

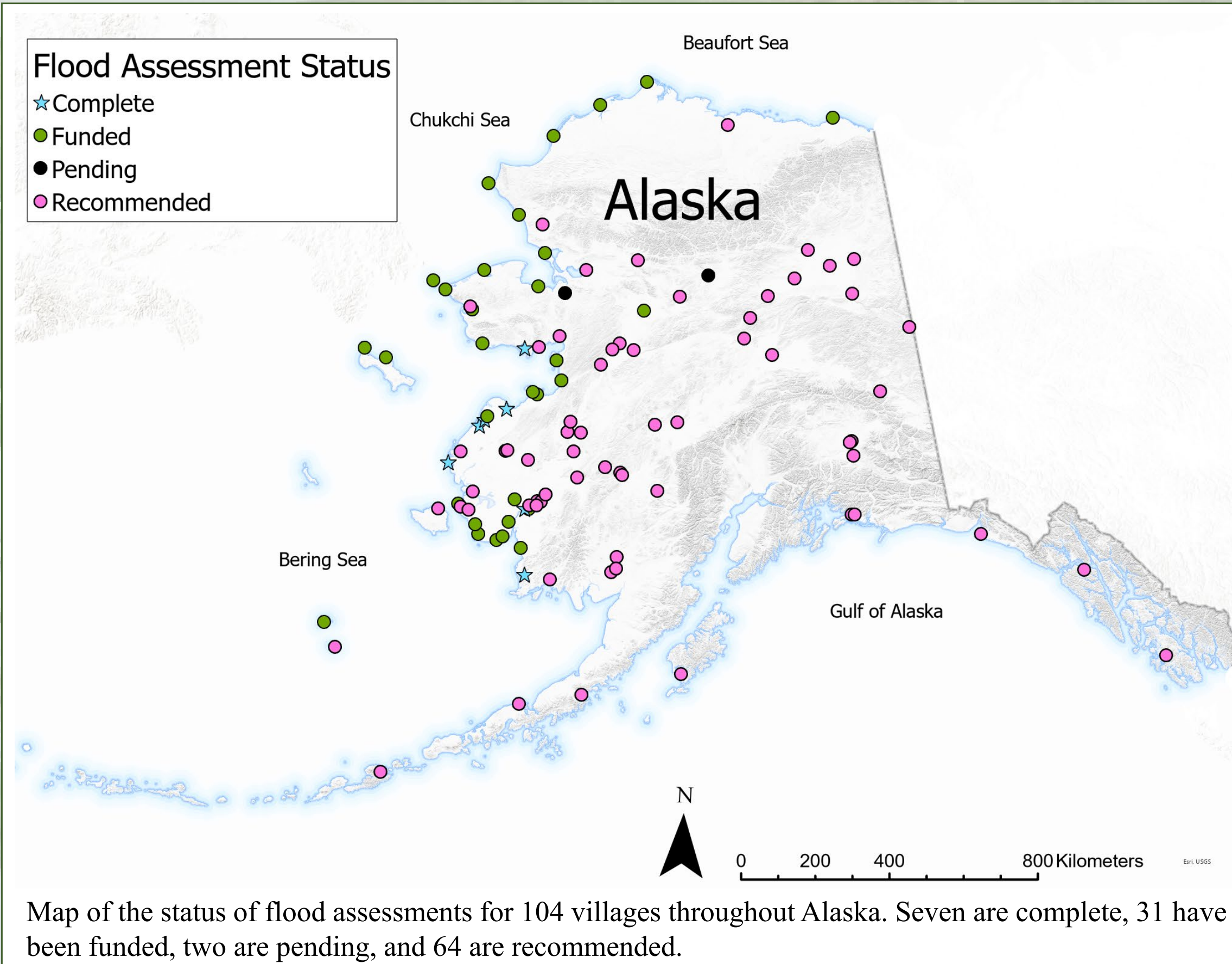
Developing Flood Impact Assessments to Support Alaska Coastal Communities

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Arctic Coastal Dynamics: Rates, Impacts, Hazards, and Implications for the Future III Poster
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Abstract

