**Bowling Green, Kentucky**
**Stormwater Best Management Practices (BMPs)**
**Stormwater Pollution Treatment Practices (Structural)**

PTP-06

## Activity: Water Quality Units

PLANNING CONSIDERATIONS:

Design Life:
35 years

Acreage Needed:
Low

Estimated Unit Cost:
Moderate

Annual Maintenance:
Moderate to High


WQ

**WQ**

Target Pollutants, Pollutant Removal

Litter and Debris
Total Suspended Solids (TSS); 21%
Nutrients – Total Phosphorous; 17%
Metals – Lead/Zinc/Copper/$NO_2$+$NO_3$; 24/17/0/5%

### Description

Water quality units target pollutants from urban areas or hotspots and provide water quality benefits at stormwater inlets. Units are generally designed as compact below grade systems constructed of precast concrete. Units often employ a swirling motion or baffling that causes sediments and particulates to settle out and a chamber to capture floatable material. Water quality units included here are hydrodynamic separators, filtration units, and continuous deflection separators.

Hydrodynamic separators are flow-through systems with a separation cylinder unit to promote the settlement of sediments and other pollutants. No outside power source is required as the system is designed to utilize the energy of flowing water. Means of separation vary between hydrodynamic separator units, which may employ velocity reduction to allow settling or indirect filtration.

Filtration units are devices inserted into storm drains to filter or absorb sediment, pollutants and oil and grease. Filter media cartridges are commonly used to collect and dispose of pollutants.

Continuous deflection separators treat runoff by screening sediment and debris via a vortex of water that deflects sediment and debris into a sump while water flows through a screen.

### Suitable Applications

Water quality units work well in areas targeting floatables, grass solids, oils and grease. Water quality units are most suitable for highly impervious sites. Because of their limited removal ability of soluble pollutants and fine particles, these devices should be used as a pretreatment device, and should not act as a stand-alone practice for new development. However, when space is limited, water quality units are ideal for retrofit applications. Site types may include automotive lots, parking lots, roadways, road salt storage facilities, hazardous substance facilities and rooftop runoff.

Suitable Applications (cont.)

Water quality units are typically suitable for the following applications:

- Impervious area runoff
- Retrofit applications
- In conjunction with other stormwater BMPs

Target Pollutants

Target pollutants and removal effectiveness may vary widely between the unit type and manufacturer. If available, independent data should be used to consider a water quality unit brand or manufacturer. Independent studies suggest that water quality units primarily target litter and debris with limited pollutant removal capacity, particularly for fine particles and soluble pollutants. Target pollutant information for this fact sheet was based on data from the Environmental Protection Agency's fact sheet, *Manufactured Products for Stormwater Inlets*, referencing S.S. Greb and R. Waschbusch's study, "Evaluation of Stormceptor® and multi-chamber treatment train as urban retrofit strategies", 1998. This study investigated 45 precipitation events over a 9-month period and calculated percent removal rates to reflect overall efficiency, accounting for pollutants in bypassed flows.

Approach

- Hydrodynamic Separators

Hydrodynamic separators are generally considered flow-through devices that promote settling or separation to remove sediment and other pollutants by a swirling action. These structures do not require outside power sources, and become effective through the energy of flowing stormwater. These units are typically placed beneath parking lots or streets, and are directly connected to impervious areas. Although the City does not endorse specific vendors, units that may fall into this category include the Baysaver, produced by Baysaver, Inc.; Crystal Stream Oil/Grit Separator produced by Practical Best Management (PBM); the Vortechs System produced by Vortechnics, Inc.; and the Downstream Defender produced by Hydro International. An example of a hydrodynamic separator as provided by a typical vendor is shown in the Product Examples section.

- Filtration Units

Filtration units employ some type of filter media that collects stormwater pollutants as water flows through the structure. The filter media must be regularly replaced to allow pollutant removal to continue effectively. Although the City does not endorse specific vendors, units that may fall into this category include the Arkal Filtration System produced by Zeta Technology, Inc.; the StormGate, StormFilter, StormScreen and Catch Basin StormFilter produced by Stormwater Management, Inc.; and Aqua-Swirl Concentrator and Aqua-Filter produced by Aquashield, Inc. An example of a filtration unit as provided by a typical vendor is shown in the Product Examples section.

