"What happened to the Riparian Wetlands?"

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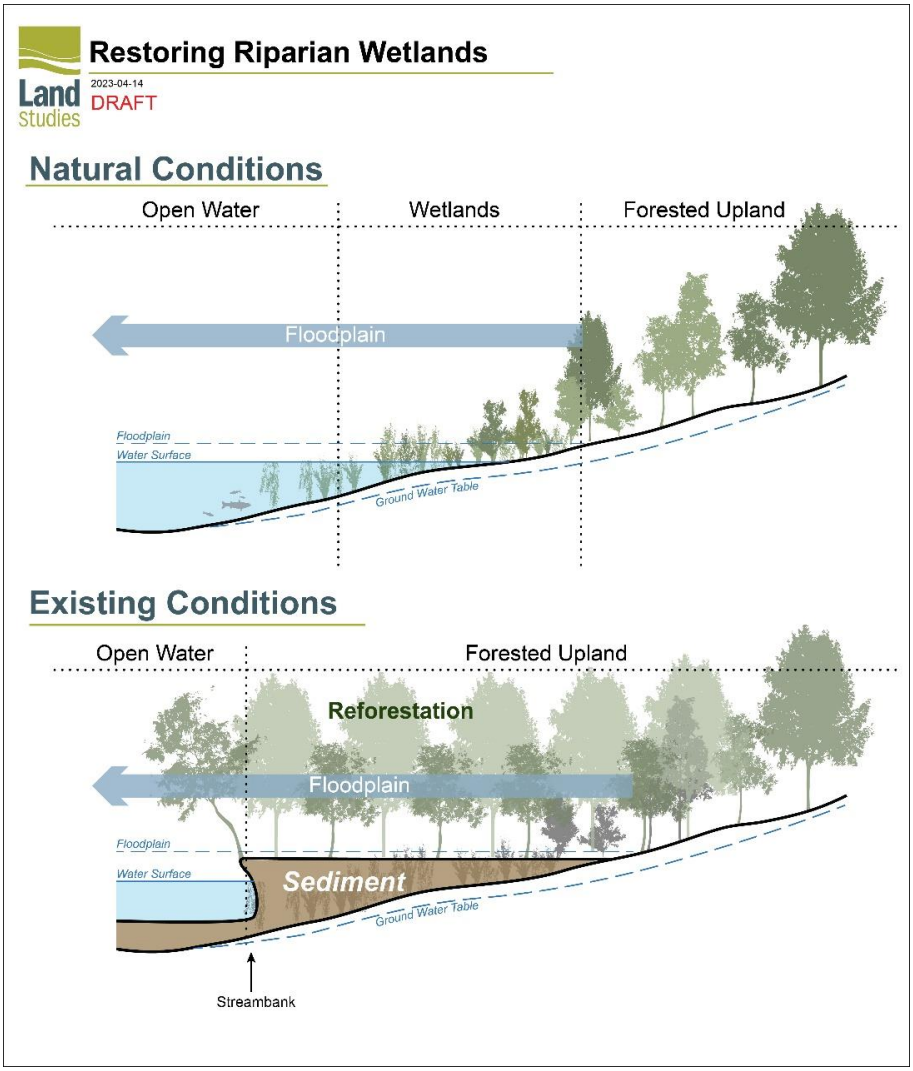
This site was selected for a wetland meadow restoration based on the historical evidence found in the soil under the high streambanks. The buried floodplain contained lots of organic material with preserved seeds and herbaceous plants. Radiocarbon dating and analysis of the preserved macrofossils indicate that a wetland meadow persisted at this very location for thousands of years – from 11,000 BC until the early 1700's.

A wetland meadow condition like this was once prevalent thoughout the region. Today, the condition that is not only uncommon but imperiled. In the mid 1700's, erosion from colonial settlement buried this wetland meadow and filled the entire riparian corridor with tons of sediment. Hundreds of thousands of acres of wetland meadow met the same fate throughout the Mid-Atlantic region.

This restored wetland meadow condition serves important ecologial functions for amphibians, reptiles, birds, mammals and fish. It also supports invisible and delicate biogeochemical processes such as carbon sequestration and denitrification which naturally clean the waterway of pollutants.



Restoring Riparian Wetlands

Wetlands are vital to the health of aquatic ecosystems, especially streams and rivers. Prior to European colonization most stream systems were fringed with extensive and complex wetland corridors. These wetland corridors extended across valley bottoms, providing flood storage, groundwater recharge, filtering pollutants, and fostering a biodiverse ecosystem with vibrant wildlife conduits. These areas were important for Indigenous people who harvested food, medicine and materials from this rich, productive and biodiverse landscape. Spiritual connections with water are shared in Indigenous oral tradition of the Susquehannock and Lenni-Lenape tribes that once called Lancaster County home. Macrofossils (seeds and plants) can still be found, preserved in historical wetland layers throughout Lancaster County. Radiocarbon dating shows that these riparian plant communities consisted of mostly herbaceous plants (sedges, rushes and grasses) for thousands of years.