Coastal communities in Alaska experience frequent flooding from storms, yet the majority don't have a clear and consistent storm and associated flooding record. Local and statewide flood mitigation decisions require a clear understanding of flood risk, but the risk for many communities has not been adequately determined due to lack of official records or interpretation of flood impacts. One key dataset that is commonly missing is a complete list of all known flood events, along with flood heights relative to a consistent vertical datum. Water level sensors are largely absent in rural Alaska so determining the height of past events requires more creative efforts. This poster expands upon a methodology for compiling historical storm heights and identifying flood impact categories for individual communities in Alaska. Estimates are computed from community-based observations and written accounts estimating the height of recorded flood events. Flood impact categories are defined using National Weather Service terminology and are based on the elevation of residences, airstrips, and other critical infrastructure within the community. Flood categories are reported in community specific reports and map products, which can be used to estimate flood impacts from forecast storms and inform infrastructure management.



Background

Like much of the eastern U.S., western Alaska is subject to damaging storm surge from Arctic and extra-tropical cyclones. Along the western coast of Alaska are numerous isolated rural communities which are impacted by these storms. Typically storms occur during winter months when temperatures are low and daylight hours are minimal, compounding challenges in forecasting, monitoring, and emergency response. The significant flood and erosion hazard has led many community planners to develop mitigation plans or even partial or total relocation of a community. Reports show at least 187 villages are experiencing erosion and/or flooding impacts (UAF and USACE 2019). However, flood history in western Alaska is poorly documented and baseline flood planning resources are often out of date. These types of documentation are critical for communities not only for planning purposes, but also for funding and emergency assistance during a disaster. The work performed here is one of the first major efforts to create a comprehensive flood information resource based on observed events.

References

Buzard, R.M., Overbeck, J.R., Christ, Jonathan, Endres, K.L., and Plumb, E.W., 2021, Coastal flood impact assessments for Alaska communities: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2021-1, 16 p.
 Buzard, R.M., Overbeck, J.R., Turner, M.M., and Christian, J.E., 2022, Coastal flood impact assessments for Alaska communities: Kotlik, in Buzard, R.M., Overbeck, J.R., Christ, Jonathan, Endres, K.L., and Plumb, E.W., Coastal flood impact assessments for Alaska communities: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2021-1C, 57 p. <https://doi.org/10.14509/30783>
 Overbeck, J., Hendricks, M.D., and Kinsman, N.E.M., 2016, Photogrammetric digital surface models and orthoimagery for 26 coastal communities of western Alaska, in DGGs Staff, Elevation Datasets of Alaska: Alaska Division of Geological & Geophysical Surveys Raw Data File 2016-1, 3 p.
 UAF and USACE. 2019. "Statewide Threat Assessment: Identification of Threats from Erosion, Flooding, and Thawing Permafrost in Remote Alaska Communities".

Methods

The community-based flood assessments include three primary analyses:

1. Estimating historical storm heights based on written and photographic accounts of past storms.
2. On the ground field documentation, confirmation, and engagement with community members.
3. Determining the community's thresholds of minor, moderate, and major flooding as defined by the National Weather Service (NWS).



Major flooding: At what height...

1. Have several buildings been flooded with over 1 foot of water?
2. Have the fuel storage or power generation facilities flooded?
3. Has the airstrip been completely inundated?
4. Has flood water reached the drinking water source?
5. Has flood water reached wastewater facilities?

Moderate flooding: At what height...

1. Have several buildings been flooded with up to 1 foot of water?
2. Have people in the lowest area(s) been evacuated to higher ground due to flooding?
3. Has flood water cut off access to larger parts of town?
4. Has flooding closed the airstrip?

Minor flooding: At what height...

1. Has water come into yards, or under elevated buildings?
2. Has flooding reached property (such as vehicles, not homes) in low lying areas?
3. Has flooding reached roads or the airport runway, but remained low enough to safely travel?

