

# Quantifying Climate Change Impacts to City of Santa Barbara Water Supplies

## AUTHORS

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## CLIENT

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## OBJECTIVES

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The objective of this project is to make projections of climate change impacts to the City of Santa Barbara's surface water and groundwater supplies, identifying the average loss of and need for new supply. Throughout the project, students will:

- Use the City's current sources of water and storage capacity to establish a supply baseline
- Utilize outputs from existing climate change models for Santa Barbara County (eg. City of Santa Barbara Sea Level Rise Model, PPIC, Cal-Adapt) to evaluate the potential for:
  - Changes to quantity and timing of precipitation events, including likelihood of extended droughts
  - Increased frequency of fire events and associated sedimentation impacts
- Determine range of potential impacts of climate change on the annual quantity of water available from surface reservoirs and local groundwater
- Project the city's water supply needs through 2050 and determine the future supply gap
- Provide possible management strategies to address the identified water supply and storage gaps
- Evaluate long term availability of current sources compared with projected demand (if time allows)

## SIGNIFICANCE

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The City of Santa Barbara provides water to a service area of approximately 20 square miles with a population of roughly 92,000 people, with average daily pre-drought (or pre-2013) consumption of approximately 38.4 acre feet of potable water.<sup>5,6</sup> Current projections show that the population is expected to grow by 7,240 people by 2050.<sup>4</sup> The city's water supply is comprised of several sources: surface water from Lake Cachuma, Gibraltar Reservoir and Devils Canyon Creek; groundwater from production wells and infiltration to Mission Tunnel and Tecolote

Tunnel; imported water from the State Water Project (including supplemental water purchases/exchanges); desalination; recycled water system; and conservation methods.<sup>5,7</sup> Though the City of Santa Barbara has a long-term water supply plan to follow through 2030, the implications of climate change on the water supply sources and storage infrastructure necessitate further study and adaptive planning.

While uncertainty over exact climate change impacts for Santa Barbara remains, the city's climate action plan projects an average temperature increase of 1.8-5.4 F<sup>0</sup>, a 12-35% decrease in overall rainfall with increasingly erratic, more extreme weather events, greater risk of seawater intrusion into aquifers, and greater risk of wildfires in Southern California.<sup>3</sup> In order to prepare for the impacts of climate change, the City of Santa Barbara seeks to have a more detailed analysis, using outputs from existing climate change models for Santa Barbara County, in order to more accurately predict variability in surface reservoirs and local groundwater sources. Additionally, the City would like to better understand the impact of wildfires and the subsequent increased sediment load on reservoir capacity.

By establishing the rate and extent of reduction to the City's future water sources, the supply gap would be incorporated into the City of Santa Barbara's next Long Term Water Supply Plan, which will cover the period through 2050. As climate change impacts availability of existing supplies, reliable long-term water supply requires exploring the feasibility of expanding current water sources or finding new opportunities for the City's supply. Santa Barbara's planned methods for securing long term water security can serve as an example for other coastal cities interested in predicting future supply gaps and exploring new potential water supplies and management strategies.

## **BACKGROUND**

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The City of Santa Barbara has records detailing:

- Historical water demand
- Quantity of water supply from each source
- Projected climate impacts
- Gibraltar Reservoir Operations
- Lake Cachuma Operations
- Surface water and groundwater monitoring
- Groundwater modeling and technical studies

Both Santa Barbara's Long-Term Water Supply Plan and Climate Action Plan cover the time period up to 2030. The objectives and deliverables of this project would directly contribute to the City of Santa Barbara Long Term Water Supply Plan, covering the time period through 2050, taking into account more accurately projected impacts of climate change over that period.

## **AVAILABLE DATA**

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- Water Supply
  - Current City of Santa Barbara water use from each of the City's sources
  - City of Santa Barbara water quality reports for each reservoir and aquifer
  - City of Santa Barbara Urban Water Management Plan population growth projections and future water demand
- Storage Capacity
  - City of Santa Barbara Gibraltar Reservoir bathymetric surveys

- County of Santa Barbara Public Works and USGS rainfall, river-stream and reservoir data
- U.S. Bureau of Reclamation Lake Cachuma records
- Cachuma Operations and Maintenance Board data
- Climate Data
  - City of Santa Barbara’s Sea Level Rise Model
  - Intergovernmental Panel on Climate Change gridded climate model output
  - Cal-Adapt Precipitation and Temperature Models for Santa Barbara County
  - Cal Fire - FRAP Projects and Fire Probability Maps
- Water Resources Models
  - California State Department of Water Resources, California Water Project data
  - RHESSyS Watershed Model, calibrated for Mission Creek Watershed <sup>1,8,9</sup> and including fire data <sup>2</sup>
  - USGS California Basin Characterization Model

## **APPROACH**

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- Complete an overview of current surface water and groundwater supplies for City of Santa Barbara
- Utilize the City of Santa Barbara’s Sea Level Rise Model to evaluate the following:
  - Projected changes to precipitation
  - Projected temperature changes and drought occurrence
  - Likely occurrence of fire events in the watershed
- Use a watershed model (e.g. RHESSyS) to model the effect of climate change on water availability for surface reservoirs and groundwater
- Using historical data for reservoir sedimentation rates and occurrence of fires within the watershed, create simple model projection of future reservoir storage loss
- Determine the supply gap between the future City water demand and projected supplies

