Appendix B

CANALILLO
DESIGN PROPOSAL

Credits

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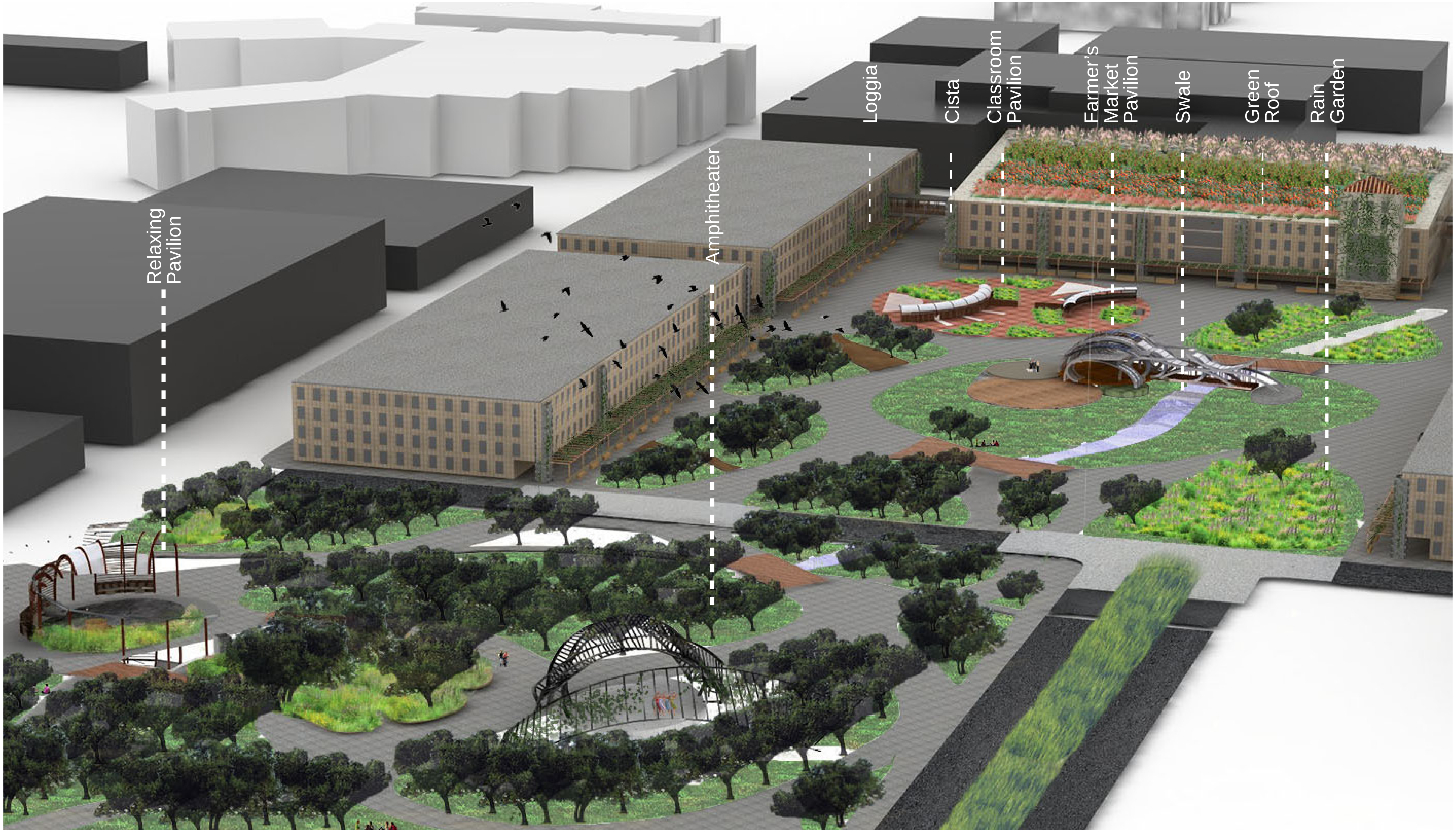

Relaxing Pavilion
Amphitheater
Loggia
Cista
Classroom Pavilion
Farmer's Market Pavilion
Swale
Green Roof
Rain Garden

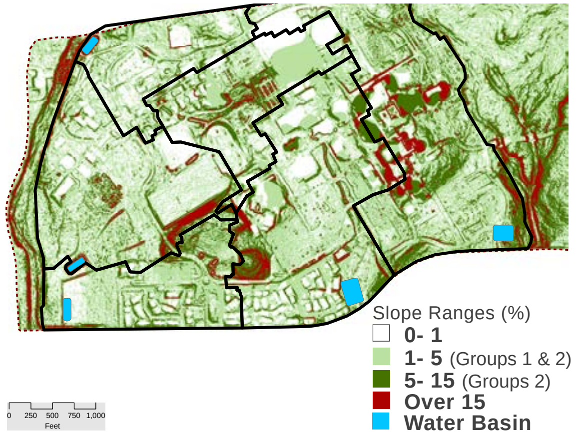
Introduction

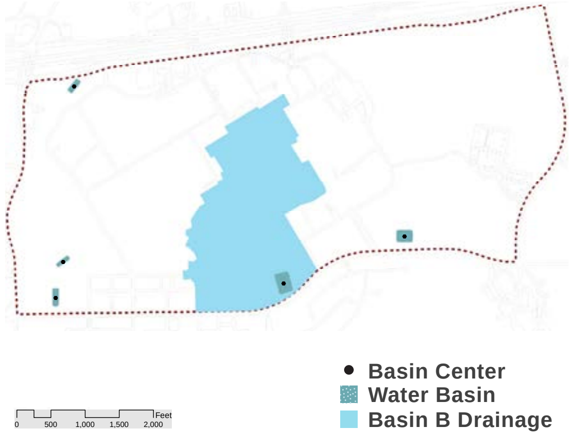
The three main goals of the Canalillo project, which is planned to replace the traditional central quadrant of the main campus, are to recharge the aquifer, collect rainwater, and enhance water quality through a series of LID practices known as the treatment train. These goals will be achieved by implementing different types of LID practices throughout the central quad. The strategies to achieve these goals include planting 27 new trees that will be added to the existing 127 trees on site; adding multiple rain gardens that will be spatially distributed throughout the site; enhancing the performance of the existing swale by retrofitting it into a bioswale; and adding CISTAs, an avant-garde prototype cistern that will reuse collected stormwater for irrigation purpose.

This transformation of the central quad will offer a great opportunity for future generations to be educated about sustainability by the model that UTSA offers as and experiential and innovative open lab. This radical change of landscape will also replace the existing sand filter of WQB-D that is challenged by complex maintenance and operation.

