STORM WATER MANAGEMENT MASTER PLAN FOR CENTRAL CAMPUS

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) THE RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) 2013

TEAM SPARTANS
MICHIGAN STATE UNIVERSITY
REGISTRATION NUMBER: M40

SPARTANS WILL.

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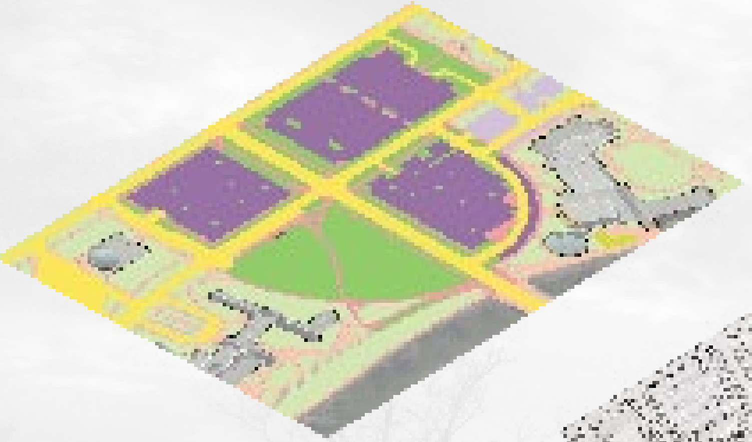

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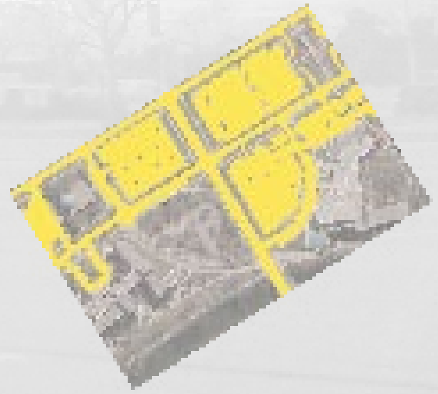


MOBILE ACCESS

MASTER PLAN

RAIN GARDENS

AMPHITHEATER

This features the crest of a Spartan helmet, built into the slope. Located just outside Erickson Hall, the home of MSU's education program, this Spartan head brings minds together. Formed in opposition to the grade change, this plaza is screened from passersby through vegetative buffers and rain gardens. This creates a private space ideal for an outdoor classroom or special event, particularly with its proximity to Erickson Hall. The planted terraces allow infiltration and create a variety of informal seating options. Also, the amphitheater is surrounded by the rain gardens and a swath of green space with water drop shaped planting pattern.

WINDING PATHWAY

The winding paths represent the paths the Spartans took to their fated battle with Leonidas against the Persian army, as well as the Eurotas River of the Spartan homeland. The surrounding landscape is planted with native species, highlighted by educational signs explaining the potential for native plants in design projects.

GREEN HOUSE

A new biodome-type greenhouse adds a unique element to the site. Unlike any other attraction on campus, the greenhouse design is derived from a request by The Student Greenhouse Project. It would sustain a variety of tropical plant species year-round, as well as a seasonal butterfly exhibit previously taking place in a smaller greenhouse to the south. This could be an educational space as well, used for classes or independent site visitors. The surrounding plaza spaces and stepped terraces create seating for visitors The greenhouse stands tall in the center, representing the mountains and valley in which the Spartans made their final stand. As they fought, they made a ring, shields locked in a protective dome-like barrier against enemy weapons. The greenhouse framework represents this impenetrable shield dome, with the crosspieces representing the showers of Persian arrows raining down against it. The doorways are reminiscent of the Spartan helmet, showing the typical eyes and nose piece.

SPARTAN SCULPTURES

A cluster of life-sized Spartan sculptures adds an artistic element, bringing the persona to life in a form that people can interact with.

RAIN GARDENS

INFILTRATION BASIN

The lower portion of the main water management system alternates deep, heavily-planted infiltration basins with large raised sections of grass to create usable space in the midst of the rain gardens. A cluster of covered seating areas on the infiltration basin, connected be a meandering boardwalk, provides another space for social gatherings and studying.

