Verification Statement

Hydro International DryScreen® Hydro Dynamic Separator
Registration number: (V-2025-01-01)
Date of issue: 2025-January-30

Technology type	Hydro Dynamic Separator	
Application	Technology to remove sediment, trash and debris from stormwater and snowmelt runoff as well as other pollutants that attach to sediment particles, such as nutrients and metals	
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Verified Performance Claims

The Hydro International DryScreen® Hydro Dynamic Separator (HDS) was tested by Verdantas LLC, Alden Flow Labs of Holden, Massachusetts, USA in 2024 following the test procedure outlined in the *Canadian Publicly Available Specification (PAS) for Testing and Verification of Oil and Grit Separators* (version June 2023).

The performance test results were verified by Toronto and Region Conservation Authority (TRCA), Vaughan, Ontario, Canada following the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol as outlined in the Hydro International DryScreen® Verification Plan (2024-06-17). The following performance claims were verified:

Capture test[1]:
With a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and an influent test sediment concentration of 200 mg/L, the Hydro DryScreen® HDS removes 64.3, 60.9, 54.8, 49.2, 42,7, 30.2 and 24.5 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Scour test[1]:
With 15.2 cm (6 inches) of test sediment pre-loaded mimicking 50% of the manufacturer's recommended maximum sediment storage depth, the Hydro DryScreen® HDS generates corrected effluent concentrations of 0.0, 0.0, 5.0, 8.2 and 3.6 mg/L at 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

[1] The claims can be applied to other units smaller or larger than the tested unit as long as the untested units meet the scaling rule specified in the Canadian PAS for Testing and Verification of OGS (version June 2023).

Technology Application

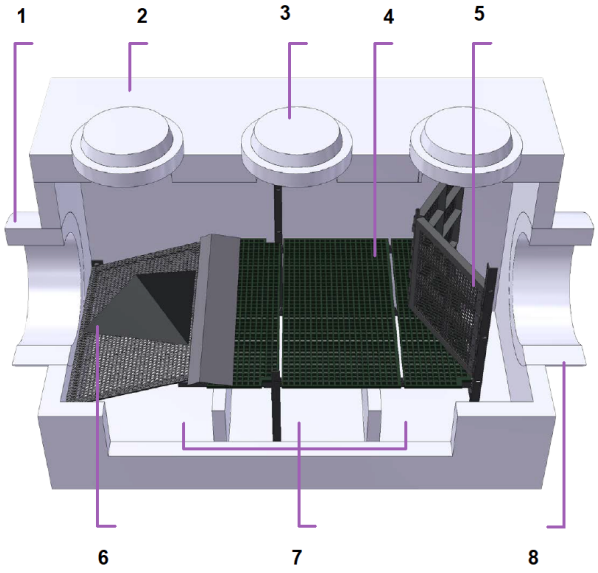
The Hydro DryScreen® HDS offers a compact treatment solution in places where pollutants sediment, trash, debris, and nutrients are of concern. Hydro DryScreen® is a gravity separation system that couples pretreated screening with enhanced baffle box sedimentation.[2] Hydro DryScreen® can be utilized in areas where high stormwater flow rates would exceed the capacity of round HDS units, there is a concern that trash and debris would impair the capability of other HDS systems, and/or there is a desire to prevent nutrient leaching in an HDS from organics captured by the device.

Technology Description

The Hydro DryScreen® is a next-generation baffle box Hydro Dynamic Separator (HDS) that captures sediment and screens trash and other solids. Organic materials are stored dry to prevent nutrient leaching between storm events. The Hydro DryScreen® HDS design includes a large, blinding-resistant screening capture area and utilizes a patented flow diffuser that evenly spreads debris across the entire treatment surface area.

Hydro DryScreen® operates on the principle of slowing stormwater velocity through screens and baffles, which allows solids to settle and deposit into a sump. As stormwater enters the Hydro DryScreen® chamber, the flow is dissipated and slowed by the flow diffuser. Gross solids (organics and trash) are conveyed around the diffuser and captured on the horizontal screen, where they are held dry. As stormwater encounters the first baffle wall, the velocity slows again, allowing suspended particles to settle. Other solids in the flow stream strike the baffle wall and settle to the sump. The stormwater flow continues through the next two baffle chambers, where smaller particles settle. Treated stormwater is discharged via the outlet pipe located after the final baffle chamber.

