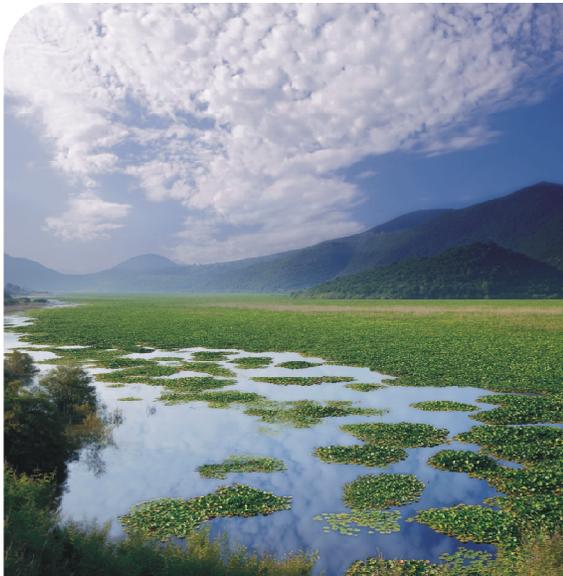


Enhanced Treatment Wetlands for Ethanol Removal

***22nd International Petroleum Environmental Consortium
Denver, Co***

Presented by:
**Amanda Ludlow, Principal Scientist
Roux Associates, Inc.**



November 19, 2015

Overview

- Site Background
- Project Description
- Feasibility and Design Challenges
- Engineering Design
- Project Status

Bulk Storage Petroleum Terminal, New York



Loading Rack

Existing Wastewater Treatment System

Contact Water Storage Tank

Hudson River

Contact Water

- ❑ Comprised of petroleum product/water mixtures
- ❑ Generated during tank cleanouts and other tank maintenance activities
- ❑ Combined with stormwater runoff from transfer areas on site

Wastewater Receipt (2012)	Estimated Terminal Runoff (gallons)	Off-Site Delivery (gallons)	Total Water (gallons)
Annual Total Waters	360,000	849,446	1,209,446

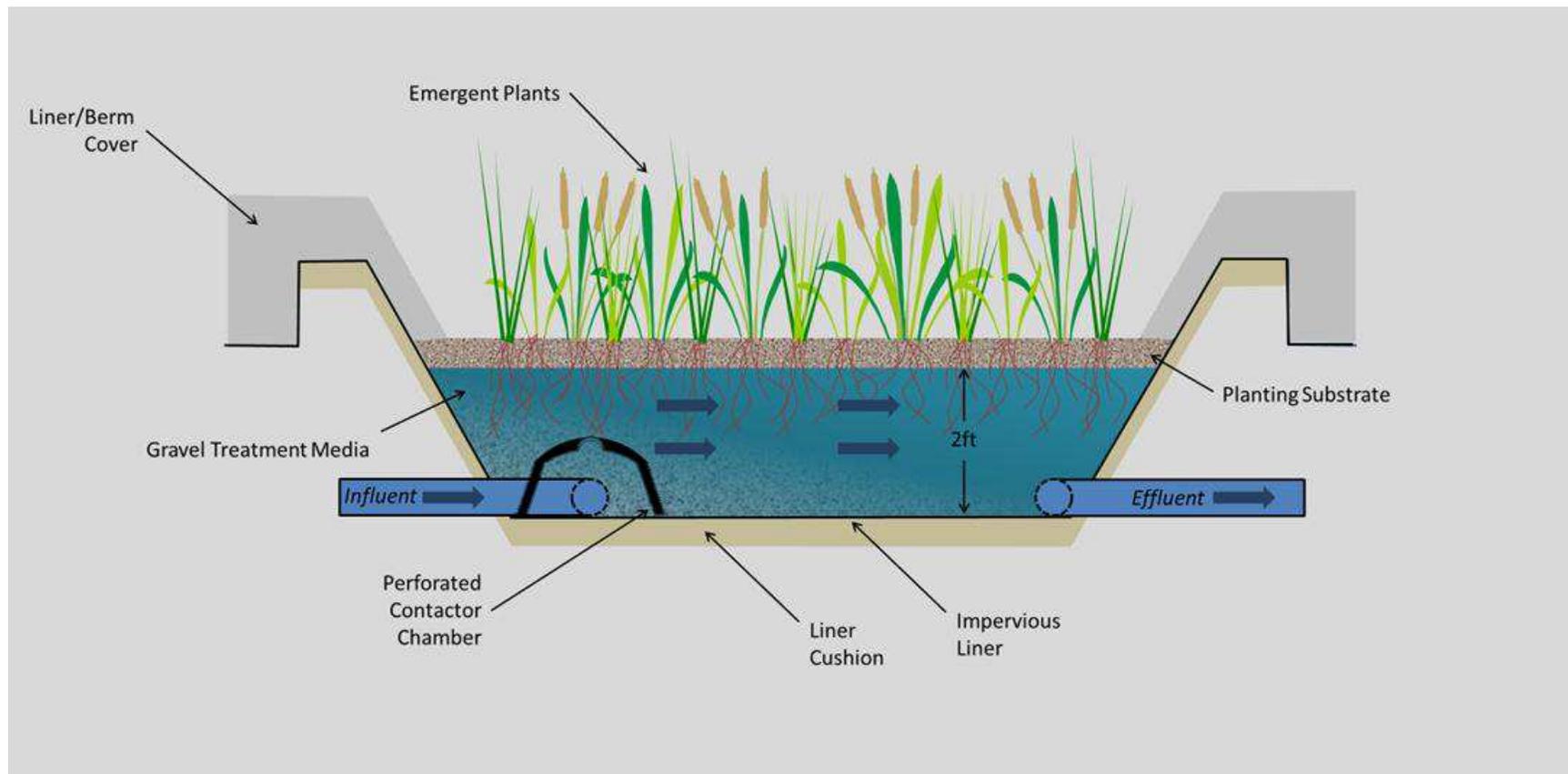
Contact Water

Analyte	Units	Maximum Concentrations
Benzene	mg/L	18.7
Toluene	mg/L	57.6
Ethylbenzene	mg/L	5.9
Xylenes (total)	mg/L	41.6
BTEX	mg/L	123.8
Ethanol	mg/L	16,700
Oil and Grease	mg/L	13.7
Total Suspended Solids	mg/L	28
BOD, 5 day	mg/L	16,800
COD	mg/L	51,100
Dissolved Oxygen	mg/L	3.04
pH	s.u.	5.4

