

APPENDIX C

Summary of Climate Change Legislation, Forecasted Future Effects, and Sea Level Rise Studies

This appendix includes a summary of recent legislation, a chart showing estimated time lines for projected climate changes and associated effects in the coming decades, and a summary discussion of local sea level rise studies.

Climate Change Legislation

Since the CAP was adopted in 2012, new climate change legislation has passed. Details are focused on 2015 changes and more information about California climate change laws can be found on the state's California Climate Change webpage.

Federal

At the federal level, although comprehensive climate change legislation has been proposed on several occasions, there is no federal law in the United States that explicitly requires public entities or private companies to mitigate their impact on global climate although many other laws have the effect of requiring or encouraging mitigation. The Center for Climate and Energy Solutions and Columbia Law School Sabin Center for Climate Change Law tracks federal legislation related to climate change.

In 2013, President Obama issued The President's Climate Action Plan and established a State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience. The Task Force were charged with providing recommendations on how the federal government can respond to the needs of communities dealing with the impacts of climate change. The 2015 General Plan Implementation Report included a report prepared by a University of California Santa Barbara intern highlighting existing City programs that are in alignment with the Task Force recommendations.

State

Recent California climate change legislation includes:

January 2015 - In his inaugural address, Governor Brown identified five key climate change "pillars" for obtaining GHG emission reduction by 2030: 50% renewable electricity; 50% reduction in petroleum use by vehicles; double energy efficiency savings at existing buildings; carbon sequestration in the land base; and reduce short-lived climate pollutants.

April 2015 - Governor Brown issued Executive Order B-30-15 setting a new greenhouse gas (GHG) emissions target for 2030 at 40% below 1990 levels. The 2030 target acts as an interim goal and increases the likelihood of success in reaching the 2050 goal (80% reduction below 1990 levels).

May 2015 – California initiated a first-of-its-kind agreement with international leaders from 11 other states and provinces, nicknamed Under 2 MOU, to limit the increase in global average temperature to below 2 degrees Celsius. Since May, other governments continue to join the MOU. If the signatories represented a single country, it would be the second largest economy in the world behind only the United States.

October 2015 – The Clean Energy and Pollution Reduction Act of 2015 (SB 350) Establishes targets to increase retail sales of renewable electricity to 50% by 2030 and double the energy efficiency savings in electricity and natural gas end uses by 2030.

Climate Change Effects

Climate processes are complex, not completely understood, and not easily forecasted into the future. Most modeling to date are at the global and regional levels. The timing, paces, and extent of climate changes ahead for California and Santa Barbara are uncertain. Research is underway at many academic and research institutions and agencies toward "downscaling" climate model information to local levels. The following chart summarizes available California or Santa Barbara projections and updates recent climate change effects.

The initial version of the chart is Figure ES-2 in the *2012 City of Santa Barbara Climate Action Plan*. Climate Action Plan (CAP) Strategy 69 directs updates to projected climate effects time lines be provided in status reports. Projections to the year 2050 were used to correspond to Governor Schwarzenegger’s 2005 Executive Order S-3-05 general goal of statewide annual emissions reduction to 80% below 1990 levels by 2050.

Summary of Forecasted Future Climate Change Effects (2016 update)	
Temperature, rainfall, extreme weather	
Temperature	2050 projection (CA): average temperature increase: 3.2°F (low emissions) – 5.4° (high emissions); more frequent heat waves. <i>In CA, average annual temperature increased 1.7°F over the period 1895-2011. According to NASA and NOAA, the earth’s 2015 surface temperatures were the warmest since record keeping began in 1880.</i>
Precipitation	2050 projection (CA): average rainfall decrease of 12–35%; less snow pack, more droughts. <i>Santa Barbara County received 70% of normal rainfall in Water Year 2015 (Sept 1 – Aug 31).</i>
Wildfires	2050 projection (CA): greater wildfire risk (warmer, drier conditions). By 2050, 24 more high wildfire potential days than in 2000. <i>Since 2010, an average of 3 more large wildfires burn in CA than in the 1970s. Nearly 900,000 acres burned in 2015, compared with 500,000 in a typical year.</i>
Storm events & flooding	2050 projection (CA): more erratic weather patterns and extreme rainstorm events, with associated storm damage and flooding. <i>Updated data for Southern California available next year (CoSMoS 3.0).</i>
Pests & vectors	2050 projection (CA): potential for altered transmission patterns for pests, vectors, and diseases. Increased toxic ocean algae blooms expected. <i>In 2015, the largest and longest lasting ocean toxic algal bloom in more than a decade occurred from central CA to Alaska, resulting in significant impacts to coastal resources. In 2016, freshwater toxic harmful algal blooms (HABs) caused by cyanobacteria have been escalating throughout the state. To date in 2016, West Nile virus has been detected in mosquitoes and birds in 30 CA counties, and the first confirmed human death occurred; human cases of WNV are up 31% compared to the 5-year average. To date, mosquitos that carry Zika virus have been found in 12 CA counties.</i>
Air pollution	2050 projection (CA): increased smog production and changes to pollen production; reactive nitrogen disposition affecting plants <i>A short-term rise in particle pollution in 2016 was attributed to wildfires and drought. In the summer of 2016, the worst smog in years inundated Southern CA with the highest level of ozone readings since 2009.</i>
Water pollution	2050 projection (CA): increased risk for pollution of streams (higher temperatures; urban runoff during intense storms); seawater intrusion into groundwater; ocean acidification affecting sea creatures. <i>Globally, measurements made over the last few decades have shown an increase in ocean acidification (OA) and hypoxia. Research indicates that the West Coast of North American will face some of the earliest, most severe changes in ocean carbon chemistry.</i>

