CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

MEETING OF NOVEMBER 12-13, 2014
BARSTOW

ITEM: **12**

SUBJECT: **CLIMATE CHANGE WORKSHOP - THE ROLE OF THE LAHONTAN WATER BOARD IN ADAPTING TO CLIMATE CHANGE**

INTRODUCTION: Climate change is having, and will continue to have, widespread impacts on California's diverse population, natural resources and economy. Because the Lahontan Water Board region spans nearly 600 miles along the eastern side of the Sierra Nevada mountains from the Oregon border south through Lake Tahoe, Mono Lake, Death Valley, to its southern boundary including Lake Arrowhead and Silverwood Lake, the Lahontan region will experience differing effects from climate change. The northern region is expected to receive more precipitation as rain and less snow, while the southern part will be hotter and drier. Enclosure 1 is a map of the entire Lahontan region showing the northern and southern parts.

Although the State leads the world in actions to reduce greenhouse gas pollution, climate change impacts resulting in increased wildfires, severe storms and floods, and habitat changes and water supply challenges will still occur. These impacts will also have serious public health consequences – extreme weather events, heat-related illness, infectious diseases and food insecurity – that will disproportionately affect the State's most disadvantaged citizens. Addressing the growing threats brought about or exacerbated by climate change will require a fundamental shift in water resource management and water quality protection as the amount, timing and form of precipitation changes. In addition, the frequency and severity of floods and drought will increase and runoff patterns will change. This workshop will provide information for the Board to consider in shaping and prioritizing its future actions and role in adapting to climate change.

Climate impacts to the California coast from erosion, rising sea level and tropical storms deservedly receive much public attention, but there are equally important climate impacts to consider on inland communities and resources such as those in the Lahontan Region. Grasslands and forests face more frequent and severe drought, wildfires and insect outbreaks. Both of these types of ecosystems

can help absorb carbon dioxide to counteract the emissions that cause climate change and to continue to do so, but need to be managed to withstand climate threats such as drought, increased risk of severe wildfires and pest infestations. Many Sierra Nevada forests are not healthy and are susceptible to disease and intense wildfire (see Enclosure 2). Inland infrastructure such as water and wastewater treatment plants, powerlines and pipelines, bridges and roads, may be at risk from damage by more frequent or intense flooding or catastrophic wildfire. Changes in snowpack and natural water storage will impact ranchers and farmers, as well as the Region's winter recreation opportunities and related businesses. Changing pressures from invasive plants, diseases, and insect pests will further impact surface waters, fisheries, ranches and farms. Changes in temperature and precipitation will change habitat, and related plant and animal communities. Public health impacts such as from prolonged heat/drought, severe storms, flooding, landslides, heat emergencies, less water and more wildfires impact everyone in the State – both on the coast and inland.

DISCUSSION: Past resource management efforts emphasized protecting and managing resources to maintain status quo or restore back to a historical state. Now we need to implement strategies to prepare for and adjust to current and future climate change. These adaptation strategies will draw from existing practices but may differ in where, when or how they are applied. For example, disadvantaged communities in our region, being affected by a lack of financial resources and expertise, may need special strategies.

With climate change happening now, the Lahontan Water Board wants to tackle the issues and is reaching out to all stakeholders for their input. A series of two workshops has been scheduled to cover the region's diverse geographies and communities. Enclosure 3 is the public notice for the climate change workshop series, showing the times, locations, and speakers. Following the workshop series, staff will compile the input and expects to submit a report to the Water Board summarizing the suggested changes by spring 2015.

This initial workshop will begin with scientists presenting information about what environmental changes they expect in the southern part of the Lahontan region. Next staff will explain what tools Lahontan currently has for adaptation. Enclosure 5, the fourth of four documents as part of the California Adaptation Planning Guide, developed by the California Emergency Management Agency and California Natural Resources Agency in 2012, introduces some adaptation strategies that communities can use to meet the adaptation needs. The Adaptation Planning Guide categorizes the

adaptation strategies into seven impact sectors: 1) Public Health, Socioeconomic, and Equity Impacts, 2) Ocean and Coastal Resources, 3) Water Management, 4) Forest and Rangeland, 5) Biodiversity and Habitat, 6) Agriculture, and 7) Infrastructure. To prepare for participation in the workshop, attendees should familiarize themselves with the Adaptation Planning Guide and understand that all the strategies listed may not be applicable in the Lahontan region and that there may be strategies that are not listed.

WORKSHOP AGENDA

1. Expected environmental climate change effects in the southern Lahontan region – Daniel Cayan, PhD, Scripps Institution of Oceanography and the U.S. Geological Survey. (Enclosure 6)

2. Expected impacts to groundwater resources from climate change – John Izbicki, PhD, US Geological Survey. (Enclosure 7)

3. Brief update on the State's actions on research, planning, and policy around climate change – Max Gomberg, State Water Resources Control Board. (Enclosure 8)

4. Overview of Lahontan Water Board's regional policies and other tools which can be used for climate change adaptation – Lauri Kemper, PE, Assistant Executive Officer of Lahontan Water Board. (Enclosure 9)

5. Stakeholders, Water Board members, and staff breakout into groups to brainstorm ideas for climate change adaptation. Water Board members and staff will facilitate each group keeping in mind environmental justice principles and who is affected by the proposed action. The Adaptation Planning Guide is meant to be used as a reference for ideas on potential adaptation strategies. The goal of each breakout group is to identify long-term concerns, needs, and issues that should be addressed, and prioritize the needs and actions. To make the action items and priority list, each group should focus on answering two primary questions:

    a. **In the year 2040, what policies and tools should the Lahontan Water Board have for dealing with the effects of climate change?**

b. What are the key steps the Lahontan Water Board should take to get from the current policies and practices to the desired state in 2040?

Issues to Consider in Breakout Groups

Groundwater Reliability: issues involve accumulation of salts, reduced groundwater quantity and quality, overdraft, and need for recharge areas.

Watershed Protection: issues involve forest management and restoration of healthy forests for resiliency and carbon sequestration during climate change, proactive costs of management as compared to reactive costs of wildfire fighting and burn area rehabilitation, ecosystem changes and sedimentation from wildfire, invasive species, lake and reservoir management, and algal blooms and toxins.

Land Use: issues involve alternative energy, new construction, low-impact development, riparian/floodplain construction/protection, and agriculture

Infrastructure Protection: issues involve roads, bridges, sewer lines, pump stations, water lines, power lines, and contingency planning.

Monitoring: issues involve status and trend monitoring, effectiveness monitoring, salt and nitrate loading in groundwater, lowering groundwater tables, changes in stream flows and flood frequency, stream temperatures, biological community response, reference station selection, and other pertinent requirements in Water Board orders.

BACKGROUND: Current policies and practices for climate change adaptation and some web links for additional information:

Lahontan Water Board current practices

- Discretion to authorize or limit degradation of water quality, under State Board Resolution No. 68-16 (see Enclosure 4). One example is the requirement to increased nitrogen removal and improved treatment as part of permitting wastewater treatment plants. Another example is the requirement to use best practices to reduce pollutant loads to groundwater from dairies, agriculture, and golf courses.
- Encourage recycled water use. The State Water Board Recycled Water policy can be found here

(http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2013/rs2013_0003_a.pdf) and it requires development and implementation of salt and nutrient management plans.
- Promote fuel reduction/forest health restoration projects to reduce risk and effect of catastrophic wildfire.
- Prohibit new development in riparian/flood plain areas of Lake Tahoe and Truckee watersheds.
- Require flood plain/wetland protection and mitigation measures as part of a dredge and fill permitting for surface waters.
- Encourage Low-Impact development practices.
- Require post-construction permanent stormwater control and treatment as part of construction permitting.
- Conduct ambient water quality monitoring to determine status and trends.

California State Agencies and Others

- The California EPA has a web page with Fact Sheets designed to help overcome common barriers to implementing Low-Impact Development: http://water.epa.gov/polwaste/green/bbfs.cfm
- The California Low-Impact Development Portal (https://www.casqa.org/resources/california-lid-portal) has many great resources, including a draft FAQ document (https://www.casqa.org/sites/default/files/downloads/ca_lid_faq_06-28-2011.pdf)
- Sierra Nevada Conservancy issued a report, "The State of Sierra Nevada's Forests," on September 22, 2014, which concluded that the funding and pace for ecological restoration must be doubled or tripled to restore health and resiliency for climate change. The Executive Summary is provided as Enclosure 2 for this item. For the entire report, go to http://www.sierranevada.ca.gov/our-work/state-of-the-sierra
- Sierra Nevada Conservancy co-published in April 2014, a report titled, "Mokelumne Watershed Avoided Cost Analyses: Why Sierra Fuel Treatments Make Economic Sense," which concluded that the long-term cost savings of proactive forest management is cost effective to reduce the risk of destructive, high severity wildfires. For the full report, go to http://www.sierranevada.ca.gov/our-work/mokelumne-watershed-analysis/mokelumne-watershed-analysis
- The Sierra Nevada Alliance published its 3rd edition Sierra Climate Change Toolkit in 2011 (http://sierranevadaalliance.com/wp-content/uploads/2014/02/3reditionclimatechangetoolkit.pdf).

The toolkit is designed specifically for Sierra resource managers, local governments, planners, non-profits, activists, and concerned citizens looking to adapt to climate change by reducing greenhouse gas emissions and protecting the unique Sierra Nevada resource. The Toolkit covers a wide range of topics, including: 1) the science of climate change and impacts at the global, national, state, and regional levels; 2) the national, state, and regional context in which climate change emission reduction and adaptation efforts are occurring; 3) frameworks, specific strategies, and case studies for reducing greenhouse gas emissions and adapting to climate change impacts through existing planning processes in the Sierra; 4) tools to help communicate climate change and build support for local action; and 5) additional resources to help specific planning processes or projects address climate change.

- The California Natural Resources Agency published a California Change Adaptation Planning Guide in September 2012. Enclosure 2 in this item contains the fourth of four documents. The full guide and all associated documents can be viewed and downloaded here http://resources.ca.gov/climate/safeguarding/adaptation_policy_guide/
- Cal-Adapt is a web-based, geospatial information planning tool for users to explore potential risks from climate change and to begin the adaptation planning. Cal-Adapt has links to the current climate change research. To access the tool, go to http://cal-adapt.org/ .

Additional information on climate adaptation may be accessed at the California Climate Change Portal. http://www.climatechange.ca.gov and at the US Environmental Protection Agency's climate site. http://epa.gov/climatechange .

The Lahontan Water Board is posting all workshop presentations, research papers, planning documents, and other material relevant to climate change adaptation on its website at http://www.waterboards.ca.gov/lahontan/ .

RECOMMEN-DATION:

No decision requested, though Water Board staff request Board member involvement and input during the breakout group discussion of the workshop. Following the workshop series, Water Board staff will compile the prioritized actions from each breakout group and will report to the State Water Board summarizing the outcomes and planned future actions.

Enclosures:

ENCLOSURE	Description	Bates Pages
1	Map of Lahontan Region	**12-11**
2	State of Sierra Nevada's Forests, Executive Summary, from the Sierra Nevada Conservancy, September 22, 2014	**12-15**
3	Public Notice for Climate Change Workshops	**12-19**
4	State Water Board Resolution No. 68-16	**12-23**
5	California Adaptation Planning Guide: Identifying Adaptation Strategies	**12-27**
6	Powerpoint Presentation by D. Cayan	**12-97**
7	Powerpoint Presentation by J. Izbicki	**12-107**
8	Powerpoint Presentation by M. Gomberg	**12-117**
9	Powerpoint Presentation by L. Kemper	**(to be provided under separate cover)**

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ENCLOSURE 1

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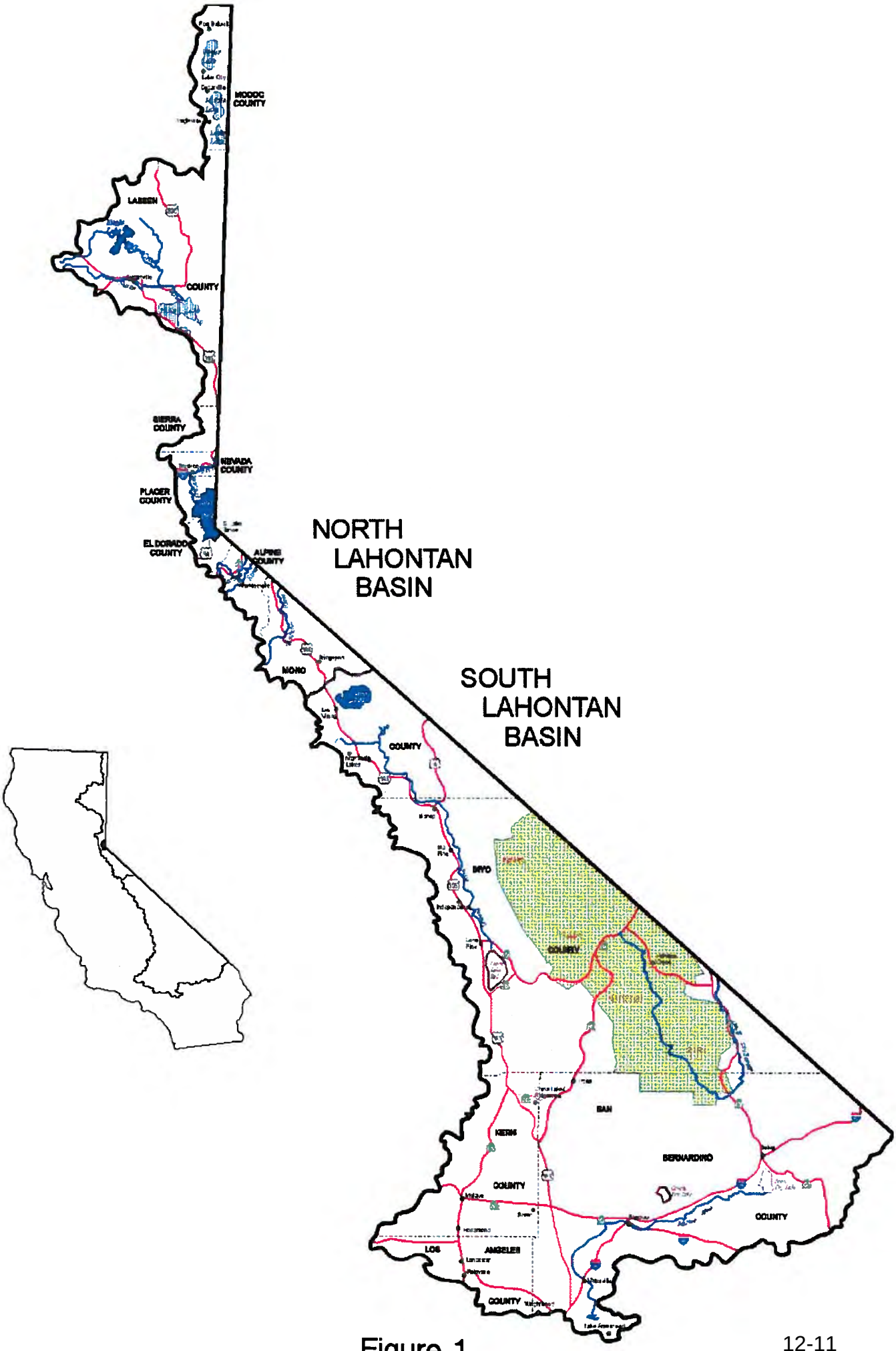
MODOC COUNTY
LASSEN
COUNTY
SIERRA COUNTY
NEVADA COUNTY
PLACER COUNTY
EL DORADO COUNTY
ALPINE COUNTY
NORTH LAHONTAN BASIN
MONO
COUNTY
SOUTH LAHONTAN BASIN
INYO
COUNTY
KERN
COUNTY
SAN BERNARDINO
COUNTY
LOS ANGELES
COUNTY

Figure 1

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ENCLOSURE 2

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The State of the Sierra Nevada's Forests

Report released by the Sierra Nevada Conservancy on September 22, 2014

Many Sierra Nevada forests are unhealthy and susceptible to disease and intense fire.

EXECUTIVE SUMMARY

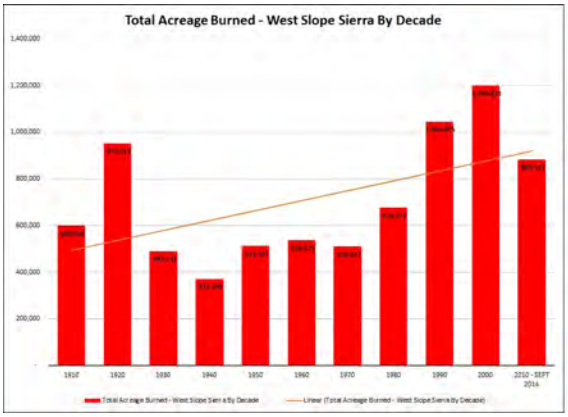
There is a growing understanding that many Sierra Nevada forests are not healthy and that overgrown forests are susceptible to disease and intense wildfire. There is likewise broad consensus that science-based ecological restoration of our Sierra Nevada forests must be dramatically increased in order stem the tide of large, uncharacteristic wildfires. These wildfires threaten the very lifeblood of California - the forested watersheds of the Sierra Nevada.

The State of Sierra Nevada's Forests Report identifies the wide range of benefits provided by our Sierra Nevada forests and watersheds that are at risk:

- The Region is the origin of 60% of California's developed water supply.
- These watersheds are the primary source of fresh water flowing into the Sacramento-San Joaquin Delta, California's water "hub."
- The forests of the Sierra Nevada store massive amounts of carbon, assisting in the state's efforts to combat climate change.
- The forests and watersheds provide crucial habitat to hundreds of species.
- The area provides world class recreational opportunities enjoyed by millions from around the world.
- The Region is a major producer of wood products and hydro-electric power.

Key findings of this report include the following:

- ✓ The United States Forest Service Region 5 estimates that between six and nine million acres of lands for which they have management responsibility are in need of restoration. In order to return these lands to ecological health, a two to three times increase in the pace and scale of ecological restoration must occur.
- ✓ The amount of area consumed by fire in the Sierra Nevada continues to increase. More land has burned in the first four-and-a-half-years of this decade than seven entire decades in the past.
- ✓ Between 1984 and 2010, there was a significant increase in the number of acres within a forest fire burning at high-intensity, from an average of 20% in mid-1980's to over 30% by 2010.
- ✓ High-intensity burn areas can experience runoff and erosion rates five to ten times greater than low- or moderate-intensity burn areas. The sediment that is carried in the runoff not only degrades water quality and damages infrastructure, it fills reservoirs, reducing storage capacity.



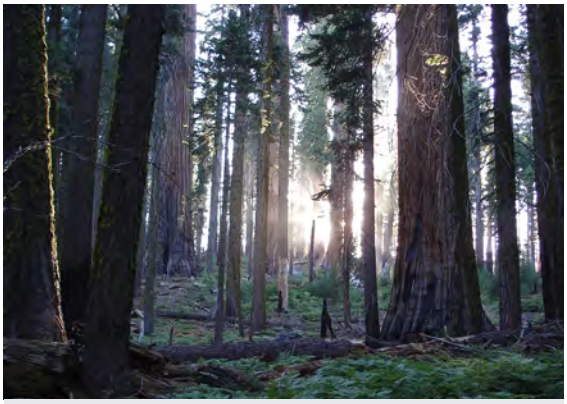
Wildfires in California have become larger and more extreme over the last two decades and many predict that this trend will continue to increase unless the pace and scale of forest restoration dramatically increases.

✓ The 2013 Rim Fire, the largest fire in the recorded history of the Sierra Nevada, burned 257,000 acres, almost 40% of which was at high intensity. Estimates are that that fire produced the same amount of greenhouse gas emissions that 2.3 million vehicles produce in a year.

This report identifies the following impediments to increasing pace and scale, and potential solutions to these challenges:

- Funding currently available is inadequate in relation to the need for forest restoration, especially for critical projects that don't "pay for themselves" with removed material.
- Improving the efficiency of lengthy and complex planning processes and encouraging efforts to address larger landscape restoration projects in a collaborative manner must occur.
- In order to adequately handle the pace and scale of needed restoration, wood and biomass processing infrastructure in the Sierra Nevada must be enhanced.
- Acknowledging the important ecological role of fire and increasing the use of prescribed and managed fire as a forest restoration tool is necessary.

According to the USFS, "Only an environmental restoration program of unprecedented scale can alter the direction of current trends."



Giant Sequoias are the largest living things on Earth and only grow in the Sierra Nevada.

Failure to understand the urgency of the situation in the Sierra Nevada will have devastating impacts on California's environment and economy. The potential for more megafires like the Rim Fire is high and the trend of larger, more intense fires is clear, with the current drought and ongoing temperature increases making the situation all the more urgent.

This report provides a framework through which this issue can be addressed. It will require a renewed commitment at the state, federal and local levels. The alternative of the status quo is simply not acceptable.

Urgent action is needed in the Sierra Nevada to avoid devastating impacts on California's environment and economy.

The Sierra Nevada Conservancy is a state agency that carries out a mission of protecting the environment and economy in a complementary fashion across 25 million acres, one-quarter of the state. To learn more, please visit the Sierra Nevada Conservancy Web site.

11521 Blocker Dr., Suite 205 Auburn, CA 95603
(530)823-4670 (877)251-1212
s i e r r a n e v a d a . c a . g o v

SIERRA NEVADA CONSERVANCY

ENCLOSURE 3

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CALIFORNIA Water Boards

Edmund G. Brown Jr. Governor

Matthew Rodriquez Secretary for Environmental Protection

Lahontan Regional Water Quality Control Board

Climate Change Adaptation Planning
PUBLIC INVITATION

Join the Water Board to identify how climate change may affect you and provide your input to prioritize its actions.

Learn from researchers what is happening

↓

Identify existing and new tools for adaptation

↓

Help shape and create the Water Board policies

WORKSHOP SERIES

November 13, 2014, 8:30am – 11:30am
Hampton Inn & Suites
2710 Lenwood Road, Barstow, CA

Daniel Cayan, PhD – southern Lahontan region climate effects
John Izbicki, PhD – groundwater
Max Gomberg – state policies
Lauri Kemper – regional policies

January 15, 2015, 8:30am – 12:00 noon
Lake Tahoe Community College
1 College Way., South Lake Tahoe, CA

Michael Dettinger, PhD – northern Lahontan region climate effects
Geoff Schladow, PhD – Lake Tahoe
Arlan Nickel and Maureen McCarthy, PhD – adaptation strategies
Douglas Smith – state & regional policies

Stakeholders, Water Board members, and Water Board staff, will begin brainstorming ideas once the proper knowledge is gained from researchers for any needs, as well as short or long term actions the Water Boards should address in order to assist in the adaptation to climate change. The Water Board will develop a planned action report regarding the input received and may hold future workshops to explore potential changes to existing policies.

For more information about the workshops, please contact Douglas F. Smith at DFSmith@waterboards.ca.gov 530-542-5453

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ENCLOSURE 4

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STATE WATER RESOURCES CONTROL BOARD

RESOLUTION NO. 68-16

STATEMENT OF POLICY WITH RESPECT TO
MAINTAINING HIGH QUALITY OF WATERS IN CALIFORNIA

WHEREAS the California Legislature has declared that it is the policy of the State that the granting of permits and licenses for unappropriated water and the disposal of wastes into the waters of the State shall be so regulated as to achieve highest water quality consistent with maximum benefit to the people of the State and shall be controlled so as to promote the peace, health, safety and welfare of the people of the State; and

WHEREAS water quality control policies have been and are being adopted for waters of the State; and

WHEREAS the quality of some waters of the State is higher than that established by the adopted policies and it is the intent and purpose of this Board that such higher quality shall be maintained to the maximum extent possible consistent with the declaration of the Legislature;

NOW, THEREFORE, BE IT RESOLVED:

1. Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.

2. Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.

3. In implementing this policy, the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act.

BE IT FURTHER RESOLVED that a copy of this resolution be forwarded to the Secretary of the Interior as part of California's water quality control policy submission.

CERTIFICATION

The undersigned, Executive Officer of the State Water Resources Control Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on October 24, 1968.

Dated: October 28, 1968

Kerry W. Mulligan
Executive Officer
State Water Resources
Control Board

ENCLOSURE 5

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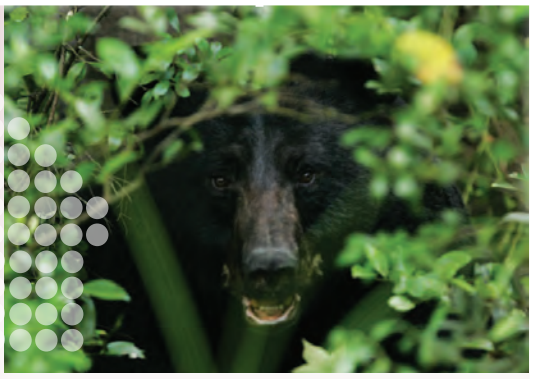
CALIFORNIA ADAPTATION PLANNING GUIDE



IDENTIFYING ADAPTATION STRATEGIES

Cal EMA California Emergency Management Agency

California natural resources agency

FEMA

California Adaptation Planning Guide

PREPARED BY:
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Sacramento, CA 95814-5512

WITH TECHNICAL SUPPORT FROM:
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San Luis Obispo, CA 93407

July 2012

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"It's time for courage, it's time for creativity and it's time for boldness to tackle climate change" - Governor Brown, September 2011

September 4, 2012

Dear reader,

We are pleased to present the "Climate Adaptation Planning Guide" prepared by California Emergency Management Agency and the California Natural Resources Agency. The Guide is designed to provide guidance and support for local governments and regional collaboratives to address the unavoidable consequences of climate change.

The State of California is leading the way on climate change adaptation in conjunction with local and regional efforts. Local and regional responses to climate change are identified in state-level planning documents including the California Emergency Management Agency's State Hazard Mitigation Plan, and the California Climate Adaptation Strategy. In addition, we anticipate on-going collaboration and engagement at the regional and local-scale. To that end, the Governor's Office of Planning and Research hosted a one-day conference earlier this year titled "Confronting Climate Change: A Focus on Local Government Impacts, Actions and Resources," and is promoting additional outreach and partnerships.

As climate change impacts your community, it is important for local governments to be prepared to meet this new reality. We hope you find this Planning Guide of value.

Sincerely,

Ken Alex
Senior Policy Advisor to Governor Edmund Brown and
Director of the Office of Planning and Research

John Laird
Secretary for Natural Resources Agency

Mark Ghilarducci
Secretary
California Emergency Management Agency

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Acknowledgements

The *Adaptation Planning Guide* (APG) has benefited from the ideas, assessment, feedback, and support from members of the APG Advisory Committee, local governments, regional entities, members of the public, state and local non-governmental organizations, and participants in the APG pilot program.

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Steve Sanders	Institute for Local Government

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EXECUTIVE SUMMARY

The *California Adaptation Planning Guide* (APG), a set of four complementary documents, provides guidance to support communities in addressing the unavoidable consequences of climate change. The APG, developed by the California Emergency Management Agency and California Natural Resources Agency, introduces the basis for climate change adaptation planning and details a step-by-step process for local and regional climate vulnerability assessment and adaptation strategy development.

The *APG: Identifying Adaptation Strategies* describes selected adaptation strategies, grouped according to the "impact sectors" presented in more detail elsewhere in the APG. This document supports communities following the climate adaptation strategy development process presented in *APG: Planning for Adaptive Communities*. The climate adaptation strategies included are examples of adaptation policies that can be implemented at a local or regional level. They provide ways to address adaptation needs through planning, development, environmental conservation, and emergency management.

California Adaptation Planning Guide Documents

- *APG: Planning for Adaptive Communities* – This document presents the basis for climate change adaptation planning and introduces a step-by-step process for local and regional climate vulnerability assessment and adaptation strategy development. All communities should start with this document.
- *APG: Defining Local & Regional Impacts* – This supplemental document provides a more in-depth understanding of how climate change can affect a community. Seven "impact sectors" are described to support communities conducting a climate vulnerability assessment.
- *APG: Understanding Regional Characteristics* – The impact of climate change varies across the state. This supplemental document identifies climate impact regions, including their environmental and socioeconomic characteristics.
- *APG: Identifying Adaptation Strategies* – This supplemental document explores potential adaptation strategies that communities can use to meet adaptation needs. Adaptation strategies are categorized into the same impact sectors used in *APG: Defining Local & Regional Impacts*.

YOU ARE HERE

The presented strategies can be implemented on a local or regional level and provide ways to address many potential climate change impacts. Communities should expect to go beyond the strategies listed in this document, however, to address all of their adaptation needs. This may include bolstering programs that are already locally effective or developing innovative strategies based on specific local or regional characteristics.

These examples of strategies must be tailored to fit local needs and conditions. To aid local jurisdictions in adjusting the strategies, the following information is presented for each strategy:

- **Description** – A basic description of the strategy intent and structure
- **Factors to Consider** – Things to keep in mind when tailoring a strategy for local or regional implementation
- **Sources of Information** – Resources that provide additional detail on each strategy
- **Examples of Applications** – Communities implementing similar strategies
- **Funding Sources** – Possible sources of funding for the strategy (where applicable)
- **Sector Overlap** – Other climate impact sectors addressed by the strategy (where applicable)
- **Co-benefits** – Other community benefits resulting from the strategy (where applicable)

APG: Identifying Adaptation Strategies provides a broad sampling of many different policies that can be implemented to tackle climate adaptation challenges facing California communities in the coming years. Involvement and participation of a broad range of local stakeholders is important in addressing these challenges.

Introduction

The APG: Identifying Adaptation Strategies identifies potential strategies that communities can use to address their adaptation needs.

The *California Adaptation Planning Guide* (APG) is a resource developed by the State of California Emergency Management Agency and California Natural Resources Agency. The APG provides guidance to support communities in addressing the unavoidable consequences of climate change. The APG is made up of four documents (see Figure 1). APG: Identifying Adaptation Strategies is one of the three documents intended to support the adaptation strategy development process presented in *APG: Planning for Adaptive Communities*.

A step-by-step process for adaptation strategy development is presented in *APG: Planning for Adaptive Communities*. Three additional documents provide additional resources and detail for communities going through the planning process.

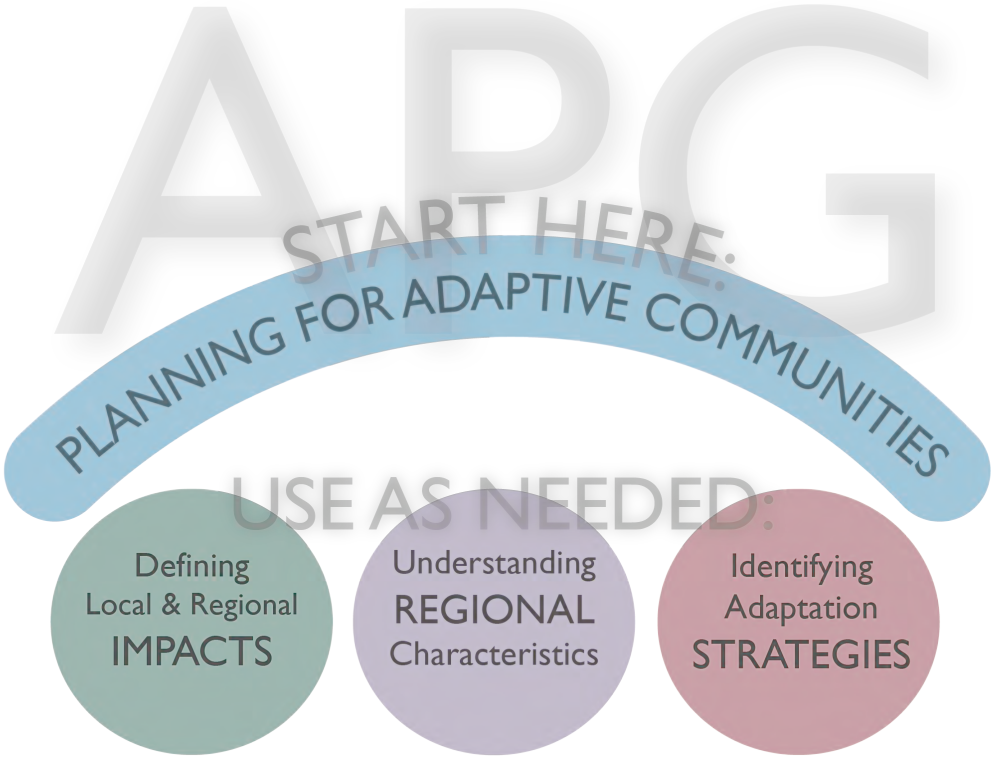


Figure 1. The four *California Adaptation Planning Guide* (APG) documents. All APG users should start with *APG: Planning for Adaptive Communities*. The other three documents support the process presented in the first document by providing additional information and greater detail.

The process presented in *APG: Planning for Adaptive Communities* is organized into nine steps (see figure 2). This document, focused on strategies, supports Step 7 (Identify Strategies) in the adaptation strategy development process, Identify Strategies. Information provided in the strategy descriptions will also aid communities in completing Step 8 (Evaluate & Prioritize) and Step 9 (Phase and Implement).

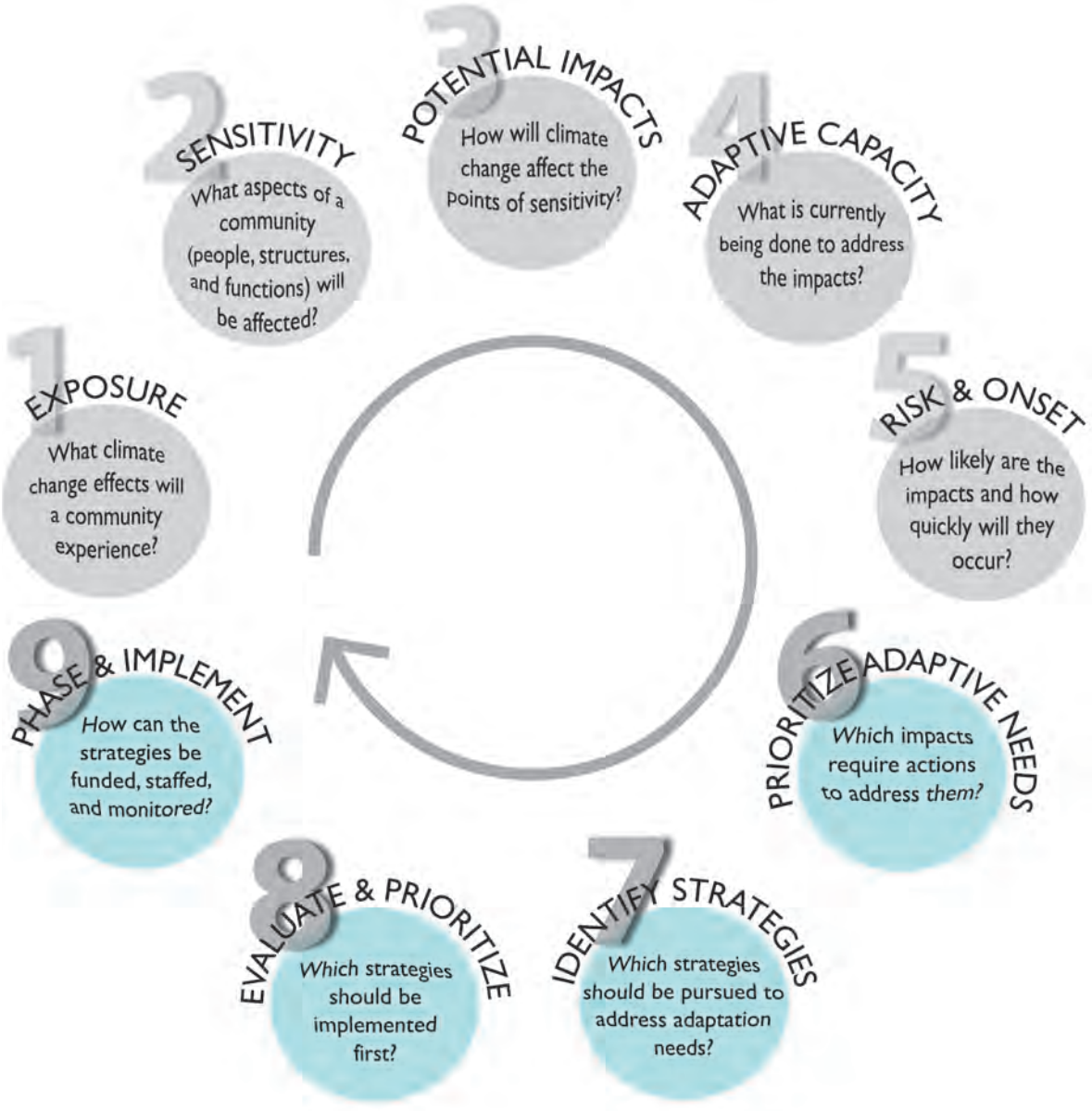


Figure 2. The nine steps in adaptation strategy development.
The gray steps are part of vulnerability assessment (steps 1-5) and the blue steps are adaptation strategy development (Steps 6-9). The *APG: Identifying Adaptation Strategies* focuses on Steps 6-9.

What is the *APG: Identifying Adaptation Strategies* document and how should it be used?

APG: Identifying Adaptation Strategies describes selected adaptation strategies organized by impact sector. The impact sectors are the same as those presented in *APG: Defining Local and Regional Impacts*.

The *APG: Identifying Adaptation Strategies* is not intended to provide a comprehensive listing of strategies. Instead, it provides example actions that can be implemented on a local or regional level and provides ways to address many of the potential impacts described elsewhere in the APG. Communities should expect to go beyond the strategies listed in this document to address all of their high-priority adaptation needs. This may include bolstering programs that are already locally effective or developing innovative strategies based on particular characteristics.

Strategies will require adjustment or greater specificity for application in a community. To aid in the adjustment process, the discussion of each strategy includes a brief description, factors to consider, examples of applications, sources for the strategy itself and/or places to learn more, and possible funding sources, when available.

Climate change impacts often interact. As a result, many strategies address multiple climate impact areas. The discussion of each strategy notes the overlap with other climate impact areas. It is also important to recognize that a strategy will be easier to implement if it addresses other community needs in addition to climate change adaptation. Co-benefits have been noted when applicable.

The following table shows how strategies may overlap multiple impact sectors (see Table 1). For communities concerned about a particular impact sector, the table aids in identifying all potential strategies. Strategies are organized into the following sectors:

- **CA**: Comprehensive Adaptation Strategies
- **PHSE**: Public Health, Socioeconomic, and Equity
- **OCR**: Oceans and Coastal Resources
- **WM**: Water Management
- **FR**: Forest and Rangeland
- **BH**: Biodiversity and Habitat
- **AG**: Agriculture
- **IN**: Infrastructure

Table1. Climate Change Adaptation Strategies with Sector Overlap identified.

STRATEGY NUMBER	STRATEGY	PUBLIC HEALTH, SOCIO-ECONOMIC, & EQUITY	OCEAN & COASTAL RESOURCES	WATER MANAGEMENT	FOREST & RANGELAND	BIODIVERSITY & HABITAT	AGRICULTURE	INFRASTRUCTURE
CA 1	Incorporate climate change adaptation into relevant local and regional plans and projects.	X	X	X	X	X	X	X
CA 2	Establish a climate change adaptation public outreach and education program.	X	X	X	X	X	X	X
CA 3	Build collaborative relationships between regional entities and neighboring communities to promote complementary adaptation strategy development and regional approaches.	X	X	X	X	X	X	X
CA 4	Establish an ongoing monitoring program to track local and regional climate impacts and adaptation strategy effectiveness.	X	X	X	X	X	X	X
PHSE 1	Review and update heat response plan in light of climate change (heat events) projections	X						
PHSE 2	Partner with existing public health community outreach and engagement efforts.	X						

[CA: Comprehensive Adaptation Strategies; PHSE: Public Health, Socioeconomic, and Equity Impacts]

Table1 (Cont'd). Climate Change Adaptation Strategies with Sector Overlap identified.

STRATEGY NUMBER	STRATEGY	PUBLIC HEALTH, SOCIO-ECONOMIC, & EQUITY	OCEAN & COASTAL RESOURCES	WATER MANAGEMENT	FOREST & RANGELAND	BIODIVERSITY & HABITAT	AGRICULTURE	INFRASTRUCTURE
PHSE 3	Increase participation of low-income, immigrant, non-English-speaking, racially and ethnically diverse, and special needs residents in initial CAP planning and implementation.	X						
PHSE 4	Develop an urban heat island reduction program that includes an urban forest program or plan.	X			X	X		
PHSE 5	Review/conduct a communitywide assessment and reevaluate/develop a program to address health, socio-economic, and equity vulnerabilities.	X						
PHSE 6	Focus planning and intervention programs on neighborhoods that currently experience social or environmental injustice or bear a disproportionate burden of potential public health impacts.	X						
PHSE 7	Refine emergency preparedness and response to address health impacts.	X	X	X	X			X
PHSE 8	Link climate change adaptation strategies with social equity and public health strategies.	X						
PHSE 9	Use performance metrics and data to evaluate and monitor the impacts of climate change strategies on public health and social equity.	X						
OCR 1	Develop an adaptive management plan to address the long-term impacts of sea level rise.		X					X
OCR 2	Facilitate managed retreat from, or upgrade of, the most at-risk areas.		X			X		X

[CA: Comprehensive Adaptation Strategies; PHSE: Public Health, Socioeconomic, and Equity Impacts; OCR: Ocean and Coastal Resources]

Table1 (Cont'd). Climate Change Adaptation Strategies with Sector Overlap identified.

STRATEGY NUMBER	STRATEGY	PUBLIC HEALTH, SOCIO-ECONOMIC, & EQUITY	OCEAN & COASTAL RESOURCES	WATER MANAGEMENT	FOREST & RANGELAND	BIODIVERSITY & HABITAT	AGRICULTURE	INFRASTRUCTURE
OCR 3	Require accounting of sea level rise in all applications for new development in shoreline areas.		X			X		X
OCR 4	Preserve undeveloped and vulnerable shoreline.		X	X		X		
OCR 5	Use transfer of development rights for the rebuilding of structures damaged or destroyed due to flooding in high-risk areas.		X	X		X		
WM 1	Develop coordinated plans for mitigating future flood, landslide, and related impacts through concurrent adoption of updated general plan safety elements and local hazard mitigation plans.			X				X
WM 2	Implement Assembly Bill 162 (2007) requiring flood hazard information in local general plans.			X				X
WM 3	Implement National Flood Insurance Program (NFIP) activities to minimize and avoid development in flood hazard areas.			X				
WM 4	Restore existing flood control and riparian corridors.			X		X		
WM 5	Implement general plan safety elements through zoning and subdivisions practices that restrict development in floodplains and landslide hazard areas.			X				
WM 6	Implement Senate Bill 5 (2007) in communities within the Sacramento-San Joaquin Drainage District.			X				X

[OCR: Ocean and Coastal Resources; WM: Water Management]

Table1 (Cont'd). Climate Change Adaptation Strategies with Sector Overlap identified.

STRATEGY NUMBER	STRATEGY	PUBLIC HEALTH, SOCIO-ECONOMIC, & EQUITY	OCEAN & COASTAL RESOURCES	WATER MANAGEMENT	FOREST & RANGELAND	BIODIVERSITY & HABITAT	AGRICULTURE	INFRASTRUCTURE
WM 7	Develop a water recycling program.			X				
WM 8	Implement tiered pricing to reduce water consumption and demand.			X				
WM 9	Increase "above-the-dam" regional natural water storage systems.			X	X	X		
FR 1	Establish a management program to track forest and rangeland health.			X	X	X		
FR 2	Develop, adopt, and implement integrated plans for mitigating wildfire impacts in wildland-urban interface (WUI) areas				X			X
FR 3	Design homes, neighborhoods, and streets to minimize vulnerability to fire hazards in WUI areas	X			X			X
FR 4	Encourage compliance with statutory requirements for vegetation management around structures, and promote fuel breaks to slow fire spread in WUI areas.				X			X
FR 5	Reintroduce fire (controlled or prescribed burns) to fire-prone ecosystems.				X	X		
FR 6	Manage fuel load through thinning and brush removal.				X			
BH 1	Identify and protect locations where native species may shift or lose habitat due to climate change impacts (sea level rise, loss of wetlands, warmer temperatures, drought)		X	X		X		

[WM: Water Management; FR: Forest & Rangeland; BH: Biodiversity & Habitat]

Table1 (Cont'd). Climate Change Adaptation Strategies with Sector Overlap identified.

STRATEGY NUMBER	STRATEGY	PUBLIC HEALTH, SOCIO-ECONOMIC, & EQUITY	OCEAN & COASTAL RESOURCES	WATER MANAGEMENT	FOREST & RANGELAND	BIODIVERSITY & HABITAT	AGRICULTURE	INFRASTRUCTURE
BH 2	Collaborate with agencies managing public lands to identify, develop, or maintain corridors and linkages between undeveloped areas.			X		X		
BH 3	Use purchase of development (PDR) or conservation easements to protect climate-vulnerable habitats.		X	X	X	X		
AG 1	Promote economic diversity.	X					X	
AG 2	Assist and educate farmers in adapting to climate change.						X	
AG 3	Support alternative irrigation techniques (e.g., subsurface drip irrigation) to reduce water use and encourage use of climate-sensitive water supplies.			X			X	X
IN 1	Incorporate consideration of climate change impacts as part of infrastructure planning and operations.							X
IN 2	Climate impact assessment on community infrastructure.							X
IN 3	Facilitate access to local, decentralized renewable energy.	X						X
IN 4	Prioritize low-impact development (LID) stormwater practices in areas where storm sewers may be impaired by high water due to sea level rise or flood waters.	X	X	X		X		X

[BH: Biodiversity & Habitat; AG:Agriculture; IN: Infrastructure]

Adaptation Strategies

Effective adaptation strategies are tailored to local or regional context, including the biophysical setting, economic conditions, and social and political setting. As a result, the strategies in this document should be viewed as a starting point from which to develop adaptation strategies that will be locally or regionally effective.

For each strategy, the following information is provided:

- Description – A basic description of the strategy intent and structure
- Factors to Consider – Things to keep in mind when tailoring a strategy for local or regional implementation
- Sources of Information – Resources that provide additional detail on each strategy
- Examples of Applications – Communities implementing similar strategies
- Funding Sources – Possible sources of funding for the strategy (where applicable)
- Sector Overlap – Other climate impact sectors addressed by the strategy (where applicable)
- Co-benefits – Other community benefits resulting from the strategy (where applicable)

Co-benefits can involve a wide range of community-specific needs. In evaluating the strategies, a community should consider the ways in which they can serve additional purposes. Where applicable, possible community co-benefits are identified.

Comprehensive Adaptation (CA)

Strategies that focus on communitywide goals that address multiple climate change impacts can serve as unifying actions that support other actions that focus specifically on a particular impact type. Four comprehensive strategies are briefly described below.

