Introduction

The White Fox Wetland Mitigation Bank was established by a private landowner along the floodplain of the White Fox River in Wright County, Iowa. The 90-acre site was a former gravel mine and now is in row crop production. The landowner recognized that continuing to utilize this area for row crop production was not in his best interest from a financial or environmental perspective.

During the initial assessment of the property, the team identified severely eroded streambanks, which increased the sediment load within the stream. Other site conditions included an oxbow that had been isolated by manipulating the source of hydrology and a flood plain that was disconnected from the stream.

This project is an excellent example of how to successfully restore an aquatic ecosystem in a sizable floodplain by utilizing design methods and applicable best management practices to ensure the land in and around the site is improved for the long-term (see Figure 1).

Figure 1. White Fox Mitigation Bank Restoration

Background

White Fox Creek was historically a natural meandering stream with what appeared to be intact buffers and associated floodplain wetland areas (see Figure 2). In the 1950s, portions of the creek were channelized and, as a result, several of the natural meanders were lost. A gravel mining business also operated adjacent to White Fox Creek (see Figure 3). The greatest impacts to White Fox Creek occurred in the 1960s and 1970s. It was during this time that the stream was severely channelized. The channelization included installing a ditch plug that minimized the stream's connectivity to its former channel (see Figure 4). Work began in 2019 to improve the site (see Figure 5).

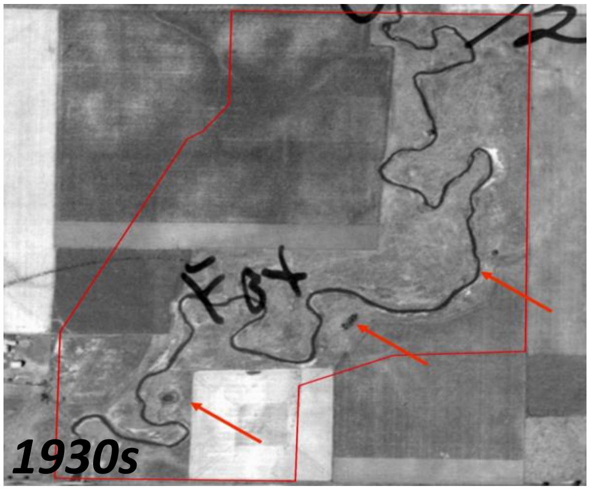

Figure 2. Markings show a naturally meandering stream, intact buffers, and floodplain wetland areas.

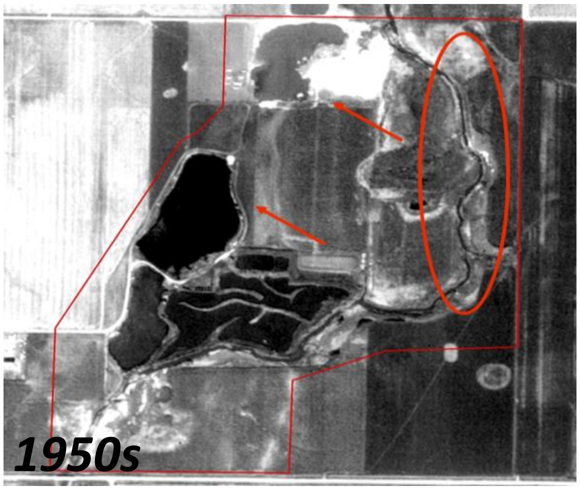

Figure 3. Markings show the gavel mining business, a channelized creek, and natural meanders lost.

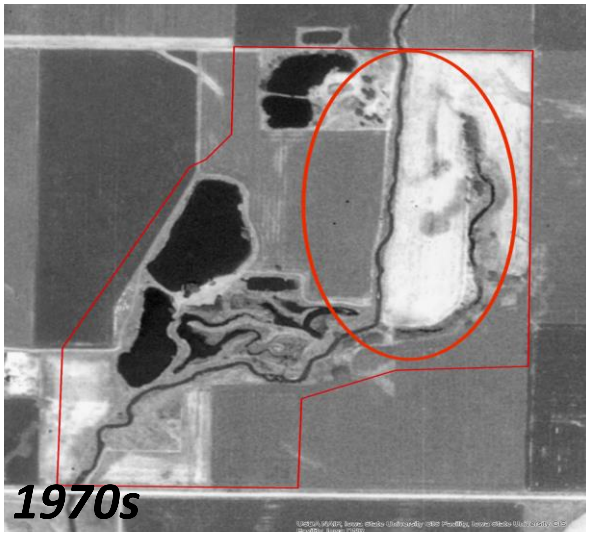

Figure 4. Markings show a severely channelized stream and very few remaining natural features.

