Attachment 1

Manufactured Treatment Device (MTD) Registration

1. **Manufactured Treatment Device Name:** Kraken Stormwater Filtration Systems

2. **Company Name:** Bio Clean Environmental Services, Inc. a Forterra Company
   Mailing Address: 398 Via El Centro
   City: Oceanside
   State: CA, Zip: 92058

3. **Contact Name (**to whom questions should be addressed**):** Zachariha Kent
   Mailing Address: 398 Via El Centro
   City: Oceanside
   State: CA Zip: 92058
   Phone number: 760-433-7640 Cell Phone: 760-579-9752
   Fax number: 760-433-3176
   E-mail address: zach.kent@forterrabp.com
   Web address: http://www.biocleanenvironmental.com/

4. **Technology**
   Specific size/capacity of MTD assessed (include units):

   The Kraken KF-4-4 was tested at a hydraulic loading rate 8.5 gpm per cartridge.

   Range of drainage areas served by MTD (acres):

   The system is scalable from 0 to 20 plus acres. Can be used in both flow and volume based designs.

   Include sizing chart or describe sizing criteria:

Filter Models	Treatment Flow Rate (cfs)	Treatment Flow Rate (gpm)	Maximum Contributing Drainage Area (ac) (C= 1.0)	Maximum Contributing Drainage Area (ac) (C= 0.80)	Maximum Contributing Drainage Area (ac) (C= 0.60)
KF-2.5-4	0.15	68.22	0.76	0.95	1.27
KF-4-4	0.30	135.99	1.52	1.89	2.53
KF-4-6	0.46	204.20	2.28	2.84	3.79
KF-4-8	0.61	271.97	3.03	3.79	5.05
KF-8-8	0.91	407.96	4.55	5.68	7.58
KF-8-10	1.25	561.00	6.25	7.81	10.42
KF-8-12	1.48	662.88	7.39	9.23	12.31
KF-8-14	1.82	815.92	9.09	11.36	15.15
KF-8-16	2.16	968.96	10.80	13.49	17.99
KF-10-16	2.88	1292.10	14.40	17.99	23.99

See the above chart for sizing. The above sizing chart is based on Uniform Intensity Approach as detailed in the CASQA Stormwater BMP Handbook using the Rational Method. A uniform rainfall intensity of 0.20 in/hr was used to determine the maximum contributing drainage areas at different C values (1.0, 0.80 Commercial Development & 0.60 Detached Multi-Unit Residential).

Intended application: on-line or offline:

NJDEP Online approved. Can also be used offline.

Media used (if applicable):

Reusable membrane filtration cartridges.

5. Warranty Information (describe, or provide web address)**:**

5 year warranty free of manufacture's defects. See Section D for Kraken Warranty.

http://www.biocleanenvironmental.com/

6. Treatment Type

☒ Hydrodynamic Structure
☒ Filtering Structure
☐ Manufactured Bioretention System
Provide Infiltration Rate (in/hr):
☐ Other (describe):

7. Water Quality Treatment Mechanisms (check all that apply)

☒ Sedimentation/settling
☐ Infiltration
☒ Filtration (specify filter media) Membrane Filtration
☐ Adsorption/cation exchange
☐ Chelating/precipitation
☐ Chemical treatment
☐ Biological uptake
☐ Other (describe):

8. Performance Testing and Certification (check all that apply):

Performance Claim (include removal efficiencies for treated pollutants, flow criteria, drainage area):

NJCAT - Average TSS Removal Rate of 89% with maximum removal rate of 98% at treatment flow rate based on a verified loading rate of 8.5 gpm per cartridge. NJCAT verified and NJDEP approved. See Section E for NJCAT Technology Verification for more information.

WA TAPE - Average TSS Removal Rate of 85% and 72% total phosphorus removal based on a verified loading rate of 8.5 gpm per cartridge. TAPE approved. See Section F for TAPE Technology Verification for more information.

Specific size/Capacity of MTD assessed:

KF-4-4 (for both NJCAT and TAPE) which is 4'x4' ID / treatment flow of 0.303 cfs.

Has the MTD been "approved" by an established granting agency, e.g. New Jersey Department of Environmental Protection (NJDEP) , Washington State Department of Ecology, etc.

☐ **No**

☒ **Yes**; For each approval, indicate (1) the granting agency, (2) use level if awarded (3) the protocol version under which performance testing occurred (if applicable), and (4) the date of award, and attach award letter.

- WA TAPE – completed all field testing and met protocol requirements – CULD for TSS and phosphorus – September 2017
- NJCAT Verification February 2016
- NJDEP Approval June 2, 2016

Was an established testing protocol followed?