Sea level rise	
Sea level rise (<i>from year 2000</i>) <i>See page 3 for discussion of local sea level rise studies and forecasts</i>	2030 projections (SB): range 0.4 – 10 inches 2060 projections (SB): range 2.7 – 27 inches 2100 projections (SB): range 10.6 -60 inches <i>New research has shown global mean sea level rising slightly slower from 1993-2014, but that sea level rise is recently accelerating.</i>
Coastal flooding and inundation (multiple hazards to resemble large [100-year] coastal storm)	2030-2100 projections (SB): increased areas subject to 100-year flooding and inundation; permanent inundation of some low-lying areas. Flooding for portions of the City remains a key issue in the 2060 – 2100 timeframe. <i>Storms in early 2016 brought some minor flooding to the Santa Barbara area, but no permanent inundation.</i>
Beach erosion	2030-2100 projections (SB): potential erosion or loss of beaches, storm erosion leads to much higher loss, particularly from 2060 – 2100. <i>No permanent loss of beaches due to erosion determined to date. Existing shoreline protection reduces the potential for erosion in some places, presuming it remains intact and is maintained.</i>
Coastal bluff erosion	2030-2100 projections (SB): increase in existing erosion rate with sea level rise; further increases when accounting for block failure, threatening cliff-top homes. <i>No known increases in bluff erosion rates to date. Updated modeling indicates coastal bluff erosion extending further inland than previously projected.</i>
Tsunami	2050, 2100 projection (SB): low probability of occurrence and low risk of damage. <i>No recent changes in tsunami projections.</i>
Public services	
Water supply	2030 projection (SB): adequate water supply. 2050, 2100 projections (CA): increased pressures on statewide water supplies due to less rainfall and less water storage as snow pack, with increased irrigation demand and increased population. <i>Current multi-year drought has resulted in short-range water deficit locally and statewide. City activities are underway to conserve water and increase supplies.</i>
Agriculture and food supply	2050, 2100 projections (CA): alterations in crop yields, growing seasons, pest ranges from changes in temperature, rainfall, extreme weather, and water supply. <i>The direct costs of the drought to agriculture statewide is estimated at \$1.8 billion in 2015 and 10,100 direct seasonal jobs.</i>
Energy demand	2050, 2100 projections (CA): increased statewide energy demand with population increase, and more demand for cooling, peak summer demand, utilities, water transport, and industries. <i>Energy demand statewide in 2014 grew by 1% over the previous year.</i>
Biological resources	
Natural habitats and species	2050, 2100 projections (CA): Varied species responses to changes in temperatures, rainfall, weather patterns, extreme events, wildfire, rising sea levels, coastal erosion, and air and water pollution. Individual species may adapt, survive in reduced ranges, migrate, or not survive. A general trend is anticipated for plant and animal species to move northward and upslope. <i>Per a UCLA-led study in 2016, 15% percent of plant species in CA are moving northward and upslope.</i>

Local economies	
Fisheries and tourism	2050, 2100 projections (CA): Marine habitat changes could affect fishing industry. Weather events, coastal erosion could affect tourism. <i>Research from the Scripps Institution of Oceanography is showing wide-ranging declines in fish populations since 1970 in the California Current. There is no indication to date that weather events and coastal erosion have affected tourism.</i>

Regional and Local Sea Level Rise Studies

The following summarizes regional and local studies of sea level rise recently completed or underway.

City of Santa Barbara Sea Level Rise Vulnerability Study (Griggs/Russell, UC Santa Cruz, 2012). This grant-funded study assessed the likelihood and magnitude of greater future coastal hazards in Santa Barbara, including beach and cliff erosion, storm wave damage, flooding, and inundation, and identified potential adaptation options. (Study included as Appendix B of 2012 Climate Action Plan).