Figure 1 -An example of a riparian wetland corridor prior to European colonization (Great Marsh, Chester County, PA - courtesy Drs. Merritts & Walter, F&M).

European settlement expanded into frontier areas where floodplains were dammed to harness the water power for production of staple products such as lumber and flour. Dam construction coincided with the clearing of native forests and meadows to make room for colonial agriculture. Sediment eroding from the uplands filled the mill ponds and floodplains with thick layers of legacy sediment. These legacy sediment deposits have changed the riparian corridor dramatically. In fact, most of the streams we see today bear little resemblance to the riparian stream and wetland ecosystems that blanketed the valleys for thousands of years.

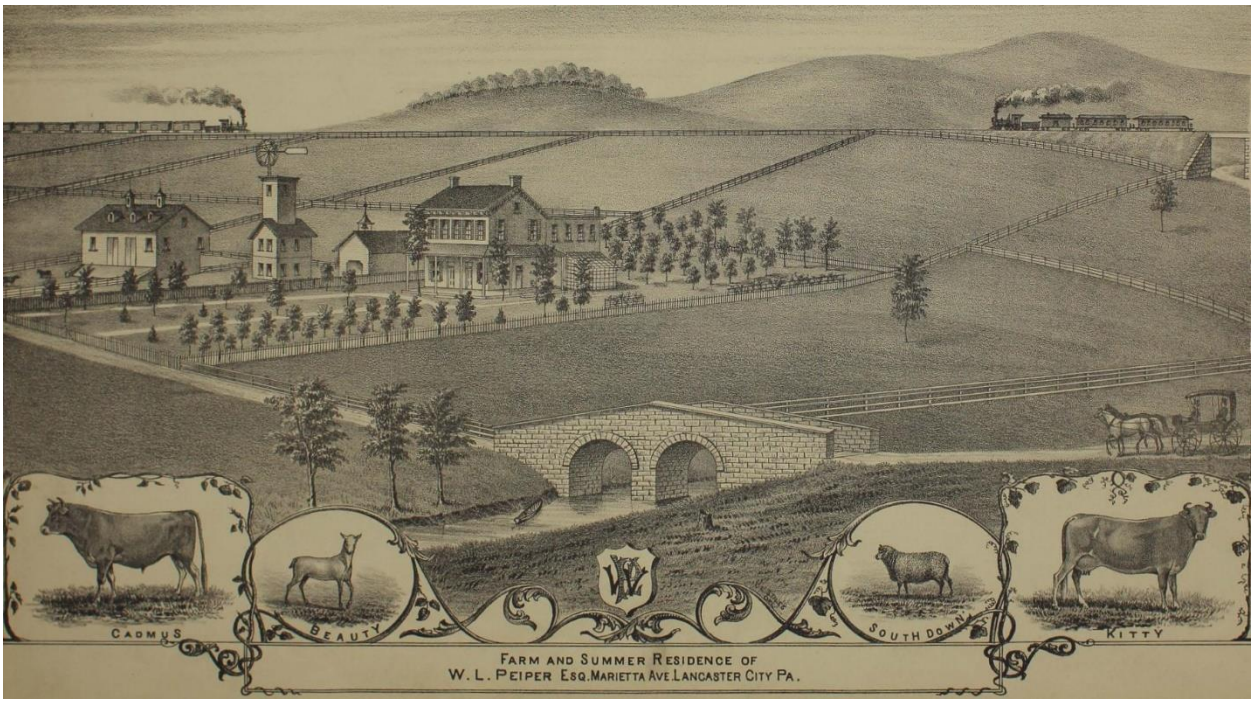


Figure 2 – Little Conestoga Creek at Marietta Avenue (1875 Historical Atlas of Lancaster County, Everts & Stewart)

The modern riparian corridor has assumed characteristics of an upland ecosystem which is devoid of the wetland processes necessary for a healthy riparian ecosystem. Now there is more damaging flooding, eroding streambanks, polluted waterways, and critical biodiversity loss – all issues that can be improved with a healthy riparian corridor.

Figure 3 - Typical stream conditions along the Little Conestoga Creek

Efforts to restore these important riparian floodplain wetlands are underway in Lancaster County and beyond. Restoration typically involves removal of thousands of pounds of sediment that have buried the wetland complex over the last few hundred years, thereby exposing the historic wetland system. Restored wetland systems and their ecological function provide significant benefits to our communities and the environment. The buried wetland complex has been largely forgotten and now a hard "streambank" edge separates the high floodplain from the stream channel.

Figure 4 - An example of a restored riparian wetland corridor.

