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ENVIRONMENTAL ANALYSIS

OVERVIEW

The *Environmental Analysis* describes existing campus conditions during fall 2016 that relate to the broad scope of environmental sustainability—an area in which Mt. SAC's leadership is widely acknowledged. This analysis provides a shared understanding of these conditions, which informed EFMP discussions and influenced the scope of the recommended projects described in Chapter 10: *Facilities Recommendations and* Chapter 11: *Site and Infrastructure Improvements Recommendations*. This information will also inform ongoing and future planning efforts such as Mt. SAC's *Climate Action Plan* and *Infrastructure Master Plan*. The information in this chapter will assist Mt. SAC in achieving its goals and objectives of using resources efficiently, promoting the health and well-being of students and employees, enriching students' learning experiences, and minimizing negative environmental impacts, while reducing the operating cost of campus facilities. This analysis was developed with the input of the many faculty, staff, and students who participated in the March 2017 EFMP Eco Charrette and the May 2017 Mt. SAC Climate Action Planning Conference.

- **Campus Sustainability:** A description of the College's sustainability-focused actions, initiatives, and governance structures, and examples of the ways that the College has been recognized for its accomplishments in this area
- **Campus Climate Conditions:** A description of prevalent climate and environmental conditions at the campus and how facilities could be sited, oriented, and designed to take advantage of these conditions
- **Resource Analyses:** A report on the current state of Mt. SAC's stormwater management, water use, energy use, and waste management
- **Carbon Footprint Analysis:** A snapshot of Mt. SAC's carbon footprint, including how it compares to the footprints of several peer institutions, the biggest contributors to its carbon footprint, and where to direct efforts that would yield the greatest reductions in its carbon footprint

ENVIRONMENTAL ANALYSIS

CAMPUS SUSTAINABILITY

Mt. SAC is a recognized leader among California Community Colleges in the area of environmental sustainability. On August 18, 2014, Mt. SAC's President and CEO, Dr. Bill Scroggins, galvanized the College by signing Second Nature's American College and University Presidents' Climate Commitment. This action is accelerating the College's progress toward defining and achieving its vision for environmental sustainability.

Interest in sustainability has inspired students, faculty, staff, and administrators to participate in organizations and committees that focus on increasing the importance of sustainability in Mt. SAC's programs, practices, and services. The Climate Commitment Implementation Committee supports the creation, administration, and update of Mt. SAC's *Climate Action Plan*. The Sustainability Committee provides input and supports students and faculty in implementing sustainability activities and events. The Academic Senate Task Force on Sustainability was an ad-hoc group that, in 2017, developed recommendations on the integration of sustainability into the educational experiences of all students through curriculum, research, and professional development for faculty.

ENVIRONMENTALLY SUSTAINABLE FACILITIES

Over the past two decades, Mt. SAC's facilities have become increasingly sustainable. The College has taken advantage of opportunities such as Proposition 39 and utility company incentives to fund retrofits. Mt. SAC reinvests energy savings to pay for additional retrofits.

Leadership in Energy and Environmental Design (LEED) is a globally-recognized certification program for sustainable facilities design and construction. It provides a framework to create healthy, highly efficient, and cost-saving green buildings. Mt. SAC's LEED Certified buildings include the following.

- Business and Computer Technology Center (LEED Silver)
- Administration Building (LEED Certified)
- Mountie Café (LEED Silver)
- Design Technology Center (LEED Silver)
- Child Development Complex (LEED Certified)
- Athletics Complex East (LEED Silver, in progress)
- Student Success Center (LEED Silver, in progress)

Other sustainable facilities accomplishments include the following.

- Energy and water conservation retrofits
- Drought-tolerant landscaping and drip irrigation conversions
- Bus and carpool programs organized by students via social media
- Electric vehicle (EV) charging stations
- Central cooling plant with thermal energy (ice) storage

Mt. SAC is committed to building all future facilities to standards that would, at minimum, achieve LEED Silver certification. Currently, many more sustainability-related projects are being planned, such as those listed below.

- An on-campus Transit Center that will make riding the bus to campus more convenient
- More electric vehicle charging stations
- Reclaimed water service to irrigate the athletics fields south of Temple Avenue
- Additional recycling containers
- Water bottle filling stations
- Increased use of recycled building materials

SUSTAINABILITY GRANTS AND AWARDS

- Mt. SAC received a $14,000 grant to promote mulching and recycling of green waste

- The U.S. Department of Labor awarded a $30,000 grant to fund Mt. SAC's innovative building automation system

- Irwindale Chamber of Commerce honored Mt. SAC with its 2014 Water Sustainability Award and its 2015 Energy Preservation Award

- The California Community Colleges Board of Governors honored Mt. SAC for Excellence in Energy and Sustainability, Best Overall Proposition 39 Project for the Central Plant and Thermal Energy Storage System project

- In 2017, Dr. Scroggins presented the Mt. SAC Presidential Student Sustainability Awards to encourage students to participate in sustainability actions, advocacy, and research

- A California Public Utilities Commission grant is helping to fund three years of Mt. SAC's Energize Colleges Program, which places students in internships to work on campus sustainability projects

CAMPUS CLIMATE CONDITIONS

ENVIRONMENTAL ANALYSIS

CAMPUS CLIMATE CONDITIONS INDEX

ENVIRONMENTAL ANALYSIS

CAMPUS CLIMATE CONDITIONS

Understanding the climate conditions that exist on Mt. SAC's campus is an important first step toward planning responsively and sustainably. Constructing outdoor spaces and buildings to work in harmony with environmental factors, such as wind and solar exposure, can simplify the effort and reduce the resources needed to maintain a comfortable and welcoming campus for students and employees.

CLIMATIC PROFILE

Mt. SAC's campus is in California Climate Zone 9, situated in the Pomona-Walnut Valley, one of southern California's inland valleys. The terrain is hilly and climate conditions are influenced by the occurance of thermal belts. Hilltops and valley bottoms are colder in the winter and warmer in the summer than the slopes and hillsides from which cold air drains and warm air rises. The ocean's moderating influence is not as strongly felt as it is on the coastal plains to the southwest. The temperature range over the year is more extreme, with hotter summers and colder winters. Days are mostly clear and sunny. Most of the rain falls during winter and early spring in infrequent but high-magnitude storm events that have the potential to erode soils and overwhelm stormwater infrastructure.

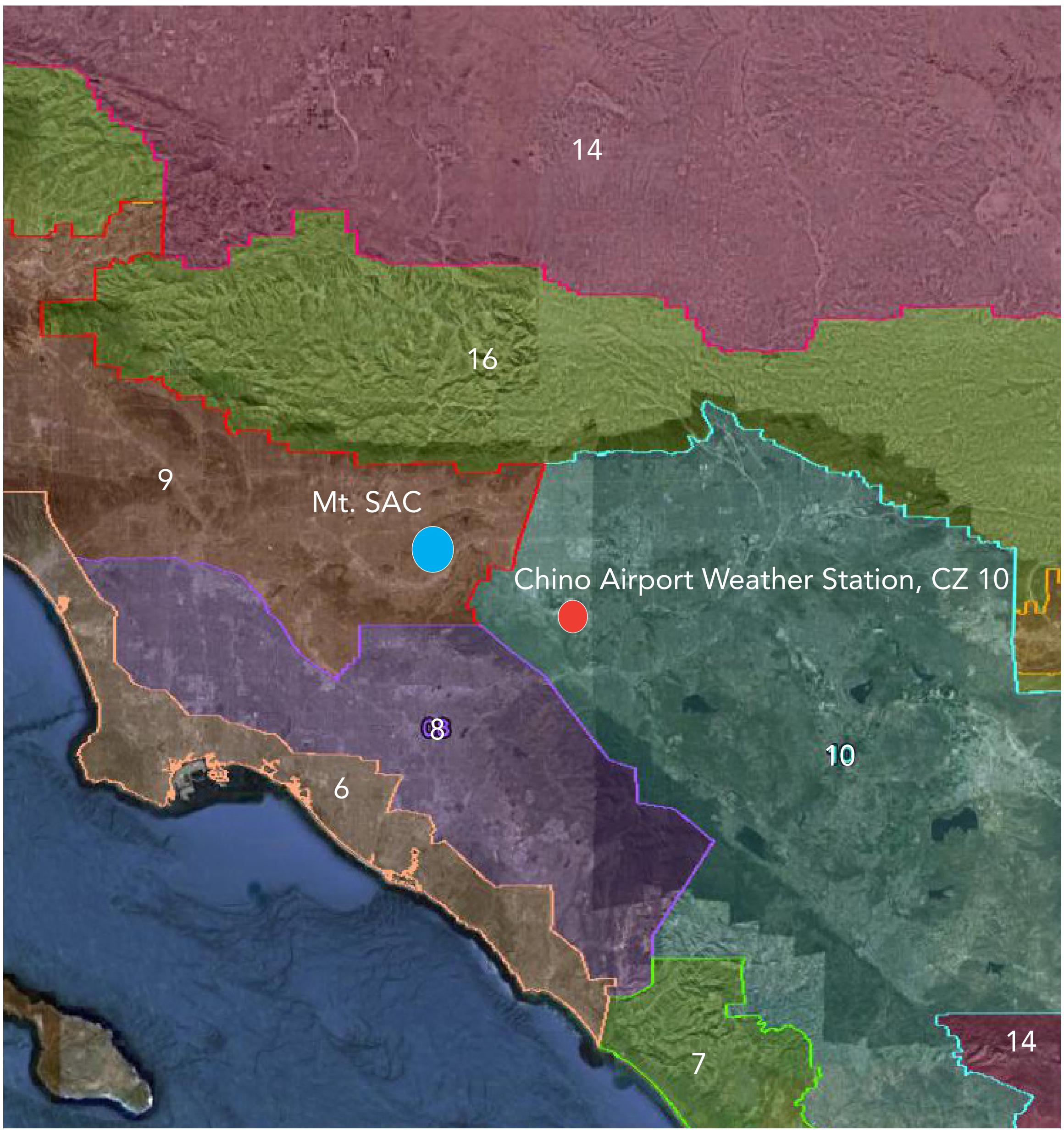
CLIMATE ANALYSIS METHODOLOGY

This analysis uses weather data from the Chino Airport Weather Station, which, although located in Climate Zone 10, is the nearest weather station and experiences the most climatically similar conditions to Mt. SAC's campus. Weather data was imported into Climate Consultant Version 6.2 software and graphed within a series of charts, shown throughout this section.

The following abbreviations for units of measurement are fused in this chapter.

- o CO2e: Carbon Dioxide Equivalent (climate warming potential)
- o Degrees F: Degrees Fahrenheit (temperature)
- o kBtu: Thousand British Thermal Units (energy)
- o lbs: Pounds (weight)
- o mph: Miles Per Hour (speed)
- o SqFt: Square Feet (area)
- o Yr: Year (time)

CLIMATE ZONE MAP WITH LOCAL WEATHER STATION SOURCE AND LOCATION



ENVIRONMENTAL ANALYSIS

CAMPUS CLIMATE CONDITIONS *(cont.)*

THERMAL COMFORT

Thermal comfort is a result of the combined effects of solar radiation, temperature, air movement, and relative humidity. The temperature swing at Mt. SAC's campus over the year is more extreme—with hotter summers and colder winters—than the coastal climates to the southwest of the campus.

DIURNAL TEMPERARATURE

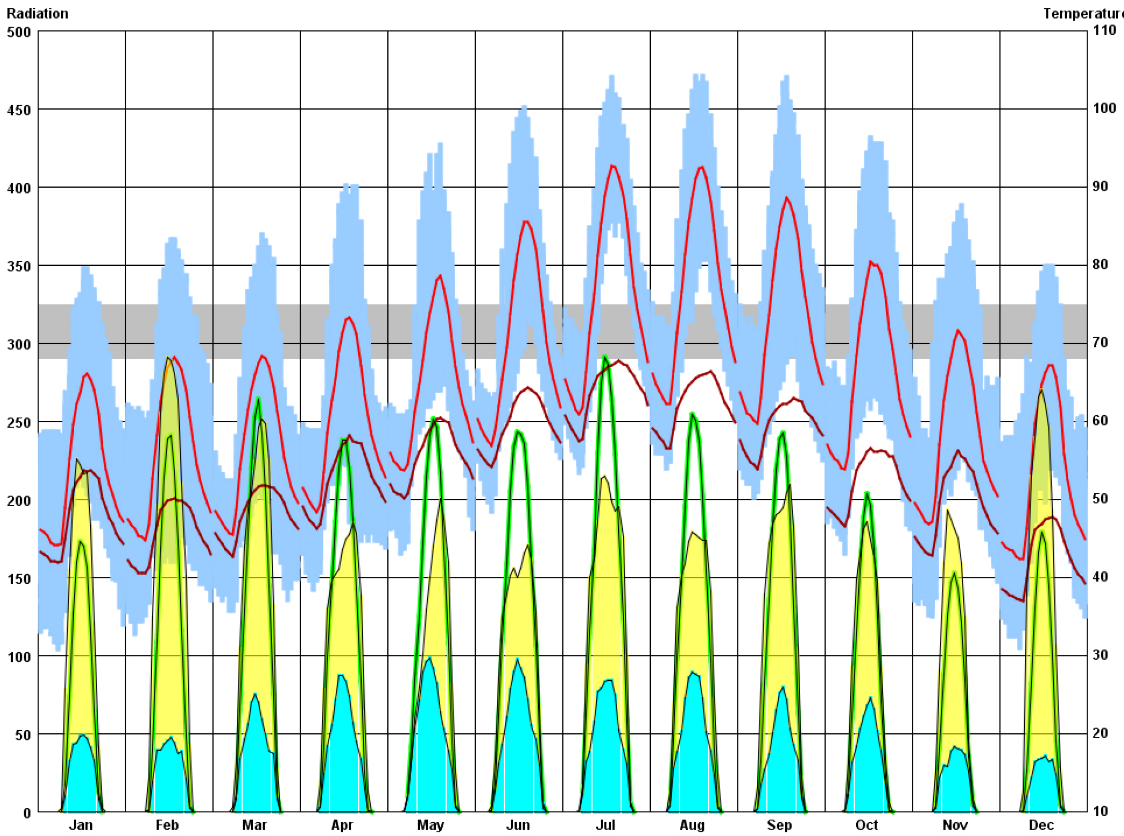
The Diurnal Temperature chart on the opposing page shows that, most of the time, dry bulb temperatures at Mt. SAC are within or close to the thermal comfort range for most people, which is shown by the horizontal grey bar.

