SOLUTIONS FOR STORMWATER TREATMENT
MODULAR WETLANDS

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National Sales Manager

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PNW Regional Sales Manager
Presentation Overview

Modular Wetland System Linear

- Product Overview & History
- Configurations & Options
  - Sizing
- Construction & Assembly
- Installation Guidelines
- Maintenance Guidelines
  - Case Studies
  - Costing
  - Q & A
Development History

- Original concept based upon sub-surface flow gravel wetlands which have been used for several hundred years to treat wastewater and other polluted water. Have been used to successfully treat stormwater for over 50 years.
Product Overview

Development History

- In 2006, Bio Clean Environmental Services, Inc. formed a subsidy called Modular Wetland Systems, Inc. with the purpose of creating a subsurface flow wetland system for use in highly urbanized areas.

- The initial design was similar to the non-proprietary designs yet with a more advanced pre-treatment apparatus.
Development History

• In 2007, the Modular Wetland System Linear (MWS Linear) was commercially launched. During the next few years installation were completed in the Southern California area:
Development History

- In 2009, the MWS Linear 2.0 was released which included the patented “perimeter biofiltration” design along with more advanced pre-filter cartridges. This was the unit tested under the TAPE protocol currently in use:
Biofiltration Defined – media filters with the inclusion of vegetation and enhanced microbial communities.

Sub-Categories

Bioretention/Rain Gardens
- Downward Flow
- Aerobic Systems

Modular Wetlands (SSF)
- Horizontal Flow
- Aerobic / Anaerobic Systems

How Is It Different?
Advantages

The Modular Wetland System Linear 2.0 Provides Two Distinct Advantages:

1. MULTI-STAGE PRE-TREATMENT
   i. Protects biofilter from sediment
   ii. Decreases overall maintenance cost

2. HORIZONTAL FLOW BIOFILTRATION
   i. Minimizes clogging
   ii. Greater surface area

3. ORIFICE CONTROLLED DISCHARGE
Superior Design with Pre-Treatment

Systems Features & Operation

- Pretreatment Chamber
- Biofiltration Chamber
- Discharge Chamber
How It Works  Horizontal Flow Biofilter

Patented Design

Perimeter Void Space Maximizes Surface Area
How It Works  Horizontal Flow Biofilter

Bioretention/Rain Garden

- 4’ x 4’ = 16 Sq Ft
- = 16 gpm

Modular Wetlands

- (3.4 x 3.7) x 4 = 50 Sq Ft
- = 50 gpm

Both Systems Have Same Media
Thickness & Loading Rate
Horizontal Flow Biofiltration Systems Allow Sediments to Accumulate Below the Media Bed

Drastically Reduces Clogging

Water Flow Unimpeded
Is Pre-Treatment Important?

Downward Flow Bioretention Systems Accumulate Sediment On Top of the Media Bed

Leads to Rapid Clogging of Filtration Media
How It Works

Pre-Filter Cartridge

Pre-Filter Cartridge Housing

Individual Media Filters

3.2 Sq Ft of Surface Area per Media Filter
How It Works

Pre-Filter Cartridge

Full Size Cartridge
Holds Up to 8 Media Filters

Half Size Cartridge
Holds Up to 4 Media Filters
How It Works  Pre-Filter Cartridge
Pollutant Efficiency

<table>
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<tr>
<th>Pollutant</th>
<th>Efficiency</th>
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</thead>
<tbody>
<tr>
<td>TSS (Sil-Co-Sil 106) (mean particle size 20 microns)</td>
<td>85%</td>
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<tr>
<td>Oils &amp; Grease</td>
<td>91%</td>
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</table>

- Made of various oxides to promote ion exchange of dissolved pollutants.
- 80% void space allows for double the contact time compared to granular media.
- Excellent physical filtration capacity and hydraulic capacity.
- Perlite can also be used.
Wetland Media™ vs. Traditional Bioretention Media

“Ideal for Phosphorus impaired water bodies and Nutrient TMDLs.”

**Wetland Media™**
- **No Organics**
- **Removes Phosphorus**
- **48% Void Space**
- **Greater Surface Area**
- **Maximum Evapotranspiration**
- **High Ion Exchange Capacity**
- **Light Weight**

**Traditional Bioretention Media**
- **Contains Organics**
- **Studies have shown that bioretention media can leach nutrients such as phosphorus.**
- **May Leach Phosphorus**
- **40% Void Space**
- **Minimal Surface Area**
Why Organic Free Media?

