

Public Infrastructure Technical Work Group (PI TWG) Catalog of Policy Options

The purpose of the Public Infrastructure Technical Work Group (PI TWG) is to provide policy options for “*adapting infrastructure to a changing climate*” for the Adaptation Advisory Group (AAG).

Public Infrastructure are the essential facilities and utilities under public, cooperative or private ownership that deliver goods and services to communities.

The **Effects of Climate Change in Alaska** to which public infrastructure must be adapted, are:

- Increased flooding (this includes coastal inundation, storm surges, coastal and river erosion, siltation, and sea level rise);
- Decreased duration and extent of sea ice;
- Increased wind;
- Thawing permafrost; and
- Increased fire risk.

POLICIES	PROGRAMS	TASKS
1. Collect, assess and monitor data needed to develop sustainable solutions to adapt public infrastructure to the effects of a changing climate.		
	<p>1. Establish a statewide baseline inventory of public infrastructure to evaluate climate change impacts on infrastructure.</p>	<p>A. Inventory existing public infrastructure in Alaska and document its existing conditions.</p> <p>(ISER-UAA developed a preliminary and limited database of existing public infrastructure that was created to project the added cost (above normal wear and tear) from the effects of climate change on infrastructure at risk. See Larson, P.H., et al. (2008)</p>
		<p>B. Estimate the remaining useful life of the existing public</p>

		<p>infrastructure.</p> <p>D. Inventory the physical and environmental conditions (permafrost, river and coastal shorelines, etc.) that exist at the locations of the existing public infrastructure.</p>
	<p>2. Create a statewide observation network to monitor and update the infrastructure database.</p>	<p>A. Develop the observation network in conjunction with developing the public infrastructure database.</p>
	<p>3. Conduct a statewide assessment and analysis on the vulnerabilities of public infrastructure to the impacts of climate change.</p>	<p>A. Conduct vulnerability assessments and evaluate the associated risks on the current climate impacts to existing public infrastructure.</p> <p>B. Based on the assessments and new climate projections, analyze for future vulnerabilities based on risk levels.</p> <p>C. Develop statewide, regional and local vulnerability assessment tools based on the results of the assessment and analysis.</p>
	<p>4. Develop an adaptive climate change model for public infrastructure that recommends strategies and approaches to identify short and long-term sustainable solutions to a changing climate.</p> <p style="text-align: center;"><u>NOTES</u></p> <p>A) Forward this program & tasks to Research Needs group.</p> <p>B) It is assumed that research for improving climatic models will be done by others. However, the output data from the climatic models would be required as input into the adaptive climate change model.</p>	<p>A. Develop the adaptive model using results of the public infrastructure database and the vulnerability analysis noted above and output data from climatic models.</p> <p>B. Develop and recommend strategies and approaches to identify short and long-term sustainable solutions to climate change.</p> <p>C. Begin a process based on the modeling results to review and modify engineering design standards, building codes, and operation and maintenance practices to adapt for future climate changes.</p> <p>D. Develop statewide, regional and local adaptation tools based on the adaptive climate change model.</p>
	<p>5. Enact a law to create and authorize a Public Infrastructure Commission on Climate Change (PICCC) to develop, implement and administer the databases and modeling programs listed above under a central source</p>	<p>A. Provide oversight and coordination to ensure these programs and tasks are accomplished.</p> <p>B. Establish policies and procedures.</p>

