IOWA | Civil and Environmental Engineering

FINAL REPORT

Wetland and Trail Restoration
#09-Spring2022

Iowa CEE
Chuck Smith - Project Manager
Lara Gavin - Technical Coordinator
Grant Hemphill - Report Editor

Table of Contents

Section I – Executive Summary

This report outlines design plans to improve existing trail systems and wetlands/flood prairies for the City of Monticello, IA. The name of the student design team associated with this project is “Iowa CEE”, referred to in this report as “the team”. The team consists of Chuck Smith, Lara Gavin, and Grant Hemphill.

Collectively, the team has prior project experience with State Revolving Fund (SRF) projects, wetland PERMT application writing, stormwater management and treatment design, civil engineering design, and trail design.

The team responded to the City of Monticello’s request for an evaluation, design, and redesign of two sites in Monticello, IA: these sites being a riverside constructed wetland at the corner of Riverside Dr, E 3rd St and N Main St; and a 12-acre flood plain and prairie located behind 199-153 N Main St and bounded by N Main St, E 1st Street, and Kitty Creek.

The riverside site was a constructed wetland first designed about 30 years ago as an Iowa DNR Resource Enhancement and Protection (REAP) stormwater wetland. The site had since deteriorated and required restoration. The 12-acre site, in a floodplain with bottomland forest and prairie, had an existing detention pond which had been influenced by recent construction. This site had a stormwater drain which discharged to Kitty Creek and needed restructuring to allow treatment of some portion of stormwater. Existing paved trail was present around both the riverside wetland and through Baty Disc Golf Course in Willow Park (south of the 12-acre site, bounded by E 1st Street). These trails connected through the 12-acre site in mowed paths maintained by the Monticello Parks and Recreation Department.

The client’s main goals for this project were (1) management of stormwater quality and quantity before release to the Maquoketa River and (2) to connect local parks with a trail system to promote recreational activity in the community. These goals were accomplished through an iterative process of evaluating several alternatives on their capacity to meet standard design recommendations and to satisfy project goals. Trails were designed to meet the objective of connecting the sites with surrounding areas while not interfering with the hydrologic function of the stormwater structures. State standards and commonly accepted design guides (Iowa Storm Water Management Manual, EPA Stormwater Wet Pond and Wetland Management Guidebook) for similar projects were referenced in the design phase.

For both wetland areas, planned dredging of existing detention ponds/wetlands to increase detention volume presented challenges due to the lack of variance in topography of the area. In the 12-acre site, a challenge was connecting the existing trail to the proposed trail system across 1st street to the north. This was challenging due to the need to maintain stormwater drainage through the ditch on the north side. Property rights and easements must be acquired prior to construction planning. Vegetation and wetland structures to treat stormwater runoff should minimize chloride, *E. coli* bacteria, sulfate, and turbidity. These contaminants have been found in samples taken locally in the Maquoketa River.

Final design recommendations for the riverside site include minor improvements to the wetland and the removal and replacement of the trail system. For the wetland, the existing stormwater treatment was determined to be adequate and only requires the concrete conveyance channel to be replaced with a native plant-lined swale for appropriate erosion control and stormwater treatment. For the trails, the existing trail system will need to be removed and replaced with a higher standard trail that is ADA compliant. The request for a river access at this site was evaluated and determined to be infeasible due to the heavy erosive nature at the river's bank.

For the 12-acre site, final design recommendations include completely redesigning the floodplain into a constructed wetland and constructing concrete trails to connect the existing trail to the south to the local business district to the west and eventually north to the riverside site. The existing pond will overflow into a new conveyance channel to the existing storm ditch where it will combine with outflow from storm sewers and into a constructed wetland. Diverting the combined stormwater into a wetland system for treatment will improve stormwater quality, reduce erosion, and increase the aesthetic value of the area. The new trail system will serve as a berm and help to direct pond outflow toward the wetland entrance.

The design period for this project was approximately three months, and the estimated construction period would be done in phases to accommodate funding and seasonal limitations. The team expects construction would complete in about 6 months given permits and funding are approved and acquired. The cost estimate for design services is $28,600 (or $8,580 for the Riverside site and $20,200 for the 12-acre site), and construction cost is estimated to be $415,700. The total cost of the project is estimated to be $444,300.

The project included development of a maintenance plan feasible for the Monticello Parks and Recreation Department to execute long-term with one to three staff members and occasional help from the Public Works Department and volunteers (see Appendix C).

Section II – Organization Qualifications and Experience

i. Name of Organization

The name of the student team associated with this project is “Iowa CEE”, referred to in the following extent of this report as “the team”.

ii. Organization Location and Contact Information

The team is associated with the University of Iowa in Iowa City, IA. The Project Manager of the team is Chuck Smith.

iii. Organization and Design Team Description

The team consists of students from the University of Iowa who are participating in the Civil and Environmental Engineering department’s capstone design class. The team consists of:

Project Manager – Chuck Smith (Civil Engineering, Management). Chuck has 14 years of experience in the military and nuclear power field. He specializes in organizational and leadership skills. As a management focused civil engineering student, he will be getting a minor in business administration and works well with cost estimates.

Technical Coordinator – Lara Gavin (Civil Engineering, Water Resources). Lara has been working as a water resource intern since May of 2021 with HR Green in Cedar Rapids and particularly enjoys working on green infrastructure projects.

Report Editor – Grant Hemphill (Environmental Engineering, Sustainable Water Development). Grant is pursuing an MSE with the Sustainable Water Development program at Iowa. He is involved as an IIHR Lab Research Assistant, and a student operator at the Iowa City Water Treatment Plant.

The faculty advisor for the team is Dr. Tim Mattes. Other course instructors are Paul Hanley, Rick Fosse, and Chris Stoakes.

iv. Description of Experience with Similar Projects

Collectively, the team has prior project experience with State Revolving Fund (SRF) projects, wetland PERMT application writing, stormwater management and treatment design, civil engineering design, trail design. The team also possesses soundly developed leadership, organization, scheduling, and communication skills. Individual resumes for the team members can be found in appendix A.

Section III – Proposed Services

i. Project Scope

As proposed, the team provided the following requested services for each of the two sites: water quantity and quality handling evaluation and design, trail development, and assessment of river access. The two sites named “Riverside Wetland Site” and “12-Acre Site” are located in the northern region of Monticello, IA and generally outlined in Figure 1 below.