CA 1: Incorporate climate change adaptation into relevant local and regional plans and projects.

Description: This strategy should be the long-term goal of all adaptation planning efforts. Climate change adaptation should become one of the many standard considerations in all local and regional planning decisions.

This long-term goal seeks to have consideration of projected climate impacts and potential consequence included in all relevant local policy. This can be achieved

by developing and adopting a climate adaptation plan and bringing all other local plans into agreement. Another way is simply to include climate change projections and potential impacts as part of the periodic update process for all plans.

Factors to Consider: Community and staff understanding of and support for climate adaptation strategies are critical for comprehensive integration and long-term implementation of the strategies. As a result, integration of climate adaptation into community plans should be pursued in parallel with outreach and education programs.

Sources of Information and Examples of Application:

- The City of Chula Vista adopted a freestanding climate adaptation plan that was developed through extensive outreach and community engagement. The identified strategies cross multiple impact sectors and city departments. The plan sets a trajectory for adaptation in Chula Vista and a basis to guide the update of other city plans. (City of Chula Vista. 2011. *Climate Adaptation Strategies*. Retrieved from http://www.chulavistaca.gov/clean/conservation/Climate/documents/ClimateAdaptationStrategiesPlans_FINAL_000.pdf)

CA 2: Establish a climate change adaptation public outreach and education program.

Description: Long-term implementation of climate change adaptation requires community support. This support is only possible if the potential consequences of climate change are understood.

A public outreach and community education program should seek to raise public awareness of the potential threats of climate change and the community benefits of taking action. Emphasis should be placed on the tangible outcomes projected for a community, such as lack of water, beach erosion, and public safety risks such as wildfire. In addition, the extent to which adaptation can be achieved while also addressing other community needs (co-benefits) should be clearly explained. Continued engagement also requires frequent opportunities for community input.

Factors to Consider: The outreach and education program can take many forms. The format, delivery methods, and content should be tailored to community characteristics and reflect the climate concerns most important to the community. This effort should be viewed as an ongoing effort that will be critical for continued community engagement in adaptation action through time. An informed and committed community can maintain adaptation actions even with turnover in political leadership.

Sources of Information and Examples of Application:

- The APG document, *APG: Planning for Adaptive Communities* (2012) includes a section focused on community outreach and education.
- The San Francisco Bay Conservation and Development Commission (BCDC) has a web resource called "Local Government Adaptation Assistance Program." Included on this site are climate change educational materials and public outreach assistance documentation. (http://www.bcdc.ca.gov/planning/climate_change/LocalGov.shtml)
- The San Diego Bay adaptation strategy includes a strong education and outreach component. (ICLEI-Local Governments for Sustainability. (2012). *Sea Level Rise Adaptation Strategy for San Diego Bay.* Retrieved from http://www.icleiusa.org/action-center/planning/san-diego-bay-sea-level-rise-adaptation-strategy)

CA 3: Build collaborative relationships between regional entities and neighboring communities to promote complementary adaptation strategy development and regional approaches.

Description: Many climate change impacts have spatial extents that go beyond political boundaries. Impacts such as sea level rise, wildfire, water management, and others are likely best addressed in collaboration with neighboring jurisdictions to ensure not only that the impacts are addressed efficiently, but also that actions taken in each community are complementary.

Factors to Consider: Collaborative relationships can be facilitated by building on the relationships established through existing regional organizations such as regional transportation planning agencies, air boards, or metropolitan planning organizations. Non-governmental organizations can also facilitate regional collaboration.

Sources of Information and Examples of Application:

- The Institute for Local Governments (ILG) is an organization that provides resources to California communities. The ILG has resources to aid communities in establishing collaborative relationships with other communities or regional entities. http://www.ca-ilg.org/
- Regional collaboration is encouraged by state guidance as well. (California Natural Resources Agency (CNRA). 2009. 2009 California Climate Adaptation Strategy. Retrieved from http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf)

CA 4: Establish an ongoing monitoring program to track local and regional climate change impacts and adaptation strategy effectiveness.

Description: Climate change impacts vary with location. Uncertainties and contextual considerations make accurate prediction of climate impacts difficult. Climate change adaptation strategies should be adjusted based on the effectiveness of a strategy and adequacy of the strategy to address projected changes. These adjustments cannot be made without data.

Factors to Consider: Monitoring can be labor and cost intensive. Indicators should be chosen carefully. Each community should identify the most important risks posed by climate change and identify indicators that will allow for risk to be assessed. In addition, each adaptation strategy should include identification of an indicator that allows for assessment of effectiveness.

Sources of Information and Examples of Application:

- The City of Chula Vista adopted a freestanding climate adaptation plan(2011). Each strategy in the plan has a phasing program, cost estimate, responsible department, and performance metrics (indicators). The City released the *Climate Action Plan Progress Report* in 2012 that includes an assessment of the adaptation strategies adopted the prior year.
  (City of Chula Vista. 2011. Climate Adaptation Strategies. Retrieved from http://www.chulavistaca.gov/clean/conservation/Climate/documents/ClimateAdaptationStrategiesPlans_FINAL_000.pdf)
  (City of Chula Vista. 2012. Climate Action Plan Implementation Progress Report. Retrieved from http://www.chulavistaca.gov/clean/conservation/Climate/documents/AttA_ClimateActionPlanUpdate_Apr12ProgressReport_FINAL.pdf)

Public Health, Socioeconomic, and Equity Impacts (PHSE)

The overarching aim of strategies should be to improve community planning and design to promote healthy living and to balance integration of social, economic, and environmental concerns. This will require identifying mechanisms to institutionalize the consideration of health and equity in local and regional land use and transportation decision making in, for example, local general plans, regional transportation plans, or environmental impact mitigation. This integration will result in identification of strategies with co-benefits, ensuring that multiple city needs are met and resources are efficiently used. For example, community design ("smart growth") that promotes walking

and bicycling to increase physical activity can also decrease motor vehicle greenhouse gas emissions and other air pollutants. Another example is the incorporation of trees and green space into infill development, which can help mitigate heat island effects.

Adaptation strategies that increase health risks and/or greenhouse gas emissions should be avoided, when possible. An example would be a strategy that promotes air conditioner use to address heat impacts without encouraging changes in electricity production reliance on fossil fuel combustion. Because of the potentially severe consequences of heat events, efforts do need to address the availability and use of affordable cooling techniques, including air conditioners, for vulnerable populations who do not have them.

PHSE 1: Review and update heat response plans in light of climate change (heat events) projections.

Description: Heat response plans use a number of different methods to address cooling. The local public health department should be contacted to coordinate efforts.

One strategy in a heat response plan is establishment of a cooling center, a place where residents can go to cool off on high heat days. Cooling centers are often located in local government-run facilities such as senior centers or neighborhood parks and recreation sites and are open to all. Typical locations include community centers, fairgrounds, libraries, and other public facilities.

Factors to Consider: Plans and resources are needed to identify and provide assistance to individuals requiring transportation to the cooling centers. These centers must also be prepared to accommodate companion animals to ensure that vulnerable residents with pets will use the facilities. Cooling strategies for persons exposed to risk of exertional heat illness (those engaged in outdoor work) should also be identified.

Source of Information and Example of Application:

- Kern County has established cooling centers with "temperature triggers" indicating when they become active. This program was funded through a grant from PG&E. (http://www.co.kern.ca.us/pio/coolingcenters.asp)

Co-Benefits: cost savings - with better preparation for heat events, the cost of the heat-related health consequences will be reduced.

PHSE 2: Partner with existing public health community outreach and engagement efforts.

Description: "Public health departments and agencies have longstanding connections with communities, expertise in community education and organizing, and established relationships with community-based organizations." (CDPH, 2012, p.34). An outreach program focused on vulnerable populations must identify the populations present in a given community, develop a plan to disseminate the information, and develop materials most appropriate for that population. Perhaps the most important step for a community is to identify dissemination networks (e.g., community-based organizations, local government, philanthropic organizations) that can reach vulnerable populations such as residents near the coastline, residents in flood zones, those susceptible to wildfires, people who live alone, the elderly, outdoor workers and their employers, residents in urban heat islands, asthmatics, and immigrants with literacy/language needs.
Factors to Consider: Planners should coordinate with public health officials to use existing contacts with vulnerable populations. Public health officials and non-profits can use their social networks to help inform these communities about changes to the physical environment that will reduce impacts on these communities.

Sources of Information:

- California Department of Public Health (CDPH). 2012. Climate Action for Health: Integrating Health into Climate Action Planning. Retrieved from http://www.cdph.ca.gov/programs/CCDPHP/Documents/CAPS_and_Health_Published3-22-12.pdf
- California Department of Public Health. 2007. Public Health Impacts of Climate Change in California: Community Vulnerability Assessments and Adaptation Strategies. Report No. 1: Heat-Related Illness and Mortality Information for the Public Health Network in California, pp.38-39. http://www.ehib.org/papers/Heat_Vulnerability_2007.pdf
- California Natural Resources Agency. 2009. 2009 California Climate Adaptation Strategy. Retrieved from http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf

Examples of Application:

- Outreach targeting local health agencies with specific focus on identifying vulnerable populations is included in San Luis Obispo County's Energy Wise Plan (2011; chapter 7): http://www.slocounty.ca.gov/planning/CAP

Adaptation in Action: Kern County Cooling Centers

Kern County, located in the southern Central Valley, already experiences extreme heat events and the frequency of these events is projected to increase due to climate change. For community members who do not have access to a setting with temperature control (e.g. air conditioning), cooling centers have been established to provide somewhere to escape the heat. The opening of these centers is tied to a set of temperature triggers that vary by location.

The temperature triggers for opening the cooling centers, based on the National Weather Service forecast as of the previous day, are as follows:

- San Joaquin Valley / Kern River Valley Centers: 105 degrees
- Mountain Center(s): 95 degrees
- Desert Centers: 108 degrees

Cooling centers include a wide range of community facilities including senior centers, parks and recreation facilities, community centers, police departments, and veteran's centers. When they have been made available, announcements are made via TV, radio, and the Internet. In addition, transportation is available for community members that do not have a way to travel to one of the centers.

Source: http://www.kerncountyfire.org/index.php?option=com_content&view=article&id=59&Itemid=66 , http://www.co.kern.ca.us/pio/coolingcenters.asp

PHSE 3: Increase participation of low-income, immigrant, non-English-speaking, racially and ethnically diverse, and special needs residents in initial climate action plan (CAP) planning and implementation.

Description: "Many health departments have bilingual community health outreach workers with relationships and access to low-income and underrepresented communities, along with knowledge of community assets and vulnerabilities. These personnel can help cities and counties connect with many underserved and vulnerable populations, disseminate information and gather input as the climate action plan is prepared, and simultaneously improve community health," (CDPH, 2012, p.34).

Factors to Consider: Implementing climate change strategies requires long-term engagement and collaboration with the interrelated demands for economic justice, safe and affordable housing, access to healthy and affordable food, and concerns about neighborhood safety and violence. A high level of participation

from vulnerable and affected communities improves the CAP and the process through which it is produced.

Sources of Information:

- California Department of Public Health (CDPH). 2012. Climate Action for Health: Integrating Health into Climate Action Planning. Retrieved from http://www.cdph.ca.gov/programs/CCDPHP/Documents/CAPS_and_Health_Published3-22-12.pdf
- ICLEI/Local Governments for Sustainability Community Engagement Tool: icleiusa.org/action-center/learn-from-others/small-communities-toolkit/community-engagement
- Institute for Local Government climate change and public engagement resources (including case studies of successful city and county efforts to engage the public in sustainability planning and projects, plus the publication "How to Harness the Power of Your Community to Address Climate Change: A Local Official's Guide"): http://www.ca-ilg.org/promoting-community-individual-action

PHSE 4: Develop an urban heat island reduction program that includes an urban forest program or plan. Develop a program that coordinates a variety of actions that mitigate the elevated temperatures found in urban areas. Consider using expansion and improvement of urban forests as part of an adaptation response to reduce the heat island effect.

Description: Urban heat island mitigation strategies serve to alleviate heat threats by limiting the degree to which the sun can heat an urban environment. The measures included in an urban heat island reduction program focus on increasing vegetation (e.g., through urban forests, vegetative cover, "green" roofs) or increasing the extent to which sunlight is reflected (e.g., through "cool" roofs and "cool" pavement). An urban forest program plans for tree planting and long-term maintenance. Increased tree cover in an urban area reduces experience of heat in urban settings. Trees limit the extent to which urban surfaces warm, cool local temperature through evapotranspiration, and provide shade to residents and nearby buildings. As a co-benefit, these programs serve to sequester greenhouse gases, result in more appealing streets, and can add value to property.

Factors to Consider: This is a strategy with many co-benefits, but one that must be tailored to local need. Not all strategies that reduce an urban heat island will work equally well in all places. A community will need to evaluate which strategies are most easily implemented, which are likely to be most effective, and which satisfy other local needs. To be successful, an urban forest program must be comprehensive. Creating a comprehensive program requires evaluation

of existing urban trees, identification of areas in need of tree canopy, and development of a long-term maintenance program. When choosing trees, consider reduction of potential allergen side effects.

Sources of Information:

- United States Environmental Protection Agency. (2011). Urban Heat Island Mitigation. http://www.epa.gov/heatisld/mitigation/index.htm
  This resource provides basic information, example strategies, and public outreach materials.
- United States Environmental Protection Agency. (*n.d.*). *Reducing Urban Heat Islands: Compendium of Strategies Heat Island Reduction Activities*. Retrieved from http://www.epa.gov/heatisld/resources/pdf/ActivitiesCompendium.pdf
- Keithley, C. and C. Bleier. (2008). *An Adaptation Plan for California's Forest Sector and Rangelands* Retrieved from http://www.fire.ca.gov/resource_mgt/resource_mgt_EPRP_Climate/Climate_change_Forestry_Adaptation_strategies_12-11-10.pdf

Examples of Application:

- New York City has developed an urban heat island reduction plan built on detailed data analysis intended to better understand heat in the urban context and tailor strategies. (Columbia University Center for Climate Systems Research and NASA/Goddard Institute for Space Studies. (2006). *Mitigating New York City's Heat Island with Urban Forestry, Living Roofs, and Light Surfaces*. Retrieved from http://www.fs.fed.us/ccrc/topics/urban-forests/docs/NYSERDA_heat_island.pdf)
- The City of Santa Monica has developed an urban forest management plan. (City of Santa Monica. (2012). *Urban Forest Management Plan*. Retrieved from http://www.smgov.net/uploadedFiles/Portals/UrbanForest/Handout%206%20-%20Urban%20Forest%20Master%20Plan.pdf)
- The City of Portland, OR has a multifaceted urban forestry program including maintenance, oversight, and monitoring. (http://www.portlandonline.com/parks/index.cfm?c=38294)

Funding Sources:

- The California Department of Forestry and Fire Protection, Urban and Community Forestry Program lists a series of grants to help support an urban forestry program. (http://www.fire.ca.gov/resource_mgt/resource_mgt_urbanforestry.php)

Sectors Overlap: Forest and Rangeland, Biodiversity and Habitat

Co-Benefits: greenhouse gas emissions reduction, air quality improvement, water quality protection, stormwater management

PHSE 5: Conduct a communitywide assessment and develop a program to address health, socioeconomic, and equity vulnerabilities. Identify the specific populations and locations with highest vulnerability to climate-related health problems to support development of a multi-faceted program to address needs. Review any existing communitywide health assessments to evaluate their responsiveness to climate change impacts.

Description: This strategy involves identifying and reducing climate-related health, socioeconomic, and equity vulnerabilities. Existing communitywide assessments, if they exist, should be reevaluated for new, additional, or different risks due to climate change. If one does not exist, a communitywide assessment should be conducted to identify vulnerable populations and to assess the modifications required to address needs. For example, communitywide assessments could identify the homes occupied by disabled persons and seniors; assess the safety, energy, and water use efficiency of these homes; and recommend a program for modifying or retrofitting the homes. Retrofits can include weatherproofing, energy-efficient appliances, and shade cover. Identification of urban heat islands should be included in this assessment and could lead to targeted efforts to increase shading through efforts such as expansion of parks and community gardens. As rising temperatures may also increase air pollution, the assessment should consider ways to reduce air pollution in "toxic hot spots" to limit current and future health effects.

Factors to Consider: Planners need to incorporate health, socioeconomic, and equity concerns into their public education efforts, assessments, and recommendations regarding both large-scale land use decisions and individual projects. Policies included in general, community, and area plans and regulations included in zoning ordinances can provide planners with the necessary leverage for addressing health issues. Some of the data necessary to make communitywide assessments may already exist. Many public health departments already have plans for vulnerable communities. In coordination with public health departments, these data and plans should be used in planning efforts.

Sources of Information:

- California Natural Resources Agency. 2009. 2009 California Climate Adaptation Strategy. Retrieved from http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf
- Energy Upgrade California—Low-income Energy Assistance Program. This program provides resources for energy audits and weatherization of residences.

Examples of Application:

- Some communities have turned to mapping technologies to identify vulnerable neighborhoods. Differential exposures to the health-damaging impacts of climate change, such as excessive heat and extreme weather events, can be examined from a geographical equity perspective by using GIS maps overlaid with vulnerability models and current socioeconomic, racial/ethnicity, and cultural group distributions in California. (Morello-Frosch, R. et al. 2009. The Climate Gap: inequities in how climate change hurts Americans & how to close the gap, pp. 22-23. Retrieved from http://dornsife.usc.edu/pere/documents/ClimateGapReport_full_report_web.pdf)

Adaptation in Action: Oakland Climate Action Coalition

Oakland Climate Action Coalition (OCAC) aimed its community organizing efforts at robust active participation to improve public health and climate goals. In the lead-up to the Oakland Energy and Climate Action Plan (ECAP), OCAC organized several community meetings to discuss the ECAP and the impacts it would have on ethnic and low-income communities—from adaptation and public health to greenhouse gas reduction and infrastructure (for example, transit-oriented development). There was active participation among Latina women through Mujeres Unidas y Activas (with a strong emphasis on interrelated concerns about food and families), as well as among residents from the West Oakland Environmental Indicators Project.

Source: California Department of Public Health (CDPH). 2012. Climate Action for Health: Integrating Health into Climate Action Planning. Retrieved from http://www.cdph.ca.gov/programs/CCDPHP/Documents/CAPS_and_Health_Published3-22-12.pdf

ellabakercenter.org/index.php?p=gcjc_oakland_climate_action_coalition

PHSE 6: Focus planning and intervention programs on neighborhoods that currently experience social or environmental injustice or bear a disproportionate burden of potential public health impacts.

Description: Because specific neighborhoods already experience social and environmental injustice and/or bear a disproportionate burden of public health impacts as a result of these inequities, proactive strategies that address current inequities can build the adaptive capacity of these neighborhoods. Proactive strategies–such as those that address the risks of heat island effects, poor housing quality, and a lack of access to transportation to escape extreme weather events–can also reduce the potential for climate change to worsen inequities and public health impacts on the poor and communities of color. It is important that communities have the opportunity to be involved in determining the best strategies for an area. Community involvement allows for social and environmental justice issues to be addressed, and community buy-in is essential to effectively implement strategies.

Factors to Consider: Environmental and social justice organizations and public health officials are already working with vulnerable neighborhoods on a variety of planning and intervention programs. Local agencies should coordinate with organizations and departments on setting priorities for, coordinating, and implementing these efforts.

Sources of Information:

- Morello-Frosch et al. 2009. The Climate Gap: Inequalities in How Climate Change Hurts Americans & How to Close the Gap. PERE, USC Program for Environmental and Regional Equity. Retrieved from http://dornsife.usc.edu/pere/publications/
- Climate Plan (A coalition of environmental and non-profit planning groups). Social Equity and Affordability: http://www.climateplan.org/resources/social-equity-and-affordability/

Examples of Application:

- City of Chula Vista Climate Action Plan—Climate Change Working Group. http://www.chulavistaca.gov/clean/conservation/Climate/ccwg1.asp
- PolicyLink. (*n.d.*) Equitable Development Toolkit. Retrieved from http://www.policylink.org/site/c.lkIXLbMNJrE/b.5136575/k.39A1/Equitable_Development_Toolkit.htm

PHSE 7: Refine emergency preparedness and response to address health impacts. Update existing emergency preparedness plans and conduct exercises to augment preparedness to better address local health impacts.

Description: Local health departments and local emergency managers should work to incorporate climate change risks into existing emergency preparedness plans and design. They should also work together to augment preparedness measures for events likely to increase with climate change (e.g., heat waves, wildfires, floods). This effort should also include developing plans for anticipated impacts such as sea level rise and saline intrusion into drinking water. In some cases, this can include updating existing emergency response plans.

Factors to Consider: Preparation also should ensure completeness and availability of identified emergency supplies and resources, including but not limited to items such as water main repair parts, generators, pumps, sandbags, road clearing, medical supplies and services, and communication facilities. The effort should include identifying and cataloging the current supply and procuring additional items and services to ensure preparedness in the event of a climate-related emergency.

Sources of Information:

- California Natural Resources Agency. (2009). *2009 California Climate Adaptation Strategy.* Retrieved from http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf

Examples of Applications:

- The City of Santa Cruz included explicit accounting of public health concerns in their adaptation plan. (City of Santa Cruz. (2011). *Climate Adaptation Plan.* Retrieved from http://www.cityofsantacruz.com/Modules/ShowDocument.aspx?documentid=23643)
- San Luis Obispo County's *Energy Wise Plan* (2011; chapter 7) includes a policy item for update of the County's Emergency Operations Plan to include health-related events. (http://www.slocounty.ca.gov/planning/CAP)

PHSE 8: Link climate change adaptation strategies with social equity and public health strategies. Include social equity and public health as considerations in all adaptation policy development processes.

Description: Many climate change adaptation strategies can focus on or be paired with strategies addressing existing social equity and public health issues, including those associated with climate change. These strategies should improve community planning and design efforts that promote healthy built environments and living and balance health, socioeconomic, equity, and environmental concerns. For example, efforts to link land use with transportation options can be targeted to affordable housing. Measures to address temperature increases, such as provision of urban forests, can be combined with recreational opportunities, such as public parks and pedestrian and bike paths. Measures to increase consumption of local goods and reduce associated transportation needs, such as provision of farmers' markets and community gardens, can be used to address community development, food security, and sustainability.

Planning agencies should regularly coordinate with health agencies and the local community to ensure that consideration of adaptation strategies is mutually beneficial to planning and public health concerns.

Factors to Consider: Collaborating with environmental and social justice and public health organizations on climate change strategies creates opportunities to efficiently address social equity and public health impacts, providing multiple benefits and building coalitions around climate change measures.

Sources of Information and Examples of Applications:

- The *Healthy by Design* workbook provides guidance and strategies for addressing public health and equity threats. (Sonoma County Department of Health Services. (2010). *Healthy by Design: A Public Health and Land Use Planning Workbook*. Retrieved from http://www.healthysonoma.org/javascript/htmleditor/uploads/Healthy_By_Design_Workbook.pdf)
- Specific guidance and strategies have been provided by the California Department of Public Health. (California Department of Public Health. (2012). *Climate Action for Health: Integrating Public Health into Climate Action Planning.* Retrieved from http://www.cdph.ca.gov/programs/CCDPHP/Documents/CAPS_and_Health_Published3-22-12.pdf)
- San Luis Obispo County's Health Commission has recently been designated by the Board of Supervisors as a referral agency for planning matters that may affect public health. Examples of projects referred for review include land use permits such as multifamily developments and policy matters such as general plan updates. The Health Commission has authorized the Healthy

Eating Active Living San Luis Obispo (HealSLO) Working Group to provide comments to the County Planning and Building Department on their behalf. The HealSLO Working Group is a made up of healthcare professionals, educators, agriculturalists, urban planners, recreational leaders and interested community members. Comments provided for land development projects are usually sent directly to the Planning Department, but comments for proposed land use policy matters are first brought to the Health Commission for their review and approval. (http://www.healslo.com/)

PHSE 9: Use performance metrics and data to evaluate and monitor the impacts of climate change strategies on public health and social equity. Coordinate with other agencies that also evaluate and monitor impacts, such as the public health department.

