TAKING IT OUTSIDE

DESIGNING OUTDOOR LEARNING OPPORTUNITIES FOR SALINE HIGH SCHOOL

UNIVERSITY OF MICHIGAN
SCHOOL FOR ENVIRONMENT AND SUSTAINABILITY

MASTER'S PROJECT // APRIL 2022

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We also would like to take the time to thank our point of contact at Saline High School, Drew Denzin, for sharing his knowledge of the school and being a representative of the school's interests.

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EXECUTIVE SUMMARY

In this project, our team set out to provide ideas for design interventions and for creating educational opportunities for Saline High School's Campus. With the construction of a new high school in the early 2000s, the Saline campus incorporated what used to be surrounding wetlands, agricultural and forested land, and preserved some of the habitat areas while converting the majority of the land into a more 'traditional' high school campus landscape. There is ample space and opportunity to provide the school with creative design solutions which would allow the school community to better utilize their campus while also infusing sustainability, environmental awareness, and a culture of stewardship into the curriculum. Teachers at the school remarked on the lack of dedicated space for gathering a whole class for outdoor learning. Outdoor classrooms were included in nearly every one of the eight design areas. Each design area has associated educational opportunities tailored to the area and proposed design. Every effort was made to incorporate educational opportunities for a diverse set of subjects, from science and math to art and language. This project incorporates research-based design practices to develop design recommendations focused on enhancing the local environment and providing educational opportunities to Saline High School students.


INTRODUCTION

OUR TEAM

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BACK-GROUND

SALINE HIGH SCHOOL

Saline High School is a public high school located in Saline, Michigan. It is a part of the Saline Area Schools and comprises a 500,000 sq ft facility that sits on roughly 200 acres of land. Originally a small school with a much smaller campus, Saline High School has grown in recent decades. As the population within the school district grew, the need for a new, larger school became apparent, and the district purchased a large tract of land on the eastern edge of Saline. The land upon which the new high school is sited was previously used for agricultural purposes, and before that was home to several Native American communities. The land, which had been primarily used for agricultural purposes, was acquired and became part of the campus.

Currently, much of the surrounding land is either underutilized or unused, creating an opportunity for a revitalization of both the land and the school's curriculum. At the present time the school is surrounded by mowed fields of grass, sports fields for football, baseball and softball, hardscape spaces such as parking lots and tennis courts, as well as a network of stormwater retention ponds, wet meadows, and forest lands. Our team believes that much of this land could be better utilized to engage the student population on issues such as climate change, sustainability, and local ecology, as well as creating places in the outdoors where students, faculty, staff and local community members can simply use and benefit from. From an academic standpoint, the potential for use and learning is enormous. There is an opportunity to link issues such as climate change, ecology and sustainability to many areas of the curriculum beyond the sciences, including Writing, Art, History, and more.

OBJECTIVES & PURPOSE

OBJECTIVES & PURPOSE

We began this project with one main objective: to generate individual landscape interventions, at a variety of scales, to respond to various needs and priorities of different areas of the campus. We had three goals in addition to the main objective which include: (1) the designs must provide ecosystem services, such as sustainable stormwater management, pollinator habitat, and/or increased canopy cover, (2) each design must incorporate education opportunities for a diverse set of school subjects, and (3) the designs must create outdoor classroom space. We identified seven location-specific "design improvement areas" and one thematic design improvement.

The seven design improvement areas are: the eastern stormwater retention pond, a grassed terrace seating area and ramp, a sensory education trail, a semi-circular patio for faculty use, a native prairie, an interior courtyard, and retrofitting an existing parking lot. Each of these design improvement areas include explicit educational opportunities that were formulated for each design. Every effort was made to ensure that all the design areas have ample space for teachers to take their entire class outside. When asked about improvements they would like to see made to the campus, many teachers responded that there was a lack of places outside to take an entire class of students to sit down and have class. This is a main consideration our team took every opportunity to address in these seven designs.

The eighth design, the "No-Mow" area, is our one thematic design. It differs from the other seven designs because it doesn't have one specific location. Rather, a no-mow area can be implemented at various locations around the campus, big or small. Rather, the establishment and maintenance concepts introduced in the native prairie (pg. 28) can be applied to these areas. We recommend that spaces around campus that lack clear purpose or use, and that currently take up maintenance resources by necessitating regular mowing, be transformed into no-mow areas.

OBJECTIVES & PURPOSE

THE CAMPUS AS A CLASSROOM

The first step in our process was to conduct research on combining nature with formal education, with the aim to incorporate landscape design with school curriculum. Based on our research, we concluded several methods can be used in order to incorporate nature and the environment into most school subjects. This can be done through combining design courses with natural resources, utilizing outdoor classrooms, and incorporating various topics and activities related to the environment and local ecology into a diverse array of courses. Though it is natural to default to science when thinking of ways to incorporate the environment and local ecology into school courses, our team wanted to make sure that courses from all subject areas could find ways to connect to our design ideas.

Studies have shown that the environment has a positive effect on human behavior and psychology.[1] Additional studies have shown that incorporating nature and green space into classrooms and campuses increases students' overall wellbeing and academic performance.[2] Above all, incorporating education into the designs can foster a culture of stewardship.

Outdoor classrooms

The areas we designed have a large amount of seating, in the form of picnic tables, benches, and steps, which provide areas for teachers to conduct classes outdoors.

For example, the Pond design includes a wooden deck along the eastern retention pond. This allows students to collect water and creature samples easily without disrupting the pond edge. They can use the picnic tables under the large shade tree to do class work and artistic activities. These outdoor classroom opportunities shorten the distance between students and the nature, ensuring that the students can fully reap the benefits that nature can offer.

Education and the Environment

In some locations, we have designed some extracurricular activities related to the environment or activities that can be combined with existing courses.

For example, in the Sensory Education Trail, students can make nest boxes and place them in the woods around the trail, and go bird watching (Appendix I - Example Activity 1). They can make sample plots in different plant communities, measure biodiversity, and compare them. The areas around the trail can also be used for found-object art, encouraging students to use resources they find along the trail to make sculptural pieces. We aim to diversify the campus environment design, and create spaces for teachers to use for outdoor teaching.

Informational Signs

In each design improvement area, we have identified key elements and goals, and have employed ecological design principles (see page 11 for a mock-up design of these signs). We have designed a series of informational signs to explain these design goals and principles to visitors.

These signs can also be used to explain themes such as local ecology in each area to teach relevant ecological knowledge. For example, explaining aquatic ecosystems by the pond, explaining sponge cities and urban ecosystems in the open space in the semi-circular patio, and in the native prairie, explaining the grassland ecosystems. Text and photos can be used side-by-side illustrative diagrams. Oftentimes, visuals can better convey complex ideas better than large blocks of text can. These information signs play a big role in the sensory education trail as well, where they can be of a more interactive nature.

Future master projects can further develop this idea and even design specific signs for a variety of locations around campus.

DESIGN & EDUCATION

The design improvements in this section combine landscape design and education in order to increase students' awareness of issues such as sustainability, local ecology, and climate change.

Designs for various styles of informational signage that can be placed around campus.

DESIGN AREAS

Context map of school campus showing the seven location-specific design areas.

THE PONDS

The retention ponds and surrounding area have great potential for use as an outdoor classroom space. With this in mind, the first part of the design concerns safety and accessibility within and around the space. New crosswalks for pedestrians and concrete stairs and a ramp with railings are designed to provide safe and accessible connection across the street and to the ponds.

The second part of this design concerns user interaction with the ponds themselves. This includes a wooden deck on the banks of the larger pond, allowing for a variety of class uses. A defined footpath around the retention ponds will provide access for guided walks led by teachers. A proposed seating area on the downside of the slope will provide multi-functional space for students and faculty. The trail provides multiple points of view for observation, and the large platform at the entrance can be used as an outdoor classroom and gathering space.

Outdoor Learning Opportunities

The pond has beautiful views and can be used as a place for sketching, painting, photography and art classes. The trail provides multiple locations for observing, and the large platform at the entrance can be used as an outdoor classroom for teachers.

