United States Environmental Protection Agency

North Wastewater Treatment Plant Restoration

FINAL DRAFT

Photo: Southern equalization basin at the decommissioned treatment facility

JUNE 2015
EPA 833-R-14-45.3K

About the Green Infrastructure Technical Assistance Program

Stormwater runoff is a major cause of water pollution in urban areas. When rain falls in undeveloped areas, soil and plants absorb and filter the water. When rain falls on our roofs, streets, and parking lots, however, the water cannot soak into the ground. In most urban areas, stormwater is drained through engineered collection systems and discharged into nearby water bodies. The stormwater carries trash, bacteria, heavy metals, and other pollutants from the urban landscape, polluting the receiving waters. Higher flows also can cause erosion and flooding in urban streams, damaging habitat, property, and infrastructure.

Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, *green infrastructure* refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, *green infrastructure* refers to stormwater management systems that mimic nature by soaking up and storing water. Green infrastructure can be a cost-effective approach to improving water quality and helping communities stretch their infrastructure investments further by providing multiple environmental, economic, and community benefits. This multibenefit approach creates sustainable and resilient water infrastructure that supports and revitalizes urban communities.

The U.S. Environmental Protection Agency (EPA) encourages communities to use green infrastructure to help manage stormwater runoff, reduce sewer overflows, and improve water quality. EPA recognizes the value of working collaboratively with communities to support broader adoption of green infrastructure approaches. Technical assistance is a key component to accelerating the implementation of green infrastructure across the nation and aligns with EPA's commitment to provide community-focused outreach and support in response to the President's *Priority Agenda for Enhancing the Climate Resilience of America's Natural Resources*. Creating more resilient systems will become increasingly important in the face of a changing climate. As more intense weather events or dwindling water supplies stress the performance of the nation's water infrastructure, green infrastructure offers an approach to increase resiliency and adaptability.

For more information, visit *http://www.epa.gov/greeninfrastructure*.

Acknowledgements

Principal EPA Staff

Tamara Mittman, EPA
Christopher Kloss, EPA
Jamie Piziali, EPA
Leah Medley, EPA

Community Team

Karen Howard, City of Iowa City
Ben Clark, City of Iowa City
Brenda Nations, City of Iowa City
Mike Moran, City of Iowa City
Zac Hall, City of Iowa City
Doug Boothroy, City of Iowa City
Kris Ackerson, City of Iowa City

Consultant Team

Russ Dudley, Tetra Tech
William Musser, Tetra Tech
Jonathan Smith, Tetra Tech
Martina Frey, Tetra Tech
John Kosco, Tetra Tech

This report was developed under EPA Contract No. EP-C-11-009 as part of the 2014 EPA Green Infrastructure Technical Assistance Program.

DRAFT

Contents

DRAFT

Figures

Tables

DRAFT

DRAFT

1 Executive Summary

Like many riverine communities across the country, Iowa City has a rich history that is intricately linked to its water resources. Development has encroached upon the Iowa River and Ralston Creek to the point where some areas of the channels have been hardened, straightened, or even buried. "Sunny-day development" of Iowa City's floodplains has left critical infrastructure vulnerable to large floods and heavy storm events, which potentially will occur more frequently with climate change affecting weather patterns.

The North Wastewater Treatment Plant, inundated during the flood of 2008, is one example of critical public infrastructure being susceptible to flooding from the Iowa River. Located at the confluence of Ralston Creek and the river and immediately upstream of Highway 6, the North Wastewater Treatment Plant site becomes completely isolated during the 100-year flood event. Rather than continually protecting the treatment plant from future floods or repairing it after flood damage, Iowa City has decommissioned the plant and is removing all of the built components from the floodplain. As part of that project, the city plans to soften the edge along the Iowa River by creating a public park with 5 acres of restored floodplain and wetland area along Ralston Creek.

Stream restoration and restored wetlands at the treatment plant site can result in benefits to water quality, flood resiliency, urban habitat, recreation, and education, and can serve as a catalyst to encourage additional economic development in the adjacent areas. To create a viable and sustainable ecosystem that can support the necessary flora community, a reliable water supply is needed to establish the wetland conditions. Since this area is at the confluence of the river and Ralston Creek, excavation of the floodplain is proposed to tie into the ground water table. To maximize the water quality potential of the wetland area, restoration of the creek banks is proposed that will allow stormwater runoff from the Ralston Creek subwatershed to flow into the wetland area during more frequent storm events. Stream restoration structures and emergent plant species are proposed that support long-term stability, habitat creation, and aesthetics of the project site.

The stream and floodplain restoration is one component of a larger proposed park plan, which in turn is part of a larger redevelopment master plan for downtown Iowa City. Trails and pathways will connect the restoration site with the remainder of the park and the adjacent proposed mixed-use development area. City residents and visitors will be able to access the restored area at a variety of points, and helping to instill a strong environmental ethic in frequent users of the park. The green infrastructure concepts implemented at a large scale in the restored wetland will be easily expanded beyond the site with the proposed implementation of smaller stormwater gravel wetlands to treat stormwater from impervious areas proposed as part of the master redevelopment plan, further connecting neighboring residents to Ralston Creek and their local environment.

DRAFT

2 Introduction

Iowa City's history as the former state capital and home to the University of Iowa is richly intertwined with the Iowa River. Residential and commercial zones are located on both sides of the river, and the university's world-renowned hydraulics laboratory is built on the river to enable scientists to draw water directly from it for experiments. Even with the Coralville Reservoir controlling much of the watershed upstream, Iowa City has experienced several large floods and has suffered extensive damage to many city and university properties. As the city continues to grow, much of its growth is focused on moving critical infrastructure out of the floodplain and providing effective management and safe access to the Iowa River corridor.

One such project is the decommissioning and demolition of the North Wastewater Treatment Plant, located at the confluence of the Iowa River and Ralston Creek north of Highway 6 (see Figure 1). The site is approximately 1 mile south of the University of Iowa campus and downtown Iowa City and is easily accessible from nearby residential areas. The majority of the plant components had been elevated out of the floodplain, but areas received floodwaters during extreme flood events; most recently in the summer of 2008, leaving the facility nearly inoperable. Because of the increased risk, the plant was decommissioned and Iowa City received funding to demolish its components in preparation for converting the area into a public park. The park will serve as a focal point and provide river access for Riverfront Crossings, a planned mixed-use redevelopment area to the north and east of the project site, and will include restoration of Ralston Creek back to a historic riparian wetland/floodplain.

DRAFT

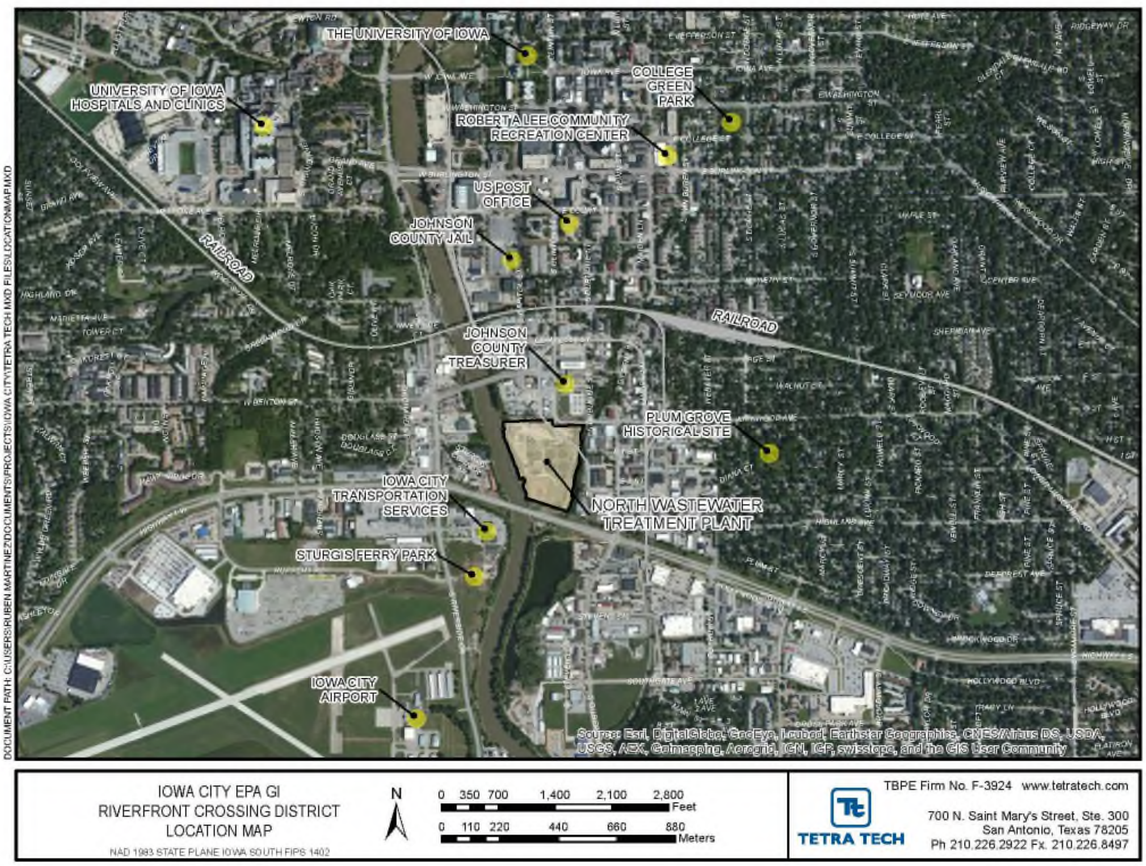


Figure 1. Location of the North Wastewater Treatment Plan within Iowa City

2.1 Historical Conditions

The Iowa River has served as a major corridor for Iowa City commercial and residential areas and the University of Iowa campus dating back to the 19th century. Several railroad and vehicular bridges have provided easy access to both sides of the river, and a low-head dam is located at the Burlington Street Bridge, originally to provide river water to run early hydraulic experiments at the University of Iowa's C. Maxwell Stanley laboratory—one of the nation's oldest hydraulics labs.

Iowa River flows are partially managed by the Coralville Reservoir located approximately 5 miles upstream of the city. During the historic Iowa Flood of 2008, waters rose to record-breaking levels over the reservoir's emergency spillway, causing the river to crest at 31.5 ft[1], which was over 9 ft above the flood stage of 22 ft. The flooding significantly affected sections of the city and the university and inundated the North Wastewater Treatment Plant (Source: Iowa Homeland Security.

Figure 2), which is located at the confluence of the river and Ralston Creek.

Following the extreme flood event, Iowa City developed plans to decommission the treatment facility and direct wastewater to the upgraded South Wastewater Treatment Plant. The North Wastewater

[1] "Iowa flood of 2008." Accessed from Wikipedia on September 29, 2014.

Treatment Plant is no longer operating and plans are currently being developed to demolish the existing buildings on the site.

Source: Iowa Homeland Security.

Figure 2. 2008 Flood Overview—North Wastewater Treatment Facility

The floodplain at the confluence of the creek and the river was modified to accommodate the construction of the North Wastewater Treatment Plant. Since it was initially built in the mid-1930s, the treatment facility has undergone modifications and expansions that have further altered the local landscape. The treatment plant and the construction of Highway 6 along the southern border of the plant have divided and greatly impacted the natural floodplain.

The historic condition of the floodplain area is unknown, but review of the Soil Survey of Johnson County Iowa (Schermerhorn 1983) indicates that the site consists of Sparta loamy fine sand, typical of stream benches and uplands. This soil type is excessively drained and normally found on shallow slopes, common with the loess and glacial drift that makes up much of the soil parent material in the region.

2.2 Project Overview and Goals

The construction of the North Wastewater Treatment Plant and Highway 6, along with the need to protect critical infrastructure from flood events, resulted in the straightening and hardening of Ralston Creek and created a disconnection of the Ralston Creek and Iowa River floodplains. With the removal of the buildings and equipment, Iowa City has the opportunity to transition the site back to its historic, natural condition.

