

**A Framework for Building Climate Literacy and Capabilities Among
Federal Natural Resource Agencies**

*Prepared by the Climate and Natural Resources Working Group for the
Council of Climate Preparedness and Resilience*

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Executive Summary

Federal agencies responsible for safeguarding and managing the Nation's public natural resources have a duty to develop the institutional knowledge and capability needed to anticipate, plan for, and respond to climate change. This report, *A Framework for Building Climate Literacy and Capabilities Among Federal Natural Resource Agencies*, provides a strategic approach for agencies to collaborate and implement climate training and education programs.

Federal Response

In October 2014, the Administration released its *Priority Agenda for Enhancing the Climate Resilience of America's Natural Resources (Priority Agenda)*. The *Priority Agenda* was developed by the interagency Climate and Natural Resources Working Group (CNRWG), which includes the Departments of Defense (DOD), Interior (DOI), and Agriculture (USDA), the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), the Federal Emergency Management Agency (FEMA), and the U.S. Army Corps of Engineers (USACE).

Included in the *Priority Agenda* are strategic actions for Federal natural resource management agencies to enhance the climate resilience of natural resources, including developing a framework for building climate literacy. An interagency team of CNRWG agencies convened in 2015 to develop this framework called for in the *Priority Agenda*.

Federal agencies have made significant progress over the past decade developing a broad range of climate change training courses and activities to improve climate literacy and capability that advances resilience. This progress has benefitted the Federal workforce, as well as partners and communities. While significant progress has been made, additional actions are needed to advance Federal efforts to build a climate literate and capable workforce.

A Way Forward

This report describes common climate training and education goals and objectives, efforts to provide climate training for senior leaders, and opportunities to work with external partners and stakeholders on climate training. The report recommends that agencies:

- Conduct climate training and education needs assessments;
- Establish clear goals and objectives for climate training and education;
- Integrate climate training needs into existing training curricula; and
- Increase coordination and collaborative training efforts.

As our understanding of climate change and its impacts progresses, this framework will serve as a model for Federal agencies to integrate new knowledge and understanding into their climate training and education programs, and to continue building interagency coordination and collaboration.

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I. Introduction

Throughout the country, climate change is altering the structure and function of ecosystems, changing the distribution and abundance of plants and animals, and limiting the ability of lands and waters to provide critical services to communities. Receding glaciers, melting sea-ice, sea-level rise, extreme weather events, and increased temperatures are just a few examples of how climate change is impacting natural resources, as well as the public infrastructure, services, and local economies that depend on those natural resources. Observed and projected climate change impacts threaten the ability of government agencies at all levels to fulfill their missions and provide effective public services. As noted in the third National Climate Assessment, climate change is projected to worsen even with significant greenhouse gas emission reductions.

Members of the Federal workforce with natural resource management, infrastructure, emergency management, and/or similar responsibilities subject to climate risks need the knowledge, awareness, and technical capabilities to understand and prepare for climate impacts. The purpose of this report is to describe a framework for building a climate literate Federal workforce with the capacity to identify and address climate readiness actions across their areas of responsibility. This includes the protection and conservation of natural resources, employee safety, critical infrastructure, and other public services.

A. A Call for Action

The Administration's *Priority Agenda for Enhancing the Climate Resilience of America's Natural Resources* (Priority Agenda, October 2014) was prepared in response to Section 3 of Executive Order (EO) 13653 – *Preparing the United States for the Impacts of Climate Change* (November 2013). The *Priority Agenda* provides a strategy with commitments by Federal agencies to enhance the climate resilience of natural resources. Among the actions identified, these agencies committed to the following:

“By 2015, NOAA, USDA, and DOI, in cooperation with other Federal agencies, will define a framework for education and training to build climate literacy and capability among relevant Federal agency staff and technical service providers, such as planners, engineers, and consultants. The framework should include assessing climate literacy in Federal agencies and developing partnerships with non-profit or professional groups to promote climate resilience outreach, education, training, certification, and engagement of academic training capability.”

Additionally, Executive Order 13693 – *Planning for Federal Sustainability in the Next Decade* (March 2015) – directs the Office of Personnel Management to include environmental sustainability and climate preparedness and resilience into Federal leadership and educational programs.

An interagency team consisting of several CNRWG agencies and the Office of Personnel Management convened in 2015 to develop the climate literacy framework called for in the *Priority Agenda*. The framework also incorporates elements of the climate leadership training called for in Executive Order 13693.

B. A Priority for Federal Agencies

The profound impacts of climate change on America's natural resources can be observed across the country. Projections indicate that the impacts will intensify over a timeframe spanning multiple generations. Reducing vulnerability requires the ability to understand climate science and the ability to use the knowledge effectively.

Federal natural resource management agencies are keenly aware of the implications climate change will have on their work. The importance of developing a climate literate and capable workforce, particularly in regard to the development of future leaders, is imperative to enable both the current and future agency workforce to be better prepared. Although Federal agencies have made significant progress towards improving climate literacy and capabilities, additional actions are needed.

Resilience Planning Guidance Available Through the Climate Resilience Toolkit

Federal agencies of the United States Global Climate Change Research Program developed the [Climate Resilience Toolkit](#), led and hosted by NOAA. The Toolkit features a framework to guide the process of planning and implementing resilience-building projects. The 5-step process outlines a workflow that was developed through research and refined through practice to confront climate vulnerabilities. The Toolkit includes links to training opportunities for resource managers and scientists from the National Weather Service, NOAA Digital Coast, EPA and MetED University Corporation for Atmospheric Research.

II. A Framework for Enhancing Workforce Climate Literacy and Capabilities

As part of the review process for developing this report, the interagency team inventoried existing climate training activities for Federal natural resource management agencies and other agencies with similar climate risk exposure. Federal agencies have an extensive set of ongoing and planned climate training activities and courses designed for the Federal workforce, as well as for external partners and stakeholders including state, tribal, and local governments. Appendix 1 describes many of the climate training activities underway.¹ While it is clear that agencies are actively engaged in climate training, existing gaps in the development of a climate-informed workforce need to be addressed. An interagency framework will provide further direction for agencies to coordinate and collaborate.

