

**Detroit River International Wildlife Refuge Master Plan
and Restoration Guidelines for the Taylor Unit**
Capstone Report

Client: Detroit River International Wildlife Refuge

Team Members: Audrey Pangallo, Ya Cai, Chen Zhang

Advisor: Robert Grese

A project submitted
in partial fulfillment of the requirements
for the degree of
Master of Landscape Architecture
(Environment and Sustainability)
at the University of Michigan
April 2018

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Abstract

Our client, the Detroit River International Wildlife Refuge, recently acquired a forty-three acre parcel of land from donors Clive and Clarice Taylor. The Taylor Unit is located in the Berlin Charter Township and Pointe Mouillee State Game Area, off of Labo Road. The site has several constructed ponds and wetlands, a small woodland, and fallow agricultural fields. This project developed a master plan for the site, educational guidelines, and restoration guidelines for the Taylor Unit.

A site analysis and field work was done for this site, examining existing ecological diversity. Despite having several environmental stresses, the Taylor unit has a large amount of biodiversity on site relative to its surrounding agricultural context. In addition to ecology, this project also looked at the design potential of the site, analyzing views, the integrity of the trail system, and where rest areas should be placed.

The master plan was created to capitalize on the existing trail system, views, and biodiversity of the site, while providing educational programming. A parking lot which accommodates bus parking and a demonstration garden were added in the entrance. The trails were restored and a boardwalk was added for visitors to gain access to the back of the property. Planting suggestions were made for several parts of the site, including the fallow field and grassland areas, as well as the riparian areas along the ponds and wetlands. Finally, a pavilion rest area was added at the center of the site. The goal is that this master plan be a useful tool in updating and developing the Taylor Unit in the future.

Acknowledgments

We would like to acknowledge our advisor, Bob Grese, for providing us guidance in this project. We would also like to acknowledge Dr. Catherine Riseng, for advising us on the aquatic ecological aspects of this project. We would also like to acknowledge Peter Sanderson of Washtenaw County Parks for helping us budget the built elements of our design. Additionally, we would like to acknowledge Clive and Clarice Taylor, for making a diverse landscape. It was fun to create a design for it. Finally, we would like to acknowledge the staff of the Detroit River International Wildlife Refuge for giving us the privilege of designing and learning from this project.

Introduction

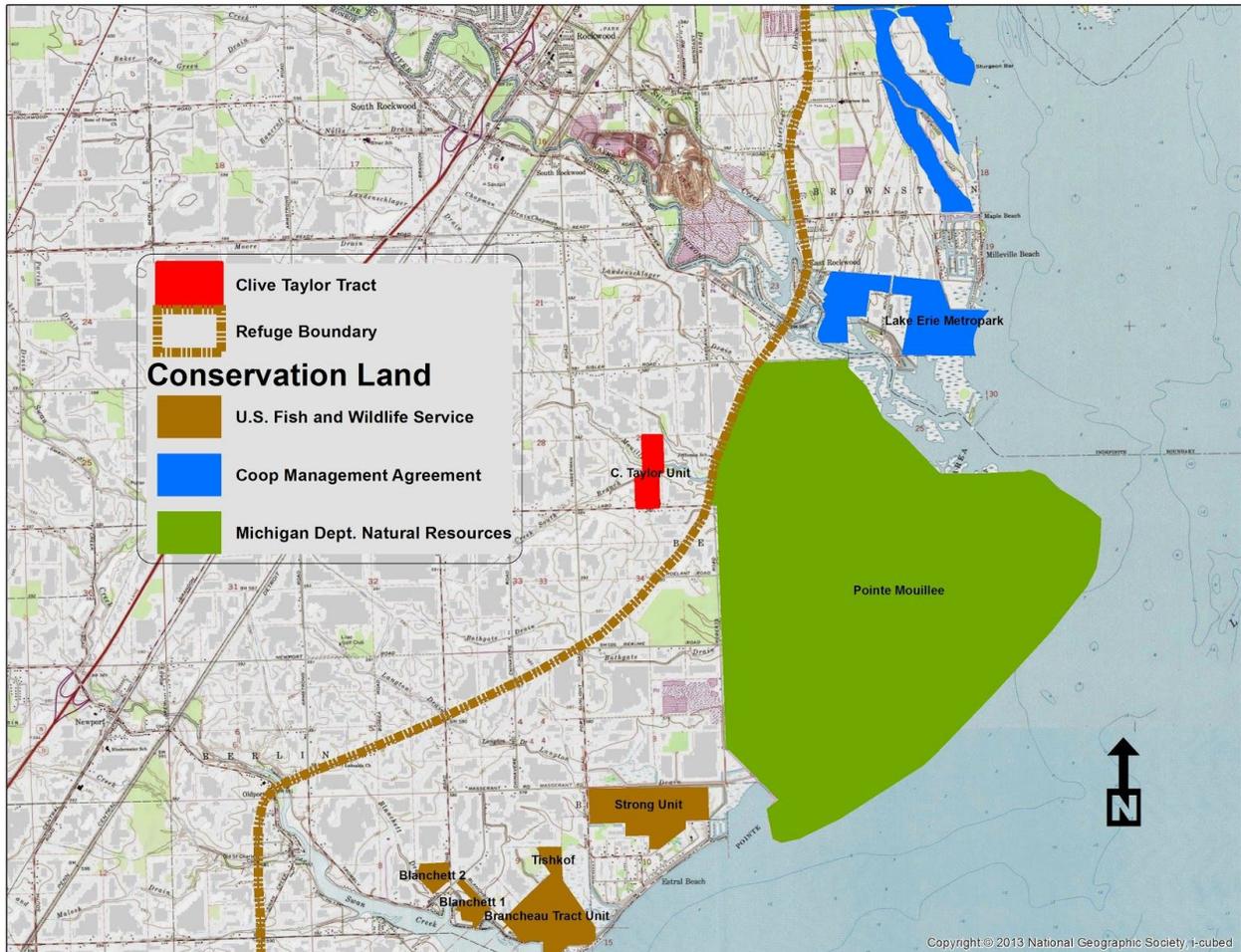
The United States has a long history of ecosystem conservation. Since President Theodore Roosevelt established the first wildlife refuge through an executive order in 1903, legislation protecting wildlife has expanded into a system of refuges and national parks that occupy several areas in the United States today. The latest legislation, called the National Wildlife Refuge System Improvement Act, was passed in 1997, and this provided more guidelines on how the United States should manage its conserved habitats. Currently, National Refuge System manages more than 93 million acres of habitat, comprised of over 540 refuge areas across the United States.

In 2001, The US Fish and Wildlife Service set aside land for wildlife conservation in Southeastern Michigan, twenty miles south of Detroit. This reserve, called the Detroit River International Wildlife Refuge (DRIWR), is tasked with promoting biodiversity and conserving habitat for Michigan’s native plants and animals. The refuge also promotes public engagement on their lands through recreation, education, and volunteering activities. Currently, this organization has 6,107 acres of existing land along the lower Detroit River and western shore of Lake Erie, including wetlands, marshes, and islands. The DRIWR is unique because of its proximity to Detroit. The heavily urbanized context in the region creates many challenges for both wildlife and wildlife conservation. Having the refuge near an urban area helps create essential patches and corridors for wildlife not frequently found in other urbanized areas.



Recently, Clive and Clarice Taylor donated forty-three acres of land to the refuge. This site is named for the previous owners and is called the Taylor Unit. The Taylor Unit is near the Berlin Charter Township and the Pointe Mouillee State Game Area. Since this site is connected to Lake Erie and the State Game Area through Mouillee Creek, it has the potential to function as a useful habitat patch for insects, amphibians, and migrating birds. As a result of the creek running through the site, it also

contains existing wetland habitat and the potential for wetland meadow habitat to be restored there. The northern end of the site contains grassland areas and three constructed ponds. In addition to the useful features of the site, the Taylor Unit also has old agricultural fields in the southern end of the site near the entrance, which previously grew winter wheat.



Wildlife Refuge Properties

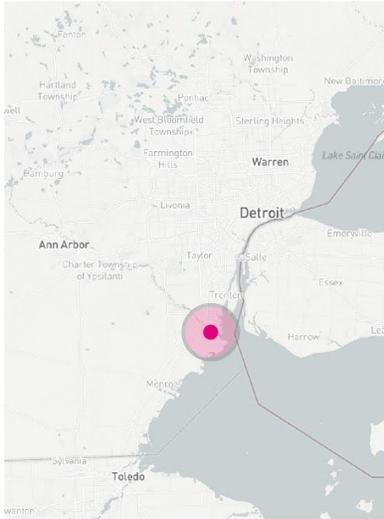
Client Needs

The client would like the Taylor unit to become both a functional ecological site as well as an education resource for the refuge. They have requested a variety of requirements for this master plan. They include:

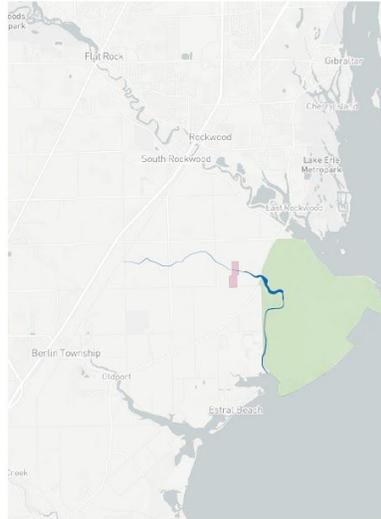
1. Educational areas with accommodations for up to sixty school children
2. A parking lot which accommodates a school bus
3. A picnic and lunch area with bathrooms
4. Incorporation of volunteer stewardship
5. ADA accessibility in trails (ABA ½" Gravel Used In Trails)
6. Create pollinator habitat on site
7. Create a planting plan for the site
8. Include bird, bat, and duck houses made by volunteers
9. Create a staged and inexpensive plan
10. Honor Clive's design intention in the final product

Context

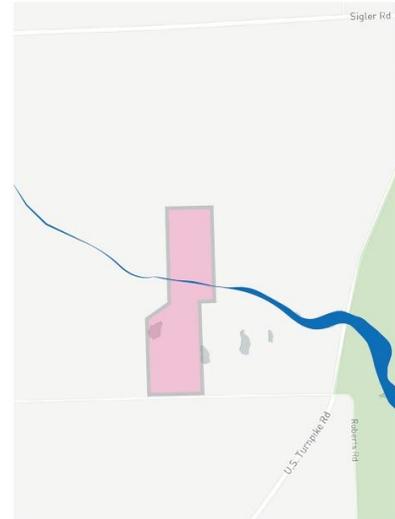
Regional Context



South Eastern MI

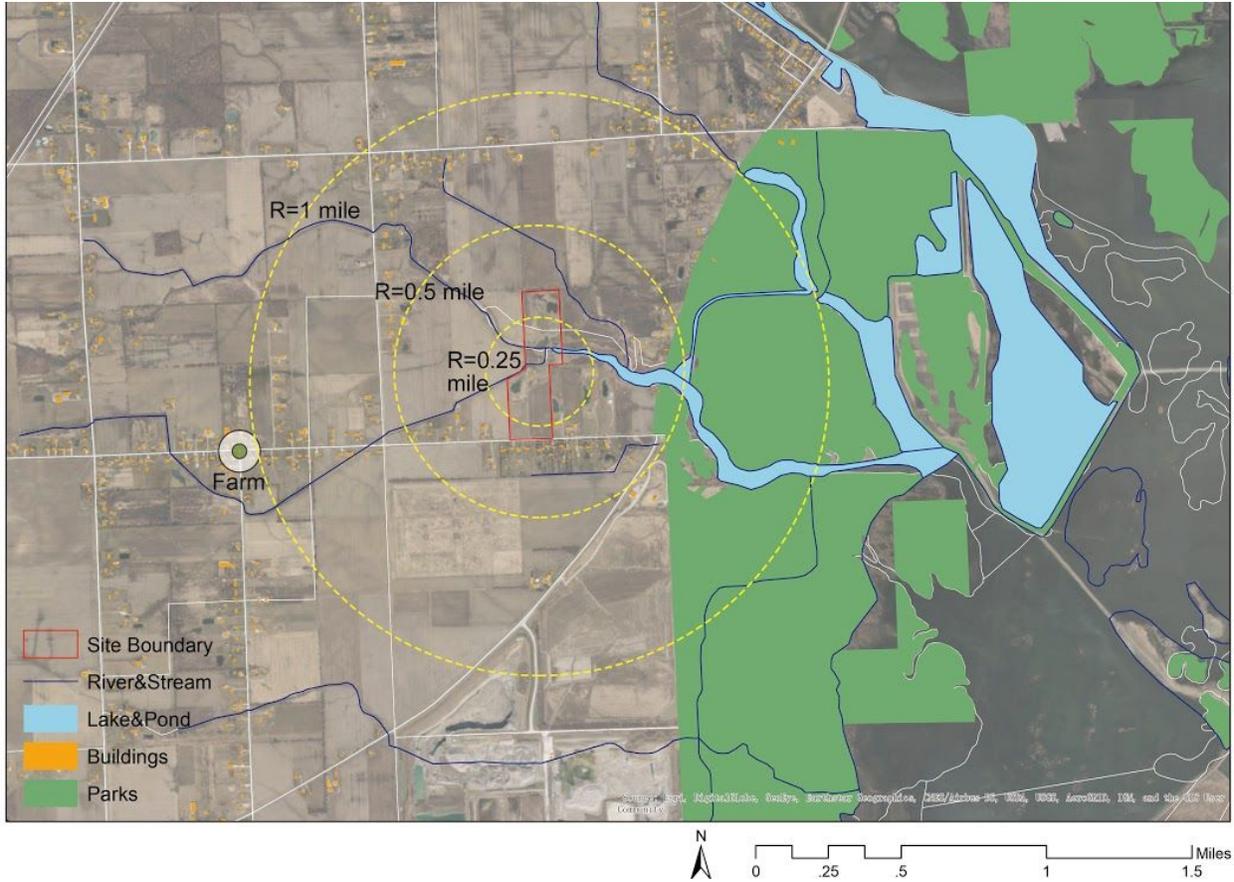


East Berlin Charter Twp



Taylor Unit Site

The Taylor Unit is located with Mouillee Creek going through the middle of the site. The development in this area has the opportunity to add an impressive local attraction as well as an ecological patch. This would contribute greatly to the existing ecological patches on in the region, such as the Pointe Mouillee State Game Area. The population nearby is very low, with agricultural fields and scattered homes surrounding the site. Since there are very few public facilities nearby, the unit would play an important role in providing public open space and ecological functions within this agricultural context.



Regional Context

Within 10-minute walking distance, the Taylor Unit can be closely connected to the existing green space in the eastern side of the region, thereby creating a more connected series of habitats along Mouillee Creek.

