RIVERFRONT STRATEGIC GROWTH PLAN

MUSCATINE, IOWA | MAY 2014

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The University of Iowa School of Urban & Regional Planning | Iowa Initiative for Sustainable Communities

ACKNOWLEDGEMENTS

The Mississippi Riverfront Student Group would like to thank the following people for their guidance and assistance with various aspects of our project over the course of the semester:

Adam Thompson, Muscatine Department of Community Development

Steve Boka, Muscatine Department of Community Development

Richard Klimes, Muscatine Department of Parks & Recreation

Mark Even, Muscatine Department of Parks & Recreation

Mike Ferguson & Jason Liegois, The Muscatine Journal

Jamie Hopkins, Millie Morris, & Brian Linderman, Muscatine Public Radio

Blanca Davison & Rosa Mendoza, The Diversity Service Center of Iowa

Greg Jenkins, Muscatine Chamber of Commerce

Betty Collins & Bobby Fiedler, Musser Public Library

Keith Porter & the Muscatine Rotary Club

Trisha Sotelo & Christie Saunders, Muscatine Young Professionals Network

The Muscatine Soccer Club

Lucie Laurian, The University of Iowa

Elizabeth Macias & Misty Rebik, The University of Iowa

Charles Connerly & Miwa Matsuo, The University of Iowa

Bob Gassman, Neumann Monson Architects

Matthew Gordy, Iowa State University

EXECUTIVE SUMMARY

The goal of this project was to create a Riverfront Strategic Growth Plan for Muscatine, Iowa over the 2013-2014 academic year as part of the Iowa Initiative for Sustainable Communities (IISC). In collaboration with Gary Carlson (HNI Corporation) and Rich Dwyer (Kent Corporation) of the Mayor's Community Improvement Action Team, the project developed a plan to integrate existing and future redevelopment projects, physically and visually connect the downtown commercial district with the riverfront, and provide recreational amenities best suited to the interests of Muscatine residents and prospective visitors. In addition to ensuring that the riverfront corridor is a functional and beautiful place in and of itself, the plan also emphasizes its roles as a component of the larger city parks system, as an element of local character, and as a gateway for regional recreation and tourism.

The following problem statement was used to guide plan development:

> *"Muscatine's Riverside Park lacks consistent physical and visual connections both between its elements and with the downtown. Now that the city's initial riverfront redevelopment goals have been met, there is no strategic plan in place to nurture the relationship between the park and downtown or to guide future growth with respect to community preferences and the area's unique characteristics."*

Recommendations for addressing this statement were developed based on field observations, research on current best practices and benefits of riverfront development, and an analysis of physical and financial constraints. Additionally, public input was gathered through a survey, which ran from November 2013 through January 2013, and an open house held on Mar 8, 2014. A detailed account of the methodology employed and results obtained to develop this plan can be found in the *Final Work Report: Riverfront Strategic Growth Plan for Muscatine, Iowa,* authored by the same group.

COMMUNITY PROFILE

In the 2011 Census, there were 22,918 people, 9,176 households, and 5,793 families residing in Muscatine. Figure 1 shows the racial makeup of the city: 82% White, 2% African American, 0.6% Asian, and 1% from two or more races. 14% of the total population identifies as Hispanic or Latino.

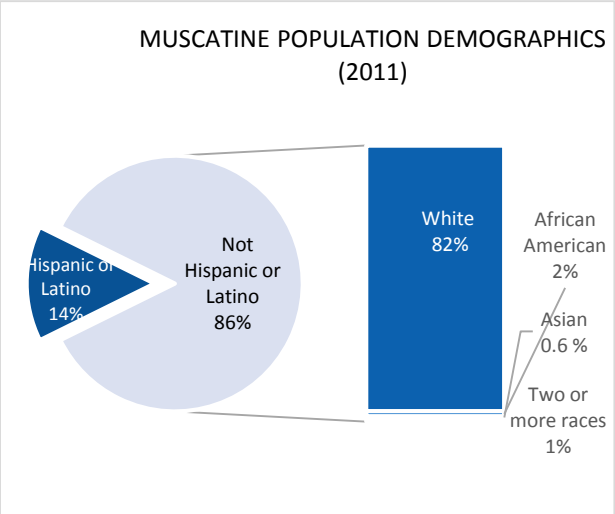
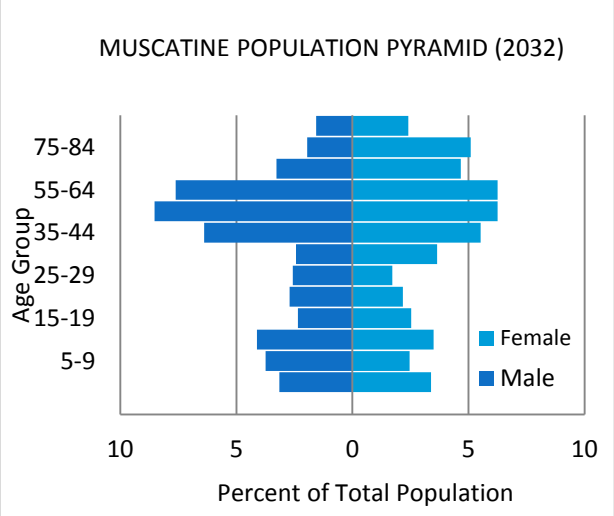


Figure 1. Muscatine population by Race/Ethnicity, 2011. Source: U.S. Census Bureau, 2009-2011 American Community Survey.

A population projection with detailed demographic information provides insight on the potential changes in community preferences and the future demand of the park. Using the cohort component method to project the population, detailed information on population structure and composition was obtained, informing predictions about the future needs and preferences affecting Muscatine's park system (Figure 2).



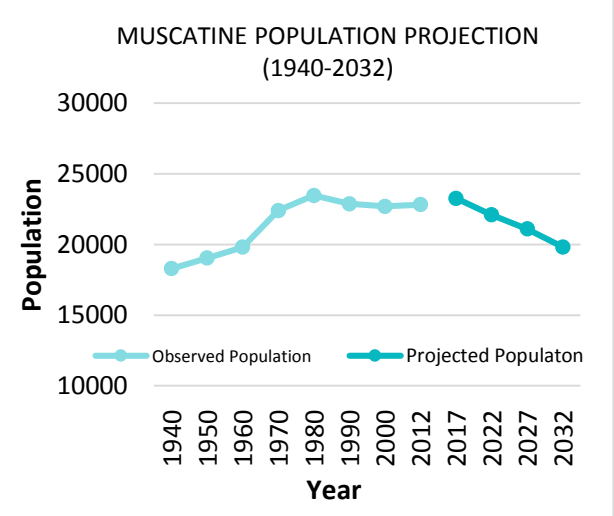


Figure 2. Population pyramid of Muscatine 2032.
Figure 3. Muscatine Population Projection (1940-2032). Source: U.S. Census Bureau.

Adjusting with different fertility rates for the Hispanic Population, the cohort component projection estimated that the city will have a population of 21,857 in 2032. Compared to the population of 24,820 in 2012, the 2032 population represents a 12% decrease. The main reason for the decreasing trend shown in Figure 3 is the net migration of the young adult groups who will move out of the city. However, given the stability of Muscatine's population since 1980, a substantial decline is not likely to happen in the future. Although the cohort component model has limitations, it is more valuable for predicting changes in population

composition, which is important to the planning process and recommendations for the future usage of the riverfront park area.

PROJECT DESCRIPTION

Project Area

The study area centers on Riverside Park, located between Mississippi Drive and the Mississippi River, extending from Mad Creek downriver just past Ash Street. It is important to note that Riverside Park is considered by many residents to extend from Mad Creek all the way to Musser Creek. All functional and design elements recommended in the plan will be applicable to the narrow riverfront area connecting Riverside and Musser Parks, but those specific features were not examined.

Riverside Park is an important community asset due to its multiple roles as a component of the larger city parks system, as an element of local character, and as a gateway for regional recreation and tourism. It is therefore necessary to consider not only internal park elements, but also the park's connection to other parts of the city. This plan emphasizes the connection between the downtown and the riverfront with the goal of bolstering both areas through a concerted approach.

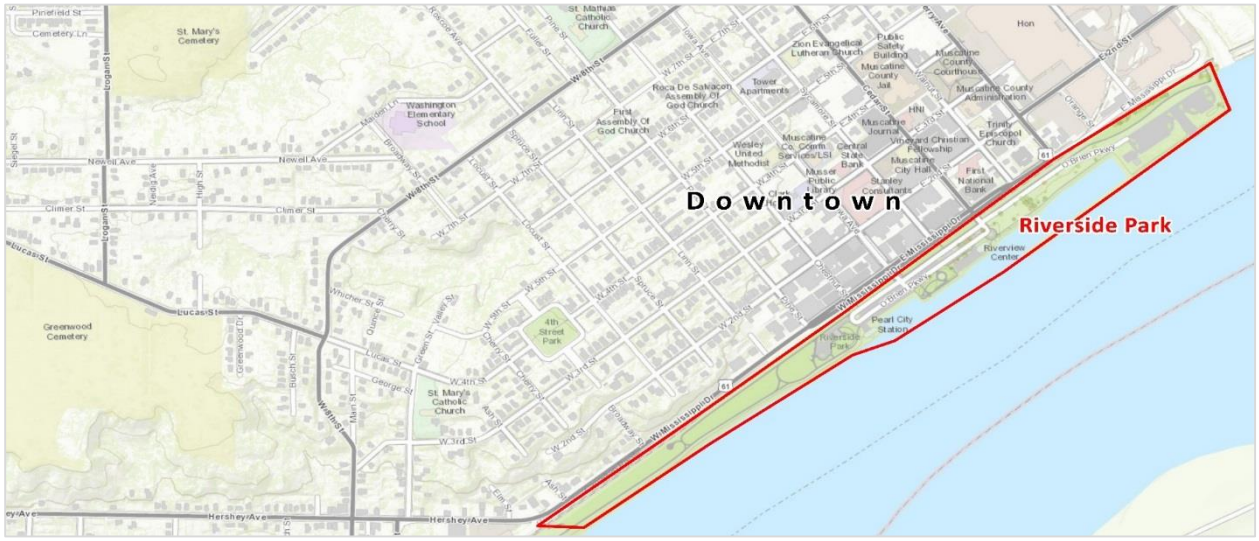


Figure 4. Our project area encompasses the riverfront and its connection with downtown. Map by Heather Milway.

Challenges & Constraints

After beginning research and conducting several field visits, a list was compiled of the key challenges to be addressed by the project. First, observations showed that certain areas of the park do not transition well into each other. Similarly, the connection with downtown also lacked appropriate visual cues, in addition to being somewhat pedestrian unfriendly. Additionally, parking lots covered a significant portion (24%) of the park, contrary to the typical vision of parks as predominantly green space. While it is necessary to provide free public parking at this location, it was recognized that softening the existing cementscape with natural elements may also be desirable. Downriver of the parking lots, a large open

expanse was initially created to provide space for unstructured recreational activities such as Frisbee. It was suggested that this space may be suitable for an alternative or enhanced use, such as an outdoor performance venue; determining this capacity was part of the challenge. Finally, observations revealed that although quite a bit had been done to unify the area visually through elements such as the "String of Pearl" historic lighting, railings, and building renovations, there were places within the park where the theme broke down, as well as opportunities to expand the theme to create a richer aesthetic experience.

In addition to these challenges, six factors constraining riverfront development were identified:

- Flooding
- Railroad & Highway Location
- Facility Easements
- Historic Character
- Parking Needs
- Viewshed of the Mississippi River

Problem Statement

Muscatine's Riverside Park lacks consistent physical and visual connections both between its elements and with the downtown. Now that the city's initial riverfront redevelopment goals have been met, there is no strategic plan in place to nurture the relationship between the park and downtown or to guide future growth with respect to community preferences and the area's unique characteristics.

Project Goals

Once the foundation of the project was established, a set of specific goals was devised to guide the project. The seven goals were:

- Better flow between park facilities
- Improved connection with downtown
- Identify community preferences
- Reconcile the need for parking with the desire to maintain park-like aesthetic
- Determine optimal use of large open expanse
- Establish a unified identity for the area

Approach & Methodology

To address the issues described in our problem statement, the research team began by observing current conditions, researching examples of successful public spaces in other waterfront communities, and developing ways to evaluate community preferences. The team then developed preliminary alternatives based on a synthesis of primary and secondary data gathered over the course of the Fall semester. In the Spring semester, the team gathered additional information and public input, refined and expanded our proposed alternatives, and ultimately recommended the alternative that best fulfilled specific evaluation criteria. Figure 5 breaks this methodology down step by step.

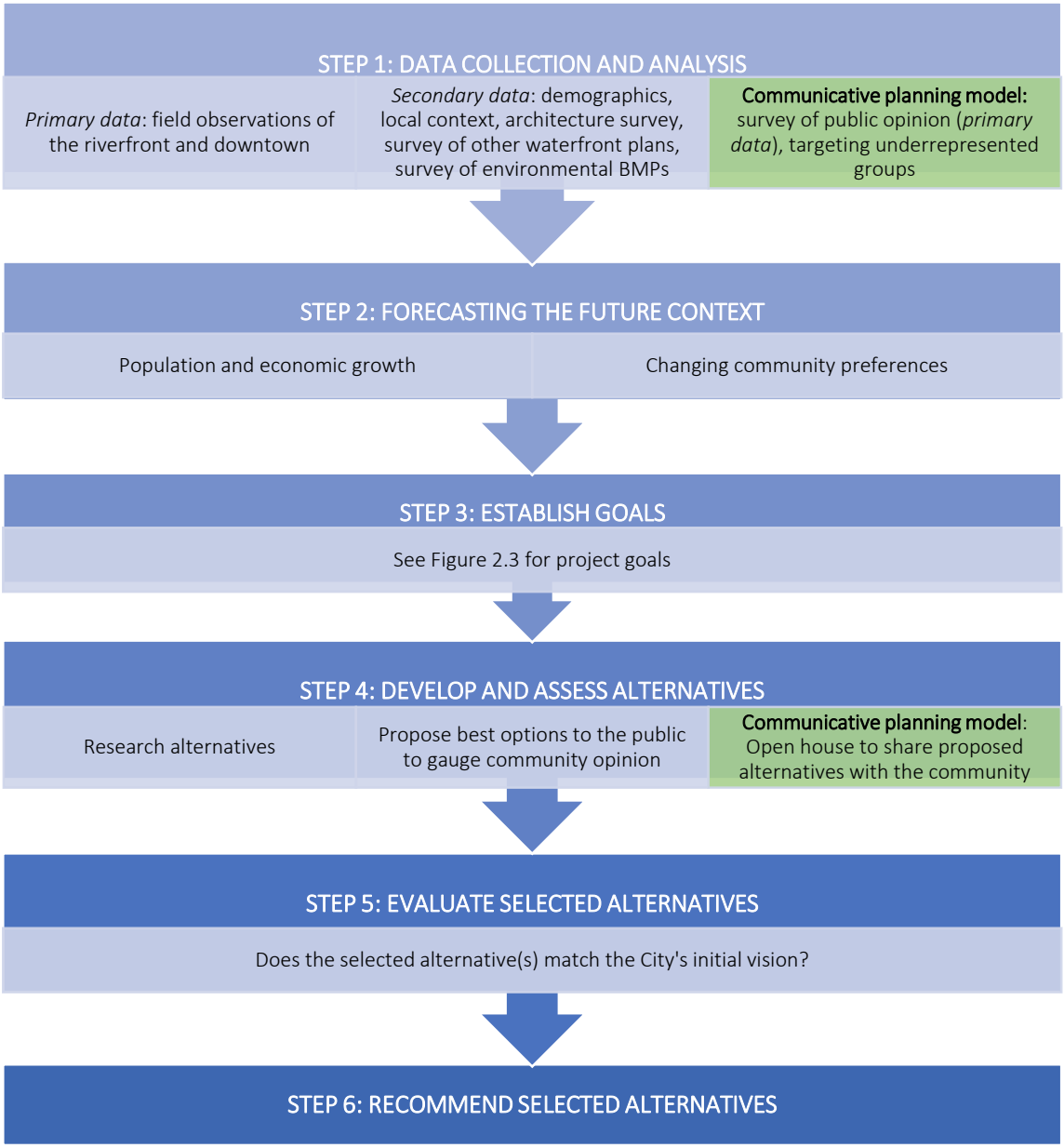


Figure 5. Step-by-step description of the quasi-rational research methodology.

REPORT OF EXISTING CONDITIONS

1997 Riverfront Redevelopment Plan

Riverside Park is one of Muscatine's three community parks, located just south of the downtown between Mississippi Drive/County Highway 6 and the Mississippi River. In the 1850s this tract of land was dominated by a railroad switchyard and waste area. The city later purchased the land and converted it into what is now named Riverside Park, which remained relatively unchanged until 1996. The city contracted a private planning firm, JJR Incorporated, to create a redevelopment plan. The RRP outlined six areas to improve the riverfront. The improvements ranged from expanded boating facilities to pedestrian mall creation.

