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Technical Memorandum

To: BCWMC Technical Advisory Committee (TAC)
From: Barr Engineering Co.
Subject: Supplemental Information for BCWMC Review of Stormwater MTDs
Date: July 2, 2019
Project: 23/27-0051.45 2019 008
c: Laura Jester, BCWMC Administrator

Background

At their May 29, 2019 meeting the Bassett Creek Watershed Management Commission's (BCWMC's) Technical Advisory Committee (TAC) reviewed a Technical Memorandum for stormwater Manufactured Treatment Devices (MTDs), which is enclosed as Attachment 1. At that meeting, the TAC recommended the following actions:

1. Cooperate with other watershed management organizations to send a letter to the Minnesota Pollution Control Agency (MPCA), formally requesting that the MPCA evaluate the performance of stormwater MTDs and include protocols for MTDs in the Minnesota Stormwater Manual (Option 1). The BCWMC approved this recommendation at their June 20, 2019 meeting.

2. Direct the BCWMC Engineer to provide additional information at the next TAC meeting regarding:

    a. Relying on a third-party entity's certification/verification to set a blanket total phosphorus removal (i.e., 50% for the State of Washington's Technology Assessment Protocol – Ecology (TAPE) program) (Option 3)

        Option 3: Require that applicants provide verification or certification of stormwater MTDs from a specific, or one of a group of specific, third-party entities, such as WADOE-TAPE-GULD, NJDEP/NJCAT, or Canadian ETV program. The BCWMC will accept the verified or certified pollutant removal efficiencies as applied to the development/redevelopment site, as long as the MTDs are designed in accordance with the manufacturer's recommendations.

    b. Relying on the data from a third-party entity's certification/verification to set phosphorus removals (Option 6)

        Option 6: Same as option 3, but also require that applicants provide the MTD testing data used for the verification or certification, including the particulate phosphorus loading, the particulate phosphorus removal efficiency, the dissolved phosphorus

loading, and dissolved phosphorus removal efficiency. The BCWMC will review and accept the median pollutant removal efficiencies from the MTD testing data used for the verification or certification as applied to the respective particulate and dissolved phosphorus loading values for the development/ redevelopment site, as long as the MTDs are designed in accordance with the manufacturer's recommendations.

c. "Integrating" the cities' and BCWMC's review processes (i.e., should the process change when MTDs are proposed?)

d. The TAPE program protocols

This memorandum provides the requested supplemental information.

Comparable Stormwater Treatment Methods

To better understand the application of MTDs, it can be helpful to compare these devices to other conventional stormwater BMPs. For example:

- A MTD that provides filtration is often comparable to a sand filter BMP.
- A MTD that provides filtration and chemical treatment is often comparable to an iron enhanced sand filter (IESF) BMP.
- A MTD that provides filtration with a vegetative component is often comparable to a biofiltration basin (or rain garden) BMP.

While this may help understand the mechanisms for stormwater treatment, applying and modeling these MTDs is difficult due to the variance in treatment efficiency. The following development/redevelopment example is included to illustrate Option 3 and Option 6.

Example Project:

A development/redevelopment project in the Bassett Creek watershed creates 1.5 acres of new/fully reconstructed impervious surfaces. The site consists of primarily clay soils, therefore the applicant plans to utilize flexible treatment option (FTO) #2 to provide 60% total phosphorus (TP) removal.

The assumed loading breakdown between particulate phosphorus (PP) and dissolved phosphorus (DP) varies between different stormwater quality modeling software.

Table 1: Phosphorus loading for common water quality modeling programs

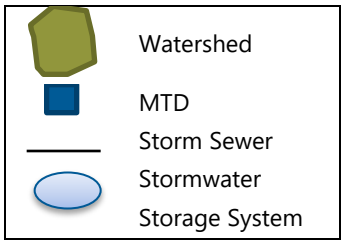
Component	MIDS (lb/year)	MIDS (%) [1]	P8 (lb/year)	P8 (%) [2]
PP	1.472	55	3.6	68
DP	1.205	45	1.7	32
TP	2.677		5.3	

[1] Based on information developed by Saint Anthony Falls Laboratory and the City of Prior Lake during MIDS development.
[2] Based on the Nationwide Urban Runoff Program (NURP) study in 1986 by the U.S. Environmental Protection Agency (EPA).

Table 2: Required phosphorus removal for common water quality modeling programs

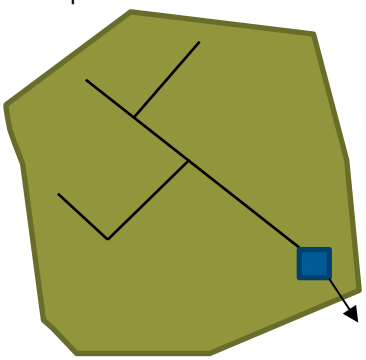
Water Quality Modeling Program	Required TP Removal (%)	Required TP removal (lb/year)
MIDS	60	1.61
P8	60	3.18

The following calculations use the MIDS calculator to evaluate the example stormwater treatment systems. Based on the information shown in Table 1, utilizing P8 to model the example stormwater treatment systems will provide different results, however, we anticipate the results to follow a similar pattern for TP removal. Note: P8 may show that the single MTD for stormwater treatment the BCWMC requirements for water quality when applied using alternative 6 due to a higher percentage of particulate phosphorus within the total phosphorus loading.



Scenario 1: Single MTD for Stormwater Treatment

MTD provides 85% PP removal; 25% DP removal; certified for 50% TP removal



Application of Option 3 for Scenario 1 TP Removals:

$$MIDS\ TP\ Removal = (1.47\ PP\ Loading) \times (0.5) + (1.21\ DP\ Loading) \times (0.5) = 1.34 \frac{pounds}{year}$$

$$\boldsymbol{Percent\ MIDS\ TP\ Removal} = \frac{1.34\ TP\ Removal}{2.68\ TP\ Loading} = \mathbf{50}\%$$

Application of Option 6 for Scenario 1 TP Removals:

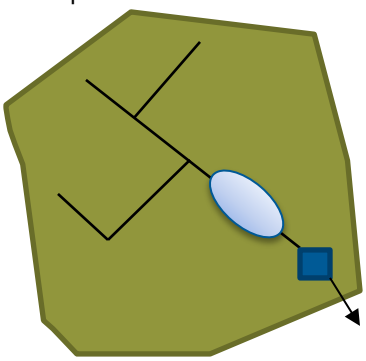
$$MIDS\ TP\ Removal = (1.47\ PP\ Loading) \times (0.85) + (1.21\ DP\ Loading) \times (0.25) = 1.55 \frac{pounds}{year}$$

$$\boldsymbol{Percent\ MIDS\ TP\ Removal} = \frac{1.55\ TP\ Removal}{2.68\ TP\ Loading} = \mathbf{58}\%$$

Scenario 2: Stormwater Storage System Routed to MTD for Stormwater Treatment

6000 cubic-foot stormwater storage system (Design Level 2 pond) provides 82% PP removal; 8% DP removal

MTD provides 85% PP removal; 25% DP removal; certified for 50% TP removal



Application of Option 3 for Scenario 2 TP Removals:

$$MIDS\ TP\ Removal\ (Pond) = (1.47\ PP\ Loading) \times (0.82) + (1.21\ DP\ Loading) \times (0.08) = 1.30 \frac{pounds}{year}\ (49\%)$$

$$MIDS\ TP\ Removal\ (MTD) = (0.26\ PP\ Loading) \times (0.5) + (1.11\ DP\ Loading) \times (0.5) = 0.69\ \frac{pounds}{year}\ (26\%)$$

$$\boldsymbol{Percent\ MIDS\ TP\ Removal} = \frac{1.99\ TP\ Removal}{2.68\ TP\ Loading} = \mathbf{74}\%$$

Application of Option 6 for Scenario 2 TP Removals:

$$MIDS\ TP\ Removal\ (Pond) = (1.47\ PP\ Loading) \times (0.82) + (1.21\ DP\ Loading) \times (0.08)$$

$$= 1.30 \frac{pounds}{year}\ (49\%)$$

$$MIDS\ TP\ Removal\ (MTD) = (0.26\ PP\ Loading) \times (0.85) + (1.11\ DP\ Loading) \times (0.25)$$

$$= 0.50\ \frac{pounds}{year}\ (19\%)$$

$$\boldsymbol{Percent\ MIDS\ TP\ Removal} = \frac{1.80\ TP\ Removal}{2.68\ TP\ Loading} = \mathbf{67}\%$$

City Review Process:

Currently, the BCWMC Engineer receives submittals for development/redevelopment projects when the design is complete (e.g., when the city approves the final plat). Sometimes the applicant sends the plans out to bid concurrent with the BCWMC Engineer's review. For proposed projects with MTDS, we recommend that the member cities consider coordinating with the BCWMC Engineer early in the applicant's design process – for example, after concept plan approval. This recommendation is based on the added complexity of reviewing MTDs and the potential for significant changes to the proposed plans/design based on the BCWMC Engineer's findings. The coordination is anticipated to include, at a minimum, a discussion with the member city and/or potential applicant regarding required submittals, and could go so far as to include a preliminary review (i.e., review of third-party data to set phosphorus removals). The early coordination/preliminary review may help minimize significant design changes or challenges regarding storm water treatment.

Washington State Department of Ecology: Technology Assessment Protocol – Ecology

The Washington State Department of Ecology (WADOE) has a Technology Assessment Protocol – Ecology (TAPE) program used to provide certification of MTDs for removal efficiencies of total suspended solids (TSS) and TP. The TAPE program sets a protocol for testing and then reviews the laboratory and field testing data. The laboratory and field testing must be performed or contracted by the MTD manufacturer and must be performed under the established TAPE protocols. If the testing data meets the minimum certification requirements, WADOE provides a TAPE certification for the TSS and/or TP removal efficiencies. The TAPE process includes a series of use level designations (Pilot, Conditional, General) that are achieved based on submittal and review of sufficient laboratory and field data. The desired outcome is the General Use Level Designation (GULD) certification. TAPE Certifications overview is enclosed as Attachment 2. The TAPE review fees to obtain certification, provided as part of a GULD, total approximately $30,000.

Recommendation:

We recommend the following:

1. Consider convening a work group comprised of other local watershed districts, watershed management organizations, municipalities, the MPCA, and the University of Minnesota (St. Anthony Falls Lab) to discuss MTDs. The purpose of the work group would be to share information and suggest procedures/best practices regarding MTD review and approval.
2. In the interim, implement Option 6 for BCWMC review of MTDs to require WADOE TAPE certification and apply the removal efficiencies of the MTD, based on the testing data, to the water quality treatment calculations.
3. The BCWMC should consider developing a generalized guidance for using MTDs as part of a stormwater treatment system, including required submittals, which the member cities could provide to developers. This would likely require a modification of the Requirements for Improvements and Development Proposals Document.

Attachment 1

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Technical Memorandum

To: BCWMC Technical Advisory Committee (TAC)
From: Barr Engineering Co.
Subject: Stormwater Manufactured Treatment Devices
Date: May 22, 2019
Project: 23/27-0051.45 2019 008
c: Laura Jester, BCWMC Administrator

1.0 Problem Statement

The Commission has seen an increase in the use of proprietary stormwater manufactured treatment devices (MTDs) for development and redevelopment projects. There are not widely accepted levels of treatment or pollutant removal efficiencies associated with these devices and while most proprietary MTDs undergo testing and third party review, the conditions that they are tested under may not be consistent with the conditions in the Bassett Creek watershed. At their April 18, 2019 meeting, the BCWMC directed the TAC to provide direction to the Commission and BCWMC Engineer regarding review and acceptance of proprietary stormwater manufactured treatment devices (MTDs).

2.0 Background

The BCWMC adopted the Minnesota Pollution Control Agency's (MPCA) minimal impact design standards (MIDS) in 2015, per policies in the BCWMC's 2015 – 2025 Watershed Management Plan (Plan). MIDS includes water performance quality goals for development and redevelopment projects that create more than one acre of new and/or fully reconstructed impervious surface. The BCWMC modified their water quality performance goals in 2017 for linear projects.