The city intends to convert the treatment facility site into a multiuse public park to increase access to the Iowa River and provide open, natural space for the benefit of the community. A 5-acre portion of the site will be designed to reestablish natural floodplain connections and promote additional flood mitigation benefits with the creation of off-channel constructed wetlands. The purpose of the project is to produce a concept plan for the restoration of Ralston Creek that improves flow and habitat conditions and maximizes treatment of stormwater overflows in constructed wetlands within the reclaimed floodplain.

2.3 Project Benefits

To protect critical infrastructure near the treatment facility, Ralston Creek has been straightened, hardened, and essentially forgotten. Riprap lines both banks in some areas and the channel cross-section remains uniform through much of the study reach. Without restoration of the floodplain, which is significantly higher than the bed of the creek and disconnected from bankfull flows, adjustments to the channel pattern or cross-section will have little impact on the health of the ecosystem. Creating a floodplain that is accessible under frequent flow conditions will help establish hydrologic regimes necessary to create healthy stream conditions and promote aquatic life while also reconnecting nearby residents to a water resource that has been significantly minimized throughout Iowa City.

2.3.1 Water Quality Benefits

A constructed wetland system located within the Ralston Creek floodplain will accept stormwater flows from the creek and provide water quality benefits through longer residence time and additional plant uptake processes. By primarily treating creek flows that occur during short, intense storm events, the off-channel wetland can provide water quality benefits in addition to site-scale green infrastructure distributed throughout the watershed. Restoration from a channelized stream reach to a naturalized section can increase travel time, and a study by Bukaveckas (2007) has shown that slowing water velocities can result in significantly higher nutrient uptake rates. Cadenasso et al. (2008) offered many options for reducing nitrate yield from urban areas, noting that that the “key ability of new functional interfaces to serve as hot spots for denitrification in urban watershed is for them to capture nitrate-laden water and hold it long enough under the anaerobic, high-carbon conditions suitable for denitrification to occur.” Directing lower storm flows from Ralston Creek into a constructed wetland area to provide the necessary conditions and residence time for denitrification could result in a significant reduction in nutrients reaching the Iowa River.

2.3.2 Flood Resiliency Benefits

The North Wastewater Treatment Plant was located at the confluence of Ralston Creek and the Iowa River, an area typically prone to flooding. The wastewater treatment facilities were elevated to remain outside of the floodplain, creating an island between Ralston Creek and the Iowa River during flood events. By lowering this elevated area and focusing on a tiered approach to the landscape and plant material, the restored floodplain area will be capable of handling larger and longer flood events impacting the Iowa River.

2.3.3 Habitat Benefits

The Iowa River and Ralston Creek upstream of the North Wastewater Treatment Plant have heavily developed riparian areas and channel banks. There is little shelter or food supply to encourage a diversity of aquatic animals within the Iowa River or Ralston Creek corridors throughout Iowa City. Restoration of Ralston Creek and the surrounding floodplain into a riparian wetland area would provide much needed habitat to sustain a rich aquatic ecosystem. In a survey of why landowners restore wetlands conducted by Pease et al. (1996), providing habitat for wildlife was listed as “extremely important” by more than 80 percent of the respondents.

2.3.4 Recreational and Educational Benefits

Restoration of Ralston Creek and the associated floodplain at this location creates an opportunity for area residents and visitors to access the stream that has largely been unavailable in its current condition with heavily developed riparian areas and an incised stream channel. A tiered approach to the restoration will result in a range of elevations that inspires a variety of habitats and multiple vantage and access points to interact with the habitat areas.

2.3.5 Local Redevelopment Benefits

The conversion of the North Wastewater Treatment Plant site to a park and restored floodplain serves as a critical focal point of a planned Riverfront Crossings redevelopment project (HDR 2013). The park district, shown conceptually in Source: HDR 2013.

Figure 3, is central to the walkable, mixed-use redevelopment anticipated on both sides of the Iowa River and Ralston Creek. The proposed park will serve as a public amenity for the neighboring community and the entire city but will also inspire green infrastructure and sustainability themes that can be carried out in a smaller scale in the surrounding residential and commercial areas.

Source: HDR 2013.

Figure 3. Riverfront Crossings Conceptual Rendering of the Park District (Labels Added)

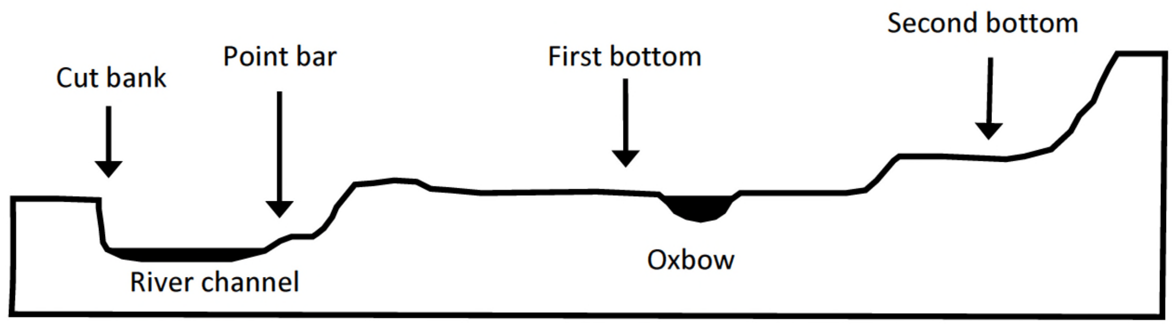
3 Design Approach

Floodplain restoration of the 5-acre portion of the site focuses on the reconnection of more frequent storm flows within Ralston Creek to a larger floodplain area. A constructed wetland is included to maximize water quality benefits associated with stormwater inundating the larger floodplain area.

The restored portion of Ralston Creek, the reclaimed floodplain area at the confluence of the creek and the Iowa River, and the constructed wetland are designed to mimic historical conditions at the site or natural features commonly found in these environments. The design is intended to improve ecosystem health at all flow levels through the establishment of multiple inundation zones defined by different flood events. By establishing different zones, a wide variety of plant species can be incorporated to create a diverse environment necessary for resilience under varying water surface elevations.

Multiple zones located at different elevations are typical of forested floodplains within Iowa. Randall and Herring (2012) noted that "flooding can both enhance and stress a riparian ecosystem." They identify three main floodplain site types, shown in Source: Randall 2012.

Figure 4 as "point bars", "first bottoms", and "second bottoms". The design of the restored Ralston Creek and reclaimed floodplain follows these types, with the point bar established by adding curvature to the Ralston Creek pattern, the constructed wetland simulating an oxbow feature within the first bottom, and the remnant treatment facility site elevation serving as the high terrace or second bottom.



Source: Randall 2012.

Figure 4. Floodplain Site Types

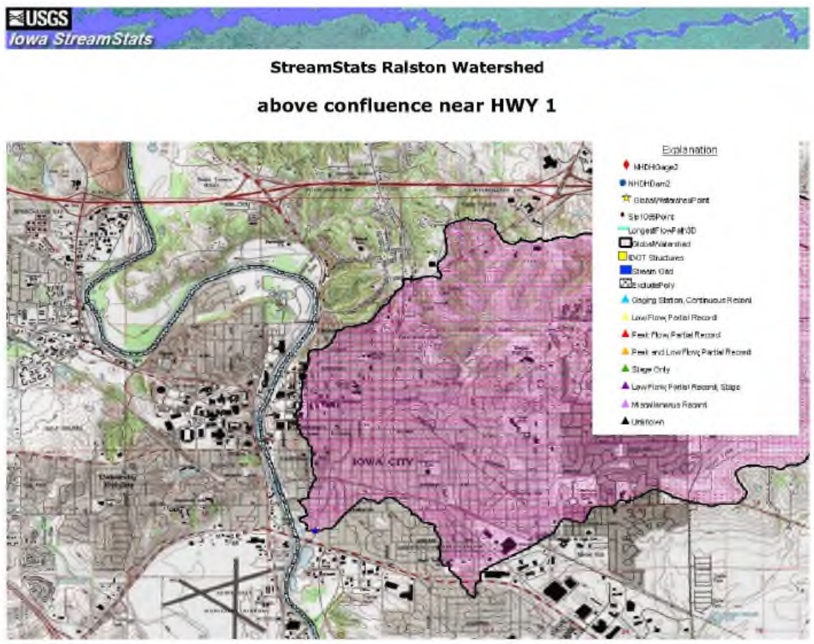
The hydrology of Ralston Creek serves as the basis for establishing elevations of the floodplain zones. The Ralston Creek watershed (5,850 acres) is much smaller and more urbanized than the Iowa River watershed (more than 3,200 square miles at Iowa City), making Ralston Creek much more responsive to smaller but more intense storm events. Targeting the more frequent fluctuations is consistent with typical design guidance for other green infrastructure, such as EPA's criteria of retaining the 95th percentile storm (USEPA 2009). In this instance, the lower storm events are not used to size the floodplain/wetland area but to set the elevation to the point at which flows will access the overbank area.

3.1 Hydrology

The restoration site is influenced by flows from Ralston Creek and the Iowa River; both have defined FEMA floodplains. The Johnson County Flood Insurance Study (FIS) indicates that the 100-year flood (the highest elevation that has a 1 percent chance of occurring annually) for the Iowa River varies from an elevation of 644.6 ft at Highway 6 and increases to an elevation of 645.5 ft at the railroad crossing located near the northern portion of the treatment facility site (FEMA 2002). This represents approximately a 1-foot drop in head as the river flows along the site from north to south, passing under the structures at the railroad, Benton Street, and Highway 6. Flood elevations of all of the expected storm events vary from about 18 ft to about 26 ft above the stream bed of the Iowa River. With most of the existing treatment plant site being situated at elevations above 640 ft, most of the site is currently only subjected to the 10 percent chance flood (or 10-year return frequency) and higher. This is typical of a higher terrace feature. Access to a floodplain between the 1- and 10-year return intervals is not consistently available throughout the site. Setting the water surface elevations for lower flood events is important to establishing the correct elevation for the first bottom zone. During higher flood events, the floodplain in this area is dominated by the Iowa River, but during lower flood events, the water surface elevations will most likely differ between the Iowa River and Ralston Creek.

Randall and Herring (2012) indicate that first bottoms flood every 1–3 years, which is consistent with commonly used bankfull frequencies often used in stream restoration design (Woodyer 1968). Established flood elevations are not available within the FIS for events below the 10-year return interval, so to develop water levels for lower storm events, USGS StreamStats was used to determine flows at the ungaged Ralston Creek (Eash et al. 2013)[2]. Source: USGS StreamStats.

Figure 5 shows the delineated watershed for Ralston Creek displayed in the StreamStats program.



Source: USGS StreamStats.

Figure 5. Screen Capture from USGS StreamStats Showing the Ralston Creek Watershed

StreamStats can be an effective way of quickly establishing flows over a broad range of return intervals but still needs to be converted to flood elevations. To determine elevations, a cross-section of Ralston Creek established from site topography was provided by the city. Manning's equation was used along with conservative assumptions for energy slope (0.004) and roughness (0.05) to develop a stage-discharge relationship for Ralston Creek in the area of the treatment facility site, as shown in

Figure 6. Flows for the 2-, 5-, 10-, 25-, and 50-year return intervals are converted to elevations using this relationship, as shown in Table 1.

Table 2 compares the elevations calculated using the StreamStats flows and the stage-discharge relationship to the established elevations presented in the FIS. The difference at the 10-year flood is less than one-half foot but this difference doubles at the 50-year return interval. The reliability of this analysis is limited at higher flow events, but can be used for lower events to establish the first bottom level. For this conceptual design, the top of the bank for the restored Ralston Creek will be set at 634 ft to fit within the 1–3-year flood frequency typical of Iowa floodplains.

DRAFT

[2] A USGS stream gage is located along the south branch of Ralston Creek but is not appropriate for use to determine flows at the treatment facility site.

