Technical Abstract
Downstream Defender®

Performance Verification of Oil and Grease Removal

The Downstream Defender® is a high efficiency advanced vortex separator used to intercept pollutants from urban runoff before they reach sensitive downstream waterways. Although the Downstream Defender® is primarily used to remove sediment from stormwater runoff, independent laboratory and field testing has shown that it is also very effective at capturing oils and grease. Tests conducted under simulated oil spill conditions showed that the Downstream Defender® maintains greater than 80% removal efficiency for a wide range of loading rates. Field testing on an urban mixed-use site showed effective control of oil and grease, limiting the average effluent concentration to 16 mg/L.

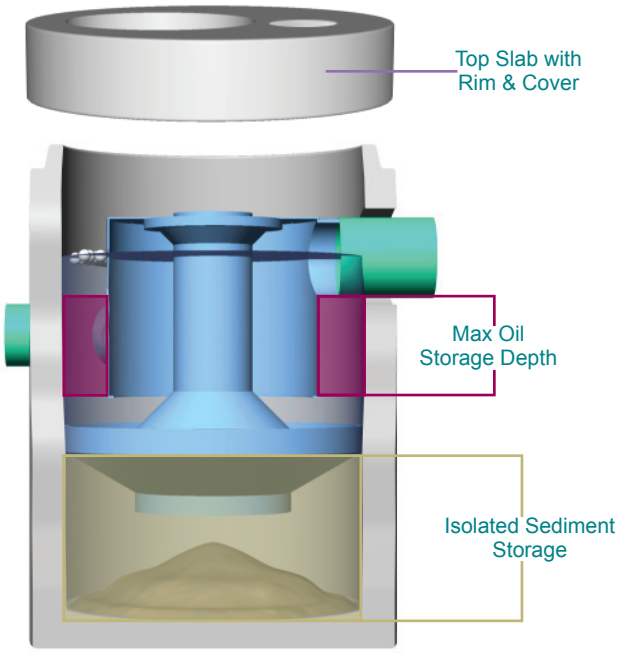

Fig.1 The pollutant storage zones of the Downstream Defender®.

Flow-modifying internal components (Fig.1) are not only critical for promoting separation of pollutants, they also ensure that the sediment and oil storage areas are protected, even at very high flow rates. The internal components keep pollutants such as sediment, oil, floating trash and debris from being washed out during the intense part of a storm. Without this protection, loss of pollutants would occur as they accumulate in the device between clean-outs.

Laboratory Oil Removal Efficiency Testing

An independent third-party laboratory study was conducted in 2000 by Coventry University's School of the Built Environment on a 4-ft Downstream Defender® (Pratt 2000)[1].

The test procedures were designed to simulate a spill event and to determine the efficiency at 6 constant flow rates, each having run durations of 20-27 minutes. The test pollutant was commercially available Shell motor oil. Five effluent samples were collected at each flow rate and analyzed with a Nicolet-250 Fourier Transfer InfraRed Spectrometer based upon ASTM D-3921-81.

Test results demonstrate greater than 80% removal efficiency for all tested flow rates (Fig.2). The results conclude that the Downstream Defender® is an effective device for removing oil in spill-like conditions.

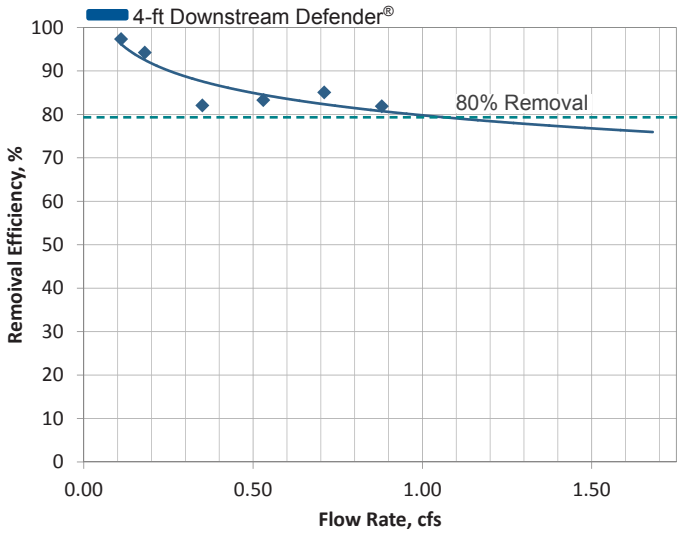

Fig.2 Measured oil removal efficiency of the 4-ft Downstream Defender®.