Figure 6. The Mississippi Mist water feature dominates the area RRP labeled for Millennium Plaza. Photo by Adnya Sarasmita.

Community Projects

Figure 7. The Mississippi Harvest was added to Riverside Park by the CIAT as public art and as a historical marker. Photo by Adnya Sarasmita.

A second group in the city called the Community Improvement Action Team (CIAT) also made improvements to the park after the 1997 RRP's implementation. The CIAT created two plans, the Pearl of the Mississippi I & II, to improve Riverside Park. The plans placed historic lighting along the trails in the park, expanded and remodeled the Riverview Center, installed a water feature entitled "Mississippi Mist" and commissioned a twenty-five foot tall statue entitled "Mississippi Harvest."

Muscatine Park System & Riverside Park Niche Analysis

A park system analysis of Muscatine revealed the strengths and weaknesses of Riverside Park, pointing out the future direction and potential improvement of Riverside Park. "Park types, facilities standards, and location criteria help the city with park planning, acquisition, development and upkeep."[1] The system of park classification from the National Recreation and Park Association (NRPA) establishes a framework for park development and enhances the overall function of various recreation parks in the city as a whole. A community park

[1] National Recreation and Park Association, Recreation Park and Open Space Standards and Guidelines. 1983.

services the surrounding neighborhoods within a 1 to 3 miles radius. Figure 10 shows the service areas of three community parks in Muscatine with a 1.5 miles radius. Given that the park service area is larger than the city's boundary, there may be a spillover effect which means that the parks might also attract visitors from other areas.

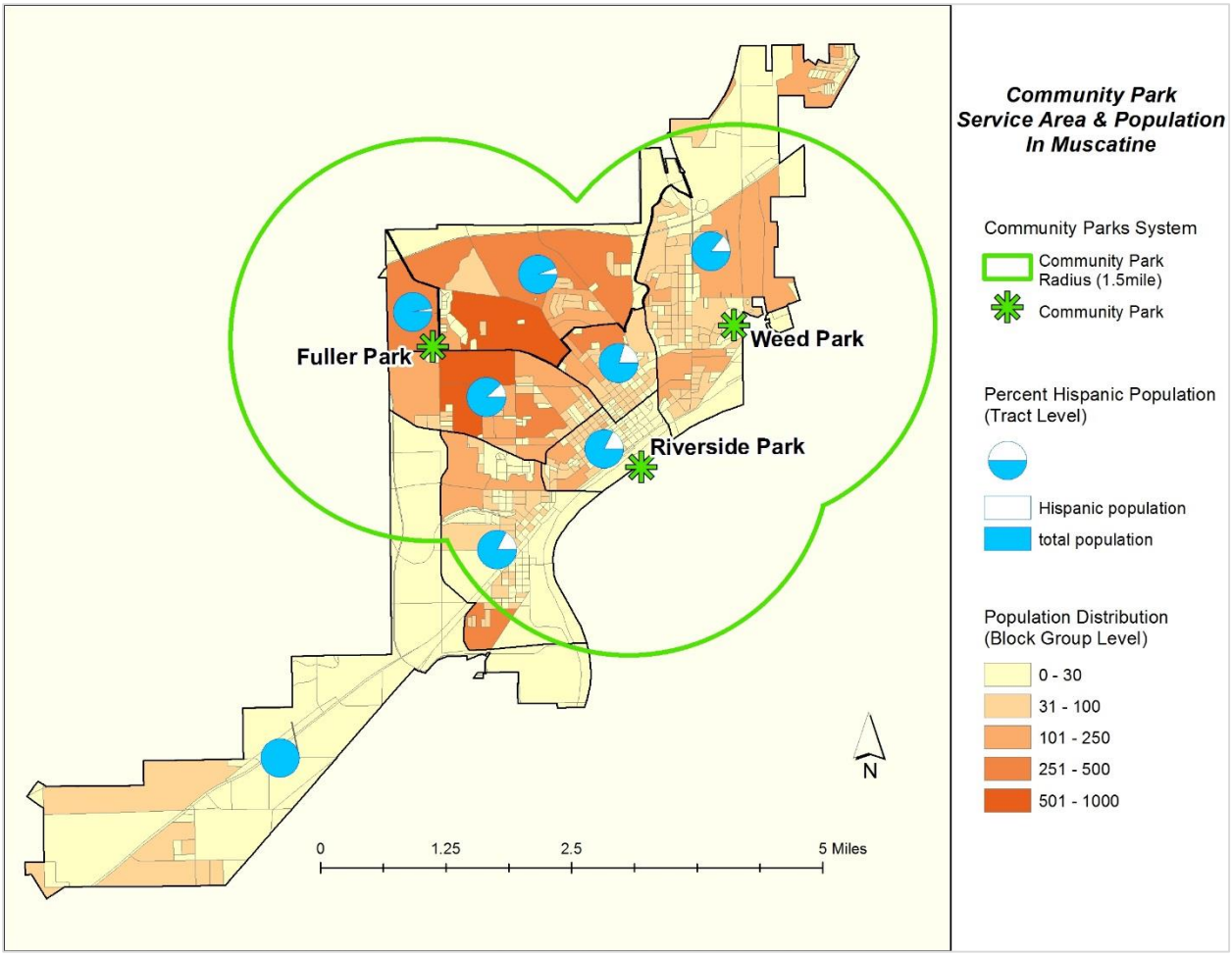


Figure 8. Community park service area and population In Muscatine, IA. Source: U.S. Census Bureau, 2010 Census; City of Muscatine Comprehensive Plan; Recreation, Park and Open Space Standards and Guidelines, National Recreation and Park Association, 1983. Map by Xiaodan Chen.

Parking Facilities

There are ten parking lots in the project area: the parking lots along the Mississippi Drive that can be seen from the Riverside Park, and Riverside Park Parking Lots 1, 2, and 3. The layout of the parking lots is presented in Figure 11.

Figure 9. Riverfront parking facilities. Map by Xiaodan Chen.

Riverside Park Facilities

Muscatine's Riverside Park provides various facilities, which not only meet visitors' requirements but also enrich the functions of the park. Figure 12 indicates the spatial layout of the facilities.

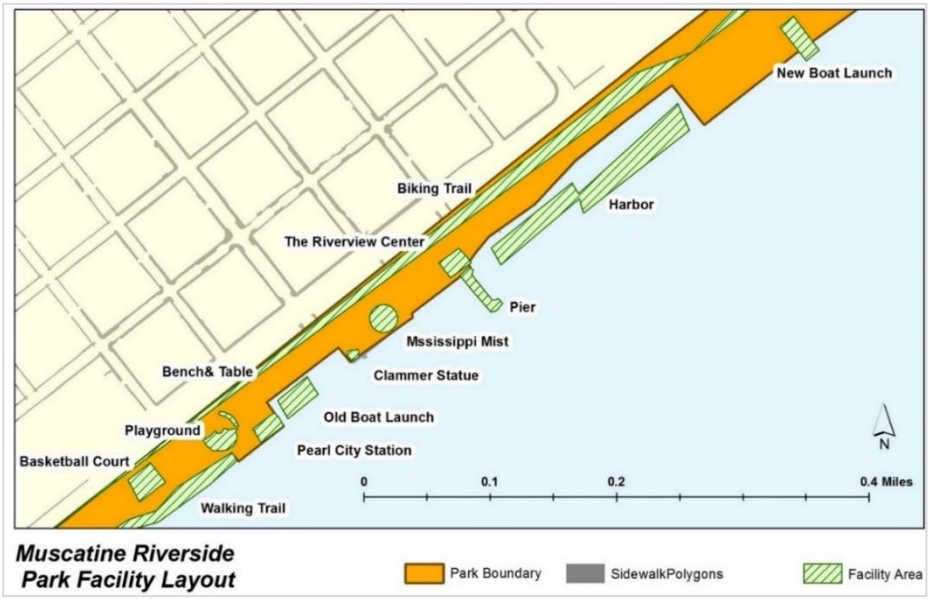
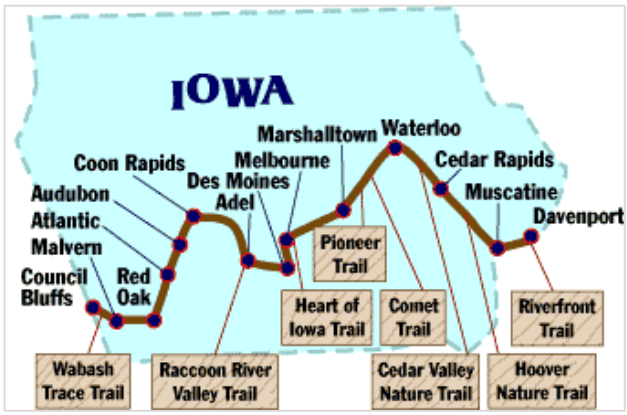


Figure 10. Spatial layout of Riverside Park Facilities. Map by Xiaomei Xu.

Muscatine's Running River Bike & Pedestrian Trail System

Riverside Park is accessible from the Muscatine Running River Bike and Pedestrian Trail System, which also serves as part of the multi-state Mississippi River Trail and American Discovery Trail networks (Figures 13 and 14).



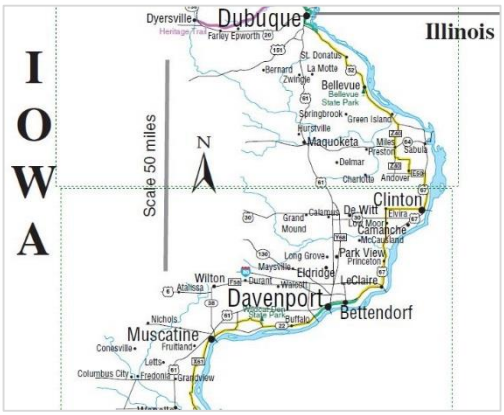


Figure 11. Iowa Mississippi River Trail Network. Source: Mississippi River Trail, Inc.

Figure 12. Iowa American Discovery Trail Network. Source: American Discovery Trail Society, 2001-2011.

SUMMARY OF FIELD OBSERVATIONS

Visitor Count Data

In order to get primary data about how people use facilities in the park, the research team conducted 12 field trips to Muscatine's Riverside Park between September 7 and November 2013. To ensure no bias on date and time in field trips, the group conducted trips on different dates and time: weekday, weekend, morning to noon (6:00 am- 12:00 pm); afternoon (12:00 pm- 6:00 pm); and evening (6:00 pm and later). Data on the observed number of park visitors and facility usage are displayed in Table 1 and Figure 13.

Race	*Observed Number*
White	501
Hispanic	47
African American	12
Asian	1
Other	0
Total	561

Table 1. Summary of total visitors observed during all field visits by race.

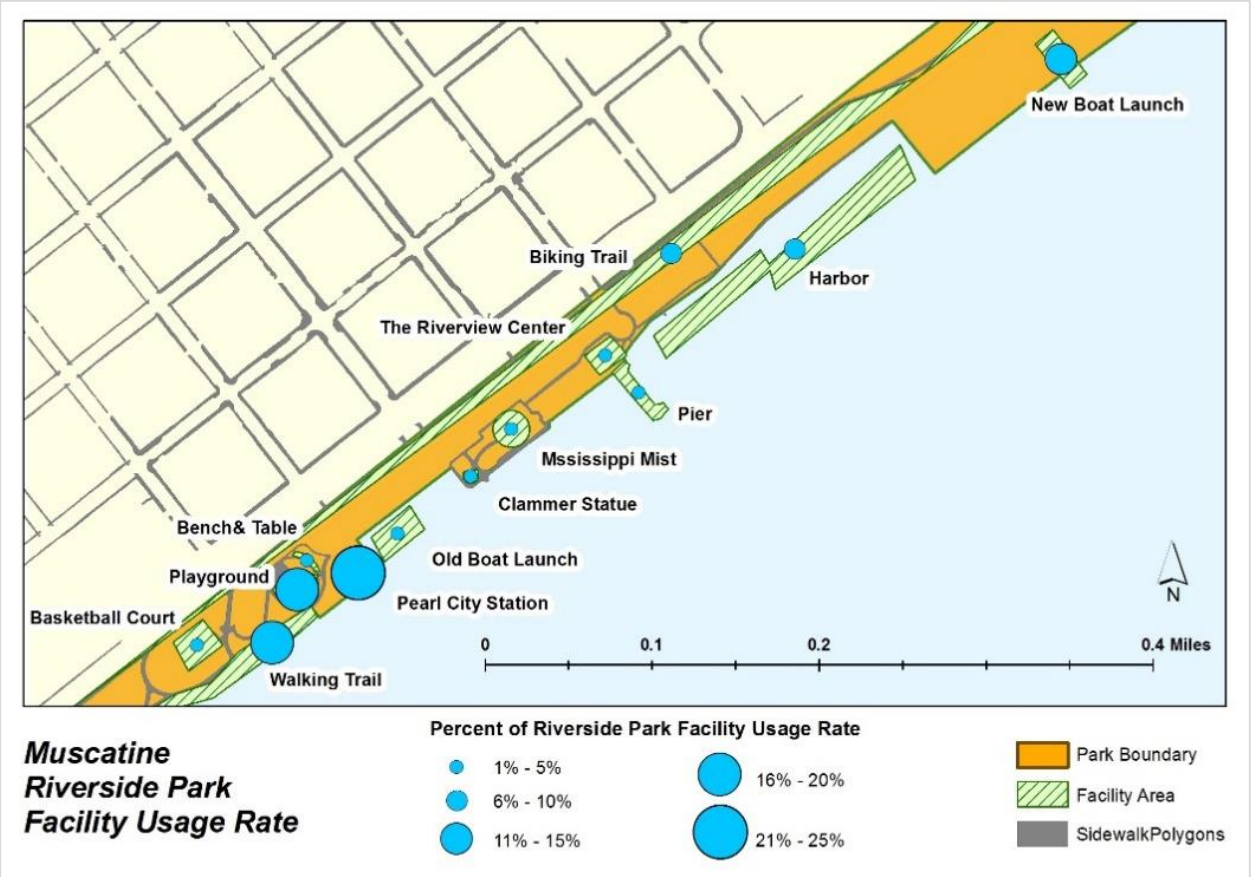
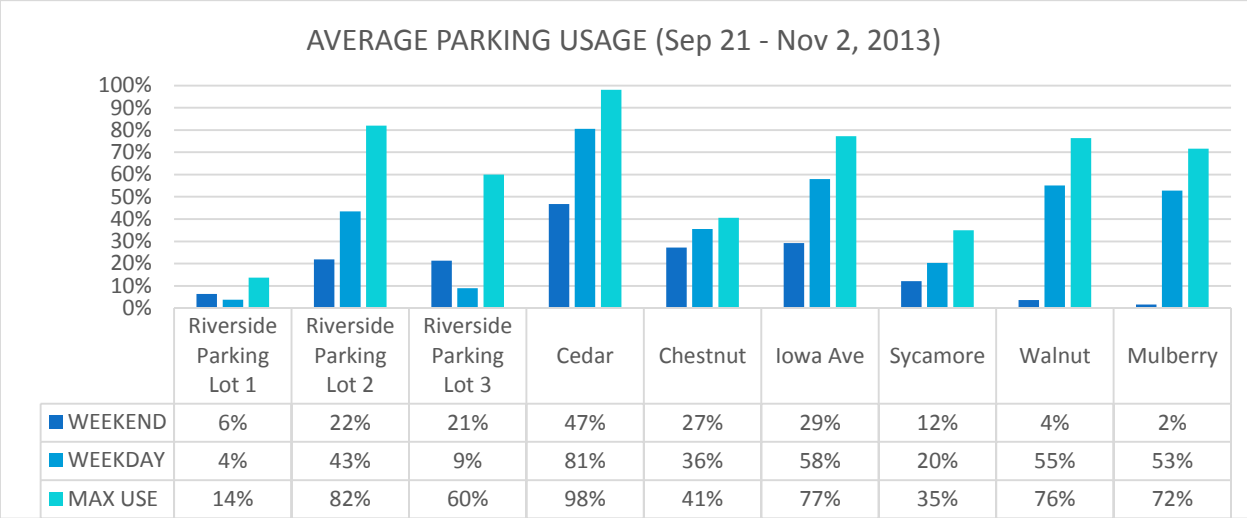


Figure 13. Map summary of facility use. Map by Xioamei Xu.

Parking Data Summary

The goal of conducting parking observations was to find out the average and peak use of the parking lots. We also wanted to know the relationship between the Riverside Park parking lots and the nearby downtown parking lots. However, one of the limitations of our observations was that several peak usages of the parking lot did not fall into the time period from September to November.



