

Climate Resiliency Resource List

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Introduction

Over the last decade The University of California, Santa Barbara (UCSB) has been able to drastically reduce greenhouse gas emissions through energy efficiency and renewable energy. While reducing emissions has been the priority, the campus also recognizes the need to adapt to an already changing climate. This guide is meant to be a resource for planners and individuals interested in climate resilience. The document is organized by topic area and is broken into 5 different sections: Sea Level Rise, Erosion, Transportation, Drought, Energy, and Vector Habitats.

Mission

The Climate Resiliency Resource Guide was created by UCSB's Climate Resiliency Committee in 2017 to serve as a living document which could aid in the university's research, plans, and future in addressing impacts of climate change on campus. This guide's purpose is to act as a collection of information relevant to UCSB to provide those working on addressing these issues with one accessible document containing multiple sources of information.

Resources

Sea Level Rise

With global average temperatures rising and ice caps melting, global sea level is projected to climb between 1 to 4 feet by 2100. As a campus nudged against the coastline, we are particularly vulnerable to sea level rise. The following resources assess local vulnerability to sea-level rise and potential impacts.

- 2015 City of Goleta Coastal Hazards Vulnerability Assessment and Fiscal Impact Report
<http://www.cityofgoleta.org/home/showdocument?id=11317>
 - *This report outlines the climate-related threats to coastal communities from sea level rise and describes ways in which Goleta can adapt to, and monitor, these hazards. The report includes sea level rise projections for the UCSB region and potential areas of risk. Appendix A of the report identifies areas of the campus at risk of flooding and the potential impacts to our energy and transportation infrastructure.*
- 2015 City of Santa Barbara Sea Level Rise Vulnerability Assessment:
http://www.bren.ucsb.edu/research/2015Group_Projects/documents/SeaLevelRiseSB_Thesis.pdf
 - 2014 The City of Santa Barbara Sea Level Rise Vulnerability Assessment Final Work Plan
http://sealevelrisesb.weebly.com/uploads/2/8/5/0/28505163/sea_level_rise_sb_work_plan_june_2014.pdf
 - 2012 City of Santa Barbara Sea-Level Rise Vulnerability Study (white paper):
<http://www.energy.ca.gov/2012publications/CEC-500-2012-039/CEC-500-2012-039.pdf>

- CA Coastal Commission Sea Level Rise Policy Guidance: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits
https://documents.coastal.ca.gov/assets/slr/guidance/August2015/0_Full_Adopted_Sea_Level_Rise_Policy_Guidance.pdf
 - *This documents provide a step-by-step process for addressing sea level rise and adaptation planning in new and updated Local Coastal Programs. Included in the 2015 City of Santa Barbara Sea Level Rise Vulnerability Assessment are a number of best practices for adapting to sea level rise that are relevant to the UCSB campus. Strategies discussed include: retreat or relocate, protect in place, and elevate for critical infrastructure to reduce the risk of damage to hazardous areas.*
- Santa Barbara County Coastal Resiliency Project:
<http://longrange.sbcountyplanning.org/programs/Coastal%20Resiliency%20Project/coastalresiliency.php>
 - *This website provides information on the Santa Barbara County Coastal Resiliency Project and offers several useful resources.*
- Goleta Seven Meter Sea-Level Rise Map: <https://tnms.org/2012/07/31/goleta-seven-meter-sea-level-rise-map-pdf/>
 - *This map by Darren Hardy depicts flooding caused by a 7-meter rise in sea level rise along the coast of UCSB.*
- Flood Control Maintenance Activities in the Goleta Slough- Proposed Updated Maintenance Program
<http://cosb.countyofsb.org/uploadedFiles/pwd/Water/Environmental/GoletaSloughFSEIR-Section3.pdf>
- Full Flood Control Maintenance Activities in Goleta Slough Report
<http://cosb.countyofsb.org/pwd/pwwater.aspx?id=21178>
 - *The two documents listed above look at potential strategies for dealing with Goleta Beach flooding. The first resource provides specific information on hydraulic desilting, dragline desilting, and ecological recovery tactics, while the second resource contains information on the environmental impact of those projects. Flood management will be key in mitigating the impacts of sea level rise on the 217 highway, which is a major campus point of entry.*
- WEBSITE: Coastal Resilience- Santa Barbara County
<http://maps.coastalresilience.org/network/>
 - *Coastal Resilience is a program led by The Nature Conservancy to examine nature's role in reducing coastal flood risk. They have developed a web mapping tool that can be used for identifying at risk coastline. They have also developed a network of practitioners around the world supporting hazard mitigation and climate adaptation planning. UCSB can use their visualization platform to look at ecological, social, and economic information alongside sea level rise and storm surge scenarios for our geographic region.*
- WEBSITE: 2015 Goleta Slough Management Plan
<http://www.goletaslough.org/committee/2016-goleta-slough-management-plan/>
 - *This website contains the full management plan for Goleta slough and includes information on campus infrastructure vulnerable to inundation.*

- Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States <https://www.fema.gov/media-library-data/840f98e4cb236997e2bc6771f04c9dcb/>
 - *The document link above provides guidelines for analyzing and mapping coastal hazards along the pacific coastline. The report by the Federal Emergency Management Agency gives recommendations for action regarding the whole pacific United States coastline.*
- Combating Sea-Level Rise in Southern California: How Local Governments Can Seize Adaptation Opportunities While Minimizing Legal Risk <http://cityofgoleta.org/home/showdocument?id=12008>
 - *The City of Goleta report gives useful information on: the comparison of hard or soft armoring of coastal development protection, the existing local coastal programs working on sea level rise mitigation, and the regulatory setbacks and development rights for carrying out strategies for Goleta.*

Erosion

Climate change and sea level rise can catalyze coastal cliff erosion by increasing the frequency of storms, and raising the base on which storm surges build. This may then speed up coastal erosion by increasing stress on the bluffs. The university and the neighboring community of Isla Vista have already witnessed significant coastal cliff erosion. The following resources address adaption to cliff erosion through sand budgets, protection structures, and mitigation alternatives.

- Beach Width and Climate Oscillations along Isla Vista, Santa Barbara, California http://www.sbcountyplanning.org/projects/11DVP-00000-00016/Documents/RESUB/RevelGriggs2006_final.pdf
 - *This study provides useful information on long term beach width data for campus point beach. The study also looks at how El Nino weather patterns affect local coastal erosion through sand depletion. UCSB can use this information to predict erosion rates along campus based on predicted weather patterns.*
- Environmental Impact Report Goleta Beach County Park Managed Beach Retreat Project 2.0 http://www.sbcountyplanning.org/projects/11DVP-00000-00016/Documents/Vol_I-Goleta%20Beach%20Tech%20Proposal_forWeb.pdf
 - *This proposal is to restore the recreational value at Goleta beach by increasing the beach width, which also provides a large co-benefit of helping to mitigate the impact of large storms on coastal cliff erosion.*
- The Impacts of Coastal Protection Structures in California's Monterey Bay National Marine Sanctuary <http://montereybay.noaa.gov/resourcepro/resmanissues/pdf/022305armoring.pdf>
 - *This report focuses on the potential impacts of coastal protection structures on the resources of the Monterey Bay National Marine Sanctuary. Potential impacts of coastal protection structures on the Campus Point Marine Protected Area may be similar. Additionally, the report provides general background information on relevant coastal armoring policies around marine sanctuaries.*
- California Coastal Sediment Master Plan Status Report (statewide) http://dbw.ca.gov/csmw/pdf/SMP SR_status_report.pdf

- Coastal Regional Sediment Management Plan- Central Coast from Pt. Conception to Pt. Mugu http://www.dbw.ca.gov/csmw/pdf/CRSMP_Report_FINAL_30Mar2011.pdf
- Development of Sand Budgets for California's Major Littoral Cells (Chapter 5- Santa Barbara) http://www.dbw.ca.gov/csmw/pdf/Sand_Budgets_Major_Littoral_Cells.pdf
 - *These reports address the sediment deposits on the California coastline. The first report outlines the creation of the California Coastal Sediment Master Plan and has a map of critical coastal erosion areas, potential sediment sources, and littoral cells of Santa Barbara and Ventura Counties. While the second plan looks specifically into the sediment supply of the beaches from Pt. Conception to Pt. Mugu and describes plans to maintain this supply with a changing coastal circulation pattern in order to decrease projected erosion. Chapter 5 in the third plan addresses specifically Santa Barbara littoral cell including the sand sources, bluff erosion, beach nourishment, sand sinks, and dunes.*
 - Website for agency, BEACON, in which put together the plan <http://www.beacon.ca.gov/index.html>
 - BEACON - Beach Erosion Authority for Clean Oceans and Nourishment (Santa Barbara and Ventura counties)
- Evaluation of Erosion Mitigation Alternatives for Southern Monterey Bay (case study usage) <http://montereybay.noaa.gov/new/2012/erosion.pdf>
 - *Great case study on different erosion mitigation measures, including land use planning, nonstructural, and structural measures for mitigating erosion. A cost benefit analysis for each of the measures is also provided.*

Transportation

Coastal erosion, sea level rise, and extreme weather events caused by a changing climate can disrupt transportation. This disruption could impact access to UCSB especially from Highway 101 and Route 217. The following documents provide information on potential impacts of climate change on local transportation infrastructure and potential strategies for improving resiliency.

