

Report Title

Operational Drainage Management Plan

Property Address

The Flaxworks
Cleator
Cumbria
CA23 3DU

Client

Cleator Mills Business Park Ltd

Our Reference

25-176r002

Date

September 2025

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INTRODUCTION

This Operational Drainage Management Plan has been prepared to support the development for the refurbished office and associated car parking infrastructure on land at The Flaxworks, Cleator, Cumbria, CA23 3DU.

The site lies within the administrative boundary of Cumberland Council (CC) and is currently subject to a planning application ref 4/24/2315/0F1.

This report identifies necessary maintenance measures to ensure drainage systems operate in accordance with the requirements of all statutory bodies and prevent potential effects upon the environment and nearby sensitive receptors during the operational phase of the development.

SITE

The site comprises of a depot for a plant hire company including:

- Office
- Car Parking
- Landscaping and fencing

OPERATIONAL ACTIVITIES WHICH MAY POLLUTE

ACTIVITIES

The following operational activities are assessed as having a likelihood to pollute :

- Car Parking serving the office development.

The operations are considered very low risk.

ENVIRONMENTAL PROTECTION MEASURES

There are a number of environmental protection measures proposed for the site. These include:

- Downstream Defender (2 no).

Full operational manuals are appended to this report.

MAINTENANCE ACTIVITIES

The following tables relate to the maintenance requirements to drainage installed on the site and all works required to them..

#	Description	Frequency
1.	GENERAL REQUIREMENTS	
	Maintenance activities comprise ● Regular Maintenance ● Occasional Tasks ● Remedial Work	
	<u>Generally</u>	
	Litter Collect all litter or other debris and remove from site at each site visit.	Monthly
2.	FILTER DRAINS AND INFILTRATION TRENCHES	
	<u>Regular Maintenance</u>	
	Grass Edges Mow 1m min. wide grass surround to drain at 100mm and 150mm maximum to filter runoff and protect drain from silt.	Monthly or as required
	<u>Occasional Tasks</u>	
	Weeds Hand pull or spot treat individual weed growth only if necessary ensuring weedkiller does not enter the filter drain. Weed growth usually dies in dry weather.	As required
	<u>Remedial Works</u>	
	Siltation at Surface	

#	Description	Frequency
	Where there is no protective geotextile remove all stone and perforated pipe replacing as original Spec. and include separating geotextile as below.	As required
	Where there is a separating geotextile (see Spec.) then remove surface stone layer and separating geotextile that protects the stone drain below. Replace geotextile and top stone layer.	As required
3.	INFILTRATION DEVICES SOAKAWAYS, INFILTRATION TRENCHES AND INFILTRATION BASINS	
	<u>Occasional Tasks</u>	
	Infiltration Basins Where there is a build up of silt in basis at intels, i.e. 50mm or more above the design level then remove when the ground is damp in autumn or early spring and turf to the original design levels. Spread excavated material on site above SuDS design profile, e.g. top of banks, in accordance with E.A. Waste Exemption Guidance. Infiltration Trench Hand pull or spot treat individual weed growth only if necessary, ensuring weedkiller does not enter the drain and inhibit breakdown of pollutants.	As required As required
	<u>Remedial Works</u>	
	Infiltration Basin Where the infiltration basin is compacted then reinstate by removal of silt and decompaction of the surface by scarifying, spiking or the use of hollow tines to the basin area.	As required
4.	INLETS, OUTLETS, CONTROLS, AND INSPECTION CHAMBERS	
	<u>Regular Maintenance</u>	
	Inlets, outlets and surface control structures Inspect surface structures removing obstructions and silt as necessary. Check there is no physical damage.	Monthly

#	Description	Frequency
	Strim vegetation 1m min. surround to structures and keep hard aprons free from silt and debris	Monthly
	Inspection chambers and below ground control chambers Remove cover and inspect ensuring water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt. Undertake inspection after leaf fall in autumn.	Annually
	<u>Occasional Maintenance</u>	
	Check topsoil levels are 20mm above edges of baskets and chambers to avoid mower damage	As necessary
	<u>Remedial Work</u>	
	Unpack stone in basket features and unblock or repair and repack stone as design as necessary.	As required
	Repair physical damage if necessary.	As required
5.	OVERFLOWS AND FLOOD ROUTES	
	<u>Regular Maintenance</u>	
	Overflows Jet pipes leading from overflow structures annually and check by running water through the overflow. Check free flow at next SUDS feature - inlet to basin or chamber.	Annually
	Overflows Remove any accumulated grass cuttings or other debris on top of grass weirs or stone filled baskets overflows.	Monthly
	Flood Routes Make visual inspection. Check route is not blocked by new fences, walls, soil or other rubbish. Remove as necessary.	Monthly
	<u>Remedial Works</u>	
	Overflows	

#	Description	Frequency
	If overflow is not clear then dismantle structure and reassemble to design detail.	As required
6.	ORNAMENTAL PLANTING AND EXISTING VEGETATION	
	<u>Regular Maintenance</u>	
	Grass Maintenance Amenity Grass - Mow all grass verges, paths and amenity grass at 35-50mm with 75mm max. All cuttings to remain in situ.	16 visits
	Rough grass - Mow at 75-100mm but not to exceed 150mm. All cuttings to wildlife piles.	4-8 visits
	Wildflower areas strimmed to 50mm in September-October or Wildflower areas strimmed to 50mm July and September or Wildflower areas strimmed to 50mm or 3 year rotation 30% each year. All cuttings to wildlife piles	1 visit 2 visits 1 visit
	Ornamental tree and shrub planting Weed all shrub beds as detailed spec as necessary. Cut back planting from lights, paths and visibility sight lines in late autumn and as necessary. Cut hedges slightly tapered back from base with flat top at specified height. Do not mulch planting adjacent to permeable/porous paving surfaces.	4 visits

#	Description	Frequency
	Remove stakes and ties from trees when no longer needed for support and within 3 years of planting. Protect from strimmer damage and remove competitive growth until well established.	
	Native trees and shrub planting Prune to shape in year 1. Protect trees from strimmer damage and remove competitive growth until well established. Remove stakes and ties from trees when no longer needed for support and within 3 years from planting.	1 visit
	Existing trees Check existing trees for safety.	1 visit
	<u>Remedial Works</u>	
	Replace trees and shrubs which fall in the first five years after planting. Carry out tree surgery as necessary	

APPENDICES

Operational manuals

- Downstream Defender



Downstream Defender® Select Separator Performance Declaration

Testing carried out according to British Water Code of Practice

Manufacturer: Hydro International Ltd.

Treatment Device Name/Model: Downstream Defender® Select (1.2m)

General description: Downstream Defender® Select is a chamber-based, advanced hydrodynamic vortex separator that reliably captures and retains sediments, oil, trash and floatables from surface water runoff.

Envisaged application: The Downstream Defender® Select separator can be used as a stand-alone SuDS component, giving equivalent performance to detention basins and filter drains, or it may be used in combination with other components as part of a wider SuDS scheme to provide improved performance levels or additional levels of redundancy. It is particularly beneficial in space or access constrained schemes where other systems such as ponds, detention basins and swales would not be feasible or pose health and safety concerns. It can also be used as a replacement to sediment forebays to reduce maintenance requirements of downstream systems.

Pollutant(s) captured: TSS, metals (sediment bound) & hydrocarbons (sediment bound)

Device size / capacity:	1.2m Manhole
Sediment storage capacity:	450 l
Treatment flow rate:	30 l.s ⁻¹
Connectable area:	4,000m ²
Pollutant retention flow rate:	44.5 l.s ⁻¹
Maximum capacity flow rate:	120 l.s ⁻¹
Device head loss (at Treatment flow rate)	0.15m
Device head loss (at Maximum capacity flow rate)	0.5m
Sediment capture and retention efficiency	57.3 %

Dated: (07/03/2022, See test report pages 21-22)

Witnessing party: (FP Environmental Associates)



BRITISH WATER
expertise worldwide

Downstream Defender® Select Separator Performance Declaration

Available Models

Device size / capacity:	1.0m	1.2m	1.5m	1.8m	2.1m	2.4m	3.0m
Sediment storage capacity:	310 l	450 l	710 l	1020 l	1390 l	1810 l	2830 l
Treatment flow rate:	21 l.s ⁻¹	30 l.s ⁻¹	48 l.s ⁻¹	69 l.s ⁻¹	94 l.s ⁻¹	123 l.s ⁻¹	192 l.s ⁻¹
Connectable area:	2,800m ²	4,000m ²	6,400m ²	9,200m ²	12,500m ²	16,400m ²	25,600m ²
Pollutant retention flow rate:	31 l.s ⁻¹	44.5 l.s ⁻¹	70 l.s ⁻¹	100 l.s ⁻¹	136 l.s ⁻¹	178 l.s ⁻¹	278 l.s ⁻¹
Maximum capacity flow rate:	70 l.s ⁻¹	120 l.s ⁻¹	170 l.s ⁻¹	278 l.s ⁻¹	355 l.s ⁻¹	529 l.s ⁻¹	787 l.s ⁻¹
Device head loss (at Treatment flow rate)	0.15m	0.15m	0.22m	0.23m	0.24m	0.25m	0.26m
Device head loss (at Maximum capacity flow rate)	0.5m	0.5m	0.5m	0.5m	0.5m	0.5m	0.5m
TSS Mitigation Index	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Metals Mitigation Index	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Hydrocarbons Mitigation Index	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Downstream Defender® Select

Design Data

The Downstream Defender® Select is the **new generation of advanced hydrodynamic separator** for treatment of urban surface water runoff. Its customisable performance and extended range of chamber sizes allows engineers to tailor their drainage designs to meet specific pollutant removal standards. The Downstream Defender® Select also offers easier installation with much more flexibility of pipe sizes and connections and can accept up to three inlets.



