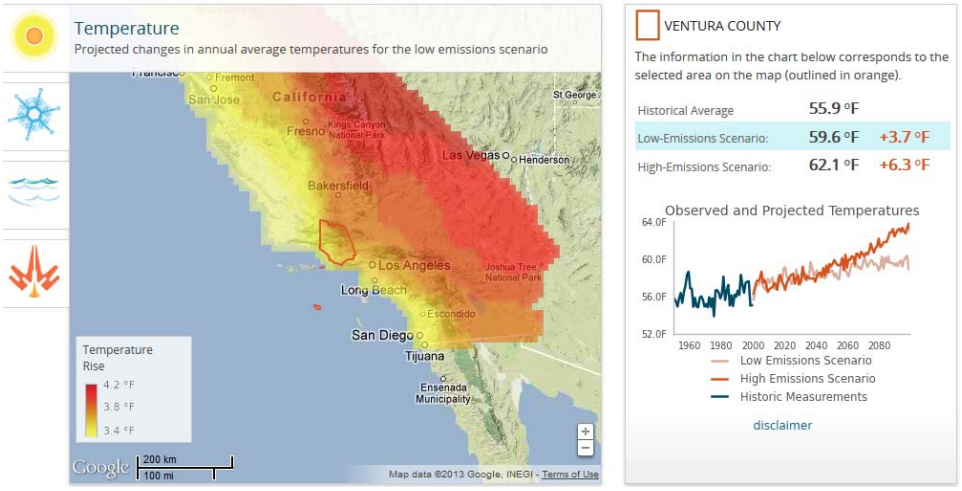
SECTION 13.0 - CLIMATE CHANGE



The IRWM Plan Standards require that IRWM Plans address adapting to the effects of climate change and mitigating the effects of climate change by reducing greenhouse gas emissions. Specifically, IRWM Plans must include a discussion of the potential effects of climate change on the Region, including an evaluation of the Region's vulnerabilities to the effects of climate change, and potential adaptation responses to those vulnerabilities, as well as a process that discloses and considers greenhouse gas emissions when choosing between project alternatives.

IRWM Regions are encouraged to consider and implement "no regret" adaptations to the general effects of climate change. Such adaptations are those that make sense in light of the current water management context for a Region and also help in terms of effects of climate change. These "no regret" adaptations, such as increasing water use efficiency, practicing integrated flood management and seeking to enhance and sustain ecosystems.

13.1 Overview of Climate Change Impacts

13.1.1 Statewide Impacts and Vulnerability

Climate change has already begun to impact California. Climate change, caused by the accumulation of greenhouses gases in the atmosphere, will have an increasing impact in future decades. Climate change is causing warmer temperatures, altered patterns of precipitation, runoff, and rising sea levels. Climate change compromises our ability to effectively manage water supplies, floods and other natural resources. Planning for and adapting to these changes, particularly their impacts on public safety, ecosystems, and long-term water supply reliability, will be among the most significant challenges of this century.

According to Dr. Daniel Cayan (Research Meteorologist at the Scripps Institution of Oceanography (SIO), University of California, San Diego, and Researcher in the U.S. Geological Survey), "To prepare for and to reduce these problems requires us to make decisions based on projections of conditions that have never been experienced by humans."

Some basic information about climate change (excerpted from "Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water, California Department of Water Resources, October 2009):

- Historic hydrologic patterns can no longer be solely relied upon to forecast the water future;
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management, and ecosystem functions;
- Significant and ongoing investments must be made in monitoring, researching, and understanding the connection between a changing climate, water resources and the environment;
- Extreme climatic events will become more frequent, necessitating improvements in flood protection, drought preparedness and emergency response;
- Water and wastewater managers and customers – businesses, institutions, farms, and individuals – can play a key role in water and energy efficiency, the reduction of greenhouse gas emissions, and the stewardship of water and other natural resources;
- Impacts and vulnerability will vary by region, as will the resources available to respond to climate change, necessitating regional solutions to adaptation rather than the proverbial one-size-fits-all approach; and
- An array of adaptive water management strategies must be implemented to better address the risk and uncertainty of changing climate patterns.

Statewide Assessments of Vulnerability

California produces periodic scientific assessments on the potential impacts of climate change in California and reports potential adaptation responses. Required by Executive Order #S-03-05, these assessments influence legislation and inform policy makers.

- The First Climate Change Assessment, released in 2006, looked at the potential impacts of climate change on key state resources such as the water supply, public health, agriculture, coastal areas, forestry, and electricity production and demand. The assessment influenced the passage of Assembly Bill 32, the California Global Warming Solutions Act of 2006.

- The Second Climate Change Assessment, released in 2009, attempted to provide initial estimates of the economic impacts of climate change. It concluded that adaptation - as a complementary approach to mitigation - could substantially reduce the economic impacts of loss and damage that result from a changing climate. Findings from the Second Assessment were instrumental in preparing California's 2009 statewide adaptation strategy.

- The Third Climate Change Assessment, released in 2012, was shaped by the request for more information on vulnerability and adaptation options discussed in the 2009 California

Adaptation Strategy. It made significant progress in projecting climate change impacts, but also in better understanding the interactions of those potential impacts with on the ground exposure, sensitivity, and response capacity of natural and human systems.

