

KOTZEBUE

GATEWAY INTO THE ARCTIC

PROJECT TITLE

[e.g. A Master Plan and Detailed Area Design]

for

CLIENT/CITY/ORGANIZATION

Kotzebue, Alaska

A Capstone Study Proposal

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February of 2022

Bachelor of Landscape Architecture Program

Department of Plant and Soil Sciences

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In partial fulfillment of the requirement for the degree of

Bachelor of Landscape Architecture

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LARC 467 Capstone Studio Instructor 2022

Table of Contents

| | |
|----------------------|-----------|
| Land Acknowledgement | 5 |
| Mission Statement | 6 |
| Problem | 7 |
| Site Analysis | 12 |
| Proposal | 38 |
| Next Steps | 42 |
| Appendix A | 44 |
| Sources | 48 |



Kotzebue National Forest, Kotzebue, AK,
around 1971 to 1972. Photograph by
unknown.

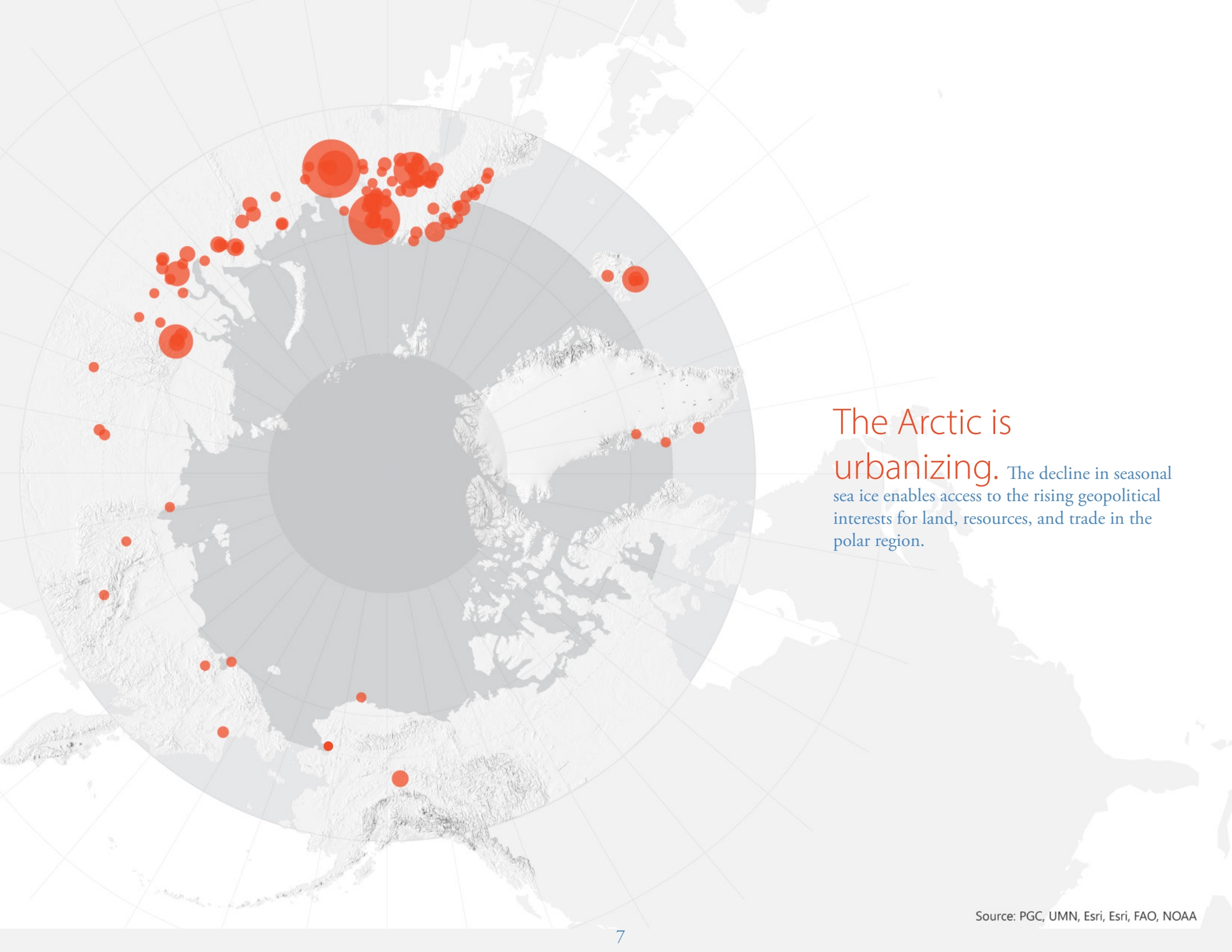
Acknowledgment

Iñupiat communities in the Arctic face marginalization, loss of land and resources, human rights violations, discrimination, and unemployment. For 10,000 years, the Iñupiat resided in the Northern Territory of Alaska. The commencing of trade between Kotzebue and Russia provided a more manageable lifestyle with advanced tools; the tradition remained. At this point, the Iñupiat proved they could adapt while continuing a traditional Iñupiat lifestyle.

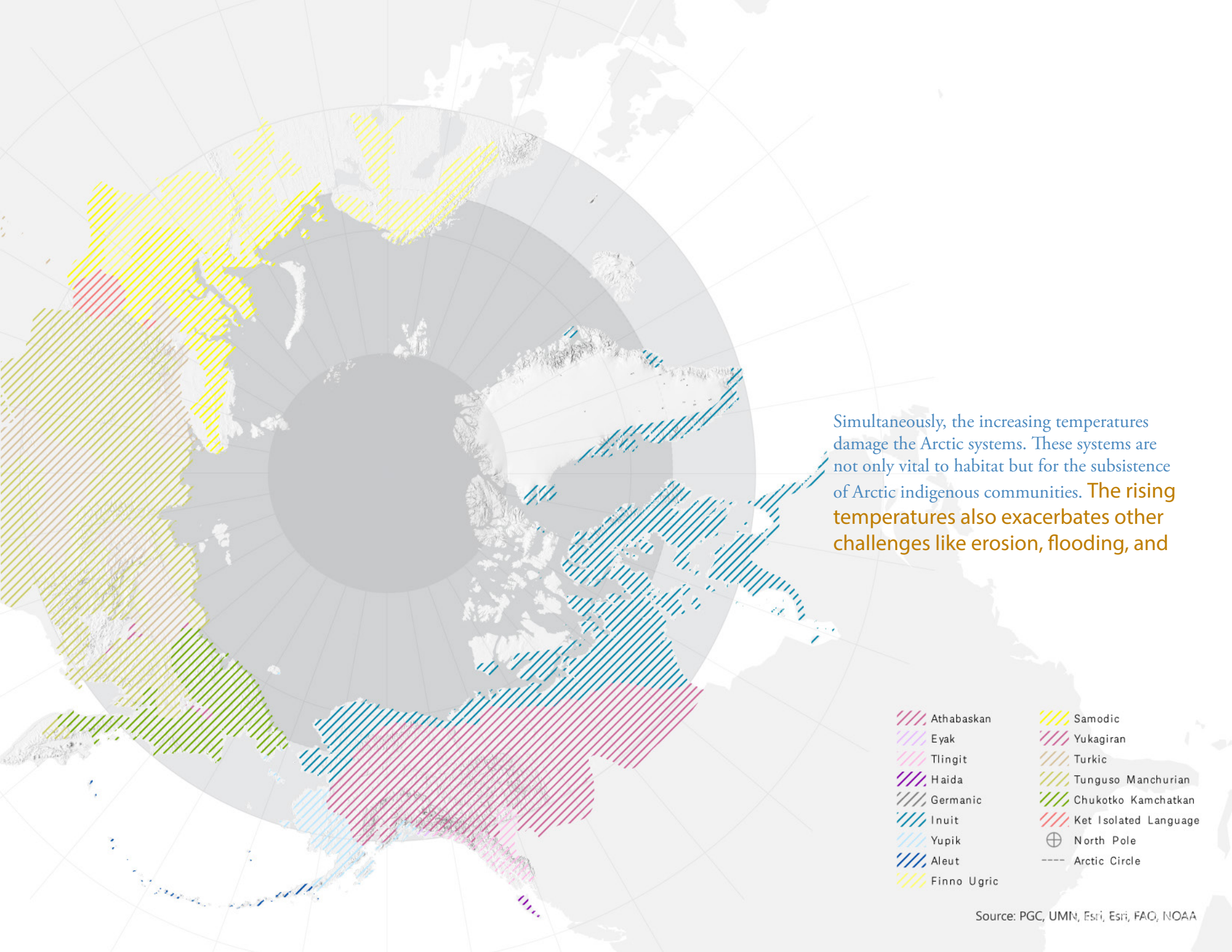
Up until the 19th century, the community of Qikiqtagruk (Kotzebue) maintained traditional practices. In the early 20th century, missionaries of different faiths arrived to convert the local beliefs preceding America's claim to the territory. Since then, the American government has offered new technology and education in an indirect agreement to Americanize and leave behind thousands of years of tradition. While foreigners displaced a portion of the local population, the colonization also displaced the culture from the Alaskan natives. Acknowledgment is not enough; the solution must prioritize the existing cultures in a resilience and adaptation plan.