Opportunities exist to improve coordination and collaboration for climate training and education planning activities. However, agencies must first identify their common climate training goals and objectives. While agencies have certain climate training goals that are specific to their missions, there is a common set of goals that apply to a broader base of agency missions.

The following section describes shared Federal goals and objectives for climate training, and a framework for how agencies can plan for climate training moving forward. This framework can be used individually by agencies or as a model for interagency coordination and collaboration.

¹ The chart in Appendix 1 lays out a range of climate change trainings and education activities available to the Federal workforce and partners through multiple agencies.

A. Federal Goals and Objectives for Climate Training

The overarching goal of climate training in Federal natural resource agencies is to build climate literacy and capability in the workforce. This will enable agencies to successfully carry out their missions in an era of rapidly changing climatic conditions.

A climate-literate and capable workforce can more readily integrate climate considerations into all activities, from day-to-day operations to long-term planning. More specifically, the workforce should be able to:

- Understand the diverse range of impacts that a changing climate has on natural, cultural and historic resources and infrastructure, including the underlying scientific principles, historic trends in natural resource conditions, modeled projections of future changes, and uncertainties associated with such projections;
- Critically assess the adequacy of existing institutional planning and decision-making processes within the context of climate risks;
- Routinely assess and communicate the climate risks associated with continuing or departing from business-as-usual operations, including the vulnerability of managed systems; and
- Communicate meaningfully with the public to invite participation in climate preparedness, resilience, and adaptation.

NOAA's Climate Stewards Education Project

NOAA provides live and archived monthly broadcasts of nationally recognized scientists, educators, and communicators for a broad national audience including the Federal workforce through the NOAA [*Climate Stewards Education Project*](#). Evaluations indicate that on average, 86% of webinar attendees intend to use what they learned in their work over the next 12 months.

Objectives to meet these goals should include:

- Cataloguing existing climate education programs;
- Generating information about climate literacy and workforce informational needs;
- Developing coordinated climate educational packages; and
- Creating accountability within agencies for training their workforce.

B. Addressing Climate Risk with a Climate-Informed Workforce

A common framework for climate training provides the opportunity to share an understanding of ideas, definitions of terminology, and appreciation of mission diversity. This ensures clear communication between agencies and with the public about climate risk. Each agency should develop a climate educational package that includes:

- (1) formal learning objectives;
- (2) a developed curriculum; and
- (3) assessments or evaluations to measure results.

The learning objectives should integrate climate literacy ([see the "Climate Literacy" text box in this section](#)) at a minimum into agency needs and priorities. The curricula of natural resource management agencies should align where possible, sharing use and development of basic

modules, advanced training, and terminology. Evaluation metrics should, at a minimum, indicate if natural resource management personnel have completed relevant training.

There are numerous existing examples of comprehensive educational packages and climate courses (both basic and advanced) within natural resource management agencies; emerging efforts should take advantage of and leverage existing resources where possible.

Members of the Federal workforce need access to educational resources, the time and opportunity to engage with the resources, and an incentive, or a requirement, to complete trainings. Supervisors need to be grounded in the issue and its importance and be held accountable for their workers' engagement.

For the general workforce, expectations could include required certificates of completion for basic education modules, whereas specialists could be required to attend an intensive seminar or workshop one or more times per year. These activities should be included in workplans and performance criteria, while supervisors' criteria could be amended to ensure participation in climate education.

A comprehensive and coordinated program to educate the Federal workforce should convey information for different audiences. It should create a baseline level of a climate literate general workforce that will enable effective agency response to climate risk. Building capability in key areas of specialization should involve intensive education and interaction. The program should thus incorporate several elements, including basic education, intensive training, and discipline-specific workshops (Figure 1).

Most members of the Federal workforce should have access to climate information through interactive internet and video courses and resources. Live meetings can be supplemented with distance learning reinforcement. Viewing online lectures and electronic presentations prior to live workshops will provide participants with a knowledge base, allowing in-person workshops to focus on interactive exercises. Follow-up activities online will cement skills learned during live training sessions.

Climate Literacy

Climate literacy, as defined by the U.S. Global Change Research Program's (USGCRP) document [*Climate Literacy: The Essential Principles of Climate Science*](#), is an understanding of your influence on climate and climate's influence on you and society. A climate-literate person:

- Understands the essential principles of Earth's climate system;
- Knows how to assess scientifically credible information about climate;
- Communicates about climate and climate change in a meaningful way; and
- Is able to make informed and responsible decisions with regard to actions that may affect climate.

For more on climate literacy, see the [USGCRP](#) document.

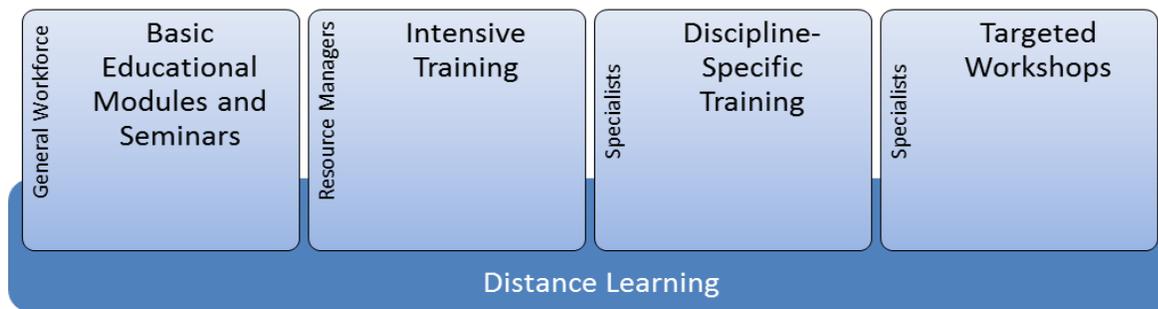


Figure 1. Conceptual diagram of educational, training, and developmental efforts leading to increased climate preparedness. Distance learning can be incorporated into all activities.

C. Basic Climate Literacy

Basic educational modules should impart a baseline level of climate literacy, such that participants understand the basic principles of climate, identify scientifically credible climate information, meaningfully discuss climate change, and make climate-informed decisions (USGCRP 2009). Members of the Federal workforce should have access to online educational modules, and live sessions can be incorporated into existing unit-level meetings. Basic educational modules and seminars in natural resource management agencies should convey fundamental principles of climate change and its effects on natural systems. They will be used at the unit level to generate discussion of how unit or resource areas can adapt to projected changes.