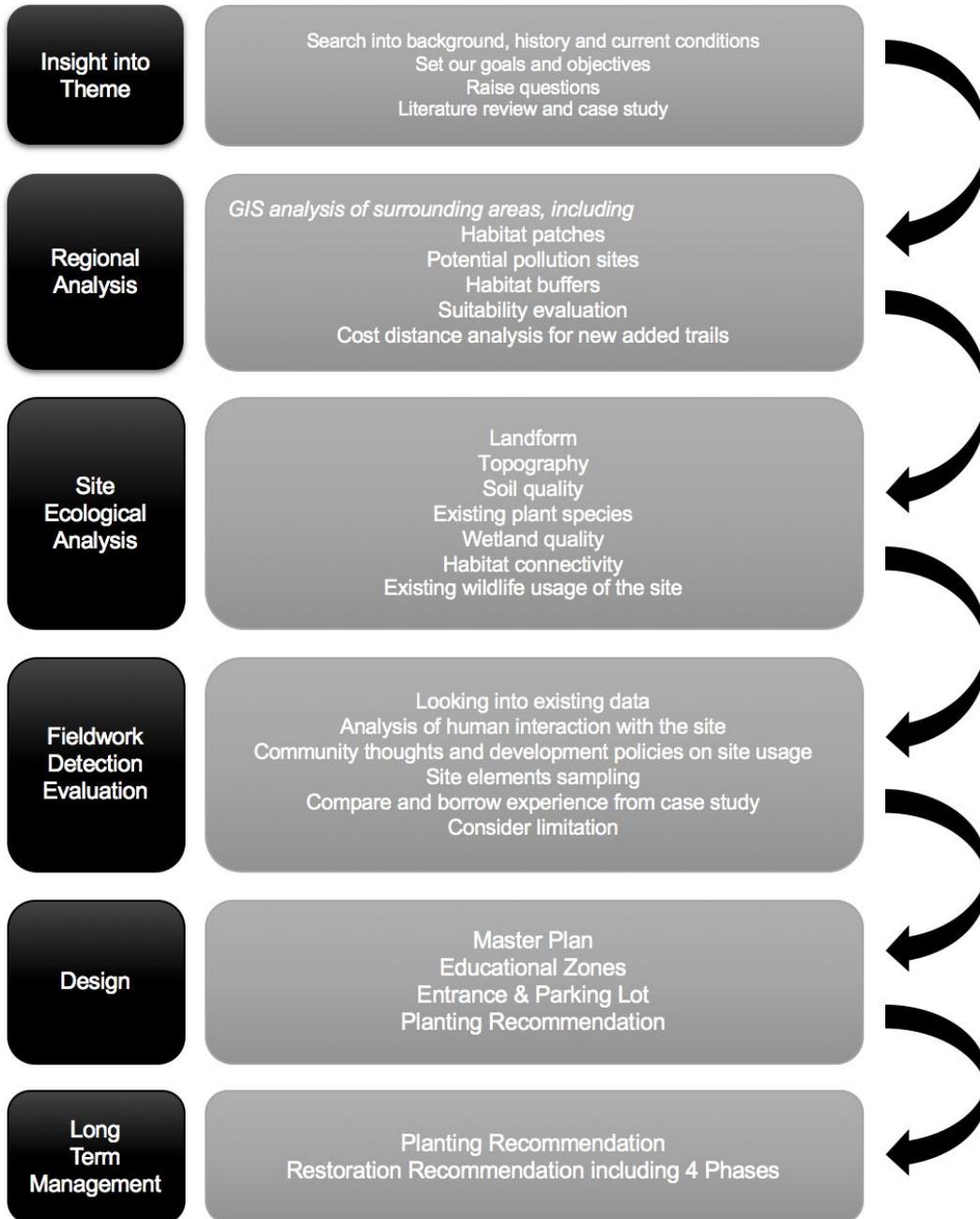
Design Process

Data Collection

We performed a literature review of wetland restoration techniques and a case studies to find precedents for this type of project. We used two comparison sites for our research. We also performed a site analysis through field work and GIS. The field work consisted of plant identification, identification of existing habitat, and finding potential views and educational sites.. Additionally, water depth was measured to get an idea of

the pond quality. We utilized GIS to gain observations about soil type, runoff, and flooding. We also conducted demographic research for this project. This was done to get an idea of the population we would be serving with our design.

Design Process



Research and Case Studies

Data Collection and Literature Review

As part of our literature review, we examined comparison sites, environmental education programs, and the historical ecosystems of the region. The two comparison sites we looked at are Crosswinds Marsh in New Boston, Michigan and the Gibraltar Bay Unit in Grosse Ile, Michigan. Crosswinds was chosen as a comparison restoration site and the Gibraltar Bay Unit was chosen because it is a second Refuge site. Our educational research looked at two programs as well, Project WILD and a transformation project of Menomonee Valley in southeastern Wisconsin. Finally, we looked at the historical ecosystems, as described in the last section of the research.

Case Study Comparison and Analysis

Scale Comparison



Crosswind Marsh, New Boston, Michigan
Area: 1050 acres



Gibraltar Bay Unit, Grosse Ile, Michigan
Area: 40.5 acres

Case 1: Crosswinds Marsh



In 1993, the Metro Airport Authority bought 1,050 acres of farmland in order to offset runway expansions at the Detroit International Airport. SmithGroup JJR proposed a design which established functional, self regulating wetlands. They identified three different ecosystem types; emergent meadow, wetland, and forested.

A new planting plan and a functional design were proposed by designers and biologists. The design can establish functional and self regulating wetland systems. In addition, the functional wetland systems did not use any man made infrastructure. Once the wetlands were built, 10,000 seedlings 300 acres of wetland seed were planted to create the habitat. The park receives around 15,000 visitors a year. The restoration was successful, and the park is now home to 200 species of birds, 170 species of plants, 20 species of fish, 30 species of mammals, 21 species of reptiles and amphibians, and 70 species of butterflies and dragonflies (JJR website---Crosswinds Marsh Interpretive Preserve).



Bird eye view of marsh



Broad walk



Floating pavilion

Given the success of the Crosswinds Marsh and its proximity to our project site, we propose using this site as a research precedent for our project. As part of our research, we visited this site to explore what works well in this design in order to determine if similar concepts can be used in our own work.

Study Points from Crosswinds Marsh:

- Use recycle and local materials in boardwalks, benches, and sign materials
- Representative symbols for educational meaning



Wood benches



Trail markings



Symbols on the posts

Case 2. Gibraltar Bay Unit



The Gibraltar Bay unit is a fish and wildlife refuge property located on Grosse Ile. Its size is very close to our site. According to the Grosse Ile Nature and Land Conservancy, “the 40.5-acre marsh and upland area was previously a Navy seaplane base (1927) and also a NIKE missile base (1954 to 1963). In 1972 the Defense Department turned this site over to the Environmental Protection Agency for use as a wetlands research area. In April of 1990, at the center of the property, six acres of meadowland were still completely covered with pavement and huge steel doors were lying on the ground. In 1990, the doors were removed, the cement was hauled away, and Nature, with a little help from humans, could once again flourish. In May of 1993, the Environmental Protection Agency (EPA) granted stewardship of the area to the Grosse Ile Nature and Land Conservancy. In 2009 the Nature Area was made part of the Detroit River International Wildlife Refuge. The Conservancy is here to protect and assist Nature in reclaiming this area” (The Land and Nature Conservancy). This site promotes environmental education and recreation for students. Given the similarities of this site to the project site, an investigation of the design here will help inform our own design at the Taylor Unit.

Study Points from *Gibraltar Bay Unit* :

- Specific areas for wild species
- Clear boundaries between people and wildlife



Small mount



Wild birds in specific areas



Trails and fences as boundaries

Environmental Education Research

With environmental education for K-12 students as a major focus for the Taylor Unit, we explored several examples of environmental programs to determine what types of support facilities would be desirable. According to the Environmental Education definition provided by US EPA, Environmental Education is intended to help people explore



environment, encouraging them to participate in solving environmental issues, and take action to improve the environment. It is not limited by any specific formats, which means diverse activities could happen under formal or informal settings. So human willingness is the term coming first. As a result, individuals could understand the environmental issues deeper, increase their interests in learning environmental skills, and make responsible decisions more reasonably (Environmental Protection Agency). The Taylor Unit has lots of potential opportunities for conducting such processes.

The US EPA defines the components of environmental education as “awareness and sensitivity to the environment and environmental challenges, knowledge and understanding of the environment and environmental challenges, attitudes of concern for the environment and motivation to improve or maintain environmental quality, skills

to identify and help resolve environmental challenges participation in activities that lead to the resolution of environmental challenges” (Environmental Protection Agency).

We based the facilities we suggest for environmental education programs on a review of “Project WILD” and “Transformation of Menomonee Valley”. Descriptions of those programs are included below:

Case 1: Project WILD

Project WILD is a national-wide project that link students and wildlife very closely. We think this program is very useful because through diverse activities it suggested between children and wildlife, responsible actions towards wildlife conservation and related natural resources can be easily conveyed. The program is suitable for students in kindergarten through high school.



As the intrinsic, ecological value of wildlife is so strong, it is playing an important role in helping teaching how ecosystems function. Human beings should become a responsible object to our planet when facing competing needs and pressures affecting the quality and sustainability of life on earth (Project WILD). The program emphasized this because they think that young people and educators have a vital interest in learning about our natural world. So this group should be paid more attention to during the promotion of environmental education.

The activities suggested by Project WILD instructional materials are suitable for use in both classroom and informal settings. As the introduction on Project WILD website said: “The activities can be easily adapted to meet the learning requirements for academic disciplines ranging from science and environmental education to social studies, math, and language arts. Educators may choose one or more Project WILD activities to teach a concept or skill” (Project WILD).

Sample Activities: Adapted from Project WILD

- Then and Now

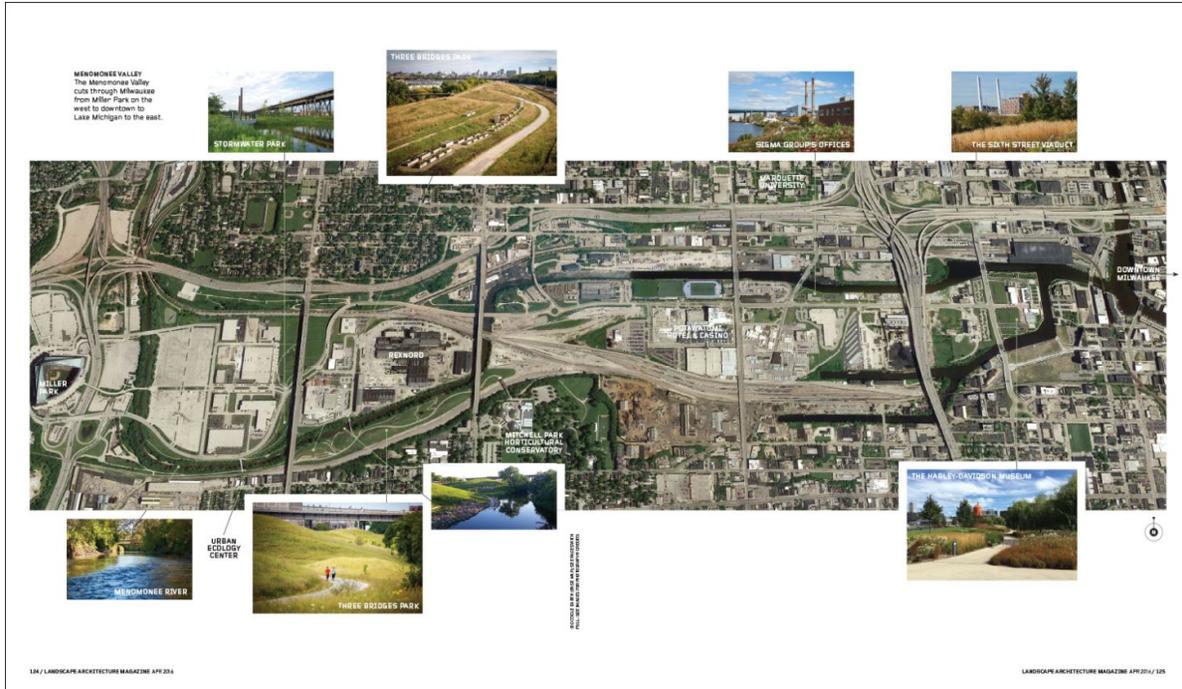
"Then and Now" helps students to visualize the effects of human development on wildlife. How do human settlements (parking lots, apartment buildings, etc.) influence wildlife habitat and populations? What are the effects of man-made structures on native and non-native species? These questions are explored by interpreting aerial photographs and related information sources in an attempt to uncover some of the correlations between changes in habitat and types of wildlife (Project WILD, Science and Civics: Sustaining Wildlife).

- The Birding Beat

Take a hike along Birding Lane and try to identify as many birds as you can! Learning to identify birds is a challenge that promises to delight and reward the novice and expert birder alike. Things that bird watchers check for include the silhouette (size and shape of a bird, habitat (where you see it), plumage (color and color patterns of feathers), sounds, behaviors, and other field marks that stand out. These can be important clues to help you identify what you are observing (Project WILD, Flying Wild).

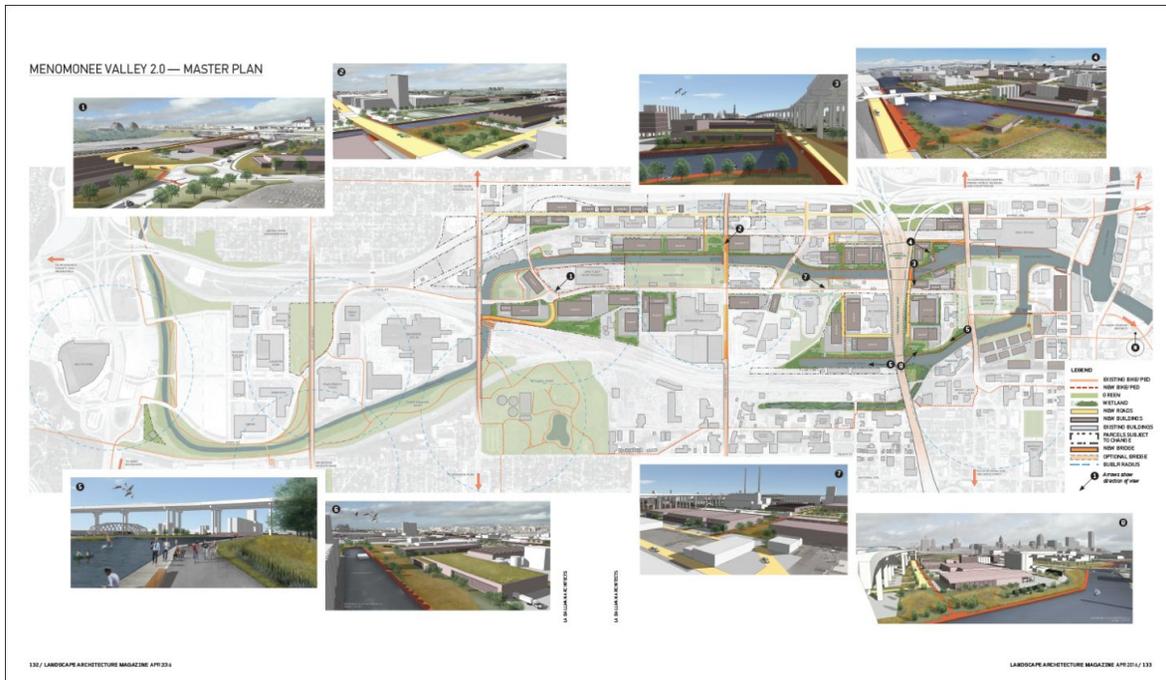
Case 2: Transformation of Menomonee Valley, Wisconsin

The Menomonee Valley is still industrial, this project is kind of a transformation for the valley, transforming it into a sustainable business park while the existing buildings could be there forever. Where we learned a lot through this project is the Urban Ecology Center in Milwaukee, which runs Neighborhood Environmental Education Project as its initiative. As the introduction of that project said: "It focuses on a two-mile radius around the park - an area that is home to 11 schools. The idea is to expose kids to nature close to home" (Arvidson 2016). The ecology center has rooms that can provide children and adults with gear for experiencing the landscape such as snowshoes, fishing rods and waders, hiking boots and so on.



Site Current Condition

The Menomonee Valley cuts through Milwaukee from Miller Park on the west to downtown Lake Michigan to the east.



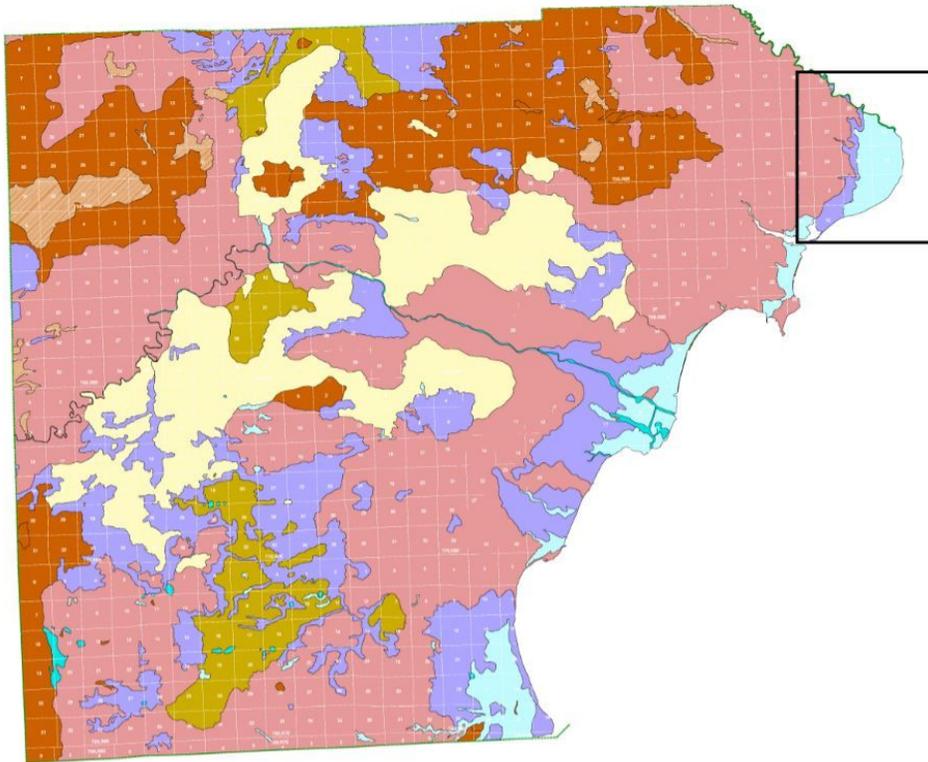
New Master Plan

NEEP project was focused on engaging children from neighborhoods adjacent to the section of the Menomonee River included in this master plan.

