Operation and Maintenance Manual

First Defense® and First Defense® High Capacity

Vortex Separator for Stormwater Treatment
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I. First Defense® by Hydro International

Introduction
The First Defense® is an enhanced vortex separator that combines an effective and economical stormwater treatment chamber with an integral peak flow bypass. It efficiently removes total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captured pollutants. The First Defense® is available in several model configurations (refer to Section II. Model Sizes & Configurations, page 4) to accommodate a wide range of pipe sizes, peak flows and depth constraints.

Operation
The First Defense® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The First Defense® has been designed to allow for easy and safe access for inspection, monitoring and clean-out procedures. Neither entry into the unit nor removal of the internal components is necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

Pollutant Capture and Retention
The internal components of the First Defense® have been designed to optimize pollutant capture. Sediment is captured and retained in the base of the unit, while oil and floatables are stored on the water surface in the inner volume (Fig.1).

The pollutant storage volumes are isolated from the built-in bypass chamber to prevent washout during high-flow storm events. The sump of the First Defense® retains a standing water level between storm events. This ensures a quiescent flow regime at the onset of a storm, preventing resuspension and washout of pollutants captured during previous events.

Accessories such as oil absorbent pads are available for enhanced oil removal and storage. Due to the separation of the oil and floatable storage volume from the outlet, the potential for washout of stored pollutants between clean-outs is minimized.

Applications
• Stormwater treatment at the point of entry into the drainage line
• Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
• Retrofit installations where stormwater treatment is placed on or tied into an existing storm drain line
• Pretreatment for filters, infiltration and storage

Advantages
• Inlet options include surface grate or multiple inlet pipes
• Integral high capacity bypass conveys large peak flows without the need for “offline” arrangements using separate junction manholes
• Proven to prevent pollutant washout at up to 500% of its treatment flow
• Long flow path through the device ensures a long residence time within the treatment chamber, enhancing pollutant settling
• Delivered to site pre-assembled and ready for installation
II. Model Sizes & Configurations

The First Defense® inlet and internal bypass arrangements are available in several model sizes and configurations. The components of the First Defense®-4HC and First Defense®-6HC have modified geometries as to allow greater design flexibility needed to accommodate various site constraints.

All First Defense® models include the internal components that are designed to remove and retain total suspended solids (TSS), gross solids, floating trash and hydrocarbons (Fig.2a - 2b). First Defense® model parameters and design criteria are shown in Table 1.

First Defense® Components
1. Built-In Bypass
2. Inlet Pipe
3. Inlet Chute
4. Floatables Draw-off Port
5. Outlet Pipe
6. Floatables Storage
7. Sediment Storage
8. Inlet Grate or Cover

Contact Hydro International when custom sediment storage capacity is required.
Contact Hydro International when larger pipe sizes are required.

Minimum distance for models depends on pipe diameter.

Fig.2a) First Defense®-4 and First Defense®-6; b) First Defense®-4HC and First Defense®-6HC, with higher capacity dual internal bypass and larger maximum pipe diameter.

III. Maintenance

Overview

The First Defense® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the First Defense®. The First Defense® 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 First Defense® will no longer be able to store removed sediment and oil. Maximum pollutant storage capacities are provided in Table 1.

The First Defense® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole. Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the First Defense®, nor do they require the internal components of the First Defense® to be removed. In the case of inspection and floats removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

Maintenance Equipment Considerations

The internal components of the First Defense®-HC have a centrally located circular shaft through which the sediment storage sump can be accessed with a sump vac hose. The open diameter of this access shaft is 15 inches in diameter (Fig.3). Therefore, the nozzle fitting of any vactor hose used for maintenance should be less than 15 inches in diameter.

Determining Your Maintenance Schedule

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 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. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil / flotables removal, for a 6-ft First Defense® typically takes less than 30 minutes and removes a combined water/oil volume of about 765 gallons.

Table 1.