The BCWMC Requirements for Improvements and Development Proposals (Requirements) document states that non-linear development and redevelopment projects that create more than one acre of new and/or fully reconstructed impervious surfaces, on sites without restrictions, must meet the BCWMC water quality performance goals. These goals (from MIDS) include onsite retention of 1.1 inches of runoff from the new and fully reconstructed impervious surfaces. Sites with restrictions, such as shallow depth to bedrock, contaminated soils, shallow groundwater, tight clay soils, existing site constraints or zoning requirements, etc., may follow the flexible treatment options (FTO) approach. The most common outcome of the FTO approach is a revised water quality performance goal of FTO #2, which requires onsite retention to the maximum extent practicable and removal of 60% of the total phosphorus load from the new and fully reconstructed impervious surfaces at the site. For the purposes of this discussion, we assumed that stormwater MTDs are designed and implemented as part of the stormwater management system to meet the FTO #2 water quality performance goal.

The BCWMC Requirements document states that to meet the BCWMC water quality performance goals or FTO, BMPs must be designed in accordance with the Minnesota Stormwater Manual or as otherwise approved by the BCWMC. The Minnesota Stormwater Manual does not provide design guidance for stormwater MTDs and does not currently provide certification or approval of stormwater MTDs. Therefore, the applicant must demonstrate, to the satisfaction of the BCWMC Engineer and the Commission, that

their proposed stormwater MTD is designed appropriately and provides pollutant removals, in conjunction with the rest of the stormwater management system, that meet the BCWMC water quality performance goals or FTO. The project review fee schedule includes a $1,000 add-on fee for projects involving review of alternative BMPs (i.e., BMPs not included in the Minnesota Stormwater Manual).

3.0 Types of stormwater treatment

Stormwater BMPs can provide stormwater treatment to reduce or limit downstream pollutant loading in several ways and many stormwater MTDs utilize a combination of the following practices:

- Pretreatment: upstream sedimentation, screening, and/or energy dissipation to protect and extend the long-term functionality of the downstream BMP
- Infiltration: stormwater enters the soil at the source; sediment and pollutants remain onsite.
- Sedimentation: as part of stormwater detention, sediment and non-dissolved (particulate) pollutants settle to the bottom of the water column
- Filtration: stormwater is routed through a filtering medium to trap sediment and pollutants but allow stormwater to pass through
- Biofiltration: similar to filtration, but additional pollutant removal is provided by evapotranspiration from the vegetation
- Chemical Treatment: chemicals are used to target and trap, settle, or breakdown specific pollutants.

4.0 Conventional Stormwater BMPs

The MPCA's Minnesota Stormwater Manual provides estimated median pollutant removal percentages for conventional stormwater BMPs as shown in Table 1.

Table 1: Conventional stormwater BMPs and estimated median pollutant removal efficiencies

Practice	Treatment Type	Pollutant Removal Efficiencies (%)			
		Total Suspended Solids (TSS)	Total Phosphorus (TP)	Particulate Phosphorus (PP)	Dissolved Phosphorus (DP)
Infiltration [1]	Infiltration	100[2]	100[2]	100[2]	100[2]
Biofiltration	Biofiltration	80	44-71	80	0-60
Sand filter	Filtration	85	50	91	0
Iron enhanced sand filter	Filtration and Chemical Treatment	85	77	91	60
Dry Swale	Pretreatment	68	44-71	80	0-60
Wet Swale	Pretreatment	68	0	0	0
Stormwater Pond [3]	Sedimentation	84	50	91	0
Stormwater Wetland	Sedimentation and Biofiltration	73	38	69	0
Permeable Pavement	Infiltration or Filtration	74	45	82	0
Green Roof	Pretreatment	85	0	0	0

[1] BMPs designed to infiltrate stormwater runoff, such as infiltration basins/trenches, bioinfiltration, permeable pavement with no underdrain, tree trenches with no underdrain, and BMPs with raised underdrains.

[2] Pollutant removal is 100 percent for the volume infiltrated and 0 percent for the stormwater bypassing the BMP. For filtered stormwater, see values for the other BMPs in the table.

[3] Dry ponds do not receive credit for volume or pollutant removal.

5.0 Stormwater Manufactured Treatment Devices on the Market

There are many options on the market for stormwater MTDs. Two manufacturers that appear to be active in Minnesota are Bio Clean Environmental and Contech Engineered Solutions. Table 2 lists a number of manufacturers that provide MTDs for filtration, biofiltration, or chemical treatment. MTDs designed primarily for pretreatment, infiltration, or sedimentation practices are not included in the table.

Table 2: Manufacturers and stormwater MTDs

Manufacturer	MTD	Treatment Type
AquaShield	Aqua-Filter with Perlite Media	Filtration and Chemical Treatment
AquaShield	BioFilter	Biofiltration
BaySaver Technologies	BayFilter with Enhanced Media Cartridges	Filtration and Chemical Treatment
Bio Clean Environmental Services	Kraken Filter	Filtration
Bio Clean Environmental Services	Modular Wetland Systems	Biofiltration
Bio Clean Environmental Services	Water Polisher	Filtration
Contech Engineered Solutions	Filterra	Biofiltration
Contech Engineered Solutions	Jellyfish Filter	Filtration
Contech Engineered Solutions	StormFilter with PhosphoSorb Media	Filtration and Chemical Treatment
Cultec	StormFilter 330	Filtration
Environmental 21	ESK Koala	Filtration
Environmental 21	PuriStorm	Filtration
Hydro International	Bioinfiltrator	Biofiltration
Hydro International	Up-Flo Filter with CPZ Media	Filtration and Chemical Treatment
Lane Enterprises	StormKleener	Filtration
Oldcastle Infrastructure	BioMod	Biofiltration
Oldcastle Infrastructure	BioPod	Biofiltration
Oldcastle Infrastructure	PerkFilter with ZPC Media	Filtration and Chemical Treatment
Rotondo Environmental Solutions	StormGarden	Biofiltration
StormTree	Tree Filter	Biofiltration
StormTree	DrainGarden	Biofiltration
StormwateRx	Aquip	Filtration
SunTree Technologies	Nutrient Removing Filtration System (NRFS)	Filtration and Chemical Treatment
SunTree Technologies	NutriMax Engineered Wetlands	Biofiltration
SunTree Technologies	SkimBoss UpFlow Filter	Filtration and Chemical Treatment

6.0 Specific Examples from BCWMC Development Reviews

As part of the review process for development and redevelopment projects in the Bassett Creek watershed, the BCWMC Engineer has reviewed stormwater MTDs for the following projects:

- Ridgedale Active Adults [Avidor] Apartments - Minnetonka (BCWMC #2018-16)
    - Contech Engineered Solutions – StormFilter with PhosphoSorb Media
    - Bio Clean Environmental Services – Kraken Filter
- Ridgedale Executive Apartments - Minnetonka (BCWMC 2018-28)

  - Bio Clean Environmental Services – Kraken Filter
- Marsh Run Apartments- Minnetonka (BCWMC #2019-06)
  - Contech Engineered Solutions – Jellyfish Filter
  - Contech Engineered Solutions – StormFilter with PhosphoSorb Media

7.0 Third Party Testing Overview

Manufacturers of stormwater MTDs often subject their devices to third party testing to establish or verify treatment and pollutant removal efficiency. Third-party entities provide varying levels of verification or certification (Table 3) and pollutant removal efficiencies also vary between manufacturer claims, laboratory testing, and field testing (Table 4).

Table 3: Third party entities, programs, and approvals

Entity	Program	Approval	Approval Qualifications	Approval Level
State of Washington Department of Ecology (WADOE)	Technology Assessment Protocol – Ecology (TAPE)	Pilot Use Level Designation (PULD)	Laboratory Testing Data	N/A
		Conditional Use Level Designation (CULD)	Laboratory Testing Data and Field Testing Data	N/A
		General Use Level Designation (GULD)	Laboratory Testing Data and Field Testing Data following TAPE protocol	Removal of 50% TP and 80% TSS
New Jersey Corporation for Advanced Technology (NJCAT)	Technology Verification Program	Verification	Laboratory Testing and Assessment of Data Quality (QA/QC)	N/A
State of New Jersey Department of Environmental Protection (NJDEP)	Process for Approval of Use for MTDs	Certification	NJCAT Verification	Removal of 80% TSS
Canadian Environmental Technology Verification (ETV) Program	General Verification Protocol (GVP) and General Test Protocol	Verification and Certification	Laboratory Testing Data and Field Testing Data	N/A
Environmental Protection Agency (EPA)	Environmental Technology Verification (ETV) Program [1]	Verification	Unknown	Unknown

[1] Program Dissolved in 2014

Table 4: Devices and removal efficiencies

Manufacturer and MTD	Removal Efficiency (%) [1]															
	Manufacturer's Performance Claims [3]				Laboratory Testing				Field Testing				WADOE TAPE Certification		NJDEP Certification	
	TSS	TP	PP	DP	TSS	TP	PP	DP	TSS	TP	PP	DP	TSS	TP	TSS	TP
AquaShield Aqua-Filter with Perlite Media	-	-	-	-	91	92	-	-	92	69	-	-	CIP	CIP	80	-
AquaShield BioFilter	-	-	-	-									-	-	-	-
BaySaver Technologies BayFilter with Enhanced Media Cartridges	80	65	-	-	81.5	-	-	55	80	64	-	-	80	50	80	-
Bio Clean Environmental Services Kraken Filter [2]	**89**	**72**	**-**	**-**	**83 [4]**	**-**	**-**	**-**	**91**	**75**	**-**	**-**	**CIP**	**CIP**	**80**	-
Bio Clean Environmental Services Modular Wetland Systems	85	64	-	67	91	-	-	-	85	65	-	-	80	50	-	-
Bio Clean Environmental Services Water Polisher	85	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contech Engineered Solutions Filterra	86	70	-	-	83	-	-	50 [5]	85	73			80	50	80	-
Contech Engineered Solutions Jellyfish Filter [2]	**89**	**59**	**-**	**-**	**86 [6]**	**-**	**-**	**-**	**89**	**59**	**-**	**-**	**CIP**	**CIP**	**-**	-
Contech Engineered Solutions StormFilter with PhosphoSorb Media [2]	**89**	**82**	**-**	**50**	**88 [4,6]**	**-**	**-**	**50**	**85**	**75**	**-**	**-**	**80**	**50**	**80**	-
Cultec StormFilter 330	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental 21 ESK Koala	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental 21 PuriStorm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydro International Bioinfiltrator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydro International Up-Flo Filter with CPZ Media	-	-	-	-	87 [4]	-	-	-	90	-	-	-	-	-	80	-
Lane Enterprises StormKleener	80	-	-	-	81	-	-	-	86				-	-	80	-
Oldcastle Infrastructure BioMod	-	-	-	-									-	-	-	-
Oldcastle Infrastructure BioPod	-	-	-	-	81	97	-	-	84	64	-	-	80	50	80	-
Oldcastle Infrastructure PerkFilter with ZPC Media	80	60			82 [6]	-	-	-	85	62	-	-	80	50	80	-
Rotondo Environmental Solutions StormGarden	-	-	-	-	81	18	-	5.4	85	54			CIP	CIP	-	-
StormTree DrainGarden	-	-	-	-	94	38	-	-	-	-	-	-	-	-	-	-
StormTree Tree Filter	85	63			94	38	-	-	-	-	-	-	CIP	CIP	-	-
StormwateRx Aquip	-	-	-	-	-	-	-	-	98	60	-	-	CIP	CIP	-	-
SunTree Technologies Nutrient Removing Filtration System with Biosorption Activated Media	95	95	-	-	67	-	-	-	61	-	-	-	-	-	50	-
SunTree Technologies NutriMax Engineered Wetlands	83	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SunTree Technologies SkimBoss UpFlow Filter	81	79	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] Removal efficiencies either reported as average or median values, depending on reporting. When both are provided, the median value was generally used.
[2] Manufacturers and MTDs in **bold** have been submitted to the BCWMC for review
[3] Manufacturers' performance claims obtained from brochures or websites
[4] Suspended sediment concentration (SSC) removal efficiency, not TSS removal efficiency
[5] Orthophosphate removal efficiency, not DP removal efficiency
[6] Sil-Co-Sil 106 use to simulate TSS
CIP = Certification in Progress

8.0 Modeling Alternatives and Assumptions

The BCWMC Requirements document states that the MIDS calculator, P8, WINSLAMM, or other BCWMC-approved approaches may be used to demonstrate compliance with BCWMC water quality goals or FTOs. The MPCA's Minnesota Stormwater Manual lists 28 models or tools that include water quality modeling, but the MIDS calculator, P8, or hand calculations are the most commonly submitted documentation for compliance with the BCWMC's water quality goals or FTOs.