	<p>and to facilitate inter-agency cooperation.</p> <p style="text-align: center;"><u>NOTES</u></p> <p>The PICCC would consist of state and local government officials and representatives from the University of Alaska, engineering profession and other interested stakeholders. Also, the PICCC would advise stakeholders by establishing a web-based system on the current and future effects of climate change on public infrastructure and the strategies and approaches for state agencies and local governments to adapt public infrastructure to a changing climate.</p>	<p>C. Develop annual work plans and request funding.</p> <p>D. Measure progress toward goals in a given year and performance over several years.</p>
<p>2. Adopt a statewide planning initiative requiring that state agencies and local governments collaborate to address climate change's effects to public infrastructure.</p>		
	<p>1. Develop a public infrastructure planning network between state agencies and local governments.</p>	<p>A. Develop a network by enhancing on the current practices in place between state and local governments.</p>
	<p>2. Empower local community leaders to develop adaptation action plans and incorporate this information into their community plans.</p>	<p>A. Disseminate and monitor data outputs from the databases and the adaptive model via the planning network for developing adaptation action plans.</p> <p>B. Provide the current vulnerability assessment and adaptation tools.</p> <p>C. Set up a statewide database to record and share adaptation action plans and outcomes.</p>
<p>3. Enact sustainable solutions to adapt public infrastructure currently at significant risk, and future public infrastructure, to the effects of climate change. Accomplish by establishing a statewide capital program.</p> <p><i>Some suggest important to add prioritization concept.</i></p>		
	<p>1. Enact a law to create and authorize the state funding program.</p>	<p>A. Write regulations.</p> <p>B. Identify federal and state funding sources and request funding.</p> <p>C. Establish policies and procedures.</p>

Details

A. Specific infrastructure vulnerabilities to assess:

Airports and Landing Strips - Evaluate the impacts on airports and landing strips related to thawing permafrost, coastal and river erosion and flooding, including the need to relocate, re-align or repair airstrips.

Buildings - Evaluate the existing damage and loss to public buildings due to shoreline erosion, less shorefast ice, melting permafrost, storms, realignment of rivers and flooding and identify the need to relocate buildings (e.g. Koyukuk) and plan for future siting. Evaluate wild fire risk to buildings due to increased wild fire intensity and frequency and increased threat from diseased/dead trees (e.g. Caribou Hills fire in 2007).

Coastal and River Shorelines - Evaluate the vulnerability of existing and future unprotected reaches of shoreline with respect to existing infrastructure. Determine need for and type of shoreline protection appropriate to these reaches.

Fuel Delivery and Storage, Fuel and Utility Pipelines – Evaluate the impacts of coastal inundation and coastal and river erosion on buried or aboveground utility and oil pipelines. Evaluate the impacts of sea thawing permafrost on existing buried or aboveground pipelines. Evaluate the impacts of thawing permafrost and erosion on shoreline and riverside fuel delivery, storage, and piping.

Harbors - Evaluate the impacts of increased siltation in harbors stemming from glacier melt and flooding events. Evaluate the vulnerabilities of wave barriers, seawalls, piers and wharves to increased wave strength and inundation.

Highways, Roads, Bridges and Sidewalks (HRBS) - Evaluate and address damage to HRBS from thawing permafrost and temperature changes. (Building on permafrost in the first place changes the temperature profile of the permafrost. This effect needs to be netted out from the temperature effects related to greenhouse gas-induced climate change.) Evaluate and address damage to and loss of HRBS from coastal and river erosion. Evaluate and address buckling and submersion of boardwalks in village communities. Evaluate and address damage to HRBS from glacier melting, flooding, avalanches, and debris flows.

Landfills - Evaluate the current and future flooding and erosion impacts to dumps and landfills caused by storm surges for communities most vulnerable along shorelines of rivers and seas.

Navigational Hazards - Identify and evaluate risk from new navigational hazards due to inundated underwater structures.

Water, Sewer and Storm Water Systems - Evaluate the current and future flooding and erosion impacts from climate change (thawing permafrost and flooding and erosion from storm surges) on water and sewer facilities for communities most vulnerable along shorelines of rivers and seas. Investigate the contamination impacts from flooding on surface water and well water sources for drinking water and sewage lagoons. Evaluate the public health impacts due to contamination of public drinking water and surface water from climate change related storm surge, coastal inundation or erosion on dumps, landfills and sewage lagoons. *Also relevant to Health & Culture TWG.*

B. Specific engineering and structural codes, standards, designs or practices to potentially modify:

Airports and Landing Strips - Develop new standards for developing airport and landing strips in light of climate change impacts. Develop a comprehensive airstrip maintenance plan to address issues associated with climate impacts (thawing permafrost, ice, heavy precipitation, flooding, vegetative growth, etc...). Re-evaluate current icing and ice control methods due to more ice from longer seasonal transition periods. Evaluate and address dangerous flying conditions associated with icing, coastal fog, and non-traditional storms.