Key Features

- » Selectable performance levels for pollutant targets and retention.
- » Extended range of chamber sizes.
- » Can accept up to three inlet pipes.
- » Can accept a range of pipe sizes.
- » No moving parts and no power requirement.
- » Available in concrete or plastic chambers.

Fig 1. Downstream Defender® Select. **Advanced Vortex** models in concrete and plastic shown with **Hydro-Logic® Smart Monitoring** and **enhanced hydrocarbon (oil) retention options**.

Targeted Pollutant Removal

The Downstream Defender® Select performance can be tailored to remove some or all of the following pollutants:

Sediment (Total Suspended Solids)



The Downstream Defender® Select is a highly effective sediment/TSS removal device. It can be sized in a number of ways to suit the application and level of protection required (see Table 2).

Gross Pollutants



100% removal of floatable debris, such as food wrappers, Styrofoam cups and drinks cartons.

Sediment Bound Hydrocarbons (including Polycyclic Aromatic Hydrocarbons - PAHs)



PAHs have low solubility in water and are readily adsorbed onto sediment particles. Effective removal of sediment particles will also ensure the removal of many PAHs.

Liquid Hydrocarbons (oils)



Effective spill containment device at low flow rates. Note these systems are not considered oil separators according to the BS EN 858-1 and must not be used in applications where full certification is required.

Sediment Bound Heavy Metals and Nutrients



As an efficient device for removal of fine sediment, the Downstream Defender® Select is also effective for the removal of sediment bound pollutants.

Downstream Defender® Select Model Options

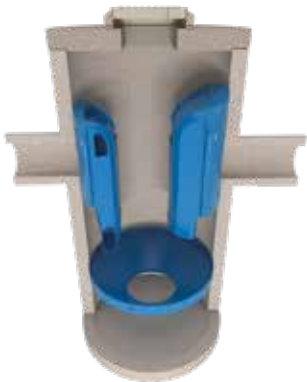
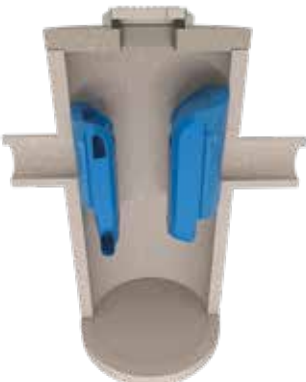
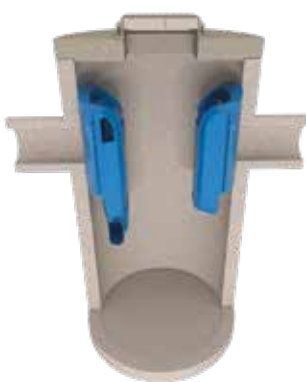
Downstream Defender® Select Model			
	Advanced Vortex Our recommended model which provides sediments, litter and hydrocarbon (oil) removal with enhanced sediment retention up to four times the treatment flow rate. 	Vortex Plus Provides sediments, litter and hydrocarbon (oil) removal, with sediments retained at up to two times the treatment flow rate. 	Vortex A simpler model providing removal of sediments, with retention up to two times the treatment flow rate. 
Key Pollutants			
Sediments	Coarse and fine	Coarse and fine	Coarse and fine
Sediment retention	Retained up to 4 x treatment flow rate	Retained up to 2 x treatment flow rate	Retained up to 2 x treatment flow rate
Litter, debris	✓	✓	✗
Liquid hydrocarbons (oils)	✓	✓	✗
Hydrocarbon (oil) retention	Option for increased retention on request	Option for increased retention on request	✗
Sediment bound metals	✓	✓	✓

Table 1 - Downstream Defender® Select pollutant removal performance

The Downstream Defender® Select may be sized for different target particle sizes and removal efficiencies – contact us for site specific design.

Enhancement Options

Make Maintenance Smart

To help with SuDS maintenance plans and to ensure that maintenance is cost-effective, add Hydro-Logic® Smart Maintenance to any model and get automated maintenance alerts.

The Hydro-Logic® Flexi Logger and ATEX/IECEX sensors capture real-time data for flow levels and/or sediment build-up. Level monitoring will enable the detection of blockages relating to the unit, and sediment level monitoring can be set to a trigger point and self-report to the client's maintenance team when maintenance is due.

✓ Reduce Risk ✓ Save Costs



Fig 2. Downstream Defender® Select Hydro-Logic® Smart Maintenance. Available for all models.

Enhanced Oil Retention

The option of storing hydrocarbons (oils) as solids can be added, providing increased retention, even at flow rates where the unit is bypassing.

This option is available for the **Advanced Vortex** and **Vortex Plus** models only.

The Downstream Defender® Select with Enhanced Media has been tested and witnessed to the Deutsches Institut für Bautechnik (DIBt) protocol for liquid hydrocarbons capture and retention, achieving 98%. The WRc Performance Declaration is available on request.

✓ 98% liquid hydrocarbon retention

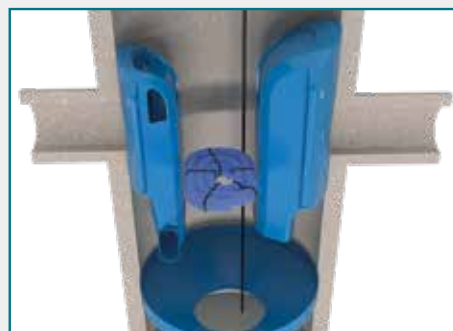


Fig 3. Enhanced hydrocarbon (oil) retention option for the Downstream Defender® Select. Available for the **Advanced Vortex** and **Vortex Plus** models only.

Pollutant Retention

It is important to ensure that pollutants in a rainfall event are retained throughout subsequent events. The Downstream Defender® Select offers engineers the option of specifying the retention performance of sediments. The **Vortex** and **Vortex Plus** models provide sediment retention up to twice the treatment flow rate, and the **Advanced Vortex**, with its benching skirt creating a calm sediment storage zone, provides sediment retention up to four times the treatment flow rate.



Fig 4. Downstream Defender® Select with enhanced sediment retention available for the **Advanced Vortex** model only.

The Simple Index Approach (SIA)

The Simple Index Approach (SIA) outlined in CIRIA C753 The SuDS Manual is a water quality design method for sites with a low to medium risk pollution hazard level. Sites with a high risk pollution hazard level should consider a more precautionary approach.

The approach assigns pollution hazard indices to the given land use for three pollutant groups, total suspended solids (TSS), metals and hydrocarbons. SuDS components are then selected until their combined pollution mitigation index score is greater than the pollution hazard index for each pollutant group.

SIA Performance Claims are only applicable when the Downstream Defender® Select is designed using Table 3 for advanced treatment designs.

Downstream Defender® Select Mitigation Indices ^{(a)(b)}			
Model	Total Suspended Solids (TSS)	Metals	Hydrocarbons (Oils)
Vortex	0.3	0.2	0.2
Vortex Plus	0.5	0.4	0.5 / 0.6 *
Advanced Vortex	0.5	0.4	0.5 / 0.6 *
* 0.6 mitigation index requires hydrocarbon retention media supplied by Hydro International Ltd			
Notes: (a) All mitigation indices supplied by Hydro International Ltd are calculated using the methods laid out in the British Water How To Guide: Applying the CIRIA SuDS Manual Simple Index Approach to Proprietary / Manufactured Stormwater Treatment Devices. The Advanced Vortex and Vortex Plus models have also been independently verified by the WRc, with the WRc Performance Declaration available on request. (b) Mitigation Indices quoted for the Downstream Defender® Select are valid when the unit is designed according to the Treatment Flow Rate (see Table 3).			

