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ON THE
FEDERAL CLIMATE ADAPTATION AND RESILIENCE FOR THE 21ST CENTURY

BEFORE THE
HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

1. INTRODUCTION

Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee, thank you for the opportunity to testify today regarding the National Oceanic and Atmospheric Administration's (NOAA) efforts to adapt our facilities and operations to a changing climate, and to describe how we support the nation's preparedness and resilience.

2. NOAA'S UNIQUE ROLE IN ADDRESSING CLIMATE CHANGE

As part of Executive Order (E.O.) 14008, *Tackling the Climate Crisis at Home and Abroad*, President Biden directed all federal agencies to develop a *Climate Action Plan for Adaptation and Resilience* that would "describe steps the agency can take with regard to its facilities and operations to bolster adaptation and increase resilience to the impacts of climate change." The Department of Commerce (DOC) plan addresses the actions we are taking as a Department to ensure our facilities and properties are protected, but it also spells out actions that NOAA and our partner agencies are taking to extend our climate science, products, and services in collaboration with others. This approach recognizes and leverages NOAA's unique role and capabilities in support of nation-wide efforts to prepare for, adapt to, and respond to climate change and its impacts.

NOAA's efforts to enhance climate resilience in real assets extends beyond our own physical infrastructure to other federal and international efforts using NOAA climate products and services. In fact, NOAA's most impactful contribution to federal agency climate adaptation and resilience planning efforts is our ability to help others build resilience and prepare for the impacts of climate change. NOAA has extensive data, tools, and scientific programs that can support enhanced climate adaptation capabilities throughout the country with a range of partners. NOAA is already working with other federal agencies and international partners to prepare and build resilience, and, as we look to the future, NOAA is uniquely positioned to lead the way with science and expert consultation. This testimony will discuss both our efforts to make our own

federal operations more resilient to climate change and our significant activities to support a *Climate Ready Nation: that is, a thriving nation whose prosperity, health, safety, and continued growth benefit from a shared understanding of and collective action on climate change.*

3. **NOAA'S MANDATE TO ENHANCE NATIONAL CLIMATE ADAPTATION AND RESILIENCE**

NOAA's weather and climate offices and programs touch every U.S. community and affect every sector of our economy in every state and territory across the Nation. For more than 50 years, NOAA has invested steadily in observing, modeling, predicting, and understanding Earth's system. We understand that simply releasing data and/or tools to the public does not mean that they will necessarily be incorporated into decision making. Thus, we attempt to work directly with a wide range of users of our information to learn about their planning needs and to engage with them on the use of our products. We have a wealth of information, products and services to share. Our data feeds into NOAA's world-class climate and weather models, which provide Americans with daily, weekly, and monthly weather forecasts, and longer-term climate projections. We share this decision-ready information publicly and directly with users, including other federal agencies, through our many partnerships and "boots on the ground" activities across the country.

For example, NOAA's National Centers for Environmental Information (NCEI) is the nation's "scorekeeper" in terms of assessing high-impact weather and climate events by understanding their historical perspective. As part of its responsibility of monitoring and assessing the climate, NCEI tracks and evaluates climate events in the United States and globally that have great economic and societal impacts. NCEI has shown that, over the last four decades, the annual average of billion-dollar natural disaster events in the United States have quadrupled. In 2021, there were 20 weather/climate disaster events in the U.S. that each resulted in losses exceeding $1 billion. We know that human-caused global warming and natural climate variability combine to produce extreme weather and climate events that impact human welfare and natural systems. The drivers of these disasters and their costs are not solely due to climate change; we know, for example, that more people are more vulnerable now as they build, live, and work in harm's way.

Federal agencies, state and local governments, and the commercial sector rely on NOAA's science, observations, and data to help them meet their own missions and plan for their people. At NOAA, we advance scientific understanding with our in-house research and development capabilities and cooperative scientific partners, and design research to readily integrate into operations and to support applications. We collect long-term environmental observations, including key climate parameters, from *in situ* measurements, satellites, radar, atmospheric greenhouse gas sampling stations, ocean buoys, uncrewed systems, aircrafts, and ships. These observations provide essential inputs into NOAA's world-class Earth system models that, when

operated and analyzed by NOAA's premier scientists and elite forecasters, characterize our changing climate, with predictive capabilities on seasonal, annual, decadal, and centennial time scales.. In order to inform the congressionally mandated National Plan for Civil Earth Observations, NOAA works with other 12 U.S. Group on Earth Observations (USGEO) member agencies to coordinate and assess federal earth observations, conduct a biennial collection of agency satellite observation needs, and address data management principles, standardization, and implementation frameworks.