Buildings - Establish a mechanism to evaluate and recommend new design standards for structures (and placement of mechanical and electrical equipment) that may be vulnerable to climate change related hazards. Do the same for maintenance and inspection practices. Develop probabilistic design tools for public infrastructure systems.

Coastal and River Shorelines - Evaluate existing shoreline protection structures to determine their effectiveness under varying sea level rise and the need for modification/ replacement/ abandonment. Evaluate design requirements for hard structural options such as dikes, levees, floodwalls, saltwater intrusion barriers. Evaluate non-structural options for beach protection (flood walls, dune restoration and creation, and periodic beach nourishment). Review available federal, state, and local shoreline protection programs and recommend how each could be modified to address future changes in sea level rise with respect to infrastructure and other land assets.

Design Standards for Floods - Incorporate projected climate change considerations into the design storm event, and the design criteria applicable to vulnerable infrastructure. Revise design standards to address lower probability events (e.g. some cities are protecting to the 500 year event rather than the 100 year event because of the increased vulnerability). Evaluate the need to raise or redevelop structures to a defined elevation above the base flood elevation. Such action would need to be based on compliance with climate change-proofed comprehensive standards/codes; base flood elevation refers to the 100-yr flood incorporating sea level rise considerations.

Fuel Delivery and Storage, Utility and Fuel Pipelines - Develop new standards for the future development of shoreline and river-side fuel delivery, storage, and pipeline facilities. Develop appropriate standards for the future development of buried and above-ground utility and oil pipelines taking into account sea level rise, coastal and river erosion, and thawing permafrost. *Also relevant to Health & Culture TWG.*

Harbors - Develop measures to minimize the impacts of siltation in harbors stemming from glacier melt and flooding events.

Highways, Roads, Bridges, Sidewalks - Strengthen design codes for bridges, roads, and highways, to account for climate change impacts.

Landfills - Develop new standards for the future development of landfills that will address impacts associate with climate change such as sea level rise, thawing permafrost, and more intense storms.

Navigational Hazards - Develop operational protocols that specify disclosure requirements for this coastal hazard. Develop retreat strategies for the management of existing structures or conditions that may become submerged hazards to navigation or public health (e.g. effluent outfalls, water intakes, septic fields, rock walls, docks, and piers.

New Transportation Modes - Develop new modes of transportation that can travel across the altered rural landscape. Develop nautical vessels capable of navigating rivers during times of low water flow and flooding events. *Also relevant to EA TWG.*

Piers and Wharves - Review construction standards for piers and wharfs for resistance to potential wave forces. Increase construction protocols/conventions for piers and wharves for resistance potential wave forces. Sea ice will impact offshore resource development and marine supply to coastal villages. This is of special importance for the Bering, Chukchi and Southern Beaufort Seas. **TWG- please comment on whether both the following statements should be in here?** Create new standards for floating piers to accommodate both lower water flow and flooding events. Create new standards for floating piers to accommodate both higher water levels and flooding events.

Soft Structural, Bioengineered and Vegetative Engineering Options - **TWG Members have raised concerns about this to discuss.** Develop a suite of low-technology and soft structural/bio-engineered construction and best management techniques for Alaska's regions that will protect natural coastlines, riverfronts, improve drainage, and reduce storm water retention (including but not to vegetative solutions, better use of natural swales and wetlands and reduced paving). Evaluate the effectiveness of soft structural options such as dune restoration and creation, wetland restoration, periodic beach nourishment, temporary barriers and other options and implement the best options based upon effectiveness and feasibility.

Water, Sewer and Storm Water Systems - Develop new standards for designing water and sewer systems that will address future conditions caused by climate change. Evaluate and improve capacity of storm water infrastructure in areas subject to increasing high intensity rainfall events.

