

AVOIDING MALADAPTATIONS TO FLOODING AND EROSION:
A CASE STUDY OF ALASKA NATIVE VILLAGES

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Abstract

This article offers perspective on how Alaska Native Villages (ANVs), which are small and rural indigenous communities, are adapting to changes in flooding and erosion. It considers which adaptations might be maladaptations and what might be done to facilitate adaptation short of relocating entire communities. It outlines the United States' legal framework applicable to flooding and erosion and considers why this framework may do little to assist ANVs and similarly situated small and rural communities. Findings regarding adaptation strategies and obstacles are drawn from my Ph.D. research, which involved a review of plans for 59 ANVs and 153 interviews and conversations with ANV residents as well as those outside ANVs who make or influence policy that affects ANVs. Findings also draw from my practical perspective of having lived in and worked for ANVs for several years. I find that small and rural communities such as ANVs and external institutions in terms of the adaptation strategies that each desire and are able to carry out. Aside from legal reforms, there is a need for better partnerships between communities and external entities so that these communities can more readily obtain adaptation assistance and have a stronger voice in how this assistance takes place.

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I. INTRODUCTION

Flooding is the most common disaster in the State of Alaska,² the United States,³ and perhaps around the world.⁴ Flooding and erosion are particularly significant to many Alaska Native Villages (ANVs), which are nationally recognized tribes as well as settlements, for several reasons. First, a large percentage of these communities face significant flooding, erosion, and other climate-related impacts to their traditional lifeways, and some are imminently threatened and in need of relocation.⁵ This vulnerability relates to their location in flood- and erosion-prone areas along shorelines. Historically, ANVs avoided flooding catastrophes through seasonal migration, but colonization (including laws regarding school attendance) forced villages

² DEPARTMENT OF MILITARY AND VETERANS AFFAIRS, DIVISION OF HOMELAND SECURITY AND EMERGENCY MANAGEMENT, STATE OF ALASKA HAZARD MITIGATION PLAN 3-1 (2013).

³ Gov't Accountability Office (GAO), *Flood Insurance: Participation of Indian Tribes in Federal and Private Programs*, GAO-13-226 1 (2013); Mary W. Downton & Roger A. Pielke Jr., *Discretion without Accountability: Politics, Flood Damage, and Climate*, 2 NATURAL HAZARDS REV. 157, 157 (2001).

⁴ DEBBY GUHA-SAPIR ET AL., ANNUAL DISASTER STATISTICAL REVIEW 2011, Centre for Research on the Epidemiology of Disasters (2012), <http://crmi-undp.org/documents/documentos/98.pdf>.

⁵ See BROOKE C. STEWART ET AL., REGIONAL CLIMATE TRENDS AND SCENARIOS FOR THE U.S. NATIONAL CLIMATE ASSESSMENT, PART 7, CLIMATE OF ALASKA (2013)http://www.nesdis.noaa.gov/technical_reports/NOAA_NESDIS_Tech_Report_142-7-Climate_of_Alaska.pdf [<https://perma.cc/3MQP-F5NZ>]; see generally C.B. Field et al., eds., CLIMATE CHANGE 2014: IMPACTS, ADAPTATION, AND VULNERABILITY, CONTRIBUTION OF WORKING GROUP II TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 32 (2014); F. STUART CHAPIN III ET AL., *Alaska*, pp. 514–36 in CLIMATE CHANGE IMPACTS IN THE UNITED STATES: THE THIRD NATIONAL CLIMATE ASSESSMENT 514-36 (2014); GAO, ALASKA NATIVE VILLAGES: MOST ARE AFFECTED BY FLOODING AND EROSION, BUT FEW QUALIFY FOR FEDERAL ASSISTANCE, GAO-04-142 (2003); GAO, ALASKA NATIVE VILLAGES: LIMITED PROGRESS HAS BEEN MADE ON RELOCATING VILLAGES THREATENED BY FLOODING AND EROSION, GAO-09-551 (2009).

into settlements that may not have been suitable for permanent habitation.⁶

Second, the remote location of ANVs limits the mobilization of large infrastructure and Western goods and services, and can impede post-disaster recovery.⁷ Further, ANVs are often small and impoverished communities without their own tax base.⁸ They have limited capacity to build new infrastructure and must rely on external funding and consultants.⁹ Finally, ANVs represent unique cultures with subsistence lifeways and distinct ways of understanding the world.¹⁰ The idea of moving away from an ANV (or even moving back from the shoreline) is

⁶ Robin Bronen, *Climate-Induced Displacement of Alaska Native Communities*, BROOKINGS INSTITUTION i (2013), www.Brookings.Edu/Research/Papers/2013/01/30-Arctic-Alaska-Bronen [<https://perma.cc/GP6M-AQ5X>]; James D. Ford et al., *Climate Change Policy Responses for Canada's Inuit Population: The Importance of and Opportunities for Adaptation*, 20 GLOBAL ENV'T'L CHANGE 177, 187 (2010); Amanda H. Lynch & Ronald D. Brunner, *Context and Climate Change: An Integrated Assessment for Barrow, Alaska*, 82 CLIMATIC CHANGE 93, 104 (2007); Elizabeth Marino, *The Long History of Environmental Migration: Assessing Vulnerability Construction and Obstacles to Successful Relocation in Shishmaref, Alaska*, 22 GLOBAL ENV'T'L CHANGE 374, 375, 378 (2012).

⁷ Patricia Cochran et al., *Indigenous Frameworks for Observing and Responding to Climate Change in Alaska*, 120 CLIMATIC CHANGE 557 (2013); F. Stuart Chapin & Patricia Cochran, Final report to Communities from the Alaska Native Science Commission and the University of Alaska Fairbanks, Community Partnership for Self Reliance and Sustainability (2014) (on file with the author); Sharon McClintock, *Coastal and Riverine Erosion Challenges: Alaskan Villages' Sustainability*, CLIMATE CHANGE AND ARCTIC SUSTAINABLE DEVELOPMENT: SCIENTIFIC, SOCIAL, CULTURAL AND EDUCATIONAL CHALLENGES (Douglas Nakashima ed., 2009).

⁸ Alaska Division of Community and Regional Affairs, Community Database Online, [<https://perma.cc/8XTQ-TL96>].

⁹ RICHARD J. T. KLEIN, GUY F. MIDGLEY, AND BENJAMIN L. PRESTON, ADAPTATION OPPORTUNITIES, CONSTRAINTS, AND LIMITS, IN CLIMATE CHANGE 2014 IMPACTS, ADAPTATION, AND VULNERABILITY WORKING GROUP II CONTRIBUTION TO THE IPCC FIFTH ASSESSMENT REPORT, GLOBAL AND SECTORAL ASPECTS 907 (2014).

¹⁰ Annette Watson and Orville Huntington, *They're Here - I Can Feel Them: The Epistemic Spaces of Indigenous and Western Knowledges*, 9 SOC. & CULTURAL GEOG. 357 (2008); Thomas Berger, A LONG AND TERRIBLE SHADOW: WHITE VALUES, NATIVE RIGHTS IN THE AMERICAS SINCE 1492 (2d. ed.1999).

undesirable to many ANV residents.¹¹ While a few ANVs are currently seeking to relocate, many others are attempting to adapt in place.¹²

In this article, I offer a perspective on how ANVs are adapting in place to flooding and erosion, which adaptations might be maladaptations, and what might be done to facilitate adaptation short of relocating entire communities. Specifically, I consider how federal legislation might be adjusted to better respond to the unique situation of ANVs, and how, even without legislative change, agencies can work to avoid maladaptations. This article is based on dissertation research aiming to understand how ANVs are adapting to climate change and responding to disasters, and how laws and planning processes help or hinder. My research involved multiple approaches, each of which I cover in more detail in a separate article.¹³ The first approach was to review literature related to studies of adaptation, studies of Alaska Natives, and commentary on laws. The second approach was to review relevant laws themselves. The third approach involved 153 interviews and conversations¹⁴ with ANV residents as well as those outside ANVs who make or influence laws that affect ANVs. I specifically sought participants from ANVs that had national disaster declarations due to flooding within recent decades. Of the 59 ANVs from which my participants were drawn, 42 had been included in a state disaster

¹¹ Henry P. Huntington, Sarah A. Kruse, and Astrid J. Scholz, *Demographic and Environmental Conditions Are Uncoupled in the Social-Ecological System of the Pribilof Islands*, 28 POLAR RES. 119, 125 (2009).