The Third Climate Change Assessment concluded that:

Temperatures in California will rise significantly during the 21st century.

- By 2050, California is projected to warm by approximately 2.7°F above 2000 averages, a threefold increase in the rate of warming over the last century.
- By 2100, average temperatures could increase by 4.1 to 8.6°F, depending on emissions levels.
- Springtime warming – a critical influence on snowmelt – will be particularly pronounced.
- Summer temperatures are projected to rise more than winter temperatures, and increases are projected to be greater in inland California, compared to the coast.
- Heat waves are projected to be more frequent, hotter, and longer. There are projected to be fewer extremely cold nights.

Precipitation models continue to show a Mediterranean pattern of weather.

- Wet winters and dry summers with variability are projected to persist.
- Several climate models indicate drier conditions by the mid-to-late century, in Central and Southern California.

Wildfire risk in California will increase as a result of climate change.

- Earlier snowmelt, higher temperatures and longer dry periods over a longer fire season would directly increase wildfire risk.
- That risk is also projected to be influenced by changes in vegetation, lightning strikes, and human activities, particularly land use development patterns.

Climate change could have major impacts on public health and well-being.

- Sensitive segments of the human population are particularly vulnerable to extreme heat and ground-level ozone.

Climate change will impact the supply of water throughout the State.

- The State will be challenged to manage water under changing climate conditions, including responding to increased demand for water as temperatures rise, snowmelts and runoff occur earlier and faster than in the past, and historical sea level rise threatens aging coastal water infrastructure.
- Climate change effects on water supplies and stream flows are expected to increase competition among urban and agricultural users.

- Water districts with limited or no access to state water would need to rely on local sources for water, making sustainable groundwater management more critical than in the past.

Increases in average temperature and higher frequency of extreme heat events combined with new residential development across the state are projected to drive up the demand for cooling in summertime.

- The Third Assessment notes that climate change is leading to an increase in energy demand.
- Energy supply from hydropower, especially in higher elevations, is vulnerable to changes in snowpack and spring runoff.
- Transmission lines for electricity are not designed to carry the higher loads projected by the assessment, and are projected to be more vulnerable to destruction by fire as a result of higher temperatures and more wildfires.

Sea level rise is occurring more quickly than had been anticipated in earlier assessments and this impacts coastal flooding.

- Sea level along the state's coastline in 2050 could be 10-18 inches higher than in 2000, and 31-55 inches higher by the end of this century. This represents a four- to eightfold increase in the rate of sea-level rise over that observed in the last century.
- By 2050, coastal 100 year storm events could strike annually on average as a result of sea-level rise.
- Sea level rise and coastal flooding are expected to put critical infrastructure at risk, including ports, transportation routes, power plants, etc.

California's ecosystems are vulnerable to the effects of climate change.

- Climate conditions are changing so rapidly that some vegetation cannot keep pace and some species are unable to quickly adapt to changing temperatures, precipitation and sea level rise.
- Identifying and then providing migration corridors that will allow species to migrate to more suitable habitat will be critical to their survival as the climate changes.

California's agriculture is also vulnerable to climate change.

Changes in temperature and water availability — annual and seasonal shifts as well as extreme highs and lows — affect both crop yield and quality, making the sector highly sensitive to climate change.[1]

[1] "Our Changing Climate 2012: Vulnerability and Adaptation to the Increasing Risks from Climate Change in California", CEC Publication # CEC-500-2012-007, July 31, 2012.

13.1.2 Local Climate Change Stressors and Vulnerabilities

Overview of Current Ventura County Climate

Ventura County has a Mediterranean climate, with wet, mild winters and dry, warm summers. The average July high temperature is 79 degrees, and the average January low temperature is 42 degrees. The average annual rainfall is approximately 18 inches. Most of the precipitation comes between the months of November through March with very little precipitation during the rest of the year. Ventura County has six diverse microclimates:

- Highlands and mountains of the Western Transverse Mountain Range in the northern portion of the County
- Coastal Plains, primarily located on the Oxnard Plain Coastal Strip
- Interior valleys such as the Ojai Valley
- Interior valleys with coastal influence such as the Santa Clara River Valley
- Interior valleys without coastal influence, such as the Conejo and Simi Valleys

Process for Addressing Climate Change in the WCVC IRWM Region*:*

Stakeholders in WCVC began to focus intently on the potential impacts of climate change in 2011 through discussions in each watershed, and at the regional level. A consultant was hired to assist with development of this portion of the IRWM Plan update. In March of 2012 WCVC, together with the Santa Barbara County and Upper Santa Clara River IRWM Regions and DWR, conducted a local climate change workshop. The workshop was well attended, and resulted in a compilation of information that was posted on the WCVC website:
http://www.ventura.org/wcvc/documents/climate_change.htm

WCVC Climate Change Stressors and Vulnerabilities

This section identifies the potential climate change stressors and vulnerabilities in the WCVC Region. Climate change assessment is performed using the output of computer models that project future conditions from inputs of GHG emissions. These models provide potential climate scenarios that are used for planning purposes.

