UC SANTA CRUZ

WATER ACTION PLAN

DECEMBER 2013

Contents

Executive Summary

Monterey Bay

UC Santa Cruz

This Water Acton Plan has been developed to acknowledge achievements and identify strategies that can be implemented to reduce the UC Santa Cruz demand on water resources and to promote healthy watersheds in and around the campus.

Consistent with the State of California law establishing a goal to reduce per capita potable water use consumption by 20%, the UC Board of Regents Policy on Sustainable Practice, Sustainable Water Systems section (Policy) states that "...each campus will strive to reduce potable water consumption adjusted for population growth by 20% by the year 2020."

In addition, the Policy stipulates that each campus will develop and maintain a Water Action Plan (WAP) to identify the campus' long term strategies for achieving sustainable water systems.

UC Santa Cruz has been proactive in water conservation over the last decade and, as a result, campus potable water use has seen an overall downward trend while campus population has increased.

As its potable water use baseline, a metric identified in the Policy, the Campus has selected historical use over a three year period (Fiscal Years 2003-2005), 14,200 gallons per capita. In FY 2012 the campus used 9,100 gallons per capita, nearly a 36% reduction from the baseline, surpassing the 20% goal.

These reductions have been achieved, in part, through extensive retrofits of high-flow plumbing fixtures to low flow fixtures. After a campus-wide water efficiency survey, a list of high-priority projects, including retrofit of plumbing fixtures in high use facilities, was created and targeted for implementation. The Campus completed the high priority projects in 2010.

While the campus achieved the reduction goal in FY 2012, it is committed to continued conservation, efficient use of limited water resources, partnering with our water provider, and promoting education and research that explore new technologies and techniques for potable water use reduction as our campus grows.

Additionally, UC Santa Cruz is active in the management of our natural stormwater system. The campus is currently participating in the Central Coast Regional Water Quality Control Board Joint Effort for Low Impact Development and Hydromodification Control. The Joint Effort is a collaborative, region-wide approach to implement low impact development to help manage watersheds. The goal of this effort is to develop rigorous post-construction requirements that protect watershed processes.

California Rivers

Key Elements

UCSC developed a three-year water use baseline that aligns with City of Santa Cruz's baseline for the campus

UCSC reduced per capita water use in fiscal year 2011-12 by nearly 36% from the baseline

UCSC is part of a Joint Effort partnership with the Regional Water Quality Control Board to promote healthy watersheds

Key Opportunities

Research, identify, and apply new technologies and improvements that reduce campus water consumption and/or increase efficiency

Evaluate the use of the non-potable water sources for irrigation of Farm, Arboretum, toilets, recreation fields and/or cooling tower make-up water

Promote student-directed educational campaigns to effect behavioral change and reduce water consumption

UC Santa Cruz Water Action Plan

As part of the University of California commitment to sustainable practices, the Sustainability Steering Committee recommended the inclusion of a Sustainable Water Systems section in the Regents Policy on Sustainable Practice. In accordance with the Policy, each UC campus is to prepare a Water Action Plan (WAP) that identifies long term strategies for achieving sustainable water systems.

The WAP recognizes the limited nature of water resources in our region and the campus' role as a responsible steward in the community. It identifies the achievements in water conservation and responds to the Regents Policy on Sustainable Practice.

The WAP identifies the active outreach programs and student-based activities that demonstrate the continued engagement in campus-wide water use reduction strategies. It identifies new technologies to consider for the delivery of water for potable and non-potable use. It recognizes the commitment landscape operation staff have incorporated into daily operations and acknowledges the focus on maintaining efficient irrigation systems while promoting native and low water use landscapes.

The WAP reviews strategies for non-potable water use including potential use of a unique karst aquifer that underlies the campus. It outlines the stormwater system that is managed in a natural environment, utilizing deep ravines, sink holes and swallow holes all in a landscape

Sustainable Water Systems Policy Text:

With the overall intent of achieving sustainable water systems and demonstrating leadership in the area of sustainable water systems, the University has set the following goals applicable to all campuses including medical centers:

1. ***In line with the State of California's law establishing a goal to reduce per capita potable water consumption by 20%, each campus will strive to reduce potable water consumption adjusted for population growth by 20% by the year 2020. This target will be re-evaluated and recommendations for adjustments will be made as necessary by the Sustainable Water Systems Working Group. Campuses that have already achieved this target are encouraged to set more stringent goals to further reduce campus potable water consumption.***
2. ***Each campus will develop and maintain a Water Action Plan that identifies the campus' long term strategies for achieving sustainable water systems.***

dominated by redwood forest and open meadows.

Regents Policy

The University of California is committed to responsible stewardship of resources and to demonstrating leadership in sustainable business practices. The University's campuses should be living laboratories for sustainability, contributing to the research and educational mission of the University, consistent with available funding and safe operational practices.

To that end and inspired by students' calls for action, the University's institutional commitment to campus sustainability began in June 2003, when the Board of Regents adopted green building and clean energy policy principles. In June 2004, President Dynes issued detailed guidelines for the Policy on Green Building Design and Clean Energy Standards. Reflecting its broadened scope, the policy's name was changed to the Policy on Sustainable Practice. This comprehensive policy established the university as a leader in promoting environmental stewardship among institutions of higher education.

The Sustainable Water Systems section was approved by the Sustainability Steering Committee as a new policy section in 2012 and was adopted by The Regents in fall 2013. Policy provisions address campus water use reduction, watershed management, and education and outreach, and recognize the uniqueness of each campus' regional water resources. The guidelines recognize past achievements and provide flexibility in policy implementation.

UC Santa Cruz students

Kresge College

UCSC Physical Context/Natural Setting

The UC Santa Cruz campus is situated at the northwest edge of the city of Santa Cruz, and slopes upward in a series of marine terraces from an elevation of 300 feet at its southern boundary on High Street to an elevation of about 1,200 feet at its northwestern boundary. The three youngest terraces roughly correspond with lower, central, north, and upper campus areas.

UC Santa Cruz is known for the outstanding natural beauty of the campus landscape and the quality of the campus's built environment. The scenic and aesthetic quality of the campus is largely a function of the campus's natural setting and the diversity of its natural features.

The campus abuts open-space park areas to the north, east and west and residential portions of the city of Santa Cruz to the south. The campus is bounded on the east by the Pogonip City Park and the Henry Cowell Redwoods State Park, on the north by private land, and on the west by Wilder Ranch State Park. Several residential neighborhoods lie to the south of the campus, and the

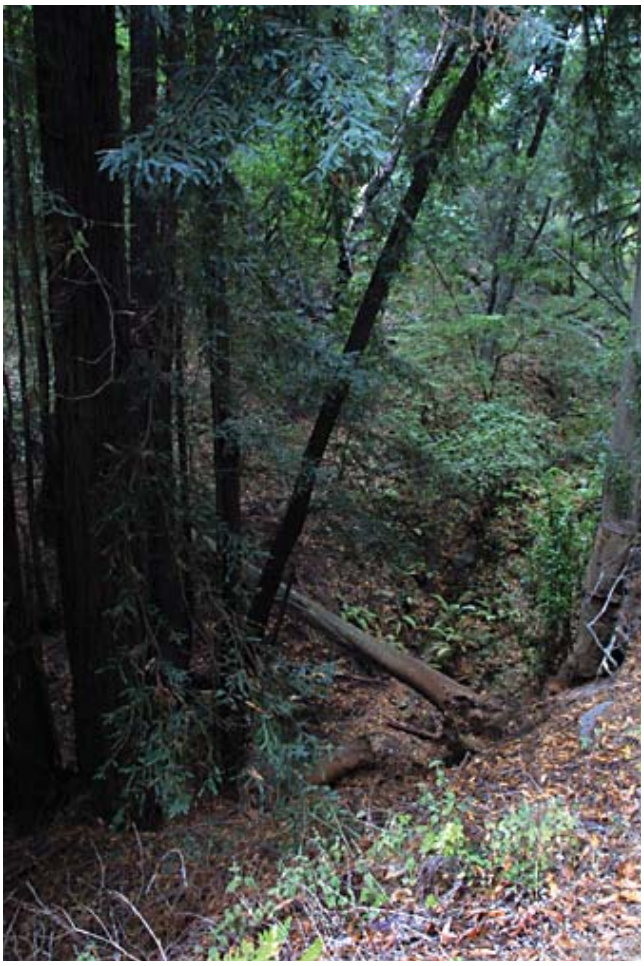
UC Santa Cruz in regional open space context

rural residential Cave Gulch neighborhood lies just outside the western campus boundary.

The campus landscape is as varied as its topography. Expansive meadows at the campus' main entrance gradually transition to redwood forests in the central campus and to chaparral and mixed evergreen forests in the undeveloped north and upper campus. Due to the campus' elevation above the surrounding area, broad, uninterrupted views of the city of Santa Cruz and Monterey Bay are available from several locations on the lower and central campus.

The campus site consists of a series of relatively level marine terraces separated by steep slopes. The site rises nearly 900 feet from south to north. The central and lower portions of the campus are divided roughly in thirds by two steep north-south trending drainages and their tributaries. Jordan Gulch and its tributaries delineate the eastern third of the campus, while Moore Creek and its tributaries delineate the western third. Other drainages include Cave Gulch, which has its headwaters in the northern part of the campus and runs along the southwestern margin of the campus, and Wilder Creek, which also runs along a portion of the campus's western margin. In some areas of the campus, these creeks form ravines, some as much as 70 feet deep and 350 feet wide. A number of smaller drainages originate along the campus's eastern boundary and drain down to the Pogonip City Park.