The retention ponds are an example of an aquatic ecosystems, found not only in southeast Michigan, but in many places around the globe. As such, they can be used as case studies and research locations for students. A variety of aquatic plants grow in the ponds, which can provide materials for biology and botany classes to use for class experiments. In the environmental science classes, students can learn about the work that wetlands and similar ecosystems do to purify water. As well as how to protect and support not only the aquatic organisms in the wetland but also the wildlife that rely upon those organisms as a food source. This area also offers excellent opportunities to discuss and discover the role of wetlands in the larger hydrological cycle and their impact on water bodies further downstream.

Existing condition

GOALS & BENEFITS

- Provide opportunities for students to get closer to the retention ponds in a safe and accessible way
- Create usable outdoor classroom space that minimally impacts the existing ecosystem.

COST & MAINTENANCE CONSIDERATIONS

- Cost: Medium
  - The main expense would be the initial investment for building the wood deck and the concrete steps and ramp.[3,4] Informational signage and outdoor tables and chairs are not too expensive and maintenance costs are low.
- Maintenance: Low

KEY ELEMENTS

- A path that encircles both ponds can be used for teacher-guided walks during classes.
- Stairs with railings and new crosswalks provide safe and accessible connections across the road.

EDUCATION OPPORTUNITIES

- Outdoor Classroom space
- Recognize wetland plants, aquatic microintervetibrate, and waterfowl
- Local ecology - ecological system of the ponds and their function
- Difference between a natural embankment and a concrete embankment
- Landscape drawing, painting, and photography

Site plan diagram of footpath around ponds for guided class walks.

Proposed design improvement for the eastern stormwater retention pond.

GRASS TERRACE

This large grassy slope is located on the east side of the main school building. The slope provides an excellent place to create a multi-functional space for the school community. Taking advantage of the existing slope, we suggest the creation of an outdoor amphitheater/ classroom that uses the height difference to create a stepped space, leaving space at the bottom of the grassy slope for a stage area that could be used for teaching, performances, and more.. Additionally, the stepped surface is more conducive to intercepting rainwater and protecting the soil from erosion, creating an excellent opportunity to illustrate natural process in what might be seen as an unlikely venue, utilizing eco-revelatory design as a point of departure on discussions about how sustainability can be introduced in all sorts of places and landscapes.

Outdoor Learning Opportunities

Taking inspiration from amphitheaters, this intervention functions as an outdoor classroom where students can use the stepped lawn as a seating area for an audience to view teachers or students speaking from the grassed 'stage' area at the bottom of the hill, or to watch a performance of music, dance or theater in the outdoors; imagine a discussion of England's historic Globe Theater as students study or perform a Shakespeare play! Music classes could conduct orchestral and/or choir practices or performances here as well.

Students would be able to get close contact experiences with various plants, and even grow flowers and plants by themselves in this outdoor space. They would also be able to gain knowledge of plants and their habits, requirements, and physiology from study that incorporates sight, touch, observation, and smell. Teachers can design courses or exhibition boards that illustrate things such as the distribution of plant communities tied to elevation change, or about solar exposure, wind exposure, and micro-climates. In environmental science classes, teachers can use this as an example to introduce concepts like water conservation and soil erosion.

Existing condition

GOALS & BENEFITS

- Multi-functional outdoor space that utilizes the existing topography of the site.
- Planted area increases habitat area and offers visual interest for classroom windows facing the site.
- Provides outdoor classroom area and recreation opportunities.

COST & MAINTENANCE CONSIDERATIONS

- Cost: Low to High

  Cost is dependent of the material used for the steps.[5, 6]

  If the height difference of the terrain is used to build the steps, cost for upkeep will be minimal, just checks to see if the retaining wall is solid

- Maintenance: Low to High

  Maintenance is dependent on the material used for the steps.[7,8]

KEY ELEMENTS

- Outdoor stage area draws inspiration from amphitheater designs
- Different sized steps allow for multiple uses.

EDUCATION OPPORTUNITIES

- Outdoor classroom space
- Concert, chorus, and drama stage space
- Learn about soil erosion and how to protect against it
- Calculate runoff and mapping runoff on a slope

Rendering of proposed design

SENSORY EDUCATION TRAIL

The Sensory Educational Trail is located in the northern part of the campus. The design encourages students to experience nature with their senses: hearing, touching, smelling, and seeing. The trail can provide students with a space to experience forests, local ecology, and stewardship principles. The trail also provides bird observing and biology sample collection opportunities for students to take a deep dive into an immersive experience in nature.

One feature of the design are informational signs showing students information about local plants and birds they might see along the trail. An example of these signs is on page 11. The trail can be used as immersive art exhibition space, encouraging students to create found-object art with natural materials they find along the trail, such as twigs and leaves.

Outdoor Learning Opportunities

The sensory education trail is specially designed for nature education. There are various signs introducing knowledge about forests, ecology, and environmental protection on the trail. And these signs are not only introductions in words, but also have interactive features for students to engage with, such as models, physical samples, quizzes, and animal sounds. Surrounded by trees, students can experience nature through seeing, hearing, and touching, while doing activities such as handcrafts, sample collection, and bird watching.

Existing condition

GOALS & BENEFITS

- Utilize existing infrastructure and improve upon the existing trail.
- Provide an area for immersive education in nature and space for students to experiment in different subjects ranging from art to science.

COST & MAINTENANCE CONSIDERATIONS

- Cost: Low to Medium

  Initial costs consist of the cost for the informational boards and initial cleanup of the trail. For many of the activities, such as building next boxes and found-material art, students will use materials they find along the trail.

- Maintenance: Low

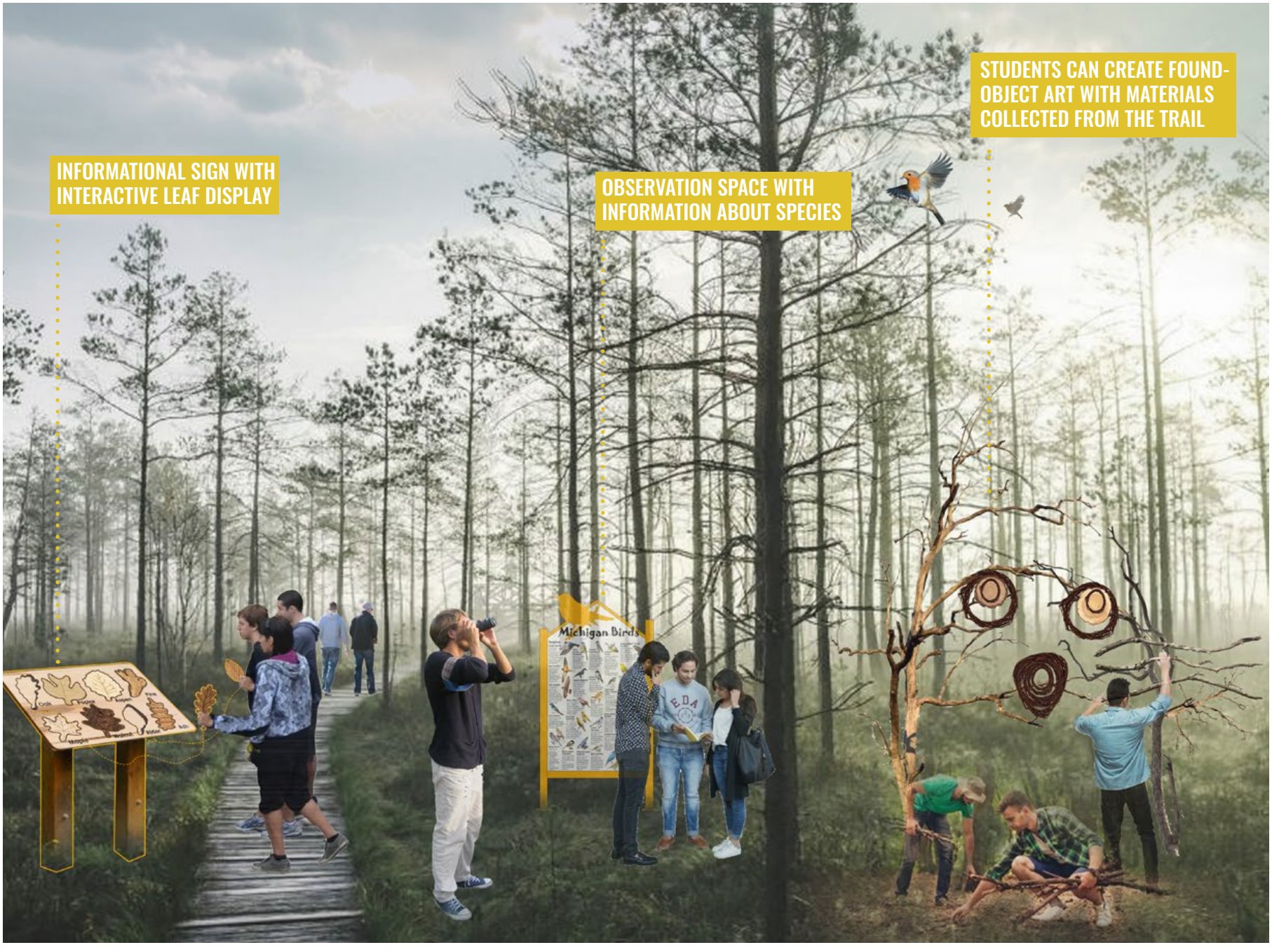
  Maintenance wouldn't differ from what is currently done to the maintain the existing trail