Focus on Bioretention Monitoring

Washington Department of Ecology

General observations of the preliminary data from the project sites above include:

- TSS, dissolved zinc, and fecal coliform decrease significantly.
- PAHs and phthalates decrease.
- Phosphorus and dissolved copper increase significantly.
- Short-term significant increases in nitrate also possible.
How It Works  Orifice Controlled Discharge

Creates a Critical Point of Restriction Less than the Hydraulic Capacity of the Wetland Media Creating an Inherit Safety Factor
## Current List of Agency Approvals

<table>
<thead>
<tr>
<th>Agency</th>
<th>Product</th>
<th>Type</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>WA DOE</td>
<td>MWS-Linear</td>
<td>GULD; TSS, TP, Metals</td>
<td>2014</td>
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<tr>
<td>Oregon, CWS</td>
<td>MWS-Linear</td>
<td>Accepted per WA GULD*</td>
<td>2015</td>
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<tr>
<td>City of Nashville, TN</td>
<td>MWS-Linear</td>
<td>Accepted; 80% TSS Removal</td>
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<td>Virginia DEQ</td>
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<td>Rhode Island DEM</td>
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<td>Texas TCEQ</td>
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<td>Maryland MDE</td>
<td>MWS-Linear</td>
<td>Approved; Water Quality</td>
<td>2015</td>
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</table>
Configurations & Options

The Most Versatile Biofiltration Available

• Available in “Side-By-Side” Orientation (internal bypass available)
• Or in “End-To-End” Orientation (linear applications, roadways)
Configurations

Grate/Drop Inlet Type
Configurations

Vault Type
Configurations – Flow Based Design

One or More Inflow Pipes Can Be Connected to the Pre-Treatment Chamber

Height of System Can Vary from 2’ to 7’ With an Open Planter
## Flow Based Sizing – WA

Assumes 100% Impervious

<table>
<thead>
<tr>
<th>Model</th>
<th>Dimension (ft)</th>
<th>Surface Area (sq ft)</th>
<th>Treatment Flow (cfs)</th>
<th>Area Treated (acres)</th>
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<tbody>
<tr>
<td>MWS-L-4-4</td>
<td>4 x 4</td>
<td>22</td>
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<tr>
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<td>4 x 19</td>
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Flow Based Sizing

Shallow Units Maintain Same Retention Time & Performance

2.75 Ft Height Unit
DVERT Trough – Bypass options

DVERT Trough

- Diverts treatment flows from standard catch basins to the Modular Wetland
- Simplifies Installation for Retrofits
DVERT Trough – Bypass options

DVERT Trough Connected to Standard Inlet
DVERT Trough – Bypass options

DVERT Project Example
Construction & Assembly

Precast Concrete Structure

- Designed for lateral, downward and traffic loading requirements
- Custom design and options available
Construction & Assembly

Precast Concrete Structure

- Various lid and hatches available per request of client
Construction & Assembly

Delivered To Job Site Fully Assembled

- Ready for installation upon arrival
Activation

Occurs After Project is Completed & Site is Stabilized

- Unit is inspected to ensure proper installation
- Vegetation is planted
Maintenance Guidelines

Fast & Simple

- Pretreatment chamber minimizes maintenance requirements
- Pre-filters protect wetland chamber from clogging
Maintenance

Trash Rack (optional)

Pre-Treatment Chamber
Maintenance

Large Storage Capacity

Efficient Sediment Removal
Maintenance

Separation Chamber

Quick Cleaning
Pre-Filter Cartridges – Less Time to Replace Media

Effectively Protects Biofilter From Clogging

Maintenance

Easy to Remove
Maintenance

Pre-Filter Cartridges – New Media
Case Studies

Marina Del Rey, CA Infill Project

• Variety of landscape used to match surroundings
• Utilize internal bypass feature to minimize complexity
Case Studies

Marina Del Rey, CA Infill Project


  - Total Capital Cost: $87,000
  - Total Installation Cost: $26,000
  - Average Yearly Maintenance Costs: $2,600

- Reason Chosen: The Modular Wetland was able to provide the highest treatment flow rate of any biofiltration BMP in the smallest footprint. Linear design also allowed it to be used in narrow street planter applications.