Mission Statement

This project will assess erosion mitigation and adaptation methods in Kotzebue as the community's vulnerability increases from the degrading natural systems. Developing a conceptual plan may promote the opportunities that prioritize short-to mid-term erosion mitigation and improve other subsistent relationships between culture and the landscape. This proposal requires a thorough understanding of the dynamic Arctic landscape and systems of the Kotzebue Sound, the community's subsistence with the landscape, and deeply rooted cultural traditions. Understanding these factors will promote a design that achieves the goal and visually communicates ideas for the community.



The Arctic is urbanizing. The decline in seasonal sea ice enables access to the rising geopolitical interests for land, resources, and trade in the polar region.



Simultaneously, the increasing temperatures damage the Arctic systems. These systems are not only vital to habitat but for the subsistence of Arctic indigenous communities. **The rising temperatures also exacerbates other challenges like erosion, flooding, and**

- Athabaskan
- Eyak
- Tlingit
- Haida
- Germanic
- Inuit
- Yupik
- Aleut
- Finno Ugric
- Samodic
- Yukagiran
- Turkic
- Tunguso Manchurian
- Chukotko Kamchatkan
- Ket Isolated Language
- North Pole
- Arctic Circle

Source: PGC, UMN, Esri, Esri, FAO, NOAA



Gateway into the Arctic Kotzebue, or as locals call it – Qikiqtaruk – a “small island” (Hensley, 2009) is a city in the Northwest Arctic Borough in Alaska. The city is situated 26 miles north of latitude 66°30’ N – known as the Arctic Circle.

Kotzebue ●

Se Chukchi Sea

The Kotzebue Sound

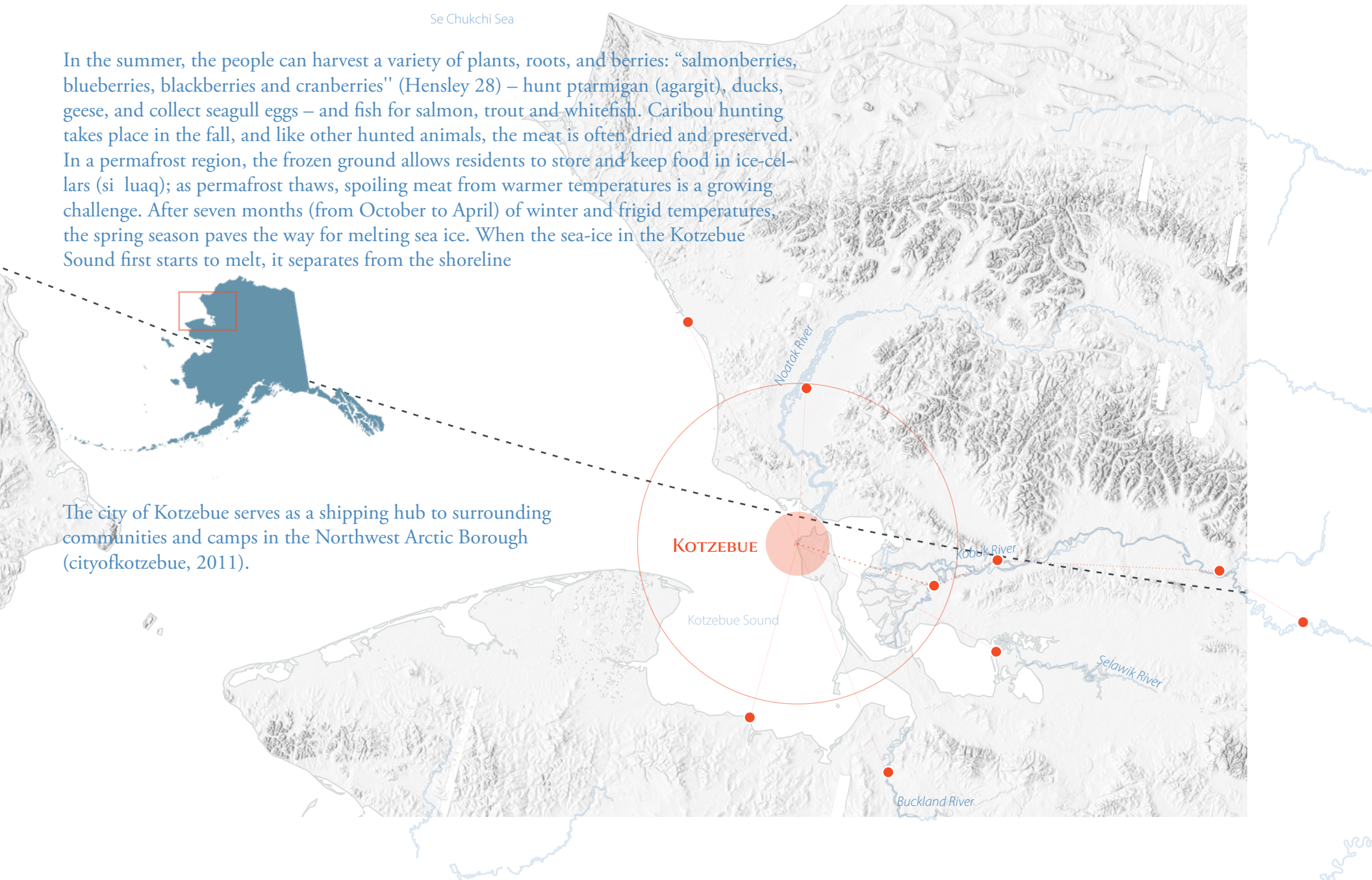


The city rests on the northern end of the Baldwin Peninsula in the Kotzebue Sound – the eastern region of the Chukchi Sea. Significant amounts of freshwater from the Noatak, Kobuk, Selawik, and Buckland Rivers flow into the Kotzebue Sound, characterizing it as an estuarine embayment – a “unique feeding, breeding, and molting habitat for marine animals” (Hauser et al., 2021) promoting hunting for the village -- one of many traditional practices. The Inupiat Eskimo’s **subsistence** relies on the surrounding geological and ecological systems for cultural traditions, and, ultimately, their **identity**.