Table 2 - SuDS Mitigation Indices for Downstream Defender® Select

Sizing for Advanced Treatment

The Downstream Defender® Select, when designed for advanced treatment, offers an annualised removal efficiency of >50% of all particles up to 1000 microns with a mass-median particle size (D50) of 63 microns and a specific gravity of 2.65.

- Tested to the British Water Code of Practice.
- Calculations third party verified by the WRc.
- Treatment Flow Rate should be greater than or equal to the site's Water Quality Flow Rate.
- Catchment Area is calculated using an assumed M1:15 rainfall intensity of 27 mm/hr or 75 l/s/ha.
- Headloss assumes free discharge.
- Hydraulic capacity should be greater than or equal to the site's Peak Discharge Flow Rate.

Model diameter (m)	Treatment flow rate (l/s)	Catchment Area (m²)	Headloss (mm)
1.0	21	2800	160
1.2	30	4000	170
1.5	48	6400	220
1.8	69	9200	230
2.1	94	12500	240
2.4	123	16000	250
3.0	192	25600	260

Table 3 - Downstream Defender® Select design information for advanced treatment (fine particle removal).

Sizing for Basic Treatment

The Downstream Defender® Select, when designed for basic treatment, offers removal efficiencies for > 80% of particles from 150-350 microns with a mass-median particle size (D50) of 230 microns and a specific gravity of 2.65.

The supporting testing was conducted on a full size 1.2 m unit for flow rates from 10 l/s to 50 l/s.

- Treatment Flow Rate should be greater than or equal to the Water Quality Flow Rate.
- Catchment Area is calculated using an assumed rainfall intensity of 15 mm/hr or 42 l/s/ha and requires an external bypass.
- Alternative rainfall intensities can be used to size your Downstream Defender® Select
- Headloss assumes free discharge.
- Using an external bypass will allow for larger hydraulic capacity in order to exceed the site's Peak Discharge Flow Rate.

Model diameter (m)	Treatment flow rate (l/s)	Catchment Area (m²)	Headloss (mm)
1.0	33	7900	270
1.2	47	11300	280
1.5	74	17800	310
1.8	107	25700	320
2.1	145	34800	340
2.4	189	45400	360
3.0	296	71000	370

Table 4 - Downstream Defender® Select design information for basic treatment (coarse particle removal).

Sizing for Betterment

If there is no treatment objective, the Downstream Defender® Select can be designed by ensuring the hydraulic capacity of the device is greater than the site peak discharge flow rate.

More information on hydraulic capacities for Downstream Defender® Select units can be found on Page 7, Table 6.

Important Sizing Information

The Treatment Flow Rate for Basic Treatment is higher than that for Advanced Treatment. This is due to the much larger particle size distribution used for the testing. Larger particles settle more readily in the drainage network which means that they are more easily captured inside a hydrodynamic vortex separator than finer material.

Though this data is a valid way to size a Downstream Defender® Select, these larger particles are not representative of typical stormwater runoff in the UK, Europe or the USA. Official testing protocols in these regions require strict particle size distribution control during testing to ensure that performance claims are relevant for the application.

Only Downstream Defender® Select units sized according to advanced treatment methods have official particulate metals and sediment-bound hydrocarbons claims. This is because these claims are generated using the guidance in the British Water How To Guide: Applying the CIRIA SuDS Manual Simple Index Approach to Proprietary / Manufactured Stormwater Treatment Devices, which does not consider testing using larger particle size distributions.

Site Configuration

The Downstream Defender® Select can accommodate a change in pipe direction to suit site specific requirements and accept up to three inlet pipes.

Online configuration

An online Downstream Defender® Select will need to be sized to pass all flows during all storm events through the chamber.

The peak flow through an online Downstream Defender® Select is largely dependant on the diameter of the connected pipework.



Fig 5. Downstream Defender® Select - online configuration

Online with external bypass

An online Downstream Defender® Select with an external bypass is common for regions with high peak flows or extended storms. It will bypass the flow from large storm events around the treatment chamber using offset pipework or a weir wall.

The peak flow through this configuration of Downstream Defender® Select is largely dependant on the surrounding drainage layout.

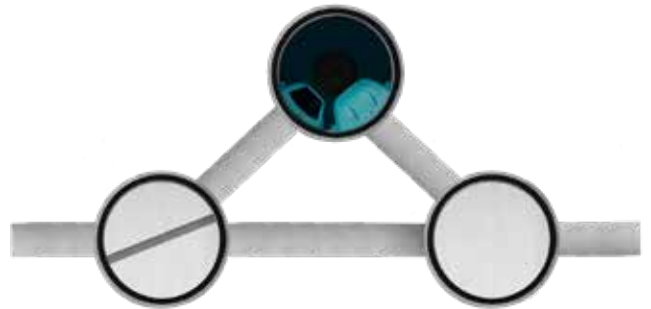


Fig 6. Downstream Defender® Select - external bypass configuration

It is recommended to design an external bypass configuration for catchments where the peak flow rainfall intensity is much larger than the treatment flow rate or average annual rainfall intensity.

Pipework

Pipe angles can be adjusted to suit. Minimum angle between inlets and outlet is 90°. All pipe connections are at the same invert level.

Please contact Hydro International with your requirements.

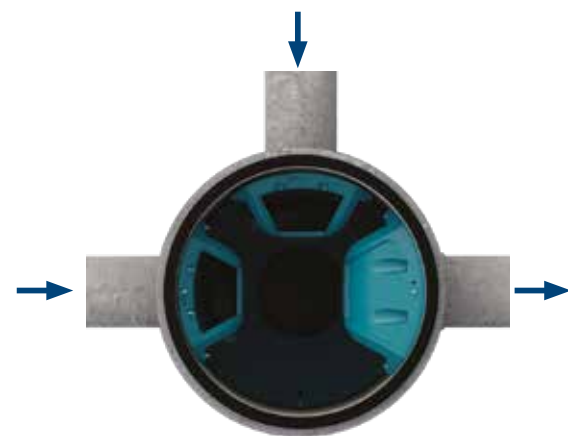


Fig 7. Downstream Defender® Select with two inlets

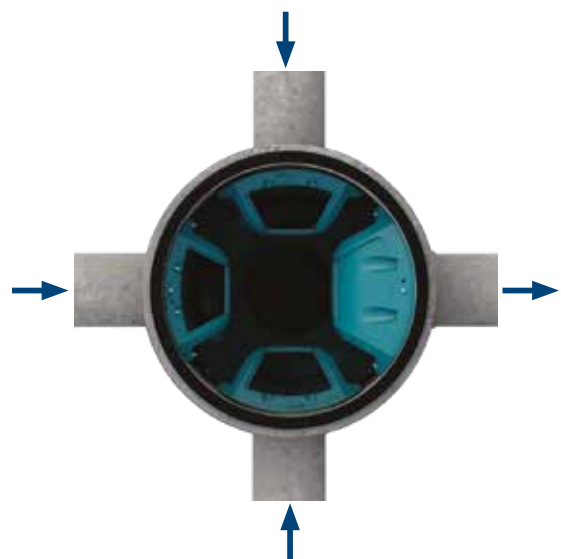


Fig 8. Downstream Defender® Select with three inlets

Pipe Sizes

The Downstream Defender® Select can accept a range of **inlet / outlet pipe** sizes, removing the need for complicated pipe connections or couplers. The inlet pipe size must always be equal to or smaller than the outlet pipe size.

Additional pipe sizes may be accommodated, please contact Hydro International for assistance.

Chamber size	1.0 m	1.2 m	1.5 m	1.8 m	2.1 m	2.4 m	3.0 m
Pipe sizes	150	150	300	375	375	500	600
	225 ^{a)}	225	375 ^{a)}	400	400	600 ^{a)}	675
	300	300 ^{a)}	400	450 ^{a)}	450	675	750 ^{a)}
		375	450	500	500 ^{a)}	750	900
				600	600		
					675		
Notes:							
a) The recommended pipe size for optimum performance.							

Table 5 - Downstream Defender® Select pipe sizes.

Hydraulic Capacity and Peak Flow

The hydraulic capacity or peak flow rate for an online Downstream Defender® Select is the maximum flow rate that can pass through the chamber with a maximum headloss of 500 mm. The peak flow through an online Downstream Defender® Select is largely dependant on the diameter of the connected pipework.

The hydraulic capacity or peak flow rate for an offline for a Downstream Defender Select with an external bypass can be directed around the hydrodynamic vortex separator.

Model diameter (m)	Online hydraulic capacity		External bypass hydraulic capacity ^(a) (l/s)
	with recommended outlet pipe size (l/s)	with maximum outlet pipe size (l/s)	
1.0	46	70	220
1.2	84	107	320
1.5	144	170	500
1.8	217	278	720
2.1	271	355	980
2.4	422	529	1280
3.0	652	787	2000
Notes:			
a) Values calculated using the catchment area for Basic Treatment in Table 3 and an assumed peak rainfall intensity of 101 mm/hr or 280 l/s/ha.			