	Riverside Parking Lot 1	Riverside Parking Lot 2	Riverside Parking Lot 3	Cedar	Chestnut	Iowa Ave	Sycamore	Walnut	Mulberry
WEEKEND	6%	22%	21%	47%	27%	29%	12%	4%	2%
WEEKDAY	4%	43%	9%	81%	36%	58%	20%	55%	53%
MAX USE	14%	82%	60%	98%	41%	77%	35%	76%	72%

Figure 14. Average parking usage during field observations (Sep 21 - Nov 2, 2013).

Figure 14 shows the average parking use on weekend and weekday. There are 385 parking spaces in Riverside Park. Lot 1 is used primarily for boating activities. Its observed usage was less than 10% on both weekdays and weekends. The peak usage of this parking lot is in summer when several events are held; however, it is used less in other seasons. Lot 2 not only serves the parking needs of park visitors, but also provides additional free parking space for downtown activities. Because the parking lot attracts more vehicles from downtown businesses than actual park visitors during the week, the percent of use on weekday is higher than weekend. The maximum use of this parking lot reached 82% with 200 cars parked in Riverside Park. At that time, about 30%-40% of vehicles were from other counties and states. Lot 3 is next to the playground and mainly serves parents with children. The average usage of Lot 3 was about 21% at weekend and 10% on weekday. A license plate survey indicated that most of the users are local residents of Muscatine. Another public parking lot facing Riverside Park is the Cedar Street parking lot. It had 81% use on weekdays and 47% use during the weekend. The high usage rate indicates a high demand for free parking in the downtown area near Riverside Park. The current solution to meet this need is the complementary function of the Riverside Park Parking Lot 2. During our field observations, we noticed many people who parked their cars in Riverside Park and walked across Mississippi Drive to the downtown area, rather than using these lots exclusively to visit the park.

PUBLIC INPUT

Muscatine has a long history with successful public involvement in their planning processes. The Riverfront Strategic Growth Plan garnered public involvement in three ways: a public opinion survey, focus group data from other teams working in Muscatine, and finally, a public open house.

Survey

The survey was designed to examine how the park is currently used by the public. The twenty-two question survey asked the public to describe how they used and viewed the park, what future improvements they wanted to see, and what relationship Riverside Park and downtown share.

Figure 15. Four "ideal type" alternatives presented in the Riverfront & Downtown Area Survey. [1] High Tech Riverfront, [2] Botanical Art Garden Riverfront, [3] Natural Riverfront, [4] Fitness Riverfront.

The project used a targeted approach to distribute the survey. This targeted approach increased the focus on groups that have been absent in the past; for example, the survey was translated into Spanish to encourage members of Muscatine's Hispanic population to take the survey. Participants accessed the survey online or obtained paper copies from the Musser Public Library, City Hall Community Development Department, and the Muscatine Diversity Center. Additionally, the survey was advertised on utility bill inserts distributed in December 2013, expanding the targeted group to every resident that receives city utility bills. The survey launched on November 11th, 2013 and was available online and in paper copy locations until January 14th, 2014.

Survey Results

The survey received a total of 320 respondents with a margin of error of 5.44% at a 95% confidence level. 85% of respondents lived and worked in Muscatine. Three respondents did not live or work in Muscatine. The average age of respondents was 41-60. 78% of respondents had children. Demographic characteristics of the sample population were distributed as follows: 85% non-Hispanic white, 7% Hispanic or Latino, 0.3% African American, 1% Asian American, 1% other, and 6% declined to answer. Overall, this demographic composition was fairly representative of the entire Muscatine population.

Most respondents reported visiting Riverside Park on a monthly basis. Respondents cited physical activities, entertaining children, and enjoying the view of the river as their top three

reasons for visiting the park. The biking/walking trail, playground, picnic tables/benches, and Pearl City Station/Riverview Center were listed as the most commonly used facilities. 67% of respondents both traveled to the park by car and preferred the current level of parking provided. Respondents reported not feeling completely safe crossing Mississippi Drive between Riverside Park and downtown. Respondents also indicated a disconnection between Riverside Park and the downtown area manifested in the visual appearance, physical connections, and environment of the two areas.

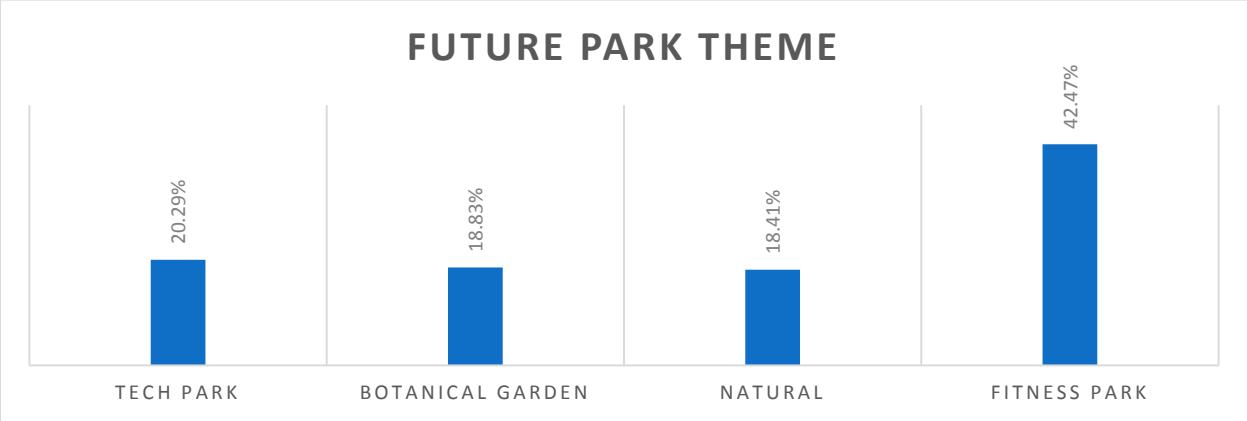


Figure 16. The image corresponding to the Fitness Park alternative was the most popular with respondents.

The survey asked respondents to choose an ideal park theme from the four images presented in Figure 15. These preliminary High-Tech, Natural, Fitness, and Botanic Art Garden alternatives were developed to represent extreme examples for parks, based on Max Weber's "ideal type" theory.[2] Respondents favored images corresponding to the Fitness and Arts & Industry themes over the Working Ecosystem and Botanic Garden themes (Figure 16). Respondents also indicated that the top three facilities that could be added to Riverside Park to increase their frequency of their visits were a concert/performance venue, more outdoor recreation opportunities, and more landscaping and trees.

Correlations/ Regressions

Correlations were utilized to determine if certain subsets of the Muscatine population had different preferences for the riverfront. Results showed that "young professional" respondents indicated that there is currently too much parking on the riverfront. Additionally, this age group responded that they would like to see wayfinding signage in Riverside Park to direct them to local restaurants and businesses in downtown. Secondly, older respondents identified that Riverside Park and downtown are not well connected.

[2] Ideal Type. Ashley Crossman. From: http://sociology.about.com/od/I_Index/g/Ideal-Type.htm.

Additionally, older respondents did not find the view of downtown from Riverside Park visually appealing.

In addition to correlations, regressions were used to determine what characteristics of respondents influenced their answer choices. The characteristics used were age, number of children, gender, years lived in Muscatine, and minority classification. The model showed that respondents who belonged to a minority and a younger age group indicated that there is too much parking at the Riverfront.

Focus Group Data from Other IISC Muscatine Student Groups

Findings from focus group conducted by other IISC student groups working in Muscatine were also gathered to increase the level of public comment taken into consideration for the Riverfront Strategic Growth Plan. According to a focus group organized by the Population Workforce Survey and Analysis group, young professionals wanted to see more outdoor dining options, a reduced emphasis on historic aspects of Muscatine, greater walkability, expanded recreational opportunities, and more wayfinding for local businesses and restaurants. Bicyclists interviewed by IISC's Connectivity Master Plan Group expressed a desire for more for parks and recreation areas to server as destinations or hubs for wayfinding and connectivity, more mobility in the downtown, more bike racks, and more amenities such as benches, water fountains, and restrooms in Riverside Park.

Public Open House

On Saturday March 8th, 2014 the Muscatine Riverfront Student Group held an open house to present preliminary concepts to the community and gather public comment on each of three proposed alternatives. The open house asked residents to rank the alternatives through voting. Participants could also vote for a "no improvement" or "business as usual" alternative by returning their stickers rather than placing them on a display board. Each alternative included five proposed facilities that fit with the overall theme. Additionally, participants indicated whether they would be willing to contribute finances or volunteer their time for physical labor or fundraising activities in order to help their favorite theme(s) be implemented.

Public Open House Results

A total of 50 participants cast their votes at the open house. The Arts & Industry theme was the favorite, capturing 44% of the votes. The Working Ecosystem alternative was the second most popular theme capturing 26% of votes, with the Fitness Riverfront coming in third with 24%. 6% of participants voted to maintain baseline conditions.

ALTERNATIVE 1: WORKING ECOSYSTEM RIVERFRONT

Figure 17. Site plan for the Working Ecosystem alternative.

This concept emphasized the use of natural elements to create a working landscape that provides environmental services with tangible benefits. Facilities featured in this alternative include an expanded playground, a sheltered picnic area, a wetland boardwalk, an amphitheater, and a native prairie walkway.

Features

A playground area is added near the splash pad to improve the flow of activities within the park. Based on our field observations, the playground is one of the most popular features of the park. However, the parking lot located between the playground and the splash pad poses a safety threat to children, who are the main users of these two facilities. Expanding the playground area to the splash pad would not only eliminate the safety issues associated with having to cross the parking lot but also create a better flow between elements within the park. This feature also addresses the public's desire to have more outdoor recreation amenities. A continuous curvy red bench runs along this area to give a more vibrant tone in contrast to the natural background colors (Figure 18). To address the popular public request for more sheltered picnic areas, this feature is situated adjacent to the playground and splash pad, allowing families and parties with concurrent activities to be close together (Figure 19).

Figure 18. A sheltered picnic area provides additional seating and shade for park visitors.

Figure 19. The existing activity areas are unified by an expanded playground area and a long, curving red bench.
Figure 20. A reconstructed wetland filters stormwater, acts as a flood buffer, and provides an educational opportunity

One of the main features of this alternative is the restoration of wetlands. According to the NRPA Recreation Guide and Standards, a community park like Riverside Park is responsible for providing certain environmental benefits to the area. In response to this requirement, the vision of Working Ecosystem Riverfront includes a functional and educational reconstructed wetland, which provides flood mitigation and storm water filtration services to the area. This wetland area will be unique among Muscatine's three community parks. Reconstructed wetlands would be situated at the north end of the river and along the river edge and adjacent to the activity intensive area of the park (Figure 20). In addition to enhancing the enjoyment of the river, this feature also provides flood mitigation and storm water filtration services to the area, as well as creating habitat for birds and aquatic species. This supports one of the 2013 Comprehensive Plan's goals to improve environmental quality of the community and public understanding of environmental issues.

Figure 21. A recessed amphitheater provides space for performances and community events without disrupting views of the river.
Figure 22. A native prairie walkway is a low-cost, low-maintenance way to build flood resilience.

One of our project goals is to determine possible uses of the open space on the park, and a performance venue is one of the most desired facilities for concerts and public events (Figure 21). It is also consistent with the comprehensive plan goal to construct a performance venue at Riverside Park. By constructing the amphitheater into the ground, it preserves the viewshed of Mississippi River and is also consistent with the natural theme of the park. Another ecosystem service that this first alternative offers is the conversion of the park's large open space into a natural prairie habitat (Figure 22). This native vegetation helps to build flood resilience and is low in cost and maintenance.

ALTERNATIVE 2: ARTS AND INDUSTRY RIVERFRONT

Figure 23. Site plan of the Arts and Industry alternative.

The second alternative was the Arts and Industry Riverfront theme. This concept combines elements of local arts and industry to celebrate Muscatine's past, present, and future. Facilities proposed for this alternative include the installation of solar panels, food carts, extension of the splash pad, stairs access to the river edge, a venue for performance arts, and an outdoor art gallery.

Features

Muscatine's comprehensive plan states a desire to create public facilities that are a model for the private sector in implementing environmental quality programs. Additional environmental quality goals include reducing environmental impacts related to energy consumption and production. As part of Muscatine's vision of the future, the installation of solar panel roofs over the parking areas will not only provide shade for parked vehicles, but also set an example for renewable energy practices (Figure 24).

Figure 24. Solar panels address the city's desire to create energy efficient public facilities.

Figure 25. Mobile food vendors provide a unique outdoor dining opportunity and encourage visitors to spend more time in the riverfront area.

Figure 26. Stairs to the water's edge connect park visitors to the river.

In addition to our public survey, we gathered public input information from other IISC groups that have conducted focus groups with various demographics. The young professionals group indicated that they would like to have more outdoor dining opportunities in the area, and bringing food carts into the park provides that option while at the same time inviting visitors to enjoy the river while having their meal (Figure 25). Encouraging downtown restaurants to invest in food carts as satellite locations provides one possibility for connecting with the downtown area. Food carts and a performance arts venue would attract more people to Riverside Park, increasing the low usage rate observed during our field visits.

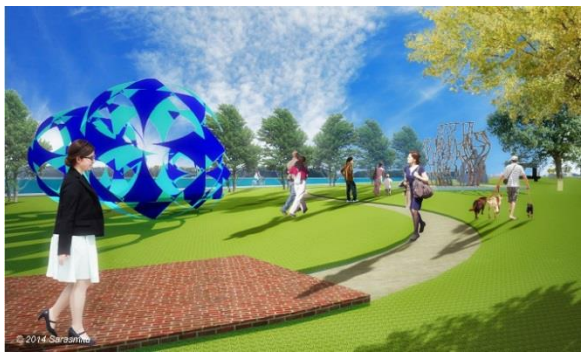


Figure 27. A traditional bandshell provides a venue for concerts and performances. Rendering by Matthew Gordy, 2013.
Figure 28. An outdoor gallery showcases Muscatine's unique local culture.

A continuous, meandering set of stairs descending to the river runs along the river's edge, giving visitors access to the water and enhancing the river experience (Figure 26). Groundcovers for these wide steps alternate between stones and grasses to allow for some water absorption. For this alternative, the performance art venue takes the form of an enclosed staging area instead of the open amphitheater presented in the first alternative (Figure 27). This illustration is taken with permission from landscape architect Matthew Gordy's existing design for Riverside Park band shell.

In this alternative, the open space at the south end of the park is utilized as an outdoor art and industry gallery that will act as an outdoor extension of the Muscatine History and Industry Center located downtown (Figure 28). According to the NRPA Recreation Guide and Standards, one requirement of a community park like Riverside Park in Muscatine is to provide art opportunities to the community. The proposed outdoor gallery would promote the aesthetics and quality of life of Muscatine while filling the current lack of art opportunities among the three community parks in Muscatine. Sculptures and art works exhibited on the gallery are inspired by local industries and promote local and regional artists. Art works could be a mix of permanent and rotational exhibitions. This use of the open space is consistent with the comprehensive goal for installation of public art that enhances the aesthetics and quality of life of Muscatine.

ALTERNATIVE 3: FITNESS RIVERFRONT

The third alternative was the Fitness Riverfront theme. This concept built on the objectives of the city's Blue Zones Initiative to promote a healthier lifestyle within the community. This alternative offers abundant opportunities for physical exercise and outdoor recreation, which vision addresses the City's stated goals of expanding year-round recreational opportunities and creating streets that are welcoming and comfortable for pedestrians. The on-site facilities include: a farmer's market and food carts, outdoor fitness equipment, a fishing pier, a sports complex, and an events tent.

Features

Figure 29. Site plan of the Fitness alternative.

The existing farmer's market currently located in downtown is relocated to the riverfront to increase sustained usage of the park and give the shoppers an opportunity to enjoy the river and the other park facilities while supporting local business and agriculture (Figure 30). The farmer's market supports Muscatine's Blue Zones Initiative by providing healthy and local food options. Food carts and an outdoor dining area are integrated with the farmer's market to give an enhanced experience.

Figure 30. The farmers market provides a consistent weekly attraction while mobile food carts are available throughout the week.

Figure 31. Outdoor fitness equipment acts as a riverfront gym that all community members can access.
Figure 32. An extended fishing pier enhances the river access that Muscatine residents already enjoy.

Clusters of outdoor fitness equipment are situated in the park to fill in the gaps between existing facilities and create a better flow throughout the park (Figure 31). This feature is also consistent with Blue Zones objectives. A fishing pier is added as a water-related recreational facility for people to enjoy the river and accommodate fishing activity (Figure 32). Riverside Park's fishing pier is currently the only fishing facility among the three community parks in Muscatine. This vision improves on the existing fishing pier by widening it and adding a fence to increase safety.

Figure 33. Additional sports facilities provide structured recreational space.
Figure 34. An events tent acts as a versatile, flood-proof event venue.