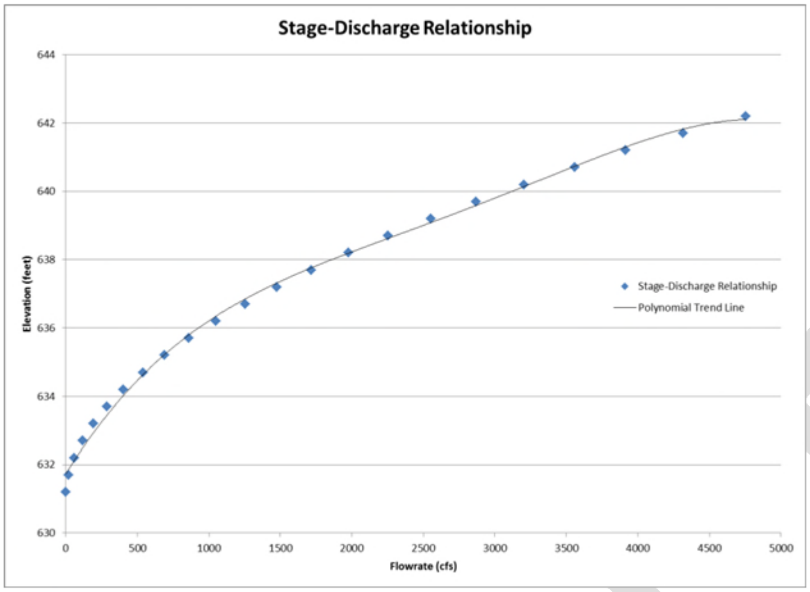


Figure 6. Stage-Discharge Relationship for Ralston Creek Determined Using Flows from StreamStats

Table 1. Ralston Creek Water Surface Elevations

Frequency (Years)	Flow (CFS)	Elevation (ft)
2	558	634.7
5	1,210	636.7
10	1,850	638.0
25	2,830	639.5
50	3,500	640.6

Table 2. Difference in Elevation between the FIS and those Determined by StreamStats Flows

Frequency (Years)	Elevation from FIS (ft)	Elevation from StreamStats (ft)	Difference (ft)
10	638.4	638.0	0.4
50	641.4	640.6	0.8

Comparison against the Iowa River water surface elevations can be made by performing a regression analysis on gage data over a period of 111 years. Stage and discharge data were obtained for the Iowa River stream gage at Iowa City from the USGS National Water Information System[3]. This gage is located 0.8 miles upstream from the mouth of Ralston Creek. A Log Pearson Type III flood frequency analysis was performed to determine flowrates for the 2- and 5-year return intervals. A stage-discharge relationship was developed for the Iowa River gage and used to convert the selected flows to water

[3] http://waterdata.usgs.gov; Accessed on 09/29/2014.

surface elevations. A consistent conversion factor was applied to relate the water surface elevations determined at the stream gage to water surface elevations at the treatment facility site. Table 3 includes the Iowa River elevations calculated with the regression analysis as well as the 10-year water surface elevation included in the FIS. These elevations are compared to the Ralston Creek elevations. Although there is minimal difference shown at the 2-year frequency, this difference varies significantly at higher flood events.

Table 3. Comparison of Iowa River and Ralston Creek Flood Elevations

Frequency (Years)	Iowa River		Ralston Creek		Difference (ft)
	Elevation from FIS (ft)	Elevation from Regression (ft)	Elevation from FIS (ft)	Elevation from StreamStats (ft)	
2		634.9		634.7	0.2
5		638.9		636.7	2.2
10	639.8		638.4		1.4

Establishing an oxbow feature or, in this case, an off-channel constructed wetland, requires tapping into ground water sources to obtain the hydrologic conditions necessary to support emergent wetland plant species. Since this project is at a conceptual level, no soil borings or ground water investigations were conducted. Instead, past soil investigations were used to determine potential ground water levels. A subsurface investigation was conducted by Stanley Consultants in July 1994 as part of proposed wastewater treatment and collection facilities improvements. Four borings were conducted within or adjacent to the treatment facility; a map of the boring locations (indicated in white text) and the boring logs are included in Appendix A. Ground water levels for the boring locations are shown in Table 4.

Table 4. Ground Water Elevations

Boring No.	Description of Location	Surface Elevation (ft)	Ground Water Elevation (ft)
NP-1	NE corner of site, near east bank of the Iowa River	645.1	630.1
5	E side of site, along west bank of Ralston Creek	641.5	631.5
7	SE corner of site, along west bank of Ralston Creek	641.5	633.0
7A	SE corner of site, along east bank of Ralston Creek	646.4	626.4
Range of Elevations		641.5–646.4	626.4–633.0

Source: Stanley Consultants 1994.

The borings conducted in 1994 show a range of ground water levels across the site. Excluding boring 7A, which is located on the east side of Ralston Creek and not within the treatment site facility, values range from approximately 630 ft at the northeast corner of the site near the Iowa River to 633 ft at the southeast corner of the site near Ralston Creek. For the purposes of this concept design, a summer ground water range of 630–633 ft will be used to establish elevations for the constructed wetland.

Revisiting the cross-section showing the typical zones of Iowa floodplains, the defining elevations for each level are listed in Table 5. These elevations are used to define the grading within the proposed 5-acre restoration area.

DRAFT

Table 5. Design Elevations for Floodplain Zones

Floodplain Feature	Elevation (ft)
Point Bar	632–634
First Bottom	634
Constructed Wetland	631
Second Bottom (Higher Terrace)	638–640

The elevations are set from existing flood studies and gage analysis. Proposed grading changes within the site are intended to make the area more accessible to flood flows and could have an effect on the floodplain surface elevations. A section of the Flood Insurance Rate Map (Figure 7) shows that a large portion of the treatment facility site is located in Zone X as opposed to Zone AE. The floodplain model might need to be altered and resimulated to provide the final floodplain elevations needed for design. The current floodplain delineation also includes both a floodplain (flood hazard) and a floodway. The proposed project should not intend to alter the floodway but will create a larger floodplain area by removing some of the fill material where the treatment plant was constructed. A more detailed hydraulic modeling analysis of the Iowa River was not performed as part of the conceptual design but should be included in future design efforts, especially if the berm along the east bank of the Iowa River is significantly altered as part of the park redevelopment.

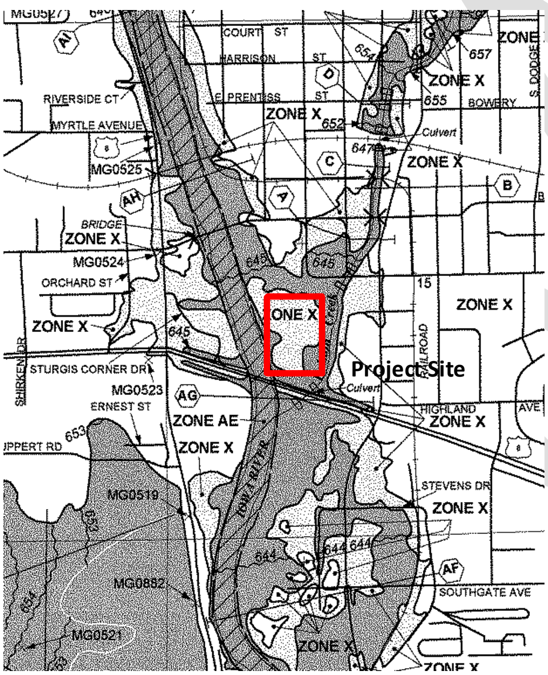


Figure 7. Section of the Johnson County FIRM, Panel 195

3.2 Soils

The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) provides soil surveys for Johnson County with dates of 1922 and 1983. Evaluating both surveys often provides separate information, as older soil surveys often provide a better context for replicating the historic floodplain conditions and more recent surveys provide data on current disturbed conditions. In this case, the two soil surveys represent conditions before and after the construction of the North Wastewater Treatment

DRAFT

Plant. According to the 1922 survey, the prevailing soil types were silt loams of loessial origin. Rolling hills found within the region were forested and the soils were not high in organic matter. Flatter areas typically consisted of prairies generally well supplied with humus. Floodplains along rivers often made for very fertile agricultural lands and were historically stripped of timber and converted to farm land.

According to the 1922 NRCS soil survey, along the course of the Iowa River there was little alluvial land but below Iowa City there was approximately 30 square miles of floodplain and terrace. Above Iowa City, there were only occasional expansions of the narrow floodplain, but below the city, the valley widened to 2–3 miles and produced tillable bottom land that could be used for agriculture.

The 1983 NRCS maps show the site soils as 7, 11B, 41, 163F, and 793. The Iowa River is listed as "W" for water. The portion of the property where the treatment plant is currently located is completely in the designation 41, which refers to soil type "Sparta"—fine sand mixed with loamy fine sand. This soil type maintains a depth to the high water table of at least 6 ft or more below the surface. Sparta is an extremely well-drained soil type and is designated as Hydrologic Soil Group A.

The 11B area is designated "Colo"—frequently flooded soil and is found at the location of Ralston Creek. This soil type consists primarily of silty clay loam with a high water table typically found between 1 –3 ft below the surface. Colo is subjected to occasional flooding and is poorly drained, designated as Hydrologic Soil Group B/D. A map of the soils found in the area is included in Appendix B.

Soils with hydrologic groups of A and B and high water tables are not hydric and not conducive to wetland formation without connecting to reliable hydrologic conditions needed to create a saturated or inundated condition that promotes anaerobic conditions during the wet season. However, these soils can support vibrant forested areas that accept overbank riverine flooding. Creation of off-channel wetland systems in this area requires the connection to the ground water level to establish the necessary hydrologic conditions. This is similar to oxbow lakes that are formed from remnant channel sections that are closely tied to the ground water level. In natural environments, these oxbow lakes often transition to wetland areas through the accumulation of sediment and wetland seed banks during overbank flood flows.

3.3 Topography

The confluence of the Iowa River and Ralston Creek is near the portion of the state where the riverine system transitions from riparian conditions to the north characterized by steeper bluffs cut by the river and little adjacent floodplain to conditions further south characterized by broader expanses of floodplain as much as 2–3 miles wide. The restoration system proposed in this conceptual design would transition to overbank systems that follow the concept of providing for multiple hydrological conditions and habitats, to match the overall transition to wider floodplains typical of southern Iowa.

3.4 Geomorphology

No geomorphological field assessments were conducted as part of this conceptual-level design. To develop an understanding of geomorphologic conditions, historic maps and an external stream assessment were examined.

The Iowa Department of Natural Resources (DNR) recently conducted a watershed wide assessment of Ralston Creek, producing several informative maps that document current stream conditions. Shown in Figures 8 through 11, the DNR evaluated stream parameters such as channel pattern, bank stability, channel condition, and bank height. A comparison of the parameters between the section of Ralston Creek along the treatment facility site and the dominating condition of the Ralston Creek watershed is included in Table 6.

Table 6. Ralston Creek Watershed Stream Assessment

Stream Parameter	Condition at Treatment Facility Site	Dominating Condition in Watershed
Channel Pattern	Meandering, Straight	Straight
Bank Stability	Moderate Erosion, Minor Erosion	Stable
Channel Condition	Past Channel Alteration	Natural Channel
Bank Height	6–10 ft	3–6 ft, 6–10 ft