Although the existing basin treat and infiltrate stormwater into the Edwards Aquifer Recharge Zone (EARZ), it is limited to quality of water for a small portion of rainfall during peak storms. Because of its engineered nature as well as the surfaces impermeability, the majority of rain is washed off to the sewage system, and none of the rainfall is collected from rooftops for reuse, and the area largely lacks aesthetics and users' interaction with nature.

By implementing this proposed design on UTSA's central quad, the existing, parking-dominated spaces will be transformed into a welcoming landscape for the community and students to come together and engage in multiple outdoor activities and educational experience.






North Paseo
Main Paseo
South Paseo
Existing Paseo
Future Paseo
Design Zone (Central Quad)
Image Location
Existing Buildings
Future Buildings
Water Quality Basin-D (WQB-D)

Appendix B

Innovations & Design Features

The Canalillo project comprises a treatment train that collects, filters, and infiltrates rainwater into the aquifer. The system offers the university additional credits of campus sustainability through fulfilling additional points towards STARS in both operation and academic categories. This additional credit includes three sub-categories: OP10, OP27, and AC9. Several structures are integrated in the system including modular cisterns, which will be part of building external façades throughout the central quad. Permeable concrete in key places of the site will also filter rainwater, but the main infiltration locations will be four rain gardens at the corners of the quad, as well as the bioswale. The five structures distributed throughout the site increase the university's sustainability and economic benefits through enhancing the return on investment (ROI). Students will also benefit from the multiple outdoor spaces created for enhancing awareness of LID and eco-friendly design.

F1

F2

Bioretention

(Located along the swale)

- Allow for knowledge to be attained from the implementation of green infrastructure typologies.
- Places of gatherings, and bicycle rentals.
- Provides natural settings that are both pleasing, and therapeutic for people.

By implementing a variety of LID techniques including five rain gardens, bioswale, and permeable concrete, and water harvesting system in this part of the main campus, students and visitors will gain an understanding of LID benefits. Additionally, installing proper signage throughout the site, offers a transformational experience for students and community members. Open spaces, and structures proposed as places of gathering are opportunities to interact with nature. Phase 1 of this project will not only help reduce costs over time, but provide a more natural setting emulating the pre-development site that will help improve water quality and reduce runoff volume.

F3 source: treehugger.com

Water Harvesting

(Along building facades)

- RECYCLED MATERIAL
- ADAPTABLE
- LID PRACTICES

- Allow for knowledge to be attained from the implementation of green infrastructure typologies.
- Raises LID awareness and student/ community hub.

A water harvesting techniques used in the loggia design is the Cista concept. This concept is a rain water storage tank. It stores water in a vertical tank that sit up against the building facade. These tanks are placed where the gutters are located. This tanks receive water from the green roof and can store up to 100 gallons. The tanks are covered in a steel mesh which help vines grow up the vertical tank.

Sustainable Structures

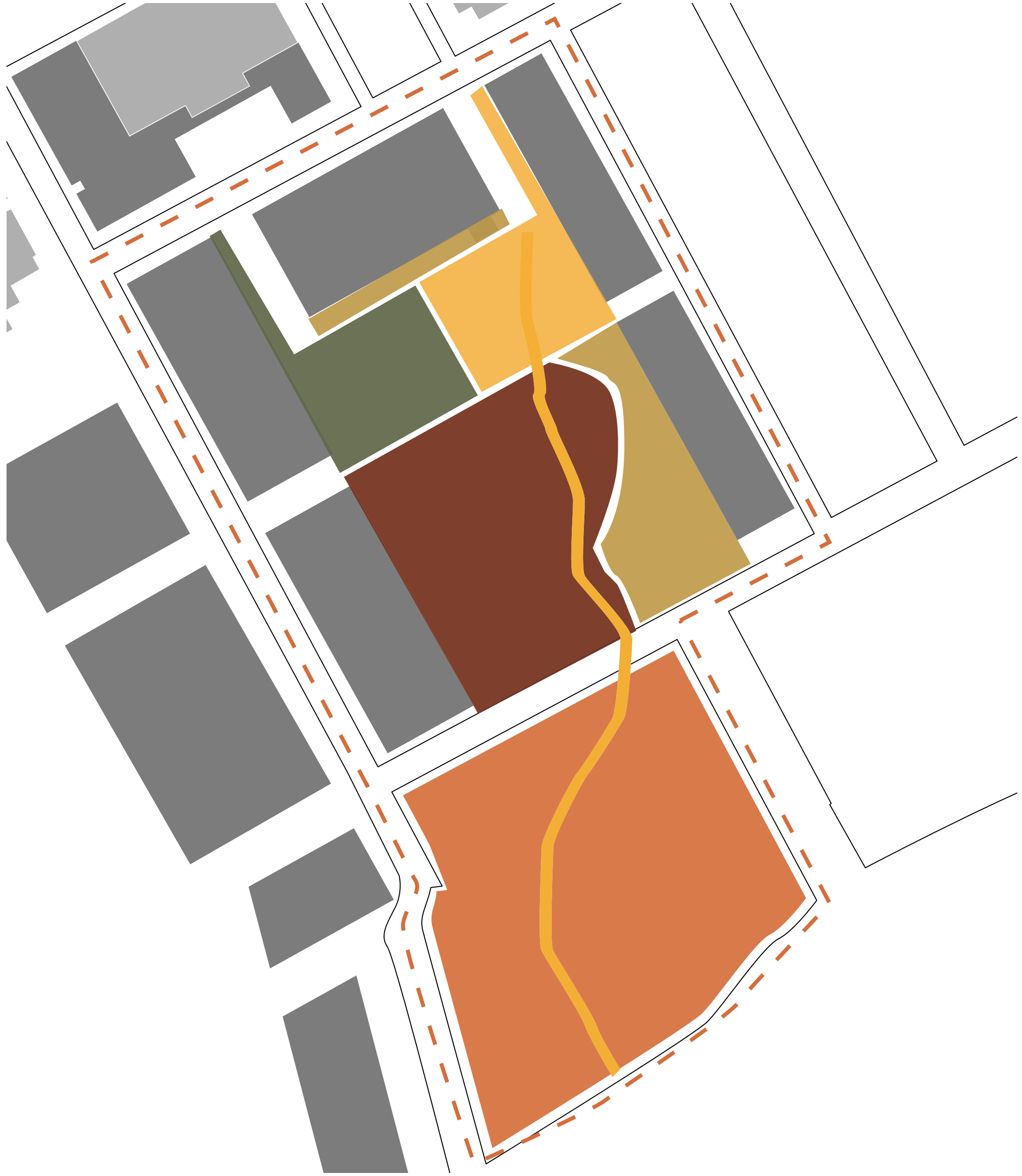
- SHADING
- SOCIAL INTERACTIONS
- NATURAL VENTILATION
- ADAPTABLE
- LID PRACTICES
- PHOTOVOLTAIC PANELS

- Sustainable structures provide resting, social, water harvesting areas, and bicycle rentals.
- Raises LID awareness and student/ community hub.

