Implementation of Low Impact Development (LID) Systems: The Use of Filtrexx® FilterCell™ Technology for Nutrient Management

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Introduction

The Filtrexx FilterCell™ filtration system is a temporary or permanent water or stormwater filtration system used to remove sediment and/or soluble pollutants. This portable Land Improvement System (LIS) uses organic FilterMedia™ and native vegetation to remove pollutants from water and stormwater before it is discharged into collection ponds, wetlands, infiltration basins, fields, or receiving waters.

This innovative filtration system utilizes a mesh-like "sock" and an all-organic fill material in conjunction with native vegetation and proprietary flocculants to filter point and non-point runoff sources. Flocculants are prescribed on a site-specific basis to remove target pollutants from contaminated water and stormwater flows. Filtrexx® FilterCell™ technology used in conjunction with proprietary flocculants, have demonstrated the following pollutant removal levels[1]:

Target Pollutant	Percent (%) Removal
Petroleum Products	99%
Bacteria	99%
Phosphorous	92%
Nitrogen	25-33%
Heavy Metals	47-73%

The FilterCell™ technology can be utilized in temporary applications during land disturbing/construction activities or for permanent applications where native vegetation can be established to create a permanent organic vegetative filter designed into the existing landscape[2].

Typical applications include sediment and soluble pollutant control of stormwater and agricultural runoff. In addition, vegetated FilterCells™ reduce runoff velocity and pollutant levels flowing into surface waters, therefore decreasing soil erosion and increasing pollutant removal through trapping, sediment deposition, and biological plant uptake.

REFERENCES

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[3] Faucette, L.B. 2005. Removal and Degradation of Petroleum Hydrocarbons from Storm Water with Compost. Filtrexx Tech Link #3307.

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Nutrient Management with Filtrexx® FilterCell™ Technology

Application

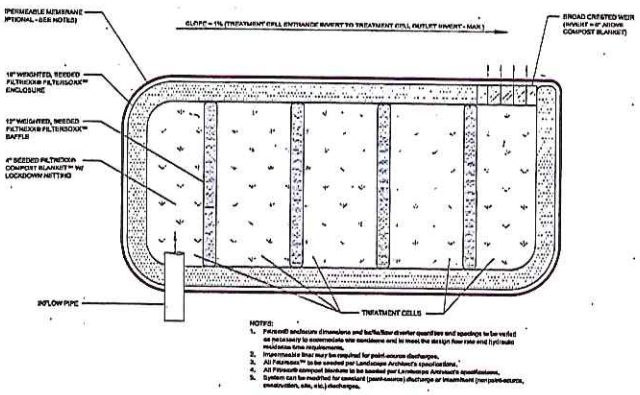
The Filtrexx FilterCell™ system can be used for temporary applications during land disturbing or construction activities or for permanent applications where vegetation can be established to create a permanent organic vegetative filter that is designed into the landscape. Typical applications include:

- Pretreatment for temporary sediment detention ponds
- Post-treatment for temporary sediment detention pond discharge or emergency storm overflow
- Pretreatment for permanent storm water collection ponds
- Sediment and soluble pollutant control of storm runoff
- Sediment and soluble pollution filtration from contaminated effluent

Vegetated FilterCells™ can also be used to reduce runoff velocity flowing into surface waters. Reducing runoff velocity will decrease soil erosion and increase pollutant removal through trapping, sediment deposition, and plant uptake.

Advantages

- FilterCells™ are easily installed and can establish vegetation in difficult areas
- FilterCells™ can be easily designed and incorporated as one treatment in a treatment train approach to stormwater management
- FilterCells™ can be used to filter pollutants and infiltrate stormwater entering or leaving areas where stormwater may pass, collect, drain, or be stored
- FilterCells™ have the ability to bind and absorb soluble nutrients, metal, and hydrocarbons that may be in stormwater runoff, thereby reducing loading to nearby receiving waters
- FilterCells™ can remove pathogens and pesticides from storm runoff preventing pollution of receiving water bodies
- FilterCells™ can be customized to remove target pollutants from contaminated water, such as phosphorus and suspended solids
- FilterCells™ can be customized to handle a variety of water pollutant concentrations, pollutant loads, and water volumes



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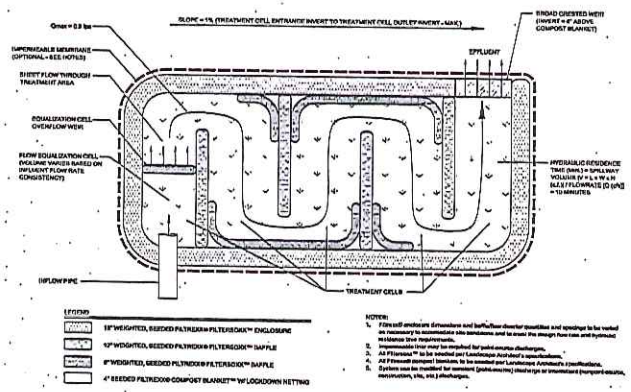

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FilterCell™ Real World Applications

Base Installation of FilterCell™

Treatment of Field Drainage Area Runoff

Example of FilterCell™ for Pollutant Filtration

Fully Vegetated FilterCell™

Conclusion

The primary function of the FilterCell™ filtration system is to remove sediment and soluble pollutants, such as nutrients, heavy metals, petroleum hydrocarbons, and pesticides from stormwater runoff or contaminated effluent water. By using organic matter and humus rich materials, the FilterCell™ system is able to chemically absorb pollutants rendering them less toxic and less available to animals and humans[3, 4].