KEY ELEMENTS

- A walking trail to meet different educational needs
- Informational signage that incorporates sensory elements for touch and hearing

EDUCATION OPPORTUNITIES

- Outdoor classroom space
- Learn about succession in a plant community from field to forest
- Local ecology: forest ecosystem structure and function
- Bird watching
- Building nest boxes for local bird species (Appendix I - Example Activity 1)
- Forest as gallery space for art made out of natural, found materials
- Footpath for physical education classes



Rendering of proposed design

SEMI-CIRCULAR PATIO

This design improves on the existing infrastructure and provides improvements that enhance its current uses. The patio is primarily used as a space for faculty to eat lunch and for some teachers to take their classes outside.

Taking these uses into consideration, the improvements are primarily aesthetic. The existing concrete wall was added to, create a seat ledge all the way around. Plantings are added to the perimeter of the concrete wall incorporating the existing trees to create a visual barrier between the patio and the road on the other side of the lawn. New tables and chairs were added to create space for faculty and for use as outdoor classroom space.

Outdoor Learning Opportunities

The semi-circular patio space is a good place for outdoor classrooms, group discussions, and recitations. This is a no-mow area, and the vegetation grows naturally. Students can compare them with carefully pruned vegetation to learn about ecological niches, biodiversity and other knowledge associated with them. Different vegetation has different blooming periods and attracts different pollinators.

Students could be tasked with creating bloom charts that show the different bloom periods and bloom colors of the different plant species (Appendix III). Students can also observe pollinators and different animals that make use of the space as habitat by adding ecological value symbols to their bloom charts. (Appendix III).

Existing condition; Photo: Google

GOALS & BENEFITS

- Visual barrier to block view of road incorporates existing trees and creates pollinator habitat.
- Creates a purposeful area for faculty to eat lunch and outdoor classroom space
-

COST & MAINTENANCE CONSIDERATIONS

- Cost: Medium

  Cost considerations include adding onto concrete wall to create a seat wall, new plantings, and new tables and chairs.
- Maintenance: Medium

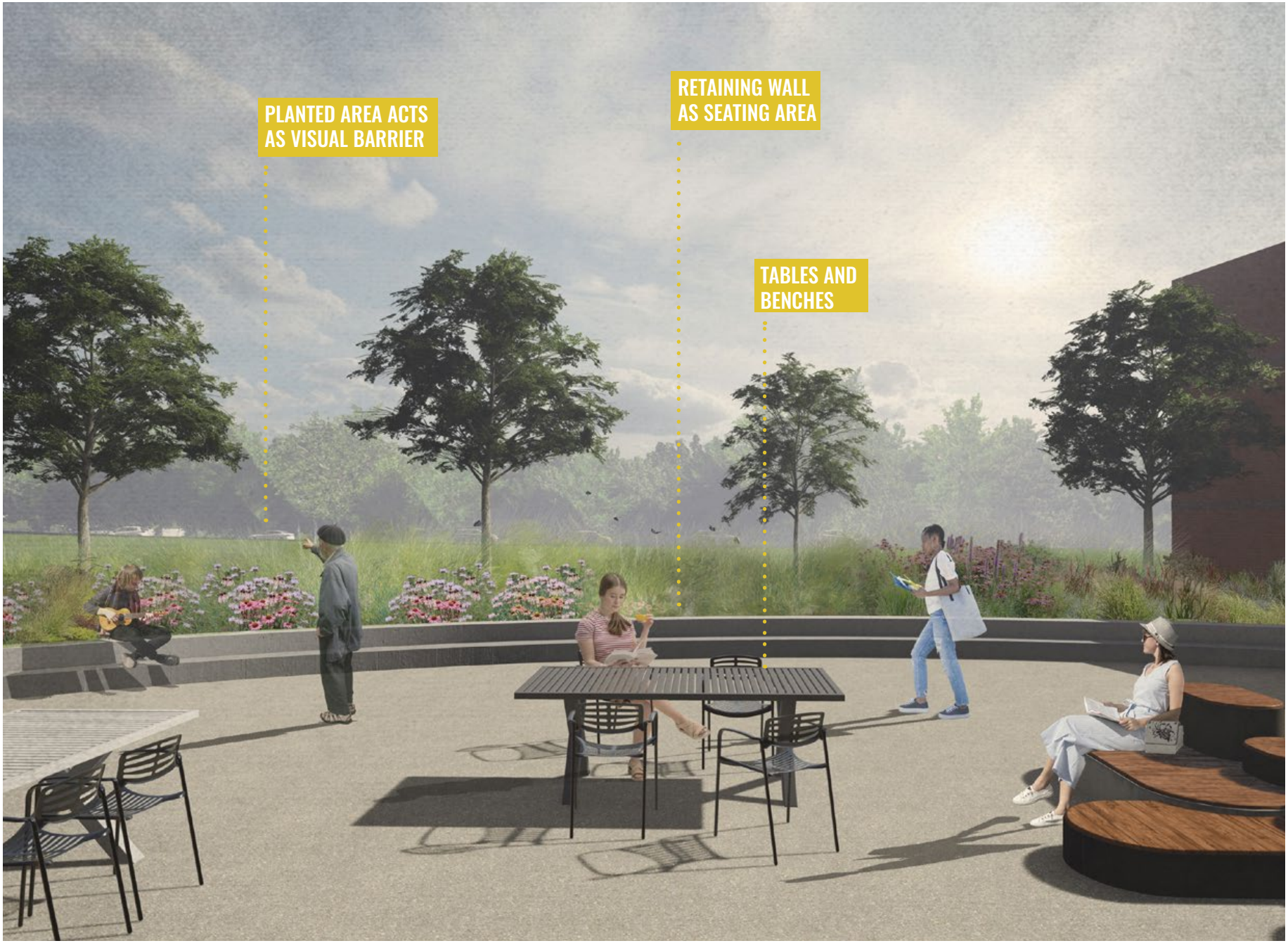
  Maintenance needs amount to the care and keeping of the planting around the existing trees.

KEY ELEMENTS

- Visual barrier provided by the plantings behind the concrete ledge obscures view of road
- Dedicated tables and chairs for faculty use. Easily stacked during winter

EDUCATION OPPORTUNITIES

- Outdoor classroom space
- Local Ecology: biodiversity of organism on planted foliage
- Keeping track of the different insects identified
- Insects and their pollination benefits
- Create bloom chart that shows times of bloom an ecological benefits of each plant species (Appendix III)
- Group project space



Rendering of proposed design

NATIVE PRAIRIE

This design began as a way to decrease the amount of area requiring frequent mowing. The area itself is nearly 5,000 square feet. Once established over a period of 2-3 years, maintenance needs would amount to mowing on a schedule of once a year 3-5 years, a period similar to the natural pattern of wildfire that was a part of the native prairie ecosystem in southeast Michigan.