ANAEROBIC DIGESTION BASIN

A circle containing a "V"-shaped path represents a traditional Spartan hoplon shield. The lower portion of the Spartan shield circle is an anaerobic digestion basin, with limited planting of deep-rooted species.

FLUSH SAND FILTER

The upper quarter of the Spartan shield circle is the first flush sand filter, planted with only short, fibrous-rooted grasses.

BIOSWALE

A meandering bioswale flows through the planting area and directs the storm water to the flush sand filter.

COVERED AMPHITHEATER

This amphitheater sits in the center of the site, the dramatic center point to the site's radial design theme. The amphitheater design features small patches of green walls, as well as a large green wall which forms the back of the amphitheater. This green wall is sustained by rain water collected by the angular roof beams, which catch the rain as it falls and direct it into the interior of the wall, where water can be held until needed. This wall and radial beam arrangement represent the hoplon shield and dory spears, corresponding with the nearby Spartan helmet forming the other amphitheater.

ASTRONOMY PLAZA

The Plaza provides opportunities for astronomy. Star-gazing night, for example, could take place here rather than at the nearby planetarium, allowing more open space for gathering.

COVERED PATHWAY

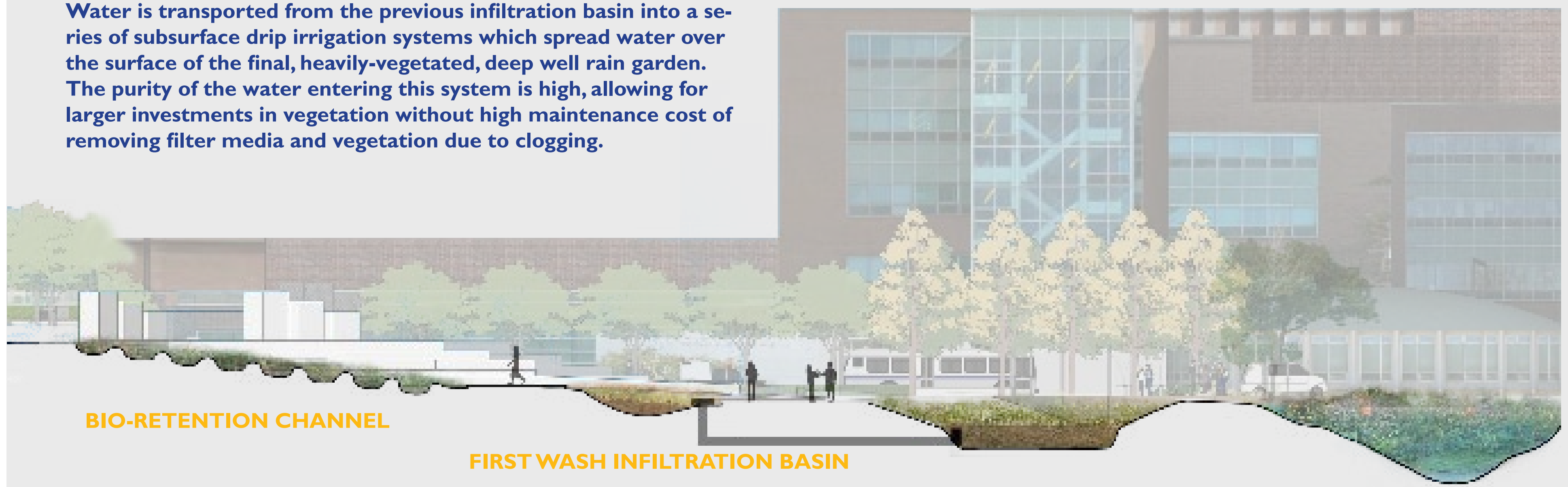
The pathway cover contains solar panels, serving to both create shade in the open space and power the pump bringing water into the cistern.

GLASS PYRAMIDS AND CISTERN

These small glass pyramids are built directly above the cistern, which is located at the highest point of the site to facilitate downward flow into bioswales. The small glass pyramids onsite bring another mountainous element into the site, representing the ancestral home of the Spartans, and also provide a view down into the dimly-lit cistern. As a significant element in the design and a unique feature on campus, the cistern could also be a point of education, providing information about the unique storm water management strategies being used onsite.

