Report of Investigation 2021-3 Naknek

EROSION EXPOSURE ASSESSMENT—NAKNEK

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Naknek, Alaska, in 2006. ShoreZone, shorezone.org.

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EROSION EXPOSURE ASSESSMENT—NAKNEK

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NAKNEK EROSION EXPOSURE ASSESSMENT

This is a summary of erosion forecast results near infrastructure at Naknek, 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 the 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 (Quantum Spatial, 2019).
- Computed infrastructure cost of replacement based on square or linear footage from Buzard and others (2021).

Naknek is located at the head of Bristol Bay and the mouth of the Naknek River as it empties into Kvichak Bay. The coastline is macrotidal, making it primarily tidally influenced with tides ranging greater than 20 feet. The community of Naknek is perched on coastal bluffs that experience

undercutting from waves and high-water events as well as slumping and failure from runoff (Ecology & Environment, Inc. and LeMay Engineering & Consulting, Inc., 2017). Naknek is a commercial fishing industry hub of Bristol Bay and a large cargo hub for southwest Alaska (Ecology & Environment, Inc. and LeMay Engineering & Consulting, Inc., 2017). Large fishing and cargo vessels cause wake that can result in erosion.

We forecast erosion 60 years from the most recent shoreline (2018) at 20-year intervals to identify the exposure of infrastructure to erosion. The analysis is carried out on the northern bank of the Naknek River in areas that do not have docks or ports as well as along the western portion of Naknek on Kvichak Bay. Nearly 13,000 feet of the coastline in our study area has docks and other coastal infrastructure that does not allow us to forecast erosion because we cannot determine the effects dock infrastructure will have on erosion rates.

Erosion forecasts show five residential buildings, one commercial building, and two unspecified buildings are exposed to erosion in Naknek (tables 1–3). By 2078, erosion is forecast to undermine three feet of power lines and 225 feet of roads (table

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1; fig. 1). The total replacement cost of infrastructure is $3.5 million (± $1.1 million) through 2078 (table 2; figs. 1 and 2). We do not estimate erosion exposure for fuel lines because the data are not available. Although the erosion forecast does not reach the Naknek wastewater facility, the shoreline may erode close enough to impact its function. Most shorelines used in this analysis are bluff top edges. The shoreline east of the Port of Bristol Bay is a grassy lowland area, which is forecast to erode approximately 220 feet, but uncertainty is large due to accretion from 1951 to 1980 and erosion from 1980 to 2018. If the grassland erodes, rates may slow when the shoreline reaches the forested bluff (indicated with a green line) inland.

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 (n)	Power Lines (LF)	Water Lines (LF)	Roads (LF)
2018 to 2038	2	0	0	48
2038 to 2058	3	3	0	83
2058 to 2078	3	0	0	94
Combined Total	8	3	0	225

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

Cost to Replace Impacted Infrastructure					
Erosion Forecast Date Range	Buildings	Power Lines	Water Lines	Roads	Sum
2018 to 2038	$800,000	$0	$0	$200,000	$1,000,000
2038 to 2058	$1,567,100	$50,000	$0	$0	$1,617,100
2058 to 2078	$912,100	$0	$0	$0	$912,100
Combined Total	$3,279,200	$50,000	$0	$200,000	$3,529,200

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 Buildings and Tank Facilities		
Erosion Forecast Date Range	Building Type	Cost of Replacement
2018 to 2038	Residential (1)	$400,000
	Unspecified (1)	$400,000
2038 to 2058	Residential (2)	$890,600
	Unspecified (1)	$676,500
2058 to 2078	Residential (2)	$912,100
	Commercial (1)	NCA