The park currently has one small on-site basketball court. For the Fitness alternative, this court is renovated and a second court is added to attract more users. Futsal (a modified form of soccer with fewer players and smaller field) fields are added for recreational games and to provide public practice space (Figure 33). An events tent occupying the open space area of the park accommodates a variety of performances and events (Figure 34). The cover of this tent can be taken apart for more versatile uses.

ALTERNATIVE SCORING CRITERIA

A series of criteria was developed to objectively assess the suitability of each alternative for Muscatine. The four criteria used to score alternatives were public input, economic feasibility, city vision, and compatibility with constraints. A weight was assigned to each criterion according to significance. Each alternative could score a maximum of ten points per criteria category; the points earned were then multiplied by the weight to determine total score for each category. The total scores for all criteria were added to determine the total points. The alternative with the most points was presumed the best suited for Muscatine.

After scoring each alternative using criteria based on the results of open house, city goals expressed in the 2013 Comprehensive Plan, compatibility with the project constraints, and a basic economic feasibility study, our group arrived at our final recommendation. The Working Ecosystem theme ranked the highest across our evaluation criteria. This result was mainly due to the theme's relatively low maintenance and implementation costs, the two most heavily weighted categories. It also provides a greater number of potential funding opportunities from federal and state grants related to environmental projects.

Category	Weight	Subcategories		Compatibility (Yes/No)	Points possible	Points	Total Points
Public Input	10%	Number of votes				10	
		Total Number of votes		50			
City Vision	15%	Public facilities should be a model for the private sector in implementing environmental quality programs			1		
		Reduce environmental impacts related to energy consumption and production			1		
		Work with community partners to improve environmental quality of the community and public understanding of these issues			1		
		Regulate development in the floodplain			1		
		Expand cold and all-weather amenities and activities			1		
		Streets that create an attractive public realm, further community appearance goals, and act as welcoming and comfortable places for people while safely accommodating vehicles			1		
		Public signage should promote community identity, further community appearance goals and visitor wayfinding			1		
		The City of Muscatine will be in compliance all relevant state and federal stormwater regulations			1		
		Installation of public art that enhances the aesthetics and quality of life of Muscatine			1		
		Construct a bandshell at Riverside Park that is aesthetically pleasing and consistent with the design of other developed amenities in Riverside Park; funding from non-municipal sources			1		
Constraints	25%	Flooding	Reduces impervious surface area		1		
			New facilities/plantings are flood resistant		1		
			New facilities/plantings need low maintenance after the flood		1		
			New facilities are outside max flood range		1		
			New facilities are outside average flood range		1		
		Parking	Meets baseline parking requirement		1		
		Viewshed	Viewshed unblocked		1		
		Historic Character	Compatible with historic character		1		
		Environmental Impacts	Provides wildlife habitat		1		
			Utilizes stormwater BMPs		1		
Economic Feasibility	20%	Implementation Costs	Estimated cost relative to other alternatives	1st	10		
				2nd	6.66		
				3rd	3.33		
	30%	Maintenance Costs	Estimated cost relative to other alternatives	1st	10		
				2nd	6.66		

FINAL RECOMMENDATION

Figure 35. Final recommended site plan.

The Working Ecosystem theme is geared towards utilizing elements of nature in a controlled and managed way to fit within project constraints while still highlighting the riverfront's unique characteristics. Green infrastructure is installed throughout the park to help cope with flooding and reduce the amount of pollution that flows into the Mississippi River from Muscatine. Although the Working Ecosystem theme serves as the overarching concept across the park, individual features from all three alternatives were chosen based on feasibility and public support demonstrated at the open house.

Parking

City	Total Area (acres)	Parking Area (acres)	Percent Coverage	Number of Parking Spaces
Burlington	22	2	11%	179
Davenport	60	4	7%	256
Des Moines	100	8	8%	300
Eau Claire	10	0.5	6%	81
Rock Island	9	0.3	4%	31
St. Charles	25	1	3%	41
Muscatine	44	11	24%	385

Table 2. Summary of parking data for comparable riverfront parks. Data from GIS analysis completed by Heather Milway.

The final recommendation proposes that some of the parking spaces on the Riverfront be shifted to downtown to create a more park-like aesthetic and reduce the amount of impervious pavement. Seven cities of comparable size and situation with successful riverfront [re]developments were examined to establish a baseline for riverfront parking provision. Currently 24% of Muscatine's riverfront is allocated to parking, with a total of 385 parking spaces for visitors. Of the seven cities examined, Muscatine has the highest percent coverage of pavement and number of parking spaces (Table 2). This data combined with the parking observations from field observations support the recommendation to shift a portion of the parking into downtown to improve physical and visual cohesion at Riverside Park.

Figure 36. Iowa Ave is transformed into a blending corridor through roadway resurfacing, creating active building facades, and constructing a gateway to welcome visitors.

Downtown Connectivity

One of our main project goals was to create a stronger connection between riverfront and downtown. The plan proposes to transform Iowa Avenue into a blending corridor between the park and downtown area through resurfacing of roads, creating active building façades along the corridor, and constructing gateways to welcome visitors. Wooden pergolas mirrored across Mississippi Drive onto Iowa Avenue corridor act as a gateway into the park and, along with the use of brick pavers, create a seamless connection between the two areas. This corridor would be transformed into the main pedestrian access for visitors moving between the riverfront and downtown, while auto traffic would be directed towards the Cedar Street entrance. To create a more attractive public realm, vegetative screens and consistent landscaping are used to enhance the visual experience along the Mississippi Drive Corridor, which also serves as an integral foreground for the park.

Figure 37. Design elements such as brick pavers and wooden pergolas continue from the downtown into the park at Iowa Ave, which becomes the main pedestrian entrance.

Figure 38. Consistent landscaping along Mississippi Drive creates a visual connection between the riverfront and downtown.

Figure 39. The relocation of the Saturday farmer's market and introduction of mobile food vendors supports a sustained increase in day-to-day usage.

Farmer's Market and Food Carts

One way to create a sustained increase in usage is by concentrating activities on the riverfront. The results of our public open house indicated strong support from the public for designating a portion of the park to accommodate the farmer's market and food carts. The plan recommend that the existing farmer's market be relocated to Riverside Park to draw visitors to the riverfront on Saturday mornings. To draw visitors during the rest of the week, the plan recommends introducing mobile food vendors, which are ideal for this location due to the flood constraint and their non-permanent nature. Movable food carts or trucks have been found to be effective community development tools in other communities. They could also provide entrepreneurial opportunities for small start-ups or serve as satellite locations for downtown restaurants, further enhancing the connection with downtown.

Figure 40. Relocating parking to connect the splash pad and playground areas makes the activity space safer and visually more pleasing while maximizing the space park visitors have for recreation.

Picnic Area and Playground

Currently there is an abundance of parking lot surrounding Mississippi Mist area, separating the splash pad from the playground, two areas intended for children's activities. This condition is not ideal from an aesthetic, functional, or safety point of view. By relocating a portion of the parking lot, our recommendation reconfigures this space and creates a more unified recreational area for the visitors. The plan recommends that this area be transformed into a picnic area and additional children's playground. These facilities would support activities in the adjacent facilities, with the picnic area providing seating for food cart patrons and for guardians supervising children playing on the splash pad and playground. Picnic tables are shaded with individual umbrellas, due to the popular public request for more sheltered seating facilities.

Figure 41. A staircase down to the water connects people directly to the river and emphasizes Riverside Park's defining natural feature.

Stairs to the River

Based on the public survey results, one of the top reasons for visiting the park was to enjoy the river, and the plan emphasize this defining natural feature in our recommendation. A meandering staircase down to the water connects people directly to the river, something that is not currently facilitated by the park's existing features. In the plan recommendation, there are two sets of staircases, one located to the south of the Riverview Center, and placed at the old boat launch is currently located.

Figure 42. The proposed events tent is sited to take advantage of existing landscape features and designed to be disassembled in the event of a flood, making it a flexible venue for a variety of community events.

Events Tent

After considering several possible designs, a deconstructible tent-style venue was identified as the most practical and versatile option for this particular location. The proposed structure would be sited to take advantage of existing landscape features and designed to be disassembled in the event of a flood or during a long event hiatus period, making it a flexible venue for a variety of community events.

Figure 43. An outdoor gallery landscaped with native prairie plants offers visitors the experience of viewing artistic representations of local culture while walking through a landscape that reflects Iowa's natural history.

Native Prairie Walkway and Outdoor Art Gallery

In the remaining open space at the downriver end of the park, the plan proposes combining natural prairie landscaping with an outdoor gallery. This art gallery can act as an outdoor extension of the Muscatine History and Industry Center located downtown, giving visitors the experience of viewing artistic representations of local history and culture while walking through a landscape that reflects Iowa's natural history. The native prairie in our proposed design is a landscaped prairie rather than a purely natural prairie, giving it a well-maintained look. Breaking up the prairie using walkways and art displays would alleviate the problem of pests often associated with native prairies. The key to an environmentally successful prairie is selecting native plant species that are adapted to local conditions because they are more resilient to drought and flood, and also provide habitat for native butterflies.

Figure 44. Grass pavers installed in overflow parking areas contributes to a park-like aesthetic and expands activity areas while still providing parking for peak usage periods.

Green Parking

During the site visits in late summer through early fall, two of the main observations were that the park's activity areas are broken up by parking lots, and that during our observation period, parking usage was low on average. However, it was also apparent that people enjoy being able to park for free in this area, and parking must be maintained for large events. The plan recommends the use of grass pavers for overflow parking during peak usage periods. This can be executed in various ways, such as installing grasscrete or a turf reinforcement grid. The idea of a green overflow parking area is beneficial both from an environmental and a parking provision standpoint. The green overflow parking serves as a permeable surface for stormwater infiltration and also provides 88 additional parking spaces when needed.

Through parking relocation and provision of green overflow parking, the plan recommendation is able to reconfigure the park into a more functionally and aesthetically cohesive recreational space while only reducing parking by 47 spaces, or 12% of the existing amount of parking. This shows that by improving space efficiency, it is possible to maintain a balance between Riverside Park's function as a public recreational area and providing parking to support park activities.

IMPLEMENTATION STRATEGY

Potential Funding Sources

In the past, riverfront improvements have been funded by the city, Muscatine Power & Water, Federal grants, and private philanthropy. The Mayor's Community Improvement Action Team has played a large role in private fundraising for riverfront projects in recent years. The City of Musatine invested millions of dollars during the early stages of development, ultimately transforming the riverfront from an industrial area to a continuous stretch of public open space. Now that many of the City's original redevelopment goals have been met, funding for additional improvements will ideally come from non-municipal sources, such as private donations, public-private partnerships, or grants.

Grants

Because the park is a public good, private sector actors generally have less incentive than the public sector in providing financial support for the project. To ensure the successful implementation of the project, grants will therefore be a crucial source of financing.

Land and Water Conservation Fund (LWCF)

"The Land and Water Conservation Fund (LWCF) Program is a federally funded grant program which provides match funds of 50% for outdoor recreation area development and acquisition."[3] Iowa's cities and counties are eligible applicants. Eligible projects are listed below:

- "Observation and sight-seeing facilities;
- Picnic facilities, including open shelters;
- Playground equipment and outdoor sports facilities such as ball fields and game courts, golf courses, etc;
- Lake and pond construction for boating, fishing and aesthetic purposes;
- Renovation or redevelopment of existing facilities which have deteriorated or become outdated;
- Support facilities including roads, parking, signs, walkways, utility systems, lighting, restrooms, concession buildings, trailer dumps, fences, etc."[4]

[3] Iowa Department of Natural Resources. From: http://www.iowadnr.gov/InsideDNR/GrantsOtherFunding/LandWaterConservationFund.aspx
[4] Ibid.

Based on these requirements, projects at Muscatine's Riverside Park are eligible to apply for this grant.

Natural Resources and Outdoor Recreation Trust Fund (fka Sustainable Funding)[5]

"The Natural Resources and Outdoor Recreation Trust Fund is generated by a sales tax rate of three-eighths of one percent. The trust fund will serve as a central depository for the revenue and will distribute the funds to seven funding subcategories:

- 7% Lake Restoration
- 10% Trails
- 13% REAP (Resource Enhancement And Protection program)
- 13% Local Conservation Partnership program
- 14% Watershed Protection
- 20% Soil Conservation and Water Protection (IDALS)
- 23% Natural Resources (DNR)"[6]

Public improvements at Riverside Park could qualify for funding from the Local Conservation Partnership program, Watershed Protection and Soil Conservation and Water Protection. Since parts of the project do not match these topics, it is expected to use this grant as part of the project budget. However, the fund has not acquired any receipts so far; therefore; it is a standby funding source for the project.

REAP City Parks and Open Spaces Grant Program

REAP provides money to cites for projects such as Parkland expansion and multi-purpose recreation developments through competitive grants.[7] The fund is distributed among three city size categories (Table 3).

Population	2013 (FY14) Available Funding
0 - 2,000	$524,468
2,000-25,000	$782,752
Over 25,000	$1,086,517

Table 3. City Population and Available Funding. From http://www.iowadnr.gov/Environment/REAP/REAPFundingatWork/HistoricalResources.aspx.

Muscatine's population size falls into the second category. No fund matching is required to obtain this grant. The proposed park improvement projects also fit these

[5] Iowa Department of Natural Resources. NATURAL RESOURCES AND OUTDOOR RECREATION TRUST FUND REPORT, 2012.
[6] Ibid.
[7] Iowa Department of Natural Resources. From: http://www.iowadnr.gov/Environment/REAP/REAPFundingatWork/CityParksOpenSpaces.aspx

application requirements. City Park and Open Space grant applications are typically due in mid-August.

Historical Resource Development Program

This program, operated by The State Historical Society in the Department of Cultural Affairs, provides grants for projects related to historic resource development or preservation.[8] "The purpose of this program is to provide funds to preserve, conserve, interpret, enhance, and educate the public about the historical resources of Iowa."[9] Agencies of Certified Local Government are included in the list eligible applicants. "Historic preservation is one of the basic categories that supported by grants under this program."[10] Applications are accepted in mid-May each year.

The Riverfront Strategic Growth Plan not only helps to create a better environment for the community, but also makes efforts to protect historic resources in the park. For example, the remains of the old Muscatine High Bridge is part of Muscatine's historic heritage; preservation of such historic resources is involved in the plan.

Sales tax revenues

A statewide measure passed in fall 2010 allows Iowa counties to hold referenda on raising the sales tax by 3/8 cent.[11] The raised tax revenue will work as a dedicated funding source for environmental improvements. Researchers in the Iowa State University Department of Economics estimate that passing such a referendum in Muscatine County could potentially generate $1,639,544.[12]

Vision Iowa

Vision Iowa is a program that assists projects with recreational, cultural, entertainment and educational attractions.[13] Eligible projects for this program must be available to the general public for public use and consist primarily of vertical infrastructure (land acquisition and construction, major renovation and major repair of buildings, site development, and recreational trails[14]). The program includes three funds: Vision Iowa, Community Attraction

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[8] Iowa Department of Natural Resources. From: http://www.iowadnr.gov/Environment/REAP/REAPFundingatWork/HistoricalResources.aspx
[9] Ibid.
[10] Ibid.
[11] Daniel Otto, Kristin Tylka, and Susan Erickson. *Economic Value of Outdoor Recreation Activities in Iowa*. Iowa State University, 2012.
[12] Ibid.
[13] VISION IOWA. Iowa Economic Development, 2014. http://www.iowaeconomicdevelopment.com/CommunityDevelopment/VisionIowa.
[14] Vertical Infrastructure Definition. Iowa Legislative Fiscal Bureau, 2000.

and Tourism (CAT) and River Enhancement Community Attraction and Tourism (RECAT).[15] The City of Muscatine has successfully obtained CAT grants for riverfront improvements in the past.

Regulations and Policies

Because we have considered the goals and values expressed in local plans and ordinances since the beginning of the project, the Riverfront Strategic Growth Plan is unlikely to conflict with these important documents. Obstacles may arise, however, in assuring compliance with state and Federal policies regulating the environmental impacts of development. Table 4 summarizes the relevant laws and policies that may apply to selected improvements.

	Connection with Downtown	Stairs Access	Farmers Market + Food Carts	Outdoor Gallery	Events Tent
Local					
Muscatine Comprehensive Plan	"Streets that create an attractive public realm, further community appearance goals, and act as welcoming and comfortable places" "Gateways into Muscatine will be attractive, contribute to improving the city's identity, and help implement the master community image/appearance plan"	"Construct a bandshell at Riverside Park…" "Community events and activities that enhance civic pride and spirit, improve the health of, enhance the quality of life in Muscatine, and reflect the diversity of Muscatine"	"Reduce litter problems…"	"Installation of public art that enhances the aesthetics and quality of life of Muscatine"	"Community events and activities that enhance civic pride and spirit, improve the health of, enhance the quality of life in Muscatine, and reflect the diversity of Muscatine"
Municipal zoning code	Downtown zoning district (updated ordinance) + Downtown Commercial Historic District overlay	Flood Plain Zoning District/Flood Channel (Floodway) Zoning District overlays			
Muscatine stormwater management policies	Potential for including stormwater management facilities?	X			
2010 Flood Control Manual		X		X	
State					
Facility easements		X (Iowa DNR)			
Federal					
Section 404 of the Clean Water Act		X			
National Environmental Policy Act		X			

Table 4. Relevant laws, regulations, and policies likely to affect riverfront improvements.