Tidal Datum	Abbreviation	ft MHHW	m NAVD88
Mean Higher High Water	MHHW	0.00	1.913
Mean High Water	MHW	-0.86	1.649
Mean Tide Level	MTL	-1.95	1.318
Mean Sea Level	MSL	-2.05	1.289
Mean Low Water	MLW	-3.04	0.985
Mean Lower Low Water	MLLW	-3.22	0.932
North American Vertical Datum of 1988	NAVD88	-6.28	0.000

The following datasets were required for each community:

- Reported events (written accounts, water level sensor data, photographs, flood staff recordings, etc.)
- Mapped location of community infrastructure and first floor elevation surveys
- High resolution orthoimagery (<40cm resolution) and digital elevation or surface models
- Tidal datum geodetically tied to the orthometric height



Elevation Feature	Elevation (ft MHHW)	Vertical Uncertainty (ft)
Evacuation center (school)	9.4	0.1
Fuel tank farm platform	9.3	0.1
Water treatment plant	8.3	0.1
Highest recorded flood	7.7	0.4
Several buildings (flooded 1 or more ft)	6.0	0.1
Wastewater lagoon	5.6	1.3
Lowest residences (flooded 0 to 1 ft)	5.5	0.5
Airstrip covered	5.4	1.1
Major	5.4	1.1
Access way to larger parts of town	4.2	0.5
Lowest building	4.1	0.1
Airstrip use or access	3.5	0.5
Moderate	3.5	0.5
Access road threatened	3.0	0.5
Minor	2.2	0.6
Low-lying property	2.2	0.6
Minor	2.2	0.6

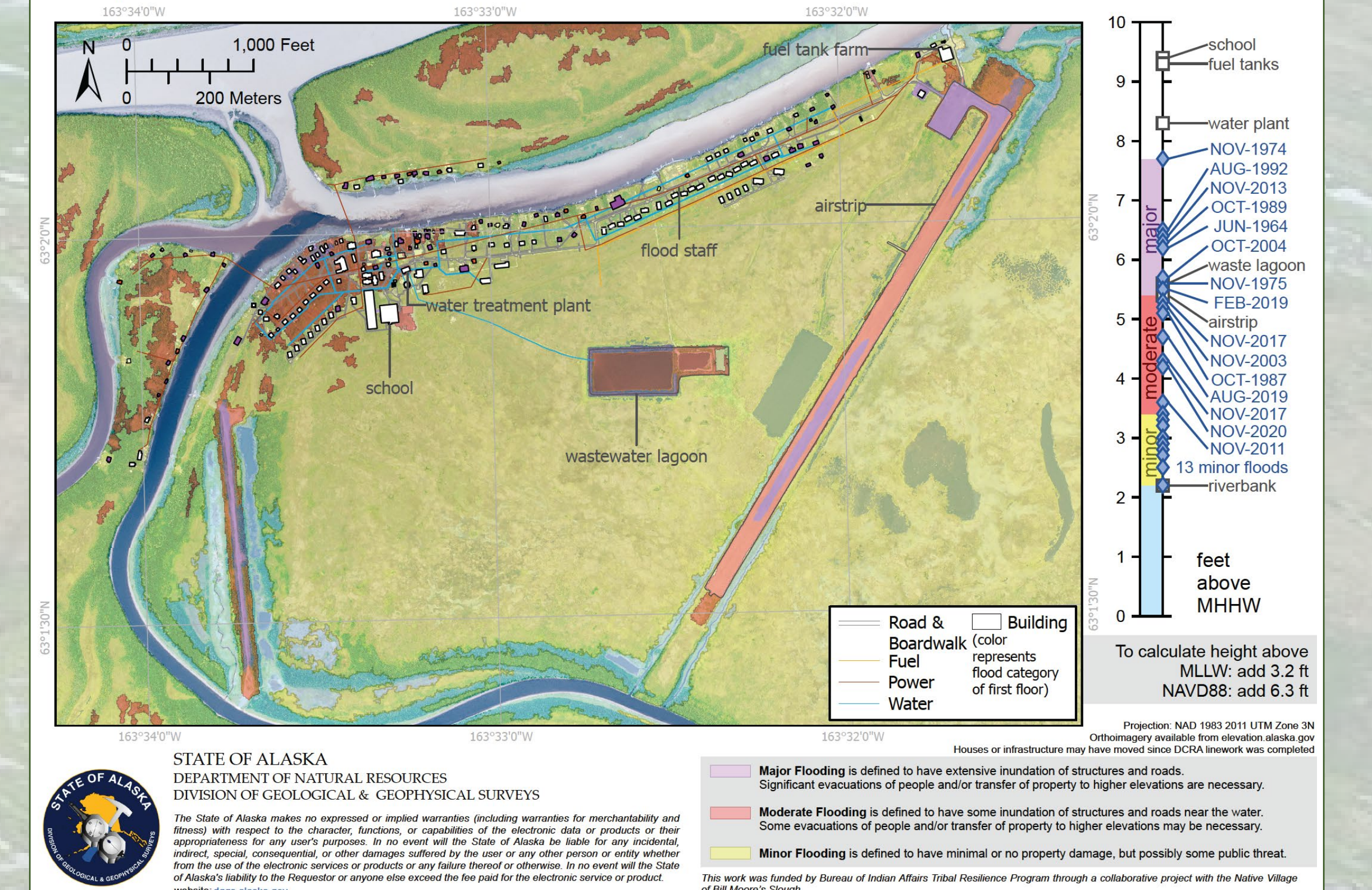
Aerial imagery of Kotlik with infrastructure outlines overlaid (top). Infrastructure elevations in Kotlik tied to thresholds of minor, moderate, and major flooding. Kotlik tidal datum tied to orthometric height (bottom left).