Effluent Control Field Monitoring

The National Hydraulic Research Institute of Malaysia (NAHRIM) led a field monitoring program in 2010 to evaluate water quality improvements of runoff from an urban, mixed-use site[2]. The field site, located in southern Malaysia, is known for high concentrations of oils, grease, trash and sediment. A variety of point and non-point source pollution is conveyed into a roadside open channel. The Downstream Defender® was retrofitted into the existing drainage network in an off-line configuration by in-

Downstream Defender®

stalling a weir wall in the channel and diverting untreated flows into the unit (Fig.3).

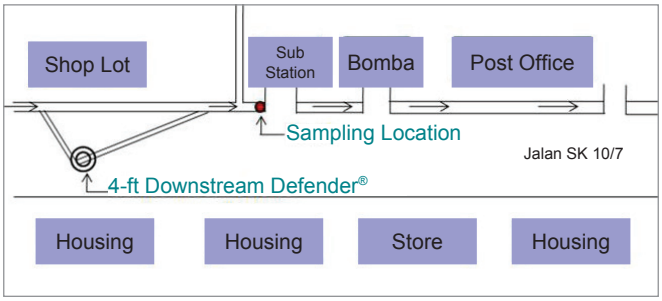

Fig.3 Schematic layout of Downstream Defender® installation showing sampling location.

Samples were collected prior to (Fig.4a) and following (Fig.4b) installation of a 4-ft diameter Downstream Defender® to determine its efficacy in removing and controlling oil and grease (O&G) found in a typical urban "hot spot". The post-installation effluent concentrations were compared with the pre-installation levels to ascertain device efficacy under varying influent concentrations typical of urban hot spots.

Fig.4(a) Pre-installation and (b) post-installation effluent in a storm trench where the 4-ft diameter Downstream Defender® was installed.

Eighteen "pre-installation and 12 "post-installation" samples were collected over the six-month monitoring period and analyzed for oil and grease by an independent accredited laboratory.

Field Monitoring Results

Post-installation conditions showed a significant drop in oil levels, with net O&G reduction > 89% when compared to pre-installation monitoring levels. More importantly, as shown in Fig.5, the average post-installation O&G effluent concentration was 16.2 mg/L, with a median of 13.0 mg/L. These results demonstrate consistent post-installation effluent O&G concentrations below 20 mg/L over the two-month monitoring period.

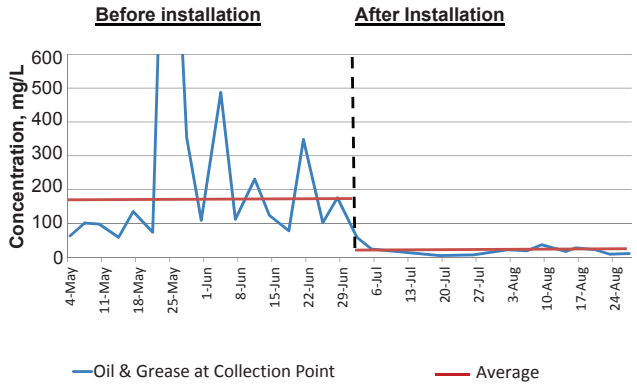

Fig.5 Oil & Grease concentrations before and after Downstream Defender® installation.

Downstream Defender® Sizing

There are 5 standard precast model sizes available, as shown in the table below. Treatment flow rates are based on test results using fine sediments. Listed oil storage capacities are the maximum volumes provided during operation. Larger oil storage volumes are possible. Contact Hydro International for more information.

Model Diameter	Oil Storage Volume	Max. Oil Clean Out Depth	Treatment Flow Rate for 80% TSS Removal of 106um Sediment	Peak Treatment Flow Rates
(ft)	(gal)	(in)	(cfs)	(cfs)
4	70	16	1.56	3.0
6	216	23	4.30	8.0
8	540	33	8.82	15.0
10	1,050	42	15.42	25.0
12	1,770	49	24.32	38.0

References

1. Pratt, C. et al. "Laboratory Tests Conducted in the School of The Built Environment, Coventry University, UK, on Downstream Defender for Hydro International plc., Clevedon, BS21 7RD". May - June 2000.

2. Research Centre For River Management, National Hydraulic Research Institute of Malaysia (NAHRIM). "Study On The Effectiveness Of The Downstream Defender, Serial no.: DD 2344". 20 November 2010.

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