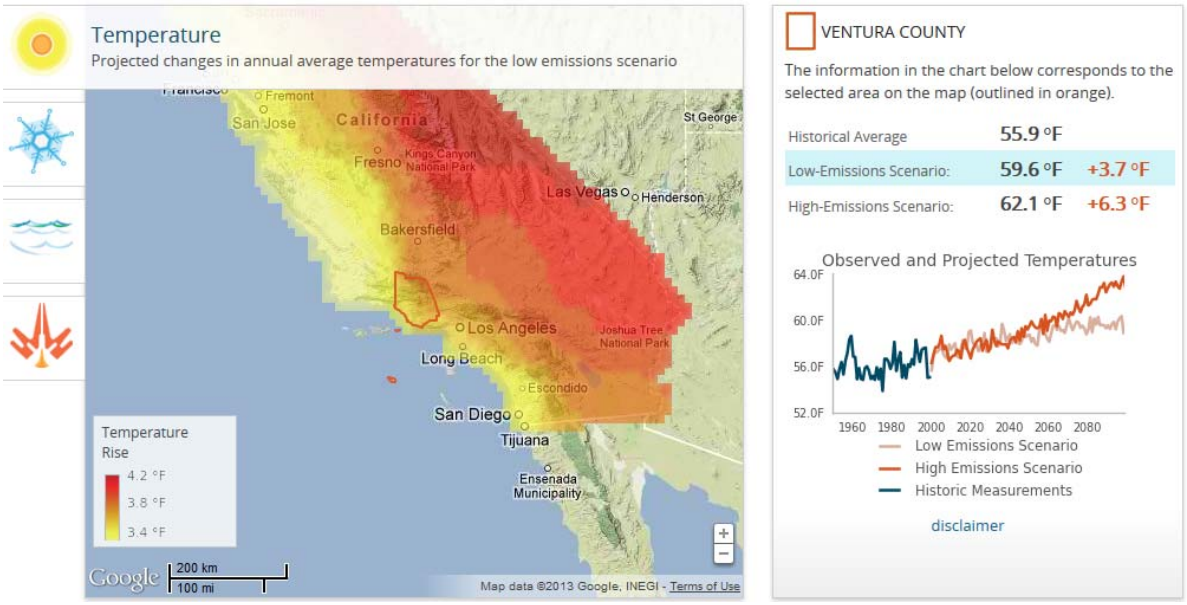
The primary climate stressors projected by global climate models that are important to this Region are changes in air temperature, changes in precipitation patterns (longer, more frequent droughts and more extreme flood events), and sea level rise. A stressor related to higher temperatures and changes in precipitation is more frequent and intense wildfires. The State of California 2009 Climate Change Impacts Assessment prepared by DWR (DWR 2009) provides the scientific basis for developing statewide climate change impact projections, and provides future climate projections to support water resources decision-making in California.

In 2012, the California Energy Commission's Public Interest Energy Research Program (PIER) established the Cal-Adapt website (http://cal-adapt.org). The website provides output from four climate models and two internationally accepted GHG emissions scenarios. Scenario A2 assumes high growth in population, higher GHG emissions and little to no global cooperation on reducing GHGs, while Scenario B1 assumes social consensus for sustainable development and lower GHG emissions. Given the inability to reach global decisions on climate change mitigation measures, and adopting a precautionary approach, this document, for the most part, analyzes stressors and vulnerabilities based on Scenario A2. In those cases where a comparison between the two Scenarios could assist with future decision-making, data from both is used.

Climate Stressors

Stressor: Higher Temperatures

Under Scenario A2 (high emissions scenario) overall air temperatures in Ventura County are expected to rise 6.3°F by 2100. The historical average temperature is 55.9°F. The increase in temperatures would likely be accompanied by more frequent heat events, with related ecosystem and human health impacts.



While average temperatures will increase by 6.3°F, the expected rise in minimum temperatures is 7.2°F. This means warmer nights, fewer freezing events and warmer winters, with implications for agriculture and ecosystems.

Stressor: More Frequent and Intense Wildfires

Because wildfire risk is determined by a combination of factors including precipitation, winds, temperature, and landscape and vegetation conditions, future risks will not be uniform throughout the state. In years with wet winters, annual vegetation growth is plentiful. But

accentuated dryness during summer would produce a hazardous fuel load that worsens the wildfire problem in some of Southern California wildlands. With expanding development into the urban/wildland interface, threats to human safety and property are even greater. The spread of invasive species that are more fire-prone, coupled with more frequent and prolonged periods of drought, are projected to increase the risk of fires and reduce the capacity of native species to recover. Wildfires also impact air quality, human health and soil erosion, and are an added stress on the watersheds. Increased soil erosion following fires can reduce the capacity of flood control infrastructure and increase flooding.

