



**CONESTOGA-ROVERS
& ASSOCIATES**

TREATMENT WETLANDS AS INFRASTRUCTURE

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Presentation Overview

1. What are Treatment Wetlands?
2. Where do Treatment Wetlands Fit?
3. Treatment Wetland History
4. Design Guidance
5. Types of Treatment Wetlands
6. Infrastructure Applications and Treatment Capabilities
7. Benefits
8. Case Studies



What are Treatment Wetlands?

(constructed wetlands, engineered wetlands)

A **treatment wetland** is a vegetated, engineered system designed to filter and treat pollutants in water.



Where do Treatment Wetlands Fit?

Basic Wastewater Treatment Process:

1: Collection

2: Treatment

3: Discharge



Treatment Wetlands



Gray vs. Green Infrastructure?

Gray infrastructure is typically:

- Driven by mechanical processes
- Single purposed
- Centralized
- Comprised of human-made materials

Green infrastructure is typically:

- Driven by natural processes
- Multipurposed
- Distributed rather than centralized
- Land and vegetation based



Treatment Wetland History

- **1952:** technology developed from research at the Max Planck Institute in West Germany
- **1970's:** technology transferred to North America
- Treatment Wetlands & New York State:
 - **1973,** Brookhaven National Laboratory, NY, first engineered, constructed wetland pilot system in North America was constructed
 - **1990s, Minoa, NY,** some of the first research on horizontal subsurface flow wetlands was conducted



Design Guidance

*No equivalent to “10 States Standards”
for wetland systems*

- EPA Guidance Documents
- New York State Stormwater Manual
- Treatment Wetlands 2 (textbook)
- Academic Literature
- Water Environment Research Foundation (WERF) Reports



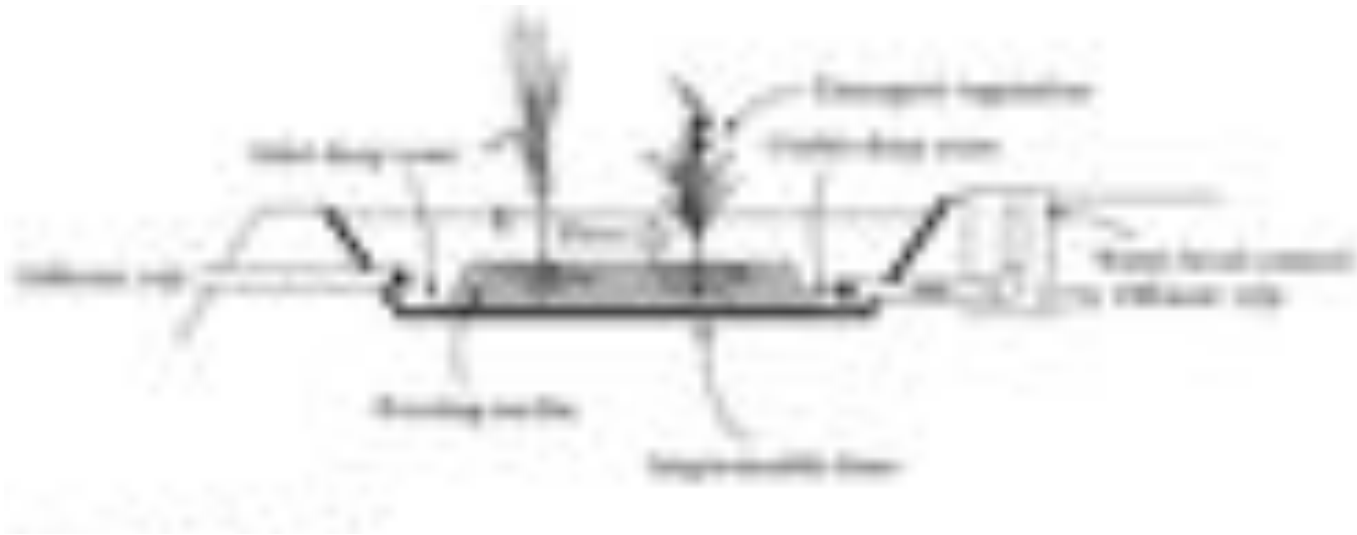
Types of Treatment Wetlands

1. Free Water Surface
2. Horizontal Subsurface Flow
3. Vertical Flow



Free Water Surface Wetland Schematic

Free water surface wetlands (FWS) have areas of open water and are similar in appearance to natural marshes. FWS wetlands typically contain floating vegetation and emergent plants.

