1.3 RELATIONSHIP TO THE CAMPUS MASTER PLAN

The Landscape Master Plan is a companion document to The University of Texas at Austin 2012 Campus Master Plan which was unanimously approved by the University of Texas Board of Regents in the spring of 2013. The Campus Master Plan provides a broad vision for future facilities growth, ideas for enhancing the campus environment and guidelines for architectural design. Of the eight key recommendations of the Campus Master Plan, four in particular have significant implications for the treatment of the campus landscape. They are:

• Expansion of campus facilities in new districts, that will require an integration of buildings and landscape
• Revitalization of the core campus and the call to protect historic buildings and landscape
• Redevelopment of the Central Campus to accommodate growth and enhance its pedestrian environment
• Transformation of Waller Creek and the San Jacinto corridor, making it less of a barrier within the campus

A principal goal of the Landscape Master Plan is to provide a more detailed level of guidance for the development of the landscape in response to these master plan concepts. The Landscape Master Plan has also coordinated its recommendations with the 2008 University of Texas at Austin Public Art Master Plan.

Throughout the Landscape Master Plan report, the campus area designations (Core, Central, and East) established in the Campus Master Plan will be used.
The inaugural year for Texas CityLab would not have been possible without the dedication and generous support of:

The University of Texas at Austin
Office of Sustainability
The University of Texas at Austin
Campus Planning and Facilities Management
The Center for Sustainable Development within
The University of Texas at Austin School of Architecture

We would also like to thank all faculty and student participants in the Texas CityLab program, as well as the following specific individuals and organizations for their contributions:

Jim Walker | Director, Office of Sustainability
Alice Gerhart | Office of Sustainability
Katherine Lieberknecht | Texas CityLab Principal Investigator
Sarah Wu | Center for Sustainable Development
Kaethe Selkirk | Texas CityLab Coordinator
Raksha Vasudevan | Texas CityLab Graduate Research Assistant
Katie Slusher | Texas CityLab Final Report Editor
INTRODUCTION

Historically, a university’s academic activities rarely utilize the operational structure of the university in the lab or classroom. For the last several years, The University of Texas at Austin (UT Austin) has supported staff at all levels throughout Facilities Services, Campus Planning, Environmental Health and Safety, and other units whenever strategic opportunities arise to engage with faculty and students. Meaningful collaboration of this kind enriches a student’s learning experience as well as the sense of purpose among staff.

So we were prepared and excited when Texas CityLab approached now retired Dr. Steve Kraal proposing a pilot program with Campus Planning and Facilities Management. Using the UT Austin Main Campus as the test bed, students worked with staff on reimagining some of our operational challenges, while Texas CityLab leadership refined their program. As you will see in this report, the collaboration was a success. Not only were new ideas and relationships launched that will continue to benefit University Operations staff and the operations of the university, but Texas CityLab is even more prepared to serve communities across Texas.

DR. PATRICIA CLUBB
Vice President for University Operations

I am pleased to introduce the Texas CityLab 2014-15 report, which gives an overview of student research focused on sustainability issues at UT Austin. In our inaugural year, Texas CityLab partnered 15 existing UT Austin classes with applied service-learning projects focused on the “city” in our own backyard—the 80,000 students, staff, and faculty that make our campus a living example of challenges that Central Texas cities face as our region experiences remarkable growth.

Although the following report only has space to showcase a sample of the dozens of projects completed by over 500 students from 11 academic departments, it gives a glimpse of what it looks like when city staff, faculty, and students engage with CityLab projects—namely, students out in the field, doing research on sustainability issues, interacting with city staff, and connecting with the broader public.

One quick anecdote illustrates the synergy that occurs when students, from across the disciplines, conduct place-based, applied research. During our inaugural year, I was fortunate enough to wear two CityLab hats, as both principal investigator for the program and also as a participating faculty member through my Water Resources Planning course. As part of that course, I took my class to see how the UT Austin Lady Bird Johnson Wildflower Center (WFC) combines green stormwater infrastructure, rainwater harvesting systems, and vegetative management; our purpose was to learn more about these examples of best management practices for urban creeks. Just before we left for our visit, I received an email from WFC staff: our visit coincided with perfect weather for a prescribed burn; would my class like to watch—from a safe location?

Since 2001, the WFC has used prescribed burns to manage grasslands for a host of benefits, including water quality and quantity management. With a small amount of trepidation, I said the class would love to watch the burn (from an appropriate distance).

And we did—and not only was the combination of flames and firefighters much more exciting than our normal Tuesday afternoon schedule of PowerPoint slides and discussion, but the experience really brought to life the connections among land management, water quality and quantity, and a city’s watershed. Hence the beauty of getting out into the city—and the field and creek—to learn about these critical sustainability issues first hand.

The publication of this report wraps up our inaugural year of Texas CityLab, and I would like to take a moment to give heartfelt appreciation to all who helped us along the way. I would like to extend specific gratitude to Texas CityLab staff, and the members of our Advisory Board, who coordinated and supported the program; to the participating faculty and students who made the program possible; and, of course, to the staff and leadership of UT Austin’s Office of Sustainability within Campus Planning and Project Management, who contributed generous amounts of support, time, and expertise in their role as our city partner for the 2014-15 year.

UT Austin’s motto is “What Starts Here Changes the World.” Although it is a bit premature to say that Texas CityLab has changed the world, it is absolutely true that Texas CityLab did start here, with UT Austin’s Office of Sustainability as our first city partner. I hope that the following report provides a sense of what Texas CityLab has accomplished so far, its potential, and how its impact will grow as we bring our program to other communities in Central Texas.

DR. KATHERINE LIEBERKNECHT
Principal Investigator, Texas CityLab
Texas CityLab (TCL) is an experienced-based, interdisciplinary learning program that partners Central Texas communities with university courses and resources. Sponsored by The University of Texas at Austin Center for Sustainable Development (CSD), TCL strengthens sustainability in the built environment. Each year, TCL contracts with one Texas city; together, CityLab personnel and city officials identify sustainability projects for existing university classes to address. TCL program staff then enlist 10-20 university courses to tackle these identified projects, harnessing the energy, enthusiasm, and research of faculty and students across multiple campus departments. At the end of the academic year, TCL presents the partner city with a report of student- and faculty-led analysis, best practices, and proposed designs. Examples include stormwater management, affordable housing, efficient transportation, and community outreach strategies. TCL results in sustainability progress for communities, meaningful learning and professional development for students, and an opportunity for faculty to link classroom work to life outside the university.

In its inaugural 2014-2015 academic year, Texas CityLab partnered with UT Austin’s Campus Planning & Facilities Management (CPFM). As the “city” in our backyard, the 80,000-person UT Austin campus offered an ideal platform for Texas CityLab. Over the course of two semesters, classes in multiple disciplines undertook sustainability projects on campus, addressing issues jointly identified by CPFM and Texas CityLab. Working with UT Austin’s Facilities and Operations team and in alignment with the Campus Master Plan goals, courses focused in part on one of the following five project areas: Waller Creek, Wildlife and Biodiversity, Value Proposition of Sustainability Initiatives, Zero Waste, and Living Laboratory: Bridging Energy & Water Conservation with Academics. Fifteen classes from eleven academic departments participated in Texas CityLab projects. Individually, each course provided direct analysis of a pressing sustainability issue on campus. In one classroom, for example, civil engineering students redesigned stormwater drains near Speedway, a campus road. CPFM can use these designs to slow and redirect stormwater runoff away from Waller Creek. In another, students conducted waste audits across campus to inform community consumption recommendations and recycling campaigns. CPFM can use this work as the foundation for communication and design strategies that encourage behavior change across campus.

Together, the projects provide an interwoven, comprehensive and fresh understanding of UT Austin’s campus. In addition to classroom-based research, Texas CityLab’s work with CPFM included multiple events and culminated in a symposium where student researchers presented their work to community leaders and peers. The following annual report summarizes the student research and provides university leadership with environmental, infrastructural and policy recommendations specific to the UT Austin community and context. In addition to this report, comprehensive documentation of all student work can be found in the full files, which have been presented to CPFM. University leaders can use this report and associated data to continue to promote and implement sustainability work across campus.
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Texas CityLab volunteers conduct a rainwater runoff demonstration during the Explore UT event on campus
“Texas CityLab] was helpful to understand the importance of sustainability as well as the growing demand of consumers on a company’s sustainability efforts. As a senior moving into a real job, it will help me to have insight on such issues.”

“Pushing for sustainability is always good but often people don’t know where to start. This project provided a start for me.”

“The CityLab project gave me the opportunity to apply what I was learning in class and work with different research methods hands-on...I feel like my research mattered.”

“Texas CityLab] was helpful to understand the importance of sustainability as well as the growing demand of consumers on a company’s sustainability efforts. As a senior moving into a real job, it will help me to have insight on such issues.”

“The CityLab project gave me the opportunity to apply what I was learning in class and work with different research methods hands-on...I feel like my research mattered.”
The Energy and Water Conservation Program (EWC) at UT Austin has been charged with conserving 20 percent of the demand side energy and water consumption in the Education and General assigned spaces throughout campus by the year 2020. Texas CityLab participants supported this goal by conducting building-specific energy audits and conservation research across campus.