C. Integrate climate change considerations into emergency, community and transportation planning, and into planning for and siting of new public infrastructure and facilities. Specific tasks could include:

Emergency and Disaster Planning - Community emergency and disaster plans, including designating emergency evacuation routes, must incorporate climate change hazards and vulnerabilities. Require municipalities to have written and operational disaster response plans that are updated at least every 5 years, and that include consideration of likely changes in the frequency and intensity of extreme events due to climate change. Re-evaluate evacuation routes in light of climate change and modify as necessary. Synchronize future design with emergency planning and evacuation infrastructure requirements.

Community Planning - Integrate climate change considerations into community comprehensive, land use and facility planning. Consider developing a prototype Community Adaptation Plan for community use to ensure climate change considerations and related hazards and vulnerabilities are considered. Do not site public infrastructure and critical facilities in high risk areas identified in the vulnerability analysis. Provide funding and enforce requirement for municipal governments to enact comprehensive plans. Include an evaluation of the significance of threatened historical structures and develop plans for their relocation and/or protection. Use LEED standards for new building construction to reduce heat generation. Develop new, or expand current storm water management facilities and systems to address increased precipitation and possible flooding.

Community Development Setbacks and Related Tools - Community and state planning should include and enforce setback ordinances/no-development zones for high hazard areas. Investigate potential and limitations of shoreline erosion buffers, eminent domain, vesting, grandfathering, purchase of development rights, and amortizing strategies to limit development in high hazard areas.

Transportation Planning - Ensure climate change is considered as part of update and review of Alaska's State Transportation Plan and regional plans (e.g. Southeast Alaska Transportation Plan Update). Review Department of Transportation's Future Corridors Initiatives to insure it appropriately addresses climate change. Require/Enable Metropolitan Planning Organizations to take climate into account¹.

¹ Anchorage MATS <http://www.muni.org/transplan/amats.cfm> Fairbanks Metropolitan Area Transportation System (FMATS) <http://www.dot.state.ak.us/nreg/planning/fmats/index.shtml>

Consider whether rural infrastructure and alternate routes are needed to supplement lost rural routes due to shortened ice road season, thinner winter ice, insufficient snow, or ground that does not freeze. Develop new regulations for traveling across ice roads, taking into account thinner ice and shorter season length. Develop river transportation routes to accommodate lower water flow as well as flooding events.

Plan for reduced sea ice and new shipping lanes opening up in the Arctic Ocean and Beaufort Sea. Consider establishing a container port facility in Nome, Barrow or Prudhoe Bay, linked by rail, to the continental interior. Without this, opportunities associated with increased arctic shipping will not be realized by Alaska. Monitor shipping lanes through the Arctic Ocean and Beaufort Sea for ice melt, glacier melt, and related navigation problems. Sea ice will impact offshore resource development and marine supply to coastal villages; this will be of special importance in the Bering, Chukchi and Southern Beaufort Seas. Address national security concerns associated with new shipping lanes in the Arctic Ocean and Bering Sea. *Also relevant to EA TWG.*

Design Standards for Floods - Incorporate projected climate change considerations into the design storm event, and the design criteria applicable to vulnerable infrastructure. Revise design standards to address lower probability events (e.g. some cities are protecting to the 500 year event rather than the 100 year event because of the increased vulnerability). Evaluate the need to raise or redevelop structures to a defined elevation above the base flood elevation. Such action would need to be based on compliance with climate change-proofed comprehensive standards/codes; base flood elevation refers to the 100-yr flood incorporating sea level rise considerations. Consider whether longer rural airstrips are needed to accommodate larger planes with greater cargo capacity to compensate for the shortened ice road season.

New Transportation Modes - Develop new modes of transportation that can travel across the altered rural landscape. Develop nautical vessels capable of navigating rivers during times of low water flow and flooding events. Provide rural public transportation across new and existing rural transportation routes to more efficiently move people and freight across the altered rural landscape. *Also Relevant to EA TWG and Research Needs Group.*