SUMMER AND WINTER TEMPERATURES

During the summer months, temperatures on Mt. SAC's campus are approximately 10 degrees Fahrenheit higher than the comfort zone.

During the winter, temperatures on Mt. SAC's campus are approximately 10 degrees lower than the comfort zone.

DIURNAL TEMPERATURE



TEMPERATURE (DEGREES F)

- DRY BULB MEAN
- WET BULB MEAN
- DRY BULB (ALL HOURS)
- COMFORT ZONE

RELATIVE HUMIDITY (PERCENT)

- GLOBAL HORIZ
- DIRECT NORMAL
- DIFFUSE

CAMPUS CLIMATE CONDITIONS *(cont.)*

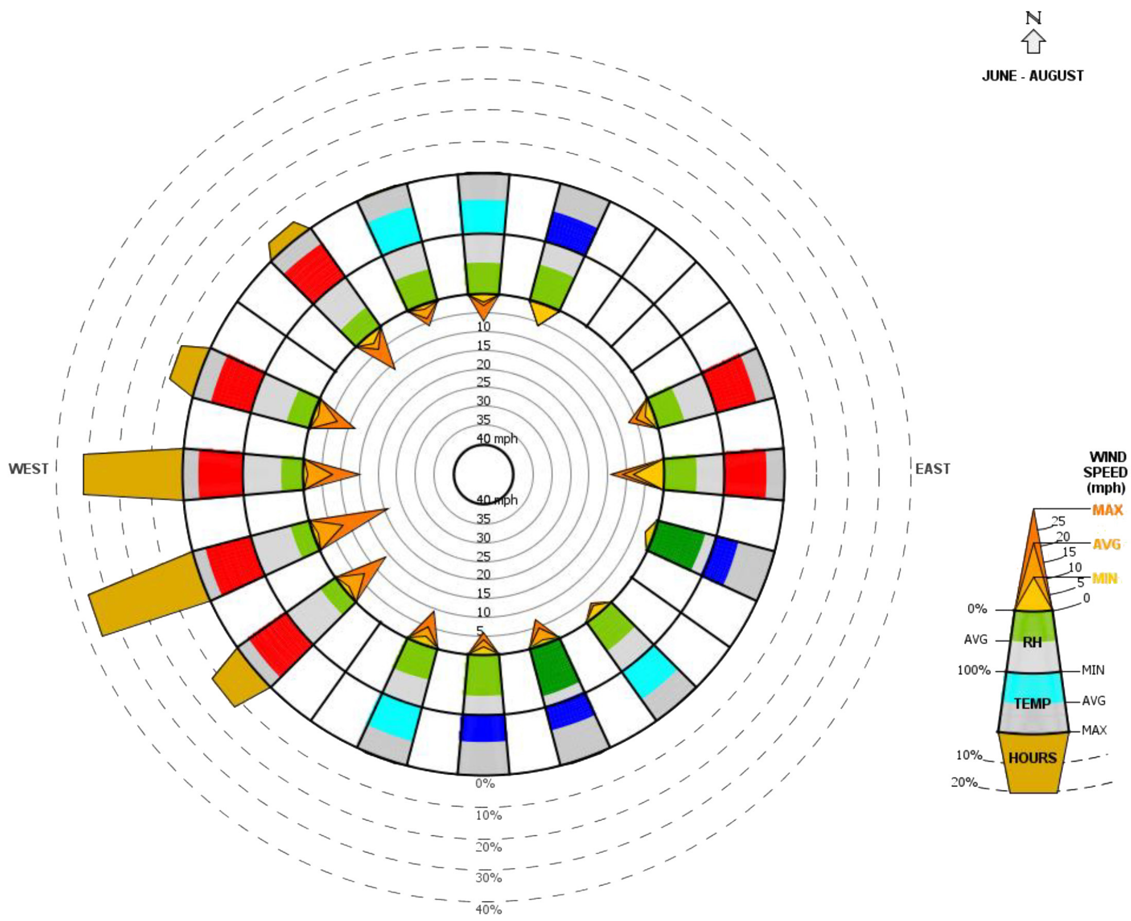
WIND PATTERNS

The wind rose diagrams on pages 8.11 and 8.13 illustrate the characteristics of air movement on the campus, including wind direction and frequency, velocity, temperature, and humidity. This information can be used to orient new buildings to optimize the effects of natural ventilation, to determine which outdoor areas would be comfortable for gathering, and to identify where landscaping and vegetation could buffer uncomfortable weather conditions. The cardinal directions are shown along the circumference of the wind roses and indicate wind direction. The frequency of wind from each direction is indicated by the length of the dark yellow trapezoids. Wind speed is indicated by the length of the orange arrows. Temperature and relative humidity are indicated by colors shown on the legend.

SUMMER WINDS

During the summer, between the hours of 8 a.m. and 5 p.m., the prevailing wind comes from the west, as indicated by the Summer Wind Rose Diagram on the opposing page. These winds range between 5–10 miles per hour with gusts that reach 25 miles per hour. These summer winds tend to be hot and dry with a temperature range of 75–100 degrees Fahrenheit, and an average relative humidity range of 30–70 percent. These warm and dry winds are fairly consistent throughout the summer and fall. Since the humidity levels are low, these winds create conditions that favor the use of evaporative cooling, either in conjunction with water elements or an indirect/direct evaporative cooling system.

SUMMER WIND ROSE DIAGRAM



TEMPERATURE (DEG. F)

- < 32
- 32–70
- 70–75
- 75–100
- > 100

RELATIVE HUMIDITY (PERCENT)

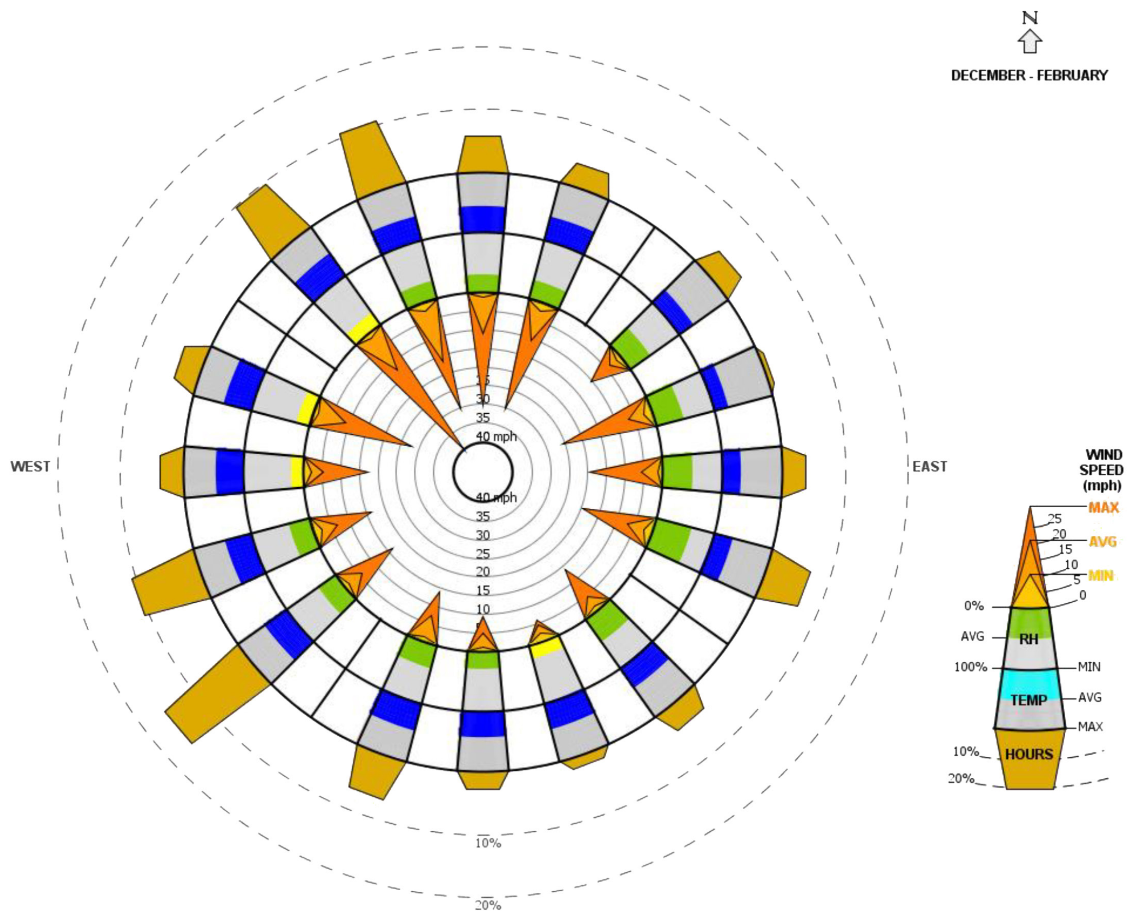
- < 30
- 30–70
- > 70

CAMPUS CLIMATE CONDITIONS *(cont.)*

WINTER WINDS

During the winter, between the hours of 8 a.m. and 5 p.m., the prevailing winds come from the northwest and southwest, as indicated by the Winter Wind Rose Diagram on the opposing page. These winds range between 5–7 miles per hour with gusts that reach 40 miles per hour. The prevailing winds tend to be cool and dry, with a temperature range of 32–70 degrees Fahrenheit and a relative humidity of 30 percent. These cool and dry winds are well suited for naturally ventilating buildings during temperate winter days.

WINTER WIND ROSE DIAGRAM



TEMPERATURE (DEG. F)

- < 32
- 32–70
- 70–75
- 75–100
- > 100

RELATIVE HUMIDITY (PERCENT)

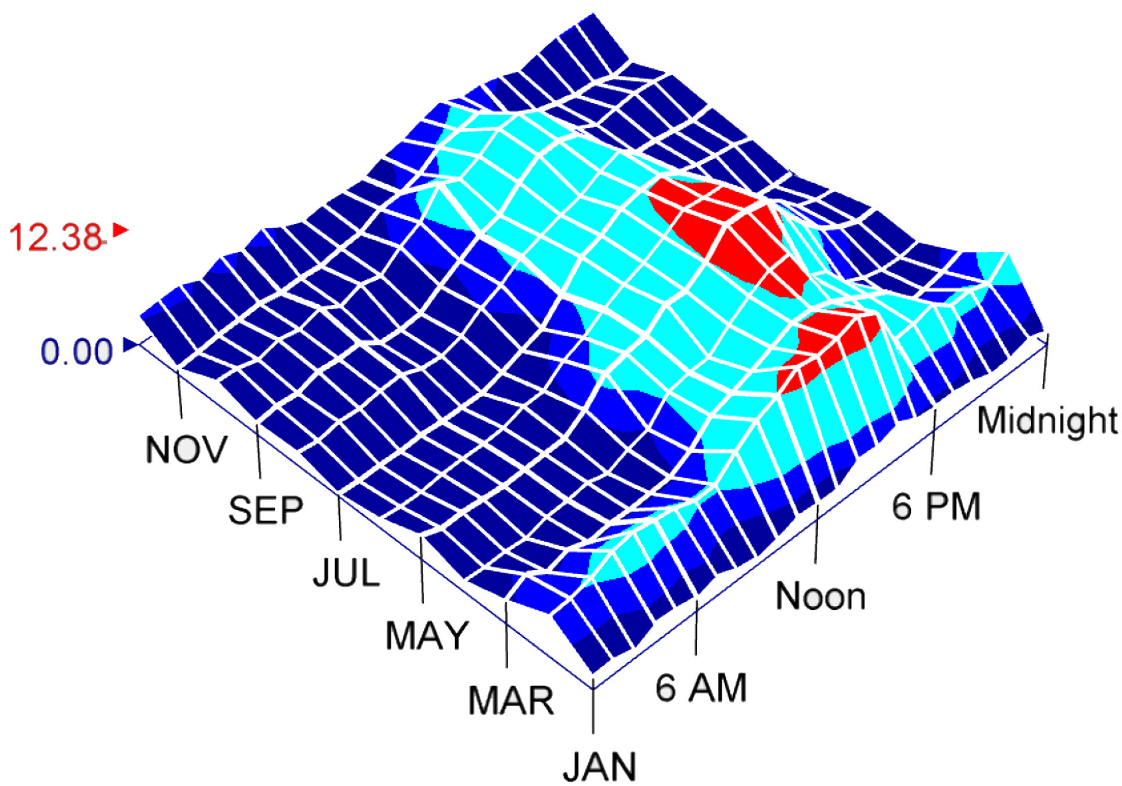
- < 30
- 30–70
- > 70

CAMPUS CLIMATE CONDITIONS *(cont.)*

WIND SPEED

The Wind Speed Diagram on the opposing page illustrates average wind velocity on Mt. SAC's campus over the hours of the day and months of the year. This diagram, accompanied by the wind rose diagrams on pages 8.11 and 8.13, begin to tell us when natural ventilation would be the most effective for passive cooling, and when, mechanical cooling would be necessary on campus. The campus experiences an average wind velocity of 5–10 miles per hour, or slightly higher in the afternoon hours during most of the year, with an average maximum velocity of 12.38 miles per hour in May. High winds also occur in the afternoon hours during the months of February, March, June, and July. These winds also tend to be dry and warm. During this time of year, the temperature may be uncomfortable at times, and therefore mechanical cooling would be warranted in buildings. During the evenings from September through November and during the mornings or the late afternoons from February through May, gentle and cool breezes prevail, creating conditions in which natural ventilation would be effective.