COURSES

MECHANICAL ENGINEERING 397
Energy, Technology, and Policy

CIVIL ENGINEERING 397
Renewable Energy and Environmental Sustainability
Students in Dr. Michael Webber’s Energy, Technology, and Policy undergraduate course analyzed the efficacy of energy conservation methods for the UT Austin campus by generating practical tools and recommendations for current and future savings.

KEH FARN TAN
STUDENT RESEARCH

The report Energy Analysis of Two Buildings at The University of Texas at Austin and Policy Recommendations examined consumption data of chilled water and steam for the HVAC system at Garrison Hall (GAR) and North Office Building A (NOA) for the setback energy conservation measure (ECM). Setback, an operational strategy, limits the cooling and heating that can occur during unoccupied hours, for the purpose of saving energy. Initial analysis showed savings during both setback and occupied hours and further study revealed greater savings due to setback versus savings due to other ECMs.

Data analysis illuminated where savings occurred, namely during the hours shortly after the setback was released. In GAR, ECMs yielded savings of 30 percent for chilled water and 40 percent for steam usage; for NOA, savings reached 37 percent for chilled water and 60 percent for steam. Incrementally releasing setback and extending setback hours during summer months are potential strategies for further increasing energy savings.

Difference in Savings per Hour (%): Occupied vs Setback
Laboratories are extremely energy-intensive environments due to their constant ventilation requirements, perpetual operation, and specialized equipment. In addition to energy usage, labs also demand high water usage and generate tremendous amount of wastes. UT Austin aims to reduce its energy consumption at the building level by 20 percent by 2020, and research laboratories are the biggest consumers, spending three to five times more energy than a normal building. This report focuses on how energy savings can be achieved in labs, including best practices as part of other universities’ sustainability laboratory initiatives. While some of the efficiency improvement efforts require large-scale redesigns of buildings that are beyond what individual researchers can accomplish, there are many practices that can conserve energy in a lab environment, such as closing the sash of unused chemical fume hoods and regularly defrosting ultra-low temperature freezers. These small behavioral changes can sometimes be a big step in energy and water conservation.

An assessment of five universities with sustainable laboratory initiatives—University of California Berkeley, University of Washington, Harvard University, University of Colorado Boulder, and the University of British Columbia—helps to inform how much of each is needed in that zone. Based on outdoor temperatures, the hot and/or cold deck temperatures can be lowered and raised respectively to more closely match zone loads in a building. A cold deck reset can be applied across campus to reduce chilled water usage during hotter weather to keep air cool in buildings; conversely, a hot deck reset keeps air warm in buildings to reduce energy usage during cooler weather.

### RECOMMENDED BEST MANAGEMENT PRACTICES

- Increase personal outreach to individual students, faculty, and community members and engage larger-scale energy campaigns.
- Publicly recognize newly certified labs, whether through social media or an awards ceremony.
- Provide small incentives to certify as a Green Lab, such as gift cards or a free bag of coffee, in order to create a “buzz” around the program.
- Consider a policy that incentivizes labs to conserve by rewarding them with a share of the costs they saved through conservation.
- Increase campus-wide effort and voluntary participation (a campus “culture” of sustainability) to push the program forward.
- Engage Green Labs with more students through class projects as a way to raise awareness on campus. For example, Green Labs could collaborate with classes in the College of Fine Arts to create visually compelling posters while providing class credits.

### Sources


### TOBIN McKEARIN

**STUDENT RESEARCH**

The spreadsheet created for this project is a tool for assessing the energy and financial savings of the cold deck reset/hot deck reset energy conservation measure (ECM). In air handlers for multizone buildings, the ‘hot deck’ provides maximum heat and the ‘cold deck’ provides maximum cool air, with a dual damper in each zone that regulates how much of each is needed in that zone. Based on outdoor temperatures, the hot and/or cold deck temperatures can be lowered and raised respectively to more closely match zone loads in a building. A cold deck reset is applied across campus to reduce chilled water usage during hotter weather to keep air cool in buildings; conversely, a hot deck reset keeps air warm in buildings to reduce energy usage during cooler weather.

Collaboration with Amanda Berens and John Milton—energy engineers at UT Austin—facilitated the creation of the spreadsheet that their office can use to see energy and cost savings from cold and hot deck resets.

With a cold deck reset, a small part of a typical building at UT Austin can save approximately 9.370 ton-hours of energy each year, equating to $1,744 saved for the year. With a hot deck reset, a small part of a typical building at UT Austin can save approximately 6.16 x 10^8 BTUs of energy each year, equating to $12,584 saved for the year. Since both of these estimates cover one small part of one building the values scale up quickly if applied across campus and can lead to substantial savings in energy and money.
CIVIL ENGINEERING 397
RENEWABLE ENERGY & ENVIRONMENTAL SUSTAINABILITY
DR. YING XU | SPRING 2015

In Dr. Ying Xu’s undergraduate Civil Engineering course Renewable Energy and Environmental Sustainability, students used Autodesk’s Vasari software to analyze environmental and climatic conditions and the impact of building form on energy usage. Working alone or in pairs, 19 students analyzed four buildings on the UT Austin campus, some already existing and others awaiting construction: Sutton Hall, the Chemical and Petroleum Engineering building, the Belo Center for New Media, and the Engineering Education and Research Center for the Cockrell School of Engineering. Reports for each building summarize suggested operational strategies and retrofits to achieve improved building performance.

MALLA DAOU
STUDENT RESEARCH

The roof of the Chemical and Petroleum Engineering building receives the majority of the solar radiation striking the building; this passive energy can be utilized by installing photovoltaic panels. The installation of a Building Automation System for monitoring and control strategies would also contribute to long-term savings. High performance double glazed (low-e-glazing) windows on the south side, an exhaust heat recovery system and low velocity ductwork and piping to minimize friction loss) could all be installed. More affordable, short-term options include replacing lighting fixtures with high efficiency lighting triggered by occupancy sensors, scheduling night setbacks, and using window shades to reduce direct sunlight.

To evaluate the impact of building materials on the EUI, we modeled alternative insulation and the US National Median Reference Values for Portfolio Property Managers, a program of educational sites is 59.6 (kBtu/ft²). This property category was used in lieu of the ‘University’ materials:

- Dormitories: Our particular building better matches the use of an adult education and vocational school.

Figure 12: Monthly Cooling Loads – No Shading

Top left: Monthly cooling loads with no window shading and single-pane glass.

Bottom left: Monthly cooling loads with window shading and reflective glass.

Figure 13: Monthly Cooling Loads – Shading

Top left: Monthly cooling loads with window shading and reflective glass.

This report assessed environmental conditions at Sutton Hall and provided recommendations for energy saving improvements. Solar radiation consistently reaches the building year-round, based on diurnal weather averages data. To take advantage of this we propose that UT Austin install solar heating and cooling. A solar space heating system on the outside of the south facing wall would preheat the air coming into the building during the winter and reduce the heating load. A solar water heating system could reduce the energy expended for heating water. A solar cooling system that uses some sort of thermally activated coolant could reduce the air conditioning load.

Additionally, windows could be upgraded to be operable and a ventilation system should be installed on the roof to allow for air circulation. At this site, wind primarily hits the south face of the building, thus taking advantage of ventilation on that face should be primary. Upgrading the windows to higher insulation glazing would additionally reduce the amount of heat loss during the winter thus reducing the heating load.

To evaluate the impact of building form and location on energy usage, the team analyzed environmental and climate data from Sutton Hall which is situated on the south side of the University of Texas at Austin campus, facing the Colorado River. The site is a typical mild climate and the building consists of interior and exterior mass materials, roofing, and building skin.

A cooling load assessment diagram for Sutton Hall indicates that the east and west sides of the building experience the most cooling load during the summer months, while the north side has a lower load.

This report assessed environmental conditions at Sutton Hall and provided recommendations for energy saving improvements. Solar radiation consistently reaches the building year-round, based on diurnal weather averages data. To take advantage of this we propose that UT Austin install solar heating and cooling. A solar space heating system on the outside of the south facing wall would preheat the air coming into the building during the winter and reduce the heating load. A solar water heating system could reduce the energy expended for heating water. A solar cooling system that uses some sort of thermally activated coolant could reduce the air conditioning load.

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Figure 14: Cooling Load Assessment Diagram

This report assessed environmental conditions at Sutton Hall and provided recommendations for energy saving improvements. Solar radiation consistently reaches the building year-round, based on diurnal weather averages data. To take advantage of this we propose that UT Austin install solar heating and cooling. A solar space heating system on the outside of the south facing wall would preheat the air coming into the building during the winter and reduce the heating load. A solar water heating system could reduce the energy expended for heating water. A solar cooling system that uses some sort of thermally activated coolant could reduce the air conditioning load.

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Figure 15: Summer Solar Radiation Assessment Diagram

This report assessed environmental conditions at Sutton Hall and provided recommendations for energy saving improvements. Solar radiation consistently reaches the building year-round, based on diurnal weather averages data. To take advantage of this we propose that UT Austin install solar heating and cooling. A solar space heating system on the outside of the south facing wall would preheat the air coming into the building during the winter and reduce the heating load. A solar water heating system could reduce the energy expended for heating water. A solar cooling system that uses some sort of thermally activated coolant could reduce the air conditioning load.