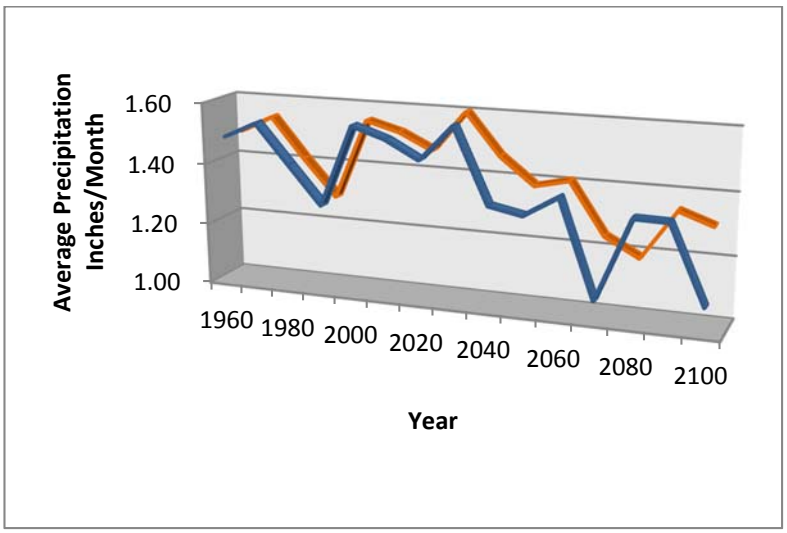
The potential for more frequent wildfires, combined with changes to precipitation, mean that higher rates of soil erosion and runoff are likely in the County's watersheds, affecting water supply and quality, and reducing ecosystem services provided in these watersheds.

Stressor: Longer, More Frequent Droughts and More Extreme Flood Events

Global models clearly indicate reduced precipitation for California's mountains and inland valleys. Because the County depends, at least partially, on water from the State Water Project, any changes to precipitation for State sources would result in reduced availability and increased costs for that water. While global models include fluctuations, with increased rainfall predicted to occur in the 2030 decade, the general trend is towards lower monthly and annual precipitation levels. By 2100, using Scenario A2 (the higher emissions scenario), Ventura County's 2100 rainfall totals are projected to decline by 2.16 inches below rainfall levels in 1960.

It is important to note that global models also predict differences in the way precipitation occurs, with more extreme weather events possible. The combination of flood events and sea level rise is particularly critical to coastal communities and ecosystems.