[15] Iowa Economic Development, 2014.

Individual Features

Enhanced Connection with Downtown

Enhancing the visual connection between Riverside Park and the downtown central business district will require cooperation with downtown property and business owners. Including downtown area stakeholders early in the planning process will help to ensure cohesion throughout the district and a seamless transition between privately owned structures and the public right-of-way. Additionally, these improvements will need be coordinated with other public improvement projects such as those recommended in the Mississippi Drive Corridor Study.

Stairs Access

The riverfront stairway cannot be fully constructed until 2020, when the DNR easement on the old boat launch expires. However, implementation can be executed in stages, allowing a portion of the stairs to be constructed upriver of the old boat launch prior to 2020. This project will likely require a permit in order to comply with Section 404 of the Clean Water Act. If obtaining this permit results in the project being classified as a Federal action, compliance with the National Environmental Policy Act will also be required. Additional time and costs should be budgeted into the project to account for the intensive environmental impact analyses mandated by these policies. Given its location in the floodplain, it will also be necessary to ensure conformance with the National Flood Insurance Act, local flood plain zoning regulations, the 2010 Flood Control Manual, and local stormwater management policies.

After the facility is constructed, there will inevitably be maintenance and operational issues to address. The City of Muscatine will be responsible for overseeing maintenance, post-flood cleaning, and safety concerns associated with the structure, among other issues.

Farmers Market & Food Carts

Relocating the existing Muscatine Farmers Market is unlikely to require any major structural or institutional changes. Mobile food vendors will be a brand new amenity in Muscatine, so the City may wish to develop a program to organize and regulate riverfront food carts if it is not possible to regulate this use under existing food service regulations.

Both positive and negative impacts of mobile food vendors have been noted in other cities, providing Muscatine with the opportunity to learn from their experiences. These range from positive impacts such as improved “street vitality and neighborhood life,” increased foot traffic, increased public perception of safety, and the creation of a venue for social interaction

to negative effects such as excess garbage in the absence of adequate disposal facilities.[16] Thinking through the potential effects of food carts on the riverfront area will help the City capitalize on positive impacts while minimizing negative ones through preventive actions such as ensuring the availability of seating and trash receptacles.

With food carts growing in popularity across the county, many cities are now able to provide recommendations regarding the regulation of mobile food vendors. Building off of other cities' experiences, Muscatine can help ensure a successful food cart program by minimizing barriers to entry, establishing firm health and sanitation guidelines, and sharing information with all stakeholders.[17] This includes creating a centralized permitting process so that all necessary paperwork can be filed with one department or agency, and setting permit fees that generate revenue to pay for increased park maintenance associated with the presence of food carts while not prohibiting individuals from investing in food carts. At the beginning, the City of Muscatine will probably want to keep fees low to encourage vendors to undertake the risk of setting up. The City may even want to offer grants or other forms of assistance to encourage entrepreneurial initiative. Finally, actively sharing information about the program will encourage restaurants and individuals to invest in food carts and make sure that the community is aware of this new dining opportunity.

The plan recommends that the City of Muscatine look to other cities where successful food cart programs have been established to get ideas for structuring permit forms and requirements and operating guidelines. The National League of Cities report on mobile food vending contains a comprehensive summary of food cart programs in cities across the U.S., while the Urban Vitality Group's study of food trucks in Portland, Oregon provides insight into potential benefits and challenges.

Outdoor Gallery and Native Prairie Walkway

Muscatine does not currently have a public art program to coordinate artists and corporate donors for the creation of a riverfront outdoor gallery. Although City staff and CIAT members have gained some experience in commissioning public art through projects such as "The Clammer," organizing multiple works may require additional planning and/or regulation. Many options exist for accomplishing this comprehensive plan goal, but it will ultimately be up to the city to decide what program structure will work best in Muscatine and what resources to allocate toward its operation. Public art programs can be initiated through percent-for-art programs, contracting a private art advisor or consultant, forming

[16] Urban Vitality Group, "Food Cartology: Rethinking Urban Spaces as People Places," https://www.portlandoregon.gov/bps/article/200738.

[17] National League of Cities, "Food on Wheels: Mobile Vending Goes Mainstream," 2013. http://www.nlc.org/Documents/Find%20City%20Solutions/Research%20Innovation/Economic%20Development/FoodTruckReport2013_Final_9-26.pdf.

collaborative community partnerships, or holding public art competitions; the St. Louis Regional Arts Commission's Public Art Guide provides a basic overview of these and other options, including an 11 step public art planning outline.[18] The Americans for the Arts website also contains advice on commissioning artwork, navigating legal and copyright issues, and planning for maintenance.[19]

Native prairie landscaping surrounding the outdoor art gallery is expected to be both attractive and beneficial at Riverside Park. Although the recommended prairie landscaping area will likely be too small to support a full prairie ecosystem, using native prairie plants in place of traditional landscaping will have the advantages of being pest and drought resistant, requiring little to no irrigation or fertilization, and attracting butterflies to add a unique and interesting element to the Riverside Park experience.[20] Additionally, many such plants are adaptable to the wet or mesic soils that may be present at the riverfront. The University of Iowa Libraries provide a list of native prairie species by county along with descriptions of each species' characteristics and growth habits, allowing the City of Muscatine to select plants that are adapted to specific local conditions.[21] A more general statewide guide to landscaping with native plants is available from the Iowa State University Extension (Appendix B).

Sheltered Picnic Area

Because the sheltered picnic area is more in line with previous park developments, city staff and CIAT members will likely be familiar with the implementation of this project.

Events Tent

The proposed events tent is sited to take advantage of existing landscape features and designed to be disassembled in the event of a flood, thus addressing two major aspects of have to develop plans for maintenance, event coordination, safety, food and/or alcoholic beverages provision at events, and potential liability issues, among other matters.

Green parking

Green parking should be implemented in low traffic areas, such as overflow parking spaces and service drives. The US EPA provides basic information related to green parking techniques, including limitations and cost considerations, on their NPDES website[22] as well

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[18] St. Louis Regional Arts Commission, "Public Art Practices: A Reference Guide for Developing Public Art Programs and Projects," 2007. http://www.art-stl.com/assets/pdfs/PublicArtGuide.PDF

[19] Tools and Resources for Public Art Professionals, Americans for the Arts, 2014. http://www.americansforthearts.org/by-program/networks-and-councils/public-art-network/tools-resources

[20] Iowa State University Extension, *Sustainable Urban Landscapes: Introduction to Iowa Native Prairie Plants*, 2008. https://store.extension.iastate.edu/Product/sul18-pdf.

[21] The University of Iowa Libraries, "Iowa Prairie Plants: Prairie plants found in Muscatine county," 2014. http://uipress.lib.uiowa.edu/ppi/counties.php?record=77.

[22] United States Environmental Protection Agency, "Green Parking," 2006. http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=89.

as a more detailed report describing all types of green parking lot resources.[23] Companies such as NDS Pro, Invisible Structures, Terra Firm Enterprises, Grassy Pavers, Atlanta Core Systems, and Pavestone sell green parking products and may be able to ship to Muscatine.

Stormwater Wetland at Mad Creek

The construction of stormwater wetlands differs from the restoration of natural wetland systems in that they are specifically engineered to provide ecosystem services for human developments rather than to mimic natural conditions to support aquatic plant and animal life. However, benefits such as reduction of peak flows and pollutant removal can only be attained when stormwater wetlands are properly planned, sequenced, constructed, and managed. Ideally, the City of Muscatine will select contractors who are familiar with green infrastructure techniques and become familiar with the current information available on stormwater wetland construction. The EPA provides a basic overview of stormwater wetland principles and considerations on its National Pollutant Discharge Elimination System (NPDES) website,[24] while the North Carolina Cooperative Extension recently published a useful construction guide that provides more detailed advice (Appendix C).[25] Finally, Iowa-specific wetland information, including a list of appropriate plant species, is available from the Iowa State University Extension's 1999 report, *Managing Iowa Habitats: Restoring Iowa Wetlands*.

Project Phasing

Although the proposed phasing could change due to the uncertainty of funding and other related issues, it is important to identify a timeline for implementing specific features of the final recommendation based on expected financing and difficulty of construction.

We propose that implementation take place over three 5 year phases, with a total project duration of 15 years. During Phase 1 (2015 to 2020), the city would start to acquire the necessary construction permits for all 3 phases. The city could install the expanded picnic area and park gateway arch, implement wetland restoration at Mad Creek, resurface the existing basketball court, relocate the farmer's market, and begin introducing mobile food carts during this phase. Construction of the outdoor gallery and events tent would also begin in Phase 1 if funds are available and likely continue into Phase 2. The installation of the riverfront staircase could be started in this phase after acquiring the necessary permits from the US ACE and Iowa DNR.

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[23] United States Environmental Protection Agency, *Green Parking Lot Resource Guide*, 2008. http://www.streamteamok.net/Doc_link/Green%20Parking%20Lot%20Guide%20(final).PDF.
[24] United States Environmental Protection Agency, "Stormwater Wetland," 2012. http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=74.
[25] North Carolina Cooperative Extension, *Urban Waterways: Stormwater Wetland Construction Guidance*, 2010. http://www.bae.ncsu.edu/stormwater/PublicationFiles/WetlandConstruction2010.pdf.

Phase 2 (2020 through 2024) includes the installation of native prairie plantings and resurfacing of Iowa Avenue. The outdoor gallery and event venue initiated during Phase 1 could be completed before 2025. The city could also start working with downtown property owners to implement the downtown archway and other design features during this phase. Phase 3 (2025 to 2030), involves putting the finishing touches on the final parking lot landscaping and downtown archway.

Phase 3 (2025 to 2030), involves putting the finishing touches on the final parking lot landscaping and downtown archway.

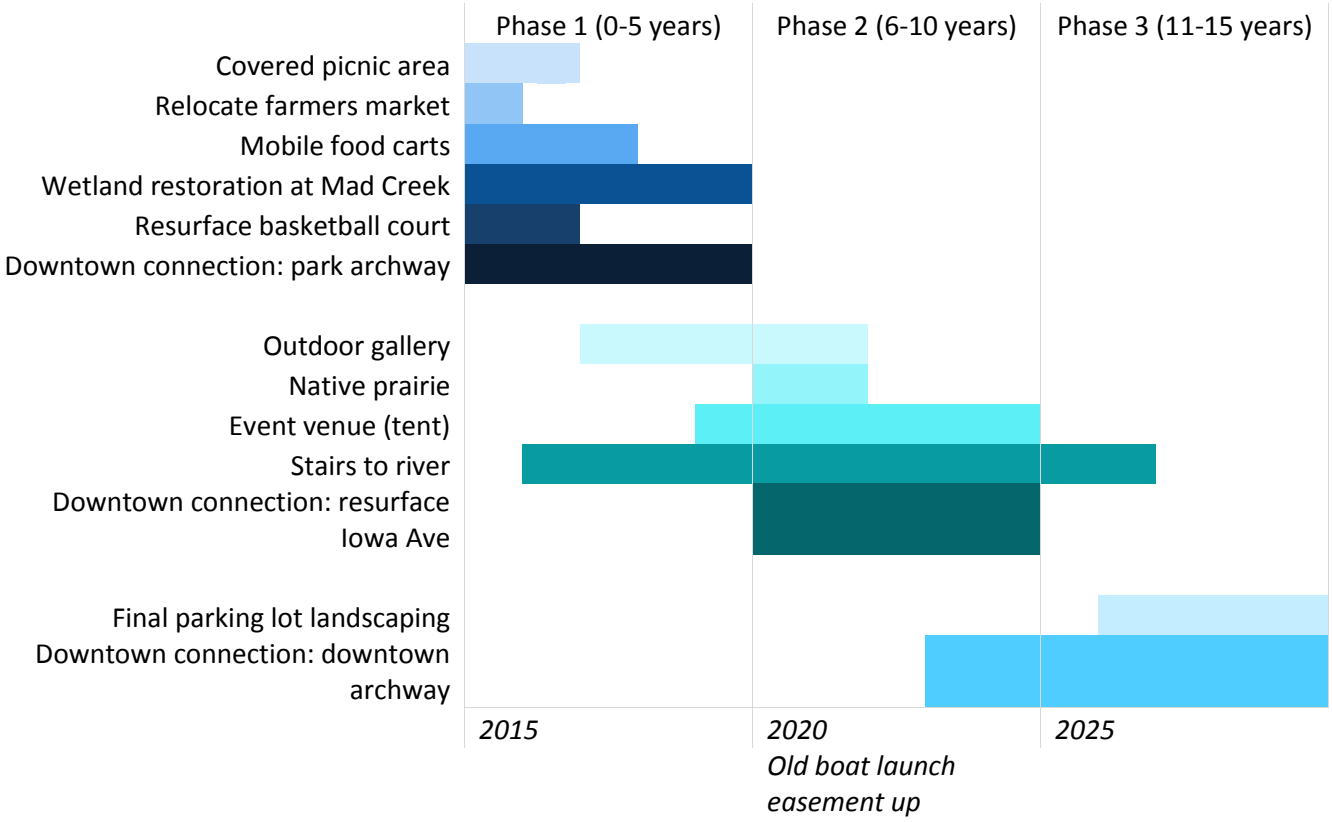

Table 5. Proposed phasing of recommended riverfront improvement projects over the next 15 years.

Monitoring & Performance Measurement

Performance indicators include the usage of the park and changes of downtown overtime.

Park Usage

After the full implementation of each phase, the observation of monthly and seasonal park usage will be helpful to answer whether the improvements of Riverside Park attract more events and people. The future field observation needs to include different times of a day, different days of the week, and different seasons of the year.

Simply counting the number of people using different facilities can yield quantitative data describing general usage of the park. Other formats might include interviewing or surveying

park users. Interviews can provide more detailed information about demographic characteristics, number of visitors from outside of the region or local residents, and other qualitative information about people's satisfaction of the park. Generally, visitors from outside of the region are expected to generate a larger economic impact in the local area.

Events held in the park serve as another performance indicator. Staff should keep track of the number and kind of events that take place in the park. For example, date, place (which facility of the park), the name of the event, the name of the holder, and number of participation.

Parking is also an important component of the park. Through observation and counting the number of cars parked in the park, the plan obtained the percentage of parking usage which indicates potential adjustment from the relation between parking supply and demand.

Staff in Muscatine's Community Development Department can compare future results to the data gathered from our group's field observation to analyze the performance and improvement of the park in the future. Sample data sheets that could be used to collect such data can be found in Appendices D and E.

Changes in the Downtown Area

To measure the full impact of park improvements, the plan also looked at changes manifested in the surrounding area over time. If park improvements are significant enough to encourage increased usage of the riverfront area, increased property values, sales tax revenues, and changes in land use patterns could represent the tangible economic benefits of such improvements. The indicators might include property value, land use pattern, and sales tax revenue of the city.

The property value in the downtown area adjacent to the park might increase due to the increased amenity value of the Mississippi River and Riverside Park. Property value data can be obtained from the American Community Survey Five-Year Estimate and from local government.

Municipal sales tax revenue may increase with more visitors coming to enjoy Riverside Park. People outside of the region and local residents tend to engage in more activities in the downtown area because of the better connection between the park and downtown area. Restaurants, retail, and accommodation services are likely to benefit from the improvement of the park and an increased number of public events.

CONCLUSION

Over the course of the 2013-2014 academic year, our team has learned and accomplished a great deal toward improving Muscatine's riverfront. The two biggest lessons learned are that Muscatine's residents wish to see the area change into a more unified space and that there are many opportunities for Muscatine to concentrate more activities at the riverfront.

Many considerations went into the final recommendation. The scoring criteria showed that this theme was the most economical to maintain and implement in addition to being compatible with the site constraints. Our research showed that the Working Ecosystem theme also has the most grant funding opportunities. Selecting features that are likely to yield a high level of public support ensures the success of implementation, which will rely at least in part on private fundraising.

Moving forward, Muscatine should use the implementation strategies outlined in our report to ensure smooth and efficient implementation. Muscatine should also continue to monitor and evaluate the effectiveness of the proposed improvements through field observations and public opinion surveys. The riverfront area is an important gateway and recreation space for Muscatine, and now has the opportunity to become a more connected and aesthetically pleasing area to draw future residents and tourists.