Table 6 - Downstream Defender® Select approximate hydraulic capacity.

Model diameter (m)	Oil Storage Capacity (l)		Minimum sediment storage capacity ^(c) (m ³)
	Minimum liquid hydrocarbon (oil) storage capacity up to Treatment Flow Rate ^(a)	Solid state storage capacity with enhanced retention option ^(b)	
1.0	256	43-70	0.31
1.2	442	43-70	0.45
1.5	849	85-140	0.71
1.8	1458	85-140	1.02
2.1	2550	128-210	1.39
2.4	3586	170-280	1.81
3.0	6811	231-350	2.83

Notes:

- (a) Liquid oil storage capacity is valid up to the Treatment Flow Rate. Oil capture and retention is only available for the **Advanced Vortex** and **Vortex Plus** models.
- (b) Permanent oil storage capacity is available when using the enhanced oil retention option (available for the **Advanced Vortex** and **Vortex Plus** models only).
- (c) Additional sediment storage capacity for all Downstream Defender[®] Select models (**Advanced Vortex**, **Vortex Plus** and **Vortex**) can be provided to extend maintenance intervals if required.

Table 7 - Downstream Defender[®] Select storage capacities.

Design your own Downstream Defender[®] Select with our Online Design Tool



Register free and design your own Downstream Defender[®] Select and try out different performance objectives.

Project designs can be saved and submitted for a free review by our expert technical team if required. General arrangement drawings and quotes can also be requested from the tool for any saved design.

Visit: hydro-int.design

Maintenance

Periodic removal of captured pollutants is essential to the continuous, long-term functioning of your Downstream Defender® Select. The device will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the Downstream Defender® Select will no longer be able to store removed sediment and oil. Pollutant storage capacities are provided in Table 7.

The frequency of clean-out is determined in the field after installation. During the first year of operation, the unit should be inspected every six months or sooner to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge Judge® can be used to determine the level of accumulated solids stored in the sump.

To enable the provision of maintenance plans for planning applications, a typical maintenance schedule for a Downstream Defender® Select is shown in Table 8.



Activity	Frequency
Inspection	• Regularly during first year of installation. • Every 6 months after the first year of installation
Hydrocarbons (oils) and floatables removal	• Once per year, or as needed with sediment removal. • Following a spill in the drainage area.
Sediment removal	• As and when alerted by the Hydro-Logic® Smart Maintenance system, or • At intervals as determined by the first year's inspections • Following a spill in the drainage area.
Note: For most clean-outs it is not necessary to remove the entire volume of liquid in the vessel. Only removing the first few inches of oils/floatables and the sediment storage volume is required.	

Table 8 - Typical maintenance schedule for a Downstream Defender® Select

We can provide full inspection and maintenance services for the Downstream Defender® Select, as well as for any other Sustainable Drainage Systems (SuDS) on your site - providing peace of mind and saving you time and money.

For more information, please call 01275 878371 or email sudservices@hydro-int.com

Dimensions and Weights for Concrete Chambers

Material	Chamber Diameter Internal - mm (A)	Chamber Diameter External - mm (includes base slab and any extrusions) (B)	Recommended Inlet and Outlet Pipe Internal Diameter- mm ¹ (E)	Minimum Depth to Invert - mm ² (C)	Total Chamber Height Including cover - mm ³ (D)	Maximum Component Lift Weight - kg ⁴
Concrete	1050	1420	225	840	2390	2770
Concrete	1200	1460	300	1074	2831	2320
Concrete	1500	1760	375	1227	3276	3530
Concrete	1800	2160	450	1440	4090	5250
Concrete	2100	2650	500	1500	4364	6670
Concrete	2400	2950	600	2047	5375	8600
Concrete	3000	3480	750	1915	5437	14080

Notes:

- (1) Recommended inlet and outlet pipe internal diameter. For alternative pipe sizes to allow for easier connections, please see Table 5.
- (2) Minimum depth to invert shown. Depth to invert can be increased if required.
- (3) Minimum chamber depth shown. Additional sediment storage capacity or increased depth to invert can be provided if required. Total chamber height for concrete units **includes** the cover slab.
- (4) Maximum component weight is based on a single inlet and includes internal components.

Table 9 - Downstream Defender® Select dimensions and weights for concrete chambers

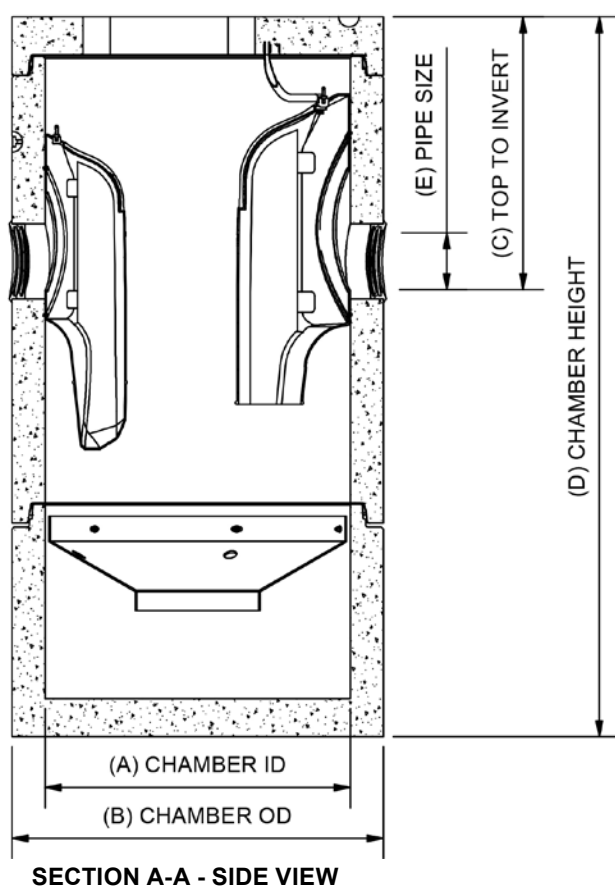


Fig 9. Downstream Defender® Select concrete chamber dimension drawing.

For General Arrangement drawings please email stormwater@hydro-int.com or submit a request at hydro-int.design

Dimensions and Weights for Plastic Chambers

Material	Chamber Diameter Internal - mm (A)	Chamber Diameter External - mm (includes base slab and any extrusions) ⁵ (B)	Recommended Inlet and Outlet Pipe Internal Diameter- mm ¹ (E)	Minimum Depth to Invert - mm ² (C)	Total Chamber Height Including cover - mm ³ (D)	Maximum Component Lift Weight - kg ⁴
HDPE Single Wall	1030	1282	225	662	2012	125
HDPE Single Wall	1200	1435	300	900	2512	170
HDPE Single Wall	1500	1735	375	1036	3012	240
HDPE Single Wall	1800	2317	450	1220	3490	410
HDPE Single Wall	2100	2630	500	1350	3920	750
HDPE Single Wall	2400	2930	600	1620	4440	950
HDPE Single Wall	3000	3530	750	1700	5270	1200

Notes:

- (1) Recommended inlet and outlet pipe internal diameter. For alternative pipe sizes to allow for easier connections, please see Table 5.
- (2) Minimum depth to invert shown. Depth to invert can be increased if required.
- (3) Minimum chamber depth shown. Additional sediment storage capacity or increased depth to invert can be provided if required. Total chamber height for plastic units **excludes** the cover slab.
- (4) Maximum component weight is based on a single inlet and includes internal components.
- (5) Maximum external diameter includes lifting lugs and base slab.

Table 10 - Downstream Defender® Select dimensions and weights for plastic chambers

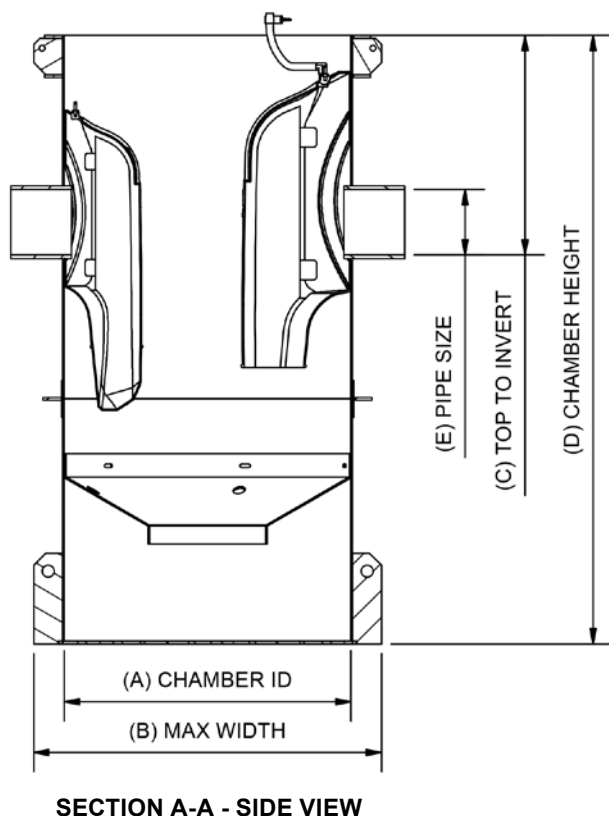


Fig 10. Downstream Defender® Select plastic chamber dimension drawing.