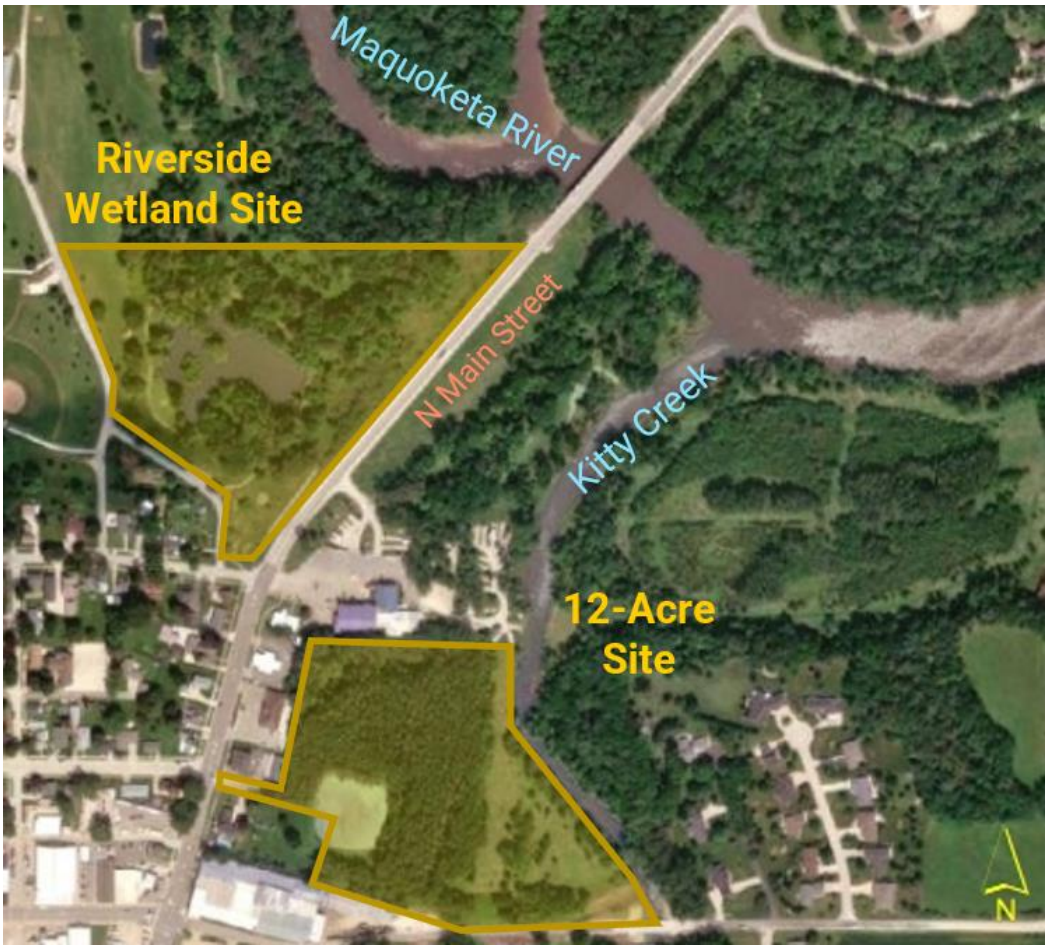


Figure 1 – Overhead view of wetland sites in Monticello, IA.

The riverside site was one of the first funded Iowa DNR REAP projects but has since deteriorated after decades of neglect. The riverside location was initially dug by private property owners and experienced a good deal of new development. Developing solutions at each site required evaluating existing wetland or floodplain function, planning corrective structures, and designing trail connectivity improvements. After inspection, the team found that the bank of the river was too susceptible to erosion to confidently recommend recreational river access. If the client deems this

a necessary inclusion, plans should be made in accordance with Chapter 3 of the Iowa DNR River Programs Manual. The team has delivered a phasing plan in which each design element has a recommended plan and noted alternatives, maintenance guidance, and construction cost estimates.

ii. Work Plan

A. Design

Outlined below, the Gantt chart presents the approach of the team in preparing project design elements. Each list item includes work duration and delivery. Deliverable items include design drawings, design report and associated supplement, maintenance reference handbook (Appendix C), design presentation, and an informational poster. Refer to figure 2 below.

B. Accomplished Design Schedule

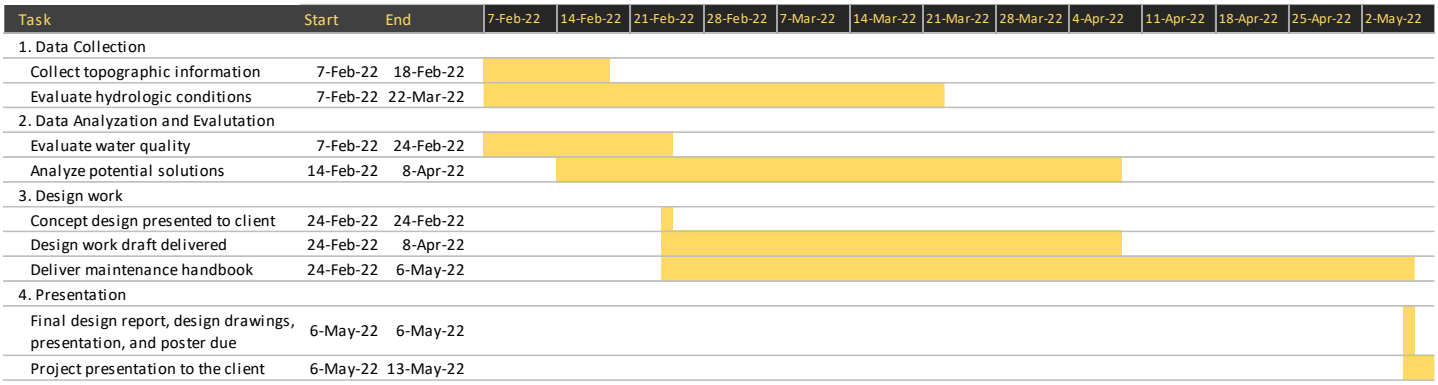


Figure 2 – Gantt chart of accomplished design work.

iii. Methods and Design Guides

Using a model of existing storm sewer provided by the City of Monticello, the team estimated catchment areas to calculate outflows from culverts which outlet into the project areas. Referencing this resource and available LIDAR mapping, total inflows into the wetland systems was estimated using calculations laid out in the Iowa Stormwater Management Manual (ISWMM) Chapter 9. From this, standard constructed wetland designs were evaluated on their ability to retrofit into existing systems while addressing the goals of the project. Design standards and guides for the reconstructed wetlands included section 9.08 of the ISWMM from the Iowa DNR. State Revolving Fund (SRF) preferences were noted during design. A project initiation meeting needs to be held and work record request forms and permits need to be acquired before funding is

granted. Through an iterative process of combining elements of design and fitting them to existing structures, plans were verified by flow analysis calculations and finalized.