Average Precipitation (Inches Per Month)
1960 to 2100

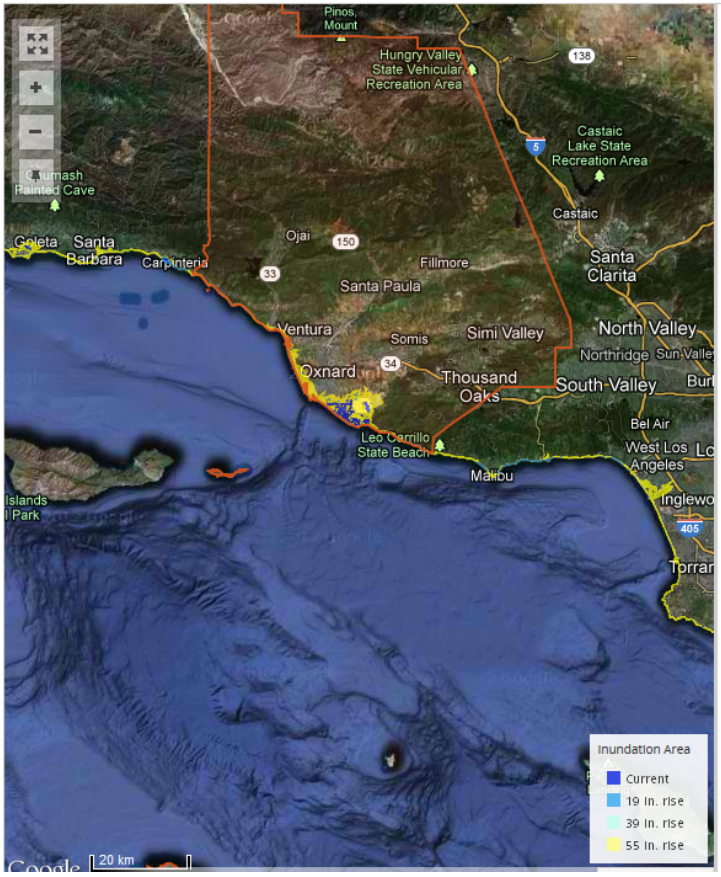


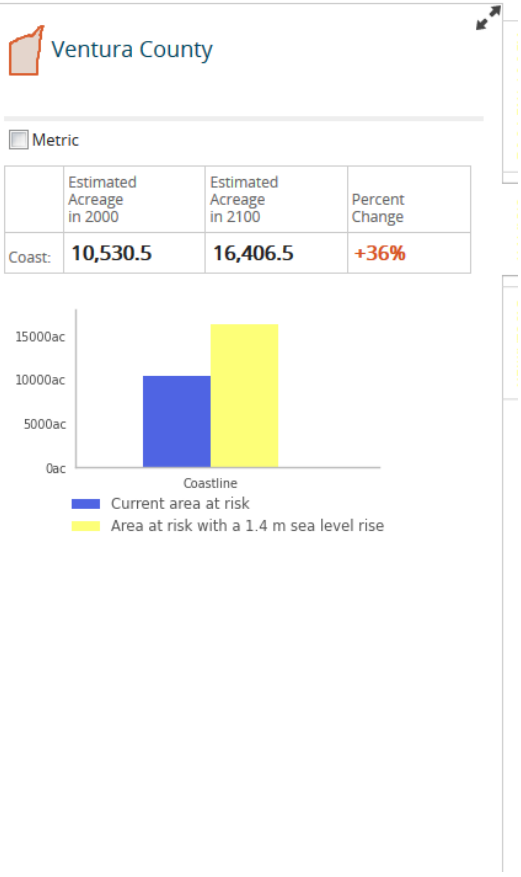
Source: Cal-Adapt

Year	Scenario A2: High Emissions	Scenario B1: Low Emissions
1960	1.49	1.49
1970	1.54	1.54
1980	1.41	1.41
1990	1.29	1.29
2000	1.55	1.55
2010	1.52	1.52
2020	1.46	1.47
2030	1.58	1.60
2040	1.34	1.47
2050	1.31	1.38
2060	1.38	1.41
2070	1.07	1.24
2080	1.34	1.18
2090	1.33	1.34
2100	1.09	1.30

Stressor: Sea Level Rise

SEA LEVEL RISE: THREATENED AREAS MAP





California's Cal-Adapt website states that "Global models indicate that California may see up to a 55 inch (1.4 meter) rise in sea level within this century given expected rise in temperatures around the world."[2] This type of sea level rise, combined with a 100 year flood event, would lead to significant inundation in the coastal regions of Ventura County.

These data were developed by scientists from the United States Geological Survey (USGS) in the Bay Area and the Pacific Institute (Coast). The darker blue areas are already threatened today, while the lighter shades are areas projected to also be threatened given the expected sea level rise.

[2] This projection is based on a paper prepared by the California Climate Change Center: The Impacts of Sea-Level Rise on the California Coast", CEC-500-2009-024-D. This is consistent with the National Research Council's conclusions, published in "Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present and Future", National Academies Press, 2012.

The USGS and Scripps Institute estimate that the replacement value of buildings and contents in Ventura County vulnerable to a 100 year coastal flood with a 1.4 meter sea-level rise would be $2.2 billion.

Climate Change Vulnerabilities

The purpose of identifying climate change vulnerabilities is to identify opportunities for making substantive changes today to enhance future resilience. This allows planners to determine the degree to which a system is susceptible to the adverse effects of climate change, including climate variability and climate extremes. Through a series of workshops and meetings, WCVC stakeholders developed a detailed matrix to identify vulnerabilities related to the climate change stressors described above.

Water demands and water supply, water quality, water-related infrastructure, agriculture and human populations are the key vulnerabilities associated with climate change in the IRWMP planning area. Those vulnerabilities vary depending upon the results of climate change. Based upon the scenarios and assumptions of this plan, the results that are most likely to impact vulnerabilities across the three watersheds in the planning area are: longer, more frequent droughts, higher temperatures, more extreme flood events, more frequent and intense wildfires and sea level rise. A tabular version of the following analysis is attached as Appendix "A".

Available Water Supply

With longer and more frequent droughts and higher temperatures, there would be higher water use, especially for agriculture and landscape irrigation. This would likely be exacerbated by increased evaporation and evapotranspiration. More frequent and intense wildfires would increase water demands for firefighting. Sea level rise would make coastal agricultural wells more vulnerable to salt water intrusion, increasing the demand for surface or imported water. Less predictable precipitation may result in changes to when and how much local water is available for use and recharge and how water supply is managed.

Reliability of water supply is a function of local and imported water sources being available when needed. A portion of the water supply for eastern Ventura County is imported through Metropolitan Water District. MWD's Integrated Water Resources Plan, 2010 Update describes uncertainties that create the potential for dramatic shifts in water management. With respect to imported water, the Update states: "Metropolitan's planning relies on nearly 100 years of historical data to forecast future conditions, including the frequency and abundance of rainfall. However, analysis of thousands of years of climate variability, along with models of potential future climate, indicate weather patterns may fall outside the range of the historic data used in Metropolitan's planning models. Changes in climate could significantly affect water supply reliability." (MWD Integrated Water Resources Plan, 2010 Update, Executive Summary).

The State Water Project issued its Final Delivery Reliability Report for 2011, in June 2012. The report states: "…as climate change continues to affect California, past hydrology is no longer a

reliable guide to future conditions." (p. 28). Specific aspects related to climate change that may alter reliability are: decreased water availability with reduced snowpack, increased SWP water demands, and sea level rise in the Delta.

Water Quality

Longer, more frequent droughts and higher temperatures that result from climate change could impact water quality by increasing eutrophication and algal biomass, reducing dissolved oxygen levels and cold water pools for fish. These factors may also impact water managers' ability to meet water quality standards, made worse if extreme floods, wildfires and sea level rise occur simultaneously. Poor water quality may result from increased sedimentation and accelerated runoff from burned areas. Severe storms and floods would generally increase turbidity, and deposit waste and other pollutants into local streams and rivers. Sea level rise would increase salinity in estuaries and near shore aquifers, reducing their availability for the current ecosystem and human uses.

