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VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Kraken® Membrane Filtration System

Contech Engineered Solutions LLC
Oceanside, CA, USA

Registration: GPS-ETV_VR2022-06-30

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

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June 30, 2022
Vancouver, BC, Canada

Verification Body
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Verification Overview

This Environmental Technology Verification (ETV) of the Kraken™ Filter is the second part of a two-part verification process and entails the verification of performance claims based on field testing data collected in accordance with The Washington State Department of Ecology emerging stormwater treatment technologies, in accordance with guidelines identified by Ecology (2011) in the Technology Assessment Protocol – Ecology (TAPE). This complements the first part of the verification completed in March 2019 which verifies performance test data collected in accordance with the New Jersey Department of Environmental Protection (NJDEP) *Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device (January 2013)*.

Technology description and application

The Kraken™ Filter is an engineered storm water quality treatment device utilizing a reusable membrane filter designed to remove high levels of TSS, hydrocarbons, particulate metals and nutrients found in contaminated storm water. Each filter contains a large surface area which is designed to deal with high TSS and particulate concentrations. The large surface area of each filter allows it to operate at a loading rate from one fifth to one twentieth the loading rate of other media filtration devices to improve longevity. The Kraken™ Filter is different from other membrane filters in that it has separation chambers that are utilized as a form of pre-treatment for floatables, oils, coarser sediments and other suspended particulates. By filtering out the coarser material prior to reaching the membrane filters, the efficiency of the unit is increased and maintenance requirements reduced.

Once the water exits the pre-treatment chamber, it passes through the filter chamber orifices and into the filtration chambers where the membrane filters are located. The membrane filters are used to filter out finer micron sediments and associated contaminants. The Kraken™ Filter is a unique design in that the filter's efficiency is controlled by an internal riser tube so the filters will only begin to process and discharge once the water level has reached to the top of the filter column, close to the maximum hydraulic grade line (HGL) in the filtration chamber. The riser tubes also control the flow rate to a level substantially less than the flow capacity of the membrane filters. This creates a built-in safety factor to ensure longevity of the system's treatment capacity. It also helps to guard against clogging by ensuring the sediment loading is evenly distributed along the full height of the cartridge. Each filter chamber also includes one drain down cartridge which has an additional small drain orifice at the bottom of the tube to allow the chambers to drain dry after each storm event.

Since the standard cartridges have risers, there is no positive pressure on the influent side of the filter membrane during the drain down period, thereby allowing sediment which has accumulated on the surface of the membrane to be flushed off. This prevents biofouling of the filter material by eliminating the anaerobic environment associated with bacteria growth that can occur on the material.

Figures 1 and 2 show cut-away views of the system's pre-treatment, filtration and discharge chambers. The pre-treatment chamber is portioned into primary and secondary separation chambers divided by a baffle wall. The second separation chamber contains a floatables/oil baffle wall that extends upward. This wall directs water to pass underneath it, thereby trapping floatables and free floating hydrocarbons. After water passes under the floatables/oil baffle walls, it travels upward to the filter chamber orifices and enters the filter chambers.

The Kraken™ Filter also offers an optional internal bypass weir. The bypass weir is located at the effluent end of the secondary pre-treatment chamber and allows runoff to pass directly from pre-treatment chamber to discharge chamber without passing through the filtration chambers. Water will pass over the weir once incoming flow exceeds the system's treatment capacity. This prevents scouring of fine sediment

captured in the filtration chambers. The Kraken™ Filter can also be used without the internal bypass feature in a traditional setup using an external flow splitter/diversion weir structure. In this configuration the internal bypass weir is not present in the system.

