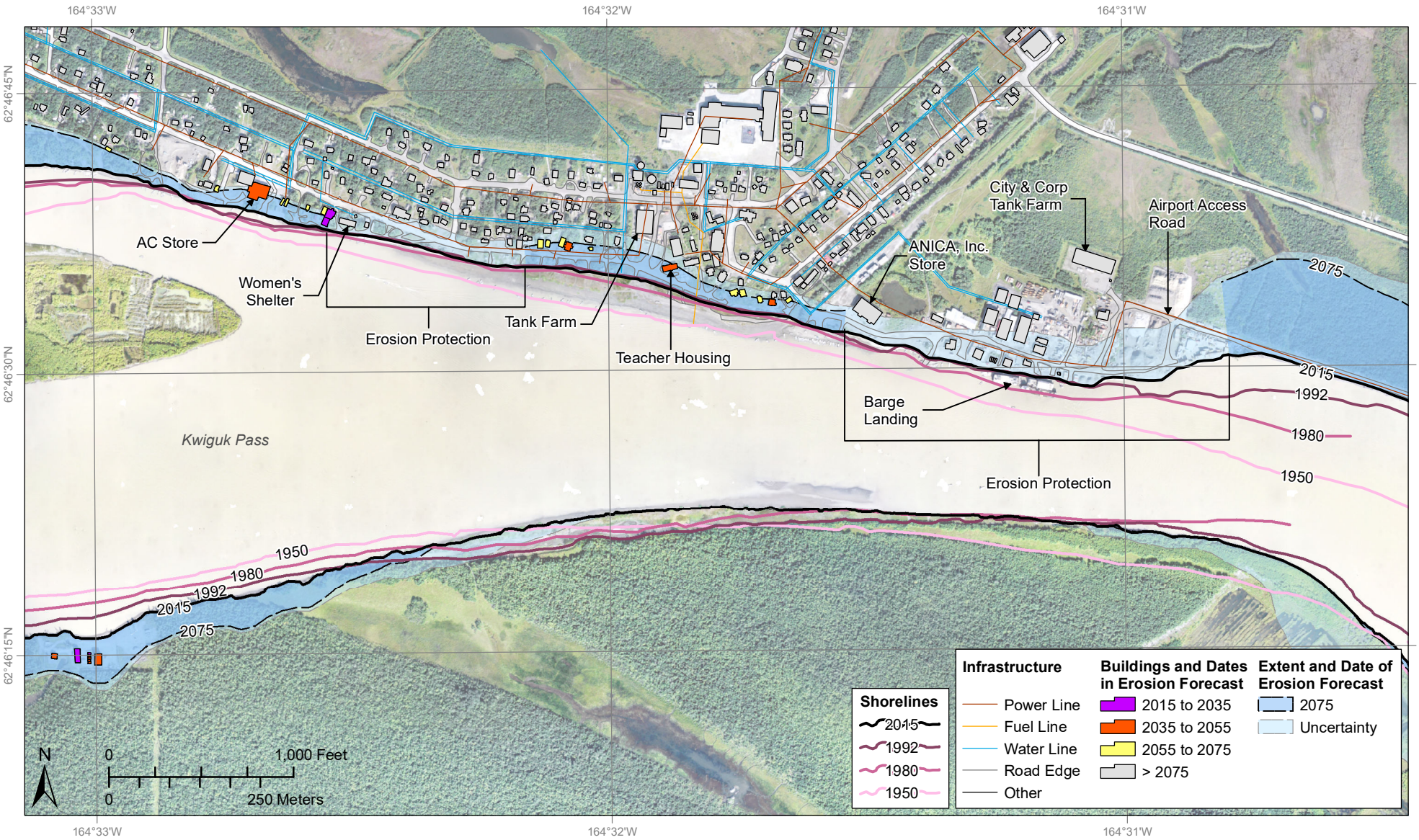
Buzard and others, 2021
Emmonak, Sheet 2 of 2

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