RAIN GARDEN SYSTEM

To address water quality issues, a number of new rain garden technologies are utilized. In our rain garden system, water first travels through a heavily vegetated bioswale utilizing plants with exceptional filtration and phytoremediation properties. The plants in the bioswales are selected to remove phosphorus and heavy metals from contaminated water.
The water then travels into a shallow infiltration basin to remove a majority of total suspended solids and prevent the dissolved nutrient load. The filter media in this basin will be a sandy loam mix with minimal investment in vegetation. By extending the life cycle of the preceding rain gardens, more permanent planting and investments can be made.
To increase the likelihood of nitrification, a saturated zone is created in the next filtration basin. As water flows into this area, it filters through media into a saturated zone lined by an impermeable layer. Research shows that the anaerobic conditions created in the saturated zone will significantly reduce nitrate leaching. (Yang, McCoy, Grewal, Dick, 2013) The basin is underdrained with a perforated pipe, with an outlet eight inches below the surface of the filter media. Water moves out of this system when head pressure is enough to force water up and out of the pipe into the next basin. The design utilizes the mechanics of groundwater seepage to return water to the river. This method more closely corresponds with the way that water would naturally move through the site and into the river.
Water is transported from the previous infiltration basin into a series of subsurface drip irrigation systems which spread water over the surface of the final, heavily-vegetated, deep well rain garden. The purity of the water entering this system is high, allowing for larger investments in vegetation without high maintenance cost of removing filter media and vegetation due to clogging.



BIO-RETENTION CHANNEL

Heavily vegetated;
6" sand, loam, compost;
6" drainage gravel;
2" washed stone.

FIRST WASH INFILTRATION BASIN

18" sandy loam filter media
6" perforated underdrain

SATURATED INFILTRATION BASIN

4" fine gravel
6" perforated underdrain

DEEP INFILTRATION BASIN

1' water ponding space
3' sand loam, compost
1' sand
1' gravel

DEEP INFILTRATION BASIN

The deep infiltration basin not only functions as a bioretention space; it also provides an interesting place for the MSU students, faculty, staff, and visitors.

The first three feet of this basin are composed of a sandy loam and compost mix for plant growth and hydrologic properties. Below that layer is a one-foot-deep layer of washed stone with a foot of charcoal below that. The deepest two layers are designed to withstand heavy, long-lasting rain events, employing the large amount of available pore space to hold large quantities of water. The collected water can be held in this area and slowly released into the ground as it moves toward the Red Cedar River. The entire system is designed to retain all storm water in the calculated watershed, and to only release water directly into the river during storm events of 100-year storms or larger.

