Report of Investigation 2021-3 Dillingham

EROSION EXPOSURE ASSESSMENT—DILLINGHAM

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Dillingham, Alaska in 2004. Photo: Alaska Division of Community and Regional Affairs, www.commerce.alaska.gov/dcra/dcrarepoext/Pages/PhotoLibrary.aspx.

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Division of Geological & Geophysical Surveys

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EROSION EXPOSURE ASSESSMENT—DILLINGHAM

Richard M. Buzard[1], Mark M. Turner[1], Katie Y. Miller[1], Donald C. Antrobus[2], and Jacquelyn R. Overbeck[1]

DILLINGHAM EROSION EXPOSURE ASSESSMENT

This is a summary of erosion forecast results near infrastructure at Dillingham, 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 GIS shapefiles and metadata from the City of Dillingham (2021) GIS Public Works open data site.
- Added infrastructure such as roads and buildings, 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).

Dillingham is located in southwest Alaska at the head of Nushagak Bay at the confluence of the Wood and Nushagak Rivers. Erosion at Dillingham is caused by tidal fluctuations and severe storm events (City of Dillingham, 2016). Erosion ranges from 3 to 9.8 feet per year along most of the shoreline fronting the City of Dillingham but reaches up to 16.4 feet per year on the shoreline adjacent to the wastewater lagoon (Overbeck and

others, 2020). Efforts to control riverbank erosion began in 1983 with the construction of a seawall east of the city dock to Snag Point (U.S. Army Corps of Engineers, 2009). Shoreline protections also exist along the east bank of the boat harbor and along the shoreline fronting the mooring facilities of Bristol Alliance Fuels.

We forecast erosion 60 years from the most recent shoreline (2018) at 20-year intervals to identify the exposure of infrastructure to erosion (tables 1–3). Erosion is not forecast where shoreline protection structures exist. Southwest of the boat harbor, erosion is forecast to reach 17 buildings between 2038 and 2078 (table 1). These are either identified as residences or unspecified (table 3). East of Snag Point, rapid and consistent erosion of a peat meadow is encroaching on the wastewater lagoon and nearby water and sewer lines. The City of Dillingham (2018) reports the sewage outfall pipe is currently experiencing erosion impacts. Erosion is forecast to undermine the entire pipe and reach the wastewater lagoon by 2058. However, the peat meadow fronting the lagoon infrastructure transitions into a vegetated hill covered with fill from the lagoon's construction (fig. 1). This topographic variation

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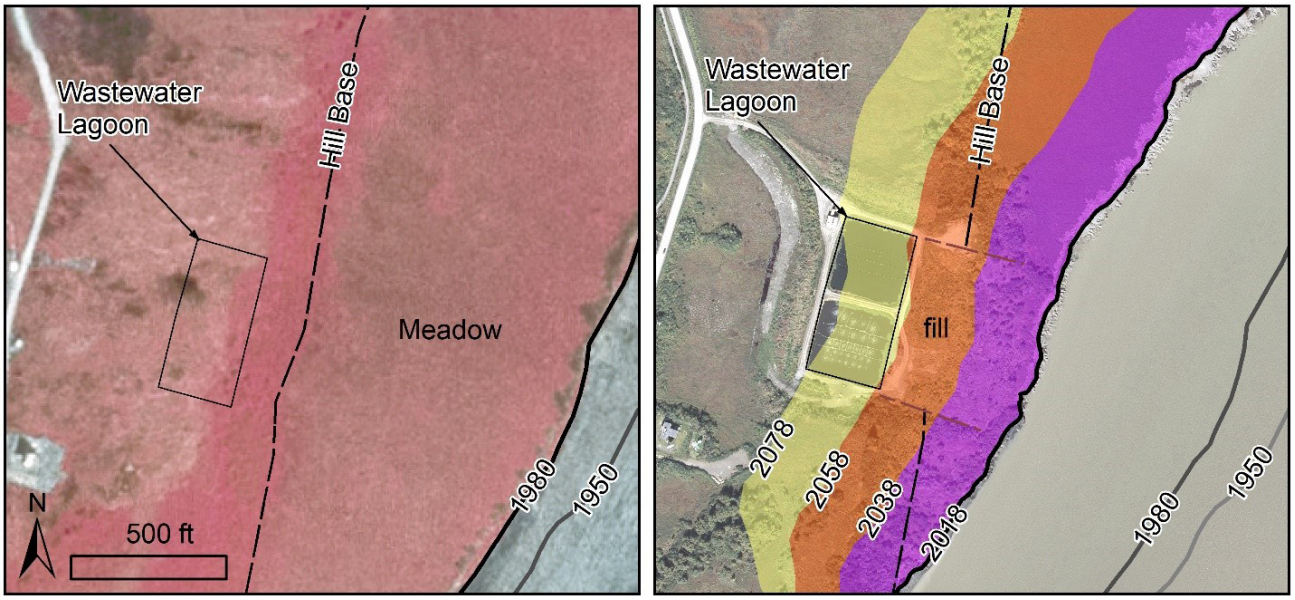