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Figure 16: Solar Radiation Assessment Diagram

This report assessed environmental conditions at Sutton Hall and provided recommendations for energy saving improvements. Solar radiation consistently reaches the building year-round, based on diurnal weather averages data. To take advantage of this we propose that UT Austin install solar heating and cooling. A solar space heating system on the outside of the south facing wall would preheat the air coming into the building during the winter and reduce the heating load. A solar water heating system could reduce the energy expended for heating water. A solar cooling system that uses some sort of thermally activated coolant could reduce the air conditioning load.

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Figure 17: Solar Radiation Assessment Diagram

This report assessed environmental conditions at Sutton Hall and provided recommendations for energy saving improvements. Solar radiation consistently reaches the building year-round, based on diurnal weather averages data. To take advantage of this we propose that UT Austin install solar heating and cooling. A solar space heating system on the outside of the south facing wall would preheat the air coming into the building during the winter and reduce the heating load. A solar water heating system could reduce the energy expended for heating water. A solar cooling system that uses some sort of thermally activated coolant could reduce the air conditioning load.

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Based on analysis of the soon-to-be-built Engineering Education and Research Center, the massing and orientation proposed by Ennead Architects achieves the best energy performance. Glazing area and treatment yielded the most energy savings compared to other assembly modifications. Heat gains through windows were minimized by using double pane, low-e-glazing, as well as lowering the window-to-wall ratio on the east and west sides of the building. This combined design adjustment reduced the building energy use intensity from 55 kBTU/sf/yr to 47 kBTU/sf/yr. Increases in wall and roof insulation produced insignificant improvements and would likely not be cost effective.

### Table 2 - Comparison of Total Energy Use Intensity for the Three Designs

<table>
<thead>
<tr>
<th></th>
<th>Design 1 - Ennead</th>
<th>Design 2 - Tower</th>
<th>Design 3 - Double L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity EUI (kWh/sf/yr)</td>
<td>12</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Fuel EUI (kBTU/sf/yr)</td>
<td>12</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Total EUI (kBTU/sf/yr)</td>
<td>55</td>
<td>75</td>
<td>77</td>
</tr>
</tbody>
</table>

### Table 3 - Comparison of Annual Electricity and Fuel Use, Cost, Carbon Emissions, and Roof PV Potential

<table>
<thead>
<tr>
<th></th>
<th>Design 1 - Ennead</th>
<th>Design 2 - Tower</th>
<th>Design 3 - Double L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Electricity Use (kWh)</td>
<td>5,396,202</td>
<td>7,180,510</td>
<td>7,263,401</td>
</tr>
<tr>
<td>Annual Fuel Use (Therms)</td>
<td>54,068</td>
<td>80,398</td>
<td>85,716</td>
</tr>
<tr>
<td>Annual Cost ($)</td>
<td>503,896</td>
<td>676,466</td>
<td>687,377</td>
</tr>
<tr>
<td>Annual Carbon Emissions (ton/yr)</td>
<td>5166</td>
<td>6923</td>
<td>7029</td>
</tr>
<tr>
<td>Roof PV Potential (ton/yr offset)</td>
<td>-1809</td>
<td>-1290</td>
<td>-1777</td>
</tr>
</tbody>
</table>
UT Austin’s Campus Master Plan calls for the campus to move towards achieving 90 percent diversion of campus waste from landfills by 2020. This goal provided an opportunity for classes to examine how best to catalyze positive action from staff, students and faculty on campus. Classes in this project area used the University’s Campus Master Plan as a starting point and test bed for communication and design strategies to encourage behavior change across campus.

COURSES

ADVERTISING 385
Advertising, Sustainability, and the Conscientious Consumer

ADVERTISING & PUBLIC RELATIONS 373
Integrated Communications Campaigns

COMMUNITY & REGIONAL PLANNING 383
Resource Management & Recycling
In Advertising, Sustainability, and the Conscientious Consumer, an undergraduate course taught by Dr. Lucy Atkinson, students conducted research on the 'green gap in zero waste' at UT Austin. Through qualitative observations and background analysis, students examined: zero waste comprehension across the campus community, including students, tailgaters, staff, and faculty; how UT Austin has marketed its zero waste goal to various audiences; where UT Austin has made improvements in waste diversion; and finally, what motivates people at UT Austin to recycle.

Class research identified two challenges currently facing the Zero Waste Initiative and provided several tactics for addressing them. First, UT Austin’s zero waste efforts appear to be stunted by a lack of cohesive branding across campus. Surveys suggest that the UT Austin community is confused about how to sort within the existing recycling system, making the sorting process burdensome and inconvenient. CPFM could consider implementing consistent labeling that includes clear instructions on waste bins to increase clarity and ease of use.

Second, a discrepancy exists between students’ self-reported support of the Zero Waste Initiative (high) and the frequency they recycle (low). Referencing both the social learning and social norms theories, there is great potential in learning through observation and positive pressure from peers as a strategy for changing students’ habitual recycling behavior. Guerilla marketing techniques are also recommended for their high level of intrigue and low cost. Additionally, suggested marketing strategies include rewards systems, branded promotional items, and sponsorship of existing student events as ways to encourage cultural change.

### Table: Knowledge vs. Interview

<table>
<thead>
<tr>
<th>Observation</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Not enough knowledge</td>
</tr>
<tr>
<td></td>
<td>I have enough knowledge!</td>
</tr>
<tr>
<td>Attitude</td>
<td>Recycling is inconvenient</td>
</tr>
<tr>
<td></td>
<td>and tiresome</td>
</tr>
<tr>
<td></td>
<td>Recycling is helpful and</td>
</tr>
<tr>
<td></td>
<td>important!</td>
</tr>
<tr>
<td>Social Norm</td>
<td>Peer pressure and social</td>
</tr>
<tr>
<td></td>
<td>environment (e.g., physical</td>
</tr>
<tr>
<td></td>
<td>distance from the public)</td>
</tr>
<tr>
<td>Campus</td>
<td>Students don’t utilize</td>
</tr>
<tr>
<td>environment</td>
<td>recycling bins enough</td>
</tr>
<tr>
<td></td>
<td>UT campus doesn’t have enough</td>
</tr>
<tr>
<td></td>
<td>recycling bins and correct</td>
</tr>
<tr>
<td></td>
<td>signage!</td>
</tr>
</tbody>
</table>
Students in Dr. Lucy Atkinson’s Integrated Communication Campaigns undergraduate course worked in small groups to develop either a broad umbrella campaign for UT Austin’s core sustainability initiatives, or an issue-focused campaign that was geared towards one of Texas CityLab’s five focus areas. Students worked in small groups to develop campaign proposals of varying scopes and scale to help CPFM brand sustainability across campus.

Enthusiasm for creating a more pervasive recycling culture can be encouraged by connecting the message of the awareness campaign to a very well-known UT Austin myth. In a poll of students, 97 percent of respondents knew the campus legend of the albino squirrel: it is said if a student spots the albino squirrel before a test, he or she will get an A. Incorporating this concept into a branding strategy for zero waste stations leverages the recognition of this piece of UT Austin student culture to encourage campus recycling.

Initial assessment of the current state of campus sustainability initiatives utilized the Strength, Weaknesses, Opportunities, and Threats (SWOT) analysis tool. Research findings showed that freshmen were unaware of the Zero Waste Initiative and did not know what the term ‘single-stream recycling’ meant. Also, the majority of undergraduate students had never visited the UT Austin sustainability website or its social media platforms.

<table>
<thead>
<tr>
<th>STRENGTHS</th>
</tr>
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<tbody>
<tr>
<td>• The University of Texas at Austin is a single-stream campus, which makes recycling easier and more efficient</td>
</tr>
<tr>
<td>• UT Zero Waste has a clear goal of diverting 90% of all waste from landfills by 2030</td>
</tr>
<tr>
<td>• Majority of students want to recycle and actively search for bins, and believe that decreasing the amount of waste in landfills is a good thing</td>
</tr>
<tr>
<td>• Location of UT Austin is very eco-friendly and proactive about environmentally friendly activities</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>WEAKNESSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Lack of design consistency throughout recycling bins</td>
</tr>
<tr>
<td>• Not enough bins placed around campus</td>
</tr>
<tr>
<td>• Unpredictability makes the process of recycling difficult and confusing, meaning many students and faculty simply opt for the easier option</td>
</tr>
<tr>
<td>• Difficulty in accessing information about the program and single-stream recycling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OPPORTUNITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Opportunity for growth due to current lack of awareness by students over the Zero Waste Initiative and single-stream recycling</td>
</tr>
<tr>
<td>• Opportunity to capitalize on the city of Austin’s “green” agenda</td>
</tr>
<tr>
<td>• Make a new tradition within the UT community</td>
</tr>
<tr>
<td>• Align recycling efforts with UT’s culture</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THREATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Apathetic attitude of students towards recycling</td>
</tr>
<tr>
<td>• Many students who live off campus will have different recycling programs based on their living situation</td>
</tr>
<tr>
<td>• Potential for misconceptions about single-stream recycling and message overload</td>
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</table>

Below: SWOT analysis chart of current zero waste efforts
COMMUNITY & REGIONAL PLANNING 383
RESOURCE MANAGEMENT & RECYCLING

DR. ROBERT YOUNG | SPRING 2015

The zero waste commencement research included evaluations of satellite commencements within colleges and schools for maximum potential diversion; studies of other university models and best practices; and, lastly, developing a zero waste plan for the spring 2015 commencement. Two primary methods were used in considering a UT Austin zero waste commencement: a review of best practices and precedent projects from other universities and an online questionnaire sent to convocation and commencement coordinators across campus. The best practices section included a review of strategies undertaken by other universities to minimize waste and increase diversion at commencements and other large events on their campuses. These best practices focused on methods for diversion rooted first in minimization and secondarily in proper recycling and composting behavior, as well as resources that suggested procedures and protocols to aid departments and event coordinators in planning zero waste events. In addition to gathering and presenting best practices, students sent a questionnaire to campus commencement planning staff focusing on questions of event budgeting, priorities, attendance, scope, current waste practices and willingness to alter practices in the future.