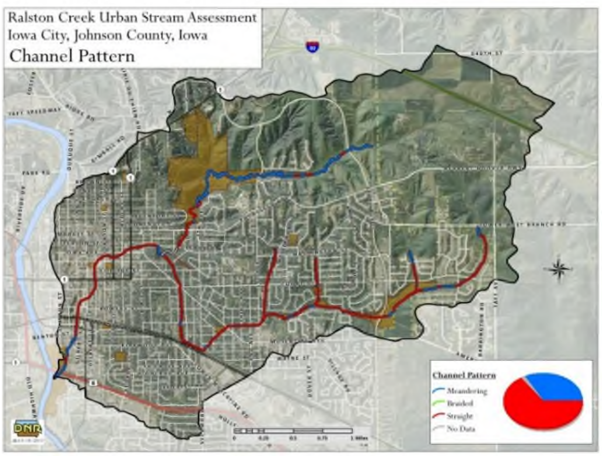


Figure 8. Channel Pattern of Ralston Creek

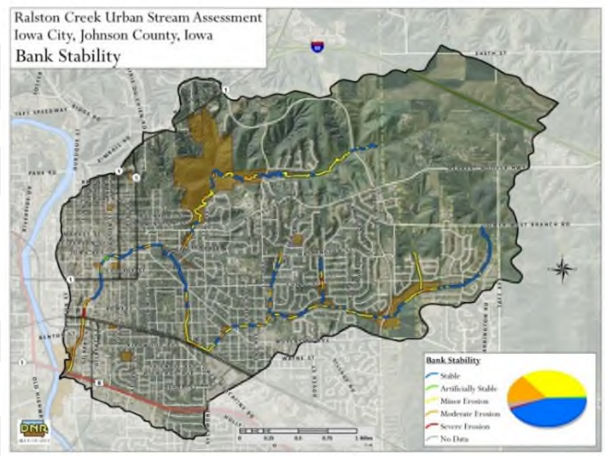


Figure 9. Bank Stability of Ralston Creek

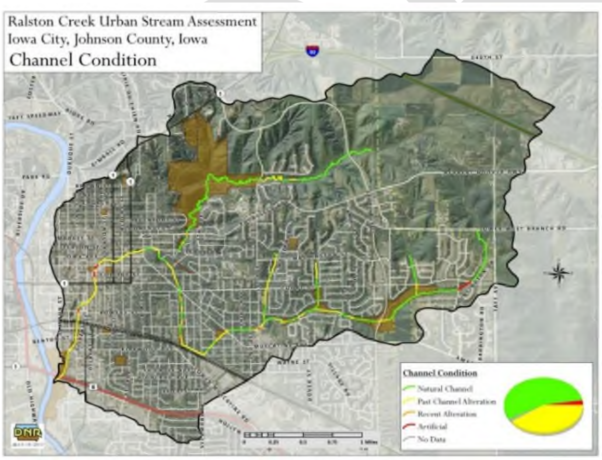


Figure 10. Channel Condition of Ralston Creek

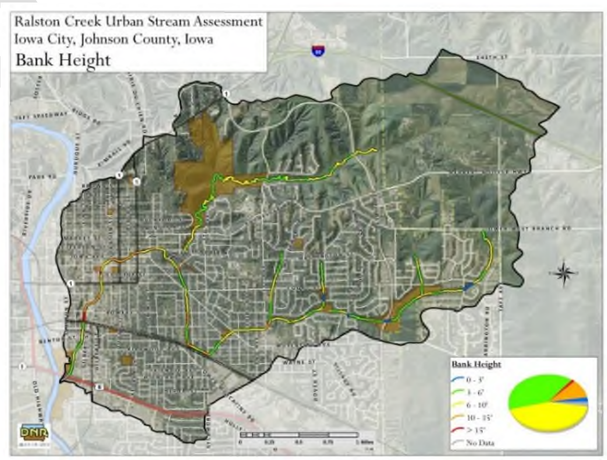


Figure 11. Bank Height of Ralston Creek

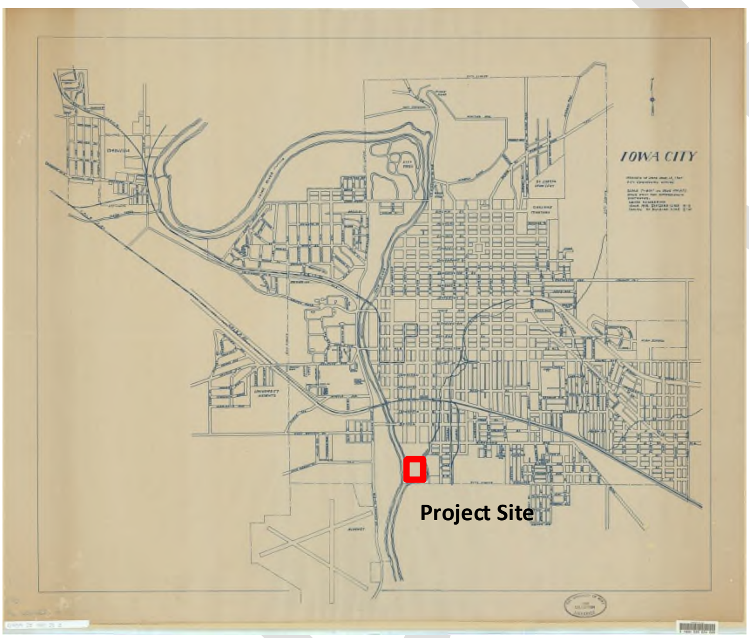
Source: DNR 2014.

In comparison to the overall condition of Ralston Creek, which is dominated by stable and natural channels, the section of Ralston Creek bordering the treatment facility site is disconnected from the floodplain, altered, and showing erosion. The figures show a more comprehensive view of Ralston Creek from the assessment. Even though much of Ralston Creek is considered to be a natural channel condition, high banks and erosion are still present in these sections. This assessment indicates that Ralston Creek could be evolving due to changes in hydrology within the watershed and that there could be a great opportunity to improve this section of Ralston Creek to match the pre-existing natural conditions found upstream and serve as a guide for future restoration upstream if instabilities continue.

The assessment validates the opportunity for channel restoration along the selected reach of Ralston Creek. As discussed in section 3.1, Iowa floodplains typically include a point bar that extends towards a first bottom. Establishing the appropriate connection to the first bottom is critical to restoring a natural channel condition. Even with this connection, creating a point bar feature is not possible in a straightened stream channel. An investigation into previous conditions can help to establish the appropriate curvature to help initiate the creation of point bar features. A 1947 map of Iowa City prepared by the Iowa City Engineer's Office is shown in Source: Iowa City Engineering Office 1947

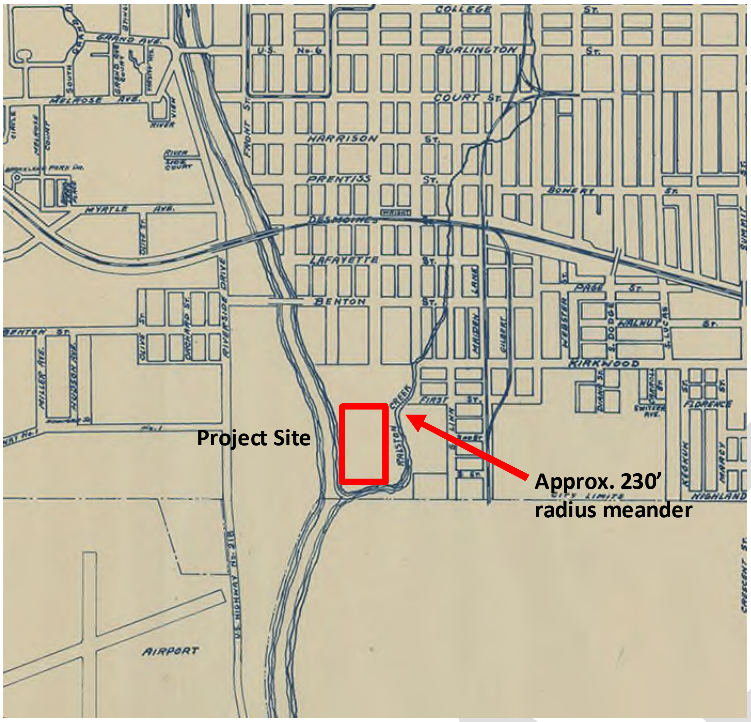
Figure 12. A close-up of the treatment facility site (Source: Iowa City Engineering Office 1947

Figure 13) shows the historic pattern of Ralston Creek. Mimicking these conditions leads to the establishment of a meandering channel with a radius of curvature in the bends of approximately 230 ft.



Source: Iowa City Engineering Office 1947

Figure 12. Map of Iowa City (1947)



Source: Iowa City Engineering Office 1947

Figure 13. Close-up of Treatment Facility Site (1947)

3.5 Habitat and Water Quality

Wetlands have been used for both treatment of both stormwater and wastewater flows (USEPA 1999; Miller 2007) and are becoming more frequently promoted as a green infrastructure technique to improve water quality. Stormwater runoff is a major source of pollutants to our waterways and has been shown to transport pesticides, oils, heavy metals, nutrients, and other pollutants (Lenhart 2011). Constructed wetlands can play an important role in limiting the impacts of urban runoff. Their benefits can include mitigating peaks in flow for flood control, replenishing ground water, reducing channel erosion, filtering runoff with vegetation, providing wildlife habitat, and pollutant removal. Stormwater wetlands are one of the most reliable and efficient methods of pollutant removal among stormwater practices, while also offering aesthetic and economic value (SMRC 2014; USEPA 1995). Stormwater wetlands provide valuable habitat for a diverse wildlife population and can improve downstream water quality and wildlife habitat by removing pollutants, reducing sediment loads, and reducing streambank erosion (USEPA 1999).

The effectiveness of stormwater wetlands in pollutant removal is dependent on establishing proper hydrology, appropriate flow paths, wetland system type, and loading rates. Stormwater wetlands achieve pollutant removal through physical (e.g., sedimentation, filtration), chemical (e.g., precipitation, adsorption to sediments), and biological (e.g., plant and bacterial uptake) mechanisms (EPA 1996). EPA, in a 1999 Storm Water Wetlands fact sheet, indicates significant long-term removal rates for many key pollutants found in urban environments (Table 7). Significant improvements have been made since that time in siting and design of wetlands to increase treatment of more troublesome pollutants such as total nitrogen.

DRAFT

Table 7. Performance of Storm Water Wetlands

Pollutant	Removal Rate
Total Suspended Solids	67%
Total Phosphorus	49%
Total Nitrogen	28%
Organic Carbon	34%
Petroleum Hydrocarbons	87%
Cadmium	36%
Copper	41%
Lead	62%
Zinc	45%
Bacteria	77%

Source: Modified from USEPA 1999

A recent study of stormwater wetlands in North Carolina found significant reductions in peak flows and runoff volumes by 80 and 54 percent, respectively. In addition, pollutant load reductions were significant (TKN: 35%; NO_{2+3}: 41%; NH_4-N: 42%; TN: 36%; TP: 47%; OP: 61%; and TSS: 49%) (Lenhart 2011). The International BMP Database is a compilation of BMP effectiveness measures from various designs throughout the world. According to the July 2012 update, when looking at wetland basins and channels, median removal of pollutants comparing inflow to outflow include TSS: 20.0–20.4 mg/L inflow and 9.06–14.3 mg/L outflow; TP: 0.13–0.15 mg/L inflow and 0.08–0.14 mg/L outflow; TN: 1.14–1.59 mg/L inflow and 1.19–1.33 mg/L outflow (Leisenring 2012).

Although the types and effectiveness of constructed wetland systems vary, a common factor in the success of all wetland systems is the presence of proper hydrology. The dominant soils in the treatment facility site are well draining and not conducive to establishing the anaerobic conditions necessary to support wetland vegetation. In many example cases of creating wetlands, a natural or synthetic liner is installed to prevent water from draining through the soil media and ultimately establishing a hydric soil community. This is dependent on a reliable water supply that can provide the proper hydrology. In the case of constructed wetlands for wastewater treatment, this supply can be obtained reliably from effluent discharges. In the case of stormwater treatment, the wetland system would be reliant on the dynamic nature of storm events. In both cases, proper sizing of the wetland to match the incoming load is critical to the success of the system.

Alternatively, a constructed wetland can also tie into the ground water supply to provide the necessary hydrology. Ground water can provide a reliable source of water for wetland systems, even in well drained soils, and is not dependent on loading variations. Ground water levels do fluctuate, which can lead to large-scale changes in plant communities, but effects can be mitigated by providing a diversity of plants at a variety of elevations throughout the wetland area. A thorough understanding of the local groundwater table is needed to ensure wetland plant communities are able to access the groundwater supply at the correct times throughout the year. The fluctuation of the groundwater table will ultimately define the final grading plan and the correct ground elevations will establish a strong wetland plant community.

DRAFT

The diversity of plants and elevations also supports a range of habitats and promotes use by a variety of wildlife. Wetlands can provide a food source, access to water, and refuge from predators and environmental conditions. Wetlands are among the most biologically productive ecosystems in the world. Up to one-half of North American bird species nest or feed in wetlands and, although wetlands make up only approximately 5 percent of land surface in the continental U.S., about 31 percent of plant species in the U.S. are found in wetlands (USEPA 2001a). Constructed wetlands have been shown to support high levels of biodiversity among phytoplankton, zooplankton, benthic macroinvertebrates, fish, and birds (Shaharuddin 2011). A national survey conducted by James Pease (1996) found that 85 percent of landowners believe providing habitat for wildlife is an extremely important reason for restoring wetlands. Bordered by the Iowa River on the west, Highway 6 on the south, and existing and proposed development areas on the north and east, the treatment facility site is an important urban oasis for wildlife.

