Hydro-Brake® Optimum Design Tool User Guide

Quickly and easily compare flow control solutions to achieve the best hydraulic control for your site
Hydro-Brake® Optimum Design Tool

The Hydro-Brake® Optimum Design Tool allows you to quickly and easily compare a number of different flow control options for your site to develop the most robust and sustainable drainage solution possible. In just three simple steps you can obtain:

- Detailed dimensional drawings
- Hydraulic modelling data for direct import or copy/paste into commercial hydraulic modelling software

Access the Hydro-Brake® Optimum Design Tool and watch our step by step guide at www.hydrobrakeoptimum.com

Flow Control Design in Just 3 Simple Steps

1. **Step 1: Enter Design Inputs**
2. **Step 2: Review Design Online**
3. **Step 3: Download Detailed Design Outputs Direct to your computer**
Introduction

We believe that bringing water quantity back under control is the core aspect of any sustainable drainage solution as it not only helps to combat flooding, but facilitates effective surface water treatment practises, helps reduce pollution shock loads to the receiving water environment and can enable holistic urban water cycle management.

We place flow control design and application at the centre of all that we do.

What is the Hydro-Brake® Optimum?

Hydro-Brake® Flow Controls are devices for controlling liquid flow, which are designed and manufactured exclusively by Hydro International. They are self-activating, relying on the energy within the water flow to generate and sustain an air-filled vortex within the unit.

The Hydro-Brake® Optimum is the latest in a long line of Hydro-Brake® Flow Control developments dating back over 30 years and is the result of over 600 days of laboratory testing and over 10 years of computer processing time running Computational Fluid Dynamics (CFD) simulations.

Key Advantages

- Performance backed by significant R&D investment.
- Independently accredited by the British Board of Agrément (BBA) and the Water Research Council (WRc).
- Unique tailoring of the hydraulic response curve to meet specified design objectives.
- Up to 15% storage saving compared to other vortex flow controls.
- Clearances up to 20% larger than other vortex flow controls.
- Optional future-proofing through adjustable inlet controls.
- Verified structural fit for purpose.
- Integral bypass door in line with the outlet to provide a clear line of sight through the unit.
- A range of cost saving installation options.
- No moving parts = reduced maintenance burden.
- Self-activating with no external power requirements = No running costs.
- A proven track record, demonstrated by over 30,000 installations worldwide.
How the Hydro-Brake® Optimum Works

The hydraulic behaviour of the Hydro-Brake® Optimum is described by its hydraulic characteristic curve, which relates the discharge flow from the unit to the hydraulic head acting upon that unit.

The hydraulic characteristic curve consists of three distinct sections, each corresponding to a different governing flow control regime:

1. **The pre-initiation phase (Figure 2)** – governed by orifice flow and defined on the characteristic curve as the region between the origin and the point at which the vortex begins to have a throttling effect (Flush-Flo™ point). In this region, the depth of water is below the soffit of the outlet orifice of the flow control.

   ![Figure 2: The pre-initiation phase](image)

2. **The transition phase (Figure 3)** – governed by vortex formation and defined on the characteristic curve as the region between the Flush-Flo™ and the point at which the vortex has fully initiated (Kick-Flo® point). In this region, the vortex will continually form and collapse. A trapped volume of air inside the Hydro-Brake® Optimum will exert a back-pressure and cause the discharge rate to reduce even though the hydraulic head continues to increase.

   ![Figure 3: The transition phase](image)
3. **The post-initiation phase (Figure 4)** – governed by stable vortex flow and defined on the characteristic curve as the region above the Kick-Flo® point. A stable vortex is formed and sustained. An air-filled core at the centre of the vortex acts as a pseudo-physical flow restriction by reducing the cross sectional area available for the passage of water.

![Figure 4: The post-initiation phase](image)

**Design Flexibility**

As shown in Figure 5, it is possible for the Design Point to be achieved using a number of different flow control configurations, each with a different hydraulic response or characteristic curve.