Additionally, this lawn is viewed from a number of classroom windows. Views with more plant diversity are associated with higher test scores, graduation rates, and increased attention capacity.[9] In comparison, large expanses of landscapes such as featureless lawns are associated with decreased test scores and negative emotions.[10]

The design of the native prairie incorporates a path right through the meadow to allow for existing emergency evacuation routes, as well as providing a variety of locations and vantage points for sketching and sampling.

Outdoor Learning Opportunities

We have reserved a native prairie with a path. Grassland is also an important part of the ecosystem. This natural prairie can enrich the ecological environment of the campus and provide experimental sites for biology and environmental science courses. In the prairie, students can delineate quadrants, measure them, and calculate grassland biomass and biodiversity, as well as learn about soil structure. The Native Prairie is also a great place for en plein air painting and sketching. In addition to science and art classes, the large meadow can be used for have picnics, treasure hunts, scavenger hunts, and hide-and-seek in physical education classes or extracurricular activities.

Existing condition. Photo: Google Maps

GOALS & BENEFITS

- Creates visual interest for all seasons
- Provides habitat and food source for migrating birds, insects, and small mammals
- Increases overall stormwater infiltration in this area

COST & MAINTENANCE CONSIDERATIONS

- Cost: Low to Medium
- Maintenance: Low

The area is approximately 1,000 sq feet, and once established, meadow plantings can largely be left alone other than work done to periodically maintain the edges. This area would be excluded from normal mowing needs.

KEY ELEMENTS

- Path through center of meadow maintains the primary egress route for evacuations
- Creates large no-mow area, decreasing overall maintenance

EDUCATION OPPORTUNITIES

- Outdoor classroom space
- Local ecology: explore experiment fields and grassland ecosystems; explore root systems and soil structure.
- Observing the soil profile
- How temperature and precipitation affect The Meadow
- The differences between mowed areas and The Meadow
- Hide and seek
- Compilation of botanical drawings of campus plants

PLANT PORTRAITS


Eutrochium purpureum


Aster laevis


Amorpha canescens


Andropogon gerardii


Echinacea purpurea


Rudbeckia hirta


Coreopsis lancelota


Eragrostis spectabilis


Eryngium yuccifolium


Liatris spicata


Monarda fistulosa


Panicum virgatum


Schizachyrium scoparium


Solidago rigida


Solidago speciosa


Sorghastrum nutan


Sporobolus heterolepis

Rendering of proposed design

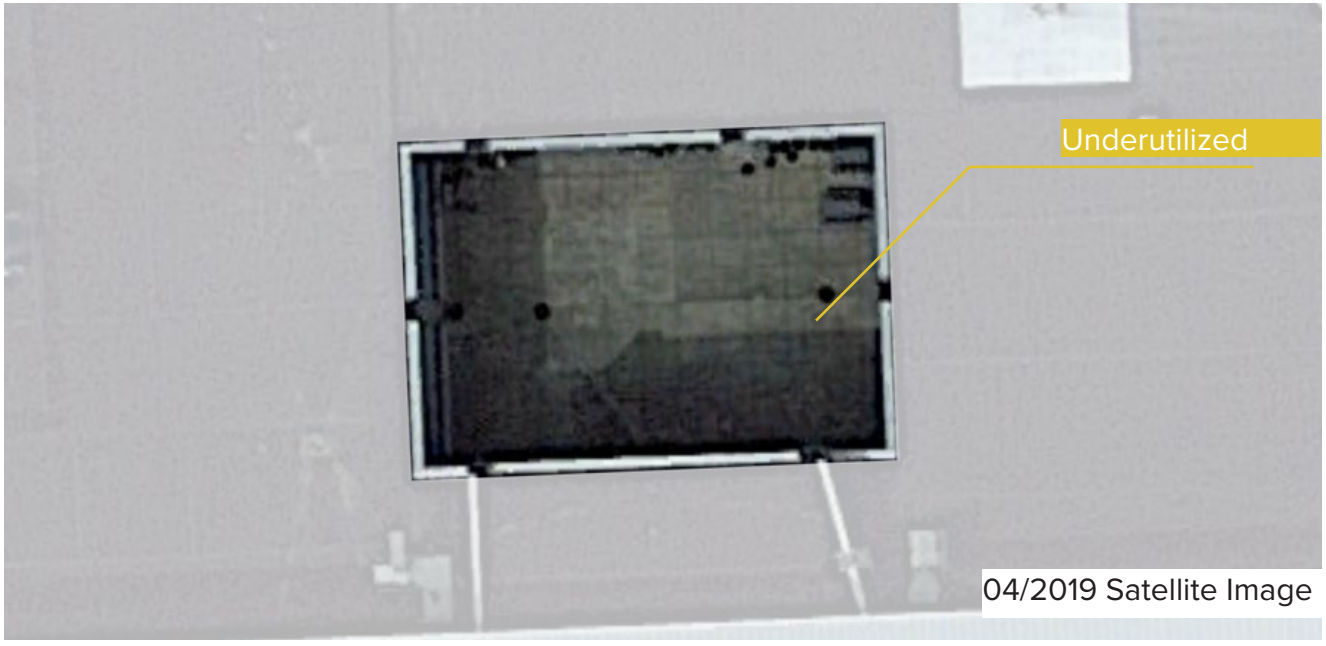
COURTYARD

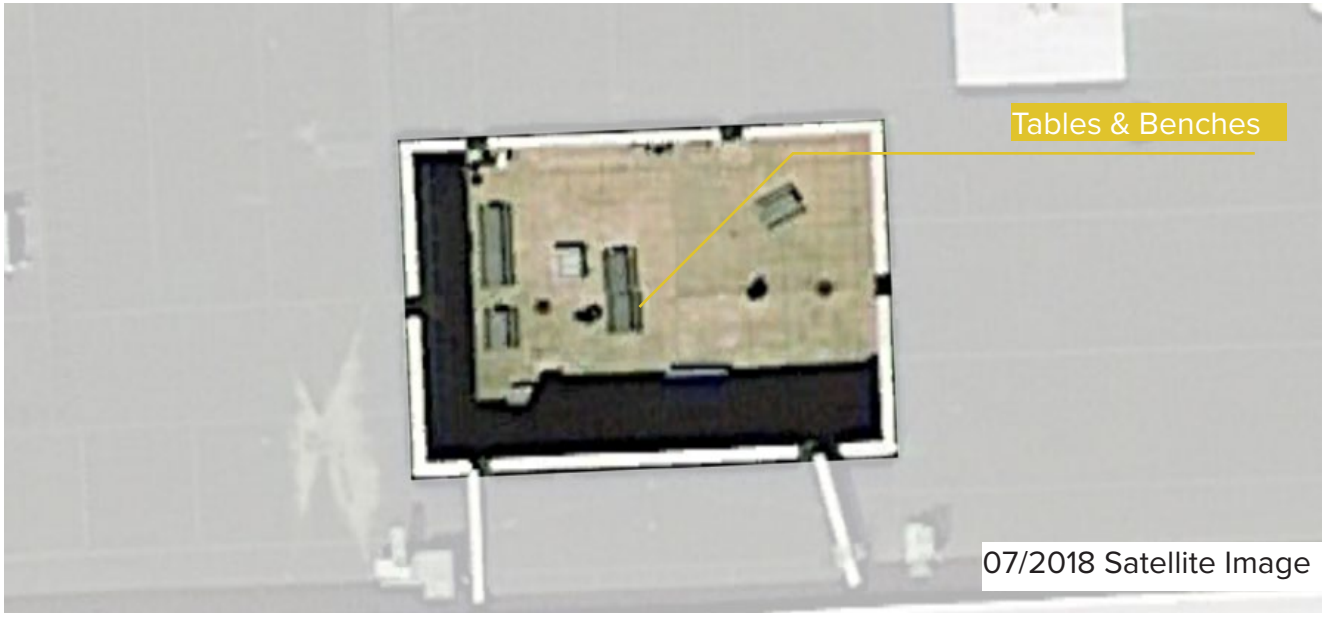
This design activates the underutilized interior courtyard and transforms it into a multi-functional space, requiring low maintenance. Students and teachers alike are able to hold various activities such as eating lunch, communicating, or simply having a moment with nature.