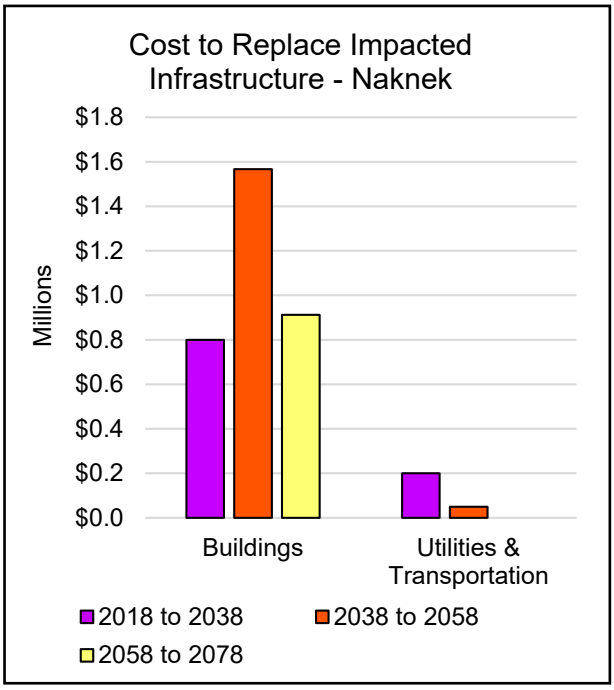

Figure 1. This figure summarizes the replacement cost of all infrastructure in the erosion forecast area. Twenty-year intervals are symbolized by color: purple represents the time interval 2018 to 2038, red represents 2038 to 2058, and yellow represents 2058 to 2078. The bulk of costs are buildings, especially from 2038 to 2058.

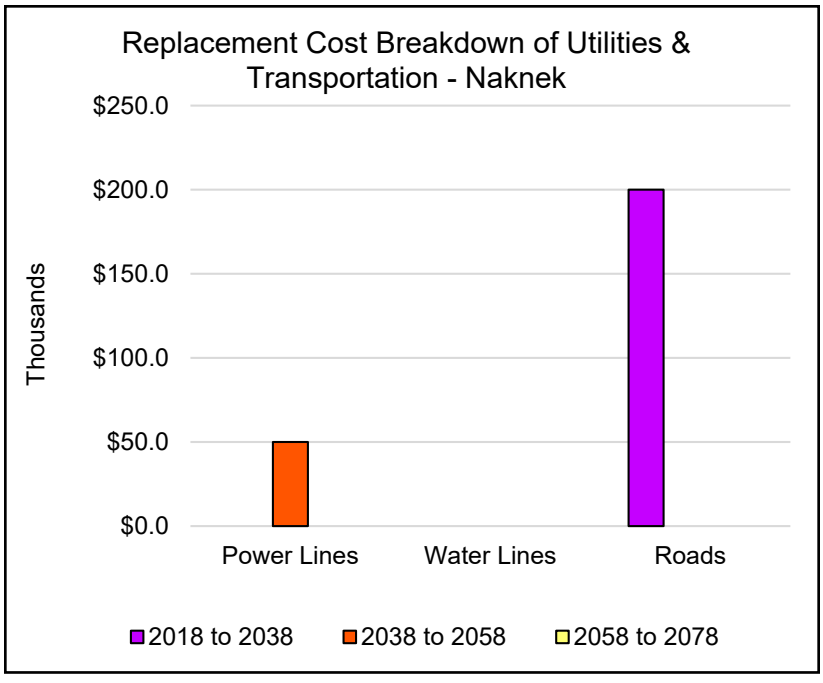

Figure 2. This figure breaks down the replacement cost of all utilities and transportation. The greatest cost is erosion of roads from 2018 to 2038.

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 Naknek was not consulted for this report.