Filter Baffles™ can be injected with flocculants to allow for custom design to target specific pollutants in water and stormwater, thereby reducing their concentration and load exiting the system. The organic humus rich system is also designed to absorb large volumes of water thereby reducing mass loading of pollutants exiting the system. Flow diverters and filtration baffles also increase the flow path and reduce flow velocities which allows for increased settling of suspended solids, reduction of turbidity, and increased reaction time to absorb soluble pollutants. The result is systematic reduction of pollutants leaving the filtration system and ultimately migrating to sensitive receiving waters and wetlands.

The vegetated FilterCell™ system is effective at filtering pollutants from water and stormwater due to flow velocity reduction and physical trapping of pollutants by the vegetation[5]. Vegetation can increase surface roughness which can reduce flow velocity. Large particles are typically removed in greater efficiencies than suspended particles through reducing flow velocity and constructing/maintaining vegetated filters. Many plants have the ability take up excess nutrients and other pollutants trapped in the vegetation, while microorganisms can decompose and/or incorporate these pollutants into their biomass, making them less toxic to aquatic ecosystems. Organic matter supplied in GrowingMedia™ increases the diversity and population of microorganisms that can decompose and incorporate captured pollutants.

Maintenance is a key consideration, as sediment build-up will significantly reduce the ability of a vegetated FilterCell™ to remove pollutants from effluent or runoff water; however, unless sediment accumulation is extreme, FilterCell™ vegetation will continue to grow in and through deposited sediment.

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Providing Environmental Solutions

Implementation of Comprehensive Stormwater Management (SWM) Planning & Green Technology Best Management Practices (GTBMPs) for New Castle County (NCC) Municipal Separate Stormwater Sewer System (s) (MS4)

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Introduction

In March of 2007, The State of Delaware's New Castle County Department of Special Services (NCCDSS) requested a level of service relative to the county's Stormwater Pollution Prevention Plan (SWPP).[1] Comprehensive Stormwater Management (SWM) and Green Technology Best Management Practices (GTBMPs) design criteria required to maintain and enhance the structural, functional, and ecological integrity of county-owned SWM systems for the short and long-term were provided. NCC is classified as a Phase I MS4 under the EPA's stormwater program.[2]

The first phase of the process included site tours and assessments of Stormwater Management Systems (SWMSs) currently managed and maintained under a Comprehensive Stormwater Management Plan (CSWMP).

The second phase included an interpretation of the Management Units (MUs) and implementation procedures. This was completed in a conventional classroom situation accompanying the methods required to meet all learning styles.

The third phase was to conduct a needs assessment relating to four (4) professionally-engineered SWM systems, all of which were design-built retrofits. These four (4) SWMSs would be known as "Pilot Programs" and CSWMP manuals were created for each.

The fourth phase included "in-the-field" training exercises required to inform and demonstrate maintenance and management GTBMPs procedures and techniques to NCCDSS park maintenance staff.

The fifth phase was to create a cost(s) analysis for a continued maintenance and management program for sixty-two (62) remaining County-owned Stormwater Facilities.[3]

The final stage was to design a "NCCDSS Stormwater Facility Maintenance & Management Service Provider Request for Proposals Qualifications Statement".[4]

The CSWMMP and GTBMPs resulted in structurally, functionally, and environmentally sound SWMSs. All of the pilot program sites are adjoining areas where public use is significant; therefore meeting public expectations regarding aesthetic appeal in an environmentally sound manner is an objective. NCCDSS now possesses a much improved understanding of the capital required for the continued maintenance, management, regulatory policy, educational criteria, and the necessary qualifications for service providers. The acquired qualitative and quantitative information[5] may be applied to all components of the county-owned MS4s.

REFERENCES

[1] USEPA, "Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites", EPA 833-R-060-04.

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[3] State of Delaware, Department of Labor, Division of Industrial Affairs, Prevailing Wage Rate Sheets, 2007.

[4] New Castle County Department of Special Services: Stormwater Facility Maintenance and Management Service Provider Request for Proposal Qualification Statement, 2008.

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[6] USEPA, Clean Water Act, Section 402, Phase II National Pollution Discharge Elimination System (NPDES) Stormwater Program, National Menu of Best Management Practices.