There are a total of five structures located along the site which consist of a Loggia, Bike Rack Pavilion, Amphitheater, Balance, and Concatenation. These structures provide student hubs that promote social and educational interaction by making students a part of the LID setting. This helps raise awareness, improves the student experience with environment, and includes water conservation.

Design Phases
(By zone)

The overall Canalillo project will span across 20 year of implementation that complements the proposed 2040 UTSA master plan. The proposed five phases will incorporate locations of LID practices throughout the site, and materials and plants selection. Retrofitting the existing swale into a bioswale as well as constructing one rain garden, and a segment of a green shaded pathway connecting the buildings, known as loggia, represent the first phase of this design proposal. Consecutive phases include permeable concrete, three rain gardens, green roof, sustainable structures, tree planting, and water harvesting system. The bioswale will help move water out of the campus, prevent flooding, as well infiltrate water into the aquifer.



- **Existing Building**
- **Future Building**
- **Design Zone**

Phase I

(Bioswale)

In phase one the bioswale running across the site will be the first issue targeted in the design process as well as one out of five rain gardens. Also in phase one is the loggia, a longitudinal arcade system for the five academic buildings overlooking the quad. The first part of the loggia encompassed in this phase will be for one of the five buildings.



Phase II
(Rain Gardens)

The second phase consists of the implementation one rain garden, permeable paths, and two loggia projects.



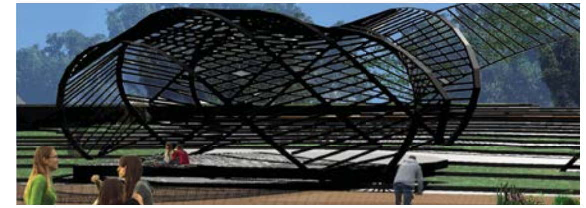
Phase III
(Classroom Pavilion)

The third phase will include the construction of the Bike Rack Pavilion which includes the third rain garden, as well as the extension of permeable paths and a Loggia facade.



Phase IV
(Farmer's Market Pavilion)

The fourth phase will construct the Concatenation project and will also include four regular gardens, permeable paths, and the last Loggia facade.

Phase V
(Relaxing Pavilion & Amphitheater)

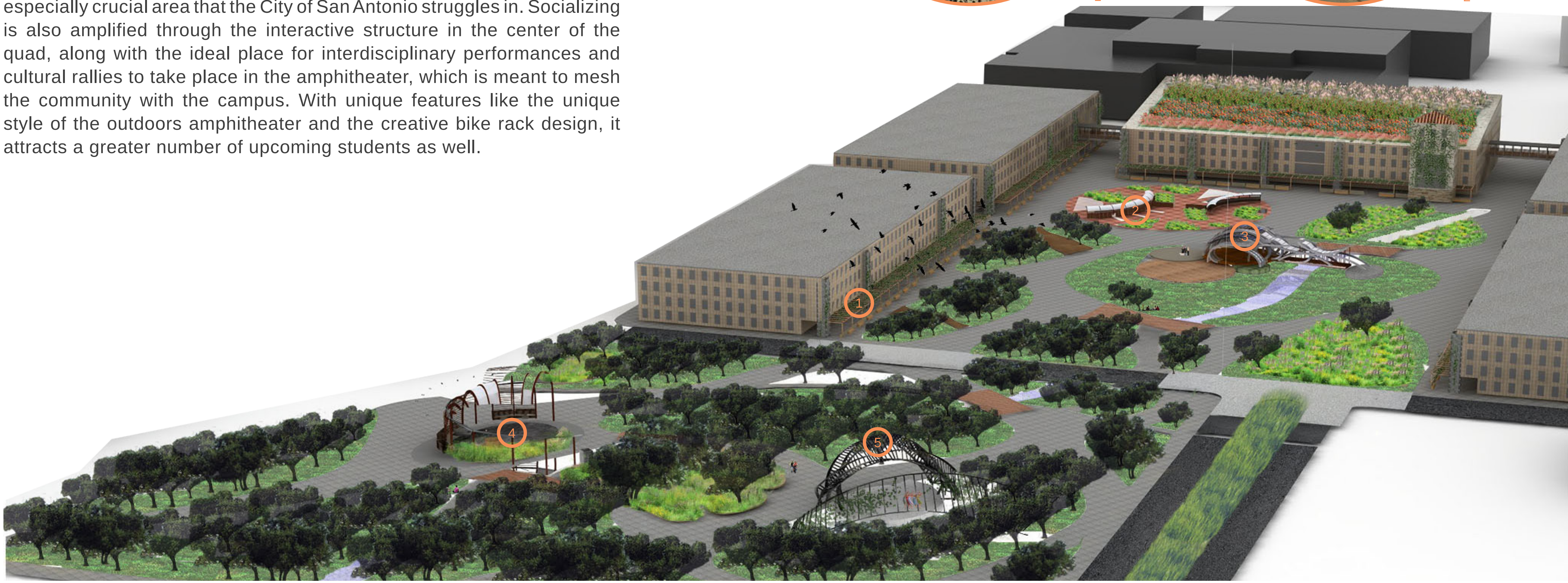
The last Phase will encompass the entire other half of the project. This phase includes the construction of the Amphitheater and the balance project. This phase also includes the final of eight regular projects, two rain gardens, and permeable paths,

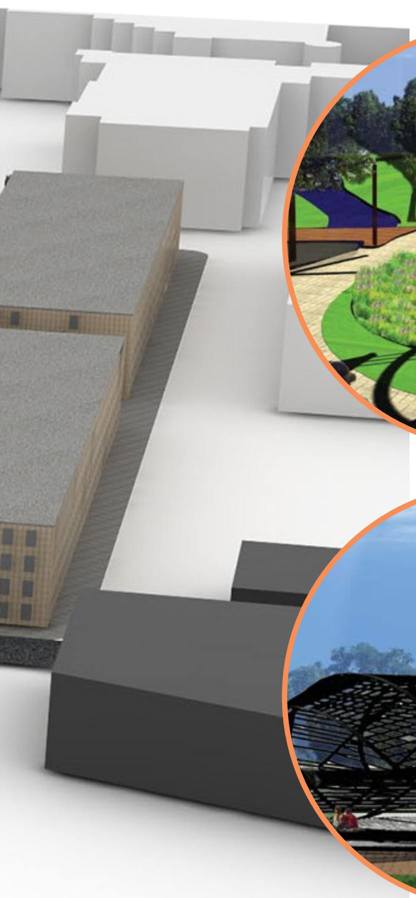
Sustainable Structures

Social Interactions on campus are also enhanced with elements like the attractive seating of shaded loggias. The implementation of the bike rack will also save the city energy through the prominence of the bike rack, which will hopefully influence automobile users to start riding their bikes to school a lot more, and will also encourage a healthier lifestyle, an especially crucial area that the City of San Antonio struggles in. Socializing is also amplified through the interactive structure in the center of the quad, along with the ideal place for interdisciplinary performances and cultural rallies to take place in the amphitheater, which is meant to mesh the community with the campus. With unique features like the unique style of the outdoors amphitheater and the creative bike rack design, it attracts a greater number of upcoming students as well.