Figure 1. Predicted erosion changes at Dillingham wastewater lagoon. (Left) The color-infrared image of the 1980 Dillingham coast shows the base of the hill. (Right) 2018 image of the same area. The wastewater lagoon is built into the hill, and fill from the construction is deposited seaward. Erosion continues at a linear rate toward the hill's base and fill area, suggesting exposure by 2058. However, the fill area has different lithology and vegetation cover that can significantly change erosion rates.

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)**	**Water Lines (LF)**	**Roads (LF)**	**Wastewater Lagoon (SF)**
2018 to 2038	0	610	0	0
2038 to 2058	9	981	0	2,006
2058 to 2078	8	1,258	856	97,854
Combined Total	17	2,849	856	99,860

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**	**Water Lines**	**Roads**	**Wastewater Lagoon**	**Sum**
2018 to 2038	$0	$244,100	$0	$0	$244,100
2038 to 2058	$4,506,200	$392,500	$0	$6,000,000	$10,898,700
2058 to 2078	$2,480,100	$503,100	$342,300	$0	$3,325,500
Combined Total	$6,986,300	$1,139,700	$342,300	$6,000,000	$14,468,300

Table 3. Cost estimate of exposed buildings and tank facilities by 20-year interval. The count of exposed residential or unspecified buildings is denoted in parentheses.

Cost to Replace Exposed Buildings and Tank Facilities		
Erosion Forecast Date Range	**Building Type**	**Cost of Replacement**
2018 to 2038	none	0
2038 to 2058	Residential (4)	$ 2,808,500
	Unspecified (5)	$ 1,697,700
2058 to 2078	Residential (2)	$ 1,180,100
	Unspecified (6)	$ 1,300,000