Looking at the two projects introduced above, one is helping to borrow some activities that could happen between children and wildlife, even the environment. Another one is a good example showing the support to conduct educational projects on a site. Since the Taylor Unit is a totally undeveloped site, to run successful programs such as listed in the two examples, several places will be needed to provide for groups of children in classes to gather, have interesting plants close to trails and boardwalk for them to explore, provide docks for water-based explorations, have storage facilities for equipment for exploring the outdoor and so on.

Historical Ecosystems

In and around our project site, the historical ecosystems were wet prairies, mesic beech sugar maple forest, emergent marshes and swamps. Wet prairies typically occur on level topography in seasonally flooded areas in river floodplains and lakeplains. As a result of the seasonal flooding, these ecosystems often have high organic matter which is deposited by water flow. These ecosystems are characterized by fire as well as flooding. Fire helps release plant nutrients into the ecosystem which encourages new growth. Together, repeated fires and flooding help maintain species diversity in these ecosystems. Wet prairies are frequently associated with southern mesic forests in Michigan, such as the mesic beech and sugar maple forest (Kost et al 2007). Mesic hardwood forests often act as the transition between wet floodplain areas and dry uplands. They have moist soils and are often quite shady, and due to this they are dominated by shade and moisture loving species like the American Beech (*Fagus granifolia*) and Sugar Maple (*Acer saccharum*). Often, due to their high soil moisture, these ecosystems can also contain ephemeral wetlands (Michigan Department of Natural Resources). Finally, the last historical ecosystem in the region near the Taylor Unit is the emergent marsh or swamp. These ecosystems occur along the edges of lakeplains or river floodplains associated with the Great Lakes. The difference between these and wet prairies is emergent marshes are typically characterized by having areas of standing water with emergent wetland species. Wet prairies have herbaceous species as well however they do not frequently have standing water, only highly moist soils (Kost et al 2007).



Vegetation circa 1800 of Monroe County, Michigan

An Interpretation of the General Land Office Surveys

By P. J. Carter and D. A. Albert
Michigan Natural Features Inventory
1997

Legend

- ✓ ASPEN-BIRCH FOREST
- ✓ BEECH-SUGAR MAPLE FOREST
- ✓ BEECH-SUGAR MAPLE-HEMLOCK FOREST
- ✓ BLACK ASH SWAMP
- ✓ BLACK OAK BARREN
- ✓ CEDAR SWAMP
- GRASSLAND
- HEMLOCK-WHITE PINE FOREST
- HEMLOCK-YELLOW BIRCH FOREST
- JACK PINE-RED PINE FOREST
- ✓ LAKE/RIVER
- ✓ MIXED CONIFER SWAMP
- ✓ MIXED HARDWOOD SWAMP
- ✓ MIXED OAK FOREST
- ✓ MIXED OAK SAVANNA
- ✓ MIXED PINE-OAK FOREST
- ✓ MUSKIEG/BOG
- ✓ OAK-HICKORY FOREST
- ✓ OAK-PINE BARREN
- ✓ PINE BARREN
- ✓ SAND DUNE
- ✓ SHRUB SWAMP/EMERGENT MARSH
- ✓ SPRUCE-FIR-CEDAR FOREST
- ✓ WET PRAIRIE
- ✓ WHITE PINE-MIXED HARDWOOD FOREST
- ✓ WHITE PINE-RED PINE FOREST
- ✓ WHITE PINE-WHITE OAK FOREST
- ✓ = LAND COVER TYPE PRESENT ON THIS MAP



Scale 1:85,000



Map Projection: Lambert Conformal Conic

SOURCES: Carter, P.J., D.A. Albert, H.A. White, S.L. Hart, J.B. Reed,
D.L. Price, D.M. Kasper, S.A. Carter, C.W. Schwan, B.A. Hayslett,
B.J. Albert, L.S. Lohrman, J.M. Korman, L. Hayslett, P.J. Siskaly,
C.J. Deane, L.J. Springer. Digital Map Projection: 1987; P.J. Siskaly,
Michigan's Predecessors' Organization, as interpreted from the General
Land Office Survey, 1815-1850.
Michigan Natural Features Inventory, Lansing, MI. Digital Map.



Historical Ecosystems in Monroe County. The Taylor Unit is located within the black outline (Michigan Natural Features Inventory).

Site Analysis

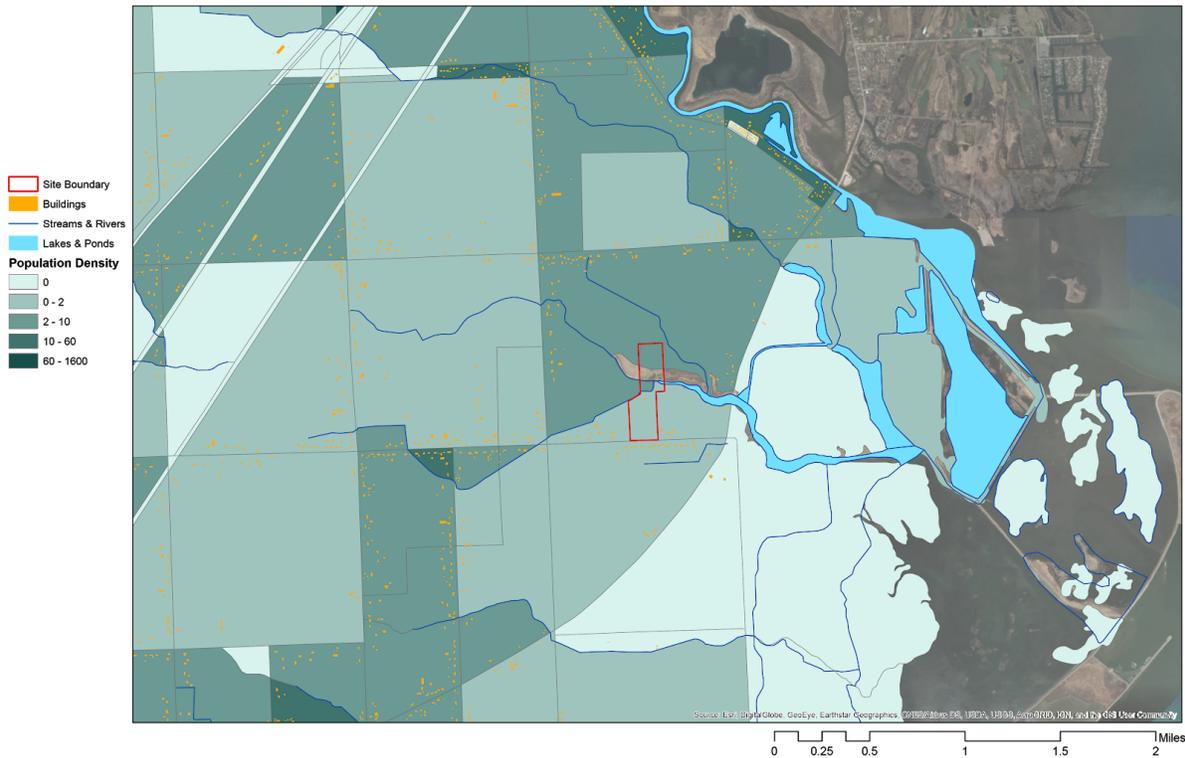
Site Description



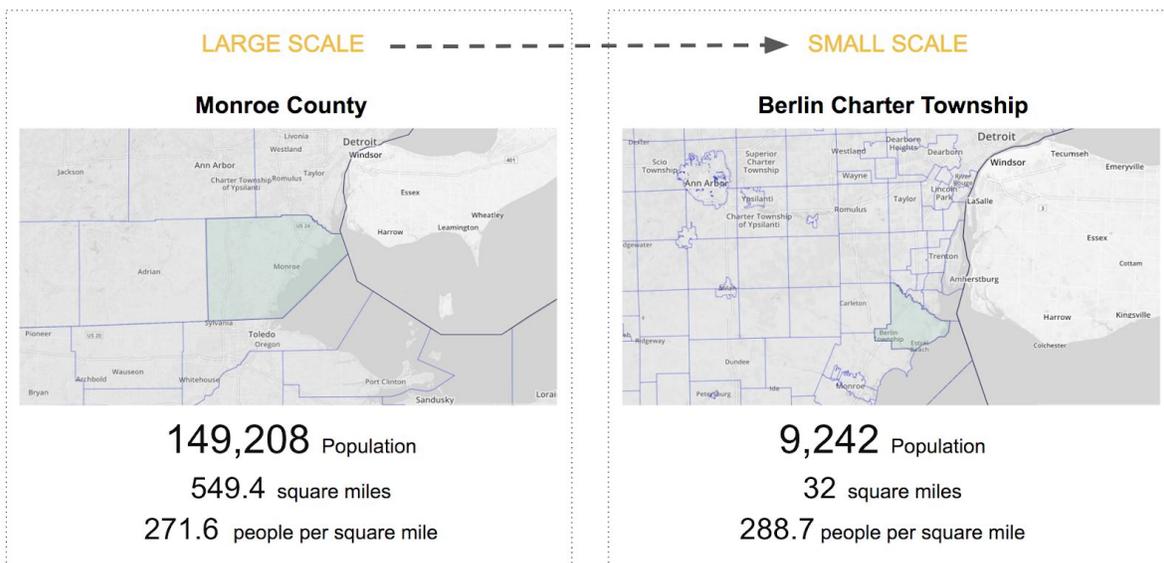
The Taylor Unit is forty-three acres and has several ecosystem types on site. The northern end of the site consists of rolling topography and grassland. Three constructed ponds are located at the northeast corner of the site. These ponds are not groundwater fed and water levels typically drop over the course of the field season. Towards the center of the site, adjacent to Mouillee Creek, there is wetland habitat as well as an Oak-Hickory dominated forest. The forest is understory has limited plant species and is dominated by invasive honeysuckle (*Lonicera spp.*) and dames rocket (*Hesperis matronalis*), likely indicating the forest was heavily grazed or is recovering cropland. The wetland habitat is made up of constructed ponds which are fed by the creek and are heavily dominated by invasive cattail (*Typha latifolia*). This area of the site also has two constructed bioswales. The southern end of the site is fallow agricultural fields. On the western part of the site there is another constructed pond, this pond appeared to be fed by groundwater as the water levels stayed the same throughout the field

season.

Demographic Data



Generally speaking, the population density surrounding the site is very low. Despite the low population density, the Taylor Unit does have immediate neighbors who together with others in the township and county serve as potential users for the site. We compared all the demographic related data in both county scale and township scale that our site located:



Data from Census Reporter, Monroe County and Berlin Charter Township, MI

Age Distribution

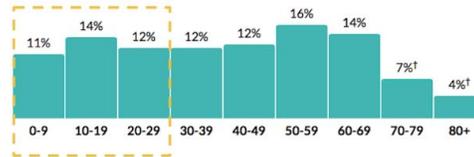
Monroe County 2016

42.2

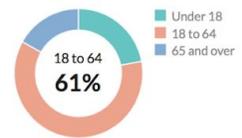
Median age

a little higher than the figure in Michigan: 39.7
about 10 percent higher than the figure in United States: 37.9

Population by age range



Population by age category



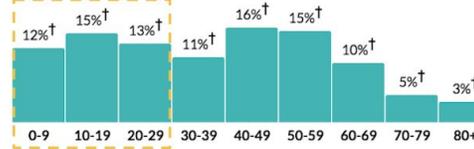
Berlin Charter Township 2016

39.1

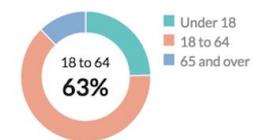
Median age

a little less than the figure in Monroe County: 41.7
about the same as the figure in Michigan: 39.5

Population by age range



Population by age category



Data from Census Reporter, Monroe County and Berlin Charter Township, MI

With the emphasis of the Taylor Unit on providing environmental education to school groups and families, the number of children in the area is important to know. For Monroe County, children and youth make up a large percentage of the population and those numbers are even higher for Berlin Township.

Unit & Occupancy

Monroe County 2016

63,694

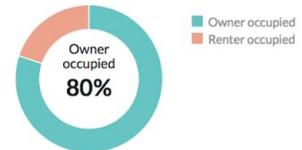
Number of housing units

Michigan: 4,560,164
United States: 135,702,775

Occupied vs. Vacant



Ownership of occupied units



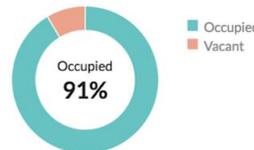
Berlin Charter Township 2016

3,778

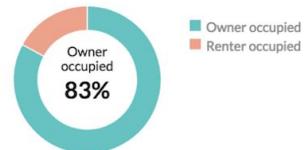
Number of housing units

Monroe County: 63,403
Michigan: 4,539,838

Occupied vs. Vacant



Ownership of occupied units



Data from Census Reporter, Monroe County and Berlin Charter Township, MI

The occupancy rate here is very high which indicates the target population group is very stable.

Education Attainment

Monroe County
2016



Berlin Charter
Township
2016

91%

High school grad or higher

about the same as the rate in Michigan: 90.4%

a little higher than the rate in United States: 87.5%

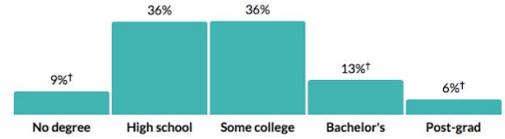
19.3%

Bachelor's degree or higher

about two-thirds of the rate in Michigan: 28.3%

about three-fifths of the rate in United States: 31.3%

Population by minimum level of education



91%

High school grad or higher

about the same as the rate in Monroe County: 90.2%

about the same as the rate in Michigan: 89.6%

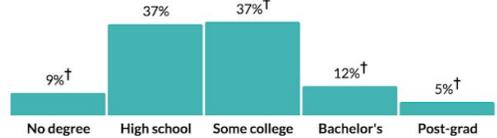
17.2%

Bachelor's degree or higher

about 90 percent of the rate in Monroe County: 18.6%

about two-thirds of the rate in Michigan: 26.9%

Population by minimum level of education



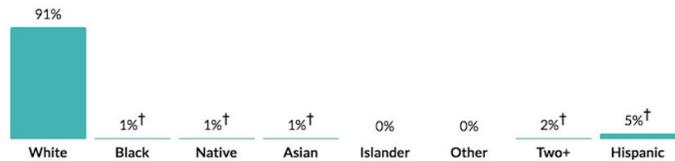
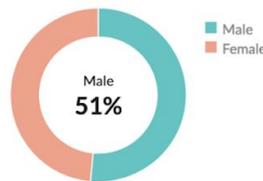
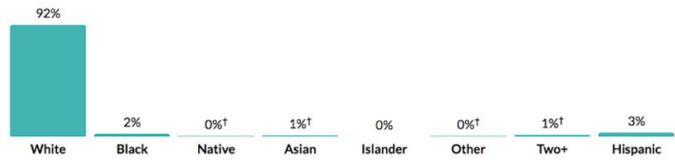
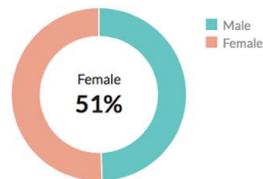
Data from Census Reporter, Monroe County and Berlin Charter Township, MI