1

2





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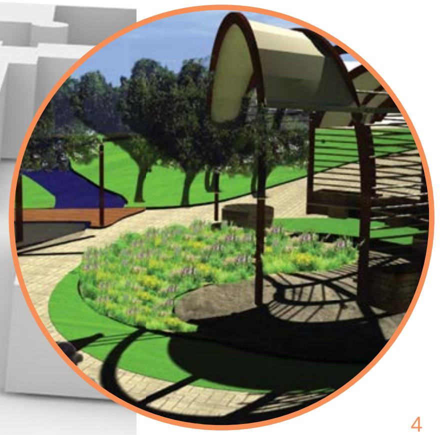

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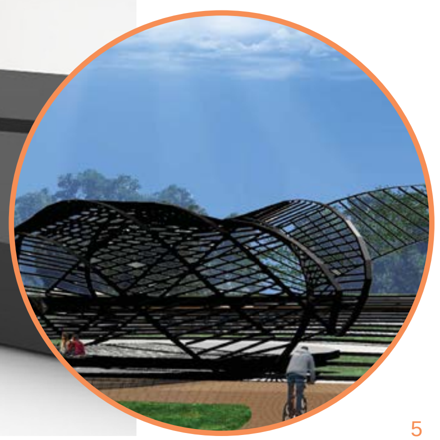

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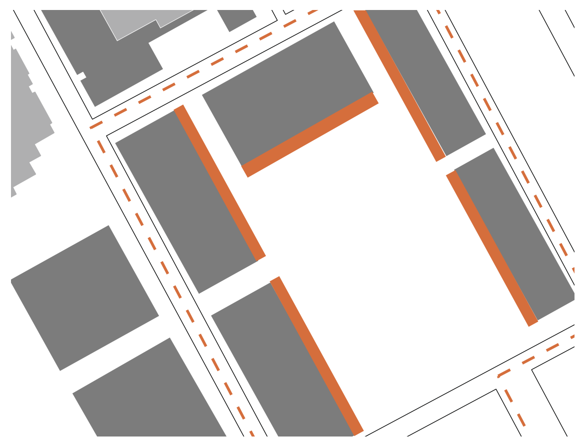
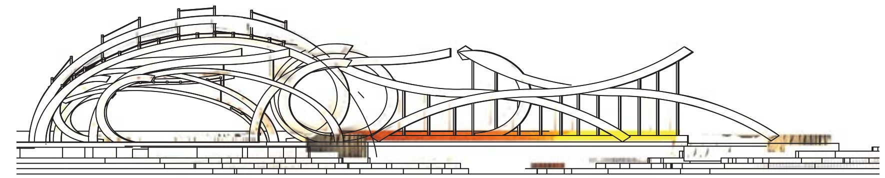
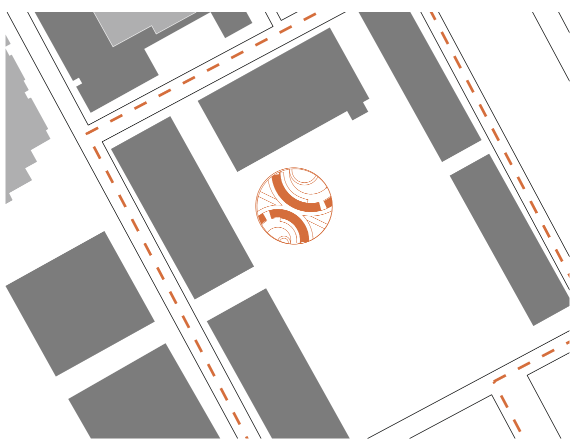


1. Loggia

(Phase I, II, III, IV)

The loggia is located along the five building facades as illustrated on the plan. Each facade will be finished according to the phases. As mentioned before each loggia has water harvesting tanks known as Cistas. These loggias also provide a shaded resting and transitional area, perfect for studying and social interaction.





2. Classroom Pavilion

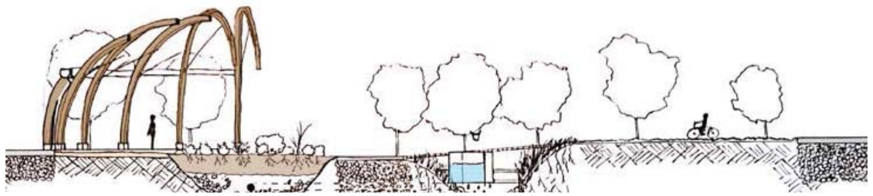
(Phase III)

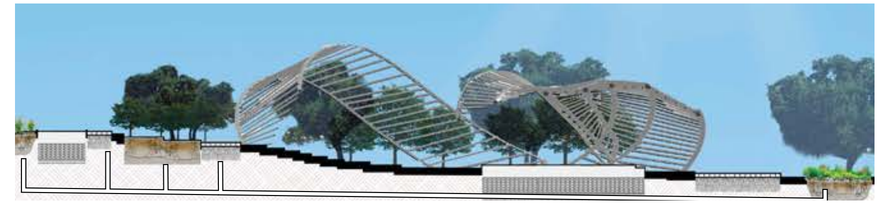
This pavilion is a great place for students and/ or educators to come to gather and teach, work on homework, study, or just socialize while being able to work with interactive screens. The pavilion also can hold student's or faculty's bikes and look at the upcoming events with a electric bulletin board at the top of the rack.

