Cascade Separator™

Technical Design Guide

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Introduction

The Cascade Separator™ is a compact, below grade stormwater treatment system that employs opposing vortices that enhance particle settling and a unique skirt design that allows for sediment transport into the sump while reducing turbulence and resuspension of previously captured material. Cascade Separator® is the newest innovation in stormwater treatment from Ocean Protect. The separator was developed by using advanced modelling tools in an industry leading stormwater laboratory.

With the ability to accept a wide range of pipe sizes at varying angles, the Cascade Separator™ can treat and convey flows from small to large sites. A unique internal bypass design means higher flows can be diverted without the use of external bypass structures. This innovative hydrodynamic separator excels at sediment capture and retention while also removing hydrocarbons, rubbish, and debris from stormwater runoff.

Operational Overview

The internal flow controls of the Cascade Separator™ are illustrated in Figure 1. Low, frequently occurring storm flows enter the device via one or more inlet pipes, or a surface grate. Once inside the device, water is directed to two separate inlet flumes. As a result of the directional flow into the centre tube via the flumes, vortices are created operating in opposite directions. This innovative design is unlike any other device on the market and facilitates enhanced particle separation. The downward swirling vertical water column allows for sediment to settle into the sump and water to exit through an outlet window. Flow that eventually exceeds the capacity of the flumes can also exit over the flume without re-suspending previously captured pollutants. The system incorporates a partially perforated slanted skirt that equalizes the pressure between the storage and treatment zone while reducing the potential for scour. The skirt also allows transport of sediment and debris into the sump zone which improves ease of maintenance since all captured material can be removed through the centre tube.

The outlet deck incorporates two drain down pipes that extend downward and allow the system to drain to the outlet pipe invert elevation after the storm event has subsided, while preventing captured hydrocarbons from leaving the system.

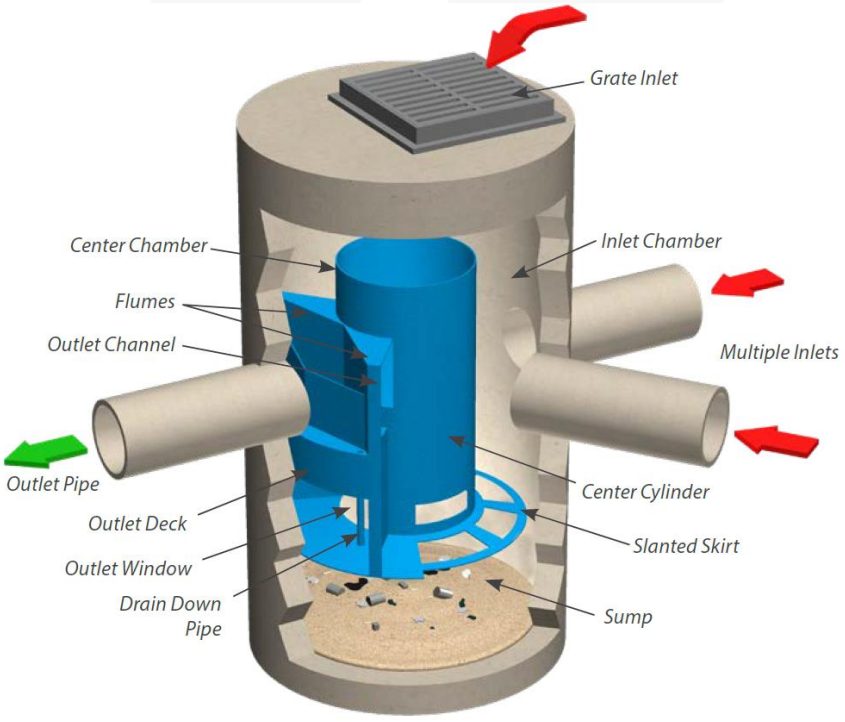

Figure 1: Cascade Separator™ Components

Selection Process

For online installation the first step in the selection process is to determine the proposed pipe size at the device location and then to select a model from Table 1.

The Peak Flow for each model in Table 1 denotes the maximum hydraulic capacity that the Cascade Separator™ can convey when in an online configuration.