4 Conceptual Design

The approach to the conceptual design of this restoration site was to re-create the historic floodplain conditions and establish an off-channel wetland to maximize water quality treatment at frequent storm events. This approach requires the establishment of multiple elevations that replicate the functionality of typical floodplain systems in this region but also stabilizes entry and exit points for flows from both Ralston Creek and the Iowa River. Ultimately, the functionality of the flood flow and water quality components of the site should seamlessly integrate with the other proposed modifications and amenities of the park site to encourage public interaction and environmental education in all portions of the reclaimed treatment facility site. Figure 14 shows a cross section of the proposed restoration design for Ralston Creek and the off-channel wetland area.

Figure 14. Conceptual Rendering of Restoration Cross Section

4.1 Stream/Wetland Complex

To develop a restored stream/wetland complex that restores natural functionality of this site, a 5-acre parcel was selected that begins near the abandoned railroad crossing of Ralston and gradually expands to include the area between the Iowa River and Ralston Creek on the south side of the site, ending near the Highway 6 embankment. An outline of the selected area is included in Appendix C. The primary floodplain and wetland restoration components will be included within this area, although grading could extend beyond this boundary to tie into existing grades or other park features. Appendix D includes conceptual grading plans of the site with cross-sections and a close-up view of the grading in this area is shown in Figure 15.

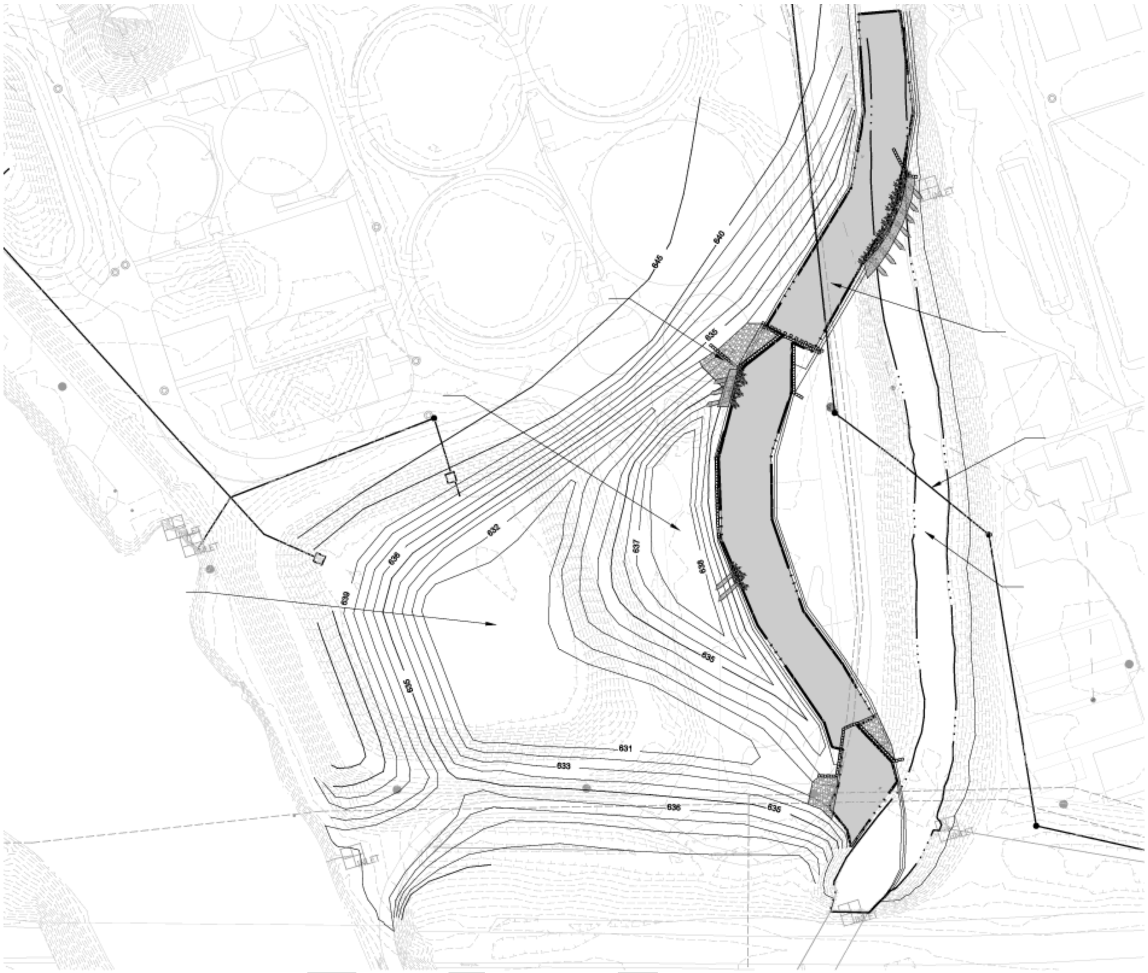


Figure 15. Proposed Grading for the Restoration Area

Restoration of Ralston Creek into a natural channel with a stable stream/floodplain connection requires adjustment of the channel cross-section and pattern further to the west. The top elevation of the banks is generally set at 634 ft to provide overbank flows under the 1–2-year flood frequency. A bench will be graded into the east bank of the creek at this elevation until it matches the existing left bank. This will reduce stresses along the existing left bank, which is not currently controlled by the city. A radius of curvature of approximately 230 ft, estimated from historical maps of the area to match pre-existing conditions, is used to pull the channel away from the existing left bank and push it back to reconnect with the existing channel location slightly upstream of the culvert under Highway 6.

Reestablishing sinuosity within this section will help naturally create point bars in the meander bends connecting the stream bed to the first bottom (or primary bench). Creating these point bars is important for sediment management within this reach and to encourage habitat diversity in the channel. Point bars and channel sinuosity can also have an effect on local variations in water surface elevation for various flood events, adjusting specific locations of overbank flows.

The ground water-supplied wetland area is established by utilizing the existing topography to simulate an oxbow lake configuration. Significant excavation is necessary to establish the approximately 631-ft elevation required to access the ground water table. This excavation is minimized as much as possible by locating the wetland area at the site of the existing equalization pond (elevation of approximately 638 ft). Typically, oxbow lakes are formed as remnant channel sections of large meanders that are cut off from the main channel; to simulate this formation, a high terrace is left between Ralston Creek and the created wetland. This high terrace (or second bottom) is located at an elevation of approximately 638 ft to adhere to the secondary level found in Iowa floodplains and would be a typical feature of stream corridors throughout this region.

This high terrace serves multiple functions. Primarily, it helps to ensure that the newly established floodplain and wetland area are only accessed at specific locations. The significant modifications to the channel pattern and overbank floodplain proposed in this concept design can alter the creek's capacity to transport sediment. Loads from upstream could dynamically adjust water surface elevations and overbank flow locations. Maintaining this high terrace helps ensure that overbank flows primarily follow designed entrance points into the wetland area and exit points out of the wetland area, which can be reinforced to provide long-term stability of the system. The high terrace also creates a higher established bank on the outside bend of the restored stream channel, helping to maintain natural flow conditions within Ralston Creek. Finally, the high terrace allows a wider variation of plant material within the area, to include less flood-resistant plants, and better access to multiple viewpoints for the park users.

To promote more access to the wetland and floodplain area during lower storm events, the conceptual design includes lower portions of the west bank of Ralston Creek in areas where a remnant channel could be found. These lower areas, located at approximately 633 ft, would be accessed during the 1-year flood event or perhaps even more frequently. These areas should be graded appropriately to maintain a positive drainage from the entrance to the exit to facilitate a natural flow-through system following the direction of the riparian corridor.

Water surface elevations of the 2-year flood frequency for the Iowa River are similar to those established for Ralston Creek. Currently, a berm along the east bank of the Iowa River prevents the flows from accessing this area, and it is not until nearly the 10-year flood event that portions of this site become directly inundated by the Iowa River. The concept plan proposes to lower the elevations only slightly, to an elevation of approximately 636 ft that is more closely tied with the 5-year flood event. No other major changes are proposed to the berm at this time as a way to reduce grading and cut on the site and to minimize any impacts to the Iowa River floodway. Coordination with other proposed park uses could adjust the ultimate grading and elevations within this area.

This proposed design requires a significant amount of cut and ultimately removal of material from the site to match the multiple design elevations. Initial estimates indicate a net cut of more than 64,000 cubic yards of material.

4.2 Water Quality Treatment

By not connecting the Iowa River and Ralston Creek at lower flow events, the full wetland and floodplain area is available to treat smaller storm events from the Ralston Creek watershed. With an overbank connection to Ralston Creek near the mouth, this area can assist in removing sediment, nutrients, and other pollutants before they enter the Iowa River. Stormwater flows up to the 2-year event will enter only from Ralston Creek[4] and the proposed inclusion of the high terrace and additional site grading will result in longer flow paths and residence times within the system.

[4] Flood events higher than the 2-year event will begin to experience backwater effects from the Iowa River.

The ultimate size of the wetland portion is dependent on available ground water hydrology, but a minimum of 0.5 acre of permanent wetland area (located at an elevation of 631 ft) is proposed. This permanent wetland area could expand to 1.0 acre depending on ground water and overbank flow availability. Significant water quality improvements are not limited to the permanent wetland area. As the water surface elevation increases, larger portions of the site are accessed causing filtering and uptake processes to occur. Figure 16 shows the inundation of the site under flood conditions. The permanent wetland area under normal flow conditions (631 ft, shown in blue) is approximately 0.5 acre. As the water surface elevation increases to 634 ft (between the 1- and 2-year events), flows inundate more than 1 acre of the site. At 634 ft, nearly 4 acres of the restored site is accessed by flood flows. Under current conditions, water would still be primarily confined to the banks of Ralston Creek at this elevation but under restored conditions there is the possibility for significantly more water quality benefits through physical, biological, and chemical processes.

