WASHINGTON STATE DEPARTMENT OF ECOLOGY

August 2008

PILOT USE LEVEL DESIGNATION FOR BASIC TREATMENT

For

Imbrium Systems Jellyfish™ Filter

Ecology's Decision:

Based on Imbrium Systems Corporation's application submissions, Ecology hereby issues pilot use level designation (PULD) for the Imbrium's Jellyfish™ Filter as a basic treatment device for total suspended solids (TSS) removal. Jellyfish™ Filter units must be sized in accordance with the company guidelines submitted to Ecology (Dated May 7, 2008). Assuming a maintenance cycle of one year, the guidelines include the following:

(1)- Determine the number of cartridges needed based on sediment mass loading:

- **Calculate the total annual sediment mass loading to the facility.**
- **Assuming each draindown cartridge removes 25 pounds of sediment and each standard cartridge removes 50 pounds of sediment; calculate the number of cartridges needed.**

(2)-Determine the number of cartridges needed based on hydraulic loading:

- **Assuming a flow rate of 25 gpm for each draindown cartridge and 50 gpm for each standard cartridge, calculate the number of cartridges needed**

(3)- Compare the number of cartridges needed to handle the sediment mass loading versus hydraulic loading and use the larger of the two.

The table below illustrates the hydraulic capacities associated with various Jellyfish™ systems using varying number of filter cartridges.

System sizing illustration[a]

Manhole Diameter	Diameter Cartridge	Number Cartridges	Cartridge Flow Rate	Number Draindown Cartridges	Water Quality flow rate[b]
4 feet	12 inches	2	50 gpm	1	125 gpm
6	12	6	50	1	325
8	12	12	50	2	575
10	12	16	50	3	875
12	12	24	50	4	1300
Rectangular	12	variable	16 to 50	variable	variable

a. Cartridges with 54-inch tentacles, standard head

b. The draindown cartridge has a flow rate capacity of 25 GPM

The use level designations expire on February 1, 2011 unless extended by Ecology, and is subject to the conditions specified below.

Ecology's Conditions of Use:

Jellyfish™ Filter units shall be designed, installed, and maintained to comply with these conditions:

1. **Jellyfish™ Filter units must be designed, assembled, installed, operated, and maintained in accordance with Imbrium Systems' applicable manuals and documents and the Ecology Decision.**

2. **Jellyfish™ Filter units are approved for basic treatment at the hydraulic loading rate of 25 gpm for draindown and 50 gpm for standard cartridges at the 15-minute water quality design flow rate (as specified in Ecology's most recent Stormwater Manual), as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model. Note that if single event methods are used to estimate runoff flowrates, Figures 9.6a and 9.6b of the 2005 Stormwater Management Manual for Western Washington should be used to adjust the peak single event flowrate for calculation purposes. This is done by dividing the peak 10 minute flowrate predicted by the single event method by the ratio indicated in Figure 9.6a for on-line designs, or Figure 9.6b for off-line designs. The 6-month, 24-hour rainfall amount for the project site must be known to identify the appropriate ratio. The adjusted flowrate is then divided by the approved module flowrate to compute the number of modules necessary. Note: This method is not applicable for Eastern Washington.**

3. **Imbrium Systems commits to submitting a QAPP for the Technical Review Committee (TRC) review and Ecology approval by February 1, 2009 that meets the TAPE requirements for attaining a GULD for basic treatment. Additional QAPPs must be reviewed and approved by the TRC and Ecology for each field site (maximum of five sites) in Washington State. The sites chosen should be reflective of the product's treatment intent.**

4. **Local jurisdictions must file a "Pilot Level Technologies Notice of Intent" form with the Department of Ecology prior to authorizing Jellyfish™ Filter for a pilot use level application.**

5. **Imbrium Systems shall complete all required testing and submit a TER for TRC and Ecology review by August 1, 2010.**