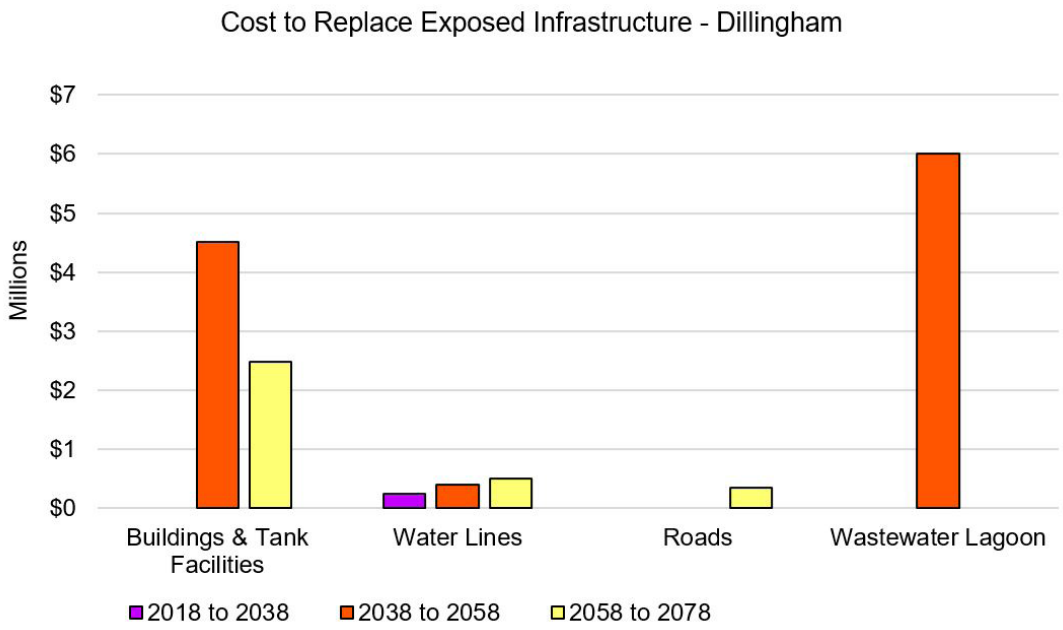

Figure 2. This figure shows the replacement cost of utilities, transportation infrastructure, and buildings in the erosion forecast area. Twenty-year intervals are symbolized by color: purple represents the time interval 2018 to 2038, orange represents 2038 to 2058, and yellow represents 2058 to 2078. The greatest single cost is the wastewater lagoon that is forecast to begin experiencing erosion by 2058. The total cost of buildings exceeds this, reaching over $7.0 million.

can significantly alter the rate of erosion, so a site investigation is appropriate to assess exposure of the lagoon and nearby infrastructure more accurately. The total estimated replacement cost of infrastructure exposed to erosion is $14.5 million (± $4.3 million) by 2078 (table 2; fig. 2). We do not estimate erosion exposure for power and fuel infrastructure because the data were not available.

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 Dillingham 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
Dillingham, Alaska

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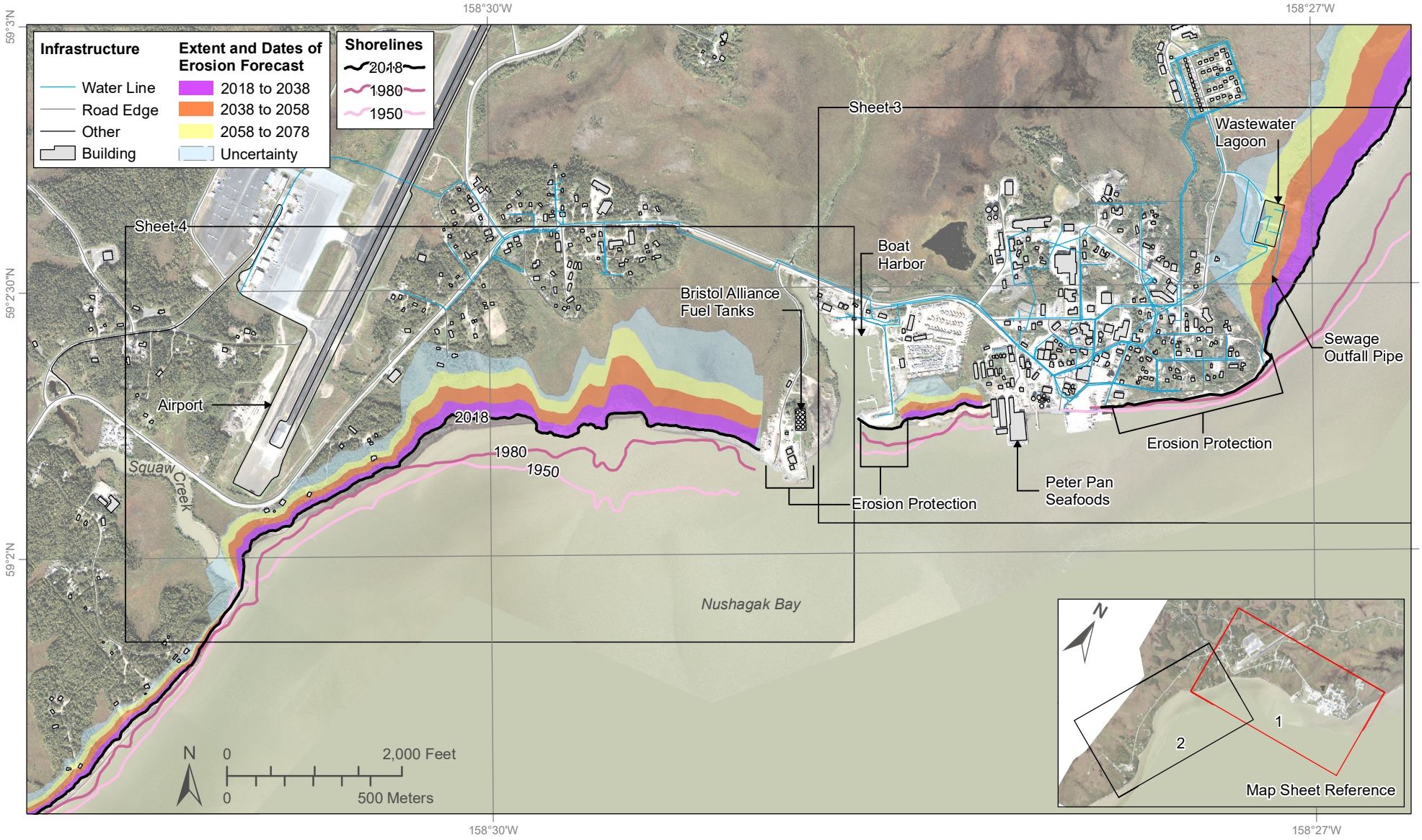