In the summer, the people can harvest a variety of plants, roots, and berries: “salmonberries, blueberries, blackberries and cranberries” (Hensley 28) – hunt ptarmigan (agargit), ducks, geese, and collect seagull eggs – and fish for salmon, trout and whitefish. Caribou hunting takes place in the fall, and like other hunted animals, the meat is often dried and preserved. In a permafrost region, the frozen ground allows residents to store and keep food in ice-cellars (si luqaq); as permafrost thaws, spoiling meat from warmer temperatures is a growing challenge. After seven months (from October to April) of winter and frigid temperatures, the spring season paves the way for melting sea ice. When the sea-ice in the Kotzebue Sound first starts to melt, it separates from the shoreline

The city of Kotzebue serves as a shipping hub to surrounding communities and camps in the Northwest Arctic Borough (cityofkotzebue, 2011).



History

Iñupiat communities in the Arctic historically and currently face hardships in various realms of society – political and economic marginalization, loss of land and resources, human rights violations, discrimination, and unemployment – and the consequences of climate change exacerbate these affairs. The Iñupiat Eskimos inhabited the Northwest Arctic Borough for 10,000 years (Northwest Arctic Borough, 2022), and Qikiqtagruk served as a trading hub for the surrounding communities. In the late 1700s, trade commenced between Qikiqtagruk and Russia, supplying Qikiqtagruk with more advanced Serbian technology (e.g., metal utensils, axes, saws, and rifles), making daily life more manageable (Hensley, 2009). In the 19th century, Christian missionaries who arrived at Kotzebue converted Alaskan natives to Christianity (Hensley, 2009). The missionaries brought education that discouraged cultural traditions, including speaking Eskimo Iñupiaq, learning native history, traditional art, singing, and dancing. In 1818, colonizers named changed the name from Qikiqtagruk to Kotzebue after Lt. Otto Von Kotzebue who ‘discovered’ the Kotzebue Sound. The United States purchased the territory of Alaska from Russia for \$7.2 million in 1867 (Office of the Historian, Foreign Service Institute). By 1899, the city implemented the first post office, and the surrounding towns grew because of the popularity of gold mining (Northwest Arctic Borough, 2022). Since then, Kotzebue and Alaskan communities continued to face marginalization and loss of land and respect from outsiders. Conversations of native rights grew louder from the community and activists like Kotzebue-born William Hensley.



Photo of Kotzebue Mission, Cape Blossom
(taken August 1906, F.H. Nowell).

Integrating Foreign Practices

Though the Arctic systems in the Kotzebue Sound promote the unique relationship between the communities and landscape, the extreme conditions also challenge vitality and practices – both traditional and adapted.

The people of Kotzebue today and their ancestors proven themselves as resilient and adaptive to environmental and anthropogenic stressors such as climate change, colonization, and a portion of missionaries with their pejorative enlightenments. But, we should not confuse the Inupiat's adoption of foreign practices with another complete and successful American indoctrination story.

In the late 1700s, the commencing of trade between Kotzebue and Russia provided a more manageable lifestyle with advanced tools (Hensley, 2009). The Inupiat's transactions with Russia and future foreign cultures did not indicate a loss of culture for Kotzebue. Rather, their readiness to utilize unfamiliar tools demonstrated the community's desire to continue their traditions more manageably: metal tools lasting longer than ones crafted from wood or bone – guns boosting rates of successful hunts on the sea ice – and street lights lighting the way “on stormy evenings” (Hensley, 2009). Some of these advancements promoted additional time to adopt and adapt new and existing traditions encouraged by living rather than fretting to survive.



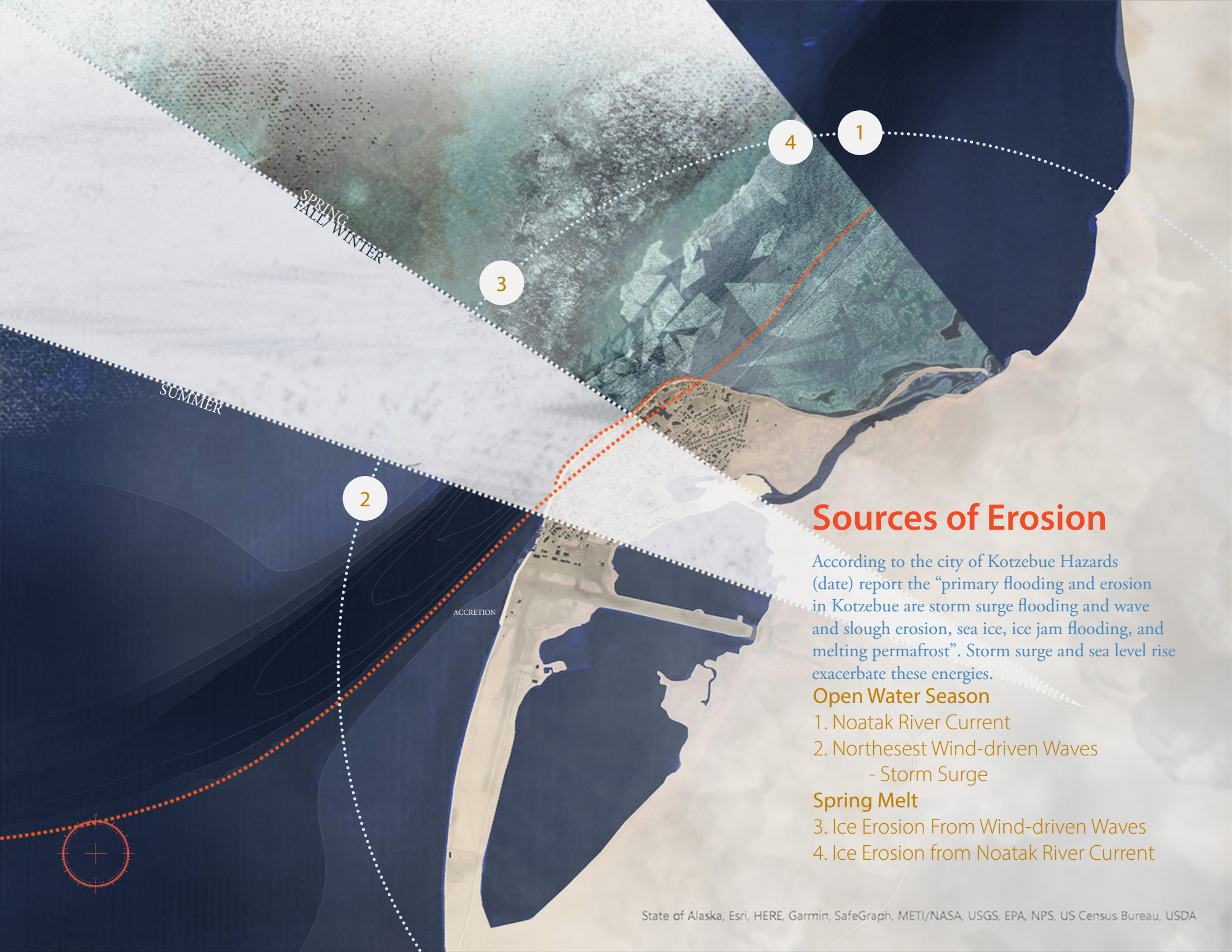
Photo of Kotzebue Power Lines (taken between October, 1971 to October, 1972, unknown photographer).