We regularly equip our interagency colleagues with climate data products and services they need to make informed decisions to minimize exposure to extreme weather and climate impacts. For example, NOAA's data on precipitation, extreme events, and sea level rise, along with other resources, underpin the Department of Defense (DoD) Climate Assessment Tool. This Tool enables branches of the Military and their installation personnel to deliver consistent exposure assessments and identify regions or installations for additional climate-related studies and is crucial in helping the DoD determine where best to apply resources to improve climate adaptation and resilience. NOAA's data, and staff expertise, played a pivotal role in DoD's work to produce a regionalized sea level and extreme water level database for 1,774 coastal and tidally-influenced military sites worldwide. These data assist decision makers in managing their risks in the context of plausible future sea level and extreme water levels. This study and database led to a new DoD requirement for all construction of U.S. military installations to take the risk of sea level rise into account, including that of Naval Station Norfolk, the Nation's largest naval station, located in a region increasingly prone to high-tide flooding events measured by NOAA's tide stations. NOAA continues to play a key role in DoD Coastal Assessment Regional Scenario Working Group (CARSWG) science advances and directives.

NOAA's climate data and products are also released publicly, including on NOAA's Climate.gov website, which provides continuously updated climate data, science, outlooks, and information accessible to non-technical audiences. Keeping these data and information accessible to individuals and community leaders is crucially important to NOAA. In October 2021, we released a redesign of climate.gov which added new features to make it easier to navigate and find the desired data and information. In addition, we understand that simply developing and releasing tools to the public does not assure their use; therefore, we work with the public to understand their needs and provide resources that they can use in their decision making. Our education, outreach, and extension efforts ensure communities are knowledgeable about and can use NOAA's climate science and tools. These on-the-ground efforts couple science and community-based organizations so that highly vulnerable and marginalized groups are reached and the next generation of climate resilience workers can be trained.

We translate our data into usable tools for our partners at all levels. For example, NCEI is continuing to develop increasingly tailored resources for assessing risk. In December 2021,

NCEI released an interactive NOAA risk mapping tool that provides detailed information on a location's susceptibility to weather and climate hazards that can lead to billion-dollar disasters—such as wildfires, floods, drought and heat waves, tornado outbreaks, and hurricanes. The tool expands upon FEMA's National Risk Index to provide a view of a location's risk for, and vulnerability to, single or multiple combinations of weather and climate hazards for every county and county-equivalent in all 50 states, and the District of Columbia. In addition, in January 2022, NCEI published climate summaries for every state, plus Puerto Rico and the U.S. Virgin Islands, that spell out recent local conditions and provide insights about the state's future climate outlook under different scenarios. For more specialized users, NOAA's extensive suite of online tailorable products and services, such as the Digital Coast, the Coastal Inundation Dashboard, and the National Integrated Drought and Information System, help decision makers reduce risk to life and property now and into the future. Federal agencies can use these NOAA tools to assess current and future weather- and climate-related risks relevant for their facilities and missions.

NOAA also has programs that provide hands-on, place-based assistance to state, local, and Indigenous leaders, underserved communities, and businesses across the country. This capability is reflected in the **first Priority Action identified in the *DOC Climate Action Plan*:** to *foster and enhance the resilience of vulnerable communities against the key climate risks of extreme heat, drought, wildfires, flooding, coastal inundation and impacts to fisheries.* The first priority action draws attention to the important work NOAA is doing with communities across the United States. These communities are experiencing complex challenges resulting from insufficient capacity and readiness to prepare for and manage the effects of a rapidly changing climate. In recognition of these challenges, NOAA works to ensure that these communities, especially the more vulnerable and underserved, have access to accurate weather and climate information and, increasingly, that local networks of partners and experts work collaboratively to make decisions that expand opportunities to adapt to the impacts of climate change. Our Regional Climate Centers, Sea Grant Colleges, Regional Integrated Sciences and Assessments (RISA) program, Regional Climate Service Directors, Fisheries Science Centers, and more, build and leverage trusted relationships to identify what users need, and provide actionable support. NOAA's National Integrated Drought Information Systems has brought together multi-agency, tribal, and academic partnerships to work with its 8 regional hubs to develop Drought Early Warning Systems and bolster regional, state and local resilience to drought. NOAA co-leads the National Climate Task Force's Coastal Resilience Interagency Working Group. It also works directly with states and local communities through our Coastal Zone Management Program, National Sea Grant College Program, Community-based Habitat Restoration Program, Office of National Marine Sanctuaries, Coral Reef Conservation Program, Digital Coast, and National Coastal Resilience Fund, among others, to restore coastal habitats such as marshes, mangroves, kelp forests, and coral reefs. And our 122 Weather Forecast Offices, 13 River Forecast Centers, and ten National Centers, including the Climate Prediction Center, answer questions about climate in

every U.S. county and territory. NOAA's 12,000 employees are deeply embedded in communities throughout the Nation, and are relied upon by the communities they serve.