Description: Public health agencies can assist local planning agencies with the evaluation of proposed and/or implemented climate adaptation strategies as they relate to public health. According to the California Department of Public Health (2012), data providing a snapshot of the health of local communities are available from more than 35 county and local health departments. Because of concerns regarding the potentially inequitable consequences of climate adaptation strategies, jurisdictions should consider and monitor the impacts of strategies on public health.

Sources of Information:

- The Department of Public Health advocates for monitoring and identifies useful metrics for tracking impacts. (California Department of Public Health. (2012). *Climate Action for Health: Integrating Public Health into Climate Action Planning.* Retrieved from http://www.cdph.ca.gov/programs/CCDPHP/Documents/CAPS_and_Health_Published3-22-12.pdf)
- Human Impact Partners provides an online source for policy, case studies, and other information focused on integration of health considerations into a variety of planning policies and programs. (http://www.humanimpact.org/)
- The California Department of Public Health provides a list of more than 35 county and local health departments that compile periodic, statistical snapshots of the health status of communities. The list of these reports can be found at cdph.ca.gov/programs/CCDPHP/Documents/Co_Health_Status_Reports2011.xls

Examples of Application:

- Human Impact Partners provides a toolkit for integrating public health and equity into sustainability plans. (Human Impact Partners. 2011. *Elevating Health & Equity into the Sustainable Communities Strategy (SCS) Process*. Retrieved from http://www.humanimpact.org/hips-hia-tools-and-resources)

Ocean and Coastal Resources (OCR)

In the long term, sea level rise needs to be addressed based on local need and context through a variety of policy measures. Part of the aim is to have sea level rise included as a critical consideration when evaluating development proposed near shorelines. Another goal in planning for sea level rise is identifying areas for restoration or protection for ecosystem integrity and/or the safety of nearby communities.

OCR 1: Develop an adaptive management plan to address the long-term impacts of sea level rise. Include an assessment of local vulnerability, including infrastructure such as roads and water reclamation facilities, buildings in the inundation areas, and ecosystems.

Description: An adaptive management plan can provide for flood and erosion protection with consideration for future sea level rise, taking into account 100-year flood events when planning new development and infrastructure projects and/or maintenance and reconstruction of existing projects. This plan should result in identification of areas of priority, suggested strategies, long-term indicators, and integration into other local policy documents (e.g., local hazard mitigation plans).

Factors to Consider: These measures are likely to be most successful if efforts are made to coordinate sea level rise protection measures with adjacent jurisdictions to create contiguous shoreline protection. The California Coastal Commission should also be involved in this process.

Sources of Information:

- Travis, W., and LaClair, J. (2011). Public workshop on key outstanding elements of Bay Plan Amendment no. 1-08 dealing with climate change. San Francisco, CA: San Francisco Bay Conservation and Development Commission. http://www.bcdc.ca.gov/

Examples of Application:

- The City of San Diego, in collaboration with ICLEI, has begun the adaptive management plan process (*Sea Level Rise Adaptation Strategy for San Diego Bay*). A preliminary listing of intended steps can be reviewed here: http://www.icleiusa.org/library/documents/San_Diego_Bay_SLR_Adaptation_Strategy_Exec_Sum.pdf
- The City of Santa Cruz has adopted an adaptation plan that serves as an amendment to its local hazard mitigation plan (LHMP). While this amendment must also be matched with updates of information on other hazards for purposes of FEMA LHMP approval, this adaptation plan reflects a useful example of the type of assessment identified above. (City of Santa Cruz. (2011). *City of Santa Cruz Climate Adaptation Plan.* Retrieved from http://www.cityofsantacruz.com/Modules/ShowDocument.aspx?documentid=23643)

Sector Overlap: Infrastructure

OCR 2: Facilitate managed retreat from, or upgrade of, the most at-risk areas. Gradually retreat from the most at-risk areas, use these areas differently, or upgrade buildings and other facilities in at-risk areas. Develop plans allowing for coastal inundation in defined areas.

Description: Jurisdictions should assess local risk areas based on projected coastal inundation and the importance of facilities, infrastructure, or ecosystems that are at risk. Based on this assessment, top-priority areas should be identified and actions should be taken for retreat or upgrade. Each development or infrastructure project must be assessed based on how long the action will be adequate given sea level projections.

Factors to Consider: When evaluating development or infrastructure projects, determine whether to (1) relocate them inland, (2) elevate them above projected sea level rise, or (3) leave them in place and make new or proposed facilities more flood-proof. Determine factors such as cost, environmental impacts, funding sources, timing, and compatibility with other plans. These choices should be made in close collaboration with the California Coastal Commission.

Sources of Information and Examples of Application:

- A successful example of this strategy is in Ventura, where a bike path at Surfers' Point was relocated 65 feet inland using California Coastal Conservancy grant funds. Source: http://articles.latimes.com/2011/jan/16/local/la-me-surfers-point-20110116
- Another example is in Pacifica, where the City partnered with the Pacifica Land Trust and the California Coastal Conservancy to purchase two homes and their surrounding acreage. After demolition of the homes, the dunes were rebuilt and four acres of beach and the nearby estuary were restored. Source: http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_retreat.html#1

Sector Overlap: Biodiversity and Habitat, Infrastructure

Co-benefits: public safety, recreation, tourism

Adaptation in Action: Managed Retreat at Surfer's Point

The City of Ventura was experiencing ongoing coastal erosion at Surfer's Point, a popular surf destination adjoining the Ventura County Fairgrounds parking lot. A coastal bike path near the site had already been undermined.

While the process was time-consuming and occasionally contentious, consensus on a managed retreat approach was reached by a working group made up of representatives from the City, the County of Ventura, the Ventura County Fairgrounds, the California Department of Parks and Recreation, the Surfrider Foundation, and other stakeholders in the region.

The managed retreat project included (NOAA, 2007, ¶4):

- Relocating the bike path and public parking lot more than 60 feet inland
- Removing existing rip rap
- Restoring the area to a more natural beach habitat
- Continuing to provide adequate parking for beach goers and the fairgrounds
- Providing for ongoing beach renourishment
- Preserving public access to the area via Shoreline Drive
- Advocating for the removal of the Matilija Dam to increase sand supplies to the beach

The managed retreat solution protects the relocated bike path and maintains the surf break for which the site is named.

Sources:
National Oceanic and Atmostpheric Adminstration. 2007. Managed Retreat Strategies – Case Studies. Retrieved from http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_retreat.html#2

Barboza, T. 2011. In Ventura, a retreat in the fact of a rising sea. Los Angeles Times. January 16. Retrieved from http://articles.latimes.com/2011/jan/16/local/la-me-surfers-point-20110116

OCR 3: Require accounting of sea level rise in all applications for new development in shoreline areas. Ensure that all applications for new development account for projected sea level rise and provide adequate protection (e.g. setback, armoring).

Description: Shoreline areas can include beaches, bluff-tops, and areas along bays or estuaries. Accounting of sea level rise in these areas requires that jurisdictions prepare projected sea level maps to estimate long-term changes in the coastline, bluff erosion rates, and projected coastal flooding. Based on these maps, appropriate setback and/or other appropriate protection can be determined. For consistency, consideration of sea level rise should be included in project review guidelines, integrated into local coastal plans, and reviewed as part of California Environmental Quality Act (CEQA) evaluation.

Factors to Consider: Collaboration among adjoining jurisdictions will foster more comprehensive shoreline protection. The implementation of this strategy will also require staff and community education about sea level rise, inherent risks, and available options for addressing the risk.

Sources of Information and Examples of Application:

- The San Francisco Bay Conservation and Development Commission (BCDC) Bay Plan Amendment No. 1-08 requires mapping and accounting of sea level rise impacts in land use and management decisions. (http://www.bcdc.ca.gov/proposed_bay_plan/10-01Resolution.pdf)
- Sea Level Rise Planning Maps is a clearinghouse site that houses sea level rise maps and evaluation for 13 East Coast states. This is a good example of the type of mapping and evaluation that can support this strategy. The web-based Cal-Adapt tool (Cal-Adapt.org) provides a base but will require local evaluation of land use policy, projected growth, and ecosystem vulnerability. (http://plan.risingsea.net/index.html)
- The County of San Luis Obispo included sea level rise considerations in a recent climate plan. (San Luis Obispo County. 2011. EnergyWise Plan. Chapter 7. Retrieved from http://www.slocounty.ca.gov/planning/CAP)

Sector Overlap: Biodiversity and Habitat, Infrastructure

Co-Benefits: public safety

OCR 4: Preserve undeveloped and vulnerable shoreline. In shoreline areas, preserve undeveloped land to support ecosystem adaptation in areas where sea level rise may cause inland migration of species and habitat.

Description: Undeveloped shorelines areas, particularly along bays or estuaries, should be evaluated for ecological value, vulnerability, and role in local flood protection. Protection and restoration of these areas should be pursued to provide flood protection and to allow habitat and species migration. Tools that can be used to facilitate this protection can include several that are familiar to local and regional jurisdictions, including land use designations (e.g., zoning), building setbacks, consideration during project review, easement acquisition, and habitat conservation plans in situations where special-status species are present.

Factors to Consider: Land use and tax policies should be evaluated to avoid development on restorable habitat that is critical to ensuring that ecosystems are resilient to climate change impacts. Action such as land preservation can be coordinated with local land conservation and wildlife organizations. The California Coastal Commission should also be consulted. These actions do not need to strictly prohibit development. Instead, shoreline areas should be carefully evaluated. In some cases, development can be managed to allow for future ecosystem resilience.

Sources of Information:

- Travis, W., and J. LaClair. 2011. Public workshop on key outstanding elements of Bay Plan Amendment no. 1-08 dealing with climate change. San Francisco, CA: San Francisco Bay Conservation and Development Commission. http://www.bcdc.ca.gov/

Examples of Application:

- Similar strategies have been identified for the Bay Area:
  - BCDC. 2011. Revised Staff Report and Staff Recommendation for Proposed Bay Plan Amendment 1-08b Concerning Climate Change. Retrieved from http://www.bcdc.ca.gov/proposed_bay_plan/10-01Recom.pdf
  - Travis, W., and J. LaClair. 2011. Public workshop on key outstanding elements of Bay Plan Amendment no. 1-08 dealing with climate change. San Francisco, CA: San Francisco Bay Conservation and Development Commission. http://www.bcdc.ca.gov/
- The Puget Sound region in Washington State is pursuing similar policies:
  - State of Washington Department of Ecology. 2011. Shoreline Master Program (SMP) Handbook, Appendix A. Retrieved from http://www.ecy.wa.gov/programs/sea/shorelines/smp/handbook/sea_level_guidance.pdf

Sector Overlap: Water Management, Biodiversity and Habitat

Co-benefits: recreation and open space, tourism, public safety

OCR 5: Use transfer of development rights for the rebuilding of structures damaged or destroyed due to flooding in high-risk areas. Designate areas for increased density in a community, allowing land owners in the high-risk areas to sell their development rights.

Description: Transfer of development rights (TDR) is often used to preserve agricultural lands or undeveloped areas. In this case, the same approach would be used to transfer the development rights of a high-risk property to a lower-risk property. The advantage is that the land owner in the high-risk area is compensated for the loss of development potential and a flood-prone area is set aside, decreasing flood risk for the whole community.

Factors to Consider: Often the most controversial aspect of TDR programs is selection of the receiving areas that will see an increase in development density. Community acceptance of this density increase requires that the program be accompanied by public education and outreach. Local land trusts can be valuable collaborators in developing the program, particularly restricting new development in high-risk areas.

Sources of Information:

- Grannis, J. 2011. Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use: How Governments Can Use Land-Use Practices to Adapt to Sea-Level Rise. Retrieved from http://www.georgetownclimate.org/sites/default/files/Adaptation_Tool_Kit_SLR.pdf
- Titus, J. 2011. Rolling Easements. Retrieved from www.epa.gov/cre/downloads/rollingeasementsprimer.pdf

Examples of Applications:

- Monterey Bay. (2011). Adaptation in Action: Examples from the Field. Retrieved from http://www.climatechangemontereybay.org/solutions_adaptation.shtml#endnotes
- San Luis Obispo County. (2011). *EnergyWise Plan*. Retrieved from http://www.slocounty.ca.gov/planning/CAP

Sector Overlap: Water Management, Biodiversity and Habitat

Co-Benefits: public safety

Water Management (WM)

This sector focuses on strategies that address climate change impacts on water, including surface water systems, groundwater, flooding, drought, and water supply. The strategies listed below seek to limit community exposure to threats such as flooding or landslides. This can be done through land use policy (zoning, general plans, etc.) or through update of local plans.

Water supply impacts due to reduced snowpack, intense storms, reduced precipitation, or drought can be addressed through promotion of efficient water use, which is often included in urban water management plans and climate plans focused on greenhouse gas reduction. Selected measures to reduce local water use are identified below. These measures and others are now required for California jurisdictions. Senate Bill X7-7 (2009) requires a 20 percent reduction in urban per capita water use in California by 2020. Measures that focus on personal water use and efficiency are not covered in the following water management strategies because there are many sources for this information, including the following:

- California Air Pollution Control Officers Associations. (2010). *Quantifying Greenhouse Gas Mitigation Measures.* Retrieved from: http://www.capcoa.org/wp-content/uploads/2012/03/CAPCOA-ModelPolicies-6-12-09-915am.pdf
- Environmental Protection Agency. (1998). *Water Conservation Guidelines.* Retrieved from http://www.epa.gov/WaterSense/pubs/guide.html

WM 1: Develop coordinated plans for mitigating future flood, landslide, and related impacts through concurrent adoption of updated general plan safety elements and local hazard mitigation plans. Both in fully built-out and in growing communities evaluate projected risks of flooding, landslides, and related hazards. Determine long- and near-term action plan priorities to reduce potential losses. Identify hazard mitigation projects to be included in the five-year capital program.

Description: California law requires each city and county to prepare a general plan, including a safety element that identifies local hazards, such as flooding and landslides. The safety element sets forth goals, objectives, policies, and programs for reducing risk, vulnerability, and losses related to hazards. The federal Disaster Mitigation Act of 2000 requires adoption of local hazard mitigation plans as a precondition for mitigation grant eligibility.

Local jurisdictions should update general plan elements, and, where applicable, local hazard mitigation plans to reduce potential losses of life and property from existing and increased flooding and landslide risks.

Factors to Consider: All of California's cities and counties have adopted general plan safety elements but many of these are not up-to-date. New knowledge has become available since their adoption, both as a result of disaster experiences as well as the federal law requirement for local hazard mitigation plan adoption as a precondition for receiving mitigation grants. Federal regulations emphasize setting priorities regarding risks and actions to mitigate hazards, adding a useful dimension to general plan safety elements. California law now provides for state financial incentives for adoption of a local hazard mitigation plan as part of the safety element (AB 2140, 2006). By concurrently updating and adopting safety elements and local hazard mitigation plans, communities can provide for greater disaster loss avoidance and place themselves in stronger positions financially.

Sources of Information:

- California Emergency Management Agency (Cal EMA). 2010. *California Multi-Hazard Mitigation Plan.* Retrieved from http://hazardmitigation.calema.ca.gov/docs/2010_SHMP_Final.pdf
- Governor's Office of Planning and Research. 2003. *General Plan Guidelines.* Retrieved from http://cnps.org/cnps/conservation/conference/2006/General_Plan_Guidelines_Overview%202003.pdf
- Cal EMA. Hazard Mitigation Web Portal. http://hazardmitigation.calema.ca.gov/

Examples of Application:

- According to the 2010 California Multi-Hazard Mitigation Plan, 324 of California's 482 cities, or 67 percent, and 37 of its 58 counties, or 64 percent, had Federal Emergency Management Agency (FEMA)-approved locally adopted hazard mitigation plans as of December 2009. Local hazard mitigation plans for cities and counties covered 31,030,978 people, or 81 percent of the state's population. Compared to 2007, this represented a 34 percent increase in number of cities, a 23 percent increase in number of counties, and a 17 percent increase in total population covered. However, since most of these local hazard mitigation plans were adopted separately from safety elements, the challenge of integrating and strengthening mitigation planning through concurrent adoption remains.

Sector Overlap: Infrastructure

Co-Benefits: public safety

WM 2: Implement Assembly Bill (AB) 162 (2007) requiring flood hazard information in local general plans. Amend city and county general plan land use, housing, safety, and conservation elements to address new flood hazard and water resource information requirements.

Description: AB 162 expands consideration of flood risk in local land use planning throughout California. The recent legislation requires cities and counties to amend local general plans in several very specific ways, including requirements to:

- Identify and annually review new mapping of areas subject to flooding as part of the land use element; and
- Amend housing, safety, and conservation elements to take into account specific flood risk and water management information and issues.

While some of the requirements of AB 162 apply statewide, other provisions apply to lands within the Central Valley. The California Department of Water Resources (DWR) has prepared a guidance document describing the new requirements affecting local planning responsibilities such as general plans, zoning ordinances, development agreements, tentative subdivision maps, and other actions.

Factors to Consider: In addition to data from FEMA's Flood Insurance Rate Maps showing areas within 100-year floodplains (1 percent annual occurrence risk) and 500-year floodplains (0.2 percent annual occurrence risk), local general plans must now include references to a new series of 200-year (0.5 percent annual occurrence risk) flood hazard maps. DWR has a long-term program to prepare these for the Central Valley and other parts of California. This recent legislative initiative has been in effect since 2009.

Sources of Information:

- Cal EMA. (2010). *California Multi-Hazard Mitigation Plan.* http://hazardmitigation.calema.ca.gov/docs/2010_SHMP_Final.pdf
- Department of Water Resources. (2010). *Implementing California Flood Legislation into Local Land Use Planning: A Handbook for Local Communities.* Retrieved from: http://www.water.ca.gov/floodmgmt/lrafmo/fmb/docs/Oct2010_DWR_Handbook_web.pdf

Examples of Applications:

- The requirement for evaluating 200-year flood hazards is being implemented in the Central Valley Flood Protection District in 2012 (see Strategy WM 6).

Sector Overlap: Infrastructure

Co-Benefits: public safety

WM 3: Implement National Flood Insurance Program (NFIP) activities to minimize and avoid development in flood hazard areas. Participate in national programs (under the National Flood Insurance Act of 1968) geared to reducing flood exposure and covering flood losses through private insurance.

Description: Local jurisdictions should use Federal Insurance Rate Map (FIRM) data for the 100-year floodplain (area with 1 percent annual flood recurrence risk) as a source for determining general plan policies and zoning patterns. Local jurisdictions should also participate in the Community Rating Service system, which reduces rates for flood insurance purchasers. Flood-prone Severe Repetitive Loss communities should pursue flood mitigation assistance grants designed to reduce flood exposure. Jurisdictions should use federal mitigation grant funds to purchase flood threatened or damaged property and raise elevations of homes and key infrastructure facilities.

Factors to Consider: Together with other examples below, these practices represent a powerful combination of tools to strengthen natural hazard mitigation in the course of day-to-day development planning. When applying them, however, communities should consider factors such as cost, environmental impacts, funding sources, timing, and private property rights.

Sources of Information and Examples of Application:

- Cal EMA. (2010). *California Multi-Hazard Mitigation Plan*. http://hazardmitigation.calema.ca.gov/docs/2010_SHMP_Final.pdf
- Federal grants under the Hazard Mitigation Grant Program of the Stafford Act (1988) and Flood Mitigation Assistance grant program of NFIP for flood mitigation activities by communities with FEMA-approved local hazard mitigation plans.

Co-Benefits: public safety

WM 4: Restore existing flood control and riparian corridors. Develop projects that mitigate riverine flooding, improve surface retention and subsurface water storage, and enhance timing of water delivery through restoration of waterways to more natural states.

Description: Jurisdictions should evaluate flooding potential, monitor and improve natural conditions to improve flood flow, reduce erosion, improve habitat, and protect adjacent neighborhoods. Jurisdictions should provide for flood and erosion protection with consideration for 100-year flood events, taking into account existing flood management deficiencies and potential increase in flows from climate change, when planning new development and infrastructure projects

and/or maintenance and reconstruction of existing projects. Where possible, jurisdictions should convert concrete-lined channels to soft-bottomed waterways, install landscaping on embankments to slow flood waters, provide natural planting to encourage biodiversity, and build retention basins for percolation into aquifers. Additional benefits include expansion of active recreation.

Factors to Consider: When pursuing such projects, communities should determine factors such as cost, environmental impacts, funding sources, timing, and compatibility with other plans.

Sources of Information:

- Cal EMA. 2010 California Multi-Hazard Mitigation Plan. http://hazardmitigation.calema.ca.gov/docs/2010_SHMP_Final.pdf

Examples of Applications:

- A highly prominent example of this strategy representing an ambitious undertaking is restoration of the Los Angeles River: http://lariver.org/

Funding Sources:

- The California Urban Streams Restoration Program (USRP) provides grants to local communities for projects to reduce flooding and erosion and associated property damage; restore, enhance, or protect the natural ecological values of streams; and promote community involvement, education, and stewardship. http://www.water.ca.gov/urbanstreams/

Sector Overlap: Biodiversity and Habitat

Co-Benefits: recreation and open space, public safety

WM 5: Implement general plan safety elements through zoning and subdivisions practices that restrict development in floodplains and landslide hazard areas. Minimize or avoid development in 100-year (areas with one percent annual flood recurrence) floodplains and landslide areas. Use commonly applied hazard mitigation practices through zoning and subdivision reviews for new developments.

Description: This strategy includes a combination of a variety of commonly used zoning and subdivision practices, including: (1) restricting allowable residential densities in hazardous areas, reducing the potential number of structures at risk; (2) clustering development or setting it back from flood hazard areas to reduce exposure; (3) transferring allowable density from hazardous sites to safer areas; (4) adopting slope-density formulas limiting the number of dwellings on hillsides subject to slippage or subsidence; (5) modifying proposed parcel boundaries and

street locations to avoid hazardous areas; and (6) requiring multiple ingress and egress points for emergency access and evacuation.

Factors to Consider: Together with other examples below, these practices represent a powerful combination of tools to strengthen natural hazard mitigation in the course of day-to-day development planning. When applying them, however, communities should consider factors such as cost, environmental impacts, funding sources, timing, and private property rights.

Sources of Information:

- Cal EMA. (2010). *California Multi-Hazard Mitigation Plan*. http://hazardmitigation.calema.ca.gov/docs/2010_SHMP_Final.pdf

Examples of Application: Also commonly used are a mix of complementary techniques for minimizing or avoiding development in flood- and landslide hazard-prone areas:

- Purchase of agricultural and conservation easements by private land trusts;
- Establishment of open space easements;
- Donation property for tax credits;
- Acquisition of land or development rights using developer fee or bond financing; and
- Limitations on infrastructure provision and extensions.

WM 6: Implement Senate Bill 5 (2007) in communities within the Sacramento-San Joaquin Drainage District. Amend local general plans and revise zoning to conform to the Central Valley Flood Protection Plan (CVFPP) upon its adoption by the Central Valley Flood Protection Board.