Figure 1 illustrates the design of the the Hydro DryScreen® HDS. The internal components of the Hydro DryScreen® HDS have been designed to capture and retain floating pollutants, like trash and organic matter as well as particulate matter that will settle. A horizontal screen is positioned above the system's sump which allows them to dry out and makes it easier to view during inspections and remove when it's time to clean out. The vertical screened weir traps and prevents floating pollutants on the horizontal adjustable dry screen from being carried downstream.



Hydro DryScreen® HDS Components

1. Inlet pipe
2. Precast vault
3. Access lids
4. Adjustable height dry screen
5. Vertical screened weir
6. Flow diffuser
7. Sediment storage sump
8. Outlet pipe

Figure 1 – Hydro International DryScreen® Hydro Dynamic Separator

[2] Baffle boxes attach to stormwater outfalls and contain a series of sediment settling chambers separated by baffles. Stormwater runoff enters through the boxes which capture sediment and pollutants in the storage zones. When the first chamber is full, flow is directed to the second chamber, and so on.

The storage capacity of each Hydro DryScreen® model is determined by the height of the vertical screen. Pollutants that settle during separation and fall into the sump are trapped between two baffle walls. Most of the pollutants that cannot be screened will settle into the first chamber and the adjacent two chambers will capture what does not have time to settle in the first chamber. The sump of the Hydro DryScreen® retains a standing water level between storm events. The water in the sump prevents stored sediment from solidifying in the base of the unit. The sump depth on standard models is 3-ft which is the maximum sediment storage depth.

Hydro International possesses full ownership of the Hydro DryScreen® technology and it is commercially available. Hydro DryScreen® is patent protected and available for review at: https://patents.google.com/patent/US10287769B2/en?oq=US10287769

Description of Test Procedure

The test data and results for this verification were obtained from independent testing conducted on a 11.83m long by 0.91m wide (1.67 m^2) by ~1.2m high screening Hydro DryScreen® HDS, in accordance with the *Canadian PAS for Testing and Verification of OGS* (version June 2023). The laboratory test procedure was originally prepared by the Toronto and Region Conservation Authority in association with a 31-member advisory committee from various stakeholder groups in 2013. The 2023 update included a 14-member steering group, a 30-member review panel, as well as a public review period.

Verification Results

Toronto and Region Conservation Authority verified the performance test data and other information pertaining to the Hydro DryScreen® HDS. A Verification Plan was prepared to guide the verification process based on the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol.

Test Sediment

The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the testing procedure. The *Canadian PAS for Testing and Verification of OGS* (version June 2023) current at the time of testing (2024) required that the test sediment batch be separated into individual batches for use in testing at each of the required SLRs (minimum 7) for the sediment removal test and for preloading (minimum 1) during the sediment scour and resuspension test. Samples of sediment from each individual test run batch were collected and analyzed for PSD in accordance with ASTM D6913-17 and ASTM D7928.

The average PSD of the samples taken met the specified PSD percent less than values within a boundary of 5% and had a median particle size less than 75 µm. Comparison of the individual sample to the specified PSD shown in **Figure 2** indicates that the test sediment used for the capture test met this condition. The median particle size (d50) of the seven individual samples 71 µm (which is lower than the 75 µm target).

Sediment Removal Testing

The capacity of the device to retain sediment was determined at seven surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run. Performance was evaluated with a false floor simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the total mass injected and retained by the unit were determined for each of the tested surface loading rates (**Table 1**). There was no Sediment retained in the inlet pipe during the tests and negligible deposition (light coating only) on the dividing walls at the 40 & 80 tests.