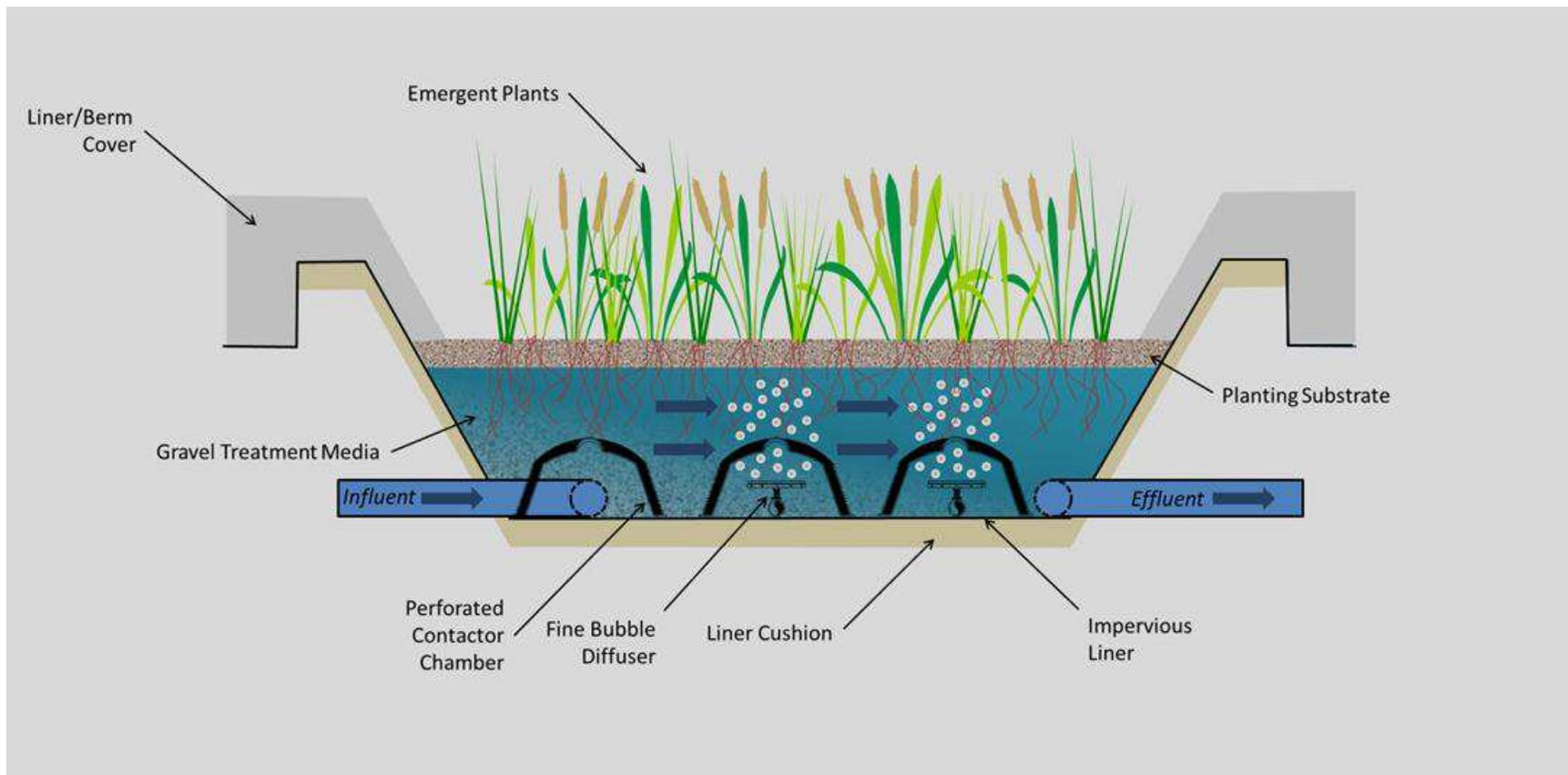
Treatment Wetlands

- Petroleum impacted wastewater
 - BTEX
 - TSS
 - BOD
- High strength BOD
 - Airport deicing
- Enhanced Treatment Wetlands
 - Increase degradation rates
 - Year round microbial activity in cold climate
 - Reduce HRT