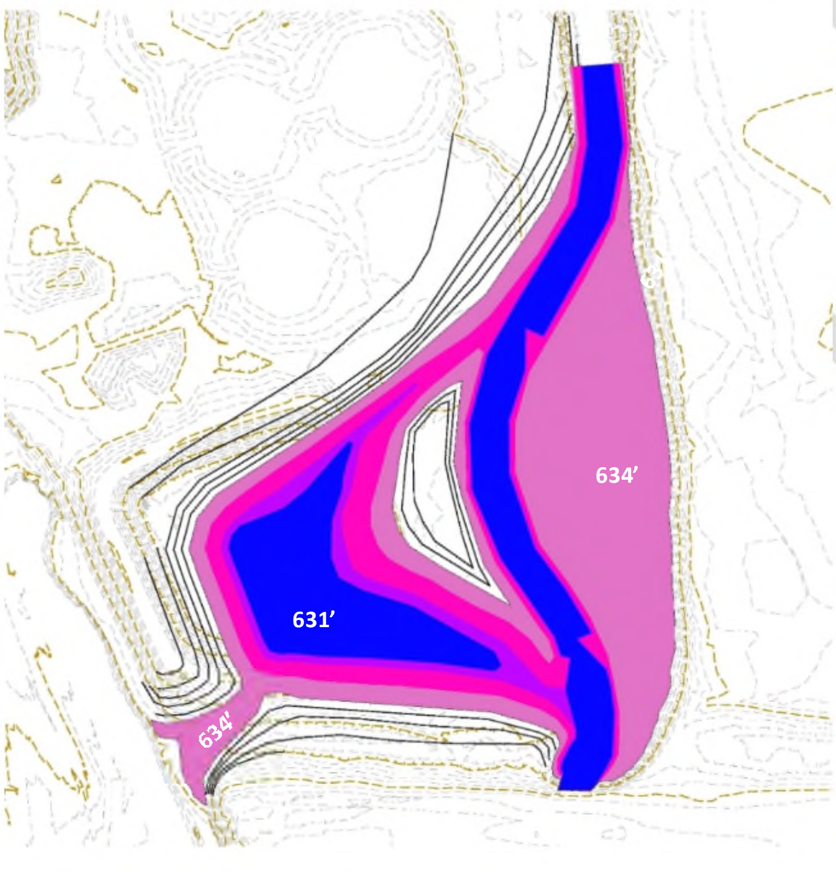


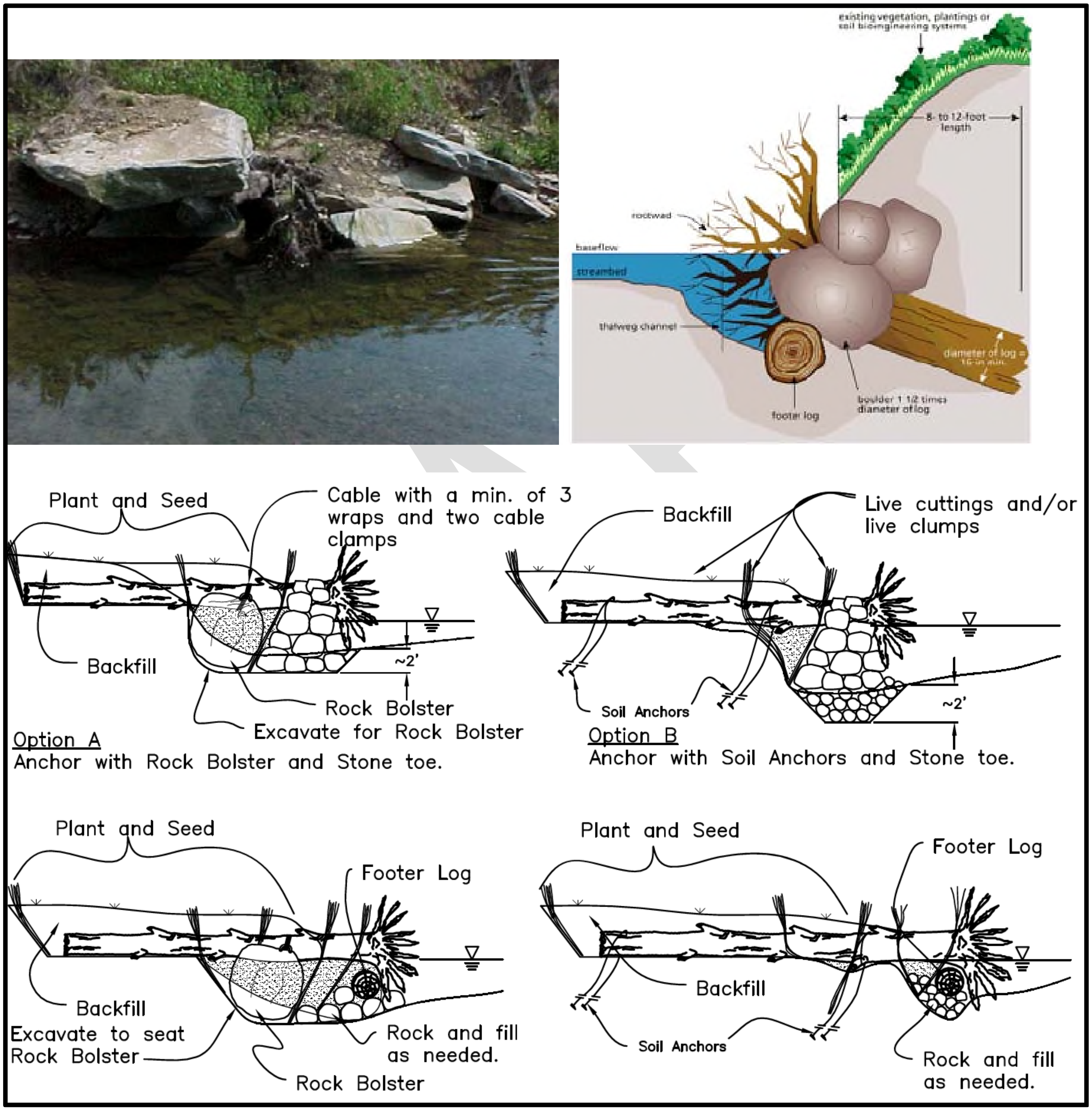
Figure 16. Site Inundation Under Flood Conditions

4.3 Typical Restoration Components

Typical restoration features that would be beneficial in the design of a stormwater wetland and in improving the bank and meander pattern of Ralston Creek include root wads, cross vanes, vegetated soil lifts, and imbricated stream bed material.

Root wad structures can be used to help stabilize banks as well as provide in-stream habitat among the root branches for fish and invertebrates. Source: USEPA 2001b; NRCS 2008.

Figure 17 shows typical examples of how a root wad can be used along the edge of a streambank.



Source: USEPA 2001b; NRCS 2008.

Figure 17. Examples of Design Details and Field Photos of Root Wads Used in Restoration

Cross vanes or J-hook vanes can be used to stabilize a channel and channel flow away from banks to prevent erosion.

Source: *NRCS 2006, 2007.*

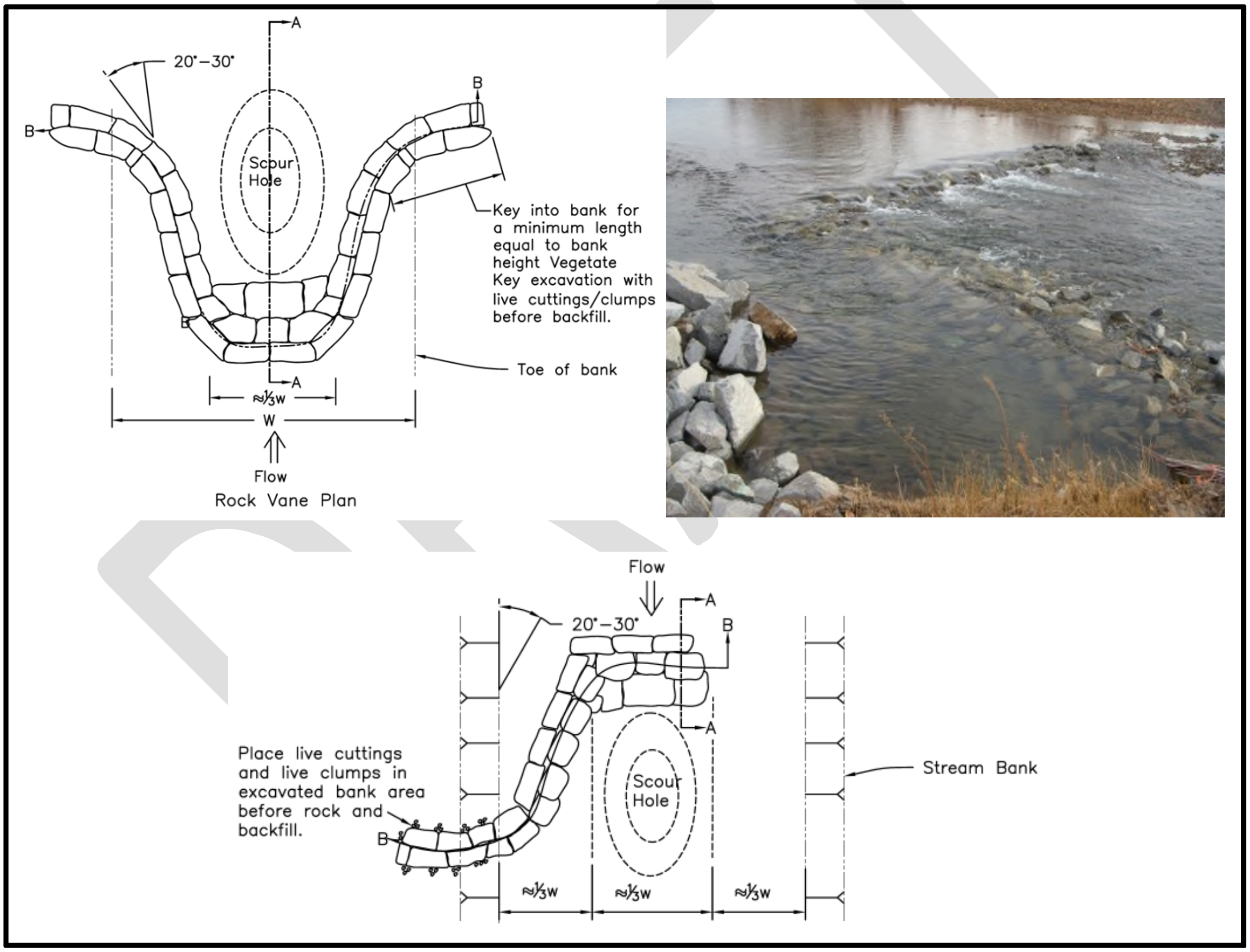
Figure 18 shows a typical detail of cross vanes and J-hook vanes as well as a photo of a cross vane in practice.

Soil lifts can be used to stabilize a bank and gradually tie in to a more gradual slope. Source: WSSC 2013.

Figure 19 shows a typical detail of a soil lift.

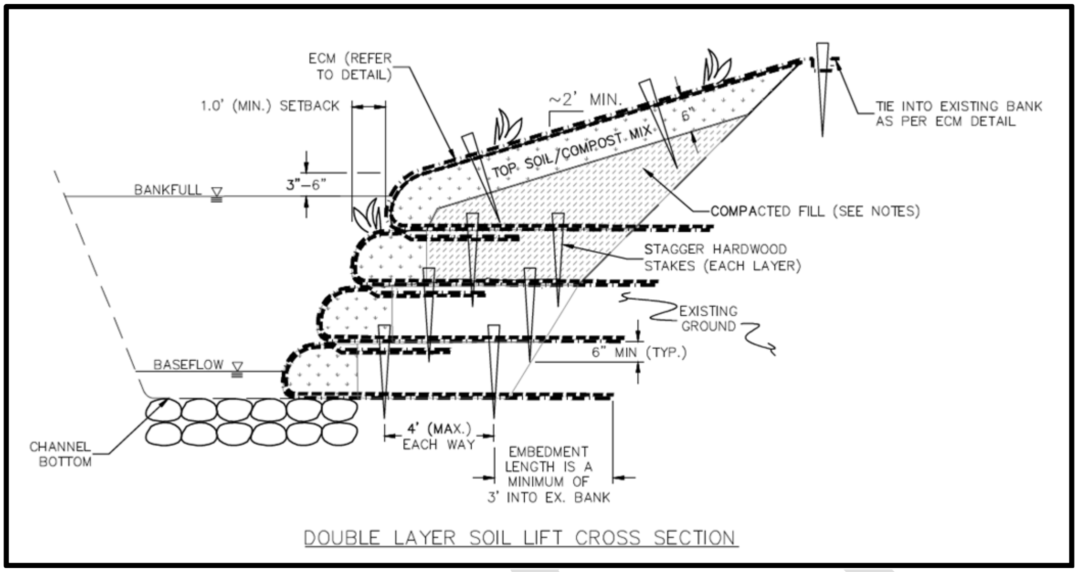
Imbricated rip-rap can be used to stabilize a bank and prevent erosion. Source: M-NCPPC 2014

Figure 20 shows a typical detail of imbricated rip-rap.



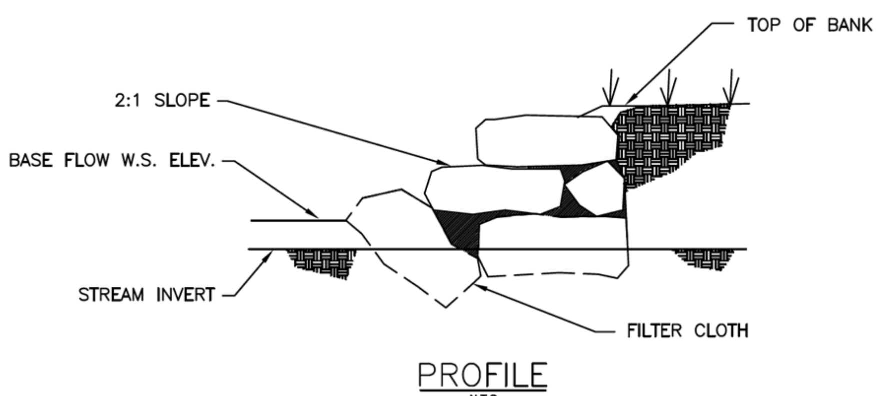
Source: NRCS 2006, 2007.