Description: The Central Valley Flood Protection Act, enacted by SB 5, seeks to address flooding problems in portions of the Delta by directing the California Department of Water Resources (DWR) and the Central Valley Flood Protection Board (CVFPB) to prepare and adopt a Central Valley Flood Protection Plan (CVFPP) by July 1, 2012. The purpose of the CVFPP is to establish a system-wide approach to improving flood management in the areas currently receiving some amount of flood protection from the existing facilities of the State Plan of Flood Control. Cities and counties within the boundaries of the Central Valley Flood Protection District must amend their general plans to conform to the CVFPP within 24 months of its adoption, and must amend their zoning to conform within 36 months. Once general plan and zoning ordinance amendments are enacted, the approval of development agreements and subdivision maps is subject to restrictions in flood hazard zones. Central Valley counties are obligated to develop flood emergency plans within 24 months of CVFPP adoption.

Factors to Consider: Hearings were held during the spring of 2012 leading to adoption of the CVFPP by the Central Valley Flood Protection Board on June 29, 2012.

Sources of Information:

- Cal EMA. (2010). *California Multi-Hazard Mitigation Plan*. http://hazardmitigation.calema.ca.gov/docs/2010_SHMP_Final.pdf
- CA Department of Water Resources. (n.d.). Flood Safe California. Powerpoint Presentation: "Central Valley Flood Protection, Implementing SB 5 (Machado, Florez, Wolk, Steinberg, and Laird)." http://www.water.ca.gov/floodsafe/docs/Central_Valley_Flood_Protection_Plan.pdf

Examples of Application:

- The CVFPP is part of a larger bond program approved by California voters in 2006 following Hurricane Katrina in New Orleans and the Gulf Coast states. The voter-approved $4.09 billion Proposition 1E (the Disaster Preparedness and Flood Prevention Bond Act of 2006) is funding flood management projects, including repairs and improvements to levees, weirs, bypasses, and other flood control facilities throughout the state. Proposition 1E allocates $3 billion to repair and improve state and federal facilities that are part of the State Plan of Flood Control for the Central Valley and to reduce the risks of levee failure in the Sacramento-San Joaquin Delta. The voter-approved $5.4-billion Proposition 84 (the Safe Water Quality, Supply, Flood Control, River and Coastal Protection Act of 2006) will allocate about $1.2 billion in additional funding for flood control projects, including the Delta Levee Program, State Flood Control Subventions Program, and floodplain evaluation and delineations.

Sector Overlap: Infrastructure

Co-Benefits: public safety

WM 7: Develop a water-recycling program.

Description: Recycling water is a water management strategy that relies on reuse of already acquired local water. It may also be an energy-efficient option in some regions. Approved uses of recycled water are identified in Title 22 of the California Code of Regulations (http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Recharge/Purplebookupdate6-01.PDF).

Recycling water means reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishment of groundwater basin. A recycling program could therefore promote both municipal and onsite water reuse.

Factors to Consider: The level of wastewater treatment should match the water quality needed for the desired type of reuse. For example, recycled water used for landscape irrigation requires less treatment than recycled water used for drinking water. Onsite water recycling, often called gray water recycling, includes wastewater from bathroom sinks, bath and shower drains, and clothes washing drains that is reused within the same building or property. Therefore, wastewater and water agencies should collaboratively adopt policies and develop facility plans that promote the use of recycled water for all appropriate, cost-effective uses while protecting public health.

Sources of Information:

- United States Environmental Protection Agency. (2012). Water Recycling and Reuse: The Environmental Benefits. Retrieved from: http://www.epa.gov/region9/water/recycling/
- California Air Pollution Control Officers Associations. (2010). Quantifying Greenhouse Gas Mitigation Measures. Retrieved from: http://www.capcoa.org/wp-content/uploads/2012/03/CAPCOA-ModelPolicies-6-12-09-915am.pdf (Reclaimed water is Strategy WSW-1 [p. 332].)

Examples of Applications:

- City of San Diego has developed a water purification demonstration project: http://www.sandiego.gov/water/waterreuse/demo/
- The City of San Luis Obispo has a recycled water program in which treated water is used for non-potable uses such as irrigation of City-owned park areas, agriculture, and construction areas. The procedures for recycled water can be reviewed here: www.slocity.org/utilities/download/reuseprocedures.pdf

Funding Sources:

- California State Water Resources Control Board - Water Recycling Funding Program: http://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/

WM 8: Implement tiered pricing to reduce water consumption and demand. Increase the incentive to consumers to be more thoughtful about water use by pricing water to reflect its value.

Description: In a tiered pricing format, the rate charged for water consumption each month depends on the level (tier) of consumption. Water is the least expensive when used within the first tier. When a customer's water use exceeds the tier's limit, the customer is charged at a higher, second-tier rate on the excess usage. This process repeats as consumption continues into higher tiers.

Factors to Consider: Tiered pricing can only be implemented once metering has been established. Public education and outreach must accompany the implementation of a tiered pricing program, to clearly explain the process and emphasize the benefits of water conservation. Typically, the more dramatic the rise in cost from tier to tier, the greater the incentive to conserve water. Conversely, a less steep tiered pricing structure may not produce the desired level of conservation.

Sources of Information and Examples of Applications:

- Equinox Center. 2009. A Primer on Water Pricing in the San Diego Region. Retrieved from http://www.equinoxcenter.org/assets/files/pdf/Equinox%20Water_Pricing_Brief%20102609.pdf

Co-Benefits: greenhouse gas emissions reduction

WM 9: Increase "above-the-dam" regional natural water storage systems. Restore meadows and apply forest treatments to allow for increases in water storage and recharge of the groundwater supply.

Description: "Above-the-dam" storage refers to natural, ecosystem-based processes of storing water in mountainous areas, particularly in the Sierra. Meadow restoration is one example and has the co-benefits of improving ecological health and restoring and extending habitat. Meadow restoration has an additional benefit as a climate change adaptation strategy, in that it provides habitat corridors that facilitate species migration in response to a warming climate. Furthermore, improving forest health and resiliency through land management practices that reduce fire fuel loading will also contribute positively to the quality, quantity, and late season storage of water in the Sierra Nevada.

F*actors to Consider*: Cost-benefit analysis of increasing manmade reservoir capacity vs. implementing ecosystem restoration should incorporate the co-benefits of meadow restoration and forest treatment listed above. Furthermore, groundwater recharge through the ecosystem also reduces the impact of flooding, which is more likely to occur with the faster snowmelt predicted throughout the remainder of the century.

Sources of Information and Examples of Application:

- California Natural Resources Agency Sierra Nevada Conservancy. 2009. The climate action plan of the Sierra Nevada: A regional approach to address climate change version 1.0. Auburn, CA: California Natural Resources Agency. http://www.sierranevada.ca.gov/docs/climate_action_plan-1.pdf

Sector Overlap: Biodiversity and Habitat, Forest and Rangeland

Co-Benefits: recreation and open space, public safety

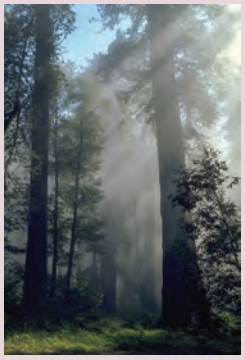
Forest and Rangeland (FR)

Climate change is projected to alter the species composition and health of forest and rangeland areas. One potential outcome of these changes is increased frequency and severity of wildfires. Strategies for this sector focus on increasing community resiliency through improved monitoring and better management of the wildland-urban interface (WUI) and reducing wildfire risk itself through forest thinning and prescribed burns.

FR 1: Establish a monitoring and management program to track forest and rangeland health.

Description: Some of the most difficult climate change impacts of climate change to address are those that progress slowly and are therefore more difficult to recognize. Shifts in forest health and invasive species spread can have detrimental impacts on biodiversity and wildfire frequency. Without careful monitoring, these changes may be missed during the early stages of forest succession. A monitoring program allows for management of these systems to be responsive and tailored to regional needs. A monitoring program enables identification of areas where insects and disease, invasive species, and tree mortality levels are high or increasing. Careful management can maintain economic value, watershed function, and biodiversity. These factors not only relate to forest and rangeland health, but also wildfire risk.

Adaptation in Action: City of Arcata



The City of Arcata owns and manages 2,134 acres of forest land. This land is managed for multiple purposes and city benefits. Acquired in 1955, the City updates the management plan for the forest every 10 to 15 years. The current management focus is on sustainable, community-based forest management, combining three elements of sustainability– ecological, social, and economic. The Forest Management Plan is developed and implemented through interdisciplinary teams that include a range of natural scientist as well as community stakeholders.

The management of the forest provides an array of benefits to the City of Arcata including the following: watershed protection and restoration; wildlife habitat protection and restoration; recreation; carbon sequestration; and timber harvest. Revenue from carefully managed timber harvest allows for the forest to be self-supporting with excess funds going to park maintenance and acquisition.

The City Forest not only provides the City of Arcata with a host of community benefits, but also results in improved climate resilience as a well-managed forest will be less vulnerable to climate impacts on biodiversity, habitat quality, aquatic ecosystems, and wildfire.

Sources:
Forest Management Plan: http://www.cityofarcata.org/departments/environmental-services/city-forests/forest-management-plan
Arcata City Forest http://www.cityofarcata.org/departments/environmental-services/city-forests

Factors to Consider: A monitoring and management program must be tailored to the specific local or regional setting. The potential threats to the ecosystem should be defined as specifically as possible to ensure that the data obtained and the management plans developed are useful.

Sources of Information and Examples of Application:

- California Department of Forestry and Fire Protection. 2012. Adaptation to Climate Change. Retrieved from http://www.fire.ca.gov/resource_mgt/resource_mgt_eprp_climate/climate_change_adaptation.php
- California Department of Fish and Game. 2007. California Wildlife: Conservation Challenges - California's Wildlife Action Plan. Sacramento: UC Davis Wildlife Health Center. Retrieved from: http://www.dfg.ca.gov/wildlife/wap/report.html

Sector Overlap: Biodiversity and Habitat

Co-Benefits: greenhouse gas sequestration, recreation and open space, tourism, air quality

FR 2: Develop, adopt, and implement integrated plans for mitigating wildfire impacts in wildland-urban interface (WUI) areas. Prepare and adopt general plan safety elements, local hazard mitigation plans, and community wildfire protection plans to establish policies and programs for reducing vulnerability to fire risk in WUI areas.

Description: Communities should evaluate projected risks to WUI areas from wildfires resulting from climate change and set plans and action priorities to reduce potential losses. Such plans provide a policy and programmatic foundation for hazard mitigation actions, such as adjusting construction, land use, and fuel management practices to reduce fire spread in existing and new development in WUI areas.

Factors to Consider: Under California law, cities and counties must adopt general plan safety elements that address various natural hazards, including projected impacts of wildfire threats in WUI areas. Communities are also encouraged by federal law to pursue similar plans as a precondition for receipt of federal grants. For example, under the Disaster Mitigation Act of 2000, preparation of a local hazard mitigation plan is a precondition for federal hazard mitigation grant fund eligibility. Under the Healthy Forests Restoration Act of 2003, preparation of community wildfire protection plan is required as a precondition for receiving fire mitigation assistance grants.

Many general plan safety elements were adopted more than decade ago, while areas of knowledge about climate change have emerged more recently. Adoption of a local hazard mitigation plan or community wildfire protection plan as part of the safety element can benefit a community by bringing its general plan up to date.

Sources of Information:

- A. L. Westerling, B. P. Bryant, H. K. Preisler, T. P. Holmes, H. G. Hidalgo, T. Das, and S. R. Shrestha. 2009. "Climate Change, Growth, and California Wildfire" California Climate Change Center, California Energy Commission. http://www.energy.ca.gov/2009publications/CEC-500-2009-046/CEC-500-2009-046-F.PDF
- Governor's Office of Planning and Research. 2003. General Plan Guidelines. http://cnps.org/cnps/conservation/conference/2006/General_Plan_Guidelines_Overview%202003.pdf

- Cal EMA. 2010 California Multi-Hazard Mitigation Plan. http://hazardmitigation.calema.ca.gov/docs/2010_SHMP_Final.pdf

Examples of Application:

- Following the Tea Fire of 2008 and Jesusita Fire of 2009, Santa Barbara County updated and adopted its local hazard mitigation plan as part of the county general plan safety element. (http://www.countyofsb.org/ceo/oes.aspx?id=376)

Sector Overlap: Infrastructure

Co-Benefits: public safety

FR 3: Design homes, neighborhoods, and streets to minimize vulnerability to fire hazards in WUI areas. Adopt local building, zoning, and subdivision ordinances that encourage "Fire Safe design" – construction and landscape practices that slow the spread of fire and facilitate fire suppression in WUI areas.

Description: Communities should regulate development in and adjacent to WUI areas where fire spread can be facilitated by factors such as topography, weather, fuel accumulation, and presence of flammable vegetation near structures. To minimize fire spread in WUI areas, communities should pursue use of fire-resistant and fire-retardant building and landscape materials, limit housing densities, encourage adequate street widths and connections, establish sufficient water storage and pressure for firefighting, and promote fire prevention practices such as visible house numbering.

Factors to Consider: Experience with wildland fires has demonstrated that fire-resistant construction and neighborhood design are important factors in minimizing fire spread and facilitating fire suppression. Public Resources Code Sections 4201-4204 and Government Code Sections 51175-89, the state's Fire Hazard Severity Zones (FHSZ) law, describe known fire hazard severity risks on a scale ranging from Moderate to Very High within unincorporated county State Responsibility Areas (SRAs) as well as within incorporated city Local Responsibility Areas (LRAs), and require county adoption of FHSZ maps in all SRAs and use of fire-retardant construction measures within Very High FHSZs. Cities are also encouraged to adopt FHSZ maps in LRAs and apply fire-retardant construction measures in VHFHSZs.

Sources of Information:

- Cal EMA. Hazard Mitigation Web Portal. http://hazardmitigation.calema.ca.gov/

- California Department of Forestry and Fire Protection (CAL FIRE). Fire Hazard Severity Zones
  http://frap.fire.ca.gov/projects/hazard/fhz.html
  http://frap.fire.ca.gov/projects/hazard/PRC_4201-4204.pdf
  http://frap.fire.ca.gov/projects/hazard/GC_51175-51189.pdf
- Cal EMA. 2010 California Multi-Hazard Mitigation Plan.
  http://hazardmitigation.calema.ca.gov/docs/2010_SHMP_Final.pdf

Examples of Application:

- The community of Rancho Santa Fe in San Diego County has vigorously implemented Fire Safe design by vigorously encouraging fire-retardant construction and fire-resistant landscaping practices that enable effective fire suppression and greater homeowner safety. (http://www.rsf-fire.org/ordinances/ordinances.html#WUI)

Sector Overlap: Public Health, Socioeconomic, and Equity; Infrastructure

Co-Benefits: public safety

FR 4: Encourage compliance with statutory requirements for vegetation management around structures, and promote fuel breaks to slow fire spread in WUI areas. Enforce statutory standards for provision of defensible space inhibiting wildfire spread on private properties, and implement community shaded fuel breaks to slow the spread of wildfire.

Description: Communities should provide incentives to land owners promoting creation of defensible space around existing structures through removal of flammable materials and trimming of vegetation to reduce fire spread.

Factors to Consider: Public Resources Code Section 4291, California's defensible space law, requires management of vegetation within 100 feet of structures. Adopted after the 1991 Oakland Hills (Tunnel) Fire, the law has been implemented sometimes with federal fire management assistance grants available under the Healthy Forest Restoration Act. A challenging aspect of this law's implementation is securing property owner compliance. To encourage property owners' efforts, cities and counties employ a variety of incentives, including community cleanup days, free chipping, and free green waste hauling. Authorities also sponsor creation of shaded fuel breaks to thin "fuel ladders" to reduce fire spread.

Sources of Information:

- Cal EMA. 2010 California Multi-Hazard Mitigation Plan. Retrieved from http://hazardmitigation.calema.ca.gov/docs/2010_SHMP_Final.pdf
- Cal FIRE. Defensible Space Law. Retrieved from http://www.fire.ca.gov/communications/communications_firesafety_100feet.php

Examples of Application:

- In 2000, the federal Bureau of Land Management (BLM) and CAL FIRE began working on a community fuel break to protect the communities of Poppet Flat and Rancho Encino and the Silent Valley RV Club. The strategic placement of this fuels treatment project slowed the progress of the October 26, 2005, Esperanza Fire, helping to protect these communities. (http://cdfdata.fire.ca.gov/fire_er/fpp_planning_success_detail?story_id=26)
- In Cambria, CAL FIRE is creating the Bridge Street Fuel Break Project, a shaded fuel break to protect the community from fire spreading from surrounding forests. The project is thinning vegetation in a 100-foot-wide zone along the community's northeastern perimeter. The shaded fuel break is expected to materially slow the spread of fire, helping firefighters and residents protect the community. (http://www.fire.ca.gov/resource_mgt/downloads/EP_PublicNotice/BridgeStreet_FuelBreakProject/BridgeStreet_FuelBreak_CEQADocument.pdf)

Sector Overlap: Infrastructure

Co-Benefits: public health

FR 5: Reintroduce fire (controlled or prescribed burns) to fire-prone ecosystems.

Description: In some areas of the state, there is a legacy of over a century of fire suppression that has resulted in high fuel loads. Increased temperature and reduced precipitation increase the risk associated with these fuel loads. Managed fire allows for past ecosystem function to be restored and reduces the risk of wildfire associated with the history of fire suppression. Controlled burns allow maintenance of function and structure amidst increasing threat of destruction from evolving fire frequency and severity.

Factors to Consider: There is risk associated with prescribed burns. The high fuel load that a prescribed burn seeks to reduce also can cause the fire to get out of control. The conditions, timing, safety planning, and noticing to surrounding community members must be carefully considered in a prescribed burn. The other risk that must be managed and addressed is smoke, which can travel great distances and pose a health risk to vulnerable populations.

Sources of Information:

- Cayan, D., A. Lynd, M. Hanemann, G. Franco, and B. Croes. 2006. Scenarios of climate change in California: An overview. Sacramento, CA: California Climate Change Center. Retrieved from http://www.climatechange.ca.gov/
- California Air Resources Board. 2003. Prescribed Burning and Smoke Management. Retrieved from http://www.arb.ca.gov/smp/progdev/pubeduc/pbfs.pdf

Examples of Application:

- The Long-Canyon-Pismo Vegetation Management Program (VMP) prescribed burn is planned for approximately 1,500 acres just outside the City of Pismo Beach's northern border. (http://www.pismobeach.org/index.aspx?NID=575)

Sector Overlap: Biodiversity and Habitat

FR 6: Manage fuel load through thinning and brush removal.

Description: Past fire suppression practices have resulted in increased fuel load. Thinning and brush removal are approaches to reducing this load and associated fire risk. Communities should collaborate with regional conservation districts, CAL FIRE, and other local entities to identify high fire risk and high value areas. Based on this assessment, this group should work together to devise a management plan. Thinning is one of several management practices that can reduce fuel load.

Factors to Consider: Thinning is an effective means of mitigating particular types of fire risk such as crown burning. It is also more appropriate in certain forest types than others. Thinning can vary in scale and intensity (e.g., mechanical thinning, hand thinning, and brush removal). The most appropriate areas in which to engage in thinning and the approach taken must be carefully considered.

Sources of Information:

- Keithley, C. and C. Bleier. 2008. An Adaptation Plan for California's Forest Sector and Rangelands. California Department of Forestry and Fire Protection. Retrieved from http://www.fire.ca.gov/resource_mgt/resource_mgt_EPRP_Climate/Climate_change_Forestry_Adaptation_strategies_12-11-10.pdf
- California Department of Forestry and Fire Protection. 2012. Adaptation to Climate Change. Retrieved from http://www.fire.ca.gov/resource_mgt/resource_mgt_eprp_climate/climate_change_adaptation.php

Examples of Applications:

- San Diego County. 2010. San Diego County Multi-Jurisdiction Hazard Mitigation Plan San Diego County, California. Retrieved from http://www.co.san-diego.ca.us/oes/docs/2010_HazMit_Plan.pdf
- Humboldt County. 2007. General Plan – Safety Element. Retrieved from http://co.humboldt.ca.us/gpu/docs/prelimhearingdraft/group3/safetyelement3-21-07posted.pdf

Co-Benefits: public safety

Biodiversity and Habitat (BH)

For local jurisdictions, the preservation of biodiversity and habitat threatened by climate change often requires collaboration, or at least awareness, of efforts occurring at larger scales. Provision of adequate habitat to allow any necessary wildlife migration may not be possible in small jurisdictions, but these communities can position their efforts to complement larger efforts by carefully managing open space and creating connections between areas of undeveloped land.

BH 1: Identify and protect locations where native species may shift or lose habitat due to climate change impacts (sea level rise, loss of wetlands, warmer temperatures, drought). Modify conservation and open space management priorities to include species adaptation to the effects of climate change.

Description: The modification of management practice can include actions such as purchasing and protecting habitat corridors that move up in elevation, so that species have somewhere to migrate as temperatures increase. Communities have several plans and policies that govern the acquisition, establishment, and management of parks and open space. These should be updated to assure that adaptation needs are included in the criteria used for determining actions.

Factors to Consider: Communities should identify the vulnerable species and habitats in their region as well as the threats that climate change poses. The type of land management or park establishment needed should result from this evaluation.

Sources of Information:

- California Department of Parks and Recreation. 2007. California State Parks' response to climate change (p.1). Retrieved from http://ohv.parks.ca.gov/pages/1140/files/09-11-07revisedohmvr%20commission%20climate%20change%20synopsis.pdf

Examples of Applications:

- San Luis Obispo County. 2011. EnergyWise Plan. Retrieved from http://www.slocounty.ca.gov/Assets/PL/CAP-LUCE/final/SLOCoCAP_Board_Approved-Complete+Doc.pdf

Sector Overlap: Oceans and Coastal Resources, Water Management

Co-Benefits: recreation and open space

BH 2: Collaborate with agencies managing public lands to identify, develop, or maintain corridors and linkages between undeveloped areas.

Description: Species that have several populations distributed over a larger range are less susceptible to climate change impacts. Connected blocks of habitat are less likely to produce fragmented, small species populations. As a community acquires additional open space lands, those that adjoin existing public land should be given priority. In addition, climate change should be considered in the restoration and/or management of these properties. Communities located near state or federal public lands can coordinate their land conservation practices and open space management to foster landscape connectivity.

Factors to Consider: The species and habitats most vulnerable to climate change in a region must be evaluated to identify adaptation needs. This can provide information regarding minimum corridor width and habitat needs.

Sources of Information and Examples of Application:

- San Diego County. 2011. San Diego County General Plan – Conservation and Open Space Element. Retrieved from http://www.sdcounty.ca.gov/dplu/generalplan.html

Sector Overlap: Oceans and Coastal Resources, Water Management

Co-Benefits: recreation and open space

BH 3: Use purchase of development rights (PDR) or conservation easements to protect climate-vulnerable habitats. Protect these lands to allow for migration and to link fragmented landscapes.

Description: PDR or conservation easements allow for compensation of land

owners. There are often limited funds for completion of a PDR or easement. For that reason, careful consideration of the habitat and species associated with a property is required. The focus should be on allowing space for species migration or linking larger tracts of protected land to create a corridor.
Factors to Consider: These projects are often best pursued in collaboration with a local land conservancy or land trust. These organizations are familiar with deed limitations and often have relationships with land owners in their region. PDR is voluntary and therefore relies on a land owner's good relationship with the community. Restoration may be required on these sites and long-term monitoring should be initiated to evaluate ecological function.