- Continuous Deflection

Continuous deflection separators are similar to hydrodynamic separators in that they are flow-through devices that use stormwater flow to employ separation of particles and removal of sediment. In addition, this device also utilizes a fine screen to separate solids and water. Stormwater flows tangentially through the screen to reduce the propensity for blocking or clogging. Sediment particles are allowed to settle out, accumulating in a containment sump. Although the City does not endorse specific vendors, units that may fall into this category include the Continuous Deflection Separator (CDS) produced by CDS Technologies, Inc. An example of a continuous deflection unit as provided by a typical vendor is shown in the Product Examples section.

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**Design Criteria**

The sizing and design for water quality units should be based on the manufacturer's product specifications. Units are generally designed according to the peak flow rate for a given design storm event at the inlet. Units may have features designed to reduce the velocity of the stormwater flow entering the unit, which increases the capacity of sediment removal of the system.

**Cost**

Costs for water quality units vary by type and manufacturer. In general, costs for water quality units increase for sites requiring treatment for high peak flows or where pre-manufactured units are not available. If pre-manufactured units cannot accommodate the site or design conditions, cost may increase for a customized unit.

**Installation Procedures**

Installation procedures should be followed by the manufacturer's instructions. A representative from the company who manufactured the water quality unit should be present during installation activities. Installation of the water quality unit should be conducted by a qualified individual under the supervision of the representative from the unit's manufacturer.

**Maintenance and Inspection Procedures**

Maintenance instruction should be obtained from the manufacturer to maintain the pollutant removal effectiveness of water quality units. Water quality units are reliable and relatively low maintenance systems due to their design with no moving parts. Maintenance is primarily needed to clean the system of debris and pollutants to keep it working properly. When not properly maintained, Water quality units have a high failure rate.

Maintenance and inspections should be conducted regularly after storm events to ensure the long term functionality of the system. By inspecting the unit before and after a significant rain event, the amount and the types of materials being captured can be monitored. This practice can aid in scheduling maintenance based on physical observation and attention to rainfall frequency. Consideration should also be placed on droughts or dry periods, where accumulation of pollutants can build up and create large amounts of floatables, debris, sediment, oils, hydrocarbons, and other pollutants during first-flush events.

Access to manholes should be clear and unobstructed to allow maintenance to the unit.

Semi-Annual Inspection

- Inspect unit for sediment buildup and structural damage

Routine Maintenance

- Remove sediment and debris from unit via vacuum truck, sump vac or other means.
- Increase maintenance schedule to remove debris during heavy leaf fall or other seasonal accumulation of trash or debris.
- Inspect after significant rainfall events to see if maintenance is needed.

**Product Examples**

This section provides examples of water quality units relating to a specific vendor for hydrodynamic separators, filtration units, and continuous deflection units.

*The City of Bowling Green does not endorse the manufacturers or brand product names listed. The following examples are meant to facilitate the evaluation of specifications for water quality units in general and to provide the user with a cross-section of water quality unit products available on the market.*

Product Examples – Hydrodynamic Separator

Hydrodynamic Separator: *Vortechs® System, a product by Vortechnics®, Inc.*

This hydrodynamic separator (Figure PTP-06-02) is designed to promote gravitational separation of particles using a swirl action in a cylindrical tank. The tank has compartments separated by baffle walls to control floatables at low, medium and high flows. The unit size is based on site area, runoff coefficient and time of concentration, regional precipitation intensity distribution, and anticipated pollutant characteristics. This data is applied to the Rational Method to estimate pollutant removal efficiency. The Rational Method works well for designing this system for most sites due to small site area and impervious surface characteristics. Flow rates calculated for each rainfall intensity are used to generate an operating rate for the Vortechs® System unit. Pollutant removal efficiencies can then be paired with operating rates based on laboratory tests and pollutant types and loads expected for the site.

The design incorporates the following features:

- Cylindrical grit chamber
- Baffle wall
- Flow control wall
- Shallow depth dimension required for installation

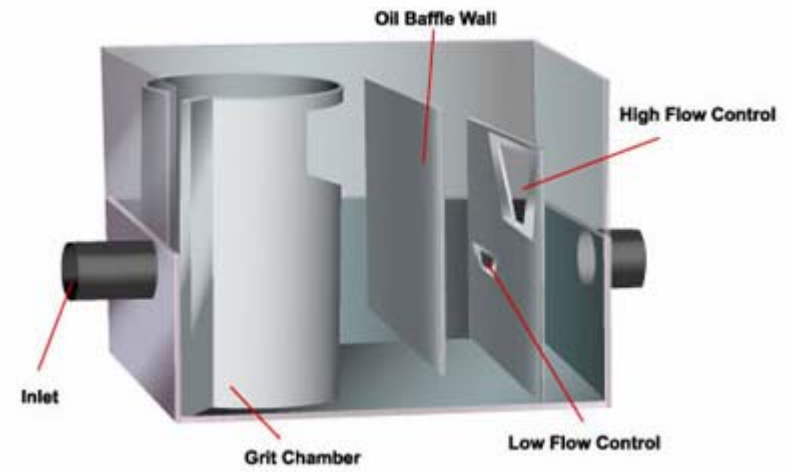


**Figure PTP-06-02 Hydrodynamic Separator, Vortechs® System Schematic**
*Source: University of Massachusetts Amherst Stormwater Technologies Clearinghouse, www.mastep.net.*

Product Examples - Hydrodynamic Separator (cont.)

