

# Alaska's Climate Change Strategy: Addressing Impacts in Alaska

## Draft Executive Summary

August 24, 2009

### INTRODUCTION

In Alaska, climate change has begun to touch almost every aspect of the natural world and the human systems which have evolved around, and rely on, a set of stable and predictable climatic conditions and seasons. It is a world where a warming environment has already begun to render ground and building foundations unstable, disrupted transportation routes, and has triggered phenomena placing coastal communities in imminent danger from flooding and erosion. Impacts have resulted in myriad consequences to residents of the state, to subsistence livelihoods, to the wildlife and vegetation in Alaska's terrestrial and marine environments, and to the many industries which support the Alaskan economy.

While these changes are of critical import to Alaskans, they have also garnered attention of United States and world leaders. The primary driving force has been the accelerated retreat of Arctic sea ice which has been a catalyst for multi-disciplinary planning and underscored the need for increased domestic and international cooperation. A navigable Arctic Ocean presents opportunities for shipping and commerce in the Northwest Passage along with an elevated interest in developing fisheries and mineral resources. Consequently, this raises the need for additional and improved weather and navigational tools, research to better understand and manage our strategic assets, and increased efforts to provide national, environmental and economic security. Another key factor which has served to elevate widespread interest in the Arctic is the important role in which the Earth's polar region plays in influencing climate and oceans on a global scale. What happens here has far-reaching and long-lasting implications.

To address the impacts of climate change on Alaska, on September 14, 2007, Governor Palin signed Administrative Order 238, which established and charged the Alaska Climate Change Sub-Cabinet to advise the office of the Governor on the preparation and implementation of a comprehensive Alaska Climate Change Strategy. This document represents the recommendations of the Adaptation Advisory Group (AAG), which

#### Box 1. Sectors Addressed by the AAG Report

*Alaska's economy and the health and well-being of its residents will be affected by climate change. Key impacts being addressed include:*

##### **Public Infrastructure**

Impacts of climate change on public and private or cooperatively owned infrastructure for transportation, shoreline protection, water and sanitation, and defense.

##### **Health and Culture**

Erosion, changes in permafrost, and extreme events are already resulting in impacts on some coastal communities, sanitation infrastructure, and archaeological sites and gravesites. Climatic changes and associated changes in natural systems are leading to stresses on subsistence communities, and also create the potential for health impacts due to vector-, water-, and food-borne diseases

##### **Natural Systems**

Impacts of changing climate on marine, terrestrial, and freshwater ecosystems will changes have implications for Alaska's economy and subsistence communities. Changes in fisheries and forest resources, modes of travel, and the diversity and location of different plant and animal species, will have both beneficial and adverse impacts on the services that natural systems provide.

##### **Other Economic Activities**

Changing climate may affect all sectors of Alaska's economy, because of dependency on weather conditions and/or the natural environment, or reliance on engineered infrastructure that is threatened by changes. Changing climate can also create economic development opportunities.

*The adaptation component of Alaska's climate change strategy contains adaptation options designed to reduce the vulnerability of Alaska's natural and human systems to climatic changes, and take advantage of the economic opportunities that might arise.*

1 was charged with evaluating and developing options to adapt to climate change. The report also provides  
2 additional background on projected climate and impacts for Alaska.

3 The types of recommendations contained in this report vary. The options range from new systems  
4 approaches and institutional structures to adoption of new or revised policies, initiatives, and other actions.  
5 The Sub-Cabinet will consider these, as well as recommendations from the Immediate Action Work Group, the  
6 Mitigation Advisory Group, and the Research Needs Work Group in the context of other complementary  
7 efforts. A comprehensive Climate Change Strategy for Alaska will then be drafted for consideration by the  
8 Governor. While no one report or event can set a definitive course of action in the dynamic and uncertain set  
9 of circumstances created by a changing climate, the work of the Adaptation Advisory Group establishes a  
10 foundation from which to make progress towards improving our individual and societal ability to adapt.