Figure 5. Between the 1930s and 2019, over 3000' of stream channel had been lost in just one-half mile.

Project Team

Scientists and staff from JEO Consulting Group Inc. were engaged to review the property and develop alternatives that would provide economic benefits to both the landowner and the surrounding community. Some of the required erosion control and sediment control solutions were manufactured by American Excelsior Company.

The Plan – Bio Engineered Solutions

The main objective was to develop an ecologically sound restoration plan that would avoid impacts to adjacent agricultural land, create resiliency to reduce downstream flooding, and maximize the potential value of the mitigation bank. Bio engineering provides streambank stability while improving the ecological function of both the stream and riparian area. Vegetative restoration is preferred over hard armoring and other engineered revetment techniques like rip rap for many reasons (see Figure 6).

Environmental Benefits of Vegetative Restoration

Reduce velocity and increased sedimentation	Filter of contaminants like heavy metals	Safer and softer than hard armor and rip rap	Easier site access than rip rap
Less destructive installation than rip rap	Return site to natural vegetated conditions	Increased stormwater filtration	Increased stormwater infiltration
Vegetation can be mowed if desired	Cooler water discharges than hard armor	Lower carbon footprint than rip rap	Lower installed cost vs. hard armor and rip rap

Figure 6. Environmental Benefits of Vegetative Restoration

The Plan – Bio Engineered Solutions - Continued

The White Fox Mitigation Bank utilized native grasses, wildflowers, and live Willow and Red Osier Dogwood stakes combined with erosion control blankets (ECBs). Curlex® ECBs were chosen for this project based on decades of performance data. The three most common natural fibers used in ECBs are straw, coconut, and excelsior (wood) (see Figures 7-9).


Figure 7. Straw Fibers

Straw is an agricultural by-product. It is straight and contains hollow and flat fibers. Straw fibers have their limitations, most concerning is that they float. More and more states do not allow straw in channels. Straw products inherently contain seeds, some of which may be noxious weeds.


Figure 8. Coconut Fibers

Coconut fibers are typically imported from Southern Asian countries. Coconut is considered a durable long-lasting material. Thick, heavy mats do provide good protection, but if products are too thick, they can impede vegetation growth. Coconut is generally considered to have a poor carbon footprint. Coconut fibers introduce a nonnative matrix into the environment and their dark color may cause seed burn out before germination.


Figure 9. Curlex Fibers

Curlex excelsior fibers are a superior natural fiber for many reasons. Curlex expands and contracts to conform to irregularities and mechanically bind to the soil. Curlex has engineered curls and barbs (see Figure 9). Curlex has a higher Manning's n than straw. That "roughness" slows water velocity, resists shear stress, holds the blanket in place, and captures sediment from overland flow. Curlex is made from Great Lakes Aspen, which is naturally seed-free and domestically sourced from members of sustainable forestry programs. Unlike pine excelsior, Curlex contains no pitch or resin. Curlex fibers are listed as an EPA approved sorbent, which proves their effectiveness at removing polynuclear aromatic hydrocarbons (PAHs) from contaminated stormwater.

Executing the Plan

Concepts for the restoration plan were developed by a multi-disciplinary team consisting of ecologists, mine reclamation experts, hydrogeologists, hydraulic engineers, and natural channel design experts. Reference sites were utilized within the undisturbed stream segments to help the team determine the best slope design features and vegetation types required for the restoration area.

Work included a small diversion channel to reconnect a large portion of the floodplain on the west side of the creek. This allowed for capture and storage of more water, reduced downstream flooding, and provided additional aquatic habitat. Overbanking was stored on the east side of the stream. This increased the overall hydrology to the remnant stream channel and increased aquatic habitat.