Sources of Information:

- Byers, E and K. Marchetti. 2005. The Conservation Easement Handbook. Trust for Public Land and Land Trust Alliance. Retrieved from http://learningcenter.lta.org/attached-files/0/57/5752/CEH_preview.pdf
- Western Governors' Association, Trust for Public Land, and National Cattlemen's Beef Association. 2001. Purchase of Development Rights. Retrieved from http://www.westgov.org/wga/publicat/pdr.pdf

Examples of Application:

- A case study on a project by the Big Sur Land Trust is provided in the following reference: Feifel, K. 2010. Adding the Impacts of Climate Change to a Strategic Plan: Big Sur Land Trust [Case study on a project of the Big Sur Land Trust]. Product of EcoAdapt's State of Adaptation Program. Retrieved from CAKE: http://www.cakex.org/case-studies/2830

Sector Overlap: Oceans and Coastal Resources, Water Management

Co-Benefits: recreation and open space

Agriculture (AG)

For local jurisdictions, agriculture is a difficult sector to address directly. Agricultural activities primarily take place on private land and farmers generally obtain their own water supply. Local and regional jurisdictions can take action to support climate-friendly and adaptive changes by farmers. Incentives and resources can also be provided to ease the strain placed on agriculture by climate change.

AG 1: Promote economic diversity. Adjust land use regulations (e.g., agricultural zoning) to encourage the diversification of potential sources of farm income, including value-added products, agricultural tourism, roadside stands, organic farming, and farmers markets.

Description: Diverse income sources can serve to reduce the financial consequences of climate change impacts on agricultural land owners. Adjustment of land use regulations will allow and encourage practices such as agricultural tourism or other commercial operations.

Factors to Consider: Adjustments to allow agricultural tourism must carefully consider the adjacent land owner and the potential consequences of new commercial operations such as increased traffic.

Sources of Information:

- Barbieri, C., E. Mahoney, and L. Butler. 2008. Understanding the Nature and Extent of Farm and Ranch Diversification in North America. Rural Sociology, 73(2), 205-229.

Examples of Application:
Several counties in California have allowed for agricultural tourism in their zoning codes:

- County of San Diego. 2010. County of San Diego Zoning Code. San Diego, CA. Retrieved from http://www.sdcounty.ca.gov/dplu/zoning/index.html
- County of El Dorado. 2010. El Dorado County Code Title 17: El Dorado County Zoning Ordinance. Retrieved from http://www.edcgov.us/Government/Planning/Zoning_Ordinance_and_Maps.aspx
- County of Lake. 2005. Lake County Zoning Code. Retrieved from http://www.co.lake.ca.us/Government/Directory/Community_Development/ZoneOrd.htm

Sector Overlap: Public Health, Socioeconomic, and Equity

Co-Benefits: economic continuity

AG 2: Assist and educate farmers in adapting to climate change. Work with entities such as resource conservation districts, cooperative extensions, and other agricultural organizations to introduce adaptation techniques and shorten the time it takes for new scientific findings and adaptive approaches to reach farmers.

Description: Agricultural associations, cooperative extensions, resource conservation districts, and other entities are positioned to understand the needs and concerns of farmers. Working with these entities will allow jurisdictions to identify those agricultural techniques and information most likely to be beneficial to local farmers. Methods can include distribution of educational materials, workshops, or demonstration/training sessions on adaptive techniques.

Factors to Consider: Communities should identify organizations most closely aligned with local farmers to assure information reaches its intended audience. Strategies and support should be specifically tailored to local needs.

Sources of Information and Examples of Application:

- San Luis Obispo County's *EnergyWise* Plan includes efforts to provide up-to-date science and research to local farmers. (San Luis Obispo County. 2011. EnergyWise Plan. Retrieved from http://www.slocounty.ca.gov/Assets/PL/CAP-LUCE/final/SLOCoCAP_Board_Approved-Complete+Doc.pdf)

Adaptation In Action: adaptation in yolo county

A web-based resource has been developed in Yolo County to "help equip farmers and local policy makers with relevant climate change information that can be used to plan for the future" (http://agadapt.ucdavis.edu/, ¶ 2). The website, developed in collaboration with University of California Davis and funded through the California Energy Commission, provides user-friendly resources including assessments of climate change impacts on agriculture and adaptation strategies. In addition to serving as an information source, the website complements community engagement efforts such as workshops and speaker events.

Source: Agricultural Adaptation to Climate Change in Yolo County. Retrieved from http://agadapt.ucdavis.edu/

AG 3: Support alternative irrigation techniques (e.g., subsurface drip irrigation) to reduce water use and encourage use of climate-sensitive water supplies.

Description: Local jurisdictions can promote alternative irrigation techniques through partial or full coverage of cost and technical support. Water use savings result in reduced greenhouse gases. In some cases, the conversion to alternative irrigation techniques can be funded as offsite mitigation of greenhouse emissions as part of a project's CEQA review. An incentive program should be accompanied by an outreach program to raise awareness of the program and irrigation alternatives.

Factors to Consider: The current irrigation techniques in a region and the growing requirements for crops must be evaluated in developing a program and/or fund to support irrigation upgrades. Changed irrigation practices may not be useful for all crops and entail substantial investment, labor, and energy. A program focused on irrigation techniques should be developed in collaboration with local agricultural organizations or resource conservation districts.

Sources of Information and Examples of Applications:

- The state has developed assessments evaluating the potential of adaptive actions in agriculture. (Jackson, L.E., F. Santos-Martin, A.D. Hollander, W.R. Horwath, R.E. Howit, J.B. Kramer, A.T. O'Geen, B.S. Orlove, J.W. Six, S.K. Sokolow, D.A. Summer, T.P Tomich, and S.M. Wheller. 2009. *Potential for adaptation to climate change in an agricultural landscape in the central valley of California.* Sacramento, CA: California Climate Change Center. http://www.energy.ca.gov/2009publications/CEC-500-2009-044/CEC-500-2009-044-F.PDF)
- The county of San Luis Obispo includes water supply measures and assessment in their *EnergyWise Plan*. (San Luis Obispo County. 2011. *EnergyWise Plan*. Retrieved from http://www.slocounty.ca.gov/planning/CAP)

Sector Overlap: Water Management

Co-Benefits: greenhouse gas emissions reduction

Infrastructure (IN)

Infrastructure strategies seek to improve the resilience of systems that provide the resources and services critical to community function: roads, rail, water (pipes, canals, and dams), stormwater, waste (sewer and solid waste), electricity, gas, and communication systems. Climate change increases the likelihood of both delays and failures of infrastructure.

IN 1: Incorporate consideration of climate change impacts as part of infrastructure planning and operations. Carefully assess the potential impact of climate change as part of the update of plans that manage community infrastructure systems, such as urban water management plans, stormwater management plans, transportation plans, and capital improvement plans.

Description: There a number of plans, programs, or other actions that manage the infrastructure systems in a community. These plans should assess the vulnerability of infrastructure lines to multiple climate change impacts and provide for relocation or retrofit based on level of risk. Addressing climate

change in plans and ongoing operations procedures (e.g., maintenance) assures improved preparation and greater resilience to climate change impacts.
Factors to Consider: Community plans and programs should be consistent. One plan that should include careful assessment of climate change impacts on infrastructure systems is a local hazard mitigation plan (LHMP). This assessment should result in LHMP strategies, but also adjustment of other community management plans.

Sources of Information and Examples of Application:

- The City of Santa Cruz Climate Adaptation Plan (2012) is an amendment to the City's 2007 Local Hazard Mitigation Plan. The climate adaptation plan includes an assessment of infrastructure with specific focus on potential disruption of critical community services. (http://www.cityofsantacruz.com/Modules/ShowDocument.aspx?documentid=23643)

Co-Benefits: public safety

IN 2: Assess climate change impacts on community infrastructure.
Complete an overall assessment, including economic impacts and threats to public health and safety, for projected climate change impacts on local transportation, water, wastewater, stormwater, energy, and communication systems.

Description: The assessment of projected climate change impacts on community infrastructure should assess consequences under a "do nothing" scenario. The assessment should evaluate a full range of potential impacts. The outcome of the assessment is a "hot spots" map that identifies critical locations in infrastructure systems.

Factors to Consider: Particular attention should be paid to the economic risk associated with climate change impacts on infrastructure. While retrofit or relocation of infrastructure such as roads or water mains can be costly, the costs associated with projected disruption to these systems can be even higher. The economic risk can be a strong justification for short-term action.

Sources of Information:

- California Natural Resources Agency (CNRA). 2009. *2009 California Climate Adaptation Strategy*. Retrieved from http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf

Examples of Application:

- The *Sea Level Rise Adaptation Strategy for San Diego Bay* (2012) includes a detailed assessment of infrastructure vulnerability. (ICLEI-Local Governments for Sustainability. (2012). Sea Level Rise Adaptation Strategy for San Diego Bay.

Retrieved from http://www.icleiusa.org/action-center/planning/san-diego-bay-sea-level-rise-adaptation-strategy)

- The City of Santa Cruz Climate Adaptation Plan includes a detailed, map-based assessment of infrastructure. Projected impacts were assessed and categorized by level of potential impact. (City of Santa Cruz. (2012). City of Santa Cruz Climate Adaptation Plan. Retrieved from http://www.cityofsantacruz.com/Modules/ShowDocument.aspx?documentid=23643)

Sector Overlap: Public Health, Socioeconomic, and Equity

Co-Benefits: Public Safety

IN 3: Facilitate access to local, decentralized renewable energy.

Description: Decentralized renewable energy de-emphasizes reliance on larger centralized energy facilities and allows a greater amount of energy to be produced locally. There are a variety of ways to facilitate or promote residential renewable energy. Strategies include solar rebate programs, integration into development requirements, and collaboration with energy suppliers (e.g. PG&E).

Factors to Consider: This is a strategy most often associated with greenhouse gas (GHG) emissions reduction. As a result, it serves to meet state, regional, and local requirements. These requirements include those of the California Environmental Quality Act (CEQA). Under CEQA, renewable energy can be a mitigation measure for GHG emissions.

Sources of Information:

- California Natural Resources Agency (CNRA). 2009. *2009 California Climate Adaptation Strategy*. Retrieved from http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf

Examples of Application:

- The City of Chula Vista *Climate Change Working Group Measures Implementation Plan* includes a measure focused on energy efficiency and renewable energy development. The strength of this plan is that each measure is accompanied by a detailed implementation plan that includes upfront and on-going program costs. (http://www.chulavistaca.gov/clean/PDFs/CCWGImplementationPlans_FINAL_REVOct08.pdf)

- Through the *City of San Francisco - Solar Energy Incentive Program*, the City and County of San Francisco provides incentives to residents and businesses that install solar energy on their properties. The program provides incentives of $2,000 to residential participants and even higher amounts for participating businesses. (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA168F)

Sector Overlap: Public Health, Socioeconomic, and Equity

Co-Benefits: greenhouse gas emissions sequestration

IN 4: Use low-impact development (LID) stormwater practices in areas where storm sewers may be impaired by high water due to sea level rise or flood waters.

Description: Elevated water levels due to sea level rise or inland flooding can back up a stormwater system. The inability of stormwater to drain can result in flooding in areas inland from the receiving body. Low-impact development (LID) delays and reduces the volume of stormwater handled by the system, thus reducing the risk of flooding. LID practices manage stormwater close to its source by mimicking a site's predevelopment hydrology and use design techniques that infiltrate, evapotranspirate, and reuse runoff.

Factors to Consider: The implementation of low-impact design strategies for adaptation should be targeted for those areas of a community most vulnerable to having stormwater systems back up. This requires that a community conduct an assessment to identify stormwater outfalls most likely to be flooded.

Sources of Information:

- The United States Environmental Protection Agency's "Low Impact Development" website includes a wide range of information including fact sheets, case studies, and literature reviews. (http://water.epa.gov/polwaste/green/index.cfm)

Examples of Application:

- Sea Level Rise Adaptation Strategy for San Diego Bay (2012) includes a step-by-step process for evaluation, prioritization, and implementation of low-impact design practices. (ICLEI-Local Governments for Sustainability. (2012). Sea Level Rise Adaptation Strategy for San Diego Bay. Retrieved from http://www.icleiusa.org/action-center/planning/san-diego-bay-sea-level-rise-adaptation-strategy)

Sector Overlap: Public Health, Socioeconomic, and Equity; Ocean and Coastal Resources; Water Management; Biodiversity and Habitat

Co-benefits: water quality

ENCLOSURE 6

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Climate Variability and Change and California Water

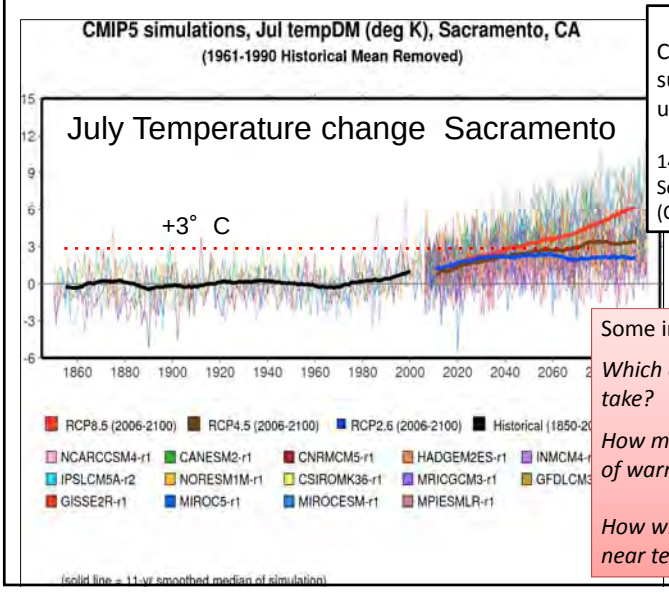
Lahontan Water Board Barstow, CA November 13, 2014

Dan Cayan Scripps Institution of Oceanography and USGS
(with Mike Dettinger, David Pierce, Suraj Polade, Mary Tyree, Alexander Gershunov)

key points

- Broad impacts of climate change will increase in future decades
- Average precipitation may not change much, but volatile precipitation climate in present and future produces periodic dry (and wet) spells.
- Importance of the presence or absence of few very large storms

virtually all climate simulations project warming, but with a wide envelope of temperature change



CMIP5 GCMs project +3° C summer warming by 2060, under mid and high RCPs

14 GCMs X 3 RCP Emissions Scenarios IPCC 5th Assessment (CMIP5) models

Some important questions:

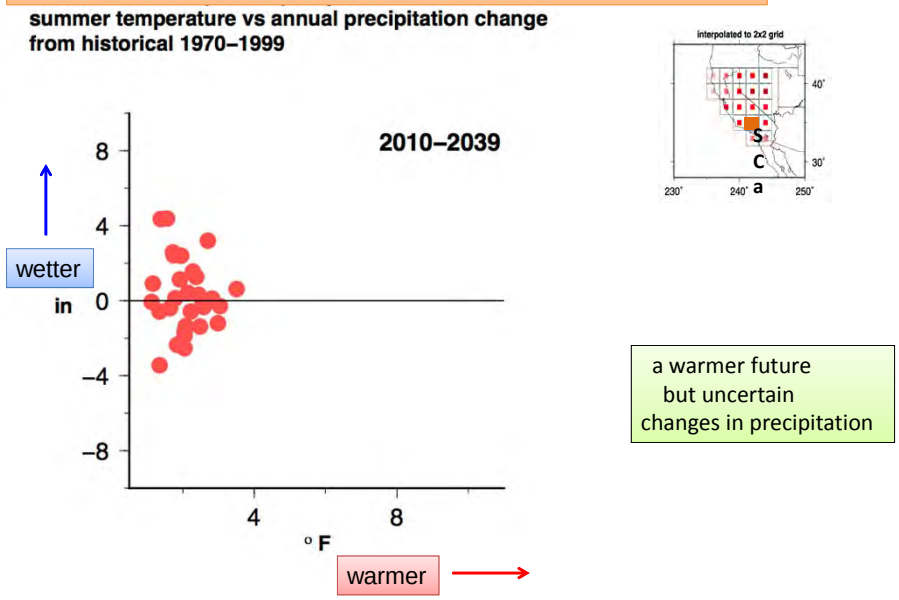
Which emissions pathway will we take?

How much summer amplification of warming?

How will temperature change in near term?

Projected change temperature and precipitation

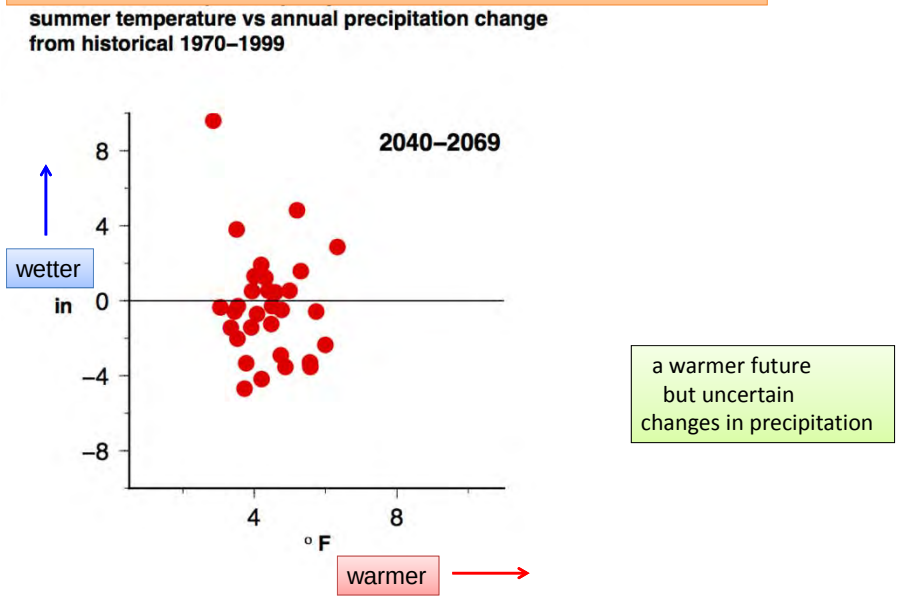
31 Global Climate Models RCP 8.5 Los Angeles region



a warmer future
but uncertain
changes in precipitation

Projected change temperature and precipitation

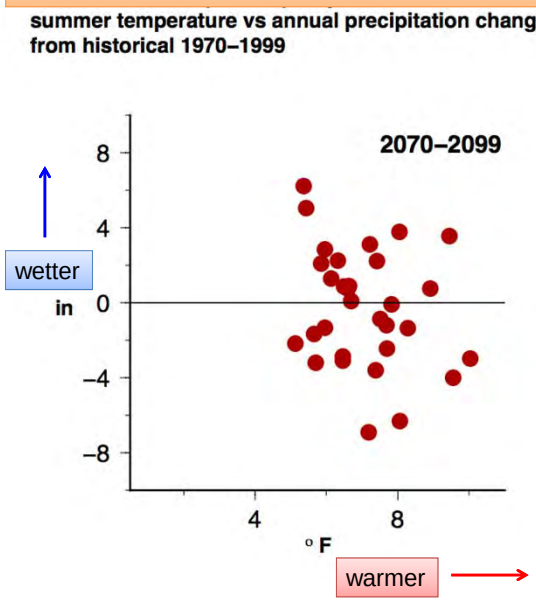
31 Global Climate Models RCP 8.5 Los Angeles region



a warmer future
but uncertain
changes in precipitation

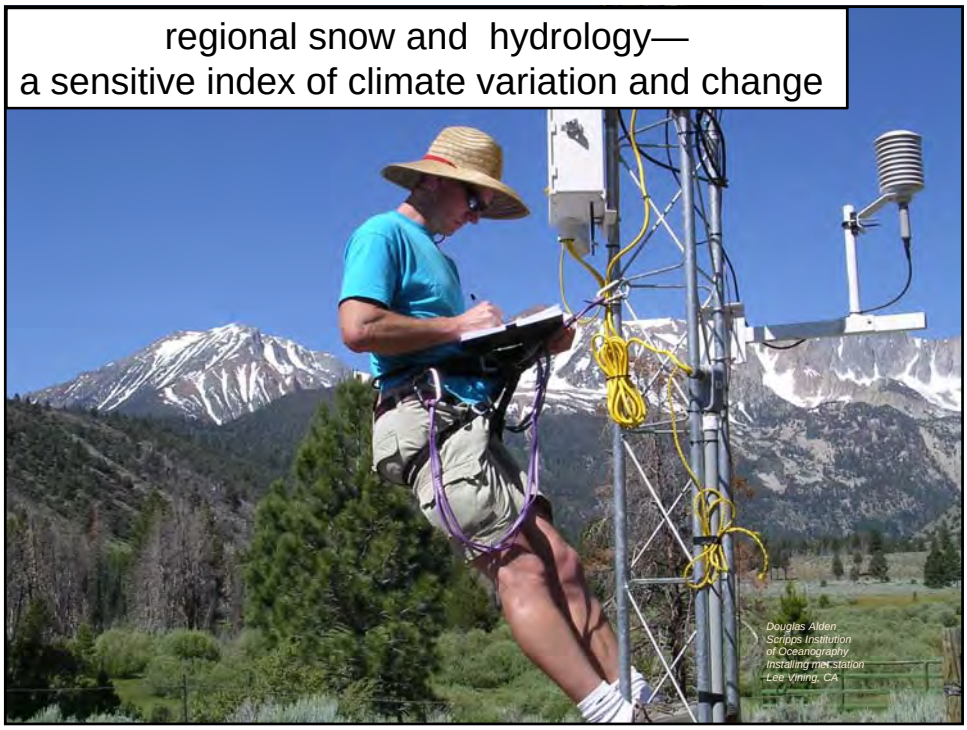
Projected change temperature and precipitation

31 Global Climate Models RCP 8.5 Los Angeles region

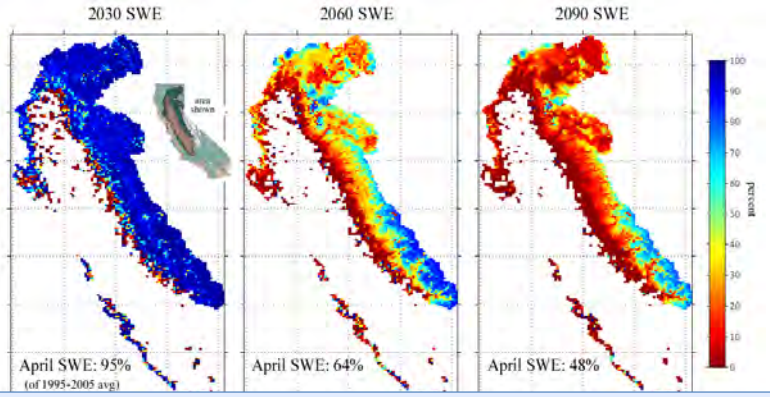


a warmer future
but uncertain
changes in precipitation

regional snow and hydrology—
a sensitive index of climate variation and change



Loss of California Spring Snowpack from 21st Century warming

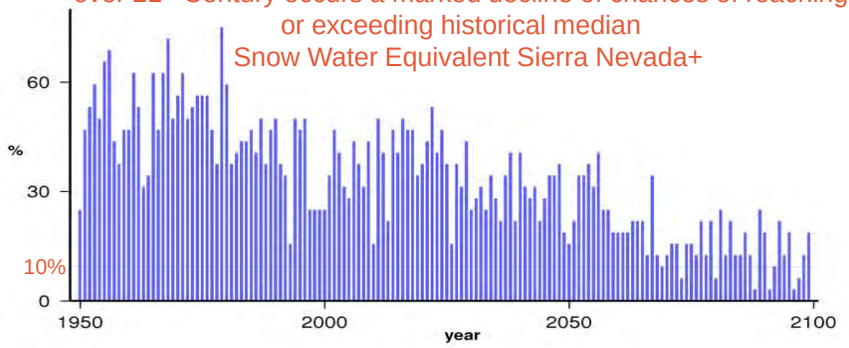


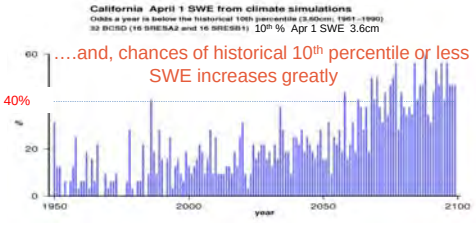
•Under this scenario, California loses half of its spring (April 1) snow pack due to climate warming. Less snow, more rain, particularly at lower elevations. The result is earlier run-off, more floods, Less stored water. This simulation by Noah Knowles is guided by temperature changes from PCM's Business-as-usual coupled climate simulation. (this is a low-middle of the road emissions and warming scenario)

Knowles, N., and D.R. Cayan, 2002: Potential effects of global warming on the Sacramento/San Joaquin watershed and the San Francisco estuary. *Geophysical Research Letters*, **29**(18), 1891.