¹²See Elizaveta Barret Ristroph, *When Climate Takes a Village: Legal Pathways toward the Relocation of Alaska Native Villages*, 7 CLIMATE LAW 259 (2017).

¹³ Elizaveta Barret Ristroph, *Presenting a Picture of Alaska Native Village Adaptation: A Method of Analysis*, 5 SOC. & ANTHROPOLOGY 762 (2017).

¹⁴ *Id.* at 763 n.2. These were conversations where participants essentially answered the interview questions but did not want to be formally interviewed. Interviews and conversations took place between June 2016 and March 2017 in person in ANVs and at conferences pertaining to ANVs, or by phone calls from Fairbanks to participants' locations.

declaration pertaining to a climate-related disaster during the study period, and 36 of these had been part of a national disaster declaration. Eighteen participants from ANVs that had experienced disaster declarations described these events.

The fourth approach was to analyze community plans relevant to the 59 ANVs from which I selected participants, including hazard mitigation plans required by the Federal Emergency and Management Agency (FEMA) for certain kinds of disaster assistance¹⁵ and plans related to economic development and land use. I used qualitative content analysis¹⁶ to identify major adaptation actions, relevant laws and agencies, facilitators, barriers, recommendations for change, and other themes that arose from interviews and those conversations that covered interview questions, as well as in community plans.

Research was authorized by the Institutional Review Board of the University of Hawaii, and ethical considerations required keeping confidential the identity of research participants. For this reason, names of participants and ANVs are generally not mentioned in this article.¹⁷

¹⁵ 42 U.S.C. § 5165(a) (2012).

¹⁶ MATTHEW B. MILES & A. MICHAEL HUBERMAN, *QUALITATIVE DATA ANALYSIS: AN EXPANDED SOURCEBOOK* 56 (2d ed. 1994); JULIET CORBIN & ANSELM STRAUSS, *BASICS OF QUALITATIVE RESEARCH: TECHNIQUES AND PROCEDURES FOR DEVELOPING GROUNDED THEORY* (3d ed. 2007).

¹⁷ The differences in the questions answered by different participants (despite starting out with just two questionnaires—one for each set of participants) limited the ability to quantitatively compare responses between different participants. Given this limitation and the subjectivity of my coding, I decided that using inferential statistics was not appropriate. See H. RUSSELL BERNARD & GERY W. RYAN, *ANALYZING QUALITATIVE DATA: SYSTEMATIC APPROACHES*, (1st ed. 2009); Yan Zhang & Barbara M. Wildemuth, *Qualitative Analysis of Content, in APPLICATIONS OF SOCIAL RESEARCH METHODS TO QUESTIONS IN INFORMATION AND LIBRARY SCIENCE* (Barbara M. Wildemuth 2d ed. 2017).). I thus avoid referring to specific numbers of participants in this article. To give an order of magnitude of the responses I got, I refer to “a few” (about 2 to 5), “several” (about 6 to 10), “a number of” (10-30), or “many” (more than 30). These categorizations are not statistically significant and should not be interpreted in that manner.

Section II contains a literature review of “protect in place” adaptation strategies relevant to ANVs. It summarizes national laws and institutions relevant to flooding and erosion outside the context of national disaster declarations, and it explains how ANVs are left out of these laws and institutions. Section III highlights my findings on the flooding and erosion that ANVs are experiencing, how they are adapting, obstacles to carrying out adaptation actions, and the problems associated with hard armoring (a key adaptation measure for coastal ANVs). Section IV suggests measures to better respond to flooding and erosion in a manner that allows ANVs to avoid relocation. These measures may also be relevant to other small, rural, and/or indigenous communities in climate-vulnerable locations.

II. BACKGROUND AND LEGAL FRAMEWORK FOR FLOOD ADAPTATION

A. Background on Flooding and Erosion in Alaska Native Villages

In Alaska, major floods have traditionally occurred along rivers during “spring breakup” (when ice creates dams that overflow) and during heavy late-summer runs. More recently, as the climate has changed, autumn sea storms and storm surge have caused major floods and episodic erosion in communities along Alaska’s northern and western coasts.¹⁸ This flooding relates to the later formation of shorefast ice, which traditionally protects coastlines from flooding.¹⁹

In addition to the rapid flooding described in the previous paragraph, Alaska’s coastal

¹⁸ Lynch & Brunner, *supra* note 6, at 102; U.S. ARMY CORPS OF ENGINEERS, ALASKA DISTRICT, AN EXAMINATION OF EROSION ISSUES IN THE COMMUNITIES OF BETHEL, DILLINGHAM, KAKTOVIK, KIVALINA, NEWTOK, SHISHMAREE, AND UNALAKLEET (2006).

¹⁹ Field et al., *supra* note 5, at 1570.

and riverine communities also struggle with more gradual erosion.²⁰ Gradual erosion of Alaska's coastlines relates to sea level rise²¹ and other factors.²² Sea-level rise along the northern and western coasts may weaken permafrost-rich coastal bluffs, increasing the rate of thawing.²³ When permafrost melts, episodic erosion tends to be irreversible and unpredictable.²⁴

There is not a statewide, consistent dataset of sea level rise, flooding, or erosion rates for Alaska. A few researchers and entities, including the State Division of Geological and Geophysical Services, have put together datasets for a handful of sites.²⁵ In 2003, the U.S. Army Corps of Engineers projected erosion costs based on the erosion mitigation measures that had previously been taken, as opposed to assessing actual erosion rates.²⁶ In 2009, the Army Corps

²⁰*Id.* at 1590.

²¹ While sea level rise may be a concern along the northern and western coasts of Alaska, it is not yet a problem in parts of southern Alaska. There, the collision of tectonic plates and uplift from glaciers melting result in land rising faster than the sea erosion. Kimberly deGrandpre, *Relative Sea Level Change in Western Alaska as Constructed From Satellite Altimetry and Repeat GPS Measurements*, (Aug. 2015)(unpublished M.Sc. thesis, University of Alaska Fairbanks); Jeffrey T. Freymueller, et al, *Active Deformation Processes in Alaska, Based on 15 Years of GPS Measurements*, Active Tectonics and Seismic Potential of Alaska, Geophysical Monograph (2008). Data on sea level rise trends in Alaska is extremely limited, with just a few data points being gathered by the National Oceanic and Atmospheric Administration and others. *See, e.g.*, National Oceanic and Atmospheric Administration, *Sea Level Trends, U.S. Stations Linear Mean Sea Level Trends and Standard Errors in Mm/Yr and Feet/Century*, (2018) <https://tidesandcurrents.noaa.gov/sltrends/mslUSTrendsTable.htm> [<https://perma.cc/9K7B-WEKF>].

²² B. M. Jones et al., *Increase in the Rate and Uniformity of Coastline Erosion in Arctic Alaska: Higher and More Uniform Arctic Erosion*, 36 *GEOPHYSICAL RESEARCH LETTERS* L03503 (2009).

²³ *Id.*; Chapin et al., *supra* note 5, at 20.

²⁴ Email from Ruth Carter, Question on Erosion (Oct. 12, 2017) (on file with the author).

²⁵ Alaska Division of Geological & Geophysical Surveys, *Alaska Shoreline Change Tool*, Digital Data Series 9 (2015), <http://maps.dggs.alaska.gov/shoreline/#-15864221:11032612:9> [<https://perma.cc/WD5S-KTW2>]; J. C. Mars & D. W. Houseknecht, *Quantitative Remote Sensing Study Indicates Doubling of Coastal Erosion Rate in Past 50 Yr along a Segment of the Arctic Coast of Alaska*, 35 *GEOLOGY* 583 (2007).