Water Related Infrastructure

Impacts on water related infrastructure are direct and indirect. Direct impacts include lack of reliable power supplies when transmission lines and power plants are threatened by fires, floods and sea level rise. Direct impacts can result from damage to water conveyance systems. Indirect impacts on water related infrastructure include reduced access to reliable electricity for pumping and distribution when high temperatures increase summer energy demands. While the State is increasing the supply of renewable energy sources (water, solar), these sources are also vulnerable to the results of climate change. In addition to lack of reliability, damage and competitive demands for power are likely to result in increased costs for electricity used to purvey water.

Ecosystems and Habitats

Ecosystems and habitats are vulnerable to less and/or more variable in-stream water. More droughts, higher temperatures and wildfires increase aquatic and ecosystem stress, by increasing water temperatures and reducing instream water quality. As the climate changes, the range, composition, distribution and migrations patterns of plant and animal communities are also likely to change. With increased pests, invasive species and diseases, ecosystem services[3] would likely be reduced. They would likely be reduced further by alteration in stream channels and sediment transport due to altered precipitation patterns producing drought conditions, larger storms, and increased coastal erosion and salinity in estuaries and near shore aquifers.

Agriculture

Agriculture is an important part of the IRWMP Plan area's economy. As noted above, agriculture is particularly vulnerable to water reliability. In the worst case scenario, cropland may be taken out of production due to lack of water and agricultural land in coastal areas may become less productive as a result of sea level rise and salt water intrusion. With increased temperatures and

[3] Ecosystem services are defined as the important benefits for human beings that arise from healthily functioning ecosystems, including but not limited to production of oxygen, soil genesis, and water detoxification.

more frequent droughts, evapotranspiration would likely increase and soil moisture levels would likely decline, increasing water demands and costs. Changes to nighttime temperatures and seasonal water supplies would likely result in shifts in crop behavior and health. Increased pests and diseases that result from heat and drought, along with other factors, would likely impact crop productivity.

Human Populations

The IRWM Plan area includes a range of population distribution, including cities, suburbs and less densely populated areas. Climate change impacts on human populations occur both directly and indirectly. Humans may be directly impacted by higher temperatures, exposure to fires and intense floods and landslides brought on by more intense rain events. Public health officials are exploring the impacts of climate change on provision of services to the frail and elderly. From an economic perspective, because climate change may result in reduced availability of water, the impacts range from increased costs to displacement of people and businesses.

Please see the watershed specific sections of the IRWM Plan (Appendices A, B and C) for information about climate stressors in each watershed. There is some variability in climate among the three watersheds.

Appendix A
Regional Vulnerabilities to Climate Change
Ventura County

	Longer, More Frequent Droughts	Higher Temperatures	More Extreme Flood Events	More Frequent & Intense Wildfires	Sea Level Rise
Water Demand (demands on available supply)					
1. Higher water use, especially for agricultural and landscape irrigation	✓	✓			
2. Increased evaporation and evapotranspiration	✓	✓			
3. Higher water demands for firefighting				✓	
4. Increased water demand from contaminated coastal agricultural wells					✓
Water Supply (available water)					
5. Less predictable precipitation	✓				
6. Less groundwater recharge	✓	✓			
7. Reduced water supply reliability	✓	✓	✓		
8. Less usable water supply due to reduced water quality from increased sedimentation and accelerated runoff in burned areas			✓	✓	
9. Damage to reservoir operations, wells, water diversions and conveyance systems			✓		
10. Near shore groundwater supplies threatened by salt water intrusions					✓
Water Quality					
11. Increased eutrophication and algal biomass	✓	✓			
12. Reduced dissolved oxygen	✓	✓			
13. Reduced cold water pools for fish (e.g. California steelhead trout)	✓	✓			
14. Inability to meet water quality standards	✓	✓	✓	✓	✓
15. Poor water quality from increased sedimentation (turbidity) and accelerated runoff in burned areas			✓	✓	
16. Increased turbidity, pathogens, trash and other pollutant loads from severe storms			✓		
17. Increased salinity in estuaries and near shore aquifers					✓
18. Reduced groundwater and lake water quality	✓	✓		✓	✓

Water Related Infrastructure					
19. Access to electricity for pumping and distribution threatened by higher summer energy demands and increased power outages	✓	✓			
20. Access to electricity threatened by potential fires, floods and sea level rise			✓	✓	✓
21. Increased sediment in water systems			✓	✓	
22. Insufficient capacity and/or water to address firefighting needs	✓	✓		✓	
23. Levee stress/failure			✓		✓
24. Impacts to wastewater treatment plants and reservoir operations within the watershed			✓		✓
25. Impacts to wastewater treatment plant (Ventura Water Reclamation Plant) outside the watershed (near Santa Clara River mouth) from discharges within the watershed			✓		✓
26. Damage to conveyance systems			✓		
27. Increased sediment in water systems	✓	✓	✓	✓	
Ecosystems and Habitats					
28. Less and more variable in-stream water	✓	✓			
29. Increased aquatic and terrestrial ecosystem stress	✓	✓		✓	
30. Increased water temperature and plant/animal mortality	✓	✓			
31. Changes to the range, composition, distribution and migration of plant/animal communities	✓	✓	✓		✓
32. Increased pests, invasive species and diseases	✓	✓		✓	✓
33. Decreased ecosystem services	✓	✓	✓		
34. Short-term habitat loss	✓	✓			
35. Habitat changes from frequent fires due to loss of seedbeds/vegetative restarts				✓	
36. Reduced in-stream water quality	✓	✓	✓	✓	
37. Alteration in stream channels and sediment transport			✓		
38. Increased frequency of disturbance	✓	✓	✓	✓	
39. Increased salinity in estuaries and near shore aquifers		✓			✓
40. Increased coastal erosion			✓		✓
Agriculture					
41. Increased evapotranspiration and soil moisture deficits	✓	✓			
42. Increased water demands and costs	✓	✓			
43. Shifts in crop behavior (flowering/ripening)	✓	✓			
44. Increased pests and diseases	✓	✓			
45. Reduced crop productivity	✓	✓	✓		