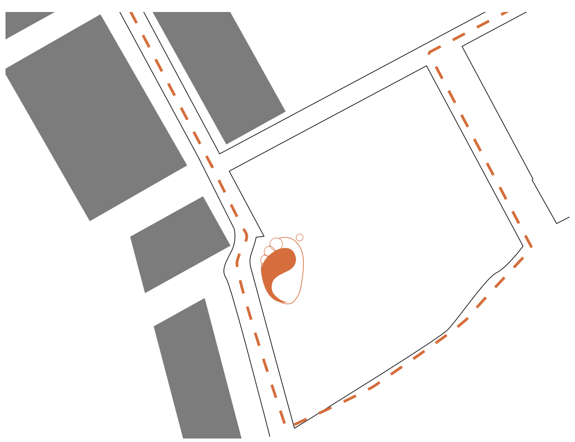
3. Farmer's Market Pavilion

(Phase IV)

The Concept behind this pavilion was to connect UTSA to the surrounding community as well as being a meeting / event venue for student life, and raise awareness and support the recharge zone above the Edwards aquifer. The pavilion's curvilinear forms are based on the paths designed for the site that connects the adjacent neighborhoods to UTSA to create a synergetic partnership.



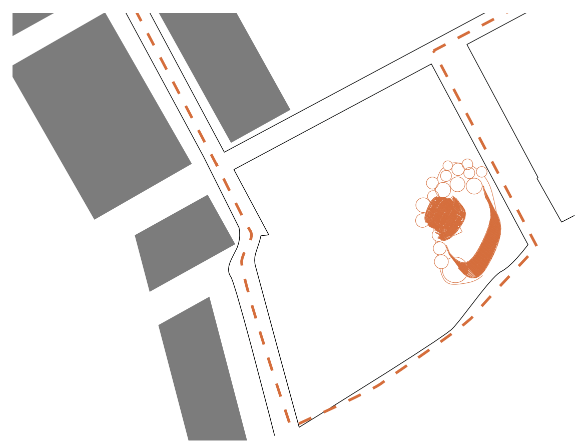




4. Relaxing Pavilion

(Phase V)

The structure proposed represents the two sides of the site where it sits in. The two side represent the built and natural environment. It is a balance and a transitional area between the two.
The way a raingarden and vegetated swale slowdown and capture stormwater runoff. While also keeping the social characteristics of the sombrilla, being its organic opposite

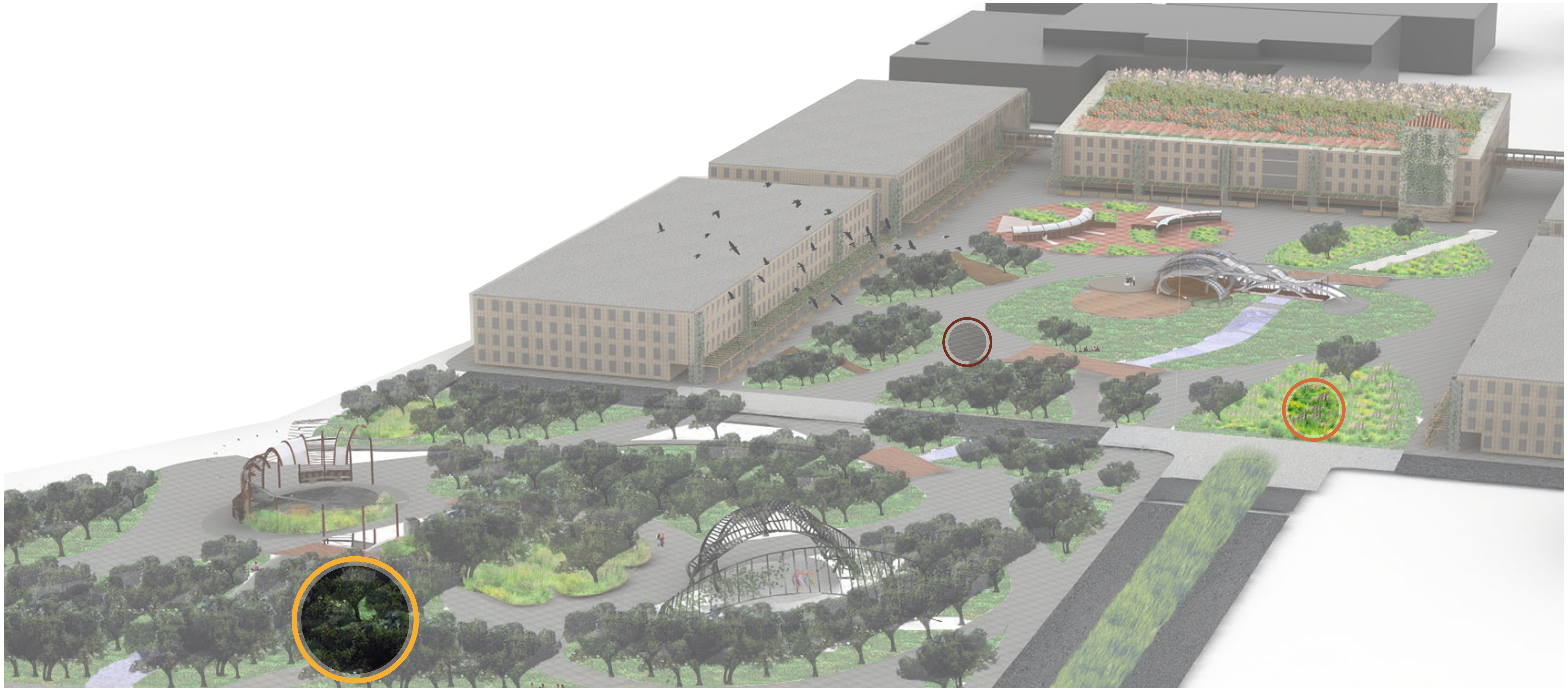


5. Amphitheater

(Phase V)

The Amphitheater will is a structure that will house student activities this structure is an ideal place for interdisciplinary performances and cultural rallies.

Plant Selection



Paving Materials
(Walkways)

Permeable Asphalt

Water to returns to the ground faster. Reduces water collection on roads and paths

Interlocking Permeable Pavers

Tightly linked and water to return to ground quicker

● *On UTSA recommended plant list*

No plant species substitutions will be allowed

Trees
(Entire Site)

Texas Lantana

Lantana urticoides
3- 6’ tall

● 

Cedar Elm

Ulmus crassifolia
50-78 ft. tall

● 

Orchird Tree

Phanera variegata
10-12 ft. tall

● 

Texas Red Oak

Quercus buckleyi
30- 50 ft. tall

Ground cover
(Setback areas/ Bio swales/ Patio areas)