8.1 MIDS Calculator

The MIDS calculator was developed to assist designers and regulators in determining conformance to the MIDS performance goals. The MIDS calculator is a tool used to determine stormwater runoff volume and pollutant reduction capabilities of various low impact development BMPs. The MIDS calculator estimates the stormwater runoff volume reductions for various BMPs based on the MIDS performance goal (retain 1.1 inches of runoff from impervious surfaces) and annual pollutant load reductions for total phosphorus and total suspended solids. The MIDS calculator divides the total phosphorus concentration into dissolved and particulate phosphorus at a ratio of 45% and 55%, respectively. This means that an applicant must treat or retain a portion of the dissolved phosphorus to achieve 60% total phosphorus removal.

Stormwater BMPs that are not specifically included in the MIDS calculator, such as stormwater MTDs, can be added to the calculator using the "other" BMP option. The "other" BMP option allows user-defined stormwater volume and pollutant reduction amounts to be entered. However, the MPCA's Minnesota Stormwater Manual states that the user must provide evidence and support for each of the stormwater volume and pollutant reduction amounts entered in the "other" BMP. Thus, the applicant must provide evidence and support for their pollutant reduction claims.

The issue that arises during most development and redevelopment reviews is that the removal efficiency breakdown between particulate phosphorus and dissolved phosphorus is not provided by manufacturers, laboratory testing, field testing, or third party entities; therefore, applicants do not have adequate information to use in the MIDS calculator.

8.2 Program for Predicting Polluting Particle Passage thru Pits, Puddles, and Ponds (P8)

The P8 model predicts the generation and transport of stormwater runoff pollutants in urban watersheds. In P8, continuous water-balance and mass-balance calculations are performed on a user-defined system consisting of watersheds, devices, particle classes, and water quality components.

The default settings in P8 include five particle classes based on the velocity at which the particle classes settle. These settling velocities range from 0.03 – 15 feet per hour for particulate particle classes. Dissolved pollutants are assumed to have a settling velocity of zero.

Water quality component concentrations are computed from the concentrations of each particle class and the particle compositions (mg/kg). Particle compositions have been calibrated so that median runoff concentrations correspond to values reported by the Nationwide Urban Runoff Program (NURP). Using the default particle size distribution (PSD) for a median site (NURP50 PSD) results in a division of the total phosphorus concentration into dissolved and particulate phosphorus at a ratio of 70% and 30%,

respectively. The applicant still must provide evidence and support for the pollutant reduction claims, however, this means that an applicant does not necessarily need to treat or retain a portion of the dissolved phosphorus in order to achieve 60% TP removal.

9.0 Options for BCWMC review of Stormwater MTDs

Table 5 includes options for BCWMC review of stormwater MTDs. Following each option are the BCWMC Engineer's recommendations and/or comments.

Table 5: Options for BCWMC review of stormwater MTDs

No.	Option	Comments
1	Require that stormwater MTDs be certified or approved by the MPCA, and listed in the stormwater manual with recommended pollutant removal efficiencies, prior to acceptance.	Recommended (as a long term option): • This option removes the burden of accepting stormwater MTDs and verifying their pollutant removal efficiencies from the BCWMC and places it on the MPCA. If the MPCA were to develop and provide statewide guidance, protocols, or certifications for MTDs, this has the potential to greatly simplify the development/redevelopment review process for BCWMC and others (e.g., other watershed organizations and cities). • We recommend the BCWMC send a letter to the MPCA, formally requesting that they evaluate MTDs and include development protocols in the Minnesota Stormwater Manual. Not Recommended (as a short term option): • We understand the MPCA has solicited input regarding evaluating stormwater MTDs. However, it is unknown if the MPCA will take this on and development of protocols, guidance, or a certification program would likely be a number of years away from publication. • Selecting this option now would essentially prohibit the use of stormwater MTDs in the Bassett Creek watershed to meet BCWMC water quality performance goals or FTOs, which may limit the stormwater treatment options for developers in the watershed.
2	Accept pollutant removal efficiencies of stormwater MTDs as indicated in applicant submittal, as long as the MTDs are designed in accordance with the manufacturer's recommendations and the submittal is provided with a professional engineer's (PE) stamp.	Not recommended: • Pollutant removal efficiencies provided by manufacturers are based on site conditions that may not be consistent with site conditions in the Bassett Creek watershed; namely a different proportion of particulate phosphorus and dissolved phosphorus loading. • This difference in site conditions can lead to pollutant removal efficiencies in the Bassett Creek watershed that are lower than those reported by the manufacturers and third party testing entities. • Most applicants are unaware of the discrepancy and may not understand or be concerned with the effect on the watershed.
3	Require that applicants provide verification or certification of stormwater MTDs from a specific, or one of a group of specific, third-party entities, such as WADOE-TAPE-GULD, NJDEP/NJCAT, or Canadian ETV program. The BCWMC will accept the verified or certified pollutant removal efficiencies as applied to the development/redevelopment site, as long as the MTDs are designed in accordance with the manufacturer's recommendations.	Not recommended: • Similar to option 2, verified or certified pollutant removal efficiencies provided by third-party entities are still based on site conditions that may not be consistent with site conditions in the Bassett Creek watershed; namely a different proportion of particulate phosphorus and dissolved phosphorus loading. • This difference in site conditions can lead to pollutant removal efficiencies in the Bassett Creek watershed that are lower than those reported by the manufacturers and third party testing entities. • In addition, most applicants are unaware of the discrepancy and may not understand or be concerned with the effect on the watershed.
4	Same as options 2 or 3, but also require monitoring of all proprietary stormwater MTDs.	Not recommended: • Same as option 2 or 3, and member cities have expressed that monitoring places an undesirable burden on them to develop and implement a monitoring program that is accurate, fair, and reproducible. • This would also require staffing and funding resources, which could be more effectively spent in other ways. We would prefer an overall program led by the MPCA, based on monitoring, as a long-term solution, see option 1. • Alternatively, a group of watershed districts and watershed management organizations could implement a monitoring program.
5	Same as option 3, but also require a breakdown of particulate and dissolved phosphorus removal efficiencies. The BCWMC will accept the verified or certified pollutant removal efficiencies for particulate and dissolved phosphorus as applied to the development/ redevelopment site, as long as the MTDs are designed in accordance with the manufacturer's recommendations.	Recommended (but may not be feasible): • The verified or certified pollutant removal efficiencies with a breakdown of particulate and dissolved phosphorus provided by third-party entities allows for an accurate application of pollutant removal efficiencies for the site conditions in the Bassett Creek watershed. • This may be infeasible because third party entities currently do not provide verification or certification to this level.
6	Same as option 3, but also require that applicants provide the MTD testing data used for the verification or certification, including the particulate phosphorus loading, the particulate phosphorus removal efficiency, the dissolved phosphorus loading, and dissolved phosphorus removal efficiency. The BCWMC will review and accept the median pollutant removal efficiencies from the MTD testing data used for the verification or certification as applied to the respective particulate and dissolved phosphorus loading values for the development/ redevelopment site, as long as the MTDs are designed in accordance with the manufacturer's recommendations.	Recommended (as alternative to option 5): • This requires the MTD to be verified or certified by a third party entity, but allows the BCWMC to evaluate the MTD testing data, including the respective particulate and dissolved phosphorus loading and removal efficiencies to ensure that the pollutant removal efficiencies are accurately applied for the site conditions in the Bassett Creek watershed.

Attachments:

Brochures for select stormwater MTDs previously reviewed by BCWMC

Brochures for select stormwater MTDs previously reviewed by BCWMC

Bio Clean Environmental Services – Kraken Filter

Bio Clean

A Forterra Company

Kraken™ Filter

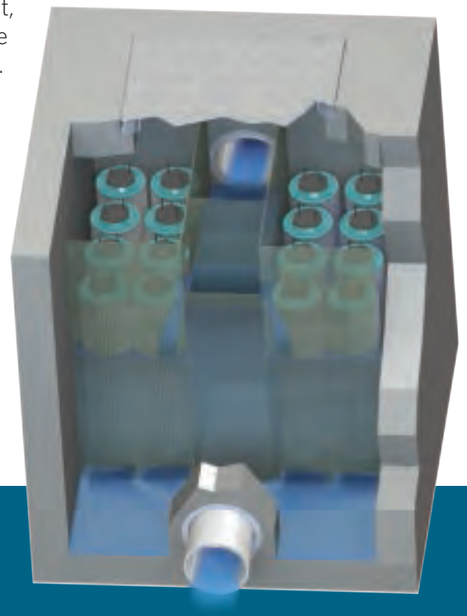
A Stormwater Filtration Solution

OVERVIEW

The Bio Clean Kraken™ Filter is a state-of-the-art system utilizing advanced membrane filtration, ensuring a high level of removal for not only TSS, but also metals, trash, nutrients, and hydrocarbons. The Kraken™ membrane filter cartridge provides high flow rates and over 170 sq. ft. of surface area. This much surface area allows it to operate at a loading rate of only 0.05 gpm/sq. ft. to ensure maximum performance and minimum maintenance. The Kraken™ Filter's low loading rate successfully overcomes high maintenance requirements and frequent clogging issues often found in other filter systems advertising high loading rates.

Each membrane filter cartridge is lightweight, washable, reusable, and more sustainable than typical granular-filled media cartridges. By eliminating the need to purchase new granular media and dispose of spent media, the Kraken™ Filter provides lower life cycle and maintenance costs.

Each filter cartridge is equipped with easy-to-grab handles and is pressure fitted, allowing it to be quickly removed, cleaned, and reattached without the use of tools.



PERFORMANCE

85-89% REMOVAL OF TOTAL SUSPENDED SOLIDS (TSS)

72% REMOVAL OF PHOSPHORUS

ADVANTAGES

- NO GRANULAR MEDIA TO REPLACE
- HIGH FLOW RATES AND MAXIMUM SURFACE AREA
- LOADING RATE OF 0.05 GPM / SQ. FT. FOR MINIMAL MAINTENANCE
- MEMBRANE FILTER CARTRIDGES CAN BE EASILY REMOVED AND CLEANED BY HAND
- BUILT-IN PRETREATMENT CHAMBER CAPTURES TRASH, SEDIMENTS, DEBRIS, AND HYDROCARBONS
- FILTER CARTRIDGE DRIES OUT BETWEEN STORM EVENTS TO PREVENT BIOFILM GROWTH WHICH CAN CAUSE CLOGGING AND OTHER PERFORMANCE ISSUES
- NJDEP ONLINE INSTALLATION APPROVED

APPROVALS

The Kraken™ Filter has received NJCAT Verification for 89% TSS removal and NJDEP Certification at an 80% TSS removal rate. In addition, the Kraken™ Filter NJCAT Verification is also for online installations.

NJCAT Verified

NJDEP Certified

TAPE PERFORMANCE

The Kraken™ Filter completed its TAPE field testing in the spring of 2016. The Kraken™ has met the performance benchmarks for basic treatment (TSS) and phosphorus. The system features washable and reusable cartridges to reduce overall maintenance costs.