- Corridor Data Sheet State Route 217 http://www.dot.ca.gov/dist05/planning/sys_plan_docs/tcr_factsheet_combo/sb_sr217_tcr_fs.pdf
 - *This document contains a map of State Route 217 and includes: pavement conditions, traffic performance measures, annual average daily traffic (AADT) data, and ramp details.*
- California Flood Risk: Sea Level Rise Santa Barbara Quadrangle: http://www2.pacinst.org/reports/sea_level_rise/hazmaps/Santa_Barbara.pdf
 - *This map shows how sea level rise could affect highway 101, south of campus.*
- Goleta Beach 2.0 Project Overview (cliff erosion project) http://sbcountyplanning.org/projects/11DVP-00000-00016/Documents/DEIR/2_GB_Project%20Description.pdf
 - *The plan for Goleta Beach renovations outlines a proposed location for the bike path connecting to the campus. It also recommends creating a compacted earth embankment and a surface drainage line to mitigate flooding for Route 217.*

- US Department of Transportation Climate Resilience Pilot Program: Outcome, Lessons Learned, and Recommendations
https://www.fhwa.dot.gov/environment/climate_change/adaptation/resilience_pilots/2013-2015_pilots/final_report/fhwahep16079.pdf or
https://www.fhwa.dot.gov/environment/sustainability/resilience/pilots/2013-2015_pilots/final_report/chap00.cfm
- Climate Change and Sea Level Rise: Impacts on Pavement and Road Design
<http://nh.stormsmart.org/files/2011/11/Jacobs-Road-Design.pdf>
 - *These reports outline successful approaches for addressing the resilience of transportation systems to extreme weather and climate change. The report evaluates several strategies for addressing sea level rise, including bridge creation, raising and widening roads, and raising and reinforcing roads. The second resource also provides blueprint sketches of these plans for different roadways.*
- Goleta Airport Infrastructure Vulnerability and Adaptation Summary Sheets (Table SI-8)
<http://www.goletaslough.org/2016ManagementPlan/Appendix%20F%20-%20Infrastructure%20Vulnerability%20Summary%20Sheets.pdf>
 - *Pages 23 through 27 describe the hazards, vulnerability, and adaptive measures for Highway 101, Route 217, and smaller surface streets passing through or adjacent to the Goleta Slough Management Area.*

Drought

Climate change is predicted to cause more frequent and severe droughts. Our campus will need to be prepared for possible trigger cuts and further constraints on water availability. The resources listed below offer information on improving resiliency to drought through adaptation strategies, including water efficiency and vegetation modification.

- City of Santa Barbara Fire Department's High Hazard Area Desirable Plant List
<https://www.santabarbaraca.gov/civicax/filebank/blobdload.aspx?BlobID=16481>
 - *The list of desirable plants put together by the SB Fire Department could be useful when planting or replacing flora on campus. The list also provides information on each plant's water needs, native geographical area, and other characteristics, such as erosion control.*
- Managing Turfgrasses during Drought <http://anrcatalog.ucanr.edu/pdf/8395.pdf>
 - *This report addresses how to efficiently cultivate turf grasses, which are used for recreation and aesthetics on campus, in the Californian Mediterranean climate of long, hot, dry summers, and how to manage turfgrasses during drought.*
- City of Santa Barbara's Addendum to the WUCOLS Plant Lists
<https://www.santabarbaraca.gov/civicax/filebank/blobdload.aspx?BlobID=19984>
 - *This is a list of plant species with low water use. The City of Santa Barbara is hoping to facilitate a shift in landscaping towards more drought resistant species by listing different grasses, ground-covers, perennials, shrubs, trees, and vines, which have low water needs.*
- Drought Planning: A 10-Step Process
<http://www.wamis.org/tools/info/droughtplanning.pdf>

- *The Basics of Drought Planning: A 10 step process put together by the National Drought Mitigation Center may be relevant if the campus faces future trigger cuts that require drastic reductions in water use.*

Energy

More frequent and severe storms, fires, and landslides can damage or destroy transmission lines delivering electricity from the source to facilities such as UCSB. Santa Barbara County receives electricity from a power plant in Santa Clara through a 220kV transmission line that crosses over the north edge of a mountain range, which is extremely susceptible to weather events that could halt the transfer of electricity. The resources below provided information on energy reliability and resiliency for the Santa Barbara area.