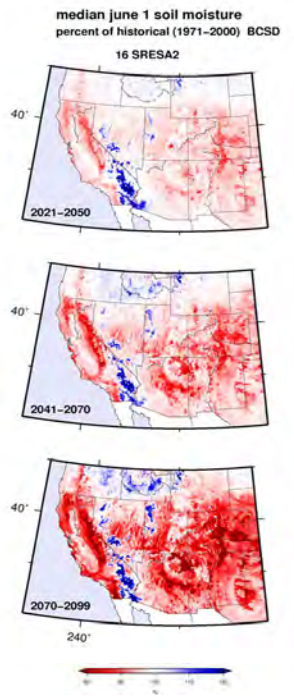
California April 1 SWE from climate simulations
Odds a year is above the average historical median (11.86cm; 1961–1990)
32 BCSD (16 SRESA2 and 16 SRESB1) Median Apr 1 SWE 11.9cm

over 21st Century occurs a marked decline of chances of reaching or exceeding historical median Snow Water Equivalent Sierra Nevada+





….and, chances of historical 10th percentile or less SWE increases greatly



early 21st

middle 21st

late 21st

Drier Summer Landscapes

increased warming and diminished snow causes successively greater soil drying throughout 21st Century

(*this picture could change somewhat under more recent CMIP5 simulations*)

Cayan et al. Ch 6 Southwest Climate Assessment

since 1985 the number of large wildfires in western U.S. increased four-fold

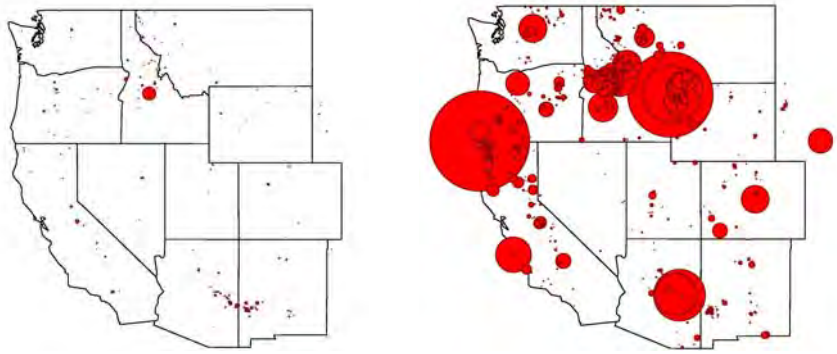
relative to previous 15 years, mostly forest fires, not shrubland fires

Anthony Westerling et al. *Science* August 2006

large summer wildfires occur more often in years with early/warm springs

Late Snowmelt Years

Early Snowmelt Years



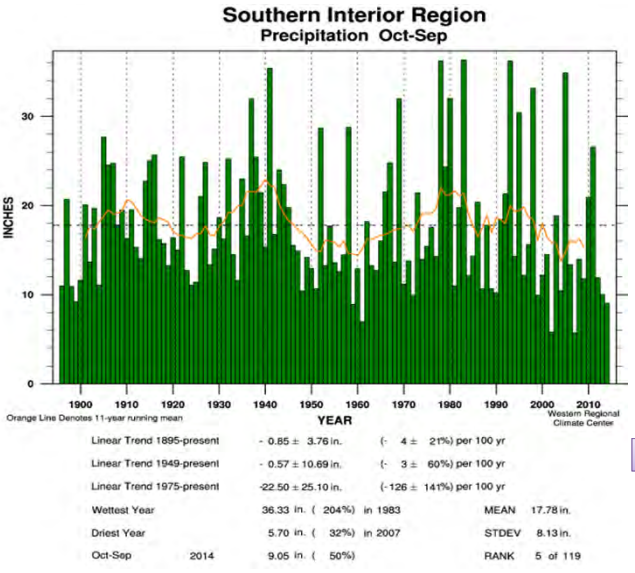
1972 - 2003, NPS, USFS & BIA Fires over 1000 acres

Area burned is proportional to size of red dots

The warming and earlier springs during last few decades have extended and intensified the fire season in mid-elevation forests

Tony Westerling et al *Science* 2006

2012-2014 dry spell is characteristic of California's volatile precipitation climate



Southern California Interior Annual Precipitation

coef of Variation 46%
mean 17.8 inches
std dev 8.1 inches

California has a narrow seasonal window to generate its annual water supply.

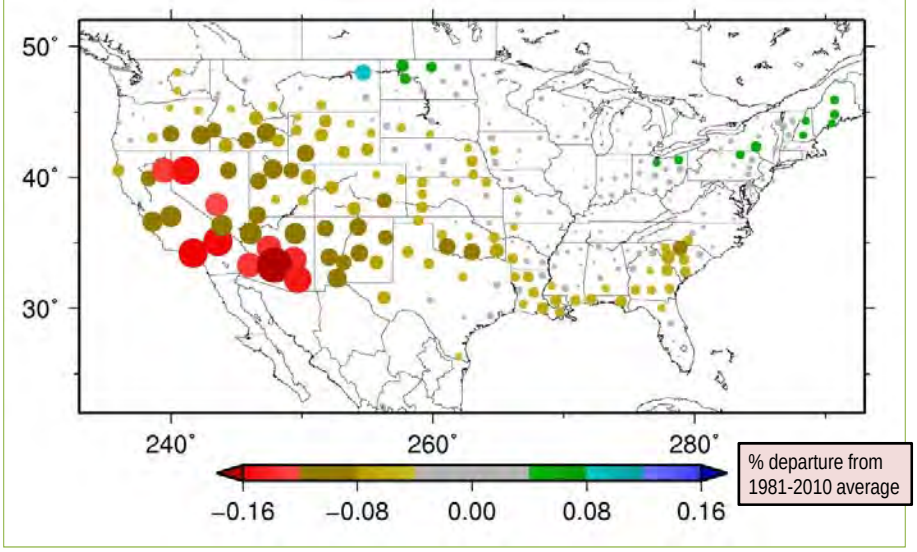
If atmospheric conditions are unfavorable during that period, a dry year results

2014 ~50% of long term average

California Climate Tracker
Western Regional Climate Center

California and much of western region has been more-or-less dry since 1999

observed precipitation departure (% of average), 1998-99 thru 1912-13 Inot including the present water year)



Loss of water during the recent drought has caused the earth's crust to rise

GPS displacements relative to 2003-2012 average—4mm upward displacement average over western US

Ongoing drought-induced uplift in the western United States
by A. A. Borsa (1), D. C. Agnew(1) and D. R. Cayan(1,2)
published in the online version of *Science* on August 20, 2014.
1 Scripps Institution of Oceanography, UC San Diego
2 US Geological Survey La Jolla, CA

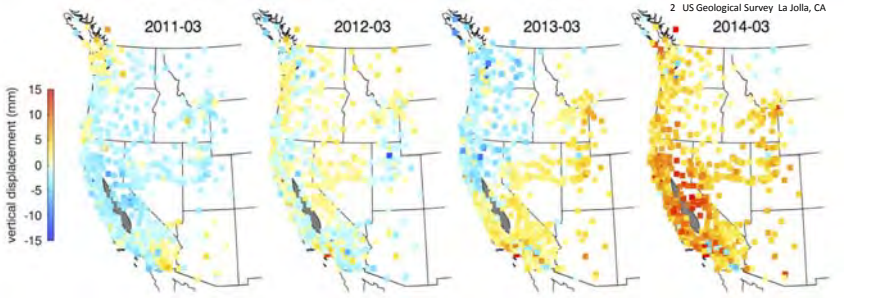
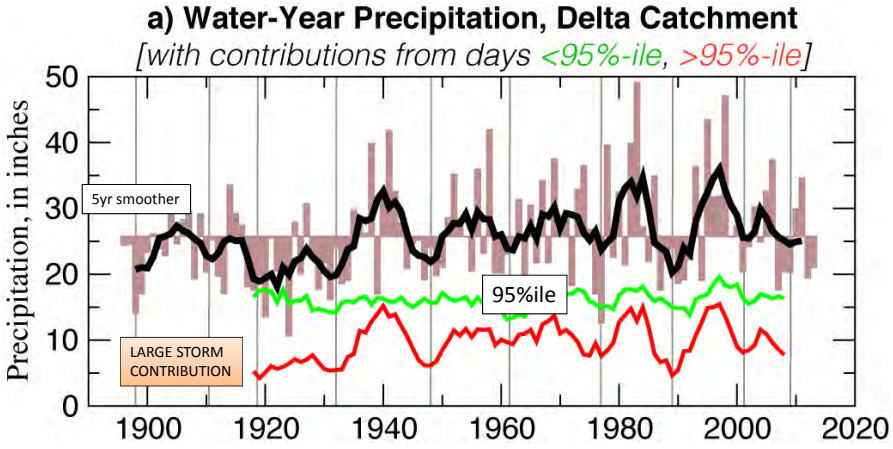


Figure 2. Maps of vertical GPS displacements on March 1 of 2011 through 2014. Uplift is indicated by yellow-red colors and subsidence by shades of blue. Gray region is where stations were excluded in the Central Valley of California due to strong agricultural pumping signal.

GPS estimate by Borsa et al. in present study showing deficit of ~240km**3 water in March 2014 relative to 2003-2014 baseline over western U.S., west of 109° W.
This is in general agreement with GRACE satellite observations, S. Castle et al 2014 GRL found ~65km**3 water water loss in Colorado Basin during 2004-2013.

a few large storms (or their absence)

account for a disproportionate amount of California's precipitation variability



Mike Dettinger

Dettinger and Cayan Drought and the Delta—A Matter of Extremes
accepted, San Francisco Estuary and Watershed Science, April 2014

Summary Points

- California's climate is prone to year-to-year and longer term variation in precipitation—drought is an expected part of our climate—present and future.
- California dry spells often build up over multiple years,. A more/less dry pattern has been in place since 1999. A variety of climate patterns may produce drought--there is not a unique atmospheric drought-circulation pattern.
- The absence of a few very large storms is often a key driver of dry years. And large storms are frequently involved in "busting" drought.
- Climate change will broadly affect California hydroclimate and impact sectors and systems across-the-board. Expected impacts of climate change: longer "warm" season, loss of spring snow pack, increased wildfire threat, more winter floods.
- Climate changes in annual precipitation is not so clear in California. However, climate change may shift precipitation characteristics—fewer overall wet days but more intense heavy events. Climate change projections—warmer, fewer overall wet days but more intense heavy events.

  Implications:
  - Less snow, more rain
  - Earlier run-off from traditionally snow-fed mountain watersheds
  - Higher floods
  - Potentially, less stored water

ENCLOSURE 7

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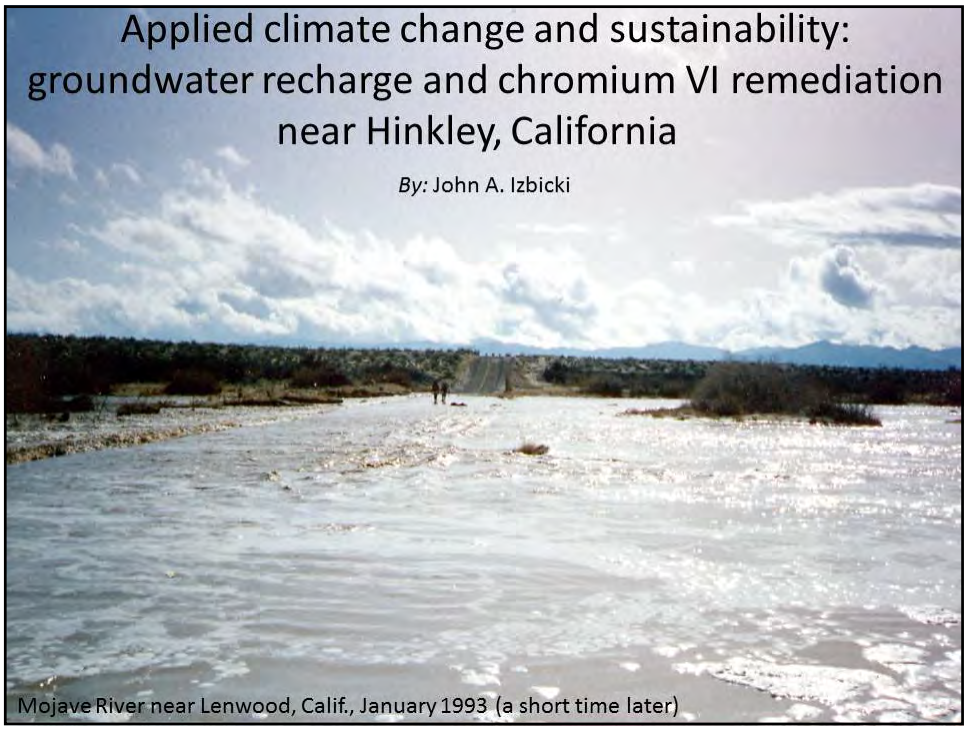
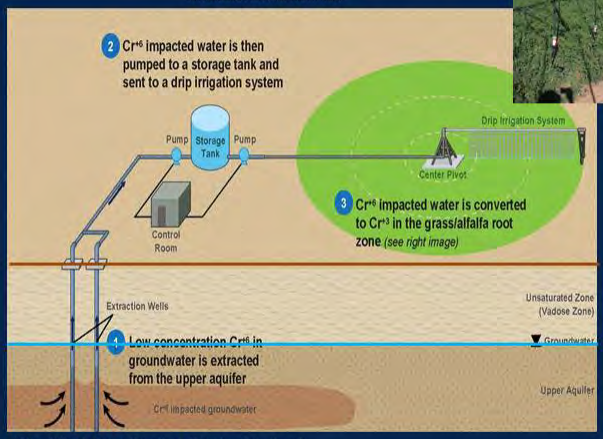
Applied climate change and sustainability: groundwater recharge and chromium VI remediation near Hinkley, California
By: John A. Izbicki
Mojave River near Lenwood, Calif., January 1993


Applied climate change and sustainability: groundwater recharge and chromium VI remediation near Hinkley, California
By: John A. Izbicki
Mojave River near Lenwood, Calif., January 1993 (a short time later)

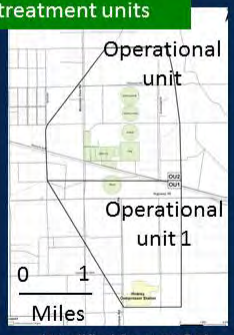
Sustainability of agricultural land treatment to remove Cr VI

Reduction of Cr VI to Cr III in agricultural treatment units



(Modified from Project Navigator, Inc.)

Proposed agricultural treatment units



(Modified from PG&E)

Groundwater pumping required for agricultural treatment units and reduction of Cr VI to Cr III

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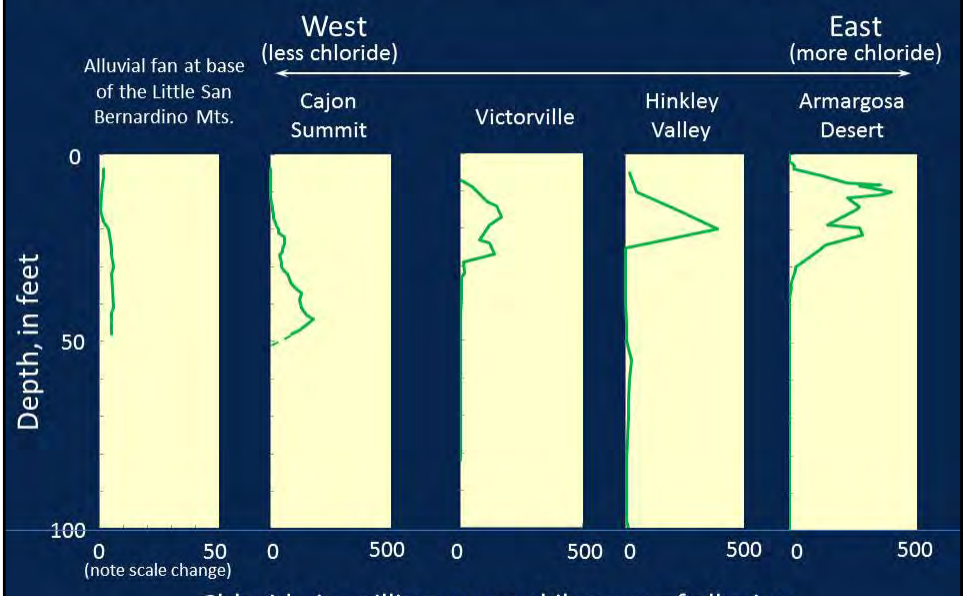
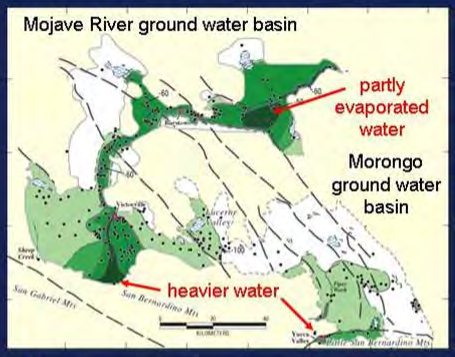
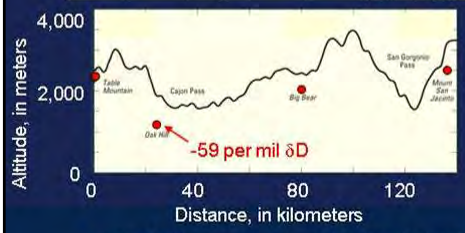
Changing climate in the Mojave Desert in recent geologic time



(Data from various sources)

delta Deuterium composition of water from wells





Projected topography along the San Gabriel, San Bernardino, and San Gabriel Mountains

delta Deuterium, in per mil

- > -60
- -60 to -70
- -70 to -80
- -80 to -90
- < -90

- Isotopically heavier precipitation, condensed at lower altitudes and warmer temperature near Cajon Pass, gives rise to surface flow in the Mojave River
- Similar processes give rise to recharge in the southern part of the study area near San Gorgornio Pass
- Isotopically heavy water west of the Mojave River recharged as infiltration from intermittent streams near Cajon Pass

(From Izbicki and others, 2004)

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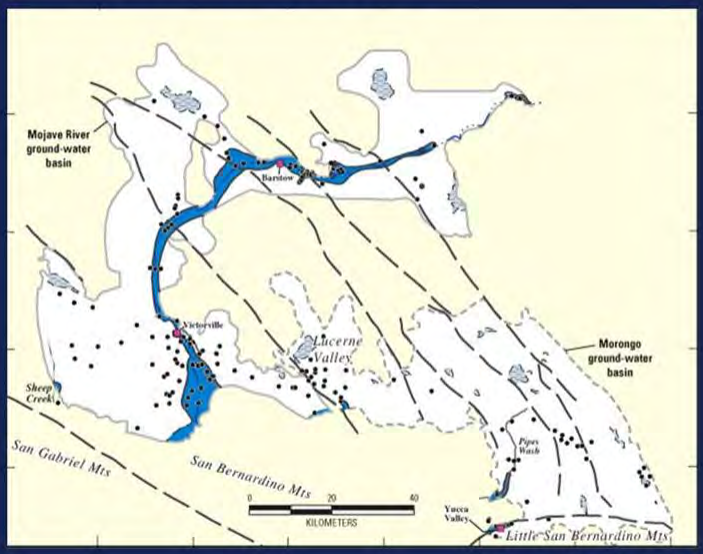
Tritium in water from wells



Tritium, in tritium units

- > 0.2
- < 0.2

(From Izbicki and others, 2004)

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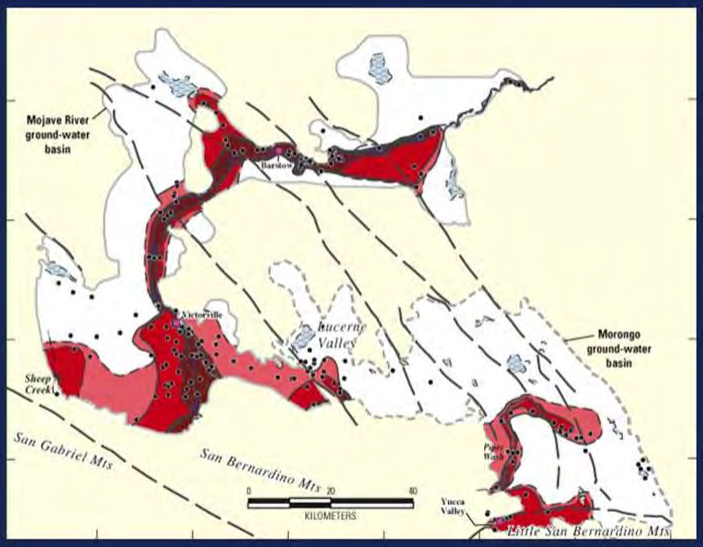
Carbon-14 in water from wells



(From Izbicki and others, 2004)