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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 Forecast
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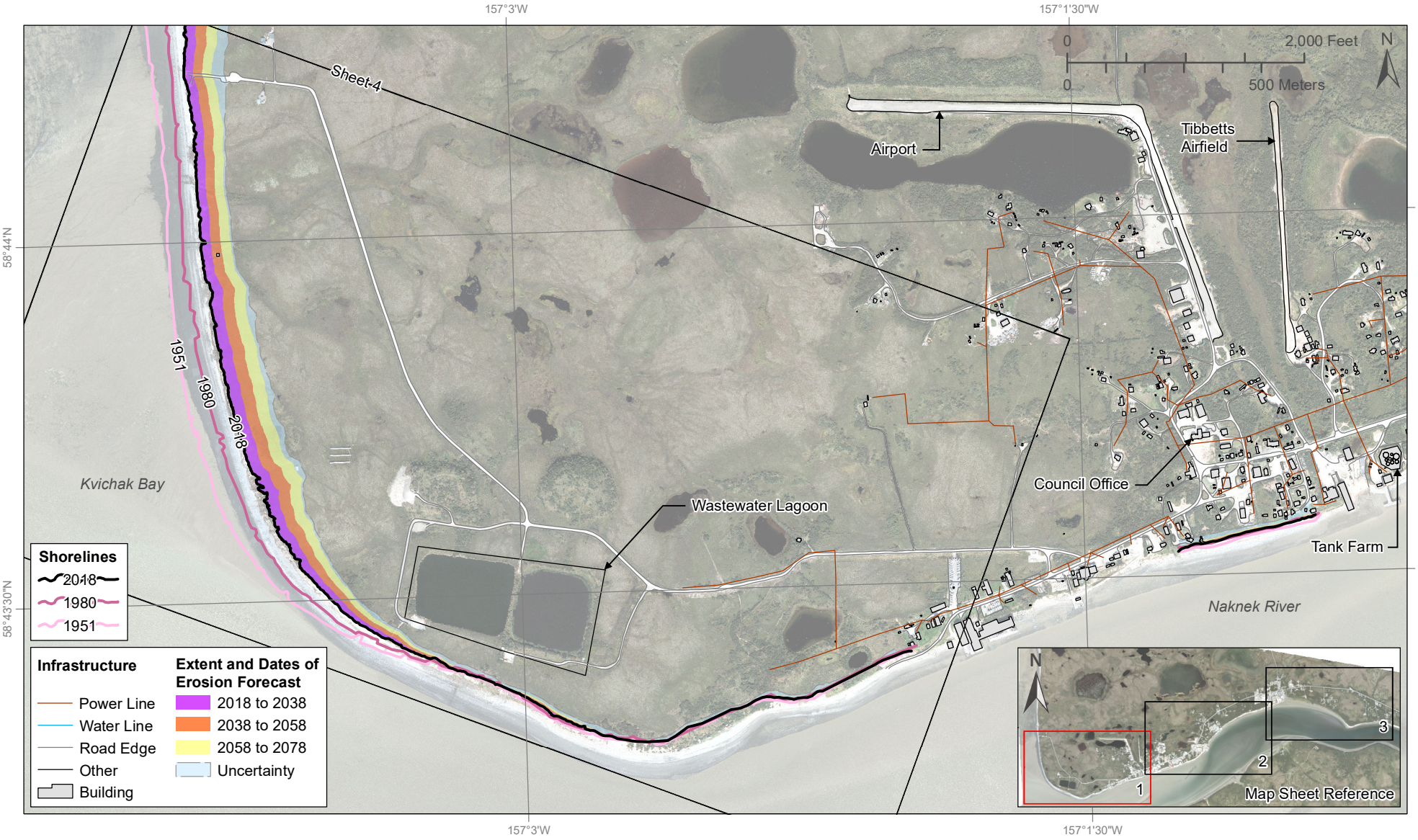

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Projection: NAD83 UTM Zone 4N. Orthoimagery year: 2018. Orthoimagery available from elevation.alaska.gov

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 (1951 to 2018) 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: 2018 to 2038 (purple), 2038 to 2058 (orange), and 2058 to 2078 (yellow). The area of uncertainty of the 2078 shoreline at a 90 percent confidence interval is light blue. Areas that are not colored by time interval are not forecast to erode by 2078 based on the historical shoreline change rate. For more detailed information about the impacts to infrastructure from erosion at Naknek, refer to the Naknek erosion exposure assessment report.