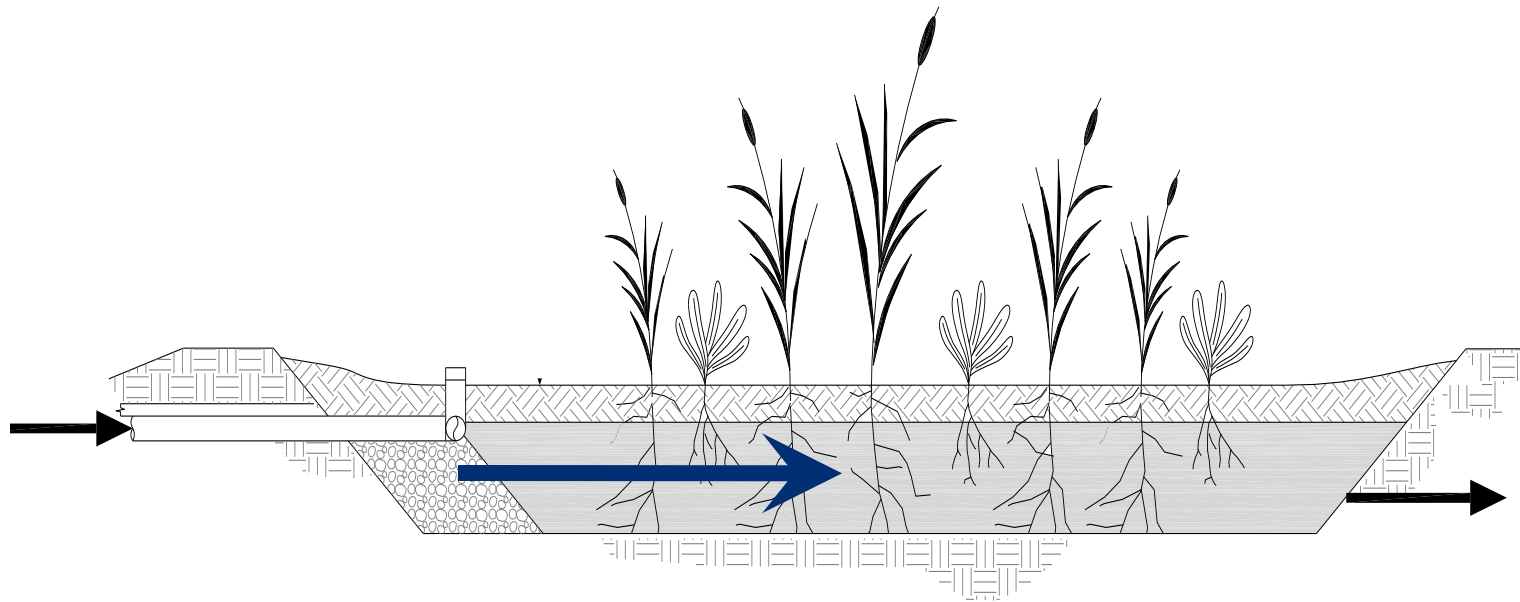


Newly Constructed Free Water Surface Wetland



Horizontal Subsurface Flow Wetlands

Horizontal subsurface flow wetlands (HSSF) typically have a gravel bed planted with wetland vegetation. The water, kept below the surface of the bed, flows horizontally from the inlet to the outlet.