An in-depth understanding of the flow regimes and interactions at each stage of the hydraulic characteristic curve allows custom configuration of the Hydro-Brake® Optimum to achieve the hydraulic profile best suited to the site requirements.

![Figure 5: Various Hydro-Brake® Optimum hydraulic responses resulting in the same Primary Design Point](image)
Design Inputs

The Design Inputs consist of:
- Design Flow
- Design Head
- Hydraulic Objective
- Customised Flush-Flo™ Flow Rate
- Water Type – ‘Surface Water Only’, ‘Foul Water’ and ‘Combined Surface and Foul Water’.
- Sump Available
- Mounting Style
- Adjustable Inlet

Hydro-Brake® Optimum units can also be designed for foul / combined, sump-less and retrofit applications – for further information and a custom design service call the Hydro-Brake® Hotline: +44 (0) 1275 337937.

Setting the Design Flow

The Design Flow should be equal to the maximum permissible discharge rate from the catchment. This will generally be set by the authority responsible for the receiving body.

For sites where the discharge is to a surface water body or watercourse this will typically be the environmental regulator. In the UK this will generally be the Environment Agency (England), Scottish Environmental Protection Agency, Natural Resources Wales or the Northern Ireland Environment Agency.

For sites where the discharge is to a new or existing sewer, the sewer undertaker will generally set the rate at which flows can be accommodated by the sewer infrastructure.

Early consultation with the relevant authority is recommended.
Determining Design Head

If the Hydro-Brake® Optimum discharges as a free outfall, the design head is taken as the difference in elevation between the invert of the outlet and the top water level upstream.

The upstream top water level will often be defined by the soffit of the upstream storage structure. Whether this is an oversize pipe (Figure 6), a culvert, a geocellular storage system (Figure 7) or an above ground structure such as a pond or detention basin (Figure 8) the same principle applies.

![Figure 6: Determining design head for pipe storage systems](image)

![Figure 7: Determining design head for geocellular storage systems](image)

![Figure 8: Determining design head for above ground storage systems](image)
Setting the Hydraulic Objective or Specifying a Flush-Flo™ Flow Rate

As highlighted in Figure 5, it is possible to alter the physical geometry of the Hydro-Brake® Optimum in order to manipulate the head-discharge characteristic curve and produce a customised hydraulic response to best suit the site requirements.

There are four options to customise the hydraulic profile:

1. **Minimise storage requirements (default)**
   
   This is the default option and will generally result in the smallest volume of upstream storage.

   When this option is selected, the transition phase will be extended by maximising the flow rate at the Flush-Flo™ point and maximising the head at the Kick-Flo® point. This will pass the greatest possible volume of water downstream during the earlier stages of a storm event and preserve the upstream storage capacity for as long as possible.

2. **Minimise blockage risk**
   
   Selecting this option will maximise the inlet and outlet openings of the Hydro-Brake® Optimum unit to maintain the largest possible clearances and minimise the risk of any debris that is being carried within the flow from becoming lodged in the unit.

   Selecting this option will generally result in a marginally higher upstream storage volume requirement than Option 1.

3. **Future proof**
   
   The addition of an adjustable inlet to the Hydro-Brake® Optimum allows the design flow to be adjusted by up to 20% post-installation.

   Selecting this option will design the Hydro-Brake® Optimum such that the adjustable inlet gate is initially set at or close to its mid-point. This will provide the greatest degree of flexibility for dealing with future changes in the system requirements and will typically allow for the design flow to be increased or decreased by up to 10% post-installation.

   **Note**: Modelling of the range of adjustment is not currently supported in the software. Contact us to obtain full details.

4. **User specified Flush-Flo™ Flow Rate**
   
   The flow rate at which the vortex begins to form (or Flush-Flo™ point) can be specified. This can be less than, equal to or greater than the Design Flow depending on the application and can be used to customise the hydraulic response when the standard objective options listed above are not suitable.