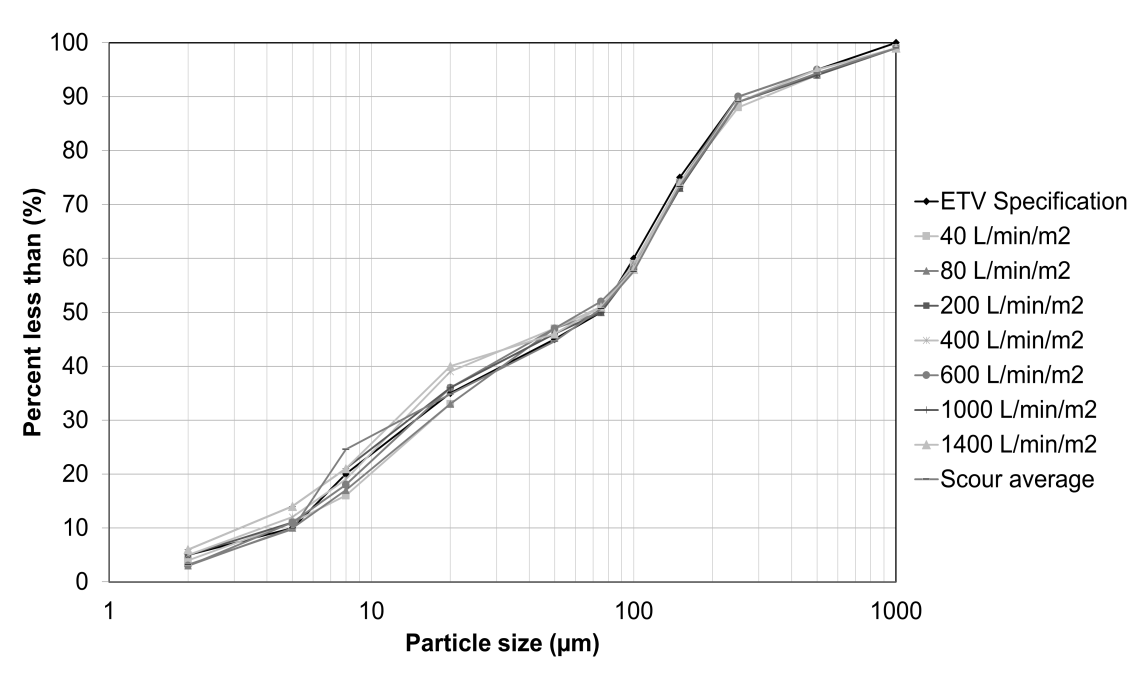


Figure 2 - PSD of test sediment from the Sediment Removal test and the ETV Specification

Particle size fraction (µm)	Surface loading rate (L/min/m²)						
	40	80	200	400	600	1000	1400
>500	100*	97	88	79	100*	97	100*
250 - 500	100*	100*	100*	100*	100*	100*	74
150 - 250	100*	100*	100*	100*	85	68	51
100 - 150	98	95	99	94	73	35	27
75 - 100	96	88	71	62	62	18	18
50 - 75	56	93	51	58	25	12	11
20 - 50	30	26	6	7	5	6	3
8 - 20	5	12	9	2	2	0	0
5 – 8	0	0	0	0	0	0	0
<5	0	0	0	0	0	0	0
All particle sizes by mass balance	**64.3**	**60.9**	**54.8**	**49.2**	**42.7**	**30.2**	**24.5**

* Removal efficiencies were calculated to be above 100%.

Table 1 Removal efficiencies (%) of the Hydro DryScreen® HDS at specified surface loading rates

In some instances, the removal efficiencies were above 100% for certain particle size fractions. These discrepancies are not unique to any one test laboratory and are attributed to errors relating to the blending and disaggregation of retained sediment, collection of representative samples for laboratory submission, and laboratory analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device. The results for “all particle sizes by mass balance” (see Table 1) are based on measurements of the total injected and retained sediment mass, and are therefore not subject to blending, sampling or PSD analysis errors.

Figure 3 compares the particle size distribution (PSD) of the average of the test sediment samples to the PSD of the sediment retained by the Hydro International Hydro DryScreen® HDS at each of the tested surface loading rates. As expected, the capture efficiency for fine particles was generally found to decrease as surface loading rates increased.