NOAA engages with partners to plan for and adapt to climate change, by offering training, delivering fit-for-purpose information, implementing habitat restoration and nature-based approaches for resilience, and helping decision makers to prioritize adaptation measures. With over 100 staff throughout the country, the Office of Habitat Conservation's Restoration Center is a recognized center of excellence providing project design, permitting, construction, and monitoring expertise to local partners. Fisheries biologists, engineers, and other experts work directly with coastal communities to overcome technical hurdles and shape effective solutions that maximize resource benefits, the health of our living marine resources, and community resilience. NOAA will continue to work with partners on nature-based approaches to addressing climate change, including as consistent with the President's America the Beautiful Initiative.

In all aspects of our climate work, partnerships are crucial to success. Within and outside the federal government, NOAA convenes and works directly with our government partners to produce climate science and to support the agencies who need to use our science within their missions. For example, under the Congressionally mandated U.S. Global Change Research Program (USGCRP), NOAA works with the other 12 USGCRP member agencies to produce the periodic National Climate Assessment. NOAA also co-leads multiple interagency working groups focused on global climate change and climate science, adaptation and resilience, international collaboration, climate and human health, sustained assessments, and the social sciences of climate and global change. For instance, NOAA's National Integrated Heat Health Information System (NIHHIS) program is co-leading the National Climate Task Force's (NCTF) Extreme Heat Resilience Interagency Working Group to build a coordinated whole of government policy and response to extreme heat impacts which are projected to increase due to climate change. NIHHIS is hosting a national meeting in April to convene government and non-government stakeholders to elevate the conversation on extreme heat preparedness and developing heat resilient communities. Additionally, released in February 2022, NOAA led development of an interagency Sea Level Rise Technical Report, providing the most up-to-date sea level rise projections available for the United States. The Technical Report is the latest product of the Interagency Sea Level Rise and Coastal Flood Hazard and Tool Task Force and provides data critical to adaptation planning across sectors.

The impact of partnerships is reflected in the **second Priority Action identified in the *DOC Climate Action Plan:*** *to support the development of climate-ready infrastructure via the development of forward-looking building standards*. In this priority action, NOAA, jointly with DOC sister agency the National Institute of Standards and Technology (NIST), are committed to working together to identify and utilize appropriate climate data for application in building standards. In this effort, NOAA will identify existing climate data and projections, and, where

needed, develop new information to inform federal and non-federal bodies to develop standards, building codes, and guidelines that account for increasingly extreme weather events and other climate change challenges. This information will be crucial as NIST continues to engage with its stakeholders in the building science community.

This work is already underway. In November 2021, NOAA's Climate Program Office announced a new partnership with the University of Maryland (UMD) Center for Technology and Systems Management and the American Society of Civil Engineers (ASCE) to accelerate the development of climate-smart engineering codes and standards. This partnership is especially impactful as the vast majority of building codes in the United States and abroad rely on consensus guidance provided by ASCE, the nation's oldest engineering society. This collaboration will advance the use of NOAA-produced climate science and understanding within engineering practice for the design and construction of climate-resilient infrastructure, through developing and updating ASCE codes and standards.

NOAA is also playing a leadership role in implementation of the Federal Flood Risk Management Standard. As a member of the NCTF's Flood Resilience Interagency Working Group, NOAA co-chairs and provides input to the Federal Flood Risk Management Standard Science Subgroup, focused on updating the standard's Climate-Informed Science Approach to determining future flood hazards with the latest science guidance and developing tools and resources for agency implementation of the standard. This critical work will ensure federal investments are resilient to current and future flood hazards, reducing the devastating impacts of flooding on the nation's communities while providing dramatic savings over the long-term and ensuring uninterrupted public services.