● 

Gulf muhly

Muhlenbergia capillaris
2- 3 ft. tall

● 

Yellow bells/ Esperanza

Tecoma stans

● 

Cedar Sage

Salvia roemeriana
1- 1.5 ft. tall

● 

Texas Sage

Leucophyllum frutescens

Dwarf Palmetto

Sabal minor
3- 9 ft. tall

Turk’s Cap

Malvaviscus arboreus var. drummondii

● 

Red Yucca

Hesperaloe parviflora
3- 5 ft. tall

Switchgrass

Panicum virgatum

Resiliency

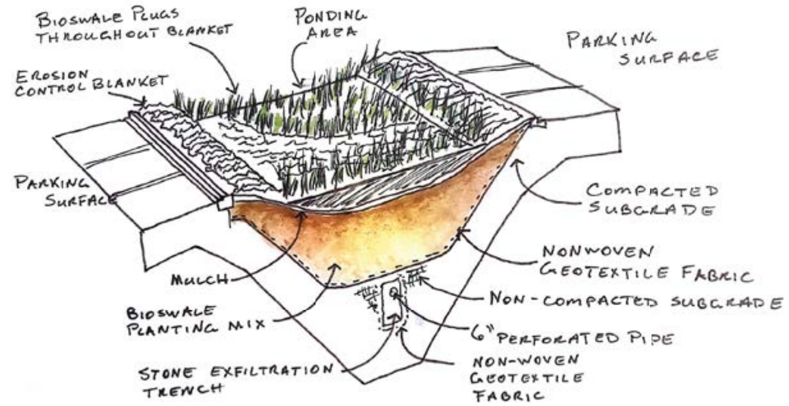
Even though San Antonio has been in intense droughts with little or no rain throughout the years, stormwater runoff at UTSA Main Campus has been an issue during major rainfalls. The implementation of rain gardens along with a vegetated swale and permeable pavement will help reduce the amount of runoff and enhance the quality of infiltrated water.

Intensive research and drainage modeling located four spots that would retain a maximum amount of stormwater to be treated and filtered into the vegetated swale, and ultimately be infiltrated into the Edwards Aquifer. Although current TCEQ regulations restrict unlined practices over the EARZ, this proposed scenario of stormwater treatment train could be examined through a pilot project that measures pollutant loads before and after infiltration through this system.

Rainfall over urban areas causes pollutants to be carried to the ground by surface runoff. Due to the Edwards Aquifer rules, the use of permanent Best Management Practices (BMP's) is required on areas over the aquifer, such as UTSA main campus, to prevent pollution; they also help reduce the peak runoff rates and runoff volumes of storms (Center for Research, 2011). Bioretention basins, or rain gardens, are the BMP's that use adsorption, plant uptake, microbial activity, filtration, and sedimentation to remove pollutants and provide high removal of sediment, metals, and organic material (Dorman et. al., 2013). Also, studies indicate that bioretention basins remove TSS by 89%, which comply with the aquifer's rules (Dorman, et. al., 2013). Quality of recycled blowdown water from the AC condensate of Engineering buildings was obtained, and the results show that it can be used to irrigate the flora of the proposed LID practices.

Rain Garden

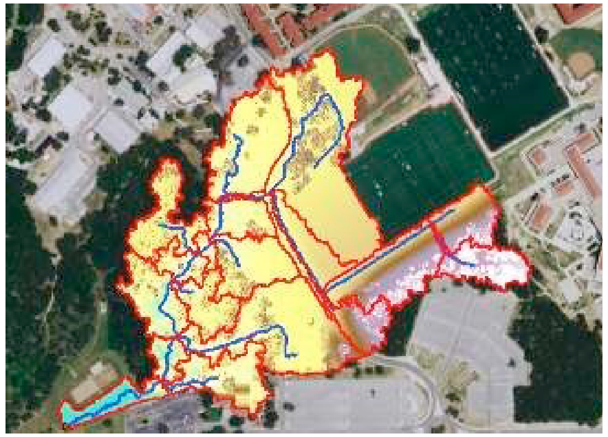
Swale



Drainage Area delineation using GIS tools

Rainfall over urban areas causes pollutants to be carried to the ground by surface runoff. Due to the Edwards Aquifer rules, the use of permanent BMPs is required on areas over the aquifer, such as UTSA, to prevent pollution. LID also help reduce the peak runoff rates and runoff volumes of storms (Center for Research, 2011). Bioretention basins are best management practices that use adsorption, plant uptake, microbial activity, filtration, and sedimentation to remove pollutants, and provide high removal of sediment, metals, and organic material (Dorman et. Al., 2013). Also, studies indicate that bioretention basins remove TSS by 89%, which comply with the aquifer’s rules (Dorman, et. al., 2013).