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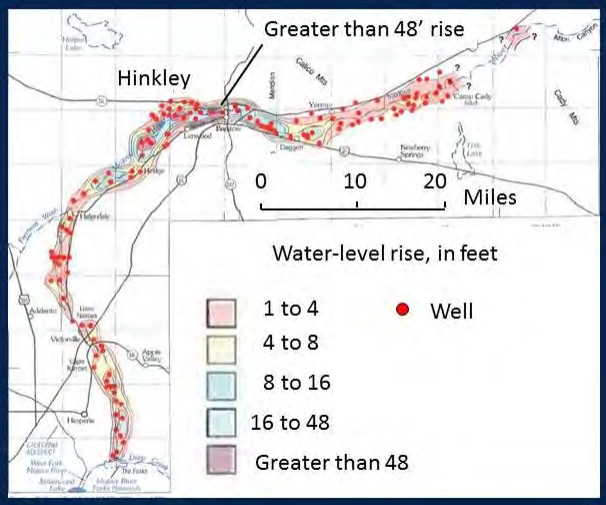
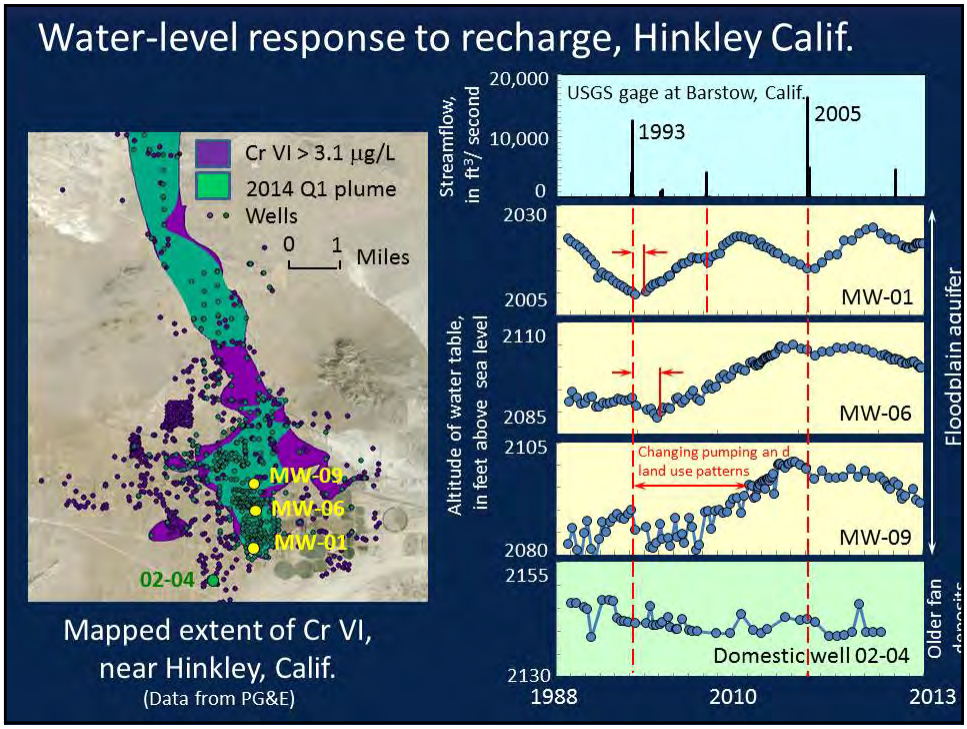
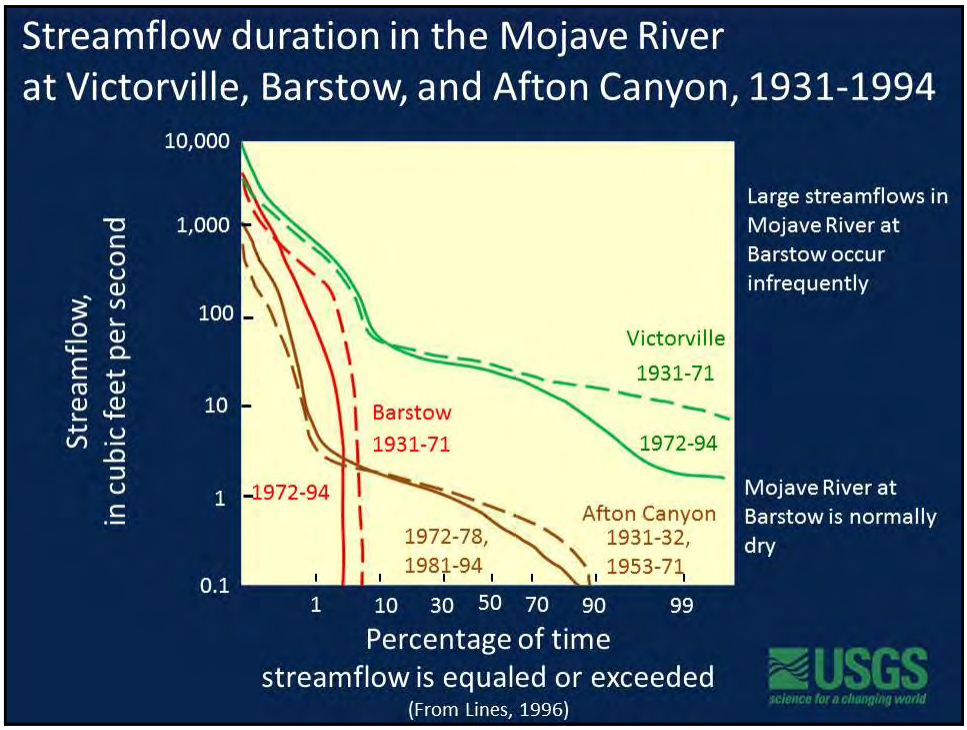
Water-level rise along the Mojave River November 1992 to March 1993

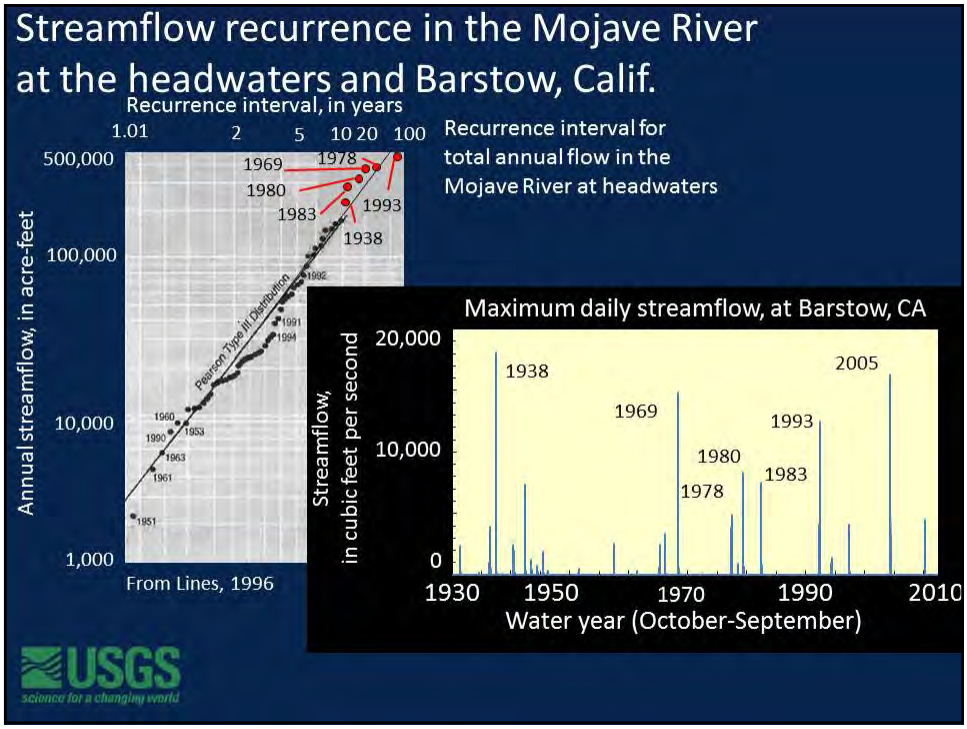


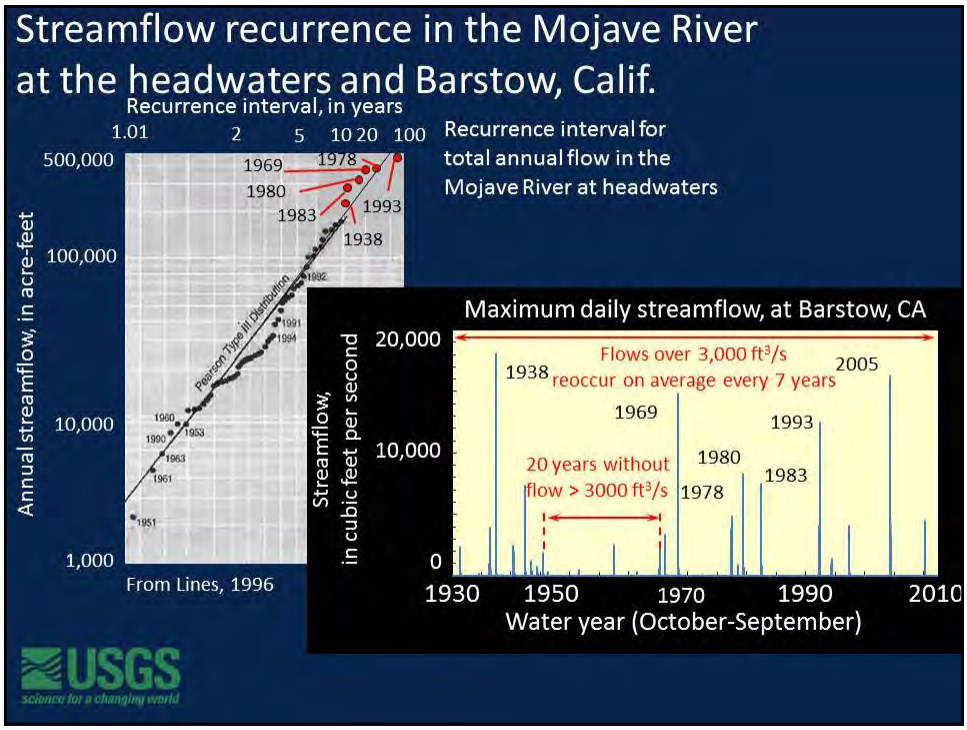
(From Lines, 1996)

USGS science for a changing world


Water-level response to recharge, Hinkley Calif.
Cr VI > 3.1 µg/L
2014 Q1 plume
Wells
0 1 Miles
MW-09
MW-06
MW-01
02-04
Mapped extent of Cr VI, near Hinkley, Calif.
(Data from PG&E)
Streamflow, in ft³/ second
20,000
10,000
0
USGS gage at Barstow, Calif.
1993
2005
Altitude of water table, in feet above sea level
2030
2005
MW-01
2110
2085
MW-06
2105
2080
Changing pumping and land use patterns
MW-09
2155
2130
Domestic well 02-04
Floodplain aquifer
Older fan
1988
2010
2013


Streamflow duration in the Mojave River at Victorville, Barstow, and Afton Canyon, 1931-1994
Streamflow, in cubic feet per second
10,000
1,000
100
10
1
0.1
Victorville
1931-71
1972-94
Barstow
1931-71
1972-94
Afton Canyon
1931-32,
1953-71
1972-78,
1981-94
1 10 30 50 70 90 99
Percentage of time streamflow is equaled or exceeded
(From Lines, 1996)
Large streamflows in Mojave River at Barstow occur infrequently
Mojave River at Barstow is normally dry
USGS
science for a changing world


Streamflow recurrence in the Mojave River at the headwaters and Barstow, Calif.
Recurrence interval, in years
1.01
2
5
10
20
100
500,000
100,000
10,000
1,000
Annual streamflow, in acre-feet
1969
1978
1980
1983
1993
1938
Pearson Type III Distribution
From Lines, 1996
Recurrence interval for total annual flow in the Mojave River at headwaters
Maximum daily streamflow, at Barstow, CA
Streamflow, in cubic feet per second
20,000
10,000
0
1938
1969
1980
1978
1983
1993
2005
1930
1950
1970
1990
2010
Water year (October-September)
USGS
science for a changing world


Streamflow recurrence in the Mojave River at the headwaters and Barstow, Calif.
Recurrence interval, in years
1.01
2
5
10
20
100
500,000
100,000
10,000
1,000
Annual streamflow, in acre-feet
1969
1978
1980
1983
1993
1938
Pearson Type III Distribution
From Lines, 1996
Recurrence interval for total annual flow in the Mojave River at headwaters
Maximum daily streamflow, at Barstow, CA
Flows over 3,000 ft³/s reoccur on average every 7 years
20 years without flow > 3000 ft³/s
Streamflow, in cubic feet per second
20,000
10,000
0
1938
1969
1980
1978
1983
1993
2005
1930
1950
1970
1990
2010
Water year (October-September)
USGS
science for a changing world

Conclusions

Mojave River at Barstow, January 18, 1993. Flow is about 4,200 cubic feet per second (From Lines, 1996)

- Climate in the Mojave Desert has been changing for millennia
- Uncertainty as to the long-term changes in climate on Groundwater recharge from the Mojave River—generally drier climate versus larger and more frequent extreme events
- Other man-made influences have already created measurable impacts on groundwater recharge and availability
- The existing record (1931 to present) shows streamflows greater than 3000 ft^3/s and subsequent large-scale recharge occurs on average every 7 years, but that extended periods of up to 20 years can occur without significant flow and recharge from the Mojave River

USGS
science for a changing world

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ENCLOSURE 8

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Climate Change Adaptation and Mitigation Policy: Statewide Vision and Framework

Max Gomberg
Climate Change Advisor,
State Water Resources Control Board
November 13, 2014

Multiple State Planning Efforts

- Water Action Plan
- AB 32 Scoping Plan
- Safeguarding California Plan
- California Water Plan Update
- Desert Renewable Energy Conservation Plan

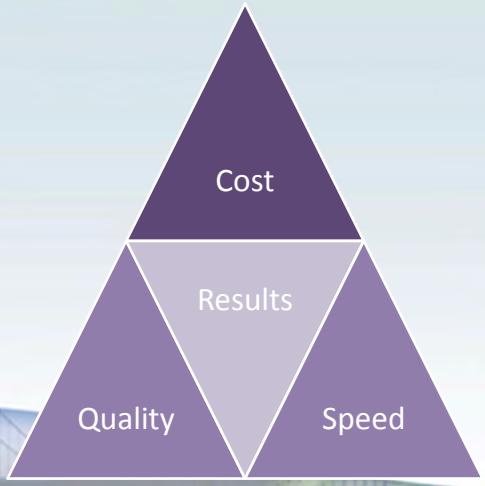
Research and Policy Guidance

- Statewide Climate Assessments
  - 4th Assessment proposals under development
  - http://resources.ca.gov/climate/fourth/
- Adaptation Planning Guide
- Governor's Office of Planning and Research – General Plan Guidelines Update
- Federal focus on resilience

Challenges

- Lack of funding
  - Siloes in funding streams
- Disaster response and recovery vs. slower moving changes (e.g., loss of Sierra snowpack)
- Regulatory uncertainty

Effective Adaptation Requires Investment



5

2014 Executive and Legislative Drought Response Actions

- Three Executive Orders
- Emergency Legislation ($687 million)
- Water Bond ($7.5 billion)
- Groundwater Management Legislation
- Other Drought Bills
  - Homeowner Associations
  - Pavley & Wolk Bills (Stormwater capture, Voluntary energy use reporting, Leak detection)

Water Bond 2014

Watershed Protection, Watershed Ecosystem Restoration, State Settlements - $1.495B

- Conservancies $327.5M
- Wildlife Conservation Board $200M (restoration of flows)
- Department of Fish and Wildlife $285M (out of Delta, no mitigation on BD
- Department of Fish and Wildlife $87.5M (in Delta with constraints)
- State settlement obligations including CVPIA $475M.
- Rivers and Creeks $120M.

Statewide Flood Management - $395M

- Statewide flood management projects and activities $100M.
- For Delta levee subvention programs and delta flood protection projects $2

General Provisions

- Funding eligibility requires urban or agricultural water management plans Conservation Act.
- Bay Delta Conservation Plan neutral.
- Protects existing water rights and reaffirms area of origin protections.
- The bond includes $7.12 billion in new debt, plus the repurposing of existing unspent bond funds of $425 million for a total of $7.545 billion. None of the repurposed bond funds would be taken from existing projects.
- Assumes repurposing of $105M from Prop. 84, $95M from Prop. 50, $86M from Prop 13, $25.5M from Prop 204, $13.5M from Prop 44, and $100M from Prop IE

Water Bond 2014

Regional Water Reliability $810M

- Integrated Regional Water Management $510M.
- Stormwater capture $200M.
- Water conservation $100M.

Safe Drinking Water - $520M

- Provide clean, safe and reliable drinking water to all Californians. With minimum to leverage federal funds for safe drinking water and clean water programs and for disadvantaged communities.
- Small Community Wastewater Program $260M.
- Drinking Water Public Infrastructure $260M.

Storage - $2.7B

- Continuous appropriation for water storage projects.

Water Recycling - $725M

- Statewide water recycling projects and activities.

Groundwater Sustainability - $900M

- Prevent and reduce groundwater contaminants $800M.
- Provide sustainable groundwater management planning and implementation $100M.

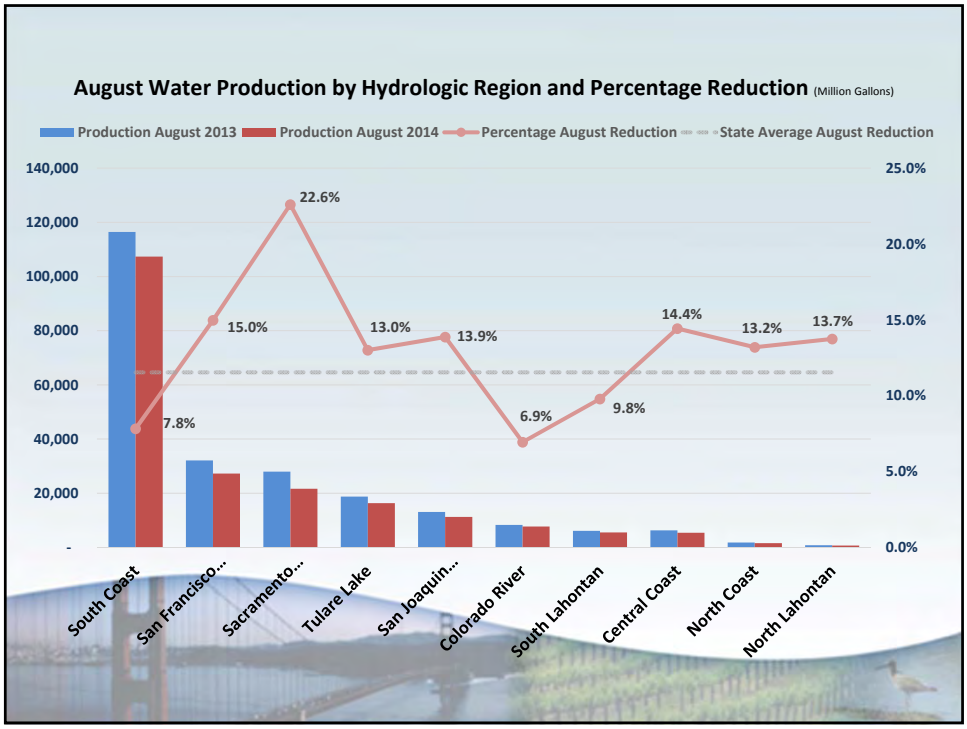
Inter-Agency Coordination

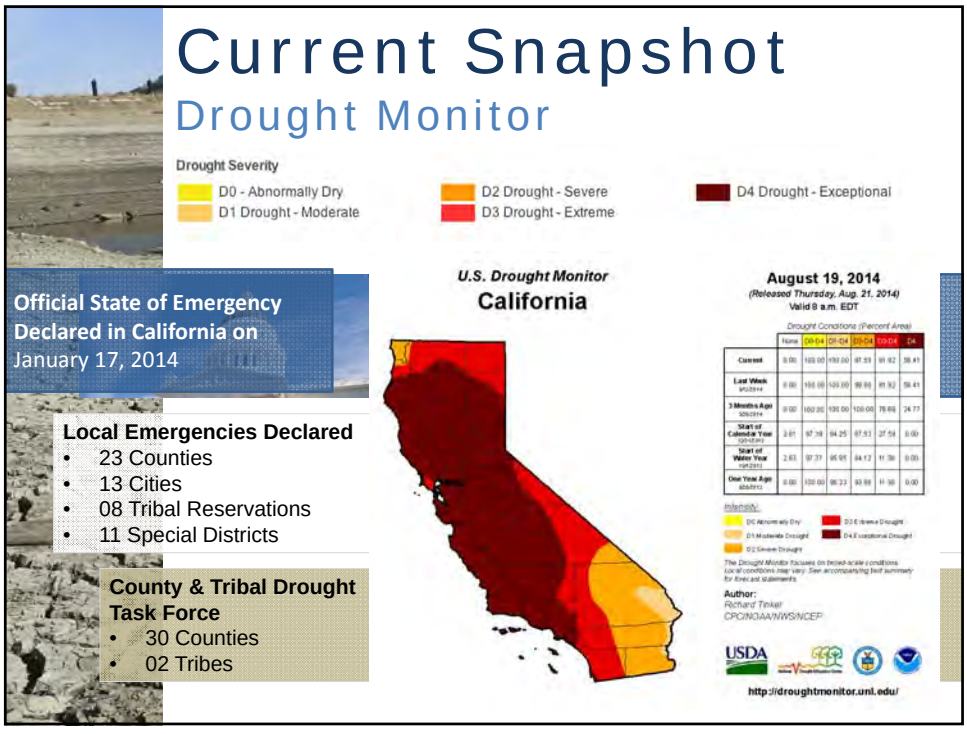
- Water-Energy Team of Climate Action Team (WETCAT)
  - WETCAT Principals
    - Ann Chan, Resources Agency
    - Rob Oglesby, Energy Commission
    - Catherine Sandoval, Public Utilities Commission
    - Frances Spivy-Weber, State Water Board
- Water and Wastewater Sector response to SONGS shut down
  - Dialogues between Gov's Office, agencies, water & wastewater agencies, IOUs, and other stakeholders

Lessons from Australia

- The most effective drought response starts ahead of the drought
- Changes in water use initiated during a drought can become permanent

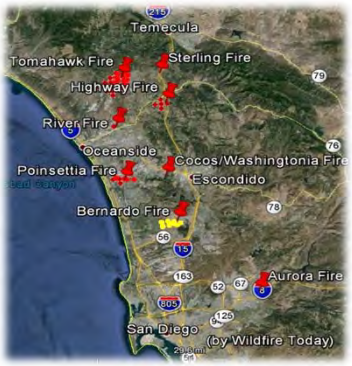
At the local Bunnings hardware store in Perth, soak well kits and rainwater-harvesting tanks are available off-the-shelf.


August Water Production by Hydrologic Region and Percentage Reduction (Million Gallons)
Production August 2013
Production August 2014
Percentage August Reduction
State Average August Reduction
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
7.8%
15.0%
22.6%
13.0%
13.9%
6.9%
9.8%
14.4%
13.2%
13.7%
South Coast
San Francisco...
Sacramento...
Tulare Lake
San Joaquin...
Colorado River
South Lahontan
Central Coast
North Coast
North Lahontan


Current Snapshot
Drought Monitor
Drought Severity
D0 - Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Official State of Emergency Declared in California on January 17, 2014
Local Emergencies Declared
• 23 Counties
• 13 Cities
• 08 Tribal Reservations
• 11 Special Districts
County & Tribal Drought Task Force
• 30 Counties
• 02 Tribes
U.S. Drought Monitor
California
August 19, 2014
(Released Thursday, Aug. 21, 2014)
Valid 8 a.m. EDT
Author:
http://droughtmonitor.unl.edu/

INCREASED WILDFIRE THREATS

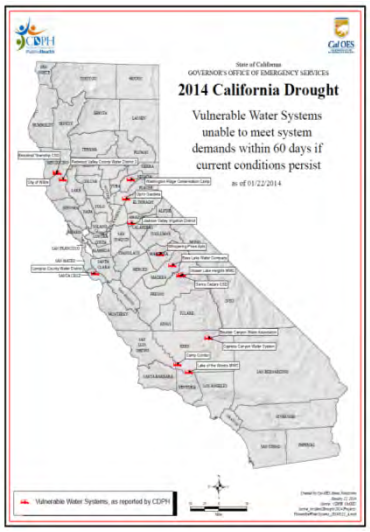
- State firefighters have responded to 5,329 fires so far this year, compared to 4,356 normally this time of year.
- Fires have burned 91,912 acres in state responsibility areas.



Drinking Water

Drought Impacts

- Several cities and towns in danger of running out of drinking water in **60-90 days.**
- Several dozen communities on "critical watch" list: **120-150 days** from running out of drinking water.
- Domestic wells are already **dry** and we expect more to dry up as water tables decline.



Drought Resilience Gaps

ENCLOSURE 9

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