Beyond online or in-person modules, a basic climate literacy course can be expanded to facilitated one- to two-day seminars that go into depth about climate change and its effects on agency work and priorities. For example, the first half can be largely comprised of presentations on climate change, ecosystem or resource response, and management strategies. The second half can be tailored to the needs and concerns of the unit. Needs range from general brainstorming and discussion to creating lists of potential project activities. The role of the seminar facilitators is to answer specific questions, provide intra- and inter-agency continuity by familiarizing with other climate programs, and maintain a dialogue focused on climate change activities. These seminars can set the stage for “next steps,” in which plans for further training, activities, or discussions, are initiated.

**NOAA’s Communication
Climate Science Workshops**

NOAA, through its Cooperative Institute for Climate and Satellites-North Carolina partner, engaged in a series of Communication Climate Science workshops to build climate communications capacity among NOAA staff and partners. The workshops empowered staff with the resources, tools, techniques and tactics to respond to questions about climate science.

1. Basic Climate Literacy Opportunities

A variety of basic climate literacy courses are currently offered by Federal agencies and nongovernmental organizations. Many of these courses can be used by Federal agencies to advance workforce climate literacy objectives. The following two courses were designed by Federal agencies and are available or will be made available to other agencies.

U.S. Forest Service -- Climate Change Science and Modeling

The U.S. Forest Service offers a basic course entitled [Climate Change Science and Modeling](#). This 20-minute online educational module is part of a three-module package and provides a brief overview of the climate system, greenhouse gases, climate models, current climate change impacts, and future projections. If users answer the 14 questions at the end of the module, they will receive a certificate with their name and the date completed. The module has undergone formal scientific peer-review and Forest Service policy review before being published as a USDA Forest Service General Technical Report (PNW-GTR-902). It is certified by the Forest Service as Section 508 compliant, is closed-captioned, and is accompanied by a printed narration script with screenshots of the visuals. It is also available on CD-ROM.

U.S. Environmental Protection Agency -- Climate Change Adaptation Introductory Training

EPA designed the [Climate Change Adaptation Introductory Training](#), a self-directed, online, climate adaptation learning module as internal awareness training for its staff. To date, over 40% of EPA staff has completed this training. The training is tailored to raise awareness of EPA programmatic vulnerabilities from a changing climate. The course will be made available across the Federal workforce in the near future.

D. Skills and Knowledge for Technical and Scientific Staff

The three training approaches below can provide in-depth information about climate change science, adaptation and mitigation, and ecosystem and resource response. Such trainings will aid specialists as they design climate-informed best management practices, standards and criteria, plans, and practices.

1. Intensive Training

Intensive training includes longer courses providing more in-depth information than that provided in seminars. The intensive training moves beyond a simple overview of climate change, providing participants with a detailed explanation of fundamental climate processes, interactions and anthropogenic changes. Additionally, greater detail of the mechanisms of ecosystem and resource response to climate stressors is presented and discussed. Tools and applications relevant to carbon and climate are presented by experienced instructors. Participants are given the opportunity to evaluate issues or resources in their own units using these tools. An emphasis is placed on both the strengths and limitations of management-related decision-making tools, and the information gleaned from these exercises informs subsequent preparedness and adaptation lectures and discussions.

2. Discipline-Specific Training

Specialists should have access to in-person workshops that provide in-depth information and discussion about the interaction of climate change with specific discipline areas

Climate Integration into the National Advanced Silviculture Program

The USDA Forest Service incorporated climate change into its certification course for vegetation management – the National Advanced Silviculture Program (NASP). A problem-solving approach builds upon local knowledge and experience to arm participants with a structure for incorporating these considerations into future management strategies. This integration has helped provide the latest scientific information and forest management strategies to certified natural resource managers and silviculturists.

(e.g., mitigation, silviculture, fish biology, and hydrology). Discipline-specific trainings allow for focused presentation and discussion of climate change implications for specific resource areas. Although climate change science, system response, and management are included in these types of trainings, the information most relevant to particular resource areas is emphasized. This type of training is comprised of activities designed to draw upon participant expertise and interest.

3. Targeted Workshops

Specialists should be encouraged to work closely with researchers through combined in-person and video-linked workshops to address specific needs and questions in natural resource management. Targeted workshops will improve the ability of natural resource managers to design or alter techniques and programs to incorporate climate change considerations. These workshops will also likely involve close collaboration between researchers and managers as they answer basic questions such as: “What do we know now that requires us to change our actions?” and “How can we practically change our plans and actions to meet changing needs?” As climate change challenges become more clearly identified, targeted workshops will be critical tools in pooling expertise to meet specific needs of natural resource managers and focus on their specific issues, resources, and locations. The structure of the workshops will depend upon management objectives and desired outcomes. They will likely include little focus on traditional educational models, but instead focus more on shared learning through detailed technical discussion within the context of climate projections and impacts.

Climate Change and Water Working Group Program

The Federal Climate Change and Water Working Group (CCAWWG) works with the University Corporation for Atmospheric Research (UCAR) [COMET](#) Program and [NOAA-RISA](#) (Regional Integrated Sciences & Assessment) program to develop a new COMET Professional Development Series, “Assessing Natural Systems Impacts under Climate Change.” This series is designed to provide technical and discipline-specific training to water resources professionals on how to incorporate climate change science and uncertainties into a variety of natural resource impacts assessments. CCAWWG is working with curriculum development experts at UCAR and the Bureau of Reclamation to develop distance-learning and workshop courses to meet the needs of general audience communities playing a role in water management as well as more technically oriented water resource professionals. These include long-term planning and environmental compliance, environmental adaptive management, infrastructure asset management, dam safety, and reservoir operations. Pilot courses include surface water hydrology, crop water demand, sedimentation and river hydraulics, and ecosystem response. Additional information about these discipline-specific courses is available [online](#).