WIND SPEED DIAGRAM



WIND SPEED (MPH)

54%	< 3
15%	3–5
27%	5–10
5%	10–20
0%	> 20

CAMPUS CLIMATE CONDITIONS *(cont.)*

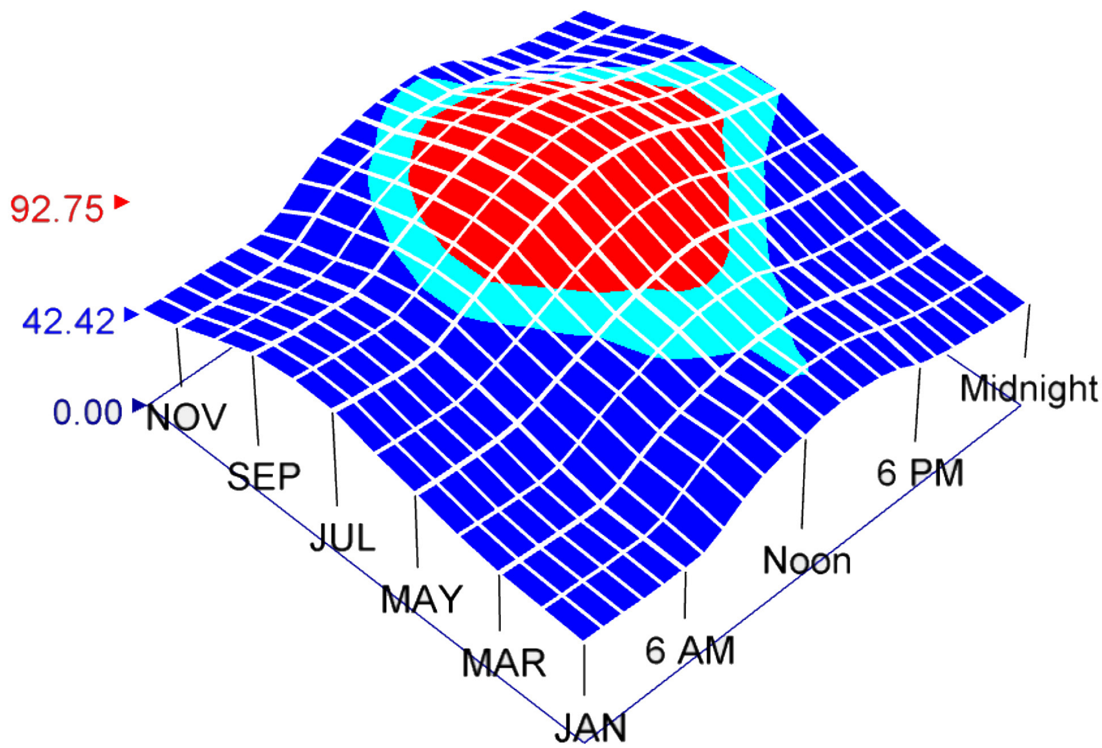
DRY BULB TEMPERATURE

The Dry Bulb Temperature Diagram on the opposing page illustrates prevalent outdoor temperatures that occur on Mt. SAC's campus over the hours of the day and months of the year. This information indicates when mechanical cooling or heating is likely to be necessary to maintain comfort within indoor spaces, as well as when sun exposure or shade is necessary to maintain comfort outdoors.

The maximum dry bulb temperatures at Mt. SAC occur during May through November, with the peak of 92.75 degrees Fahrenheit occurring during the noon hour in August. This peak temperature is accompanied by clear skies. During this time, solar power systems would reach peak production. In addition, mechanical cooling would be required to keep buildings cool and comfortable. However, the temperature is fairly comfortable for most of the time. During 82 percent of the year, it ranges between 32–75 degrees Fahrenheit and the College could rely less on mechanical cooling. Natural ventilation may even be an option during the late afternoon hours.

From November through January, the campus experiences cooler temperatures, with the coldest times of the day occuring between 10 p.m. and 6 a.m. During these times of year, radiant heated floors combined with natural ventilation would be effective for buildings during evening and night classes.

DRY BULB TEMPERATURE DIAGRAM



DRY BULB TEMP (DEGREES F)

0%	< 32
68%	32–68
14%	68–75
18%	75–100
0%	> 100

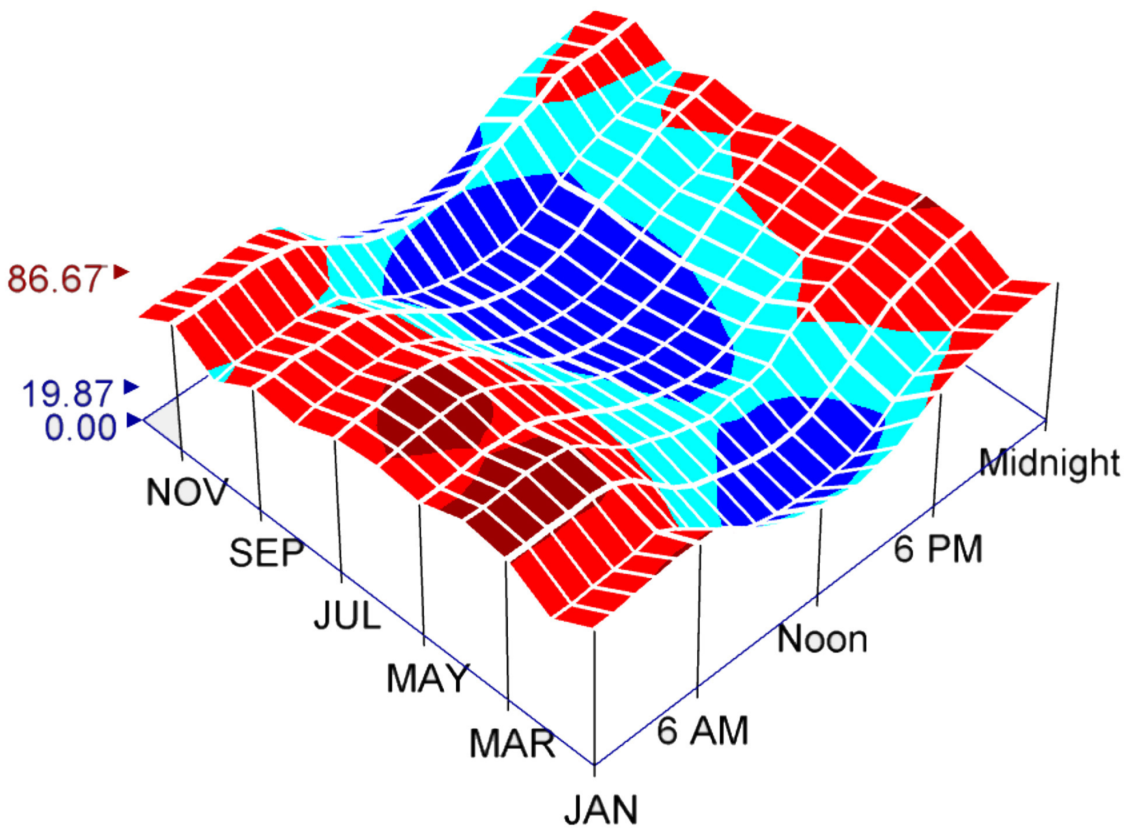
CAMPUS CLIMATE CONDITIONS *(cont.)*

RELATIVE HUMIDITY

The Relative Humidity Diagram on the opposing page indicates when building occupants may benefit from either more or less humidification to be comfortable. People generally are most comfortable when the relative humidity is approximately between 40–50 percent. During 37 percent of the year, Mt. SAC experiences 50–60 percent relative humidity in the mornings and evenings. During this time, some form of natural or mechanical ventilation would be needed to reduce the level of humidity.

During the middle of the day, however, the humidity level tends to be very low—between 20–40 percent—and humidification, combined with either heating or cooling, is necessary to maintain comfort. During these conditions, direct-indirect air handling units would be well-suited to cool and humidify interior spaces.

RELATIVE HUMIDITY DIAGRAM



RELATIVE HUMIDITY (PERCENT)

0%	< 20
22%	20–40
31%	40–60
37%	60–80
11%	> 80

CAMPUS CLIMATE CONDITIONS *(cont.)*

SKY COVER RANGE

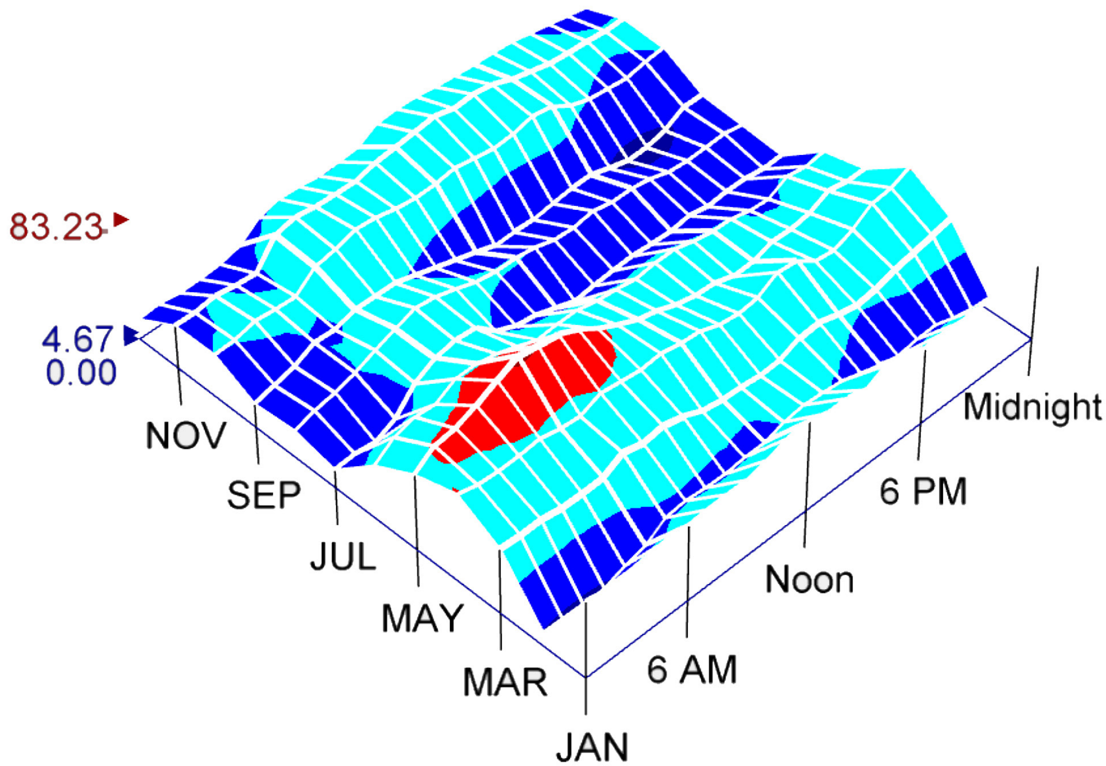
The Sky Cover Diagram on the opposing page indicates the occurrence of cloud cover over the months of the year and the hours of the day over Mt. SAC's campus. This information shows the times when being outdoors would be pleasant and comfortable, when solar shades would be necessary for indoor comfort, and when solar photovoltaic systems would be most efficient.