Benefits

The sediment that filled the valley bottoms creates steep banks that erode and experience flooding with faster velocity (water speed), higher flood elevations and larger peaks. Restoring riparian wetlands dramatically improves the function and stability of the floodplains. These connected wetland complexes improve flood storage capacity and reduce stress on public infrastructure like bridges and roadways, making our communities more resilient in a changing climate.

Pollutants such as sediment clog waterways, and excess nutrients like nitrogen and phosphorous cause algae to grow faster than the ecosystem can handle and decrease the oxygen levels in the water. All are major contributors to problems in the Chesapeake Bay. Removing legacy sediment and eroding streambanks reduces sediment and pollutants in the waterways.

The restored floodplain wetlands are connected to groundwater, improving the replenishment of cold groundwater with surface water (the hyporheic connection) which is an important factor for streams to support sensitive species of macroinvertebrates (aquatic bugs) and fish (like brook trout).

The consistent hydrology and rich soils of wetlands support a greater diversity of native plant species that provide a dense vegetative mat, helping reduce opportunities for aggressive, invasive plant species to get established. Native plants support the foundation of a healthy ecosystem, providing critical habitat for pollinators and wildlife. A diverse wetland plant community also promotes natural mosquito control, with more native predators such as dragonflies, frogs, turtles and fish.

Figure 5 - A dense mix of grasses, sedges and rushes typical of a healthy riparian wetland plant community.

Figure 6 - A dense community of herbaceous wetland plant species along a stream in a restored riparian corridor.

Snapshot of the benefits of riparian wetland restoration:

- More resilient to major flooding (less repairs to infrastructure)
- Attenuates (decreases) intense storm events for the site as well as downstream property and people
- More plants and animal species (repopulation by listed T&E species means it automatically achieved a High Quality status the first year after construction)
- Nutrient Processing
    - Denitrification (biogeochemical) – reduces Nitrogen in the water (good)
    - Sediment removal (bank erosion is gone) and floodplain deposition (regional sediment improvement)
    - Phosphorous removal (through deposition and no more eroding banks)
- Habitat
    - Diverse wetland meadow habitat is an imperiled resource
    - Utilized by amphibians, reptiles, birds, macroinvertebrates (good bugs), fish and mammals
- Groundwater recharge and exchange
- Productive food source for various life stages of many animals
- Organic carbon and Particulate Organic matter storage (important for bio/geo/chemical processes, algae and the base of the critter food chain)

Construction

Restoring stream and riparian wetland systems requires heavy equipment to excavate thousands of pounds of sediment to reconnect the floodplain, protect infrastructure and restore the wetland soils. In many cases, trees need to be removed to regain the complex functions that were lost in the valley bottom. These trees grew on top of the layers of sediment that are covering the natural wetland that existed for thousands of years. Once the wetland elevation is restored, a dense community of sedges and rushes will thrive in this frequently inundated environment, are established to help stabilize the floodplain. Deliberate variation is introduced to the floodplain with a series of depressions to create different layers of wetland types. The contractor also installs erosion control matting (to prevent more soil from washing away) and installs native species of wetland seeds along with larger plants (called plugs) that have already begun growing. This combination is used to give the newly restored wetland a jump start in becoming a highly functioning ecosystem.

Figure 7 - Specialized contractors are used to carefully peel back the layers of sediment and expose the historical wetland.

The Science

How do we know these wetland complexes existed in the floodplains? Researchers have been studying the effects of early colonial settlement and the impact of mill dams on streams. Franklin & Marshall College professors, Dr. Robert Walter and Dr. Dorothy Merritts, have led this research with extensive publications on their findings (http://www.bsr-project.org/journal-articles.html). Their conclusions have grown into research collaborations with agencies such as PA Department of Environmental Protection, US Environmental Protection Agency, US Geological Survey, as well as other institutions like Johns Hopkins University, University of Louisville, Drexel University, Elizabethtown College, and UC Berkeley. Much of this research has been conducted right here in Lancaster County at the Big Spring Run restoration site (www.BSR-project.org).

The target restoration condition is based on the historical evidence of the ecosystem found at each site, along with evidence from other sites in the area. The wetland meadow was selected since the historical floodplain was found to contain layers of preserved organic material. Samples from the organic layer were collected, confirming that many different types of herbaceous meadow plants were present for thousands of years. Seeds for species of sedges, rushes and grasses were present and radiocarbon dating was used to identify the age range of the material found in the buried historical floodplain layer. This information provides a timeline of sediment deposition and identifies the elevation and condition of the original wetland. The radiocarbon dating results show the original wetland layer is consistently between 300 years and 11,000 years old. The more recently deposited sediment, called legacy sediment, is found to have been deposited since European colonization began in the area. The stream banks very clearly record the historical timeline of thousands of years of wetland meadow that is covered by significant soil deposition due to European settlement in the watershed.

Figure 8 - Evaluation of soil layers in a trench along the Little Conestoga Creek