E. Climate Leadership Development

Attaining agency climate literacy goals and objectives relies on a climate-informed and knowledgeable agency senior leadership cadre. Senior leaders must have a firm understanding of climate-related risks to their missions and be able to lead, develop and implement climate training curricula.

Many of the goals in the President’s Climate Action Plan (and supporting Executive Orders) require Federal leadership across multiple agencies to promote greenhouse gas mitigation and climate preparedness. Executive Order 13693 *Planning for Federal Sustainability in the Next Decade* (March 2015), calls on the Office of Personnel Management (OPM) to advance Federal leadership education and training to address this need:

Sec. 11. Employee Education and Training. Within 180 days of the date of this order, the Office of Personnel Management, in coordination with DOE, GSA, EPA, and other agencies as appropriate, shall:

(b) initiate the inclusion of environmental sustainability and climate preparedness and resilience into Federal leadership and educational programs in courses and training, delivered through electronic learning, in classroom settings, and residential centers, particularly developmental training for Senior Executive Service and GS-15 personnel.

In response to Sec. 11, an interagency workgroup, along with OPM, is building on the “Climate Change and Sustainability for Senior Executive Leaders” course series developed by the USACE Institute for Water Resources. These courses blend and balance leadership development with climate change and sustainability education. The course series has been informed by and will leverage existing technical content mentioned elsewhere in this document and includes, but is not limited to, courses offered by the National Conservation Training Center (see Section F1).

The climate leadership challenges confronting federal leaders and executives vary according to agency mission, their roles, and their day-to-day job responsibilities. Therefore, the response to EO 13693 has been to develop modular content that can be scaled to fit the needs of the widest possible range of federal leaders. The courses developed to date can be taught in as little as a few hours to as long as 3-4 days. This allows content to be delivered as part of a short continuing education series, as part of OPM’s [Leadership Education and Development \(LEAD\)](#) series, or embedded within executive development programs (including OPM’s [Leadership for a Democratic Society](#)). The modular format also allows for efficient delivery of customized courses at various venues and to various audiences. These courses will be adapted for specific audiences and levels of leadership and will include the following:

1. Current courses for Senior Executive Service (SES) positions:

Climate Change and Sustainability for Senior Executive Leaders – This recently developed course is a 2.5 hour course comprised of the following three parts: Climate and Sustainability 101; Responding to Climate Change and Federal Leadership and Decision-Making. It has helped over 500 Senior Executives and senior managers from more than 35 federal agencies improve their abilities to lead their agencies through climate change and sustainability challenges. The course is a mix of lecture and participant discussion.

A one-hour version of *Senior Executive Service Orientation and Onboarding* focuses on current Federal policy, EO’s, Federal agency climate adaptation plans, and anticipated climate leadership challenges executives will face.

2. Current courses for GS 14-15 positions:

Climate Change and Sustainability for Executives—One-half to a full day course for executives in the Senior Executive Service Candidate Development Program (SESCDP), custom programs, or OMB’s Leadership for a Democratic Society.

Climate Change and Sustainability Essentials—A 4-day course that could be a stand-alone Skill Immersion course or could be offered within the LEAD Certificate Program at the Manager level or above (some GS-13 managers could attend depending on their role).

In keeping with the goals of the President’s Climate Action Plan, all of these training options will be available outside of the Federal government. The interagency workgroup on climate leadership will work with representatives who served on the State, Local, and Tribal Leaders Taskforce to expand the audience for these courses.

F. Working with Partners, Stakeholders and the Public

Providing effective training to stakeholders first requires the ability and willingness to listen. As agencies provide training to “stakeholders” in their own workforce, other agencies, or the public, they need to adopt an affirmative approach in learning about stakeholder needs, capabilities, and sensitivities. All trainings should be adjusted to meet stakeholders where they are and help them fulfill their missions in a more climate-informed manner. Engaging with both Federal and non-Federal partners can help agencies learn from each other and from organizations that specialize in climate education more efficiently. Agencies need to ensure that these partnerships are a good fit and will provide net benefit.

A similar approach should be employed when training the public so that they can advance their climate preparedness, resilience and adaptive capacity. The Federal workforce should adjust their trainings to meet the public where they are, listen to their needs, and build upon their existing skillsets and capabilities.

California LCC and Partners Implement Climate Smart Conservation

The Forest Service, California Department of Fish & Wildlife, National Park Service and other partners are now working across boundaries as part of the Riparian Habitat Joint Venture to incorporate new adaptation strategies into their management plans developed by the California Landscape Conservation Cooperative (LCC). This multi-stakeholder effort developed landscape-scale adaptation strategies for local resources of the Sierra Nevada. Using a climate smart approach of identifying local resources and conducting vulnerability assessments, the partners developed locally-relevant strategies and actions considering climate change.

Examples of Federal Climate Training Engagement with Partners, Stakeholders, and the Public

1. National Conservation Training Center (U.S. Fish and Wildlife Service)

The U.S. Fish and Wildlife Service (FWS) National Conservation Training Center (NCTC) currently offers a suite of four climate change training courses. These courses are generally open to all, although some specific sessions may have restrictions. The development and delivery of NCTC’s climate change curriculum has been partner-based since its inception, working with the

best subject matter experts from Federal, state and local agencies, non-profit organizations, academia and the private sector.

Climate Change Vulnerability Assessment course: The FWS and National Wildlife Federation (NWF) developed a three-day course entitled *Climate Change Vulnerability Assessment* based on “Scanning the Conservation Horizon – A Guide to Climate Change Vulnerability Assessment.” These classes are attended by a diverse group of participants (see Table F.1.). Requests for this course have come from USGS, BLM, NPS, the Landscape Conservation Cooperatives (LCCs), the National Estuarine Research Reserve System and the Choctaw Nation of Oklahoma. The instructor cadre comes from a number of partner agencies and organizations, including non-profit organizations (e.g. Geos Institute, NatureServe, Point Blue Conservation Science), state agencies (e.g. California Department of Water Resources, Florida Fish and Wildlife Conservation Commission, Massachusetts Division of Fisheries and Wildlife), NOAA, USACE, USGS, FWS and the private sector. NWF provides instructors for almost every session.