The following will be undertaken if time allows:

- Expand upon the policy brief for the City of Santa Barbara to include the following:
  - Update “safety margins” of the 2011 supply plan
  - Exploration of options to expand supply from current sources
  - Proposed new sources of water for incorporation into the City’s supply portfolio

## **DELIVERABLES**

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Beyond a final written report, policy brief, poster, and oral presentation, the group will provide:

- An assessment of the projected impacts of climate change on water availability and storage capacity for the City of Santa Barbara until 2050, to contribute to the City’s Long Term Water Supply Plan
- A policy brief detailing the City of Santa Barbara’s projected water supply gap, and, if time allows, strategies for the City to expand its water supply sources to meet the future water demand

## **INTERSHIPS**

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The Water Resources Division of the City of Santa Barbara is able to sponsor one internship with funding of \$1,500. This will be a part time position hired through UCSB and invoiced to the City of Santa Barbara. Please see the Client Letter of Support for additional details.

## Supplemental Materials

### REFERENCES

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<https://www.santabarbaraca.gov/civicax/filebank/blobdload.aspx?BlobID=17720>
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<http://meetings.sbcag.org/Meetings/SBCAG/2018/10%20Oct/Item%207%20Draft%20Regional%20growth/Attachment%20A%20Regional%20Growth%20Forecast.pdf>
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6. Water Resources Division, Public Works Department. 2018. *Water Distribution*. City of Santa Barbara. Available at: <https://www.santabarbaraca.gov/gov/depts/pw/resources/system/distribution/default.asp>
7. Water Resources Division, Public Works Department. 2018. *Water Sources*. City of Santa Barbara. Available at: <https://civicaweb.santabarbaraca.gov/gov/depts/pw/resources/system/sources/default.asp>
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9. Shields, C., Tague, C. (2015) Ecohydrology in semiarid urban ecosystems: Modeling the relationship between connected impervious area and ecosystem productivity, *Water Resources Research* 51: 302-319. doi: 10.1002/2014WR016108

### Budget & Justification

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It is not anticipated that the proposed project would require additional funding beyond the \$1,300 contributed by the Bren School.

### Client Letter of Support

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(See Attached)



# City of Santa Barbara

Public Works Department

[SantaBarbaraCA.gov](http://SantaBarbaraCA.gov)

January 25, 2019

## Main Office

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93102-1990

Bren Group Project Review Committee  
Bren School of Environmental Science and Management  
2400 Bren Hall, University of California, Santa Barbara  
Isla Vista, CA 93106-5131

## Administration

Tel: (805) 564-5377  
Fax: (805) 897-2613

**SUBJECT: CITY OF SANTA BARBARA SUPPORT OF GROUP PROJECT PROPOSAL**

## Engineering

Tel: (805) 564-5363  
Fax: (805) 564-5467

Dear Members of the Bren School Group Project Committee,

## Facilities

Tel: (805) 564-5583  
Fax: (805) 897-2577

The City of Santa Barbara Water Resources Division would like to offer our enthusiastic support of the Group Project proposal *Quantifying Climate Change Impacts to City of Santa Barbara Water Supplies*.

## Street Maintenance

Tel: (805) 564-5413  
Fax: (805) 897-1991

The City of Santa Barbara (City) provides water to a population of approximately 92,000 community members. Although the City's supply sources are diversified, including surface, ground, imported, desalinated, and recycled water, in addition to conservation methods, the implications of climate change on future supply and storage infrastructure necessitate further study and adaptive planning.

## Transportation

Tel: (805) 564-5385  
Fax: (805) 564-5467

As the Water Supply Manager for the City, I am responsible for long-term planning of the City's water supplies and evaluating both demand and supply management strategies. As the client of the project, the City can provide information detailing the City's historic water demand, quantified water supply for each of our sources, reservoir operations data, as well as groundwater and surface water monitoring data. Additionally, the City previously developed a Sea Level Rise Model, which incorporates relevant precipitation and temperature data.

## Water Resources

Tel: (805) 564-5387  
Fax: (805) 897-1991

With our own data, combined with the multitude of other available resources, we are well-positioned to support a team of Bren students in evaluating impacts of climate change to the City's water supplies. The objectives and deliverables of this Group Project would directly contribute to the next update to the City of Santa Barbara Long Term Water Supply Plan (LTWSP), through the year 2050. The updated LTWSP will take into account projected impacts of climate change over that period, and Santa Barbara's planning methods can serve as a model for other coastal cities interested in predicting future supply gaps and evaluating management strategies.

If the proposal is accepted by the Group Project Committee, I am committed to supporting the group of students throughout the process by providing mentorship and guidance, existing data held by the City, as well as \$1500.00 in financial support to fund a part-time internship supporting the Group Project over the summer of 2019. We look forward to working with Bren students on this project.

Please do not hesitate contact me if you have any additional questions or concerns.

Sincerely,

A handwritten signature in black ink that reads "Kelley A. Dyer". The signature is fluid and cursive, with the first name "Kelley" and last name "Dyer" clearly legible.

Kelley A. Dyer, Water Supply Manager  
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KAD/mef