<table>
<thead>
<tr>
<th>First Defense® High Capacity Model Number</th>
<th>Diameter</th>
<th>Treatment</th>
<th>Peak Online Flow Rate</th>
<th>Maximum Pipe Diameter</th>
<th>Oil Storage Capacity</th>
<th>(V_p^2) (m²)</th>
<th>(D_m) (m)</th>
<th>(D_r) (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FD-3HC</td>
<td>3 / 0.9</td>
<td>0.85 / 24.0</td>
<td>15 / 424</td>
<td>18 / 457</td>
<td>125 / 473</td>
<td>0.4 / 0.3</td>
<td>2.0 - 3.5</td>
<td>0.6 - 1.0</td>
</tr>
<tr>
<td>FD-4HC</td>
<td>4 / 1.2</td>
<td>1.50 / 42.4</td>
<td>18 / 510</td>
<td>24 / 600</td>
<td>191 / 723</td>
<td>0.7 / 0.5</td>
<td>2.3 - 3.9</td>
<td>0.7 - 1.2</td>
</tr>
<tr>
<td>FD-5HC</td>
<td>5 / 1.5</td>
<td>2.35 / 66.2</td>
<td>20 / 566</td>
<td>24 / 609</td>
<td>300 / 1135</td>
<td>1.1 / 0.8</td>
<td>2.5 - 4.5</td>
<td>0.7 - 1.3</td>
</tr>
<tr>
<td>FD-6HC</td>
<td>6 / 1.8</td>
<td>3.38 / 95.7</td>
<td>32 / 906</td>
<td>30 / 750</td>
<td>496 / 1878</td>
<td>1.6 / 1.2</td>
<td>3.0 - 5.1</td>
<td>0.9 - 1.6</td>
</tr>
<tr>
<td>FD-7HC</td>
<td>7 / 2.1</td>
<td>4.60 / 130.2</td>
<td>40 / 1133</td>
<td>42 / 1067</td>
<td>750 / 2839</td>
<td>2.1 / 1.9</td>
<td>3.0 - 5.5</td>
<td>0.9 - 1.7</td>
</tr>
<tr>
<td>FD-8HC</td>
<td>8 / 2.4</td>
<td>6.00 / 169.9</td>
<td>50 / 1415</td>
<td>48 / 1219</td>
<td>1120 / 4239</td>
<td>2.8 / 2.1</td>
<td>3.0 - 6.0</td>
<td>0.9 - 1.8</td>
</tr>
</tbody>
</table>

*a Contact Hydro International when larger pipe sizes are required.
*b Contact Hydro International when custom sediment storage capacity is required.
*c Minimum distance for models depends on pipe diameter.

Fig.3 The central opening to the sump of the First Defense®-HC is 15 inches in diameter.
Inspection Procedures

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. Fig. 4 shows the standing water level that should be observed.

4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the components and water surface.

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel.

6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

7. Securely replace the grate or lid.

8. Take down safety equipment.

9. Notify Hydro International of any irregularities noted during inspection.

Floatables and Sediment Clean Out

Floatables clean out is typically done in conjunction with sediment removal. A commercially or municipally owned sump vac is used to remove captured sediment and floatables (Fig 5).

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 vactor hose and skimmer pole to be lowered to the base of the sump.

Scheduling

• Floatables and sump clean out are typically conducted once a year during any season.

• Floatables and sump clean out should occur as soon as possible following a spill in the contributing drainage area.

Recommended Equipment

• Safety Equipment (traffic cones, etc)

• Crow bar or other tool to remove grate or lid

• Pole with skimmer or net (if only floatables are being removed)

• Sediment probe (such as a Sludge Judge®)

• Vactor truck (flexible hose recommended)

• First Defense® Maintenance Log

Maintenance at a Glance

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regularly during first year of installation</td>
<td></td>
</tr>
<tr>
<td>Every 6 months after the first year of installation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Oil and Floatables Removal</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once per year, with sediment removal</td>
<td></td>
</tr>
<tr>
<td>Following a spill in the drainage area</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sediment Removal</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once per year or as needed</td>
<td></td>
</tr>
<tr>
<td>Following a spill in the drainage area</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: For most clean outs the entire volume of liquid does not need to be removed from the manhole. Only remove the first few inches of oils and floatables from the water surface to reduce the total volume of liquid removed during a clean out.
First Defense® Installation Log

HYDRO INTERNATIONAL REFERENCE NUMBER:

SITE NAME:

SITE LOCATION:

OWNER:             CONTRACTOR:

CONTACT NAME:           CONTACT NAME:

COMPANY NAME:           COMPANY NAME:

ADDRESS:            ADDRESS:

TELEPHONE:            TELEPHONE:

INSTALLATION DATE:    /    /    

MODEL SIZE (CIRCLE ONE):     FD-4      FD-4HC      FD-6      FD-6HC

INLET (CIRCLE ALL THAT APPLY):  GRATED INLET (CATCH BASIN)  INLET PIPE (FLOW THROUGH)