The geology of the upper and north campus consists of weathered schist and granitic rocks, which are overlain in some areas by thin (5- to 30-feet thick) covering of sedimentary deposits. The dispersal of surface flow allows for rainwater to percolate into the ground and recharge a shallow groundwater system. In the north

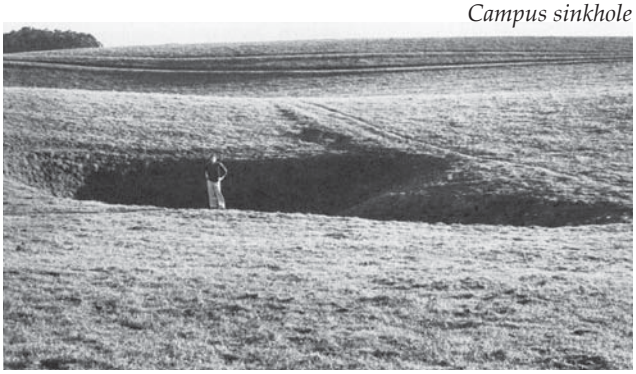


campus, the shallow groundwater feeds forest springs and seeps located along the southern and eastern edge of the north campus. Many of the forest springs are perennial (i.e., flow throughout the year) during years of average and high rainfall.

The southern two-thirds of the campus is underlain by marble and schist bedrock. This portion of the campus is cut by several steep-walled north-south flowing streams, but very little storm water is conveyed by surface streams to channels downstream of the campus. Instead, most storm water is captured by the karst aquifer, stored and transmitted via solution channels and caves, and discharged in springs at lower elevations to the east, south and west of the campus.

Due to its limited thickness and extent, and moderate permeability the upper/north campus groundwater system is not considered a viable source for long-term groundwater supply for the campus. The karst aquifer underlying the central and southern portions of the campus is a significant groundwater resource that the Campus has not yet utilized.

Campus sinkhole



Water Supply

Water Supply

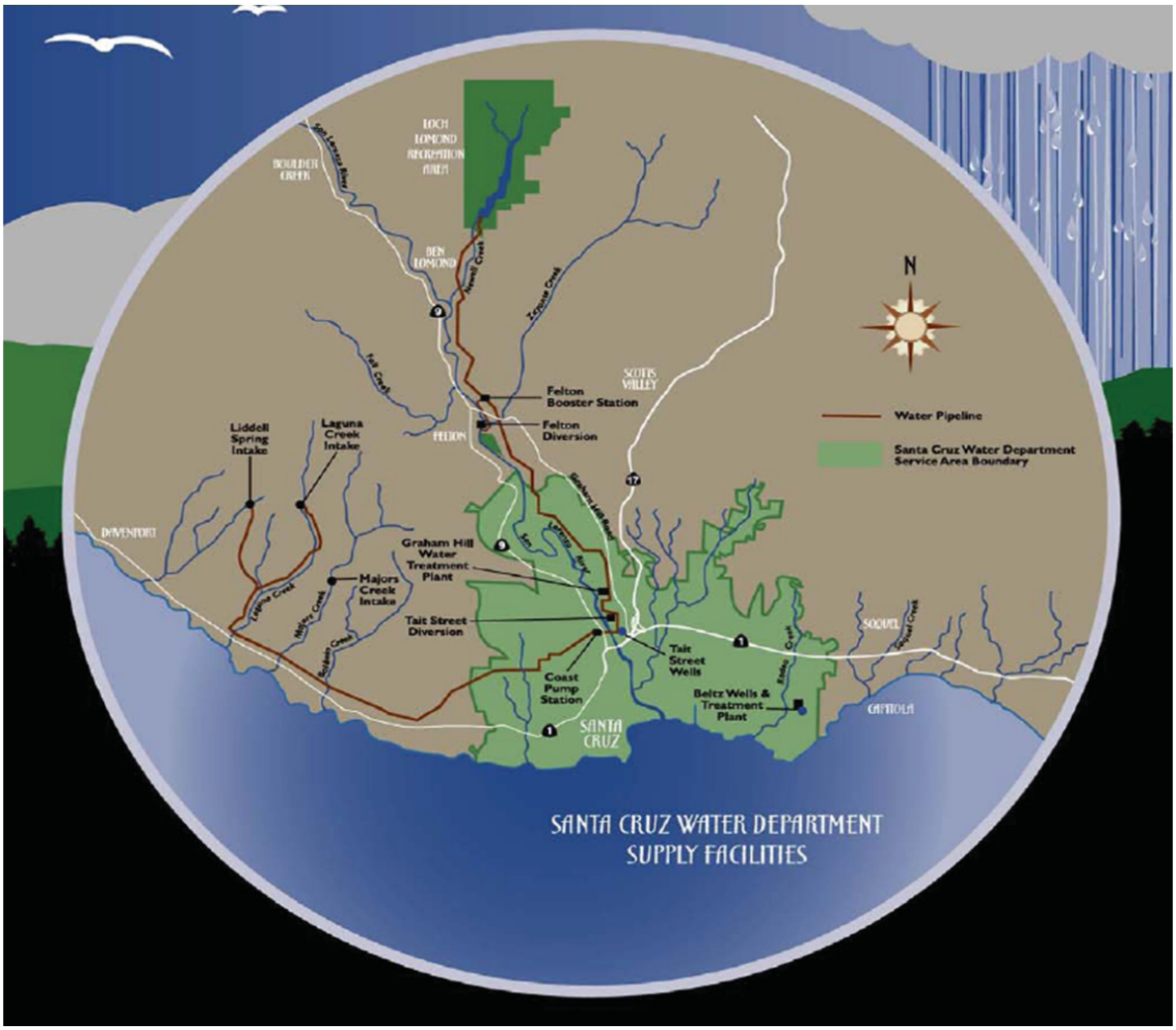
The UC Santa Cruz campus receives potable water through four connections to the City of Santa Cruz Water District (SCWD) system. SCWD pumps potable water to three consecutive in-line reservoirs at separate elevations ranging from 400 feet to 1,113 feet at a point in the northern campus. A campus water system then distributes water to campus facilities in eight separate pressure zones.

The SCWD system relies entirely on rainfall, surface runoff, and groundwater infiltration occurring within watersheds located in Santa Cruz County. No water is purchased from state or federal sources or imported to the region from outside the Santa Cruz area. The SCWD currently has four water supply sources: 1) surface water diversions from three creeks and one natural spring on the Santa Cruz County North Coast; 2) surface water diversions from San Lorenzo River; 3) surface water from Loch Lomond Reservoir; 4) groundwater extracted from the Purisima Formation by the Live Oak well system.

On average, about 75 percent of the City's annual water supply needs are met by surface diversions from the coastal streams and the San Lorenzo River. Water stored in the Loch Lomond Reservoir is used mainly in the summer and fall months when the flows in the coast and river sources drop off and accounts for only about 21 percent of the City's annual supply. The remaining 4 percent is produced from the Live Oak wells.

The SCWD provides water to nearly 91,300 customers through approximately 24,350 service connections in the city of Santa Cruz, the campus, a portion of the unincorporated area of Santa Cruz County, and a small portion of the City of Capitola. The SCWD water service area is approximately 20 square miles in size.

The City's water system has limited remaining operational capacity, and also lacks sufficient water to supply existing demand during periods of drought. When the San Lorenzo River and coast sources run low, the system



relies more heavily on water stored in Loch Lomond to satisfy demand, which depletes available storage. In critically dry or multi-year drought conditions, the combination of very low surface flows in the coast and river sources and depleted storage in Loch Lomond reservoir reduces available supply to a level which cannot support average dry season demands.

The City's water planning documents indicate that the system is able to meet 100 percent of the existing water demand in about seven out of every 10 years, and about 90 percent of existing demand in about nine out of 10 years. There is a significant shortage about one out of every 10 years.

City Water Planning

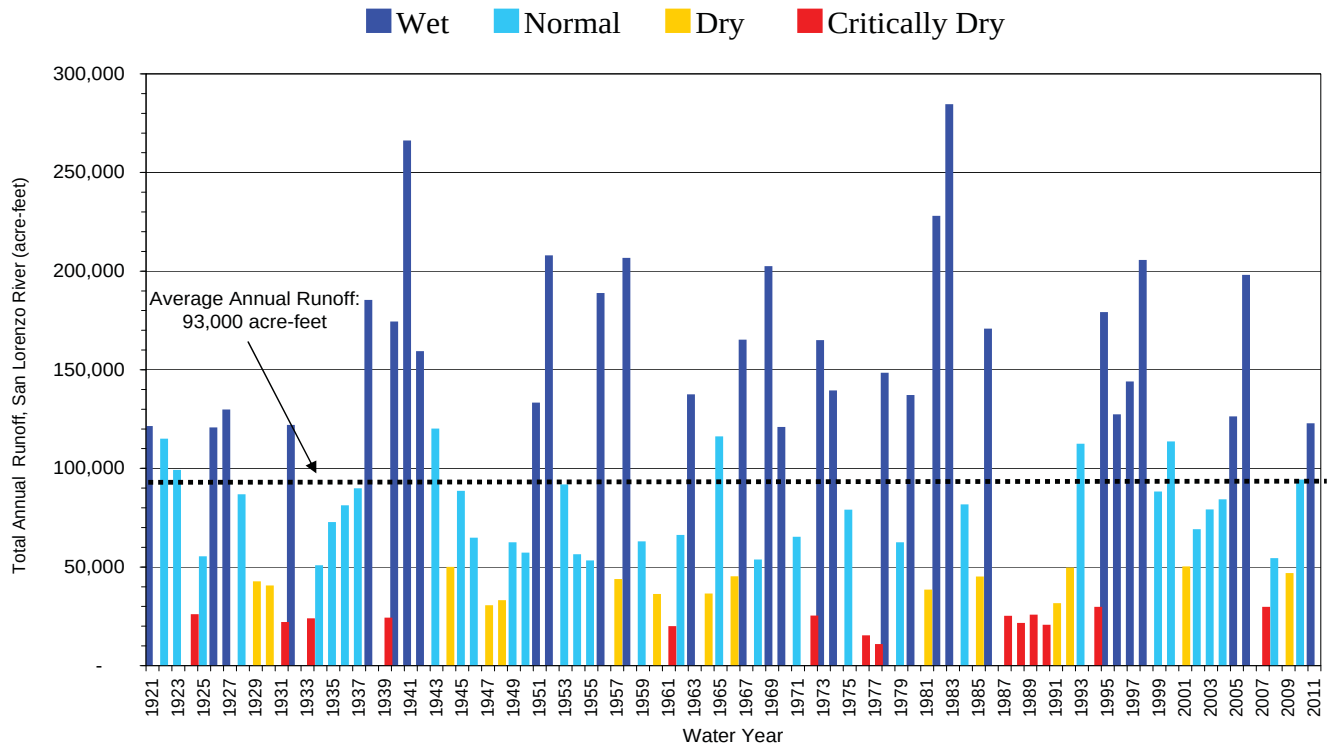
The City has been pursuing possible new water supplies for the past 25 years to meet its needs during drought periods. In 1997, the City initiated an "integrated water planning" approach to consider all practical options for balancing its water supply by decreasing demand and increasing supply.

