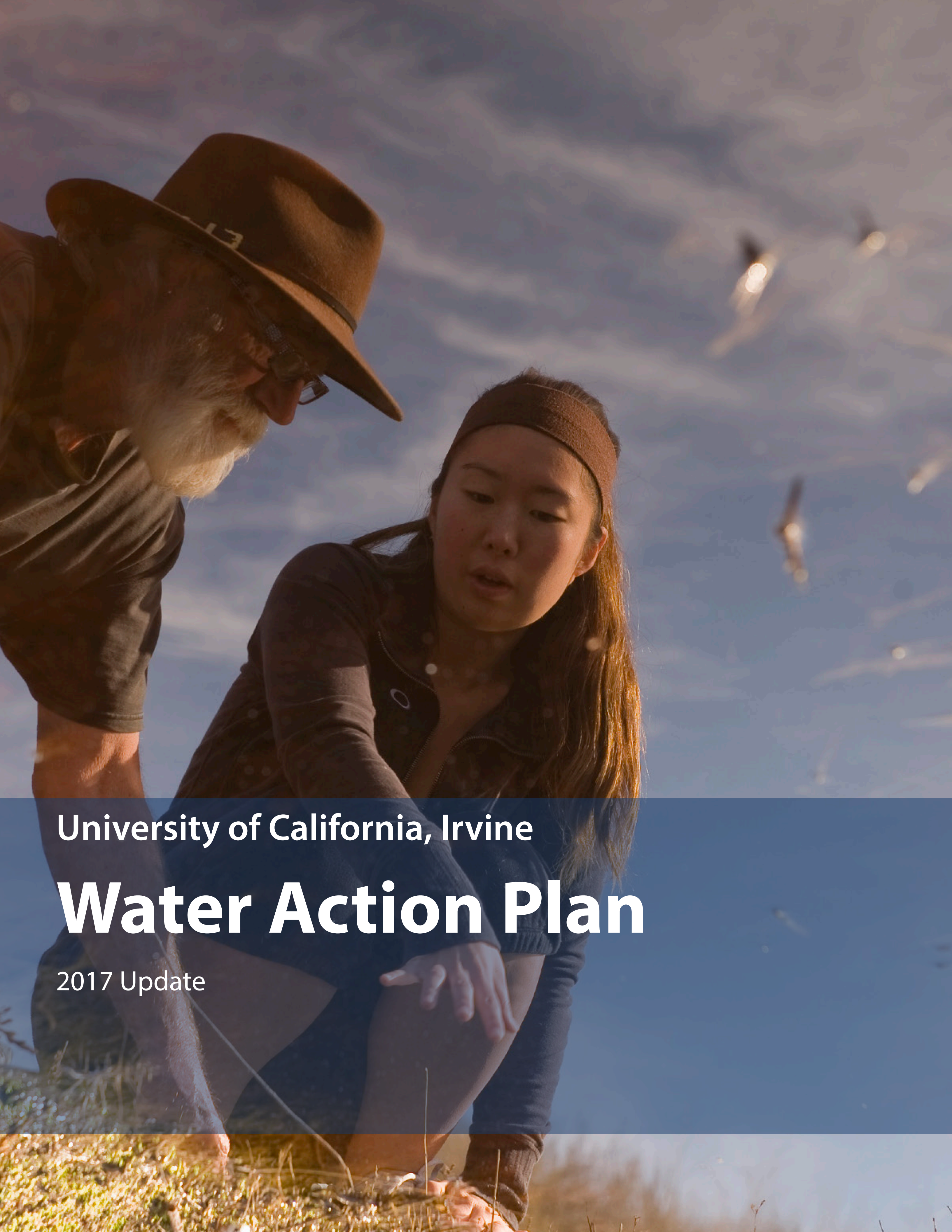


University of California, Irvine

Water Action Plan

2017 Update

University of California, Irvine

Water Action Plan

December 2017

Cover Photo Credit: Daniel Anderson

1 EXECUTIVE SUMMARY

Since 2013 UC Irvine has replaced approximately four acres of turf with drought tolerant plants saving approximately 3.5 million gallons of water annually. Credit: © 2014 University of California

The 2013 UCI Water Action Plan(WAP) provided a framework for managing water resources at the Irvine Campus and Medical Center. The WAP addressed water resource goals, planning strategies, and project opportunities in support of UC Policy on Sustainable Practices and UC Irvine sustainable water system goals. Since 2013 the Irvine Campus and Medical Center have made significant progress in reducing potable water use. The Irvine Campus has reduced annual potable water consumption by over 88 million gallons (MG), resulting in a forty four percent reduction per capita. The Medical Center has reduced potable water use by over 19 MG, a thirty seven percent reduction per capita, in the same period.

The 2017 WAP Update builds on the significant progress to date while providing a vision for a more integrated approach to sustainable management of all campus water resources - including potable, recycled, and storm water. With this approach the 2017 WAP Update can serve as a model for integrating sustainable water resource management practices, improving ecosystem function in local waterways, and protecting local water resources.

The 2017 WAP Update also reflects updates made to the UC Policy on Sustainable Practices in 2015. Changes include a new goal of 36 percent potable water reduction per capita by 2025, and new goals for landscape irrigation reduction and lab equipment replacement. The 2017 WAP Update provides updated strategies and projects to meet these new goals and establishes a 50 percent stretch goal in potable use per capita by 2025.

2 INTRODUCTION

California water supplies face an uncertain future as population growth and a changing climate apply increasingly more pressure on water resources. Although 2017 precipitation levels improved current State water conditions from a multi-year drought, changes in overall weather patterns have resulted in variable annual snowpack, precipitation type, frequency, and intensity. It is likely the State will continue to experience periods of drought that will continue to lead to future water scarcity and diminished overall reliability.

In addition to water supply uncertainty, urbanization in southern California compromises the quality of water in local streams, rivers, and ultimately the Pacific ocean. Sediment, chemicals, heavy metals, and bacteria contained in urban runoff, pose risks to the ecological health of our local watersheds. The Irvine Campus is located in the Upper Newport Bay Watershed, receiving waters that serve as riparian and estuarine habitat for sensitive native plant communities and wildlife species. Urbanization and associated impervious surfaces results in the urban stream syndrome, a condition in which water quality is compromised and the hydrologic profiles of drainages are altered by larger flows with higher erosion potential.

As Orange County's public research university, stewards of over 1,700 acres of land resources, and a large consumer of potable and recycled water, UC Irvine embraces its leadership role in reducing potable and recycled water use, sustainable management of storm water and urban runoff, stewardship of our local watershed, and serving as a living laboratory for research in urban water issues.

This Water Action Plan Update provides strategies for the Irvine Campus and Medical Center to minimize the impacts of future water scarcity and increasing costs while providing a vision for overall sustainable water management. This WAP will serve as a blueprint for responsible water use in existing facilities and will provide green building strategies to curtail projected water use. This WAP also presents opportunities for innovative storm water management and restoration of existing and historical drainages on the Irvine Campus.

3 CONTEXT

The 2017 WAP Update is consistent with the following policies, plans, and conditions.

University of California Policy on Sustainable Practices

The Sustainable Water Systems section of the Sustainable Practices Policy outlines goals for water conservation, storm water management, and education & outreach for all 10 UC campuses and five medical centers. The UC Sustainable Practices Policy was updated in 2015 with revised goals. These goals follow:

1. In line with the Federal Government's Executive Order establishing a goal to reduce growth adjusted potable water consumption by 36% by 2025, and an interim target of 20% by 2020 compared to the three-year average baseline of FY2005/06, FY2006/07, and FY2007/08. Campuses that achieve this target early are encouraged to set more stringent goals to further reduce potable water consumption. Medical Centers shall also strive to reduce potable water use and will identify a separate reduction target by June 2016.