The design aims to achieve social, aesthetic, ecological, and educational goals. The added retaining walls serve to create individual 'rooms' which can accommodate different needs and experiences. Green spaces are also added to be both aesthetically pleasing and contribute to ecological benefits such as temperature regulation, improved air quality, and rainwater retention. The space will also serve as an outdoor classroom. Additional educational opportunities are offered by planting boxes, which also serves as visual interest.

Outdoor Learning Opportunities

The courtyard in the center of the teaching building can also be regarded as a mini urban ecosystem. Compared with the ponds, woods, and meadows outside the main school building, there are many differences. Students can compare and contrast how the species and distribution of plants and animals have changed under high-intensity human use and intervention. It is also the place to show students the low impact development such as green roofs, rain gardens, sponge cities, etc. At the same time, students can use the data on campus to practice some engineering-related calculations, such as precipitation, runoff, and water purification efficiency.





Existing condition; Photos: Google Earth Pro

GOALS & BENEFITS

- Activate the currently underutilized courtyard
- Provide a multi-functional space to accommodate the needs of students and teachers.
- Create a space that is both aesthetically pleasing and possesses ecological and educational functions.

COST & MAINTENANCE CONSIDERATIONS

- Cost: Medium

  Cost considerations include adding onto concrete wall to create a seat wall, new plantings, planting soil, and new tables and chairs.

- Maintenance: Medium

  Maintenance considerations include irrigation, plant maintenance, such as deadheading, remove weeds, etc. Generally once per week of maintenance is required.

KEY ELEMENTS

- Green roof - growing plants that can accommodate shallow soil and required low maintenance
- Retaining walls - providing sitting area as well as be aesthetically pleasing
- Planting boxes - providing additional visual focuses and opportunities for plant ecology education
- Furniture - movable furnitures can be placed in open areas to accommodate higher flow

EDUCATION OPPORTUNITIES

- Outdoor classroom space.
- Learn how to grow and maintain perennial plants
- How to build an effective green roof and how it functions
- Learn about the ecological benefits of a green roof
- Impervious surfaces and how to offset their impact
- Exhibition area or student artwork, sculptures, and models

PLANT PORTRAITS


Aster laevis


Liatris aspera


Anemone virginiana


Echinacea purpurea


Tradescantia ohiensis


Sedum album


Allium cernuum


Coreopsis lanceolata


Koeleria macrantha


Sedum reflexum


Sedum sexangulare


Sedum spurium

PLANT BOXES

Movable planting boxes are designed to add flexibility, which can be moved indoor during the winter. They provide aesthetic interest and educational opportunities.

Rendering of proposed design

PARKING LOTS

This proposed design includes several features to be considered in the future in order to incorporate higher ecological and aesthetic values into the parking lots, as well as provide educational opportunities.

The design mainly concerns parking lots (c) (d). Parking lot (a) and (b) have been recently updated and/or resurfaced and as such, these designs may not be realistic to incorporate now, given the recent investments made into those parking lots. That said, should the time come for a renovation of lots a and b, these same ideas could be incorporated into their redesign at that time. The design incorporates a combination of bioswales and parking lot islands that can help to reduce runoff volume leaving the lots and improve the quality of water that does leave the lots and move into the stormwater ponds. This will also improve water retention and localized hydrology by allowing runoff infiltration into the soils beneath the lots. The proposed planting in these areas would also serve as a visual focus and improve the appearance of the parking lot. Solar panel carports will not only help reduce the consumption of energy, but also can utilize renewable energy to reduce electric bills for the school, as well as offset environmental impacts. With the combination of the green spaces and solar panel carports, it is also possible to reduce urban heat island effect of these large paved surfaces.

Outdoor Learning Opportunities

Signage in parking lots can teach students and the many community members that visit and use the high school about the impact that large paved surfaces can have on stormwater runoff, local ecology, and increased temperatures in urban areas (i.e., the urban heat island effect). Should bioswales be incorporated into the lots, signage about their function could be installed, and students in science courses could monitor stormwater amounts and quality, connecting lessons taught in the stormwater ponds with lessons linked to the parking lots. With solar panel carports, studies on electricity generation, the science of solar panels, and more are possible; the structures themselves could provide scaffolding for art displays, educational signage, and more.

Existing condition; Photo: Emily Hernandez

GOALS & BENEFITS

- To create sustainable green parking lots that hold higher ecological values
- To manage stormwater in more effective and sustainable ways
- To improve the appearance and add more aesthetic values
- To reduce overall energy consumption thus decrease

COST & MAINTENANCE CONSIDERATIONS

- Cost: Medium

  Cost considerations include constructing bioswales, replace curbing, solar panel carport, and possible redone of parking lot 7c and 7d.

- Maintenance: Medium

  Maintenance considerations include removing trash and debris, pruning and mulching of the bioswale, no irrigation should be required once the plants are established.[11] [12]Generally the bioswale should require maintenance twice per year(spring and fall).[13]

KEY ELEMENTS

- Bioswale & Island - treatment of stormwater quality and add visual focuses with the vegetation planted
- Solar panel carport - provide shade and green energy as well as reduce energy consumption and greenhouse gas emissions
- Curbing with breaks - allow runoff drain into the bioswale more easily

EDUCATION OPPORTUNITIES

- Learn how draining system work
- Learn how bioswale works
- Aesthetic and ecological values of bioswale plants

PLANT PORTRAITS

Berberis thunbergii

Liriope muscari

Anemone virginiana

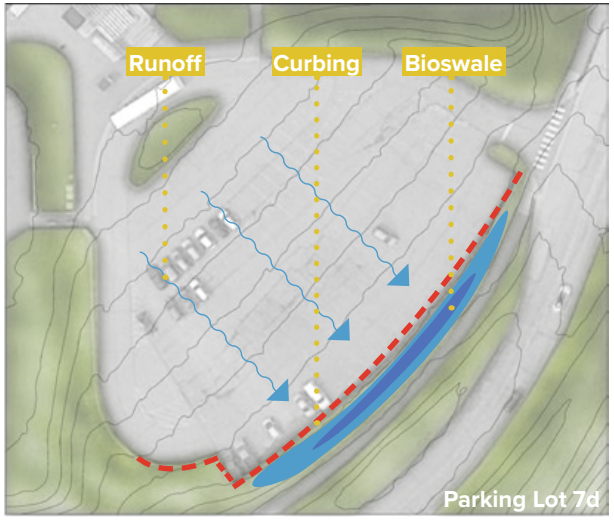
Echinacea purpurea

Rudbeckia hirta

Juniperus horizontalis

Hemerocallis ‘Stella de Oro’