Flood staff in Kotlik, photo provided by Harold Okitkun, July 2022 (far left), measuring historic flood heights in Kipnuk with Tim Samson, June 2022 (middle), community supplied photo of flooding in Golovin, September 2022 (right).

Products

Coastal Flood Impact Map Kotlik, Alaska



Floods Estimated

Flood Date	Elevation (ft MHHW)	Vertical Uncertainty (ft)	Flood Date	Elevation (ft MHHW)	Vertical Uncertainty (ft)
1974-NOV-10	7.7	0.4	2005-JAN	3.2	0.8
1992-AUG-18	6.5	1.0	2009-MAY-25	3.0	0.5
2013-NOV-06	6.4	1.1	2019-MAR-26	3.0	0.5
1989-OCT-07	6.3	1.1	2017-OCT-13	2.9	0.5
1964-JUN	6.2	0.5	2018-NOV-09	2.9	0.5
1975-NOV	5.6	1.0	2017-JAN-01	2.8	0.7
2004-OCT-18	5.7	0.5	2019-FEB-28	2.7	0.8
2019-FEB-12	5.5	0.5	2017-DEC-18	2.5	0.6
2017-NOV-12	5.3	0.5	1965-Fall	2.5	1.0
2003-NOV-08	5.2	1.2	2003-NOV-26	2.2	1.0
1987-OCT-14	5.1	1.0			
2019-AUG-03	4.7	0.5			
2017-NOV-21	4.3	0.5			
2020-NOV-11	4.2	0.5			
2011-NOV-09	3.6	0.7			
2019-JUL-03	3.4	0.5			
2019-OCT-04	3.3	0.5			
1978-AUG-19	3.2	1.2			

Floods Not Estimated

1952-NOV-10
2000-FEB-04
2002-OCT-08
2006-OCT-08

Map of the village of Kotlik and corresponding flood levels related to current infrastructure heights with storm flood estimates referenced on scale bar (top). Flood height estimates for storms in Kotlik since 1974 (bottom).

Conclusion

- This work provides concise, descriptive details of community specific impacts to date.
- Flood hazard products are vital for communities to implement hazard mitigation plans, post-disaster recovery efforts, and the design of engineering mitigation solutions.
- Currently, six community flood assessments have been completed: Nunam Iqua, Napakiak, Kotlik (results highlighted in this poster), Alakanuk, Golovin, and Hooper Bay.
- To read these reports visit the site linked to the QR code in the bottom right corner of this poster presentation. An additional 29 community flood assessments are to be completed in the coming years.

Acknowledgments

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