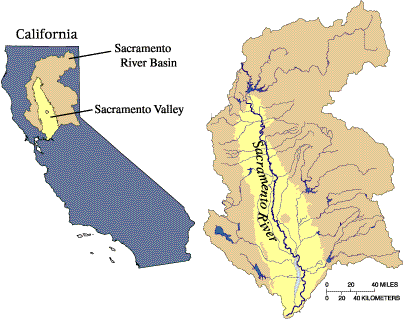
**CASE STUDY: Sacramento River, California (USA)**

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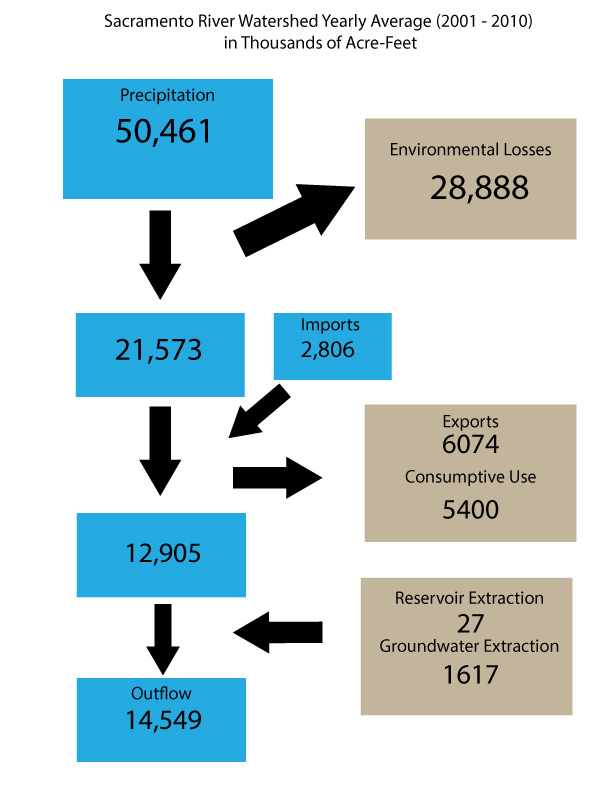
**General Overview**

The Sacramento River watershed is the largest in the State of California (USA). The river carries about one-third of the state’s total surface water runoff. This river supplies water for many uses. It supplies drinking water to millions of Californians within and outside of the watershed. Canals and pipelines allow Sacramento River water to be exported throughout the state, for use in both cities and on farms. The agricultural lands irrigated with Sacramento River water are among the most important for crop production in the entire United States. The Sacramento River also supplies water to the Sacramento Deep Water Ship Channel, which is very important in the transportation of agricultural products to the rest of the country and the entire world. Not only does the river supply water for human purposes, but it also helps sustain critically important freshwater and estuarine ecosystems.

Unfortunately, human uses of water have caused harmful effects on the natural ecosystems. The river’s hydrology has been significantly altered by dams and water diversions, which has led to a substantial loss of riparian habitats and aquatic species. Millions of salmon used to spawn upstream in the Sacramento River, but only 40,000 have been seen in recent years.

In recent years (as of 2014), California has been experiencing a very severe and long-lasting drought. This drought has caused much less water to be available to people and ecosystems. Reservoir levels are at historically low levels and water managers are making mandatory restrictions on the volume that can be released for human uses. The excessive levels of water usage, drought impacts on surface water availability, and decreasing reservoir volumes have led to greatly increased pumping of groundwater, causing rapid lowering of the groundwater levels. There is much more groundwater pumping than there is infiltration to replenish it. The average depletion of groundwater over the past ten years has been estimated at more than 1.6 million acre feet (2 billion cubic meters). Addressing the water supply issue in the Sacramento River watershed, and throughout the state of California, is a very challenging task. Changes within the watershed itself will not solve the problem. This challenge will need to be addressed with solutions by the whole state.