Trails were fit to the improved wetland structure plans and designed to connect to existing trail and sidewalk networks. The Iowa DOT Design Manual was referenced for trail design to ensure ADA compliance. Design standards from Chapter 12 - Sidewalks and Bicycle Facilities are met.

Section IV – Constraints, Challenges, and Impacts

i. Constraints

Both sites are located within FEMA National Flood Hazard Areas. A map of the hazard regions is included as Figure 1 in Appendix A. The 12-acre site is adjacent to the regulatory floodway region and trail design will take place within the area as well. The Iowa DNR Permit and Environmental Review Management Tool (PERMT) will be referenced for the design of both sites.

Both site restorations will be confined to land owned or expected to be owned by the City of Monticello as shown in Appendix A. The project should be feasible for the Monticello Parks and Recreation Department to maintain long-term with one to three staff members and occasional help from the Public Works Department and volunteers. No budget constraints were given by the client.

Trails must be designed in compliance with ADA standards and city standards to connect the existing trails at Willow Park – Baty Disc Golf Course and Riverside Gardens.

ii. Challenges

For both wetland areas, the team foresaw a challenge in the regrading and dredging of the existing detention ponds/wetlands to achieve flow toward nearby waterways. This could be difficult due to the topography of the area which will require surveying before construction is commenced.

In the southeastern wetland, the team foresees a challenge in connecting the existing trail to the south to the proposed trail system across 1st street to the north. This may be challenging due to the need to maintain storm water drainage flow in the ditch on the north side.

Overall trail connectivity may encounter routing and access conflicts. Trail routes will require further evaluation to prevent impeding wetland functionality. Property rights and easements must be considered and given proper time allowances to acquire.

The vegetation and wetland structures to treat stormwater runoff should minimize chlorides, *E. coli* bacteria, sulfates, and turbidity. These contaminants have been found in samples taken near the Monticello on the Maquoketa River.

iii. Societal Impact

The wetland restoration and trail redesign will enhance community access to recreation and connectivity. Currently, there is an 18-hole disc golf course south of 1st Street and west of Kitty Creek with a paved trail ending at 1st Street. The northwest wetland has a paved trail around the wetland connecting to the city gardens and baseball fields. The project will design a trail system to connect the disc golf course to the garden trail, while also providing access to the new Hy-Vee Dollar Fresh and downtown sidewalks.

The current wetlands may cultivate mosquitoes, which deter people from walking along the trails. By restoring the wetlands and limiting mosquito habitat, the trails can provide comfortable nature access and enhance city connectivity. Improving access to downtown will support downtown businesses.

Section V – Alternative Solutions Considered

i. Design Area I – Stormwater Management

A. Riverside Wetland

The primary plan for the wetland was to regrade the landscape to improve stormwater conveyance and treatment before entering the Maquoketa River. The most applicable design for the site would be a combination of a shallow marsh and extended detention wetland (see Attachment A for detail). Stormwater could be directed to a sediment forebay to allow for an initial settling, then through a meandering channel and pools where natural filtration and treatment occurs, eventually reaching a permanent pool with an outlet device. Section 9 of the ISWMM illustrates this concept. This design aims to maximize the functionality of the wetland, including minimizing algae and nuisance insect growth. However, after observing the wetland and evaluating the current conditions of the wetland system, the site was determined to function properly and could be improved with only minor adjustments to the wetland. Therefore, to avoid unnecessary costs the pond will not be transformed into a meandering wetland.

B. 12-Acre Site

This site currently has a detention pond which does not function as a wetland. The water in the pond is mainly runoff from the new construction and parking lot above the site. It is stagnant,

allowing algae and mosquito growth. A swale was considered as a stormwater management solution but was determined to be inadequate to handle the volume of flow from the site's drainage area. Routing the stormwater drainage back into the pond was also an option considered. See figure 3 for layout of alternative design.

Figure 3 – Alternative stormwater design considered for 12-acre site.

ii. Design Area II – Trail Design

A. Riverside Wetland

An alternative design considered for this site was to remove the existing paved trail around the riverside wetland only where needed and to connect to the river access trail. Asphalt was also considered as a surface for the path.

B. 12-Acre Site

There are several key components for the trail connection that needed to be assessed, beginning with the trail pathway to connect the existing paved trails. The route could follow existing mowed pathways or be reimagined to compliment the new stormwater detention design. The route should minimize disturbance of the landscape and maximize maintenance access. Connection of the trail to Hy-Vee Dollar Fresh and downtown Monticello are primary parts of the design. The section of

trail connecting to N Main Street between Hy-Vee Dollar Fresh and Wolken Apartments will seek to preserve existing trees if possible.

Secondly, several solutions for the ditch crossing north of E 1st Street were assessed. Both a culvert and a bridge were modeled assuming occasional flooding will occur. Location of the crossing across E 1st Street and along the ditch was also evaluated.

Several materials for the new trail were considered. Concrete is the primary material being considered to match the existing trails. However, cost estimates for asphalt and gravel trails were also performed. Sustainable materials such as recycled concrete subbase and recycled asphalt were also researched and considered. Various subbase methods were assessed for mitigation of trail settlement near marshy wetland.

Figure 4 – Alternative design considered for 12-acre site trail system.

iii. Design Area III – Ecological Resource Management

A. Riverside Wetland

The Riverside wetland is located within bottomland forest and bounded by urban development and turf. This boundary of ecosystems will interact through the wetland, and site assessment show that much of this function has been impaired by neglect and improper management practices.

Because of the potential for high flow events into the system, incorporating native plantings into the structure will contribute to velocity reduction in critical areas. Plantings are also an important aspect of the function of the natural ecosystem. They will affect the nutrient handling, habitat buffering, and aesthetic value of the area. To ensure proper establishment, longevity, and functional health of the living system of the wetland, an informed maintenance plan was developed to encompass optimal care for the timber, brush, prairie, and wetland within the site.