2. Each Campus shall strive to reduce potable water used for irrigation by converting to recycled water, implementing efficient irrigation systems, drought tolerant planting selections, and/or by removing turf.

3. Each Campus will develop and maintain a Water Action Plan that identifies long term strategies for achieving sustainable water systems. The next update of the plan shall be completed in December 2016. a. Campuses will include in this update quantification of total square feet of used turf and under-used turf areas on campus as well as a plan for phasing out un¬used turf irrigated with potable water.

4. Each Campus shall identify existing single pass cooling systems and constant flow sterilizers and autoclaves in laboratories and develop a plan for replacement.

5. New equipment requiring liquid cooling shall be connected to an existing recirculated building cooling water system, new local chiller vented to building exhaust or outdoors, or to the campus chilled water system through an intervening heat exchange system if available.
a. Once through or single pass cooling systems shall not be allowed for soft-plumbed systems using flexible tubing and quick connect fittings for short term research settings.
b. If no alternative to single pass cooling exists, water flow must be automated and controlled to avoid water waste.

UCI Strategic Plan

The 2015 UCI Strategic Plan outlines growth and expansion of the Irvine Campus based on four pillars:

• *Growth that Makes a Difference: Expanding Our Capacity to Improve Lives*

• *First in Class: Elevating the Student Experience to Prepare Future Leaders*

• *Great Partners: Making Regional and Global Connections that Enhance Our Mission and Serve the People*

• *New Paths for Our Brilliant Future: Forging Best Practices to Power the Coming Century*

The third pillar, Great Partners, aims for UC Irvine to 'partner with Orange County to develop a national model for how to live responsibly and well in the 21st century'. Sustainable water management, as a core principle, presents an opportunity for UC Irvine to build on existing partnerships in developing a sophisticated water conservation model.

Storm Water Permitting

The Irvine Campus and Medical Center are located in urban watersheds characterized primarily by impervious surfaces that have altered natural hydrologic function. Surface flows that would normally be stored or infiltrated are directed to the storm drain system increasing runoff volumes and the potential for flooding. Historically infrastructure development on both campuses focused on treating runoff as a waste product rather than as a resource. A healthy watershed, mirroring predevelopment hydrology, is characterized by low surface runoff, higher evaporation rates, and infiltration.

The Irvine Campus developed a Storm Water Management Plan (SWMP) in 2003 which details best management practices (BMP's) to meet the requirements of the federal Clean Water Act under the National Pollution Discharge and Elimination System (NPDES) Municipal Storm Water Program (MS4) permit program.

The Irvine Campus recently updated its Post-Construction Storm Water Management Requirements for projects less than one acre in size to reflect changes to the Phase II Small MS4 Storm Water Permit. Projects that create or replace 2,500 square feet or more of impervious surfaces are now required to implement Low Impact Development (LID) technologies to treat storm water.

3 IRVINE CAMPUS

Water Supply

The Irvine Campus receives both potable and recycled water from the Irvine Ranch Water District (IRWD). Forty seven percent of IRWD's water supply comes from local groundwater wells. Fifteen percent is imported through Municipal Water District of Orange County (MWDOC). MWDOC purchases water from the Metropolitan Water District (MWD) which imports water via 444 miles of aqueduct in the State Water Project and the Colorado River Project, which includes a 242 mile aqueduct. IRWD also generates recycled water by capturing and treating black water, accounting for 28 percent of total water supply.

Water Types and Usage

The UC Sustainable Practices Policy requires each campus to report total annual potable water use per weighted campus user (WCU). Baseline potable water use for the Irvine Campus and Medical Center were established using a 3-year average of fiscal years (FY) 2006-2008. WCU is used to normalize usage based on faculty, staff, and student residents and student, faculty, and staff commuters.

Potable Water

Potable water is essential to support both the academic mission and campus operations. Potable water at the Irvine Campus is used primarily to support research and education, dining facilities, student housing and athletics. In FY 2016/17 the main campus used approximately 358 million gallons (MG) of potable water to support a daytime campus population of over 30,000 students, 8,000 employees, and 8,712 students living in University-owned housing on campus. This translates to approximately 10,976 gallons per WCU annually. Roughly 262 MG of potable water is used in buildings, 80 MG is used annually in the central plant's cooling towers, and 16 MG is used annually for landscape irrigation.

Recycled Water

IRWD was a pioneer in treating wastewater for reuse for agriculture and landscape irrigation. Since 1967, IRWD has installed over 525 miles of purple pipe to serve its district. In recent years IRWD has expanded from providing recycled water for outdoor use to indoor uses such as office buildings and industrial processes.

Since the 1960's UC Irvine has used recycled water (disinfected tertiary recycled water) supplied by IRWD Michelson Treatment Plant for landscape irrigation, diverting a substantial amount of water use from the regional potable water supply. In FY 2016/17 the campus used approximately 140 MG of recycled water.

Recycled water is used for landscape irrigation, street sweeping, and dust control during construction of some capital projects. The Irvine Campus has recently taken steps on a number of projects to implement indoor uses of recycled water.

Black and Gray Water

All Irvine Campus black water (sewage) is collected in thecampus owned and operated sanitary sewer network and conveyed to IRWD Michelson Treatment Plant for treatment to recycled water. The current volume of black water produced is estimated at 490 MG annually, including on-campus faculty housing and third-party student housing. The campus reclaims approximately 34 percent of black water produced through the purchase of recycled irrigation water from IRWD.

UC Irvine has no current gray water collection and reuse systems and there is no estimate of gray water volume generated on the Irvine Campus or Medical Center. All gray water is currently collected in the sanitary sewer system and conveyed to IRWD Michelson Treatment Plant.

Projected Potable Water Use

Figure 1 below shows historical and projected per capita water usage. Projected population and building growth are expected to result in an estimated two percent annual increase in potable water usage through 2025. The projected reductions in 2017/18 and 2018/19 shown below are due to the central plant recycled water conversion project which will result in an estimated savings of 60 MG of potable water annually.

Despite the estimated increase in building and population growth, the central plant conversion project will put the Irvine Campus on track to meet the UC Sustainable Practices Policy and the UC Irvine stretch goal of 50 percent reduction per capita.