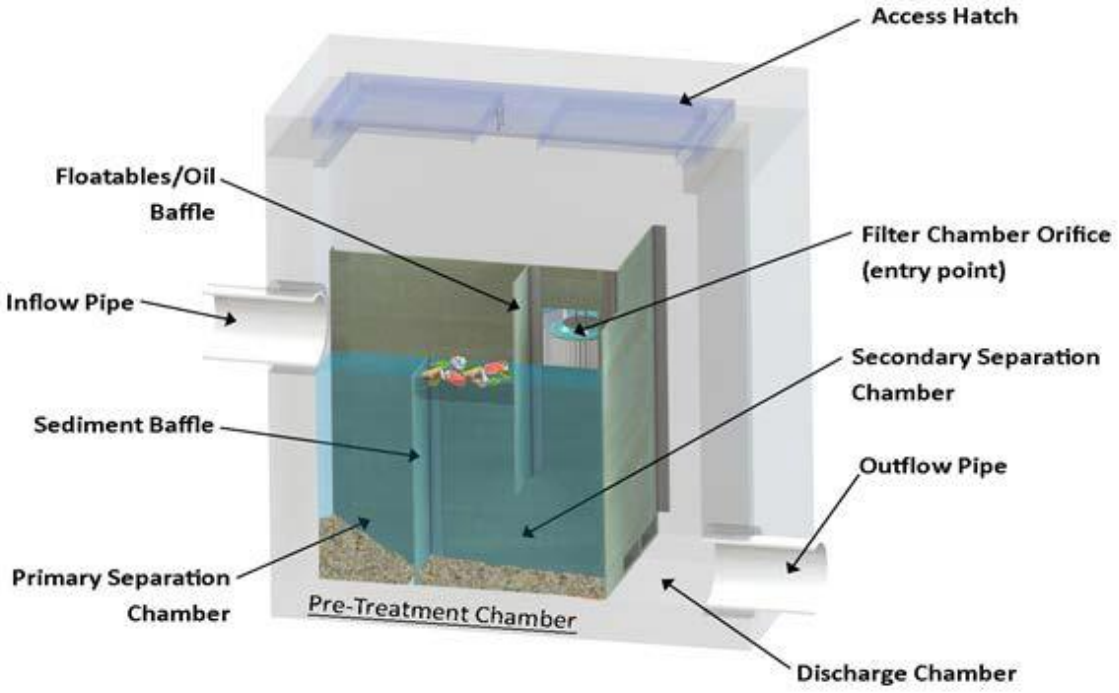

Figure 1: Kraken™ Design

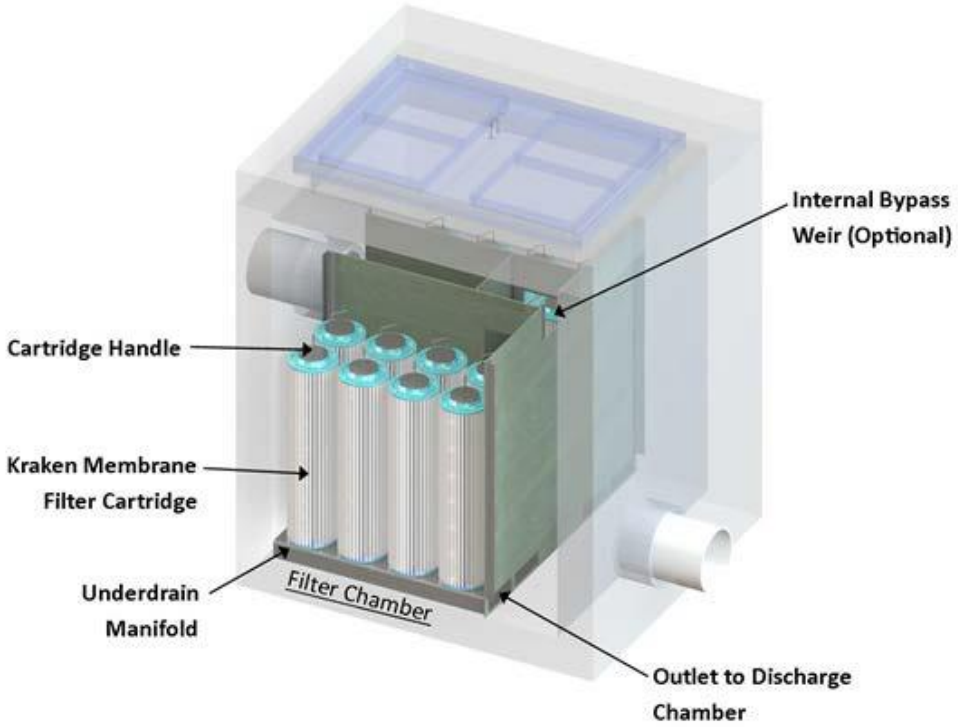

Figure 2: Kraken™ Design

Performance conditions

The data and results published were obtained by a field based testing program conducted on a Kraken Filter Model KF-4. The test program was conducted by Herrera Environmental Consultants Inc. (Herrera), an independent water technology testing organization, at the Washington State Department of Transportation (WSDOT) Test Facility, Seattle, Washington, at the Lake Union Ship Canal Bridge. Testing was conducted under The Washington State Department of Ecology (Ecology) emerging stormwater treatment technologies, in accordance with guidelines identified by Ecology (2011) in the Technology Assessment Protocol – Ecology (TAPE). Herrera was responsible for developing and implementing a quality assurance project plan (QAPP) for this project, with oversight from Bio Clean, WSDOT, and Ecology. Required laboratory services for this project will be provided by Analytical Resources Inc.

Performance claim(s)

Performance Claim 6 (TAPE)

During independent third party field testing under the Washington State TAPE Protocol (2011), which was composed of 12 qualifying storm events, the Kraken Filter removed 85% of TSS based on the bootstrapped 95 percent confidence interval (LCL95). This performance was shown for sample pairs across a range of treated flow rates up to and including the design flow rate of 8.5 gpm for a standard height cartridge. This performance claim was verified statistically at a 95% level of confidence.

Performance Claim 7 (TAPE)

During independent third party field testing under the Washington State TAPE Protocol (2011), which was composed of 13 qualifying storm events, the Kraken Filter removed 67.4% of Total Phosphorus based on the bootstrapped 95 percent confidence interval (LCL95). This performance was shown for sample pairs across a range of treated flow rates up to and including the design flow rate of 8.5 gpm for a standard height cartridge. This performance claim was verified statistically at a 95% level of confidence.

