Vortechs™

Technical Design Guide

Stopping Pollution Entering Waterways

09/22

www.oceanprotect.com.au

Introduction

The Vortechs™ is a high-performance hydrodynamic separator that effectively removes total suspended solids, oil, floating and settleable debris.

The swirl concentration operation and flow controls work together to minimise turbulence and provide stable storage of captured pollutants.

A typical system is sized to suit a specific flow rate and provide a specific removal efficiency of a predefined particle size distribution (PSD).

Operational Overview

Stormwater enters the swirl chamber inducing a gentle swirling flow pattern and enhancing gravitational separation. Sinking pollutants stay in the swirl chamber while floatables are stopped at the baffle wall.

Vortechs™ systems are usually sized to efficiently treat the frequently occurring runoff events and are primarily controlled by the low flow control orifice. This orifice effectively reduces inflow velocity and turbulence by inducing a slight backwater within the unit.

During larger storms, the water level rises above the low flow control orifice and begins to flow through the high flow control. Any layer of floating pollutants is elevated above the invert of the Floatables Baffle Wall, preventing release. Swirling action increases in relation to the storm intensity, while the sediment pile remains stable.

When the inflow is at peak capacity, the water surface in the system approaches the top of the high flow control.

The Vortechs™ system will be sized large enough so that previously captured pollutants are retained in the system, even during these infrequent events.

As a storm subsides, treated runoff decants out of the Vortechs™ system at a controlled rate, restoring the water level to a dry-weather level equal to the invert of the inlet pipe. The low water level facilitates easier inspection and cleaning, and significantly reduces maintenance costs by reducing pump-out volume.

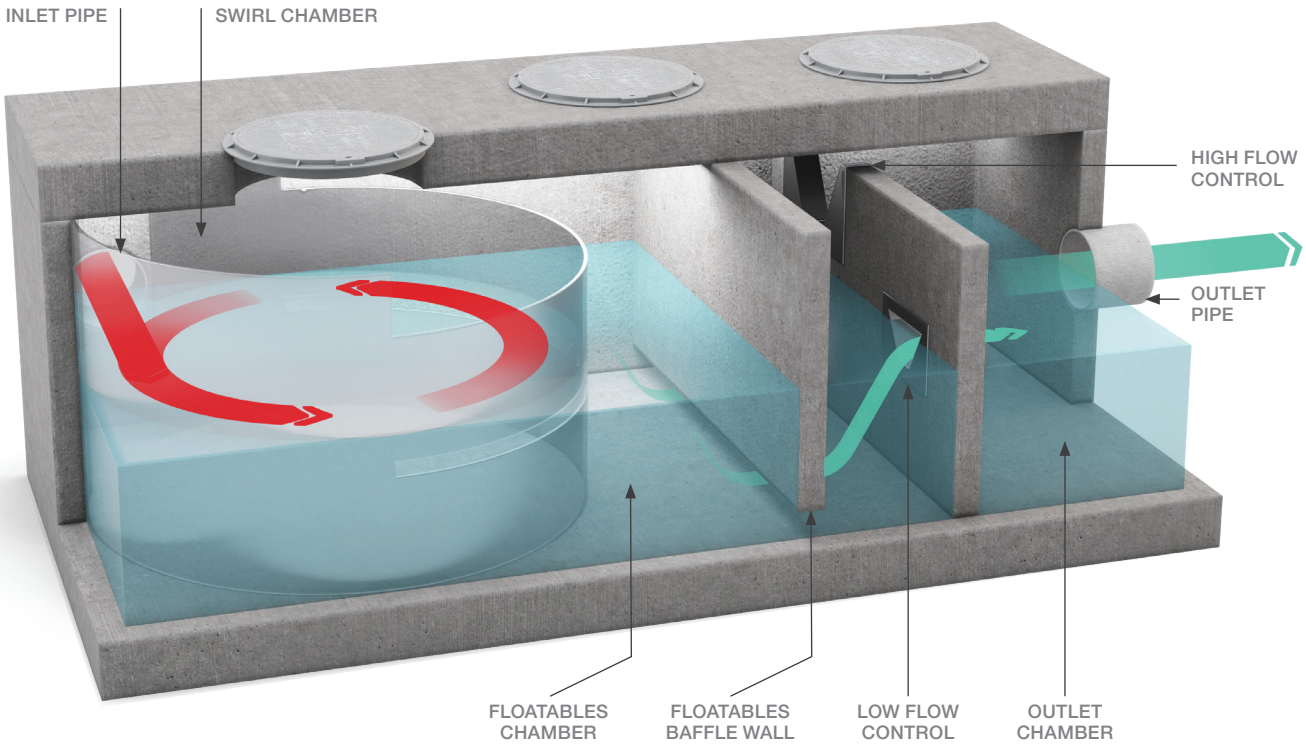

Figure 1: Vortechs™ components

Selection Process

For an end of line treatment system it is usual for the Treatable Flow Rate (TFR) to be based on the 3-month storm event flow rate. The majority of the pollutant load run-off is generated in more frequent low intensity storms and the high intensity storms contributed relatively little to the total annual volume. Sizing at the 3-month intensity statistically equates to over 95% of the annual flow volume. The higher treatable flow range in *Table 1* is used for selecting the Vortech in this situation.

When the Vortechs™ 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.

Vortechs™ systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for the desired particle side, or a particle gradation found in typical urban runoff (see Vortechs™ Performance Summary for more information). Treating at the lower flow range results in finer particle separation. The lower flow range in *Table 1* is used for MUSIC modelling.