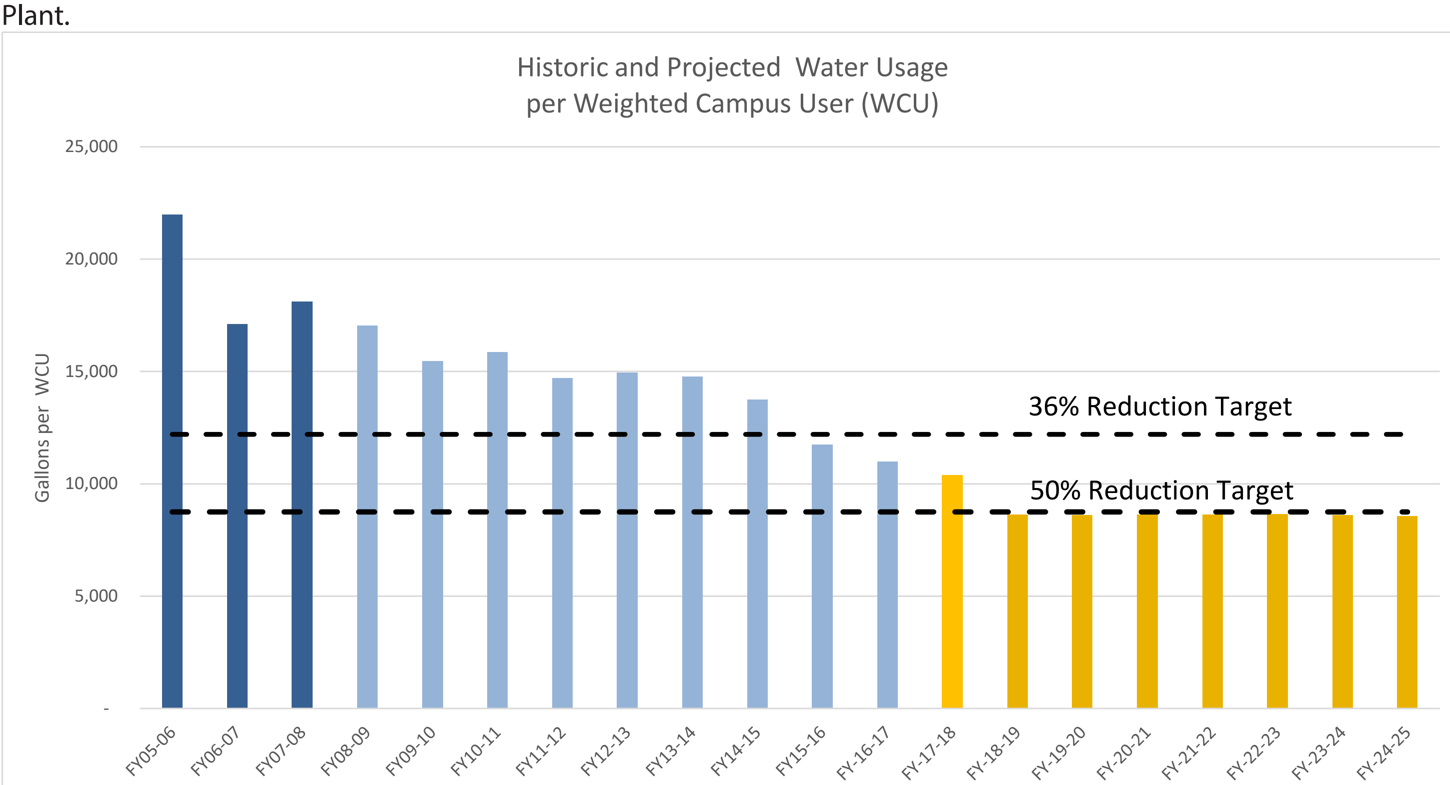


Figure 1

Water Reductions to Date

The Irvine Campus has implemented a wide array of water reduction projects since the baseline period resulting in over 78 million gallons saved annually. Reductions can largely be attributed to plumbing fixture upgrades (toilets, shower heads, and faucets) and water efficiency measures in academic buildings and student housing.

The Irvine Campus has also carried out a number of projects increasing the efficiency of landscape irrigation and turf conversions, prioritizing projects in areas that are irrigated with potable water. To date over 159,000 square feet of turf has been removed across campus and replaced with water-wise and drought tolerant plants.

25 Millon Gallons
Restroom Fixture Upgrades

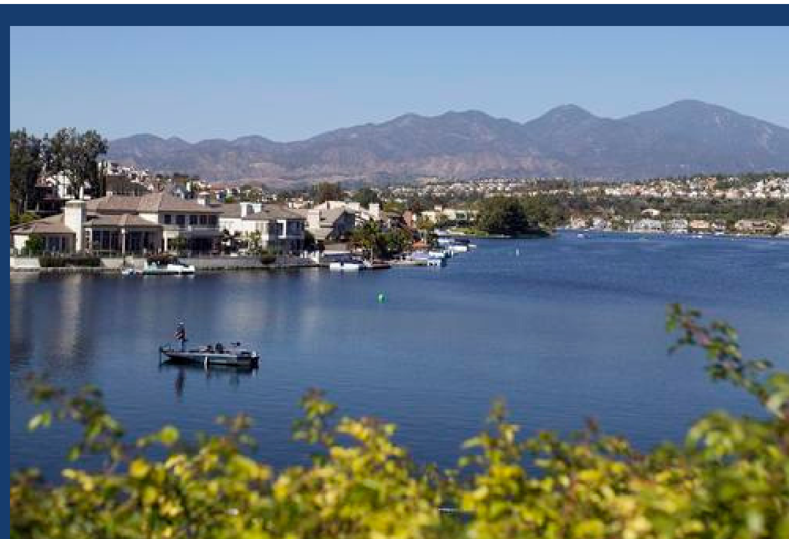
5 Millon Gallons
Replacement of Once-Through Cooling Systems

3.5 Millon Gallons
Turf Replacement and Irrigation Upgrades

45 Millon Gallons
Plumbing Retrofits in Student Housing

Annual Savings = 78 Millon Gallons

Water UCI, a campus-wide initiative, facilitates collaboration in finding solutions to issues surrounding water science, management, and policy. Centers and research programs affiliated with Water UCI include: FloodRISE, a project that promotes resilience planning to prepare for coastal flooding in Southern California and Mexico; the WEX Center, which promotes research associated with the water/energy nexus; and GIDMaPS (The Global Integrated Drought Monitoring and Prediction System).



UC Irvine Watershed

UC Irvine plays an important role in protecting its local watersheds, both at the Irvine Campus and Medical Center, from pollution. The Irvine Campus is part of the San Diego Creek sub-watershed within the 152 square-mile Newport Bay watershed. The campus is located adjacent to San Diego Creek, a tributary of Upper Newport Bay, near the terminus of the Newport Bay watershed. The Newport Bay Watershed is bounded to the east by the San Ana Mountains, the Los Angeles basin to the north, and the Pacific Ocean to the west (See Figure 2).

The 1,475 acre main campus consists of an urbanized core including 5.1 million square feet of instructional space, student housing, approximately 350 acres of irrigated landscape, and 415 acres of non-irrigated open space.

Storm Water

The Irvine Campus has an extensive network of storm water collection, conveyance, treatment, and discharge systems. This includes underground storm drain facilities, open channel flow, and storm water treatment systems. Early development of these systems focused primarily on collection and conveyance off-site. More recent storm water improvements focus on collection, retention, treatment, and percolation.