²⁶ U.S. Army Corps, *supra* note 18.

categorized the erosion threat to Alaskan communities as either high, medium, or low according to qualitative factors measured by surveys and contemporary aerial photographs.²⁷ Again, this study did not measure actual erosion rates or attempt to assess flooding. Thus, there is a lack of consistent, community-level information on flooding and erosion vulnerability for ANVs and other rural Alaskan communities.²⁸ This lack of information may limit the ability of state and national governments to systematically and equitably address flooding and erosion, although lack of political will to assist with adaptation is likely a far greater barrier than lack of information.²⁹

B. Adaptations and Maladaptations to Flooding and Erosion

The Intergovernmental Panel on Climate Change refers to adaptation as “[t]he process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities.”³⁰ Not all adaptations lead to long-term, beneficial results, however. A “maladaptation” can occur when an action either benefits one population at the expense of another (with no compensation); benefits current populations at the expense of future populations or is otherwise unsustainable; or is incompatible with climate

²⁷ U.S. Army Corps, ALASKA BASELINE EROSION ASSESSMENT, STUDY FINDINGS AND TECHNICAL REPORT (2009).

²⁸ Courtney Lyons, Courtney Carothers, & Katherine Reedy, *Means, Meanings, and Contexts: A Framework for Integrating Detailed Ethnographic Data into Assessments of Fishing Community Vulnerability*, 15 MARINE POL. 1, 9 (2016).

²⁹ Ristroph, *supra* note 13, at 769.

³⁰ Field et al., *supra* note 5, at 1758.

change mitigation.³¹ Maladaptations can occur in indigenous communities when they are subjected to solutions that have been designed for another context, from imported homes to imposed policies.³² The literature suggests various ways to avoid maladaptations, including “no-regrets” strategies that yield benefits even in the absence of climate change; reversible strategies; strategies that leave a wide safety margin at little extra cost; and strategies that take into account local values, skills, and capabilities.³³

Throughout much of the world, the three general adaptation approaches to flooding and related erosion are accommodation, protection, and retreat.³⁴ Accommodation allows flooding to occur but maintains existing land uses by protecting structures (e.g., elevating buildings). Protection maintains existing land uses by preventing flooding through hard or soft structures. Retreat forfeits existing land uses by moving development inward and allowing the coastline to move. While retreat may be the most effective of the three approaches in terms of protecting human life, it is the most difficult to implement and the most likely to generate political

³¹ Jon Barnett & Saffron O’Neill, *Maladaptation*, 20 GLOBAL ENVTL. CHANGE 211, 211 (2010); Jonathan Verschuuren, *Introduction*, pp. 1-15 in RES. HANDBOOK ON CLIMATE CHANGE ADAPTATION LAW 7 (2013).

³² Laura Mannell, Frank Palermo, & Crispin Smith, *Community-Based and Comprehensive: Reflections on Planning and Action in First Nations*, pp. 113–40 in RECLAIMING INDIGENOUS PLANNING, Ryan Walker, Theodore S Jojola, and David C. Natcher (Eds.) 122 (2013).

³³ Barnett & O’Neill, *supra* note 31; Stéphane Hallegatte, *Strategies to Adapt to an Uncertain Climate Change*, 19 GLOBAL ENVTL. CHANGE 240, 244 (May 2009).

³⁴ See A. T. Williams et al., *The Management of Coastal Erosion*, 156 OCEAN & COASTAL MGMT. 4 (2018); José Simão Antunes Do Carmo, *Climate Change, Adaptation Measures, and Integrated Coastal Zone Management The New Protection Paradigm for the Portuguese Coastal Zone*, 34 J. COASTAL RES. 687 (2018); Beatriz Azevedo de Almeida & Ali Mostafavi, *Resilience of Infrastructure Systems to Sea-Level Rise in Coastal Areas: Impacts, Adaptation Measures, and Implementation Challenges*, 8 SUSTAINABILITY 1115 (2016); Yee Huang et al., *Climate Change and the Puget Sound: Building the Legal Framework for Adaptation*, 2 CLIMATE LAW 299 (2011).

opposition.³⁵

A second-best alternative to retreat may be protection in place with soft or green infrastructure that serve as buffers.³⁶ The literature portrays this kind of soft armoring as more desirable than hard armoring, because hard structures eliminate beaches and shoreline environments, redirect wave energy to nearby areas, and affect the abundance and diversity of shoreline species.³⁷ Armoring along rivers in the form of levees can exacerbate flood impacts by depriving downstream marshes of sediment and destroying natural flood buffers.³⁸ The costs associated with hard armoring can be high and can increase over time.³⁹ Armoring can also lead to a false sense of security and more development in areas that are still vulnerable.⁴⁰

Soft armoring can be a more attractive adaptation measure than hard-armoring because it provides ecosystem services such as habitat and water filtration.⁴¹ Yet it is not without impacts,

³⁵ Mark T. Gibbs, *Why Is Coastal Retreat So Hard to Implement? Understanding the Political Risk of Coastal Adaptation Pathways*, 130 OCEAN & COASTAL MGMT. 107 (Oct. 2016); Bénédicte Rulleau & H  l  ne Rey-Valette, *Forward Planning to Maintain the Attractiveness of Coastal Areas: Choosing between Seawalls and Managed Retreat*, 72 ENVTL. SCI. & POL'Y 12 (June 2017); Huang et al., *supra* note 35, at 328.

³⁶ Huang et al., *supra* note 35, at 304.

³⁷ Megan N. Dethier et al., *Multiscale Impacts of Armoring on Salish Sea Shorelines: Evidence for Cumulative and Threshold Effects*, 175 ESTUARINE, COASTAL & SHELF SCIENCE 106 (June 2016); Niki L. Pace, *Wetlands or Seawalls? Adapting Shoreline Regulation to Address Sea Level Rise and Wetland Preservation in the Gulf of Mexico*, 26 J LAND USE & ENVTL LAW 327, 339 (2011); Robert R.M. Verchick & Joel D. Scheraga, *Protecting the Coast*, pp. 235–66 in *THE LAW OF ADAPTATION TO CLIMATE CHANGE : U.S. AND INT'L ASPECTS* (Michael Gerrard & Katrina Fischer Kuh eds. 241 2012).

³⁸ J. Peter Byrne & Jessica Grannis, *Coastal Retreat Measures*, , *supra* note 37, at 267.

³⁹ Verchick & Scheraga, *supra* note 37, at 241.

⁴⁰ Id.; Byrne & Grannis, *supra* note 38, at 267.

⁴¹ Chad J. McGuire & Devon Lynch, *Thinking Ahead: The Impacts of Sea Level Rise on Coastal Landscape Protections*, 27 NAT. RES. & ENV. 28 (2013); Diana Mitsova, Chris Bergh, & Greg Guannel, *Suitability Analysis for Living Shorelines Development in Southeast Florida's Estuarine Systems* (April 7, 2016), available at:

since it disrupts the existing habitat and typically requires sand or fill that must be dredged from somewhere. Soft armoring tends to need more space than hard armoring, and the fill protective benefits are not as well understood as those from hard armoring.⁴²

To date, much of the ANV adaptation to flooding and erosion has involved ineffective hard armoring led by outside government entities.⁴³ One example is the Army Corps' efforts in Unalakleet, where multiple erosion protection measures have been implemented along the shoreline.⁴⁴ In 2000, the Natural Resource Conservation Service (NRCS) constructed erosion protection consisting of gabions, wire baskets filled with rock, at a cost of about \$1.3 million. A late November storm in 2003 caused severe damage to the gabions, which were repaired in 2007.⁴⁵ The Corps took on a \$28 million construction project of a 1,500-foot rock revetment over the existing NRCS gabion revetment in 2010.⁴⁶ Even the Army Corps has acknowledged the

http://maps.coastalresilience.org/seflorida/methods/Living_Shorelines_Final_Report_05_06_16.pdf[<https://perma.cc/8SS2-EHS4>].