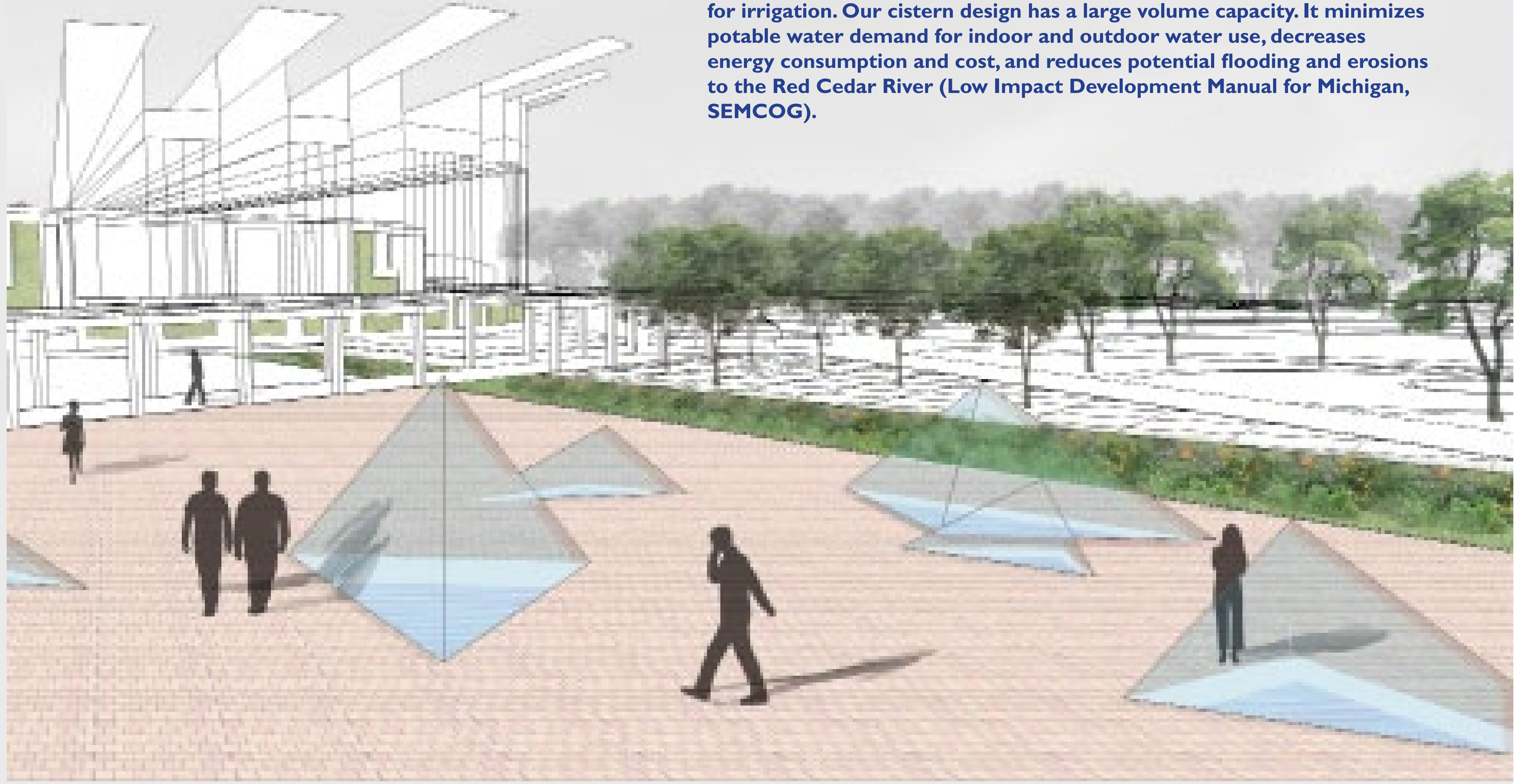
GREEN HOUSE

The greenhouse stands tall in the center, representing the mountains and valley in which the Spartans made their final stand. As they fought, they made a ring, shields locked in a protective dome-like barrier against enemy weapons. The greenhouse framework represents this impenetrable shield dome, with the crosspieces representing the showers of Persian arrows raining down against it. The doorways are reminiscent of the Spartan helmet, showing the typical eyes and nose piece.

MINI-PYRAMIDS
- GROUND CISTERN OBSERVATION STAND

The cistern is designed to hold water during the wet seasons; during dry seasons, it will slowly release it through a series of bioswales and infiltration basins. This method of storm water control decreases instances of flash flooding caused by accelerated water runoff on impervious surfaces. It also raises base flow levels, bringing the Red Cedar River closer to its natural hydrologic state.

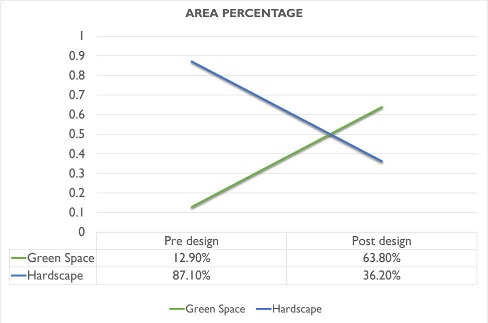
Our cistern design has considered the following factors, such as rain collection distribution area, average rainfall, dry period length and water consumption. This cistern system can efficiently capture small storm events for the buildings within the boundary and slowly discharge water into the treatment system. It also provides mitigation for large storm events. During the dry period season, the water stored in the system can be reused for irrigation. Our cistern design has a large volume capacity. It minimizes potable water demand for indoor and outdoor water use, decreases energy consumption and cost, and reduces potential flooding and erosions to the Red Cedar River (Low Impact Development Manual for Michigan, SEMCOG).