Subsurface Flow CTW

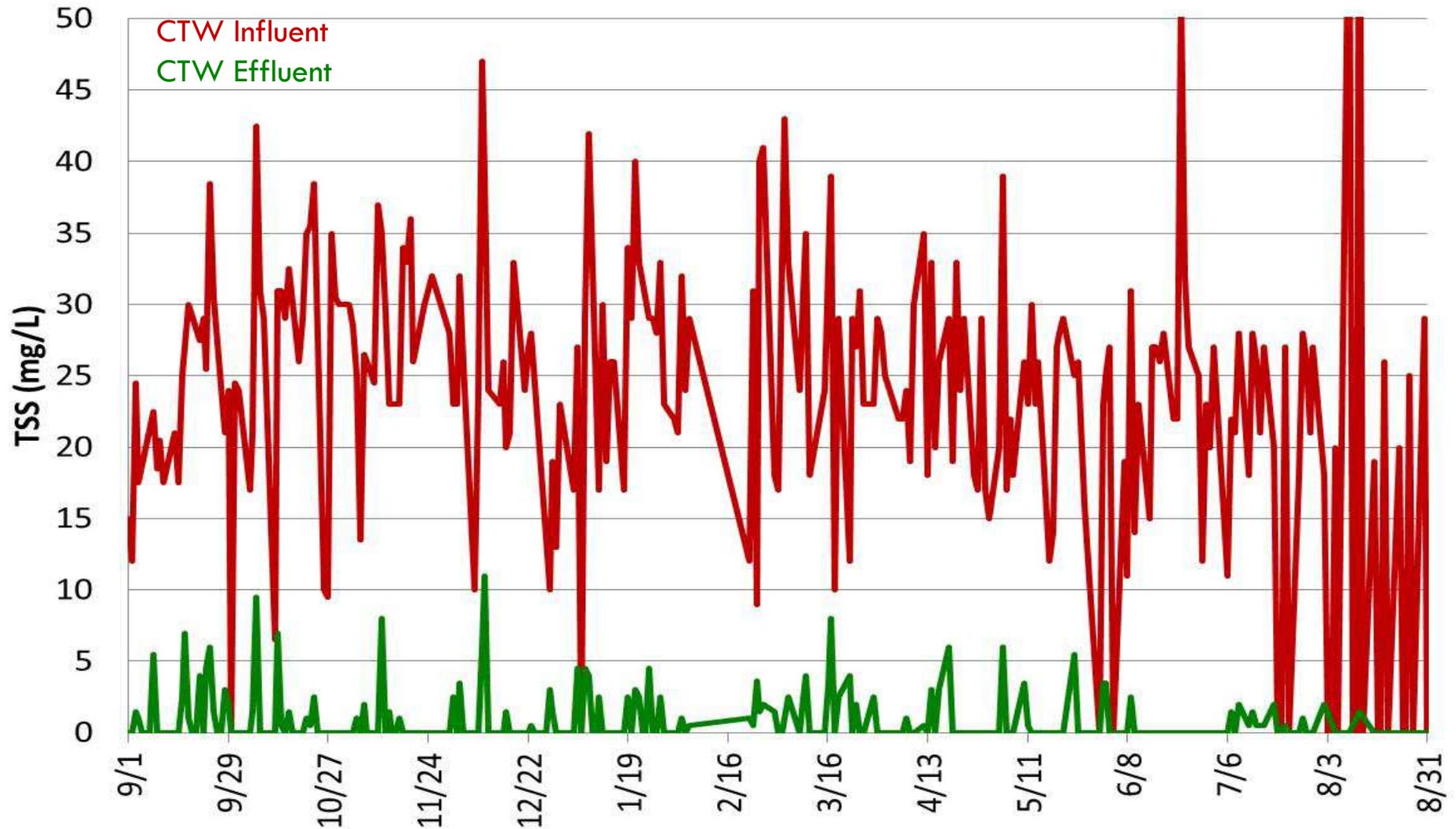


Enhanced Subsurface Flow CTW



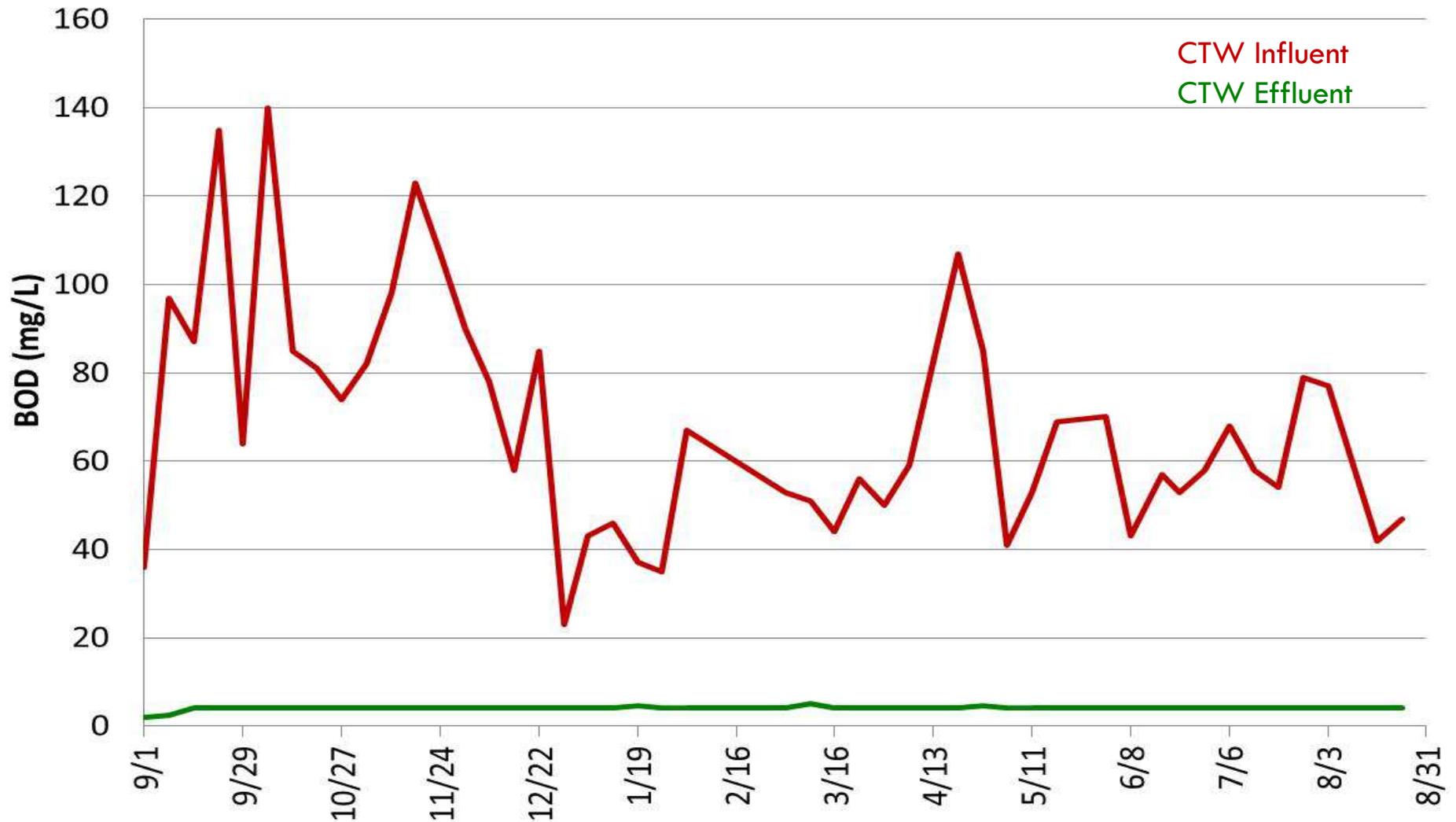
TSS Removal

Roux Associates, Inc.: Sanitary Treatment Wetland, Pittsburgh, PA



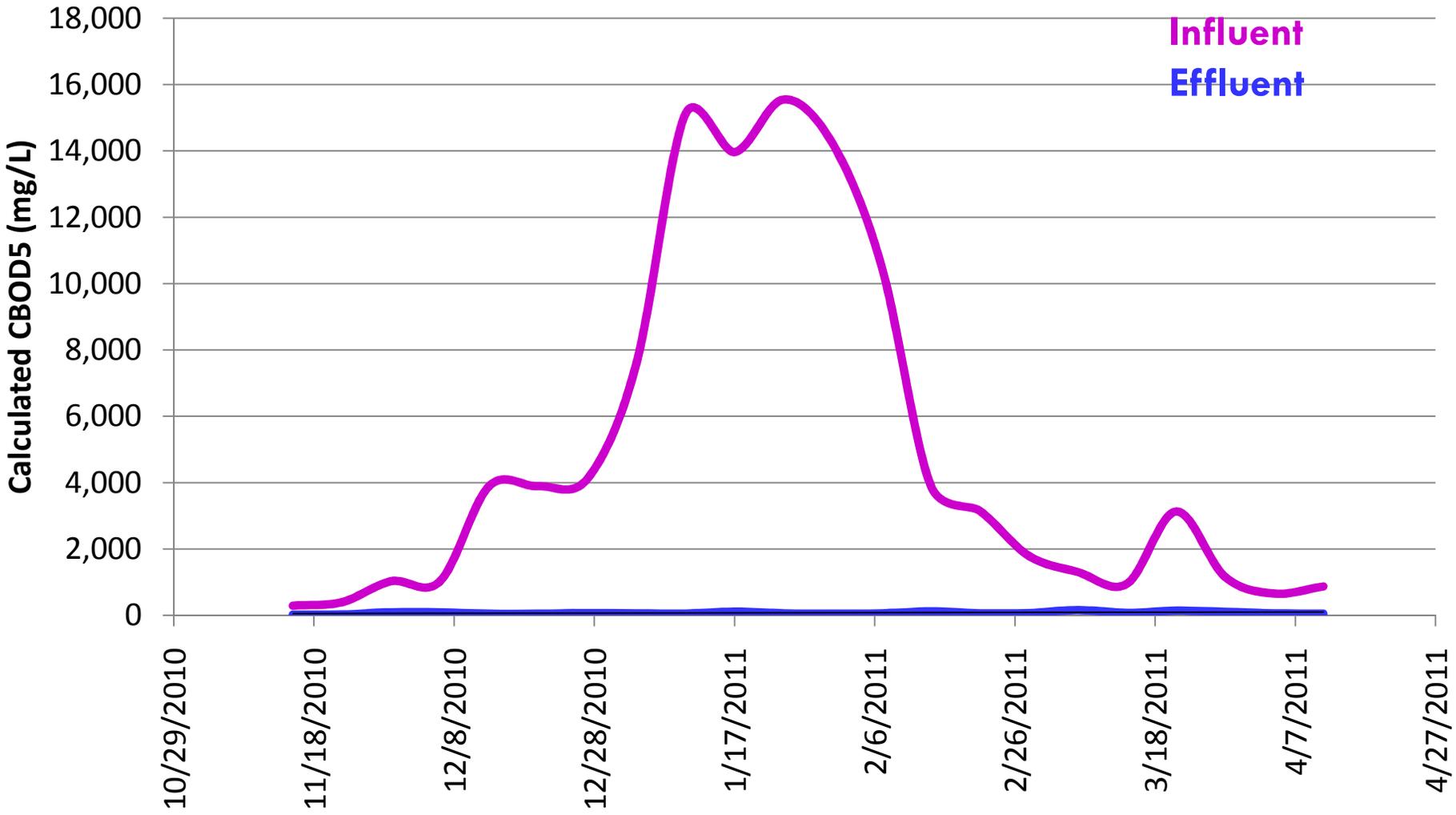
BOD Removal

Roux Associates, Inc.: Sanitary Treatment Wetland, Pittsburgh, PA



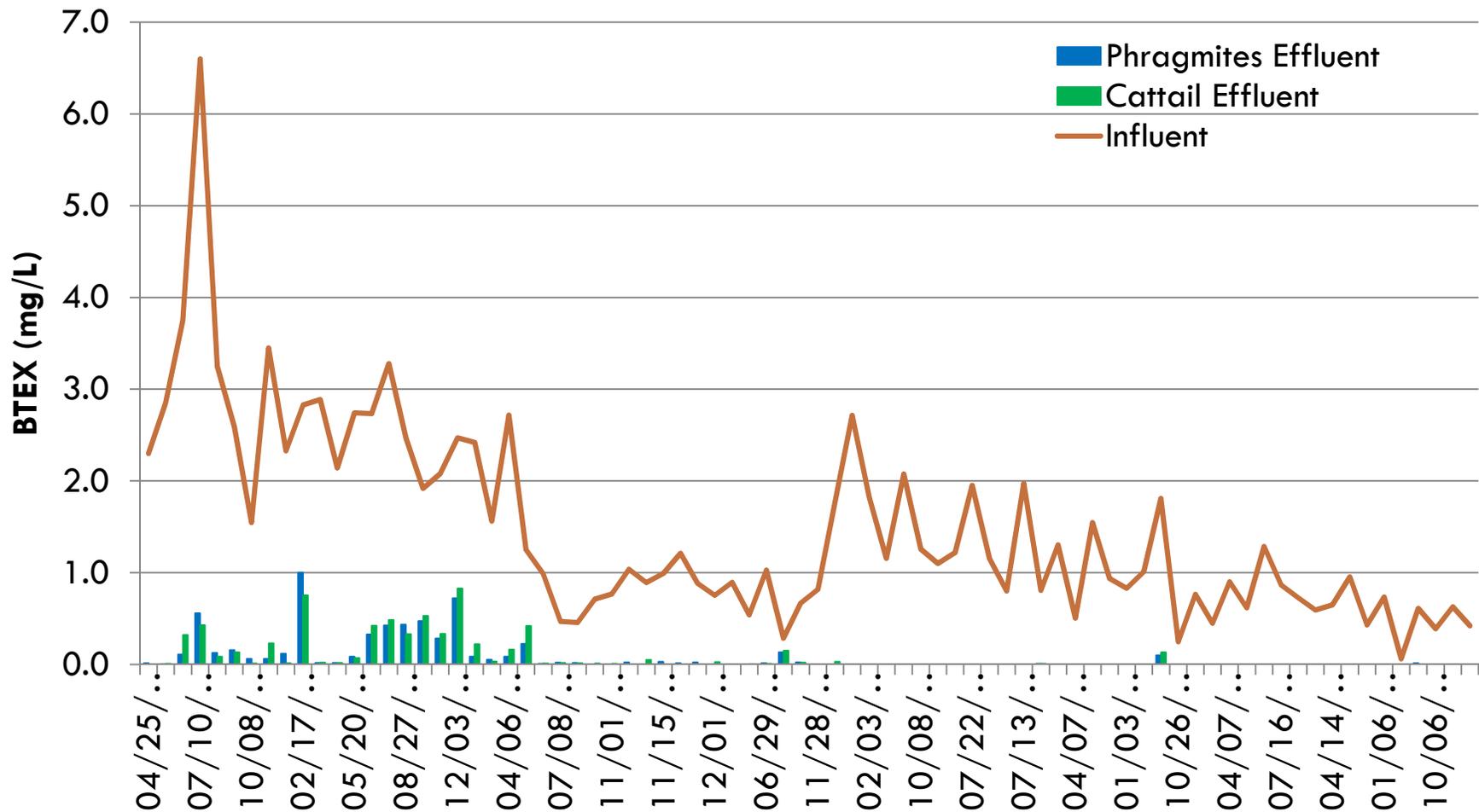
Buffalo Airport Glycol Treatment

Naturally Wallace Consulting: Wallace, Liner, and Barreto. 2012. Natural Treatment Systems – Case Studies



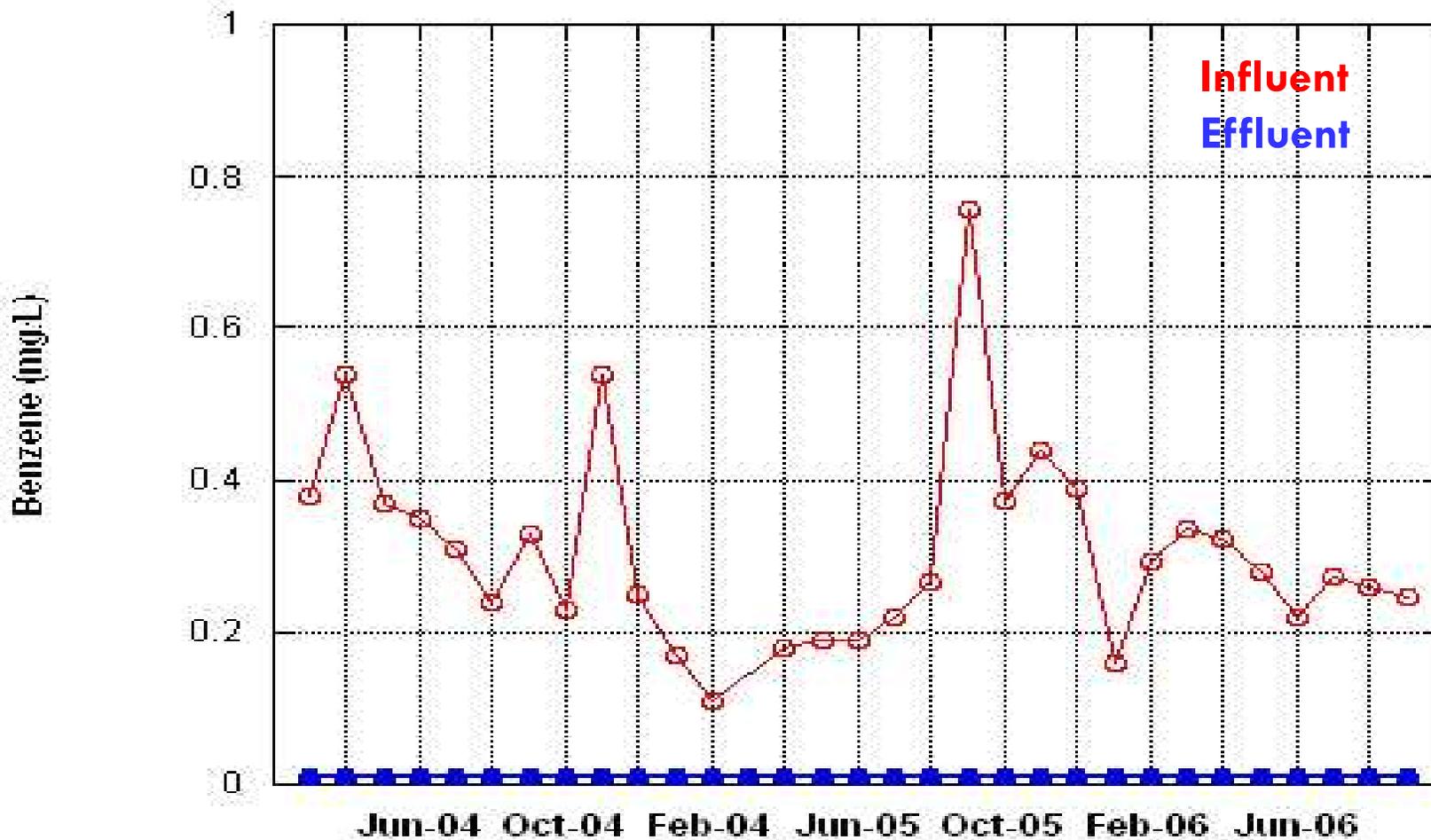
BTEX Treatment (no aeration)

Roux Associates, Inc.: BTEX Treatment Wetland, East Providence, RI



Benzene Treatment (plus aeration)

Naturally Wallace Consulting: Wallace, Liner, and Barreto. 2012. Natural Treatment Systems – Case Studies



Regulatory Issues

- Benzene > 0.5 mg/L
 - ▣ RCRA Hazardous Level (40 CFR 264.221)
 - CTW = surface impoundment
 - Double liner with leachate collection
 - Top liner to prevent migration of hazardous constituents (e.g. geomembrane)
 - Leachate collection system
 - Composite bottom liner