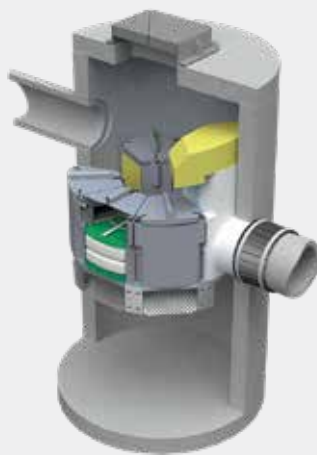
For General Arrangement drawings please email stormwater@hydro-int.com or submit a request at hydro-int.design

Our Full Range of Stormwater Treatment Solutions

We have a range of stormwater treatment devices to treat stormwater flows of varying quality. All our solutions can work alongside, enable or enhance natural SuDS, helping to meet or improve on biodiversity and amenity targets.



[Downstream Defender® Select](#)



[Up-Flo™ Filter](#)



[Hydro Biofilter™](#)

Product		Description	Targeted pollutants						
			Sediments		Litter, debris	Liquid hydrocarbons	Sediment bound hydrocarbons, nutrients and heavy metals	Dissolved metals	Nutrients
Downstream Defender® Select	Vortex	Vortex separator	Coarse & fine	Retained up to 2 x treatment flow rate	✗	✗	✓	✗	✗
	Vortex Plus	Vortex plus separator	Coarse & fine	Retained up to 2 x treatment flow rate	✓	✓ Option for increased retention on request	✓	✗	✗
	Advanced Vortex	Advanced hydrodynamic vortex separator	Coarse & fine	Retained up to 4 x treatment flow rate	✓	✓ Option for increased retention on request	✓	✗	✗
Up-Flo™ Filter	Sand	Fluidised bed up flow filtration system with Sand media	Very fine sediment		✓	✓	✓	✗	✓
	CPZ	Fluidised bed up flow filtration system with CPZ media	Very fine sediment		✓	✓	✓	✓	✓
Hydro Biofilter™		Biofiltration system	Very fine and dissolved sediments		✓	✓	✓	✓	✓

To find out more about our range of stormwater treatment solutions visit hydro-int.com.

[Downstream Defender® Select](#)

[Up-Flo™ Filter](#)

[Hydro Biofilter™](#)

Patent: www.hydro-int.com/patents

Tel: +44 (0)1275 337937

stormwater@hydro-int.com

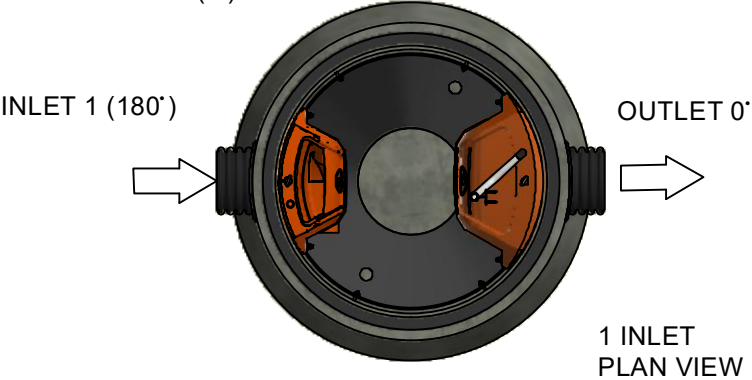
Hydro International
Unit 2, Rivermead Court, Kenn Business Park
Windmill Road, Kenn, Clevedon, BS21 6FT

hydro-int.com

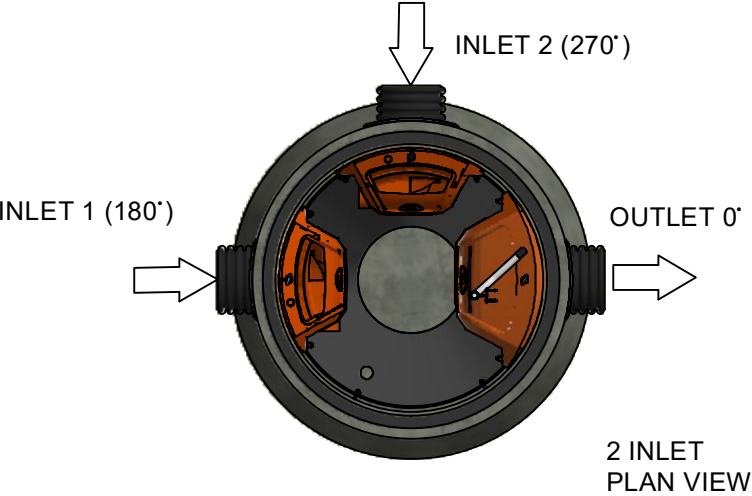
Downstream Defender® Select Design Data H/0225

PIPEWORK SHOWN FOR ILLUSTRATION PURPOSES

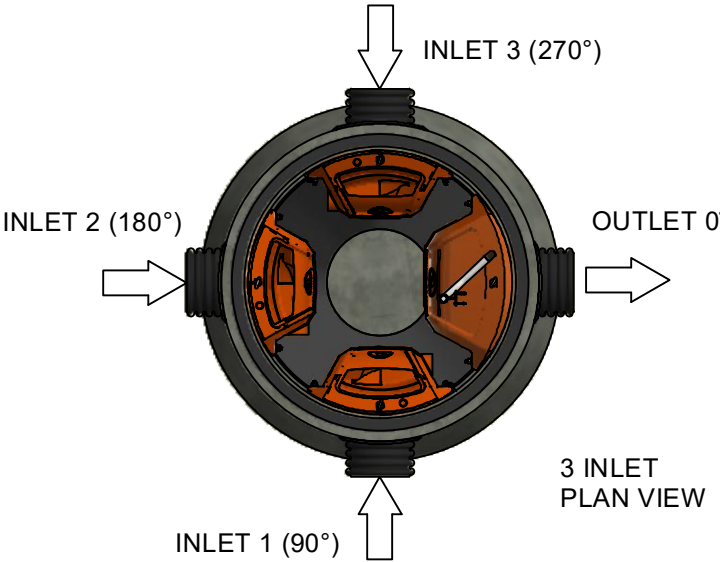
SINGLE INLET
THE INLET CAN BE POSITIONED AT ANY ANGLE BETWEEN 90°-270°
FROM THE OUTLET (0°)



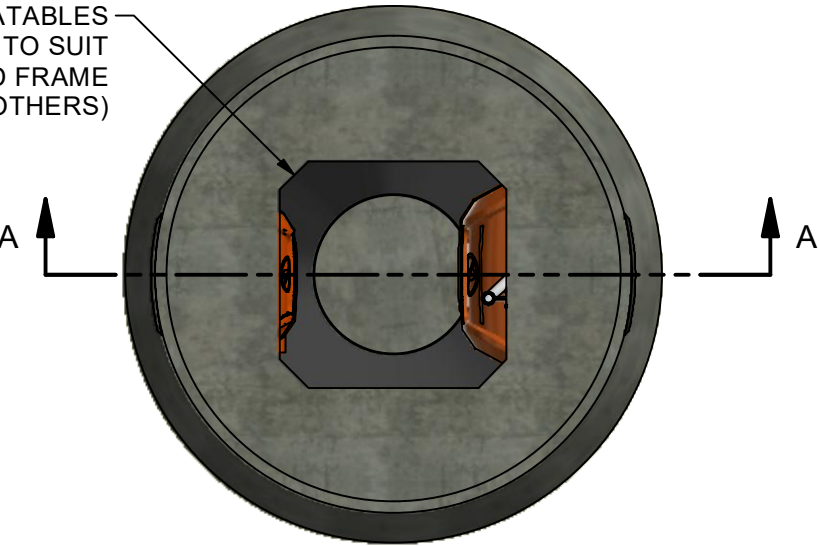
DUAL INLET
THE SECOND, INLET 2, CAN BE POSITIONED 90°-270° FROM THE
OUTLET (0°), BUT MUST BE AT LEAST 90° FROM INLET 1