**Water Budget (10 year average from 2001 – 2010)**



**Water Toolbox**

**Desalination**

There are plans to build numerous desalination plants in Southern California. One plant that is under construction will produce 50 million gallons of fresh water every day (equivalent to 56,000 acre-feet per year or 19 million cubic meters per year). This water will lessen the importance of water diversions from the Sacramento watershed to some degree. Many more desalination plants would be needed to solve the water shortage problems throughout this region, however. The Metropolitan Water District of Southern California estimates they would need to build a desalination plant every four miles between Los Angeles and San Diego to completely replace the amount of water that is imported from the Sacramento River.

<http://www.reviewjournal.com/news/water-environment/water-authority-touts-pipeline-while-foes-pursue-desalination-plant>

<http://carlsbaddesal.com/desalination-plant1>

<http://online.wsj.com/news/articles/SB124708765072714061>

**Water Reuse**

The Sacramento Water Recycling Coalition promotes recycling water for use in agriculture, landscape irrigation, industrial uses, and wildlife habitats. Recycling water will not necessarily replenish the river (see Chapter 3 in *Chasing Water*), but it can reduce the amount of water that must be withdrawn from the river to meet certain uses.

<http://www.regionalsan.com/sacramento-water-recycling-coalition>

<http://www.watereuse.org/sites/default/files/u8/WRA-Chapter-Meeting_%20SRCSD_JRR.pdf>

**Water Importation**

The Clear Creek Tunnel imports water from Lewiston Lake on the Trinity River to the Sacramento River watershed. Most of this water is then exported further south to southern California. In 1994, the Alaskan government tried to sell California an idea to pipe water from Alaska to California. This plan never became a funded project, however.

<http://www.trrp.net/background/ops/>

**Water Storage**

There are many dams and reservoirs in the Sacramento River watershed. These dams provide water storage and generate hydroelectric energy. These storage facilities have experienced a large decrease in their storage volume due to the current drought (as of 2014). There is also concern that there is not enough land to create more reservoirs because of environmental concerns and the highly-depleted condition of most rivers in this region.

<http://www.norcalwater.org/water-maps/shasta-reservoir/>

<http://www.businessinsider.com/folsom-dam-illustrates-california-drought-2014-2>

<http://www.usbr.gov/projects/Project.jsp?proj_Name=Shasta/Trinity+River+Division+Project>

<http://www.capradio.org/news/project/2014/drought/>

**Watershed Management**

There have been many watershed management plans developed in this region. Many government agencies are working to promote improved water use and water allocation. One such plan was developed by the Northern California Water Association. Their plan is called *Efficient Water Management for Regional Sustainability in the Sacramento Valley.* This plan includes alternatives to improve efficiency from the farm level to the entire watershed level. There are many physical improvements that can be made as well, such as improved irrigation piping and upgrading reservoir technologies. However, the main challenge is to get all interest groups to agree upon a water budget for the available water.

<http://www.norcalwater.org/wp-content/uploads/2013/03/water-management-in-the-sac-valley.pdf>

<http://www.norcalwater.org/wp-content/uploads/2012/01/Technicalreport-jul2011.pdf>

**Water Conservation**

New water conservation initiatives are being created every year, particularly as the drought situation worsens (as of 2014). The most recent effort for water conservation in Sacramento has been the “cash for grass” program. This allows homeowners to be incentivized to change their lawns – which require a lot of water – to native plants that will not require irrigation. This is known as xeriscaping and it has had success in other areas of the southwest United States, most notably Las Vegas and Tucson. New technologies are improving water efficiency in agricultural and residential irrigation. However, more improvements can be made in technology and legislation to encourage greater conservation.