A number of U.S. universities have begun hosting zero waste commencements, or at the very least, providing green commencements and/or zero waste event services. Student researchers found that all universities used similar tactics to reach the near unanimous goal of 90 percent diversion from the landfill. They include:
- Using caterers that are knowledgeable and capable in composting, using either biodegradable or reusable (preferred) china and dishware;

WARNER COOK, KATHERINE EASTMAN, KAYLA FENTON, LAUREN KO, BRENT PURDUE & TOM ROWLINSON

STUDENT RESEARCH

The University of Texas at Austin - School of Architecture - UTSoA

TEXAS CITYLAB ZERO WASTE PROJECT
• Using volunteer groups and promotion to ensure attendees are aware and compliant;
• Providing proper sorting systems with, at minimum, separation of recycling and compost;
• Working with material systems management groups that are competent and capable in providing recyclable and composting materials to their proper end use;
• Providing attendees with possessions that they will keep; otherwise, provide information that would normally be used in printouts through projection and online;
• Working with UT Austin Documents Solutions to minimize paper usage in convocation programs.

In particular, waste sorts—a process by which waste is separated into recycling, compost, and landfill categories—provide important steps toward accountability and accurate measurements of progress toward zero waste. Waste sorts also generate data critical to understanding the impacts a zero waste commencement may have, as well as providing an understanding of successes and failure going forward. Finally, zero waste commencements require championing on the behalf of organizers, staff, and volunteers. Most of the events mentioned the use of volunteers and educators to ensure awareness and compliance.

Without that enthusiasm, results may be difficult to achieve, not to mention increase the potential for pushback from attendees and administration.

In the assessment of behavior related to waste diversion in outdoor high student use areas (e.g., the Student Activities Center patio), current behavior in high-traffic areas was evaluated and then analyzed for cultural and structural factors affecting students’ waste diversion behaviors. Key findings include:
• Over 70 percent of landfilled waste at outdoor eatery areas could be composted;
• Compost disposal options may achieve higher landfill diversion rates;
• UT Austin’s food and beverage vendor products include a range of recyclability and compostability;

After assessing the existing infrastructure and behavior, the following policies are recommended:
• Coordinate with food and beverage vendors to increase recyclability and compostability of products;
• Invest in innovative education campaigns, such as the Texas Union’s Love Your Leftovers Composting Program and Texas Athletics’ Bleed Orange, Live Green campaign (1);
• Create uniformity of disposal bins university-wide through coordination with purchasing office;
• Provide single-stream recycling options university-wide, including outdoor recycling stations;
• Decrease the number of landfill bins university-wide;
• Phase in university-wide composting program after sustained education campaign;
• Improve zero waste practices at commencement events with improved coordination and best management practices guide;
• Create volunteer opportunities at commencement that include zero waste ambassadors to assist with proper disposal, similar to Texas Athletics Sustainability Squad and the Office of Sustainability Longhorn Recycling Roundup;
• Create university-wide Green Team to coordinate between other facility and departmental Green Teams, and report to the President’s Sustainability Steering Committee;
• Create Zero Waste Management Director position under the Associate Vice President–Utilities, Energy & Facilities Management.

Uses:

- Composting Program and Texas Athletics’ Bleed Orange, Live Green campaign (1);
- Create uniformity of disposal bins university-wide through coordination with purchasing office;
- Provide single-stream recycling options university-wide, including outdoor recycling stations;
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Source:
The costs of sustainability initiatives and programs are often immediate, while the benefits of these programs may not be seen in the near-term. Sustainability initiatives and programs frequently produce longer-term benefits to the economy, environment and people, making such benefits difficult to quantify through traditional cost-benefit analyses. Classes in this area examined the return-on-investment from sustainability initiatives, both on campus and farther afield.

COURSES

URBAN STUDIES 315
Urban Research Methods

FINANCE 377
Financial Analysis
Dr. Paul Adams’ undergraduate Urban Research Methods course focused on introductory research methods (surveys, interviews, structured observation, and secondary data/statistics) as tools for assessment and analysis of issues identified by Texas CityLab. Although students’ projects covered all five focus areas, many targeted their research questions on human factors in the valuation of various sustainability initiatives. Students summarized their findings in research papers and presentations, which can be accessed in their entirety in the complete Texas CityLab files. Here are a few examples of research projects focused on valuation of campus sustainability initiatives.

This research concluded that users of Leadership in Energy and Environmental Design (LEED) certified buildings do not always report higher satisfaction in terms of building characteristics. LEED claims that its building occupants are happier, healthier, more productive workers, even including an Indoor Environment Quality rating focused on the quality of a building’s environment in relation to health and wellbeing of those who occupy space within it. To begin to investigate these policy goals, this student surveyed satisfaction of users of UT Austin’s LEED-certified buildings: 27 students, four faculty, and three staff members. Building users were asked about satisfaction in regards to air quality, temperature, cleanliness and maintenance, lighting and noise level. Research found that users of LEED certified buildings were less satisfied the more often they used them.

Future research could seek to identify other factors that influence building user satisfaction, for the purpose of trying to isolate how much LEED certification influences building user satisfaction. Although both UT Austin and LEED intend to improve the lives of the buildings’ users, LEED certified buildings on the UT Austin campus may not fully realize this shared commitment to social welfare.
Research in this report focused on the following question: How important is campus energy conservation and sustainability to the UT Austin faculty and students? A survey of 40 students and faculty members evaluated awareness of and enthusiasm for existing sustainability efforts across campus. 98.3 percent of respondents either agreed or strongly agreed with the following statements: “energy conservation and sustainability are major problems that UT Austin is facing” and “I care about energy conservation and sustainability on our campus.” While 50 percent of respondents strongly believe that UT Austin already makes a firm effort to be a sustainable and energy efficient campus, 98.3 percent of all respondents believe that UT Austin can do more in terms of being more energy efficient and sustainable. Furthermore, 71.67 percent of all respondents did not know what it means for a building to be LEED-certified. While this research finds that energy conservation and sustainability are highly valued by the UT Austin community, there is great potential for students and faculty to learn more about different methods of energy conservation and sustainability.

Top left: Chart showing all survey respondents’ answers to questions 8–9:
#8: ‘Do you feel that UT can do more in terms of being energy efficient and sustainable?’
#9: ‘Do you know what it means for a building to be LEED-certified?’
Bottom left: Chart showing all survey respondents’ reactions to the following statements:
#3: ‘Energy conservation and sustainability is a major issue the UT is facing’
#4: ‘I care about energy conservation and sustainability on our campus’
#5: ‘UT makes a strong effort to be a sustainable and energy efficient campus’
#6: ‘UT is wasteful in regards to energy conservation’
#7: ‘There needs to be changes to the way that air conditioning is controlled throughout the different buildings on campus’
In Professor Mary Lou Poloskey’s undergraduate Financial Analysis course, students undertook financial investigations of publicly-traded corporations with stated commitments to sustainability practices. Their resulting reports focused on if, and to what degree, these initiatives achieved greater shareholder value for each corporation. Students grappled with the difficult task of correlating increased dollar values with improved environmental and community impact and created data that can be used as an initial measure of these corporations’ value proposition of sustainability. These student projects offer a framework to begin addressing institutional sustainability, an undertaking relevant to UT Austin’s interest in measuring the value proposition that sustainability measures and programs bring to its own institution and universities in general.

Students examined mission statements, corporate sustainability annual reports, governance structure; public reports and opinions of company value and reputation; company actions and any evidence of fines; and cash flows and overall valuation for a dozen companies from the food and chemical sectors. The complete Texas CityLab files, submitted to CPFM, provide the entirety of the students’ data and conclusions, most of which reflect similar assertions that corporate commitment to sustainability brings real benefit to overall company valuation. Many emphasized that the analyzed corporate sustainability initiatives should be considered long-term investments, which tend to pay out in cash flows, customer loyalty, and talent retention over long periods of time.