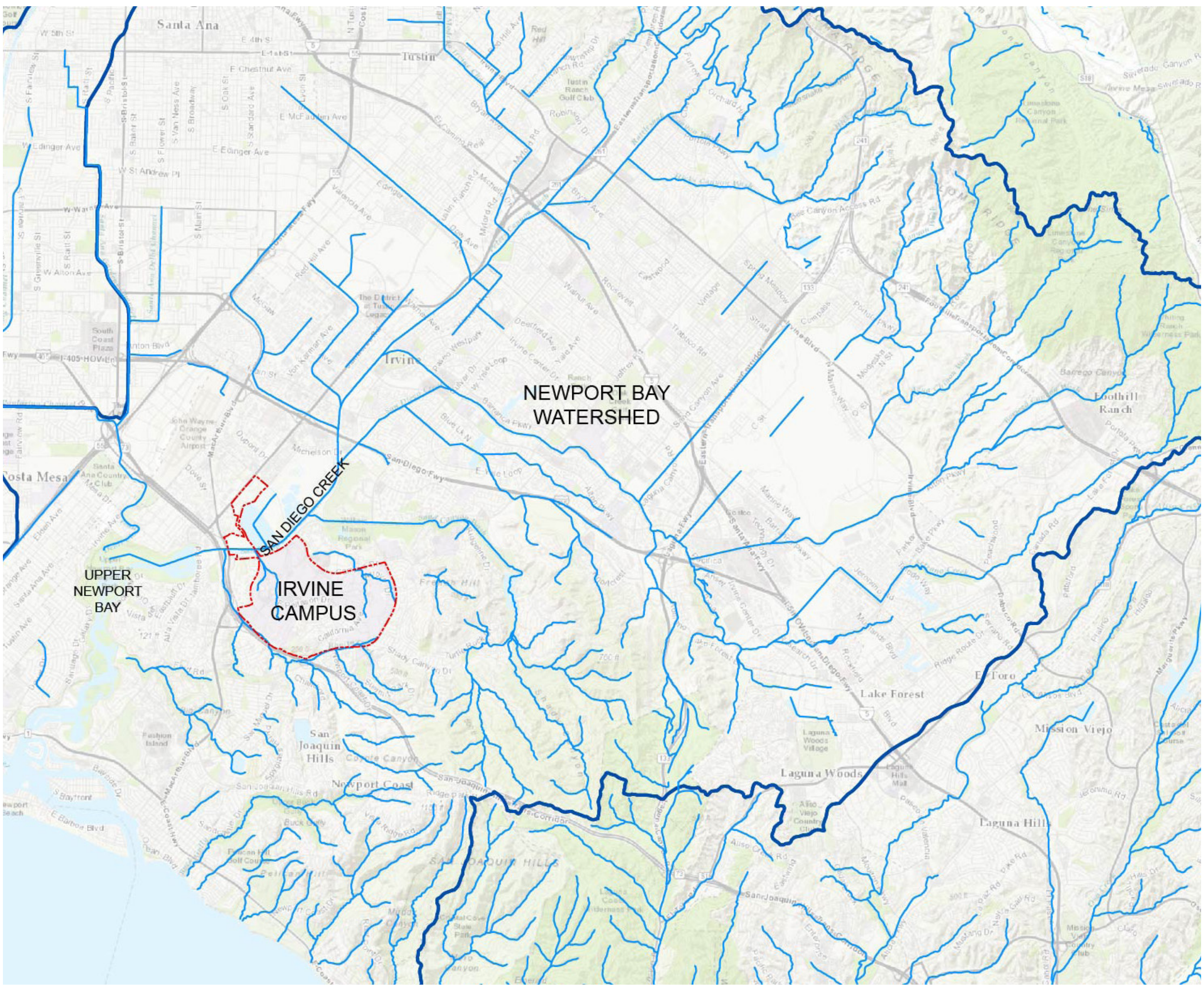


Figure 2

Low Impact Development (LID) Installations

Recent capital projects have implemented a range of LID features that treat storm water on site before entering the storm drain system and ultimately Upper Newport Bay. A few examples are shown below.

Flow-through planters at the recently completed Mesa Court Towers filter storm water through sand and phytoremediation before reentering the storm drain system.

The parking lot at Verano Place Unit 6 graduate student apartments used permeable pavement as part of earning four LEED Platinum certifications from the U.S. Green Building Council (USGBC).

Bioretention basins throughout Verano Place Unit 6 apartments filter storm water through a soil medium and through phytoremediation.

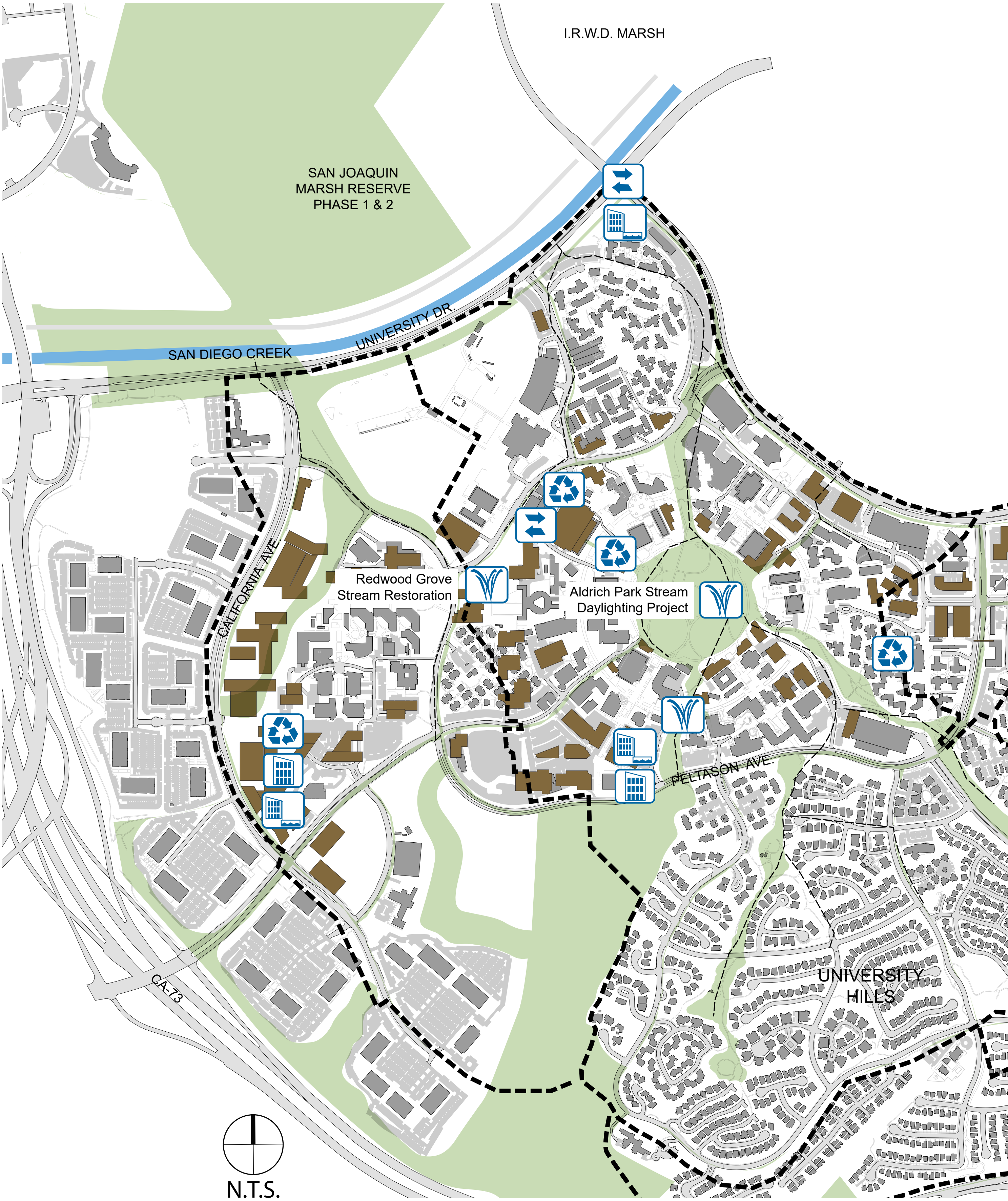

I.R.W.D. MARSH
SAN JOAQUIN
MARSH RESERVE
PHASE 1 & 2
UNIVERSITY DR.
SAN DIEGO CREEK
CALIFORNIA AVE.
Redwood Grove
Stream Restoration
Aldrich Park Stream
Daylighting Project
PELTASON AVE.
UNIVERSITY
HILLS
CA-73
N.T.S.