When the Cascade Separator™ is part of a treatment train the TFR can be selected to complement or match the flow of the other treatment systems. Modelling of the treatment system using MUSIC is often required to determine the overall performance of the treatment train.

If the listed pipe size for the selected Cascade Separator™ model is not able to meet the sites hydraulic flow capacity then a larger model will need to be selected

Model	Treatable Flow Rate (L/s)	Peak Flow Rate (L/s)	Diameter (m)	Sediment Storage Capacity (m^3)	Oil Storage Capacity (litre)	Typical Depth Below invert (m)
CS1200	51	280	1.2	0.5	530	1.4
CS1500	80	390	1.5	0.8	1040	1.6
CS2250	174	845	2.25	2.4	4270	2.5
CS3250	377	1400	3.25	4.4	8340	3.3

Table 1: Cascade Separator™ Available models

Cascade Separator™ device is designed to achieve over 80% Total Suspended Solids reduction at the Treatable Flow Rate (TFR) based on lab generated performance analysis for a particle gradation ranging between 53 and 210-microns (µm) with an average particle size (d50) of 110-microns (µm).

The Cascade Separator™ is designed to treat all flows up to the TFR. Due to its internal bypass weir configuration, flow rates in the treatment chamber only increase minimally once the TFR is surpassed. At influent rates higher than the TFR, the flow partition will allow most flow exceeding the treatment flow rate to bypass the treatment chamber. This allows removal efficiency to remain relatively constant in the treatment chamber and reduces the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as - *The rate at which the Cascade Separator™ will remove a specific gradation of sediment at a specific removal efficiency.*

The TFR can be varied depending on the gradation and removal efficiency specified by the design engineer and the unit size is scaled according to the project goal.

Hydraulic Capacity up to peak flow

The Cascade Separator™ has two inlet flumes designed to the suit the TFR. The trough walls are sized to ensure that its crest is above the maximum Top Water Level (TWL) at the weir and also within the treatment chamber. This ensures that no captured floating pollutants is inadvertently lost during a larger event.

The open trough arrangement helps with visual inspection for blockages and access to all areas for maintenance.

Configurations

The Cascade Separator™ can allow for one or more inlet pipes as per Figure 1. The unobstructed inlet zone creates the opportunity to design the device with an acute angle between the inlet and outlet pipes.

Mass load consideration

The Cascade Separator™ is designed to capture and retain sediment and oils. As a consequence of its design, debris and rubbish are also retained once directed into the centre tube. The oils and litter that float and the material that settles into the sump of the Cascade Separator™ needs to be periodically removed as per any other GPT. The sump sediment storage capacity of each Cascade Separator™ model is listed in Table 1. The frequency of maintenance depends on the amount of material generated within the contributing catchment and then mobilised in storm events.

The model selection process should consider the amount of anticipated pollution load and the subsequent frequency of maintenance. Annual sediment loads have been documented and can vary from 400 to 900 kg/ha/yr for Urban, Industrial and Commercial catchments. The density can also vary from 1.3 to 2.0 Tonne/m^3 depending on the mix of organic, litter and sediment.

For assistance with selecting an appropriate Cascade Separator™ for your project or for additional dimensional or hydraulic information please contact the engineering department of Ocean Protect.

Performance

Full Scale Laboratory Test Results

The Cascade Separator™ has received New Jersey Department of Environmental Protection (NJDEP) Certification.

All Cascade Separator™ models have the same aspect ratio regardless of system diameter.

For additional information on the testing please refer to the Performance Summary which is available for each product.

Maintenance

The table below outlines the primary types of maintenance activities that typically take place as part of an ongoing maintenance schedule for the Cascade Separator™.

	Description of Typical Activities	Frequency
Minor Service	Visual inspection of flow control trough Removal of larger pollutants in trough Measuring of sediment depth	At 6 Months
Major Service	Removal of accumulated sediment and gross pollutants	At 12 Months

For further information please refer to the Cascade Separator™ Operations and Maintenance Manual

Support

- Drawings and specifications are available at www.oceanprotect.com.au
- Site-specific design support is available from our engineers.