NOAA also provides climate science subject matter expertise to the FEMA Technical Mapping Advisory Council, a federal advisory committee established to review and make recommendations to FEMA on matters related to the national flood mapping program. Homeowners, businesses, developers, real estate investors, insurers, and mortgage lenders all depend on flood maps to understand risk; it is critical to have the latest climate science informing this national program. NOAA and other agency partners are ensuring that both the work of the FEMA Technical Mapping Advisory Council and the Federal Flood Risk Management Standard are underpinned by the best available, actionable climate science

Finally, the international community has long looked to NOAA as a leader in climate research, early warning for risk management, adaptation, and resilience. Many of the climate services capabilities around the world today have their roots in NOAA supported science and partnerships that date back to the early 1990s. For example, NOAA and our partners learned a lot about forecasting El Nino, a climate phenomenon, and applying this knowledge to managing its impacts on water resources and agriculture from our international engagements. In addition, the

President's Emergency Plan for Adaptation and Resilience (PREPARE) is a great example of what NOAA and our USG partners can offer to our international partners to address the climate crisis, and the support we can provide our own public and private sector interests and investments abroad. This kind of program cuts across many of NOAA's climate capabilities, tools, and services, and can create transformative opportunities for many of our partners in vulnerable regions, such as the island nations. Given the complexity of the climate crisis and its implications for national security, international commerce, international development and humanitarian aid, and public health and safety, the U.S. has a vested interest in understanding related impacts, vulnerability and response strategies beyond our borders, and bolstering the technical, institutional and human capacity in parts of the world.

Overall, this work will enable both federal and non-federal stakeholders to make climate-informed decisions that will mitigate the impact of climate change on our Nation's infrastructure, and facilitate informed infrastructure investments.

Our ability to help inform climate adaptation and resilience efforts, both within and outside the federal government, is vast. And, the next decade is a critical time to address the climate crisis. We have a small window to shift to a carbon neutral economy and hold climate impacts in check. We have an urgent need and unique opportunity to advance climate services across the Nation.

As we look forward, in pursuit of a *Climate Ready Nation,* NOAA will continue to increase engagement with a range of decision makers, including federal and non-federal partners, to improve the usability of NOAA's science for a range of climate-relevant decisions; provide support for vulnerable communities; and develop new or improve existing products and services that support climate readiness, response, and resilience. With additional resources, NOAA is well-poised to scale up our services so that all communities, businesses, indigenous communities, states, and Federal agencies in the United States have access to our world-class climate information, tools, and services so they can make informed decisions about their future.

We are targeting investments to address climate risks and key impact areas, including floods, fire, drought, and extreme heat and to build resilience in marine and coastal regions, while prioritizing efforts that are responsive to societal needs for climate information and support. These include, but are not limited to, critical, imminent investments as directed by Congress in the Infrastructure Investment and Jobs Act. For example, there is approximately $500M for coastal and inland flood and inundation mapping and forecasting, and next-generation water modeling and prediction science; $100M for wildfire-related prediction, detection, observation, modeling, and information dissemination; and $80M to support research supercomputing infrastructure used to underpin weather and climate model development to improve drought, flood, and wildfire prediction, detection, and forecasting. Additionally, the Infrastructure Investment and Jobs Act includes $1.27B for coastal resilience and habitat conservation at

NOAA, including $492M in National Oceans and Coastal Security Fund grants; $491M for habitat restoration; $207M for the Coastal Zone Management Program, and $77M for the National Estuarine Research Reserve Program. NOAA is also working with other agencies including the Department of Transportation to ensure their Infrastructure Investment and Jobs Act (IIJA) investments and projects are informed by NOAA's climate science and data, and the National Telecommunications and Information Administration (NTIA) to ensure their federal funding notices for IIJA-funded broadband expansion take into account climate change and weather extremes.

NOAA will specifically address inequalities in the provision of climate services to ensure that traditionally marginalized communities and groups are properly served. The magnitude of the challenges truly calls for building a workforce that includes physical and social scientists, modelers, science translators, educators, extension agents, tool developers, facilitators and trainers who reflect the diversity of our nation and who can *connect* with people across that nation, helping communities *apply* climate science as our knowledge grows. In this way, we are doing our part to support the whole-of-government effort to address the climate crisis, boost resilience, and promote economic growth. We are eager to work with communities across the United States, other federal agencies; businesses and the private sector, academia, and the public, to build a *Climate Ready Nation*, together.

4. NOAA'S ACTIONS TO BOLSTER ADAPTATION AND INCREASE RESILIENCE OF OUR SITES, FACILITIES, AND PROPERTY

NOAA's climate models project that climate-driven extreme events—including heavy precipitation events, extreme heat (even in the ocean), drought, wildfires—will continue to become more frequent and severe this century.[1] We also are reaching a better understanding of smaller events that do not make the headlines, such as sunny day flooding and stalled coastal storms that also greatly impact coastal communities. These changing conditions significantly threaten lives, livelihoods, and property. They put our government institutions and economy at risk, from U.S. military readiness to the insurance industry, from agriculture to public health. Unless substantial large-scale action is taken to address these and other climate-related risks through both greenhouse gas emission reductions and adaptation measures, the impacts on human welfare and natural systems are likely to worsen.