Figure 3

UC Irvine Sustainable Water Management Vision

UC Irvine will be a responsible ***steward*** *of all water resources while demonstrating leadership in* ***innovative*** *and* ***sustainable management*** *techniques.*

Strategies

- Improve monitoring of all water types - indoor, outdoor, and storm water (campuswide)
- Prioritize capture and reuse
- Implement potable water reduction projects in existing buildings (post 1994 construction)
- Promote a conservation ethic through outreach and education (campuswide)
- Implement innovative green building water management strategies in future buildings
- Expand recycled water use
- Pursue stream restoration projects
- Collaborate with IRWD, faculty, and students in the development of demonstration projects

Legend

- Existing Buildings
- Future Buildings
- Drainage Area
- Storm Drain System

Sustainable Water Management Opportunities

UC Irvine's vision for sustainable water resource management can be achieved through implementation of the strategies outlined in Figure 3. The following opportunities have been identified by the Water Resources Working Group (WRWG) in support of the Irvine Campus strategy. Opportunities have been identified that are either campus-wide, specific to green building, within existing buildings, education and outreach focused, or related to irrigation and landscape.

Campuswide Opportunities

Additional Campus Metering/ Improved Monitoring

Monthly water usage of both potable and recycled water continues to be obtained through billing data by Facilities Management (FM). Detailed building level metering and monitoring of water usage has been implemented since the 2013 WAP with the addition of six meters to existing research buildings. These meters have helped FM identify and resolve issues in a timely manner. Scaling this type of building level metering across campus has the potential to reduce water use by resolving leaks and similar issues.

Storm Water Capture & Reuse

The Irvine Campus has five primary drainage areas in which storm water exits the campus property before reaching San Diego Creek. During rainfall events millions of gallons of storm water are discharged into San Diego Creek and ultimately Newport Bay. Opportunities for both centralized and distributed capture and reuse of this water are currently being explored by researchers in the School of Engineering and the WRWG.

One potential centralized capture project lies within the largest drainage area (577 acres). The drainage area encompasses portions of the academic core and University Hills and outfalls into San Diego Creek west of the University Dr./Campus Dr. intersection (see Figure 3). This drainage area has the potential to produce flows of approximately 1,200 cubic feet per second (cfs) during a 25-year storm event. The first three quarters of an inch of rainfall would produce an estimated 70 million gallons of storm water. Because of its size this project presents a significant opportunity for current water supply augmentation. This project would require a detention system below the Mesa Court playfield south of the Campus Dr./University Dr. intersection. Nuisance flow and storm water would accumulate in the detention system and be pumped, treated, and used for irrigation. Additional opportunities for reuse will be explored by the WRWG including natural treatment using the San Joaquin Marsh.

Storm Water Neutrality – Led by civil engineer Stanley Grant, faculty from UCLA, Riverside, San Diego, and Santa Barbara are currently investigating how to transform each southern UC campus to become 'storm water neutral' where storm water can safely augment current water supplies and minimize flood risk. The project received a grant from UC's Multi-campus Research Programs and Initiatives (MRPI).

Anteater Learning Pavilion – Currently under construction, this academic building will be the first dual plumbed building on the Irvine Campus.

In addition to the centralized capture opportunities, the WRWG will explore potential distributed capture and reuse projects that include direct on-site reuse of storm water for landscape irrigation.

Stream Restoration Demonstration Projects

Students in the Henry Samueli School of Engineering have investigated opportunities to restore existing streams or daylight historical drainage courses on campus. Two recent projects, the Redwood Grove Stream Restoration and the Aldrich Park Stream Daylighting project, aim to help reverse symptoms associated with urban stream syndrome (imperviousness and decreased water quality) and in their design attempt to mimic pre-development conditions.

The Redwood Grove Stream Restoration project (see Figure 3) would rehabilitate an existing channel near the Ayala Science Library to treat nuisance flows and storm water from typical rain events. Complementing UCI's mission to be a living laboratory for sustainability, the project would provide opportunities for research of natural treatment systems and could serve as a demonstration project to the public.

The Aldrich Park Stream Daylighting project (see Figure 3) would redirect runoff from faculty housing and academic areas currently flowing to a large storm drain pipe under Aldrich Park to a seasonal stream crossing the park from the southeast to the northwest corner. In the event of a large storm overflow would be directed to the storm drain system. Beyond its ecological and research benefits, this project would create a landscape amenity in Aldrich Park.

Green Building Practices

To date capital construction designs have focused on indoor and outdoor potable water reduction through efficient fixtures and irrigation. In recent years storm water on site has been managed through Low Impact Development (LID) practices. Future capital construction projects can build on these best practices by designing buildings that more aggressively reduce overall water demand by seeking innovative techniques to harvest water available on site.

To achieve innovative water systems in future buildings, water harvesting techniques and storage (below-grade cisterns, etc.) can be incorporated into new buildings to collect and reuse rain and condensate water. This type of system could supplement the use of domestic potable water in toilets and urinals and minimize water needed for landscape irrigation.

All new construction projects should continue to maximize water resource measures identified in the LEED (Leadership in Energy and Environmental Design) green building rating system. This will require optimizing indoor and outdoor water efficiency measures, providing robust water metering of two or more building subsystems, and providing rainwater management systems in all new buildings where feasible.

In addition to implementing more innovative systems in academic buildings, student housing projects can seek methods to reuse gray water. Gray water has historically been treated as a waste product but is increasingly becoming regarded as a resource that can supplant potable and recycled water. Gray water, defined by the 2016 California Plumbing Code as wastewater from showers, bathroom washbasins, and washing machines, can be used for non-potable uses such as irrigation of landscaped areas. The Irvine Campus will continue to investigate existing and emerging technologies for on-site light gray water reuse including pilot, demonstration, and research project applications.

Expand Recycled Water Use

With close to 5 million square feet of new building space expected in the academic core, dual plumbing has the potential to significantly reduce growth related potable water use. Dual plumbing separates potable and recycled water lines entering the building during construction. The recycled water service can be used in place of potable water in urinals and toilets. Adding dual plumbing to new buildings is cost efficient during construction as retrofitting existing buildings is cost prohibitive.

The recycled water system used for irrigation on campus does not have adequate capacity to serve both outdoor and indoor uses. Because retrofitting existing buildings is infeasible, new buildings are being constructed with dual plumbing with the understanding that a dedicated recycled water line will likely be constructed in the future. Recent capital projects (Anteater Learning Pavilion & Interdisciplinary Science & Engineering Building) have been designed to include dual plumbing.

Figure 4 below shows a possible route for a future dedicated recycled water line. An interim solution to providing recycled water indoors would be to design water storage capabilities with new construction projects. Storage systems filled with condensate and rain water can be supplemented with recycled water from the irrigation system during the day when there is no irrigation demand.