☐ **No**

☒ **Yes**, (1) Provide name of testing protocol followed, (2) list any protocol deviations: NJCAT and TAPE

Provide the information below and provide a performance report (attached report):

For lab tests (See Section E for NJCAT Technology Verification Report):

i. Summarize the specific settings for each test run (flow rates, run times, loading rates) and performance for each run:

Effluent grab sampling was performed 5 times per run (33 runs) with each run lasting 45 minutes followed by a draindown period. Testing was completed at a flow rate of 0.303 cfs and a target sediment concentration of 200 mg/L. Loading rate = 8.5 gpm per cartridge.

ii. If a synthetic sediment product was used, include information about the particle size distribution of the test material:

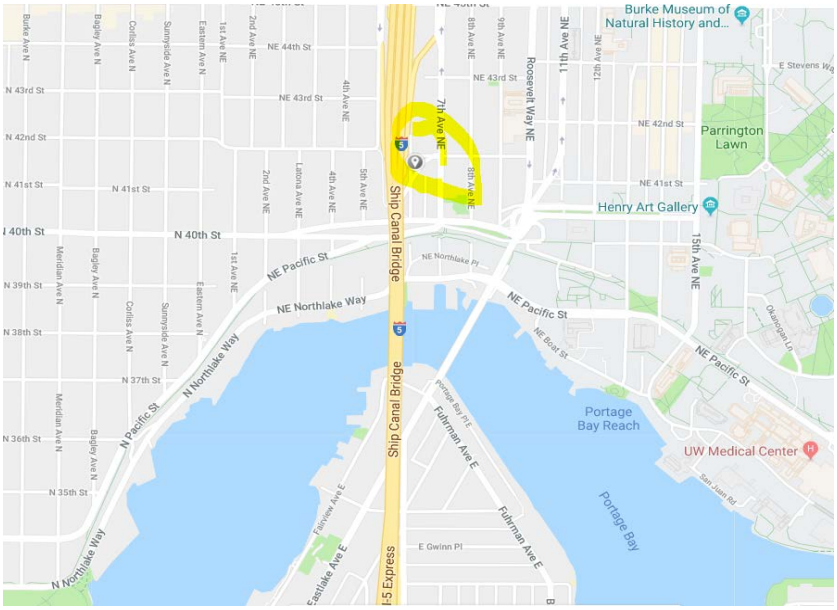
The test sediment used was a blend of two commercially available silica sediments. The blended test sediment was found to have a d50 of 52 micron with particle sizes varying between 2 and 1000 micron.

iii. If less than full-scale setup was tested, describe the ratio of that tested to the full-scale MTD:

A full scale KF-4-4 was used which is a commercially available model.

For field tests:

i. Provide the address, average annual rainfall and characterized rainfall pattern, and the average annual number of storms for the field-test location:
The SCTF is located in Seattle, Washington below the Interstate 5 right-of-way on the north side of the Lake Union Ship Canal Bridge (Figure 5).



Avg. Event Duration – 14.6 hours, Avg. Event Intensity – 0.04 in/hr
Avg. Runoff – 0.48 in, Avg. Period Between Events – 121 hours
(Minton. 2011. Stormwater Treatment, Third Edition)

ii. Provide the total contributing drainage area for the test site, percent of impervious area in the drainage area, and percentages of land uses within the drainage area (acres):

The drainage basin to the facility is approximately 31.6 acres, with 22.7 acres of

pavement and 8.9 acres of roadside landscaping. The WSDOT stormwater collection system for this drainage basin is separate from the City of Seattle's system; and collects runoff from the Interstate 5 northbound, southbound, express lanes, and the on- and off-ramps. All runoff in the drainage basin passes through 15 Type 1 and 53 Type 2 catch basins and is then consolidated in a 30 inch pipe that is routed to the facility.