APPENDIX A – 11 Step Public Art Planning Guide

Source: St. Louis Regional Arts Commission, *Public Art Practices: A Reference Guide for Developing Public Art Programs and Projects*, 2007 (10-14). http://www.art-stl.com/assets/pdfs/PublicArtGuide.PDF

11 Step Process

AN ELEVEN STEP PUBLIC ART PLANNING OUTLINE

How to Develop and Implement a Public Art Project*

Below is an elementary outline of important steps for planning a public art project. Although this outline is structured in chronological order, it might be necessary to duplicate some steps, change their order or add steps according to your needs.

Two key elements that are crucial to the public art process: Patience and Inclusion

Patience: *It is important to decide whether or not a public art project is the best solution for the situation. Public art is not a "quick fix" process. Time and energy must be spent to develop the concept, select the artist/s, and include the community.*

Inclusion: *NIMBY stands for Not In My Back Yard! While most public art projects begin with good intentions, many fail because they aren't appropriate for the community where they are installed or they are thrust on the community without warning. Insensitivity to the opinions of a community can condemn a project before it begins.*

1. **Create a Planning Committee**
   A planning committee representing the community is an essential element of successful public art projects. The planning committee should be representative of the community where the art will be installed. Factors to consider include age, cultural background, ethnicity, gender and profession. Potential committee members might include an artist, elected city official, school administrator, teacher, local newspaper staff, a leader from the religious community, business leader, bank official, students, community members, and an official from an anchor business in the community.

   Once the committee has been organized, a chair or co-chairs should be appointed. Next, determine the goals of the committee and a timetable for reaching the goals. It often helps to determine the deadline and work backwards to set intermediate goals. Structure your meeting schedule to meet the goals. Periodically check on group members' continued support of the project goals. Also, the committee should devote time to educate members about contemporary public art possibilities.

2. **Collect Visual Images and Educate the Committee**
   Compile examples of appealing historical and contemporary public art images. This may include slides, photos, brochures, magazines or images from personal travels. Have people knowledgeable in the field of public art conduct slide presentations for those interested. Use these images and presentations to generate concept and budget discussions in committee meetings and to assist in building group consensus.

   In addition, there are National, State and City public art programs across the Nation. Many offer colorful brochures or web pages that describe their programs. With a phone call, you can begin to familiarize the committee to public art projects from across the country.

3. **Determine the Budget**
Use the information gained from your concept research and initial inquiries to create a budget. Consider donations, volunteer and in-kind resources. To start a fundraising plan, use your knowledge of community members and organizations to create a list of people who have a known interest or possible interest in a public art project. Determine who might be the lead donor(s) and how much that person or organization might contribute. Create a "contributors chart" working down from the amount of the lead donors until it meets a major portion of the projected budget.

Budget Items to consider for a public art project:

- Architect/Engineer Expenses
- Artist's Fee (20%)
- Crating/Transportation
- Equipment Rental
- Fabrication Costs
- Hired Labor
- Installation Costs
- Insurance
- Legal Expenses
- Materials
- Miscellaneous Costs
- Photography
- Research Costs
- Specialized Services/ Subcontractors – electrician, plumbing, etc.
- Storage
- Studio Rent
- Travel/Mileage
- Utilities
- Maintenance
- Special Costs – installation, etc.

The Regional Arts Commission can assist you with budget development.
Contact Roseann Weiss at 314-863-5811 or roseann@stlrac.org for more information.

4. **Establish a Time Line**
Activities to consider when creating a time line are:

- Community Education
- Concept Development
- Creation of the Budget
- Fundraising
- Marketing Plan
- Artist Selection
- Contracts, Insurance
- Creation of Work
- Installation of Work
- Dedication

5. **Determine a Concept for Art Work**
Identify and discuss works of art and concepts that interest the committee. If appropriate, the artist selected can be included as part of the design team for a new building or site. In this case, the design team can work with the committee to develop the concept for art work.

6. **Conduct a Search for an Artist (or Artist Team)**
Determine if artist selection will be by invitation, local search, statewide search, regional search, national search or international search. (Remember that travel costs and a per diem for each artist will come out of the budget.) If artist selection is to be by search, rather than invitation, create a "Request for Proposal" (RFP) and distribute.

Contact *the Regional Arts Commission for information on developing an RFP and how to find mailing lists and periodicals where the RFP can be posted.*

7. **Negotiate a Contract With the Artist**
   The contract should include a timeline, copyright agreements, considerations for additional costs, insurance responsibilities and the individual responsibilities of each party involved. Public art projects often have very unique requirements, it is wise to research and gain insight from a number of people to avoid complications.

PLEASE NOTE: Important items for consideration:

- **Insurance** (Is the work insured before, during and after installation? If the artist and/or assistants are working on site, are they covered? If a child climbs on the sculpture and falls during or after installation, who is liable?)
- **Ownership of the work** – i.e. copyrights, moral rights, image ownership, resale royalties, credits, liability, etc.? (See attached article by Laura Danielson, Page 13)

8. **Develop a Maintenance/Conservation Program**
   This tends to be the most overlooked aspect of a public art project. Awareness of the maintenance requirements of a work is vital and the costs should be included in the budget. Personnel should be trained about the appropriate maintenance for each work. Most maintenance, if done regularly, is simple and inexpensive. Neglect is costly.

9. **Creation/Fabrication of the Work**
   After the artist (or artist team) has been selected and explored ideas with the committee, they can begin developing the work. It's a good idea to schedule several dates with the artist for presentations and/or studio visits with members of the committee. This allows everyone involved a chance to gain insight about the artist's concept and methods.

   Ideally, at the end of the creation/development process, the selected artist (or artist team) should be invited to present drawings, a written description, a final budget and a model (also known as a "maquette") of their work to the committee. If the committee approves the proposed work and the budget, then a meeting with community members to announce the project is recommended. If the committee doesn't approve the proposed work and/or the budget, then the artist should solicit new ideas and criticisms and work with the committee to decide what changes are appropriate. **It is important for the committee to remember that the artist has been selected for their artistic and professional skills; they should be given as much creative control of the project as possible.**

10. **Installation of the Work**
    After the work has been approved, installation can begin. Depending on the size of a project, installation work may include the artist, the artist and assistant/s, or other contractors.

11. Dedication of the Work

The new artwork is installed! Now it's time to celebrate, thank the people involved, alert the press and dedicate the work!

*Much of the information for this outline is borrowed, with permission, from The Arkansas Arts Council's Public Art Grant Program Planning Manual, by Sally Williams, Director of Public Art.

APPENDIX B – Native Prairie Landscaping

Source: Iowa State University Extension, *Sustainable Urban Landscapes: Introduction to Iowa Native Prairie Plants*, 2008 (1-8). https://store.extension.iastate.edu/Product/sul18-pdf.

Sustainable Urban Landscapes

Introduction to Iowa Native Prairie Plants

The Iowa tallgrass prairie developed over the past 9,000 to 10,000 years, after the retreat of the last glaciers. The ecosystem that developed as a prairie consisted of communities of grasses, forbs, insects, and other animals. Prairie communities vary depending on the environment. Plants and animals in these communities adapted and evolved to survive a range of conditions from hot and dry to moist and boggy.

IOWA STATE UNIVERSITY
University Extension

SUL 18 Revised August 2008

TRAER, TAMA COUNTY, IOWA

Introduction to Iowa Native Prairie Plants

This publication focuses on the native plants that inhabit prairie communities. "Native plants" are plants that were growing naturally in a particular area before human settlement. Although many native plants are "prairie plants," the focus herein is on growing individual species or combinations of species in a garden or large planting, rather than on prairie construction or restoration.

Prairies are complex ecosystems that blend the topography and soils of an area with plant and animal communities that can live together in a stable relationship. The process can be complex and requires time and patience. Also, it is difficult to develop a prairie ecosystem on a space less than about a quarter acre.

Most people, however, choose to create a natural-looking garden or planting that serves many of the same functions as a prairie, namely, beauty, weed management, wildlife habitat, and the reduction of soil erosion and runoff. When planning a garden of native plants, it is a good idea to visit other gardens that have native plantings or to visit public gardens to see the size, form, and spread of the plants you would like to grow. Local prairie enthusiasts or conservationists organize prairie walks that can be a source of specific information about prairies. A visit to a prairie enables you to see different plants in their natural setting.

There are many advantages to growing native plants:

- Native plants are well adapted to local conditions. They are vigorous and hardy, so they can survive winter cold, and summer heat, drought and windy conditions.

- Once established, they require little or no irrigation. No fertilization is needed.

- They are resistant or tolerant to most insect pests and diseases.

- A blend of native species provides season-long color and interest.

- Native species are members of a plant and animal community that balances itself when there is a diverse assemblage of species. This natural balance keeps native plants from becoming invasive.

- They attract butterflies by serving as host plants for caterpillars and nectar plants for butterflies.

- Growing native plants is a fun learning process. Each season brings some answers and more questions.

A partial guide for native plants that may be suitable for your landscape can be found on pages 3–6. Note the column listing plant height. Some of the tall natives are not suitable for small spaces without staking individual plants.

TRAER, TAMA COUNTY, IOWA

An established urban reconstructed prairie

Iowa Native Prairie Plants—Pictorial Guide

Rattlesnake master
Eryngium yuccafolium

Spiderwort
Tradescantia ohioensis

Purple prairie clover
Dalea purpurea

Butterfly milkweed
Asclepias tuberosa

Swamp milkweed
Asclepias incarnata

Purple coneflower
Echinacea purpurea

Coreopsis
Coreopsis palmata

Partridge pea
Chamaecrista fasciculata

Great blue lobelia and goldenrod
Lobelia syphilitica, Solidago sp.

Iowa Native Prairie Plants

Grasses

Common/Latin Name	Soil Moisture Conditions*	Mature Height	Flower Period	Comments
Big bluestem *Andropogon gerardi*	M	5–7′	Aug.–Sept.	Sometimes known as “turkey foot” by the pioneers. Dominant plant of the eastern tallgrass prairie. Warm-season grass.
Indiangrass *Sorghastrum nutans*	M	3–6′	Aug.–Sept.	The plant forms an attractive mounded clump; excellent specimen plant in perennial gardens; warm-season grass.
Switchgrass *Panicum virgatum*	M	3–6′	July–Aug.	Bright yellow to tan fall color; seed heads are wispy sprays; warm-season grass.
Little bluestem *Schizachyrium scoparium*	DM	2–3′	Aug.–Sept.	Red-brown and russet fall color; specimen plant in perennial gardens; warm-season grass.
Canada wildrye *Elymus canadensis*	M	2–3′	May–June	Distinctive wheat-looking seed head that provides texture to mixed plantings; cool-season grass.
Sideoats grama *Bouteloua curtipendula*	M	8–18′	Apr.–June	Establishes quickly from seed; cool-season grass.
Prairie dropseed *Sporobolus heterolepis*	M/DM	2–3′	August	Beautiful grass for variation in texture and form; warm-season grass.

Forbs

Butterfly milkweed *Asclepias tuberosa*	M	2–3′	June–Aug.	Orange to yellow flowers; attracts many butterflies; host plant for monarch butterflies.
Swamp milkweed *Asclepias incarnata*	W	3–5′	June–Aug.	Pale pink to rose colored; smaller and more compact than common milkweed; host plant for monarch butterflies.
Partridge pea *Chamaecrista fasciculata*	M	1–2′	July–Aug.	A showy, annual legume that has bright yellow flowers and dark green foliage.
Cardinal flower *Lobelia cardinalis*	W	2–3′	Aug.–Sept.	Spike of red flowers; requires wet sites; does best along stream edges.
Great blue lobelia *Lobelia syphilitica*	WM/W	2–3′	Aug.–Sept.	Medium blue flowers. More common in natural Iowa habitats than cardinal flower.
New England aster *Aster novae-angliae*	M	2–4′	Sept.–Oct.	Purple or pink. Makes attractive cut flower in the fall; attracts butterflies and moths.
Plains tickseed *Coreopsis tinctoria* Prairie coreopsis *Coreopsis palmata*	DM	1–3′	May–Aug.	Yellow flowers. After flowering, the disc turns brown and produces seeds that resemble ticks, hence its common name. Tickseed is a good nectar source for bees and a valuable plant in the prairie biome.
Pale purple coneflower *Echinacea pallida*	M	2–3′	June–July	Long-lived perennial; resembles daisies with backward, curving pink-purple ray flowers; the flower center contains a prickly raised dome.
Purple coneflower *Echinacea purpurea*	M	2–3′	July–Aug.	A native to far southeast Iowa; grown extensively in home gardens.
Bottle gentian *Gentiana andrewsii*	M	1–2′	Aug.–Oct.	The common name notes that its flowers stay closed when it is blooming. Flowers are vibrant indigo-purple.
Prairie smoke *Geum trifolium*	M/D	1–2′	May–June	Delicate reddish-pink blooms in spring give way to fluffy seed heads that look like puffs of smoke in summer. Native to extreme northeast Iowa.

False sunflower or Oxeye *Heliopsis helianthoides*	M/WM	3–5′	July–Sept.	Smaller than most sunflowers; perennial; has interesting opposite-leaved foliage with 1-inch yellow flower heads from midsummer on; can be somewhat aggressive.
Prairie blazing star or Prairie gayfeather *Liatris pycnostachya*	M	1–4′	July–Oct.	The corms served as winter food for early settlers (and rodents). This signature tallgrass prairie plant has gained fame as a lavender cut flower in the florist industry. Pycnostachya means "thick-spiked," referring to the densely packed flower spikes.
Rough blazing star or Rough gayfeather *Liatris aspera*	M/DM	2–3′	July–Oct.	Violet/purple flowers. The flower spikes are larger and more separated along the stem than those of prairie blazing star. It takes longer to establish than its cousin, prairie blazing star.
Leadplant *Amorpha canescens*	DM	1–3′	June–Aug.	Small purple flowers; grayish-white compound foliage on perennial stems.
Shooting star *Dodecatheon meadia*	M/DM	1–2′	May	Will tolerate some shade; native to eastern Iowa. Quite showy in the early season with pale pink to white dramatic flowers.
Golden Alexander *Zizia aurea*	WM/M	1–3′	Apr.–June	Perennial of moist woods, prairie meadows, and thickets; establishes quickly from seed; yellow umbel resembling a more delicate Queen Anne's lace.
Wild bergamot *Monarda fistulosa*	M	1–3′	July–Aug.	Lavender blooms; like all members of the mint family, it has square stems and is pleasantly fragrant.
Gray-headed coneflower or Yellow coneflower *Ratibida pinnata*	M	3–4′	June–Sept.	Yellow flowers. When crushed, the mature head emits an anise fragrance. Easy to establish and showy. Both gray-headed coneflower and black-eyed Susan are great additions to mass plantings because they establish quickly, bloom prominently, and in a few years are replaced by other species as the planting becomes permanent.
Black-eyed Susan *Rudbeckia hirta*	M	1–2′	June–Oct.	Gold flowers. Black-eyed Susan is a great addition to mass plantings because it establishes quickly, blooms prominently, and then in a few years is replaced by other species as the planting becomes permanent. Its life cycle ranges from a sturdy annual to biennial.
Canada goldenrod *Solidago canadensis* and Gray goldenrod *Solidago nemoralis*	M	3–5′	July–Sept.	Common; easy to establish and provides rich golden fall color. Traditionally, and because it is so showy, it is falsely accused of causing human hay fever. (Its pollen is not windborne.)
Stiff goldenrod *Solidago rigida*	M	2–4′	Aug.–Oct.	Yellow flowers. The flowers of this species are in a prominent flat-topped cluster. Before flowering, the plant is erect and subtly attractive, with downy hair on the leaves.
Spiderwort *Tradescantia ohioensis*	M/WM	1–2′	Apr.–July	The plant's form and rich violet flowers are a hidden treat in the prairie planting.
Compass plant *Silphium laciniatum*	M	4–10′	Aug.–Sept.	Yellow, daisy-like flowers; one of the signature plants of the Iowa prairie. Early travelers used the plant's habit of orienting its deeply divided, side-turned leaves due north and south, making it a natural compass.
Purple prairie clover *Dalea purpurea*	M	1–2′	June–Aug.	1–3″ terminal spikes of rose- to magenta-colored flowers that open from the top down. It establishes easily from seed, and will often flower the same season it is planted. Good addition for most urban and non-urban settings.
White prairie clover *Dalea candida*	M/DM	1–3′	June–Aug.	Similar to purple prairie clover, but the white flowers and the divided leaves are larger. It is slower to establish and does not compete very well, especially in wet soil conditions.
Round-headed bushclover *Lespedeza capitata*	M/DM	2–4′	July–Aug.	Common in most Iowa prairies; has silvery green trefoil leaves and clusters of white flowers that turn chocolate brown as they mature.
Wild petunia *Ruellia humilis*	M	8″–1′	June–Aug.	A savannah or woodland-edge plant that has light lavender 1 to 1.5″ flowers on low-growing, dark green plants.
Rattlesnake master *Eryngium yuccafolium*	M/DM	2–4′	July–Aug.	Adds texture and variety to a prairie; yucca-like leaves have soft spiny edges. Years ago it was sometimes considered a remedy for snakebite. (Don't try that at home.)