The data for Climate Zone 10 shows that the campus experiences a maximum of 83.23 percent cloud cover and a minimum of 4.67 percent cloud cover over the course of the year. Mt. SAC experiences the least cloud cover from July through September, at about 10 percent. During these times of year, solar shades would be necessary to keep building interiors cool; shade trees would be necessary to provide pedestrians with comfortable outdoor settings; and photovoltaics would be the most productive.

The campus experiences maximum cloud cover of between 60 percent and 80 percent during the morning hours in the month of May. Solar panels would be the least productive during this time of year. Buildings on campus would not be subject to overheating, however with high humidity levels, air conditioning may be necessary to provide thermally comfortable spaces within.

From March through June, the campus experiences an average of about 45 percent cloud cover, with temperate to warm temperatures. Passive cooling techniques may be an option during these times of year for at least the earlier part of the day.

SKY COVER DIAGRAM



SKY COVER (PERCENT)

3%	< 10	
32%	10–30	
60%	30–60	
4%	60–80	
1%	> 80	

CAMPUS CLIMATE CONDITIONS *(cont.)*

GLOBAL RADIATION AND HEAT ISLAND EFFECT

Global Radiation is the total amount of shortwave radiation received from above by a surface horizontal to the ground. This value is of particular interest to heat island studies, shade structure studies, and photovoltaic installations. Global Radiation includes both Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DIF). From 9 a.m. to 12 p.m., the campus receives the most global horizontal radiation, with a peak of 291.27 kBtu/SqFt in the month of July, as indicated in the Heat Island Effect Diagram on the opposing page. During this time of year, solar access is ample, temperatures are high, and shade is limited. These conditions produce three key results.

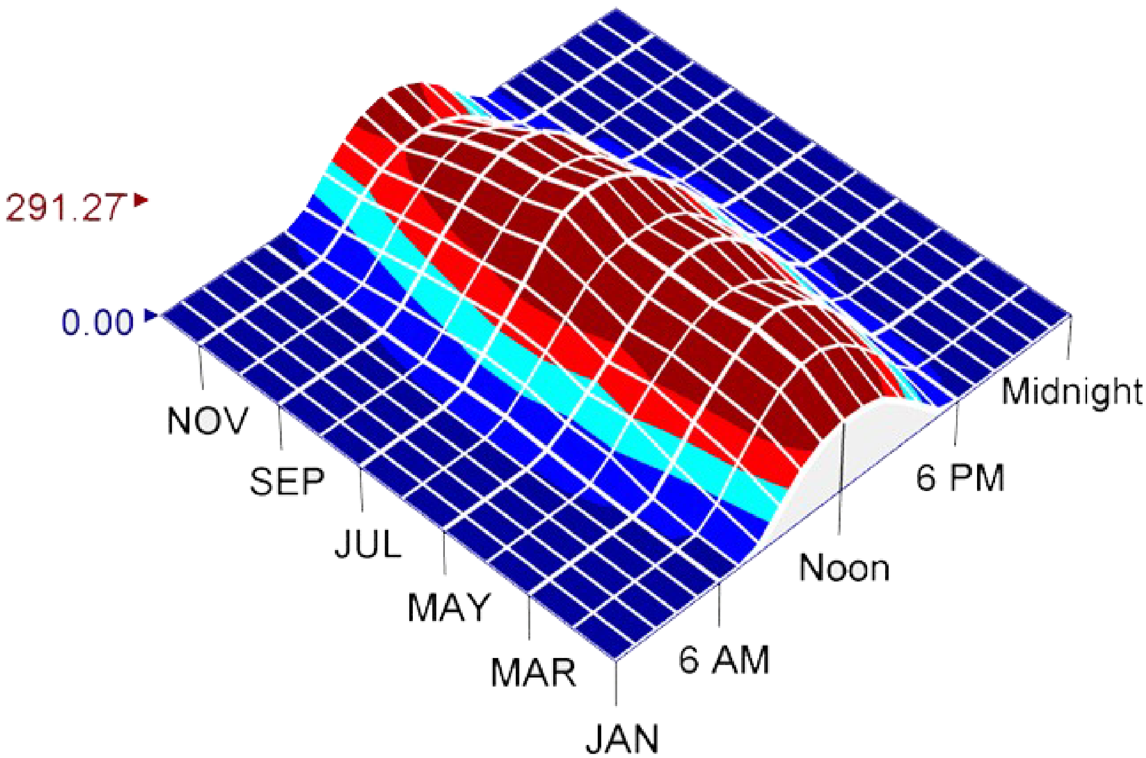
1. Mechanical cooling will be needed in order to keep buildings comfortable

2. Photovoltaic production will be at it's peak

3. Unshaded portions of the campus will experience the heat island effect

An Urban Heat Island (UHI) is an urban area or metropolitan area that is significantly warmer than its surrounding rural areas due to human activities and exposure to solar radiation. The Heat Island Effect site plan diagram in Chapter 7: *Existing Facilities and Site Analysis* illustrates which parts of campus are exposed to solar access. An ample amount of asphaltic parking and walkways reveals that the campus is susceptible to overexposure. This results in hotter surrounding buildings and uncomfortable outdoor conditions. To help combat this condition, additional shade trees, additional ground cover landscaping, alternative paving surfaces such as pavers, concrete, or even decomposed granite could be explored.

HEAT ISLAND EFFECT DIAGRAM



GLOBAL HORIZ RADIATION (BTU/SQFT)

49%	NIGHT TIME
13%	1–50
7%	50–100
9%	100–150
23%	> 150

CAMPUS CLIMATE CONDITIONS *(cont.)*

SOLAR PASSIVE STRATEGIES FOR WARM MONTHS OF THE YEAR

Mt. SAC's temperature profile, wind patterns, and solar exposure provide a unique opportunity to explore solar passive strategies that use little energy to provide environmental comfort in buildings. The analysis of climatic data imported into Climate Consultant Version 6.2 software indicates that an approach using strategies such as thermal mass, natural ventilation for cooling, and sun shading design would be the most effective means of providing comfort in Mt. SAC's buildings. Combined, these strategies, which are described below, would provide comfort during approximately 98.9 percent of the year. The results of this analysis are shown graphically in the Psychrometric Diagram: Summer and the Psychometric Diagram: Winter (shown in the Thermal Comfort Diagrams section of the *Appendix)*.

Thermal Mass And Night Flushing

When outside temperatures fluctuate throughout the day, a large thermal mass within the insulated envelope of a building on campus can regulate the daily temperature fluctuations. The building's mass would be used to absorb thermal energy from the indoor environment when it is warmer than the mass. The thermal energy would then be radiated back to the warm indoor environment when it is cooler.

Night flushing uses the cool night air to remove thermal energy that is absorbed by the structure during the day. Cool night air is brought into the building through open windows or by other means.

Natural Ventilation

Natural ventilation is an energy-efficient way to provide fresh air and thermal comfort. Buildings can be oriented and designed to simplify natural ventilation. Employing natural ventilation when conditions support its use would lessen Mt. SAC's reliance on mechanical cooling and reduce its energy consumption.

Sun Shading Of Windows

Effective use of sun shading at windows can significantly reduce the intensity of solar gains within a building. By implementing deep overhangs along the south façades of buildings and vertical fins along the east and west façades of buildings, glare-free natural daylighting can be achieved.

Building Insulation Optimization And Controling Internal Heat Gains

Buildings can be more energy efficient and less reliant on mechanical cooling by designing exterior walls and roofs to be well insulated, as indicated by a high "R-factor," using R21 wall insulation, R30 roof insulation, "cool" roofs that reflect solar radiation, and high-performance insulated glass windows and sun shading devices that allow sunlight to illuminate interior spaces without heating them.

Mechanical Cooling

In order to maintain occupant comfort, some mechanical cooling will be necessary during the warmer months. An indirect-direct mechanical cooling system is recommended for consideration, due to the campus' low humidity levels. This system would provide effective and efficient evaporative cooling. However, by implementing the solar passive strategies described above, reliance upon any mechanical cooling would be lessened, and thus building energy performance will be optimized.

SOLAR PASSIVE STRATEGIES FOR COOL MONTHS OF THE YEAR

The analysis of climatic data imported into Climate Consultant Version 6.2 software, indicates that an approach using solar passive strategies would be effective during cooler months of the year. The combination of thermal mass and building insulation optimization could help to achieve occupant thermal comfort in buildings during as much as 96.2 percent of a typical year and dramatically reduce the overall energy consumption of Mt. SAC's buildings. The results of this analysis are shown graphically in the Psychrometric Diagram: Winter (shown in the Thermal Comfort Diagrams section of the *Appendix*).

Thermal Mass

In winter, thermal mass in the floor or walls absorbs radiant heat from the sun through north-, east-, and west-facing windows. The sun penetrates these windows and warms exposed thermal masses such as concrete floors. During the night, the heat is gradually released back into the room as the air temperature drops. This maintains a comfortable temperature for some time, reducing the need for supplementary heating during the early evening.

Building Insulation Optimization

Buildings can be more energy efficient and less reliant on mechanical heating by designing exterior walls and roofs to be well insulated, as indicated by their "R-factor," using R21 wall insulation, R30 roof insulation, as well as high-performance insulated glass windows and sun shading devices that allow sunlight to illuminate interior spaces.

Mechanical Heating

In order to maintain occupant comfort, some mechanical heating will be necessary during the cooler months. However, by implementing the solar passive strategies described above, reliance upon mechanical heating will be lessened, and thus building energy performance will be optimized.

RESOURCE MANAGEMENT

ENVIRONMENTAL ANALYSIS

RESOURCE MANAGEMENT INDEX

- Stormwater Management
    - Existing Conditions
    - Stormwater Management Studies
    - Observations
- Campus Water Use
- Landscape Irrigation Intensity
- Campus Energy Use
    - Greenhouse Gas Emissions
    - Scope 1 Emissions
    - Scope 2 Emissions
    - Scope 3 Emissions
- Campus Waste Management

ENVIRONMENTAL ANALYSIS

STORMWATER MANAGEMENT

Sensitive management of stormwater that falls on Mt. SAC's campus has many benefits for both flood control and water quality. These benefits extend far beyond the campus to downstream communities, as well as sensitive river, beach, and marine environments. In this important way, Mt. SAC demonstrates stewardship of the regional environment.

EXISTING CONDITIONS

Mt. SAC is located north of San Jose Creek Reach 2, which is a tributary to the San Gabriel Watershed. Annual rainfall in this area is typically low and occurs generally in the winter months. Sources of runoff occur mainly on site, with a portion of flows originating off site from adjoining property owned by Cal Poly Pomona. The combination of existing soil characteristics and the high magnitude, low frequency storms that are typical of the region lead to conditions that are conducive to the rapid accumulation of surface water and high runoff flows during peak storms.

Surface stormwater runoff flows are collected by storm drain inlets at various locations around the campus and conveyed through underground storm drain pipes. Surface flows contained within streets are conveyed to surrounding public streets. The underground storm drain system serving the western half of the campus discharges to Snow Creek, while the system serving the eastern half of the campus discharges into an existing 60-inch to 81-inch public storm drain pipe.

STORMWATER MANAGEMENT STUDIES

To better understand existing conditions and plan responsibly for future campus development, Mt. SAC has published reports that analyze existing conditions and recommend campuswide implementation of Best Management Practices (BMPs) for the buildout of the Measure RR building program. These reports include *Campuswide Stormwater Analysis*, dated September 1, 2016, and *Farm Hydrology Master Plan: Existing Conditions*, dated September 1, 2016.

The *Campuswide Stormwater Analysis* contains two important components: Concept Storm Drain System Analysis and Concept Stormwater Quality Analysis. The analyses assess the capacity of the existing storm drain system at the completion of Measure RR program buildout and make recommendations for improvements to increase stormwater infrastructure capacities and address known deficiencies. The Concept Stormwater Quality Analysis assesses BMPs implemented as part of individual Measure RR projects, water quality regulations, and site conditions, and makes recommendations for conceptual BMPs to be implemented campuswide.

For many years now, campus construction projects have been designed to deal with stormwater within the confines of their sites using a combination of Low Impact Development (LID) measures, such as bioswales, water-quality swales, and water-quality basins. But through these studies, Mt. SAC is laying the groundwork for a comprehensive, campus-wide approach.

The Farm Hydrology Master Plan: Existing Conditions report studied the Farm area. The existing storm drain network serving the Farm is underdeveloped; several building structures and areas lack stormwater collection/conveyance devices. The remainder of the Farm drains generally as surface flows concentrated along roadways and within a series of small open channels and culverts. Off-site tributary flows from Cal Poly Pomona enter the site at the northeast corner and flow through several pastures before being collected into a storm drain just outside of the northeast corner of Parking Lot F.