POLLUTANT	AVERAGE INFLUENT CONCENTRATION (mg/L)	AVERAGE EFFLUENT CONCENTRATION (mg/L)	REMOVAL EFFICIENCY
Total Suspended Solids	73.1	7.0	85%
Total Phosphorus	0.151	0.034	72%
Suspended Solids Conc.	151.3	6.9	89%
Nitrogen (TKN)	1.5	1.0	31%
Fecal Coliform	692	355	60%
Motor Oil	4.6	0.7	81%
Total Zinc	0.158	0.054	54.3%
Total Copper	0.042	0.017	52%
Diesel Range Organics	1.2	0.4	65%

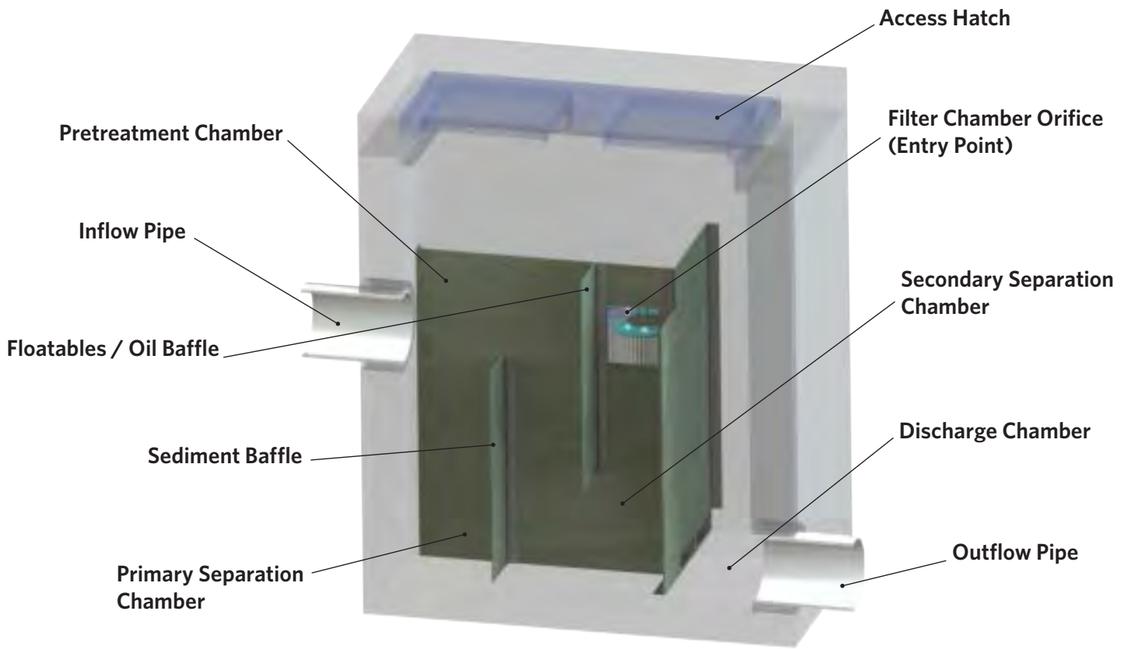
SPECIFICATIONS

Based on Max Cartridge Capacity

MODEL #	STRUCTURE SIZE (ft. x ft.)	CARTRIDGE CAPACITY	MAX MEDIA SURFACE AREA (sq. ft.)	TREATMENT FLOW CAPACITY (cfs)
KF-4-4	4′ x 4′	9 to 16	2720	0.30
KF-4-6	4′ x 6′	17 to 24	4080	0.46
KF-4-8	4′ x 8′	25 to 32	5440	0.61
KF-8-8	8′ x 8′	33 to 48	8160	0.91
KF-8-10	8′ x 10′	49 to 65	11220	1.25
KF-8-12	8′ x 12′	66 to 78	13260	1.48
KF-8-14	8′ x 14′	79 to 96	16320	1.82
KF-8-16	8′ x 16′	97 to 114	19380	2.16
KF-10-16	10′ x 16′	115 to 152	25840	2.88

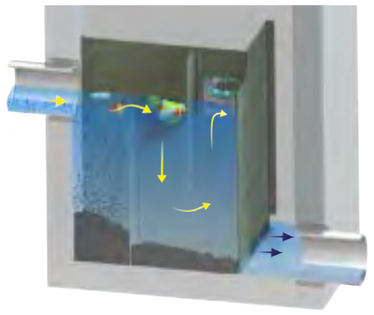
See design manual for list of all models. Many other models and structure sizes are available for higher flows. Please contact us for more details.

OPERATION



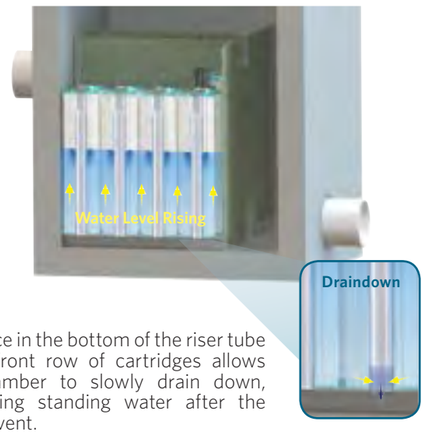
1 PRETREATMENT

To reduce loading on the membrane cartridge, runoff is initially passed through the pretreatment chamber to capture trash, hydrcarbons, and sediments. Once runoff is pretreated, it is directed to the filter chambers for primary treatment.



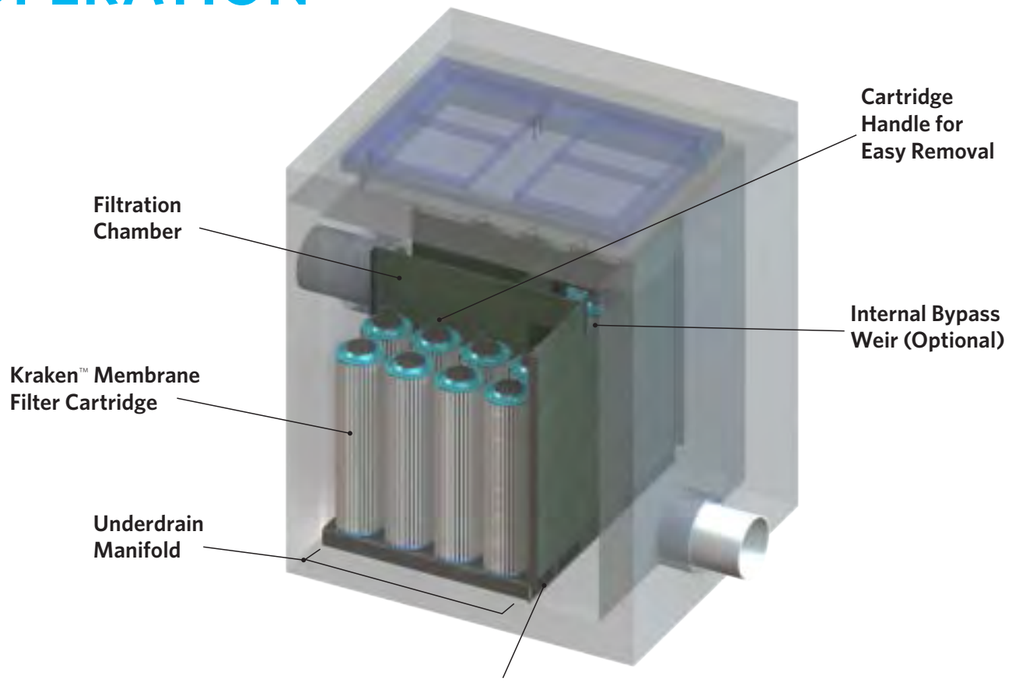
2 MEMBRANE FILTRATION FILL-UP

During the fill-up process, a riser tube prevents flow through the membrane cartridge until the water level nears the top of the cartridge. This ensures loading is evenly distributed over the vertical height of the cartridge maximizing efficiency.



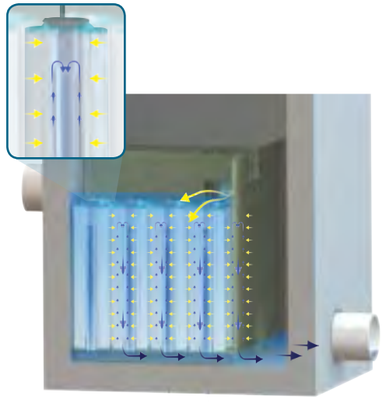
An orifice in the bottom of the riser tube in the front row of cartridges allows the chamber to slowly drain down, eliminating standing water after the storm event.

OPERATION



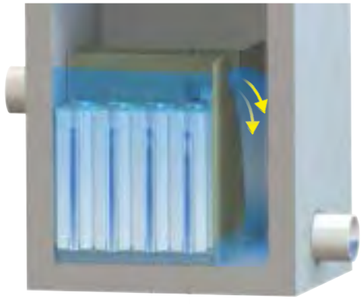
3 MEMBRANE FILTRATION PEAK CAPACITY

As the water level reaches the top of the membrane cartridges, flow through will begin. The riser tube creates an upward flow path within each cartridge to increase performance. Treated water then passes down the riser tube and collects in the underdrain manifold and flows to the discharge chamber.



4 BYPASS

An optional internal bypass is available with most system configurations. When flows exceed the treatment capacity of the system, the water level rises and goes into bypass. High flows are conveyed from the pretreatment chamber directly to the discharge chamber to prevent scouring of fine sediments captured within the filtration chamber.



INSTALLATION

Small footprint reduces installation and shipping costs.

No deep sump chamber (as found with tentacle-type systems) and reduces excavation costs.

MAINTENANCE

Lowest lifecycle cost of any media filter with fast and simple maintenance procedures.

Easily cleaned with a standard vacuum truck, and reusable cartridge can be cleaned with a standard garden hose.

Bio Clean
A Forterra Company

5796 Armada Drive Suite 250
Carlsbad, CA 92008
855.566.3938
stormwater@forterrabp.com
biocleanenvironmental.com

011019R1A

Brochures for select stormwater MTDs previously reviewed by BCWMC

Contech Engineered Solutions – Jellyfish Filter

CONTECH®
ENGINEERED SOLUTIONS

Jellyfish® Filter
Stormwater Treatment

The experts you need to solve your stormwater challenges

Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

Your Contech Team

STORMWATER CONSULTANT

It's my job to recommend the best solution to meet permitting requirements.

STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.

REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.

SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

Contech is your partner in stormwater management solutions

Setting new standards in Stormwater Treatment – Jellyfish® Filter

The Jellyfish Filter has been tested in the field and laboratory, and has received approval from numerous stormwater regulatory agencies.

The Jellyfish Filter is a stormwater quality treatment technology featuring high flow pretreatment and membrane filtration in a compact stand-alone system. Jellyfish removes floatables, trash, oil, debris, TSS, fine silt-sized particles, and a high percentage of particulate-bound pollutants; including phosphorus, nitrogen, metals and hydrocarbons. The high surface area membrane cartridges, combined with up-flow hydraulics, frequent, passive backwashing, and rinseable/ reusable cartridges ensure long-lasting performance.

Jellyfish® Filter

How the Jellyfish® Filter Treats Stormwater

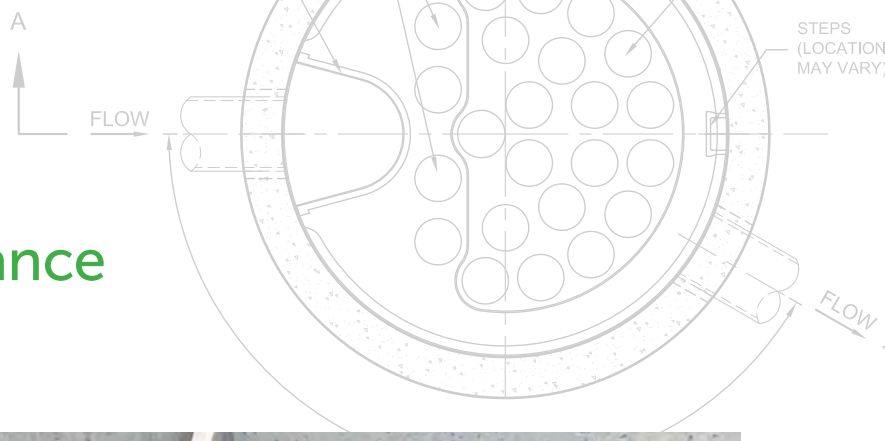
Tested in the field and laboratory ...

- Stormwater enters the Jellyfish through the inlet pipe and traps floating pollutants behind the maintenance access wall and below the cartridge deck.
- Water is conveyed below the cartridge deck where a separation skirt around the cartridges isolates oil, trash and debris outside the filtration zone.
- Water is directed to the filtration zone and up through the top of the cartridge where it exits via the outlet pipe.
- The membrane filters provide a very large surface area to effectively remove fine sand and silt-sized particles, and a high percentage of particulate-bound pollutants such as nitrogen, phosphorus, metals, and hydrocarbons while ensuring long-lasting treatment.
- As influent flow subsides, the water in the backwash pool flows back into the lower chamber. This passive backwash extends cartridge life.
- The draindown cartridge(s) located outside the backwash pool enables water levels to balance.