Climate-Smart Conservation course: NWF and FWS, along with several other partner organizations developed a three-day class, *Climate-Smart Conservation*, based on the “Climate-Smart Conservation: Putting Adaptation Principles into Practice” guidebook. Once again, along with continued NWF support, the course instructors come from many sources (Wildlife Conservation Society, NatureServe, Geos Institute, NPS, USFS, USGS, FWS and the private sector).

Scenario Planning Toward Climate Change Adaptation course: The most recent addition to the NCTC’s climate change curriculum is “Scenario Planning toward Climate Change Adaptation.” This course accompanies the guidebook “Considering Multiple Futures: Scenario Planning to Address Uncertainty in Natural Resource Conservation,” and covers the decision support methods for integrating uncertainty into climate change adaptation and other natural resource management planning. The course and guidebook were developed by the Wildlife Conservation Society in cooperation with FWS, USACE, and USGS. While originally designed as a stand-alone course, it is frequently requested by agencies in conjunction with the “Climate-Smart Conservation” course.

Climate Academy: Finally, NCTC offers the “Climate Academy,” a broad-brush course designed to address fundamentals of climate science. The Academy was developed in partnership with The Wildlife Society (TWS), the Association of Fish and Wildlife Agencies (AFWA), AFWA’s Management Assistance Team, the California Department of Fish and Wildlife, and the National Park Service (NPS). The course consists of ten online sessions, each presented by a subject matter expert or panel from a partner agency, organization or educational institution. Other

**NOAA’s Office of Coastal Management
Offers Climate Training to State and
Local Decision Makers**

NOAA’s Office for Coastal Management provides classroom trainings for state and local decision makers to help provide coastal communities with skills and resources needed for adapting to climate change while networking with state and local peers. From October 2013 to July 2015, over 850 coastal decision makers across the country have received training in three climate-relevant courses, “[Climate Adaptation for Coastal Communities](#),” “[Introduction to Green Infrastructure for Coastal Resilience](#),” and “[Coastal Inundation Mapping](#).”

cooperators include the Society for Conservation Biology, Minnesota DNR, NASA and Trout Unlimited. To receive credit for this course, the participants develop a final report or presentation addressing applications to their particular role in management of natural resources.

Table F.1. Participant affiliation in NCTC courses since May 2011

	Climate Change Vulnerability Assessment (14 classes)	Climate- Smart Conservation (8 classes)	Scenario Planning (2 classes)
Federal	273	165	28
Tribal	37	6	0
State & local	62	34	5
Non-profit organizations	27	17	1
Academia, private sector & international	43	10	2

2. U.S. Department of Agriculture Natural Resource Conservation Service

The USDA Natural Resources Conservation Service (NRCS) provides technical and financial assistance to the public to increase conservation on private lands. Farmers, ranchers, and forest landowners are facing increasing vulnerability from climate-related threats such as fires, invasive pests, droughts, and floods. Accordingly, conservationists, soil scientists, agricultural extension agents, and crop advisors must understand the impact of adaptation and mitigation practices on soils and landscape resilience. NRCS climate change education increases employees' understanding of the importance of the agency's mission relative to national and global climate issues. They can then better communicate the importance of conservation for private landowners.

NRCS has a set of eight on-line courses concerning climate change and resource implications. The courses are designed for a wide range of NRCS employees, partners, and stakeholders, including state air quality and energy contacts, conservation planners, and technical assistance providers. Courses are available on [AgLearn](#) and on the [eXtension learning network](#). Additionally, there are NRCS webinars on a wide range of climate related topics that are recorded and available [online](#).

NRCS also conducts training sessions for employees on basic soil health concepts. Its conservationists, agronomists, and stakeholders work with producers to establish conservation practices that increase soil health while increasing climate resilience. The trainings consist of a three-day course of classroom and field exercises. This concept will be expanded with soil health demonstration areas in Oklahoma, California, and other states over the coming year.

3. Forest Adaptation Planning and Practices Workshop (U.S. Forest Service)

Natural resource managers are increasingly requesting action-oriented climate resilience and adaptation education. The Forest Service's Northern Institute of Applied Climate Science (NIACS) has responded to these requests with the "[Forest Adaptation Planning and Practices](#)" workshop, which leads organizations through a structured process to design on-the-ground adaptation tactics for their projects. The workshop uses a climate-planning tool, the [Adaptation Workbook](#), in conjunction with ecosystem vulnerability assessments and a diverse "menu" of adaptation approaches to generate site-specific adaptation actions that meet management and

conservation objectives. See Figure 2 for a map of adaptation demonstrations developed through the workshops.

These workshops have generated more than 125 intentional adaptation plans for natural resource management projects, many of which are currently being implemented. Descriptions of these climate considerations and management responses are shared online as “[adaptation demonstrations](#),” and include real-world projects on Federal, state, tribal, county, conservancy, university, and private lands. The workshop, vulnerability assessments, Adaptation Workbook, and menu were developed through a partnership-based effort called the [Climate Change Response Framework](#).