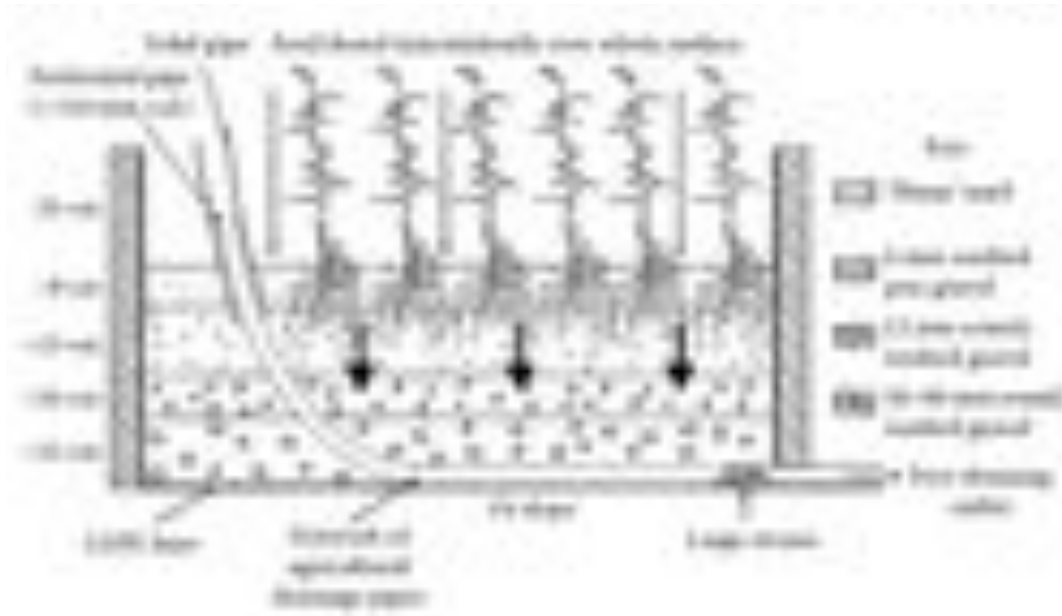


Established Horizontal Subsurface Flow Wetland



Vertical Flow Wetlands

Vertical flow wetlands (VF) distribute water across the surface of a sand or gravel bed planted with wetland vegetation. The water is treated as it percolates through the plant root zone.