Model	Treatable Flow Rate Range (L/s)	Max Online Peak Flow (L/s)	Vortech Internal Dimensions (m)	Sediment Storage Capacity (m^3)
1000	16.7 – 27.8	45.3	0.9 x 2.7	0.5
2000	28.3 – 48.1	79.3	1.2 x 3.0	0.9
3000	48.1 – 76.5	127.4	1.5 x 3.4	1.4
4000	62.3 – 104.8	169.9	1.8 x 3.7	1.8
5000	87.8 – 147.2	240.7	2.1 x 4.0	2.4
7000	116.1 – 189.7	311.5	2.4 x 4.3	3.1
9000	147.2 – 240.7	396.4	2.7 x 4.6	3.7
11000	184.1 – 303.0	495.5	3.0 x 4.9	4.3
16000	263.3 – 433.2	707.9	3.7 x 5.5	5.4

Table 1: Vortechs™ available models

Once a system size is established, the internal elements of the system are designed based on information provided by the site engineer. Flow control sizes and shapes, sump depth, oil spill storage capacity, sediment storage volume and inlet and outlet orientation are determined for each system.

Each Vortech is custom designed based on site specifics such as flow rate, pipe size, levels, HGL and anticipated pollutant characteristics. When appropriate these calculations are checked by Ocean Protect engineers when issuing the production drawing for sign off.

Bypass weir calculations are required for off-line systems. These should be done to suit the proposed diversion structure and proposed weir type.

Upstream Bypass Calculations

In some cases, pollutant removal goals can be met without treating the catchment peak flow rate and it is more feasible to use a smaller Vortechs™ configured with an external bypass. In such cases, a bypass design consisting of an appropriate length diversion weir is recommended for each off-line system.

To calculate the bypass flow over the diversion weir, first subtract the Vortech maximum on-line peak flow from the catchment peak flow (pipe or culvert flow). The result is the flow rate that must be bypassed to avoid surcharging the Vortechs™.

Mass load consideration

The Vortechs™ is designed to capture and retain sediments and debris. The material that settles into the sump of the Vortechs™ needs to be periodically removed as per any other gross pollutant trap (GPT). The sump capacity of each Vortechs™ 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 Vortechs™ for your project or for additional dimensional or hydraulic information please contact the engineering department of Ocean Protect.

Performance

Full Scale Laboratory Test Results

Laboratory testing was conducted on a full scale Vortechs™ model 2000.

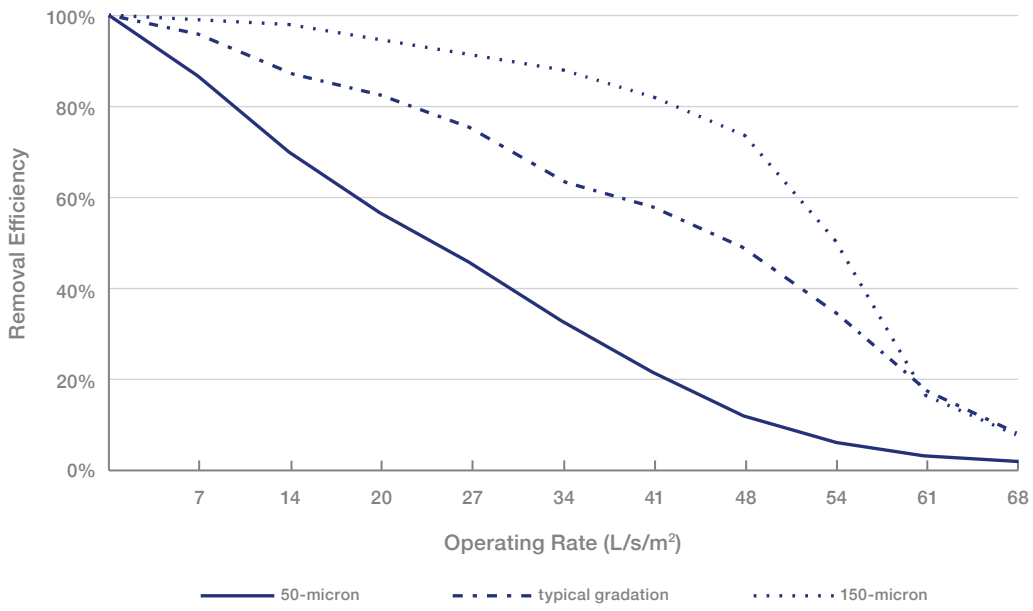

Figure 2: Vortechs™ 2000 removal efficiencies

Vortechs™ are designed to treat peak flows from 45L/s up to 708L/s online without the need for bypass. However, external bypasses can be configured to convey peak flows around the system if treatment capacity is exceeded. The Vortechs™ can also be configured to direct low flows from the last chamber of the system to polishing treatment when more stringent water quality standards are imposed. In all configurations, high removal efficiencies are achieved during the lower intensity storms, which constitute the majority of annual rainfall volume.

Maintenance

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

Service Type	Description of Typical Activities	Frequency
Minor Service	Visual inspection of swirl, floatables and outlet chambers Removal of large floatable pollutants Measuring of sediment depth	At 6 Months
Major Service	Removal of accumulated sediment and gross pollutants Inspection of the swirl chamber, baffle wall and outlet controls	At 12 Months

For further information please refer to the *Vortechs™ Operations and Maintenance Manual.*

Ocean Protect supplies and maintains a complete range of filtration, hydrodynamic separation, screening and oil/water separation technologies.

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