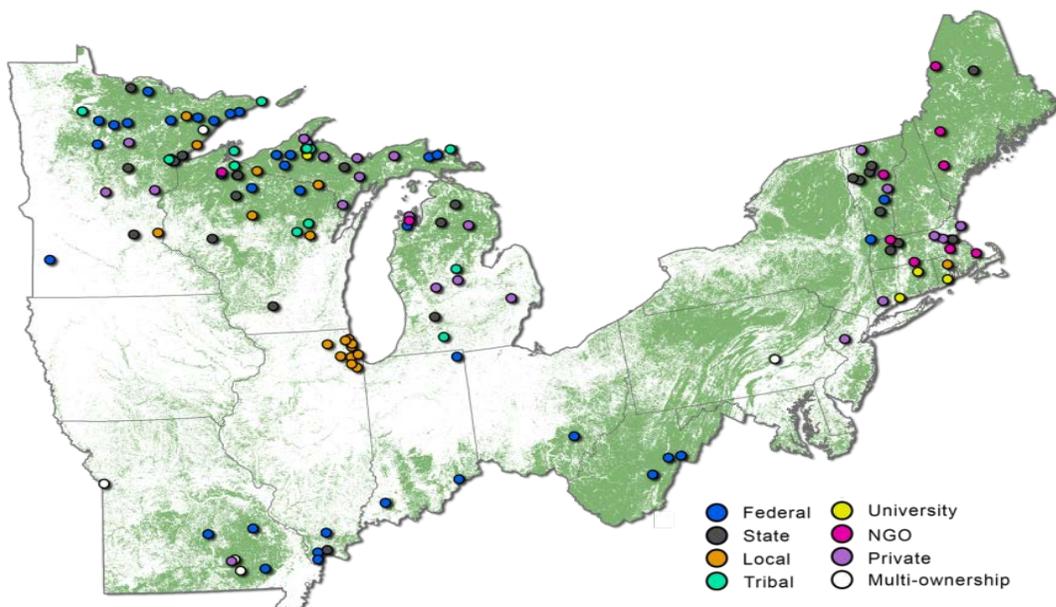


Figure 2. Adaptation demonstrations: real-world examples of intentional climate adaptation planning and implementation. Developed through the [Forest Adaptation Planning and Practices workshop](#).

4. Interpreting Climate Change Competency (National Park Service)

The NPS interpretive rangers interact with park visitors on a daily basis, and are required to be proficient in a wide array of competencies—including the knowledge, skills, and abilities required to communicate effectively. In 2010, the [NPS Climate Change Response Strategy](#) identified the need for interpretive rangers to better understand climate change in order to actively engage the public on this topic through interpretive programs and products.

Training leads for the NPS developed a new training module and competency to include a comprehensive pilot curriculum with sessions on climate change, science literacy and facilitated dialogue. This provides a means to advance visitor-centered interpretation and actively engaged park visitors.

Since 2011, over 200 individuals from the NPS and other agencies have participated in this training both in person or online, often returning to their workplace and presenting elements of the training to other staff. The program has proven remarkably successful at facilitating the flow of climate change information and interpretive best practices, ultimately benefitting NPS public audiences and stakeholders.

5. National Water Program (U.S. Environmental Protection Agency)

The U.S. EPA's National Water Program works with state, tribal, and local governments, as well as communities, to build resiliency and develop tools and trainings to respond to climate change. The following are two such tools:

The Climate Ready Estuaries (CRE) program builds capacity in coastal communities as they prepare to adapt to the effects of climate. It does this by working with the [National Estuary Programs](#) (a network of voluntary community-based programs that safeguards the health of coastal ecosystems across the country) to provide tools and assistance to assess climate change vulnerability and plan for adaptation. The program's [Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans](#) presents a guide to climate change adaptation planning based on EPA's experience with watershed management, the National Estuary Program and the Climate Ready Estuaries program. The Workbook assists as a training resource for organizations that manage environmental resources to prepare a broad, risk-based adaptation plan. The audience for this Workbook is professionals that manage environmental resources, especially organizations with a coastal or watershed focus. The Workbook and other CRE resources are available at its [website](#).

Climate Ready Water Utilities (CRWU) resources provide water utility managers with tools, training, and technical assistance needed to adapt to climate change. The [Climate Resilience Evaluation and Awareness Tool \(CREAT\)](#) is a risk assessment tool that allows water utilities to evaluate potential impacts of climate change and identify adaptation options using both traditional risk assessment and scenario-based methods. The [CRWU webinar series](#) provides climate training for water utilities, and is presented in coordination with the Water Utility Climate Alliance and other partners. It includes:

- Strategies that water utilities are using for adaptation planning and decision-making;
- Presentations from representatives of utilities that have used these methods to plan and make critical decisions; and
- Information on tools to help water utilities understand and adapt to climate change impacts.

Other CRWU resources that provide water utility managers with tools, training, and technical assistance needed to adapt to climate change are available [online](#).

III. Recommendations to Agencies

A. Conduct Climate Training and Education Needs Assessments

Leadership of agencies with natural resource management responsibilities should assess existing climate training programs and resources needed to support their missions. Leadership should identify occupational series that need further development in order to effectively deal with climate change challenges and support staff participation. In addition to advanced climate change topics such as vulnerability assessments, scenario planning and use of climate projections (downscaling), coursework could also include skills in adaptive management, structured decision making, facilitation, conflict management, communication and environmental education.

B. Establish Clear Goals and Objectives for Climate Training and Education

Federal natural resource management agencies have the responsibility to prepare their workforces to address the challenges that climate change presents. Agencies should explore opportunities to develop internal policies and guidance for implementing climate training and education programs for members of their workforce. At a minimum, agencies should clearly describe and make publically available their climate training and education goals and objectives.

The framework described in this report is a model that can be used by agencies to build and implement climate training and education programs. The framework describes an approach for building the overall climate literacy of the Federal workforce, as well as for developing specialized training courses for technical specialists, scientists, and others requiring a more advanced understanding of climate change.

C. Integrate Climate Training Needs into Existing Agency Training Curriculums

It is essential for agencies to begin integrating climate training into existing training regimes, in a similar way that climate principles and practices need to be embedded into strategic mission and operational priorities. Few agencies have the resources to create new training courses; the sheer volume of scientific findings to be included in such courses is increasing and shifting exponentially, reducing the likelihood of capturing accurate information in a timely fashion. Agencies that create smaller climate modules aligned with existing training programs can preserve scarce resources.

One way in which climate materials can be integrated effectively into existing training courses is to consider multimedia offerings, which complement the format of the established face-to-face course. For example, if a course is usually presented in a classroom, time can be reserved for a brief video climate module. Or, in the case of required online training, a climate element can be added as one of the requirements for successful completion, and/or credit for the larger course.

D. Increase Coordination and Collaborative Training Efforts

Agencies should continue working together to identify common climate training objectives and to develop courses and activities. The Climate-Smart Conservation Course (Section II. F.1.), which was developed collaboratively by multiple agencies and the National Wildlife Federation, is a good example of how courses can be developed and delivered collaboratively by agencies and partners. NOAA's Communicating Climate Science workshops are also a good example of

building climate communications capacity among the Federal workforce and partners. The federal [Climate Change and Water Working Group](#) (CCAWWG) is an effective working-level forum among federal agencies that fosters communication, operational, and research partnerships around user needs across the water resources and science communities of practice.