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Projection: NAD83 UTM Zone 4N. Orthoimagery year: 2018. Orthoimagery available from elevation.alaska.gov

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 (1950 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 Dillingham, refer to the Dillingham erosion exposure assessment report.

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Erosion Forecast
Dillingham, Alaska

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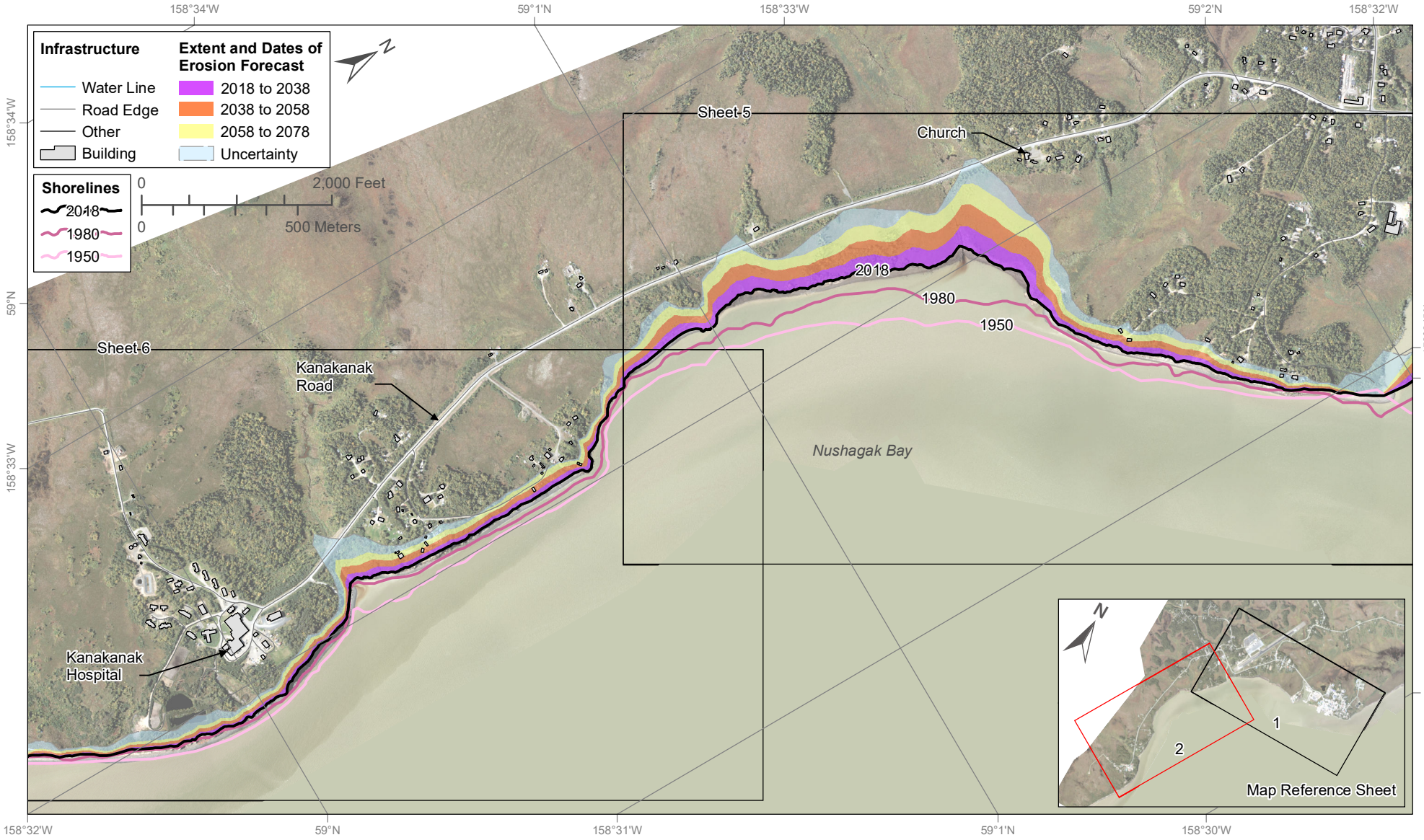