Stone toe protection was used to keep high velocity currents from undercutting the bank and causing bank failure. This technique was used in combination with additional bio engineering techniques on the bank. The stone toe was extended below the deepest estimated scour depth and embedded into the channel bottom to reduce the risk of localized scour as well.

The models below show the site before and after improvements (see Figures 10 & 11).

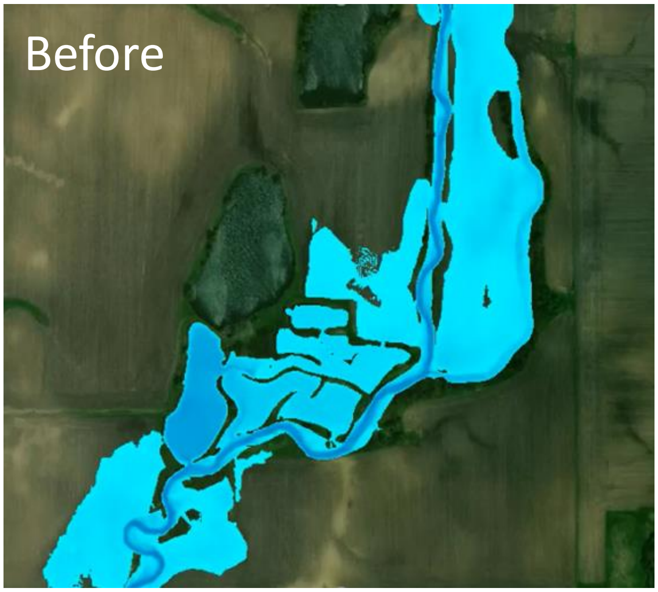

Figure 10. Before improvements, a large portion of the floodplain on the east side of the stream was not connected to the stream. This resulted from a large spoil pile that was left remaining from the gravel mining operation during the 1950s. A large portion of the west flood plain was only connected through water backing up through the remnant gravel pits. Water flowed rapidly across the east side of the flood plain, exiting quickly through a culvert with a flap gate.

Figure 11. After improvements were made, the impact was significant. The work reconnected a large portion of the floodplain on the west side of the creek. This captured and stored much more water, reduced downstream flooding, and provided additional aquatic habitat. This also allowed for much of the overbanking to be stored on the east side of the stream. This added capacity increased the overall hydrology to the remnant stream channel.

Flood Event Observations

Work on the mitigation project was completed in March 2020. Just six short weeks later, there was a major flood event that could have had a significantly negative impact on the project (see Figure 12). Vegetation had not yet had the time to fully establish (see Figure 13). The only protection was the rip rap and the Curlex ECBs. The installer knew that Curlex excelsior fibers do not float, and that ensured they stayed in place, even under significant hydraulic forces. The installer also knew Curlex ECBs are proven to prevent erosion. What impressed the installer was the ability of the Curlex ECBs to capture a great deal of sediment flowing down the stream (see Figure 14). After the storm, there was 3-4 inches of sediment trapped by the Curlex ECBs along entire length of project. This sediment capture and retention prevented the sediment from flowing downstream, causing other problems.

Figure 12. Flood Event

Figure 13. Black Willow Pre-Flood May 8, 2020

Figure 14. Black Willow Post-Flood June 14, 2020

Summary

The designed site changes and BMPs used on the mitigation project have proven to be a success. The objectives have been met. The mitigation bank project created an ecologically sound restoration that avoided impacts to adjacent agricultural land, created resiliency, reduced downstream flooding, and maximized the potential value to the owner (see Figures 15 & 16). The site will be monitored over the next ten years to document the succession of the vegetation, hydrology, soils, aquatic life, and terrestrial vertebrates.

Figure 15. White Fox Before Mitigation Bank Restoration

Figure 16. White Fox After Mitigation Bank Restoration

Special Thanks

American Excelsior would like to thank Michael Heller and JEO Consulting Group, Inc. for sharing the details of their White Fox Mitigation Bank project and for using Curlex ECBs as part of the solution.

Michael is a Senior Environmental Scientist with JEO Consulting Group, Inc., an engineering, architecture, planning, and surveying firm. JEO has 11 offices located throughout Nebraska, Iowa, and Kansas, with Michael based out of their Omaha, Nebraska office. Michael has been working in the Midwest with natural resources since 1992 and specializes as a wetland ecologist and as a stormwater manager.