⁴² Verchick & Scheraga, *supra* note 37, at 241.

⁴³ See Owen K. Mason, *Living with the Coast of Alaska Revisited: The Good, the Bad, and the Ugly*, Coastal Erosion Responses for Alaska: Workshop Proceedings Alaska Sea Grant College Program, AK-SG-06-03 (2006); see also Jon E. Zufelt & Orson P. Smith, *Shore Protection in Alaska Often Requires the Consideration of Design Modifications for Arctic Conditions*, Coastal Erosion Responses for Alaska: Workshop Proceedings Alaska Sea Grant College Program, AK-SG-06-03 (2006); Chapin et al., *supra* note 5. There has been relatively little soft armoring for ANVs compared to the efforts devoted to hard armoring. An exception is the beach nourishment effort of a large Arctic municipal government, which was unsuccessful as the material used for nourishment was too silty and washed away. Ronald D. Brunner & Amanda H. Lynch, *Adaptive Governance and Climate Change*, American Meteorological Society, 160 (2010).

⁴⁴ Bronen, *supra* note 6, at 2.

⁴⁵ U.S. Army Corps, *supra* note 18; U.S. Army Corps, *supra* note 27.

⁴⁶ U.S. Army Corps, *supra* note 27; U.S. Army Corps, "Information Paper, Status of Protection/Intervention Actions at High Risk Communities (2007).

weaknesses in its efforts, noting that government agencies are spending millions of dollars to construct erosion protection devices which have an anticipated lifespan of ten years.⁴⁷

Some of the above-described maladaptations may relate to the unpredictability of storm-driven erosion or failure to understand the natural processes of accretion. Barriers to mitigate erosion have been placed in areas experiencing accretion over time.⁴⁸ Another problem is that conditions in Alaska are different from places at which the flooding and erosion controls were originally conceptualized. Designs require modifications to withstand Arctic conditions, including freezing temperatures, permafrost, ice accretions, impacts from moving ice, and thawing.⁴⁹ Related to the design problem is the disconnect between those who are implementing the controls and those who will live with them. Those who have researched ANVs describe development decisions made by the Army Corps and others without local input.⁵⁰ Given the threat that flooding and erosion pose to the existence of ANVs,⁵¹ there is a need for a better understanding of how maladaptations occur and what policies could help avoid them.⁵²

⁴⁷ U.S. Army Corps, *supra* note 46.

⁴⁸ Lynch & Brunner, *supra* note 6, at 102.

⁴⁹ Zufelt & Smith, *supra* note 43, at 71.

⁵⁰ Brunner & Lynch, *supra* note 43, at 165; Marino, *supra* note 6, at 378; Christine Shearer, *The Political Ecology of Climate Adaptation Assistance: Alaska Natives, Displacement, and Relocation*, 19 J. POL. ECOLOGY 174, 177 (2012).

⁵¹ GAO, *supra* note 5; Marino, *supra* note 6.

⁵² Philip A. Loring, et. al., “Community Work” in a Climate of Adaptation: Responding to Change in Rural Alaska, 44 HUMAN ECOLOGY 119, 125 (Feb. 2016).

C. Legal Framework to Avoid Flooding and Erosion

This subsection describes the laws and institutions relevant to flooding and erosion outside of national disaster declarations⁵³ and shows how they do little to proactively avoid flooding and erosion damage for ANVs. While U.S. and Alaska laws do limit building in flood-prone areas, these laws can be bypassed, and there is relatively little incentive to remove or elevate existing construction in floodplains. Further, the laws do not fully reflect the realities of climate change and increased incidences of flooding across U.S. communities.⁵⁴

Two executive orders from the 1970s⁵⁵ require U.S. agencies to avoid building (or permit building) in floodplains and wetlands when practicable. Alaska State Administrative Order 175⁵⁶ mirrors these orders, requiring state-owned and state-financed construction projects to be sited and constructed in a manner that reduces the potential for flood and erosion damage. These orders are significant to ANVs because almost all community infrastructure is funded by federal and state agencies that must adhere to the requirements of the orders. President Obama's

⁵³ See generally Robert T. Stafford Disaster Relief and Emergency Assistance Act 42 U.S.C. §§ 5122(1), 5191 (1974) (amended 2018). National disaster declarations are governed by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. §§ 5122(1), 5191), which provides for substantial amounts of funding and relief following flooding disasters. I analyze disaster policy relevant to ANV flooding and erosion in a separate article.

⁵⁴ Robin Kundis Craig, "Stationarity Is Dead"—*Long Live Transformation: Five Principles for Climate Change Adaptation Law*, 34 HARVARD ENVTL. LAW REV. 9 (2010); Alexandros A. Ntelekos et al., *Urbanization, Climate Change and Flood Policy in the United States*, 103 CLIMATIC CHANGE 597 (2010); Jerry R. Stedinger and Veronica W. Griffis, *Flood Frequency Analysis in the United States: Time to Update*, 13 J. HYDROLOGIC ENG'G 199 (2008).

⁵⁵ Exec. Order No. 11988, 42 Fed. Ref. 26951 (May 24, 1977) ; Exec. Order No. 11990, Fed. Reg. 26961 (May 24, 1977).

⁵⁶ OFFICE OF THE GOVERNOR OF ALASKA, ADMINISTRATIVE ORDER NO. 175(June 8, 1998).

Executive Order 13690⁵⁷ attempted to require consideration of climate change in determining floodplain locations, but President Trump revoked this Order through Executive Order 13807.⁵⁸

Despite the laws limiting construction in flood-prone areas, a great deal of infrastructure continues to exist in these areas, and various agencies and programs are charged with protecting this infrastructure. The Federal Emergency Management Agency (FEMA) is the U.S. agency with the primary role after flooding disasters, while the Army Corps of Engineers as well as the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) have addressed flooding and erosion control before disasters. At the state level, the Division of Community and Regional Affairs (DCRA) within the Department of Commerce, Community and Economic Development has served as the lead agency in addressing erosion problems.⁵⁹ However, there is currently no statewide program or significant funding to actively avoid flooding and erosion.

1. FEMA

FEMA's role in addressing flooding outside of national disaster declarations is small compared to its post-disaster responsibilities.⁶⁰ FEMA administers various natural hazard

⁵⁷ Exec. Order No. 13690, 80 Fed. Reg. 6425 (Jan.30, 2015).

⁵⁸ Exec. Order No.13807, 82 Fed. Reg. 163 (Aug. 15, 2017).

⁵⁹ See OFFICE OF THE GOVERNOR OF ALASKA, ADMINISTRATIVE ORDER NO. 231 (Nov. 29, 2006); OFFICE OF THE GOVERNOR OF ALASKA, ADMISTRATIVE ORDER NO. 239 (Jan. 22, 2008).

⁶⁰ See U.S. GOV'T ACCOUNTABILITY OFFICE (2009) *supra* note 5; Robin Bronen, *Climate-Induced Community Relocations: Creating an Adaptive Governance Framework Based in Human Rights Doctrine*, 35 N.Y.U. REV. OF L. & SOC. CHANGE 357 (2011).

mitigation programs, including the Pre-Disaster Mitigation Program (PDM)⁶¹ and Flood Mitigation Assistance.⁶² These programs provide limited funding to states, territories, tribes, and local governments to prepare hazard mitigation plans and carry out mitigation projects such as relocating or elevating buildings. FEMA also administers the National Flood Insurance Program (NFIP),⁶³ which provides individual homeowners and renters with some insurance coverage for flood damage. To participate in NFIP, the individual must live in a community with ordinances that meet minimum federal requirements restricting development within Special Flood Hazard Areas (SFHAs) (same as 100-year floodplains). Development in these areas must have flood insurance and must comply with local floodplain management ordinances.⁶⁴ FEMA has created Flood Insurance Rate Maps (flood maps) delineating SFHAs for all communities that participate in NFIP.