Figure 18. Examples of Design Details and Field Photos of Cross Vanes used in Restoration



Source: WSSC 2013.

Figure 19. Example of Design Detail of Double Soil Lift Used in Restoration



Source: M-NCPPC 2014

Figure 20. Example of Design Detail of Imbricated Rip-Rap Used in Restoration

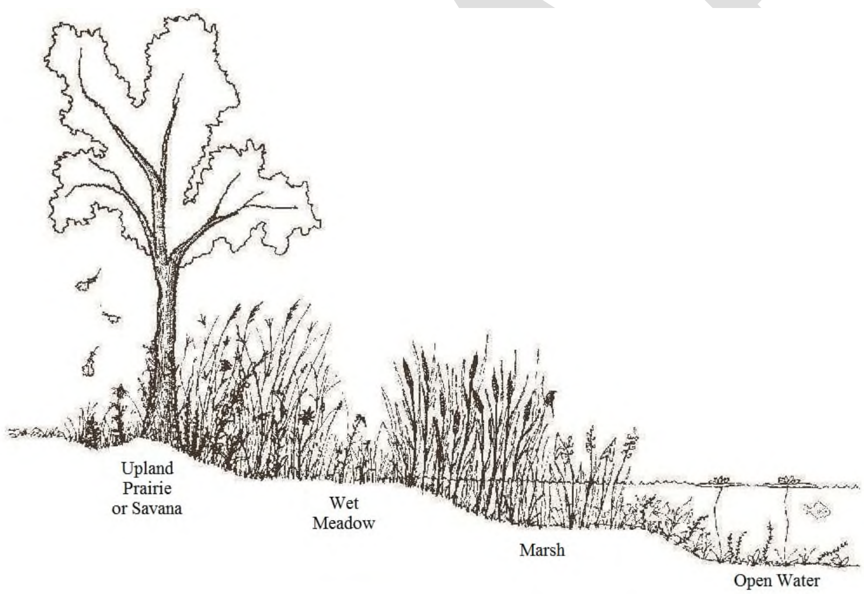
4.4 Plant Palette

In this region of Iowa, native stream/wetland systems contain a variety of species with a significant adapted variation to perennial or periodic inundation. The tolerance of those species would sort out along the hydrologic gradient based on the frequency and duration that the areas are inundated or saturated. Wetlands are typically categorized based on the typical water depth during the growing season and the vegetative community, as described in Table 8 (Shaw and Fredine 1956). The proposed restoration of the wetland involves connection to the groundwater table to maintain wetland hydrology and no open water wetland areas are proposed. Instead, the proposed wetland area will be planted with a marsh vegetative community and transition gradually to wet meadow and upland plants. The delineation between these vegetative communities will be dependent on hydrology and other environment factors and will likely adjust as the proposed restoration stabilizes. Similar plantings will be conducted along the restored Ralston Creek, with an emphasis on wet meadow plants.

Table 8. Wetland Types by Water Depth

Wetland Type	Water Depth	Vegetative Community
Wet Meadow	No standing water, soils saturated	Grasses, sedges, rushes, various broad-leaved plants
Marsh	Up to 3 ft	Grasses, bulrushes, spikerushes, cattails, reeds, pondweeds, waterlilies
Open Water	3 ft up to 10 ft	Pondweeds, coontail, watermilfoils, waterlilies

Source: Shaw and Fredine 1956.



Source: Iowa State University Extension, 1999.

Figure 21. Typical Cross Section of Wetland Types

When selecting the palette of plant species, criteria were assessed to achieve the following:

- Mimic a typical floodplain wetland with native vegetation to Iowa.
- Require as little maintenance as possible during the species establishment period.

- Contain advantageous seed dispersal and germination traits so natural regeneration occurs and the system is sustained.
- Resist varied hydrologic conditions so that adaptive management can be applied and survivability increases under natural stabilization processes.
- Are readily available at nurseries and in stock in sizes that make sense for initial planting.
- Create an environment for diverse wildlife.
- Result in an environmental restoration project that is aesthetically pleasing to the public.

The palette of plant species was created to attempt to meet the desired criteria and is based on each species' suitability for each of the wetland types described above. The conceptual grading plans will create a tiered approach with opportunities for differing hydrologic flood regimes so that the system will stabilize and adjust its native composition as any natural system does with time.

Grasses and Grass-Like Plants				
Species		**Upland Prairie**	**Wetland Type**	
Common Name	**Scientific Name**		**Wet Meadow**	**Marsh**
Big Bluestem	Andropogon gerardii	X	X	
Bluejoint	*Calamagrostis canadensis*		X	
Sedges	*Carex spp.*		X	X
Spike Rushes	*Eleocharis spp.*		X	X
Virginia Wild Rye	*Elymus virginicus*		X	
Mana Grass	*Glyceria spp.*		X	X
Rushes	*Juncus spp.*	X	X	X
Cutgrasses	*Leersia spp.*		X	
Common Reed	*Phragmites australis*			X
Fowl Blue Grass	*Poa palustris*	X	X	
Bulrushes	*Schoenoplectus spp.*			X
Dark Green Bulrush	*Scirpus atrovirens*		X	X
Wool Grass	*Scirpus cyperinus*		X	X
Prairie Cordgrass	*Spartina pectinata*		X	
Broadleaf Cattail	*Typha latifolia*			X

DRAFT

Flowering Plants				
Species		Upland Prairie	Wetland Type	
Common Name	Scientific Name		Wet Meadow	Marsh
Nodding Onion	*Allium cernuum*	X	X	
Canada Anemone	*Anemone canadensis*	X	X	
Milkweeds	*Asclepias spp.*	X	X	
Sticktight	*Bidens spp.*		X	
False Aster	*Boltonia asteroides*	X	X	
Buttonbush	*Cephalanthus occidentalis*		X	
Flat Topped Aster	*Doellingeria umbellata*	X	X	
Rattlesnake Master	*Eryngium yuccifolium*	X	X	
Bonset	*Eupatorium perfoliatum*		X	
Joe Pye Weed	*Eutrochium spp.*		X	
Sneezeweed	*Helenium autumnale*	X	X	
Sawtooth Sunflower	*Helianthus grosseserratus*	X	X	
Cow Parsnip	*Heracleum maximum*	X	X	
Rose Mallow	*Hibiscus laevis*		X	
Great St. John's Wort	*Hypericum ascyron*	X	X	
Blue Flag Iris	*Iris virginica*		X	
Prairie Blazingstar	*Liatris pycnostachya*	X	X	
Great Blue Lobelia	*Lobelia siphilitica*		X	
Monkey Flower	*Mimulus spp.*		X	
White Water Lily	*Nymphaea odorata*			X
Smartweed	*Persicaria spp.*		X	X
Pondweed	*Potamogeton spp.*			X
Mountain Mint	*Pycnanthemum spp.*	X	X	
Sweet Blackeyed Susan	*Rudbeckia subtomentosa*	X	X	
Water Dock	*Rumex britannica*		X	X
Arrowhead	*Sagittaria spp.*			X
Cup Plant	*Silphium perfoliatum*	X	X	

DRAFT

Flowering Plants				
Species		Upland Prairie	Wetland Type	
Common Name	Scientific Name		Wet Meadow	Marsh
Goldenrod	*Solidago spp.*	X	X	
Aster	*Symphyotrichum spp.*		X	
Blue Vervain	*Verbena hastata*	X	X	
Ironweed	*Vernonia gigantea*	X	X	
Golden Alexander	*Zizia aurea*	X	X	

Trees and Shrubs				
Species		Upland Prairie	Wetland Type	
Common Name	Scientific Name		Wet Meadow	Marsh
Red Maple	*Acer rubrum*	X	X	
Silver Maple	*Acer saccharinum*	X	X	
Speckled Alder	*Alnus incana*	X	X	
Ohio Buckeye	*Aesculus glabra*	X	X	
Birch	*Betula spp.*	X	X	
Pecan	*Carya illinoinensis*	X	X	
Shell-Bark Hickory	*Carya laciniosa*	X	X	
Dogwood	*Cornus spp.*	X	X	
Black Walnut	*Juglans nigra*	X	X	
Eastern Red Cedar	*Juniperus virginiana*	X	X	
American Sycamore	*Platanus occidentalis*	X	X	
Quacking Aspen	*Populus tremuloides*	X	X	
Black Cherry	*Prunus serotina*	X	X	
Swamp White Oak	*Quercus bicolor*	X	X	
Burr Oak	*Quercus macrocarpa*	X	X	
Pin Oak	*Quercus palustris*	X	X	
Black Elder	*Sambucus nigra*	X	X	

Vegetation establishment will be accomplished by a combination of grading and planting and natural regeneration. This will require proper site preparation, installation, and maintenance. With a goal of establishing the wetland vegetation as soon as possible, using primarily species that grow rapidly such as

DRAFT

grasses, sedges, cattails, and maples is recommended with a smaller proportion of slower growing plants to provide vegetation diversity and promote important wildlife value. Quickly establishing desired vegetation reduces the opportunity for the nuisance and invasive plants to take over the freshly disturbed and planted wetland and floodplain areas.

4.5 Park Configuration and Connection to Surrounding Redevelopment

Restoration of Ralston Creek and the adjacent floodplain is part of a larger effort to establish a multiple-use public park at the site of the former North Wastewater Treatment Plant. This park, currently in the conceptual design phase, will consist of many different design elements and will encourage a wide range of residential users. A section of the proposed park focused on the connection between the restoration area and the surrounding area is shown in Figure 22.

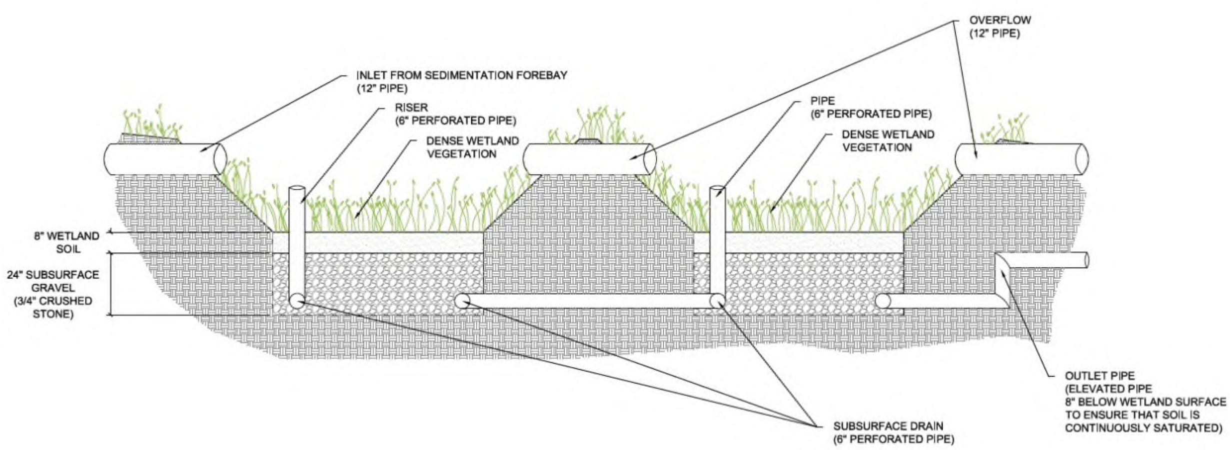
Source: RDG 2015

Figure 22. Proposed Concept for Riverfront Crossings Park

A common comment raised during public outreach events for the park project is to obtain better public access to the water. A trail system is proposed that takes advantage of multiple viewpoints over the Iowa River, Ralston Creek, and the restored wetland area. This trail system will bridge high points and include lower sections that will allow users to weave through the wetland. Although the main entrances from the surrounding development areas will be located at the north end of the proposed park, low water crossings of Ralston Creek using natural rock boulders are included in the conceptual stream restoration design. Residents and visitors will be able to access the proposed park from the planned redevelopment area through a path that will travel through the restored floodplain area and across the low-water crossing, providing a direct connection to the restored area.