Newly Constructed Vertical Flow Wetland

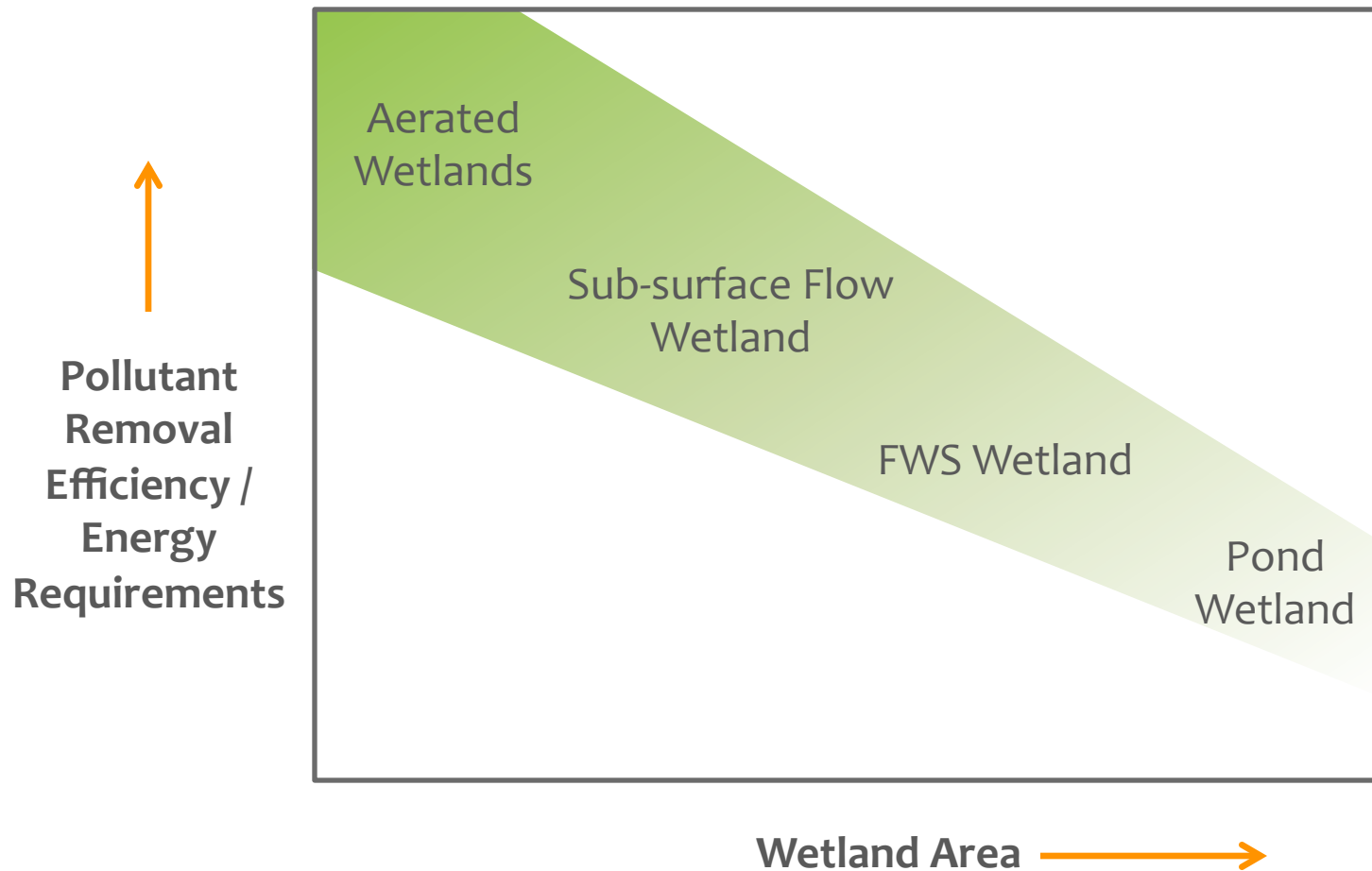


Infrastructure Applications and Treatment Capabilities

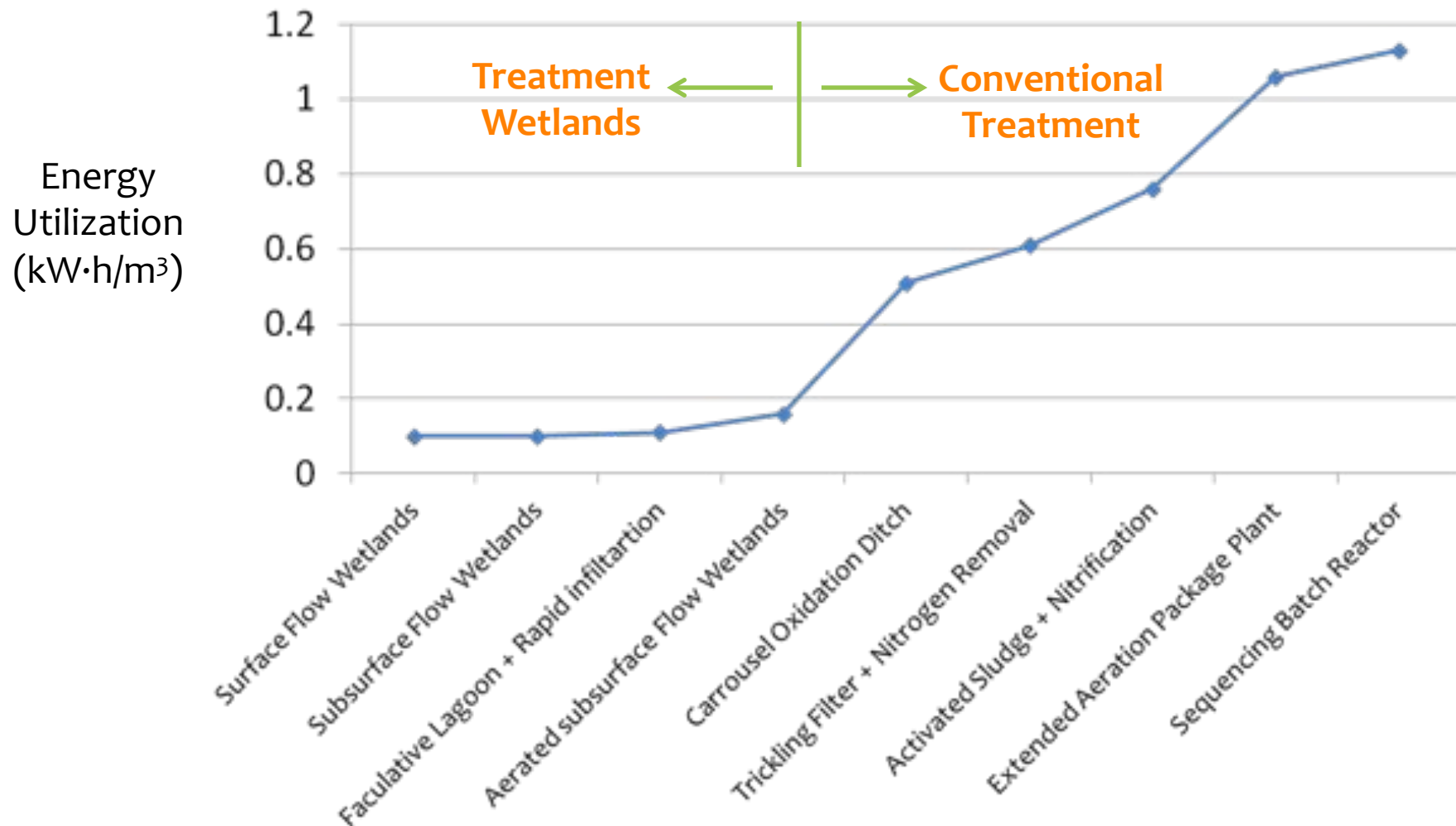
<i>Wetland Type</i>	<i>Dominant Treatment Processes</i>	<i>Typical Uses</i>
Free Water Surface	<ul style="list-style-type: none"> • Aerobic and anaerobic organic matter degradation • Particulate settling • Denitrification • Phosphorus removal through burial in sediments • Pathogen removal 	<ul style="list-style-type: none"> • Stormwater storage and treatment • Acid mine drainage treatment • Groundwater remediation • Landfill leachate treatment
Horizontal Subsurface Flow	<ul style="list-style-type: none"> • Organic matter removal by filtration and anaerobic degradation • Denitrification • Pathogen removal 	<ul style="list-style-type: none"> • Single family home or small community secondary wastewater treatment
Vertical Flow	<ul style="list-style-type: none"> • Nitrification • Aerobic organic matter degradation • Filtration of suspended sediments • Pathogen removal 	<ul style="list-style-type: none"> • CSO treatment • Municipal/domestic wastewater treatment • Landfill leachate treatment • Biosolids dewatering



Comparison of Energy/Land Requirements



Comparison of Energy Requirements (municipal wastewater)



Data Source: Kadlec, R.H., Wallace, S.D. (2009). Treatment Wetlands (2nd ed). Boca Raton, Florida: CRC Press.

Benefits

- Opportunity to reinvest in communities while solving environmental problems
- Research opportunities
- Educational opportunities
- Public/private partnerships
- Reduce Life Cycle Energy and Maintenance Requirements

Wetland wastewater treatment system in Koh Phi Phi, Thailand:



Benefits

Article from the Batavian, NY August 2011: Wakodahatchee Wetlands, Delray Beach, FL:

Batavia Wastewater Treatment Plant, one of city's hidden treasures

Submitted by Howard Chene on August 3rd, 2011 - 11:55pm



It's a place teeming with wildlife, a bit of a bird's paradise. It's 400 acres of accessible open space where local residents can walk their dogs, go for a jog or just enjoy a stroll along well-maintained paths.