- POCs – TSS, nutrients, metals, bacteria, trash, and hydrocarbons.
Case Studies

Port of Tacoma NIM Industrial Retrofit Project

- Challenges & Constraints: Existing main drainage pipe 5’ deep. Required end-of-line system capable of intercepting storm drain. Minimal space available.
  - Total Capital Cost: $100,000
  - Total Installation Cost: $45,000
  - Average Yearly Maintenance Costs: $1,200
- Reason Chosen: An existing industrial site with benchmarks for metals and other POCs. Site utilized a mobile test unit of the MWS-Linear to see if the system could hit the benchmarks which it did.
  - POCs – dissolved zinc among other pollutants.
Costing

Included In Price:

• Concrete Structure
  • All Internal Components Pre-Assembled
  • WetlandMedia In Super Sacks Or Pre-Installed
  • Installation Support
  • Inspection & Maintenance (1st Year)
• Plants & Installation of Plants (including activation)
<table>
<thead>
<tr>
<th>Model #</th>
<th>Price per System</th>
<th>Biofiltration Media Surface Area (sq ft)</th>
<th>Cost Per Sq Ft</th>
<th>Estimated Installation Cost</th>
<th>Estimated Yearly O&amp;M Cost</th>
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<tbody>
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Costing

Average Capital Cost:

- $27,000 per acre

Price Range Maintenance Cost Per Year:

- $400 - $1500 per visit

(Based on a single unit project. Projects with multiple units will have lower costs)
Vegetation

Promotes Healthy Plant Growth

Day 1

Month 14
Vegetation

Planting Options

- Trees
- Grass
- Shrubs
Dual Curb Inlet Type
Grate Type
<table>
<thead>
<tr>
<th>DESIGN REQUEST – MODULAR WETLAND SYSTEM - LINEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>I'll use the information below. This will assist in providing you with detailed sizing, drawings &amp; pricing.</td>
</tr>
</tbody>
</table>

1. Project Name: 
2. Project State & City: 
3. Unit ID (if several units are on same project): 
4. Your Name: 
5. Your Contact Email/Phone #: 
6. Desired Date to Receive Sizing/Drawing/Pricing: 

7. Configuration: Standard planted modules: [ ] Underground [ ] Direct Traffic 
NOTE: Some regulators will only accept units with required open spaces to meet their definition of tertification. 
8. Loading Requirements: Pathway [ ] Sidewalk [ ] Direct Traffic [ ] Other [ ] 
9a. If Other Please List Details [ ] BASIS 
NOTE: Standard units have pathway and sidewalk, and sidewalks. Underground configurations can have a traffic or sidewalk/knee basket by request. All will be built in poly style. Helipads that are available per request but will not cost. Standard units require sidewalks and must be placed in a landscape area. 
9b. Runoff Entry Method: Piped Flow [ ] Built-in Culvert Inlet [ ] Built-in Grate Inlet [ ] 
NOTE: Culverts may only be used if there is "a" combination of piped flow and a grate or culvert intake. Culverts may be accepted multiple below pipes. Size of pipe is limited depending on the size of the unit. 
10. Water Quality Flow Rate: [ ] CFS (Dependent on local regulations) OR [ ] CU FT (Dependent on local regulations) OR [ ] Not Required - Flow rate provided. 
10a. Water Quality Volume: [ ] CU FT (Dependent on local regulations) OR [ ] Not Required - Volume provided. 
10b. Drainage Area (acres & Impervious Coefficient): [ ] not required - Rate calculated. 
NOTE: Units may be used for either the water quality flow rate or water quality volume. For water quality volume, a pre-determined volume is required. For some of the country, volume flow based design is preferred because local regulations do not allow a method to calculate water quality flow. Please provide the drainage area (acres) and the impervious coefficient. The engineering team will determine the necessary size required based on your specific needs. 
11. Internal Bypass Desired: [ ] Yes [ ] No 
11a. Peak Flow Rate (if internal bypass desired): [ ] CFS (Dependent on local regulations) OR [ ] CU FT (Dependent on local regulations) OR [ ] Not Required - Flow rate provided. 
11b. Flow Rate (if internal bypass described): [ ] CFS (Dependent on local regulations) OR [ ] CU FT (Dependent on local regulations) OR [ ] Not Required - Flow rate provided. 
NOTE: Standard units include an internal bypass system. Internal bypass must be used with caution and a hydraulic assessment is required for each unit, including each pipe for the overall design. 
12. Finish Grade Elevation (FL, TC, CG): 
13. Inlet Pipe Invert Elevation (if applicable): 
13a. Inlet Pipe Diameter/Type (in.): [ ] PVC 
14. Outlet Pipe Invert Elevation 
14a. Outlet Pipe Diameter/Type (in.): [ ] PVC, CBCU 
NOTE: For flow based design at least 60º of fill required between invert and invert out. For volume based design at least 60º of fill required between invert and invert out for hydraulically connected pre-treatment. 
15. Ground Water Elevation (if applicable): 
16. Corrosive Soil Conditions (if applicable): 

Please email us: info@modularewetlands.com 
Any questions, contact: (866) 566-3038 

MODULAR WETLANDS
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Questions & Answers

You have Questions
We have Answers