B. 12-Acre Site

Due to the existing detention pond at the 12-Acre site, a reasonable primary design was a pond/wetland system. The wetland system could have been designed as a pocket or gravel-based wetland, given the presence of prairie along the creek-side boundary of the site (see Appendix A, Figure 5 for detail). The meeting of several ecological communities will occur at this site, including riparian forest, grassland/prairie, and wetland. As described above, caution for integrating new plantings into the existing natural community must be taken, and only native species will be considered. Assessment of the site conditions, especially those that are from the new construction of the Hy-Vee Dollar Fresh, is needed to further specify design criteria.

Section VI – Final Design Details

i. Design Area I – Stormwater Management

A. Riverside Wetland

The primary plan for the wetland is to remove the concrete conveyance channel along N Main St and replace it with a grass and marsh swale to slow stormwater flow and improve treatment before entering the Maquoketa River. The swale dimensions are shown in drawing CG301 and wetland design is shown in CG103. The existing pond should be dredged to a maximum depth of about three feet as well. The functionality of the existing wetland was evaluated and determined to be more adequate than preliminary estimates foresaw. For this reason and to minimize the impact on the local ecosystem, preference will be given to minimizing manipulation of the existing wetland. The volume of stormwater is not expected to change due to wetland improvements, but the concentration time will increase. Erosion control measures will be designed for the pond outlet

through a 24-inch diameter concrete culvert pipe. Flow will be directed toward the existing downstream floodplain and prairie, as seen in figure 5 below.

B. 12-Acre Site

Due to the location of the stormwater drainage outlet, the eastern portion of this site will be converted to a wetland to treat the stormwater discharge before entering Kitty Creek. The most applicable design for the site would be a combination of a shallow marsh and extended detention wetland (see Attachment A, Figures 3 and 4 for detail). Stormwater can be directed to a sediment forebay to allow for an initial settling, then through a meandering channel and pool where natural filtration and treatment occurs, eventually reaching a permanent pool with an outlet device. Section 9 of the ISWMM illustrates this concept. This design aims to maximize the functionality of the wetland, including minimizing algae and nuisance insect growth. The trail system will act as a berm and border to direct pond outlet flow toward the existing stormwater drain. A pair of 42-inch diameter concrete culvert pipes will be placed beneath the trail at the inlet to the wetland and at the outlet of the wetland (see figure 5 below).

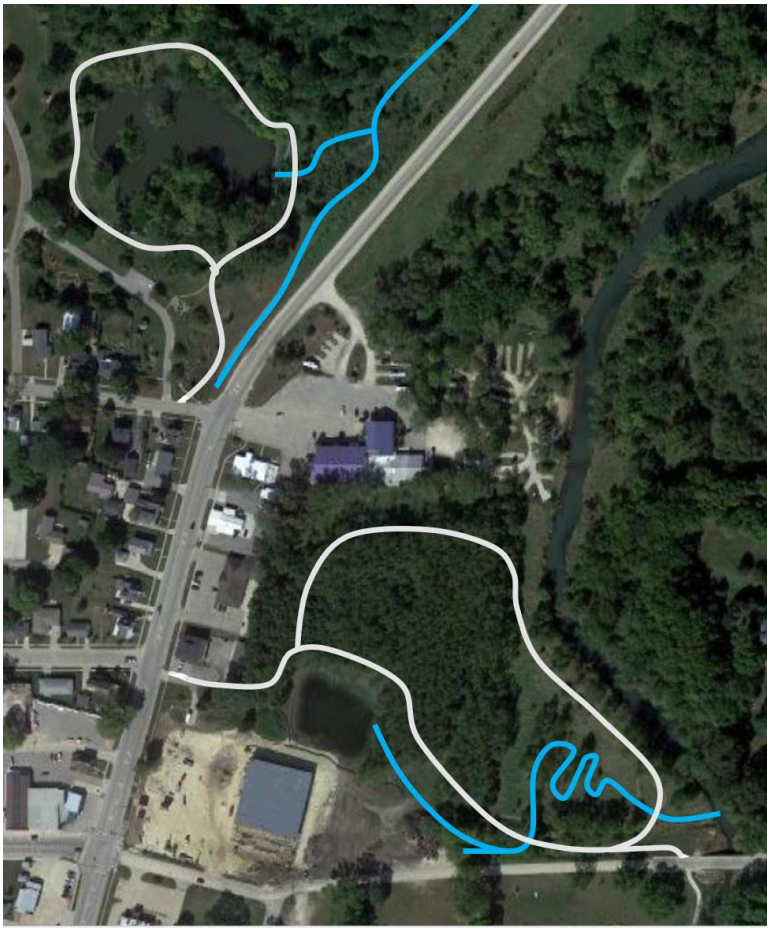


Figure 5 – Finalized trail design for trail system shown in white (stormwater structures in blue).

ii. Design Area II – Trail Design

A. Riverside Wetland

The primary trail design for this site is to remove the existing paved trail and replace it with a new ADA-compliant concrete trail. The new trail will be ten feet wide, and the concrete will be five inches thick with a four-inch-thick subbase of class A crushed stone. The crushed stone will allow moisture to drain instead of pond and adversely affect the concrete. The new trail should last many years and accommodate more pedestrians, including bicyclists. The trail will connect with E 3rd street, therefore minimizing pedestrian traffic on E 3rd St and Riverside Dr.

The current trail has a footbridge on the southeast side of the wetland, which limits access for maintenance vehicles. The new design will provide easy entry for equipment by placing a culvert where the footbridge had been.

The site was evaluated for a river access and determined to be inadequate due to the riverbank was too susceptible to erosion to confidently recommend recreational river access. According to the Iowa DNR boat access design guide, the site would require an enormous amount of rip rap to stabilize the bank and recommended such measures only for small streams. The Maquoketa river is large enough to severely erode any attempt at a boat access in this location. Final design details are shown in drawing sheet C101.

B. 12-Acre Site

There are several key components for the trail connection which were assessed, beginning with the trail pathway to connect the existing paved trails. The route could follow existing mowed pathways or be reimagined to compliment the new stormwater detention design. The route should minimize disturbance of the landscape and maximize maintenance access. Connection of the trail to Hy-Vee Dollar Fresh and downtown Monticello are primary parts of the design. The section of trail connecting to N Main Street between Hy-Vee Dollar Fresh and Wolken Apartments will seek to preserve existing trees if possible.

Secondly, several solutions for the ditch crossing north of E 1st Street was assessed. Both a culvert and a bridge will be modeled assuming occasional flooding will occur. Location of the crossing across E 1st Street and along the ditch was evaluated.