Case Study: Wellsville, NY

Groundwater Treatment System

Completed in 2008

Flow: 280,000 gpd

Area: 10 acres

Treatment Components:

- Cascade Aerator
- Sedimentation pond
- 3 free water surface wetlands
- 5 vertical flow wetlands



Case Study: Batavia, NY

Free Water Surface Wetland

Completed in 1990

Wastewater Polishing System

Average Influent Flow: 4 million gallons per day

Wetland Area: 15 acres



Case Study: Buffalo Airport, NY

Airport Deicing Fluid Treatment

Completed in 2009

Flow: 1,200,000 gpd

Treatment Components:

- Pumping system
- 4 aerated VF wetland cells



Treatment Wetland Cells

Airport Runway



Case Study: Buffalo Sewer Authority

Combined Sewer Overflow Management

Proposed System

Flow: 500,000 gpd

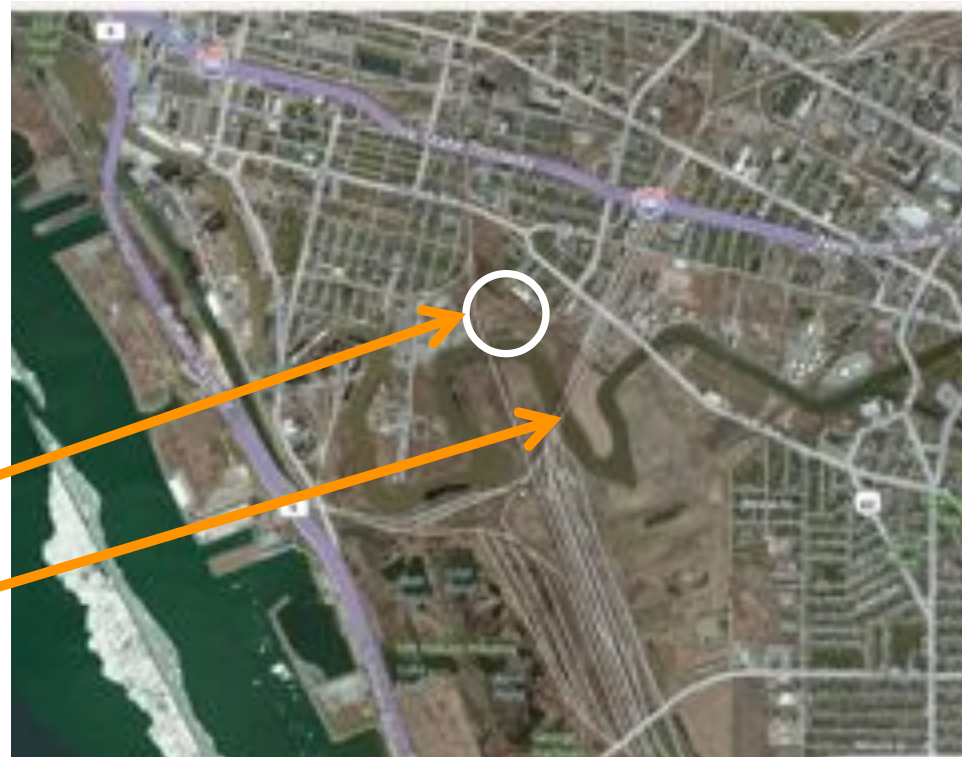
Area: 2 acres

Treatment Components:

- Screening System
- Sedimentation Tank
- 3 VF wetlands
- Cascade Aerator

Proposed Wetland Location

Buffalo River



Treatment Wetlands...

- Are part of the gray/green spectrum of infrastructure options
- Come in different forms and can be designed for a number of treatment goals:

Municipal Wastewater • CSO • Stormwater

Landfill Leachate • Groundwater • Biosolids Dewatering

- Typically have lower energy requirements and a larger footprint than other treatment options
- Can provide solutions for environmental issues while creating a community amenity

