



January 2013

**CONDITIONAL USE LEVEL DESIGNATION FOR BASIC TREATMENT
And
PILOT USE LEVEL DESIGNATION FOR PHOSPHORUS AND OIL
TREATMENT
For
Imbrium Systems Jellyfish® Filter**

Ecology's Decision:

1. Based on Imbrium Systems Corporation's application submissions, Ecology hereby issues:

- Conditional use level designation (CULD) for the Imbrium's Jellyfish Filter as a basic treatment device for total suspended solids (TSS) removal
- Pilot use level designation (PULD) for phosphorus removal and oil treatment.
- Size Jellyfish Filter units in accordance with the company guidelines submitted to Ecology (Dated April 27, 2012). Imbrium Systems bases sizing on flow rate and sediment load, according to Tables 1 and 2.

2. The table below illustrates the hydraulic and sediment load capacities associated with various Jellyfish filter cartridges.

Table 1. Jellyfish cartridge hydraulic loading rates and sediment capture capacity.

Cartridge Length	Design Treatment Flow Rate	Design Sediment Mass Loading Capacity
15 inches	Hi-Flo 22 gpm	Hi-Flo 35 lbs
	Draindown 11 gpm	Draindown 17 lbs
27 inches	Hi-Flo 40 gpm	Hi-Flo 63 lbs
	Draindown 20 gpm	Draindown 31 lbs
40 inches	Hi-Flo 60 gpm	Hi-Flo 93 lbs
	Draindown 30 gpm	Draindown 46 lbs
54 inches	Hi-Flo 80 gpm	Hi-Flo 125 lbs
	Draindown 40 gpm	Draindown 63 lbs

Table 2. System sizing illustration

Manhole Diameter (ft / m)	Model No.	Hi-Flo Cartridges ¹ 54 in / 1372 mm	Draindown Cartridges ¹ 54 in / 1372 mm	Treatment Flow Rate (gpm / cfs)	Treatment Flow Rate (L/s)
Catch Basin		varies	varies	varies	varies
4 / 1.2	JF4-2-1	2	1	200 / 0.45	12.6
6 / 1.8	JF6-3-1	3	1	280 / 0.62	17.
	JF6-4-1	4	1	360 / 0.80	22.7
	JF6-5-1	5	1	440 / 0.98	27.8
	JF6-6-1	6	1	520 / 1.16	32.8
8 / 2.4	JF8-6-2	6	2	560 / 1.25	35.3
	JF8-7-2	7	2	640 / 1.43	40.4
	JF8-8-2	8	2	720 / 1.60	45.4
	JF8-9-2	9	2	800 / 1.78	50.5
	JF8-10-2	10	2	880 / 1.96	55.5
10 / 3.0	JF10-11-3	11	3	1000 / 2.23	63.1
	JF10-12-3	12	3	1080 / 2.41	68.1
	JF10-12-4	12	4	1120 / 2.50	70.7
	JF10-13-4	13	4	1200 / 2.67	75.7
	JF10-14-4	14	4	1280 / 2.85	80.8
	JF10-15-4	15	4	1360 / 3.03	85.8
	JF10-16-4	16	4	1440 / 3.21	90.8
	JF10-17-4	17	4	1520 / 3.39	95.9
	JF10-18-4	18	4	1600 / 3.56	100.9
	JF10-19-4	19	4	1720 / 3.83	108.5

Manhole Diameter (ft / m)	Model No.	Hi-Flo Cartridges ¹ 54 in / 1372 mm	Draindown Cartridges ¹ 54 in / 1372 mm	Treatment Flow Rate (gpm / cfs)	Treatment Flow Rate (L/s)
12 / 3.6	JF12-20-5	20	5	1800 / 4.01	113.6
	JF12-21-5	21	5	1880 / 4.19	118.6
	JF12-22-5	22	5	1960 / 4.37	123.7
	JF12-23-5	23	5	2040 / 4.54	128.7
	JF12-24-5	24	5	2120 / 4.72	133.8
	JF12-25-5	25	5	2200 / 4.90	138.8
	JF12-26-5	26	5	2280 / 5.08	143.8
	JF12-27-5	27	5	2360 / 5.26	148.9
Vault		varies	varies	varies	varies

1. Shorter length cartridge configurations are available. See Table 1.

3. Ecology approves Jellyfish Filter units for treatment at the hydraulic loading rates shown in Table 1, to achieve the maximum water quality design flow rate. Calculate the water quality design flow rates using the following procedures:

- Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
- Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
- Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

4. The use level designations expire on June 30, 2015 unless Ecology extends the date, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Jellyfish Filter units shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain Jellyfish Filter units in accordance with Imbrium Systems' applicable manuals and documents and the Ecology Decision.
2. Imbrium uses sediment-loading capacity, in conjunction with the water quality design flow rate, to determine the target maintenance interval.