Performance Claim 8 (TAPE)

During independent third party field testing under the Washington State TAPE Protocol (2011), which was composed of 13 qualifying storm events, the Kraken Filter removed 51% of Total Copper based on the bootstrapped 95 percent confidence interval (LCL95). This performance was shown for sample pairs across a range of treated flow rates up to and including the design flow rate of 8.5 gpm for a standard height cartridge. This performance claim was verified statistically at a 95% level of confidence.

Performance Claim 9 (TAPE)

During independent third party field testing under the Washington State TAPE Protocol (2011), which was composed of 13 qualifying storm events, the Kraken Filter removed 57% of Total Zinc based on the bootstrapped 95 percent confidence interval (LCL95). This performance was shown for sample pairs across a range of treated flow rates up to and including the design flow rate of 8.5 gpm for a standard height cartridge. This performance claim was verified statistically at a 95% level of confidence.

Performance results

Claim 6: Total Suspended Solids Percent Removal (12 Qualifying Storm Events)

Total Suspended Solids Percent Removal

Storm Event Date	Average Influent	Average Effluent	Percent Removal
06/10/2016	46	4.4	90%
14/11/2016	31	4	87%
02/12/2016	52	4	92%
09/12/2016	116	2	98%
17/01/2017	56	9	84%
03/02/2017	44	5	89%
08/02/2017	103	4	96%
14/02/2017	162	4	98%
17/03/2017	97	9	91%
23/03/2017	50	18	64%
06/04/2017	44	4	91%
10/04/2017	158	2	99%
Percent Removal			**85%**

Claim 7: Total Phosphorus Percent Removal (13 Qualifying Storm Events)

Total Phosphorus Percent Removal

Storm Event Date	Average Influent	Average Effluent	Percent Removal
06/10/2016	0.14	0.056	60%
14/11/2016	0.062	0.024	61%
02/12/2016	0.156	0.052	67%
09/12/2016	0.29	0.024	92%
17/01/2017	0.166	0.028	83%
03/02/2017	0.136	0.024	82%
08/02/2017	0.166	0.018	89%
14/02/2017	0.216	0.014	94%
17/03/2017	0.144	0.074	49%
23/03/2017	0.078	0.03	62%
29/03/2017	0.066	0.034	48%
06/04/2017	0.11	0.018	84%
10/04/2017	0.264	0.012	95%
Percent Removal			**67.4%**