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Erosion Forecast
Naknek, Alaska

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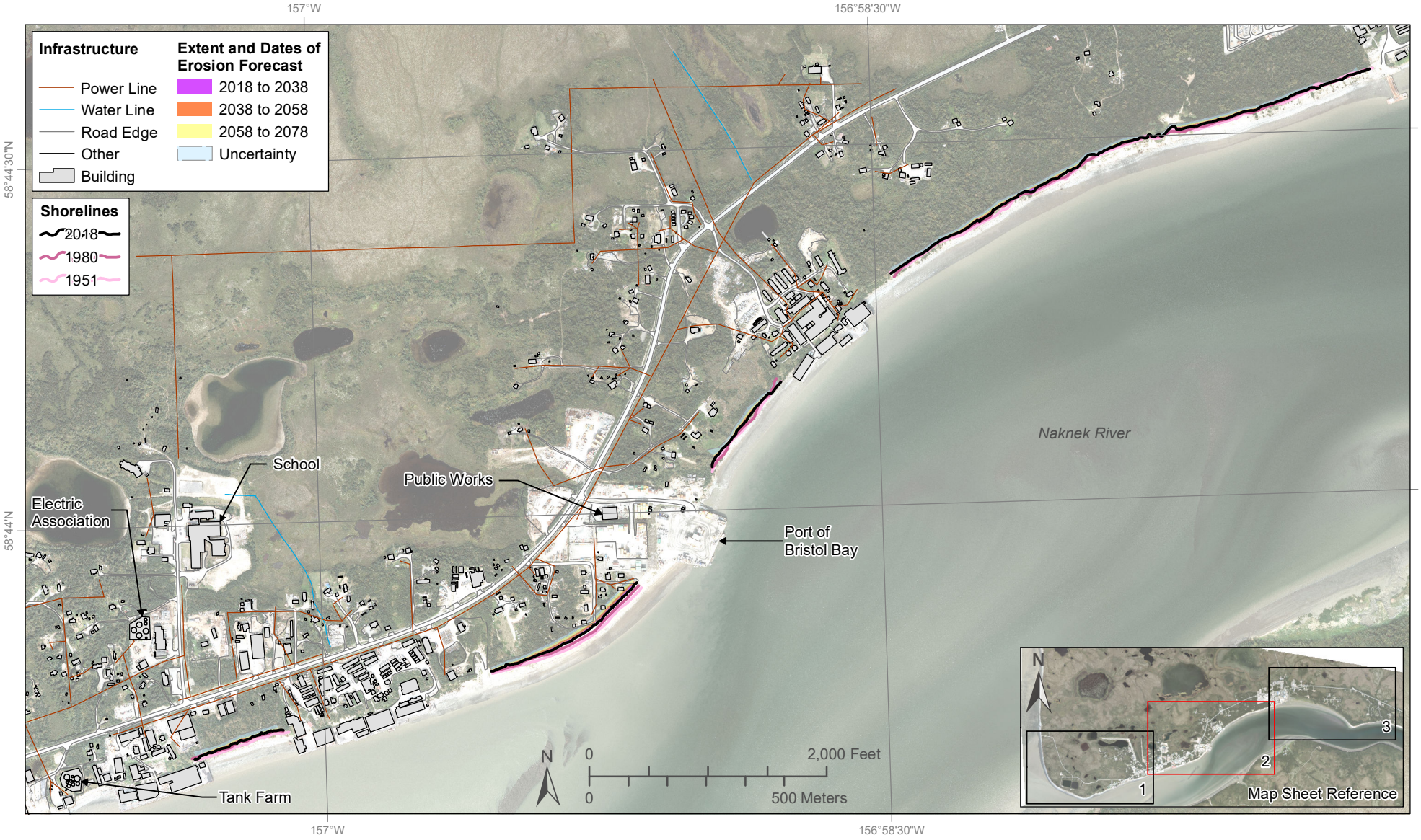