In November 2005, the City Council adopted the City of Santa Cruz Integrated Water Plan (IWP), which included three elements: conservation, use curtailment, and supplemental supply. Since 2003, the City has made substantial progress in all three areas.

Over a 10-year period ending in 2010, the City implemented a Long-Term Water Conservation Plan adopted in 2000. According to the City's 2010 Urban Water Management Plan (UWMP), over this period the City achieved an estimated 251 mg/year reduction in water demand and reduced residential per-capita water demand by about 20 gallons per day.

The City completed a comprehensive update of its Water Shortage Contingency Plan in 2009. The plan describes the conditions that constitute a water shortage, and provides guidelines, actions, and procedures for managing water supply and demands during a declared water shortage. This plan was developed to establish the actions necessary to achieve the up-to- 15 percent cutback in system-wide demand established in the City's IWP, and to describe how the City would respond if there are much larger shortages in water supply.

The Water Shortage Contingency Plan uses a staged approach that classifies a shortage event into one of five levels spanning a range from less than 5 percent up to 50 percent. The overall concept is that water shortages of different magnitudes require different measures to overcome the deficiency. Each stage includes a set of demand reduction measures that become progressively more stringent as the shortage condition worsens.

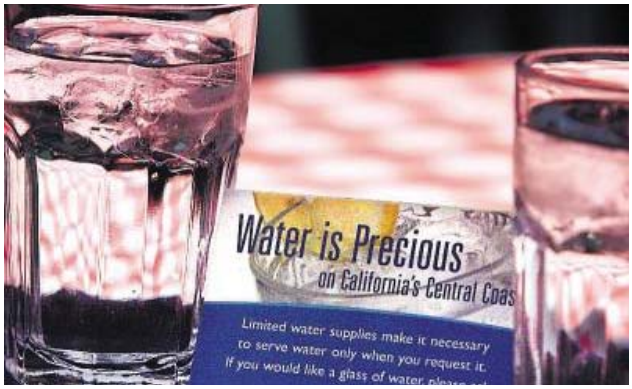


City of Santa Cruz historical runoff

The City's Water Shortage Contingency Plan includes curtailment allocations for UC Santa Cruz. These allocations, which the City developed in consultation with campus staff, are based on correlation of UC Santa Cruz water use with those of other user classes (e.g., multi-family residential, commercial, irrigation, etc.). Under these allocations, UC Santa Cruz would be required to reduce water use by a percentage approximately equal to the system shortfall. For example, in the event of a 25 percent shortfall, UC Santa Cruz would be required to reduce use by 24 percent; in a system shortfall of 50 percent, UC Santa Cruz would be required to reduce water use by 48 percent.

Table 8-5. Summary of Demand Reduction Actions and Measures

Water Shortage Condition	Key Water Department Communication and Operating Actions	Customer Demand Reduction Measures
Stage 1: Water Shortage Alert (0-5%)	• Initiate public information and advertising campaign • Publicize suggestions and requirements to reduce water use • Adopt water shortage ordinance prohibiting nonessential uses • Step up enforcement of water waste • Coordinate conservation actions with other City Departments, green industry	• Voluntary water conservation requested of all customers • Adhere to water waste ordinance • Landscape irrigation restricted to early morning and evening • Non-essential water uses banned • Shutoff nozzles on all hoses used for any purpose • Encourage conversion to drip, low volume irrigation
Stage 2: Water Shortage Warning (5-15%)	• Intensify public information campaign • Send direct notices to all customers • Establish conservation hotline • Conduct workshops on large landscape requirements • Optimize existing water sources; intensify system leak detection and repair; suspend flushing • Increase water waste patrol • Convene and staff appeals board	• Continue all Stage 1 measures • Landscape irrigation restricted to designated watering days and times • Require large landscapes to adhere to water budgets • Prohibit exterior washing of structures • Require large users to audit premises and repair leaks • Encourage regular household meter reading and leak detection
Stage 3: Emergency Water Shortage (15-25%)	• Expand, intensify public information campaign • Provide regular media briefings; publish weekly consumption reports • Modify utility billing system and bill format to accommodate residential rationing, add penalty rates • Convert outside-City customers to monthly billing • Hire additional temporary staff in customer service, conservation, and water distribution • Give advance notice of possible moratorium on new connections if shortage continues	• Institute water rationing for residential customers • Reduce water budgets for large landscapes • Require all commercial customers to prominently display "save water" signage and develop conservation plans • Maintain restrictions on exterior washing • Continue to promote regular household meter reading and leak detection
Stage 4: Severe Water Shortage Emergency (25-35%)	• Contract with advertising agency to carry out major publicity campaign • Continue to provide regular media briefings • Open centralized drought information center • Promote gray water use to save landscaping • Scale up appeals staff and frequency of hearings • Expand water waste enforcement to 24/7 • Develop strategy to mitigate revenue losses and plan for continuing/escalating shortage	• Reduce residential water allocations • Institute water rationing for commercial customers • Minimal water budgets for large landscape customers • Prohibit turf irrigation, installation in new development • Prohibition on on-site vehicle washing • Rescind hydrant and bulk water permits
Stage 5: Critical Water Shortage Emergency (35-50%)	• Continue all previous actions • Implement crisis communications plan and campaign • Activate emergency notification lists • Coordinate with CA Department of Public Health regarding water quality, public health issues and with law enforcement and other emergency response agencies to address enforcement challenges • Continue water waster enforcement 24/7	• Further reduce residential water allocations • Reduce commercial water allocations • Prohibit outdoor irrigation • No water for recreational purposes, close pools • Continue all measures initiated in prior stages as appropriate



City of Santa Cruz

Water Shortage Contingency Plan

Water Supply for UC Santa Cruz

The campus water demand represents about 6% of the total SCWD service area demand. The Campus projects that under the 2005 Long-Range Development Plan (2005 LRDP) this will increase to around 8%, in 2020.

The City of Santa Cruz projects that the City's water supply in average water years is sufficient to meet existing and projected new water demand through about 2020 (including development under the UCSC 2005 LRDP and the Coastal Long Range Development Plan for the Marine Science Campus).

UCSC has agreed to comply with the water use curtailments specified in the City's Water Shortage Contingency Plan. Even during dry years, the City may have sufficient water to meet demand during the rainy season, and may require curtailment only during the dry-season months (May through October). Therefore, water conservation measures that reduce summer water use are particularly important for the Campus.

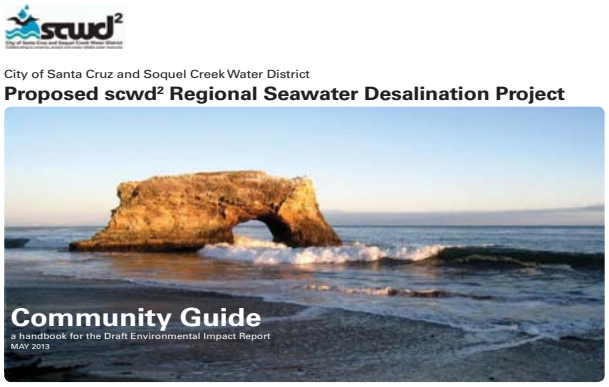
Table 3-6. Water Supply Allocation and Customer Reduction Goals

	No Deficiency		Stage 2 15% Deficiency		Stage 3 25% Deficiency		Stage 4 35% Deficiency		Stage 5 50% Deficiency	
	Delivery		Delivery		Delivery		Delivery		Delivery	
Normal Peak Season Demand = 2,473 mg	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)
Single Family Residential	100	1,031	84%	864	73%	753	62%	639	48%	495
Multiple Residential	100	524	87%	454	78%	411	69%	361	55%	287
Business	100	438	95%	416	92%	402	87%	381	70%	307
UC Santa Cruz	100	132	85%	113	76%	100	66%	87	52%	68
Other Industrial	100	23	95%	22	90%	21	85%	20	67%	15
Municipal	100	48	76%	36	57%	27	41%	20	28%	14
Irrigation	100	110	64%	70	34%	37	12%	13	0%	0
Golf Course Irrigation	100	106	73%	78	51%	54	34%	36	20%	21
Coast Irrigation	100	59	95%	56	90%	53	85%	50	67%	40
Other	100	2	95%	2	90%	2	50%	1	50%	1
Total	**100**	**2,473**	**85%**	**2,111**	**75%**	**1,861**	**65%**	**1,607**	**50%**	**1,247**
Demand Reduction %, Million gallons	**0**	**0**	**15%**	**-362**	**25%**	**-612**	**35%**	**-866**	**50%**	**-1,226**