NFIP has several limitations. The minimum federal requirements for local ordinances allowable under NFIP do not provide for retreat or limit densities in vulnerable areas; nor do they prevent rebuilding as long as structural damage is less than 50%.⁶⁵ Thus, some have argued that there is a moral hazard problem, where U.S. taxpayers are subsidizing those who choose to live

⁶¹ 42 U.S.C. §5133 (1974) (amended 2018).

⁶² 42 U.S.C. §4104c (2012); U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-15-290, HIGH-RISK SERIES, AN UPDATE, 87 (2015).

⁶³ 42 U.S.C. §§4001-4129 (2012).

⁶⁴ 42 U.S.C. §§ 4012a, 4022 (2012); FEDERAL EMERGENCY MANAGEMENT AGENCY HAZARD MITIGATION ASSISTANCE PROGRAM DIGEST 62 (2015).

⁶⁵ 44 C.F.R. §206.226(f) (2012).

in vulnerable areas.⁶⁶ Also, some argue that NFIP does not sufficiently account for climate change, as it does not adequately consider the effect of erosion or sea level rise and flood maps are often inaccurate and outdated.⁶⁷

The 2012 Biggert-Waters Act sought to update NFIP by reducing eligibility for flood insurance coverage. Properties built before NFIP were no longer “grandfathered” into the program; homes that flooded repeatedly were denied coverage; and insurance premiums were to be recalculated to accurately reflect real actuarial risk.⁶⁸ The Act authorized FEMA to update flood maps based on climate change considerations.⁶⁹ A 2014 amendment⁷⁰ rolled back these updates to some degree, repealing some rate increases,⁷¹ restoring grandfathered rates,⁷² and allowing rates to rise more gradually.⁷³ Alice Kaswan suggests the reform efforts have focused more on the program's finances than on enhancing safety, and do not provide sufficient

⁶⁶ See Jennifer Wriggins, *In Deep: Dilemmas of Federal Flood Insurance Reform*, 5 U.C. IRVINE L. REV. 1443 (2015); A. Dan Tarlock, *United States Flood Control Policy: The Incomplete Transition from the Illusion of Total Protection to Risk Management*, 23 DUKE ENVTL. L. & POL'Y FORUM 151 (2012); Byrne & Grannis, *supra* note 38, at 290; Stephen P. Leatherman, *Coastal Erosion and the United States National Flood Insurance Program*, 156 OCEAN & COASTAL MANAGEMENT 35 (2017); U.S. GOV'T ACCOUNTABILITY OFFICE (2015) *supra* note 62, at 87.

⁶⁷ Leatherman, *supra* note 66; Byrne & Grannis, *supra* note 66, at 290.

⁶⁸ Biggert-Waters Flood Insurance Reform Act of 2012, Pub. L. No. 112–141, 126 Stat. 405, § 100205, partially codified at 42 U.S.C. § 4014.

⁶⁹ *Id.* at §§ 100215(d), 100216, partially codified at 42 U.S.C. § 4101b(b)(3).

⁷⁰ Homeowner Flood Insurance Affordability Act, Pub. L. No. 113-89, 128 Stat. 1020 (2014).

⁷¹ *Id.* at § 3, codified at 42 U.S.C. § 4014(g).

⁷² *Id.* at § 4, codified at 42 U.S.C. § 4015.

⁷³ *Id.* at § 5, codified at 42 U.S.C. § 4015(e).

incentives to prompt a robust and comprehensive land-use response to impending flood risks.⁷⁴

For many Alaskan communities, the tribal government may be the only local government in place. The tribal governments of ANVs can participate in NFIP in a manner similar to that of communities if they have jurisdiction over their land such that they can enforce flooding ordinances.⁷⁵ But since the vast majority of ANVs do not have jurisdiction over tribal land,⁷⁶ they are ineligible. ANVs that overlap with incorporated municipalities could participate through the municipalities; however, the municipalities may not have sufficient capacity and resources to administer the ordinances. As of this writing, the handful of ANVs covered under NFIP participate only through their municipalities—not their tribal governments.⁷⁷

Jurisdictional issues aside, there are challenges to tribes who wish to participate in NFIP. In 2012, GAO found that just 37 of 566 federally recognized tribes throughout the United States were participating in NFIP, with three tribes accounting for more than 70 percent of the policies.⁷⁸ This is due to the lack of flood maps for many rural tribal lands, the lack of administrative resources to administer NFIP requirements, and the expense of NFIP premiums.⁷⁹

⁷⁴ Alice Kaswan, *Climate Adaptation and Land Use Governance: The Vertical Axis*, 39 COLUMBIA J. ENVTL. L. 390, 410 (2014).

⁷⁵ Insurance and Hazard Mitigation, 44 C.F.R. § 59.1 (2018).

⁷⁶ While Alaska tribes retain some of the inherent sovereign powers held by all tribes, the Alaska Native Claims Settlement Act extinguished tribal jurisdiction over lands. *See* Pub. Law No. 280 (67 Stat.) 1953 (codified as amended 18 U.S.C. § 1162, 25 U.S.C. §§ 1321-1326, 28 U.S.C. §§ 1360).

⁷⁷ FEMA, Community Status Book Report, Alaska, *Communities Participating in the National Flood Program* (July 27, 2018), <https://www.fema.gov/cis/AK.html> [<https://perma.cc/5RTU-ZJFK>].

⁷⁸ U.S. Gov't Accountability Off., GAO-13-226, *Flood Insurance: Participation of Indian Tribes in Federal and Private Programs*(2013).

⁷⁹ *Id.*

2. Army Corps

Compared with FEMA, the U.S. Army Corps of Engineers has a more significant role in controlling flooding and erosion outside of disasters.⁸⁰ Various statutes (e.g., Flood Control Act of 1944)⁸¹ authorize the Army Corps to manage individual or multiple water projects. In 2003, a Congressional Committee directed the Army Corps to assess the erosion threat and estimate relocation costs for seven ANVs (Bethel, Dillingham, Kaktovik, Kivalina, Newtok, Shishmaref, and Unalakleet).⁸² The Army Corps' 2006 Alaska Village Erosion Technical Assistance program assessment estimated that the villages of Kivalina, Newtok, and Shishmaref had 10 years to 15 years before their current locations would be lost to erosion, and that the cost to relocate these villages ranged from between \$80 million and \$200 million each.⁸³ The Army Corps concluded that the potential cost of relocating Kivalina and Shishmaref would exceed the cost of erosion control there (\$15 million and \$16 million respectively), while erosion and relocation costs would be similar for Newtok.⁸⁴

In 2005, Congress authorized the Army Corps “to carry out, at full federal expense, structural and non-structural projects for storm damage prevention and reduction, coastal

⁸⁰ Victor B. Flatt and Jeremy M. Tarr, *Adaptation, Legal Resiliency, and the U.S. Army Corps of Engineers: Managing Water Supply in a Climate-Altered World*, 89 N. CAROLINA L. REV. 1499, 1510 (2011).

⁸¹ Pub. L. No. 78-534, §§1-8, (58 Stat.) 887-91 (codified in scattered sections of 16, 33,43 U.S.C. (1944).

⁸² H.R. Conf. Rep. No. 108-10, at 807 (2003).

⁸³ U.S. Army Corps (2006), *supra* note 18.

⁸⁴ *Id.*

erosion, and ice and glacial damage in Alaska, including relocation of affected communities and construction of replacement facilities.”⁸⁵ This authority was repealed in March 2009.⁸⁶ A more recent law⁸⁷ provides similar authority to the 2005 law; however, its requirement of cost sharing of up to 35% makes participation difficult or impossible for most ANVs.

In summary, there are laws in place to discourage new construction in flood- and erosion-prone areas, and there are programs to assist communities and households affected by flooding and erosion. But there is not a comprehensive national or state effort to elevate or relocate buildings in floodplains prior to disaster, and the programs in place may be inaccessible to many ANVs.