IV. Conclusion

Climate change presents serious challenges for natural resource management agencies to successfully accomplish their missions. The ability of these agencies to prepare for and to respond to climate change risks relies on the knowledge, skills, and capabilities of the Federal workforce and senior leadership. Agencies have a broad set of existing climate training courses and activities, but additional opportunities are needed to strengthen agency efforts and expand collective efforts. As our understanding of climate change progresses, we must continue to revisit our approach toward climate training to ensure incorporation of the best available information. Agencies should continue to work together to identify the most effective development and delivery of climate training courses and activities in meeting the climate challenges of future.

Appendix 1 – Ongoing CNRWG Agency Climate Training Courses and Activities

The chart below lays out a range of climate change trainings and education activities available to the Federal workforce and partners through multiple agencies. Note that this list is not comprehensive and is not meant to describe the full suite of available climate training courses.

Course Name	Target Audience	Description
Multiple		
Climate-Smart Conservation	Federal and non-Federal natural resource managers	This training provides guidance for how to carry out adaptation with intentionality, how to manage for change, how to craft climate informed conservation goals, and how to integrate adaptation into ongoing work.
Scanning the Conservation Horizon-A Guide to Climate Change Vulnerability Assessment	Federal and non-Federal natural resource managers	This training targets professionals to better plan, execute, and interpret climate change vulnerability assessments. Provides wildlife-specific guidance for assessing species, habitats, ecosystems, and a species' sensitivity, exposure, and adaptive capacity at each of these biological levels.
Climate Change and Water Working Group (CCAWWG) Professional Development Series for General Water Resource Audiences	General water resource audiences	The <i>Integrating Climate Change Adaptation into Water, Environmental, and Land Resources Management</i> training series is designed to meet the needs of several general audience communities in implementing climate change adaptation, including water management, long-term planning and environmental compliance, environmental adaptive management, infrastructure asset management, dam safety, and reservoir operations. The series will feature a mix of online, self-paced, instructor-free web-courses and instructor-led residence or remote (virtual) courses.
Climate Change and Water Working Group (CCAWWG) Professional Development Series for Technical Water Resource Professionals	Water resource practitioners, planners, water resource engineers, technical specialists	This series provides technical training to water resources professionals on how to incorporate climate change science and uncertainties into a variety of natural resource impacts assessments, including those related to surface water hydrology, crop irrigation requirements, water temperature, river and reservoir sedimentation, water quality, and land cover.
Office of Personnel Management's Climate Change and Sustainability for Senior Executive Leaders	Senior executive leaders	This course series, developed by the USACE Institute for Water Resources, blend and balance leadership development with climate change and sustainability education
NOAA		
Climate Stewards Regional Workshops	Formal and informal educators	Participants will hear from and interact with climate science, education and communication experts, and visit research facilities to explore technologies and innovations in Earth-system research.
Climate Stewards Monthly Webinar Series	Formal and informal educators and public	Each month a nationally-recognized climate expert provides background information on an aspect of climate science, impacts, and/or solutions to an audience of 100-150.

Course Name	Target Audience	Description
Climate Game Jam, October 2-4, 2015	Interested public, game developers, climate scientists, educators, and students	In order to help connect American students and citizens with science-based information about climate change, the White House launched a Climate Education and Literacy initiative. Federal and non-governmental experts collaborate to enhance understanding of climate impacts and solutions through educational games and interactive media.
U.S. Climate Resilience Toolkit list of Training Courses	Natural resource managers	Courses are offered in online audio-visual presentations, webinars, and residence training courses formats. Each module contains a knowledge test and is appropriate for natural resource managers/stakeholders to better understand climate impacts and how to increase resilience.
NOAA Digital Coast list of Trainings	Coastal managers, planners, decision-makers	These free offerings focus on both broad and more specific areas of coastal management, including climate adaptation. Classroom-based, online instructor-led or online self-guided trainings are offered, along with related tools and resources.
USDA Natural Resources Conservation Service		
Air Quality, Climate Change and Energy	USDA employees, partners and technical service providers	Students learn about agriculture's impact on the atmosphere and other topics such as carbon sequestration, managing GHG emissions, and energy conservation.
Greenhouse Gases and Carbon Sequestration	USDA employees	This course shows the negative relationship of GHGs emitted through agricultural processes and the atmosphere, and poses methods in which agriculture can reduce its net emissions of GHGs into the atmosphere.
Introduction to Environmental Credit Training	USDA employees and public	This training provides an introductory discussion of environmental credits, environmental credit trading, and market-based approaches of environmental and economic benefits.
Why do we Care About Climate Change?	USDA employees and public	This course discusses climate change and related concepts, its impacts on agriculture and natural resources, and NRCS' role in helping private landowners and land managers address mitigation and adaptation through conservation planning.
USDA Forest Service		
Climate Change Science and Modeling: What you Need to Know	General workforce to advanced professional	Gives a brief review of current and projected climate change impacts on water resources, vegetation, wildlife, and disturbances geared towards forest and grassland ecosystems.
Climate Change Effects on Forests and Grasslands: What you Need to Know	General workforce to advanced professional	Provides interactive information relating to forest and grassland ecosystems. The course reviews projected climate change effects on water resources, vegetation, wildlife, and disturbances.
Forest and Grassland Carbon in North America: A Short Course for Land Managers	Natural resource professionals	These 15 presentations, reviewed by scientists and managers and presented by experts, are designed for land managers to inform them how forests and grasslands store and release carbon, how management affects carbon storage and release, and the emerging market contexts.
Adapting to Climate Change: A Short Course for Land Managers	Natural resource professionals	Course information includes climate variability, climate change, projections, and ecological and management responses. Lectures are from a 2008 workshop held by Forest Service and USGS scientists.