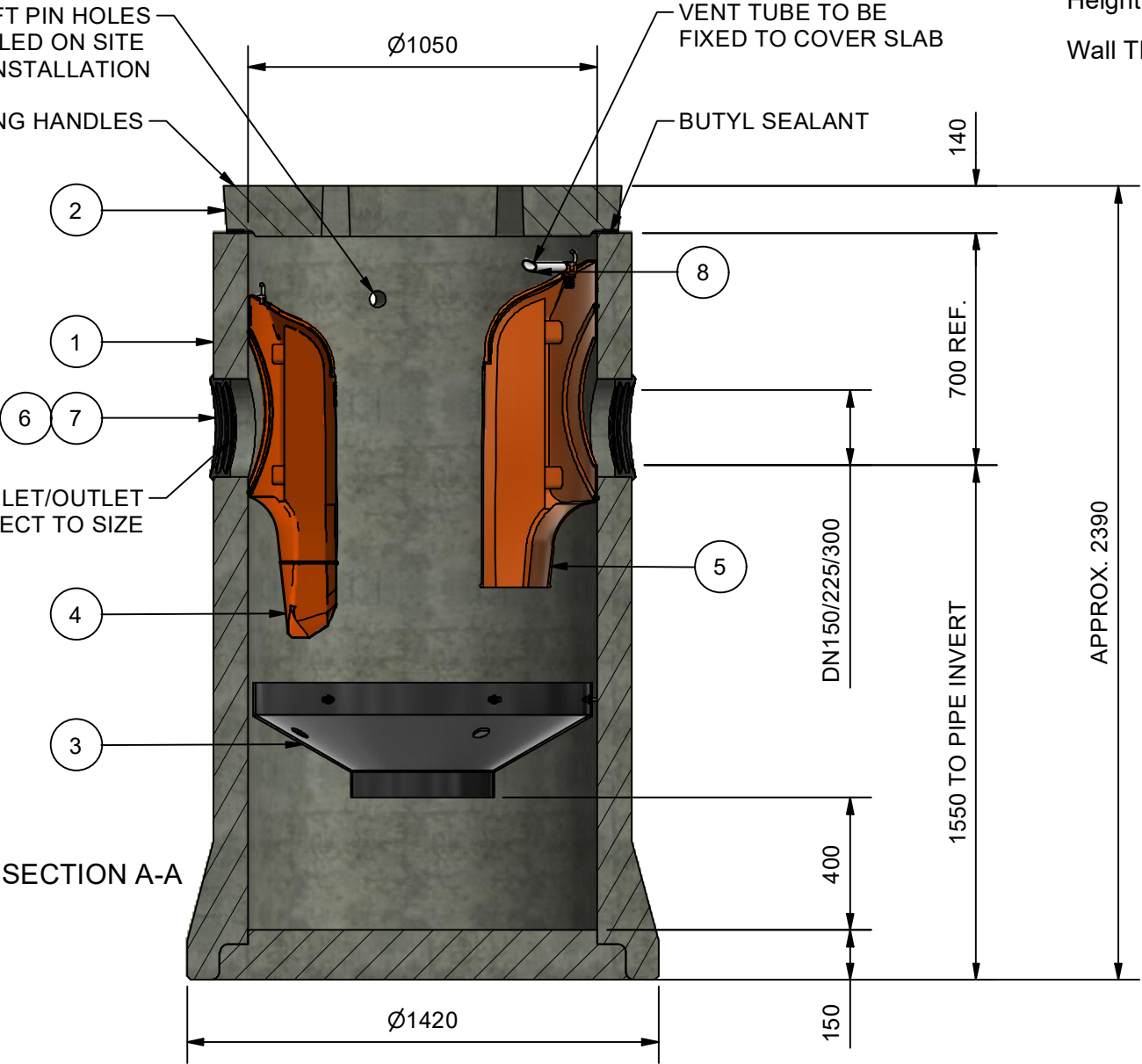
TRIPLE INLET
ALL CHUTES TO BE 90° APART - AS SHOWN IN ILLUSTRATION



ACCESS HOLE FOR FLOATABLES
AND SEDIMENT REMOVAL TO SUIT
600x600 COVER AND FRAME
(BY OTHERS)



3 x 50mm DIAMETER LIFT PIN HOLES
TO BE SEALED ON SITE
AFTER INSTALLATION
3 x LIFTING HANDLES



PARTS LIST		
ITEM	DESCRIPTION	MASS
1	Concrete Chamber	2750.0 kg
2	Cover Slab	270.0 kg
3	Benching Skirt	6.6 kg
4	Inlet Chute	5.4 kg
5	Outlet Hood	7.2 kg
6	DN150/225/300 Pipe Connection	
7	Forsheda F910 Seal	
8	PVC Flexible Hose Assembly	.1 kg

Note:
1. Angles can be adjusted to suit.
Minimum angle between inlets and outlet is 90°.
2. Maximum number of inlets is 3.
3. Allowable concrete chamber dimensional
variations:
Height ± 4%, Diameter ± 8mm,
Wall Thickness ± 8mm

REVISION HISTORY					
REV	BY	CHK	APP	DESCRIPTION	DATE
C	KP	BG	CG	COLOURS UPDATED. NOTES AMMEDED.	17/01/2023
B	JM	CG	RWB	CHUTES REMODELED	06/07/2022



IF IN DOUBT ASK

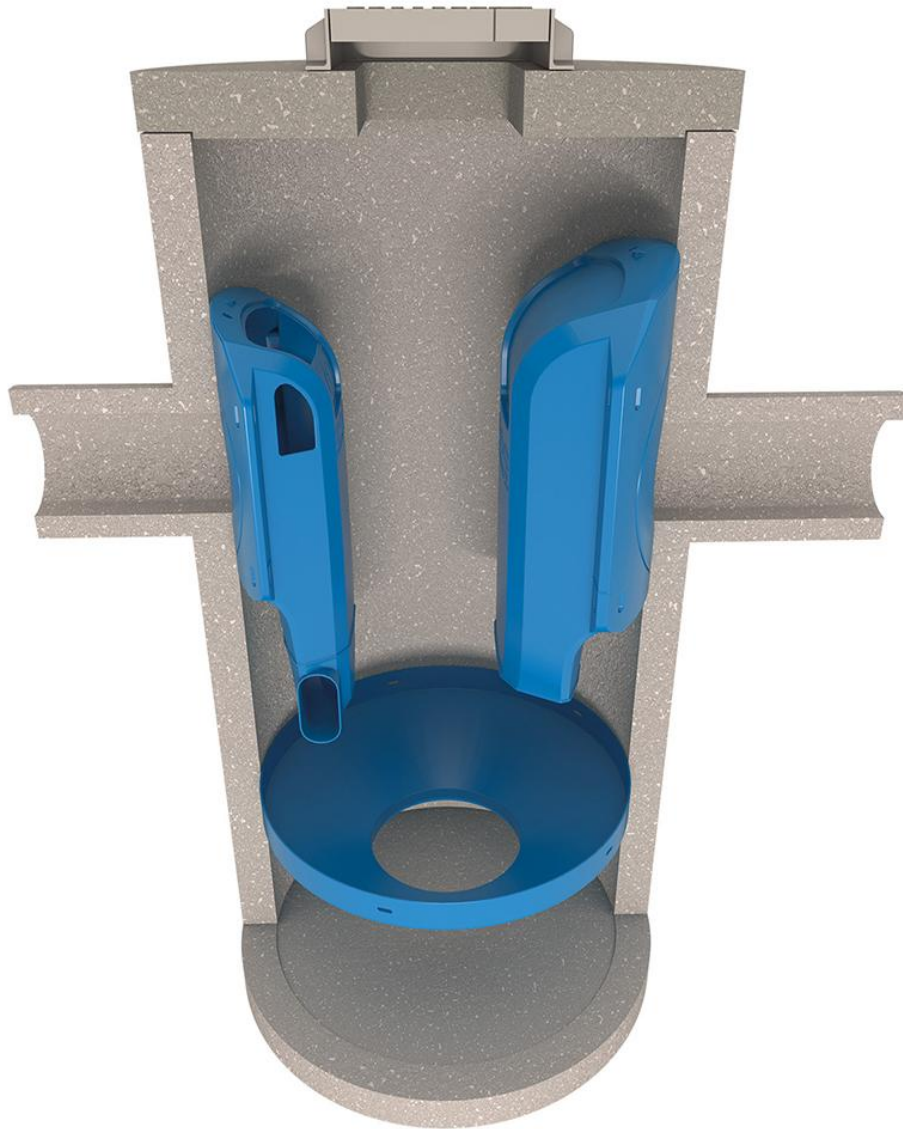
DATE: 06/07/2022		SCALE: 1:30	
DRAWN BY: KP	CHECKED BY: CG	APPROVED BY RWB	

Title
XXXXProject

Downstream Defender Select 1000
Concrete, Advanced Vortex

Hydro
International
hydro-int.com
©2022 HYDRO INTERNATIONAL

WEIGHT: N/A		MATERIAL:	
STOCK NUMBER:			
DRAWING NO.: XXXXPROJECT-1000CAV			
SHEET SIZE: A3	SHEET: 1 OF 1		Rev: C



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DISCLAIMER: Information and data contained in this manual is exclusively for the purpose of assisting in the operation and maintenance of Hydro International's Downstream Defender® Select. No warranty is given nor can liability be accepted for use of this information for any other purpose. Hydro International have a policy of continuous product development and reserve the right to amend specifications without notice

Downstream Defender® Select Operation & Maintenance Manual

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Your Downstream Defender® Select

Your Downstream Defender® Select Advanced Vortex is a **new generation of advanced hydrodynamic vortex separator** for treatment of urban surface water runoff.