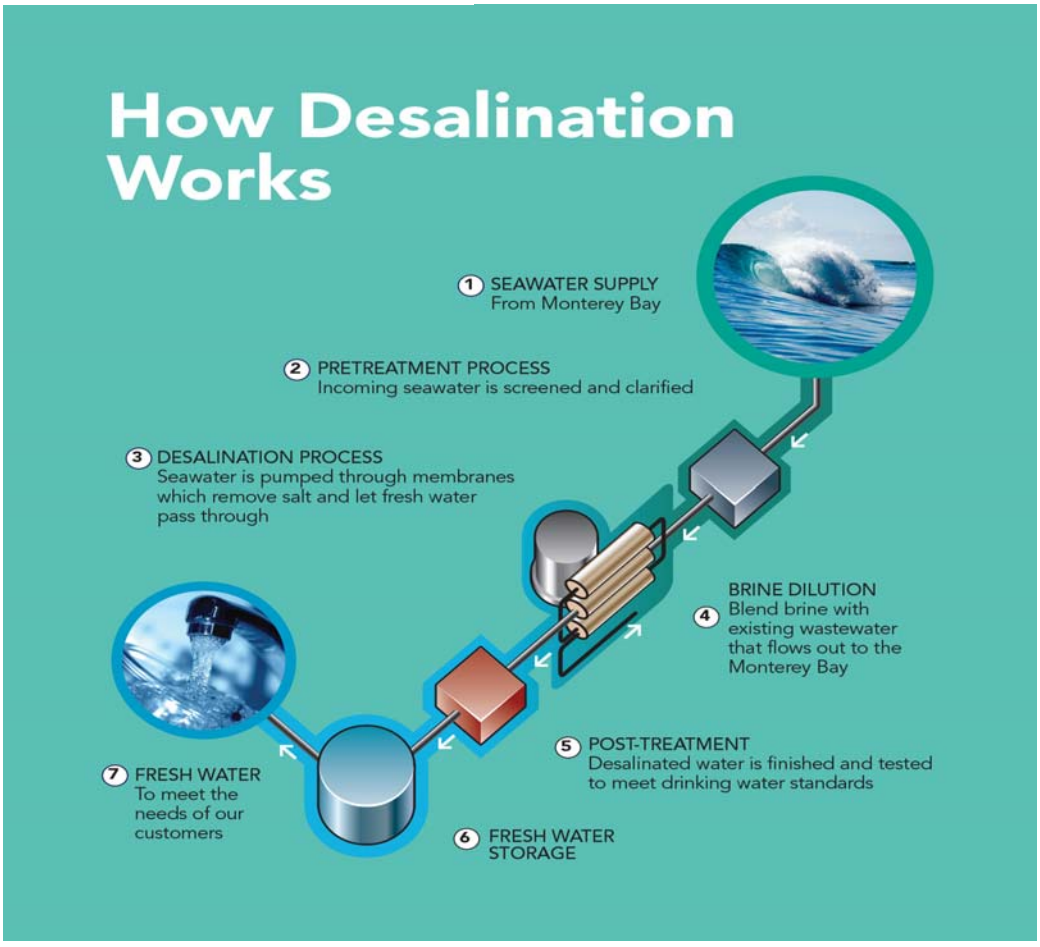
Supplemental Supply

The City's IWP identified the development of a seawater desalination plant and distribution system as the preferred supplemental supply alternative. The City is also continuing to study additional alternatives.

The SCWD is collaborating with the neighboring Soquel Creek Water District (SqCWD) to develop a seawater desalination plant and conveyance system, that would provide up to 2.5 million gallons per day (mgd) of potable drinking water to the service areas of both agencies. Under the proposed project, the SqCWD, which currently depends on groundwater from the Purisima and Aromas formations, would use water from the desalination facility, while reducing pumping from its wells and allowing the aquifers to recharge. The SCWD would use water from the facility only in drought periods. The two agencies have completed a number of technical studies, and released a Draft EIR on the Regional Seawater Desalination Project in May 2013. A public vote on the project by City of Santa Cruz residents is planned for the future. Under the proposed schedule, permitting and design could begin as early as 2014, construction would start in 2016 and the system would begin operating in 2018.



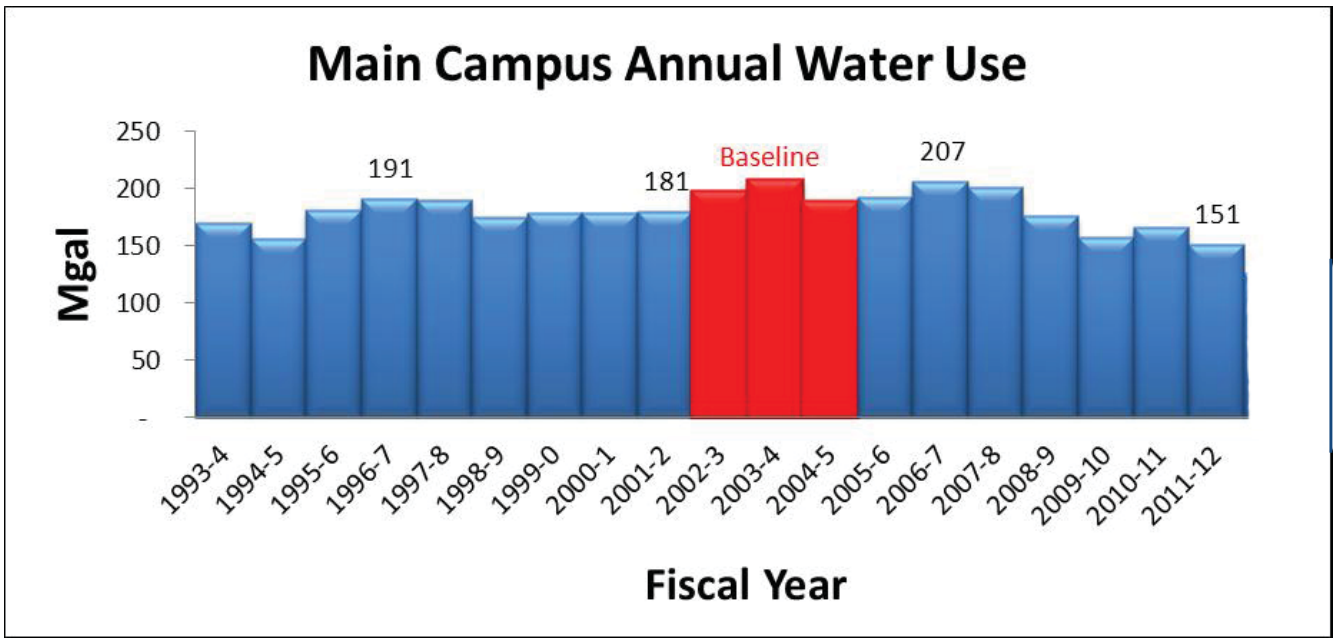
City of Santa Cruz and Soquel Creek Water District
Collaborating to conserve, protect and create reliable water resources

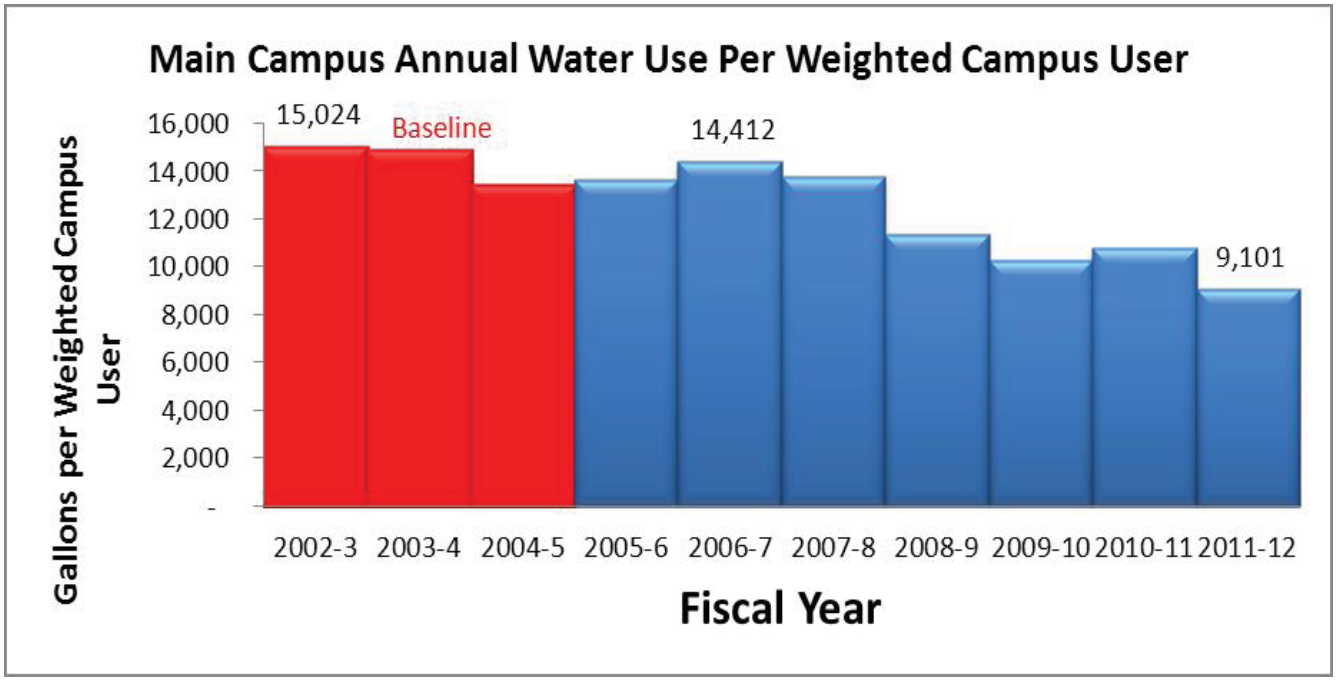


UCSC Water Use Baseline

The City of Santa Cruz Water Department has defined the campus' baseline period of "normal" year water usage as a 3-year average of peak season 2002-2004 (7 months). Since the University reports on a fiscal cycle and the Policy requires a three year annual cycle, the baseline period for this report was selected to align closely with the City of Santa Cruz' baseline period within a fiscal reporting constraint. As its baseline period, UCSC has selected the 3 years from July 2002-June 2005. The campus' baseline water use is 206.7 mg/year, or 14,218 gallons per weighted campus user.