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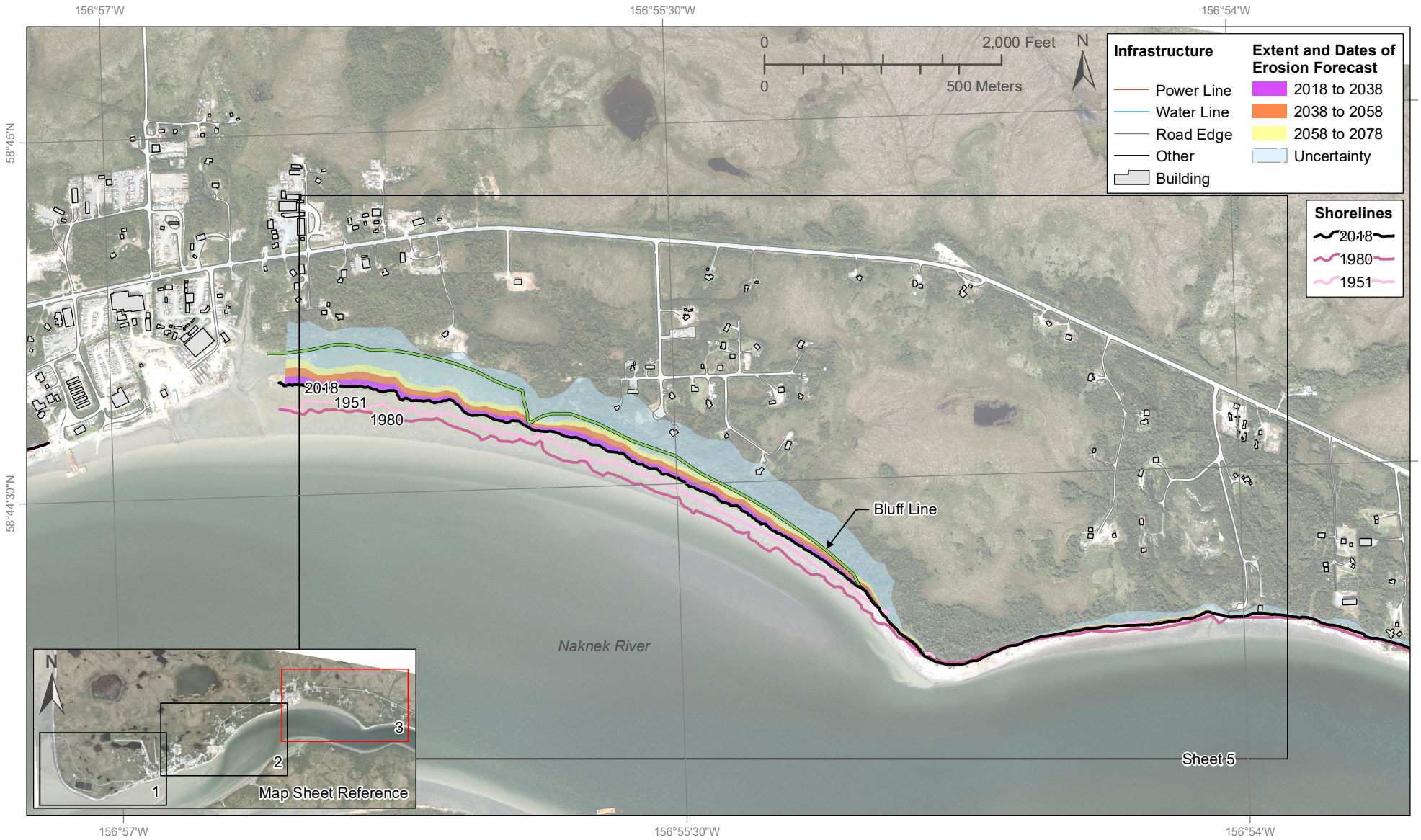