Sex & Race Distribution

Monroe County
2016



Berlin Charter
Township
2016



Data from Census Reporter, Monroe County and Berlin Charter Township, MI

Income

Monroe County 2016



Berlin Charter Township 2016

\$29,768

Per capita income

about the same as the amount in Michigan: \$29,128

a little less than the amount in United States: \$31,128

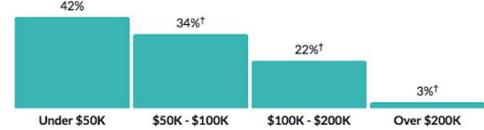
\$60,799

Median household income

about 20 percent higher than the amount in Michigan: \$52,492

a little higher than the amount in United States: \$57,617

Household income



\$29,552

Per capita income

about 10 percent higher than the amount in Monroe County: \$26,982

about 10 percent higher than the amount in Michigan: \$26,607

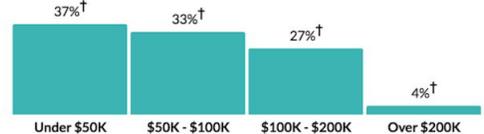
\$67,827

Median household income

about 25 percent higher than the amount in Monroe County: \$55,653

about 1.4 times the amount in Michigan: \$49,576

Household income

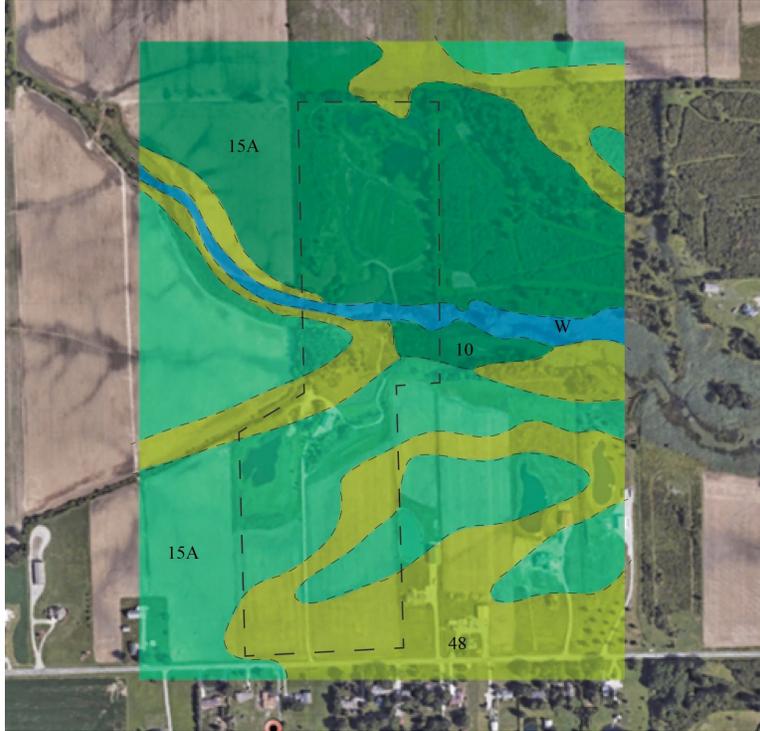


Data from Census Reporter, Monroe County and Berlin Charter Township, MI

More than 90% of the population is white. Both the county and township have a relatively higher level of education because most of the people complete at least high school. The income in Berlin Charter township is higher than the whole county (U.S. Census Bureau).

GIS Component

Our analysis of the soils on the site was limited to a GIS analysis with information from the USDA Natural Resources Conservation Service. Understanding the soils on our site was important in understanding what can be planted in this area. The soils in this site are classified as 15A, 48, and 10. The “W” in this map of our site is water, reflecting Mouillee Creek. Soil type 15A is described as a silty clay loam. This soil type is poorly drained, floods infrequently, and is generally pH neutral. It occupies most of the back of the site. The flooding and drainage of the back of the site is likely to be influenced by topography. Soil type 48 is described as being silty clay loam which floods frequently, is poorly drained, and slightly acidic. Soil type 10 is also described as silty clay loam, however it floods frequently and is slightly acidic (USDA). Despite the mild acidity of the soil, none of the vegetation growing on this site indicated that the soil pH was far from neutral. There were no plants indicative of highly acidic soil growing on site.



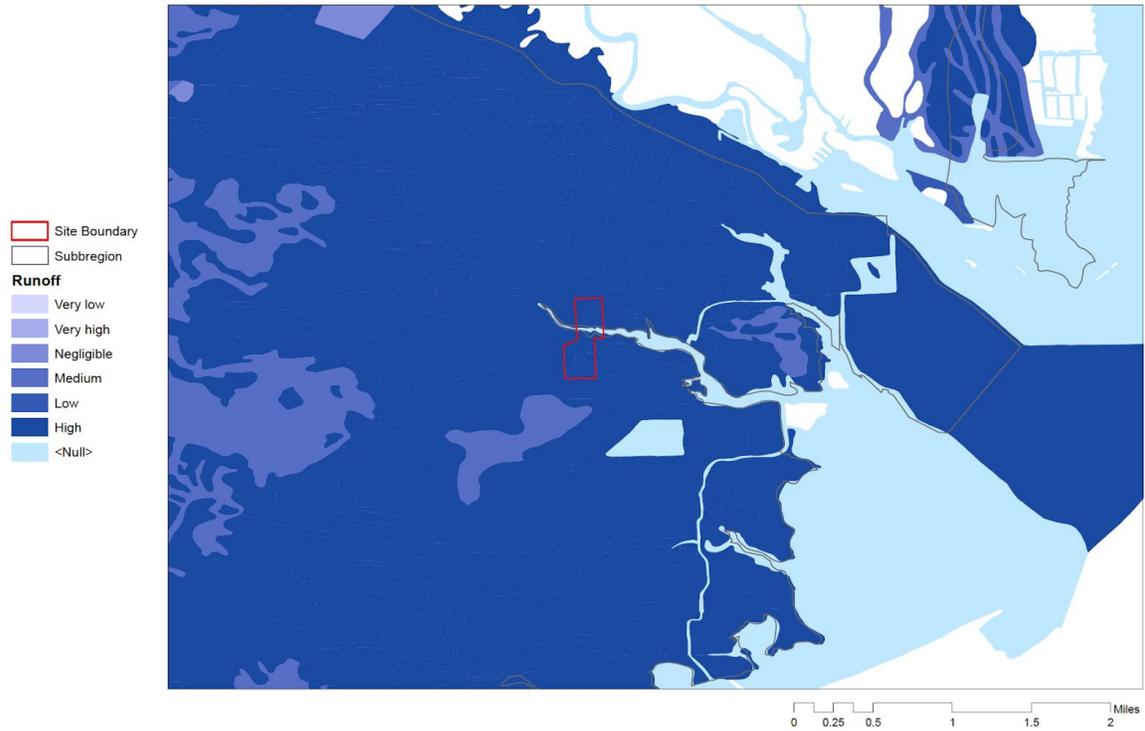
Soil Types on Site

Water Depth

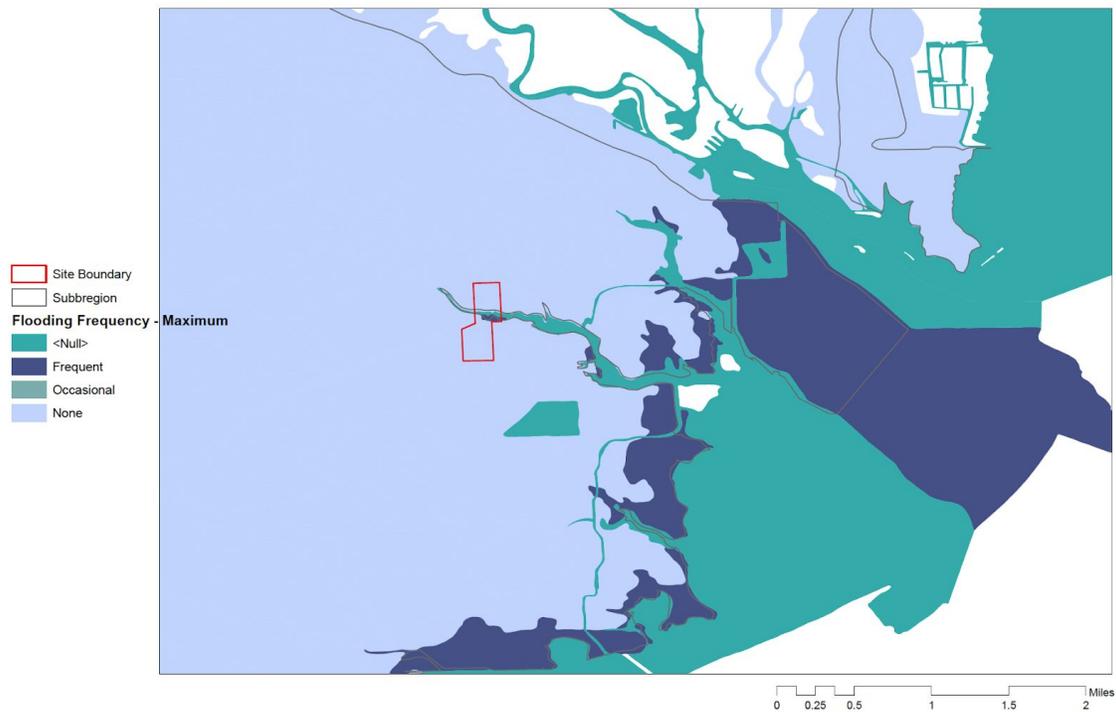


Water Depth on September, the site was always facing flooding problems.

Runoff & Flooding Frequency



Runoff Condition



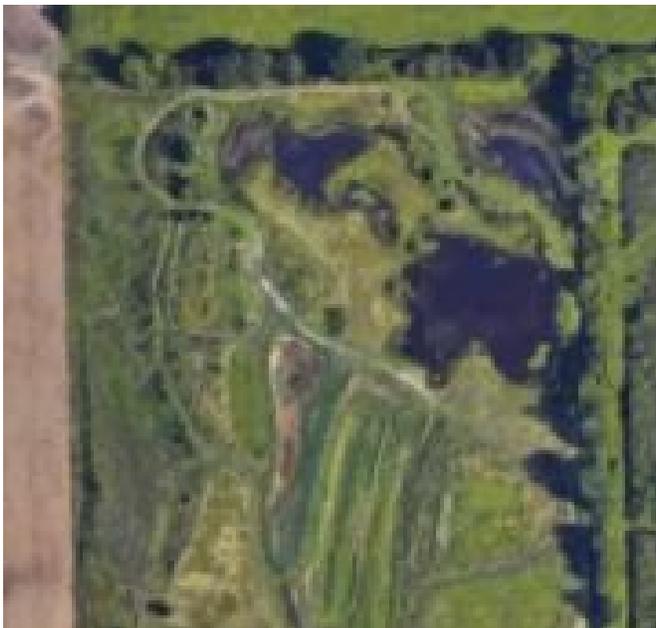
Flooding Frequency

The runoff within the Unit area is high because of the Mouillee Creek going through the middle of it. However, flooding occurs mostly along the central portion of the creek. The north and south parts have little to no flooding issues.

Ecological Analysis and Field Data

The Taylor Unit is very ecologically diverse relative to its context. We conducted our ecological analysis through fieldwork, measuring the water depth, doing a plant and animal species survey as well as a survey of the general ecological conditions. A total of fifty-one plant and animal species were counted on site, and there were certainly more than what we or our expert consultants could identify. Most of what was seen, in addition to the plants, were species of birds. For the purposes of this paper, this field analysis will be broken up into the North, Central, and Southern sections of the site.

The North Section



The Northern Section of this site has dense stands of cattails and grasses, making the western half of this section nearly impossible to walk in. This section featured three ponds, however the ponds did not appear to be receiving any groundwater inputs, and the northernmost two of them were overgrown with algae by the end of summer. Much of the vegetation appeared to be grasses and sedges. The site edges are lined with several trees, notably American Elm (*Ulmus americana*). Other species in this area

included Milkweed (*Asclepias spp*), Sumac (*Rhus typhina*), wild strawberries (*Fragaria vesca*), and Vetch (*Vicia spp*).



Overgrown caused low accessibility



Dry Pond in Summer

Central Section



This section of the site was the most diverse of the sections.. All the ponds in this section appeared to be fed by Mouillee Creek, however despite the flow of water, the ponds were still very turbid. Fish were spotted in these ponds, and it is suspected that the reason the water is so murky is because the fish are likely carp, which stir up the water. Additionally, the ponds are invaded by cattail (*Typha spp*), and lack riparian vegetation on several of the edges. Most of the ponds did, however, have large populations of Lotus (*Nelumbo lutea*). These ponds were particularly susceptible to flooding and seiches. In the early spring, water levels were much higher than expected due to lake seiches. In addition to this, the trails that crossed over the ponds and wetland areas were consistently flooded, even during the hottest and driest parts of the year. Due to this we suspect that some sort of raised crossing or boardwalk will be necessary on some part of the property to give potential visitors access to the back of the property.



Serious flooding in summer



Edge lacked vegetation



Large population of Lotus

A variety of other plant species were spotted in this area. In the small woodland, Red Oak (*Quercus rubra*), White Oak (*Quercus alba*) Pin Oak (*Quercus palustris*), Pignut Hickory (*Carya glabra*), Shagbark Hickory (*Carya ovata*), Red Maple (*Acer rubrum*), Silver Maple (*Acer saccharinum*), River Birch (*Betula nigra*), and Elderberry (*Sambucus spp*) were all found. A few sprouts of invasive honeysuckle (*Lonicera spp*) and Poison Ivy (*Toxicodendron radicans*) were also observed. In the grassland area, several prairie species were seen. These were most likely planted, these included Rattlesnake Master (*Eryngium yuccifolium*), Purple Coneflower (*Echinacea purpurea*), Rosinweed (*Silphium integrifolium*), Black Eyed Susan (*Rudbeckia hirta*), New England Aster (*Symphotrichum novae-angliae*), Teasel (*Dipsacus fullonum*), Switchgrass (*Panicum virgatum*), Compassplant (*Silphium laciniatum*), and Big Bluestem (*Andropogon gerardii*). In addition to the prairie plantings, this area also included an existing set of bioswales. These bioswales were ephemeral, as they were essentially empty in the early spring. As the season moved on, these swales flooded and several plant species came up, including lotus (*Nelumbo nucifera*), Arrowhead (*Syngonium podophyllum*), and algae (*Cladophora spp*) in the water.



Swale with Lotus



Black Eyed Susan

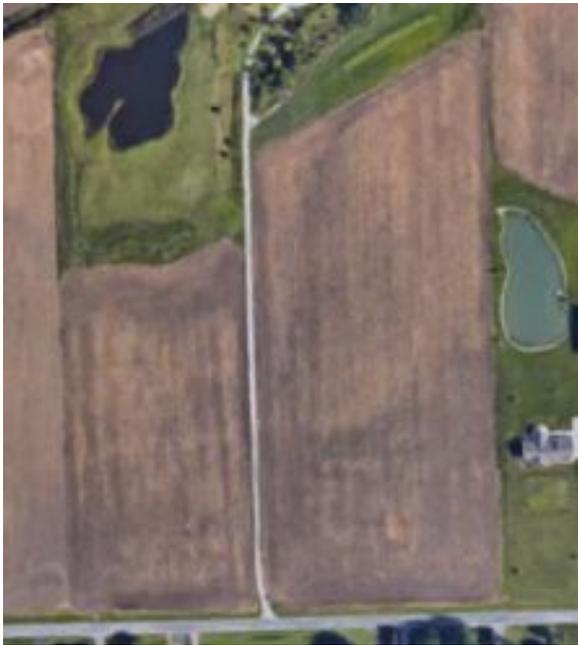


Pin Oak

Noticeably more animal species were spotted at this section compared to other sections. Snails, several insects including dragonflies, damselflies, and waterboatmen

all lived in this area. Tadpoles were also spotted in some of the flooded areas, as were grown frogs. Minnows were also seen in some of the shallower parts of the ponds. Birds were also observed here, including a Great Blue Heron (*Ardea herodias*), Canadian Geese (*Branta canadensis*), Wood Ducks (*Aix sponsa*), Purple Martins (*Progne subis*), a Bobolink (*Dolichonyx oryzivorus*), killdeer (*Charadrius vociferus*), and an Egret (*Ardea alba*).

The Southern Section



The Southern Section of this site is mostly fallow agricultural fields. These fields contain Barnyard grass (*Echinochloa spp*), clover (*Trifolium spp*), and other weedy species. Some of the prairie species found in the middle section also grow here. Additionally, there is one more pond. This pond appeared to be receiving ground water from the creek and perhaps also from drainage of the agricultural fields. It is surrounded by grasses. The road to this site extends to the entrance on the south end of the property, where there is a sign for the wildlife refuge.