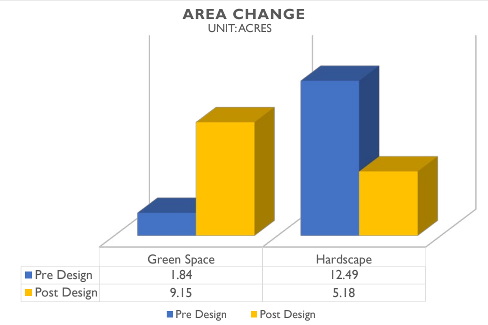


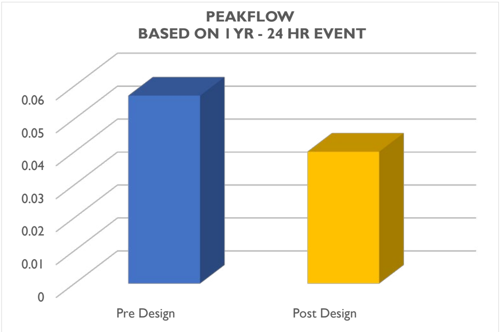
SCIENTIFIC AND STATISTICAL RESULTS

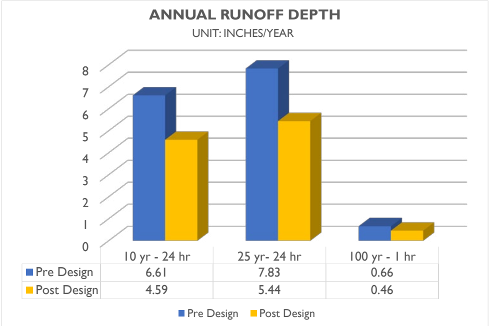
Soil And Vegetation Management	Area (Acres)
Area of protected soils	9.14
Area of restored soils	7.30
Area of protected native plant communities	8.86
Area of restored native plant communities	1.85
Increase in hardscape area shaded by vegetation	0.23
Increased area in rain garden system	1.69

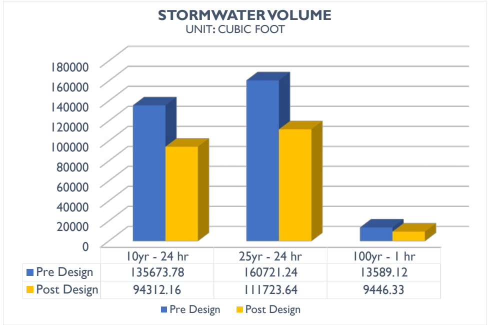
Estimated Performance of Bioretention	
Pollutants	Removal Efficiency
Total Phosphorus	70% - 83%
Metals (Cu,Zn, Pb)	93% - 98%
TKN	68% - 80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%











Project Abstract

This campus design project enhances the Michigan State University campus through conversion of hardscape to green infrastructure. Management of storm water through natural processes has been shown to improve environmental health and minimize cost of cleaning water. The proposed design will enhance the campus environmentally, socially, and economically.
The design concept focuses on incorporating Spartan spirit into campus through symbolism, educational and social opportunities, and new sustainable technologies. The new site design provides a variety of use areas and supplies an innovative storm water management system for the heart of campus.

MSU Introduction

Michigan State University is an exceptional university, internationally recognized for its success in research and academics. It has been ranked in the top 100 universities of the world for more than a decade and was listed by U.S. News & World Report as the 29th-ranked public university in the nation. (MSU Facts) As a whole, MSU is a university dedicated to excellence.
Sustainability is a part of this excellence, particularly as a land grant university. The Michigan State campus was already named one of the top five most sustainable campuses in the United States by the National Wildlife Federation's Campus Environment 2008 Report Card, an honor compounded by the report that MSU had the most "exemplary" sustainability programs of any college or university in the state. With enrollment totaling more than 49,000 students in fall 2013 ("Preliminary enrollment stats…"), as well as a large body of faculty and staff, these programs have a great impact on an extensive Spartan community.
Continued development of the Michigan State campus is based on a guiding framework which supports these sustainable initiatives. Updated every five years, the campus master plan describes the vision for the future of campus through sets of planning principles addressing issues from parking and circulation to environmental sustainability. As a whole, they place a clear focus on promoting the educational, social, aesthetic, environmental, and economic quality of campus.