   **Note**: leaving the Flush-Flo™ input box empty will automatically set the Flush-Flo™ flow rate equal to the Design Flow.
Flow Control Configurations and Water Type

Table 1 below provides a summary of the Hydro-Brake® Optimum models supported.

Table 1: Summary of Hydro-Brake® Optimum models supported.

<table>
<thead>
<tr>
<th>Range</th>
<th>Style/Typical Shape</th>
<th>Application</th>
<th>Design/Installation Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro-Brake®</td>
<td>Sump-type</td>
<td>Surface/storm water only</td>
<td>BBA and WRc Approved. Design objective can be specified. Sump-type units require the provision of a sump to accommodate the flow control. Sump-type units are unsuitable for use in foul/combined systems.</td>
</tr>
<tr>
<td>Optimum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non sump-type</td>
<td></td>
<td>Foul/combined and surface/storm water</td>
<td>BBA and WRc Approved. Design objective can be specified. Non sump-type units do not require the provision of a sump to accommodate the flow control. Instead the unit is bench into the chamber. Non sump-type units are suitable for use in both foul/combined systems and surface/stormwater systems.</td>
</tr>
</tbody>
</table>

Selection of the most appropriate Hydro-Brake® Optimum for a particular application depends on a number of considerations, including the type of sewer system, the hydraulic characteristic of the device, device clearances and overall physical dimensions. The program provides outputs for hydraulic characteristic and outlet size. Depending on the particular application of the Hydro-Brake® Optimum, the appropriate style unit is selected within the flow control design process.

Figure 9 provides information on the Hydro-Brake® Optimum style selection process taking into account the considerations of type of sewer system.

![Flow chart of Hydro-Brake® Optimum selection process.](image-url)
Design for Installation

There are four standard mounting options available:

1. **Lugs (default)**
   - This is the standard mounting arrangement. These units are supplied with an outlet spigot to allow easy location into the outlet pipe. The units are fixed into position by bolting through the fixing lugs using the fixing anchors supplied.

2. **Flat mounting plate (not pictured)**
   - This mounting arrangement is generally used where the outlet pipe is larger than the size of the Hydro-Brake Optimum unit in order to ensure a watertight seal.

3. **Curved mounting plate**
   - Curved mounting plates can be provided to suit standard manhole chamber sizes.

4. **Push-fit spigot**
   - Push-fit spigots can be provided to suit Ø150 mm, Ø225 mm and Ø300 mm outlet pipes.

![Figure 10: Mounting styles from left: Curved mounting plate; Push-fit spigot; Lugs](image)

**Note:** The Hydro-Brake® Optimum Design Tool will sometimes indicate that a particular mounting style is not available. To discuss mounting options and bespoke mounting arrangements please call the Hydro-Brake® Hotline: +44 (0) 1275 337937.

A range of off-site chamber solutions are also available – see [www.hydro-int.com/uk/products/hydro-brake-chamber](http://www.hydro-int.com/uk/products/hydro-brake-chamber) for further information

Design for the Future

An adjustable inlet can be added to any design to build in flexibility for future changes in requirements, by allowing the design flow rate to be adjusted by up to 20% post-installation.

**Note:** Designs using the Future-Proof Objective setting will require an adjustable inlet to be fitted. Modelling of the adjustment range is not currently supported in the software. Contact us to obtain full details of the adjustability for any given design.
Design Outputs – Hydraulic Characteristics

Once all the design inputs have been completed, the Design Tool will run through a complex array of calculations based on fluid dynamics to produce the best hydraulic performance to suit your requirements.

The hydraulic characteristic curve will be displayed on screen and the key control points highlighted.