Consistent with the Regents Policy on Sustainable Practice, the baseline for this plan is based on a normalized water usage defined as annual gallons of water used per weighted campus user. Weighted campus user is defined as (1 × number of on-campus residents) + (0.75 × number of non-residential or commuter full-time students, faculty, and staff members) + (0.5 × number of non-residential or commuter part-time students, faculty, and staff members).



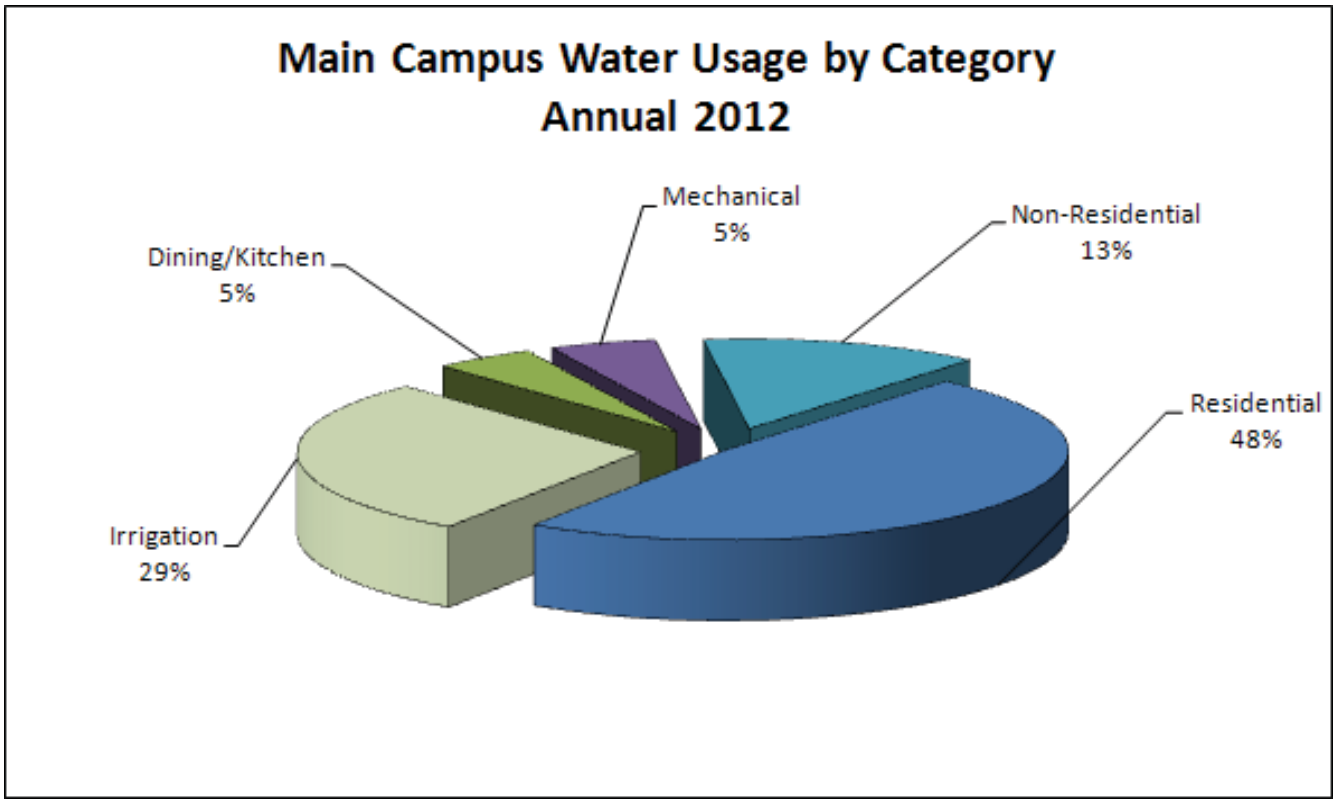


UC Santa Cruz provides beds for over 50% of enrolled students and has nearly 240 employee housing units along with 198 units for students with families. Therefore, it is not surprising that the largest share of UCSC water use is residential (48% in 2011-12). Second is irrigation (29%), followed by academic and office buildings (13%), and dining/kitchen facilities (5%). Irrigation use can be further broken down into turf (recreational fields and lawn areas), landscaping, the Center for Agroecology and Sustainable Food Systems (the Farm and Garden), and the Arboretum.

Past Conservation Efforts

In response to water shortages in the 1980s, the Campus conducted a fixture audit, and retrofitted all toilets in student housing and State buildings to 3.5 gpf and all showerheads in student housing with 2.5-gpm fixtures. Under the 1988 LRDP, the Campus implemented a variety of water conservation measures, including a program to reduce the per-acre use of water for irrigation. This program included requiring the use of predominantly drought-tolerant species in landscaping, installing automatic timing systems, irrigation water meters, drip irrigation systems, and the purchase of a central irrigation control system and weather station to schedule and monitor irrigation campuswide. At the East Athletic Field, one of the largest single users of irrigation water on campus, between 1994 and 2005, annual irrigation water use was reduced by an average of 25 percent from the 1988 LRDP EIR baseline. Part of the irrigation system installed included computer-controlled timers that respond to daily weather data and provide automated leak detection and shut down.

In 2007, UC Santa Cruz retained a consultant to perform a water efficiency survey and make water conservation recommendations for the main campus. As part of the survey, a team of 11 students conducted an inventory of restroom and kitchen fixtures and landscape irrigation. The students measured faucet and shower flow rates and toilet flush volumes, checked for leaks and missing faucet aerators, inspected kitchens, and mapped areas


Main Campus Water Usage by Category
Annual 2012
Mechanical
5%
Non-Residential
13%
Dining/Kitchen
5%
Residential
48%
Irrigation
29%

UCSC Farm

of high- and low-water-use landscaping throughout the campus. The consultant conducted a survey of campus laboratories, greenhouses, cooling towers, swimming pool, irrigation equipment and practices at the Farm and Garden and the Arboretum; and checked the data gathered by the students. The consultant also conducted a study of the water not accounted for by the Campus' water submetering system, including potential meter error, leaks, and unmetered irrigation and domestic water use.

The study included a payback analysis that provided estimated costs and the water, energy and financial savings associated with a wide range of potential water conservation projects. The final report identified 19 "high-priority" projects, which would result in an estimated 15 percent savings in total annual water use in existing facilites, a savings of approximately 30 million gallons annually.

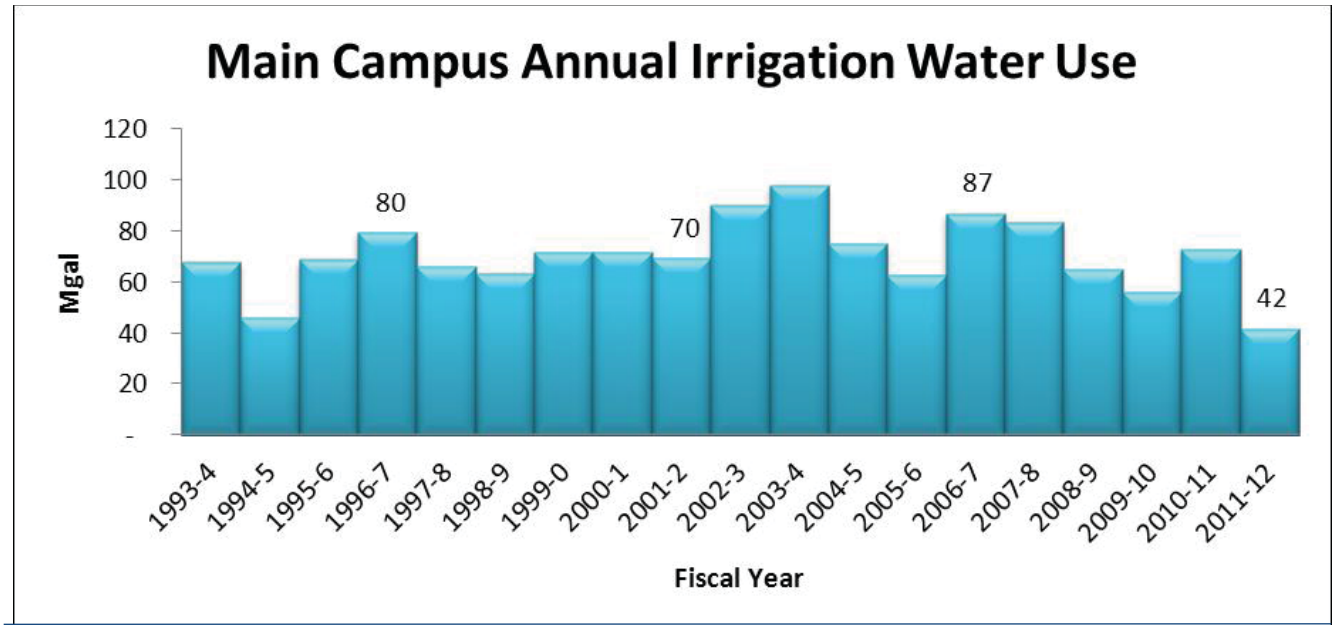
Since completion of the 2007 water efficiency study, the Campus has completed all of the 19 "high-priority" projects identified by the study report, and implemented several measures and projects intended to reduce Campus water use.