6. **Imbrium Systems may request Ecology to grant deadline or expiration date extensions, upon showing cause for such extensions.**

7. **Discharges from the Jellyfish™ Filter units shall not cause or contribute to water quality standards violations in receiving waters.**

Applicant: Imbrium Systems Corporation

Applicant's Address: 3811 S.W. Corbett Ave.
Portland, OR 97239

Application Documents:

A report prepared by Gary R. Minton, PhD, PE, with Resource Planning Associates in Seattle, Washington:

- Jellyfish™ Filter Systems Evaluation Report in Consideration for Pilot Level Designation (PLD) for Imbrium Systems Corporation, May 7, 2008 (updated July 1, 2008).

A report prepared by the New Jersey Corporation for Advanced Technology (NJCAT) Program:

- NJCAT Technology Verification, Jellyfish™ Fine Sediment Filter, Imbrium Systems Corporation, June 2008.

Applicant's Use Level Request:

Pilot use level designation as a basic treatment device in accordance with the Ecology's 2005 Western Washington Stormwater Manual and Technology Assessment Protocol – Ecology (TAPE January 2008 Revision).

Applicant's Performance Claims:

Based on results from a laboratory test system, the applicant claims:

- Jellyfish™ Filter Systems has the capability to remove 80% of total suspended solids from stormwater runoff from sites with influent concentrations between 100 mg/L and 200 mg/L and provide effluent concentrations of 20 mg/L or less with influent concentrations less than 100 mg/L given a typical particle size distribution.

- Sampling of effluent found an average D90 of about 14 microns indicating the Jellyfish Filter System is capable of removing most particles above 15 microns. This suggests the high likelihood that fields study will demonstrate the technology can meet the goal of Basic Treatment.

Recommendations:

Ecology finds that:

- Imbrium Systems should be given the opportunity to demonstrate, through additional laboratory and field testing, whether the Jellyfish™ Filter can attain Ecology's basic treatment goals.

Findings of Fact:

(1)- Laboratory Testing and Results - Testing was conducted at the Monteco Limited Research & Development Centre (RDC) in Mississauga, Ontario with third party testing oversight

provided by Prof. James Li of Ryerson University in Toronto. The laboratory set-up used a single cartridge fitted into a tank sized to be 1/7 the volume of a full-scale 7-cartridge Jellyfish filter system. Based on the lab test results:

- A Jellyfish filter system fitted with a single Jellyfish cartridge or multiple Jellyfish cartridges can remove greater than 86% Sil-Co-Sil 106 (mean particle size 22 microns) within a 95% confidence interval of +/- 1.3% at the system's 100% operating rate with influent sediment concentrations ranging from 100 to 300 mg/L. For systems using 12-inch diameter cartridges, each cartridge containing 91filtration tentacles of 54-inch length, the 100% operating rate is 50 gpm per cartridge operating at 12 inches driving head (i.e., 0.66 gpm/ft^2). Each (of the) 91 filtration tentacles is composed of three 18-inch long segments for a total length of 54 inches with 76 ft^2 of surface area.

- Test runs at 100 mg/L gave effluent concentrations consistently below 20 mg/L (10 of 11 test runs) as required by Basic Treatment ranging from 12 to 21 mg/L.

- Sampling of effluent found an average D90 of about 14 microns indicating the Jellyfish Filter System is capable of removing most particles above 15 microns.

(2)- Jellyfish Filter Performance - NJCAT review of the test results highlighted some of the key differences between a commercial full-scale Jellyfish filter system and the single-cartridge laboratory system. These differences would generally result in underestimation of the system performance based on the laboratory testing. However, other factors exist in the field that could potentially lead to under-performance of Jellyfish Filter system relative to the system tested in the laboratory. Below are the factors affecting the system performance.