*W = Wet WM = Wet Mesic M = Mesic DM = Dry Mesic D = Dry

Iowa Native Prairie Plants—Pictorial Guide

Canada wildrye
Elymus canadensis

Little bluestem
Schizachyrium scoparium

Indiangrass
Sorghastrum nutans

Sideoats grama
Bouteloua curtipendula

Prairie blazing star
Liatris pycnostachya

Gray-headed coneflower and wild bergamot
Ratibida pinnata, Monarda fistulosa (pink)

Rough blazing star
Liatris aspera

Cardinal flower
Lobelia cardinalis

Compass plant
Silphium laciniatum

Big bluestem *(Andropogon gerardii)*—MESIC, height 5–7 ft. It begins growth in late spring and flowers in late summer. This tall, deep-rooted perennial was the primary grass of the eastern tallgrass prairie that once covered thousands of acres. The seed head is three-branched, resulting in its common name—"turkey foot."

Wild bergamot *(Monarda fistulosa)*—MESIC, height 1–3 ft. This perennial prairie forb blooms between June and August. Its rosy-lavender-colored flowers are attractive to bees and butterflies.

Many native plants have been selectively bred, or even hybridized so that they meet the needs of people. An example is prairie blazing star, *Liatris pycnostachya.* Varieties of blazing star have been selected from nature for their form, flower color, and durability so they fit both landscape needs of homeowners and cut flower needs of florists.

Planting non-local strains near a prairie remnant or a native reconstruction should be avoided because of the potential for genetic contamination. If you are looking for plants that are native to your particular area, you need to find a commercial seed or plant source that is from local ecotypes. Many suggest using seed sources from within approximately a 50-mile radius of your planting. When ordering or purchasing seed, check with an expert regarding the optimum seeding rate.

Note: So called "wildflower" mixes may contain few native wildflower seeds and may contain many plants native to the United States but not to Iowa.

Local Ecotypes

Plants of the same species will vary considerably, depending on their geographic origin. Just as people have different traits that give them different attributes such as height, hair color, and facial shape, each plant species has a range of genetic variability.

For more information

Check these additional titles in the series on prairies and native plants at www.extension.iastate.edu/store.

Prairies and Native Plantings as Outdoor Classrooms, SUL 19

References and Resources for Prairies and Native Plantings, SUL 20

Grasses versus Forbs

Grasses typically have long leaves with parallel veins and can be useful in adding dimension to a planting. Several of the tall grasses wave gently in the wind, and they can provide a dash of subtle fall and winter color. Grasses do have flowers, which are generally greenish, yet some have interesting flowering structures that add appeal to the planting. Some grasses, such as Indiangrass, are well suited as stand-alone or clumps of accent plants, whereas others are better suited for filling in group plantings.

Forbs are the broadleaved plants in a prairie and often have showy blooms. Forbs may add color, texture, habitat for wildlife, and even scent to the planting.

The choice between separate plantings and mixed plantings of forbs and grasses is situation-dependent. Gardeners should consider the intended use of the site. Mixed plantings generally require more space and an understanding of the differences in biology of the plants being used.

Funding support for this publication provided by Living Roadway Trust Fund, Iowa Department of Transportation.

Environments for Native Plants

Dry soils are found on well to excessively drained, usually exposed sites. Soils that are thin to bedrock, or are sandy or gravelly and that occur on steep areas are typical. Dry sites are more common on south-facing slopes where it is the warmest and driest during the summer. Characteristics of the plants adapted to these areas include the following:

- Plants often less than 3 feet in height
- Leaves that are adapted to conserve moisture (thick surfaces, wilt throughout the day, or other actions to avoid water loss)

Mesic refers to sites that have good drainage, ample seasonally available water, and deep soils. A good description of mesic is moist, yet well drained. The subsoil (below the dark topsoil) is brightly colored, which indicates good drainage.

Wet sites have seasonally high water tables and often occur low on the landscape. Sedges (grass-like plants with triangular stems in cross section) may be a prominent group of species in wet sites, and the topsoil is either coal black to several feet in depth, or the subsoil is noticeably dull gray colored, or both.

ISU FEEL RECONSTRUCTED PRAIRIE, BOONE COUNTY, IOWA

Pale Purple Coneflower *(Echinacea pallida)*—MESIC, height 2–3 ft. Flowers bloom in June and July. These long-lived perennials resemble daisies, but with backward-curving pink-purple ray flowers; the flower center contains a prickly raised dome.

Introduction to Iowa Native Prairie Plants was originally printed as PM 1956.

Seed and plant collection ethics

Existing populations of native plants need protection. Some human-assisted seed dispersal (harvested seed) is often acceptable without the existing population being damaged, but some seed needs to remain to renew the native stand. ALWAYS get permission from the managers of a native site before harvesting seed, and limit yourself to taking no more than one-third of the seed crop produced. Taking actual plants to transplant to another area is not acceptable, unless construction or other activities on the site will cause the vegetation to be destroyed. Also, some native plants may not survive transplanting. Look for local information and assistance before you engage in collecting forays.

Prepared by Rich Pope and Linda Naeve, extension specialists, and Joyce Hornstein, former extension specialist, Department of Entomology. Photos by Rich Pope, Joyce Hornstein, Keven Arrowsmith, and Linda Naeve, Iowa State University Extension, and Steve Holland, Iowa Department of Transportation. Edited by Julie Todd, former extension specialist, Department of Entomology, and designed by Donna Halloum, Information Technology Services. Special thanks to content reviewers Dan Rockwell, Dick Faas, Inger Lamb, Jean Eels, and Carl Kurtz.

File: Horticulture 2-10

APPENDIX C – Stormwater Wetland Construction

Source: North Carolina Cooperative Extension, *Urban Waterways: Stormwater Wetland Construction Guidance*, 2010 (1-11).
http://www.bae.ncsu.edu/stormwater/PublicationFiles/WetlandConstruction2010.pdf.

URBAN Waterways

Stormwater Wetland Construction Guidance

Stormwater wetlands perform well in reducing peak flows and pollutant removal when properly designed and constructed. These wetland construction guidelines are based on experience gained at more than 30 sites across North Carolina.

Developers and community planners increasingly use stormwater wetlands to reduce stormwater peak runoff and pollutant loads. Research continues to show that wetlands can remove many contaminants from stormwater. Designs continue to improve, increasing the potential for stormwater wetlands to provide efficient pollutant treatment. In addition, properly designed systems can also provide aesthetic and environmental education amenities to local communities.

Without proper construction planning, equipment, sequencing, and techniques, however, even a properly designed stormwater wetland is likely to fall short of providing maximum benefits and being embraced by a community. Mistakes during construction can also be costly.

Since the mid-1990s, N.C. State University researchers and Cooperative Extension teams have installed more than 30 stormwater wetlands. From this experience, we have developed techniques that can help guide wetland planning and construction. A properly managed construction project is critical to ensuring that the wetland will develop properly and maximize environmental benefits. In fact, the construction process may be more important to wetland development than the site design details. Unlike some other commonly engineered projects,

Stormwater wetlands are thriving ecosystems.

stormwater wetlands are both physical and biological systems. Envisioning wetlands in this way will help designers and construction managers make informed decisions and build effective projects. Creating stormwater wetlands as thriving ecosystems will translate into improved downstream water quality for streams, rivers, and estuaries.

This fact sheet is a companion to *Stormwater Wetland Design Update* (Extension publication AGW-588-12). It was created to provide *general* guidance in the aspects of construction that should be considered for stormwater wetland projects because designs for these sys-

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tems often vary considerably. Specifically, we will focus on the importance of construction:

- Planning
- Oversight
- Sequencing
- Practices — including site layout, inlet and outlet installation, excavation techniques, erosion control and bank stability, and wetland planting and establishment

CONSTRUCTION PLANNING

Proper planning will help to get your stormwater wetland construction project off to a smooth start. Apply early for local permits (such as erosion control permits) that may be required to prevent delays in beginning construction. When scheduling construction, keep in mind that the success of any wetland construction will be measured by the establishment and growth of the vegetative community. Think of wetland construction as building a large garden, and coordinate construction with planting in mind. Therefore, take the time during the design phase to set a target construction completion date that will maximize plant growth at the site during the first growing season. Planting early in the growing season will help to protect the new wetland plants from periods of extreme heat and drought, and allow for a full season of growth. For small wetland sites (less than 1 acre), mid-spring to early summer is the ideal time for completing construction and planting. Larger sites that may require longer timetables or a phased planting approach should be planned with greater consideration. In North Carolina, construction during the early fall can be an advantage in coastal areas with shallow water tables. Winter construction can be managed for more complex sites where extra time may be needed to complete earthwork or outlet construction, or both.

Outline the specifics of construction in a guidance document for the project that includes design plans, construction guidelines, existing infrastructure, required construction materials, equipment required, and task sequences. Providing this document to potential contractors and construction staff, coupled with a site meeting to discuss the details of the project, can be very beneficial. This helps to ensure that all partners understand the importance of required tasks, techniques, and sequencing to project success and cost-effectiveness. Meeting on site also gives both the designer or project manager and the contractors the opportunity to ask questions and exchange ideas about the logistical challenges of the proposed stormwater wetland site. Explain carefully that you are not building a typical engineered pond. Making it clear that your intentions are focused on creating a garden-like

Figure 1. Meeting with contractors and stakeholders before construction will help stormwater wetland projects begin smoothly, saving time and money.

condition will help influence the perspective of potential contractors. Open and thorough communication on site goals will help to smooth construction of the stormwater wetland and set the standard for a successful project.

Make sure that all construction materials (i.e., silt fencing, erosion control fabric, seeds, plants, and outlet structures) are delivered on-site with adequate time for

ESTIMATING THE NUMBER OF WETLAND PLANTS

The number of plants needed for a project can be easily estimated based on the wetland's surface area and the required spacing that your budget will allow. Numerous plant spacing calculators are available via the Internet. Most use a simple calculation based on the following relationship:

Number of plants = Planting area (ft^2) ÷ (Plant spacing (ft))^2

You can use the following formulas derived from this relationship to calculate the number of plants required:

12-inch spacing:
No. plants = sq ft of wetland area
No. plants = 43,560 × acres of wetland

24-inch spacing:
No. plants = 0.25 × sq ft of wetland area
No. plants = 10,890 × acres of wetland

36-inch spacing:
No. plants = 0.11 × sq ft of wetland area
No. plants = 4,841 × acres of wetland

Planting on 12-inch centers will ensure widespread vegetative coverage within 1 year; 24- and 36-inch centers tend to be adequate for coverage in 2 and 3 years, respectively.

At least 6 months before construction, notify any local nursery or nurseries that will provide plants of the varieties and numbers you will need for your project to make sure the plants will be available (particularly if your project is sizable).

inspection prior to installation. Costly delays can occur if unsuitable materials need to be replaced. Also consider how material excavated during construction will be handled—will it be kept on-site or transported off-site?

CONSTRUCTION OVERSIGHT

The most detailed construction document cannot replace on-site guidance by the stormwater wetland designer or project manager. Constructing a stormwater wetland is a relatively new practice compared to constructing a stormwater detention pond. A stormwater wetland includes plants and zones with multiple elevations, which make wetlands more complex biological treatment systems than detention ponds. What may be viewed as a minor construction mistake in a detention pond could have severe consequences in a wetland.

Either the designer and/or project manager must be on-site to work with contractors to ensure that the stormwater wetland is constructed within specified tolerances. For example, the designer and/or project manager should routinely check the elevations of the internal wetland zones to prevent areas in the wetland from being dryer or wetter than designed. A difference of a few inches can make a significant impact on the type of vegetation that will be established. The condition of wetland subsoils must also be checked frequently during excavation to ensure that compaction matches the design: not overly compacted if the design calls for the wetland to partially infiltrate, or properly compacted if low infiltration is desired. Additionally, contractors and equipment operators often develop ideas during construction that can save the project time.

Figure 2. Get to know your contractors, and listen to their suggestions. Doing so will be beneficial to your project.

Having the designer and/or project manager on-site can facilitate these discussions and implementation of any changes that are beneficial to the project's timetable and success.

CONSTRUCTION SEQUENCING

A plan that outlines the most efficient sequence for constructing the stormwater wetland can save both time and money. In general, a wetlands construction sequence involves the following steps:

1. Site layout

This involves staking out the important features of a wetland on the site based on design drawings. More complex wetlands may require site surveying to establish grade stakes, a wetland perimeter, and the location of internal wetland features (such as pools and shallow water). Large wetlands that involve deep excavations may require multiple stakeouts throughout construction. All existing utilities at the site must be identified and marked *before* any construction activities.

Figure 3. Stake out the wetland perimeter, internal wetland features, and locations of structures prior to excavation. Make sure all existing utilities at the site are located and marked.

2. Erosion control measures

In North Carolina, sites that disturb less than 1 acre are not required to have a sediment and erosion control plan. However, site managers are still required to take measures that will prevent soil from leaving the site, such as installing silt fences and rock check dams at appropriate locations. If you are required to follow an erosion and sediment control plan, put the measures in place at the beginning of the project prior to excavation. Erosion control measures may need to be installed in phases, and a detailed installation schedule will be a

part of an erosion control plan. In general, all erosion control measures must be inspected and maintained regularly and after each rainfall.

Figure 4. Installation of a silt fence along a stream bank near a new stormwater wetland construction site

3. Outlet construction

Several outlet designs are recommended in *Stormwater Wetland Design Update* (AG-588-12) that offer flexibility for maintaining water depth in a stormwater wetland. If inflows can be diverted around the proposed wetland during construction, outlets can be installed at any time. If the proposed wetland has been designed to be "in-line" with stormwater flow, outlet structures should be installed before any other major excavation. Establishing the outlet will give the structure more time to stabilize, and contractors will be able to control site drainage if groundwater seepage or rainfall occurs during construction.

4. Excavation and wetland soil preparation

After the site layout has been staked, erosion control measures put in place, and the outlet installed, excavation of the site can commence. Excavation of the stormwater wetland should begin near the outlet and progress towards the proposed inlet(s) (generally from downstream to upstream). Many stormwater wetlands will require preparation of subsurface soils by compaction or soil additions (such as bentonite) to reduce infiltration. In addition, most sites will require at least topsoil addition, while others may require the incorporation of organic matter to improve vegetation growth.

5. Bank stabilization

As excavation of the site progresses, the banks should be stabilized by seeding with fast-germinating grasses native to your location. Installing lightweight erosion control fabric at the end of each day will reduce bank erosion after rainfall events.

Figure 5. Stabilize the banks each day following excavation of a stormwater wetland.

6. Inlet stabilization

After site excavation and stabilization, the areas surrounding the inlet and the forebay should be armored to dissipate the stormwater's energy as it enters the wetland. Energy can be dissipated in several ways. The most popular, effective method is to stabilize the inlet with riprap underlain with geotextile fabric. Some stormwater wetlands may have multiple inlets, so be sure to stabilize all of the inlets appropriately.

7. Final surface preparation

If the wetland surface becomes compacted through unavoidable construction traffic or crusted during extended hot, dry weather, tilling or scarifying the surface prior to planting will encourage plant growth. It is important to avoid compaction of the surface while still maintaining proposed grades, so lightweight equipment will be needed to till or scarify. *Strict oversight of grading in this phase is critical to successful wetland development.*

8. Planting

Wetland plants should be planted at the end of construction (ideally in an appropriate season) in the recommended internal wetland zones. Shrubs for wetland banks also are often planted at this time.

9. Water management

The adjustable outlet should be set to maintain an appropriate water level for early vegetation establishment within the wetland, and to provide a source of water during extended droughts.

Figure 6. The soils for this stormwater wetland are properly prepared for water and wetland plants.

Figure 7. Successful vegetation establishment greatly depends on good topsoil condition, plant spacing, and proper water management.

CONSTRUCTION PRACTICES

Well-established project management practices can be employed to help implement successfully each step in the *Construction Sequencing* section. The following construction techniques are critical and unique to stormwater wetlands.

Installation of outlet structures

The outlet structure controls the rate at which water is released from the stormwater wetland and the depth of water retained in the system between rainfall events. Therefore, outlet installation is critical to the success of a stormwater wetland system. *Stormwater Wetland Design Update* (AGW-588-12) recommends structures that include the following components: (1) Elements of a flashboard riser with tongue-in-groove boards to allow for water level adjustments. (2) A downturned drawdown orifice protected by a trash rack to reduce clogging. (3) A drainage pipe with valve for emergency or maintenance purposes.

In general, the installation of an outlet structure involves standard engineering practices. Designers should be very familiar with sizing structures; stability calculations; antiseep collars; and standards for berms, compaction, and soils. Prefabricated outlet structures will likely need to be installed with heavy equipment, while other structures can be built in-place. Some excavation is generally required to install the structure at the correct grade. Regardless of size, the outlet structure should be installed on a firm base for stability. Depending on site conditions, a concrete footing, compacted clay, or compacted gravel footing underlain with filter fabric can provide structural stability.