Entrance with sign



Gravel road when enter the site



Fallow agricultural field

Design

Master Plan

We utilized our research and site observations to create a site plan. We created a design that helps maximize the educational goals and wildlife value of the site. In order to generate a design that was most useful to our client, we also reviewed earlier visions with several of the staff members at the Refuge. Their feedback, combined with the research that we did helped us create the final site plan. Below we have the final site plan, written details about it, and various perspectives and visions of the plan.



Details

The South End of the Site:

To the south side of the site, we have added a parking lot which can accommodate both regular vehicles and school busses. Immediately next to the parking lot we have placed a demonstration garden. The demonstration garden serves several functions. For students and people who have just arrived, it gives people something to look at as well as a place to shepherd students while everyone unloads. It also helps introduce people to some of the species that they will encounter on site. The plants in the demonstration garden are listed in the planting recommendations. Areas labeled as “grassland plantings” and “agricultural grassland plantings” are new naturalized prairie plantings. In the south section of this site, a prairie style planting made up of more grasses will help maintain the agricultural aesthetic. Some of the neighbors have suggested that they would like to keep this site as farm fields, despite not being the most useful type of ecosystem to wildlife. To compromise, we are suggesting a prairie planting, which will give the similar feeling to a farm field without compromising ecological integrity.

The Central Section:

In the middle of the site, there is a gathering space with pavilion and portable restrooms, where we are anticipating people using as a lunch or picnic spot. We are also suggesting adding some riparian plantings to the edge of the pond to create more habitat here. The “Bright Trees” are showy trees. They are put by the creek so that they can be visible from Children Education Spot 1- as a method to talk about the creek. Those trees can act as a visual tool when people want to show where the creek is flowing to. Finally, we have added a boardwalk to this site. This is to deal with the continuous flooding onsite ensure that the back of the property is accessible.

The North End of the Site:

Some new forest had been added to the north-west side of the site. Given our particular site location, new forest would provide a useful patch for birds passing through. It is anticipated that this new forest will be installed using an island planting method, where smaller patches of new trees are planted and then caged in herbivore exclusion cages and allowed to seed on their own to expand the forest. In the northernmost part of the site, there are two ponds which are labeled “plant over”. These

ponds are suggested be turned into more of a vegetated wetland area. While they seemed ok in the early part of the year, as the summer went on they became very dried out, the water levels very low, and they were covered in green algae. This condition suggested that they aren't getting very much groundwater recharge, and that they might function better if they had wet-tolerant vegetation as opposed to being left open as ponds.

Educational Zones

Each Educational zone is expected to hold around twenty kids, however, this can be divided further by adding an extra group to the demonstration garden.

Grassland Education Zone

The first educational spot is located the grasslands at the back of the property, across the boardwalk. We have titled it grassland educational zone due to its proximity to the grassland plantings. Additionally, we wanted the title of each educational zone to reflect what kids might be learning about in each area. In this case, the topics of conversation would be native Michigan grasslands and prairies.



Grassland Education Zone: Prairie Playground



Location



Before



Grassland Education Zone: View from the Boardwalk



Location



Before

Lily Education Zone

The second educational spot is named the Lily Education Zone. It is located in the central part of the site by the ponds and existing woodland stand. Given its proximity to the existing forest and pond area, spot two serves a lot of functions. A dock is added in this area, as well riparian vegetation that supports aquatic insects. We called this area the “dragonfly garden” and we believe this could be a useful teaching tool for talking about aquatic habitats in Michigan. Potential activities that could be done here include collecting aquatic insects and learning about aquatic vegetation. In this educational area we have included a floating dock that cuts through the dragonfly garden. In addition to being attractive to visitors, this helps make the dragonfly garden accessible. Students or anyone with a mobility issue can take a closer look at the aquatic vegetation if they want to.



Lily Education Zone: Forestry Outdoor Classroom



Location



Before



Lily Education Zone: Dragonfly Garden



Location



Before

Human Impact Education Zone

The third spot is an area that shows human environment interaction. It is located next to the constructed pond on the southwestern part of the site. From this spot, there are views of the landfill, as well as the drainage pipes, both of which provide opportunities to talk about human interactions with the environment. A good programming option for this site would be the “Then and Now” Activity from Project Wild. The “guiding trees” listed on the plan are there to help people navigate. They are a way to signal to people where the path is. We are also suggesting a new boardwalk in this area, as the old one is too small and likely unsafe for children to walk on.



Human Impact Education Zone: Floating Dock View



Location



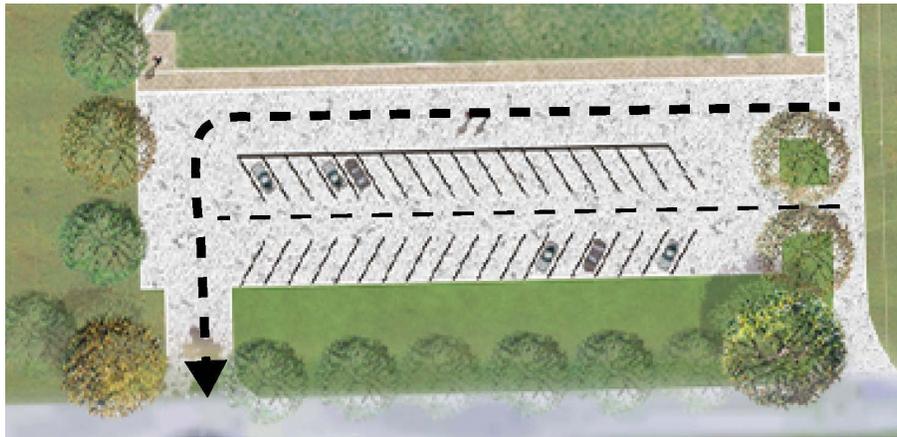
Before

Entrance, Parking Lot



The parking lot was designed as a thirty-six space lot with a bus turnaround along the edge of the lot. There are two entrances and one exit. The first, southern entrance is for cars only. The second, wider entrance is the bus entrance. The exit can accommodate both cars and buses. The bus entrance and exit were designed with a forty-five foot turn radius on the outer edge and a twenty eight foot radius along the inner edge. A separate entrance and exit was designed in order to increase the efficiency

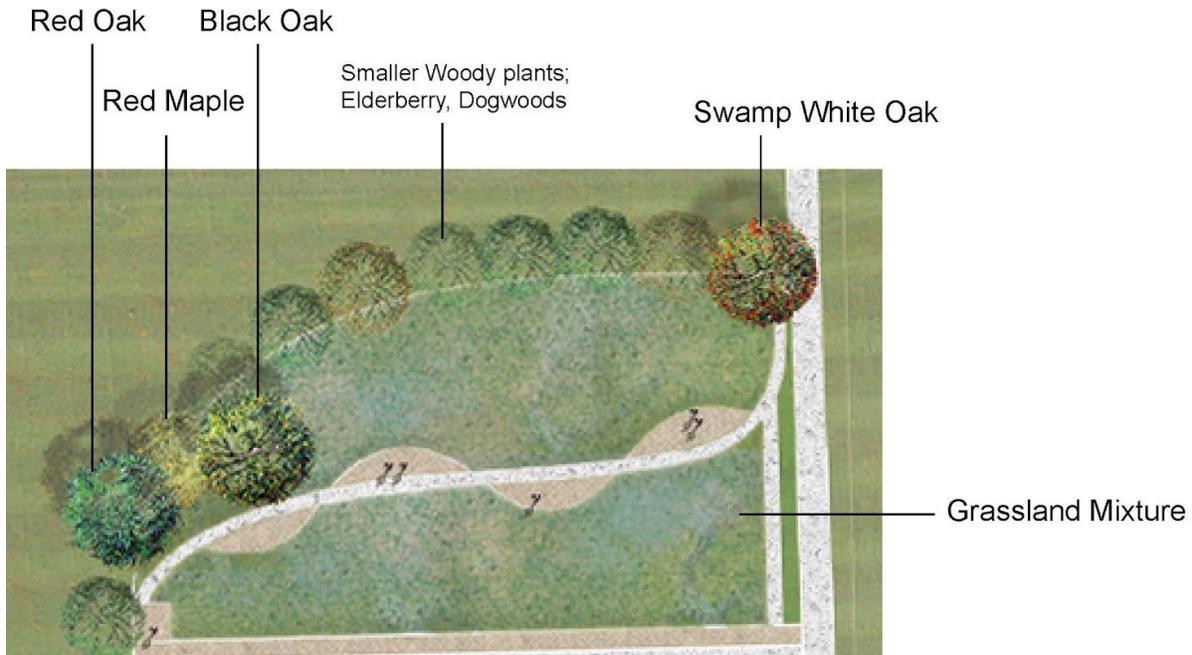
of the space. With this design, there is room for school buses to drive and park without the lot itself taking up too much space. It also helps separate the car and bus traffic in the lot.



The Parking Lot. The thicker line represents bus traffic, the thinner line represents car traffic

The parking lot spaces themselves were designed to be nine by twenty feet, which is a standard parking lot size. In keeping with ADA accessibility regulations, two of the spaces on the end are accessible and denoted as being wider, at eleven feet. Graphically, this picture shows the parking lot with lines denoted, however, the refuge has requested that the parking lot be gravel. Given this we are recommending the use of parking curbs to denote the space size and position. Finally, the edge of this parking

lot has a walking space and small gathering platform. The purpose of these spaces is to provide somewhere for groups to gather before entering the demonstration garden.



Demonstration Garden Potential Plantings

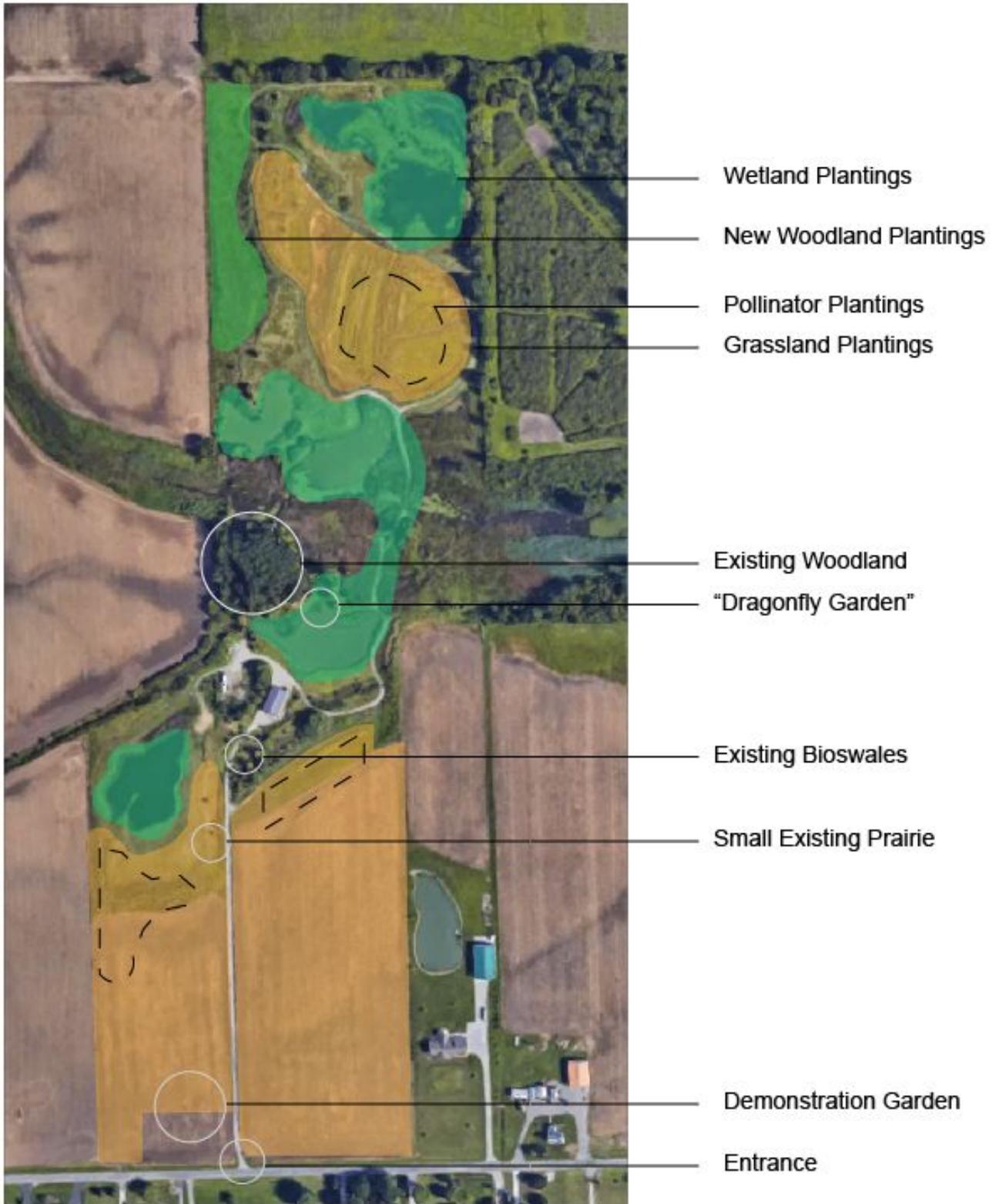
The demonstration garden's purpose is to show viewers what species they might encounter while visiting the Taylor Unit. The plantings are limited by the environmental conditions, however. The southern end of the property, in addition to being closer to the road, is drier and in full sun. So, while introducing drought tolerant plants might be easy, introducing the wetland species will not be. So, the recommended plantings are chosen to tolerate these conditions. The grassland mixture is a mix of grassland species, which is listed in the planting recommendation portion of this report. This can also be achieved using seed mixes, however it might be helpful to use some plugs in this area to promote specific species. We are also recommending here that all the species present be labeled or described in an interpretative sign, or both.

Planting Recommendations

General Overview

Our recommendations for the planting plan in the Taylor Unit involve expanding existing plantings on site to maximize ecosystem potential. We recommend keeping the existing woodland intact, as well as keeping the planted bioswales and small prairie plantings. We would like to utilize the existing prairie species and extend them into the agricultural/grassland planting zone in the south end of the site. We would also like to add another woodland patch and improve the wetland and pond areas by adding more wetland and riparian plantings.

In addition to the generalized plantings listed above, we also have a few specific gardens. We have designed a demonstration garden, to help introduce people to the species they might encounter on site, and some entrance plantings to help mark the entrance. Additionally, there are several places in the planting plan that mark pollinator habitat. For these areas we are recommending that plugs be used in order to create habitat geared specifically towards pollinating insects. The plants that contribute to this are included in the plant list in this section or in the appendix. Finally, we also have an area marked “dragonfly garden”. This is also described in the Lily Education Zone section of the paper. This garden is made up of submergent aquatic plants and riparian vegetation and is for promoting aquatic insects. The list of these plants can be found in the plant list located in the appendix.



Map of Planting Areas

Riparian, Wetland, and Plant Over Areas



Bluejoint Grass (*Calamagrostis canadensis*): This plant is indicative of southern wet meadow ecosystems in Michigan. Given that a sizable portion of this site is geared towards grassland and also very wet, many of the plant choices were chosen to accommodate that type of ecosystem.

Fowl Mana Grass (*Glyceria striata*): Similar to Bluejoint Grass, this grass was also chosen due to its ability to tolerate wetlands.

Tussock Sedge (*Carex stricta*): Like the previous two, this plant is also indicative of southern wet meadows.

Buttonbush (*Cephalanthus occidentalis*): Buttonbush is very tolerant of wet soils. Additionally, it has very attractive flowers which are useful for pollinators. This plant is

ideal for the riparian edges of ponds as well as the plantover areas where wet, inundated soil is frequent.

Boneset (*Eupatorium perfoliatum*): This is a forb which is also indicative of southern wet meadows. It is also useful for pollinators.

Blazing Star (*Liatris spicata*): This is a forb that can function in a gradient of wet areas, tolerating wet soil to medium wet soil. Given that, this plant can be useful in transitioning from the wetter parts of the site to the drier parts of the site. It is also a pollinator plant.

Swamp Milkweed (*Asclepias incarnata*): A type of milkweed that is common in wetter areas. When paired with the common milkweed that is on site, these two plants are useful for demonstrating ecosystem adaptation, due to their aesthetic equivalency.

Arrowhead (*Sagittaria latifolia*): This is a submergent plant. Currently, the only submergent plant on site is the lotus and cattails. To add more diversity in the pond, we purpose planting a few more submergent plants. This is one of the options. All the submergent plants would be useful in the dragonfly garden.