Jellyfish® Filter Standard Configuration

Learn More:
www.ContechES.com/jellyfish

Pretreat bioretention or infiltration with Jellyfish to extend service life.



Jellyfish® Filter Performance Testing Results

APPLICATION TIPS

- The Peak Diversion Jellyfish provides treatment and high-flow bypass in one structure, eliminating the need for a separate bypass structure.
- LID and GI are complemented by filtration solutions, as they help keep sites free from fine sediments that can impede performance, remove unsightly trash, and provide a single point of maintenance.
- Selecting a filter with a long maintenance cycle and low maintenance cost will result in healthy waterways and happy property owners.

The pleated tentacles of the Jellyfish® Filter provide a large surface area for pollutant removal.

POLLUTANT OF CONCERN	% REMOVAL
Total Trash	99%
Total Suspended Solids (TSS)	89%
Total Phosphorus (TP)	59%
Total Nitrogen (TN)	51%
Total Copper (TCu)	> 50%
Total Zinc (TZn)	> 50%

Sources:
TARP II Field Study – 2012 JF 4-2-1 Configuration
MRDC Floatables Testing – 2008 JF6-6-1 Configuration

Jellyfish® Filter Features and Benefits

FEATURE	BENEFITS
High surface area membrane filtration	Low flux rate promotes cake filtration and slows membrane occlusion
High design treatment flow rate per cartridge (up to 80 gpm (5 L/s))	Compact system with a small footprint, lower construction cost
Low driving head (typically 18 inches or less (457 mm))	Design flexibility, lower construction cost
Lightweight cartridges with passive backwash	Easy maintenance and low life-cycle cost

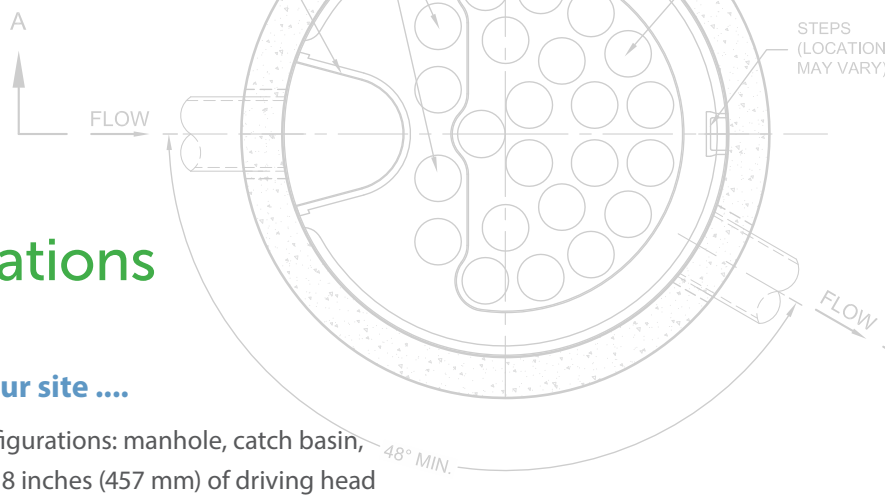
The Jellyfish Filter can be configured in a manhole, catch basin, or vault.

Select Jellyfish® Filter Certifications and Verifications

The Jellyfish Filter has been reviewed by numerous state and federal programs, including:

- New Jersey Corporation for Advanced Technology (NJCAT) – Field Performance per TARP Tier II Protocol
- Washington State Department of Ecology (TAPE – CULD)
- Maryland Department of the Environment (MD DOE)
- Canada ISO 14034 Environmental Management - Environmental Technology Verification (ETV)
- Texas Commission on Environmental Quality (TCEQ)
- Virginia Department of Environmental Quality (VA DEQ)

Field tested and performance verified

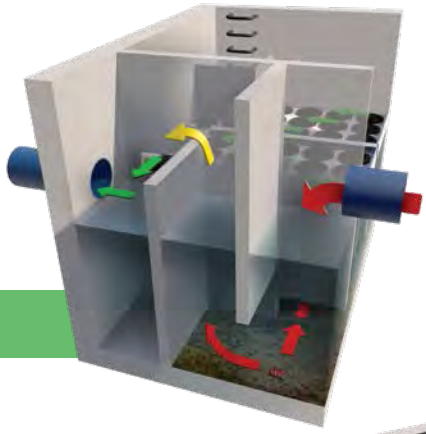


Jellyfish® Filter Configurations

Multiple system configurations to optimize your site ....

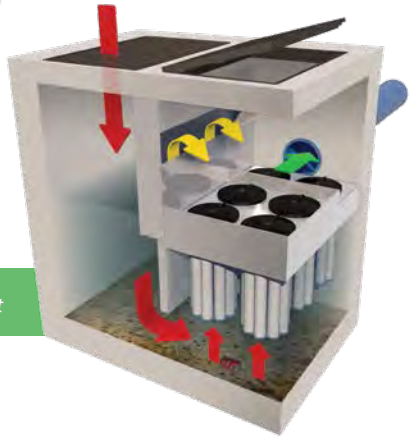
The Jellyfish Filter can be manufactured in a variety of configurations: manhole, catch basin, vault, fiberglass tank, or custom configurations. Typically, 18 inches (457 mm) of driving head is designed into the system. For low drop sites, the designed driving head can be less.

Manhole



Vault

Curb Inlet



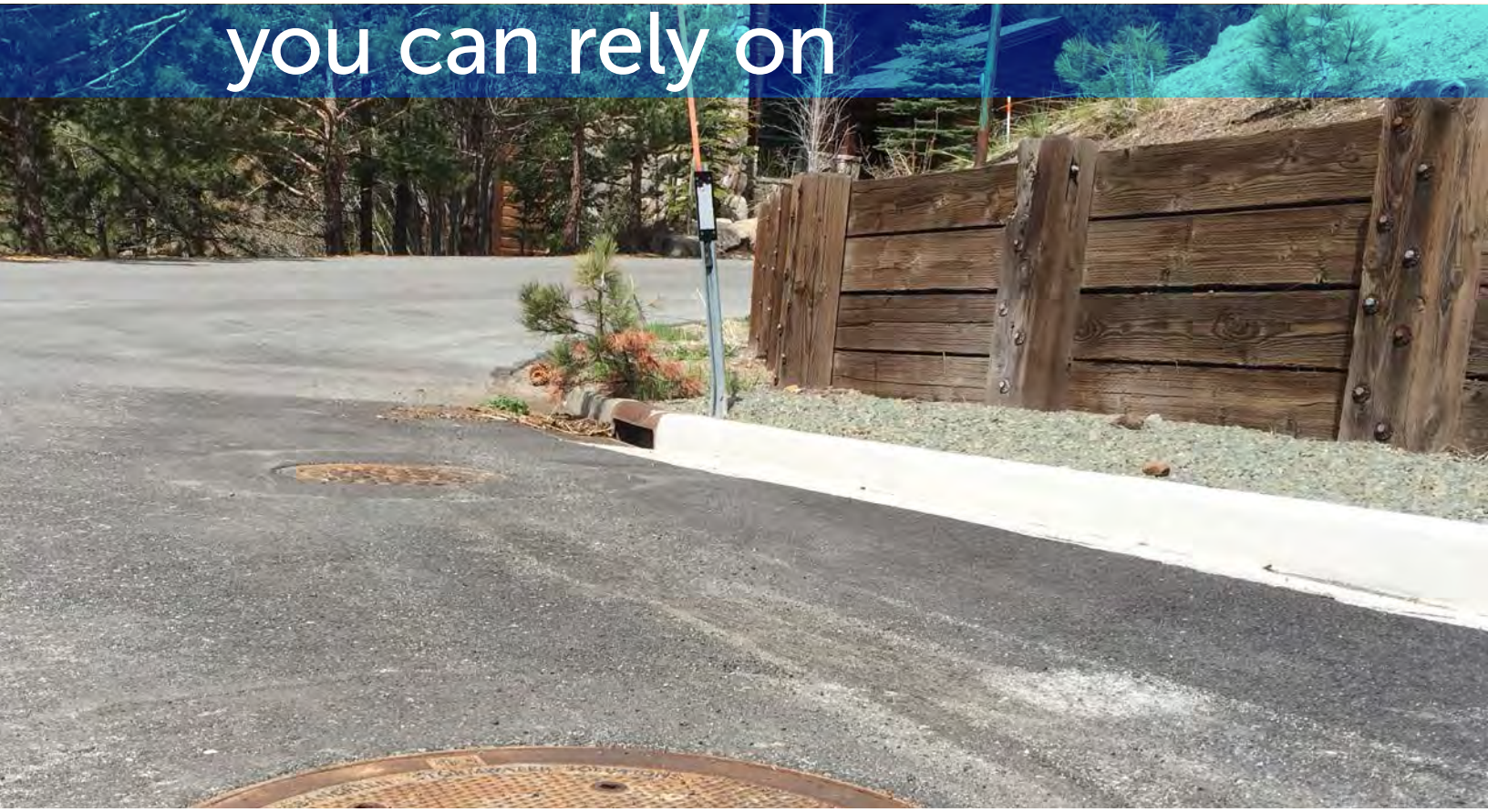
Grated Inlet

Jellyfish® Filter Maintenance

- Jellyfish Filter cartridges are light weight and reusable
- Maintenance of the filter cartridges is performed by removing, rinsing and reusing the cartridge tentacles.
- Vacuum extraction of captured pollutants in the sump is recommended at the same time.
- Full cartridge replacement intervals differ by site due to varying pollutant loading and type, and maintenance frequency. Replacement is anticipated every 2-5 years.
- Contech® has created a network of Certified Maintenance Providers to provide maintenance on stormwater BMP's.

The Jellyfish® Filter tentacle is light and easy to clean.

A partner you can rely on



STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

Few companies offer the wide range of high-quality stormwater resources you can find with us — state-of-the-art products, decades of expertise, and all the maintenance support you need to operate your system cost-effectively.

THE CONTECH WAY

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

TAKE THE NEXT STEP

For more information: www.ContechES.com

CONTECH® ENGINEERED SOLUTIONS

Get social with us:

800-338-1122 | www.ContechES.com

Brochures for select stormwater MTDs previously reviewed by BCWMC

Contech Engineered Solutions – StormFilter with Phosphosorb Media

CONTECH®
ENGINEERED SOLUTIONS

The Stormwater Management StormFilter®

The experts you need to solve your stormwater challenges

Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

Your Contech Team

STORMWATER CONSULTANT

It's my job to recommend the best solution to meet permitting requirements.

STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.

REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.

SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

Contech is your partner in stormwater management solutions

Flexible Stormwater Filtration Technology

An 8' x 24' Stormwater Management StormFilter with 60 cartridges is used to remove pollutants from runoff at Surfers Point Beach in Ventura, California.

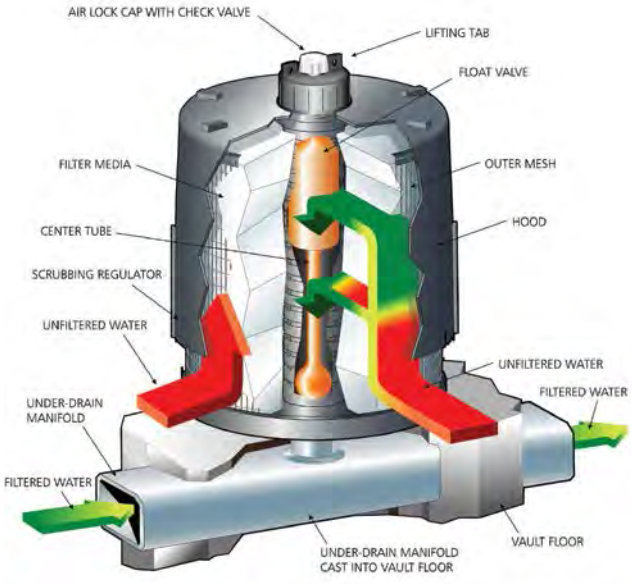
As stormwater quality regulations become more stringent, engineers need a filtration device that can tackle the most challenging pollutants and provide the flexibility to meet the needs of a variety of sites.