⁸⁵ Consolidated Appropriations Act, 2005, Pub. L. No. 108-447, Div. C, Title I, § 117, 118 Stat. 2944-45 (2004).

⁸⁶ Pub. L. No. 111-8, Div. C, Title I, § 117, 123 Stat. 606 (2009).

⁸⁷ Energy and Water Development and Related Agencies Appropriations Act, 2010, Pub. Law. No. 111-85, § 116, 33 U.S.C. § 2213.

III. KEY FINDINGS FOR ALASKA NATIVE VILLAGES

This section covers findings about flooding, erosion, and strategies to mitigate these phenomena, as described in community plans for ANVs and by interview participants from across Alaska.

Hazards and strategies described by plans, which are almost always prepared by external entities with limited ANV involvement, were not always the same as those described by participants.

Research was authorized by the Institutional Review Board of the University of Hawaii, and ethical considerations required maintaining confidential the identity of participants. For this reason, names of participants and ANVs are generally not mentioned in this article.

A. Flooding Hazards Reported

Flooding and erosion are hazards for many of the communities in my study. Almost all of the HMPs I reviewed (41 out of 43) mentioned flooding as a hazard, as did plans for two ANVs without HMPs. Thirty-three HMPs as well as plans for four communities without HMPs referred to erosion as a hazard.

Participants shared insight on changes in flooding, erosion, and climate in recent years. Many participants (mostly from the west coast and interior Alaska) referred to increasing erosion, while a number (likewise, mostly from the west coast and interior) referred to increased flooding. A few participants from the interior described ice jam flooding as being less dramatic than in the past due to thinner ice at the time of spring breakup. A few participants from the north, west, and south coasts referred to bigger tides or waves than before, and number (particularly from the west coast) referred to more storm surge-related flooding. A number throughout Alaska referred to having less snow and more rain.

One interesting finding that emerged from my plan reviews and interviews is that HMPs

appear to put less emphasis on thin ice, even though this can pose significant risk for subsistence participants that rely on thick ice for travel and transport of their harvest. Only two HMPs for ANVs on the northwest coast and one community plan on the north coast referred to less or thinner sea ice as a hazard, yet as many participants referred to thin ice as those who referred to erosion. A second interesting finding is that only one HMP in my study (for a northwest coast ANV) referred to sea level rise as a hazard, while several participants from the north and west coasts and the Aleutians referred to this phenomenon. These two findings may suggest that HMPs are not fully reflecting community hazards.⁸⁸

B. How ANVs are adapting in place to flooding and erosion

Consistent with the literature,⁸⁹ a number of participants referred to hard armoring implemented by external agencies as a major adaptation strategy. Participants referred to sea walls, wire-mesh gabions (wire baskets filled with cobbles or sandbags), wooden bulkheads, groins, revetments (small prefabricated concrete units or rocks), sandbags, and riprap. Of the 41 HMPs that mentioned flooding and erosion control measures, 23 (and one community plan) referred to hard barriers in the form of seawalls, rip-rap, stream barbs, permanent sandbags, anti-erosion turf on ground, and other controls.

⁸⁸ E.B. Ristroph, *Improving the Quality of Alaska Native Village Climate Change Planning*, 11 JOURNAL OF GEOGRAPHY AND REG. PLANNING 143 (2018).

⁸⁹ Jon E. Zufelt & Orson P. Smith, *Arctic and Low-Cost Erosion Control: Designs for Alaska*, in COASTAL EROSION RESPONSES FOR ALASKA, 67 (Orson P. Smith ed., 2006).

Only five HMPs called for soft armoring in the form of natural berms or brush along the shoreline—two riverine communities, two on the west coast, and one in the Aleutians. Several participants (about half of those who referred to hard armoring) referred to soft armoring as a desirable strategy. What could make this strategy particularly desirable is the ability of communities to carry it out on their own. For example, a representative from a riverine community said that every time they have brush cutting along the streets, they place the brush along the erosion-prone parts of the river banks.

An example of soft armoring that stands apart is the coastal berm constructed by the west coast village of Shaktoolik along the coastline. The goal of the project was to avoid damage from storm surge and woody debris that could be thrown against buildings during storms. Under the leadership of Mayor Eugene Asicksik, the municipal government got small grants that enabled it to buy two army surplus dump trucks and gravel. It hired local laborers to build the five-foot berm. A coastal engineer who provided some assistance to the project described it this way: “Shaktoolik just went out and bought a few trucks. We pointed out a few technical things...and they started hauling gravel back and building this whole berm totally on their own.”

One novel strategy referenced by eight HMPs, one community plan, and a few participants is improving or building up roads to resist flooding/erosion. An example is the community of Golovin, which used local entities and resources to elevate an important road. One resident noted that if they had built a dike, they would have had to hire engineers, whereas raising the roads was cheaper and saved them from two disasters.

Several strategies appeared frequently in HMPs even though they were mentioned with much less frequency by participants. This may be related to the fact that HMPs for ANVs are written by a handful of consultants who are only involved with these ANVs to write plans—not

to carry them out. For example, ten HMPs referred to joining the National Flood Insurance Program (NFIP), but no ANV participants even mentioned NFIP. Further, although the most common flooding mitigation measure (in 30 HMPs) was arranging for buyouts to relocate structures, few participants described buyouts as a current or potential strategy. Similarly, sixteen HMPs but only a couple participants referred to elevating buildings. The two participants said that elevation and building out of the floodplain was not something the community had wanted to do but was required in order for the community to receive federal funding.

One challenge to carrying out strategies such as relocating homes is the unwillingness of some ANV residents to live anywhere but beside the water. A number of participants described as problematic their inability to get funding to build along the water. The resistance to moving back from the water was often expressed by older residents who are more rooted in a traditional lifeway along the shoreline. One participant from an ANV that had moved up from the river onto a bluff expressed this sentiment: “It’s as if you were anywhere, not in a Native Village.” Another participant suggested the subsistence lifeway could still be accommodated by having a good access road to get to the water, although many people in ANVs lack vehicles.

Another challenge to carrying out adaptation strategies is the limited funding designated for project implementation, as opposed to the funding available for simply monitoring and planning. Adaption grants from two agencies that have relatively simple application processes—the Bureau of Indian Affairs and the Environmental Protection Agency—are only for data collection, monitoring, and planning, not for infrastructural improvements. FEMA’s hazard mitigation grants for elevation, relocation, and buyouts are so complicated that they require spending thousands of dollars to hire grant-writing consultants. Thus, as a number of participants indicated, many ANVs are “adapting” by simply collecting information or

developing plans. A few participants indicated that they were unsure what they would do with data they had collected.

To summarize, ANV adaptation strategies in HMPs (the main type of plan addressing climate change adaptation) differ from those described by participants. While HMPs suggest an array of adaptation options for ANVs (from hard armoring to NFIP participation), participants described a more limited range of actions being carried out. Data collection is something communities and residents can do with little outside help, while hard armoring is carried out by external entities.

C. Hard Armoring as a Potential Maladaptation for ANVs

A number of participants, particularly residents of ANVs on Alaska's western coast, described hard armoring in ANVs as ineffective. In the words of a resident from a northwest coast village: "The big rocks they imported from Nome [to stop erosion] are gone. Gone! All those big giant rocks are gone. Probably five or six or eight laying on the sand by the water. They call them the million-dollar rocks." A resident from Seward Peninsula (the part of Alaska that juts into the Bering Sea) suggested that his village needed to focus on moving uphill, and that, "Building another berm would be a Bandaid." A resident from further south on the western coast said that the US Army Corps of Engineers had built a breakwater to minimize the disturbance of the shoreline, "but this has triggered problems to cause even more destruction to the front of the village."