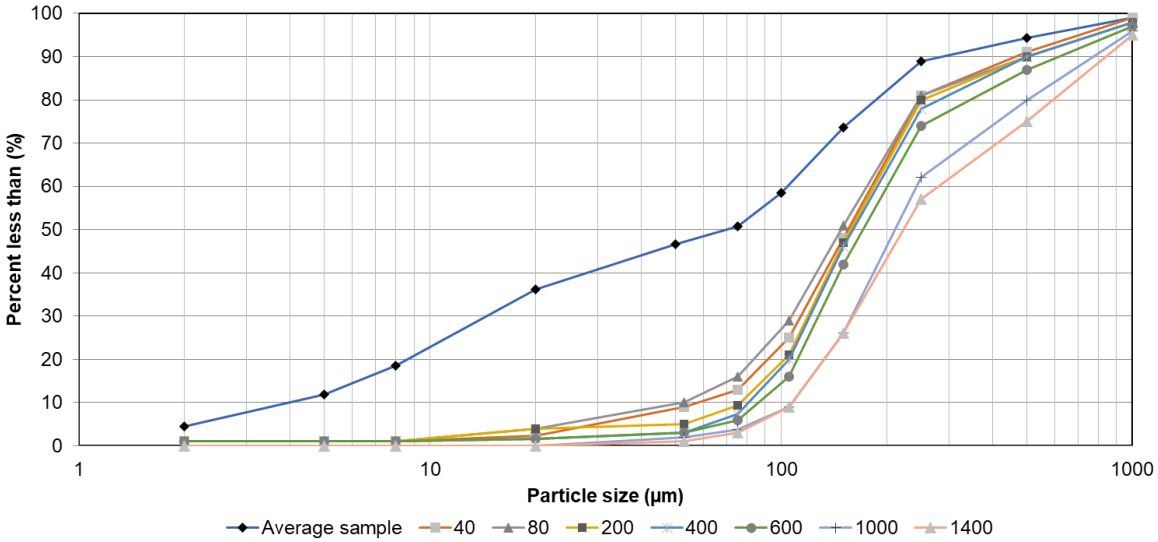


Figure 3 - Particle size distribution of sediment retained in the Hydro International Hydro DryScreen® HDS in relation to the injected test sediment average

Sediment Scour Testing

Table 2 shows the results of the sediment scour and re-suspension test for the Hydro DryScreen® HDS. The scour test involved preloading 15.2 cm (6 inches) of fresh test sediment into the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth (15.2 cm (6 inches) above sump bottom). Clean water was run through the device at five surface loading rates over a 30-minute period. Each flow rate was maintained for 5 minutes with a one-minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by methods specified in the Canadian PAS for Testing and Verification of OGS (version June 2023). The average measured effluent sediment concentrations for each tested SLR were adjusted for the d_5 particle size of 10 microns (allowed maximum) for the 40 L/min/m^2 removal efficiency test, and measured background at each SLR. The adjusted effluent data is shown in **Table 2**. Results showed average adjusted effluent sediment concentrations below 8.2 mg/L at all surface loading rates.

Run	Target Surface loading rate (L/min/m^2)	Run time (min)	Initial averaged effluent suspended solids concentration (mg/L)	Average adjusted effluent suspended sediment concentration (mg/L)[a]
1	200	1:00 – 6:00	128.5	0.0
2	800	7:00 – 12:00	33.0	0.0
3	1400	13:00 – 18:00	32.6	5.0
4	2000	19:00 – 24:00	40.1	8.2
5	2600	25:00 – 30:00	122.2	3.6

[a] The effluent suspended sediment concentration is adjusted based on the background concentration of feed water and the d_5 correction, as described in the Canadian Publicly Available Specification for Testing and Verification of Oil and Grit Separators.

Table 2 - Scour test adjusted effluent sediment concentration at each surface loading rate

Quality Assurance

Performance testing and verification of the Hydro DryScreen® HDS were performed in accordance with the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol. In addition, the *Canadian PAS for Testing and Verification of OGS* (version June 2023) specifies QA/QC requirements to ensure that results are accurate and precise, including use of certified laboratories, established test methods, calibrated equipment, tolerance limits for variations in test results, data checks, and stringent documentation.

The verifier, Toronto and Region Conservation Authority, has reviewed and confirmed that the key QA/QC requirements were addressed throughout performance testing and the generation of test results for the Hydro DryScreen® HDS. This included reviewing all data sheets and data downloads, as well as overall management of the test system, quality control and data integrity. **Table 3** summarizes the key QA/QC parameters and acceptance criteria for Hydro DryScreen® HDS technology performance testing and verification.