The Stormwater Management StormFilter® is an underground stormwater treatment device comprised of one or more structures that house rechargeable, media-filled cartridges that trap particulates and adsorb pollutants from stormwater runoff such as total suspended solids, hydrocarbons, nutrients, metals, and other common pollutants. With media options to target multiple or specific pollutants, multiple system configurations, and field and laboratory performance verified by the most stringent stormwater technology evaluation organizations; the StormFilter provides engineers the most flexible and most reliable manufactured treatment technology available.

The Stormwater Management StormFilter®

How the StormFilter Treats Stormwater

During a storm, runoff passes through the filtration media and starts filling the cartridge center tube. The air inside the hood is purged through a one-way check valve as the water rises. When water reaches the top of the float, buoyant forces pull the float free and allow filtered water to exit the cartridge. A siphon is established within each cartridge that draws water uniformly across the full height of the media bed ensuring even distribution of pollutants and prolonged media longevity. After the storm, the water level in the structure starts falling. A hanging water column remains under the cartridge hood until the water level reaches the scrubbing regulators at the bottom of the hood. Air then rushes through the regulators, breaking the siphon and creating air bubbles that agitate the surface of the filter media, causing accumulated sediment to settle on the treatment bay floor. This unique surface-cleaning mechanism prevents surface blinding and further extends cartridge life.



Learn More:
www.ContechES.com/stormfilter

The StormFilter has a 20+ year history of successful installations and over 200,000 cartridges installed worldwide.

FEATURE	BENEFIT
Siphon actuated, high surface area media cartridges	Stormwater is drawn evenly through the filter media providing efficient, effective stormwater treatment
Multiple cartridge heights	Flexibility to meet site-specific hydraulic needs and reduce system size and costs
Multiple media options	Ability to target specific pollutants of concern including TSS, phosphorus, heavy metals, and hydrocarbons
Internal peak bypass and multiple configurations	Design flexibility to meet your unique site requirements
Maintenance intervals of one to five years	Fewer maintenance events and reduced long-term ownership costs
Performance verified by both the WA DOE and NJ DEP	Superior pollutant capture with confidence
Arrives to the jobsite fully assembled	Factory build ensures quality and a simple, fast installation onsite

Design flexibility to meet your unique site requirements

StormFilter Media Options

Flexibility to target site-specific pollutants ...

- PhosphoSorb® is a lightweight media built from a Perlite-base that removes total phosphorus (TP) by adsorbing dissolved-P and filtering particulate-P simultaneously.
- CSF® Leaf Media is created from deciduous leaves processed into granular, organic media. CSF is most effective for removing soluble metals, TSS, oil and grease, and buffering acid rain.
- Perlite is naturally occurring puffed volcanic ash. Effective for removing TSS, oil, and grease.
- Zeolite is a naturally occurring mineral used to remove soluble metals, ammonium, and some organics.
- GAC (Granular Activated Carbon) has a micro-porous structure with an extensive surface area to provide high levels of adsorption. It is primarily used to remove oil and grease and organics such as PAHs and phthalates.

	PHOSPHOSORB	CSF	ZPG	PERLITE
Sediments	✓	✓	✓	✓
Oil and Grease	✓	✓	✓	✓
Soluble Metals	✓	✓	✓	
Organics		✓	✓	
Nutrients	✓	✓	✓	
Total Phosphorus	✓			

Note: Indicated media are most effective for associated pollutant type. Other media may treat pollutants, but to a lesser degree.

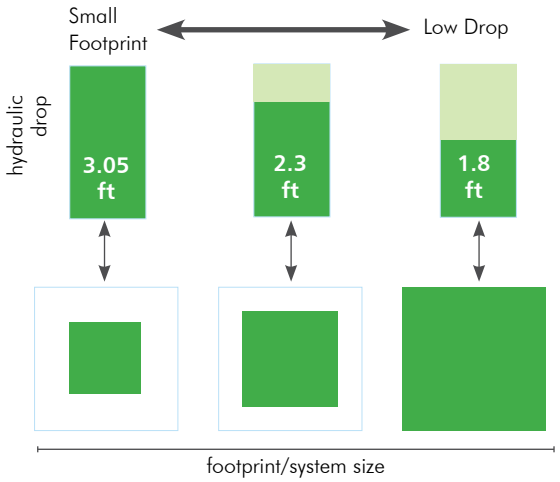
ZPG™ media is a proprietary blend of zeolite, perlite, and GAC, and is also available.

Cartridge Options

Flexibility to reduce size and costs ...

Every site is different, and one size does not fit all. Multiple cartridge heights give you design flexibility to design the StormFilter specifically for your site and reduce the cost of the system for the owner.

- 27″ cartridge – Capitalizing on sites with at least 3.05 feet of available driving head, media surface area is maximized to allow the greatest treatment rate per cartridge; best for sites with footprint constraints
- 18″ cartridge - The original StormFilter cartridge size provides a middle ground and operates with 2.3 feet of driving head
- Low Drop – Provides filtration treatment with only 1.8 feet of headloss; best for sites with limited by hydraulic constraints



CARTRIDGE FLOW RATES			
Cartridge Height	2 gpm/ft²	1.67* gpm/ft²	1 gpm/ft²
12″ LD	10 gpm	8.35 gpm	5 gpm
18″	15 gpm	12.53 gpm	7.5 gpm
27″	22.5 gpm	18.79 gpm	11.25 gpm

** For use with Phosphosorb media as per WA DOE GULD approval.*

MASS LOAD CAPACITY			
Cartridge Height	2 gpm/ft²	1.67* gpm/ft²	1 gpm/ft²
12″ LD	15 lbs	18 lbs	24 lbs
18″	22.5 lbs	27 lbs	36 lbs
27″	33.8 lbs	40.45 lbs	54 lbs

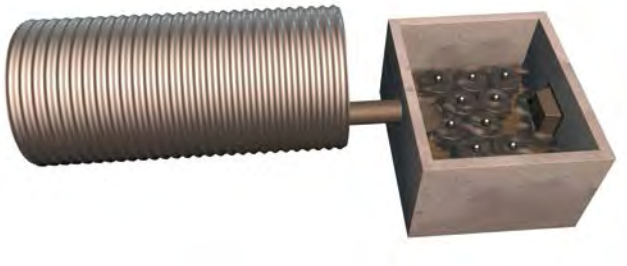
** For use with Phosphosorb media as per WA DOE GULD approval.*

Configurations

Flexibility to accommodate flows, project footprints, and hydraulics ...

The structures that house the filter cartridges can be constructed in a variety of ways to accommodate a wide range of flows, project footprints, and variable hydraulic conditions. Standard configurations include catch basin, manhole, vault, curb inlet, and linear grate.

- **The Peak Diversion StomFilter** provides treatment and high flow bypass in one precast vault, eliminating the need for an external bypass or junction structures.
- **The Volume StormFilter** is designed to meet volume-based treatment regulations and can be combined with upstream storage to treat and drawdown the water quality volume within the required drain down time.
- **The Cast-in-Place StormFilter** structures allow the highest degree of flexibility and are available for installations within buildings or other areas where precast structures cannot be accommodated. On-site Contractor assistance is provided to ensure the finished product meets Contech's standards for fit and function.



Select StormFilter Approvals

The StormFilter has been verified by some of the most stringent stormwater technology evaluation organizations in North America, including:

- Washington State Department of Ecology (TAPE) GULD – Basic, Phosphorus
- New Jersey Department of Environmental Protection (NJ DEP)
- North Carolina Department of Environmental Quality (NC DEQ)
- Maryland Department of the Environment (MD DOE)
- Texas Commission on Environmental Quality (TCEQ)
- Virginia Department of Environmental Quality (VA DEQ)
- Maine Department of Environmental Protection (ME DEP)
- St. Louis Metropolitan Sewer District

Verified by some of the most stringent organizations

StormFilter Maintenance

APPLICATION TIPS

- Clogging is a major factor in the failure of filter systems. Look for systems that offer mechanisms that prevent clogging, extend service life, and reduce life-cycle cost.
- A compact design reduces construction, installation, and life-cycle cost, so look for systems that offer the most flexibility in design and construction.
- All media filters will eventually need to be replaced. Look for filters that have lightweight cartridges and provide easy access for maintenance.

An easy-to-access treatment system can make all the difference in maintenance expenses.

Every manufactured filtration device will eventually need routine maintenance. The question is how often and how much it will cost. Proper evaluation of long-term maintenance costs should be a consideration when selecting a manufactured treatment device. The StormFilter has been optimized to reduce long-term maintenance costs with proven, repeatable performance in the laboratory and in the field.

- **Reduce Life Cycle Costs** - StormFilter has been designed for predictable maintenance intervals ranging from 1 to 5 years, resulting in fewer maintenance events and reduced life-cycle costs compared to other filtration devices.
- **Easy to maintain** - All StormFilter structures provide access for inspection, media replacement, and washing of the structure. Visual indicators for maintenance are observable from the surface.
- **Cartridge replacement program** provides refurbished cartridges that are shipped to your site ready to install. Contech arranges for empty cartridges to be picked up and shipped back, reducing cartridge costs and environmental impact.
- **Maintenance support** - Contech has created a network of Certified Maintenance Providers to provide StormFilter maintenance at the lowest possible cost.

A partner you can rely on

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

Few companies offer the wide range of high-quality stormwater resources you can find with us — state-of-the-art products, decades of expertise, and all the maintenance support you need to operate your system cost-effectively.

THE CONTECH WAY

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

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For more information: www.ContechES.com

CONTECH® ENGINEERED SOLUTIONS

Get social with us:

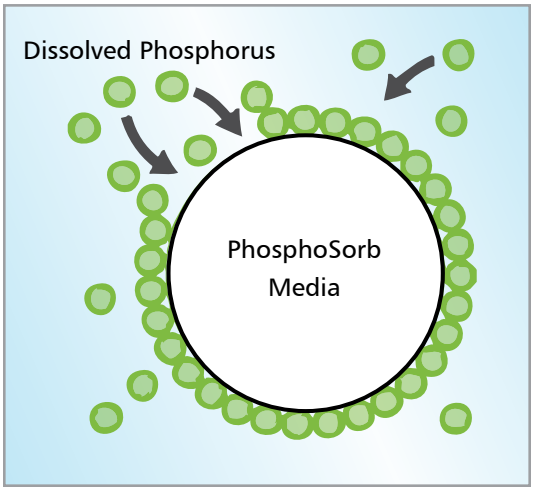
800-338-1122 | www.ContechES.com

CONTECH ENGINEERED SOLUTIONS

Introducing PhosphoSorb® Media

Effectively target TSS and Total Phosphorus in one lightweight media

Manufactured in an environmentally-friendly manner, PhosphoSorb is a lightweight media built from a Perlite base. This innovative, engineered filtration media removes total phosphorus (TP) from stormwater runoff by absorbing dissolved-P and filtering particulate-P simultaneously. Field tests of the PhosphoSorb media showed a load reduction of 89% TSS and 82% total phosphorus with an average influent concentration of 380 mg/L and 0.33 mg/L respectively.



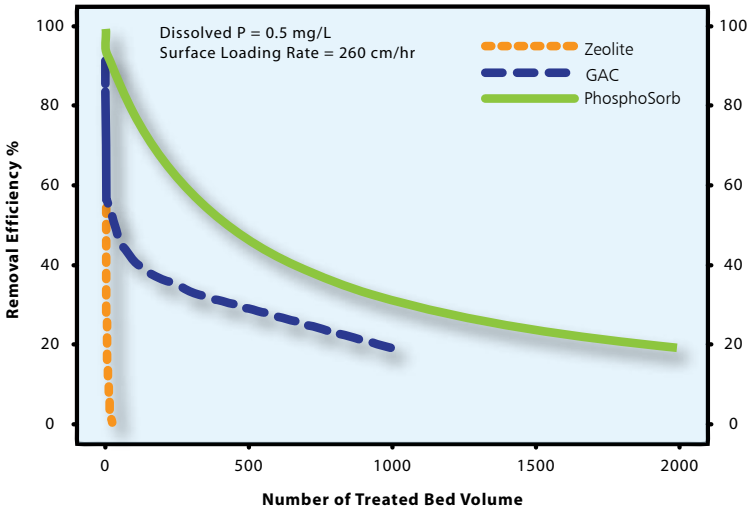
Physical Characteristics of PhosphoSorb:

Nominal Size (mm)	Bulk Density Lbs/ft³	Effective Bed Porosity (%)	Specific Surface Area (m²/g)
1.4-6.3	20-25	65%-80%	20-30

State of Washington TAPE GULD Basic Phosphorus

Key Benefits:

- Removes both TSS and TP from stormwater runoff
- Removal of both soluble and total Phosphorus can exceed 50%
- Low impact product life cycle – no production by-products
- Lightweight media – easy to handle, ship and deploy
- Flexible deployment – for use in the Stormwater Management StormFilter® and as a biofiltration soil amendment



In laboratory testing, PhosphoSorb removed 50% of the first 1,000 treated empty bed volumes (EBVs) of 0.5 mg/L influent dissolved P solution, and lasted for at least 2,000 treated EBVs.