## 11 IMPACTS ON HUMAN AND NATURAL SYSTEMS IN ALASKA

12 Over the past three decades, Alaska has experienced a sharp reduction in snow-cover extent and duration,  
13 shorter river- and lake-ice seasons, melting of mountain glaciers, sea-ice retreat and thinning, permafrost  
14 retreat, and increased depth of summer thaw. These changes are in turn affecting human and natural  
15 systems. The AAG, with the support of four Technical Working Groups, has developed options to adapt to  
16 these changes, i.e., to reduce the adverse impacts, or take advantage of the opportunities, presented by  
17 climate change. (see Box 1).

### 18 Permafrost Thawing and Sea Ice Melting

19 Permafrost underlies most of Alaska. Air temperature, snow cover, and vegetation affect the temperature of  
20 the frozen ground and the depth of seasonal thawing. Recent decades of warmer temperatures have  
21 produced extensive thawing, which has resulted in increased coastal erosion, landslides, and sinking of the  
22 ground surface, and consequent disruption and damage to forests, buildings, infrastructure, and coastal  
23 communities. In addition, many industrial activities depend on frozen ground surfaces, and many  
24 northern communities rely on ice roads for transport of groceries and other materials. Continued warming will  
25 further impair transport by shortening the seasonal use of ice roads. Thawing is projected to accelerate under  
26 future warming, with as much as the top 10 to 30 feet of discontinuous permafrost thawing by 2100.

27 Sea ice off the Alaskan Coast is retreating and thinning, with widespread effects on marine ecosystems,  
28 coastal climate, human settlements, and subsistence activities. Recent studies estimate arctic-wide reductions  
29 in annual average sea-ice extent of about 5-10% and a reduction in average thickness of about 10-15% over  
30 the past few decades. Retreat of sea ice allows larger storm surges to develop, increasing the risk of  
31 inundation and increasing erosion on costs already made vulnerable by permafrost thawing. Loss of sea ice  
32 also causes large scale changes in marine ecosystems, and threatens populations of marine mammals and  
33 polar bears that depend on ice. At the same time, the continued reduction of sea ice is very likely to increase  
34 the navigation season, and seasonal opening of the Northern Sea Route is likely to make trans-arctic shipping  
35 feasible during summer months, within several decades, although increasing ice movement will initially make  
36 shipping more difficult in some channels of the Northwest Passage.

### 37 Threats to Coastal Communities, Habitats, and Infrastructure

1 Alaska has more coastline than the other 49 states combined. Increases in the frequency and intensity of  
2 storm surges have triggered increased coastal erosion that is threatening a number of coastal villages, with a  
3 recent report from the General Accountability Office (GAO) indicated that 31 face imminent threats. Storm  
4 surges have also reduced the protection that barrier islands and spits provide to coastal habitats. Both coastal  
5 and inland infrastructure face threats due to the climate change. Thawing permafrost threatens water and  
6 sanitation infrastructure, and roads, buildings, pipelines, power lines and other infrastructure are threatened by  
7 coastal erosion and degrading permafrost.

### 8 Forest and Vegetation Changes

9 The Arctic region, particularly Alaska, is already experiencing warming that has major ecological impacts.  
10 Rising temperatures have caused northward expansion of boreal forest in some areas, significant increases in  
11 fire frequency and intensity, and unprecedented insect outbreaks. Current projections suggest that, due to  
12 increases in burn area per decade, the tundra-dominated landscape on Seward Peninsula will eventually be  
13 replaced by deciduous forest. In other areas, forested areas are likely to convert to bogs as permafrost thaws.  
14 Growing-degree days have increased by 20%, with benefits for agriculture and forest productivity on some  
15 sites, and reduced growth on others.