OBSERVATIONS

- Mt. SAC stormwater infrastructure has not been developed to the same level throughout the campus. For example, the Farm's stormwater infrastructure can be greatly improved

- Development prior to the Measure RR building program was not subject to the stricter stormwater management regulations that currently govern Mt. SAC's development

- Mt. SAC is preparing to implement a comprehensive, campus-wide approach that will reduce its impact on sensitive environments downstream and comply with current regulations

CAMPUS WATER USE

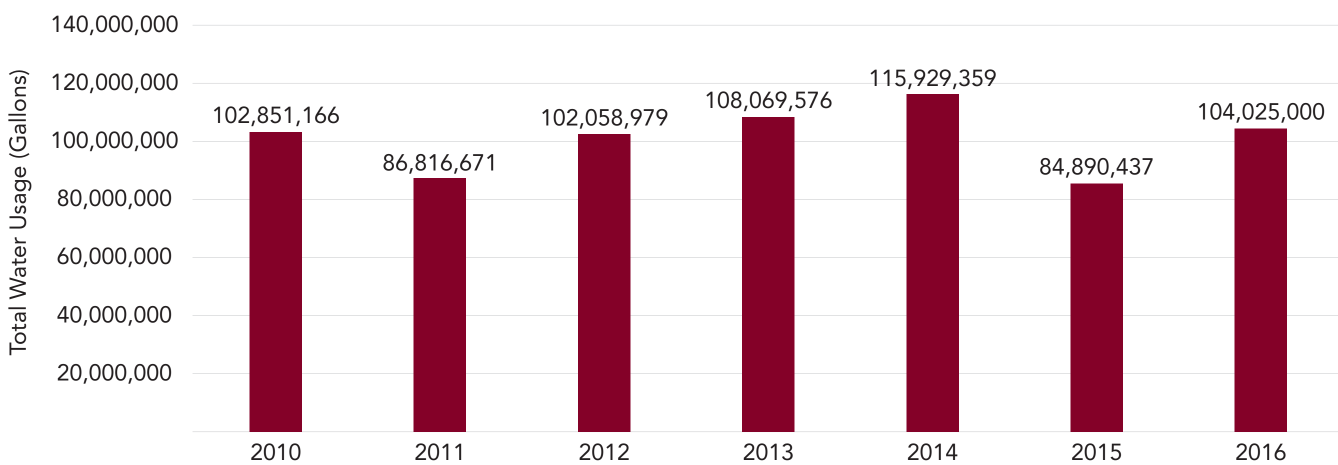
Water use data was collected for both domestic use in buildings and irrigation use. The data on the opposing page indicate that far more water is being used for irrigation than in buildings.

Mt. SAC purchases all of its potable water on a wholesale basis from Three Valleys Municipal Water District (TVMWD). As a local water agency, Mt. SAC has the legal right to produce groundwater from its own wells located on campus and has a long history of producing groundwater for its own use. Reactivating three on-campus wells, developing additional groundwater wells, and implementing aggressive strategies to conserve water are the key elements of the College's water use optimization strategy. It must be noted that the production of groundwater is contingent on identifying a feasible method of extraction that addresses the depth of the regional water table.

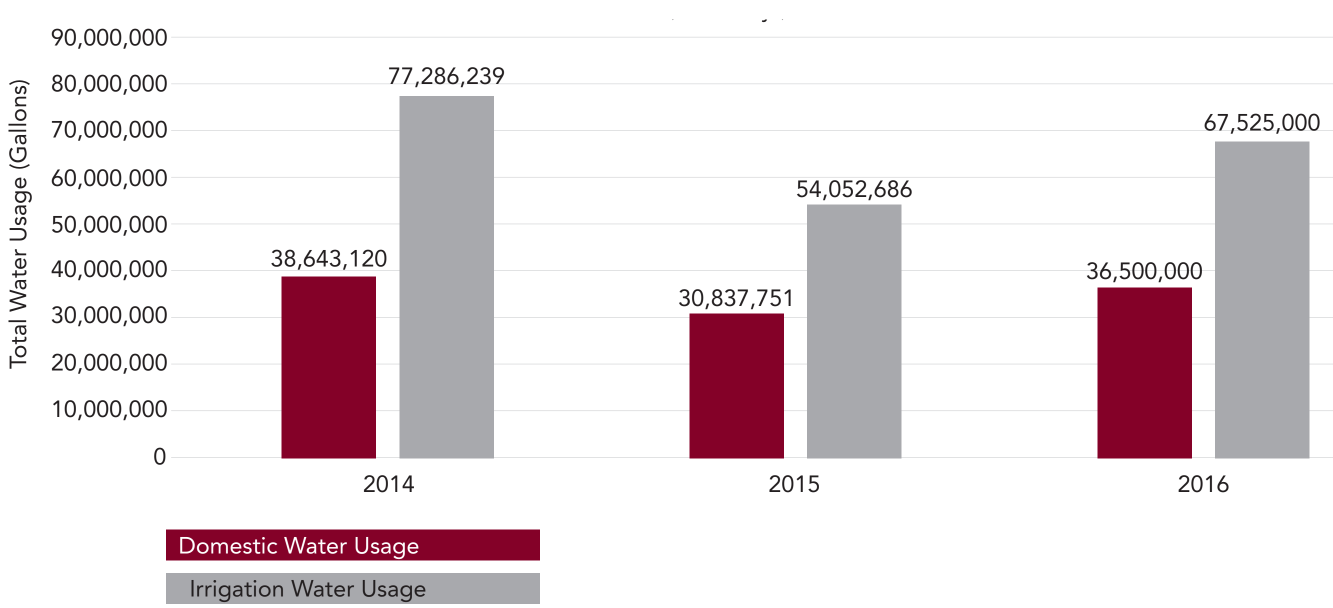
The College's water use includes on-campus domestic uses, landscape irrigation, athletic field irrigation, pasture and range land irrigation, and wildlife sanctuary uses. The College employs the following campus programs to optimize water conservation:

- Technology-based Conservation
- Effective Landscaping Design Standards
- Ongoing Maintenance Programs

ANNUAL TOTAL WATER USAGE OF MT. SAC (GALLONS/YEAR)



TOTAL WATER USAGE OF MT. SAC (GALLONS/YEAR)



ENVIRONMENTAL ANALYSIS

LANDSCAPE IRRIGATION INTENSITY

Landscape irrigation requirements are affected by the water needs of particular plants and the use of outdoor space. There are various methods of delivering water to plants in order to accommodate these demands, and consequently, Mt. SAC's landscape incorporates multiple types of irrigation across campus. The diagram on pages 8.34–8.35 shows the irrigation types, and ranks them from most to least efficient in the legend.

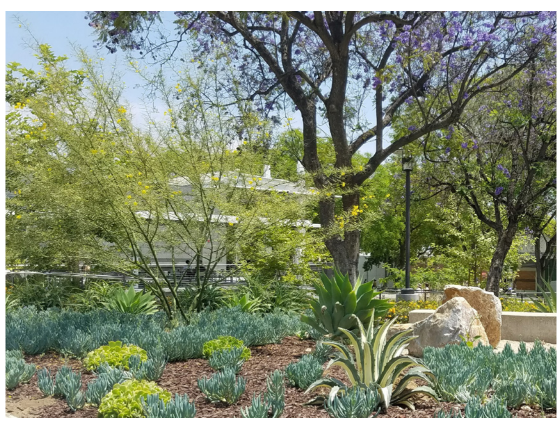
Drip irrigation is the most efficient means of irrigating non-turf areas. This form of irrigation delivers low volumes of water directly to plant roots and minimizes losses to wind, runoff, evaporation, and overspray. As a result, drip irrigation uses 20–50 percent less water than conventional pop-up sprinkler systems.

However, drip irrigation is not suitable for all types of plantings and landscape uses. High activity areas such as sports fields and pastures require more water than other areas, and also require different water distribution methods, such as rotors instead of drip. While rotors are not as efficient as drip irrigation, some types of rotors are more efficient than others.

Areas that do not utilize the most efficient irrigation type appropriate for the planting type and land use present opportunities to reduce irrigation water use. For example, areas with shrub plantings and spray nozzle irrigation could be upgraded to more efficient irrigation types. Mt. SAC is currently in the process of converting the systems in many of these areas to more efficient methods of irrigation in order to reduce water use. There is also currently an initiative to install weather-based controllers to provide additional water savings through better scheduling.

OBSERVATIONS

- The College is in the process of converting and updating irrigation systems to improve efficiency
- Planting type and open space use impact water needs and irrigation type
- Multiple campus microclimates challenge irrigation efficiency



LANDSCAPE IRRIGATION INTENSITY

BUILDING KEY

ID No.	BUILDING NAME
1A	Art Center
1B/C	Art Center / Gallery
2T/M	Performing Arts Center
3	Gymnasium
4	Administration
6	Library/Learning Technology Center
6A	Information Kiosk
7	Science South
8	Mountie Café
9A	Sac Book Rac (Bookstore)
9B	Student Services Center
9C	Student Life Center
9D	Modular 9D
9E	Student Success Center
9F	Modular 9F
9G	Modular 9G
10	Founders Hall
11	Science North
12	Building 12
12C	Elevator Tower
13	Design Technology
16A	Express Stop Modular
16B	Modular 16B
16C	Modular 16C
16D	Math Success Lab Modular
16E	Equity Center Modular
16F	Campus Testing Center Modular
17	Building 17
18	Building 18
18A	Modular 18A
18B	Modular 18B
18C	Technical Education Resource Center (TERC) Modular
18D	Classroom Modular
19A	Building 19A
19B	Building 19B
19C	Mountie Grill
20	Building 20
21A–21C	Classroom Modulars
21D	Innovative Business Projects Modular
21E	Toilet Room Modular
21F–21J	Classroom Modulars

ID No.	BUILDING NAME
23	College Services
23A	Data Center
26A	Humanities/Social Sciences North
26B	Humanities/Social Sciences East
26C	Planetarium
26D	Humanities/Social Sciences South
27A	Exercise Science/Wellness Center
27B	Pool Building
27C	Physical Education Center
28A/B	Technology Center
29	Central Plant
29B	Central Plant Office Modular
30	Adult Basic Education Center
31A/B	Cont. Ed./ESL Modular
31C	Toilet Room Modular
32	Cont. Ed./ESL Modular
35	Cont. Ed./ESL Modular
36	Older Adults Modular
38A	Adult High School Diploma Modular
38B	Basic Skills Modular
40	Building 40
40A	Modular 40A
40B	Modular 40B
43	Tilden Coil Constructors/ Vinewood Modular
44	Athletics Modular
45	Kinesiology/Athletics/ Dance
46	Emergency Operations Center
46A	Document Storage Modular
47	Facilities Planning + Management / Maintenance + Operations
48	Receiving/Transportation
51	Athletics Storage
60	Science Laboratories

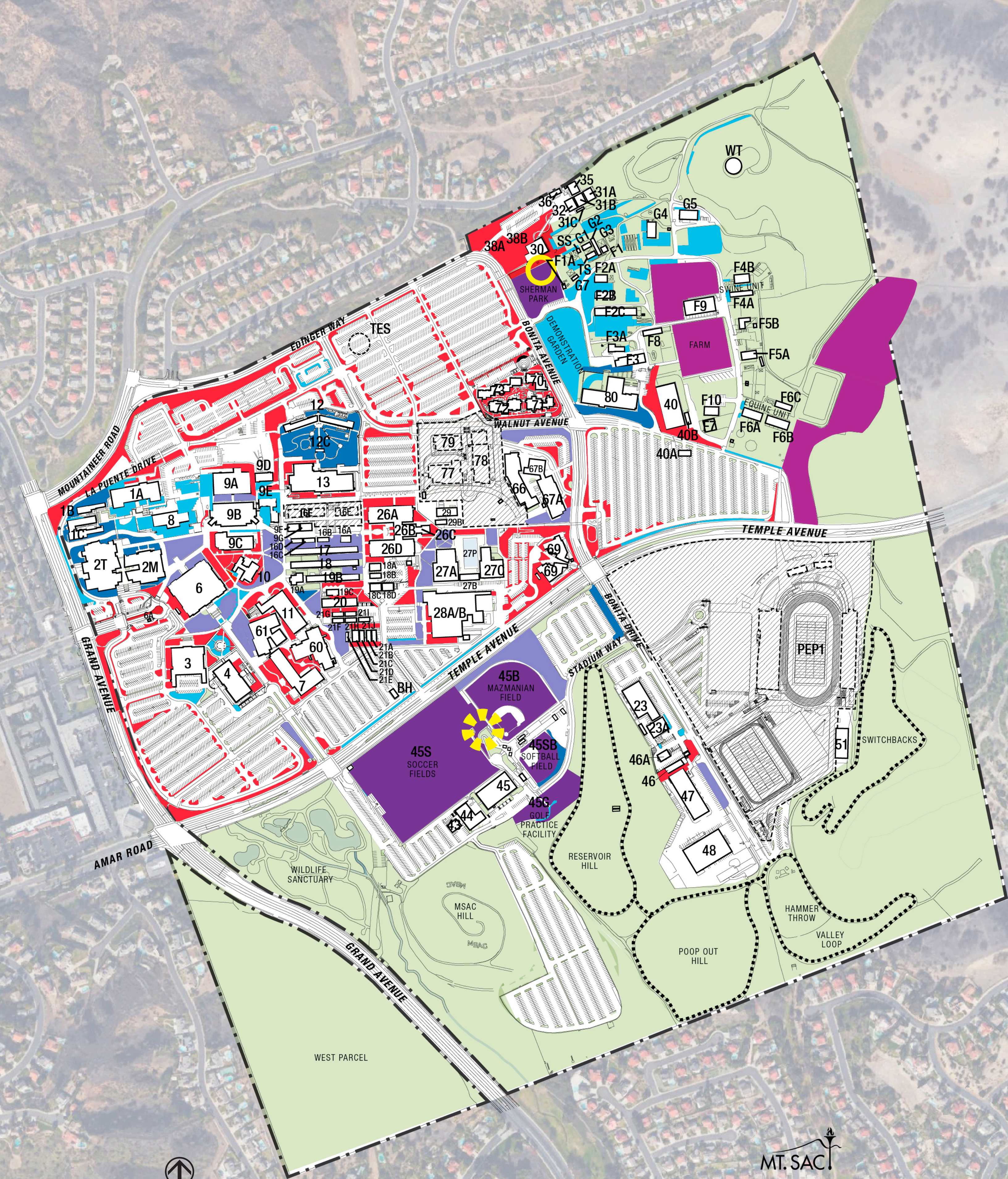
ID No.	BUILDING NAME
61	Math and Science
66	Language Center
67A	Health Careers Center
67B	Health Careers Center
69	Welding, Heating/Air Conditioning
70–73	Child Development Complex
77–79	Business and Computer Technology
80	Agricultural Science
104	Brackett Field (Off Campus)
BH	Block House
F1	Horticulture Unit
F1A	Sherman Park Restrooms
F2A	Farm Offices
F2B	Horticulture Storage
F2C	Irrigation + Landscape Construction
F3	Equipment Barn
F3A	Old Dairy Unit
F4A	Swine Market Pens
F4B	Swine Farrowing House
F5A	Vivarium
F5B	Small Animal Care Unit
F6A	Equine Breeding Barn
F6B	Equine Mare Motel
F6C	Equine Hay Barn
F7	Equipment Technology
F8	Hay Barn
F9	Livestock Pavilion
F10	48th Agricultural District Office
G1	Greenhouse
G2	Greenhouse
G3	Greenhouse
G4	Greenhouse
G5	Greenhouse
G7	Greenhouse/The Conservatory
PEP1	Physical Education Projects: Phase 1
TES	Thermal Energy Storage System
WT	Water Tower