The projects completed over the past six years are wide ranging and have included pilot tests of high-efficiency toilet, urinal, and shower fixtures; campus-wide fixture retrofits; changing cooling tower operating procedures; installing additional campus sub-meters for irrigation systems; designating a staff person to coordinate a water conservation education program for student residents; installing "purple pipe" in new and renovated buildings to facilitate future use of non-potable water for toilet flushing; replacing turf with low-water-use landscaping; replacing the existing campus sub-meters with more accurate, radio-read meters; installing efficient spray valves in kitches, cafes, and restaurants; and collection of rainwater for use in a new cooling tower.

In addition to the improvements in water use efficiency, in May-November 2009, when the City implemented Stage 2 of its water shortage contingency plan, the Campus made a coordinated effort to reduce water use in all facilities. The Campus' reduction, which ranged from 16% in September to 27% in June, exceeded its 15% overall water use reduction target.

These recent efforts have resulted in a 36% reduction in water use per weighted campus user between the WAP baseline (3 year average annual water usage from July 2002-June 2005), and the 2011-12 fiscal year.

By improving its sub-metering system, the Campus has also reduced the amount of unaccounted-for water use substantially.


Main Campus Annual Irrigation Water Use
Mgal
120
100
80
60
40
20
-
80
70
87
42
1993-4
1994-5
1995-6
1996-7
1997-8
1998-9
1999-0
2000-1
2001-2
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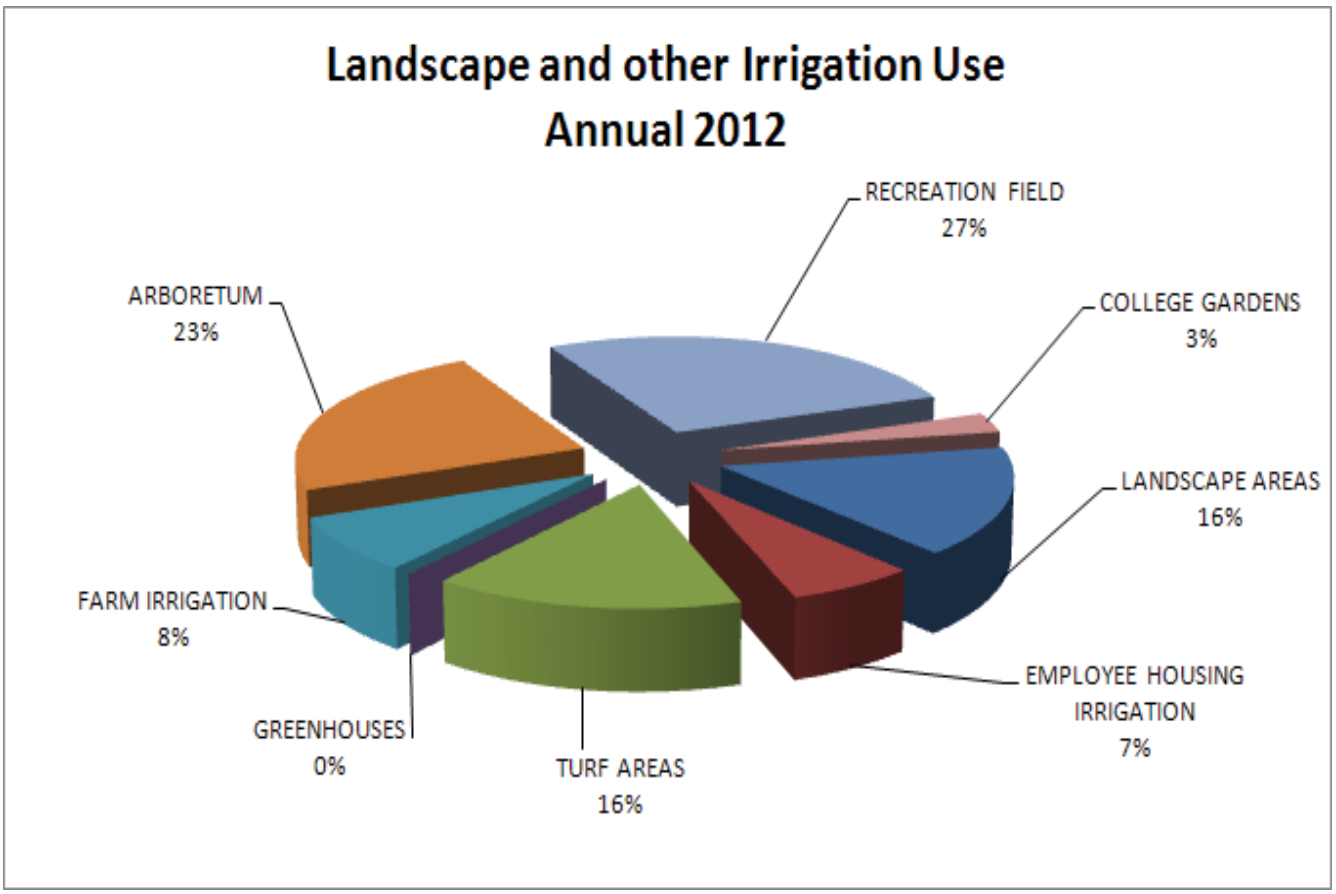
2007-8
2008-9
2009-10
2010-11
2011-12
Fiscal Year


Landscape and other Irrigation Use
Annual 2012
RECREATION FIELD
27%
ARBORETUM
23%
COLLEGE GARDENS
3%
LANDSCAPE AREAS
16%
FARM IRRIGATION
8%
EMPLOYEE HOUSING
IRRIGATION
7%
GREENHOUSES
0%
TURF AREAS
16%

Watershed Management

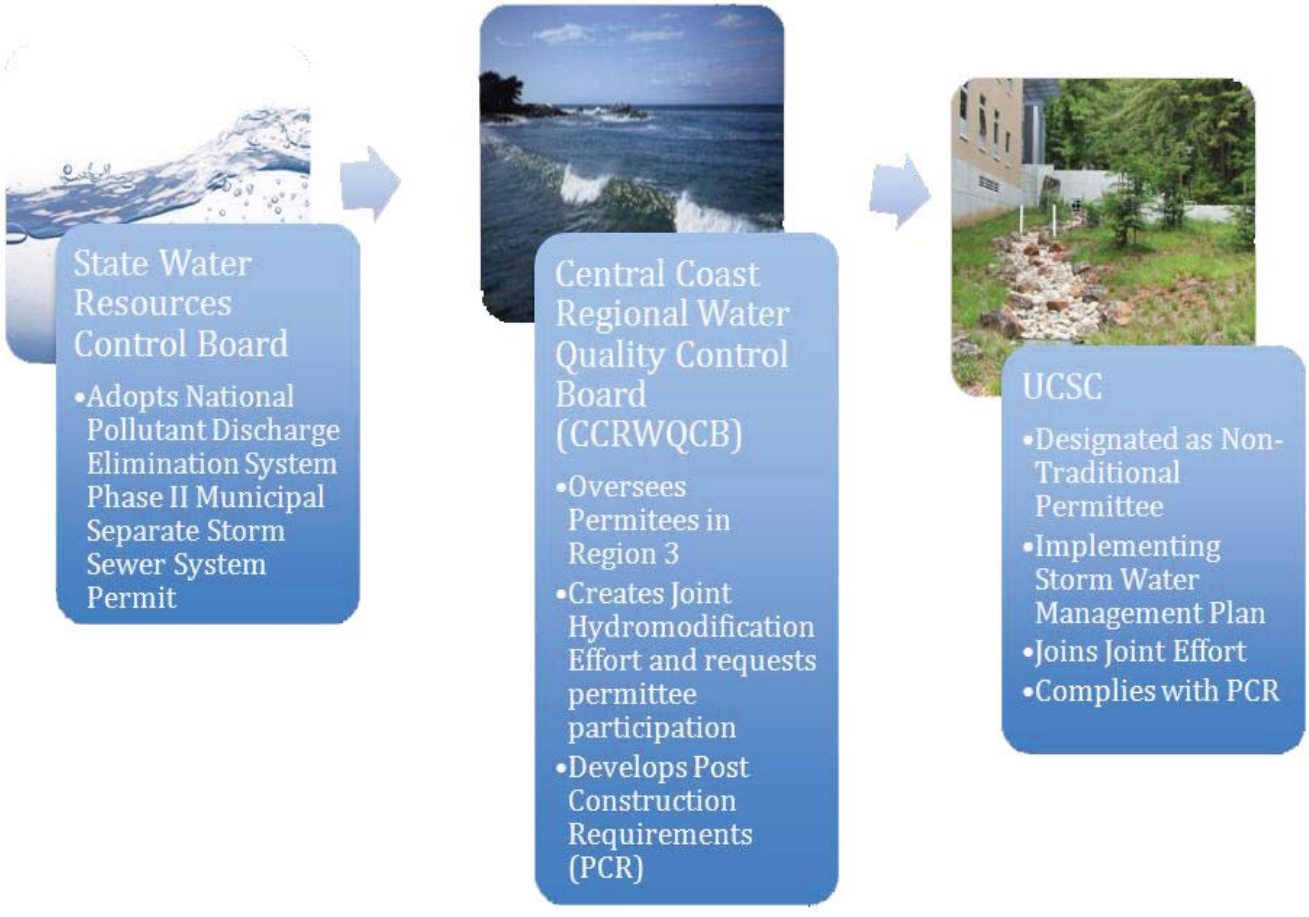
The management and maintenance of UCSC's watersheds is a collaborative effort by Physical Plant Grounds Department, UCSC Natural Reserve, and Physical Planning and Construction. Each department is responsible for aspects of maintenance, restoration, construction, and protection.