Several materials for the new trail were considered, however, concrete was chosen to match the existing trails. Cost estimates for asphalt and gravel trails were performed, but not used due to

matching and durability purposes. Sustainable materials such as recycled concrete subbase and recycled asphalt were also researched and considered, but crushed stone was ultimately chosen due to its cost, availability, and permeability for drainage, since most of the trail is near a marshy wetland. Final design details are shown in drawing sheet C101.

iii. Design Area III – Ecological Resource Management

A. Riverside Wetland

The major improvement to support this site is the planted swale to receive storm sewer outflows. Incorporating native plantings into this structure increases the resilience of its function, as the species are accustomed to the local climate. Established plantings also provide habitat for many beneficial insects and birds, contributing to the biodiversity of the area.

Because of the potential for high flow events into the system, incorporating native plantings into the structure will contribute to velocity reduction in critical areas. Plantings are also an important aspect of the function of the natural ecosystem. They will affect the nutrient handling, habitat buffering, and aesthetic value of the area. To ensure proper establishment, longevity, and functional health of the living system of the wetland, an informed maintenance plan was developed to encompass optimal care for the timber, brush, prairie, and wetland within the site.

B. 12-Acre Site

Working within the constraints of project area, a meandering wetland was designed to treat a portion of the total combined outflows from the detention pond and storm sewer. Creating an outlet for the detention pond to combine its outflows with the storm sewer will increase water cycling through the site, benefiting the ecological communities present. Reduction of algae, mosquitoes, and anaerobic bacteria is expected from this development. The meeting of several ecological communities will occur at this site, including riparian forest, grassland/prairie, and wetland. As described above, caution for integrating new plantings into the existing natural community must be taken, and only native species are considered.

Section VII – Construction Cost Proposal

Tables 1 and 2 below lay out a cost estimate for the project by task categories for each site phase. The total cost for the project is $444,300. The design services cost breakdown can be found in the Appendix B. This cost estimate is intended as an estimate only and may not reflect final costs of

design services. If the client has any questions or concerns, they may contact the student project manager, Chuck Smith, at the given contact information.

Table 1 – Cost estimate for Riverside site

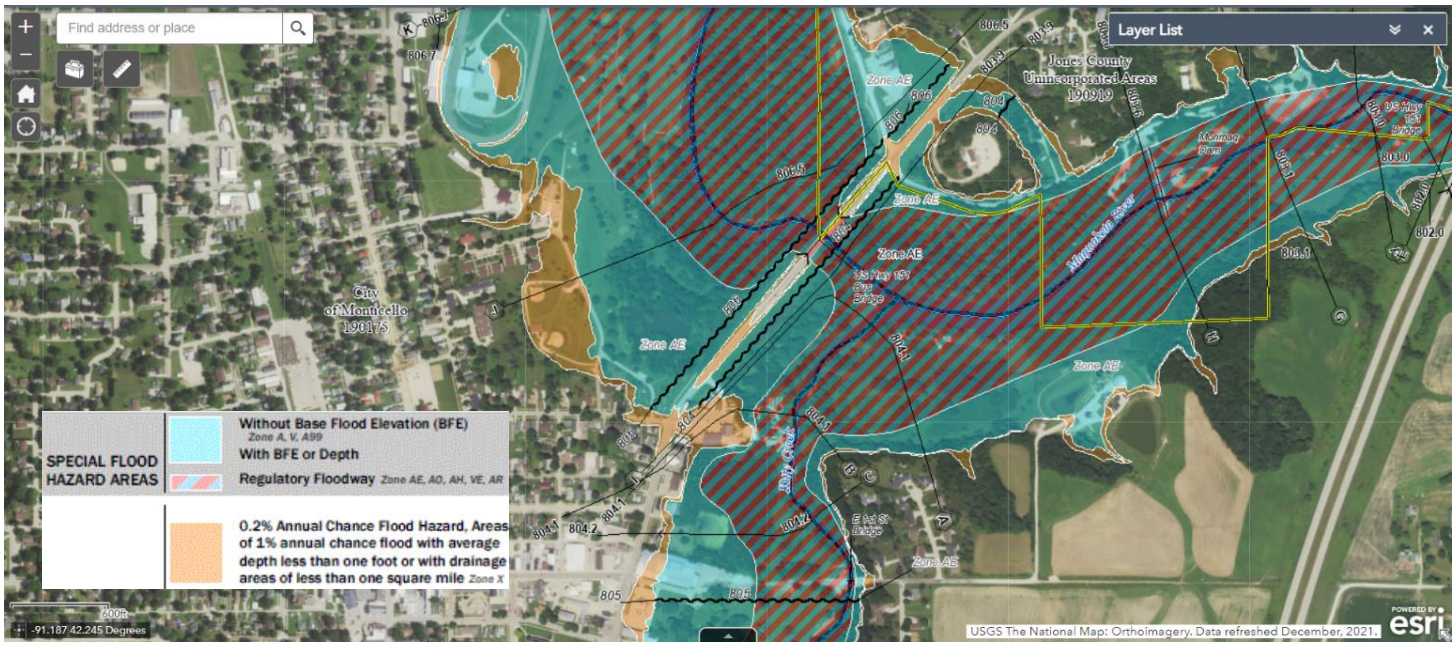
Item Description	Quantity	Unit	Unit Price	Total
RECREATIONAL TRAIL, PORTLAND CEMENT CONCRETE, 5 IN	2292.0	SY	$36.57	$83,818.44
GRANULAR SURFACING ON ROAD, CLASS A CRUSHED STONE	20621.0	SF	$0.43	$8,908.27
CULVERT, CONCRETE ROADWAY PIPE, 24 IN. DIA.	22.0	LF	$96.42	$2,121.24
REMOVAL OF RECREATIONAL TRAIL	1166.7	SY	$12.23	$14,268.33
IA CP2, CP23, CP25 WET CRP MIX (30:10)	2.5	AC	$110.00	$275.00
REMOVAL OF EXISTING P.C OVERLAY	311.1	SY	$20.07	$6,244.00
TOPSOIL, SPREAD	725.0	CY	$11.21	$8,127.25
EXCAVATION, CLASS 13, WASTE	855.1	CY	$24.65	$21,077.39
COMPACTING BACKFILL	944.9	CY	$15.61	$14,749.11
	Construction Sub-Total			$159,589.03
	Design Services Subtotal			$8,580.00
	Contingencies (10%)			$16,816.90
	Total Cost			$184,985.93