CONTECH ENGINEERED SOLUTIONS

Toll Free: 1-800-338-1122
www.ContechES.com

Attachment 2

Technology Assessment Protocol – Ecology (TAPE)

Process Overview

DEPARTMENT OF ECOLOGY
State of Washington

September 2018
Publication no. 18-10-039
Revision of 11-10-010

Publication and Contact Information

This report is available on the Department of Ecology's website at
https://fortress.wa.gov/ecy/publications/summarypages/1110010.html

For more information contact:

Water Quality Program
P.O. Box 47600
Olympia, WA 98504-7600

Phone: 360-407-6600

Washington State Department of Ecology - www.ecology.wa.gov

o Headquarters, Olympia	360-407-6000
o Northwest Regional Office, Bellevue	425-649-7000
o Southwest Regional Office, Olympia	360-407-6300
o Central Regional Office, Yakima	509-575-2490
o Eastern Regional Office, Spokane	509-329-3400

Accommodation Requests
To request ADA accommodation including materials in a format for the visually impaired, call Ecology at 360-407-6600 or visit https://ecology.wa.gov/accessibility. People with impaired hearing may call Washington Relay Service at 711. People with speech disability may call TTY at 877-833-6341.

Technology Assessment Protocol – Ecology (TAPE)

Process Overview

Water Quality Program
Washington State Department of Ecology
Olympia, Washington

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Acknowledgements

Ecology manages the TAPE program with considerable assistance from a Stakeholders Advisory Group (SAG) and Board of External Reviewers (BER). Ecology appreciates the efforts of the committee members and their willingness to share their expertise. The authors would like to thank the following people for their contributions:

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David Sample	Virginia Tech
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Introduction

This document provides an overview of the Technology Assessment Protocol-Ecology (TAPE) process for vendors, designers, and manufacturers (referred to as 'proponents') who wish to have their stormwater treatment technologies verified and certified by the Washington State TAPE program. This guide walks proponents through the TAPE process, providing an overview of the program and the specific steps required for certification. Specific guidance for designing, executing, and reporting on performance monitoring is detailed in two companion Ecology documents:

- *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE)* (Publication 11-10-061) *(aka,* TAPE Technical Guidance Manual*)*
- *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Publication 04-03-030).

Ecology updated the TAPE Technical Guidance Manual in September 2018[1]. Ecology may consider field data collected prior to September 2018 to satisfy the performance goals of TAPE. Previously collected field data must meet either the 2011 or the 2018 TAPE guidelines and include an Ecology approved Quality Assurance Project Plan, and third party review confirming that monitoring was conducted and samples were analyzed in accordance with the cited TAPE protocol and the approved QAPP. TAPE requires all new applicants to pay a fee at three stages in the certification process. Please refer to the Fee Structure Program for a description of these fees.

Overview of TAPE

The TAPE program provides a peer-reviewed regulatory verification and certification process for emerging stormwater treatment technologies. The TAPE program is administered by the Washington State Department of Ecology (Ecology), with assistance from staff at the Washington Stormwater Center (www.wastormwatercenter.org/), which provides stormwater management assistance including guidance on certification of emerging treatment technologies.

The stormwater management manuals for western and eastern Washington include design criteria and performance goals for stormwater treatment facilities in the state of Washington (stormwater management manuals). Volume V, Chapter 12 (Stormwater Management Manual for Western Washington (SWMMWW)) and Chapter 5, Section 12 (Stormwater Management Manual for Eastern Washington (SWMMEW)) of the manuals discuss Ecology's evaluation and approval process for emerging treatment technologies. The stormwater manuals do not provide criteria for the selection and sizing of emerging technologies because the technologies and the knowledge of them are rapidly evolving.

[1] Proponents accepted into the TAPE program prior to September 2018 may choose to follow either the new protocol (September 2018) or the old protocol (July 2011). Proponents submitting a technology to the TAPE program for the first time can choose between the new protocol and the old protocol until March 31, 2019, after which your QAPP must follow the new protocol. Your QAPP must state which of the two protocols is followed.

Ecology and the Washington Stormwater Center established a Board of External Reviewers (BER) to:

- Review emerging treatment technology design and performance data and recommend whether or not to certify the technology.
- Provide overall advice and guidance as the TAPE program evolves and improves.

Proponents must demonstrate performance by testing their stormwater treatment technology at field sites in the Pacific Northwest or at pre-approved testing sites located in other parts of the United States. The testing protocol is specifically designed to evaluate flow-through best management practices (BMPs) with relatively short detention times, and may not be suitable for all stormwater treatment technologies. Ecology has developed an alternative monitoring protocol that applies to long-detention BMPs (e.g., wet ponds) (Ecology 2018b). This document is included as an Appendix in the *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies*.

Based on BER technical reviews, Washington Stormwater Center staff members advise Ecology regarding which new stormwater treatment technologies meet performance goals and therefore, should be added to the list of approved technologies in the stormwater management manuals. Ecology makes the final decision to certify new stormwater treatment technologies.

Criteria for certification

Certification of emerging technologies depends on their performance relative to one or more of five performance goals (Table 1).

Table 1. TAPE Performance Goals[a]

Performance Goal	Influent Range	Criteria
Basic Treatment	20-100 mg/L TSS	Effluent goal < 20 mg/L TSS
	100-200 mg/L TSS	≥ 80% TSS removal
Dissolved Metals Treatment	Dissolved copper 0.005 - 0.02 mg/L	Must meet basic treatment goal and exhibit ≥ 30% dissolved copper removal
	Dissolved zinc 0.02 - 0.3 mg/L	Must meet basic treatment goal and exhibit ≥ 60% dissolved zinc removal
Phosphorus Treatment	Total phosphorus (TP) 0.1 to 0.5 mg/L	Must meet basic treatment goal and exhibit ≥ 50% TP removal
Oil Treatment	Total petroleum hydrocarbon (TPH) > 10 mg/L	1) Daily average effluent TPH concentration < 10 mg/L 2) Maximum effluent TPH concentration of 15 mg/L for a discrete (grab) sample
Pretreatment [b]	50-100 mg/L TSS	< 50 mg/L TSS
	100-200 mg/L TSS	≥ 50% TSS removal

mg/L - milligrams per liter
TP - total phosphorus
TPH - total petroleum hydrocarbons
TSS - total suspended solids

a. See TAPE Technical Guidance Manual for further details.
b. Pretreatment technologies generally apply to (1) project sites using infiltration treatment and (2) treatment systems where pretreatment is needed to ensure and extend performance of the downstream basic or dissolved metals treatment facilities.

Use level designations

Ecology evaluates the existing data on a stormwater treatment technology to assign use level designations that determine how many installations may occur in Washington and what the monitoring requirements are for obtaining additional data on treatment performance. Depending on the relevance, amount, and quality of performance data provided with the application for certification, Ecology will initially place the technology into one of two use level designation categories: pilot use level designation (PULD) or conditional use level designation (CULD) (Table 2). PULDs are typically given when there are sufficient laboratory data available to indicate a treatment technology may meet the performance goals for TAPE that are described in Table 1. Ecology typically issues CULDs when there are both laboratory and field data available for a treatment technology that would indicate an even greater likelihood of meeting these performance goals. Applicants may use field data that does not meet the data requirements of TAPE for CULD approval. The PULD and CULD allow installation and operation of the technology in the state of Washington in order to gather the performance data required for final general use level designation (GULD) certification. More information on the TAPE program is available on Ecology's website.

Table 2. TAPE Use Level Designations

Use Level Designation	Minimum Data Required for Certification [a]	Time Limit (months) [b]	Maximum Number of Installations in Washington State	Field Testing Required Under Designation to achieve GULD
Pilot (PULD)	Laboratory	30	5[c]	A minimum of one site located in the Pacific Northwest or at an approved Alternative Stormwater Technology Evaluation Facility; *all* sites installed in Washington state must be monitored [d]
Conditional (CULD)	Field data required; laboratory data may supplement but not substitute for required field data.	30	10[c]	A minimum of one site located in the Pacific Northwest or at an approved Alternative Stormwater Technology Evaluation Facility
General (GULD)	Field data following TAPE protocol required; laboratory data may supplement but not substitute for required field data	Unlimited	Unlimited [e]	None

a. Proponent must supply all available performance data with the initial application. PULD and CULD approvals will depend on the relevance, amount, and quality of data. Submittal of data does not ensure approval.
b. From the time the original use level designation is received from Ecology. Proponents with a PULD or CULD are typically allowed a maximum of 30 months to prepare a QAPP, receive QAPP approval, conduct stormwater monitoring according to the QAPP, and prepare a TER requesting CULD or GULD certification for their stormwater treatment technology. Proponents requiring extensions on the 30-month use level designation, or the submittal of a QAPP or TER, must submit a request to Ecology at least 2 weeks before the due date. Ecology will grant extensions only if the proponent shows that progress is being made toward completing required TAPE components.
c. Installation limit applies to devices installed to meet new and redevelopment treatment criteria. There is no installation limit for stormwater retrofit or industrial permit projects.
d. Local governments covered by a municipal stormwater National Pollutant Discharge Elimination System (NPDES) permit must submit a Notice of Intent form to Ecology when a PULD technology is proposed for installation in their jurisdiction.
e. Subject to conditions imposed by Ecology (i.e., maximum flow rates, limitations on drainage basin size, locations for use, and others as appropriate) listed in the GULD document posted on Ecology's website. Local jurisdictions may impose additional conditions.

What does certification mean?

Ecology designed the TAPE certification process to ensure that the approved treatment technologies meet applicable design criteria and performance goals for new development and redevelopment. TAPE certification means that the new technology has successfully met the TAPE performance goals, when they properly install, operate, and maintain the device.

However, TAPE certification does not mean the technology is appropriate for any and all stormwater treatment applications. Local governments should use TAPE certification as one of many factors when selecting or allowing specific stormwater control and water quality treatment solutions for use in their jurisdiction. Jurisdictions should base selection of a treatment technology on a cost-benefit analysis and not simply on the fact that a technology is TAPE-certified. Although TAPE is a Washington State protocol, several other states, counties, and cities use TAPE certification to determine whether to allow installation of a technology within their jurisdiction.

The TAPE performance goals do not address capital costs, costs for operation & maintenance (O&M), or costs for material disposal; however, proponents are encouraged to provide this supplemental information in their Technical Evaluation Report (TER). In addition, the TAPE certification process represents specific influent concentration ranges and does not typically include an assessment of long-term performance. Local governments should take these and other factors, into account when evaluating the potential use of a TAPE-certified treatment technology.

There is no specific analysis of maintenance frequency within the TAPE review process The same device will require different maintenance activities depending on the land use upstream of the device. With only one field site required, TAPE does not address general maintenance requirements.

Steps to certification

Step 1. Complete the *Emerging Stormwater Treatment Technologies: Initial Application for Certification (Initial Application)* and pay the application fee. A copy of the Initial Application form is included in the *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE).* The *Initial Application* includes information about your technology and the performance data you have collected to help us evaluate whether your technology shows promise of meeting the TAPE performance goals. If an application contains confidential business information (CBI), you must identify the information in your application. Ecology will consider if the information, according to WA state law, is confidential and inform you of our findings. Ecology will not share confidential information with others.

When we receive a completed *Initial Application*, we will assign your technology a case number and contact you if any additional information is required. The Washington Stormwater Center may ask up to three members of the BER to review and provide comments on the application. If after reviewing this information Ecology finds that your technology shows promise of meeting TAPE goals, Ecology will grant your technology either a pilot or a conditional use level designation (PULD or CULD). Our goal is to grant a use level designation within one to two months from receipt of your complete *Initial Application*. Once the proponent finds a suitable monitoring site and notifies Ecology, the deadlines for QAPP and TER submittal are set.