The outlet structure performs as intended when installed on the designed grade and leveled to maximize water level control. For example, a flashboard riser-type control structure that is installed too high would prevent

Figure 8. Examples of outlet structures built on-site *(top)* and prefabricated and delivered to the site *(bottom)*

Figure 9. Installation of a large flashboard riser outlet structure

complete drainage of the wetland if needed for maintenance, and one installed too low could experience backwater conditions. An outlet that is not level will lead to preferential flow of water over one side of the structure and reduce the intended accuracy of water level control within the wetland.

The areas and berms surrounding the outlet must be stabilized to prevent erosion and unintended loss of water from the wetlands. Following placement of the outlet structure, soils with low hydraulic conductivity or high clay content should be compacted around the structure to prevent seepage or piping of water around the outlets. Follow engineering standards for soils and mechanical compaction when at all possible. Another option is to pour concrete around the outlet pipes as an antiseep collar. This is an inexpensive way to add security to your outlet pipe installation. All berm areas should be planted immediately to stabilize the surrounding soils near the outlet.

Figure 10. Armoring downstream of the outlet structure will reduce the potential for erosion that could threaten stability.

Downstream of the outlet structure, use riprap to dissipate energy from the stormwater wetland outflow. Riprap will help protect against downstream erosion or back-cuts that might form and threaten the stability of the outlet structure.

Excavation and wetland soil preparation techniques

Techniques employed during excavation of stormwater wetlands can make or break a project from both success and budget standpoints. Problems generally occur when improper equipment is used, excavated soils are handled multiple times, or when the wetland's internal features or banks become too steep or compacted for vegetation establishment. Survey equipment should be available and regularly used during excavation. Laser-level systems are commonly utilized for construction grading

Figure 11. Keep dump trucks moving for off-site transport of soil (top), and keep the excavator operator updated on correct grade to speed construction (bottom).

and can be operated by one person. It is critical to verify that the design elevations for the wetland are being achieved during excavation. Checking the elevation frequently and relaying them to the equipment operator will help keep the wetland on grade. Surveying as the grading progresses will limit traffic in the wetland, and prevent possible damage to other areas from regrading.

Tracked excavators are preferred over rubber-tired vehicles. This is particularly important on wetter sites. Toothed buckets with a hydraulic thumb are preferred attachments because they can help prevent smearing, which causes excessive compaction, and can also be used to scarify or prep the wetland surface and side-slopes. A hydraulic thumb is most advantageous for removing debris and placing structures. Excavators with swiveling buckets can tilt 45 degrees right or left, helping the operator quickly carve out the wetland's internal features and shape side-slopes. On projects where major excavation is required, using multiple dump trucks to move the soil offsite will minimize the time the equipment operator is idle.

Excavation should begin at the outlet end and continue in the upstream direction. Many sites have good topsoil that is excellent for growing wetland plants. Often, however, designed soil cuts for the wetland expose nutrient deficient subsoil. Therefore, during excavation, the good topsoil should be stockpiled. Where topsoil must be added, the subsurface should be graded to accommodate the intended depth of topsoil addition. Once the subsurface elevations have been finalized, the topsoil can then be added or replaced.

To reduce compaction in small wetlands in the coastal plain designed to interact with groundwater, or at sites intended to infiltrate some stormwater, the operator should minimize the number of times machinery travels within the excavated wetland area. Plan excavation strategically so that the equipment's weight does not compact the soils where plants will be added. Deep pools are designed to hold water, so compaction in deep-pool areas supports performance. It is best to complete mass excavation, topsoil stockpiling, carving of wetland features (pools and shallow water areas), and topsoil replacement on the first pass with the excavator on high ground, if possible, to avoid putting equipment into the wetland later to finish these tasks.

Figure 12. If possible, keep the excavator out of the wetland and use the bucket teeth for excavation to keep the wetland soil loose for planting. Remember to stockpile topsoil for replacement!

Several excavation practices help ensure that soils will be suitable for plant establishment. A common technique used in building stormwater ponds is using the excavator bucket to smear and/or compact the soil at the bottom and banks of the pond. Operators ***should not*** use this technique in stormwater wetlands or on wetland banks because the soil may become too compacted for vegetation to establish quickly. The excavator operator should keep the teeth of the bucket down when removing wetland soils or grading banks or internal features – this will keep the soils roughened and loose for improved wetland planting success. See AG-588-17W, *Improving Exfiltration from BMPs,* by Brown and Hunt (2009). The wetland also must be excavated lower than final grade to allow for topsoil replacement. Spread the stockpiled topsoil over the excavated area uniformly, and check the grade. This loose topsoil will settle following rainfall and stormwater inflow, so topsoil elevations 0.1 foot above design grade are acceptable and recommended.

Figure 13. Surveying a properly prepared wetland surface.

Site stabilization

Chances are that during excavation, or soon thereafter, some rainfall will occur. If left unprotected, loose topsoil will erode along the wetland's banks, costing

time and money to repair. Therefore, newly constructed wetland banks should be stabilized at the end of *each* day for best protection against erosion. Smooth by hand-raking, and then seed with a quickly germinating grass or other groundcover appropriate for the local climate and season. Cover the banks with a lightweight erosion control fabric (examples include straw and coconut

Figure 14. Stabilize banks daily with lightweight fabric and seeding to reduce the chance of erosion while the wetland develops.

fibers with biodegradable mesh). This fabric is very inexpensive, easy to install, will allow germination of grass through the fibers, and will degrade quickly.

Wetland banks should be no steeper than a 3H:1V slope. Certain stormwater wetland retrofits require that bank slopes be steeper than recommended to maximize the actual wetland treatment area. For projects with steeper banks, consider tucking the erosion control fabric underneath a berm running along the wetland perimeter, and diverting the runoff into the wetland through a

Figure 15. Two examples of using slope drains for bank stabilization. Surface water generated during larger storms flowing into the wetland is directed into the drains. The drainage reduces erosion that would result from concentrated flow down the banks.

series of adjacent catch basins connected to slope drains. Slope drains can be 4 to 8 inches in diameter and made of corrugated plastic drainpipe. As water is diverted into the catch basins, the water will flow within the plastic slope drains instead of flowing down the steep banks, significantly reducing erosion. As the banks become vegetated, these slope drains may be removed.

Inlet structures

Stormwater wetland designs include a forebay, or large, deep pool near the wetland entrance that slows inflow and allows for sediment deposition. The area surrounding the inlet and the entrance to the forebay should be reinforced with riprap of granite or marl big enough to prevent severe erosion and instability in these areas. Line the target location with a geotextile fabric for additional soil stability before adding the riprap. It is also beneficial to plant vegetation near the inlet, but outside the forebay, at close spacings (i.e., on 12-inch centers)

Figure 16. Use riprap of granite or marl to slow inflow to the wetland and protect the inlet from erosion.

to encourage fast dense growth that will improve soil stability. If the wetland also receives inflow from other secondary sources, such as subsurface drains, slope drains, or surface water swales, make sure these areas are also protected against erosion.

Planting

Stormwater Wetland Design Update (AG-588-12) gives a comprehensive list of plants that researchers have found to be successful in the various stormwater wetland zones. Planting on 24-inch centers is recommended, although coverage in 1 year can be ensured if the wetland is planted on 12-inch centers. Planting on 36-inch centers is not recommended. Skimping on plants will certainly result in a stormwater wetland that will not perform as designed, particularly in the early years. If the budget for your stormwater wetland project allows, planting at higher densities will improve wetland appearance and performance.

Planting of a stormwater wetland can be completed with a local planting contractor or with volunteers. Each choice has pros and cons. Experienced contractors cost more than volunteers, but contractors plant with more efficiency and skill. Volunteers will be less expensive, but are generally less skilled and require more oversight and direction. Using volunteers, however, creates an opportunity for a community event that can raise environmental awareness. Also, the volunteers that help to plant a stormwater wetland may embrace the wetland and take pride in maintaining it through the years.

Ideally, wetland vegetation should be delivered within 24 hours of planting. Depending on the supplier, some plant species may arrive in flats, while others may be delivered as bare-root seedlings. Make sure that the plants remain moist and cool between arrival and planting. If the plants are kept on site for longer than 1 day, they will need to be watered.

The wetland soils should be wet before planting. The water could be supplied from recent rainfall, groundwater seepage, or through irrigation. Water can be held within the wetland if the outlet is adjustable and released just prior to planting. The wetland floor should be slightly muddy or have up to 2 inches of standing

Figure 17. Planting a stormwater wetland can be a community volunteer effort.

water. The zones for each wetland plant species should be identified before the volunteer or professional planters arrive. Mark these areas with flagging or with marking paint. In addition, it helps to physically place the flats or bags into their target planting areas. This will not only help speed planting, but will reduce the potential costly mix-ups that occur when species are planted in incorrect zones.

If volunteer planters are used, advertise to the community several weeks in advance through local

environmental groups, community postings, or local schools. A crew of 10 to 15 volunteer planters can plant a ¼- to ½-acre stormwater wetland over the course of a day with proper oversight and direction. It is a good idea to supply the volunteers with planting tools (shovels, sharp-shooter shovels, dibbles) and disposable work gloves, and have plenty of drinking water on hand. Orient the volunteers to the location and target spacing requirements for the different species of wetland plants. Wetland plants come in a variety of sizes. All plants should be planted with their leaves sticking out of the water. Wetland vegetation should be planted just deep enough to give the plants stability – planting too deep can stress new wetland vegetation in wet conditions. Shallow planting encourages better root growth when the wetland has plenty of water.

Early wetland establishment tips

Once a stormwater wetland has been constructed and planted, it is certainly not time to walk away. The wetland needs to be managed as it is developing. It is particularly vulnerable in its early stages to drought, large storms, and herbivory. Because of these factors, it's a good idea to budget for revegetation or repairs during the project's first year.

Water levels in the wetland should be maintained at 4 to 6 inches during the beginning of the first and second growing seasons because water that is too deep can slow the early plant establishment. Maintain this depth until the plants get taller and more mature and begin to spread across the wetland. Afterwards, normal pool levels within the wetland can be raised slowly until the levels reach the designed depths.

Weather following construction will often dictate plant success and site stability. During periods of below-average rainfall and excessive heat, all of the vegetation needs regular irrigation, so make sure you have a plan to deliver water to the wetland. Water can be pumped to flood the temporary inundation zones from a source outside the wetland, or pumped from deep pools that store some water to a sprinkler system. Make sure that the wetland's banks also receive water regularly, for instance through a temporary sprinkler system using water from in the wetland or an outside source, to help establish the vegetation that will stabilize the banks and prevent erosion.

Sometimes, too much rainfall can be detrimental to a wetland's stability. If heavy rainfall events occur right after a project's completion, even the best erosion control techniques cannot protect against bank erosion from surface water flowing into the wetland. If this happens, the banks may need to be reshaped, reseeded, and matting reapplied. One way to protect against erosion is installing slope drains, as mentioned earlier. Heavy rainfall can also submerge sensitive, young wetland plants. In general, these plants can survive a few days of submergence. However, if continued rainfall is expected or occurs, it may be advisable to lower the water using the emergency valve or by pumping. Early on, think of managing the water level to promote growth just as one would in a home garden.

Figure 18. Keep water levels relatively low during early establishment (top), and be prepared to irrigate through flooding or a sprinkler system during a drought (bottom).

Waterfowl and burrowing animals can damage plants and berms. These problems are extremely site specific. If you suspect or discover wildlife damage, you will have to discourage the animals from entering the area to protect the wetland. For example, wire strung above a wetland will discourage waterfowl from landing in the wetland and damaging the plants. See also Extension publication AGW-588-07, *Maintenance of Stormwater Wetlands and Wet Ponds,* by Hunt

Figure 19. Adding features and topsoil in a large wetland. Side-slopes have already been prepped, and grass is coming up (top). After 1 year, vegetation is successfully established (bottom).

and Lord (2006). If a dense vegetative community is established in the first growing season, plant growth will typically outpace losses from wildlife browsing. In addition, a dense stand or border of tall grasses will help discourage certain waterfowl from making your wetland a permanent home. If you find that wildlife control is necessary, contact your local wildlife control agencies to discuss management of burrowing animals, such as trapping and relocation.

CONCLUSIONS

Stormwater wetlands are important stormwater BMPs that protect water quality. These systems are successful, however, only when properly designed and implemented with care. Proper construction planning saves time and money. Practices discussed and recommended in this factsheet are based on experiences gained through implementing stormwater wetlands with various partners across North Carolina. For a successful stormwater wetland project, it is important to be firm in sticking with the design plan and construction sequencing – short cuts may save time but compromise wetland performance. It is important, however, to consider suggestions from construction contractors, who are usually more familiar with both the potential and the limitations of their equipment and crews, and often have very useful ideas that can also benefit project success.

RESOURCES

Related fact sheets in the Urban Waterways series (AG-588), North Carolina Cooperative Extension Service, N.C. State University:

Hunt, W. F., M. R. Burchell, J. D. Wright, and K. L. Bass. *Stormwater Wetland Design Update* (AGW-588-12). Online: http://www.bae.ncsu.edu/stormwater/PublicationFiles/WetlandDesignUpdate2007.pdf

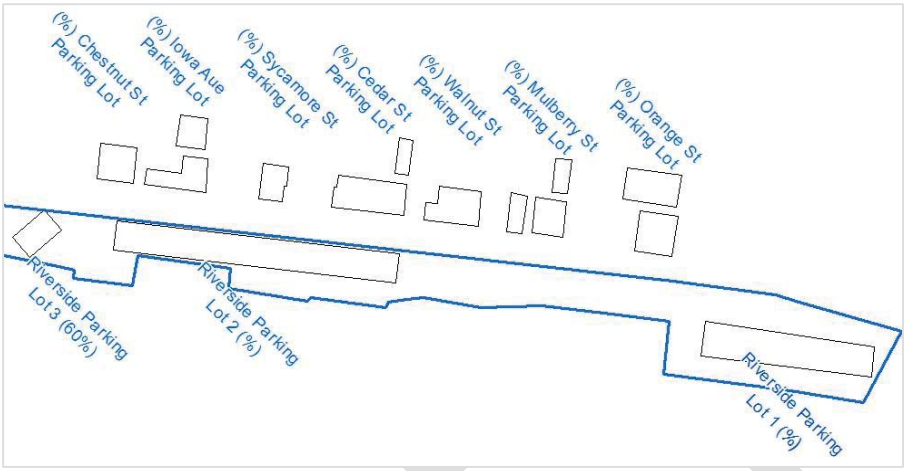
Hunt, W. F. and W.G. Lord. 2006. *Stormwater Wetland and Wet Pond Maintenance* (AGW-588-7). Online: http://www.bae.ncsu.edu/stormwater/PublicationFiles/WetlandMaintenance2006.pdf

Hunt, W. F. and B. A. Doll. 2000. *Designing Stormwater Wetlands for Small Watersheds* (AG-588-2). Online: http://www.bae.ncsu.edu/storm¬water/PublicationFiles/SWwetlands2000.pdf

BAE Stormwater Team website: http://www.bae.ncsu.edu/stormwater N.C. State University's clearinghouse for stormwater BMP guidance, including design, construction, and maintenance of stormwater wetlands, bioretention, permeable pavements, water harvesting, and level spreaders.

Mature plants beautify a stormwater wetland.

APPENDIX D – Parking Observation Template



Date:	PARKING LOT USAGE		
Time:			
Parking Lots	Total Parking Spaces	Spaces Being Used	% Being Used
Riverside Park Parking Lot 1			
Riverside Park Parking Lot 2			
Riverside Park Parking Lot 3			
Cedar			
Chestnut			
Iowa Ave			
Sycamore			
Walnut			
Mulberry			

LICENSE PLATES SURVEY								
	State of Iowa							Other States
	Muscatine	Scott	Cedar	Johnson	Washington	Louisa	Other County	
Riverside Park Parking Lot 1								
Riverside Park Parking Lot 2								
Riverside Park Parking Lot 3								

APPENDIX E – Demographic Information Template

PEOPLE IN RIVERSIDE PARK	*Age groups present*	Children (12 & under)	Youth (13-18)	Middle Age (20-60)	Senior Citizen (60-80)	Total	Comments
	Ethnicities present						
FACILITY USAGE		Children (12 & under)	Youth (13-20)	Middle Age (20-60)	Senior Citizen (60-80)	Total	
	Boat launch (new)						
	Boat launch (old)						
	Splash pad						
	Playground						
	Basketball court						
	Bike trail						
	Walking trail						
	Bench/Picnic table						
	Pearl City Station						
	The Riverview Center						
	Statue						
	Pier						
	Sitting in cars						
	Boats in harbor						