Kotzebue is already experiencing challenges exacerbated by climate change and community's **future is uncertain.**

Mitigation and adaption procedures are difficult. There is little information on sea level rise in Alaska. Permanency of communities until they need to **consider relocation from erosion, flooding and surge leads to loss of land, damaged infrastructure and food insecurity is uncertain.**



<https://blog.lib.utah.edu/head-preservation-travels-arctic-help-save-native-language-tapes/>



Sources of Erosion

According to the city of Kotzebue Hazards (date) report the “primary flooding and erosion in Kotzebue are storm surge flooding and wave and slough erosion, sea ice, ice jam flooding, and melting permafrost”. Storm surge and sea level rise exacerbate these energies.

Open Water Season

- 1. Noatak River Current
- 2. Northesest Wind-driven Waves
 - Storm Surge

Spring Melt

- 3. Ice Erosion From Wind-driven Waves
- 4. Ice Erosion from Noatak River Current

Noatak River Current

Open-Water Season

Currently, the Noatak River runs southward into the Kotzebue Sound. Though the river profiles as an estuary eventually, the form of the river continues into the sound. At this latitude, the delineation between land and water is blurred.

KOTZEBUE

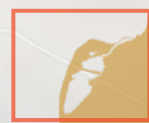
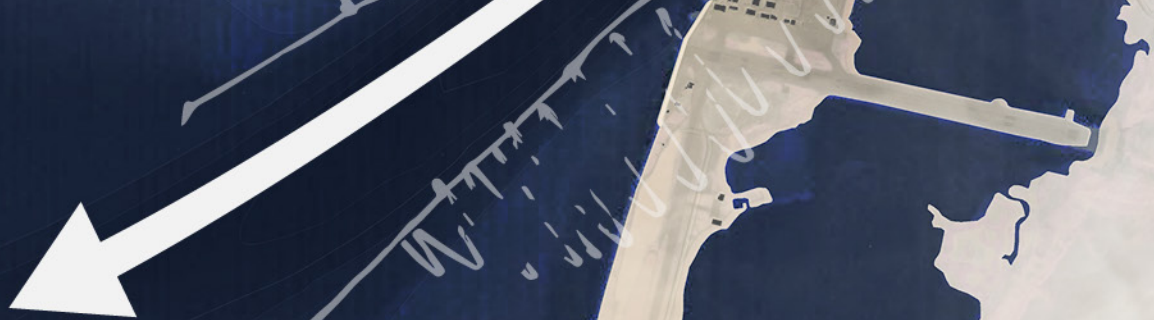
Noatak River



Noatak River Current

Open-Water Season

As the river current erodes the sediment in the sound, Kotzebue naturally wants to erode too.





0-1.64 1.64-3.3 3.3-4.9 4.9-8.2

WIND-DRIVEN WAVES

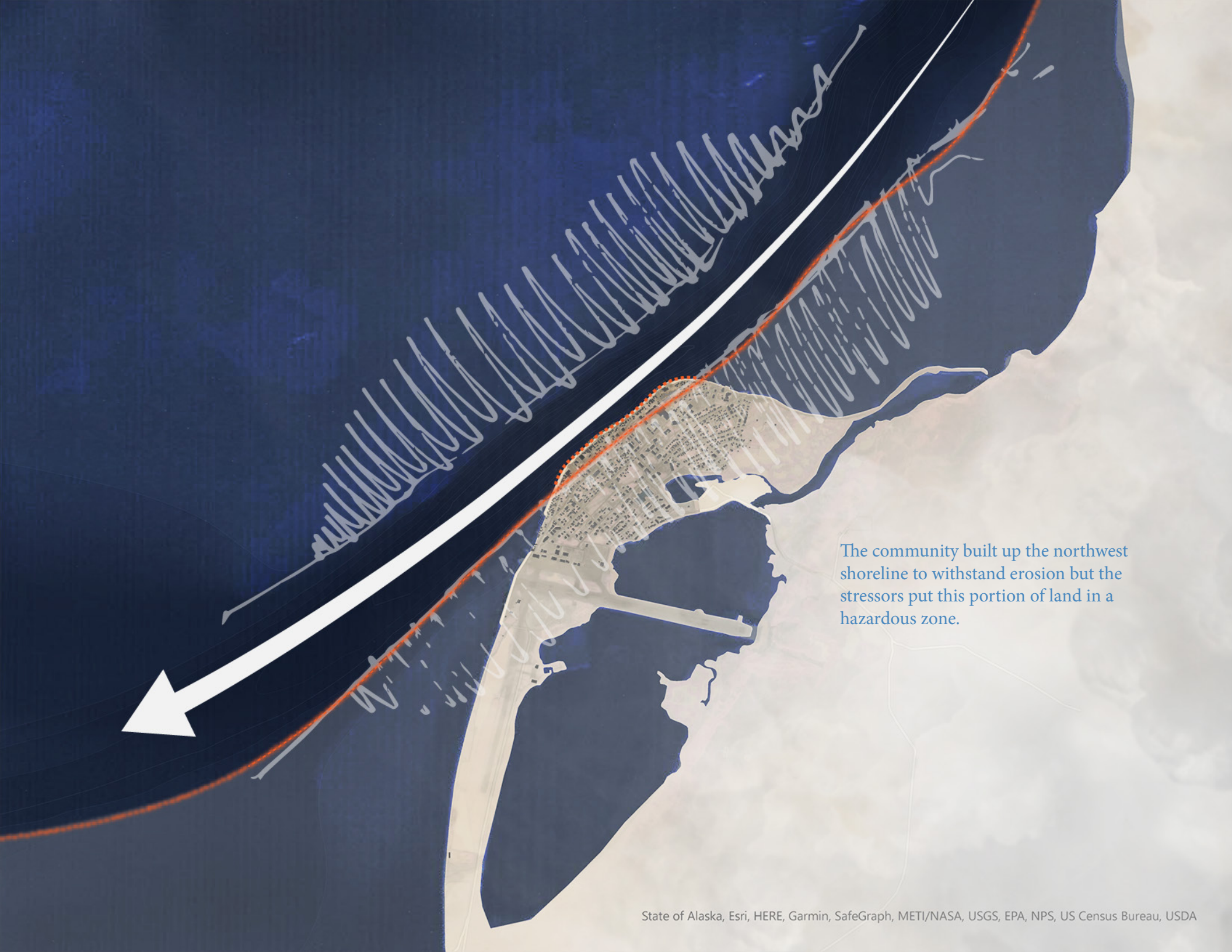
NOATAK RIVER CURRENT

ACCRETION

Wind-driven Waves

Open-Water Season

Using the Ralph Wien Airport in Kotzebue wind data from 1970 to 2018, Iowa State University articulated a wind rose, displaying winds predominantly originating from the southeast, averaging 12.3 miles per hour. According to monthly wind data, east-southeast occurs from September to April and west-northwest from **May to August.**



The community built up the northwest shoreline to withstand erosion but the stressors put this portion of land in a hazardous zone.