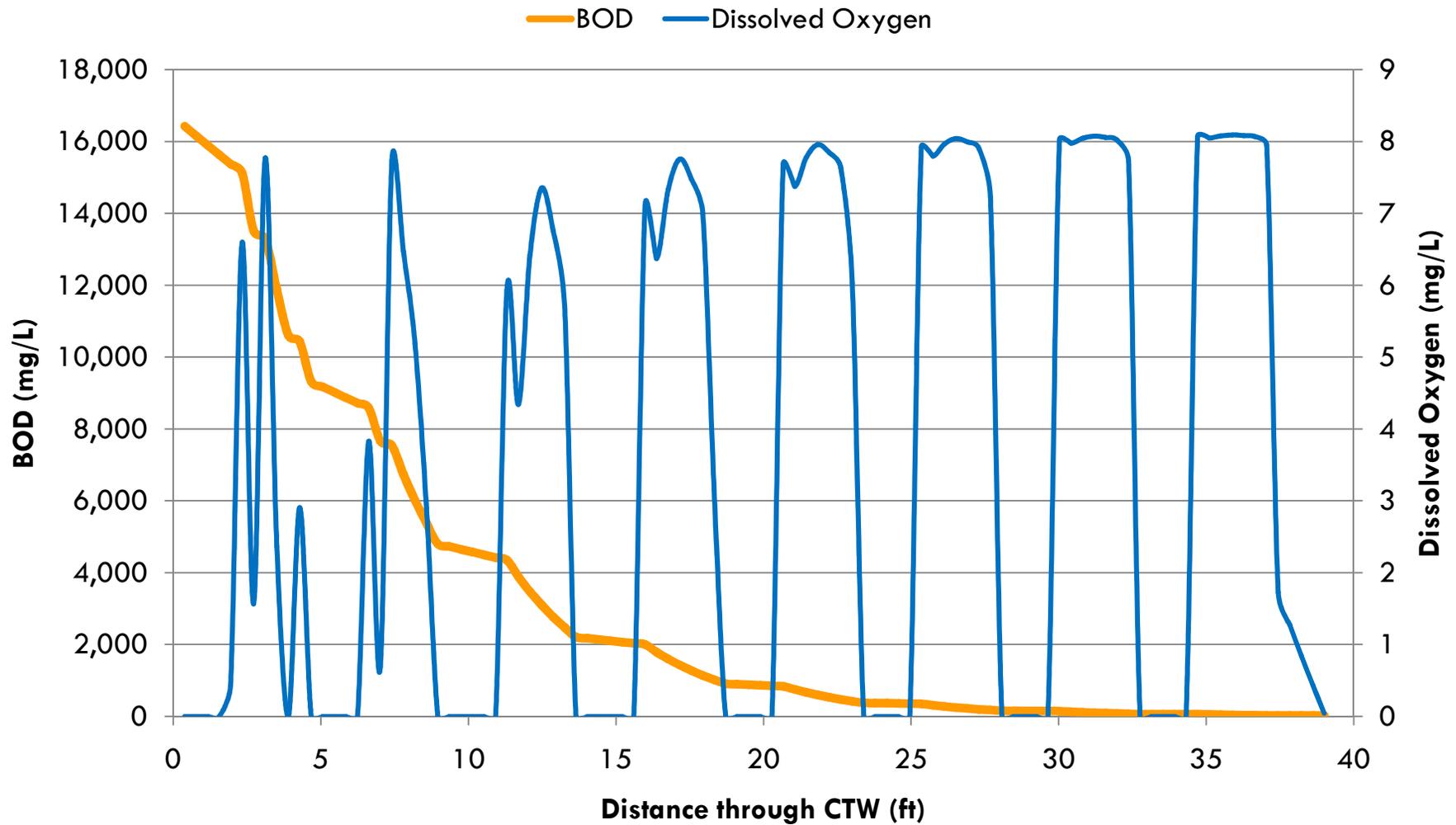
Treatment Design

- BTEX
 - CTW
 - Classified as impoundment
 - Require double liner/leachate collection
 - Volatilization
 - exceed emission limits
- Solution:
 - Pre-treatment
 - air stripper
 - catalytic oxidizer

Treatment Design

- BOD/Ethanol
 - Aerobic microbial degradation
 - BOD degradation $k=0.55d^{-1}$ (Wallace and Liner, 2011)
 - Supplemental Aeration:
 - BOD degradation $k=5.39d^{-1}$ (Wallace and Liner, 2011)
 - Reduce HRT
 - Year round reliable treatment performance
- Nutrient amendments
 - Nitrogen
 - Phosphorus
 - Potassium

BOD Degradation



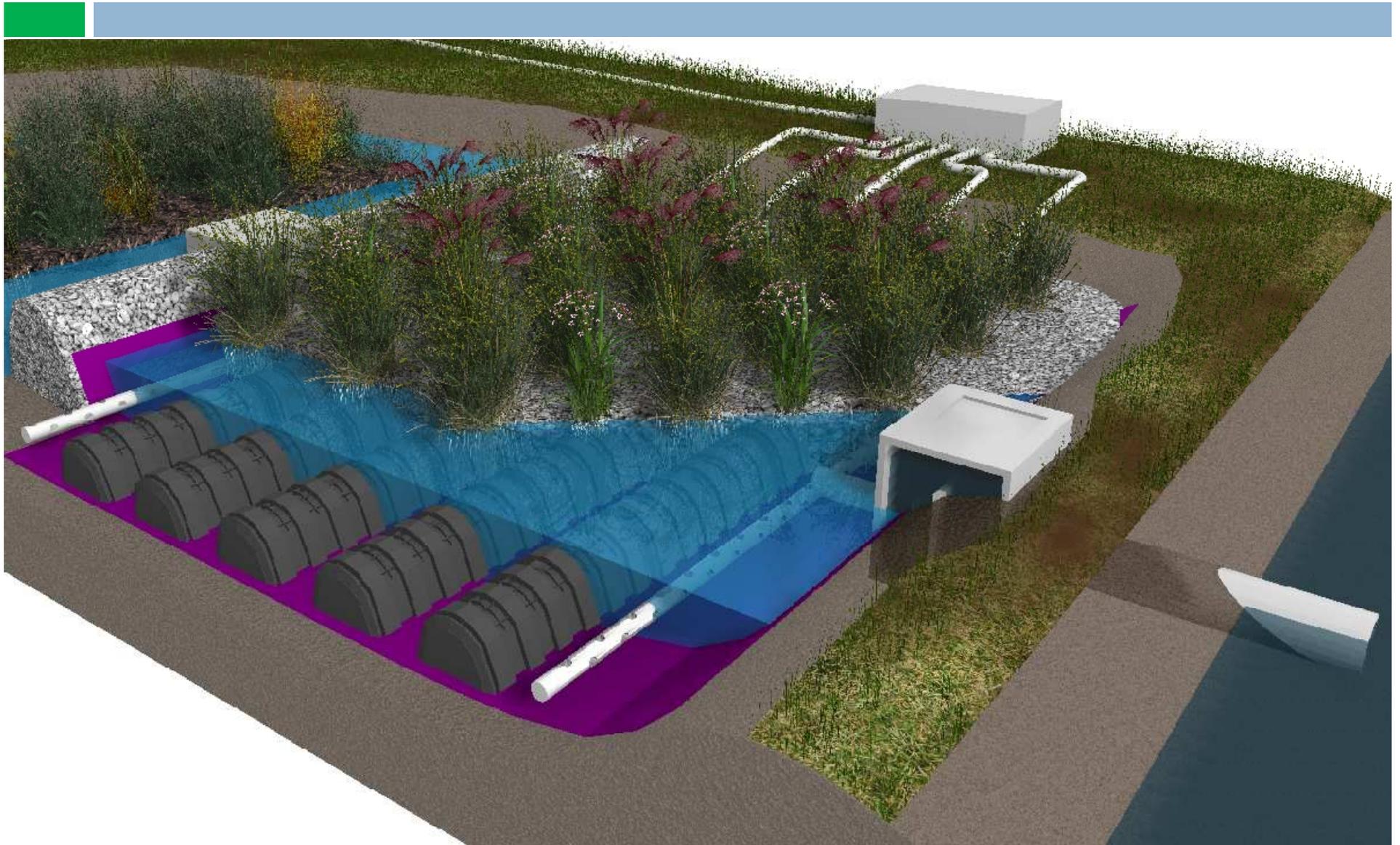
Nutrient Amendments

Nutrient	Requirement (g/kg of biomass produced)	Addition (kg/d)	Liquid Nutrient Consumption (gal/d)
Nitrogen	85	9.29	6.63
Phosphorus	17	1.86	1.45
Potassium	10	1.09	1.87