LEGEND

- PROPERTY LINE
- EXISTING FACILITIES
- FACILITIES UNDER CONSTRUCTION
- LANDSCAPE UNDER CONSTRUCTION
- DRIP IRRIGATION (MOST EFFICIENT)
- ROTARY NOZZLES
- RAINBIRD 5000 ROTOR
- RAINBIRD 6500 ROTOR
- HUNTER I-90 ROTOR
- SPRAY NOZZLES (LEAST EFFICIENT)
- SOFTSCAPE WITHOUT IRRIGATION
- CURRENT WEATHER STATION
- FUTURE WEATHER STATION
- CROSS COUNTRY COURSE

SOURCES

Mt. SAC Facilities Planning & Management and Grounds staff, Jan. 2017



MT. SAC

LANDSCAPE IRRIGATION INTENSITY

8.35

MT. SAN ANTONIO COLLEGE 2018 EDUCATIONAL AND FACILITIES MASTER PLAN

CBT AND HMC ARCHITECTS / DRAFT DATED 12.12.18

CAMPUS ENERGY USE

The level of a building's energy usage can be expressed as its Energy-use Intensity (EUI). It is calculated by dividing the total energy consumed by the building in one year (measured in kBtu) by the total gross floor area of the building.

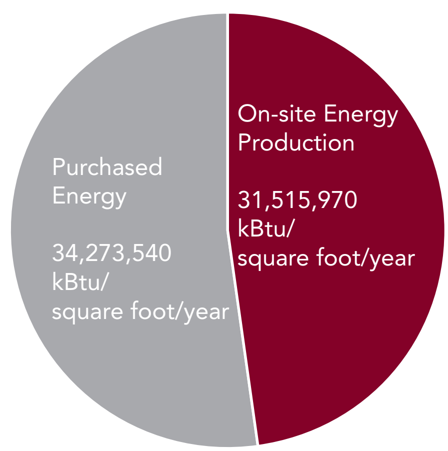
The 2030 Challenge is a nationally recognized program that provides a set of energy use targets for the building industry to reduce greenhouse gas emissions. As shown in the charts on the opposing page, the 2030 Challenge recommends an EUI of 31.2 kBtu/square foot/year for higher education buildings, with a more stringent goal of net zero energy use by the year 2030.

The EUI of the campus is currently 40.73 kBtu/square foot/year, taking into account both electrical and natural gas usage on campus. On-site energy production accounted for a total of 31,515,970 kBtu/square foot/year. Purchased electricity accounted for 34,273,540 kBtu/square foot/year. The College is more dependent on cooling processes than heating processes, which explains the larger electrical use figure.

In order for the campus to reduce its EUI down to at least 31.2 kBtu/square foot/year, various energy efficiency measures need to be implemented. These include measures such as site and building lighting upgrades, building mechanical upgrades, building envelope upgrades, and proper scheduling and maintenance of the central plant; however, the largest factor in energy use reduction is human behavior. By training staff, students, and faculty how to use their buildings and campus efficiently, energy use could drop by as much as 20 percent. This could be achieved through an education program that focuses on low hanging fruit, such as signage near lighting switches and computer stations—encouraging occupants to power down whenever possible. Educational efforts aimed at behavior change among students and staff should enlist the help of the Climate Commitment Implementation Committee and the Sustainability Committee.

ENERGY-USE INTENSITY (EUI)

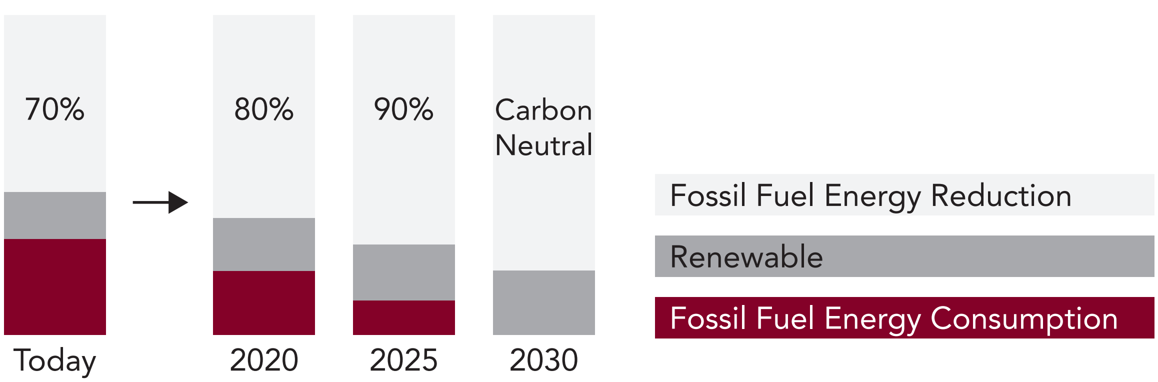
EUI (electricity and gas)
Total of 40.73 kBtu/square foot/year



U.S. MEDIANS FOR SITE ENERGY USE AND 2030 CHALLENGE ENERGY REUDCTION TARGETS BY SPACE/BUUILDING TYPE

U.S. Medians for Site Energy Use and 2030 Challenge Energy Reduction Targets by Space/Building Type *From the Environmental Protection Agency (EPA): Use this chart to find the site fossil-fuel energy targets*									
Building Use Description	**Available In Target Finder**	**Median Source EUI (kBtu/SqFt/Yr)**	**Average Percent Electric**	**Median Site EUI (kBtu/SqFt/Yr)**	**2030 Challenge Site EUI Targets (kBtu/SqFt/Yr)**				
					50% Target	**60% Target**	**70% Target**	**80% Target**	**90% Target**
Education		144	63%	58	29.0	23.2	17.4	11.6	5.8
K–12 School	X								
College/ University (campus-level)		244	63%	104	52.0	41.6	**31.2**	20.8	10.4

ARCHITECTURE 2030 TARGETS FOR CARBON NEUTRALITY



CAMPUS ENERGY USE *(cont.)*

GREENHOUSE GAS EMISSIONS

Buildings account for much of the global demand for energy and materials and the greenhouse gases (GHG) that result from their production. Greenhouse gases are measured in lbs of Carbon Dioxide Equivalent (CO2e). Greenhouse gases are categorized by source among three scopes, described below.

SCOPE 1 EMISSIONS

Scope 1 emissions are also called direct greenhouse gas emissions, and are defined as emissions from sources that are owned or controlled by the organization, such as the following.

- **Stationary Combustion:** Emissions from the combustion of fossil fuels (e.g. natural gas, fuel oil, and propane) used for space heating or other non-mobile industrial applications
- **Mobile Combustion:** Emissions from the combustion of fossil fuels (e.g. gasoline and diesel) used to fuel vehicles or other forms of transportation
- **Process Emissions:** Emissions released during a manufacturing process in specific industry sectors (e.g. cement, iron and steel, and ammonia)
- **Fugitive Emissions:** Emissions that are unintentionally released from sources including refrigerant from air conditioning and refrigeration systems and natural gas from distribution systems

SCOPE 2 EMISSIONS

Scope 2 emissions are also referred to as energy indirect emissions, and are defined as emissions from the consumption of purchased electricity, steam, or other sources of energy (e.g. chilled water) generated upstream from the organization.

SCOPE 3 EMISSIONS

Scope 3 emissions are also referred to as other indirect emissions, and are defined as emissions that are a consequence of the operations of an organization, but are not directly owned or controlled by the organization. Scope 3 emissions include a number of different sources of greenhouse gases including employee commuting, business travel, third-party distribution and logistics, production of purchased goods, emissions from the use of sold products, and others. Scope 3 emissions also include waste that is generated on site. Based on data from many companies that have conducted comprehensive assessments, it is clear that Scope 3 emissions are by far the largest component of most organizations' carbon footprint.

The breakdown of each scope into its components is further illustrated by the charts on page 8.40.

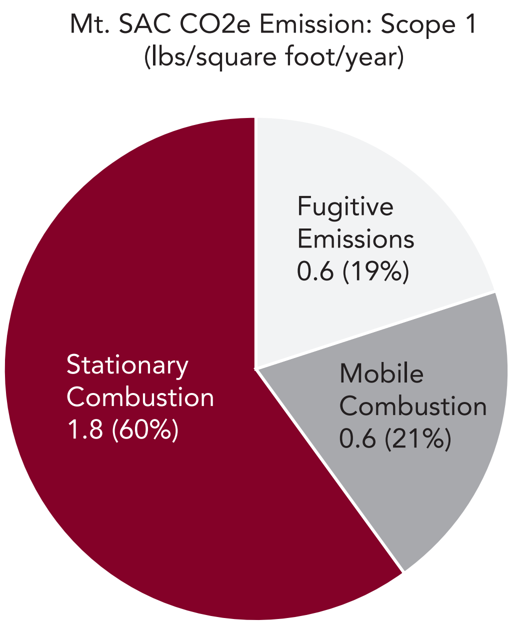
- **Mt. SAC's Scope 1 emissions:** 60 percent is attributed to stationary combustion of natural gas that is distributed by the local utility and burned on site to provide power and heat
- **Mt. SAC's Scope 2 emissions:** 100 percent is attributed to electricity purchased from the local utility

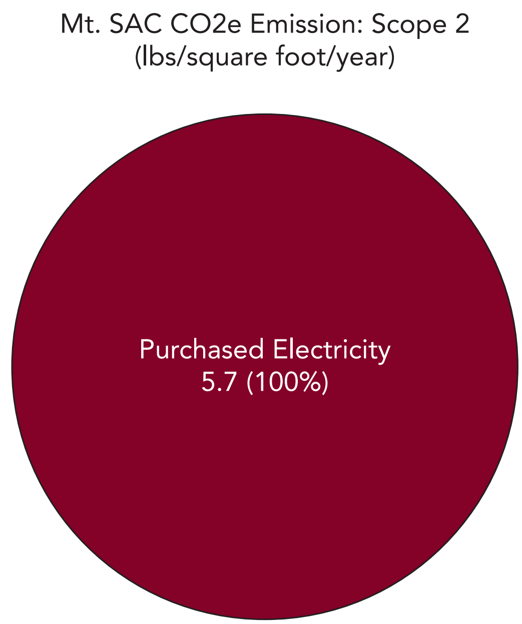
- **Mt. SAC's Scope 3 emissions:** 45.1 percent is attributed to commuting to and from campus, followed by 11.9 percent from solid waste, and 3 percent from air travel. Mt. SAC is gathering information and surveying students and employees to find ways to reduce commuting miles, while improving access to the campus