### 16 Sensitivity of Marine Ecosystems and Fisheries

17 The Gulf of Alaska and Bering Sea support marine ecosystems of great diversity and productivity, and the  
18 nation's largest commercial fishery. Recent climate-related impacts observed in the Bering Sea include  
19 significant reductions in seabird and marine mammal populations, unusual algal blooms, abnormally high  
20 water temperatures, and low harvests of salmon on their return to spawning areas. Future projections for the  
21 Bering Sea suggest productivity increases at the base of the food chain, poleward shifts of some cold-water  
22 species, and negative effects on ice-dwelling species. Warmer temperatures will also affect commercial  
23 fisheries, with large northward shifts of fish and shellfish species, and associated declines in production of  
24 cold-water species such as salmon and pollock, and increased production of other species

### 25 Changes In the Diversity, Ranges, and Distributions of Species

26 The Arctic sub-region that includes Alaska, Chukotka, and the Western Canadian Arctic, is home to over 70  
27 percent of the rare plant species that occur only in the Arctic, and home to a number of plant and animal  
28 species already classified as "threatened." Species concentrated in small areas, such as Wrangell Island, are  
29 particularly vulnerable to the direct effects of climate change, combined with competition from migrating non-  
30 native species.

### 31 Increased Stress on Subsistence Livelihoods and Lifestyles

32 Subsistence makes an important contribution to livelihood in many isolated rural communities, especially but  
33 not exclusively for native peoples. Livelihoods that sustain indigenous communities include hunting, trapping,  
34 gathering, and fishing. These activities not only make significant contributions to the diet and health of many  
35 indigenous populations, and also play large and important social and cultural roles. Reduced or displaced  
36 populations of marine mammals, seabirds, and other wildlife, together with continuing thinning of sea-ice,  
37 have affected the safety, and the dietary and economic well-being of subsistence communities.

## 1 ALASKA'S APPROACH TO ADAPTATION: RECOMMENDED OPTIONS

2 Climate change presents both potential impacts and opportunities for Alaskans and the Alaska economy.  
3 Developing a viable set of policies and actions to adapt to climate change requires recognizing the  
4 decentralized nature of government decision making, which ranges across all levels of government.  
5 Successful adaptation will require engaging not only governments, but also private business, communities and  
6 community leaders, and individual households. Developing information on climate and other information  
7 needed for adaptation and making this information accessible is key if these public and private entities are to  
8 be able to take action. Finally, an adaptation strategy must recognize both the need, in some cases, for  
9 immediate action to address observed effects of climate change, as well as the importance of developing a  
10 foundation of data, policies, and knowledge about adaptation strategies that will enable successful adaptation  
11 over the long term.

12 The options recommended by the AAG are summarized below. These are actions that the state of Alaska,  
13 sometimes in partnership or cooperation with other agencies or organizations, can take to adapt to climate  
14 change. The options include actions such as increased coordination within and outside the state, data  
15 collection or assessment, regulatory or programmatic changes, capacity building and education, capital  
16 improvements, and financial assistance. In some cases the options may require new institutions or new  
17 legislative authority, but in many cases they have been designed to build on existing programs and staff.

### 18 Public Infrastructure

19 These options address the observed and projected impacts of climate change on Alaska's infrastructure, and  
20 include priority adaptation actions that the State of Alaska should take to address the impacts and  
21 vulnerabilities associated with these impacts. Public infrastructure is defined to include essential facilities and  
22 utilities under public, cooperative, or private ownership that deliver goods and services to communities. Such  
23 infrastructure includes infrastructure related to road, air, water, and other transportation (ranging from  
24 highways to landing strips), public buildings, seawalls and river shoreline protection, power, water,  
25 communication, and other utilities and their supporting structures, and national defense infrastructure. The  
26 goal of these options is to develop a system that increases the likelihood that Alaska has sustainable  
27 infrastructure to support communities in an uncertain environment.

28 The options developed for public infrastructure are designed to address three critical problems. First, the  
29 vulnerability of, and risk to, public infrastructure is growing. In some locations, entire Alaskan villages are at  
30 immediate risk, in other locations, critical roads and public buildings are at risk. Second, adaptive capacity for  
31 existing infrastructure is low, so that new construction provides an opportunity for adaptation. Most public  
32 infrastructure is hard and fixed (for example, roads and buildings) and cannot easily alter its alignment,  
33 elevations, or structural foundation to accommodate coastal erosion or increased flood risk. Third, increased  
34 communication and coordination is critical. Increased communication and coordination across agencies,  
35 communities, and scientific and applied researchers is needed to adapt Alaska's public infrastructure.