Storm Surge

The average elevation in Kotzebue ranges from 10 to 15 feet. During storm events the land floods.

9.6'
8.1'

5.1'
4.5'

AVERAGE HIGH
MLLW



Around 6 ft Surge - LEON Network

| RETURN PERIOD [years] | KOTZEBUE SURGE LEVEL [ft MLLW] |
|--------------------------|--------------------------------------|
| 5 | 4.5 |
| 10 | 5.1 |
| 50 | 8.1 |
| 100 | 9.6 |



Bathymetry

Open-Water Season

The average depth in the Kotzebue Sound ranges 5 to 10 feet while the channel reaches a depth of 52 feet.

As water depth increases, wave height increases. If surge can double the depth of the sound it is assumed the wave height increases significantly.



Historical Shoreline



Photo of Kotzebue (taken between October, 1971 to October, 1972, unknown photographer).

The previous shoreline enabled residents to launch their boats from the shoreline with easy access. The new shoreline establishes a black and white relationship between the water and land. This landscape is all but one or the other.

New Shoreline



<https://www.kotzebueira.org/>

Sea Ice



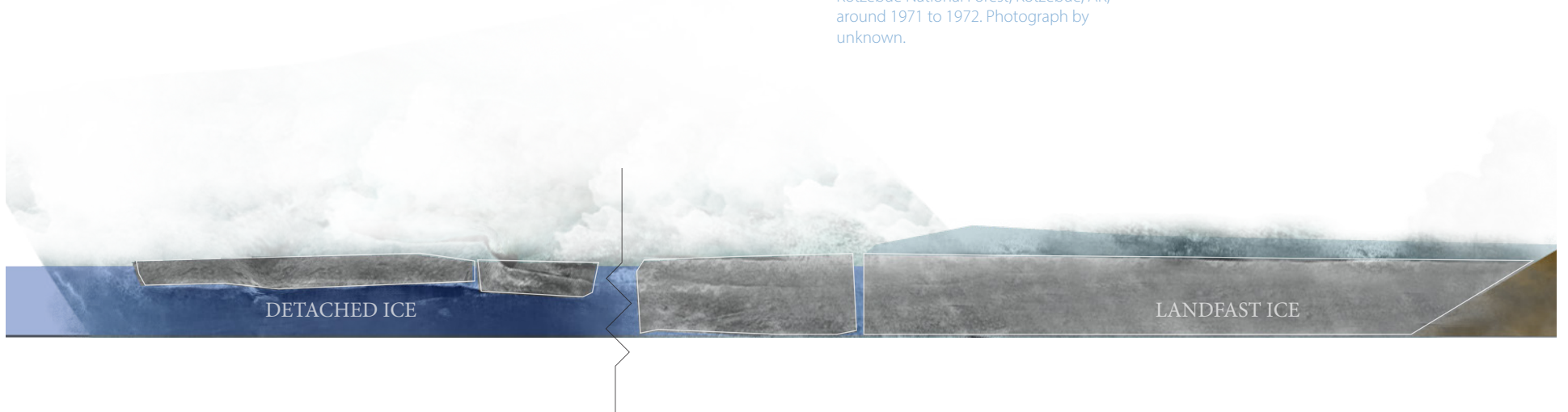
Kotzebue National Forest, Kotzebue, AK,
around 1971 to 1972. Photograph by
unknown.

Sea ice

Historically, sea-ice in Kotzebue protected the shoreline from storm events typically occurring autumn and early winter but also erodes the shoreline during the spring melt.



Kotzebue National Forest, Kotzebue, AK, around 1971 to 1972. Photograph by unknown.

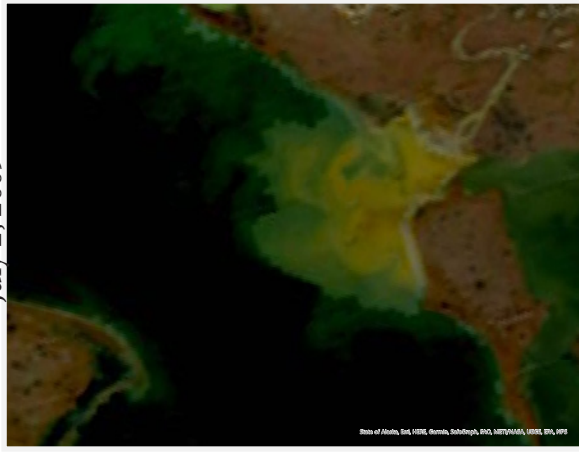


Following ice formation on the Russian coast in the Chukchi sea during October, ice forms off the Alaskan western coast and meets with the adjacent ice disconnecting northbound access to the Chukchi Sea in the Bering Strait. By early November, the Kotzebue Sound consists of 5 tenths of ice cover -- elders recall past formations in October. Using ArcGIS, a series of mappings displays the sea ice cycle from July to June in 2010 using Land Surface Reflectance (True Color, MODIS, Aqua) imagery obtained from NASA Global Imagery Browse Services for EOSDIS.

Reference Map



July 2, 2009



August 16, 2009



September 19, 2009



November 1, 2009



November 3, 2009



November 10, 2009



January 5, 2010



April 10, 2009



April 19, 2010



May 14,



May 19, 2010



May 25,



May 27,



May 28,



May 30,



June 2, 2010



June 4, 2010



SPRING

During the sea ice melt, currents occasionally push the detached and packed sea ice onto land damaging infrastructure. The pieces of ice range from 1 to 4 feet thick.