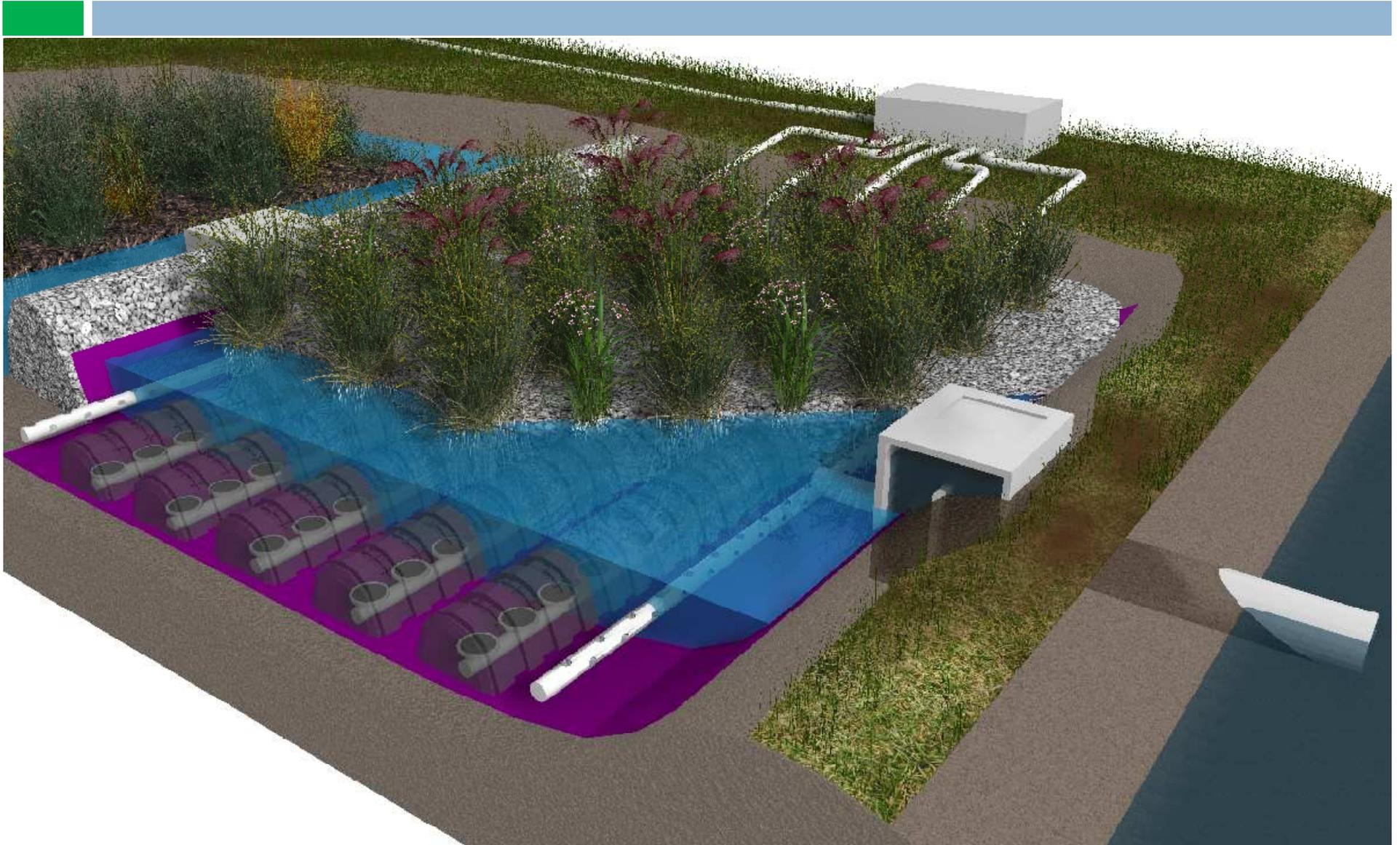
Treatment Wetland Design

- Flow = 4 gpm = 5,760 GPD
- HRT = 4 days
- Dimensions
 - ▣ Top of berm = 64' x 64'
- Depth
 - ▣ Gravel treatment media = 3 ft
 - ▣ Planting substrate = 4 inches
 - ▣ Freeboard = 14 inches
- HDPE Liner