36 The AAG is recommending a systems approach to reduce the impacts of climate change on Alaska's public  
37 infrastructure by accomplishing actions under three policies/programs.

38 **PI-1: Create a Coordinated and Accessible Statewide System for Key Data Collection,**  
39 **Analysis and Monitoring**

1 Baseline data on the condition of current infrastructure and on regional and local environmental conditions  
2 needs to be collected. We need to know where and what the problems are. We need to know what is working  
3 and what is not working. Based on the best science and collected empirical data we need to predict our future.  
4 The Environmental Atlas of Alaska must be updated. The resulting information needs to be available to all  
5 interested parties.

#### 6 **PI-2: Promote Improvements that Use the Current Best Practice**

7 Managing the risks and/or reducing the uncertainties associated with climate change will take time. Promoting  
8 sustainability, reducing operating costs, and protecting/extending the service life of existing infrastructure is  
9 always worthwhile. Simultaneous with PI-1, improvements to existing infrastructure that are worth doing  
10 regardless of climate change effects should be enacted.

#### 11 **PI-3: Build to Last; Build Resiliency into Alaska's Public Infrastructure**

12 As PI-1 and PI-2 are enacted and we learn more as a result, new and upgraded infrastructure need to be  
13 planned, designed, and built to be resilient and sustainable in an uncertain environment. Systematic feedback  
14 with a performance review and analysis needs to be integrated into the public infrastructure funding,  
15 development, construction, and operations, so that planners and builders use "what works" and codes and  
16 standards are assessed and improved as needed to achieve the best results.

### 17 **Natural Systems**

18 The Natural Systems sector addresses the observed and projected impacts of climate change on Alaska's  
19 ecosystems and the services they provide, and the AAG recommends priority adaptation actions that the state  
20 of Alaska should take to address the impacts and vulnerabilities associated with these impacts. Key impacts  
21 for Alaska include those on marine ecosystems in the seas around Alaska and the communities and industries  
22 reliant on marine-based fisheries; changes in terrestrial ecosystems and in species' diversity, ranges,  
23 distribution, and abundance, with consequences for forestry and subsistence harvest of fish and wildlife; and  
24 changes to freshwater ecosystems, with consequences for freshwater appropriates and for freshwater species  
25 and the people who access and harvest the fish and wildlife. The goal of the options below is to sustain  
26 natural ecosystem services in Alaska that meet society's essential needs, through adaptation to changing  
27 environmental conditions.

28 The five adaptation options recommended for this sector are targeted to sustaining the natural ecosystem  
29 services that meet Alaskan's essential needs for food, water, renewable resource economies, community  
30 stability and safety, and cultural well-being. The recommendations build on existing state authorities and  
31 programs, and will move Alaska forward substantially in its ability to adapt to climate change impacts.  
32 Implementation of these options will require leadership and policy direction, as well as a moderate investment  
33 in staffing and funding to complete priority tasks. However, through this work, the State will take a major step  
34 forward in integrating adaptive management to climate change over the long-term into the State's resource  
35 management programs and practices, so that it becomes a way of doing business – not a suite of separate  
36 initiatives.

#### 37 **NS-1 Fisheries Management**

1 This option incorporates climate change into fisheries assessment and management and assist fishing  
2 communities and users in adaptation. This option includes several key elements: (1) review of the state's  
3 fishing-related statutes; (2) a comprehensive assessment of existing habitat, fish species and stock monitoring  
4 programs; (3) development of a centralized source of information on climate effects; and (4) development of  
5 long-term strategy to work with fishing-reliant communities and business.

#### 6 NS-2 Wildland Fire

7 This option would review and modify as appropriate Alaska's wildland fire policy and programs to address  
8 potential climate-induced increases in wildland fire frequency, size, and geographic location. Key elements  
9 include: (1) increasing the capacity of communities to initiate, complete, and implement Community Wildfire  
10 Protection Plans (CWPP); (2) review selected wildland fire management practices for lands in Alaska; and (3)  
11 develop a comprehensive fuels management program to treat high-risk areas.