46. Cropland taken out of production due to lack of water	✓				
47. Crop losses	✓	✓		✓	
48. Range land losses (reduced soil moisture; fires)		✓		✓	
49. Increased soil erosion			✓		
50. Increased salinity in near shore aquifers used by agriculture					✓
51. Loss of agricultural land near coast					✓
Human Populations					
52. Insufficient local water supplies	✓		✓		
53. Increased water costs (from increased demand)	✓	✓			
54. Displacement of people and services	✓	✓	✓	✓	✓
55. Reduced recreational opportunities	✓	✓	✓	✓	✓
56. Economic losses and potential wide scale economic losses due to lack of water	✓	✓	✓	✓	✓
57. Property damage and losses			✓	✓	✓
58. Mortality and morbidity (from heat, fires and intense flood flows and landslides)		✓	✓	✓	
59. Increased water and sewer costs from reduced water quality and infrastructure damage	✓		✓		✓
60. Increased energy costs		✓	✓		
61. Increased property insurance costs			✓	✓	

13.2 Climate Change Adaptation Analysis

The California Department of Water Resources (DWR) provides guidance to IRWM Regions in identifying and addressing climate change impacts. In 2011 DWR published *The Climate Change Handbook for Regional Water Planning* as a resource for IRWM Regions. In addition, DWR and other State agencies have published a number of climate change resources. The State has also created a web-portal with information regarding recent climate models, links, adaptation and mitigation strategies and many other related topics: http://www.climatechange.ca.gov/.

The *Climate Change Handbook* outlines a four-step process for completing a climate change adaptation analysis: (1) Assess Vulnerability, (2) Measure Impacts, (3) Develop and Evaluate Strategies, and (4) Implement Under Uncertainty:

Assess Vulnerability: Identify the region-specific water resources (including source areas for imported water) that are potentially vulnerable to climate change in a way that is both significant for the stakeholders involved and measureable in some way. This information was used to help the WCVC conduct the vulnerability analysis above.

Measure Impacts: To the extent appropriate, quantify the climate change impacts to a region's most vulnerable water resources. This step can be highly analytical or qualitative, depending on the estimated level of vulnerability and system, operational complexity, and resources available for the analysis. This information was used to identify impacts to the Region.

Evaluate Strategies: Compare and rank existing and potential resource management strategies (RMS) based on their effectiveness in mitigating and adapting to climate change impacts. New potential projects or programs may be identified during this step of the process. Evaluating strategies for climate change adaptive capacity is an important component of the overall evaluation of individual strategies or projects, as well as integrated project portfolios, in any IRWM planning process. This information helped guide the Region in selecting appropriate RMS for local implementation.

Implement Under Uncertainty: Incorporate regional management strategies into a broader planning context that considers the uncertainties associated with climate change. This can be done in many ways, for example using approaches based on adaptive management, robust decision making, and other decision-support methods. Uncertainty influences every step of a planning process involving climate change, including methods for climate change impact measurement, project selection, implementation, and performance monitoring. This will guide future efforts of the Region in addressing climate change.

WCVC Adaptation Approaches

Stakeholders in the Region recognize the importance of developing strategies and projects which will help in adapting to climate change impacts. No regrets adaptations are already being implemented through the projects and programs included in the IRWM Plan. These include increased water use efficiency, water recycling, integrated flood management and ecosystem management.

The adaptation strategies included in the State document *2009 California Climate Adaptation Strategy,* include several strategies being implemented within the Region:

- Developing the full potential of the IRWM Plan
- Aggressively increasing water use efficiency
- Practicing and promoting integrated flood management
- Enhancing and sustaining ecosystems
- Expanding (upgrading, restoring) water storage and conjunctive management of surface and groundwater resources
- Upgrade and increase monitoring, data analysis and management
- Plan for and adapt to sea-level rise
- Support and utilize focused climate change impacts and adaptation research and analysis

The adaptation capacity of the implementing Resource Management Strategies in the Region is addressed at a high level in Section 6 – Resource Management Strategies. Adaptation does not occur at a fixed point in time and needs to be an integral part of future planning for projects and programs. In the future, more work will be needed to further define and refine appropriate adaptation projects and programs as new information becomes available.