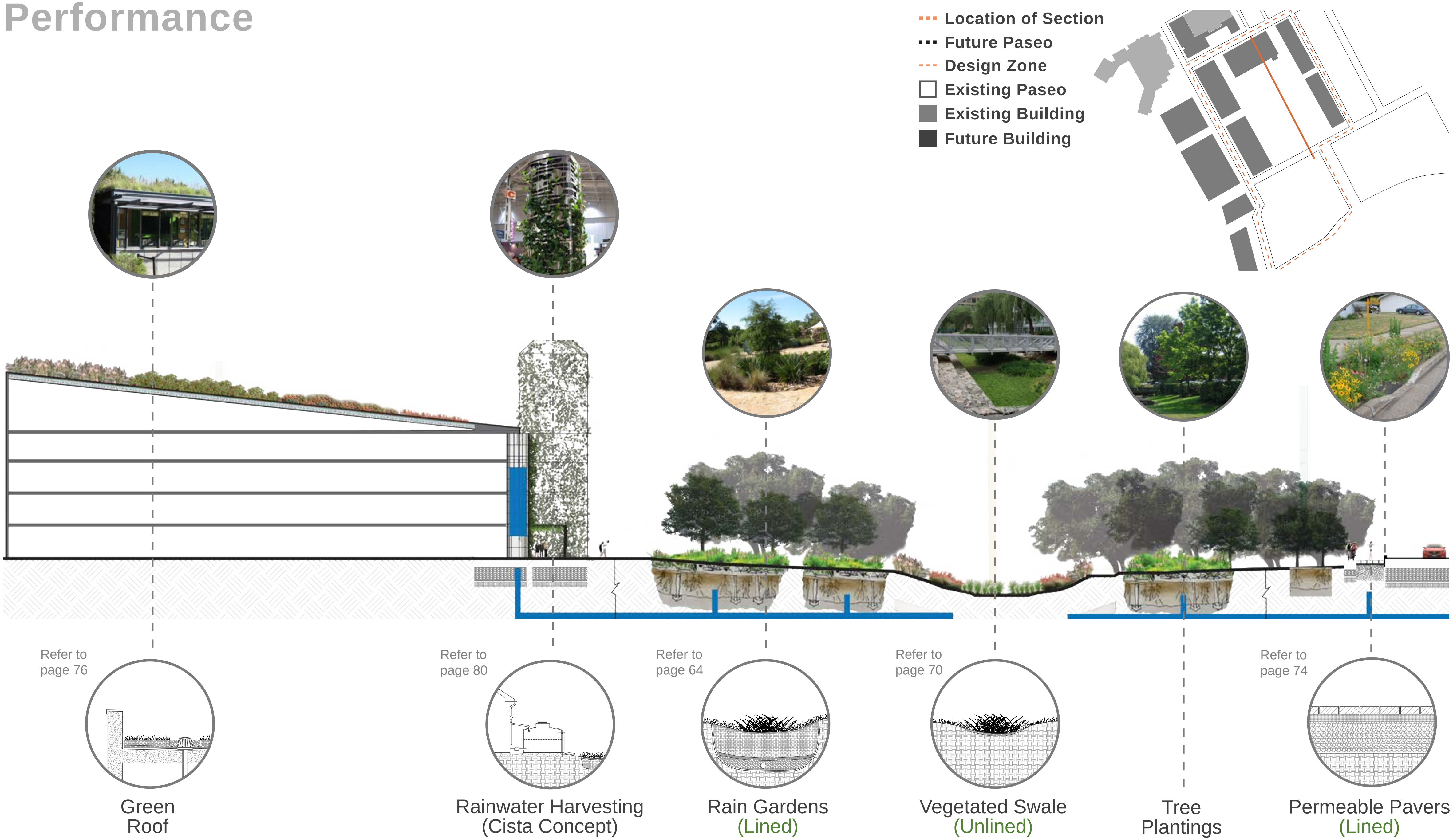
An important factor for predicting the size and locations of LID practices is to delineate the drainage area that contributes to the place where LID practices will be installed. In this project, the contributing zones were delineated using areas in the campus where LID could be installed as outlets of the regional watershed. The drainage area was calculated using a Digital Elevation Model (DEM) and a watershed processing tool in ArcGIS called HEC- GeoHMS. This software is able to transform the drainage paths and watershed boundaries into a hydraulic data structure that represents the drainage network. After determining the location of LID structures, the DEM model was processed to find the drainage network as well as the sub-areas that contribute to each LID location. Also, in addition to the water stored in the cisterns, blowdown water of the reclaimed Engineering building’s AC condensate was tested for possible irrigation use. Multiple pollutants were tested, and the results showed that blowdown water can be used to irrigate the flora of the BMP. The results are shown in the attached BMP Equations table.



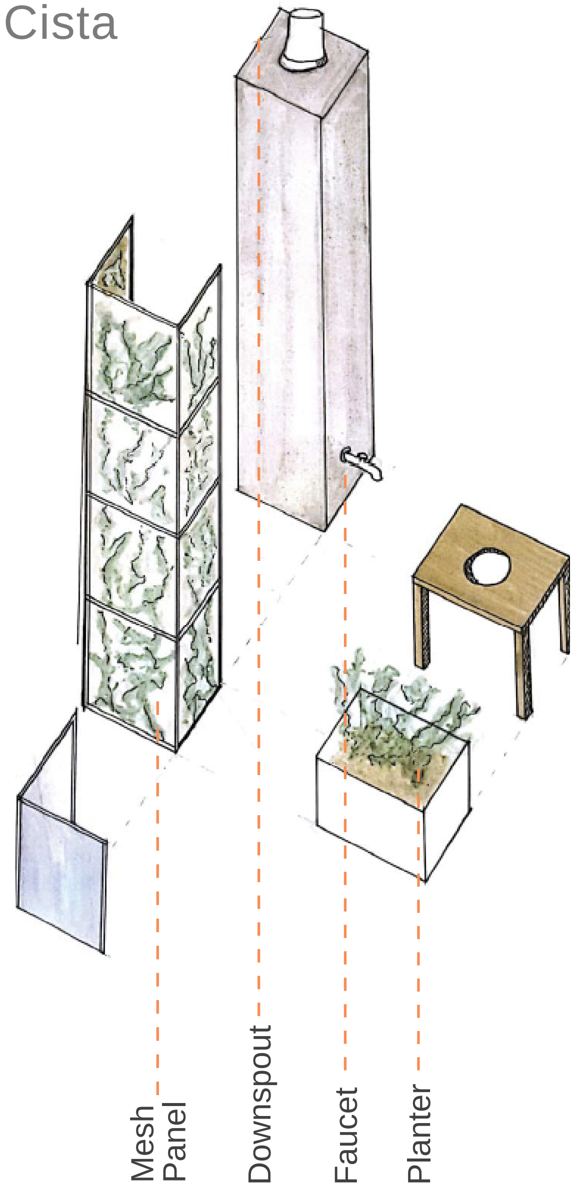
BMP Equations

Equation 3-1	LM= 27.2 (AN x P)
Equation 3-2	Equation 3-2 LR= (BMP efficiency) xPx (Ai x 34.6 + Ap x 0.54)
Equation 3-3	F= LM/ΣLR
Equation 3-4	WQV= Rainfall depth x Runoff Coefficient x Area
Where: **LM= Required TSS removal (pounds)** **AN= Net increase in impervious area (acres)** **P= Average annual precipitation (inches)** **LR= Load removed by each BMP**	Where: LM= Required TSS removal (pounds) AN= Net increase in impervious area (acres) P= Average annual precipitation (inches) LR= Load removed by each BMP BMP efficiency=TSS removal efficiency (table 3-4) Ai= impervious tributary area to the BMP (ac) Ap= pervious tributary area to the BMP (ac) P= average annual precipitation (table 3-3) F= Fraction of annual rainfall treated by BMP

Performance



Cista



Rainwater Harvesting

Rainwater harvesting is the collection, storage, and reuse of rainwater. Rainwater is collected before it is allowed to become runoff; in this case, the rainwater will be captured and stored from the rooftops of the five proposed buildings. Reducing the amount of runoff means that rainwater harvesting helps control flooding as well as decreases soil erosion typically seen with water flow. Rainwater has a very neutral pH and is free from disinfection by products, salts and minerals usually seen with other treated water sources, making it very suitable for irrigation. In San Antonio, Texas, rainfall events are uncommon but heavy. The collection and storage of rainwater can help reduce commercial water usage since it provides a water source when groundwater is limited or unavailable, such as in-between storm events or during water restrictions. But along with the independence of rainwater harvesting come the inherent responsibility of operation and maintenance. This responsibility includes purging the first-flush system, regularly cleaning roof washers and tanks, maintaining pumps, and the filtering of the rainwater.