#### 12 NS-3 Freshwater Management

13 This option addresses the effects of climate change on Alaska's freshwater resources through adaptive  
14 management, supported by improved hydrologic data. This option includes data collection, coordination, and  
15 protection. It also includes a review and adjustment as necessary of water management laws, policies, and  
16 practices in order to improve adaptive capacity.

#### 17 NS-4 Invasive and Eruptive Species

18 Under this option, the state would expand its efforts to be an active partner with all levels of government and  
19 other entities in addressing the problem of invasive and eruptive species in Alaska. The goal is to reduce  
20 introduction and spread of invasive species and eruptive species in the context of climate change.

#### 21 NS-5 Fish and Wildlife

22 Under this option, the state would improve its capability to manage fish and wildlife species adaptively in  
23 Alaska to assure sustainable management of these important resources. The option includes two specific  
24 actions: (1) develop and adopting a more timely regulatory process for the harvest of wildlife; and (2)  
25 developing a coordinating framework that documents existing fish and wildlife monitoring efforts, identified  
26 priorities for monitoring, and identifies gaps and potential for collaboration.

### 27 Other Economic Activities

28 Some of Alaska's major economic activities, such as tourism and shipping, are highly dependent on weather  
29 conditions and/or the natural environment, both of which can be significantly affected by climate change.  
30 Some activities, such as mining and oil and gas exploration, rely on engineered infrastructure that is also  
31 potentially affected by climate, weather, and underlying environmental conditions. At the same time, climates  
32 could create economic development opportunities in existing and new sectors. The options developed for this  
33 sector identify adaptive actions and options that contribute to the ability of sectors of the Alaska economy not  
34 directly supported by living systems (e.g., fishing) to adapt to the effects of climate change and ensure the  
35 sustainability of a robust Alaska economy.

1 The recommendations in this sector focus on broad issues relevant to the economy as a whole, rather than  
2 actions designed to address the concerns of a particular economic group or industry. Three options are  
3 recommended.

#### 4 EA-1: Evaluate Capability Needs for Potential Expansion of Arctic Economic Activities

5 This option recommends that the State recognize and address the potential for increased Arctic economic  
6 activities and identify gaps in infrastructure and the ability to provide an adequate presence in the Arctic  
7 coastal region to protect environmental resources, human health, and safety.

#### 8 EA-2: Develop and Evaluate Scenarios for the Alaskan Economy

9 Components of the Alaska economy will experience varying impacts due to potential effects of climate  
10 change. An assessment of economic strengths, weaknesses, opportunities and threats by sector is needed to  
11 better understand current and potential future components of the economy. This understanding will aid state  
12 agencies and other stakeholders in identifying and acting on optimum adaptive strategies and policies to help  
13 address future conditions. This option recommends conducting and managing a project to develop and  
14 evaluate possible economic scenarios for the State, based on potential climate change effects.

#### 15 EA-3: Improve Availability of Mapping, Surveying, Charting and Imagery Data

16 Accurate, timely information about the distribution and magnitude of changes is needed to better address  
17 economic challenges and opportunities. This option recommends improving the availability of data, specifically  
18 real-time mapping, digital elevation model, and imagery, to better track and understand the impacts of climate  
19 change. This option would build on the work of the Statewide Digital Mapping Initiative and aid in transitioning  
20 between locations at the water-land interface.

## 21 Health and Culture

22 Climate change is being linked to increases in the geographic range and incidence of certain infectious and  
23 non-infectious diseases, new problems in sanitation and solid waste management, and contaminant  
24 exposures in Alaska. Current programs are insufficient to identify and control these changes. To protect the  
25 health of humans and animals, both domestic and wildlife, from the effects of climate change in Alaska,  
26 existing programs and activities need to be augmented to address these emerging concerns to develop new  
27 methods for surveillance and reporting of human and animal diseases.