3. Imbrium Systems commits to submitting a QAPP for Ecology review and approval by March 31, 2014 that meets the TAPE requirements for attaining a GULD for basic, phosphorus, and oil treatment. Ecology must review and approve QAPPs for each field site (maximum of five sites) in Washington State. The selected sites should reflect 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 any pilot use level installation.
5. Imbrium Systems shall complete all required testing and submit a TER for Ecology review by July 31, 2015.
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 SW Corbett Avenue
Portland, OR 97239

Application Documents:

- Application Letter for CULD for Jellyfish Filter - Basic Treatment, Phosphorus Treatment, and Oil Treatment, dated April 27, 2012.
- Letter from Imbrium Systems dated September 4, 2012 regarding the draft CULD/PULD document.
- *TAPE Analysis of Jellyfish Filter UF Field Study Data*, prepared by Stormwater Management Services, LLC.
- *TARP Field Test Performance Monitoring of a Jellyfish Filter JF4-2-1. Performance Monitoring Report for JF4-2-1* Prepared By: University of Florida, Engineering School of Sustainable Infrastructure and Environment (ESSIE), University of Florida, Gainesville, FL 32611. Final Version: 01 November 2011.
- *Jellyfish Filter Systems Evaluation Report in Consideration for Pilot Level Designation (PLD) for Imbrium Systems Corporation*, by Gary R. Minton, PhD, PE, with Resource Planning Associates in Seattle, Washington May 7, 2008 (updated July 1, 2008).
- *NJCAT Technology Verification, Jellyfish Fine Sediment Filter*, by the New Jersey Corporation for Advanced Technology (NJCAT) Program Imbrium Systems Corporation, June 2008

Applicant's Use Level Request:

- General use level designation as a basic, phosphorus, and oil treatment device in accordance with Ecology's 2011 *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE)* Table 2.

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 capable of removing most particles above 15 microns. This suggests the high likelihood that field studies will demonstrate the technology can meet the goal of Basic Treatment.
- Data collected for 25 storm events during third-party field monitoring of the Jellyfish Filter at the University of Florida demonstrated median Total Phosphorus removal efficiency of 59%. These field monitoring results suggest the Jellyfish Filter can likely meet Ecology's goal for Phosphorus Treatment.
- Data collected for 25 storm events during third-party field monitoring of the Jellyfish Filter at the University of Florida demonstrated median Oil and Grease removal efficiency of 62%, despite median influent Oil and Grease concentration less than 1 mg/L. These field monitoring results suggest the Jellyfish Filter can likely meet Ecology's goal for Oil Treatment.

Recommendations:

Ecology finds that:

- Imbrium Systems qualifies for the opportunity to demonstrate, through field-testing in the Pacific Northwest, whether the Jellyfish Filter can attain Ecology's basic, phosphorus, and oil treatment goals.

Findings of Fact:

1. Laboratory Testing and Results – Imbrium conducted testing 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 91 filtration 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/ft²). Each (of the) 91 filtration tentacles is composed of three 18-inch long segments for a total length of 54 inches with 76 ft² of surface area (first generation membrane filtration cartridges).

- Test runs at 100 mg/L influent concentration resulted in effluent concentrations ranging from 12 to 21 mg/L. Ten of the 11 test runs had effluent less than 20 mg/L (as required for Basic Treatment).
 - 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. Field Testing Results (second-generation membrane filtration cartridges) – University of Florida (Gainesville, FL) installed and tested a Jellyfish JF4-2-1. The University conducted monitoring of the system from May 28, 2010 to June 27, 2011, with runoff from 15.01 inches of rainfall. The monitoring followed the Technology Acceptance Reciprocity Partnership (TARP) field test protocol, per the guidelines of the New Jersey Department of Environmental Protection (NJDEP). The New Jersey Corporation for Advanced Technology (NJCAT), on May 14, 2012 certified the Jellyfish Filter for 80 percent TSS removal.
- The JF4-2-1 operating at a maximum treatment flow rate of 200 gpm provided a median total suspended solids (TSS) removal of 89 percent, and a median suspended sediment concentration (SSC) removal of 99 percent. Influent TSS concentrations ranged from 16.3 to 261.0 mg/L. TSS concentrations in the range of 20-100 mg/L were reduced to less than 20 mg/L for 16 of 17 events. Average TSS removal for influent TSS between 100-200 mg/L was 90 percent.
 - Other median pollutant removals included: total phosphorus, 59 percent; total nitrogen, 51 percent; total copper, 90 percent; and total zinc 70 percent.
 - Total oil and grease influent concentrations ranged from 0.2 to 4.1 mg/L, with a median removal efficiency of 62 percent.
 - No maintenance was required or carried out during the 13-month monitoring period. Curves of head loss versus flow rate were nearly identical for the system with fresh cartridges (beginning of monitoring) and dirty cartridges (end of monitoring period). The sump and filter cartridges captured 166 pounds of dry basis particulate matter.
 - Runoff treated by the JF4-2-1 was from a nearby parking lot (approximately 75 percent pavement and 25 percent planting islands). Depending on storm event intensity and wind direction, the drainage area varied from 0.12 to 0.20 acres.

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

1. Test the system under normal operating conditions, such that pollutants partially fill the settling basin. Results obtained for “clean” systems may not be representative of typical performance.
2. Conduct field-testing at sites that are indicative of the treatment goals.
3. Conduct testing to obtain information about maintenance requirements in order to come up with a maintenance cycle.
4. Conduct loading tests on the filter to determine maximum treatment life of the system.

Technology Description: Download at: www.imbriumsystems.com

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Revision History

Date	Revision
August 2008	PULD granted
January 2012	PULD Extension granted
September 2012	CULD for Basic treatment; PULD for Oil and Phosphorus treatment.
January 2013	Modifications to format document in line with other Use Level Documents, Changes dates for QAPP, TER, and Expiration