- Central Coast Power (website) <http://www.centralcoastpower.org/>
 - *This website is for Central Coast Power, a consortium of local governments that formed to explore the feasibility of a Community Choice Energy (CCE) program to serve San Luis Obispo, Santa Barbara, and Ventura counties. CCE has the potential to provide reliable clean energy to Santa Barbara and UCSB.*
- Local Government Commission Community Choice Energy
<http://www.leanenergyus.org/wp-content/uploads/2013/10/CA-Sample-How-To-For-CCA.pdf>
 - *This document defines a community choice Energy in California, analyzes the feasibility for a certain community, and looks into finding potential partners. This can help outline UCSB's role as a potential partner in the Community Choice Energy project in Santa Barbara County.*
- SCE Santa Barbara Service Area Reliability Issues
<https://www.sce.com/wps/wcm/connect/9d344929-658a-4ea3-9f65-6a5841c143e6/SantaBarbaraReliability060214.pdf?MOD=AJPERES>
 - *These slides address the reliability issues in South Santa Barbara and potential solutions being considered by Southern California Edison. It also addresses the possibility of long term outages from natural disasters, for up to several weeks for the UCSB region.*
- Professional Consulting Services— Developing a Technical Feasibility Study on Community Choice Aggregation for the Central Coast Region
http://cosb.countyofsb.org/uploadedFiles/csd/esi/Community%20Choice%20RFP_SB%20County%20121815_clean%20final%207.pdf
- Community Choice Aggregation in California Operational Models and Best Practices
<http://www.lgsec.org/cca/CCA%20Models%20and%20Best%20Practices.pdf>
 - *The first study addresses scope of work, management models, energy efficiency and demand reduction, and cost. The second document outlines the best practices of existing Community Choice Aggregation (CCA) in California and addresses aspects to consider when looking into CCA models.*
- Assembly Bill No. 117 http://www.leginfo.ca.gov/pub/01-02/bill/asm/ab_0101-0150/ab_117_bill_20020924_chaptered.pdf
 - *This outlines the provision of Assembly Bill 117 passed in 2002 allowing for Community Choice Energy.*
- Microgrids & District Energy: Pathways to Sustainable Urban Development -Case Studies

<http://energy.pace.edu/sites/default/files/publications/USDN%20White%20Paper%20-%20Case%20Studies.pdf>

- *This document includes several case studies of microgrids and district energy projects in different sectors, including Higher Education. A campus microgrid and or district energy can help increase energy resiliency on campus.*
- Energy Research and Development Division Final Project Report on Renewable Resource Management at UC San Diego
<http://www.energy.ca.gov/2016publications/CEC-500-2016-027/CEC-500-2016-027.pdf>
 - *This report looks at the microgrid at UC San Diego and their primary integration objectives. It addresses hardware deployments and control algorithm development for solar power integration, distributed energy resource applications, distributed energy resource characterization, and lessons learned. This document may be helpful in developing UCSB's microgrid.*

Vector Habitat

Climate change creates new risks for human exposure to vector-borne diseases. Our campus can take actions to reduce this threat by reducing breeding habitat and human exposure. The resource list below provides management strategies for reducing the risk of vector born diseases.