Claim 8: Total Copper Percent Removal (13 Qualifying Storm Events)

Total Copper Percent Removal

Storm Event Date	Average Influent	Average Effluent	Percent Removal
06/10/2016	54.5	23.5	57%
14/11/2016	29.4	12.1	59%
02/12/2016	53.5	25.1	53%
09/12/2016	88.9	18.8	79%
17/01/2017	37.7	16.7	56%
03/02/2017	38.4	13.2	66%
08/02/2017	62.4	14.7	76%
14/02/2017	33.9	19.7	42%
17/03/2017	52	25.6	51%
23/03/2017	29	13.5	53%
29/03/2017	17.3	13.6	21%
06/04/2017	36.4	12.1	67%
10/04/2017	57.2	8.46	85%
Percent Removal			**51%**

Claim 9: Total Zinc Percent Removal (13 Qualifying Storm Events)

Total Zinc Percent Removal

Storm Event Date	Average Influent	Average Effluent	Percent Removal
06/10/2016	149	48.5	67%
14/11/2016	98.4	36.8	63%
02/12/2016	174	56.1	68%
09/12/2016	444	128	71%
17/01/2017	128	61.5	52%
03/02/2017	131	48.8	63%
08/02/2017	248	54.1	78%
14/02/2017	137	50.9	63%
17/03/2017	166	65	61%
23/03/2017	104	41	61%
29/03/2017	55.7	36.1	35%
06/04/2017	104	43.8	58%
10/04/2017	252	33	87%
Percent Removal			**57%**

Performance Claims were statistically analyzed and verified using the *mean* percent removal values for Claims 7, 8, 9, all of which utilized normally distributed data. The dataset for Claim 6 was not normally distributed, which required the use of the *median* of the data as a surrogate for the mean, in order to be verified statistically at a 95% level of confidence.

Verification

The verification was completed by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies ("CAWT"), contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental Management -- Environmental Technology Verification (ETV)***. Data and information were provided by the original developer of the technology, Bio Clean Environmental (since acquired by Contech Engineered Solutions), to support the performance claims and included the following: Performance test report prepared by Herrera Environmental Consulting Inc., Seattle, WA, and dated May, 2017. This report is based on field testing completed in accordance with The Washington State Department of Ecology emerging stormwater treatment technologies, in accordance with guidelines identified by Ecology (2011) in the Technology Assessment Protocol – Ecology (TAPE) and in compliance with the requirements of ISO/IEC 17025.

Updates noted

As part of the 2022 ETV renewal process, the following updates have been noted and accepted, and have been integrated into this revised Verification Statement:

1. Change in corporate ownership.
   On March 31, 2022, Contech® Engineered Solutions announced the merger of Bio Clean® product lines into its stormwater management product portfolio, including the Kraken® Filter. The move results from Contech's parent company, Quikrete Holdings, Inc., purchasing Forterra, Inc., the parent company of Bio Clean.

2. Modifications to the Kraken® Filter technology.
   At the time of publication of this Verification Statement (June 30, 2022), the following modifications to the technology were foreseen. These changes are not deemed to affect the original performance or performance claims of the technology.
   - *"Changing the rectangular under drain from metal to plastic"*
   - *"Changing the cartridge coupler from a pressure fit to quarter turn"*

3. Addition of new Kraken® Filter models that are covered by this ISO 14034/ETV Verification.
   This revision was completed to reflect the addition of three new round (manhole) Kraken Filter Models (KFR-4; KFR-6 & KFR-8) which are deemed to meet the scaling requirements for filters. Supporting documents submitted and reviewed within the parameters of the June 2022 ETV renewal included an independent assessment conducted by the New Jersey Department of Environmental Protection (NJDEP), which concluded that the aforementioned new models meet or exceed the NJDEP's requirements.

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Kraken® Membrane Filtration System please contact:

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