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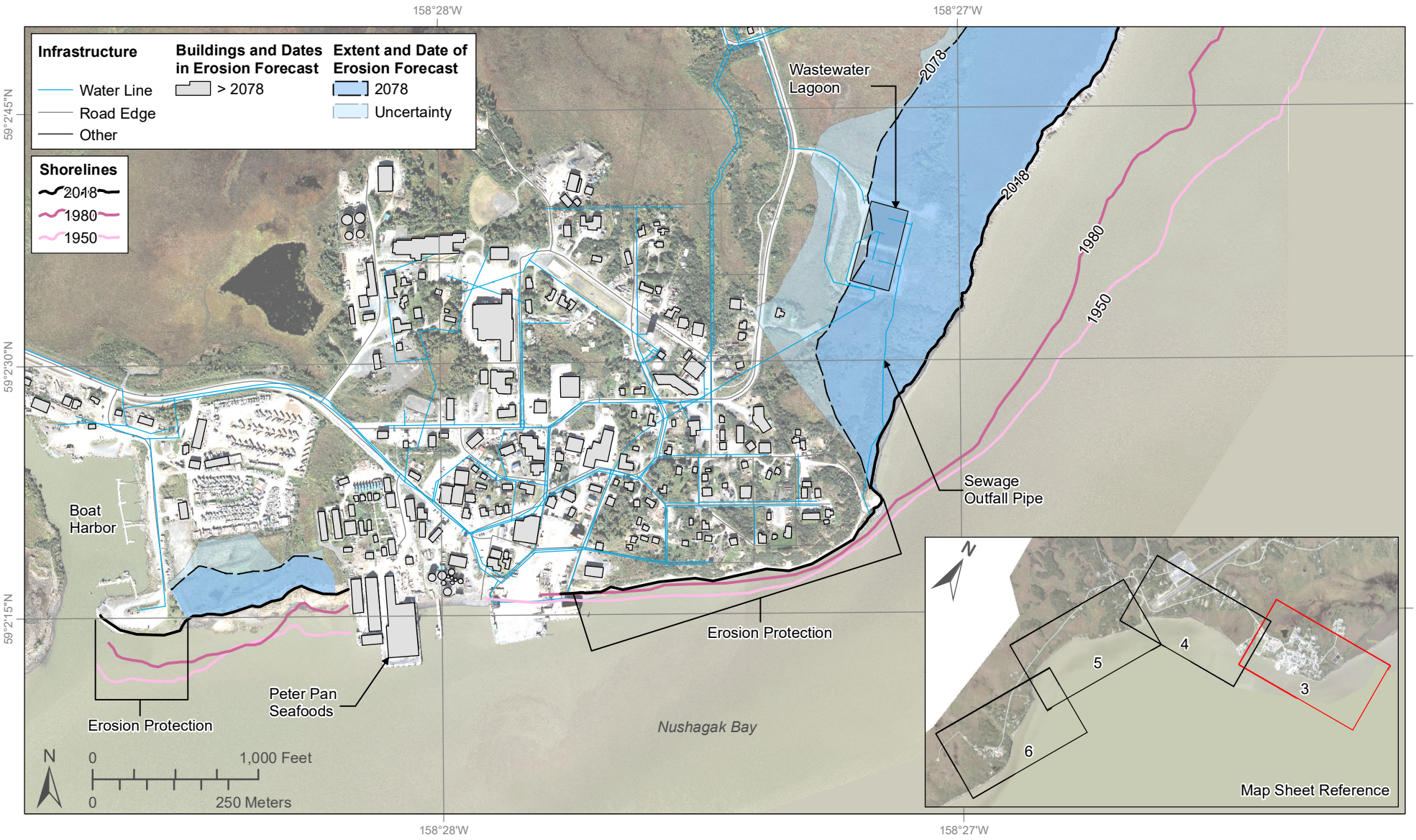