Removal efficiency performance is compared in Table PTP-06-01.

Table PTP-06-01 Performance Comparison

*Source: University of Massachusetts Amherst Stormwater Technologies Clearinghouse, www.mastep.net.*

| Pollutants Addressed | Manufacturer's Removal Efficiency Claim (%) | Minimum Particle Size | Tested Removal Efficiency (%) |
|---|---|---|---|
| Suspended sediment concentration | 35-85% | 63 | 61 % |
| Total suspended solids | 35-85% | 63 | 35 % |
| Total dissolved solids | - | - | -110 % |
| Total volatile solids | - | - | - |
| Total solids | 35-85% | 0 | - |
| Oil and grease | 35-85% | - | - |
| Debris - floatables | 35-85% | - | - |
| Debris- sinking | 35-85% | - | - |
| Zinc | 0-80% | - | 24 % |
| Copper | 0-80% | - | 33 % |
| Lead | 0-80% | - | - |
| Iron | 0-80% | - | - |
| Chromium | 0-80% | - | - |
| Mercury | 0-80% | - | - |
| Cadmium | 0-80% | - | - |
| Hydrocarbons | 35-85% | - | - |
| Organic contaminants | 0-80% | - | - |
| Salt | 0-80% | - | - |
| Fecal coliform | 0-80% | - | - |
| E. coli | 0-80% | - | - |
| Enterococcus | 0-80% | - | - |
| Total nitrogen | 0-80% | - | - |
| Total Phosphorus | 0-80% | - | 21 % |

Product Examples – Filtration Unit

Filtration Unit: *StormFilter®, a product by Stormwater Management®, Inc.*

This filtration unit (Figure PTP-06-03) utilizes rechargeable media filter cartridges to remove pollutants from stormwater as it flows into the vault and passes through the filter. Inflow to the filter media is controlled by an orifice disk that can be adjusted from 5 to 15 gallons per minute. After traveling through the filter media, stormwater is released to discharge into a pipe. The unit is sized according to peak flow designed for treatment. The peak flow is based on hydrologic characteristics of the contributing watershed and the design storm. The unit size is indirectly related to the peak flow; size increases for additional filter cartridges required to treat larger peak flows.

The design incorporates the following features:

- Rechargeable media-filter cartridges
- Flow control orifice disk at base of cartridge
- 5 basic design configurations