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Demonstration of Management Units

Basin Embankments & Soil Stabilization	Exotic Invasive & Native Nuisance Vegetation	Algae & Cyanobacteria Control	Wildlife Management
Vegetative Enhancement	Water Quality & Habitat	Rip-Rap Stabilization	Aeration
Biological Mosquito Control	EMS Products	Riparian Buffers & IVM	Educational Outreach

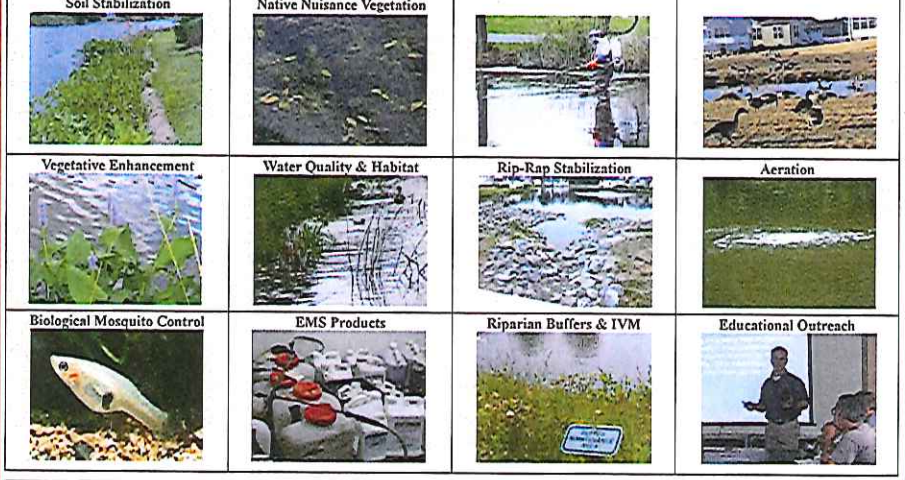


Figure 1

Emily Bissel Drainage Improvement Project
(Dry Basin/Stormwater Wetland)

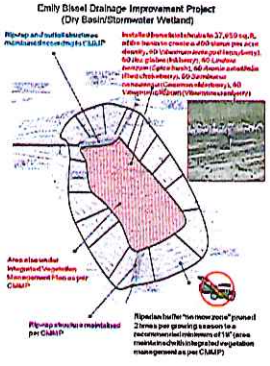


Figure 2

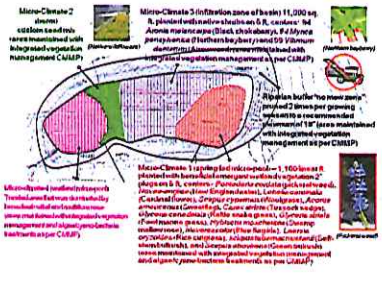
Paper Mill Park Stormwater Pond
(Wet Pond)

Figure 3

Mendenhall Village
Inline Dry Basin (Stormwater Wetland)

Figure 4

Hyde Park Delcastle Stormwater Management Retention Basin Plan View



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Site Specific Management Unit(s) Applied to Pilot Program Stormwater Management Systems

Site Specific Management Unit(s)	Basin Embankments & Soil Stabilization	Exotic & Invasive Nuisance Vegetation	Algae & Cyanobacteria Control	Wildlife Management	Vegetative Enhancement	Water Quality & Habitat	Rip-Rap Stabilization	Aeration	Biological Mosquito Control	EMS Products	Riparian Buffers & IVM	Educational Outreach
Emily Bissell Drainage Improvement Project	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓
Paper Mill Park Wet Pond	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mendenhall Village Stormwater Wetland	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓
Hyde Park Stormwater Management Basin	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

Applied Management Unit(s)

Conclusion

In order to demonstrate functional and stable SWMSs that are and have been maintained with CSWMMP and implementation procedures, NCCDSS staffing was provided with site tours to five (5) different subdivision SWMSs and one (1) municipal SWMS. Each site clearly modeled the distinct MUs. The tours and "in-the-field" interpretation of GTBMP implementation procedures proved to be successful and a holistic understanding was demonstrated through verbal collaboration and written acknowledgment. This was determined because all MUs were clearly evident, much inquiry was generated, NCCDSS engineers determined that the SWMSs were structurally and functionally sound, all systems provided quality and quantity pre-discharge treatment, and a natural beauty to the system was evident.

Demonstration Site Clearly Indicating All MU's

Following this phase the NCCDSS requested an educational seminar to further this understanding of the MUs and maintenance procedures. This was completed with methods required to meet all learning styles, demonstration of applicable regulatory policies, and current GTBMPs.[6] This phase was immediately followed by a contracted agreement between NCCDSS section and a qualified active EMS division for the design and implementation of a Comprehensive Management Plan (CMP) for the four pilot programs. These pilot program sites were all vegetatively enhanced, stabilized, and functional within eight (8) to twelve (12) weeks of initial implementation.

Before & After Photographic Documentation

Emily Bissel Before	Emily Bissel After	Paper Mill Park Before	Paper Mill Park After
June 2007	June 2008	March 2007	June 2008
Mendenhall Village Before	Mendenhall Village After	Hyde Park Delcastle Before	Hyde Park Delcastle After
May 2007	June 2008	June 2007	June 2008