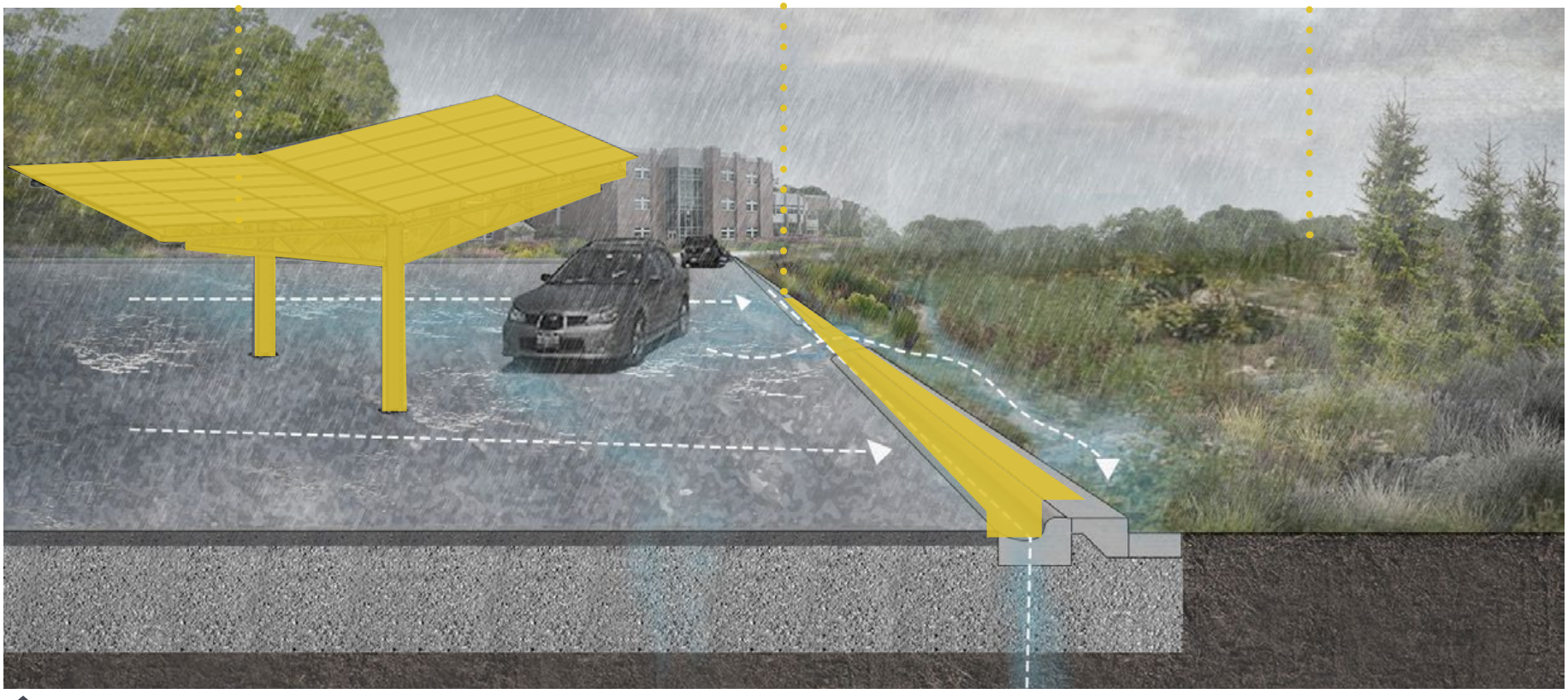
STORMWATER MANAGEMENT PLAN



Solar panel carport is proposed to both provide shade for cars and to help reduce the electricity consumption

For the parking lot that will be redone, we recommend curbing with breaks to allow runoff drain into the bioswale

Specific plants will be planted to help filter runoff for clean groundwater recharge. The plantings will also serve as a visual focus in the parking lot



Rendering of proposed design

NO-MOW AREAS

This is the only design that is not site specific, rather, it can be applied to any number of different locations around campus. The only requirement is that the area is currently not used for any specific purpose other than being an area to mow. The concept of no-mow areas can be applied to any area without a specific use, that is currently just mowed grass. The idea is that these unused, grassed areas around campus can be transformed into habitat pockets that enrich the campus landscape both aesthetically and ecologically, and reduce the need for mowing. These locations can all be different sizes and shapes, with different light, soil, and moisture conditions. But a mixture of plants can be grown in these places that don't require daily or even monthly maintenance.

The same maintenance considerations that apply to the Native Prairie would apply to these locations as well. In that sense, these no-mow areas can be thought of as mini versions of the prairie. In some site-specific circumstances, some of these areas could be mowed once a year, such as those area used as 'overflow' parking for large events such as football games.

Outdoor Learning Opportunities

Due to the variety of differences in these locations, no one no-mow area will be exactly like another. As mentioned before, they can differ in soil, light, and moisture variables. This affords students the opportunity to observe these differences. Plant and animal species may be vastly different between these areas, once the plantings become established and animals are able to utilize the habitat. Students can observe this, for example, summarize the growth conditions of each plant, and learn how differences in micro-environments affect small-scale communities in a large-scale ecosystem. Should there be interest, some of these no-mow areas could be converted into native prairie landscapes, or even wildflower 'seed bank' areas.

Existing condition
Photo: Emily Hernandez

Existing condition
Photo: Emily Hernandez

GOALS & BENEFITS

- Add biodiversity to the campus, replacing lawn grass with a variety of native plant species.
- Create pockets of habitat and food sources for birds, insects, and small animals
- Demonstrate examples of lawn alternatives.

COST & MAINTENANCE CONSIDERATIONS

- Cost: Low to Medium

  Costs amount to the purchasing of the native plants to be planted in these areas. The more areas that are converted to no-mow areas, the higher the total cost.

- Maintenance: Medium

  Maintenance needs are similar to the those of the Native Prairie and can be scheduled to be done at the same time. Initial establishment will require more maintenance than normal, but after the first two years, maintenance needs drop dramatically.

KEY ELEMENTS

- Decreases overall maintenance needs by reducing amount of grass to be mowed
- Creates visual interest without the need for building new infrastructure

EDUCATION OPPORTUNITIES

- Local ecology: recognize local plants, plant type in areas with/without sunlight
- Biodiversity: Comparing the organisms found in the no-mow areas to those found in the mowed grass areas; amount of pollinators found
- Different classes can be in charge of monitoring each no-mow area
- Seed collection and analysis

Renderings of proposed design

PRECEDENT ANALYSIS

The Morton Arboretum[14, 15]

Sustainable parking lot design and stormwater management system

Saline High School has a lot of impermeable surfaces, the majority of which are designated as parking lots. This creates a need to create sustainable parking lot design so as to improve the overall stormwater management system. The Morton Arboretum is an excellent example of incorporating sustainable stormwater management into a parking lot. The design uses permeable paving for parking lots. Runoff is directed through a series of natural water treatment processes, such as bioswales, wetland areas, planted edges, and eventually enters a meadow lake. The design reused recycled excavated soil and fill materials, and supplemented topsoil production with composted clippings plant debris. Overall, this design saved potable water through the incorporation of a rainwater harvesting system. The design also reduced flooding problems, improved water quality, and increased the biomass density index of the site.

Water Flow at the Morton Arboretum Parking Lot and Meadow Lake[16]

PRECEDENT ANALYSIS

Kroon Hall at Yale University[17, 18]

Improving the local ecosystem, adapting to climate change, and improving the sustainability of the school

This precedent is a good example of combining ecological, aesthetic and social functions together. It combines a variety of green infrastructure methods, such as a green roof, water storage, and rainwater harvesting. Together with landscape design, which provides aesthetic experiences as well as place to perform social activities, the overall design achieves a number of performance goals worth noting. After completion, the project will eliminate the need of using potable water for irrigation, through rainwater harvesting, saving 634,000 gallons of potable water per year. Additionally, water that runs through the system and is discharged into the municipal stormwater system will be treated to remove 10% of total suspended solids (TSS). Lastly, the design, once completed, will serve as a central gathering place for social events, such as alumni events, graduation, and other school activities.

Completed design at Kroon Hall, Yale University[19]

APPENDIX I

EXAMPLE ACTIVITY 1: PRECIPITATION, RUNOFF, AND RAIN GARDENS

Courses: Environmental Science, Physics, Math

Location: Parking lot, Grassed Terrace, Interior Courtyard

Goals: Understand sustainable storm water management methods.

Rainfall on impervious surfaces such as parking lots and roofs will wash away surface materials, particularly pollutants that come from cars, buses, and landscape maintenance such as snow and ice removal/storage. On large areas of sloping grassland, rainfall may wash away the soil, as well as any fertilizers, pesticides and other chemicals that might be applied to the landscape. Green roofs, bioswales, and grassed terraces, for example, can help to alleviate these situations. These solutions have been incorporated into a number of the design interventions, such as the parking lot, the grassed terrace, and the interior courtyard.