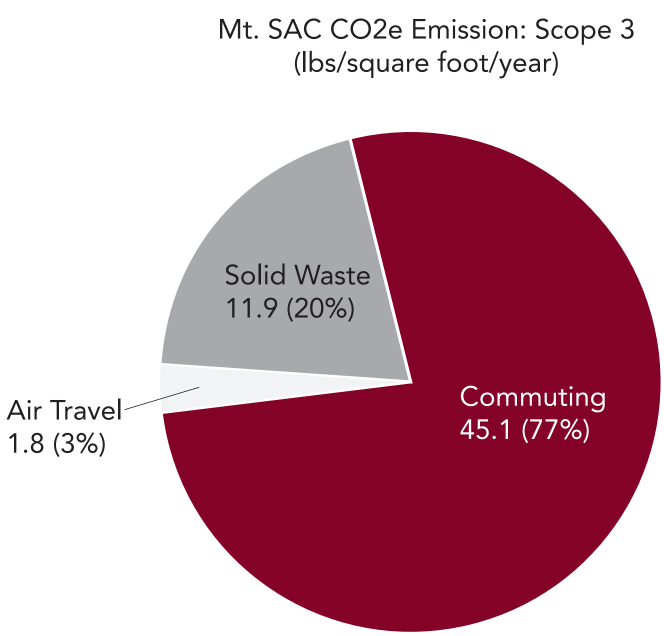
ENVIRONMENTAL ANALYSIS

CAMPUS ENERGY USE *(cont.)*

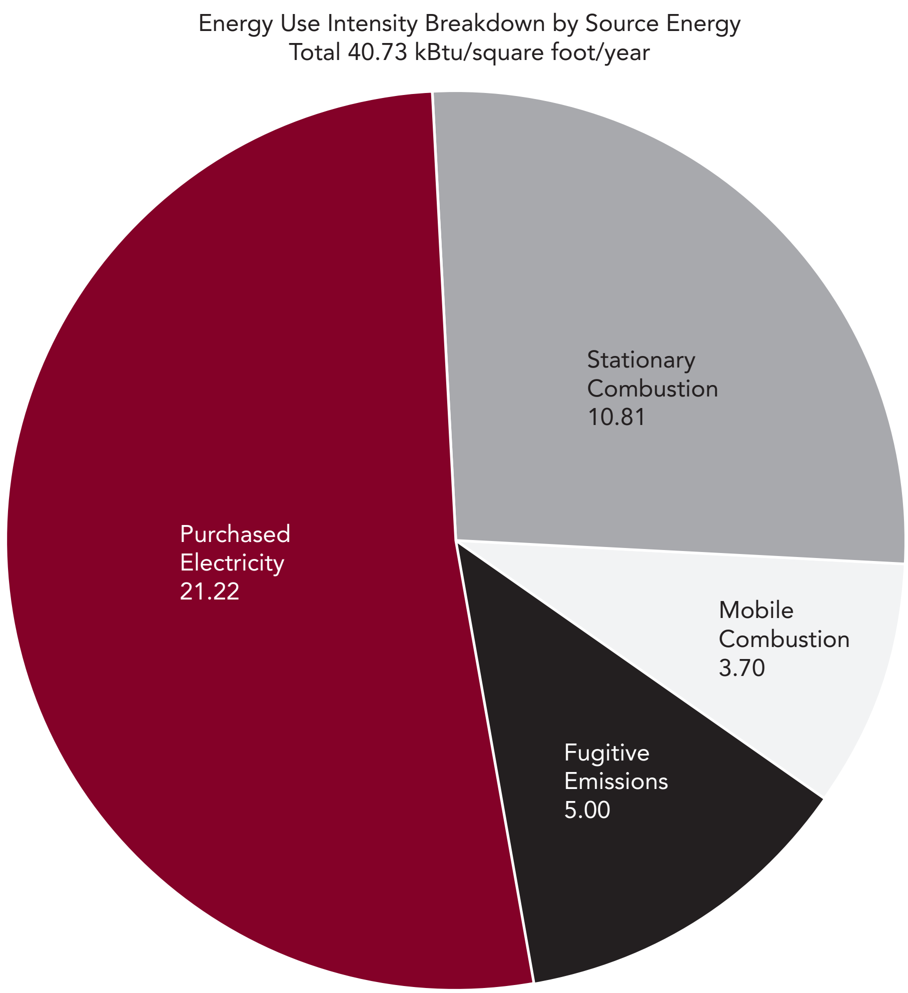
CARBON EMISSION BY SCOPE







ENERGY USE INTENSITY BREAKDOWN BY SOURCE ENERGY



CAMPUS WASTE MANAGEMENT

Mt. SAC is actively working to reduce the amount of waste that it sends to public landfills through strategies focused on reducing, recycling, and reusing. The College works with a local waste management agency that hauls its three-ton bins from the campus on a weekly basis. These bins contain commingled solid waste that is taken to an offsite recycling center and sorted into recyclable and landfill waste.

Mt. SAC's greenhouse gas emissions data indicate that, in 2012, the College generated approximately 11.9 pounds of solid waste per gross square foot of building—or 8,314 metric tons. This equated to 575.7 pounds of solid waste per capita and included mixed construction and demolition waste from campus construction projects, as well as paper, aluminum, glass, plastic, food waste, electronic waste, and clinical waste from non-construction sources. Except for construction waste, the College does not track waste generated from different sources separately. Mt. SAC is beginning to increase its diversion rate by stepping up efforts to pre-sort recyclables and reuse materials before they leave the campus. Mt. SAC has distributed recycling bins around campus.

Through its vendor Sodexo, Mt. SAC currently recycles food waste and cooking oil used at its food services facilities. Additionally, the College recycles green waste for mulching landscaped areas. Other efforts have included installing water bottle refilling stations and planning an on-campus furniture and equipment reuse event.

The College has been successfully managing waste from construction projects. The California Green Building Code requires the diversion from landfills of 50 percent of construction waste. Construction industry standards recommend the diversion of up to 75 percent. Mt. SAC is exceeding this and is well positioned to reach a construction waste landfill diversion rate of 95 percent.

The picture for waste from non-construction sources is less clear due to the lack of detailed information. Unlike construction waste, detailed tracking of non-construction waste is not required. The California Department of Resources, Recycling, and Recovery—also known as CalRecycle—recommends a 50 percent diversion rate for non-construction solid waste through source reduction, recycling, and composting. Pre-sorting and tracking of waste materials will allow the College to better understand its waste stream and monitor its diversion strategies.

Mt. SAC's climate action planning process is helping the College to set waste diversion goals and strategies. Its recommendations may include the following.

- Continue to support and fund student-run recycling programs which encourage recycling of plastics, aluminum, and paper, such as Mt. SAC's EAGLE Club which currently runs a recycling signage campaign
- Use compostable wares at food facilities, as opposed to Styrofoam and plastics
- Contract with a hauling agency which is willing to achieve a 95 percent landfill diversion rate. Most hauling agencies achieve a 50 percent diversion rate. However more are becoming well-informed about sustainable practices that keep waste out of landfills

- Sort waste onsite to improve landfill diversion rates. By sorting on site, haulers will be able to transfer recyclables to appropriate centers more efficiently

- Compost the food waste that is generated onsite for use onsite and build a well-designed composting site in the Farm Precinct

- Require the hauling agency to provide records by weight, type, and destination

- Include a recycling/reuse/waste management center in the recommended new Reuse Depot (described in Chapter 10: *Facilities Recommendations* facility and design this facility to accommodate recycling and reuse events for the College and community

- Increase the requirement for construction projects to 95 percent to 100 percent landfill waste diversion


NO SMOKING!
Except in Designated Areas
BUILDINGS 12 THRU 22
• BUILDING 9A THRU 9E
• CAMPUS CAFÉ

CARBON FOOTPRINT ANALYSIS

ENVIRONMENTAL ANALYSIS

CARBON FOOTPRINT ANALYSIS INDEX

ENVIRONMENTAL ANALYSIS

CARBON FOOTPRINT ANALYSIS

As a signatory to the American College and University Presidents' Climate Commitment, Mt. SAC is committed to reducing its greenhouse gas emissions. Fulfilling this commitment begins with knowing how its facilities and operations contribute to the College's carbon footprint. For this purpose, the EFMP includes a high-level carbon footprint analysis.

Carbon dioxide equivalent (CO2e) is a standard unit for expressing the carbon footprint of an individual or an organization. The impact of various greenhouse gases that are generated by using energy, transportation, and by disposing of waste, was translated into the amount of CO2 with the equivalent potential for climate warming. For energy, the annual usage of electricity and gas was collected. For transportation, the number of miles traveled annually by students and staff was collected. For waste, the number of pounds disposed annually was collected.

Mt. SAC's carbon footprint was calculated for three scopes. Scope 1 emissions are direct emissions from sources owned or controlled by the College. These include fuel combustion, company vehicles, and fugitive emissions. Scope 2 emissions are direct emissions from purchased electricity, natural gas, heat, and steam. Scope 3 emissions cover all indirect emissions due to the activities of the College. These include transportation to and from the campus by students and staff, and waste disposal by the College. The charts on pages 8.47–8.50 illustrate the greenhouse gas emissions of the College for the 2016 year, per square foot of the College's total gross building area (CO2e/year/gross square foot).

To provide a point of reference, the Total Carbon Dioxide Equivalent Emission chart on page 8.47 compares Mt. SAC's annual carbon footprint per gross square foot to several other community colleges in Southern California. These institutions are also signatories of the ACUPCC and data was retrieved directly from Second Nature's online database. Each of the other colleges is in an urban setting and does not have on-campus housing. On the other hand, each of these other colleges has better access to mass transit and fewer students than Mt. SAC. Given these considerations, Mt. SAC's overall carbon footprint (Scopes 1, 2, and 3) is the highest.

As shown on the charts on page 8.48, a closer look reveals that Scope 3 (transportation and waste) is the biggest contributor to Mt. SAC's total carbon footprint. By far, Mt. SAC has the highest Scope 3 emissions of the other community colleges shown. This could be attributed to the fact that Mt. SAC attracts students from San Bernardino, Los Angeles, Orange, and Riverside Counties. This results in more miles traveled by commuters. When Scope 3 emissions are excluded from the carbon footprint, a far different picture emerges. Mt. SAC's footprint ranks among the lowest. According to this analysis, low energy use by the campus' building stock (Scopes 1 and 2 emissions) can be credited.

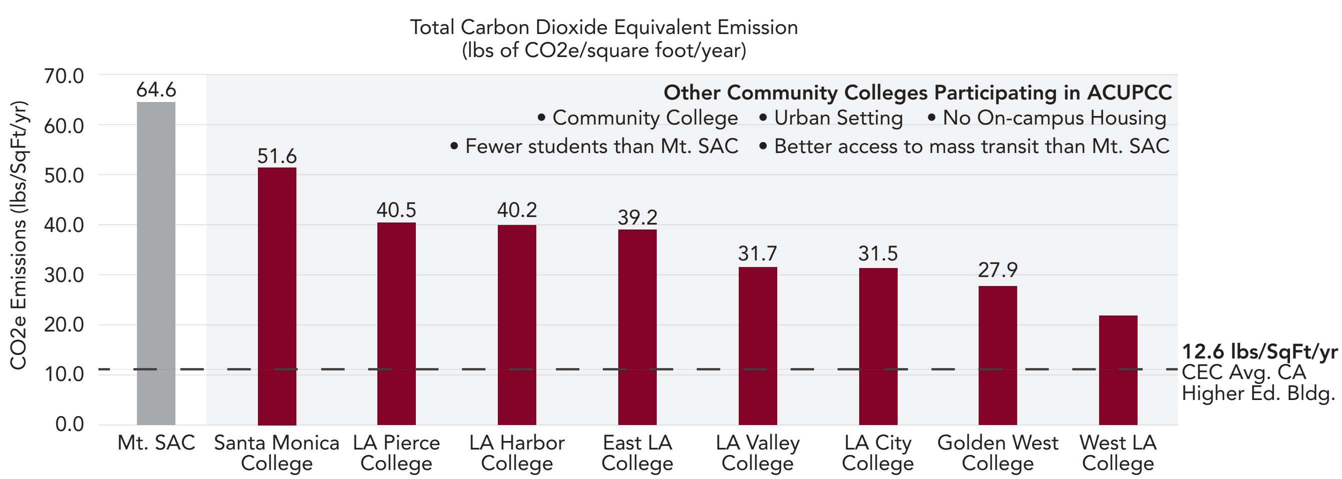
The graphs on page 8.49 show carbon footprint per capita, which ranks as the highest among the other community colleges shown. However, when Scope 3 Emissions are excluded from the carbon footprint of the College, the carbon footprint per capita is again among the lowest. This is due to the campus' lower building energy use (Scopes 1 and 2) and also to a much larger student population, compared to the other institutions.

The graph on page 8.50 shows the College's emissions for each scope separately. Scope 3 emissions (transportation and waste) far exceed Scopes 1 and 2 emissions (on-site and imported energy). A look at the contributors within each scope is revealing, as shown in the charts on page 8.40. The biggest contributor of Scope 1 emissions is stationary combustion. The biggest contributor of Scope 2 emissions is purchased electricity. The biggest contributor of Scope 3 emissions is transportation to and from the campus. In fact, transportation is Mt. SAC's biggest GHG contributor by far. Even small efforts to promote alternative transportation modes or to reduce students' need to travel to campus can have a big effect on Mt. SAC's overall carbon footprint.