<http://www.capradio.org/articles/2014/04/09/california-drought-operations-plan-for-water-projects-released/>

<http://www.capradio.org/articles/2014/04/04/bill-would-protect-homeowners-attempting-to-reduce-water-use/>

<http://www.capradio.org/articles/2014/03/05/sacramento-approves-grass-for-cash-plan/>

**Water Stakeholders**

**Agricultural Industry (Farm Bureau)**

The Sacramento River Valley has some of the most fertile and productive agricultural lands in the United States. One percent of all agricultural land in the United States is within the Sacramento River Valley, but this land produces over 8% of all the crops grown in the country. The Sacramento County Farm Bureau estimates that their county’s agricultural value is worth half a billion dollars and Sacramento County makes up less than 10% of the watershed. Agricultural production in the Central Valley of California is estimated to produce over 20 billion dollars each year. The Sacramento River’s water is also exported to other areas of California to support agricultural production.

<http://www.sacfarmbureau.org/>

**Urban Populations in California**

Water from the Sacramento River is exported to cities in Southern California. This water is delivered to 22 million people throughout California. Cities and planning districts need to negotiate for the rights to the imported water.

**Energy Companies and the US Bureau of Reclamation (hydroelectricity)**

California uses a relatively high percentage of hydroelectricity to supply energy to its residents. A total of 14% of all energy in California comes from hydroelectricity. The Sacramento River watershed has well over 50% of the state’s hydroelectric dams. Three of the five largest dams in California are in the Sacramento River watershed: Oroville, New Bullard, and the Shasta dam. The Oroville generates 2,220 Gigawatt hours (GWh), the Shasta generates 1806 GWh, and the New Bullard generates 1,314 GWh.

<http://www.ycwa.com/about/hydroelectric>

<http://www.water.ca.gov/swp/facilities/Oroville/hyatt.cfm>

<http://www.usbr.gov/projects/Facility.jsp?fac_Name=Shasta+Dam>

<http://www.energy.ca.gov/hydroelectric/hydro_power_plants.html>

**Sacramento Deep Water Ship Channel (manufacturing, transport, and agriculture)**

The Sacramento Deep Water Ship Channel is a 43-mile long channel that connects the City of Sacramento to the Sacramento River and then to the San Francisco Bay. This channel provides an alternative transport method for shipping goods to and from the region. The Sacramento port’s most important exports are the agricultural products of the region. The Army Corps of Engineers is continuing plans to expand this channel by dredging another five feet from the bottom. Dredging will allow more access to larger ships within the channel and improve the cost efficiency of transporting goods out of Sacramento. The dredging will also require more water to enter the channel from the Sacramento River watershed.

<http://www.spn.usace.army.mil/Missions/ProjectsandPrograms/ProjectsAZ/SacramentoRiverDeepWaterShipChannel(C).aspx>

**Environmental Groups (fish, ecology, whales, etc)**

The Sacramento River watershed was once a very diverse ecosystem. The highly-altered hydrology has significantly changed the ecosystem, however. The Sacramento River used to have millions of salmon that would use the river to spawn. Now, the population is below 40,000. The Sacramento River also is known to have a population of whales that journey inland for food. Environmental groups want to preserve what is left and restore the ecosystem back to health.

<http://www.sacriver.org/>

**General References**

There are links included throughout the exercise to help add more information for each section. However, a great resource that has compiled a lot of information in one place is the Sacramento River Watershed Program. They have many great resources including maps, environmental health reports, and reports from stakeholder forums.

<http://www.sacriver.org/aboutwatershed/roadmap/introduction>

More useful sources:

<http://www.norcalwater.org/wp-content/uploads/2012/01/flowssacvalley-sep2011.pdf>

<http://www.sacramentoriver.org/srcaf/index.php?id=home>

<http://www.aquafornia.com/index.php/where-does-californias-water-come-from/>

**Water Budget Documentation**

California Water Plan 2013. “Sacramento River Hydrologic Region”. <http://www.waterplan.water.ca.gov/docs/cwpu2013/2013-prd/Vol2_SacramentoRiverRR_PRD_Final_fk_wo.pdf>