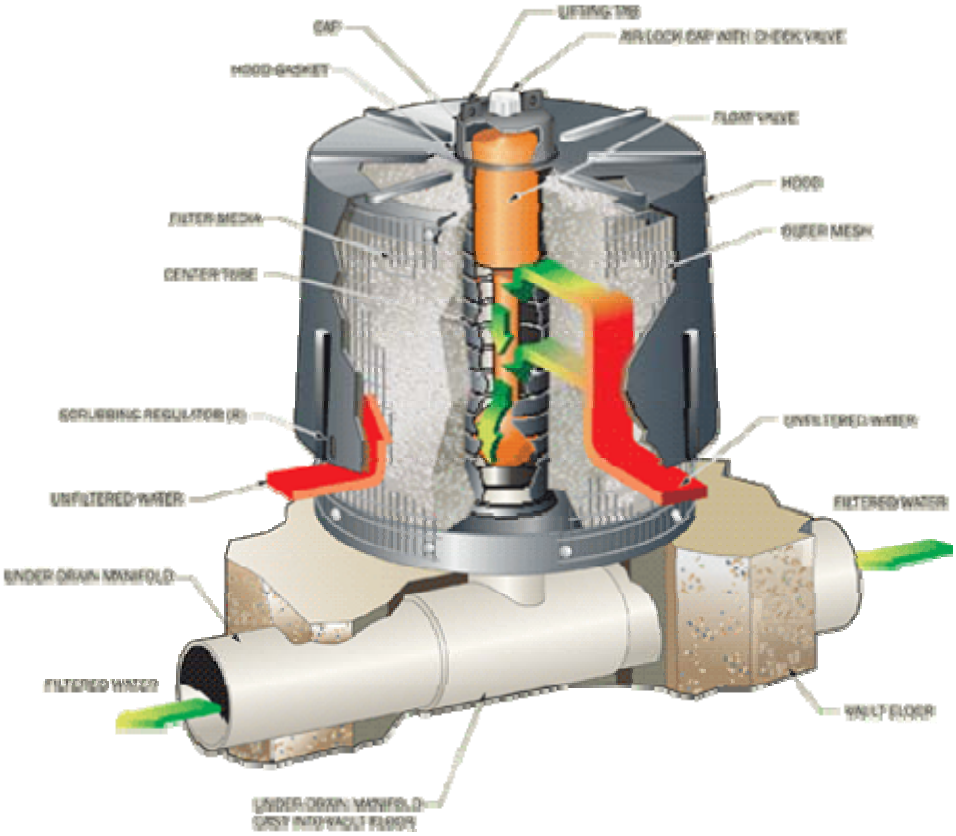


**Figure PTP-06-03 Filtration Unit, StormFilter® Schematic**
*Source: University of Massachusetts Amherst Stormwater Technologies Clearinghouse, www.mastep.net.*

Product Examples – Filtration Unit (cont.)

Removal efficiency performance is compared in Table PTP-06-02.

Table PTP-06-02 Performance Comparison

*Source: University of Massachusetts Amherst Stormwater Technologies Clearinghouse, www.mastep.net.*

| Pollutants Addressed | Manufacturer's Removal Efficiency Claim (%) | Minimum Particle Size | Tested Removal Efficiency (%) |
|---|---|---|---|
| Total suspended solids | 50-85% | - | 79 % |
| Zinc | 20-60% | - | 64 % |
| Copper | 20-60% | - | 59 % |
| Hydrocarbons | 74% | - | - |

Product Examples – Continuous Deflection

Continuous Deflection: *CDS® Inline Unit, a product by CDS Technologies®, Inc.*

This continuous deflection separator unit (Figure PTP-06-04) is installed beneath one manhole access point. The unit promotes gravitational separation of particles using a swirl action in its cylindrical tank and through a screen. Sediments settle into the separation chamber at the base of the unit. For flows greater than the treatment capacity, a bypass through the system is available.

The design incorporates the following features:

- Cylindrical grit chamber
- Flow bypass
- Separation chamber
- Small footprint area required

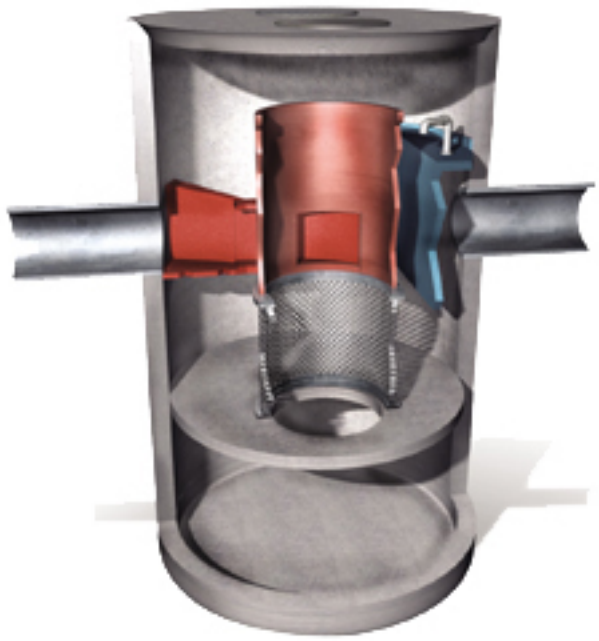

**Figure PTP-06-04 Continuous Deflection Separator Unit, CDS® Inline Unit Schematic**
*Source: University of Massachusetts Amherst Stormwater Technologies Clearinghouse, www.mastep.net.*

Product Examples – Continuous Deflection (cont.)

Removal efficiency performance is compared in Table PTP-06-02.

Table PTP-06-03 Performance Comparison

*Source: University of Massachusetts Amherst Stormwater Technologies Clearinghouse, www.mastep.net.*

| Pollutants Addressed | Manufacturer's Removal Efficiency Claim (%) | Minimum Particle Size | Tested Removal Efficiency (%) |
|---|---|---|---|
| Total suspended solids | 80% | - | 73.7 % |
| Oil and grease | 83-86% | - | - |
| Debris - floatables | 100% | - | - |