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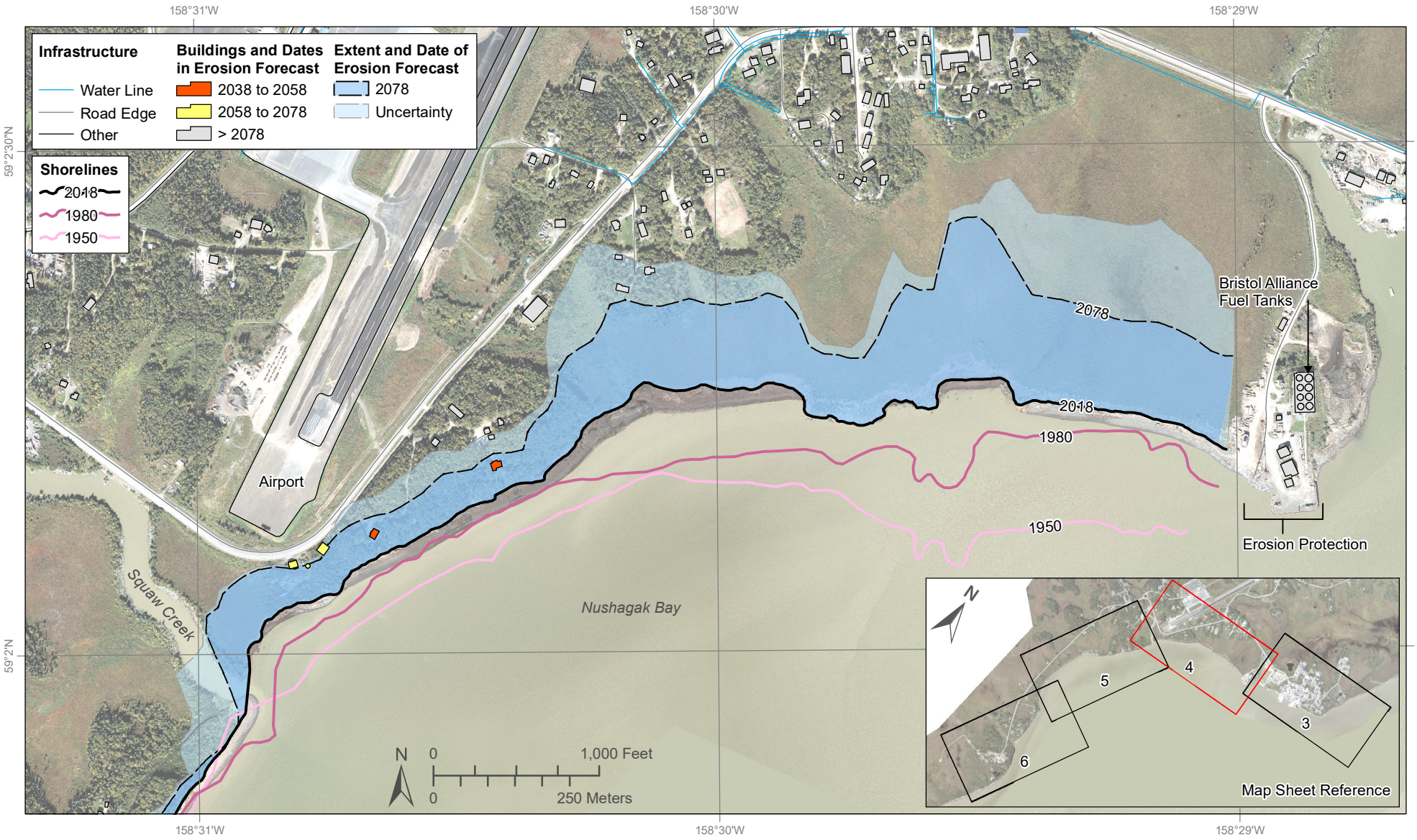