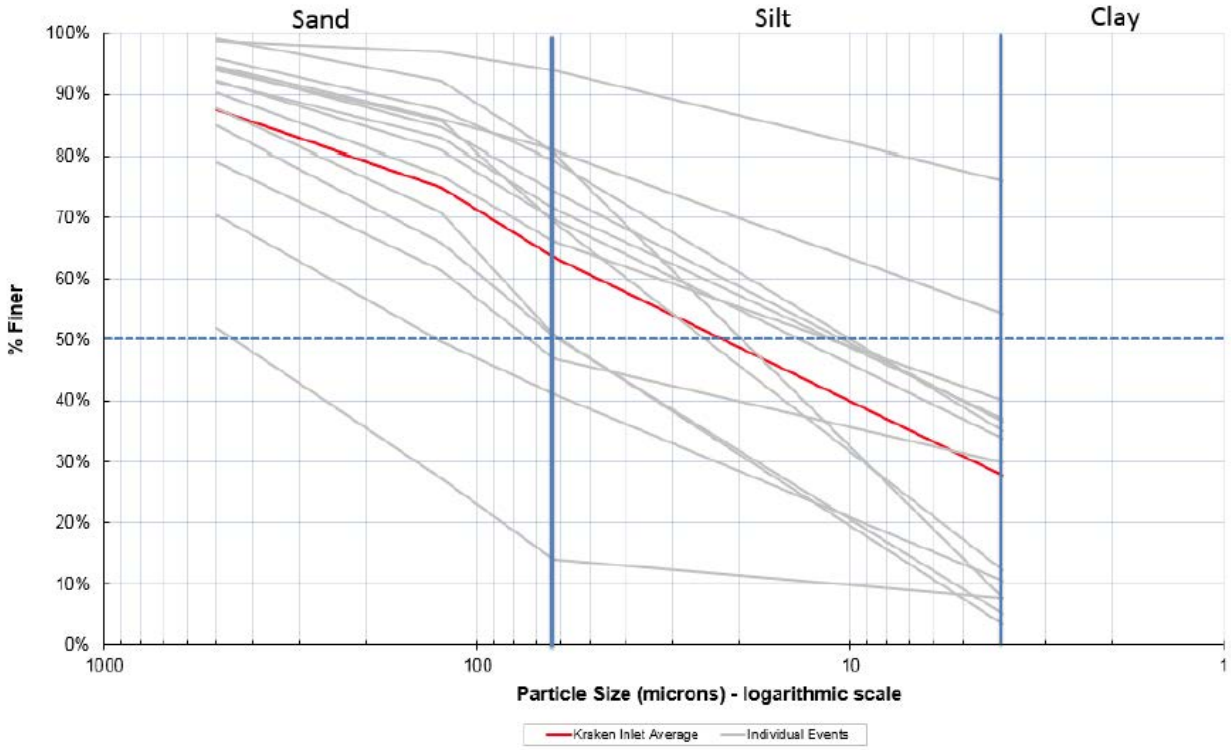
iii. Describe pretreatment, bypass conditions, or other special circumstances at the test site:

WSDOT constructed the SCTF to allow the simultaneous testing of up to four stormwater treatment technologies. This is accomplished by diverting stormwater flow from the 30 inch pipe to the site using a "draw-bridge" half-pipe structure and a series of flow splitters. First, flow from the draw bridge enters an adjustable flow splitter that diverts water toward test bays 1 and 2 on one side, and toward test bays 3 and 4 on the other side (Figure 6). On each side, the divided water then enters a second flow splitter that further divides the flow such that each of the four test bays can be used independently. Flow to each test bay can be further controlled through the use of a gate valve located at the inflow to each test bay. To fine tune the flow into each the test bay even further, a bypass valve is installed immediately upstream of the influent pipe to each system being tested. This bypass valve can divert water around the individual systems without changing the flow rate into the neighboring systems (Appendix A).

iv. Provide the number of storms monitored and describe the monitored storm events (amount of precipitation, duration, etc.): A total of 14 storm events were monitored with total storm depths between 0.19 to 2.91 inches. Durations ranged from 2 hours to 47.2 hours. This information can be found in Section F.

v. Describe whether or not monitoring examined seasonal variation in MTD performance: Monitoring occurred from October to April and did look at seasonal variation. There did not appear to be any variation in performance due to seasons.

vi. If particle size distribution was determined for monitored runoff and/or sediment collected by the MTD, provide this information: Yes, PSD analysis was done and is provided in the following chart. An analysis was done for each event and the average mean D50 was 21 microns.



9. MTD History:

How long has this specific model/design been on the market?

The Kraken Filter along with all available models has been on the market since 2015.

List no more than three locations where the assessed model size(s) has/have been installed in Virginia. If applicable, provide permitting authority. If known, provide latitude & longitude:

Currently, there are no Kraken Filters installed in Virginia, thus approval is being sought. We have installations in CA, SC, TN, NJ, WA, UT, CO and MN.

List no more than three locations where the assessed model size(s) has/have been installed outside of Virginia. If applicable, provide permitting authority. If known, provide latitude & longitude:

1. City of Denver. 2000 West 3rd Ave. Denver, CO 80223
2. City of Nashville. 3205 Whites Creek Pike, Nashville, TN 37207
3. City of Seattle. North side of the Lake Union Ship Canal Bridge.