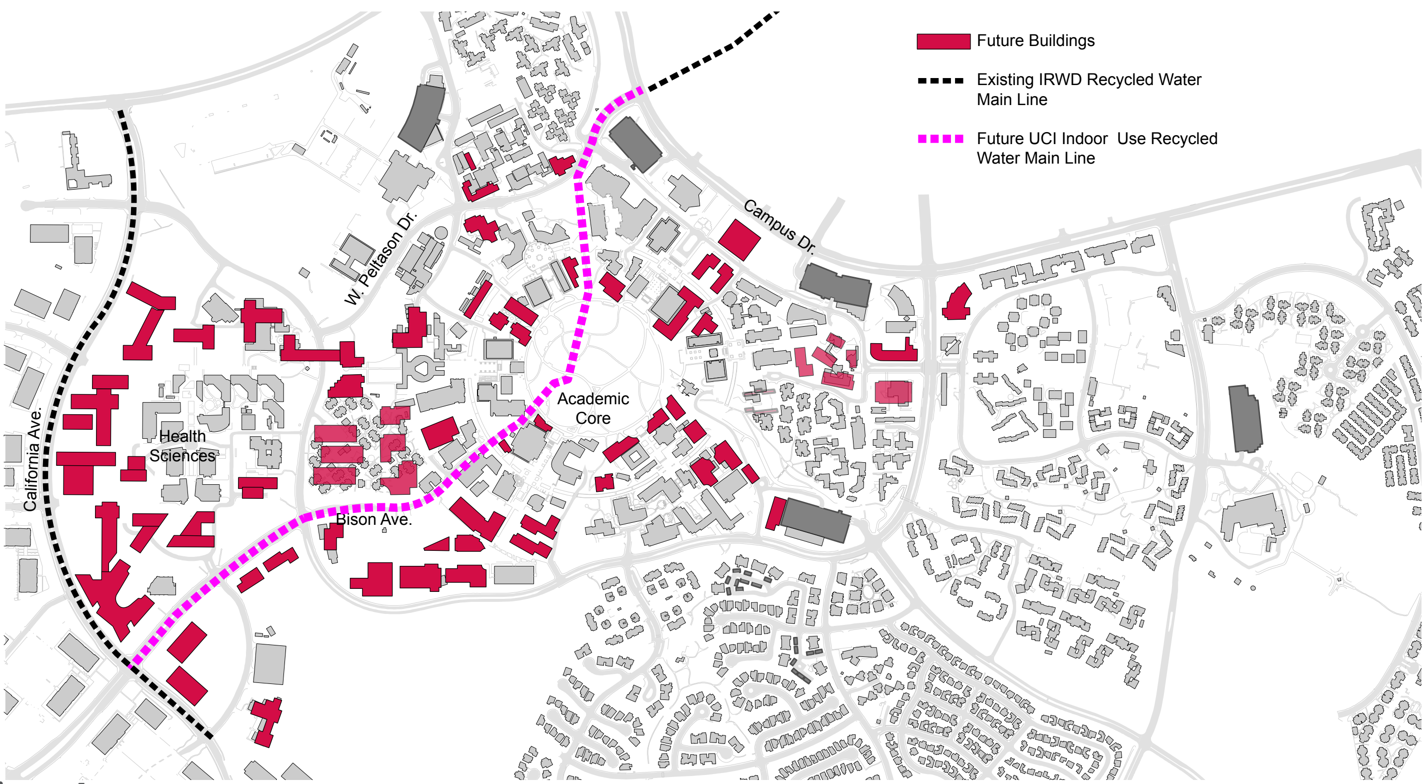


Figure 4

UC Irvine is also currently partnering with IRWD in a conversion of the central plant cooling towers to use recycled water to reduce potable water consumption. The project is currently estimated to be completed in the spring of 2018. Once completed the project estimates a savings of 60 MG of potable water annually.

Potable Water Reduction Projects

Although the cooling tower retrofit project will put the Irvine Campus on track to reach its stretch goal of 50 percent reduction per capita before 2025, potable water use will increase as the campus continues to build more academic buildings and housing. In addition to reducing growth-related water use, the WRWG has identified the following opportunities in existing facilities.

Plumbing Retrofits/Upgrades

Significant reductions have been realized by retrofitting and upgrading outdated plumbing equipment. To date all pre-1994 plumbing fixtures have been replaced with more efficient devices. The campus must now concentrate its efforts towards replacement of post-1994 fixtures that provide opportunity for water savings. FM has identified 5 MG annual savings with future plumbing upgrade projects. Student Housing has also identified opportunities for plumbing upgrades. One possible project in student housing is to retrofit shower heads in parts of graduate student housing. By replacing one shower head an estimated 7,300 gallons of water can be saved annually. Student Housing is currently identifying the total quantity of shower heads that can be replaced to determine the overall savings potential.

Condensate Recovery

Condensate recovery is the process of capturing discharged condensate from HVAC equipment and reusing on site rather than discharging into the sanitary sewer system. Since the 2013 WAP higher education institutions in southern California have begun to use condensate recovery on existing buildings to reduce water delivery and reduce associated sewerage fees.

FM is currently assessing the feasibility of installing a condensate recovery system in a Medical Science building which uses steam for cage washing. Without a return system all steam is drained to the sewer once it condenses. Installing a return system would result in 3 million gallons of water saved. The WRWG will continue to identify other condensate recovery projects for existing buildings.

Green Labs Program

This year UC Irvine launched a Green Labs Program in which reducing water consumption in labs is a component. Through an assessment process labs identify water saving opportunities as needed upgrades to existing equipment including faucets and autoclaves. The program is currently in a pilot phase and plans on expanding to more labs in 2018.

The UC Sustainable Practices Policy requires campuses to identify single pass cooling systems, constant flow sterilizers, and autoclaves with a plan for replacement. UCI Environmental Health & Safety (EH&S) has been implementing a replacement program for single pass cooling systems and has replaced a total of 36 systems with waterless condensers. FM has also performed an inventory of autoclaves across campus identifying 94 total. FM is currently piloting the use of water efficient autoclaves in a medical sciences complex. Once the pilot is complete autoclaves that have low-throughput (less than 5 cycles per day) will be identified for potential replacement with more water efficient models.

Promote Conservation through Education and Outreach

Student Housing

Since the 2013 WAP Student Affairs has continued to promote personal water conservation in housing and dining areas. Residence halls have implemented a water conservation program emphasizing peer-to-peer education through UCI's Earth Rep's program. To date, student representatives have educated over 400 residents on the importance of water as a resource and the personal impact students can have on water supply through behavior changes. In 2017 close to 2,000 shower hangers were distributed to undergraduate students through the program. In addition to the shower hangers Student Housing developed signs that give water-savings tips in bathrooms, laundry, and kitchen areas. Staff also provide opportunities to learn about drought tolerant landscaping through succulent planting events and volunteer turf removal projects. Future opportunities include education on green products that help protect waterways and a pilot study of shower timers.

Peer to Peer Engagement

Student interns engage the campus community throughout the year teaching water conservation awareness while giving advice on reducing personal water consumption. Interns use a variety of outreach techniques including displays and games while also interacting one on one with peers. Interns also use social media to advocate for water conservation through infographics and instructional videos in an effort to reach a broader audience.

Foam Rub Rinse Campaign

Facilities Management has also provided outreach to the campus community encouraging conservation of water through the Foam, Rub, Rinse campaign. Signs have been placed across the campus core encouraging this practice.

Irrigation & Landscape

The UC Sustainable Practices Policy requires each campus to reduce potable water used for irrigation. The WRWG has prioritized opportunities reducing potable water used for landscape irrigation and also recognizes the importance of being responsible users of recycled water.

The Irvine Campus has approximately 234 acres of maintained grounds, including 135 acres of lawn. Fifty seven acres of lawn area is used year-round for athletics, intramural sports, recreation, or other large events. Seventy eight acres (58 percent) of lawn area is considered under-used and 13 acres of turf is currently irrigated with potable water instead of recycled water. Under-used turf areas vary in size from small planter areas to large expanses (3+ acres). See Figure 5 for a map of utilized and underused turf area types.

The WRWG has prioritized the following strategies for reducing landscape irrigation.

Transition Potable Water to Recycled Water Irrigation

Although the Irvine Campus is primarily irrigated with recycled water (90 percent), approximately 13 acres of under-used turf within student housing is irrigated with potable water. Approximately 16 MG of potable water is used annually for irrigation. Figure 5 below outlines these areas in Verano Place and Middle Earth student housing. Transitioning these areas to recycled water provides the greatest opportunity for reduction and should be the highest priority in reducing potable irrigation.

Currently a conceptual plan has been developed for converting a portion of Verano Place (Unit 6 area) which would reduce potable water consumption by approximately 1 to 3 million gallons annually. UCI is collaborating with IRWD to develop a plan for this conversion and eventually transitioning all of Verano Place to recycled water. When completed, this will save 15 million gallons, annually.