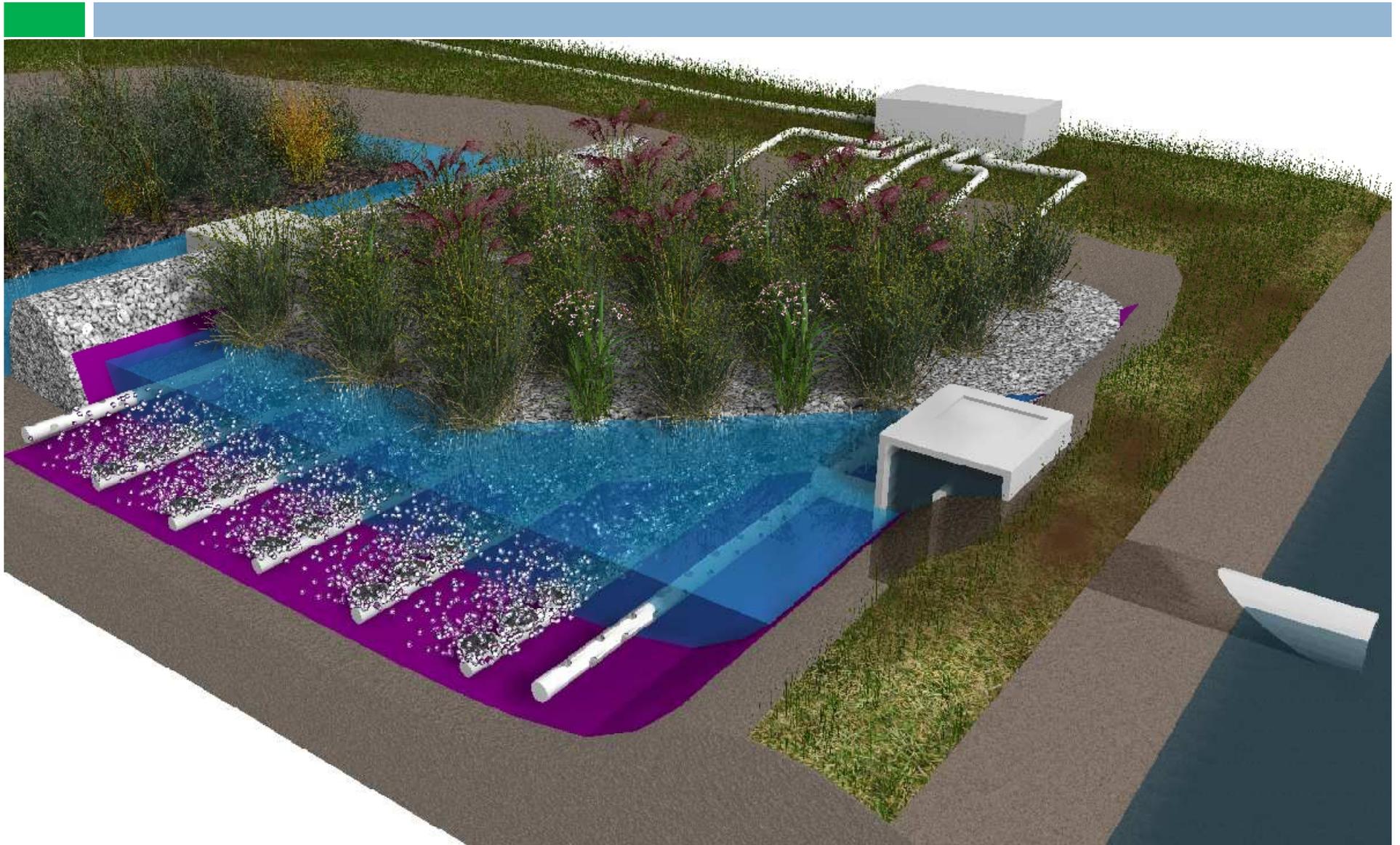
Subsurface Aeration



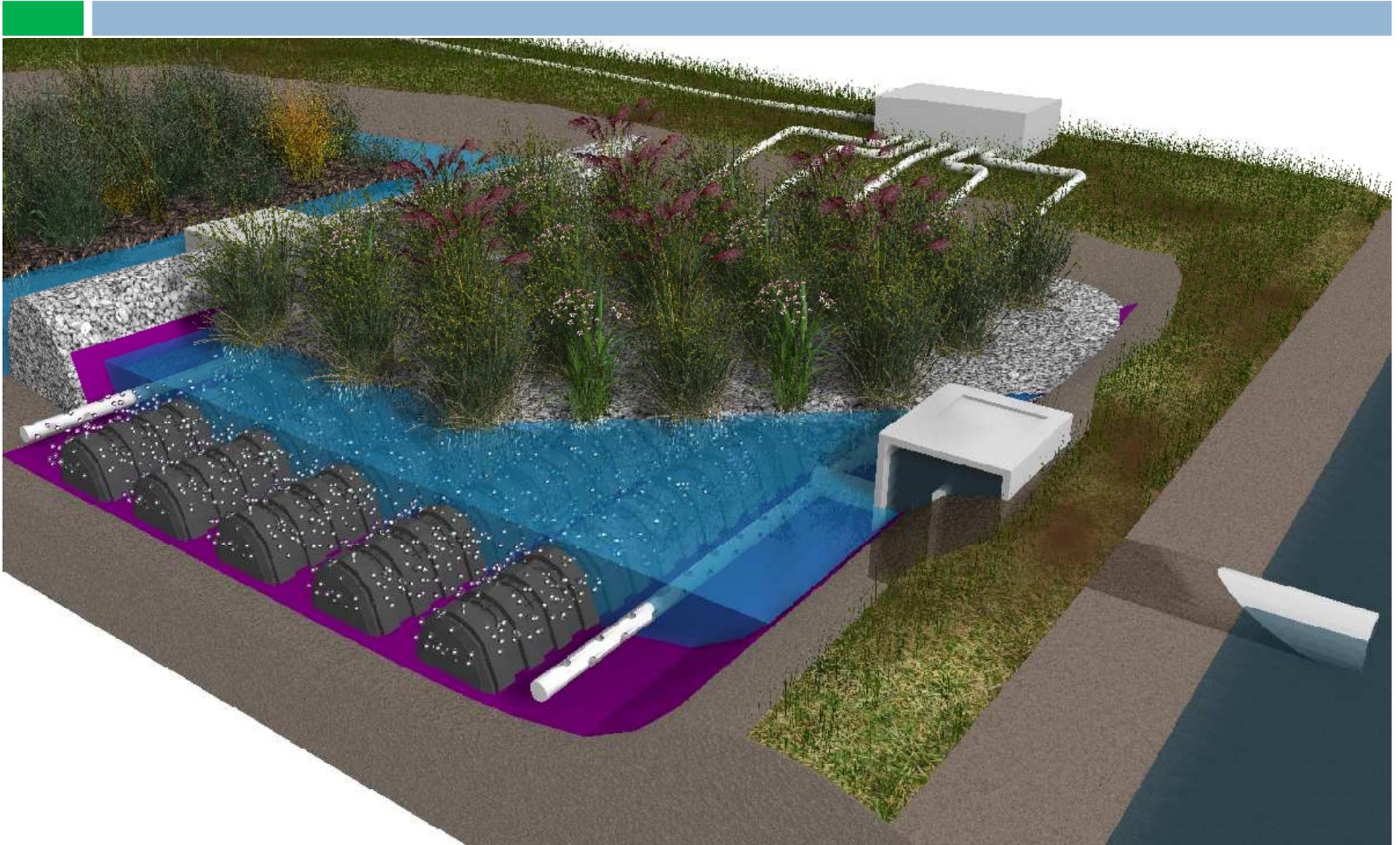
Subsurface Aeration



Subsurface Aeration



Subsurface Aeration



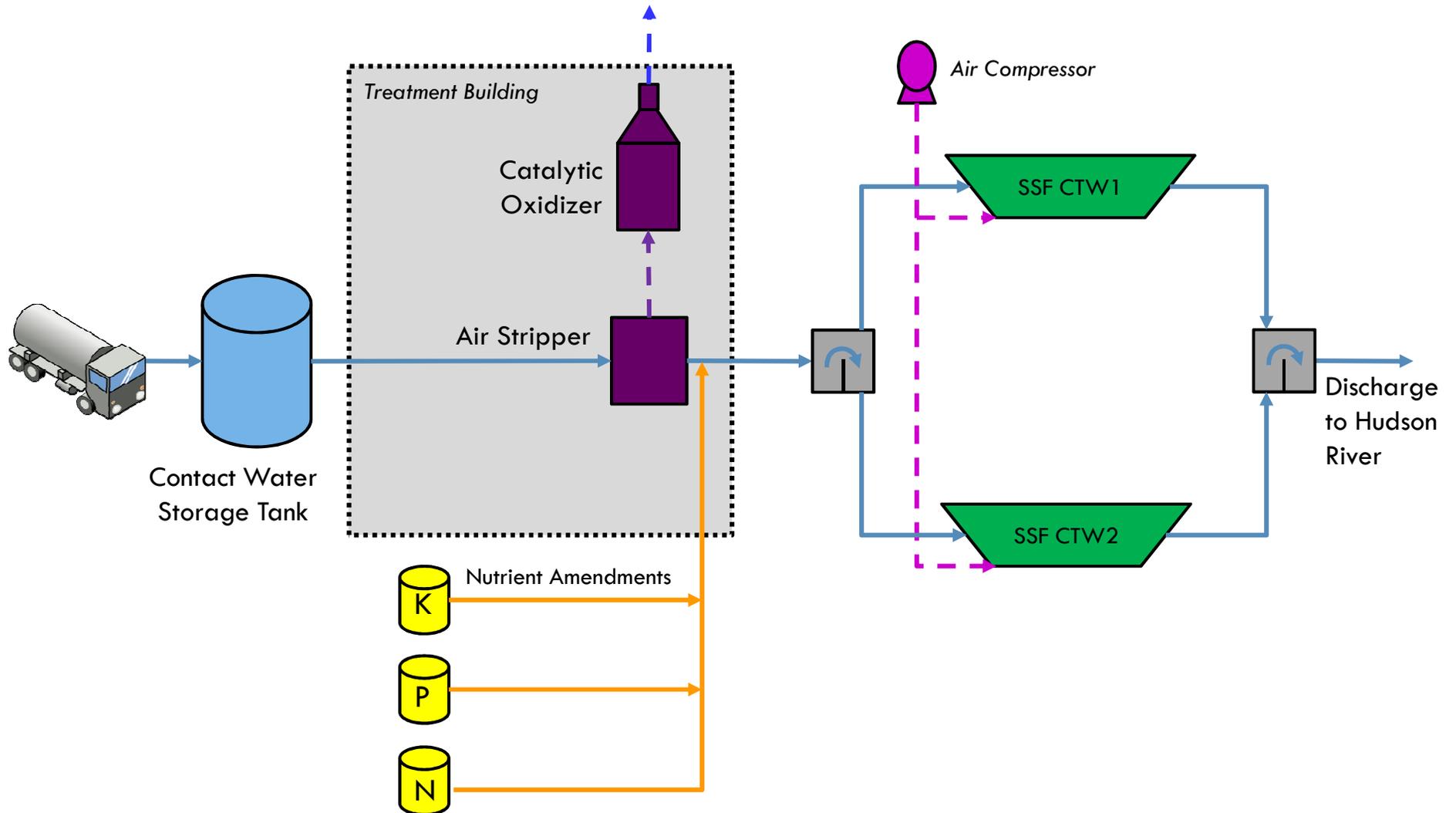
Aeration Equipment Installation



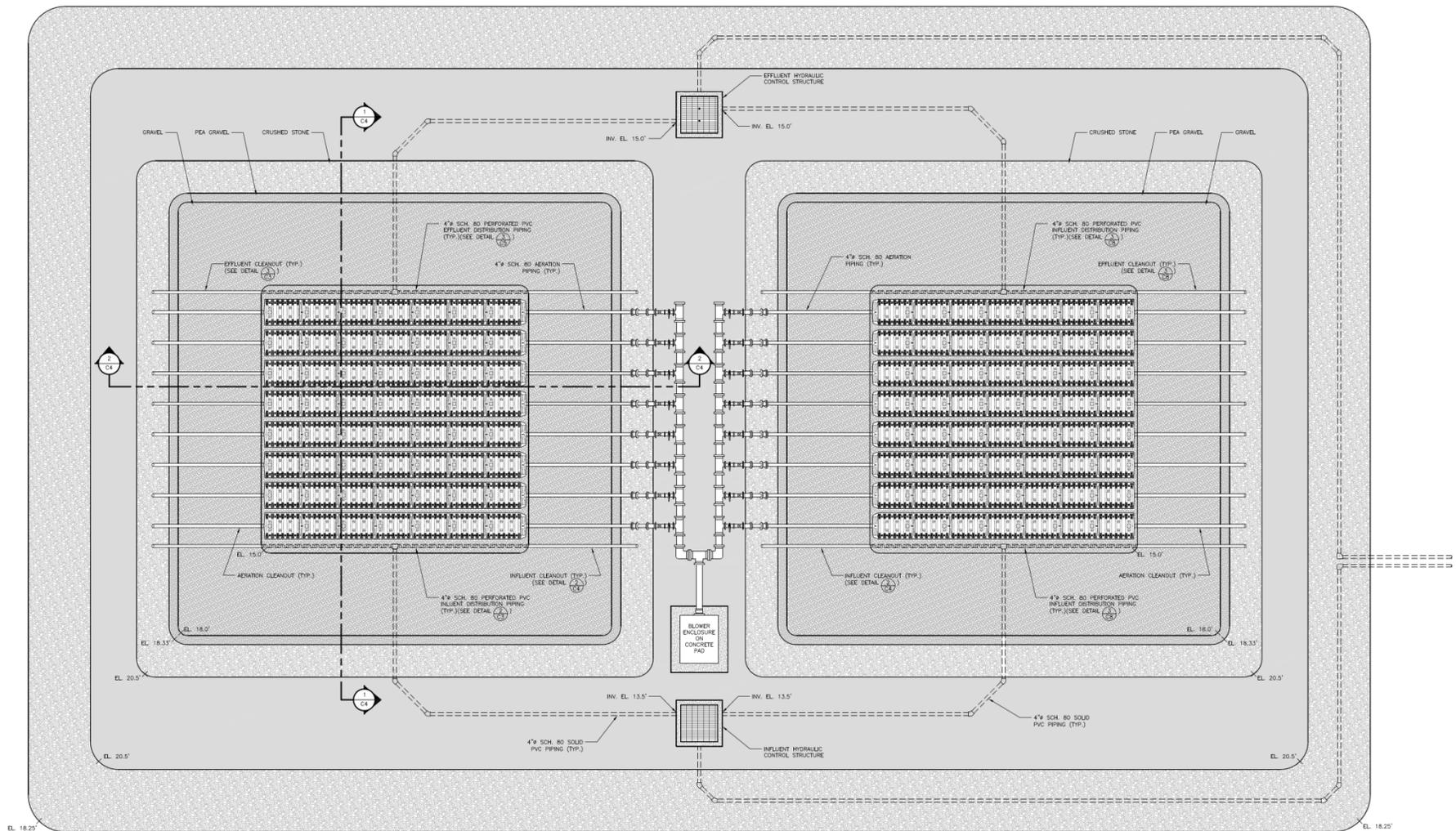
Layout



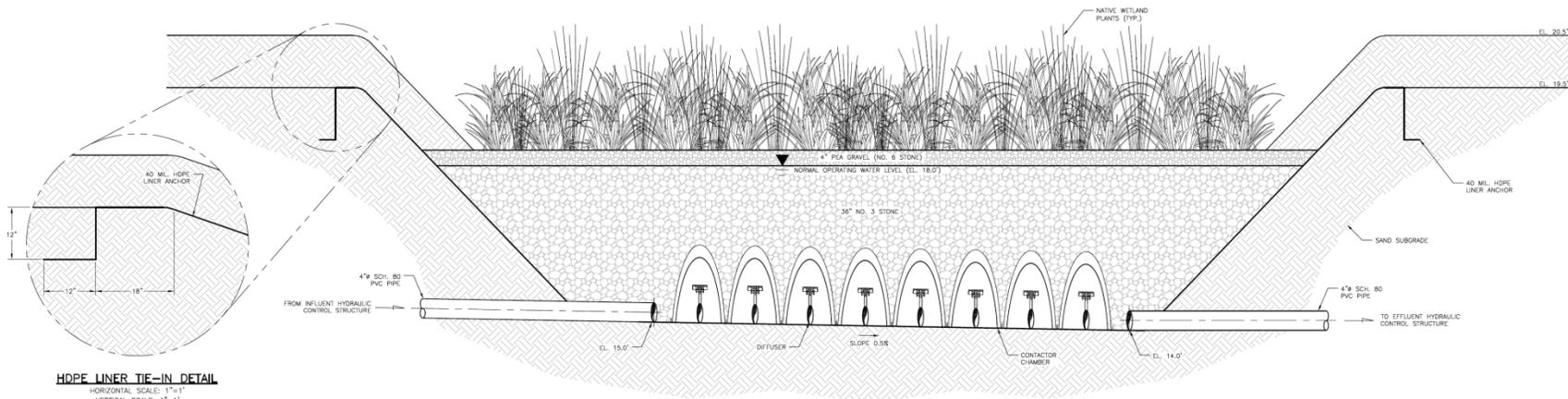
Process Design



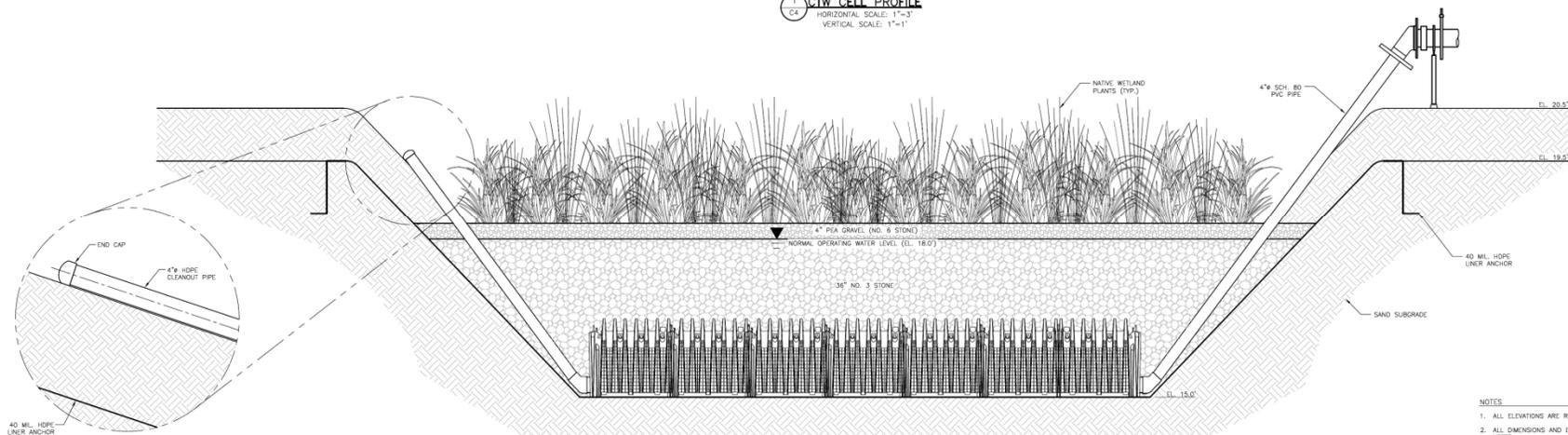
CTW Plan View



CTW Profiles



1 CTW CELL PROFILE
 HORIZONTAL SCALE: 1"=3'
 VERTICAL SCALE: 1"=1'



2 CTW CELL PROFILE
 HORIZONTAL SCALE: 1"=3'
 VERTICAL SCALE: 1"=1'

- NOTES**
1. ALL ELEVATIONS ARE RELATIVE TO MEAN SEA LEVEL.
 2. ALL DIMENSIONS AND ELEVATIONS ARE IN FEET UNLESS OTHERWISE NOTED.
 3. ALL PROPOSED ELEVATIONS SHOWN ARE THE FINISHED GRADE ELEVATIONS.
 4. ALL PIPING IN NON-PAVED AREAS SHALL HAVE A MINIMUM COVER OF 3 FEET, UNLESS OTHERWISE NOTED.