In a survey of Mt. SAC students who commute to the College, the majority of those polled responded that they travel alone. When asked what prevented their use of mass transit, most responded that mass transit results in more complicated, longer commutes, due to the need for multiple transfers between bus lines.

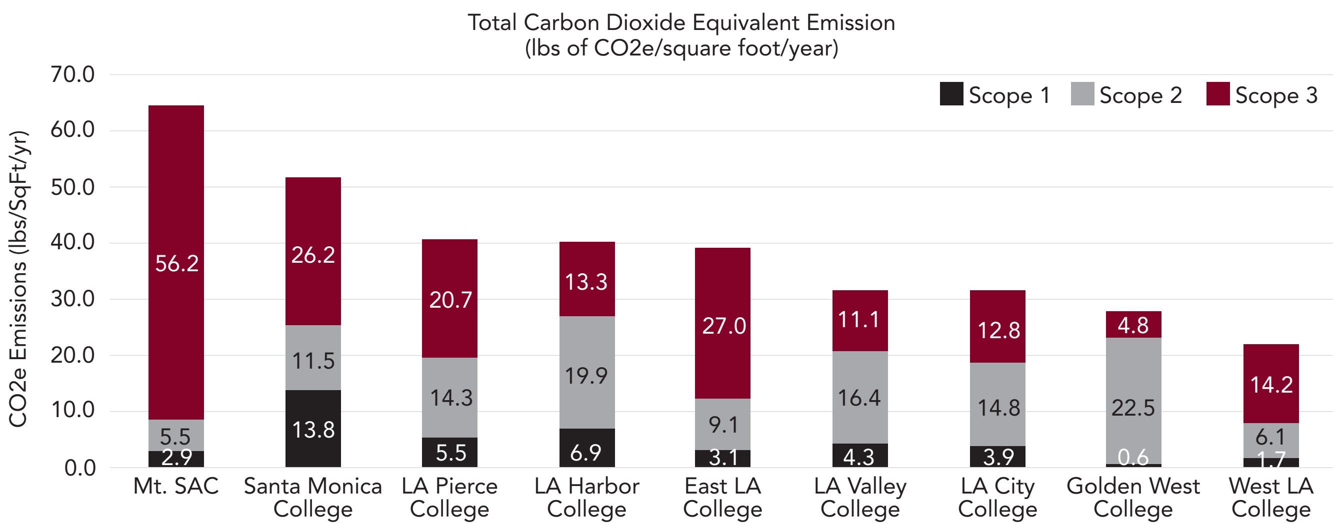
Waste disposal accounts for a far smaller portion of the Scope 3 emissions than does transportation. When compared to the EPA's baselines, Mt. SAC's emissions from waste are far less than the EPA's data for typical commercial entities. This indicates that the College is successfully reducing the amount of waste that it generates and/or diverting waste from landfills. Given this success, Mt. SAC could begin to consider more ambitious waste management goals, such as becoming a zero-waste campus.

TOTAL CARBON DIOXIDE EQUIVALENT EMISSION

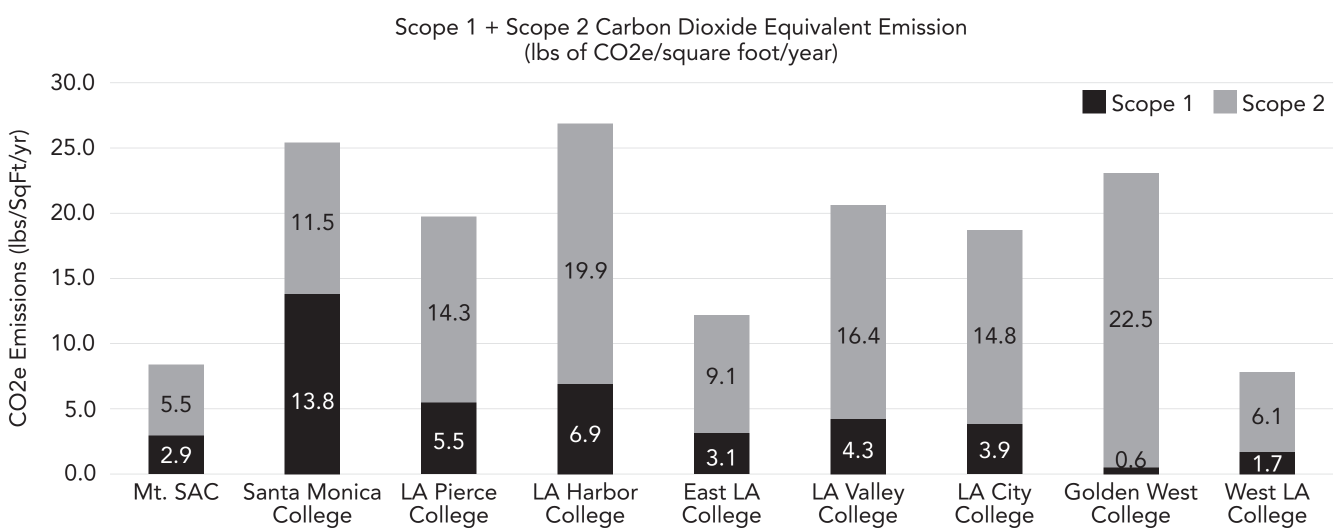


CARBON FOOTPRINT ANALYSIS *(cont.)*

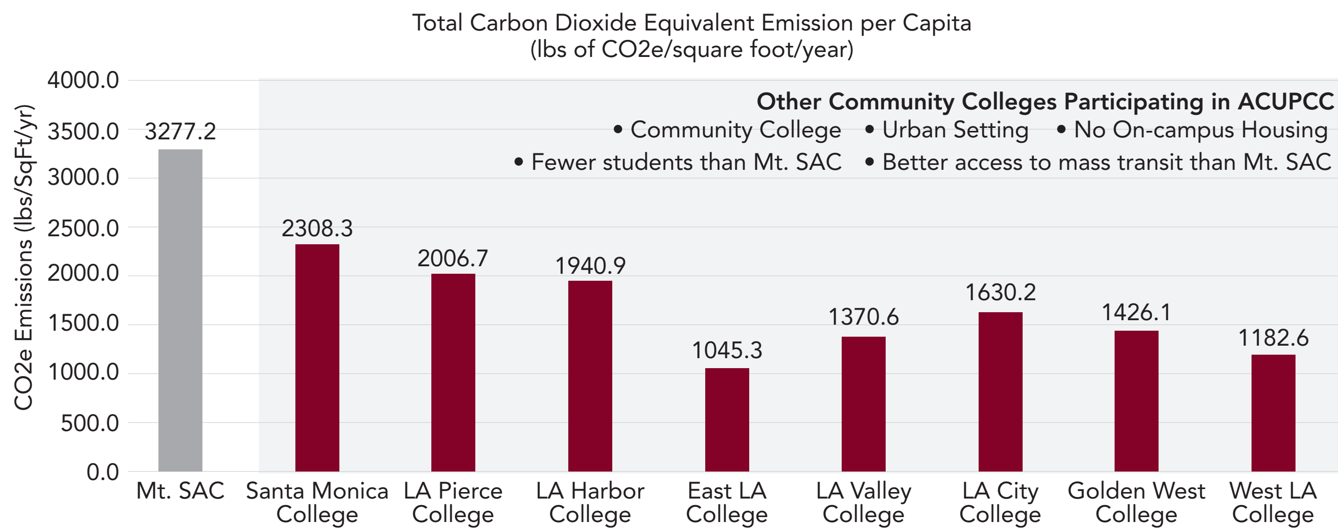
TOTAL CARBON DIOXIDE EQUIVALENT EMISSION



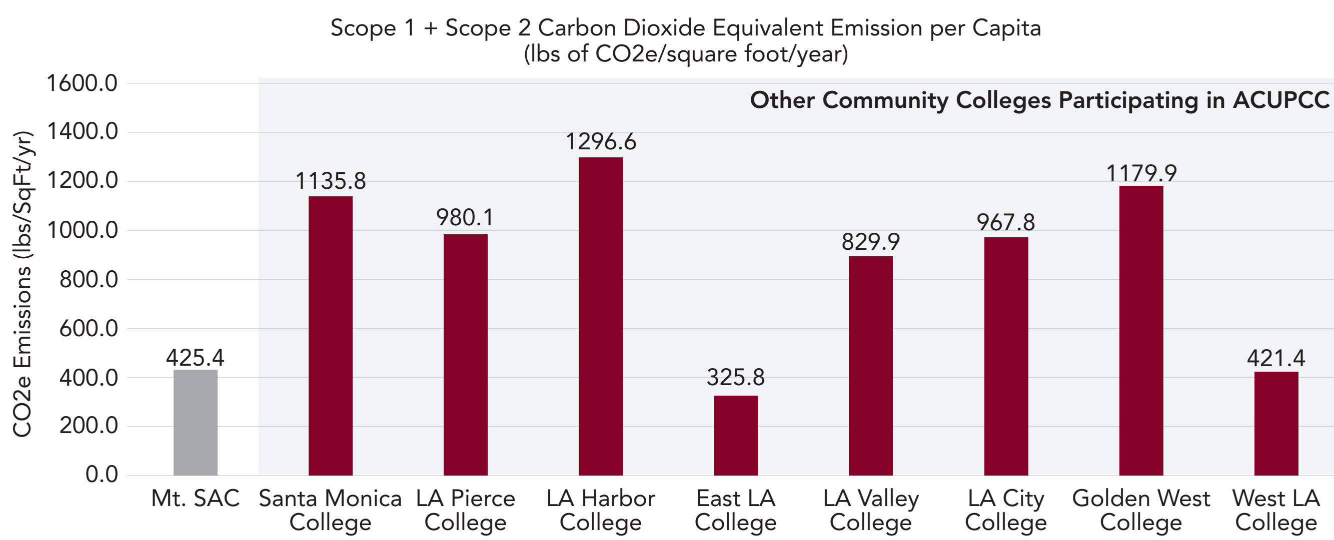
SCOPE 1 + SCOPE 2 CARBON DIOXIDE EQUIVALENT EMISSION



TOTAL CARBON DIOXIDE EQUIVALENT EMISSION PER CAPITA

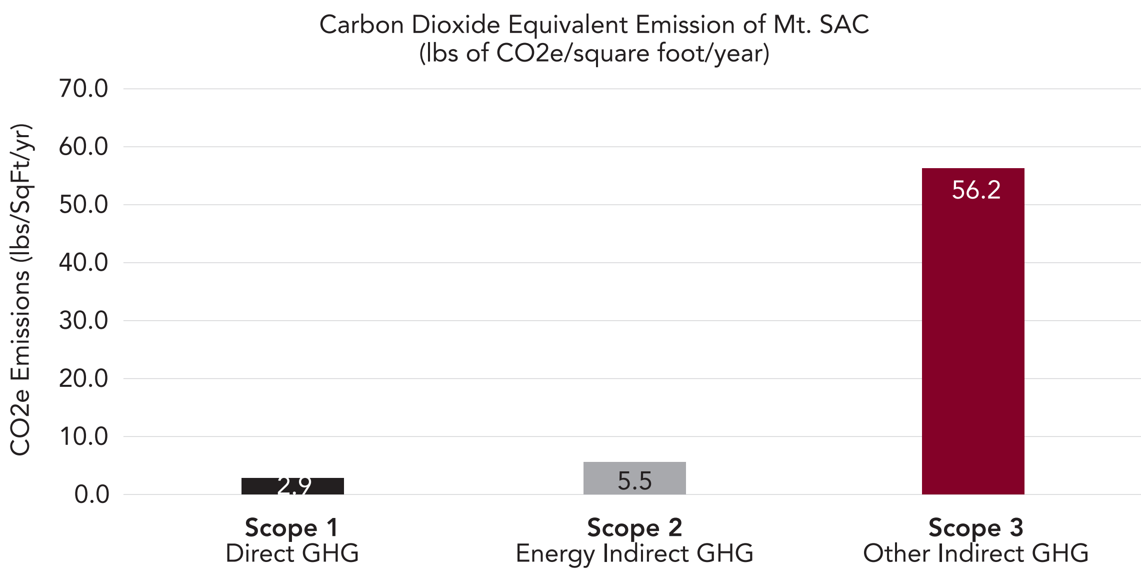


SCOPE 1 + SCOPE 2 CARBON DIOXIDE EQUIVALENT EMISSION PER CAPITA



CARBON FOOTPRINT ANALYSIS *(cont.)*

CARBON DIOXIDE EQUIVALENT EMISSION OF MT. SAC



CONCLUSION

With this carbon footprint study in hand, Mt. SAC now seeks to chart a path to carbon neutrality by creating its *Climate Action Plan*. The *Climate Action Plan* seeks to identify specific contributors to each scope and also seeks to identify specific mitigation measures to reduce the carbon impact of each contributor. These mitigation measures will be developed further and milestone reduction goals for the College's carbon footprint will be set to achieve the ultimate goal of carbon neutrality.