Common Bur-Reed (*Sparganium eurycarpum*): This splant is a submergent plant which has fun and interesting looking seeds. In addition to providing biodiversity, we felt the seeds would be fun for kids to look at. It is also a source of food for muskrats and waterfowl.

Pickerelweed (*Pontederia cordata*): Pickerelweed is our our final suggestion for submergent plants. It has very attractive purple to pale blue flowers and can be useful for pollinators.

Grassland Areas

Grassland Forbs



In addition to their individual qualities, several of these plants were chosen to help expand the already existing prairie plantings on site. Part of our design initiative was to honor Clive Taylor's original design intent, and using these plants allows for that. Additionally, all the grassland forbs are pollinator plants, which is also something we aimed to accommodate on site.

Black-Eyed Susan (*Rudbeckia hirta*): This plant is a common prairie and grassland plant and was chosen for its aesthetics, its ability to attract pollinators, and its ability to survive on the drier parts of the site, such as the old agricultural fields.

Common Milkweed (*Asclepias syriaca*): Similar to black-eyed susans, this plant was chosen to attract pollinators and help restore the grassland parts of the site. Also, it is the aesthetic equivalent to the swamp milkweed, which lives in wetter areas. Both plants growing on the site can be a teaching tool about adaptation.

Beardtounge (*Penstemon digitalis*): This plant was chosen because of its aesthetic qualities and its usefulness to pollinators.

New England Aster (*Symphyotrichum novae-angliae*): Similar to the above plants, this plant is also useful for naturalizing sites.

Purple Coneflower (*Echinacea purpurea*): Chosen as a pollinator plant. It also mirrors the aesthetics of the purple coneflower plant, which makes for nice repetition on the site.

Compass Plant (*Silphium laciniatum*): Compass plant was mainly chosen for habitat and due to the fact that it exists on site.

Stiff Goldenrod (*Solidago rigida*): Found in many prairies and grasslands, this goldenrod would do well in the old agricultural fields on the site. Additionally, goldenrod can be quite aggressive in its growth habit, which may help keep the weeds out.

Golden Alexanders (*Zizia aurea*): This plant was chosen due to its earlier bloom time. Part of our goal when picking pollinator plants was to account for the seasonality of all the plants. We attempted to have something blooming during most of the growing season.



This chart shows the when each plant is blooming during the growing season and fall semester of the school year. The idea was to make sure something was blooming during every part of the growing season for pollinators.

Grasses

Big Bluestem (*Andropogon gerardii*): Big bluestem was chosen because it is an excellent naturalizing grass. It's also very affordable.

Little Bluestem (*Schizachyrium scoparium*): Little bluestem was chosen for areas closer to trails and in the demonstration garden. Big bluestem has a tendency to get very tall, which isn't always suitable for children. We recommend using little bluestem in areas where kids might need to see into or over things.



Trees and other woody plants



Red Maple (*Acer rubrum*): This plant is common in wetter areas and very common in nurseries. It would be a useful plant near the picnic area or in the demonstration garden.

Musclewood (*Carpinus caroliniana*): This plant is suited to wet and mesic areas. It also has a fun and interesting trunk structure, making it a good plant for kids to look at.

Silver Maple (*Acer saccharinum*): This plant is occurring on site already. It was most likely planted there. This plant is common near creek and stream beds, making it a good choice for tree plantings near the central ponds.

Gray Dogwood (*Cornus racemosa*): Dogwoods do well in medium moisture areas, however it can be adaptable. We felt this plant might make a good choice as part of forest plantings and as part of the demonstration garden area.

Red Oiser Dogwood (*Cornus sericea*): Similar to the above dogwood species, however, this one has a brighter twig. It adds to the aesthetics of the area and might be useful near the entrance and demonstration garden in addition to the forested areas on the site.

Spicebush (*Lindera benzoin*): Spicebush is a common plant in mesic woodland areas. Additionally, it has an interesting scent and ethnobotanical history, which makes this plant a useful teaching tool.

Nannyberry (*Viburnum lentago*): This plant is useful for providing food for wildlife.

Red Oak (*Quercus rubra*), White Oak (*Quercus alba*): These two oaks will be useful in adding trees to the open grassland areas if they are needed there, and for creating new forest. They also support a wide variety of insects, birds, and mammals.

Swamp White Oak (*Quercus bicolor*): Similar to above, but more adaptable to wetter ecosystems.

Elderberry (*Sambucus canadensis*): Similar to spicebush and nannyberry, this plant has many interesting ethnobotanical uses and provides food for wildlife.

Number of Insect Species Each Genus Can Support	
Woody Plants	
Quercus	534
Acer	285
Carya	200
Herbaceous Plants	
Solidago	115
Aster	112
Eupatorium	42
Carex	36
Rudbeckia	17
Asclepias	12
Penstemon	8
Schizachyrium	6

From Doug Tallamy's Research on insect diversity and native plants. Abbreviated to only include species relevant to this project (Tallamy, 2009).

Seed Mixes

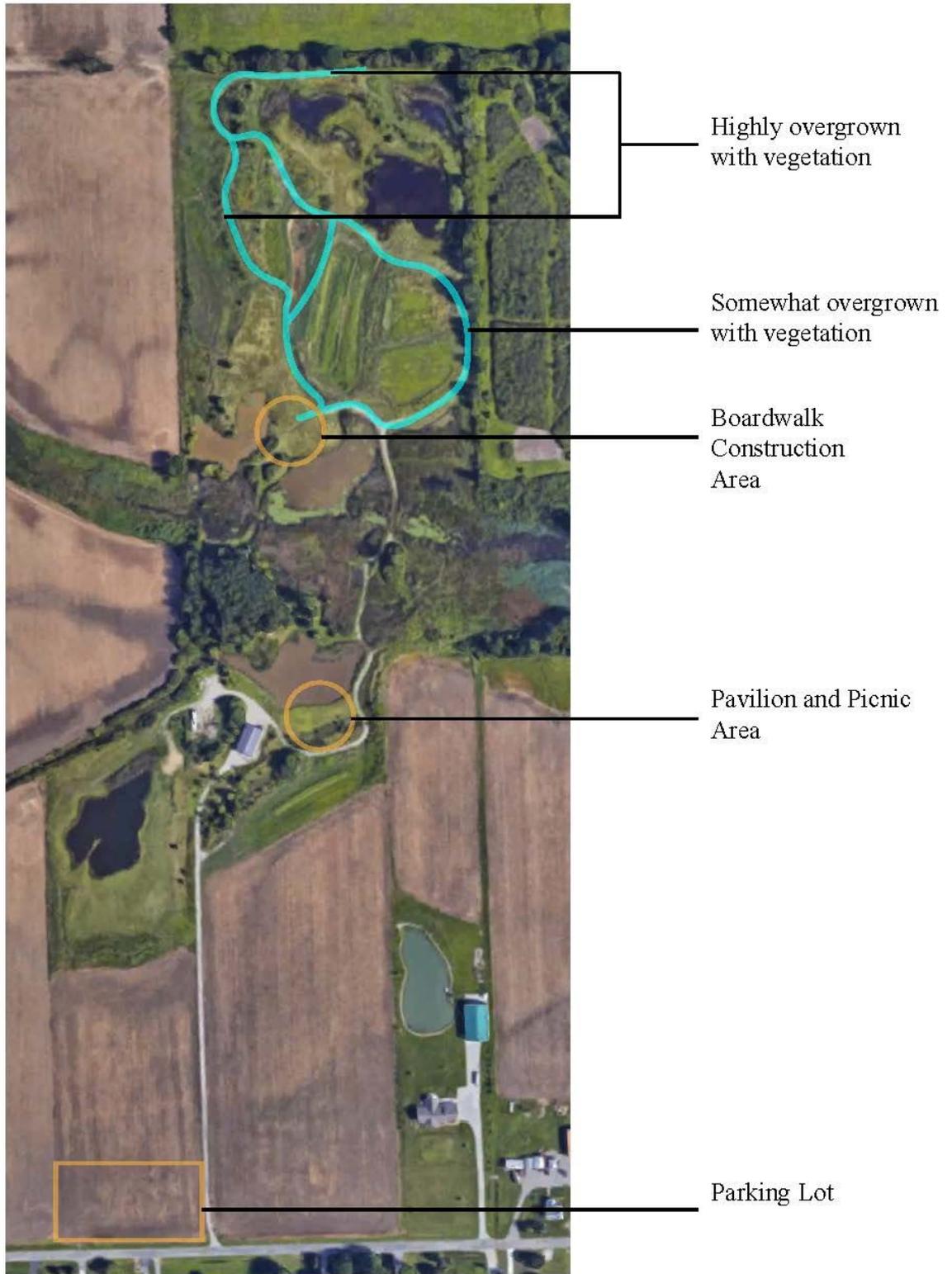
In addition to plug recommendations, we also proposed several seed mixes for planting the larger areas. These mixes are listed in the appendix under Seed Mixes. These mixes were suggested as a way to mitigate any funding issues as well as for practical reasons having to do with planting large areas on the site.

Restoration Recommendations

Phase One: Creating the Built Structures

For the start of the restoration process, we recommend starting by cleaning up the site. The trails in the north end of the site need to be cleaned up so that they are passable. Currently, much of the trails on the north and northwest areas of the site are overgrown with weedy grasses. They are not passable, not unless someone cuts through them. In other areas of the trail system, much of the gravel has fallen away from the trail, probably due to rain or possible vehicle traffic. Regardless, more gravel also needs to be laid in these sections.

We also recommend that areas requiring heavy equipment should be built first before restoring the ecosystems next to them. These areas include the parking lot, the pavilion, and the boardwalk area. Completing these areas and updating the trails will leave the site ready for ecosystem restoration.



Recommended First Steps in Construction

Phase Two: Preparing the site for new plantings

Once the built structures of the site are in place, working on the ecosystem restoration can take place. For this, we are recommending that steps be taken to prepare the fallow agricultural fields to be replanted with more ecologically efficient prairie species. This can be done in a variety of ways, however we recommend burning the fields in order to suppress the vegetation that is not wanted. Another option that can be employed is to herbicide the fields first and then burn it. We believe it is important, however, that the seed bank in the fields not be disturbed, as this might spur the growth of more weeds. Finally, in order to completely suppress the weedy species, additional mowing of the grassland areas might be necessary while the native seedlings establish.

In addition to the fields, we also believe it is necessary to make sure the spread of invasive species on this site is minimized. This site already has a significant amount of invasive cattail (*Typha spp*). It will be difficult to rid the site completely of cattail due to the context of being surrounded by agricultural fields. These produce a large amount of high nutrient runoff, which helps create an environment for cattail to thrive. In order to adequately address the cattail then, the high nutrient runoff would have to be addressed. One option here might be to work with the nearby farmers to help manage runoff from their farms. This can be done through the use of cover crops that help build soil nutrients as well as keep high levels of runoff from leaving the site. If the cattail cannot be managed, however, it still has the potential to be used as a teaching tool on this site to talk about invasive species and human impact on the environment.

Where the refuge must be on alert, however, is in the case of the invasive common reed (*Phragmites australis*). While this species is not on our site, it is in several areas nearby. This species does have a tendency to out compete cattail and it is not kid friendly. It is too tall so it restricts views for adults, so the average child is going to be dwarfed by it. Additionally, it provides poor habitat for wildlife. Part of the management for this site must be treating phragmites if it shows up.



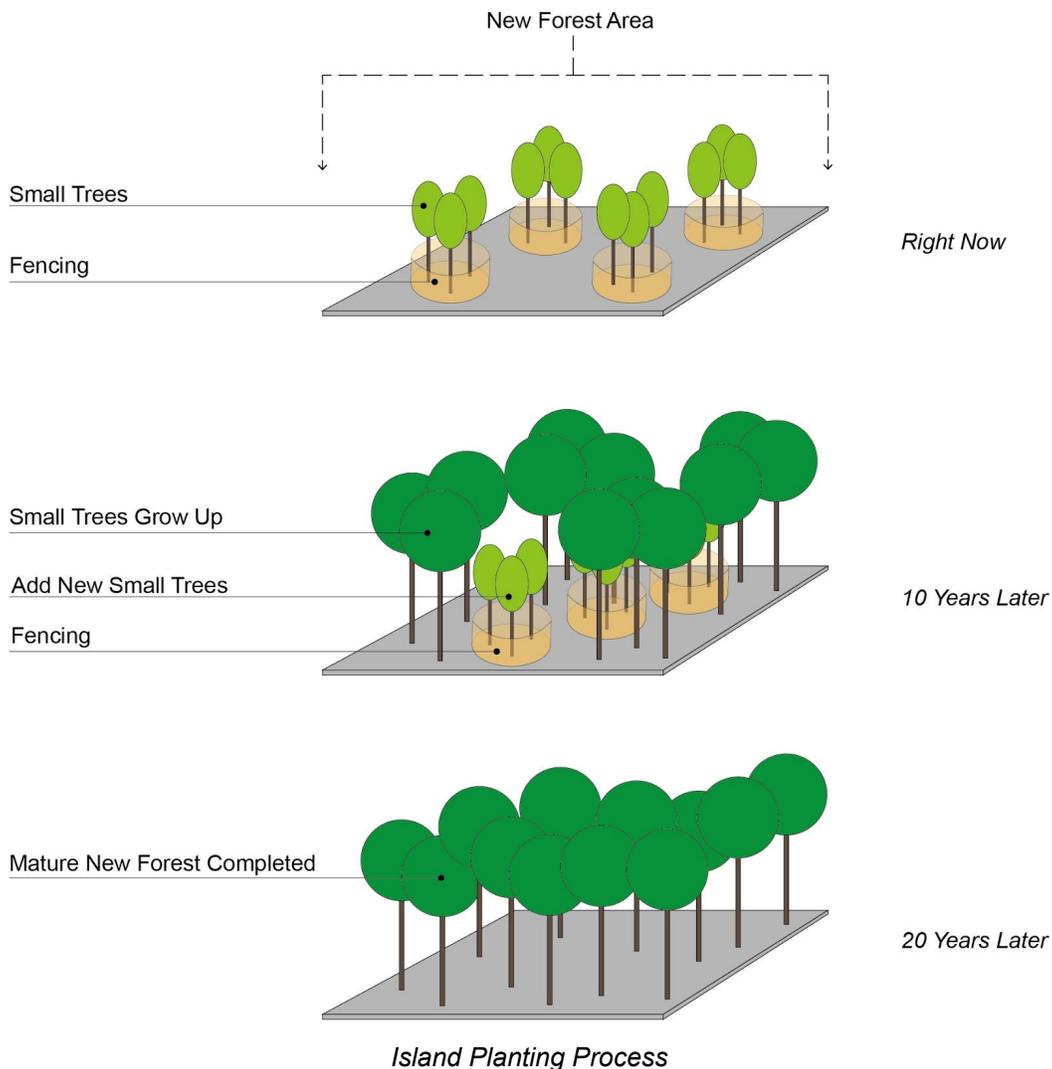
--- Phragmites Potential Burn Areas

Potential Burn Areas and Existing Phragmites Stands Nearby

Phase Three: Habitat Creation

Once the fields are prepared, they can be seeded using the seed drill. Plugs can be used in places such as the demonstration garden, around the ponds, or anywhere the refuge would like to emphasize a specific species. For trail edges, or anywhere children will need to see at a distance, we recommend limiting the height of the plants chosen. For example, using little bluestem instead of big bluestem.

For the newer patches of forest, we recommend using an island planting strategy to reforest certain parts of the site. To do this, small groups of trees can be planted and fenced off to protect from herbivory. If they are shade trees, planting a nurse tree in with plugs or bare root plantings to help maintain canopy cover while the trees grow might be ideal. Then we suggest adding more islands only when necessary and allowing the forest to spread as naturally as possible to limit spending.