As mentioned in Section II.B, some of the failures of hard armoring may relate to misunderstanding of Alaska's coastal erosion and accretion processes. A few participants from

outside ANVs suggested that the U.S. Army Corps of Engineers lacked this understanding. One Alaska coastal engineer described the Army Corps (2009) report on erosion not as a baseline study but “merely a planning document being used to make engineering and social (relocation) decisions.” He said, “There’s almost like two Corps of Engineers.” The Corps has a branch concerned with regulatory compliance, and a relatively independent civil works branch that actually designs structures. Permitting relates to the regulatory branch. “There is guidance ...but nobody seems to be following it.” Another Alaska coastal engineer said, “The way [the Army Corps] see[s] it, they don’t have to provide engineering studies. With Kivalina [a community often cited as needing relocation], there’s never been an erosion study.” A state scientist described how the Army Corps had built a revetment to address erosion in Kivalina, but due to accretion, the revetment “now has quite a bit of sand in front of it. So the revetment is not necessary unless a very big storm comes and erodes all the way back to the revetment. It seems that this sediment flow wasn’t taken into consideration.” A coastal engineer who worked for the Corps acknowledged some of the failing, noting “The shorelines of Alaska are littered with failed revetments ... because there wasn’t enough money or there wasn’t enough thought put into it.”

In addition to the lack of understanding regarding local processes of accretion and erosion, there may be a lack of fit between what outside entities like the Army Corps seek to provide and what communities need. Several participants (including a few from ANVs) described hard armoring and other infrastructure as “overbuilt” for ANVs, resulting in large, immovable, expensive structures that cannot be maintained by local residents. A coastal engineer described the hard armoring of the Army Corps this way: “The Army Corps is structured to do really big projects ... where you may have an issue that doesn’t really warrant

that level of response. They're used to funding \$10-20 million type projects.” The leader of one non-profit group working with ANVs said, “Often when the federal or state government comes in, it ‘over-engineers,’ ignoring wisdom that has worked for thousands of years and creating unsustainable, unadaptable structures. ... Putting in overengineered systems creates a demand for a workforce that is not necessarily being built at the same time we are putting these innovations in place.”

Interestingly, three quarters of those who referred to hard armoring as ineffective were from outside ANVs. I speculate, based on the experience of my interviews and my work with ANVs to get government assistance, that some within ANVs may have been reluctant to express disregard for this assistance and felt that *some* protection, even if short-lived, would be better than none at all for their communities. For example, a coastal engineer not from an ANV and an ANV resident offered different views of the same seawall. While the coastal engineer suggested that erosion had accelerated in areas adjacent to the seawall, the resident had a more ambivalent view:

There's a whole range of activities ... that are married to ... having a beach ... in front of your town. When that shoreline becomes a seawall, not only is it demarcation for many of those activities, but it's also a demarcation from that ancient relationship people had to the shoreline of their community ... The reason the town is located where it is (as opposed to in the middle of the peninsula) is because of the beach and the ocean and the access and the relationships. It's a very important part of how people define themselves and relate to the environment. But the alternative was to watch your shoreline erode and your infrastructure fall into the ocean. It was like a necessary evil in some ways.

Another reason why ANV residents were not as critical of hard armoring could be that they had limited knowledge of the ecological effects and long-term problems associated with hard armoring. Most ANV residents I interviewed had little to say about the flooding and erosion measures taken in their communities and did not offer an opinion in response to my question as

to whether one measure worked better than another. Based on the interviews as well as my review of plans and media concerning flooding and erosion control measures, it seems that measures were generally designed and implemented by outside entities rather than by ANV residents. A number of participants (mostly ANV residents) described problems with infrastructure built by outsiders without consideration of local knowledge. A number referred to the need for better communication between communities and outside entities who build ANV infrastructure. As one agency representative said,

When you build something in the Arctic it's very challenging, expensive to fix, and there may not be local capacity to fix things. Engineers may purposefully overdesign or overbuild infrastructure since they don't want it to fail. This could result in spending too much money. How do agencies contract so they don't spend too much but avoid liability? It takes multiple people talking together to work through that—the contract engineers, the people setting the standards, the community, and those who do maintenance.

An ANV resident put it more simply: “You want to get the best contractor, but you’ve got to still be able to have input.”

I do not intend to suggest that all hard armoring results in ineffective maladaptations, but rather that hard armoring has particular impacts in a permafrost rich environment where residents depend on the shoreline for their lifeway. There is a need for more consultation with ANV residents prior to implementing flooding and erosion controls to make sure the designs are appropriate for local conditions and can be maintained with local resources.

IV. DISCUSSION AND RECOMMENDATIONS

Two themes emerged from this research. One concerns the problems associated with the reactive state and national response to flooding and erosion, with limited funding and incentives

to proactively mitigate flooding and erosion hazards. The other concerns the nature of the reactive response, particularly the way in which hard armoring has been used in coastal communities such as ANVs with limited success or understanding of local conditions.

The moral hazard problem associated with post-flood bailouts in the United States is more nuanced for ANVs and other indigenous communities. Many were required to establish permanent settlements in flood- and erosion-prone places, and residents would lose their lifeway if forced to move to less flood-prone, more urban settings.⁹⁰ The residents and families of many ANVs depend on subsistence practices for their nutritional and cultural needs.⁹¹ In addition to providing for food security,⁹² subsistence enables families to spend time together and pass down

⁹⁰ Robin Bronen, *Climate Induced Displacement of Alaska Native Communities*, BROOKINGS-LSE PROJECT ON INTERNAL DISPLACEMENT (2013), www.brookings.edu/research/papers/2013/01/30-arctic-alaska-bronen [<https://perma.cc/E2KL-8LKE>].

James D. Ford et. al., *Climate Change Policy Responses for Canada's Inuit Population: The Importance of and Opportunities for Adaptation*, 20 *Global Environmental Change* 177 (2010), <https://doi.org/10.1016/j.gloenvcha.2009.10.008> [<https://perma.cc/MG2F-VWM5>].

Amanda H. Lynch & Ronald D. Brunner, *Context and Climate Change: An Integrated Assessment for Barrow, Alaska*, 82 *Climatic Change* 93 (2007), <https://doi.org/10.1007/s10584-006-9165-8> [<https://perma.cc/3CYP-98AP>].

Elizabeth Marino, *The Long History of Environmental Migration: Assessing Vulnerability Construction and Obstacles to Successful Relocation in Shishmaref, Alaska*, 22 *Global Environmental Change* 374 (2012), <https://doi.org/10.1016/j.gloenvcha.2011.09.016> [<https://perma.cc/5KD9-M2FN>].

⁹¹ Philip A. Loring et al., *Ways to Help and Ways to Hinder: Governance for Effective Adaptation to an Uncertain Climate*, *Arctic*, 73 (2011); Patricia Cochran et al., *Indigenous Frameworks for Observing and Responding to Climate Change in Alaska*, 120 *Climate Change* 558 (2013).

⁹² Patricia Cochran et. al., *Indigenous Frameworks for Observing and Responding to Climate Change in Alaska* 120 *CLIMATIC CHANGE*(2013) at 557–67, <https://doi.org/10.1007/s10584-013-0735-2> [<https://perma.cc/N635-825P>].

Davin Holen, *Fishing for Community and Culture: The Value of Fisheries in Rural Alaska*, 50 *UNIVERSITY OF ALASKA* (2014) at 403–413, <https://doi.org/10.1017/S0032247414000205> [<https://perma.cc/97TB-6LBA>].

knowledge and values.⁹³ Relocation to urban settings would not only upset the subsistence lifeway, it could eliminate ability to maintain an indigenous language and prohibit alcohol and drugs from entering the community.⁹⁴ Further, many ANVs are not even eligible for NFIP as they lack the required flood maps or the jurisdiction and capacity needed to issue and enforce flooding ordinances.

Accurate flood maps could be helpful for the many ANVs that lack them, as well as for other small, rural communities that lack up-to-date flood maps. Ideally, students and universities could work with those who have local knowledge to create and improve flood maps. While many ANVs are clearly within floodplains, flood maps could show adjacent and nearby ground that would be suitable for new construction. Flood maps would also help with eligibility for NFIP

Shannon M. McNeely, *Seasons out of Balance: Climate Change Impacts, Vulnerability, and Sustainable Adaptation in Interior Alaska*, UNIVERSITY OF ALASKA FAIRBANKS (2009) at 6, http://www.cakex.org/sites/default/files/project/documents/McNeeley_Dissertation_2009.pdf [<https://perma.cc/32FB-3TCT>].