City Website: <http://www.santabarbaraca.gov/services/planning/erds/resource/cap.asp>

Coastal Storm Modeling System for Southern California (CosMos) (US Geological Survey, pending 2016). The model downscales global data to predict future storm-induced coastal flooding and erosion in more localized areas with assumptions of future sea level rise and more extreme storm events. Southern California modeling studies, including Santa Barbara, are underway.

Project Webpage: https://walrus.wr.usgs.gov/coastal_processes/cosmos/socal2.0/index.html

Goleta Slough Area Sea Level Rise and Management Plan (ESA, Revell, 2015). A multi-agency study identified sea level rise and future effects on water levels and flooding, tides and sediment, water quality, habitats and species, and adaptation options to inform management of the Goleta Slough and environs including Airport.

Project Webpage: <http://goletaslough.org/>

City of Santa Barbara Sea Level Vulnerability Assessment (UCSB Bren School Master's Project group, Denka, Hall, Nicholson, 2015). Analysis of future inundation, storm surge, and bluff erosion effects on populations, critical infrastructure, recreation and public access, and ecological resources.

Project Brief: http://www.bren.ucsb.edu/research/2015Group_Projects/documents/SeaLevelRiseSB_Brief.pdf

Santa Barbara County Coastal Resiliency Project (ESA, Revell, pending 2016). Modeled sea level rise and other coastal hazards for County and assessing vulnerability. City is a partner along with Goleta and Carpinteria.

Project Webpage:

<http://longrange.sbcountyplanning.org/programs/Coastal%20Resiliency%20Project/coastalresiliency.php>

City of Santa Barbara Refinement of County Coastal Resiliency Project (ESA, 2016). Includes a refinement of baseline coastal conditions and sea level rise including the effects of shoreline protection and water control structures from Leadbetter Point to the eastern City limits.

Santa Barbara Area Coastal Ecosystem Vulnerability Assessment (CEVA, pending 2016) (CA Sea Grant Study; UCSB, Scripps Institute of Oceanography, and US Geological Survey researchers in coordination with cities of Santa Barbara, Goleta, Carpinteria, and County). The study will downscale climate forecasts and assess future impacts on coastal ecosystems including watersheds, wetlands, and beaches.

Project Webpage: <http://www.msi.ucsb.edu/current-projects/santa-barbara-area-coastal-ecosystem-vulnerability-assessment>

Federal Emergency Management Agency (FEMA) Open Pacific Coast Study (FEMA, pending 2017). FEMA is working on a multi-year project to update existing coastal flood hazards information to produce updated flood insurance rate maps (FIRMs). FEMA is also working on non-regulatory products that will include consideration of sea level rise.

FEMA Web Site: <https://msc.fema.gov/portal>

Data Sources (all webpages accessed in Sept. 2016):

American Lung Association: <http://www.lung.org/our-initiatives/healthy-air/sota/>

Cal-adapt: <http://cal-adapt.org/>

California Climate Change: <http://www.climatechange.ca.gov/>

California Department of Public Health: <http://www.cdph.ca.gov/Pages/DEFAULT.aspx>

California Energy Commission – *Statewide Energy Demand*, 2016.

California Freshwater Harmful Algal Blooms Assessment and Support Strategy, January 2016. California Water Boards.

Center for Climate and Energy Solutions: <http://www.c2es.org/>

Climate Central: <http://www.climatecentral.org/>

Climate Central: Western Wildfires, A Fiery Future:
<http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf>

Columbia Law School: <http://web.law.columbia.edu/climate-change/resources/climate-legislation-tracker>

Economic Analysis of the 2015 Drought for California Agriculture, UC Davis Center for Watershed Sciences. August, 2015.

EPA Climate Change Indicators: <https://www.epa.gov/climate-indicators/climate-change-indicators-ragweed-pollen-season>

NOAA Climate.gov: <https://www.climate.gov/news-features/event-tracker/record-setting-bloom-toxic-algae-north-pacific>

Santa Barbara County Public Works Historical Rainfall Information:
<http://cosb.countyofsb.org/pwd/pwwater.aspx?id=3772>

West Coast Ocean Acidification and Hypoxia Science Panel *Major Findings, Recommendations, and Actions*, April 2016.

Scripps Institute of Oceanography: <https://scripps.ucsd.edu/news/californias-fish-populations-are-declining>

UCLA Newsroom: <http://newsroom.ucla.edu/releases/ecosystems-pulling-apart-as-some-plants-shift-habitats-possibly-adapting-to-climate-change>