The water quality components of the wetland can also be extended to the surrounding redevelopment areas, expanding Iowa City's connection to this restoration. As part of the Downtown and Riverfront Crossings Master Plan (HDR 2013), wide promenades are proposed leading towards the park and ending at Ralston Creek. Constructed stormwater gravel wetlands, as shown in Source: CRWA 2009.

Figure 23, can be very effective at reducing nutrients as well as sediment (Ballestero et al. 2011). Where the water quality treatment processes associated with the restored wetland require a larger area and reliable ground water supply, constructed stormwater gravel wetlands can be installed in much smaller areas with only stormwater runoff as a water source. These facilities can be easily integrated into the redeveloped promenade areas to treat stormwater from neighboring buildings and impervious surfaces before discharging to Ralston Creek. Certain plant species can be selected for the stormwater gravel wetlands to match planting plans for the restored wetland to provide an additional visual connection between the two areas.



Source: CRWA 2009.

Figure 23. Gravel Wetland Schematic

4.6 Conceptual Design Cost Estimate

A cost estimate was prepared based on the configuration and elements of the proposed conceptual level design of the wetland and stream complex. Quantities were developed using the proposed grading to create the wetland area and the proposed location of in-stream and bank restoration components. Unit costs were assembled from typical industry values and estimates from similar stream/wetland projects. Costs to excavate and remove material from the site to create the wetland area represent the majority of the estimate but refinements to the siting of the wetland on the property and coordination with other park components neighboring projects during more detailed design phases might reduce both the amount of material to be removed and the unit costs for removing the material, greatly impacting the overall cost estimate. Utilizing region-specific unit costs and detailed quantities from design plans will also reduce the contingency included at the conceptual design phase, potentially lowering the overall cost. The conceptual design cost estimate is included in Table 9.

Table 9. Conceptual Design Cost Estimate

Item No	Description	Quant.	Unit	Unit Cost	Total
	Site Access				
1	Clearing without Grubbing (including trees < 10" DBH)	0	AC	$9,725.00	$0.00
2	Tree Removal (greater than 10" DBH) - per inch DBH	20	IN	$50.60	$1,012.00
3	Stabilized Construction Entrance - Build & Maintain	1	EA	$3,040.00	$3,040.00
4	Crew Hours - Construction Stakeout	25	HRS	$250.00	$6,250.00
	Sediment and Erosion Control				
5	Tree Trunk Protection (Per Tree)	5	EA	$185.00	$925.00
6	Diversion sandbag dike (up to 4' height)	400	LF	$50.00	$20,000.00
7	Stream Diversion - pump mobilization	2	EA	$250.00	$500.00
8	Greater than 10 inch Pump	20	ED	$1,500.00	$30,000.00
9	Stone Outlet Structure	1	EA	$1,000.00	$1,000.00
10	Temporary dewatering device	1	EA	$1,800.00	$1,800.00
11	Silt Fence	2,200	LF	$3.73	$8,206.00
	Excavation and Hauling				
12	Excavated Earth hauled Offsite for Disposal	60,500	CY	$27.50	$1,663,750.00
13	Excavated Earth for reuse on-site as fill	4,700	CY	$19.75	$92,825.00
14	Streambed and Stream Embankment	650	CY	$102.00	$66,300.00
	Structures				
15	Soil - Fabric Lift	500	CY	$171.00	$85,500.00
16	Class I Stone	200	CY	$135.00	$27,000.00
17	Log - 12 inch diameter (onsite)	120	LF	$57.00	$6,840.00
18	Class II Stone	10	CY	$163.00	$1,630.00
19	Class III Stone (stacked imbricated)	150	CY	$282.00	$42,300.00
20	Geotextile Filter Fabric (woven)	400	SY	$3.00	$1,200.00
	Landscaping				
21	Wetland Seeding	35	LB	$268.00	$9,380.00
22	Temporary and Permanent Riparian Seeding	6	AC	$2,500.00	$15,000.00
23	Wetland Planting Plug - 2 inch	500	EA	$3.45	$1,725.00
24	Tublings or approved equal	100	EA	$20.00	$2,000.00
25	Shrub - Container Grown, Height 3-4 feet	20	EA	$60.00	$1,200.00
26	Tree - Container Grown, 1-1½ inch Caliper	20	EA	$150.00	$3,000.00
	Construction Subtotal				$2,092,383.00
	Mobilization and stakeout 5%				$104,619.15
	Bonds and Insurance 5%				$104,619.15
	Construction contingency 10%				$209,238.30
	CONCEPT LEVEL ESTIMATION CONTINGENCY 20%				$418,476.60
	Total Construction Cost				**$2,929,336.20**

DRAFT

5 Future Steps

Iowa City is preparing for demolition of the North Wastewater Treatment Plan facilities and has developed concepts for the overall park plan. Park planning was performed in conjunction with this stream and wetland restoration conceptual design so that restoration components and necessary grading can be integrated into the overall park plan. Both the park plan and the restoration plan will need to advance through more detailed design phases to develop construction plans. Since the restoration plan affects a regulated waterway, environmental permitting will also be required before construction can begin.

Extension of the green infrastructure concepts implemented in the wetland to the surrounding planned mixed-use development should be integrated early in the redevelopment planning process. If the stormwater gravel wetlands can be designed along with the promenade and other necessary infrastructure, it will maximize the effectiveness and ease of implementation of these green infrastructure techniques.

6 References

Arbuckle, K., and J.L. Pease. 1999. *Managing Iowa Habitats: Restoring Iowa Wetlands.* Pm-1351h. Iowa State University Extension, Ames, IA.

Ballestero, T., R. Roseen, J. Houle, A. Watts, and T. Puls. 2012. Subsurface Gravel Wetlands for the Treatment of Stormwater. Paper presented at NJASLA 2012 Annual Meeting and Expo, January 29–31, 2012, Atlantic City, NJ.

Bukaveckas, P.A. 2007. Effects of channel restoration on water velocity, transient storage, and nutrient uptake in a channelized stream. *Environmental Science & Technology*. 41 (5):1570-1576.

Cadenasso, M.L., S.T. Pickett, P.M. Groffman, L.E. Band, G.S. Brush, M.F. Galvin, J.M. Grove, G. Hagar, V. Marshall, B.P. McGrath, J.P. O'Neil-Dunne, W.P. Stack, A.R. Troy. 2008. Exchanges across land-water-scape boundaries in urban systems. *Annals of the New York Academy of Sciences.* 1134:213-232.

CRWA (Charles River Watershed Association). 2009. *Constructed Stormwater Gravel Wetland*. Low Impact Best Management Practice (BMP) Information Sheet. Accessed October 31, 2012. www.crwa.org/projects/stormwater/stormwaterBMPs.html.

Eash, D.A., K.K. Barnes, and A.G. Veilleux. 2013. *Methods for Estimating Annual Exceedance-Probability Discharges for Streams in Iowa, Based on Data Through Water Year 2010*. U.S. Geological Survey Scientific Investigations Report 2013-5086. Reston, VA.

FEMA Federal Emergency Management Agency). 2002. *Flood Insurance Study Johnson County, Iowa and Incorporated Areas*. Flood Insurance Study Number 19103CV000A. Revised February 16, 2007. Federal Emergency Management Agency, Washington, DC.

HDR. 2013. *Downtown & Riverfront Crossings Master Plan.* HDR Engineering, Inc. Performed for Iowa City, IA.

Interagency Advisory Committee on Water Data. 1971. *Guidelines for Determining Flood Flow Frequency.* Bulletin #17B of the Hydrology Subcommittee. U.S. Geological Survey, Reston, VA.

Iowa City Engineer's Office. 1947. *Iowa City, 1947* [map]. Scale 1" = 800'. University of Iowa Libraries Map Collection. Posted April 10, 2013. Accessed October 15, 2014. http://digital.lib.uiowa.edu/cdm/singleitem/collection/sheetmaps/id/84/rec/155.

Leisenberg, M., J. Clary, and P. Hobson. 2012. *International Stormwater Best Management Practices (BMP) Database Pollutant Category Summary Statistical Addendum: TSS, Bacteria, Nutrients, and Metals*. Accessed October 15, 2014. http://www.bmpdatabase.org/Docs/2012%20Water%20Quality%20Analysis%20Addendum/BMP%20Database%20Categorical_SummaryAddendumReport_Final.pdf.

Lenhart, H.A., and W.F. Hunt III. 2011. Evaluating Four Storm-Water Performance Metrics with a North Carolina Coastal Plain Storm-Water Wetland. *Journal of Environmental Engineering.* 137(2):155-162.

Miller, J. 2007. *Constructed Wetland Technology Assessment and Design Guidance.* Iowa Department of Natural Resources.

M-NCPPC (Maryland National Capital Parks and Planning Commission). 2014. Imbricated Rip-rap Detail. Maryland National Capital Parks and Planning Commission. Standard construction details.

NRCS (National Resources Conservation Service). 2005. *Restoring Iowa Wetlands.* U.S. Department of Agriculture, Natural Resources Conservation Service, Washington, DC.

NRCS (National Resources Conservation Service). 2006. *Small Cross Vane*. Conceptual Plan. U.S. Department of Agriculture, Natural Resources Conservation Service, Washington, DC.

NRCS (National Resources Conservation Service). 2007. *Hook Vane*. Conceptual Plan. U.S. Department of Agriculture, Natural Resources Conservation Service, Washington, DC.

NRCS (National Resources Conservation Service). 2008. *Rootwad in Low Bank*. Conceptual Plan. U.S. Department of Agriculture, Natural Resources Conservation Service, Washington, DC.

Pease, J. L., M.L. Rankin, J. Verdon, and R. Reisz. 1996. *Why Landowners Restore Wetlands: A National Survey.* Iowa State University, Ames, IA.

Randall, J.A., and J. Herring. 2012. *Management of Floodplain Forests.* Iowa State University Forestry Extension, Ames, IA.

Schermerhorn, E.J. 1983. *Soil Survey of Johnson County Iowa.* U.S. Department of Agriculture, Soil Conservation Service, Washington, DC.

Shaw, Samuel P., and C. Gordon Fredine. 1956. Wetlands of the United States - Their Extent and Their Value To Waterfowl and Other Wildlife. Circular 39. U.S. Department of the Interior, Washington, DC. Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/wetlands/uswetlan/index.htm (Version 05JAN99).

Tharp, W.E., and Artis, G.H. 1922. *Soil Survey of Johnson County Iowa.* Bureau of Soils, U.S. Department of Agriculture, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 1995. *Economic Benefits of Runoff Control*. EPA 841-S-95-002. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 1996. *Protecting Natural Wetlands: A Guide to Stormwater Best Management Practices.* EPA-843-B-96-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

DRAFT

USEPA (U.S. Environmental Protection Agency). 1999. *Storm Water Technology Fact Sheet: Storm Water Wetlands.* EPA 832-F-99-025. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2001a. *Functions and Values of Wetlands*. EPA 843-F-01-002c. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2001b. *The Narrows Stream Bank Restoration and Protection Project*. 319 grant success stories. U.S. Environmental Protection Agency, Region 3.

USEPA (U.S. Environmental Protection Agency). 2009. *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*. EPA 841-B-09-001. U.S. Environmental Protection Agency, Washington, DC.

Shaharuddin, S., A.A. Ghani, N.A. Zakaria, and M. Mansor. 2011. Biodiversity in Stormwater Constructed Wetlands: Case Study of USM Wetland. In *Proceedings from 3rd International Conference on Managing Rivers in the 21st Century*. pp. 313-324. Malaysia. December 6-9, 2012.

SMRC (Stormwater Manager's Resource Center). 2014. *Stormwater Management Fact Sheet: Stormwater Wetland*. The Stormwater Manager's Resource Center. Accessed October 31, 2014. http://www.stormwatercenter.net/.

Woodyer, K.D. 1963. Bankfull Frequency in Rivers*. Journal of Hydrology* 6(2):114-142.

WSSC (Washington Suburban Sanitary Commission). 2013. *Standard Stream Restoration Details*. Washington Suburban Sanitary Commission, Washington, DC.

7 Appendix A: Soil Boring Map and Logs

DRAFT

8 Appendix B: Soil Classification Map

DRAFT

9 Appendix C: Proposed Restoration Area

DRAFT

10 Appendix D: Draft Grading Plan and Cross Sections

DRAFT