With this activity, students can learn how poor stormwater management practices can cause soil erosion and pollution through simple animations and examinations. Students can collect water samples before rainfall, and from the downstream areas, compare the pollutant and soil concentration, and calculate how much pollutant and soil was washed away during this rain. There are bioswales around the school's parking lot, and we have designed terraces on slopes. These are suitable areas to collect these samples.

Stormwater management solutions such as rain gardens, green roofs, grass swales, etc. can alleviate soil erosion and pollution. Samples can be collected from these areas to compare them with the samples collected from stagnant stormwater. By watching project examples, students will learn how sustainable stormwater management practices work during heavy rainfall events and the benefits of these practices compared to traditional stormwater management practices. Then students can do calculations on local precipitation and engineering parameters, and design their own stormwater management facilities for their school. Students could also look to the stormwater ponds to the south of the school to study the destination for all of this runoff.

EXAMPLE ACTIVITY 2: PLANT INFORMATION VISUALS

Courses: Botany, Environmental Science, Visual Arts, Languages, English, Writing

Location: all the design intervention areas

Goal: Recognize plants, learn how plants adapt to their environment, improve observation skills, improve visual and written communication.

Examples of visuals that can be made to display plant information about campus plants.

In many of the design interventions, we recommend that specific plant species be planted. The plant species differ in their traits, such as bloom time, bloom color, foliage color, and their ecological value (if they attract pollinators and/or small mammals, if they are a host plant for moth or butterfly larvae). In this activity, students can create visual and ecological charts for the plant species in each area of campus, recording these traits visually to showcase an overview of what the plants offer both aesthetically and ecologically. An example visual interest and ecological value chart is in Appendix III (pg. 50) of this booklet. This is just one way to visually display this information, but there are potentially many different ways in which interpretations of ecological or aesthetic value can be illustrated.

Teachers can provide blank forms or blank calendars for students to fill in, or they can create diagrams, drawings of seasonal colors, notes on insect or bird/animal species seen, and more. If students want to learn more about plants and enrich their calendar or sign, they can also browse the web, books, and consult local professionals for more information.

This activity can go beyond these charts too. Students could create guidebooks to plant species found on campus. They can collect information about plant classification, growth rate, moisture, light, and soil needs, as well as landscaping notes to include in their handbooks. As with the visual interest and ecological value charts, students can consult professionals, the web, and libraries to find this information. After students get familiar with the plants' blooming time and habitat, they can also design plant combinations for school or their yard.

EXAMPLE ACTIVITY 3: BIRD WATCHING

Courses: Biology, Zoology, Visual Arts

Location: Pond, Sensory Education Trail, Native Prairie

Goals: Recognize local birds, learn bird characteristics, lifestyle traits, and how to protect them.

Examples of nest boxes and feeders that students can replicate using found objects and re-purposed materials.

The campus interventions we recommend incorporate various ecosystems such as wetlands, grasslands, and forests, which will provide habitat for a variety of birds. This is a good opportunity for students to observe birds in various habitats. Students can learn avian ecology and improve their bird protection awareness, as well as their ability to record their observations, and making nest boxes or feeders. The range of species in the area is significant, with everything from ducks and geese to red wing blackbirds, cardinals, and hawks and eagles... increasing the range of habitats on campus will bring more species onto and around the campus, which will elevated student interest and learning.

Birds living in different environments have their own characteristics, such as the shape of their feet, wings, bill, and the color of their feathers. Teachers can provide visuals of the species students can expect to see in these areas, allowing students to familiarize themselves with them, and instruct them in using binoculars, and how to properly create records of their observations. Students can also come up with scientific questions from their observations.

Students can design and build nest boxes and feeders to attract birds. If conditions permit, they can make these using found objects such as branches, twigs, and leaves found around campus. They could also create bat boxes as a way to support other species as well. Teachers can provide examples of nest boxes and feeders, and then students can design and make their own interpretation. This activity is suitable for individual projects or group projects. During this process, students will think and design in terms of food selection, nest box size, shape selection, preventing predators, etc., so as to provide a safe and suitable place for birds. This is also an opportunity to engage the larger community as well, bringing in student work from the middle school's wood shop program, or involving Girl Scouts, Boy Scouts, and other youth groups interested in environmental education.

APPENDIX II

USEFUL RESOURCES

American Society of Plant Taxonomy
https://www.aspt.net

City of Ann Arbor Parks and Recreation Dept. - Natural Area Preservation
www.a2gov.org/departments/Parks-Recreation/NAP/Native-Plants/Pages/NativePlants.aspx

Cornell Lab of Ornithology - Building Birdhouses and Nest Boxes
https://nestwatch.org/learn/all-about-birdhouses/features-of-a-good-birdhouse/?__

Cornell Small Farms Program - Forest Succession and Management
https://smallfarms.cornell.edu/2016/04/forest-succession-and-management/#:~:text=Forest%20succession%20is%20simply%20the,dominant%20species%20of%20forest%20plants.&text=Many%20different%20tree%20and%20other,will%20form%20the%20early%20canopy/

Duke Forest - Forest Succession
https://dukeforest.duke.edu/forest-environment/forest-succession/

EPA - Why Wetlands are Important
https://www.epa.gov/wetlands/why-are-wetlands-important

Michigan Flora - University of Michigan
https://michiganflora.net/

Missouri Botanical Garden Plant Finder
https://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx

Susquehanna Greenway - Informational Signage Report
https://susquehannagreenway.org/greenway-signage

Texas A&M - Value of a Wetland
https://valuewetlands.tamu.edu/2015/04/15/wetland-ecological-benefits/

University of Michigan Herbarium
https://lsa.umich.edu/herbarium/databases.html

USDA - Soil Profile of Grasslands
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054308

Washtenaw County Water Resources - Rain Gardens Guide
https://www.washtenaw.org/647/Rain-Gardens