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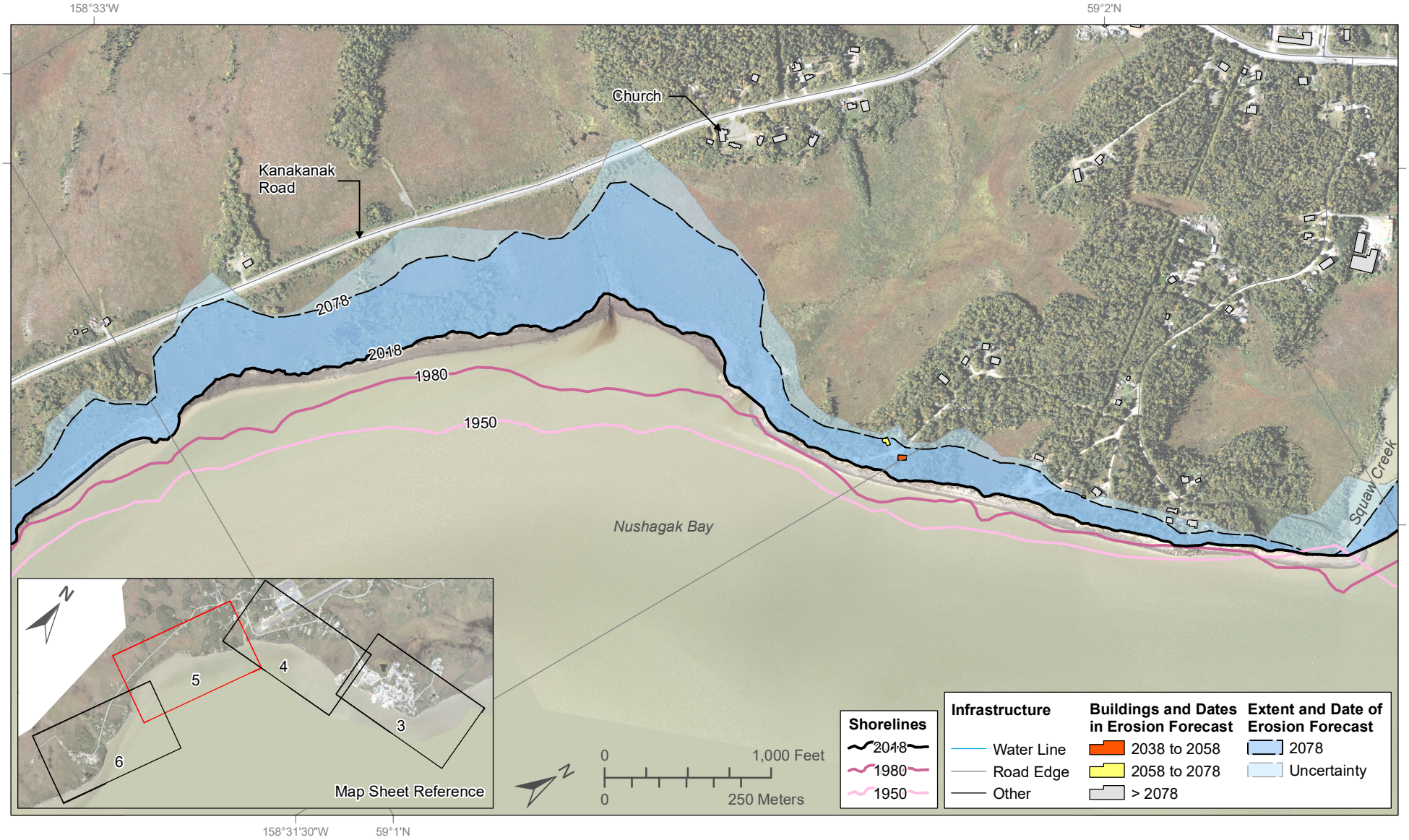