As E.O.14008 referenced, with these increasing risks and impacts, the federal government expects to experience rising maintenance costs, new programmatic challenges, and increased

[1] USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.

health and safety risks to personnel. Thus, climate adaptation is critically important to the functioning of our government and to society as a whole.

NOAA's current facilities portfolio (over 620 facilities) is intentionally distributed across the United States based on science and management mission needs. The geographical diversity of the portfolio exposes NOAA's facilities and infrastructure to the full range of weather and climate extremes.

NOAA's 2016 assessment study of our facilities' vulnerability to climate change found that most facilities and surrounding property access are either already experiencing, or will experience, risk of flooding due to increasingly heavy precipitation, while extreme heat will increase cooling loads and stresses on building HVAC systems. NOAA's many coastal facilities will continue to be affected by sea level rise, storm surge, and high winds associated with coastal storms and hurricanes, while facilities in the Southwest will continue to be threatened by wildfires, extreme heat, and drought conditions. Availability of water, fuel, and other utilities necessary for logistical support of land-based facilities, NOAA ships, and aircraft could put critical NOAA data collection missions at risk. Further, harsh conditions and the changing climate may impact NOAA's ability to maintain its facilities in Alaska, the Arctic, and in low lying areas along the east coast, for example. To assess these serious vulnerabilities, NOAA has begun to consider natural hazard resilience and climate adaptation in every stage of our strategic visioning and capital project planning.

NOAA is currently developing a strategic portfolio review to ensure facilities are aligned and capable of supporting critical missions nationwide. The analysis includes a review of facility vulnerabilities and resilience to the increasing risks of extreme weather events and the adverse effects of climate change such as sea level rise. This information will support the planning process as documented in the DOC's 2021 Federal Climate Adaptation Plan.

In addition, reduction of NOAA's carbon footprint will require planning and targeted investments. Asset scores of NOAA's current facilities provide valuable insight into a facility's energy efficiency. Carbon footprint reduction can be realized through the inclusion of: energy-efficient building systems, recapitalization of at-risk facilities (condition, location), a flexible work space model that promotes blending of an in-person and virtual workforce, and, when possible, co-location with other NOAA, government, industry, or academic partners' facilities.

NOAA will continue to evaluate climate vulnerabilities and adaptation strategies in our capital project planning processes (e.g., Business Case Analyses and Analyses of Alternatives). For at least a decade, major facility planning efforts have assessed resiliency and included related cost factors appropriate for the projects that were planned and/or executed. One example of such a project is the Ketchikan Homeport Recapitalization project in Alaska, which supports the

Administration's climate adaptation E.O.14008 and NOAA's core science mission objective. The floating pier will be designed to withstand rising sea levels due to climate change, and its reconstruction entails a significantly reduced carbon footprint with fewer piles than a traditional pier. LED lighting also adds to the environmentally conscious nature of the project. Another recent example of incorporating climate resistant adaptations into design and construction is the newly built Aircraft Operations Center (AOC) in Lakeland, Florida. This Center was built not only to withstand hurricanes, but to maintain critical operations during these high-impact weather events. Within weeks of moving into AOC, Hurricane Irma's track went right over the hangar. The building safely housed personnel, assets, and even provided shelter for local emergency management assets who were able to immediately resume operations when the hurricane passed. NOAA has and should continue to lead and set the example of incorporating all available climate adaptation technology into our facility design.

In addition to leveraging NOAA's data, planning efforts also consider other multifactorial risk data, when available, from other federal agencies, institutions, and the private sector, that take into consideration hurricanes, tornadoes, earthquakes, hail, wind, drought, floods, high daily precipitation, snowfall, wildfires, and extreme temperatures. Projects in areas with particularly high vulnerability also include an evaluation of specific natural hazard risks, such as Hurricane Impact Probability.

While there are numerous other criteria considered in planning efforts, resilience factors are essential to optimizing NOAA's operational performance, mission effectiveness, and the safety and health of our employees. Additionally, when evaluating locations for new or recapitalizing facility options, alternatives include appropriate cost factors for mitigation and adaptation to climate change. NOAA will also bolster criteria and integrate appropriate additional project costs to meet net-zero emissions performance standards set by the Administration.

5. SUMMARY

In accordance with the DOC Climate Action Plan, NOAA is working to ensure our federal operations are resilient to the impacts of climate change. At the same time, NOAA is working with a range of partners, including other federal agencies, state and local government leaders, indigenous communities, communities, private businesses, international partners, and the public, so that we can collectively, as a nation, bolster adaptation and boost resilience to the impacts of climate change.