Initial Application:

Submit one (1) text-searchable electronic (.pdf) copy, and one (1) signed copy of the TAPE confidentiality agreement

Your *Initial Application* must include as much of the following information as possible. If using data from testing following other protocols, describe how data is similar to or differ from TAPE guidelines (e.g., storm depth, sample type). If you provide insufficient information in your *Initial Application,* Ecology will return the application to you without review, pending receipt of adequate information. At a minimum, applicants should submit the following information:

- Description of physical, chemical, and/or biological treatment functions.
- Design drawings/photographs.
- Description of construction materials.
- Equipment dimensions.
- Design flow rate (gallons per minute [gpm], cubic feet per second [cfs], inches per hour [in/hr]).
- Explanation of site installation requirements (e.g., necessary soil characteristics, hydraulic grade requirements, depth to groundwater limitations, utility requirements).
- Description of any pretreatment requirements or recommendations.
- Description of any components of the treatment system that may contain copper, zinc, or phosphorus or any other constituent of concern that might contribute to increased pollutant concentrations in the effluent.
- Description of any components (i.e., concrete) that may result in pH fluctuations in the effluent.
- Detailed description of the sizing methodology.
- Expected treatment capabilities.
- Maintenance procedures.
- Description of bypass process.
- Comparison of size of laboratory unit to typical field units (if laboratory testing data is submitted).
- Raw water quality data.
- Summary of water quality data and removal calculations.
- Statistical analysis.
- Flow rate(s) used for laboratory testing.
- Influent and effluent flow data.
- Storm event information.
- Any other information or data that will help determine if your treatment technology can meet or does meet TAPE's performance goals.

Step 2. Design a performance evaluation study and write a Quality Assurance Project Plan (QAPP). The study must generate performance data of sufficient quality and quantity to evaluate with adequate statistical power how the technology performs in the field. Detailed

guidance for designing your study, including how to write the QAPP is provided in the *TAPE Technical Guidance Manual* and in Ecology's *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Website links identified earlier). Finding a field site with suitable stormwater flows and influent ranges specified in the *TAPE Technical Guidance Manual* and Table 1 of this document is often challenging; consequently, proponents are encouraged to identify sites early in the process of designing the study.

Selecting multiple field sites is often advantageous to the proponent; the QAPP must address field conditions at each field site where data collection will occur. Local governments covered by a municipal stormwater National Pollutant Discharge Elimination System (NPDES) permit must submit a Notice of Intent form (Appendix 3) to Ecology for every PULD technology proposed for installation in their jurisdiction.

QAPP:

Submit one (1) text-searchable electronic (.pdf) copy. Proponents with a PULD must include a copy of the completed Notice of Intent form (Appendix 3) with the QAPP.

Refer to the TAPE confidentiality section below for submittal requirements for QAPPs containing confidential business information.

At least three experts chosen from the BER will review the completed QAPP. The BER member review addresses the following question:

> *If the monitoring program described in the proponent's QAPP is substantively followed and completed, will the resulting data and statistical analyses allow Ecology to rigorously evaluate the technology's performance against the stated TAPE performance goals?*

Washington Stormwater Center staff will consolidate comments from the three BER members and forward the consensus recommendation to Ecology. There may be several steps in the review process as Ecology requests additional information from the applicant. If there is substantial disagreement among the external reviewers, we may request that additional BER members review the QAPP. The final decision to approve the QAPP rests with Ecology.

The proponent must submit a QAPP that meets Ecology's QAPP guidance and *TAPE Technical Guidance Manual* requirements within six months of finding a suitable monitoring site and notifying Ecology. Within three months[2] of receipt of the final QAPP, Ecology will complete the review and make a decision whether field testing can commence.

Step 3. Install, operate, and monitor the technology at one or more field sites in the Pacific Northwest or at an Ecology-approved Alternative Stormwater Technology Evaluation Facility. A list of approved facilities can be found on the Ecology website.

[2] If circumstances prevent completion of Ecology's review within the stated review period, Ecology will notify the proponent of the reason for the delay and provide an estimated review schedule.

Ecology must approve the QAPP prior to the start of field-testing. The proponent must use the approved QAPP to guide project management during this phase of the certification process. While Ecology and the Washington Stormwater Center staff are available to discuss issues arising during the field study, the proponent's project team is responsible for monitoring the site(s) according to the QAPP.

Step 4. Send us the results. Upon completion of the field sampling, use the data analysis and statistical techniques described in your approved QAPP to summarize the results and write the Technical Evaluation Report (TER). Instructions for completing the TER are found in the *TAPE Technical Guidance Manual.* Note that an independent professional third party must review key elements of the TER for all submittals that contain field monitoring data collected by a vendor or manufacturer of a stormwater treatment technology before you send it to us for review. Proponents must fill out the Excel database template with raw field data, storm data, and site information. Ecology will forward this information to the International Stormwater Database following final GULD approval.

TER:

Submit one (1) text-searchable electronic (.pdf) copy, and one (1) .CSV file with raw analytical and storm event data.

Refer to the TAPE confidentiality section below for submittal requirements for TERs containing confidential business information.

We will review each TER for completeness and then ask at least three members of the BER to conduct a thorough examination of your results, interpretations, and findings. For consistency whenever possible, TAPE will use the same reviewers who evaluated your QAPP for the review of the TER. TAPE will compile the results of the external reviews and will send a summary recommendation to Ecology. There may be requests for more information from the BER or Ecology during the TER review. Ecology intends to complete the review of your TER and make a final certification decision within three months of receiving the TER. If Ecology approves the TER, the technology receives a GULD. At a minimum the GULD identifies the type of approved treatment (basic, dissolved metals, phosphorus, and/or oil), the design flow rate, and the required maintenance interval. Ecology is responsible for the final certification decision.

Submitting information to Ecology

Initial Applications, QAPPs, and TERs, along with the appropriate fees should be sent to the Washington State Department of Ecology, using the contact information provided below. Fee information is provided at the end of this document.

Send the following: • Applications • QAPPS • TERS • Fees	**Please make checks payable to**: ***Department of Ecology***
Send to: TAPE Program Washington State Department of Ecology Cashiering P.O. Box 47611 Olympia, WA 98504-7611	
Questions? (360) 407-7052 ldar461@ecy.wa.gov	

Confidentiality

Proponents may request that certain records or other information be considered confidential. Such requests will be considered by Ecology consistent with Washington State law (RCW 43.21A.160). In order for such records or information to be considered confidential, the proponent must certify that the records or information is unique to the design and construction of the technology, or release to the public or to a competitor would adversely affect the competitive position of the proponent. The proponent must request that such records or information be made available only for the confidential use of Ecology. All monitoring data including, but not limited to, laboratory results and field measurements, QA/QC data, data qualifiers, and monitoring site information cannot be considered confidential.

To make a request for confidentiality, the proponent must clearly mark only those pages that contain confidential material with the word "confidential" and submit these pages as a separate file to Ecology. Placeholder pages must be placed in the document that state "confidential material has been provided as a separate document to Ecology." The proponent must also provide a letter of explanation as to why these pages are confidential. Ecology will review the request and send notice to the proponent either granting or denying the confidentiality request. Proponents may request return of material if Ecology denies the request for confidentiality. At a minimum, requests for confidentiality require a 1-month review.

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TAPE Fee Structure

Fee Structure for Program Participation

Fee category	Amount	Due
Initial Application	$ 5,000	Upon submittal of *Initial Application*
Quality Assurance Project Plan (QAPP) review	$ 10,000	Upon submittal of final QAPP [a]
Technical Evaluation Report (TER) review	$ 15,000	Upon submittal of final TER [b]
a. Fee must be paid before Ecology updates the TAPE website to reflect the change in the technology's status. Collection of fee does not guarantee approval of QAPP. b. Fee must be paid before Ecology updates the TAPE website to reflect the technology's new General Use Level Designation (GULD). Collection of fee does not guarantee approval of TER or guarantee GULD status.		
Please make checks payable to: Department of Ecology and send to: TAPE Program Washington State Department of Ecology, Cashiering, P.O. Box 47611, Olympia, WA 98504-7611		

TAPE is administered by the Washington State Department of Ecology with assistance from staff at the Washington Stormwater Center. The Washington Stormwater Center is a partnership between the City of Puyallup, the University of Washington Tacoma, and the Washington State University Puyallup Research and Extension Center.

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Appendix 1. Acronyms

BER	Board of External Reviewers
BMP	Best management practices
CULD	Conditional Use Level Designation
GULD	General Use Level Designation
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and maintenance
PULD	Pilot Use Level Designation
QAPP	Quality Assurance Project Plan
TAPE	Technology Assessment Protocol-Ecology
TER	Technical Evaluation Report
TP	Total phosphorus
TPH	Total petroleum hydrocarbons
TRC	Technical Review Committee
TSS	Total suspended solids

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Appendix 2. References

Ecology 2004. *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, No. 04-03-030. Washington State Department of Ecology, Olympia, WA. (www.ecy.wa.gov/programs/eap/qa/docs/QAPPtool/Mod3%20Guidelines/GuidelinesforPreparingQAPPS.pdf)

Ecology 2012. *Stormwater Management Manual for Western Washington*, No. 05-10-029, 05-10-030, 05-10-031, 05-10-032, 05-10-033. Washington State Department of Ecology, Olympia, WA. (www.ecy.wa.gov/programs/wq/stormwater/manual.html)

Ecology 2018a. *Guidance for Evaluating Emerging Stormwater Treatment Technologies. Technology Assessment Protocol – Ecology (TAPE),* No. 11-10-061, a revision of No. 02-10-037. Washington State Department of Ecology, Olympia, WA. (www.ecy.wa.gov/biblio/0210037.html)

Ecology 2018b. *Guidance for Evaluating Emerging Stormwater Treatment Technologies-Technology Assessment Protocol—Ecology (TAPE) Appendix: Modification: Evaluating Stormwater Treatment Technologies with Long Detention Times.* Washington State Department of Ecology, Olympia, Washington.

Ecology 2018c. *Stormwater Management Manual for Eastern Washington*, No. 04-10-076. Washington State Department of Ecology, Olympia, WA. (www.ecy.wa.gov/programs/wq/stormwater/easternmanual/manual.html)

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Appendix 3. Notice of Intent Form for PULD Technologies

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DEPARTMENT OF ECOLOGY
State of Washington

Notice of Intent

Pilot Use Level Designation Technologies

Treatment Facility Vendor Information				
Company:		Contact Name:		
Business Phone:	Fax (optional):	Street Address:		
Company Web Address:				
Email:		City:	State:	Zip+4:
Facility Name and Size:				
Development Level Designation Sought:				
Target Pollutants:				

Project Information	
Project Name:	Contact Name:
Local Agency with Jurisdiction:	Street Address:
Desired Installation Date:	City:
Project Type:	
Facility Discharge Receiving Water:	
Describe Proposed Testing Plan (e.g. number storms, parameters, test period, who will do work, etc.):	

Local Government Certification and Acceptance		
Printed/Typed Name	Agency	Title
Signature		Date

Submit completed forms to the following address:

Washington Department of Ecology – TAPE Coordinator
Water Quality Program
PO Box 47696
Olympia, WA 98504-7696

If you have questions about this form, contact the following Ecology staff:

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Background Information

Local governments with a National Pollutant Discharge Elimination System (NPDES) permit must submit this Notice of Intent Form to Ecology, and receive Ecology's approval prior to installing a pilot-designated technology (except in retrofit situations). All other jurisdictions are also encouraged to notify Ecology when a Pilot Use Level Designation (PULD) technology is proposed.

Local governments may allow PULD technologies to be installed **provided that** the vendor and/or developer agree(s) to conduct additional field testing based on the TAPE at **all** installations to obtain a general use level designation (GULD). Field-testing must be completed at a minimum of one site in the Pacific Northwest*, or at a pre-approved testing site located in other parts of the United States, to obtain a general use level designation.

* *Pacific Northwest refers to locations in Washington, Oregon, Northern California or British Columbia with rainfall distributions typical of a Pacific Northwest maritime climate, where long duration, low intensity storms predominate and stormwater contains mostly silt sized particles.*