28 The goal of the options recommended for this sector is to Improve adaptive capacity to maintain human health  
29 and healthy ways of life, reduce current and likely future increases in disease due to a changing climate, and  
30 prevent the destruction of gravesites, archaeological sites, and historic sites due to accelerated coastal and  
31 river erosion. Four options are recommended.

#### 32 HC-1 Augment surveillance and control programs for vector-, water-, and food-borne 33 diseases

34 This option augments surveillance and control programs for vector-, water-, and food-borne diseases likely to  
35 become greater threats because of climate change. In addition, it develop educational programs for the  
36 public, health care providers, environmental staff, and others on approaches to reduce emerging disease  
37 threats.

## 1 HC-2 Community Health Impact Evaluations

2 This options develops a tiered approach to evaluate recommended adaptation and mitigation options to  
3 determine whether they could result in adverse health impacts and, if so, to recommend approaches to reduce  
4 these risks.

## 5 HC-3 Assess Sanitation and Infrastructure Risks from Climate Change

6 This option assesses sanitation infrastructure and practices at risk from flooding, thawing permafrost, and  
7 other risks, or that is otherwise subject to changed conditions that significantly reduce performance in  
8 environmental health protection. Consider modification, rebuilding, or relocation of sanitation infrastructure to  
9 protect human and environmental health.

## 10 HC-4 Assess, Protect, and Develop Plans for Archaeological Sites and Gravesites

11 In cooperation with appropriate local, regional, and statewide entities, the state would assess archaeological  
12 sites and gravesites at risk from accelerated coastal and river erosion; convene archaeologists,  
13 anthropologists, Alaska Native elders, and others to discuss how best to address and prioritize sites at risk;  
14 and develop a plan for the protection or recovery of important at-risk sites. This option would also assist in  
15 identifying and opening new gravesites; convene a respectful discussion about gravesites and explore best  
16 practices; provide assistance for the relocation of existing at-risk gravesites.

## 17 Common Themes

18 Across the sectors, a number of common themes emerged for types of actions that will be needed in order to  
19 assist Alaska in adapting to climate change. These themes included needs for improving access to data, for  
20 community assistance, for coordination, and for education. Most of these themes are as relevant to mitigation  
21 as they are to adaptation. The recommendations fill a variety of needs that will greatly assist Alaskan efforts to  
22 address and respond to climate change, as illustrated in the figure below. Four options that represent  
23 common themes across the sectors were developed.

### 24 CT-1 Establish an Alaska Climate Change Knowledge Network

25 This option recommends establishing an Alaska Climate Change Knowledge Network (ACCKN) to provide an  
26 effective collaborative means to manage data and foster its use for adaptation. Where appropriate, the  
27 ACCKN would organize, consolidate, integrate, and archive data, information and knowledge related to  
28 climate change. They would serve as a point of coordination for National Oceanic and Atmospheric  
29 Administration's (NOAA's) proposed Regional Climate Center in Alaska.

### 30 CT-2 Coordinate Implementation of Alaska's Efforts to Address Climate Change

31 This option recommends that Alaska's efforts to address climate change continue to be coordinated internally  
32 to ensure synergy among State agency efforts and unified and strategic interaction with federal agencies, and  
33 outreach and education.

### 34 CT-3 Community Climate Impact Assistance

35 An array of state, federal and regional entities are responsible for delivering services to Alaskan villages, rural  
36 communities, and urban centers, but specific policies and regulatory constraints produce conflicting directives

1 that prevent the coordinated delivery of vital services that will enable endangered villages, traditional culture,  
2 and vulnerable communities to adapt in the face of climate change. Therefore, there is a need to establish a  
3 coordinating entity with the ability to navigate these multiple bureaucracies and to leverage their resources to  
4 support vulnerable communities in emergency response, relocation, subsistence concerns, and other  
5 priorities.

6 **CT-4 Promote Climate Change Science Through K-12 Education**

7 This option promotes development of curriculum and training to support climate change in education in grades  
8 K-12.

9