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Erosion Exposure
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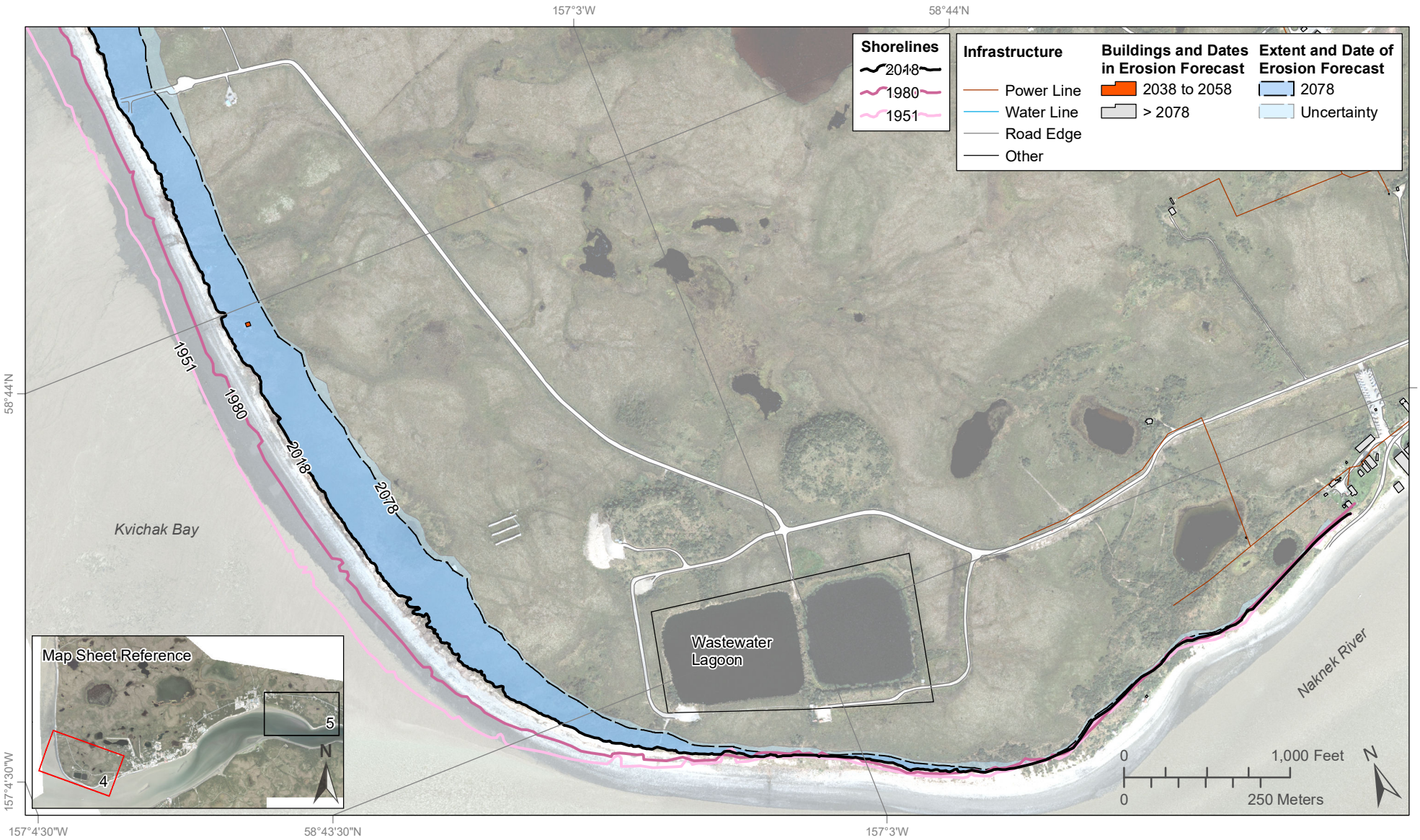