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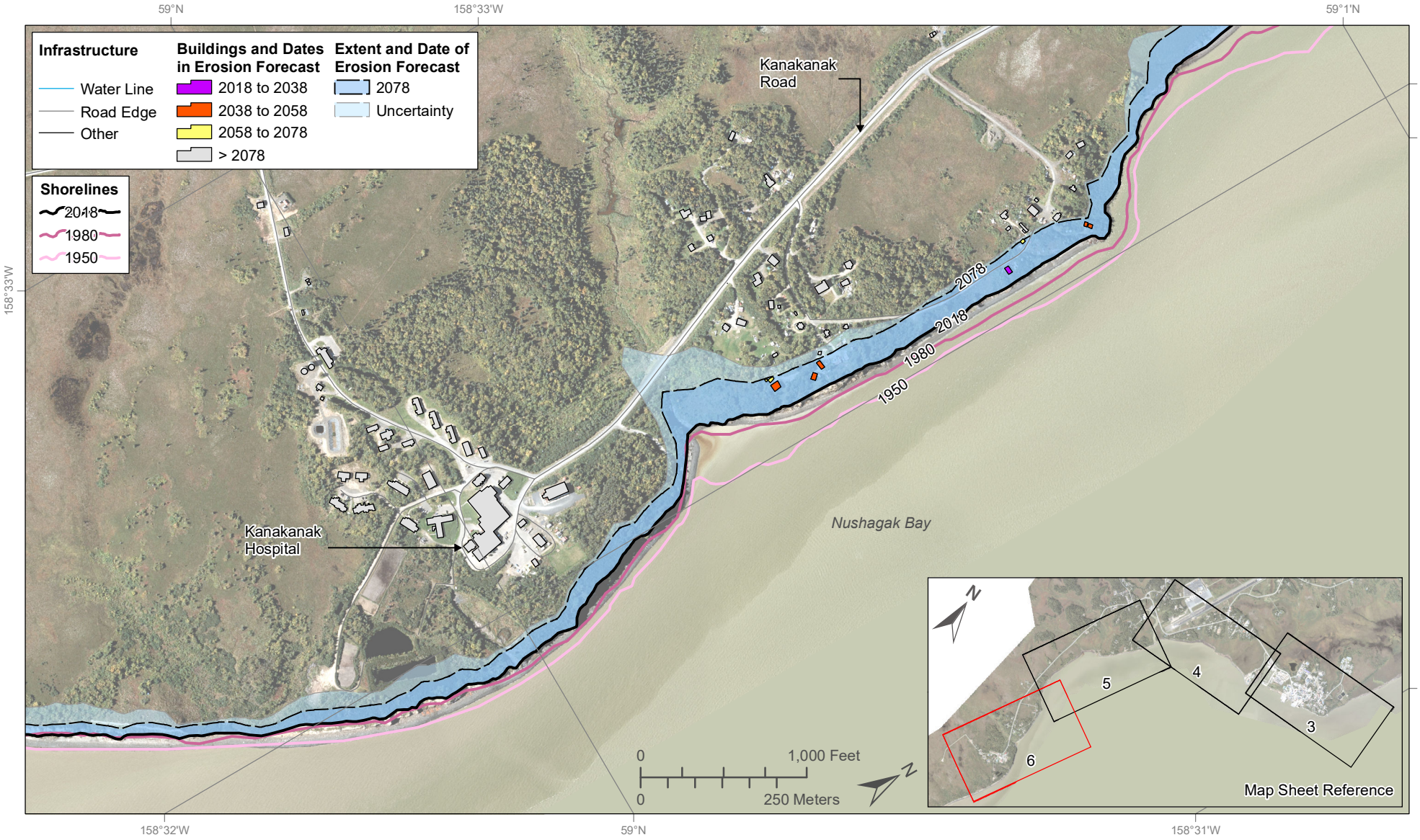

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