Course Name	Target Audience	Description
Online Resources Plus Group Discussion (Template #2, USFS Climate Instructional Package)	General workforce and natural resource professionals	This template combines online educational resources on climate change ("what you need to know series") with an in-person discussion added to a safety or staff meeting.
Climate Change All-Employee Meeting (Template #3, USFS Climate Instructional Package)	General workforce and natural resource professionals	Forests and Grasslands team members host all-employee meetings to provide climate training. These half- to full-day meetings usually facilitate large groups and involve introductions by leadership, presentations by experts, activities, and breakout-group discussions.
Training in Advanced Climate Change Topics	Natural resource professionals	This intensive one-week course provides advanced instruction on climate science, change, ecosystem response, and strategies for an uncertain future. It identifies climate and carbon tools and the need for organizational capacity. Participants plan an outreach activity at their home location.
National Advanced Silviculture Program-Climate-Informed Silviculture	Certified silviculturists	Provides practices to meet real-world management objectives relating to climate change for certified silviculturists, who approve Forest Service vegetation management projects.
Forest Adaptation Planning and Practices	Natural resource professionals	Guides professionals through the steps of the Adaptation Workbook to define their management objectives, identify challenges and opportunities for management, and develop actionable steps to adapt ecosystems to changing conditions.
Multi-Resource Vulnerability Assessment and Adaptation	Natural resource professionals	This hands-on program encompasses vegetation, wildlife, water resources, fisheries, recreation, and ecosystem services. It is intended to develop organizational capacity for addressing climate issues in resource planning and management.
U.S. Environmental Protection Agency		
EPA Climate Change Adaptation Introductory Training	EPA staff	Online, interactive e-learning module with illustrated characters, charts, maps, links and video clips. Included are climate change (CC) basics, EPA climate vulnerability and adaptation programming sections.
Office of Solid Waste and Emergency Response (OSWER) Climate Change Adaptation Training	EPA staff working on land-based issues and emergency response	Online, interactive e-learning module with illustrated characters, charts, maps, links and video clips. Included are CC impacts & OSWER vulnerability and adaptation examples, and key takeaways and resources.
Climate Change Adaptation Introductory Training for Local Governments	Mayors and other local government officials.	Online, interactive e-learning module with illustrated characters, charts, maps, links and video clips. Included are climate change basics, vulnerabilities of local communities, and key takeaways and resources.
EPA Office of Water Training Module: Understanding Climate Change Impacts on Water Resources	EPA water staff	Online, interactive e-learning module provides an introduction to the impacts of climate change on water resources and on EPA's National Water Program. It highlights the National Water Program's climate adaptation tools and includes associated case studies for each of the climate impacts. The module has four parts: Climate Change 101, Vulnerability of Water Resources to Climate Change, Explore Your Climate Region, and optional Supplemental Information.

Course Name	Target Audience	Description
Adaptation of Superfund Cleanup to Climate Change	EPA site cleanup staff, managers and contractors	This course includes an archived online webinar, slides, audio files of climate change adaptation (CCA) and how it is integrated into site operations, and case studies of weather-related impacts at superfund sites.
CREAT (Climate Resilient Evaluation and Awareness Tool)- Climate Ready Water Utilities (CRWU)	EPA water staff and public water utility managers	This course includes archived webinars of asset management, communicating climate risks, decision-making in practice, case studies, threshold analysis, sustainability and adaptation, and scenario planning.
Climate Ready Estuaries (CRE) Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans	Environmental resource managers, especially with a coastal or watershed focus	The workbook assists organizations that manage environmental resources to prepare a broad, risk-based adaptation plan.
U.S. Fish and Wildlife Service		
Climate Academy	Federal and non-Federal natural resource managers	This 6-month webinar-based series covers the fundamentals of climate science, reviews the tools and resources for climate adaptation, and increases climate literacy and communication. Participants present a final report addressing climate change in their management of natural resources.
Climate Change Vulnerability Assessment	Federal and non-Federal natural resource managers	This course guides conservation and resource management practitioners in the design of climate adaptation plans. It helps identify which species or habitats are likely to be most affected by projected changes, and helps understand why these resources are likely to be vulnerable.
Scenario Planning Towards Climate Change Adaptation	Federal and non-Federal natural resource managers	This overview course introduces the core elements of scenario planning and exposes participants to different techniques using quantitative and qualitative components. Also, it improves assessment skills for scenario planning and identifies resources and expertise needed.
Decision Analysis in a Changing Climate	Federal and non-Federal natural resource managers	This course provides a strong foundation in decision making in the context of natural resources management while decreasing climate-related uncertainty. Approaches to critical thinking, logic, reasoning, and structuring decisions are used.
Climate Projections for Ecosystem Planning	Federal and non-Federal natural resource managers	The course provides certainty for the following: when to use downscaled climate projections, how to obtain and create projections, and applying downscaled climate projections.
National Park Service		
Climate and Culture Monthly Webinar Series	Federal and non-federal cultural resource stewardship professionals	This monthly webinar series engages a wide cross-section of professionals in the unique considerations inherent in managing cultural resources in light of climate change.
Climate Change Response Program Monthly Webinar Series	Federal and non-federal resource stewardship professionals	Participants on this monthly webinar series explore a wide spectrum of climate change topics relevant to climate science and adaptation, mitigation, and communication efforts.

Course Name	Target Audience	Description
Interpreting Climate Change Training	Federal and non-federal interpretation and communications professionals	This course familiarizes front-line professionals with climate science, identifies and resolves barriers to climate communications, and introduces effective techniques for approaching the topic in programs with park stakeholders.
New Superintendents Academy	Newly-appointed Superintendents and Division Chiefs	This program provides self-directed and group-based learning over a 12-18 month period. At least 4 modules every year are dedicated to climate change issues.
Climate Change Modules, Career Academy for Natural Resources	Multi-disciplinary Natural Resource Professionals	The modules provide an introduction to climate change science and policy for natural resource professionals. The modules also provide background on the federal response to climate change and guidance on the application of climate science in park planning and communication.
Climate Change Response YouTube Channel	All Stakeholders	The NPS Climate Change Response Program has created a library of online videos that span a wide variety of climate change topics. These videos are frequently utilized as part of in-person and online training activities or in the development of supporting communication materials.
No Barriers Youth Initiative	Elementary & Secondary Students and Educators	In this program, parks are paired with local elementary and secondary schools to provide in-depth explorations of—and meaningful experiences with—observed climate change effects. Creating these experiences for students provides developmental opportunities for educators and participating resource professionals.
Incorporating climate-smart principles in park planning and decision making	Federal resource stewardship professionals	This module inspires managers to integrate principles of climate-smart conservation, as well as scenario planning, into decision frameworks of resource professionals.