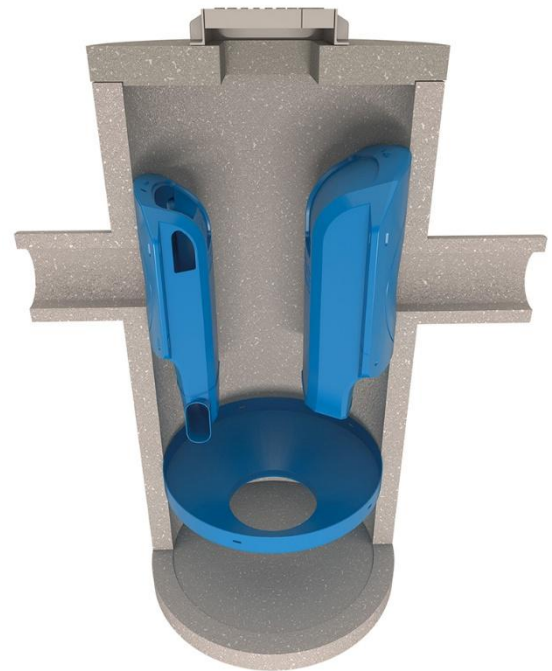
It has been developed from extensive full-scale testing, CFD modelling, and over forty years of hydrodynamic separation experience in wastewater, combined sewer and stormwater applications.

Your unit has been specifically sized and configured to meet the stormwater quality objectives for your site.

Specification

Downstream Defender Select® Advanced Vortex separator in a concrete chamber with enhanced sediment retention.

Your Downstream Defender® Select Advanced Vortex separator will remove and retain pollutants including:



Targeted Pollutants



Fine particles

**Heavy
Metals**

Liquid and sediment
bound heavy metals



Gross pollutants

Nutrients

Liquid and sediment
bound nutrients



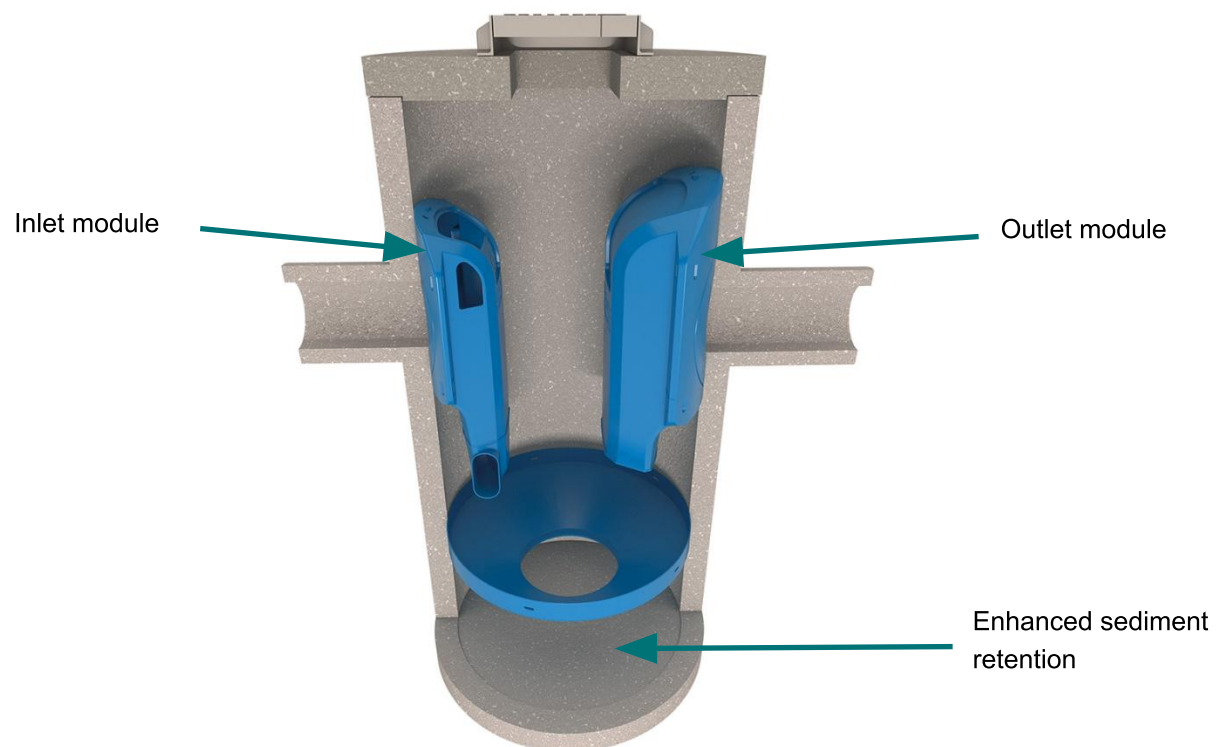
Liquid and sediment
bound hydrocarbons
(oils)

How it works

The Downstream Defender® Select uses fluid hydraulics to remove materials from water. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components.

It has unique, flow-modifying internal components that deliver high removal efficiencies with minimal turbulence and head-losses, enhancing separation and preventing washout of previously stored pollutants. Your unit also provides enhanced sediment retention for up to four times the treatment flow rate.

- 1) Stormwater is introduced into the side of the chamber via the inlet chute, generating a rotating flow.
- 2) Oils litter and floatable debris rise to the water surface and are retained in the floatables storage volume.
- 3) As the flow continues to spiral down the chamber, low energy vortex motion directs sediment inward along the benching skirt and into the protected sediment storage zone.
- 4) The flow then rotates back up the chamber and is discharged via the outlet hood.



Benefits of the Downstream Defender® Select

Assured Performance

Your Downstream Defender® Select has been design engineered and then independently tested to provide validation of performance.

Compact and space-saving

With no moving parts and a small footprint, your Downstream Defender® Select is a compact and economical solution for the treatment of non-point source pollution.

Repeatable, Reliable Performance

Your Downstream Defender® Select will deliver high removal of pollutants through advanced hydrodynamic vortex separation across a wide range of flows, achieving a long stable flow path to maximise pollutant capture from surface runoff.

It is able to tackle an assortment of pollutants including gross debris, litter, hydrocarbons (oils), coarse sediments, fine sediments and particulate organics.

No Risk of Pollutant Wash Out

Your Downstream Defender® Select is proven to prevent wash out of captured sediments up to four times the treatment flow rate. Carefully designed internal components isolate the pollution storage areas ensuring what is captured is retained, even during high flows.



Prevent washout of hydrocarbons (oils)

Find out how to upgrade your
Downstream Defender® Select
with enhanced hydrocarbon (oil) retention

Call us today on 01275 337937



Simple and straight-forward maintenance

The Downstream Defender® Select has been designed to allow for easy and safe access for inspection/monitoring and clean-out procedures. Entry into the unit or removal of the internal components is not necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

The sump of the Downstream Defender® Select retains a standing water level between storm events and prevents stored sediment from solidifying in the base of the unit.

Maintenance

Overview

Periodic removal of captured pollutants is essential to the continuous, long-term functioning of your Downstream Defender® Select. During the first year following installation it is recommended that inspections are undertaken regularly in order to establish a schedule for maintenance. Maximum pollutant storage capacities are provided in Table 1.

Your Downstream Defender® Select is designed for easy and safe inspection, monitoring and clean-out. A suitable Jet Vac truck or Vacuum Tanker is used to remove captured sediment and floatables.

Maintenance events may include hydrocarbons (oils), floatables and sediment removal. These can be removed safely from the surface, no entry into the Downstream Defender® Select is required. The internal components of the Downstream Defender® Select do not need to be removed as the jet / vacuum hose can access the full depth of the unit through the centre of the chamber.