The most expensive component of rainwater harvesting is the storage tanks. The size of the storage tanks relies on the rainwater supply, the demand, the desired reliability of the system, and budget. The rainwater supply can be determined using projected rainfall and the surface area of collection. Rainfall will be collected on each of the proposed buildings. This leads to a collection surface area of about 4.9 sq. acres also be multiplied by their respective runoff coefficients; this is because infiltration of water can be reduced depending on the material and media of the surface. For the one green roof, a runoff coefficient of 0.4 was used to allow for the amount of rainwater absorbed by the plants, while a runoff coefficient of 0.8 was used for the remaining four roofs (a value typical of concrete surfaces). Projected rainfall was calculated per day using the average daily rainfall over the past 30 years. Demand is calculated by multiplying the intended irrigation surface area (66,800 sq. ft.) by the amount of irrigation necessary per week (estimated at 1 inch/week). Reliability is based off the percentage of time the supply can meet the demand.

The material to be used for these tanks will be polyethylene because of its relatively low cost, low maintenance levels, and decent durability. A roof can be a natural collection surface for dust, leaves, twigs, insects, and animal feces. As such, a “first-flush” diverter will be utilized, rerouting the first flow of water from the catchment surface away from the storage tank. While leaf screens remove the larger debris, such as leaves and twigs that fall on the roof, the “first-flush” diverter gives the system a chance to rid itself of smaller contaminants such as dust, pollen, and feces.

Maintenance

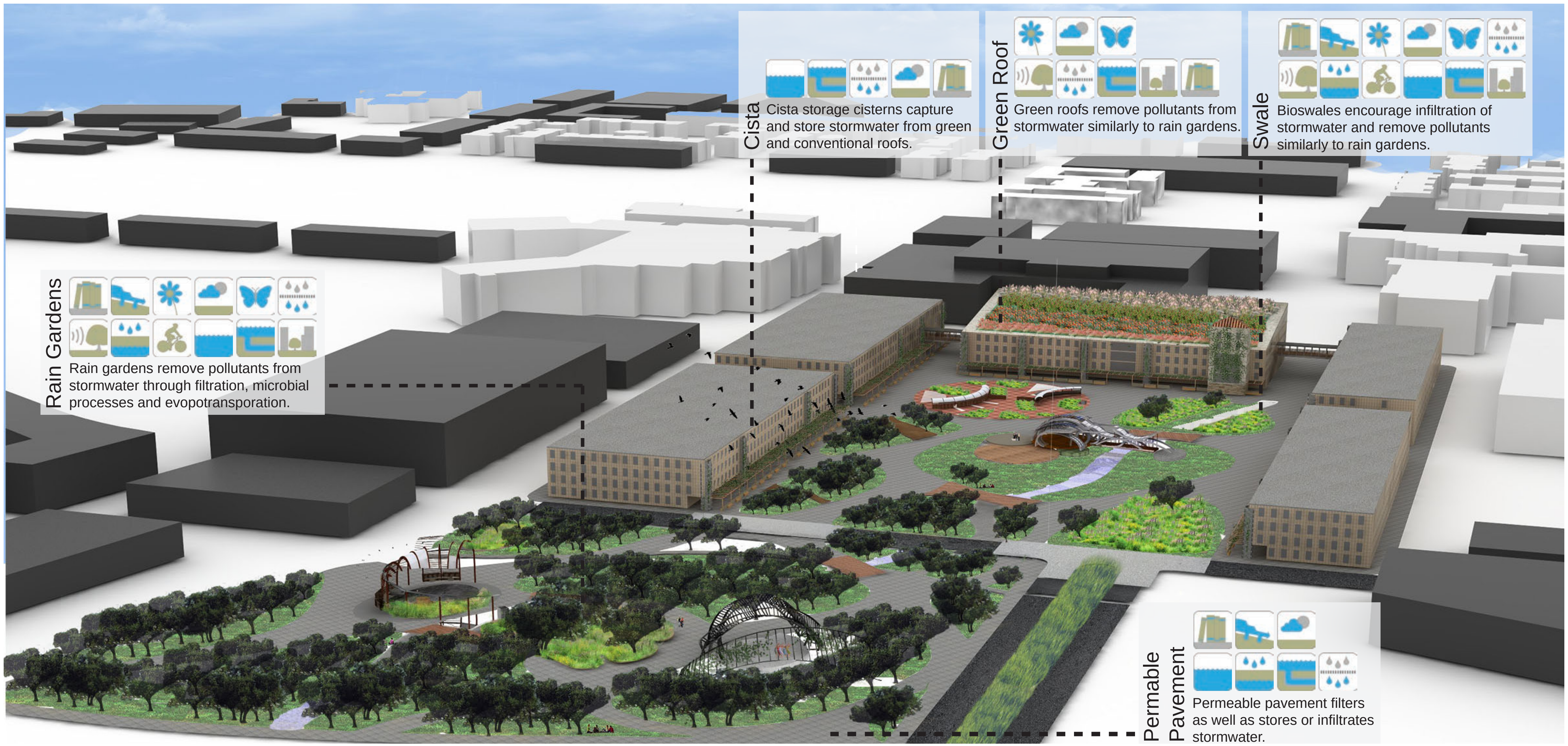


Table 1 Design & Maintenance Considerations for Canalillo Design Proposal

Canalillo	Total Area (sq ft)	Likely Overall Maintenance Complexity Level	Most Likely Maintenance Issues	Anticipated Inspection & Maintenance Frequency		Proactive Design Considerations	Proactive Maintenance Tasks
Vegetated Swale	32,120	Simple	• Sediment buildup • Litter & debris accumulation • Invasive vegetation	Before and after major rainfall events	Quarterly	• Provide a sedimentation forebay, chamber or filter strip to capture and prevent excess sediment from flowing into and clogging system • Ensure ease of access for maintenance personnel to perform litter, debris and invasive vegetation removal as well as new vegetation installation • Ensure ease of access for heavy equipment in the event that soil media removal and replacement must occur	• Clear debris, sediment, and invasive vegetation at least quarterly • Replace dead vegetation at least quarterly • Will likely require initial irrigation for plant establishment. Once vegetation has been established, irrigation will only be needed during the dry season or under extreme drought conditions. This will sustain vegetation health and effectiveness.
Rain Gardens	40,000		• Sediment buildup • Litter & debris accumulation • Invasive vegetation				
Rainwater Cisterns*	4,679		• Debris & sediment buildup inside cisterns		Twice annually	• Incorporate filtration components to strain debris from captured rainwater and prevent passage of it into storage cisterns • Ensure cisterns have adequate storage or overflow capacity to handle anticipated rainfall	• Clear gutters, downspouts, filters and tanks of debris and sediment at least twice annually • Ensure that tanks are adequately ballested before major wind related storms

*Units are cubic feet