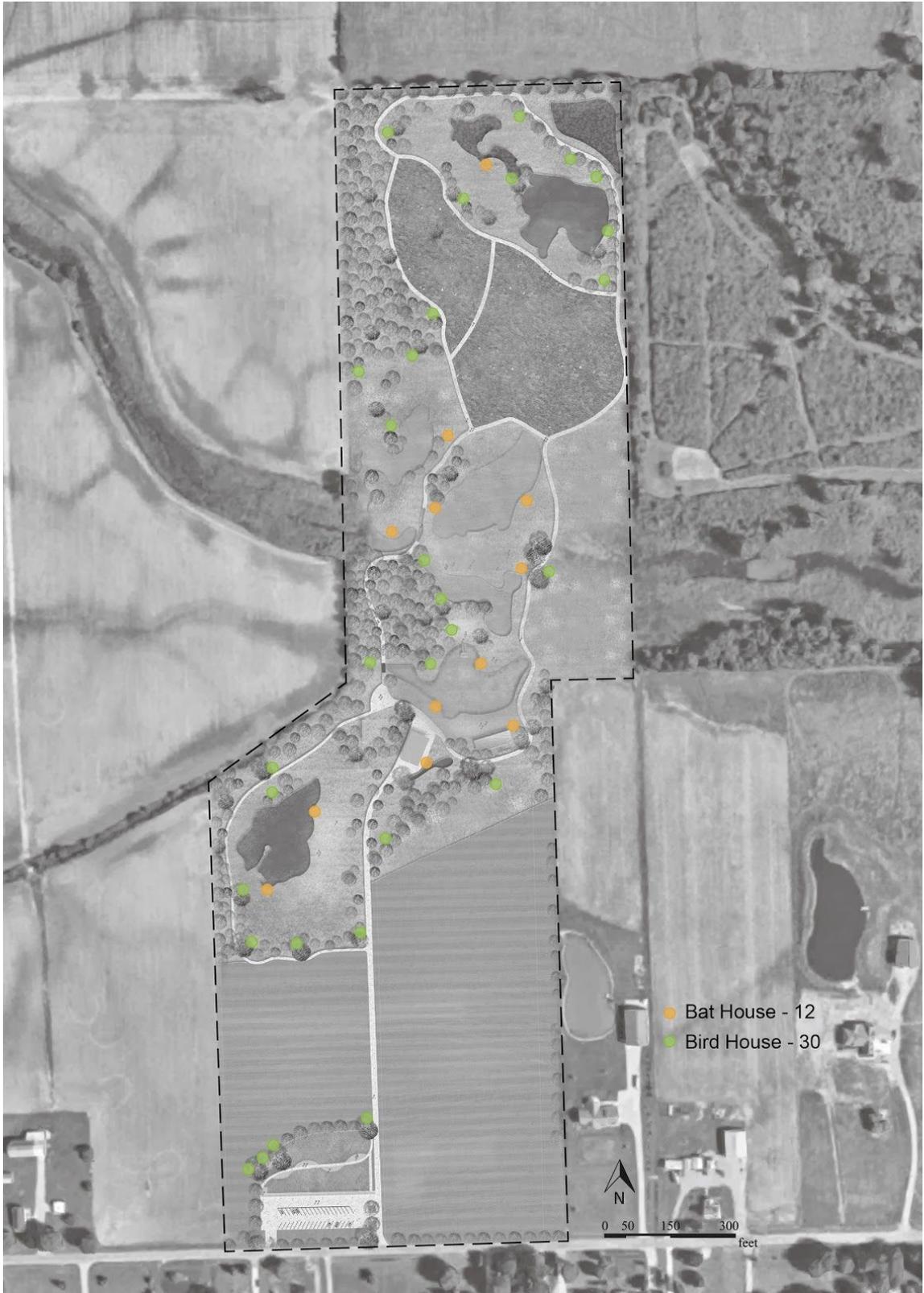


The new forested areas, combined with the older areas, also create plenty of space for bird houses. Bat houses will either need their own poles, or need to be mounted on buildings or structures on site. The pavillion and the barn would make idea locations for this.

For the wetland areas, some research has indicated that restoring seed banks and populations of insects and amphibians can be done using soil transfers. Given the context of the Taylor Unit, being further away from other wetland patches, it might be useful to consider soil transfers as a way to help restore the site.

Many of the birds seen on site have varying habitat requirements. Much of the design accommodates them, however, it is important to ensure that there are a few open spaces for the ground nesting birds, like the killdeer, to live. Aside from that, the inclusion of grassland and forest will help some of the other species. A few of the birds spotted are birds of prey, so to ensure they have adequate habitat, it becomes important to make sure their prey have spaces to live as well. This means plantings that promote insect, amphibians, and small mammals.

Finally, ensuring parts of the pond and riparian areas have plantings as well as downed woody debris is important for maintaining insect populations, mammal populations like groundhogs and woodchucks, as well as habitat for the Eastern Fox Snake.



Bird & Bat House Distribution

Phase Four: Management and Volunteer Stewardship, Monitoring

In addition to working on managing invasive species, other management techniques can be employed to promote success of the restoration. Establishing a burn regime for the grassland can help keep out non-native and unwanted species. The burn regime can vary depending on which species are wanted. In order to obtain a higher percentage of grasses, more burns might be done very early and very late in the growing season. Burns done during the growing season are useful in promoting certain forbs.

Establishing a working relationship with the nearby farmers might also make a difference in restoring this site. Cattails thrive in habitats that are rich in nitrogen, and it is likely that a lot of nitrogen is coming from agricultural runoff. To this end, farmers can actually make a big difference in the restoration by managing the runoff from their fields. The use of cover crops during the off season to help control runoff could be useful in controlling cattail populations. Depending on the crops used, this could be another source of income for the farmers as well.

Aside from this, there are other creative ways to deal with runoff. Many places have made use of floating treatment mats. These are mats of plants known for their stormwater filtration capabilities. They are typically installed in rivers and streams, and an intervention like this might be useful on the site in the future to manage runoff (Gunderson 2015).



Example of Floating Treatment Ponds at Virginia Tech

Volunteers may also prove useful in managing this site. There is much they can do here to monitor the success of the restoration. Volunteers can be trained in species surveys to monitor the condition of the site. A simple survey of vegetation can provide a lot of information about site quality. Certain species of plants can be indicators of higher quality habitat, and certain species can also give clues about soil conditions such as soil moisture or soil pH. Not only would vegetation monitoring be useful for assessing habitat quality, it would also provide educational opportunities for the refuge. Part of the training for monitoring could involve discussion of Michigan's native ecosystems, native flora, and the importance of restoration. Additionally, public participation in maintenance of the site would help provide a sense of ownership to the public, which is useful in gaining public support.

Similar surveys for habitat quality can be done by the management team at the refuge. We are recommending a qualitative survey be used rather than a quantitative survey so the refuge does not have to strain their resources. Similar wetland quality surveys such as ORAM, the Ohio Rapid Assessment Method for Wetlands, can be used as a model. This method creates a scoring system for wetlands, which allows a technician to quickly go through a site and assign a score as opposed to doing excessively detailed monitoring. Wetlands are assigned into certain categories based on the answers a technician gives to a series of questions (State of Ohio Environmental Protection Agency). Categories that the Taylor Unit might utilize include water turbidity, species diversity, and the presence of any species which might indicate a higher quality habitat. Ideally, monitoring should be done at regular intervals to ensure that no interventions are needed to maintain habitat quality.

Summary

The Taylor Unit, despite its difficult agricultural context, has much potential to become a functional ecological patch. Already there is significant biodiversity on the site due to the way Clive Taylor planted it. With an updated trail system, a parking lot, and added plantings, the biodiversity in the site would improve greatly. The site can also be very useful for education given its potential to model a few of Michigan's native ecosystems and demonstrate human impacts on the environment. By choosing native species that reflect some of the existing ecosystems on site, the Taylor unit can very effectively model prairie ecosystems, wetland and aquatic ecosystems, and forest ecosystems that exist in Michigan.

In order to restore the Taylor Unit, steps will need to be taken to prepare the site. The larger sections of the site will likely require a burn and mowing routine in order to suppress the weedy species and promote the native species. For restoring the forested areas, utilizing herbivore exclusion cages in the island planting method will help save money in the long run because they will prevent grazing on new plants. Finally, managing the water quality will likely require more intensive efforts. Working with farmers to help limit high nutrient runoff will make a substantial difference in water quality. If this is not available, planting the edge of the creek with plants that can help manage water quality in floating treatment mats can also be a good substitute. All and all, the Taylor Unit has great potential to be a functional environmental education site and ecological patch.

Appendices

Budget - Opinion on Construction Costs

Area of Site	Item	Description	Material	Quant	Unit	Unit Cost	Total Cost
1	Entrance	1 Widening the Entrance	Gravel	94.83	SYD	\$9	\$863
2	Parking Lot	2-1 Aggregate Base	Gravel	2488.73	SYD	\$9	\$22,399
3	Demonstration Garden	2-2 Kiosk for site maps and Refuge Fliers	Multiple Materials	1	EA	\$7,500	\$7,500
		3-1 Gathering Space Gravel	Gravel	271.2	SYD	\$9	\$2,441
		3-2 Gathering Space Lawn	Grass	2977.34	SYD	\$0.54	\$1,607.76
	3-3	Parking Curbs	Rubber	36	EA	\$40	\$1,440
4	Education Zone 1	3-4 Interpretive Sign	Sign Frame;Sign Board	1	EA	\$1,000	\$1,000
		4 Interpretive Sign	Sign Frame;Sign Board	1	EA	\$1,000	\$1,000
5	Education Zone 2	5-1 Floating Dock	Wood	239.34	SF	\$30	\$7,180
6	Education Zone 3	5-2 Interpretive Sign	Sign Frame;Sign Board	1	EA	\$1,000	\$1,000
		6-1 Interpretive Sign	Sign Frame;Sign Board	1	EA	\$1,000	\$1,000
		6-2 Floating Dock	Wood	1	SF	\$30	\$30
7	Picnic Area	7-1 Picnic Tables	Wood	15	EA	\$1,000	\$15,000
		7-2 Pavilion	Kit/Wood	1	EA	\$30,000	\$30,000
8	Trails	7-3 Portable Restroom	Plastic	3	EA	\$700	\$2,100
		8-1 Gravel Trails	1/2" Aggregate	793.33	SYD	\$9	\$7,140
		8-2 Boardwalk	Wood	80	LF	\$200	\$16,000
9	Misc Site Elements	8-3 Existing Bridge Enhancement	n/a	1	EA	\$150,000	\$150,000
		9-1 Trash/Recycle Bins	Plastic/Combined trash/recycle	6	EA	\$1,000	\$6,000
		9-2 Proposed Pathway Amenities (Benches, etc)	Wood	1	EA	\$1,000	\$1,000
10	Site Construction	10-1 General Conditions/Permits/Bonds/Mobilization	n/a	1	LS	\$357,115	\$357,115
		10-2 Contractor Construction Layout and Staking	n/a	1	LS	\$10,000	\$10,000
		10-3 Demolition/Removal of Trees and Vegetation	n/a	1	LS	\$35,000	\$35,000
		10-4 Machine Grading	n/a	3282.06	LF	\$20	\$65,641
		10-5 Fine Grading and Restoration Seeding	n/a	22138.37	SYD	\$20	\$442,767
		10-6 Project Cleanup	n/a	1	LS	\$10,000	\$10,000
11	Site Restoration	11-1 330' Fencing for Island Planting	Woven Wire from Home Depot: Creates 15' diameter circles	2	EA	\$260	\$520
		11-2 6' l-posts for island fencing	Wood: 3 per circle	48	EA	\$3.80	\$182.40
		11-3 Herbicide/Mowing Activities	n/a	17.37	ACRE	\$40	\$695
	11-4	Seeding Fields	n/a	17.37	ACRE	\$1,179	\$20,479
				CONSTRUCTION SUBTOTAL AT BID			\$859,976
				CONSTRUCTION CONTINGENCIES		15%	\$128,996
				TOTAL ESTIMATED FINAL CONSTRUCTION COST			\$988,972
				TOTAL ESTIMATED PROJECT COST			\$988,972

Planting Budget

Nursery	Woody Plants	Common Name	Habitat	Soil Moisture	Bloom Period	Pollinator Plant	Demonstration Garden	Price (wholesale)
Wildtype	Acer rubrum	Red Maple	Forest Areas, Entrance	Well-drained	March-April		Yes	\$10.95/gal
Wildtype	Carpinus Caroliniana	Muscledwood	Forest Area	Medium	February		Yes	\$30.00/5gal
Wildtype	Acer saccharinum	Silver maple	Forest and Riparian Areas	Medium-wet	March			\$16/gal
Wildtype	Cephalanthus occidentalis	butonbush	Riparian, Pond, and Wet areas	Medium-wet	June	Yes	Yes	\$1.75/plug or \$8.95/gal
Wildtype	Cornus racemosa	Gray Dogwood	Forest Area	Medium	May-June	Yes	Yes	\$3.50/plug
Wildtype	Cornus sericea	Red-Osier Dogwood	Forest Area	Medium-wet	May-June	Yes	Yes	\$1.75/plug
Wildtype	Lindera benzoin	Spicebush	Forest Area	Medium	March	Yes	Yes	\$3.50/plug
Wildtype	Viburnum lentago	Nannyberry	Wet Areas	Medium	May	Yes	Yes	\$1.75/plug or \$8.95/gal
hidden savanna	Quercus rubra	red oak	Grassland	dry-medium	May		Yes	\$16.00/gal
hidden savanna	Quercus alba	white oak	Grassland	dry-medium	May		Yes	\$20.00/gal
hidden savanna	Quercus bicolor	swamp white oak	Forest and Riparian Areas	Medium-Wet	April		Yes	\$16.00/gal
Wildtype	Sambucus canadensis	Elderberry	Wet Areas and Riparian Areas	Medium-Wet	June-July	Yes	Yes	\$8.95/gal
		Grasses/Sedges wet						
Wildtype	Calamagrostis canadensis	Bluejoint Grass	southern wet meadow	medium-wet				\$43.70/ 38 cell plugs
Wildtype	Glyceria striata	Fowl mana grass	southern wet meadow	medium-wet				\$43.70/ 38 cell plugs
Wildtype	Carex stricta	Tussock Sedge	southern wet meadow	medium-wet	May-June			\$49.40/ 38 cell plugs
		Grasses/Sedges Dry						
Wildtype	Andropogon gerardii	Big Bluestem	Grassland Area	dry-medium	September-February		Yes	\$43.70/ 38 cell plugs
Wildtype	Schizachyrium scoparium	Little Bluestem	Grassland Area	dry-medium	August-February		Yes	\$43.70/ 38 cell plugs
		Forbs Wet						
Wildtype	Asclepias incarnata	Swamp Milkweed	Southern wet meadow	medium-wet	July-August	Yes		\$43.70/ 38 cell plugs
Wildtype	Eupatorium perfoliatum	Boneset	Southern wet meadow	medium-wet	July-September	Yes		\$43.70/ 38 cell plugs
Wildtype	Liatris spicata	Blazing Star	wet areas	medium-wet	July-August	Yes	Yes	\$49.40/ 38 cell plugs
		Forbs Dry						
Wildtype	Rudbeckia hirta	Black-Eyed Susan	grassland areas	medium	June-September	Yes	Yes	\$43.70/ 38 cell plugs
Wildtype	Asclepias syriaca	Common Milkweed	grassland areas	dry-medium	June-August	Yes	Yes	\$49.40/ 38 cell plugs
Wildtype	Penstemon digitalis	Beardtongue	grassland areas	dry-medium	April-June	Yes	Yes	\$43.70/ 38 cell plugs
Wildtype	Symphoricarpon novae-angliae	New-England Aster	grassland areas	medium	August-September	Yes	Yes	\$43.70/ 38 cell plugs
Wildtype	Echinacea purpurea	Purple Coneflower	grassland areas	dry-medium	June-August	Yes	Yes	\$43.70/ 38 cell plugs
Wildtype	Siphium laciniatum	Compass Plant	grassland areas	medium	July-September	Yes	Yes	\$49.40/ 38 cell plugs
Wildtype	Solidago rigida	Stiff Goldenrod	grassland areas	medium	August-September	Yes	Yes	\$43.70/ 38 cell plugs
Wildtype	Zizia aurea	Golden Alexanders	grassland areas	medium	May-June	Yes	Yes	\$49.40/ 38 cell plugs
		Submergent Plants						
Wildtype	Sagittaria latifolia	Arrowhead	water/riparian edges	wet	July-September			\$1.75/Bare root
Wildtype	Sparanium eurycarpum	Common Bur-Reed	water/riparian edges	wet	July-August			\$1.75/Bare root
Wildtype	Pontederia cordata	Pickeral Weed	water/riparian edges	wet	June-October	Yes		\$3.50/Bare root or plug
		Seed Mixes						
Native Connections	Emergent Wetland Seed Mix							Acres Price Total 9 \$12,816
Native Connections	Dry-Mesic Pollinator Mix							32 \$35,328
Native Connections	Mesic Tallgrass Prairie Mix							32 \$37,728
Native Connections	Mesic Woodland Mix							3 \$5,370
Native Connections	Wet Meadow Mix							9 \$13,365

Seed Mixes

Native Connections Nursery, located in Three Rivers, Michigan.



