Arctic Civil Infrastructure and Adaptation to Climate Change
AASHTO Climate Change Symposium

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Public Infrastructure and Climate Change – ADOT/PF

- The Department of Transportation and Public Facilities (DOT&PF) manages the State’s transportation infrastructure in a very challenging environment.

- Many facilities in the Alaska’s interior, northern, and southwest regions are underlain by ice-rich permafrost.
Alaska Department of Transportation and Public Facilities

- Over 14,000 Miles of Public Roadway
- Over 5,600 Miles of State owned road
- 845 Bridges
- 257 Rural Airports
- 28 Harbors
- 720 Buildings (DOT owned or managed)
Alaska Compared to the Continental U.S.A.

Barrow = Duluth, Minnesota
Ketchikan = Jacksonville, Florida
Nome = Omaha, Nebraska
Akutan = El Paso, Texas
Potential Climate Change Impacts

- Melting/Warming permafrost
- Increased storm frequencies and intensity
- Increased Coastal erosion due to lack of sea-ice
- Increased river and shore erosion
- Sea-level rise
- Increasing temperatures
Climate Change Impacts

- Loss of the subsistence way of life
Potential Impacts to Infrastructure
Melting/Warming Permafrost

- Current estimate is the Northern Region M&O spends approximately $10+ million annually due to melting permafrost.
- This represents a fraction of the need.
- Costs will increase if warming trend continues.
Potential Impacts to Infrastructure
Melting/Warming Permafrost

- Increased highway and airport surface distress
- Increased Active Layer Detachments (slope sloughing and failures)
- Embankments built over permafrost will need to be thicker to prevent the underlying ground from thawing
- Public buildings may require relocation/reconstruction if their foundations thaw
Permafrost Problems

Dalton Highway Frost Heaves

Alaska Highway Damage and rutting

Glenn Highway Distress

Mile 15-18 Elliot Highway Pavement Rutting
Longitudinal Shoulder Cracking
Thaw Settlement
Ice-Rich Permafrost Thawing
Potential Impacts to Infrastructure
Increased Storm Frequencies and Intensities

- Changes in timing, frequency, form and/or intensity of precipitation may cause related and increasing natural processes, including:
  - Debris flows
  - Avalanches
  - Floods
- Significantly increases M&O costs
Potential Impacts to Infrastructure
Increased Storm Frequencies and Intensities

- Coastal communities and their infrastructure are vulnerable to accelerated coastal erosion due to storm activity and wave action eroding shorelines once protected by shore-fast sea ice.
Potential Impacts to Infrastructure
Loss of Shore-fast Sea Ice

Open Water Jan 2007  Open Water Feb 2006
Potential Impacts to Infrastructure
Loss of Shore-fast Sea Ice

- Erosion rate: These two photos were taken 2 hours apart, note the ATV tracks in the road (note the 55 gallon barrel). This road no longer exists.
- In 1997, Shishmaref lost 125 feet of beach in a single storm
Flooding
Potential Impacts to Infrastructure

General Warming Trend

A longer seasonal transition period from fall to winter and winter to spring may require a different and potentially more costly approach to snow and ice control.
Potential Impacts to Infrastructure

General Warming Trend

- Warming temperatures are altering the blend of vegetative growth on the North Slope of Alaska.
- Increasing temperatures will allow a variety of invasive plants and insects to prosper in Alaska.
What is ADOT & PF Doing Now

- Shoreline Protection
- Relocation
- Evacuation Routes/Shelters
- Drainage Improvements
- Permafrost Protection
The USACE has identified over 180 communities that are threatened by erosion.
Six Communities in Jeopardy

- Kivalina*
- Shishmaref*
- Newtok*
- Unalakleet
- Koyukuk
- Shaktoolik

* Have already begun relocation plans
Established Alaska Climate Change Sub-Cabinet

- Alaska Climate Change Strategy
  - Adaptation, Mitigation, & Research Needs

- Quick Action
  - Immediate Action Workgroup
    - A Model for Working with Communities through Interagency Partnership and Meaningful Local Involvement
Immediate Action Workgroup

IAWG Mission

To close a planning and execution gap identified by Governor Palin and the Congressional delegation by creating a unifying mechanism to assist the communities of Newtok, Shishmaref, Kivalina, Koyukuk, Unalakleet, and Shaktoolik. These communities face imminent threats of loss of life, loss of infrastructure, loss of public and private property, or health epidemics caused by coastal erosion, thawing permafrost and flooding.
Technical Work Groups for **Adaptation** Advisory Group

**Governor**

**Governor’s Sub-Cabinet on Climate Change**

- **Immediate Action Work Group**
- **Mitigation Advisory Group**
- **Research Needs Work Group**

**Climate Change Adaptation Advisory Group**

<table>
<thead>
<tr>
<th>Technical Work Group</th>
<th>Members</th>
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<tbody>
<tr>
<td>Public Infrastructure Technical Work Group</td>
<td>• Appointed Members</td>
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<tr>
<td></td>
<td>• Existing &amp; new infrastructure, assess design standards, retrofits, repairs, etc.</td>
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<td>Health &amp; Culture Technical Work Group</td>
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<td>Natural Systems Technical Work Group</td>
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<td>Economic Activities Technical Work Group</td>
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<td>• DOD response to opening of northern shipping routes &amp; expansion of resource development in Arctic</td>
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Components of the Alaska Climate Change Strategy

Overview of Public Infrastructure

Policy Recommendations:

• Create a Coordinated and Accessible Statewide System for Key Data Collection, Analysis, and Monitoring
• Promote Improvements that Use the Current Best Practices
• Build to Last; Build Resiliency into Alaska’s Public Infrastructure
Components of the Alaska Climate Change Strategy

The recommended adaptation options are designed as an integrated system. The three policies (in the triangle) build upon and support one another. Process of continued, routine communication and feedback is essential to adapt and refine actions taken over time.

Performance Feedback

Integrated Coordinated Decision making

Sustainable Infrastructure That supports communities In an uncertain environment

Build to Last, Build in Resiliency

Promote Improvements that Use Current Best Practices

Create a Statewide System for Key Data Collection, Analysis, Monitoring & Access

Updated key data analysis, aligned research and modeling outcomes
Components of the Alaska Climate Change Strategy

• **Adaptive Capacity for Existing Infrastructure is Low**
  
  - Public infrastructure is fixed, doesn’t lend itself well to revised alignment, elevation, or structural foundation.
  
  - When modification is possible it is typically very expensive.

• **New Construction Provides More Opportunity to Incorporate Adaptive Techniques**
  
  - High potential for adaptive capacity in new infrastructure and construction through planning for projected climatic changes and updated design and siting.
  
  - However, these techniques increase project cost.
Thank You

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