 5. SUBCONTRACTOR WILL INSTALL ALL PIPING IN ACCORDANCE WITH INVERTS SPECIFIED ON DESIGN DRAWINGS; SLOPES SHOWN IN SECTION DRAWINGS ARE APPROXIMATE AND SHOULD BE USED FOR REFERENCE PURPOSES ONLY.

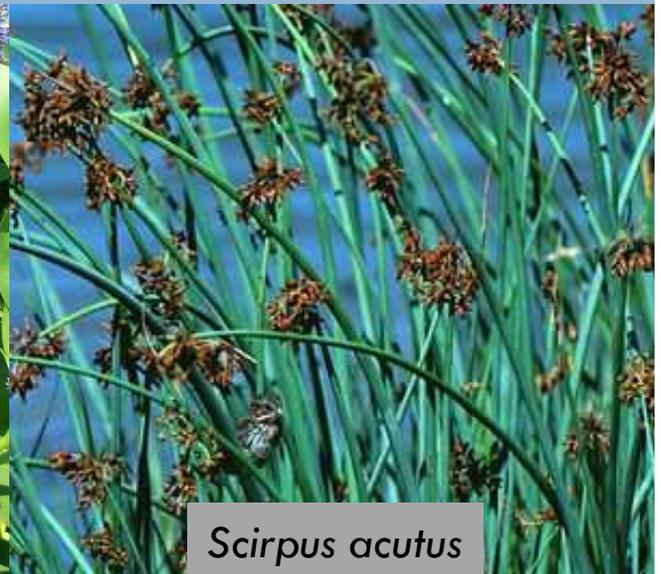
Native Species Planting



Sagittaria latifolia



Pontederia cordata



Scirpus acutus



Carex lurida



Peltandra virginica



Iris versicolor

CTW with native species (Kingston, NY)



Project Status

- ❑ Permit Modification still under NYSDEC review
- ❑ Construction spring 2016



The logo for ROUX, featuring the word "ROUX" in white, bold, uppercase letters inside a blue rounded rectangle.

ROUX

The word "Questions?" in white, bold, sans-serif font, positioned on a dark blue semi-transparent rectangular background that spans across the middle of the image.

Questions?

Contact information for Amanda Ludlow, including her name and email address, displayed in white text on a dark blue semi-transparent background.

Amanda Ludlow
aludlow@rouxinc.com