Community travels by boat to hunt Bearded Seal



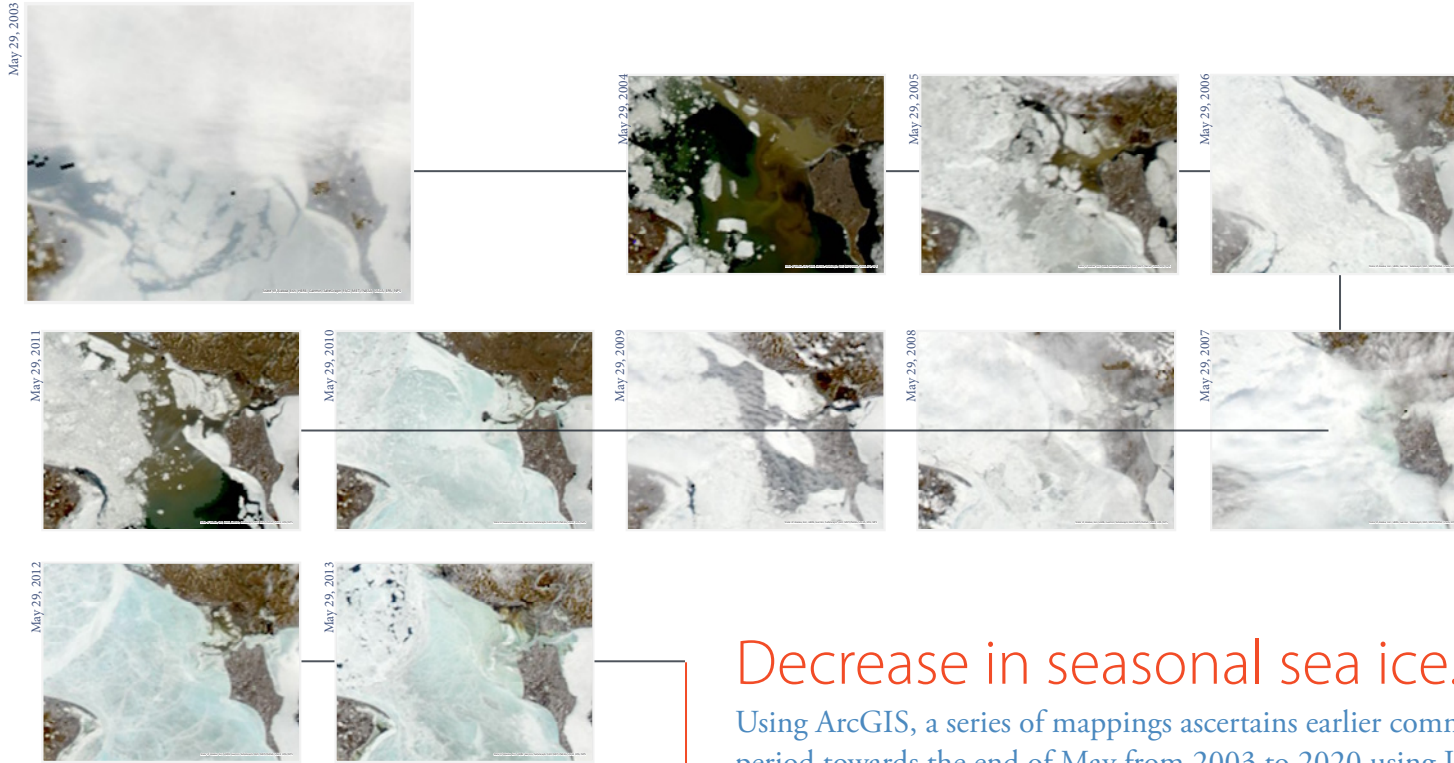
WINTER



April 3, 2021 by Wesley Early, KOTZ - Kotzebue

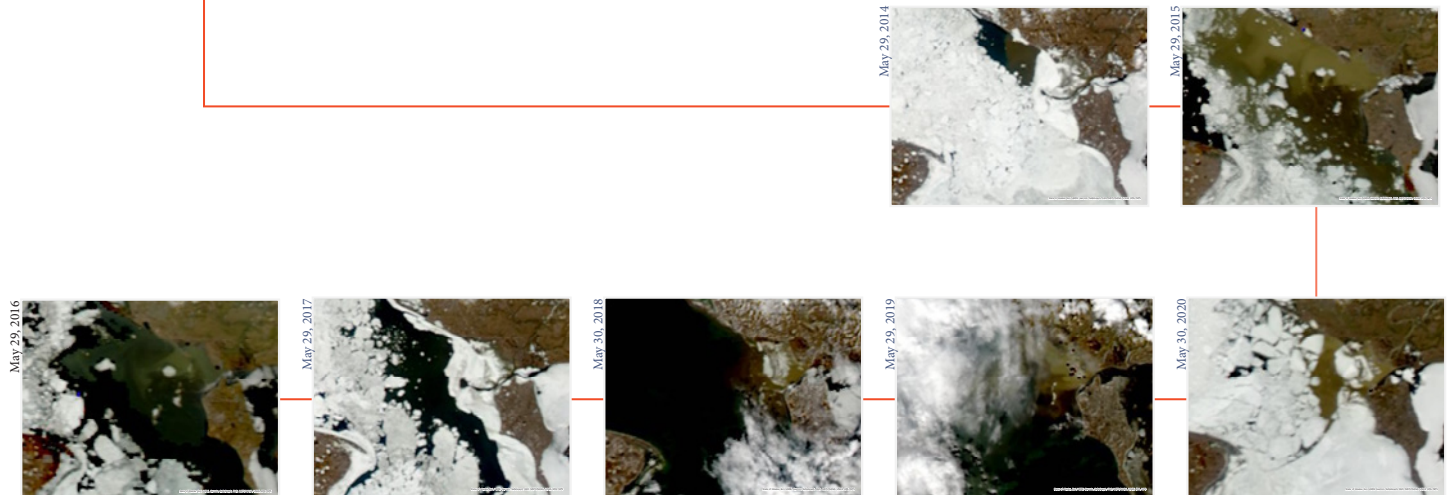


Bill Roth / ADN | Credit: Alaska Dispatch News



Decrease in seasonal sea ice...

Using ArcGIS, a series of mappings ascertains earlier commencement of the sea ice melting period towards the end of May from 2003 to 2020 using Land Surface Reflectance (True Color, MODIS, Aqua) imagery obtained from NASA Global Imagery Browse Services for EOSDIS.



What does this mean?

The decrease in sea ice trends ascertains the presence of a warming planet. The presence of ice for May and June in the Kotzebue Sound attenuates the deepwater wave energy driven by the prevailing west-northwest winds. But the increased open-water season makes the shoreline vulnerable to storm events.

While this project aims to attenuate erosion-related problems, the **time expectancy is limited. Mitigation and adaptation procedures are complex.**

Challenges Costs and data...

There is a lack of precedent studies regarding erosion control in the Arctic. The cost of materials and construction are significantly higher than the lower 48 because of transportation costs and shorter construction season. The USACE considered numerous alternatives for improved navigation to Kotzebue to decrease import costs but the future of Kotzebue is uncertain.

Alaska lacks a **Coastal Authority** to aid with planning for adaptive communities. In 2007, Alaska's former governor, Sarah Palin, formed the Climate Change Sub-Cabinet (Palin, 2007), "which established the **Immediate Action Workgroup (IAWG)** in 2007" (Bronen, 2016). The IAWG "**identifies immediate priorities for addressing climate change in Alaska**" (Opheen, 2009). In 2011, the former governor of Alaska, Sean Parnell **discontinued the IAWG.**

Currently 34 coastal states participate in "**The National Coastal Zone Management Program** comprehensively addresses the nation's coastal issues through a voluntary partnership between the federal government and coastal and Great Lakes states and territories. Authorized by the Coastal Zone Management Act of 1972, the program provides the basis for **protecting, restoring, and responsibly developing our nation's diverse coastal communities and resources.**

... While state partners must follow basic requirements, the program also gives states the flexibility to design unique programs that best address their coastal challenges and regulations. By leveraging both federal and state expertise and resources, the program strengthens the capabilities of each to address coastal issues.

... All 35 coastal and Great Lakes states and territories (**with the exception of Alaska**) participate in the National Coastal Zone Management Program."

Lack of data challenges planning in the existing complex and dynamic Arctic systems: sea ice, permafrost, snow, and intense storms with strong winds.

Sea Level Rise

There are no FEMA maps, and Alaska did not have a projected sea-level rise until the recent release of the 2022 Sea Level Rise Technical Report estimating one foot increase in the next 30 years. At the same time, one foot sounds minor; Kotzebue averages 8 to 13 feet elevation. Sea level rise, melting permafrost, and storm surge leaves the community at tremendous risk.