Notes:

- If the system doesn't undergo periodic maintenance the sediment in the sump may consolidate and could require use of a high pressure jetter to break it up before vacuum emptying.
- We would only recommend a fully competent person to carry out maintenance and inspections on our units.

We can provide full inspection and maintenance services for your Downstream Defender® Select, as well as for any other Sustainable Drainage Systems on your site – providing peace of mind and saving you time and money.

To find out more about our services, please call +44 (0)1275 878371 or email us at sudsservices@hydro-int.com.



Cut costs by making your maintenance smart

Add **Hydro-Logic® Smart Maintenance**
to your Downstream Defender® Select to get automated
maintenance alerts

Call us today on 01275 337937



Downstream Defender® Select capacities

Unit Diameter (m)	Total Sediment Storage Capacity in Chamber (m³)	Hydrocarbon (Oil) Storage Capacity (L)	Permanent Hydrocarbon (Oil) Storage with enhanced retention option (L)
1	0.31	256	9-12
1.2	0.45	442	18-24
1.5	0.71	849	27-36
1.8	1.02	1458	36-48
2.1	1.39	2250	45-60
2.4	1.81	3586	63-84
3	2.83	6811	90-120

Table 1. Downstream Defender® Select Pollutant Storage Capacities

Maintenance at a glance

Activity	Frequency
Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Oil and Floatables Removal	- Once per year, or as needed with sediment removal - Following a spill in the drainage area
Sediment Removal	- At intervals established by the inspections during the first year of installation. - Following a spill in the drainage area
NOTE: For most cleanouts it is not necessary to remove the entire volume of liquid in the vessel. Only removing the first few inches of oils/floatables and the sediment storage volume is required.	

Service - oil, floatables and sediment removal

Hydrocarbons (oils) and floatables cleanout is typically done in conjunction with sediment removal. A suitable Jet Vac truck or Vacuum Tanker is used to remove captured sediment and liquid hydrocarbons (oils) and floatables.

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a suction hose and skimmer pole to be lowered to the base of the sump.

Scheduling

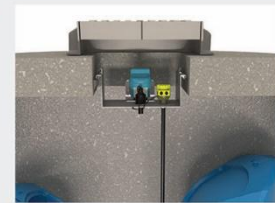
- Floatables and sump cleanout are typically conducted once a year during any season.
- If volume of sediment is greater than 75% of maximum clean-out volumes stated in Table 1, sediment removal is required.
- **IMPORTANT** – Hydrocarbons (oils), floatables and sump sediment cleanout should occur **as soon as possible** following a spill in the contributing drainage area.



Cut costs by making your maintenance smart

Add **Hydro-Logic® Smart Maintenance**
to your Downstream Defender® Select to get automated
maintenance alerts

Call us today on 01275 337937



Recommended Equipment

- Suitable Safety Equipment and Personal Protective Equipment (PPE) for the task and the working environment.
- Suitable lifting tool to lift/remove the grate or lid.
- Pole with skimmer or net.
- Sediment / Level Probe.
- A task suitable Jet Vac truck or Vacuum Tanker. (Suitability will be determined by available vehicle access points, required suction lift and Downstream Defender® Select size). The suction hose to be at least 6-inch diameter.
- Downstream Defender® Select Service Report Log.

Oil, floatables and sediment clean out guidance procedures

- 1) Set up and establish a safe working area with all necessary and appropriate warning signage to comply with legislation and any site-specific requirements. Protect with suitable safety equipment the Access Cover(s) of the Downstream Defender® Select, all activity to comply with task and location Health and Safety requirements.
- 2) Remove the Access Cover(s) to the Downstream Defender® Select.
- 3) Without entering the vessel, look down into the chamber to inspect the inside. Make note and take photographic evidence of any irregularities.
- 4) Using a sediment / level probe, measure the depth of the retained oil and floatable levels and also measure the depth of sediment that has collected in the sump of the vessel and record it in the Service Report Log.
- 5) Also record and take photographic evidence of any apparent irregularities such as damaged components or blockages.
- 6) Carefully remove any hydrocarbons (oils) and floatables stored on the surface of the water with the suction hose and/or the skimmer net.
- 7) Once all hydrocarbons (oils) and floatables have been removed, wash down the Downstream Defender® Select Internal components, this process will also enhance visual inspection. Following wash down carefully lower the suction hose into the chamber to the base of the sump and suck out the sediment and gross debris off the sump floor.
- 8) Carefully retract the suction hose from the vessel and then re-charge the Downstream Defender® Select with filtered and decontaminated grey water or if this is not possible with clean water. The Downstream Defender® Select must be filled to the connecting pipework inverts to complete the service. This requirement is to ensure the Downstream Defender® Select operates correctly.
- 9) Fully reinstate the area ensuring that it is clean and free from any litter or contamination and that all tools, equipment, safety protection and warning signage is removed. (A photo of the full working area is recommended to evidence satisfactory completion of activity).
- 10) Notify us of any irregularities noted during inspection by calling us on **+44 (0)1275 878371** or emailing us at sudsservices@hydro-int.com.

Downstream Defender® Select installation log

Hydro International Reference Number							
Site Name							
Site Location							
Owner		Contractor					
Contact Name		Contact Name					
Company Name		Company Name					
Address		Address					
Telephone		Telephone					
Fax		Fax					
Installation Date							
Model size (circle one)	1M	1.2M	1.5M	1.8M	2.1M	2.4M	3M
Inlet type(s)							

Downstream Defender® Select installation location record

Site Map	
Site Plan (include vehicle restrictions and lift heights)	

Photo 1

Photo 2

Downstream Defender® Select inspection and maintenance log

(Master Performance Control Record)

Date	Initials	Oil Depth Measured (mm)	Volume of Floatables (m ³)	Sediment Depth Measured (mm)	Volume of Sediment Removed (m ³)	Site Activity and Comments

Downstream Defender® Select service report log

Hydro Reference Number	Date of Service	Servicer (Company Initials)	Oil Depth Measured (mm)	Volume of Floatables (m ³)	Sediment Depth Measured (mm)	Volume of Sediment Removed (m ³)
Photo Evidence			Supporting Observation, Comments and Activity Record			

Contact

We are committed to excellence in water management, and we want to make sure that you are fully supported throughout your system's lifetime.

If you would like to discuss the operation and maintenance of your Downstream Defender® Select or would like to learn more about how we can help you to optimise and maintain your sustainable drainage assets to ensure effective, long-term environmental compliance, please contact one of our support specialists:

Tel: +44 (0)1275 878371

Email: sudsservices@hydro-int.com
hydro-int.com



Surface Water Treatment Device Performance Declaration

Testing carried out according to British Water Code of Practice

Product Details	Description
Manufacturer	Hydro International
Treatment Device Name/Model	Downstream Defender [®] Select
General description	The Downstream Defender [®] Select is designed for treatment of urban stormwater runoff.
Envisaged application	Device for pollutant capture and retention.
Pollutant(s) captured	TSS, Metals, Hydrocarbons.

Parameter	Value							Unit
Device size (Internal Diameter)	1	1.2*	1.5	1.8	2.1	2.4	3	m
Sediment storage capacity	310	450	710	1020	1390	1810	2830	l
Treatment flow rate	21	30	48	69	94	123	192	l/s
Connected area	2800	4000	6400	9200	12500	16400	25600	m ²

Parameter	Value							Unit
Pollution retention flow rate	31	44.5	70	100	136	178	278	l/s
Maximum capacity flow rate	70	120	170	278	355	529	787	l/s
Device head loss (at treatment flow rate)	0.15	0.15	0.22	0.23	0.24	0.25	0.26	m
Device head loss (at maximum capacity treatment flow rate)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	m
TSS capture and retention efficiency	57.3							%

TSS mitigation index**	0.5
Metals mitigation index**	0.4
Hydrocarbon mitigation index**	0.5

* Test Report and calculations for the 1.2m Downstream Defender® Select were investigated to verify their compliance with the British Water Code of Practice for the Assessment of Manufactured Treatment Devices Designed to Treat Surface Water Runoff. To ensure similar performance indices were achieved at varying device model sizes, the scaling protocols from section 6.1 of the British Water How to Guide: Applying the CIRIA The SuDS Manual (C753) Simple Index Approach to Proprietary / Manufactured Stormwater Treatment Devices were followed.

** Extrapolated value in accordance with British Water How to Guide: Applying the CIRIA The SuDS Manual (C753) Simple Index Approach to Proprietary / Manufactured Stormwater Treatment Devices. Version 7, Section 4.3, (2021 - under pre-publication review).

Witnessing party: Abdullah Saudagar
Position: Graduate Engineer
Company: Water Research Centre Ltd

Signed:



Date: 05/09/2022



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