QA/QC Parameters	Acceptance Criteria
Particle Size Distribution	Analyzed by a certified laboratory in accordance with ASTM D6913-17 and ASTM D7928. Percentages for size ranges vary by <5%, median < 75 um. PSD in water determined by ISO 13320 (2020) Particle Size Analysis – Laser Diffraction Methods.
Solids in test water	Suspended solids concentration (SSC) concentration of test water of < 20 mg/L using ASTM D3977-97 (2019) Standard Test Methods for Determining Sediment Concentration in Water Samples.
Water temperature	Temperature of water less than 25°C.
Flow measurement equipment	Equipment calibration reports submitted to confirm that reported flow rate matches actual flow rate.
Flow rate variation	Flow rates have COV < 0.04; maintained with 10% of target flow rate for CETV target flow rates.
Sediment feed	TSS concentration target = 200 mg/L with a tolerance limit of ±25 mg/L. Injection location is 0.91 m upstream of inlet to the device, as per the *Canadian PAS*. At least six feed rate calibration samples taken over duration of each test run.
Sediment moisture content	Determined by ASTM D2216 (2019), Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
Sample analysis	Conducted by qualified laboratories using standard methods and meeting the requirements of ISO 14034 and ISO 17025.

Table 3. Summary QA/QC parameters and acceptance criteria for Hydro DryScreen® HDS technology performance testing and verification

The requirements of the Verification Plan have been addressed, and there were no deviations from the test procedure. The lack of an updated Operation and Maintenance Manual was noted, but this does not impact overall compliance with the Verification Plan. The verifier has suggested including in the O&M Manual the maximum recommended sediment storage depth prior to maintenance, as well as the requirement for confined space gear in the Recommended Equipment list.

Verification Summary

In summary, the Hydro DryScreen® HDS is a viable technology that, when sized appropriately, can be used to capture and retain sediment and associated pollutants from stormwater runoff.

Table 4 summarizes the verification results in relation to the technology performance parameters that were identified to determine the efficacy of the Hydro DryScreen® HDS.

Performance Parameter	Verified Performance
Sediment Removal Rate	The sediment removal rate of the Hydro DryScreen® HDS is dependent upon flow rate, particle density and particle size. Removal efficiencies varied between 24.5% at a surface loading rate of 1400 L/min/m^2 to 64.3% at a surface loading rate of 40 L/min/m^2. The weighted average removal efficiency achieved by the unit will vary depending on the rainfall distribution of the jurisdiction in which it is installed, and site characteristics.
Sediment Scour	When pre-loaded with sediment with a particle size distribution matching that of the feed sediment used in the sediment capture test, the Hydro DryScreen® HDS generated effluent suspended solids concentrations of less than 8.2 mg/L at surface loading rates ranging from 200 to 2600 L/min/m^2.
Bypass flow rate	N/A
Head loss	The loss of hydraulic head across the unit was determined by measuring the water elevation difference between the inlet and outlet sides of the insert. Head loss may vary based on model size. Hydraulic testing was conducted at flows ranging from 0 to 56.8 L/sec. The maximum calculated unit loss was 0.24 m.

Table 4 - Summary of verification results against performance parameters

What is ISO 14034?

The purpose of environmental technology verification is to provide a credible and impartial account of the performance of environmental technologies. Environmental technology verification is based on a number of principles to ensure that verifications are performed and reported accurately, clearly, unambiguously and objectively. The International Organization for Standardization (ISO) standard for environmental technology verification (ETV) is ISO 14034, which was published in November 2016.

Benefits of ETV

ETV contributes to protection and conservation of the environment by promoting and facilitating market uptake of innovative environmental technologies, especially those that perform better than relevant alternatives. ETV is particularly applicable to those environmental technologies whose innovative features or performance cannot be fully assessed using existing standards. Through the provision of objective evidence, ETV provides an independent and impartial confirmation of the performance of an environmental technology based on reliable test data. ETV aims to strengthen the credibility of new, innovative technologies by supporting informed decision-making among interested parties.

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