UC Santa Cruz relies heavily on natural drainages to manage stormwater on its campus. In addition, the campus has constructed a variety of engineered facilities that convey runoff to the natural drainage channels. These facilities include storm water detention basins and vaults, urban contaminant removal systems, biofiltration, piping, engineered channels, catch basins, and bioswales.

Unlike pipe or gutter drainage systems, natural stream channels are rapidly evolving and dynamic – they change seasonally and, in some locations, on a storm-by-storm basis. On the UC Santa Cruz campus, canyons with drainage channels vary in depth from 10 ft. to 80 ft. and in width at the top from 30 ft. to 400 ft.

As a result of the karst topography, with sinkholes distributed in the channels and elsewhere throughout the central and lower campus, most stormwater runoff from campus development reaches the karst aquifer by way of sinkholes and swallow holes and does not flow off campus. Due to the role of sinkholes and swallow holes within the drainages, channelized surface flows are largely captured by sinkholes and swallowholes which reduces discharge of surface flows to downstream campus channels and off-campus areas. The in-channel sinkholes play a critical role in the successful operation of the campus' drainage system.

The Campus has prepared and is implementing a Storm Water Management Plan (SWMP) in compliance with the Phase II National Pollution Discharge Elimination System) NPDES program, which was promulgated in 1999 under the federal Clean Water Act. This program requires operators of small municipal separate storm sewer systems (MS4s) in urbanized areas and operators of small construction sites to implement programs and practices to control polluted storm water runoff. The UC Santa Cruz SWMP was approved by the California Regional Water Quality Control Board (RWQCB) in April 2009.



Stormwater Regulatory Flow Chart

Storm water management systems

Through Campus Design Standards, UCSC manages both quality and quantity of storm water using various structural techniques. Storm water management systems for new development must meet performance standards developed under the campus' SWMP and incorporated into Campus Standards. The Campus' planning process for new development projects encourages the incorporation of non-structural storm water management strategies at an early stage of project design. The goal is to develop systems that maintain and mimic the natural hydrology of our watersheds. A Low Impact Development (LID) Checklist is required for all capital projects that increase impervious surface. The checklist includes both non-structural and structural techniques aimed at managing storm water at its source.

As technology and engineering concepts on protection of watersheds have changed over time, so have the designs used. Most storm water runoff from impervious development on Campus is directed to a detention facility where the water is metered out at a specified rate. The discharged water is usually released to an area where the water will have a chance to infiltrate through the natural soil media providing treatment and quantity reduction. Some of the other techniques used

to control the storm water quality and quantity are: level spreaders, vegetated swales, raingardens, tree boxes, pervious pavement, retention and detention ponds, and rock swales and step pools.

The campus is in the process of implementing a multi-phase storm water infrastructure improvement project to address existing erosion and sedimentation within the campus' natural drainages. To some extent, these problems are the result of older campus development, which followed standards for design of storm water drainage systems that are now outdated. Because of the habitat and other environmental concerns associated with these drainage systems, and associated regulatory requirements, some of these improvements require a close degree of coordination with local, state, and federal agencies.

UC Santa Cruz Grounds Department is responsible for maintaining campus lands, including the storm water drainage systems. This involves not only regular inspection of engineered facilities such as catch basins and detention vaults, but inspection and maintenance of major sinkholes and natural drainage channels, which can be difficult to access.

Cave entry

PowerSave Water Education panel

Water Conservation

There are a number of staff that work on water conservation education including staff from Housing and Dining Facilities, Sustainability Office, College Programs offices, etc. Student organizations such as the Alliance to Save Energy's PowerSave Green Campus program and the Student Environmental Center implement peer-to-peer education. Past efforts have included:

- Tables at new student orientations and Fall Festival, presentation to new Residential Life Staff, and information in student move-in packets.
- A drought year marketing program that includes a campus entry banner, magnets, clings, dining hall table tents, a web site and buttons.
- A water conservation display that rotated through the five dining halls
- Educational materials for summer conferences
- Competitions among student residential apartments
- "Drop your own Drip" program, under which mock utility bills were produced monthly for apartment residents, with water usage and conservation tips
- In-person utility audits for student apartments

PowerSave Green Campus created a water conservation display to rotate through the dining halls. The display has four main components: (1) a 3-D map of where UCSC gets its water. Students can put on 3-D glasses and see the route the water takes. (2) Stacks of milk gallons that demonstrate the difference between how much water a toilet uses today vs. 1980. (3) A cookbook showing how much water it takes to make common dishes in the dining halls. (4) Posters that show metrics and graphs of how much water the average student at UCSC uses per day, month, and year.

Student Environmental Center

Every academic year, the Student Environmental Center drafts the Blueprint for a Sustainable Campus document. This document describes the student vision for sustainability across the campus, and identifies potential projects that are eligible for funding through a student fee measure. Most of the input for this document is elicited from campus stakeholders through workshops on specific topics, including water, and the annual large-scale Earth Summit event. The Blueprint provides a platform for students' ideas and energy, that is not officially overseen by the campus administration.

Academic courses related to Water

UCSC offers courses related to water issues across several academic disciplines:

1. Freshwater Ecology courses

2. Agroecosystem Analysis and Watershed Management
3. Introduction to Fresh Water: Processes and Policy
4. California Water Law and Policy
5. Water in Society
6. Aquatic Toxicology

Two examples of course descriptions are provided below:

BIOE 155 Ecology and Evolutionary Biology-Freshwater Ecology: Provides an overview of the physical, chemical, and biological processes that characterize inland waters such as lakes, streams, rivers, and wetlands. Also addresses relationships between humans and fresh water, and discusses these challenges in conservation

POLI 132 Politics- California Water Law and Policy: Explores the rich history and fundamental legal concepts surrounding water in California. Students identify, evaluate, and debate some critical water policy questions faced by Californians today and in the future.

One option for the future is to explore the potential to utilize student learning experiences to assist the campus in strategizing on water use reduction implementation. This may be accomplished through a sustainability-oriented curricular-research program that uses an innovative, transdisciplinary classroom and on-the-ground training approach. This could be achieved by providing service learning internships and using applied research projects and fieldwork to update and build upon the Water Action Plan.

Students in Water Lab

PowerSave Green Campus display

Water Teaching and Research Laboratory

The WaterLab is a pilot-scale advanced water treatment facility that is under construction in Watsonville, California and will be operated by UCSC's Center for Integrated Water Research. When completed, WaterLab will receive secondary and tertiary-treated water from the Watsonville Water Resources Center and treat it to potable quality using advanced treatment methods. Established by Environmental Studies Professor Brent Haddad, it has been designed and built by UCSC undergraduate and graduate students under the guidance of water engineer Elias Weintraub

WaterLab is intended to serve as a pilot-scale facility to test advanced treatment technologies in terms of their ability to purify water, their reliability, and their energy consumption. WaterLab will also serve to train students interested in careers in water resources management. Even while under construction, more than 300 UCSC students have visited WaterLab and several have pursued internships and independent study courses designing and building WaterLab's treatment equipment. WaterLab is jointly funded by UCSC, the City of Watsonville, and private donors.

Stormwater

As part of its Small Municipal Separate Storm Sewer Systems (MS4) permit under the federal Clean Water Act, the Storm Water Management Program has developed cducation and outreach materials aimed at educating the campus community on the importance of storm water protection, and looking at stormwater as a resource to be valued. Staff training provides information on the regulations that apply to the campus, and how protection of stormwater benefits the environment we all enjoy. The Storm Water Program hires student interns to help with implementation of the Program's Best Management Practices. Student interns provide valuable connections with their peers for educational opportunities. The Storm Water Program has developed a facebook page as a means of connecting with the campus community and providing educational materials. The Cleanwater webpage provides information about the Program, brochures about various stormwater topics, information on how to report a stormwater concern, and how to volunteer or become an intern.

The Campus has already met the water use reduction goal established by the Policy, partly as the result of the substantial investment that was made to implement the "high-priority" recommendations of the 2007 water efficiency study. However, consistent with the Campus' commitments to sustainability and to collaborating with the City of Santa Cruz to conserve the region's scarce water resources, UC Santa Cruz will continue to seek ways to increase water use efficiency and to develop non-potable water supplies.

On-going Strategies to Reduce Potable Water Use

Landscape Operations

Grounds Services is committed to landscape water conservation, and focuses on four programs.

1. **Annual preventative maintenance program:** staff have regular scheduled maintenance activities that keep irrigation systems running efficiently by fixing leaking components and adjusting heads to reduce overspray and provide appropriate water application rates.
2. **Monitoring landscape water demand**: staff evaluate and adjust irrigation schedules on manually programmed automatic controllers across campus based on evapotranspiration data. Irrigation station information for each manual controller has been built into a spreadsheet workbook so that run times for all irrigation controllers can be calculated by entering the current local evapotranspiration data in one cell. Evapotranspiration is a measure of the total water lost from the soil by evaporation from the soil surface and through transpiration, or water taken through plant roots and evaporated from leaf surfaces.
3. **Automatic system monitoring:** a centralized system automatically monitors campus weather conditions, updates remote irrigation controller schedules by radio, and monitors usage for leaks or electrical problems. The Rain Master Evolution system involves a central computer, two weather stations, and "satellite" controllers in the field, with a communication system linking the components. Irrigation systems can calculate watering needs based on whichever weather station most closely matches the individual satellite location. This system is now in use at 25 major landscape installations, and will be included with all future construction on campus.
4. **Uniform distribution of irrigation water:** UCSC Grounds staff inspect systems to maximize water use efficiency. When a sprinkler system is distributing water evenly across an irrigation zone, then the precise amount of water needed to replace lost soil moisture can be applied. With poor distribution uniformity, excess water must be applied to the irrigation zone so that the area with the lowest precipitation rate provides enough water for plant health, while other areas apply excess water.