Table 2 – Cost estimate for 12-acre site

Item Description	Quantity	Unit	Unit Price	Total
RECREATIONAL TRAIL, PORTLAND CEMENT CONCRETE, 5 IN	3122.0	SY	$36.57	$114,171.54
GRANULAR SURFACING ON ROAD, CLASS A CRUSHED STONE	28097.0	SF	$0.43	$12,137.90
EXCAVATION, CLASS 10, ROADWAY AND BORROW	8258.0	CY	$4.60	$37,986.80
CULVERT, CONCRETE ROADWAY PIPE, 42 IN. DIA.	128.0	LF	$161.83	$20,714.24
IA CP2, CP23, CP25 WET CRP MIX (30:10)	4.0	AC	$110.00	$440.00
EXCAVATION, CLASS 13, WASTE	500.0	CY	$24.65	$12,325.00
TOPSOIL, SPREAD	1600.0	CY	$11.21	$17,936.00
	Construction Sub-Total			$215,711.48
	Design Services Subtotal			$20,020.00
	Contingencies (10%)			$23,573.15
	Total Cost			$259,304.63

Section VIII – Proposal Attachments

i. Attachment A – Reference Images



FEMA's National Flood Hazard Layer (NFHL) for project location

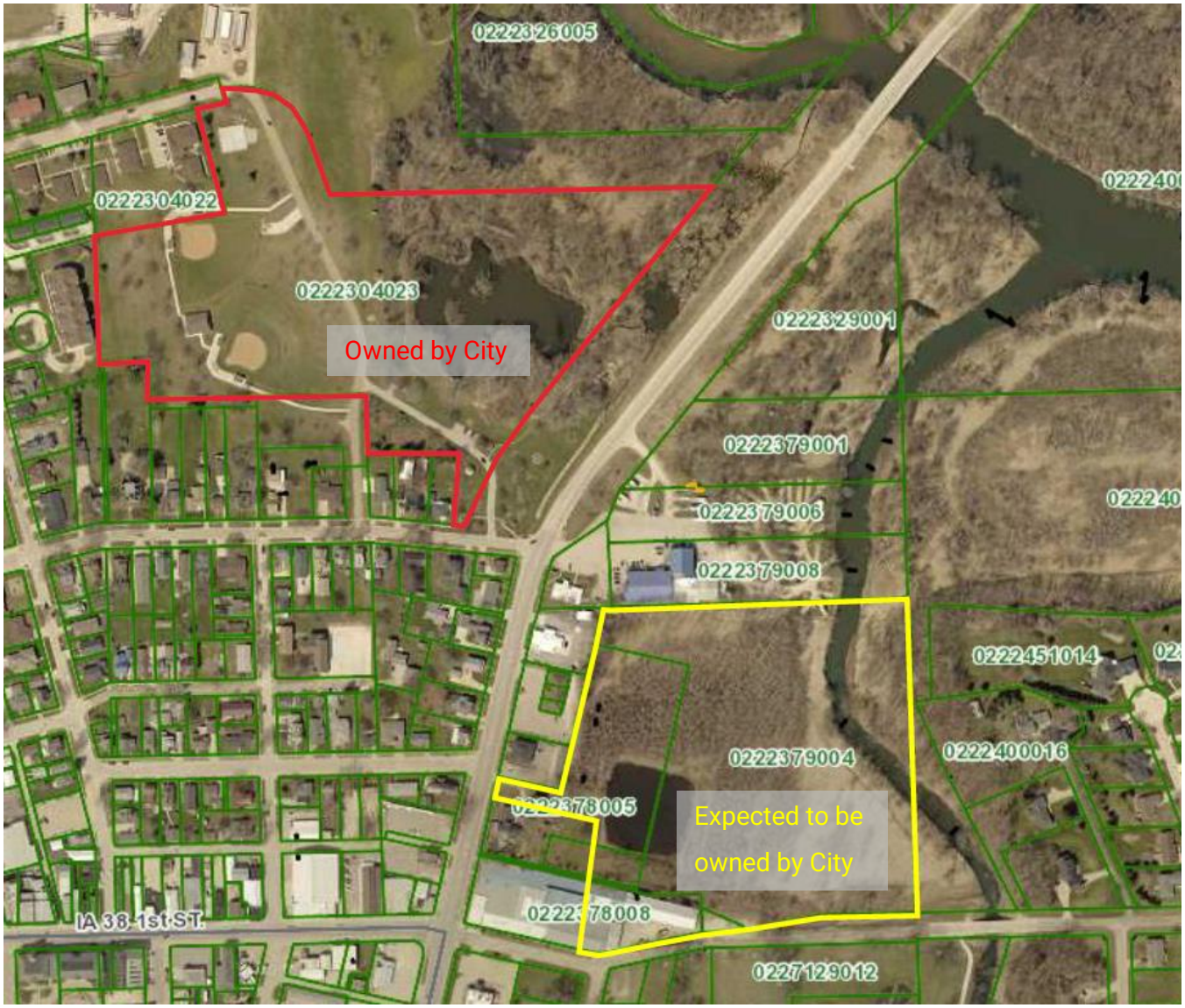


Figure 2. Approximate property boundaries for project limits

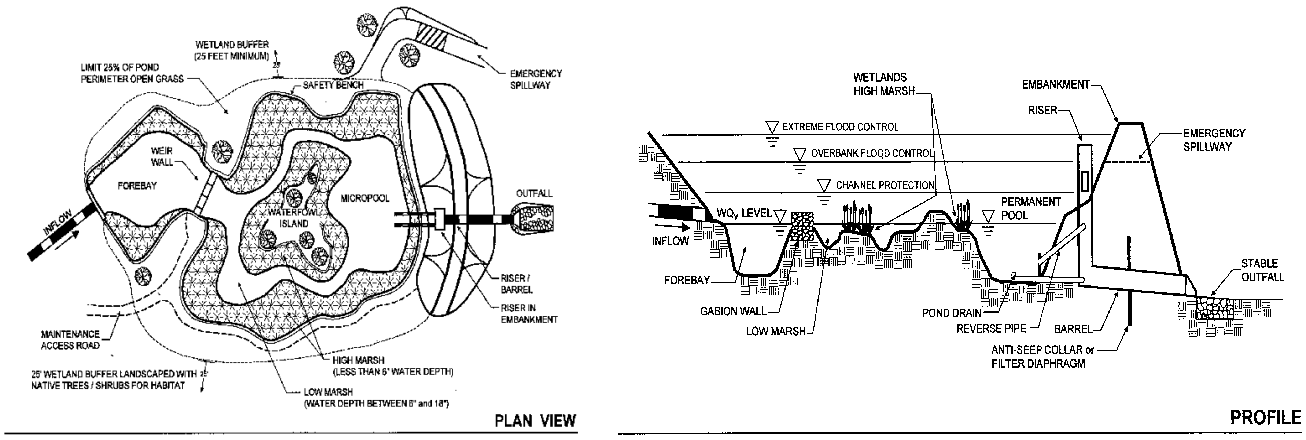


Figure 3. Shallow Marsh Wetland Design Detail

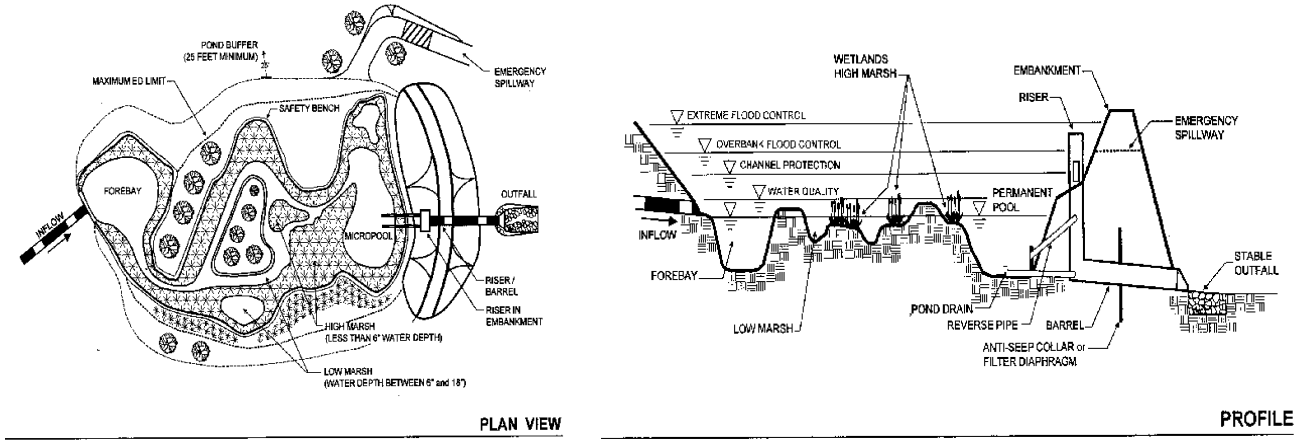


Figure 4. Extended Detention Wetland Design Detail

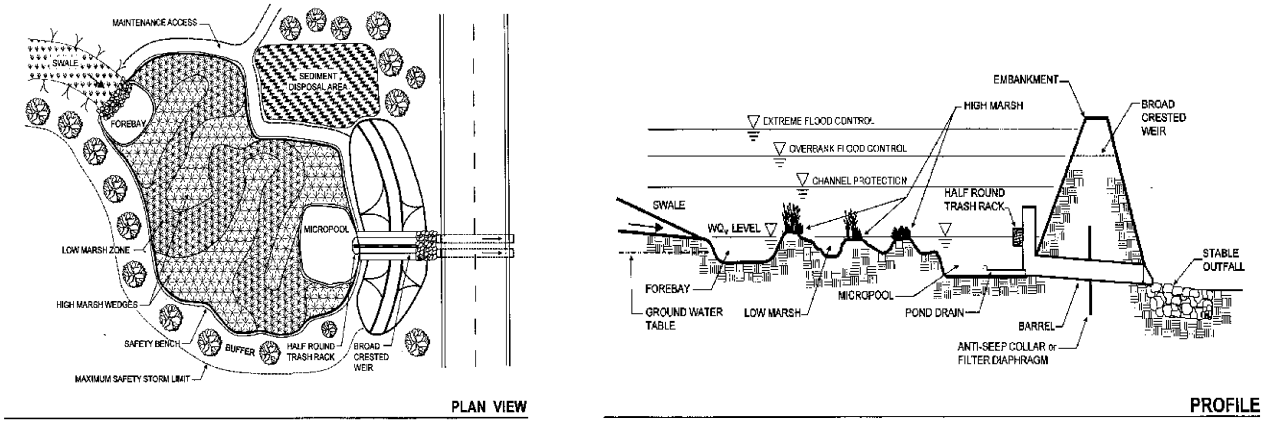


Figure 5. Pocket Wetland Design Detail

ii. Appendix B – Design services cost

Task Description	Task Hours	Hourly Salary	Multiplier for Overhead and Profit	Total
Collect information of existing landscape and future development. Evaluate hydrologic conditions.	50	33.5	2.5	$4,187.50
Evaluate water quality and research treatment methods.	40	33.5	2.5	$3,350.00