Figure 5

Improve Campus Irrigation System

In 2015 Student Housing replaced separate irrigation control systems with a central control weather based system in five of its communities. This transition has resulted in better control of water application based on micro-climates and improved monitoring.

The main campus grounds, maintained by Facilities Management, has historically used a weather based irrigation control system. However, the current system has not been fully integrated and is no longer as effective. FM is currently determining the feasibility of replacing this system with a cloud-based central management system. By implementing a new cloud-based system total irrigation water use could be reduced by 16 to 50 percent.

Turf Replacement

Turf areas, even when irrigated with recycled water, provide a signal to the community that water is being wasted. Underused turf areas, both potable and recycled, can be re-landscaped with native or drought tolerant plants. Beyond reduction in water use, replacing turf with California native plants and climate appropriate plants has the co-benefits of reduced maintenance, providing refuge space for wildlife, and improved aesthetics. As a living laboratory UC Irvine will continue to seek opportunities to implement turf conversion projects that demonstrate the benefits of using native plants.

Aldrich Hall Turf Removal

4 MEDICAL CENTER

UCIMC Clinical Lab Building. Credit Nick Merrick

Water Supply

The City of Orange Water Department (COWD) provides water to the UCI Medical Center. COWD pumps and disinfects 40 to 50 percent of its water from the Orange County ground water basin, which is managed by the Orange County Water District, imports 40 to 60 percent from the Metropolitan Water District of Southern California though the Municipal Water District of Orange County. A small percent of water is surface water supplied by the Serrano Water District in Villa Park and taken from Irvine Lake. The Medical Center has no access to municipally sourced recycled water and COWD has no means to provide it.

Water Use

The Medical Center uses potable water for both indoor and outdoor uses. Potable water use at the Medical Center is normalized by Adjusted Patient Day (APD). Adjusted Patient Day is defined as inpatient days x (gross patient revenue/inpatient revenue) where gross patient revenue is outpatient revenue plus newborn revenue plus inpatient revenue. In FY 2016 the Medical Center consumed 446 gallons of potable water per capita, a 37 percent reduction from the baseline period.

Projected Potable Water Use

Figure 6 below shows historic and projected water use through 2025 based on future building growth for the Medical Center in Orange and within the Health Sciences area of the Main Campus. The Medical Center has been on track to meet the 2020 reduction target of 20 percent per capita and the 36 percent per capita by 2025. However, with projected near term growth the Medical Center will be able to meet the 20 percent reduction target but will have to implement significant reduction projects to meet the 36 percent reduction target by 2025.

The Medical Center is planning to replace its current central plant at the Orange campus with two plants, one serving facilities that are under the jurisdiction of

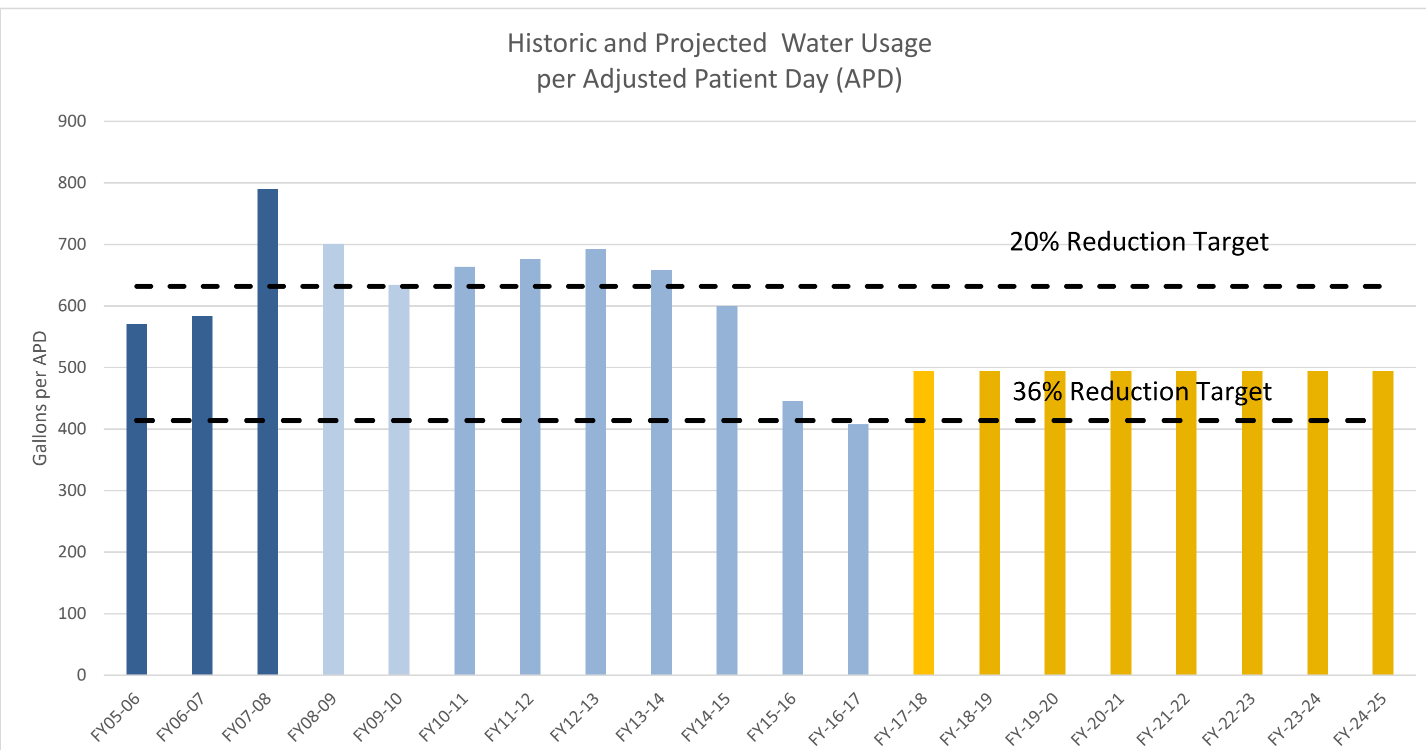


Figure 6

the Office of Statewide Health Planning & Development (OSHPD) and one serving non-OSHPD facilities. While this project will provide greater energy efficiency for the Medical Center it is estimated the cooling towers will add an additional 20 MG of water annually beginning in 2018.

Water Reductions to Date

Since the 2013 WAP the Medical Center has implemented a number of projects that have resulted in 19 million gallons of potable water saved annually. Upgrades to cooling tower equipment and adjustments in treatment at two buildings save 7.8 MG annually. Lab equipment upgrades including the addition of water flow control and retrofitted reverse osmosis systems have resulted in 3 MG potable water saved annually. Lastly plumbing fixture upgrades have achieved 8.2 MG of water savings. The table below lists these completed projects and associated annual water savings.

Projects Completed	Annual Water Savings (Million Gallons)
Controller upgrade and treatment modification for Building 57 cooling towers	7
Sterilizers upgraded with added temping water flow control	1.5
Reverse osmosis systems upgrade	.65
Controller upgrade and treatment modification for Building 54 cooling towers	.85
B1A dual flush toilet upgrade	.2
Sprayer upgrades (medical, domestic and kitchen)	8.8
TOTAL	19

Opportunities

In order to meet the 2025 reduction target of 36 percent per APD the Medical Center will need to reduce potable water use at the Orange campus including demand associated with future growth. To date the Medical Center has identified over 6 MGY of potable water reduction projects. The Medical Center will need to reduce water use by an additional 16 MGY in order to reach the 2025 goal. The WRWG will work with Medical Center staff to continue to identify reduction opportunities in existing facilities and landscape as well as opportunities to reduce water use in future facilities. The opportunities listed below are the projects that have been identified to date.