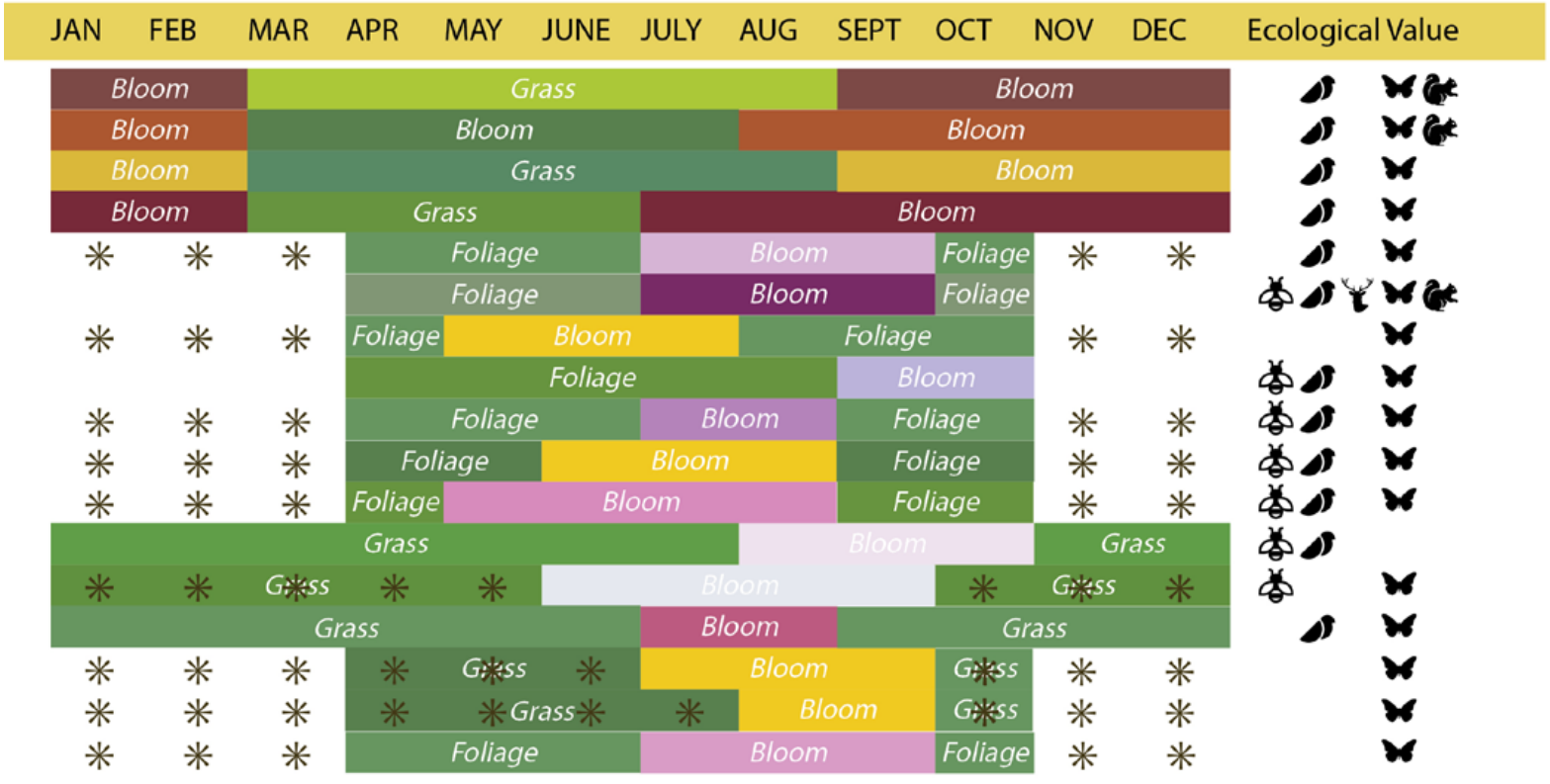
Wetlands Initiative
http://www.wetlands-initiative.org/what-is-a-wetland

WWF - Wetland Information
https://www.worldwildlife.org/habitats/wetlands

APPENDIX III

BLOOM CHART EXAMPLE: NATIVE PRAIRIE

Common Name	Botanical Name
Big Bluestem	Andropogon gerardii
Little Bluestem	Schizachyrium scoparium
Indian Grass	Sorghastrum nutan
Switch Grass	Panicum virgatum
Wild Bergermot	Monarda fistulosa
Lead Plant	Amorpha canescens
Lanceleaf Coreopsis	Coreopsis lanceolata
Smooth Aster	Aster laevis
Blazing Star	Liatris spicata
Black-eyed Susan	Rudbeckia hirta
Purple Coneflower	Echinacea purpurea
Prairie Dropseed	Sporobolus heterolepis
Rattlesnake Master	Eryngium yuccifolium
Purple Lovegrass	Eragrostis spectabilis
Showy Goldenrod	Solidago speciosa
Stiff Goldenrod	Solidago rigida
Joe-Pye-Weed	Eutrochium purpureum


JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
Ecological Value
Bloom
Grass
Foliage
KEY
Bees
Birds
Deer
Butterflies
Small Mammals
Structural interest: architectural, seeheads, stems, fiddleheads

REFERENCES

1 Bratman, G. N., Hamilton, J. P., & Daily, G. C. (2012). The impacts of nature experience on human cognitive function and Mental Health. Annals of the New York Academy of Sciences, 1249(1), 118–136. https://doi.org/10.1111/j.1749-6632.2011.06400.x

2 Matsuoka, Rodney H. "Student Performance and High School Landscapes: Examining the Links - ScienceDirect." Landscape and Urban Planning 97, no. 4 (September 30, 2010): 273–82. https://doi.org/10.1016/j.landurbplan.2010.06.011.

3 Trex Compant, Inc. (n.d.). Calculate the cost to build a deck. Trex Company, Inc. Retrieved March 18, 2022, from https://www.decks.com/calculators/cost-to-build-a-deck

4 HomeAdvisor. (n.d.). Learn how much it costs to install concrete steps. Cost of Precast Concrete Steps and Price to Install Cement Stairs. Retrieved March 18, 2022, from https://www.homeadvisor.com/cost/stairs-and-railings/concrete-steps/

5 Our Media Ltd. (2020, February 21). Garden steps and ramps: Coping with a sloping garden. Gardens Illustrated. Retrieved March 18, 2022, from https://www.gardensillustrated.com/garden-design/design-solutions-coping-with-slopes/

6 AJ McCormack and Son. (n.d.). Pavingexpert.com. Paving Expert. Retrieved March 18, 2022, from https://www.pavingexpert.com/

7 Our Media LTD. (2020, February 21). Garden steps and ramps: Coping with a sloping garden. Gardens Illustrated. Retrieved March 18, 2022, from https://www.gardensillustrated.com/garden-design/design-solutions-coping-with-slopes/

8 AJ McCormack and Son. (n.d.). Pavingexpert.com. Paving Expert. Retrieved March 18, 2022, from https://www.pavingexpert.com/

9 Matsuoka, Rodney H. "Student Performance and High School Landscapes: Examining the Links - ScienceDirect." Landscape and Urban Planning 97, no. 4 (September 30, 2010): 273–82. https://doi.org/10.1016/j.landurbplan.2010.06.011.

10 Matsuoka, Rodney H. "Student Performance and High School Landscapes: Examining the Links - ScienceDirect." Landscape and Urban Planning 97, no. 4 (September 30, 2010): 273–82. https://doi.org/10.1016/j.landurbplan.2010.06.011.

11 Penniman, D., Hostetler, M., & Acomb, G. (n.d.). Conservation Subdivision: Construction Phase—Low Impact Development (LID) and Stormwater Treatment. Department of Wildlife Ecology and Conservation, UF/IFAS Extension. Retrieved March 15, 2022, from https://edis.ifas.ufl.edu/publication/UW364.

12 Caflisch, A. M., & Callahan, K. (2015, May 26). An introduction to bioswales. Home & Garden Information Center | Clemson University, South Carolina. Retrieved March 15, 2022, from https://hgic.clemson.edu/factsheet/an-introduction-to-bioswales/

13 Sussex Conservation District. (n.d.) Bioswale Maintenance Fact Sheet. [Brochure] https://www.sussexconservation.org/images/pdfs/Stormwater_pdf/BioswaleMaintFactSheet_0.pdf

14 Chang, Yuexin, Sicheng Cui, Yingpeng Feng, Emily Hernandez, and Bihui Zhang. "Taking It Outside: Reimagining Secondary-School Landscapes," April 23, 2021. (Unpublished)

15 Landscape Architecture Foundation. (2020, March 17). The Morton Arboretum: Meadow Lake and Permeable Main Parking Lot. Landscape Performance Series. Retrieved March 24, 2021, from https://www.landscapeperformance.org/case-study-briefs/morton-arboretum-meadow-lake-parking

16 Landscape Architecture Foundation. (2020, March 17). The Morton Arboretum: Meadow Lake and Permeable Main Parking Lot. Landscape Performance Series. Retrieved March 24, 2021, from https://www.landscapeperformance.org/case-study-briefs/morton-arboretum-meadow-lake-parking

17 Chang, Yuexin, Sicheng Cui, Yingpeng Feng, Emily Hernandez, and Bihui Zhang. “Taking It Outside: Reimagining Secondary-School Landscapes,” April 23, 2021.(Unpublished)

18 Landscape Architecture Foundation. (2019, June 6). Kroon Hall, Yale School of Forestry and Environmental Studies. Landscape Performance Series. Retrieved March 21, 2021, from https://www.landscapeperformance.org/case-study-briefs/kroon-hall-yale

19 Landscape Architecture Foundation. (2019, June 6). Kroon Hall, Yale School of Forestry and Environmental Studies. Landscape Performance Series. Retrieved March 21, 2021, from https://www.landscapeperformance.org/case-study-briefs/kroon-hall-yale