Benefits to MSU

The benefits of this new design vary widely. Actions taken to improve water quality will improve environmental health and support the university's efforts toward sustainability, as well as reduce the cost of cleaning water chemically. Storm water discharge into the river will be minimized, and a reduction in peak flow amount will decrease the chances of flooding. Water quality will be improved through the reduction in nitrogen, phosphate, sedimentation, and heavy metals. Landscape water use, both potable and non-potable, will be nearly eliminated.
Additionally, the creation of new spaces for interaction and education supports the university community as a whole in their social and educational endeavors. The reduction in vehicular traffic passing through the site makes the area more pleasant for pedestrians, supporting the desired movement away from personal vehicle use on campus.

2020 PLAN

One of the major points made in the 2020 master plan relates to storm water management. The university intends to remove the majority of the surface parking in the central academic district of campus, more than 1000 parking spaces. The new design of this space, as proposed by this design proposal, will correlate with the intentions for the space as described by the 2011 master plan update.

In 1980, university president John A. Hannah said, "Long ago it was planned that the campus should be an outdoor laboratory, with all the variety of trees, shrubs, and woody plants that could be made to grow in Michigan, labeled and tagged not only for students in botany and silviculture and landscape architecture, but for all students and faculty and people in the community." This viewpoint was derived for Professor William Beal's arboretum proposal in 1872. (Campus Master Plan Update 2011 16) This site design focuses on combining these two desires into one sustainable, functional design.

The current gray infrastructure systems serve their intended purpose. Parking areas are located conveniently near to central campus, and storm water lines succeed in moving water out of the site without allowing flooding. Despite their success, however, they are somewhat insensitive to environmental concerns. Large areas of hardscape create accelerated runoff rates and increase runoff pollution; the runoff is piped directly into the Red Cedar River rather than infiltrated. A more environmentally-conscious design could improve both water management strategies and site appeal.

The goal of this endeavor is to improve the campus environment in a way that corresponds with the overall vision for the university. This includes water quality and environmental health improvements, energy savings, provision of outdoor use areas for campus users, and creation of campus identity onsite.

The goals for the project involve the needs and desire of campus users, as well as the university's stated goals for its future. The project is intended to improve the campus environment and water quality and promote energy savings while providing outdoor use areas to better serve campus users. The site incorporates Spartan spirit throughout, making this central green space attractive as well as practical.

Design Concept

The concept for the site focuses on the idea of Spartan spirit. Michigan State students proudly refer to themselves as Spartans. Being a Spartan, however, entails more than simply attending a school. True Spartan spirit reflects excellence and unity. Spartan history stretches back centuries to the original warriors of Sparta. The fierce, disciplined warriors lived, trained, fought, and died together. They were the best of their kind. Like their predecessors, modern-day Spartans work together, persevere, and excel. The design incorporates that essence into this site, bringing the soul of the original Spartans into the heart of campus.

Registration number: M40
Project location: Michigan State University, East Lansing, MI

Names and disciplines of team members:

- Na Li, landscape architecture, environmental design
- Yiwen Xu, landscape architecture, environmental design
- John Gundry, landscape architecture, environmental design
- Gina DeYoung, landscape architecture
- Brock Downs, landscape architecture
- Mingzhao Wang, environmental design
- Yuanji Li, environmental engineering
- Fangyun Zhong, environmental engineering
- Ming Li, environmental engineering
- Yang Song, environmental engineering

Name and discipline of faculty advisor:

- Dr. Jon Bryan Burley, FASLA, landscape architecture

Committee Members:

- Dr. Robert Schutzki, horticulture
- Susan Masten, Ph.D., P.E., civil engineering
- Steve Troost, MSU Campus Planner

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