The Kraken Filter has been installed in the State of Washington. Upcoming installations already specified in California, Tennessee, New Jersey among others.

10. Maintenance:

What is the generic inspection and maintenance plan/procedure? (attach necessary documents):

Maintenance requirements will vary depending on pollutant loading and individual site conditions. It is recommended that the system be inspected at least twice a year the first year to determine loading conditions. These findings should be used to establish inspection and maintenance frequency. Pretreatment chamber maintenance is achieved by opening the access hatch/manhole and, using an extension on a vacuum truck, lower the hose into the sedimentation chambers to remove all floating debris, standing water, and sediment. If maintenance is required on the cartridges, follow confined space procedures and enter the vault. Each cartridge is pressure fitted in place with handles for easy removal. Simply grab the handle and pull up. Remove cartridges from the vault and place in a large garbage can and hosed off with a standard garden hose with a low pressure nozzle. Each filter chamber should be power washed prior to reinstallation of the cartridges. Then each cartridge can be reinstalled by hand, pressing the cartridge down onto its coupler. This concludes maintenance and the vault can be closed up. See Section F for Operation and Maintenance Manuel for more information.

Is there a maintenance track record/history that can be documented?

☐ No, no track record.
☒ Yes, track record exists; (provide maintenance track record, location, and sizing of three to five MTDs installed in Virginia [preferred] or elsewhere): Maintenance records currently being collected and compiled and will be submitted at a later time.

Recognizing that maintenance is an integral function of the MTD, provide the following: amount of runoff treated, the water quality of the runoff, and what is the expected maintenance frequency for this MTD in Virginia, per year?

The Kraken Filter was tested under the latest NJDEP protocol. Loading is part the protocol and a maintenance duration is applied to the BMP. The Kraken filter exceeded the NJ CAT protocol for being able to treat in excess of 600 of pounds of sediment per acre per year. Based on the results of the NJDEP testing and protocol requirements the Kraken Filter is expected to last 1.5 years before maintenance is required. It should be noted that during the NJDEP testing the system never lost flow capacity or went into bypass. Observation of the flow through the system indicated that the system would continue to operate at full flow capacity and thus actual maintenance intervals may be much longer than 1.5 years.

Total life expectancy of MTD when properly operated in Virginia and, if relevant, life expectancy of media:

The Kraken Filter, its structure and components is designed to have a user life of 50 plus years. Since the Kraken Filter is a membrane filter as opposed to a granular media

cartridge, the life of the membrane itself is more than 5 years. The Kraken Filter cartridge can be washed and reused multiple times.

For media or amendments functioning based on cation exchange or adsorption, how long will the media last before breakthrough (indicator capacity is nearly reached) occurs?

The Kraken Filter uses membrane filtration therefore this is not applicable.

For media or amendments functioning based on cation exchange or adsorption, how has the longevity of the media or amendments been quantified prior to breakthrough (attach necessary performance data or documents)?

N/A

Is the maintenance procedure and/or are materials/components proprietary?
☐ Yes, proprietary
☒ No, not proprietary

Maintenance complexity (check all that apply):
☒ Confined space training required for maintenance (if cartridge maintenance is needed)
☒ Liquid pumping and transportation
Specify method: Vacuum Truck
☒ Solids removal and disposal
Specify method:

Vacuum truck

Other noteworthy maintenance parameter (describe):

Wash and reuse cartridges. No equipment needed to remove cartridge. Less than 30 pounds each and can be removed by hand.

11. Comments

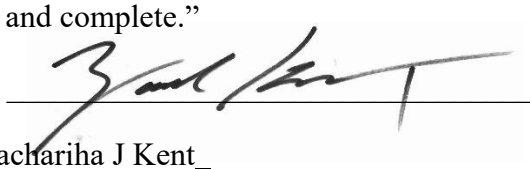
Include any additional explanations or comments:

The Kraken Filter is available in various configurations including grate and curbed inlet configurations. It can also be installed up or downstream of detention systems and utilize a flow or volume based sizing approach.

12. Certification

Signed by the company president or responsible officer of the organization:

"I certify that all information submitted is to the best of my knowledge and belief true, accurate, and complete."

Signature: 

Name: _Zachariha J Kent_____

Title: _VP of Product Development and Regulatory Compliance_____

Date: _2/25/2019_____

NOTE: All information submitted to the department will be made publically accessible to all interested parties. This MTD registration form will be posted on the Virginia Stormwater BMP Clearinghouse website.