**WESLEY FISCHER, MATTHEW LENZ, DOUGLAS SECHRIST & JAMES TRAPP**

**STUDENT RESEARCH**

Since fiscal year 2005, General Mills, Inc. (GM) North American operations have saved approximately $65 million through proactive environmental management and other initiatives to make production facilities more efficient and environmentally sustainable. The company seeks to increase the sustainability of its ingredients by sourcing their ten priority ingredients by 2020. These ingredients constitute more than 50% of their total ingredient purchases. The company also decreased its greenhouse gas output rate 23% in 2014 and 20% in 2013, with a goal of an additional 20% in 2015. Energy usage rates have also decreased 10% through 2014, unchanged from 2013. GM North America aims to decrease energy usage a further 20% in the 2015 year.

Claiborne Armistead, a division of PepsiCo, increased the number of its chip bags that are biodegradable.

As a result of PepsiCo’s many efforts towards long-term sustainability, it can be argued that these actions can directly benefit cash flows and the overall valuation of PepsiCo. These sustainability initiatives can be used for marketing and branding strategies to recruit more customers for PepsiCo’s products, directly influencing bottom line cash flows for the company. Moreover, sustainability efforts by the company could also affect investors’ attitudes toward PepsiCo stock and attract more of them who are interested in becoming shareholders in those types of companies.

**TYLER ALEXANDER, HUNTER KERSCH & BRENNAN VERHALE**

**STUDENT RESEARCH**

Biogen is a biotechnology corporation based in Cambridge, Massachusetts. While the impact of sustainability initiatives on shareholder value is debatable, it is hard to argue Biogen’s initiatives are anything but good for the company. Whether it increases shareholder trust in management’s responsibility, ethics, or values, or simply helps reduce operational inputs, environmental sustainability positively impacts the value of Biogen. The company’s efforts have received high praise, appreciation, and recognition on some of the world’s biggest stages. Price Waterhouse Cooper’s Transaction Services arm published a study in 2012 debating the financial impact of sustainability. Ultimately, using Multi-Attribute Utility Analysis (MUA), PWC translated senior management value tradeoff initiatives in terms of dollars, and found overwhelming support for environmental sustainability measures improving financial metrics. Biogen’s stock price (trading at a P/E of 34.76) reflects the positive shareholder value created by their world-leading sustainability practices.

Sources:
- all logos downloaded directly from corporation websites
The abundance of humans, wildlife, and plant species on campus presents an opportunity to identify how to more effectively integrate humans with other natural systems on the UT Austin campus. This class provided greater analysis of particular species on campus, namely squirrels. Students studied the relationships between the campus community and these plants and animals. This work directly informs how to enhance the abundant natural environment on campus while maintaining the campus as an effective space for learning.
In Dr. Kay McMurray’s undergraduate Field Biology course students used field work to produce a baseline assessment and analysis of Eastern fox squirrels’ (Sciurus niger) impact on campus. Abundant populations of fox squirrels cause significant damage to UT Austin’s natural and built environment. Students assessed population densities of squirrels across campus, quantified squirrel damage to campus trees, and assessed squirrel foraging and eating habits.

By analyzing data collected through field research, students estimated a very high density of squirrels (6.18 individuals/hectare (ha) of suitable habitat; 3.79 squirrels/ha overall in the central campus area of the UT Austin campus). Additionally, students checked every tree in the central campus area for damage and then categorized tree damage into three types: trunk, main limbs, and canopy. Roughly 50% of the 689 trees, consisting of 22 species, showed some damage attributable to fox squirrels as judged by the student observers (Table 2).

To estimate population density, students divided the campus into research zones (Table 1). Students then walked transects across each research zone; each time they observed a squirrel, they recorded the distance of the squirrel to the transect line (Figure 1). They then used the distribution of the squirrel locations to estimate population density across each zone, and in aggregate, across campus (Figure 3, next page).

Student research found that the density estimate of the model giving the best fit (uniform+cosine) was approximately 6.18 fox squirrels/ha of squirrel habitat (S.E.=1.21, CV=19.61, 95% CI [4.20,72, 9.0723]). After scaling this density estimate to include the area that is not squirrel habitat (e.g., buildings and construction), students estimate that the UT Austin campus contains an estimated 3.8 squirrels/ha and approximately 400 squirrels living in zones 1-4 and 6.

In addition to conducting research on squirrel population density and distribution of tree damage, students also had the opportunity to design and implement additional squirrel research projects. The following section highlights one research project: three additional research projects have been included in the complete Texas CityLab files presented to CPM.

Table 1—Total surveyed area and total suitable habitat

<table>
<thead>
<tr>
<th>Zone</th>
<th>Number of areas</th>
<th>Total Surveyed Area (ha)</th>
<th>Total suitable habitat (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>1.80</td>
<td>13.5</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>7.29</td>
<td>13.9</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>5.07</td>
<td>10.8</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>5.15</td>
<td>12.1</td>
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<tr>
<td>5</td>
<td>10</td>
<td>7.16</td>
<td>14.0</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>7.16</td>
<td>14.0</td>
</tr>
<tr>
<td>Sum</td>
<td>64</td>
<td>28.5</td>
<td>64.4</td>
</tr>
</tbody>
</table>

At left: Map showing zone boundaries of the UT Austin central campus

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At left: Table 2—Damage to tree species on campus

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<th>Number censused</th>
<th>Number damaged</th>
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<tbody>
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<td>227</td>
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The goal of this study was to quantify the number of trees damaged on campus by fox squirrels (this report) and to estimate the density of squirrels on campus.

Besides chewing on trees, fox squirrels on the UT campus chew through their drip irrigation systems to access water. Drip irrigation conserves water and is the most efficient method of watering a tree as well as the most effective. Groundskeepers must use less efficient means of watering the trees when this occurs. (J. Carse, pers. comm., January 2015)

Figure 1. Examples of fox squirrel damage to trees on the UT campus. Clockwise from left: canopy damage, major limb damage, trunk damage. Pictures provided by J. Carse.

Research in Adaptations of Fox Squirrel (Sciurus niger) Response to Human Presence on University of Texas at Austin Campus focuses on effects of the overlap of human and squirrel habitat on campus. Humans and squirrels on the UT Austin campus often interact—one particularly common type of interaction is the feeding of squirrels by humans. Previous studies have determined that squirrels habituate to humans in areas where they come into contact more often. This study seeks to determine whether squirrels on the UT Austin campus habituate to human presence and how presentation of food by humans affects squirrel behavioral response. Data supports the conclusion that squirrels on the UT Austin campus habituate to human presence, but does not support the conclusion that squirrels are more willing to let humans approach when food is offered.

Students used flight initiation distance and alert distance as measures of habituation and recorded these for squirrels in three high traffic and three low traffic sites on UT Austin campus. During half of the trials at each site the experimenter presented food to the squirrels. In high traffic areas, data showed that flight initiation distances and alert distances were found to be significantly lower (p=0.0499). No significant difference was found in flight initiation distances or alert distances due to food being offered (p=0.999). The interaction effect was not significant (p=0.381).

These results indicate that Eastern fox squirrels on the UT Austin campus do habituate to increased human presence in high traffic areas. Squirrel response to food presentation might have been affected by the time of year in which this study was performed, so further testing could be done at a different time to verify these results.
UT Austin’s Campus Master Plan calls for the transformation and restoration of Waller Creek in order to enhance the campus environment. However, limited staff resources for consistent evaluation and maintenance presented an opportunity for students to creatively think about how to move a plan from vision to implementation. Classes in this section studied the urban watershed and developed particular programs and policy strategies for how to manage the creek over time, specifically within the larger context of the role of an anchor institution in a city.

COURSES

CIVIL ENGINEERING 341
Introduction to Environmental Engineering

LANDSCAPE ARCHITECTURE 694
Landscape Architectural Design Studio

CIVIL ENGINEERING 365K
Hydraulic Engineering Design

COMMUNITY & REGIONAL PLANNING 387
Water Resources Planning

PUBLIC AFFAIRS 680
Policy Research Project
Dr. Kerry Kinney facilitated three projects in her undergraduate Introduction to Environmental Engineering course, as well as one additional project in her graduate Engineering Microbiology class. In the fall semester, undergraduates participated in the collection of water samples from sink taps in the Ernest Cockrell Jr. building to assess the relationship between tap location (e.g., floor of the building), chlorine residual and microbial plate counts. Spring semester undergraduate students collected samples from eyewash stations located in two buildings on campus—some of the eyewashes had been flushed recently and some had not. These water samples have been extracted and are awaiting sequencing to determine how the microbiome in the samples is affected by flushing frequency. Finally, the Engineering Microbiology graduate students collected water quality data (and samples for microbial community analysis) at three locations along Waller Creek—two located upstream and one located downstream of the Engineering Education and Research Center construction site. Students then completed an analysis of the water quality data (the sequence results are still pending) and compared the most recent data to historical trends in the water quality. In light of this data, they also examined the recently released TMDL regulatory document for this segment of Waller Creek. The results of Mapping the UTBIOME project will be presented at two conferences this summer, and previous UTBIOME work can be found in the PeerJ publication (see information below).