⁹³ Jonathan M. Hanna, *Native Communities and Climate Change: Protecting Tribal Resources as Part of National Climate Policy: Report* (2007), http://scholar.law.colorado.edu/cgi/viewcontent.cgi?article=1014&context=books_reports_studies [<https://perma.cc/36TM-U3SX>].

Michael Hibbard & Robert Adkins, *Culture and Economy: The Cruel Choice Revisited*, In *Reclaiming Indigenous Planning*, edited by Ryan Walker, Theodore S. Jojola, and David C. Natcher, 94–112. McGill-Queen's Native and Northern Series ; 70. Montreal: McGill-Queen's University Press, 2013, <http://hccproxy.lib.hawaii.edu:2048/login?url=http://site.ebrary.com/lib/honclib/Doc?id=10740369>.

Davin Holen, *Fishing for Community and Culture: The Value of Fisheries in Rural Alaska*, 50 POLAR RECORD (2014) at 403–413, <https://doi.org/10.1017/S0032247414000205> [<https://perma.cc/2MSW-BNCW>].

Mark Nuttall et. al., *Hunting, Herding, Fishing and Gathering: Indigenous Peoples and Renewable Resource Use in the Arctic*, ARCTIC CLIMATE IMPACT ASSESSMENT (2005) at 649–690.

⁹⁴ Alaska has laws that provide a method for communities to control and impose certain limits on the availability of alcohol and marijuana in a community. Alaska Statutes 04.05, 17.38; 3 Alaska Administrative Code 304, 306.

participation, although lack of jurisdiction would eliminate participation by ANVs not associated with municipal governments.

The statute on NFIP eligibility, 42 U.S.C. § 4022 (2018), could be amended to allow ANVs without land jurisdiction to participate if they exercise their sovereignty over tribal citizens to control their citizens' building in floodplains. With this amendment, ANVs that choose to enact an ordinance prohibiting their tribal members from building or substantially improving existing buildings in a floodplain could participate in NFIP if they have the capacity to do so. This could theoretically allow ANV residents to get flood insurance and could also allow ANVs to be eligible for grants under FEMA's Flood Mitigation Assistance (FMA) program. Given that ANVs, which do participate in NFIP through their city government, still have not been able to get FMA,⁹⁵ financial capacity and staffing issues may need to be addressed in addition to any change in the law.

There is no simple remedy to addressing the desire to live alongside waterways. Whether or not a community is an ANV, the shoreline is often a part of a place-based community's culture and identity.⁹⁶ For ANVs, the shoreline is intertwined with subsistence lifeways that revolve around water. Even if state and federal governments could afford to buy out all of the flood-prone properties at the same time, political resistance would be too great. In some cases,

⁹⁵ Federal Emergency Management Agency, FLOOD MITIGATION ASSISTANCE GRANT PROGRAM (2018), <https://www.fema.gov/flood-mitigation-assistance-grant-program> [<https://perma.cc/QKF7-CHJP>].

⁹⁶ See Julie K. Maldonado et al., *The Impact of Climate Change on Tribal Communities in the US: Displacement, Relocation, and Human Rights* 120 CLIMATIC CHANGE(2013)at 601–14, <https://doi.org/10.1007/s10584-013-0746-z> [<https://perma.cc/LXB5-R9GV>]; John A. Warren et. al., *Climate Change and Human Health: Infrastructure Impacts to Small Remote Communities in the North*, 64 INTERNATIONAL JOURNAL OF CIRCUMPOLAR HEALTH (2005) at 487–97, <https://doi.org/10.3402/ijch.v64i5.18030> [<https://perma.cc/K9AB-H83B>]; Susanne C. Moser, *Navigating the Political and Emotional Terrain of Adaptation: Community Engagement When Climate Change Comes Home* 2013) at 289–305.

programs to elevate buildings may be useful, similar to what has been done in south Louisiana.⁹⁷ . But not all buildings have the structural integrity to withstand elevation, and those that can be elevated may still succumb to hazards such as ice jams and ice shoves (which occur when shorefast ice moves and deforms).⁹⁸

Ultimately, each community will have to come to terms with the risks it is willing to tolerate if it wants to remain in its present location. It will be important for state and federal agencies to clearly communicate the risks as well as the assistance these agencies are willing to provide to those who remain in the floodplain. Communication with communities is also important in avoiding maladaptations along the lines of infrastructure that is “overbuilt” or does not work for communities. There is a need to consult with locals and understand local conditions prior to implementing flood and erosion controls.

As important as consultation and information gathering is, there must be a balance between devoting resources to monitoring and predicting flooding and erosion, and addressing the known risks of ANVs situated adjacent to shorelines. Simply gathering data is not enough to keep communities out of harms’ way—active adaptation efforts are needed.⁹⁹ In the case of episodic, storm-driven erosion on coastlines, monitoring may be particularly unhelpful, since time-averaged coastal change rates do not necessarily reflect the actual processes of coastal

⁹⁷ Conner Bailey et. al., *Perspectives on the Restoration of the Mississippi Delta*, (Estuaries of the World) (2014) at 125–40, https://doi.org/10.1007/978-94-017-8733-8_9 [<https://perma.cc/NW2M-JJW3>]; Stephen Bender, *Global Lessons on Development Planning and Climate Hazards Reduction*, 40 THE PUBLIC MANAGER (2011) at 21, 27-31.

⁹⁸ Andrew Mahoney et al., *Ice Motion and Driving Forces during a Spring Ice Shove on the Alaskan Chukchi Coast* 50 JOURNAL OF GLACIOLOGY (2004) at 195–207, <https://doi.org/10.3189/172756504781830141> [<https://perma.cc/5FBK-K23J>].

⁹⁹ Brunner & Lynch, *Adaptive Governance and Climate Change* (2013).

change.¹⁰⁰ Shifting state and federal funding toward elevation and relocation of buildings that are clearly in flood-prone areas and whose owners are willing to accept these changes would seem to be a “no regrets” strategy.¹⁰¹ Recognizing the limitations of state and federal funding, it is important to encourage communities to share and learn from strategies used by similarly situated communities, such as using local resources to build flood and erosion controls. Since local resources can only do so much to protect against severe natural hazards, it will be important for communities to develop the capacity to take advantage of the funding mechanisms available as well as partnerships with entities that can provide support.

V. CONCLUSION

While ANVs as well as many other communities want to stay in place and avoid retreat, there is a gap between ANVs and federal institutions in terms of the adaptation strategies that each desire and are able to carry out. Small, rural communities like ANVs lack the capacity and jurisdiction to implement large scale projects to avoid flooding and erosion. In many cases, ANVs do not even have flood maps. Federal agencies (and to a lesser extent, state agencies) can provide these resources, but it is difficult for most ANVs and other small, rural communities to obtain them without a disaster declaration or capacity to navigate complex funding opportunities. When ANVs do get infrastructure to control flooding and erosion, it is often ineffective due to poor understanding of local conditions. But given the difficulty of obtaining assistance in the first place, ANVs may be reticent to complain about it.

¹⁰⁰ Lynch & Brunner, *Context and Climate Change* at 102.

¹⁰¹ American Planning Association, “Policy Guide on Planning and Climate Change,” 2011.

The result is a reactive, potentially maladaptive approach to controlling flooding and erosion. There is a need for a better partnership between ANVs and external entities so that ANVs can more readily obtain the support they need and have a stronger voice in how this support is carried out. This conclusion applies not only to ANVs, but also to other small, rural, and place-based communities that will require adaptation assistance. As more and more communities compete for adaptation federal and state assistance, it is important not only that vulnerable communities get needed assistance, but that limited funding is spent on effective adaptation measures.