Native Connections

17080 Hoshel Rd, Three Rivers, MI 49093
 (P) 269.580.4764 • (F) 269.273.1367
 info@nativeconnections.net
 www.nativeconnections.net

Mesic Tallgrass Prairie Mix

A mix that is based on our familiarity with the flora of Michigan's few remnants of mesic and dry-mesic prairies as well as blacksoil prairies of Indiana, Illinois and Wisconsin. This mix is appropriate for medium to dry, loamy soils.

Total Seeding Rate: 33 lbs per acre
 5 lbs grasses • 3 lbs forbs • 25 lbs nurse crop
 62 native seeds per sq ft

Call, email or visit our website for pricing.

Grasses & Sedges		PLS Oz/acre
<i>Andropogon gerardii</i>	Big Bluestem	20.00
<i>Carex bicknellii</i>	Bicknell's Sedge	0.30
<i>Carex molesta</i>	Field Oval Sedge	0.30
<i>Elymus canadensis</i>	Canada Wild Rye	24.00
<i>Juncus tenuis</i>	Path Rush	0.10
<i>Panicum virgatum</i>	Switchgrass	8.30
<i>Schizachyrium scoparium</i>	Little Bluestem	13.00
<i>Sorghastrum nutans</i>	Indian Grass	14.00
Total Grasses		80.00

Forbs		PLS Oz/acre
<i>Allium cernuum</i>	Nodding Wild Onion	1.00
<i>Asclepias syriaca</i>	Common Milkweed	1.50
<i>Asclepias tuberosa</i>	Butterfly Milkweed	0.90
<i>Aster laevis</i>	Smooth Blue Aster	0.90
<i>Aster novae-angliae</i>	New England Aster	0.30
<i>Aster sagittifolius</i>	Arrow-leaved Aster	2.20
<i>Baptisia lactea</i>	White Wild Indigo	2.00
<i>Coreopsis tripteris</i>	Tall Coreopsis	0.50
<i>Desmodium canadense</i>	Showy Tick Trefoil	0.40
<i>Desmodium illinoense</i>	Prairie Tick Trefoil	0.30
<i>Echinacea purpurea</i>	Purple Coneflower	4.40
<i>Eryngium yuccifolium</i>	Rattlesnake Master	2.30
<i>Gentiana flavida</i>	Cream Gentian	0.30
<i>Heliopsis helianthoides</i>	False sunflower	4.30
<i>Liatris spicata</i>	Marsh Blazingstar	1.00
<i>Monarda fistulosa</i>	Wild Bergamot	2.40
<i>Oenothera biennis</i>	Common Evening Primrose	1.70
<i>Penstemon digitalis</i>	Foxglove Beardtongue	1.20
<i>Ratibida pinnata</i>	Yellow Coneflower	3.50
<i>Rudbeckia hirta</i>	Black-eyed Susan	4.00
<i>Rudbeckia triloba</i>	Brown-eyed Susan	3.50
<i>Silphium integrifolium</i>	Rosinweed	2.00
<i>Silphium terebinthinaceum</i>	Prairie Dock	0.30
<i>Solidago rigida</i>	Stiff Goldenrod	1.50
<i>Verbena stricta</i>	Hoary Vervain	3.40
<i>Vernonia missurica</i>	Missouri Ironweed	0.20
<i>Zizia aurea</i>	Golden Alexander	2.00
Total Forbs		48.00



Native Connections

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 info@nativeconnections.net
 www.nativeconnections.net

Wet Meadow Mix

A diverse mix styled after a classic sedge meadow community, this mix is suitable for a variety of wet sites on muck or mineral soils, including periodically inundated and persistently moist conditions. It is also useful for many practical applications, including wetland mitigations and streambank stabilization projects.

Total Seeding Rate: 31 lbs per acre

3.4 lbs grasses • 2.6 lbs forbs • 25 lbs nurse crop

93 native seeds per sq ft

Call, email or visit our website for pricing.

Grasses, Sedges & Rushes		PLS Oz/acre
<i>Beckmannia syzigachne</i>	American Slough Grass	3.00
<i>Bromus ciliatus</i>	Fringed Brome	6.00
<i>Calamagrostis canadensis</i>	Bluejoint Grass	0.20
<i>Carex bebbii</i>	Bebb's oval sedge	0.50
<i>Carex comosa</i>	Bristly Sedge	2.00
<i>Carex hystericina</i>	Porcupine Sedge	2.00
<i>Carex vulpinoidea</i>	Fox Sedge	1.20
<i>Elymus virginicus</i>	Virginia Wild Rye	32.00
<i>Juncus effusus</i>	Soft Rush	0.30
<i>Leersia oryzoides</i>	Rice Cut Grass	0.10
<i>Panicum virgatum</i>	Switchgrass	3.00
<i>Poa palustris</i>	Fowl Bluegrass	0.50
<i>Scirpus atrovirens</i>	Dark Green Bulrush	0.80
<i>Scirpus cyperinus</i>	Wool Grass	0.20
<i>Spartina pectinata</i>	Prairie Cordgrass	2.50
Total Grasses		54.30

Forbs		PLS Oz/acre
<i>Actinomeris alternifolia</i>	Wingstem	0.20
<i>Angelica atropurpurea</i>	Angelica	4.00
<i>Asclepias incarnata</i>	Swamp Milkweed	1.50
<i>Aster novae-angliae</i>	New England Aster	0.30
<i>Aster puniceus</i>	Swamp Aster	0.50
<i>Bidens cernua</i>	Nodding Bur Marigold	0.20
<i>Boltonia asteroides</i>	False Aster	0.20
<i>Cassia hebecarpa</i>	Wild Senna	6.00
<i>Eupatorium maculatum</i>	Joe Pye Weed	0.40
<i>Eupatorium perfoliatum</i>	Boneset	0.20
<i>Gentiana andrewsii</i>	Bottle Gentian	0.10
<i>Helenium autumnale</i>	Sneezeweed	1.00
<i>Helianthus grosseserratus</i>	Saw-toothed Sunflower	0.20
<i>Hypericum pyramidatum</i>	Great St John's Wort	1.60
<i>Iris virginica</i>	Southern Blue Flag Iris	3.00
<i>Liatris spicata</i>	Marsh Blazingstar	2.00
<i>Lobelia siphilitica</i>	Great Blue Lobelia	0.50
<i>Ludwigia alternifolia</i>	Seedbox	0.10
<i>Lycopus americanus</i>	Water Horehound	0.20
<i>Mimulus ringens</i>	Monkey Flower	0.10
<i>Monarda fistulosa</i>	Wild Bergamot	0.20
<i>Penstemon digitalis</i>	Foxglove Beardtongue	2.00
<i>Physostegia virginiana</i>	Obedient Plant	1.00
<i>Pycnanthemum virginianum</i>	Mountain mint	0.50
<i>Rudbeckia hirta</i>	Black-eyed Susan	2.00
<i>Rudbeckia laciniata</i>	Golden Glow	0.40
<i>Rumex verticillatus</i>	Swamp Dock	0.20
<i>Silphium perfoliatum</i>	Cupplant	4.00
<i>Solidago riddellii</i>	Riddell's Goldenrod	1.00
<i>Verbena hastata</i>	Blue Vervain	3.00
<i>Vernonia gigantea</i>	Tall Ironweed	0.10
<i>Zizia aurea</i>	Golden Alexander	5.00
Total Forbs		41.70



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Emergent Wetland Mix

A mix that features species typical of the emergent zone associated with many of Michigan's wetland ecosystems, but also includes species that will thrive in simply saturated soils. Good for stabilizing shores and providing aquatic habitat, this mix will endure periodic to year-round inundation.

Total Seeding Rate: 30 lbs per acre
 2.5 lbs grasses • 2.5 lbs forbs • 25 lbs nurse crop
 116 native seeds per sq ft

Call, email or visit our website for pricing.

Grasses, Sedges & Rushes		PLS Oz/acre
<i>Beckmannia syzigachne</i>	American Slough Grass	8.00
<i>Carex comosa</i>	Bristly Sedge	4.00
<i>Carex crinita</i>	Fringed Sedge	1.00
<i>Carex hystericina</i>	Porcupine Sedge	3.00
<i>Carex stipata</i>	Awl-fruited Sedge	2.00
<i>Carex vulpinoidea</i>	Fox Sedge	4.00
<i>Eleocharis palustris</i>	Great Spike Rush	0.30
<i>Glyceria canadensis</i>	Canada Manna Grass	2.00
<i>Glyceria grandis</i>	Reed Manna Grass	3.00
<i>Juncus effusus</i>	Soft Rush	0.40
<i>Juncus torreyi</i>	Torrey's Rush	0.20
<i>Leersia oryzoides</i>	Rice Cut Grass	1.00
<i>Scirpus acutus</i>	Hard-stem Bulrush	0.20
<i>Scirpus atrovirens</i>	Dark Green Bulrush	1.00
<i>Scirpus cyperinus</i>	Wool Grass	0.20
<i>Scirpus fluviatilis</i>	River Bulrush	8.00
<i>Scirpus validus</i>	Soft-stem Bulrush	1.70
Total Grasses		40.00

Forbs		PLS Oz/acre
<i>Acorus americanus</i>	Sweet Flag	4.30
<i>Alisma subcordatum</i>	Common Water Plantain	3.50
<i>Asclepias incarnata</i>	Swamp Milkweed	2.50
<i>Aster puniceus</i>	Swamp Aster	0.50
<i>Bidens cernua</i>	Nodding Bur Marigold	1.50
<i>Cicuta maculata</i>	Water Hemlock	0.30
<i>Eupatorium maculatum</i>	Joe Pye Weed	0.30
<i>Eupatorium perfoliatum</i>	Boneset	0.40
<i>Iris virginica</i>	Southern Blue Flag Iris	4.20
<i>Lobelia cardinalis</i>	Cardinal Flower	0.10
<i>Lobelia siphilitica</i>	Great Blue Lobelia	0.30
<i>Mimulus ringens</i>	Monkey Flower	0.10
<i>Peltandra virginica</i>	Arrow Arum	4.00
<i>Penthorum sedoides</i>	Ditch Stonecrop	0.50
<i>Polygonum pennsylvanicum</i>	Pennsylvania Smartweed	2.00
<i>Pontederia cordata</i>	Pickeral Weed	1.00
<i>Rumex verticillatus</i>	Swamp Dock	0.20
<i>Sagittaria latifolia</i>	Common Arrowhead/Duck Potato	0.30
<i>Sparganium eurycarpum</i>	Common Bur Reed	10.00
<i>Verbena hastata</i>	Blue Vervain	4.00
Total Forbs		40.00



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Mesic Woodland Mix

A mix that includes species from a variety of natural forest communities found throughout Michigan, it suits most sand, loam, and clay soils. This mix is meant for full shade and will not do well in wet or saturated conditions, but it can be customized for drier or wetter soils.

Total Seeding Rate: 31.25 lbs per acre
 3.75 lbs grasses • 2.5 lbs forbs • 25 lbs nurse crop
 56 native seeds per sq ft

Call, email or visit our website for pricing.

Grasses, Sedges & Rushes		PLS Oz/acre
<i>Bromus purgans</i>	Hairy Wood Chess	3.00
<i>Carex cristatella</i>	Crested Sedge	0.40
<i>Carex sprengeii</i>	Long-beaked Sedge	0.50
<i>Elymus villosus</i>	Silky Wild Rye	8.00
<i>Elymus virginicus</i>	Virginia Wild Rye	40.00
<i>Glyceria striata</i>	Fowl Manna Grass	2.50
<i>Hystrix patula</i>	Bottlebrush Grass	5.20
<i>Juncus tenuis</i>	Path Rush	0.40
Total Grasses		60.00

Forbs		PLS Oz/acre
<i>Allium tricoccum</i>	Wild Leek	1.00
<i>Anemone canadensis</i>	Canada Thimbleweed	0.70
<i>Aquilegia canadensis</i>	Wild Columbine	0.50
<i>Arisaema triphyllum</i>	Jack-in-the-Pulpit	0.50
<i>Aster cordifolius</i>	Heart-leaved Aster	0.10
<i>Aster shortii</i>	Short's Aster	0.10
<i>Blephilia hirsuta</i>	Hairy wood mint	0.50
<i>Campanula americana</i>	Tall Bellflower	0.30
<i>Caulophyllum thalictroides</i>	Blue Cohosh	4.00
<i>Eupatorium purpureum</i>	Sweet Joe Pye Weed	2.00
<i>Eupatorium rugosum</i>	White Snakeroot	0.50
<i>Geranium maculatum</i>	Wild Geranium	0.10
<i>Helianthus grosseserratus</i>	Saw-toothed Sunflower	1.50
<i>Impatiens capensis</i>	Spotted Touch-me-not	0.40
<i>Lobelia siphilitica</i>	Great Blue Lobelia	0.20
<i>Penstemon digitalis</i>	Foxglove Beardtongue	2.50
<i>Polygonatum canaliculatum</i>	Great Solomon's Seal	1.00
<i>Rudbeckia laciniata</i>	Golden Glow	6.40
<i>Rudbeckia triloba</i>	Brown-eyed Susan	6.70
<i>Smilacina racemosa</i>	False Solomon's Seal	2.40
<i>Solidago caesia</i>	Blue-stemmed Goldenrod	0.10
<i>Solidago flexicaulis</i>	Zigzag Goldenrod	0.10
<i>Solidago rugosa</i>	Rough Goldenrod	0.30
<i>Thalictrum dioicum</i>	Early Meadow Rue	0.10
<i>Zizia aurea</i>	Golden Alexander	8.00
Total Forbs		40.00



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Dry-Mesic Pollinator Mix

Endorsed by The Xerces Society for Invertebrate Conservation, this prairie mix provides attractive blooms of pollinator preferred forage and nectar sources throughout the entire growing season. The grasses and wildflowers also provide diverse habitat resources for a wide range of other beneficial insects. This mix is well-suited for dry to mesic soils and mixed light conditions, making it ideal for the addition of native trees and shrubs once established.

Total Seeding Rate: 31 lbs per acre
 2.3 lbs grasses • 3.7 lbs forbs • 25 lbs nurse crop

55 native seeds per sq ft

Call, email or visit our website for pricing.

Grasses & Sedges		PLS Oz/acre
<i>Bouteloua curtipendula</i>	Side-oats Grama	6.60
<i>Carex vulpinoidea</i>	Fox Sedge	1.10
<i>Koeleria cristata</i>	June Grass	1.50
<i>Schizachyrium scoparium</i>	Little Bluestem	22.00
<i>Sorghastrum nutans</i>	Indian Grass	5.30
Total Grasses		36.50

Forbs		PLS Oz/acre
<i>Agastache scrophulariaefolia</i>	Purple Giant Hyssop	0.50
<i>Amorpha canescens</i>	Leadplant	1.50
<i>Asclepias syriaca</i>	Common Milkweed	1.00
<i>Asclepias tuberosa</i>	Butterfly Milkweed	1.00
<i>Aster laevis</i>	Smooth Blue Aster	0.50
<i>Aster novae-angliae</i>	New England Aster	0.80
<i>Cassia fasciculata</i>	Partridge Pea	10.00
<i>Coreopsis lanceolata</i>	Lance-leaf Coreopsis	8.00
<i>Echinacea purpurea</i>	Purple Coneflower	7.20
<i>Eryngium yuccifolium</i>	Rattlesnake Master	1.00
<i>Liatris cylindracea</i>	Cylindrical Blazingstar	0.50
<i>Liatris spicata</i>	Marsh Blazingstar	2.00
<i>Lupinus perennis</i>	Lupine	1.80
<i>Monarda fistulosa</i>	Wild Bergamot	1.00
<i>Penstemon digitalis</i>	Foxglove Beardtongue	1.80
<i>Petalostemum purpureum</i>	Purple Prairie Clover	6.30
<i>Pycnanthemum tenuifolium</i>	Slender Mountain Mint	0.50
<i>Ratibida pinnata</i>	Yellow Coneflower	4.30
<i>Rudbeckia fulgida</i>	Orange Coneflower	1.50
<i>Rudbeckia hirta</i>	Black-eyed Susan	3.20
<i>Silphium perfoliatum</i>	Cupplant	2.10
<i>Solidago rigida</i>	Stiff Goldenrod	0.50
<i>Vernonia fasciculata</i>	Ironweed	1.00
<i>Zizia aurea</i>	Golden Alexander	1.50
Total Forbs		59.50

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