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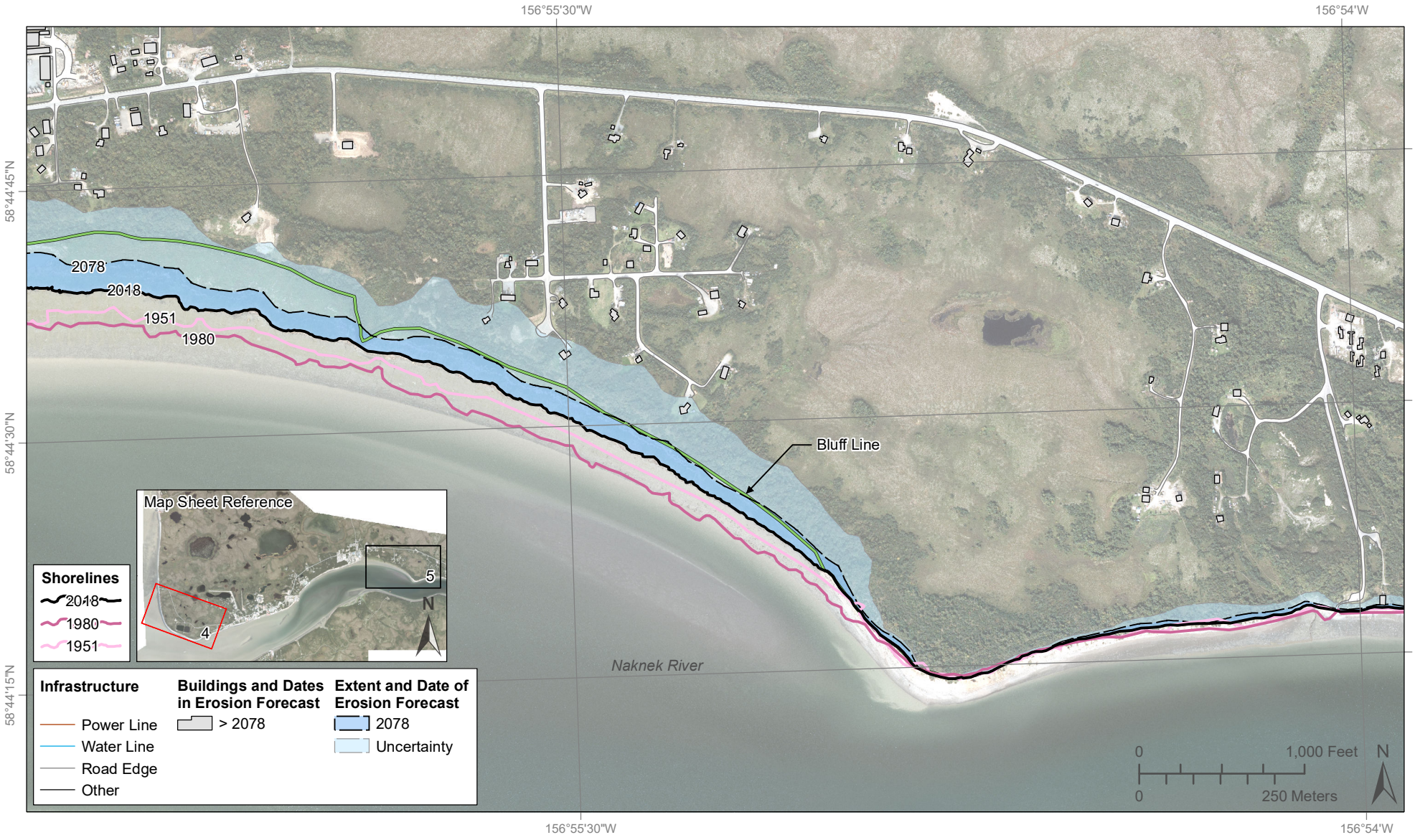

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