UTBiome: citizen science and campus community engagement, Juan Maestre, Harish Sangireddy, Paola Passalacqua, Kerry A. Kinney, Department of Civil, Architectural and Environmental Engineering, University of Texas at Austin, Austin, Texas, USA DOI 10.7287/peerj.preprints.828v1 Published 2015-02-13 Accepted 2015-02-13

Dr. Allan Shearer’s Graduate Landscape Architecture Studio created designs for multiple sites on campus that are adjacent to Waller Creek, each of which addressed three main objectives: enhancing the environment, engaging the creek, and expanding access. Prioritizing and identifying relationships among these objectives was an important part of the investigation and led to different approaches and resolutions of form. What emerges from the work are not just technically possible options, but ideas about how we might achieve a more sustainable and more resilient landscape for future generations. Highlights from all the projects are included in this report; complete designs and further documentation can be found in the Texas CityLab files.

Students divided into groups and worked on proposals in the following teams:

TAILORING THE CREEK: Adrianne Broussard, Lu Jiang, Melissa Sparks, and Quan Yin
STRING OF MOMENTS: Xuefei Dong, Kim Gilbertson, Michael Linehan, and Yiqing Wang
COMMON GROUND: Jody Broccoli-Hickey, Amy Grossman, Xiaomeng Ma, Tanya Povolny, and Shiji Zhoa

Several areas along the creek caught the attention of multiple teams and were investigated through extensive on-site surveys and a critical design process. These nodes should be recognized as locations where landscape design can have the greatest influence to create a more sustainable campus.
San Jacinto Boulevard is currently a major thoroughfare dividing what the current Campus Landscape Master Plan calls the Core (the older part of campus) from Central Campus. With the completion of the Dell Medical School in a few years and the subsequent development of the entire Medical District, San Jacinto will be needed as a connection to serve what will be a greatly expanded community. San Jacinto has also been identified by the City of Austin as a preferred path for an urban rail line to connect downtown with development north of campus. Although it is not known when this line might be constructed, each team addressed the introduction of light rail in their proposals.

The String of Moments proposal suggests that street parking be removed so that trains, vehicles, cyclists, and pedestrians can all use the corridor safely. Pedestrians are closest to the creek; next to them are cyclists. Both are separated from vehicular traffic by a curb and rain gardens, which slow down sheet flow from the streets. Cars can move both north and south along the corridor and are separated by a central median. The north and south rail lines are grouped on the east side of the road.

MULTI-MODAL TRANSPORTATION

Although UT Austin’s facilities extend north of Dean Keaton Street, the intersection with San Jacinto Boulevard is an important gateway to the campus. Two branches of Waller Creek flow through the area—one just to the west of San Jacinto, the other to the west of the Carothers Dormitory. In both cases views of the creek are currently obscured by overgrown vegetation. Dirt paths and patches of bare earth mark informal circulation routes over the large lawn.

The Tailoring Waller Creek group created a proposal for this site called The Loop. It uses a circular path system to encompass a retaining basin. Quilting the layers of vegetation collects rainwater and increases the amount of habitat for gray heron. A wood deck crosses over the retaining basin and offers an opportunity to view the water. Interaction between the dormitory and the creek is increased by terraced seating that embraces the water’s edge at multiple elevations.
The area surrounding the intersection of 24th Street and San Jacinto Boulevard will soon be enlivened by the construction of the new Engineering Education and Research Center. This portion of the creek has two water obstructions in the form of weirs. There are multiple paths bordering both the north and south lawns, but intense use on the southern lawn has resulted in compacted earth and destroyed grass. The Art Building lies across the eastern side of the street, and a water chilling station borders the southwestern section of the site.

The String of Moments team’s proposal uses a terraced slope and retaining walls to create a scheme called the Cypress Lawn. Maintaining the shade of the numerous cypress trees would invite ‘pooling’ (or gathering) of pedestrians to take place. The vegetated terracing also acts to decrease the speed of water runoff into the creek and, thereby, increase infiltration potential. On the southwest side of the creek, a more formal limestone terracing brings viewers directly to the water’s edge.

Multiple user programs and varying kinds of movement converge at the intersection of the East Mall, 23rd Street and San Jacinto Boulevard. Darrell K Royal Memorial Stadium, the Art Building, and the Alumni Center prominently mark corners, and the constant flow of buses make this area one of the liveliest on campus.

The Tailoring Waller Creek group created a design for this busy node called The Social Circle, in which peripheral vegetation strips act as physical barriers from the traffic circle’s vehicles. Terraces replace the current fountain and offer a central axis for people to occupy. The flanking grass terraces on both sides provide a place to rest beneath the shade of trees.
SAN JACINTO DORMITORY

Tucked between the San Jacinto Dormitory and Waller Creek is a semi-hidden area that affords both a visual and auditory break from the activity along this otherwise busy corridor. The site is currently dominated by an underused amphitheater, and dense vegetation on both sides of the creek block the view of cars on San Jacinto Boulevard.

The Outdoor Rug proposal from the Tailoring Waller Creek group transforms this space by replacing the amphitheater with a new lawn and terraced seating. The selective removal of vegetation allows people to occupy the banks of the creek and new paths, including a wood boardwalk, bringing people closer to the water’s edge.

SOUTHERN ENTRANCE

The southern-most area of the study area is the intersection of Martin Luther King, Jr. and San Jacinto Boulevards. This location currently serves as an entrance into the university, but it should be noted that the Dell Medical School is under construction further south along Waller Creek. The historic oil pump, Santa Rita No. 1, lies in a central plot of grass and trees on the northwest corner of the intersection.

The Common Ground group reduces impervious surfaces with their design for The Basin, which creates both a space for academic learning and helps to reduce storm water flow into the creek. The existing San Jacinto bridge is removed and replaced with a terraced slope covered with riparian plants. Seating provides opportunities for wellness learning, while a path that enters the basin could allow for academic research and observation.
Students in Dr. David Maidment’s Hydraulic Engineering Design course created mini-stormwater GIS plans for sub-watersheds of Waller Creek on the UT Austin campus. Areas of pavement with higher volumes of runoff and concentration of pollutants were specifically targeted for higher impact.

The following is a redesign of the stormwater management infrastructure for staff parking lot 53 on the UT Austin campus. The green section represents the area that will be set aside for the grass swale; the blue rectangles around the edge represent the inlets to the catch basins, and the red line connecting the inlets represents the proposed conduit system. The inlets will discharge into a catch basin located at a lower elevation. Once the catch basin has filled enough, the water will begin flowing through the new conduit pipe. This design will benefit Waller Creek with improved stormwater runoff filtration occurring at much more manageable, lower flow rates.

This project proposes reducing runoff from San Jacinto Boulevard by replacing a segment of paved parking with permeable interlocking concrete pavers. Permeable pavement is a pavement system that allows for the movement of stormwater from the street surface to the base of the road. Due to the fact that permeable pavement does not allow stormwater to directly run off the street surface, this type of pavement reduces runoff volumes, promotes higher infiltration rates, and reduces contaminant levels. Installing a permeable pavement system will allow for infiltration of the “first flush” runoff, keeping the most contaminated stormwater out of Waller Creek.

The results of the report showed that the permeable pavement was able to store 3,660 ft³ of water, or a one-year storm. Due to the fact that the first-flush of rain is being stored in the system, the team can confidently predict natural attenuation of contamination of the first two inches of rainfall through infiltration of the stormwater as it percolates into the subsurface soil.
Students in Dr. Katherine Lieberknecht’s graduate course in Water Resources Planning examined and reported on best management practices for urban creeks, with a focus on the stretch of Waller Creek within the UT Austin campus. Their applied work with Waller Creek offers a way to examine a water resource that has been heavily impacted by humans, but that still contains much potential for revitalization. Five student groups each focused on a different management area: plants, ecology, and water; connectivity and access; rainwater harvesting and its relationship to the creek's management area: plants, ecology, and water; connectivity and access; rainwater harvesting and its relationship to the creek’s stormwater function; social and health values of Waller Creek; and water quality and quantity best management practices. In their resulting recommendations for best management practices, students attempted to strike a balance between the realistic financial and staffing constraints, the increasing focus on Waller Creek as the Medical School District and the Waller Creek Conservancy’s work attempted to strike a balance between the realistic financial and staffing constraints, the increasing focus on Waller Creek as the Medical School District and the Waller Creek Conservancy’s work to shoring up the banks against erosion. Currently non-native, invasive plants populate Waller Creek’s riparian corridor, which endanger the ecological quality and value. Although many invasive species exist in the UT Austin section of Waller Creek, the five most damaging that should be targeted for removal are chinaberry (Melia azedarach), ligustrum (Ligustrum sp.), heavenly bamboo (Nandina sp.), tree of heaven (Ailanthus altissima), and poison ivy (Toxicodendron radicans). Recommended native species to replace them include turk’s cap (Malvaviscus arboreus var. drummondii), twisted leaf yucca (Yucca rupicola), Texas cypress (Taxodium distichum), and Habiturf™ grasses (a native mix developed by the Lady Bird Johnson Wildflower Center).