In order to simplify the comparison between multiple flow controls, the mean flow rate over the full range of heads up to and including the Design Head is also displayed. A minimum of 1,000 data points are used to calculate this mean flow rate to ensure that it provides an accurate description of the full hydraulic characteristic curve.
Design Outputs – Key Dimensions

The Hydro-Brake® Optimum Design Tool will also display a dimensioned drawing on screen which will include:

- Key unit dimensions, including the overall external size of the unit and the internal clearances.
- The unit outlet diameter – for surface water systems, a minimum outlet diameter of 75 mm is typically recommended. Advice on the minimum acceptable outlet diameter should be obtained from the adopting authority where relevant.
- The minimum outlet pipe diameter and manhole diameter to which the unit can be fitted and any clearances required for installation.

Design File Service

Once you are happy with the hydraulic and dimensional design outputs, the design file service allows you to receive detailed output documents directly to the email address supplied during registration. The supported output documents include:

<table>
<thead>
<tr>
<th>Hydraulic Characteristic Curve</th>
<th>Dimensioned Drawing</th>
<th>Hydraulic Modelling Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="#">PDF</a> Adobe</td>
<td><a href="#">PDF</a> Adobe</td>
<td>To suit commercial hydraulic modelling software package selected, see table below for currently supported packages.</td>
</tr>
</tbody>
</table>

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[Sample](#) [Sample](#) [Sample](#) [Sample](#)
Hydraulic Modelling Data

Hydraulic Modelling Data is currently provided in 3 different formats:

<table>
<thead>
<tr>
<th>MicroDrainage® Compatible (.csv)</th>
<th>0.1m or 0.2m Head Increments (.csv)</th>
<th>Generic Data (.csv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MicroDrainage® 2016</td>
<td>WinDes® w11 and earlier</td>
<td>WinDes® w11 and earlier</td>
</tr>
<tr>
<td>MicroDrainage® 2014</td>
<td>WinDes® 2013</td>
<td>WinDes® w11 and earlier</td>
</tr>
<tr>
<td>WinDes® 2013</td>
<td>WinDes® w12</td>
<td>WinDes® w11 and earlier</td>
</tr>
<tr>
<td>WinDes® w12</td>
<td>51 lines of Depth / Outflow (head / flow) data provided at even increments of head for Copy / Paste into MicroDrainage®.</td>
<td>110 lines of Head / flow data provided in .csv format. This data file can be opened in Excel (or similar) and accepted by some 3rd party modelling software packages.</td>
</tr>
</tbody>
</table>

51 lines of Depth / Outflow (head / flow) data provided at even increments of head for Copy / Paste into MicroDrainage®.

Depth Outflow (head / flow) data provided in increments of either 0.1m or 0.2m, suitable for input into MicroDrainage WinDes® w11

Guides to modelling the Hydro-Brake® Optimum in various commercial software packages, including MicroDrainage®, can be downloaded from [http://www.hydrobrakeoptimum.com/](http://www.hydrobrakeoptimum.com/) or obtained on request.
Expert Design Service

Our professional engineers are on hand to provide free support to aid with the correct design and application of our products within each drainage design.

Our dedicated design support team is available to advise on all aspects of Hydro-Brake® Optimum design, including use of the Hydro-Brake® Optimum Design Tool and modelling of the Hydro-Brake® Optimum in commercial modelling software. We can also provide you with a detailed quotation for any units designed using the Hydro-Brake® Optimum Design Tool.

**Hydro-Brake® Optimum**  
**Hotline:** +44 (0) 1275 337937

**Design Tool Help Desk**  
**Hotline:** +44 (0) 1275 337957

**Email:** hydrobrake@hydro-int.com

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Integrated Surface Water Management

The Hydro-Brake® Optimum can be integrated with Hydro’s industry-leading products for surface water attenuation and treatment as part of an holistic, sustainable surface water management system.

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**Downstream Defender®**  
Advanced Hydrodynamic Vortex Separator

**Stormbloc®**  
Storage / Infiltration System

**Hydro-Brake® Optimum**  
Flow Control

**Up-Flo™ Filter**
For Flow Control
Product and Design Advice:
Tel: +44 (0) 1275 337937
Email: hydrobrake@hydro-int.com