6 Feet Sea Level



8 Feet Sea Level



10 Feet Sea Level



Diagramming

The following pages are process diagrams. The original concept was to place submerged breakwaters to attenuate the energies while not interacting with boating, other activities, and to prevent ice jam. Eventually the design adapted unsubmerged breakwaters because of the harsh environment.





With natural accretion at the south end of Kotzebue, copying the etty form at the northern end would accrete sediment too.

SAND ACCRETION



Masterplan

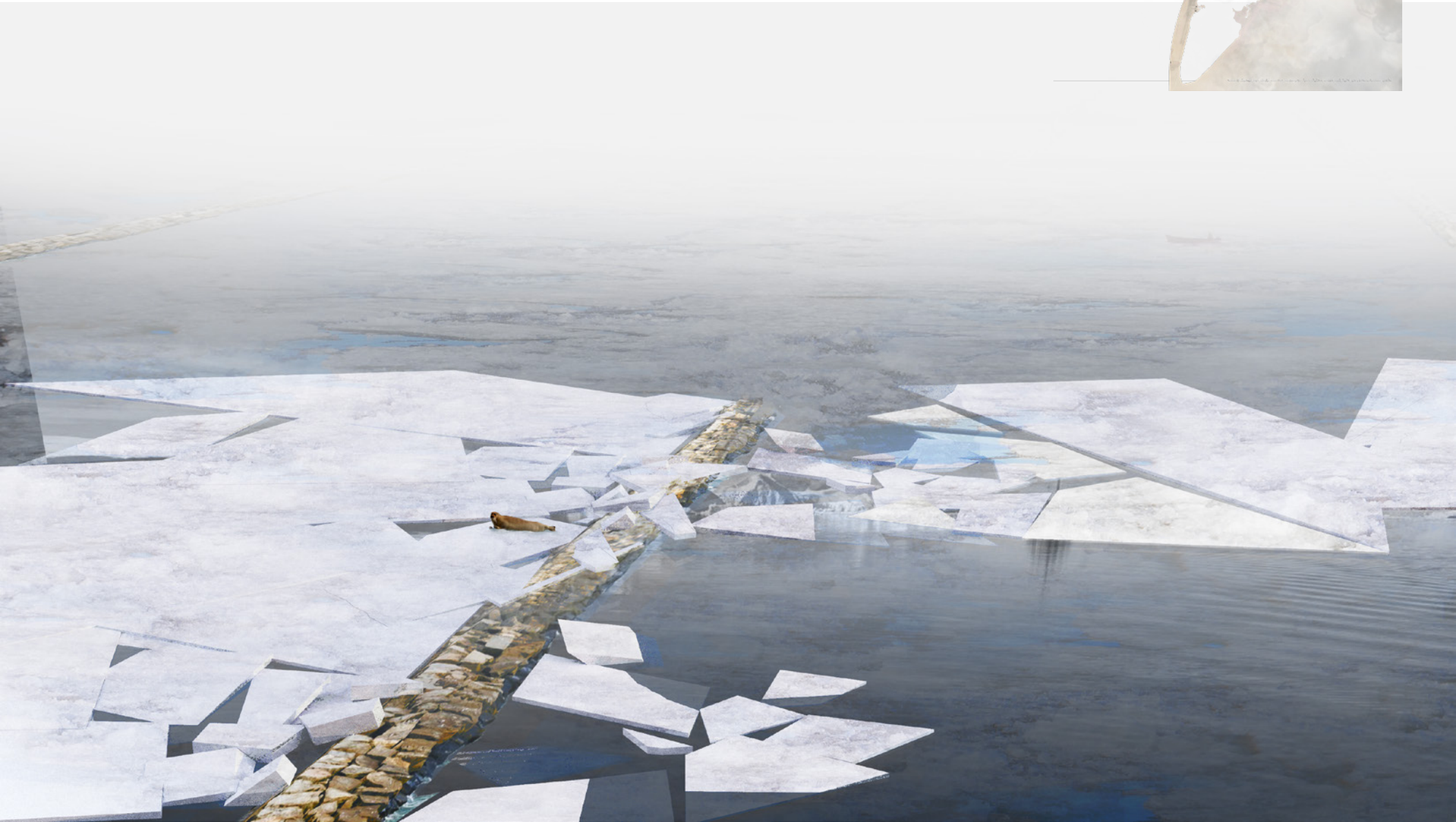


The proposal incorporates two interventions. The breakwaters to the west of Kotzebue attenuate wave energy and ice flow along the shoreline of Kotzebue with a performance expectancy of 30 to 40 years. The breakwater to the northern end of Kotzebue enables the opportunity to phase into a connected peninsula filled with trapped sediment from the Noatak River. The land to the east offers possible ground for the community to eventually migrate to, and the artificial landform can serve as a multiuse purpose for future generations.



Breakwaters In The Sound

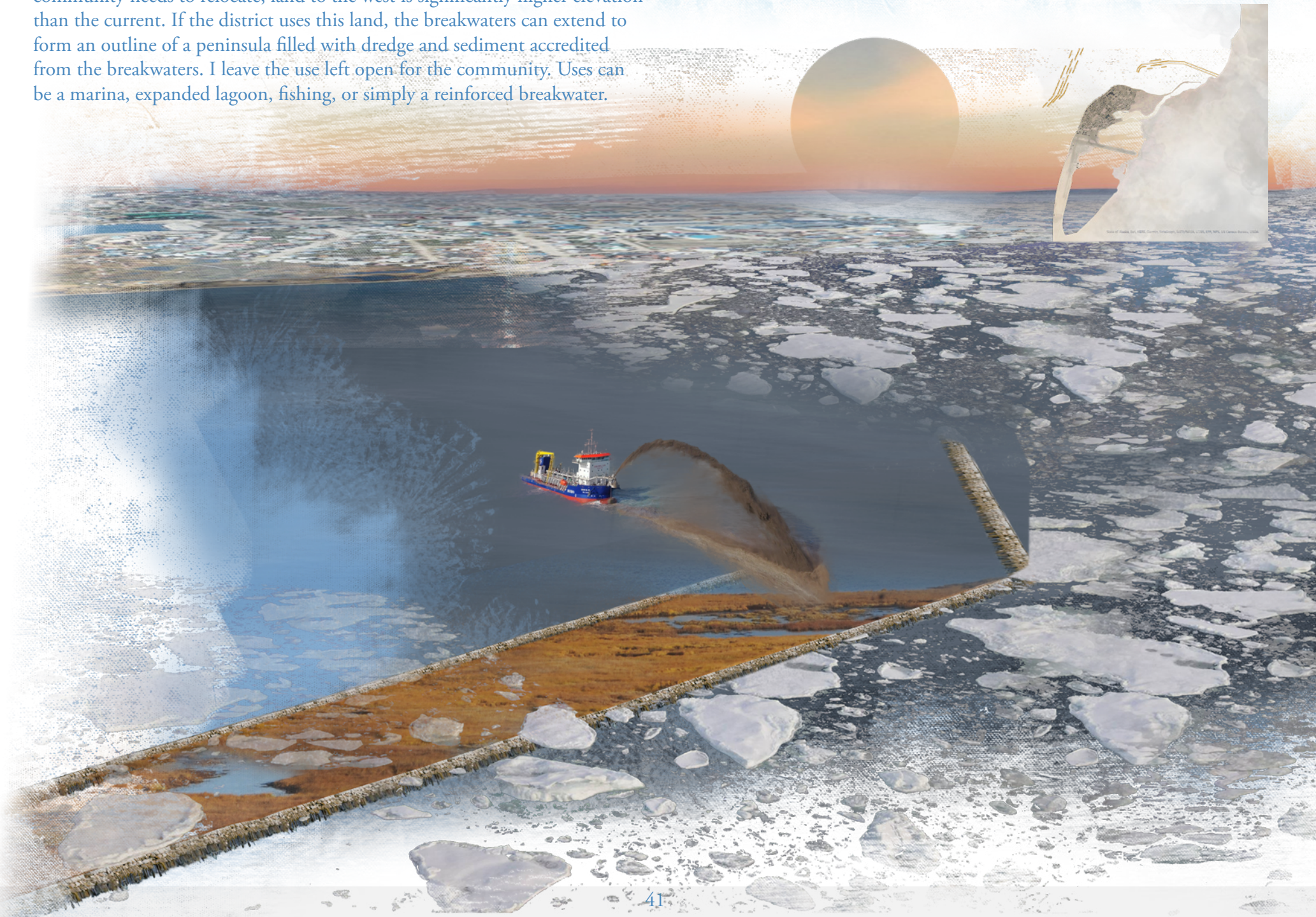
With 200' distance between the breakwaters, promotes a continuation of traditional activities during open water and sea ice season. The breakwaters attenuate wave energy and ice flow but do not eliminate it. The design imitates the original shoreline by accepting ice forces but ultimately collecting ice between the breakwaters.