Re-establish native plant assemblages to retain soils and stabilize the creek’s banks. Native plant assemblages, such as ground covers featuring native grasses, help to keep soil in place and slow down stormwater flows, ameliorating the effects of incising, fast-moving water. Native assemblages provide habitat for wildlife in addition to shoring up the banks against erosion. Currently non-native, invasive plants populate Waller Creek’s riparian corridor, which endanger the ecological quality and value. Although many invasive species exist in the UT Austin section of Waller Creek, the five most damaging that should be targeted for removal are chinaberry (Melì azedarach), ligustrum (Ligustrum sp.), heavenly bamboo (Nandina sp.), tree of heaven (Ailanthus altissima), and poison ivy (Toxicodendron radicans). Recommended native species to replace them include turk’s cap (Malvaviscus arboreus var. drummondii), twisted leaf yucca (Yucca rupicola), Texas cypress (Taxodium distichum), and Habiturf™ grasses (a native mix developed by the Lady Bird Johnson Wildflower Center).

The establishment of food production in riparian areas not only serves a practical purpose by producing food for consumption on campus, but also provides health, environmental, educational and social benefits as well. By connecting students to the food supply, a Waller Creek ‘community garden’ can provide a unique opportunity to campus administrators to further health and wellness initiatives. As part of the holistic college experience, student-led agriculture initiatives can promote a permanently healthful and enriching activity. From an environmental standpoint, biodynamic agricultural activity on the banks of the Waller Creek can promote soil health and remediate pollution. An urban farm can also provide habitat for the bird life and butterflies that migrate through Austin. The urban garden will serve as a place for students to come together, research and reflect, and through its very nature promotes a physically active and mentally stimulating environment that would enrich students’ educational experience.

There are two types of factors to consider in choosing a site for the Waller Creek Riparian Farm: agricultural factors (such as sun exposure, grade, water availability, and soil quality) and human factors (such as accessibility, visibility, existing space utilization, and usage risks, including possible soil toxicity). Two sites best meet these requirements: along the western side of San Jacinto Boulevard both north and south of 24th Street are two distinct plots of land that can offer a great opportunity to develop a campus community garden. Recommended value-added crops and native edibles for a riparian farm include: casse (Acacia jamensis), antelope horns (Asclepias asperula), Texas persimmon (Diospyros texana), prickly pear cactus (Opuntia englemannii), Texas mulberry (Morus microphylla), Mexican plum (Prunus Mexicanana), and peach (Prunus persica).
Recommendation 3: Incorporation into Pedestrian Network

Additional access points are identified on Sketch 3. These points of access should be gradually integrated into Waller Creek and the streets intersecting the creek. Many possibilities exist for this along San Jacinto Street and the streets intersecting the creek, including reduced downstream flooding and erosion. Diverting runoff from the 400,000 square feet of stadium catchment would also benefit the creek. The UT Austin Landscape Master Plan proposes an environmental framework to address Waller Creek’s environmental and social issues. The Landscape Master Plan supports the creation of an ecologically sound and physically resilient environment, including increased access and connectivity across campus. This report on connectivity and access to Waller Creek sets forth best management practices (BMPs) that address UT Austin’s community and master planning objectives; a few key examples of the recommended BMPs include:

ENGAGEMENT: ADOPT-A-CREEK

UT Austin’s staff is currently charged with the upkeep of Waller Creek, an enormous task given the size of the creek. According to the UT Austin Waller Creek website (www.wallercreekut.org), they host a creek clean-up with students twice per year. Our recommendation is to utilize the large UT Austin student body for maintenance of the creek through an adopt-a-creek program. The principle of connection to place discussed in the Landscape Master Plan can be enriched by integrating students into the upkeep of Waller Creek.

AWARENESS: PLANT SALE AND FAIR

Hosting of a plant sale and fair that features plants or products (something edible or useful) from the creek both creates a new campus tradition and also demonstrates the value of the creek. The focus on plants and products from the creek emphasizes the creek’s functional aspects, in addition to its landscape and aesthetic values. Funds raised from the sale can support the adopt-a-creek program or perhaps be used in conjunction with the Waller Creek Conservancy, a nonprofit working to protect and revitalize the stretch of the creek just south of UT Austin.

PROGRAMMING: WALLER CREEK ONE-ACTS

Waller Creek One-Acts features an event-based effort that will increase access and connectivity to Waller Creek as an environmental, recreational, and community resource community. A one-act is a play that has only one act, rather than a full performance with multiple scenes and/or transitions. The event will take place twice a year behind the Alumni Center, once in the fall semester and once in the spring semester.

L. CLINT NEF & STEVEN RICHTER
STUDENT RESEARCH: RAINWATER HARVESTING

UT Austin uses a lot of water—water for lawn and plant life irrigation systems, fountains, chilling stations, drinking fountains, sinks, toilets and showers for 80,000 students. According to CFPM, the chilling stations are the largest single demand at 400,000,000 gallons of water per year (approximately 55%). UT Austin purchases water from the local municipality at a rate of $5.95 for 1,000 gallons of water, costing the university several million dollars each year.

Contrasting usage with the average annual rainfall on campus highlights a major opportunity to change the water system at UT Austin receives an average annual rainfall of 33 inches. Since it was founded, the physical territory of UT Austin has grown tenfold, from the original 40 acres to 423.5 acres. Given these premises, Table 1 illustrates that the effective amount of storm water that falls on the catchment of the UT Austin campus is 377 million gallons, which could constitute a significant portion of water used by the university annually.

In addition, considering the amount of impervious surface on campus, rainwater usually ends up as stormwater channeled into Waller Creek, causing additional erosion and bank destabilization. Therefore, rainwater harvesting offers both a resource for UT Austin and a means of relieving stormwater pressure on Waller Creek.

While the campus will not be able to harvest all of this rainwater, there is a great opportunity for a large catchment area—the University of Texas Memorial Stadium—close to two major consumers of water on campus: both the storage tank for the cooling towers (#2) and the LBJ lawn (#3) are about 700 yards from the Texas Memorial Stadium (#1). Also included is an in-depth analysis of the site requirements and financial requirements of designing and implementing a rainwater system for the Texas Memorial Stadium. Because of high costs, a rainwater harvesting system for a 400,000 square foot university football stadium does not appear to be feasible without external funding. On the other hand, paying a minimum of $23.8 million for water over the next 10 years seems like money poorly spent in light of the amount of water sent down the storm drain without being applied to the campus’s needs, in addition to the negative impacts of using Waller Creek for stormwater disposal. Similar projects at other universities—summaries of which can be found in the Texas CityLab files—appear to be gaining popularity. To disperse costs, the rainwater harvesting system could be implemented in stages—as other campus construction and infrastructure projects become necessary, there is an opportunity for synergy with the rainwater harvest project. In the long term it is inevitable that UT Austin must find ways to use the water that falls on campus, and those plans should start with the one of the most recognizable and frequently visited sites on campus.
Waller Creek provides a unique opportunity to establish a resource for users of Dell Medical Center and students at UT Austin (see Figure 1). The enhancement of Waller Creek will have beneficial effects in the healing process of patients; improve mental health and cognitive functioning of medical center users and UT Austin students; influence the user and student populations to make healthy physical health decisions; and finally provide an opportunity for connection among a diverse student body. Key considerations in achieving these goals include user access, sensory complexity, consistent maintenance, and ecological functioning.

STUDENT RESEARCH: WATER QUALITY & QUANTITY

This report examined the available water quality and quantity related to the portion of Waller Creek flowing through the UT Austin campus. Recommended best management practices (BMPs) focus on increasing data collection, addressing water quality challenges, increasing the accessibility of data, and better involving UT Austin students in these efforts. Two key examples of these suggested BMPs are:

WATER QUALITY

The Implementation Plan recently approved by the Texas Commission on Environmental Quality (TCEQ) aims to improve water quality within Waller Creek by reducing animal waste contamination. Sources of animal waste bacteria in Waller Creek include stormwater runoff, sanitary sewer overflows, leaking or illicit discharge from centralized wastewater collection lines, unmanaged wildlife, managed livestock, domestic pets, failing on-site sewage facilities, and direct human contributions. Of these sources of bacteria, stormwater runoff comprises the major threat to the stretch of Waller Creek located on UT Austin’s campus. The TCEQ has designated three water quality monitoring stations along Waller Creek, including the 24th Street monitoring station, which is within UT Austin’s campus. As part of the ongoing effort to make Waller Creek more accessible to the public, this report suggests displaying the water quality monitoring results on a public forum such as the TCEQ website, any UT Austin-affiliated webpage, or even the forum suggested below for the display of water quantity data. Several other best management practices in the full report detail how to reduce nonpoint source animal waste bacterial contamination throughout the stretch of creek that runs through campus.

WATER QUANTITY

Designing a geo-spatial database to collect and integrate stream-gauge data on Waller Creek requires relatively low implementation funding. Local student organizations can be recruited to place and monitor gauges, as well as construct and maintain the database. In turn, this type of ownership could foster new forms of stewardship of Waller Creek. The 11 street crossings over the creek within the UT Austin campus provide ideal places to install inexpensive stream gauges for the purpose of gathering water flow data (see Figures 5 and 6).
Imagine Austin describes how Austin can be livable, natural and sustainable, mobile and educated, and how Austin can value and help improve residents’ quality of life. The Austin City Council adopted the plan in 2012, and the City created the plan to reflect Austin’s values and its goals, as well as Imagine Austin’s goals and key recommendations on how those efforts can be adapted to fit Austin’s needs.