A number of local and State entities working in the Region are engaged in conducting studies regarding specific impacts of climate change that will benefit IRWM Planning efforts. A few of these are listed below:

- The Nature Conservancy's Coastal Resilience Ventura Project
- Cities engaged in climate action planning
- County of Ventura Climate Protection Plan and related sustainability program
- The Coastal Conservancy Climate Ready Grant program and climate adaptation elements of local projects such as the Santa Clara River Parkway and Ormond Beach restoration efforts
- Southern California Association of Governments (SCAG) climate change programs
- California Dept. of Fish and Wildlife Climate Science Program - ecosystem protection efforts related to climate change
- USGS project to downscale climate models, and Southern California Bight Modeling project

These efforts need to be tied together more effectively in the future and the Region needs to prepare a more comprehensive assessment of impacts and adaptation strategies. The WCVC will create a climate change task force to work with all the entities engaged in climate change planning. The purpose of the task force will be to develop a more coordinated effort to collect and share data and information regarding climate change impacts and adaptation/mitigation and develop a more comprehensive local inventory of vulnerable infrastructure. The task force will also review and consider the results of ongoing studies, climate models and other resources to update the information in the WCVC IRWM Plan.

13.3 Reducing Greenhouse Emissions

The State's IRWM Plan Standards require IRWM Regions to disclose and consider greenhouse gas (GHG) emissions when choosing between project alternatives. IRWM Plans can help mitigate climate change by reducing energy consumption, especially the energy embedded in water use, and ultimately reducing GHG emissions. Significant amounts of energy are consumed in California as a result of water management (conveyance, treatment, distribution, heating). The Region will consider the impacts of the energy requirements of projects selected for implementation as part of the IRWM Plan.

The County of Ventura is actively involved with other stakeholders in the Central Coast to implement comprehensive energy efficiency measures. This includes the energy use related to water resources. There is strong link between management of water and energy resources; the County's energy programs are closely coordinated with the IRWM Program.

Water has always been linked to energy but recently the relationship between water and energy is emerging as a topic of importance. As water constraints increase, energy production becomes more vulnerable and concerns are raised regarding the effect energy operations have on availability and quality of water. The complex and mutually dependent relationship between water and energy is known as the water-energy nexus. Simply defined; a large amount of water is required to produce energy, and energy is required for water treatment and transportation.

Energy is required to treat wastewater and transport drinking water; Water is required to make electricity and produce transportation fuels; Energy and water are required to grow food; An increasing portion of certain crops is being used for fuel instead of food; and Water quality can be adversely impacted by food and energy production.

Balancing these competing needs and increasingly scarce resources will require behavior modification, development of innovative technology, and adoption of supporting policy by individuals, businesses, and governments.

The Ventura County Regional Energy Alliance (VCREA) is a Joint Powers Agency composed of public agencies working in collaboration to address good energy stewardship through integrated demand side management practices in the Ventura County region. Through this partnership, local governments have strived to establish Ventura County as a leader in supporting sensible growth, healthy environment and economy, enhanced quality of life, and greater self-reliance for the region.

In 2013 alone, VCREA and its partner cities completed 13 eligible energy-efficiency projects levering resources available through Southern California Edison's Energy Leader Partnership Program. These projects resulted in energy savings of more than 1,100,000 kWh and 103 kW. In addition to implementing energy-efficiency projects, local governments are taking other actions to combat climate change. These other actions include investing in solar installations and other renewable energy sources, reducing water usage by changing landscape and irrigation practices, implementing green building and purchasing policies, encouraging further development of environmental business by providing training and education opportunities, and encouraging behavioral change throughout the community through outreach and education programs.

All of these efforts combined have contributed to significant County-wide energy savings but in order to continue to lead the community with innovative energy efficiency and climate change programs, a comprehensive, community-based inventory of energy use and associated GHG emissions is needed. In 2013, VCREA received a grant from Southern California Edison to develop a regional GHG inventory and to combine the results into a regional Climate Action Plan. Completion of this plan will help provide a better understanding of energy use and emission producing

activities in the region and to identify potential target areas to be considered for the VCREA Board, individual members, and other entities.

The County of Ventura and a few local cities have joined the California Climate Action Registry to report GHG emissions related to County facilities and activities. The County of Ventura has also developed a Climate Protection Plan that calls for a 15 percent reduction in GHG emissions in County facilities by the year 2020 (for more information visit http://www.ventura.org/sustain/for-community/climate-protection/).

As part of the IRWM project review and selection process in the Region described in Section 7 – Project Review Process, a high level analysis of GHG emissions is conducted. The lead agency for a project undergoing CEQA review, must conduct a more detailed assessment of the impacts of GHG emissions associated with the project, and make a determination of significance.

A helpful resource for conducting this analysis is the California Air Pollution Control Officers Association (CAPCOA) handbook *Quantifying Greenhouse Gas Mitigation Measures – A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures.* Section 4 of that document includes water supply projects such as recycled water, gray water, locally sourced water and water use management projects such as low-flow water fixtures, conservation strategies, water-efficient landscape designs and irrigation systems, reduction of turf in landscapes and installation of native and drought-resistant landscape plantings. This information will be used by project proponents when project-specific analysis is conducted.

13.4 Plan for Ongoing Data Gathering and Analyzing Vulnerabilities

As part of the Data Management System (Section 9) and with the help of the climate change task force referenced above, the Region will incorporate and analyze data related to climate change and continue to assess and modify when necessary the vulnerabilities, inventory of vulnerable infrastructure, and adaptation strategies.