Concept design presented to client for feedback.	20	33.5	2.5	$1,675.00
Design work draft delivered.	120	33.5	2.5	$10,050.00
Maintenance Reference Handbook	40	33.5	2.5	$3,350.00
Presentation to client.	20	33.5	2.5	$1,675.00
Final version of design report, design drawings, presentation, and poster.	40	33.5	2.5	$3,350.00
			Sub-Total	$27,637.50
			Travel, Materials, and Supplies	$1,000.00
			Total Cost	$28,637.50

iv. Appendix C - Maintenance Manual

MAINTENANCE GUIDEBOOK

City of Monticello Parks and Recreation

This Guidebook provides as a general structure for event response and planned maintenance procedures. It is intended to be expanded with updated with current practices as they are introduced. State and federal regulations will continue to change following the release of this resource, and no claim of compliance is assured in following the guidance laid forward.

Prepared by
University of Iowa College of Engineering Spring 2022 Civil & Environmental Senior Design

Contents

Inspection

Determining when to reference this guidebook will be informed by practicing the inspection schedule laid out by the US EPA (see Resource 1 [section 2 – pg 23]). It contains information on the purpose of regular inspection, skill level needed to carry out different inspection items, and documentation outlines. The following table is from this resource and outlines general recurring inspection items – some may not be relevant to the needs of Monticello's wetlands but are meant to assist in forming a way of thinking about necessary inspection.