Breakwaters In The Sound - Winter



The northern end serves as a possible phasing project. Initially, the breakwaters serve as typical breakwaters, protecting the north shoreline. If the community needs to relocate, land to the west is significantly higher elevation than the current. If the district uses this land, the breakwaters can extend to form an outline of a peninsula filled with dredge and sediment accredited from the breakwaters. I leave the use left open for the community. Uses can be a marina, expanded lagoon, fishing, or simply a reinforced breakwater.



I encourage Alaska to develop a coastal management program.

I think we have the opportunity to set the paradigm that mends foreign and indigenous practices to support subsistence in the Arctic. Systems that promote survival based on traditions, culture, and ultimately identity, rather than indoctrination.

Next Steps

When I started this capstone project, I knew little about the Arctic landscape and the challenges communities face. I still have a significant amount of knowledge to learn but enough to understand there are not enough resources to support adaption and mitigation procedures in the Arctic. As a student working independently on this project, I completed merely an abstract of a solution – this abstract is enough to propel my interest in the Arctic landscape in the field of landscape architecture.

One day I wish to involve myself in the community to fill in the gaps I left open throughout the past semester. A project like this cannot work without more minds including the community and more time. With a lack of precedent studies, we need to implement a design at some point to understand what works and doesn't. We cannot always wait until we have time and money to model and landscape we do not fully understand and formulate into code.

Thank you

I want to acknowledge the help of my capstone advisor, Jules Bruck, for guiding me through the project and connecting me with Christopher Overcash and Sam Whitin from EA Engineering to work on this project – I thank them too for their assistance along the way. I also want to thank Sean Burkholder, an Assistant Professor of Landscape Architecture at the University of Pennsylvania's Weitzman School of Design, and Drew Hayes an engineer and landscape architect at ForeSite Associates, Inc., for meeting with me to discuss the use of dredge and breakwaters. I want to thank Eric Bardenhagen and Zachary Hammacker for reviewing my work and providing me with feedback. Finally, I would like to thank DJ Bromley, Nick Bruce, and Leigh Muldrow for the informal critique and support of my interests throughout the process.

Appendix A

Constraints

Importing Services


While some introduced practices integrate into the community manageably, the **residents pay a hefty price for imported goods** like oil (for heating, and land and water vehicles), construction, and groceries. Currently, Kotzebue residents pay significantly higher prices for groceries than the lower 48 states and other major cities in Alaska. According to a Kotzebue survey in 2011, one gallon of milk cost \$11.39; one gallon of milk cost \$3.69 in Fairbanks. While some companies transport commercial goods by plane, most companies ship their goods to the city at the WPT harbor during the open water season lasting from July to early October (~around 100-day annual period). Most grocery prices are high in northern Alaska towns because of the transportation costs, but Kotzebue requires additional measures to bring goods into the community.



Lightering

With shallow **bathymetry ranging from five to ten feet** off the coast of Kotzebue and a shipping channel of fifty feet, cargo ships cannot dock at the town's port. Instead, a small vessel must complete multiple trips to transport the goods from the cargo ship to the port, referred to as lightering.

Dredging the existing channel to accommodate the cargo ship initially appeals as a reasonable solution but deepening the bathymetry would prevent the formation of landfast ice.

An aerial photograph of a coastal area, likely Alaska, showing a large body of water and a peninsula. A red ship icon is positioned in the water, with a red dotted line extending from it towards the shore. Another red ship icon is visible further along the coast. The land is shown in a light tan color, and the water is dark blue.

The core assumption the report makes is “that reducing the cost of lightering fuel would provide the greatest benefit to the most people in the region” (USACE, 2019). In addition to reduced oil and food prices, the USACE Alaskan District assumed navigation improvements could promote long-term sustainability by reducing cost for “construction materials, vehicles, or appliances and other durable or non-perishable goods”, again, promoting quality housing and facilities improving overall quality of life.

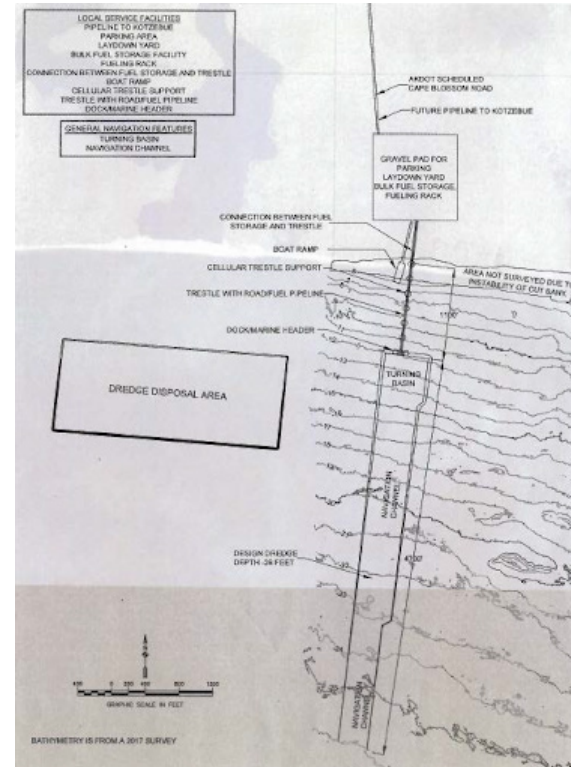
In 2016, the U.S. Army of Engineers (USACE) Alaskan District initiated a feasibility study to assess the economic benefits and environmental implications if the city adopted navigation revisions (USACE, 2019).

The USACE considered numerous alternatives ranging from \$155,590,000 to t: \$416,923,000 all promoting economic benefit to the community. Unfortunately, the future timeline for Kotzebue is uncertain.

Causeway to Dock



Trestle/Causeway/Dock with Dredging



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