Key differences between laboratory testing and field application:

- The inlet pipe in the single-cartridge system in the lab is centered, rather than tangential. The incoming flow is directed downward toward the tank floor by the inlet weir, rather than channeled around the vessel's perimeter. As a result, the laboratory system configuration likely has less pre-settling of sediment and more of a tendency for upwelling and re-suspension of sediment.

- The single-cartridge test system has only 2 inches of sump beneath the bottom of the tentacles instead of the full-scale 2 feet of sump; unfavorable for settling and re-suspension.

- The circular 6-inch deep backwash pool above the cartridge head contains a filtered water volume of 15.5 liters (4.1 gallons) in the single-cartridge system in the lab, compared to 24 liters (6.3 gallons) per cartridge in the full-scale system. The higher backwash volume per cartridge in the full-scale system should provide a more effective self-cleaning mechanism.

- However, the laboratory small-scale system cross-sectional area per cartridge is slightly higher than it would be in a full-scale system, which favors lab settling. The hydraulic loading rate is 7.1 gpm/ft^2 in the laboratory system and 11.5 gpm/ft^2 for the full-scale system.

Considering all the above points, the single-cartridge laboratory system provided a reasonable set-up for adequately assessing the Jellyfish filter system performance characteristics.

Factors potentially causing under-performance in the field:

- Dissolved/emulsified oil may be transported below the separator skirt and contaminate the filter media and potentially cause adherence of sediment to the membrane making the backwash feature less effective.

- Oil contamination in sediment will make it more cohesive and more difficult to remove with the automatic backwash compared to the clean silica-based laboratory test sediment.

(3)- Cleaning and Maintenance of the Jellyfish Filter System - The Jellyfish system is designed with self-cleaning features that remove accumulated sediment from the filtration tentacles and extend cartridge service life. Three self-cleaning mechanisms are employed: Gravity; Tentacle motion, vibration, and collision; and Backwashing.

Experimental results support the finding that a Jellyfish system fitted with 12-inch diameter Jellyfish cartridges, each with 91 filtration tentacles of 54-inch length, and when sized according to the Jellyfish System sizing illustration table (above), will treat a minimum sediment mass of 25 pounds and 68 pounds, respectively, for each draindown and standard cartridge before requiring maintenance for pollutant removal and cartridge replacement or manual cartridge backwashing. In typical installations, a minimum maintenance interval would be one year.

Other Jellyfish™ Filter Related Issues to be Addressed By the Company:

1. The system should be tested under normal operating conditions, such that the settling basin is partially filled with pollutants. Results obtained for "clean" systems may not be representative of typical performance.

2. Field testing should be conducted at sites that are indicative of the treatment goals.

3. Testing should be conducted to obtain information about maintenance requirements in order to come up with a maintenance cycle.

4. Loading tests should be conducted on the filter to determine maximum treatment life of the system.

The company will also conduct the tests below concurrent with field testing in pursuit of the GULD:

5. Evaluation of the effectiveness of the skirt in retaining floatables, and minimizing their entry into the filter chamber. As with any filtration system, a relevant concern is the blinding of the

filter surface particularly by neutrally buoyant litter such as plastic bags. Testing is best conducted in the laboratory.

6. Evaluation of the effect of total petroleum hydrocarbons (TPH) with respect to its potential to blind the filter surface. For most applications TPH concentrations in stormwater are relatively low. Furthermore, as most of the TPH is bound to sediments, little of the TPH is in free solution with the potential to blind the membrane. Nonetheless evaluation of the potential for TPH blinding is warranted. Testing is best conducted in the laboratory

7. Evaluation of the potential for blinding of the membrane surface by bacteria growth. As with any filtration system, a relevant concern is the blinding of the filter surface by the growth of bacteria, particularly systems in which the filter is permanently submerged in water or if placed in a vault where drying between storms is problematic. Testing is best conducted in the laboratory at concentrations of dissolved organic carbon (DOC) generally observed in stormwater.

Technology Description: Download at: www.imbriumsystems.com

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