Frequency	Inspection Items (Skill Level)	Maintenance Items (Related Profile Sheet)
One time - After First Year	▪ Ensure that at least 50% of wetland plants survive (0) ▪ Check for invasive wetland plants (0)	▪ Replant wetland vegetation (See M-4 Vegetation Management)
Monthly to Quarterly or After Major Storms (>1")	▪ Inspect low flow orifices and other pipes for clogging (0) ▪ Check the permanent pool or dry pond area for floating debris, undesirable vegetation (0) ▪ Investigate the shoreline for erosion (0) ▪ Monitor wetland plant composition and health (0-1) ▪ Look for broken signs, locks, and other dangerous items (0)	▪ Mowing – minimum Spring and Fall (See M-4 Vegetation Management) ▪ Remove debris (M-2 Clogging) ▪ Repair undercut, eroded, and bare soil areas (See M-4 Vegetation Management)
Several Times per Hot/Warm Season	▪ Inspect stormwater ponds and stormwater wetlands for possible mosquito production (0-1)	▪ Inspect for mosquitoes (See M-8 Nuisance Issues)
Semi-annual to annual	▪ Monitor wetland plant composition and health (0-1) ▪ Identify invasive plants (0-1) ▪ Ensure mechanical components are functional (0-1)	▪ Setup a trash and debris clean-up day ▪ Remove invasive plants (See M-4 Vegetation Management) ▪ Harvest wetland plants (See M-4 Vegetation Management) ▪ Replant wetland vegetation (See M-4 Vegetation Management) ▪ Repair broken mechanical components if needed (See M-7 Mechanical Components)
Every 1 to 3 years	▪ Complete all routine inspection items above (0) ▪ Inspect riser, barrel, and embankment for damage (1-2) ▪ Inspect all pipes (2) ▪ Monitor sediment deposition in facility and forebay (2)	▪ Pipe and Riser Repair (See M-3 Pipe Repair) ▪ Complete forebay maintenance and sediment removal when needed (See M-5 Dredging and Muck Removal)
2-7 years	▪ Monitor sediment deposition in facility and forebay (2)	▪ Complete forebay maintenance and sediment removal when needed (See M-5 Dredging and Muck Removal)
5-25 years	▪ Remote television inspection of reverse slope pipes, underdrains, and other hard to access piping (2-3)	▪ Sediment removal from main pond/wetland (See M-5 Dredging and Muck Removal) ▪ Pipe replacement if needed (See M-3 Pipe Repair)

Event Based Maintenance

Establishment Period (following construction)

Year One

The Iowa Storm Water Management Manual (ISWMM) is an excellent resource for water resource management practices. In Chapter 9 (listed below as Resource 2), ISWMM lays out practices and design standards associated with wetlands. Below is a list of actions that ISWMM has evaluated as necessary for proper establishment of an integrated stormwater wetland.

- Weed suppression by cutting native seeding areas [...] No cutting or trimming should be closer than 8 inches to ground surface. Mow native seeding areas (min. 3 times a year).
- Removal of cuttings longer than 8 inches that fall within 20 feet of the edge of water or cover areas larger than 20 square feet to off-site location.
- Systemic herbicide treatment of areas larger than 20 square feet where weeds are the dominant plant material. Hand wipe systemic herbicide on invasive weeds and woody species where native plants are the dominant plant material, taking care not to damage nearby native plants.
- Remove the above-ground portion of previously treated dead or dying weeds and woody species from planting areas.
- Add topsoil and raking to restore grade in areas where poor germination, erosion or weed removal have left rills deeper than 3 inches and longer than 10 feet or areas in excess of 20 square feet depressed or below finished grade.
- Re-seed areas where poor germination, erosion or weed removal have left areas in excess of 20 square feet bare or sparsely vegetated.
- Apply mulch to areas where poor germination, erosion or weed removal have left areas in excess of 20 square feet bare or sparsely vegetated.
- Prune dead or dying material from trees or shrubs.
- Remove weeds from the mulched areas around trees and shrubs.
- Apply appropriate insecticides and fungicides, as necessary, to trees and shrubs only to maintain plants free of insects and disease.

Recommended seed mix used is the Iowa DOT Wet CRP Mix (CP2, CP23, CP25), available through Albert Lea Seed (Resource 3 at the end of this document), priced at $110/acre.

Years Two and Three

Similarly, ISWMM put together a system of practices appropriate for the second and third years following new construction, as follows. Note that ISWMM has many helpful notes and additional information not included in this reference. The entire source of ISWMM Chapter 9 – Stormwater Wetlands is found in Resource 2 at the end of this guidebook.

- Suppress weeds by cutting portions of native planting areas where weeds comprise more than 1/4 of the plants within an area. Use string-type trimmers to prevent weeds from developing seeds. No cutting or trimming should be closer than 12 inches to ground surface. Mow native seeding areas at least three times a year.
- As allowed, add controlled burns by qualified personnel in appropriate areas on an annual or every-other-year basis to control weeds, starting in YEAR THREE.
- Remove cuttings longer than 8 inches that fall within 20 feet of the edge of water to an offsite location.
- Systemic herbicide treatment of areas larger than 20 square feet where weeds are the dominant plant material.
- Hand-wipe systemic herbicide on invasive weeds and woody species where native plants are the dominant plant material, taking care not to damage nearby native plants.
- Remove above-ground portion of previously treated dead or dying weeds and woody species from planting areas.
- Check that firebreaks have been established and are being maintained.
- Add topsoil and rake to restore grade in areas where poor germination, erosion, or weed removal, have left rills deeper than 3 inches and longer than 10 feet or areas in excess of 20 square feet depressed or below finished grade.
- Re-seed and or apply mulch to areas where poor germination, erosion or weed removal have left areas in excess of 20 square feet bare or sparsely vegetated.
- Prune dead or dying material in trees or shrubs.
- Remove weeds from the mulched areas around trees and shrubs.
- Apply appropriate insecticides and fungicides as necessary to trees and shrubs only to maintain plants free of insects and disease.
- On final inspection trip for maintenance – remove staking wires from trees but leave stakes in place.

Following an event of more than 1.25 inches of rainfall

Inspection

ISWMM Section 9.08 recommends that managers "Inspect storm inlets and outlets … Look for signs of sediment accumulation, flow channelization, erosion damage, local streambank instability".

Resources

1. https://www3.epa.gov/npdes/pubs/pondmgmtguide.pdf
2. https://www.iowadnr.gov/Portals/idnr/uploads/water/stormwater/manual/iswmm_anewchapter09.pdf
3. https://alseed.com/product/ia-cp23/

v. Appendix D – Reference Sources
   a. Iowa DOT – Section 12B-2. *Shared use path design*
   b. Iowa DNR - Iowa Stormwater Management Manual – Chapters 3, 5, and 9
   c. US EPA Stormwater Wet Pond and Wetland Management Guidebook
   d. https://www.bidx.com/ia/lettings