Facilities Maintenance and Utility Mangement Operations

The UCSC Energy Department manages and monitors water consumption on campus with an aggressive meter maintenance program. This program identifies and replaces water meters that are inaccurate, with latest technology water metering. By utilizing technologies that use equipment with little or no moving parts, the campus is now able to get more accurate consumption data, as well as able to quickly identify system leaks.

Farm Activites

1) Drip irrigation: The farm currently uses about 80% of its water through drip irrigation. For field production, newly planted crops are watered in with overhead sprinklers for 10 days (total of 3 irrigations) and then the crop is transitioned to drip. The drip lines allow us to have greater uniformity of water distribution as well as delivering water only to the plants and not to field edges and furrows. Some crops are raised exclusively on drip.

2) Dry Farming: The farm currently dry farms a portion of its tomato crop every year. This means that the tomatoes are planted soon after the last rain (or they are planted and then given only one irrigation) and then they are not watered for the remainder of their life cycle. Because the tomato plants have to search and stretch for limited water the flavor is concentrated in the fruit. Dry farmed tomatoes tend to have high acid and high sugar and lots of flavor. The farm has dry-farmed wheat in the past and plans to do the same in a small section of the new quarry fields this winter.

3) Water monitoring: After water restrictions in 2009, the Farm developed its own internal water monitoring system by installing 10 additional sub-meters to track water use at different locations on the farm. This program was designed to measure applied irrigation against crop evapotranspiration to help guide students in more precision irrigation.

Opportunities & Strategies

Campus Sustainability Office

The Sustainability Office drafts a Campus Sustainability Plan (CSP) every three years, which sets performance targets in nine different sustainability topic areas, including Water. Campus staff members work with the Sustainability Office to set priority goals and objectives to increase the efficiency of water operations on campus. The CSP goes through a rigorous internal review process and is reviewed and approved by the campus administration before publication.

CSP 2013-16 WATER GOALS & OBJECTIVES

1. Research, identify, and apply new technologies and improvements that reduce campus water consumption and/or increase efficiency.

- Initiate three pilot projects that explore and examine non-potable supply options by 2016.
- Increase water use efficiency by 5% through: 1) Detecting leaks; 2) Replacing old meters; 3) Installing meters where necessary.
- Decrease weighted campus user demand by 5–10%.
- Develop and maintain a Water Action Plan that identifies the campus's long-term strategies for achieving sustainable water systems.

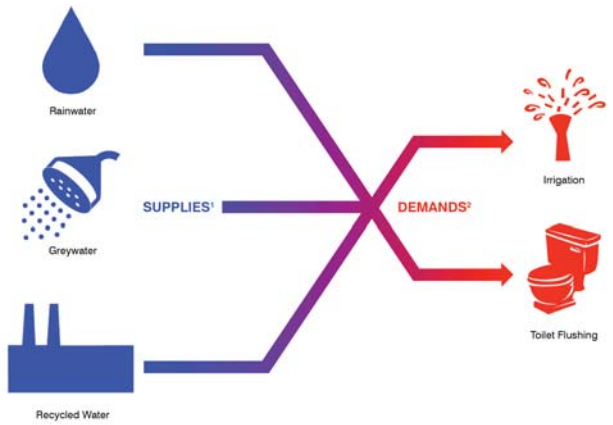
2. Implement ongoing student-directed effective educational campaigns to effect behavioral change and reduce water consumption.

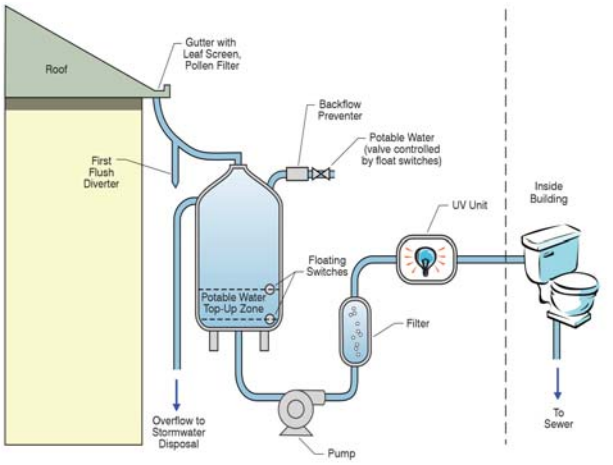
- Develop a system to provide timely data and feedback on water use to the on- and off-campus community.
- Create and administer fundamental water management training for campus community utilizing a Learning Management System by end of FY 2014.
- Incorporate water education into residential programs for new students.

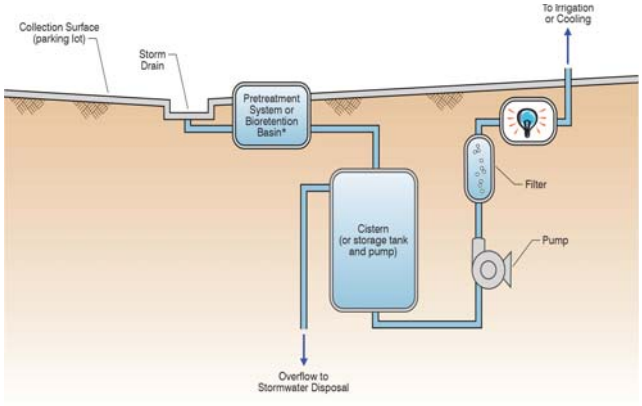
Finally, the Sustainability Office compiles an Annual Sustainability Progress Report to communicate progress on the Campus Sustainability Plan goals and objectives.

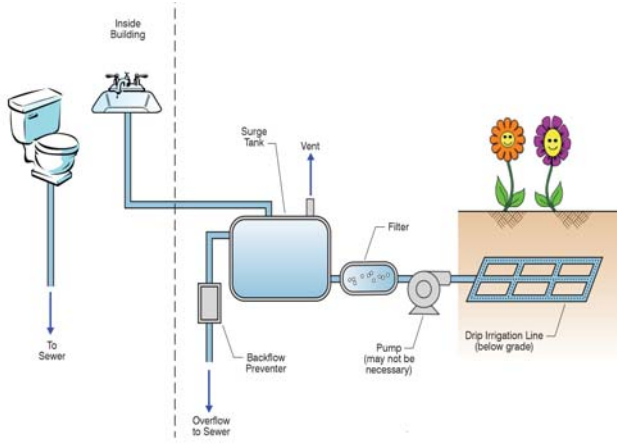
Potential Use of Non-Potable Sources

The Campus completed a Campus Water Reuse Study in May 2009. The study was prepared by Carrollo Engineers in consultation with various campus stakeholders. With the goal of reducing potable water use, the study considers four major non-potable reuse supplies: rainwater; graywater; recycled wastewater; and groundwater from the karst aquifer underlying the campus. The City of Santa Cruz does not have and is not currently planning to develop a non-potable water supply; therefore, the study considered only campus-generated sources.









2009 Water Reuse study

The study evaluated use of non-potable water for toilet/urinal flushing, cooling tower makeup water, and irrigation. The study took into account regulatory considerations; requirements for storage facilities and other infrastructure; the level of treatment required; and the location, elevation, and seasonal variation in potential supply and demand.

The study provided the campus with a menu of potential re-use opportunities and some criteria for the campus to use in selecting which projects to implement.

All the potential projects require further analysis. Those involving rainwater capture or groundwater use, will require review of potential impacts on recharge of seeps and groundwater levels.

The Campus has taken the following steps toward the use of non-potable water sources:

- Constructed a rainwater storage and re-use system as part of a new cooling tower.
- Installed "purple pipe" for future use of non-potable water for toilet flushing in the new Biomedical Sciences Facility, and in Porter Residence Halls A and B.
- Included rainwater storage for irrigation use in the design of the East Campus Infill Project.
- Evaluated non-potable water sources for the planned Social Sciences 3 building.

Future plans for the use of non-potable water include:

- As part of the redevelopment of the Family Student Housing complex, consider developing a non-potable water source for west campus student housing facilities.
- Construct a non-potable water distribution system in the planned North Loop Road.

The following on-going opportunities, consistent with current regulations, may be implemented as funding becomes available:

- evaluate Arboretum water use and identify possible ways to reduce it with new technologies
- continue fixture retrofits in State buildings
- add existing irrigation systems to centralized control system
- remove small turf areas and replace with low water use landscape when appropriate

Conclusions

The Campus has met reduction goals in the most recent year and has completed a major effort to reduce water use in existing facilities.

The Campus Sustainability Plan sets new goals that strive to achieve greater savings in the future, however the campus will need significant funding for studies, retrofits and/or new infrastructure to reach those targets.

The campus will continue to plan future development with new technologies (purple piping, evaluatation of grey water re-use with each new building, rain water harvesting, etc.).

Continued students involvement in developing water re-use pilot projects throughout the campus as a living-laboratory along with on-going awareness campaigns are key to the future sucess of reduced water use.

The campus will continue to collaborate with the City of Santa Cruz in meeting the regional water reduction goals

Actions:

1. Continue to evaluate non-potable sources for new projects. Important to include environmental impacts into account, e.g. effect on seeps.

2. For non-potable supplies: balance demand with potential supplies

3. For the Family Student Housing redevelopment project, evaluate potential non-potable water source that can include a supply for Porter College and any new development in the area

4. Include non-potable water piping in infrastructure in new campus roads

5. Evaluate the use of the karst aquifer for farm and other irrigation or cooling tower make-up

6. Use native plants for landscaping and restore areas with native vegetation

7. Reduce bottled water on campus with hydration stations

Take Back the Tap program

Center for Agroecology and Sustainable Food Systems

Native Plant Restoration

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