- Mosquito and Vector Management District of Santa Barbara County Disease Surveillance Report August 2016 <http://www.mvmdistrict.com/files/118829601.pdf>
 - *This report by the Santa Barbara County Mosquito and Vector Management District looks at the prevalence of different vector based viruses in the county in different locations including UCSB. Goleta Slough is a particular area of concern as it is a breeding location for the Tule Mosquito (Culex erythrothorax) which can carry the west nile virus.*
- Managing Mosquitoes in Stormwater Treatment Devices
<http://anrcatalog.ucanr.edu/pdf/8125.pdf>
 - *This report addresses mosquito suppression through design and maintenance, guidelines for mosquito management, and preventative engineering. With additional flooding impacting stormwater drainage, UCSB can look at this document for information on different control methods.*
- Permeable Pavement Systems Analysis
<http://doee.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/Section%203.5%20Permeable%20Pavement%20Systems.pdf>
 - *This document outlines different design variants in installing permeable pavement systems. Permeable Pavement can decrease mosquito vector habitats on campus.*
- Overview of Mosquito Control Practices in California
<http://www.cdpr.ca.gov/docs/dept/westnile/mosqover.pdf>
- Best Management Practices for Mosquito Control in California
<https://www.cdph.ca.gov/HealthInfo/discond/Documents/BMPforMosquitoControl07-12.pdf>
 - *The two studies listed above focus on mosquito control best management practices for different types of landscapes in California. They also provide information on vector control laws regulations and control programs in California.*

All Inclusive

- 2009 California Climate Adaptation Strategy Plan
http://resources.ca.gov/docs/climate/Statewide_Adaptation_Strategy.pdf
 - *This is the broad Climate Adaptation Strategy Plan for the whole state, which addresses public health, biodiversity, ocean and coastal resources, water management, agriculture, forestry, and transportation and energy infrastructure.*
<http://www.georgetownclimate.org/adaptation/state-information/overview-of-californias-climate-change-preparations/completed-goals.html> (website not PDF!)

Current Progress at UCSB

Sea Level Rise

UC Santa Barbara's Carsey-Wolf Center held a year-long initiative, Figuring Sea Level Rise, to expand conversations among stakeholders about sea level rise. There has also been research done by students within the Bren School of Environmental Science and Management focusing on the effects of sea level rise in Santa Barbara County (report listed in Sea Level Rise section.) The report provides recommendation adaptation measures for Santa Barbara as a whole. However, the campus currently lacks plans of any structural implementations recommended by these studies to combat sea level rise consequences for the campus.

Cliff Erosion

UCSB has lost significant portions of the cliffs at "pinch points" across Lagoon Road on the east side of campus, and monitoring is being done to analyze the situation. Within the Infrastructure Renewal Project, the Coastal Commission tasked Campus Planning and Design to continue to monitor the east bluffs on an annual basis. The campus has also partnered with a geo-tech firm to establish markers to measure bluff retreat, and is working with several departments on LiDar aerial photography for cliff monitoring. The campus has also retreated the fence along Lagoon Road bluffs twice in the past five years due to cliff erosion. It should be noted that the Coastal Commission restricts proactive coastal armoring along the campus.

Transportation

Through the Emergency Management and Continuity Program, UCSB's Department of Environmental Health and Safety has developed an emergency planning process to prepare for a disaster in which Highway 217 is not accessible for a small time frame. Transportation Alternatives Program (TAP) also provides an Emergency Ride Home Program. These programs address more short-term approaches to transportation issues and can be built upon to incorporate long-term transportation planning. The long-term transportation planning would be beneficial for addressing transportation changes due to climate change.

Drought

UCSB has proactively reduced water consumption over the past decade through water efficiency and the use of recycled water, drastically reducing reliance on stressed water sources by utilizing recycled water to augment potable water for campus irrigation. The campus has also reduced water demand by installing low flow appliances and fixtures, reducing turf areas, and installing a closed-loop cooling system for campus laboratories. UCSB has also continued to run an educational campaign encouraging students and staff to reduce water usage.

Energy

UCSB owns nine installed on-site solar PV systems, ranging in size from 2kW to 424 kW; the aggregate capacity of these systems is 673 kW DC. In addition, the university entered into a multi-site solar photovoltaic (PV) third party Power Purchase agreement (PPA) with SunPower, to expand solar generated electricity another 5 MW DC online. Together, the current on-campus solar, and the planned SunPower PPA comprise 11% of the total electricity demand. Recent studies have shown that the campus can feasibly double this percentage with an additional 5 MW, which could prove beneficial for campus energy resiliency.

Vector Habitats

UCSB has already shifted towards using various permeable surfaces on campus, which reduce stagnant water that can become a breeding ground for vector borne diseases. The UCSB Environmental Health and Safety department also follows the mosquito and vector management guidelines for Santa Barbara County. Adding physical structures to minimize the consequences of increased vector habitats, such as screens, could be a beneficial next step.

If you would wish to edit or add anything to this resource, please review the information below.

All general edits and comments can be emailed to Jewel.Snively@ucsb.edu

To add an additional relevant resource to this list please click see the [Resiliency Resource Addition Form](#).