Along with Senator Kirk Watson, Mayor Lefingwell appointed more than two dozen local business owners and community stakeholders to an Innovation District Advisory Group to further explore implementing an innovation zone surrounding the currently under-construction University of Texas Dell Medical School, and to further examine the effects the Zone would have on the Austin region. Together, several Austin anchor institutions currently are collaborating to form the Innovation Zone. Anchor institutions are public or private organizations that provide community benefits, and that share key characteristics such as their size, immobility, community ties, and motivation to serve the community. Examples of Austin anchors that this report identifies are: Austin Community College (ACC), Austin Independent School District (AISD), Central Health, Dell, H-E-B, the University of Texas at Austin, St. David’s Healthcare, Samsung, and Seton Healthcare Family.

The Dell Medical School, located along Waller Creek, will serve as an anchor institution within the Austin Innovation Zone. Another anchor institution, Central Health, plans to purchase medical services from the medical school, and it currently is assessing how to repurpose its Brackenridge campus that is adjacent to the new Dell Medical School. Additionally, Seton Hospital is developing a new teaching hospital within the proposed Innovation Zone. Leveraging this collaboration between the public and private sectors will result in the projected creation of 7,000 jobs and $2.7 billion in direct sales upon completion—major contributions toward economic sustainability of the UT Austin campus and the broader City of Austin area.

Ways in which anchors can help accomplish Imagine Austin’s goals include partnerships with local businesses, local procurement, event and program sponsorships, and charitable donations. This report examines intersections between local anchors and philanthropic missions to identify potential partnerships among those that align, and help identify key areas where more can be done to address Austin’s pressing needs. Beyond altruistic efforts to improve the city in which they reside, anchors have various financial incentives to behave with corporate social responsibility. These include improved public relations, workforce attraction and retention, and government incentives. Challenges exist that make anchor behavior difficult, such as aligning missions, communication strategies, governmental support, balancing corporate interests, and identifying where their efforts are most needed. Strategies to overcome these obstacles, such as a detailed mission matrix, are outlined in this report. Best practices for anchor collaboration are also examined with key recommendations on how those efforts can be adapted to fit Austin’s needs.

Data collection for this report involved research, surveys, interviews, focus groups, and conference attendance. We conducted four focus groups composed of local community leaders to gather ideas about Austin’s needs, local anchor institutions, the proposed Innovation district, and anchor collaborations to address local problems. We also used phone and in-person interviews with local leaders to gather more in-depth information regarding these issues. Internet data collection allowed for compilation of current information on Austin institutions and their goals, as well as Imagine Austin initiatives. Also, we conducted a literature review of relevant published materials on innovation districts, anchor institutions, and local partnerships. The research team developed the Austin Anchor Dashboard to measure community level outcomes and progress towards the Imagine Austin Vision. The Dashboard consists of Key Performance Indicators to evaluate Austin’s success in attaining this vision and offers suggestions for specific actions that Anchors may take to contribute to Austin’s community-wide success.

After data collection, team members developed several major research themes. The four focus groups gave the team insight into how community leaders envision anchor institutions’ roles, and their community responsibilities; additionally, the team learned how these individuals perceive the proposed Innovation Zone, and the positive and negative community effects that it could have. Team members also attended various community forums and workshops to learn about core community concerns.

In addition, to identify best practices for Austin’s planned Innovation Zone, students examined several existing innovation districts and used these case studies to provide various approaches to governance structures and insight into how Austin can achieve Imagine Austin’s goals including engaging the community, providing affordable housing, offering business services, leveraging public transit and creating education pipelines.
Explore UT—the biggest open house in Texas—is an annual event providing an opportunity for visitors to examine the rich and varied programs that are a part of everyday life on this campus. Schools across campus host activities for young children, prospective students, and alumni to all enjoy.

Texas CityLab organized an interactive rainwater lab to teach the principles of green stormwater design to area youth. Participants watched a run-off demonstration, and were then able to build a mini stormwater system out of organic matter and reused materials pulled from the School of Architecture’s waste stream.
The Symposium for Texas CityLab’s 2014-2015 year was held on May 1st, 2015 in the Main Jury Room of Goldsmith Hall. Attendees heard student presentations on class research conducted throughout the year, as well as remarks from several key stakeholders.

**AGENDA**

2:15 Opening Remarks  
Dr. Fritz Steiner: Dean, School of Architecture  
Jim Walker: UT Austin, Director of Sustainability  
Dr. Katherine Lieberknecht: CityLab, Faculty PI + Lecturer, Community and Regional Planning

2:35 Student Presentations  
Zero Waste: Warner Cook + Brent Perdue  
Value Proposition: Ashley Brandish, Ryan Brim + Jieun Lee  
Energy & Water Conservation: Daniel Tan  
Wildlife & Biodiversity: Deborah Odette + Audrey Nguyen  
Waller Creek: Jody Broccoli-Hickey

3:10 What’s Next: 2015-2016  
Leander, Texas: Dr. Katherine Lieberknecht

3:15 Closing Remarks  
Dr. Allan Shearer: Co-Director, CSD + Associate Professor, Landscape Architecture

When Texas CityLab first approached Dr. Steve Kraal, Associate Vice President of Campus Planning and Facilities Management (CPFM), over two years ago suggesting they would incentivize faculty to work with students to help his staff creatively address their day to day challenges, Steve got a headache. Staff often spoke to classes or shared information with students, but such encounters often consumed staff time with little actionable results, or worse, with students getting excited about fantastical ideas removed from operational reality.

But this opportunity was different in two ways. Texas CityLab’s core purpose was to work with cities as clients, meaning faculty and students had to approach problem solving with the budget and implementation constraints of their client in mind – not to stifle students’ imagination, but to shape it. Secondly, Steve was aware of the growing national ‘living lab’ movement in higher education – the active effort to connect the innovation found in the classroom and research lab with the operational needs of the physical campus.

Another motivation shared by Steve and the other CPMF leadership he recruited, including myself, was the interest to show off the quality and care of the work done by so many throughout CPFM, and University Operations, CPFM’s parent unit. The role of University Operations staff is to support the educational mission and keep campus running smoothly, a job which often goes unnoticed by faculty and students. We shared the hope that at least the 500 students participating in Texas CityLab courses — and likely some of the students they interacted with — would become more aware of all the work that goes into everyday tasks like removing poison ivy in Waller Creek; picking up trash and recycling; or ensuring that wildlife doesn’t get into buildings. The Texas CityLab partnership made the nuts and bolts of campus operations more visible to students and faculty, strengthening their connection to staff and the campus itself. Conversely, having a deeply considered student perspective on staff activities that depend on students’ participation is and will always be invaluable.

Those relationships – of faculty to staff, staff to students, and students to campus – are what we hope to build on going forward. Several of the specific ideas and personal collaborations mentioned in this report will continue and evolve, and new collaborations will emerge. The Office of Sustainability will take a role in helping staff across University Operations stay engaged even as many units maintain their own direct connections with faculty. Students seeking ways to use campus in their academic endeavors can contact the Office of Sustainability directly, participate in a Green Campus Tour, or get involved with one of the many sustainability focused student organizations on campus.

Since this pilot project began, Steve has retired, CPFM has been reorganized, and sustainability is more popular than ever. We thank Texas CityLab for nurturing these relationships with faculty and the living lab concept with us, and will certainly do our best to keep it growing in every corner of campus.

**CONCLUSION**

**JIM WALKER**  
Director, Office of Sustainability
Jim Walker is the director of the Office of Sustainability at The University of Texas at Austin, where he collaborates, tracks and reports on sustainability initiatives throughout campus. This includes facilitation of the President’s Sustainability Steering Committee, the campus master plan, waste reduction, energy conservation, and projects initiated through Green Fee funding. Previous to joining higher education, Jim worked as the executive director of the Central Texas Sustainability Indicators Project.

Jim received his Masters of Science in Community and Regional Planning from The University of Texas at Austin and a Bachelors of Science from the University of Redlands. He is a member of the American Institute of Certified Planners and an honorary member of the Texas Society of Architects.

Katherine Lieberknecht is a lecturer in the Community and Regional Planning program in the School of Architecture at UT Austin and currently is Principal Investigator of the Texas CityLab program. She is also a fellow with the School’s Center for Sustainable Development. Her research areas include land use and water resources planning, the equity implications of land conservation, community-based approaches to land conservation and economic development, and productive landscapes.

Dr. Lieberknecht currently teaches courses on urban agriculture systems and water resources planning and has taught courses on land conservation, non-profit management and property rights. She has published academic articles in the Journal of the American Planning Association, the Journal of Hydrology, and the Journal of Sustainable Forestry, as well as published numerous professional reports focused on land conservation, sustainable economic development, and neighborhood sustainability planning. Prior to joining the UT Austin faculty, she worked as a planner in private practice in Oregon and as staff member at the Finger Lakes Land Trust in upstate New York. She received her Bachelors of Science in Biology from the College of William and Mary, a Masters in Environmental Management from Yale University, and a Ph.D. in City and Regional Planning from Cornell University.

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