Commercial Kitchen Upgrades

The Medical Center has one commercial kitchen on site. This kitchen currently uses dish washing machines that use 324 gallons per hour (GPH). By replacing these dish washing machines with 98 GPH machines the Medical Center could save .8 MG annually. Other upgrades to trough collectors, cart washers, and pre-rinse sprayers would result in over .7 MG saved. If all of these projects were implemented over 1.5 MG of water could be saved annually.

Fuel Cell Recapture

The Medical Center uses a high-temperature fuel cell and absorption chiller system to generate close to 30 percent of the Medical Center's power. The fuel cell uses approximately 5 MG of potable water annually. Water that is lost to the atmosphere could be recaptured resulting in approximately 3.7 MG saved annually. In addition to capturing water lost to the atmosphere, water that is discharged to the sewer system could be captured and reused for landscape irrigation.

Green Building

Facilities planned at UCIMC should reflect the best practices for green building outlined on pages 20-21. Innovative water capture and reuse techniques should be explored during the design process including dual plumbing and condensate recovery.

Landscape Irrigation

The Medical Center has approximately 6.8 acres of landscaped areas (all use potable water) with 3 acres of turf. Only one acre of turf is considered utilized. One area near Shanbrom Hall is used for events and one area at the northwest corner of the property is necessary for providing obstruction free flight path for a helicopter landing pad. Approximately 1.8 acres of turf are underused and have been identified for future removal. These areas are dispersed throughout the campus (See Figure 7). A 2013 analysis of the Medical Center grounds showed that over 3 MG of potable water could be saved annually through irrigation upgrades and an additional 0.7 MG could be saved through replacement of underused turf with native and drought tolerant plants. As a first phase of turf replacement the most visible areas should be replaced along The City Dr. and Chapman Ave.

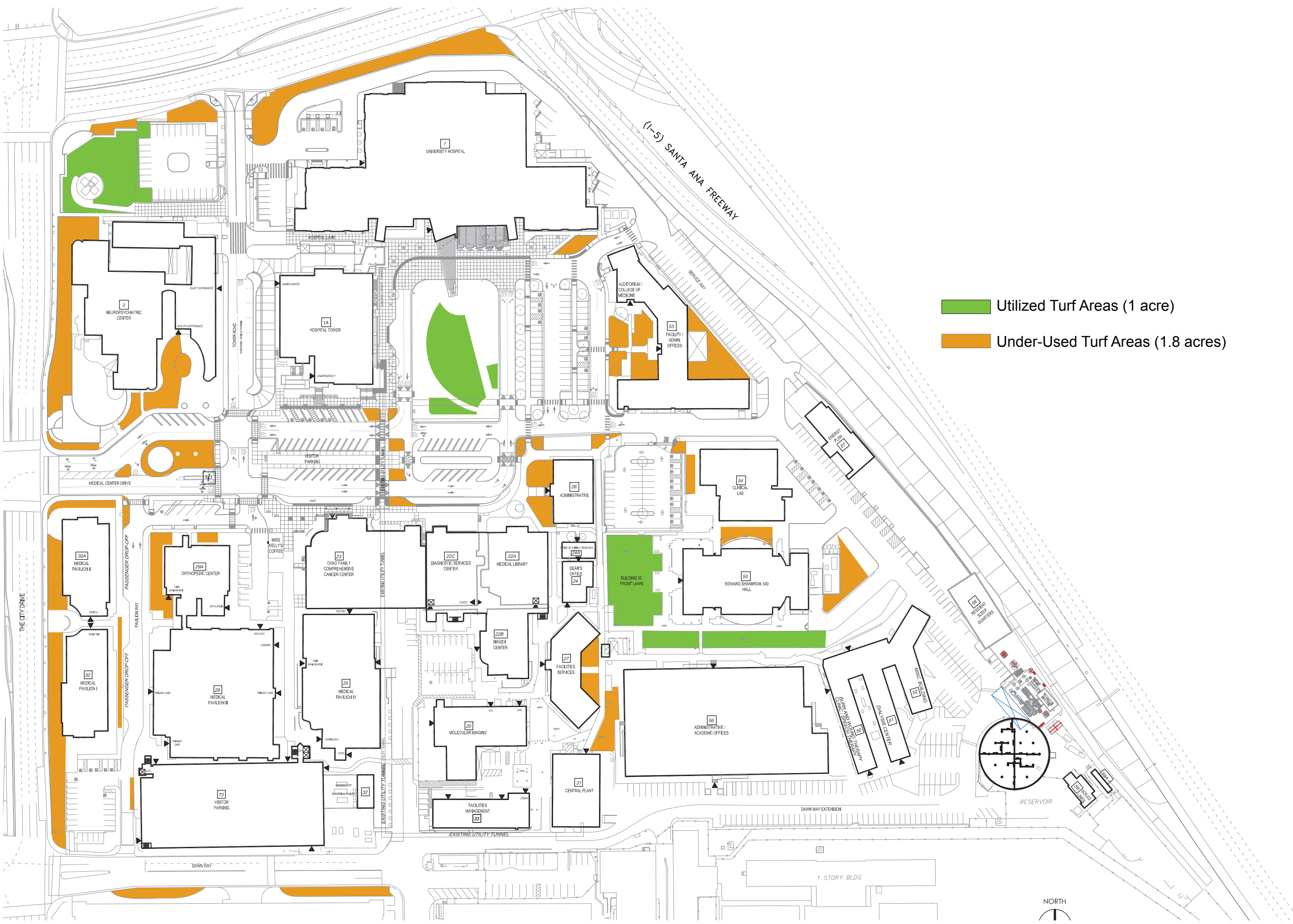


Figure 7

Project List

	Project	Annual Potable Water Savings (MG)
Campuswide Opportunities	Additional campus metering & improved monitoring	11
	Focused water audits	TBD
	Retrofit cooling towers to recycled water	60-80
	Stormwater and urban runoff capture & reuse	TBD
Existing Buildings	Expand plumbing retrofits to post-1994 buildings (Phase II)	5
	Eliminate once-through cooling systems	2
	Restroom sink upgrades	TBD
	McGaugh Hall fermenter replacement/upgrade	2
	Install hand sanitizers in all bathrooms & develop educational signage	TBD
	Foam soap educational campaign - 'foam first then rinse'	TBD
	Replace water fountains with water filling stations	Negligible
	Medical Sciences medical equipment upgrade	3
	Replace autoclaves with more efficient autoclaves	TBD
	Install aerators through Green Lab program	TBD
Green Building	Condensate water capture and reuse	0.135
	Indoor recycled water use	TBD
	Replace lab steam sterilizers with more efficient units	
	Install front loading washing machines in student housing	
Irrigation & Landscape	Transition potable water to recycled water (Verano, Middle Earth, N. Campus)	16
	Irrigation system upgrades	4
	Underutilized turf replacement	0.08
Outreach & Education	Shower hangers	TBD
	Water-savings tips signage	TBD
ARC		
Building	ARC Cooling Tower - increase cycles of concentration	TBD
	ARC Cooling Tower - recycled retrofit	1
	ARC plumbing fixture retrofit	1
	Main Campus Total (MG)	**102-122**
Medical Center		
Building	Fixture upgrades	
	Commercial kitchen upgrades	1.5
	Fuel cell recapture	3.7
Landscape	Irrigation system upgrades & turf removals	3.7
	Medical Center Total (MG)	**8.9**

UC Irvine Water Resources Work Group

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