Rinker MATERIALS™

Stormceptor® OSR

Technical Manual

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Stormceptor® OSR Technical Manual

1. About Stormceptor

Stormceptor® was developed by Imbrium™ Systems to address the growing need to remove and isolate pollution from the storm drain system before it enters the environment. Stormceptor targets hydrocarbons and total suspended solids (TSS) in stormwater runoff. It improves water quality by removing contaminates through the gravitational settling of fine sediments and floatation of hydrocarbons while preventing the re-suspension or scour of previously captured pollutants.
Through research and field application, the Stormceptor technology has been refined to successfully separate oil and sediment from stormwater runoff as well as capture oil spills. The Stormceptor Oil and Sand Removal (OSR) system has been modified from the original Stormceptor STC platform to specifically target the removal of fine sand-sized particles.

The Stormceptor OSR was developed by Imbrium Systems to maximize the treatment flow rate through the lower chamber and resulted from computational fluid dynamics (CFD) analyses and a series of physical tests. Patent pending modifications to the existing Stormceptor STC platform, which define the Stormceptor OSR include:

- Offset weir
- Increased weir height
- Use of an enhanced orifice plate
- Incorporation of a series of vertical vanes in the drop tee
- Incorporation of a wing at the base and back wall extensions on the drop tee

The Stormceptor OSR is a new, differentiated water quality treatment product focused on addressing the removal of fine sand-sized sediment. It is designed to efficiently address regional stormwater quality regulatory requirements when utilized in pre-treatment, redevelopment or retrofit projects. The Stormceptor OSR differs from the original Stormceptor STC platform, which is the core product focused on the removal and retention of very fine sediment particles.

2. Distribution Network

Imbrium Systems has partnered with a global network of affiliates who manufacture and distribute the Stormceptor System. In the United States contact Rinker Materials for additional information concerning the Stormceptor System.

United States	
Rinker Materials – Concrete Pipe Division 6560 Langfield Road Building 3 Houston TX 77092	Toll Free: 800 909 7763 Fax: 832 590 5399 www.rinkerstormceptor.com

2.1 Patent Information

The Stormceptor technology is protected by the following patents:

- **Australia Patent No**. 693,164 • 693,164 • 707,133 • 729,096 • 779401
- **Austrian Patent No**. 289647
- **Canadian Patent No** 2,009,208 •2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 (Pending)
- **China Patent No** 1168439
- **Denmark** DK 711879
- **German** DE 69534021
- **Indonesian Patent No** 16688
- **Japan Patent No** 9-11476 (Pending)
- **Korea** 10-2000-0026101 (Pending)
- **Malaysia Patent No** PI9701737 (Pending)
- **New Zealand Patent No** 314646
- **United States Patent No** 4,985,148 • 5,498,331 • 5,725,760 • 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690
- **Stormceptor OSR** Patent Pending • **Stormceptor LCS** Patent Pending

3. Stormceptor OSR Overview

The Stormceptor OSR has been designed to remove fine sand-sized sediment and oil from stormwater runoff, preventing spills and non-point source pollution from entering downstream water resources. This new technology was designed to meet the stormwater quality regulatory requirements for fine sand removal for pre-treatment, redevelopment or retrofit development projects.

The Stormceptor technology follows the philosophy of treating pollution at its source. Treatment at the source is the preferred methodology for stormwater quality improvement because water quality treatment effectiveness decreases with dilution.

- The key advantage of the Stormceptor technology compared to other storm sewer water quality control measures is the patented internal high flow diversion weir. Stormceptor treats stormwater runoff by controlling and reducing the stormwater velocity in the lower chamber. Flows are diverted into the lower chamber through a combination of the weir and orifice configuration while diverting high energy flows through the upper chamber. By controlling the flows in the lower chamber you ensure that previously captured pollutants are not scoured or re-suspended.

3.1 Benefits

A summary of the key benefits, capabilities and application of the Stormceptor OSR are:

- Small footprint to allow for easy installations
- 1 inch to 3 inch elevation drop between inlet and outlet pipes
- Suitable as a bend structure
- Pre-engineered for AASHTO HS-20 traffic loading or greater
- Compatible with standard infrastructure components
- Easy to maintain (vacuum truck)
- Pre-engineered to be non-buoyant when empty
- Spills capture and mitigation / Groundwater recharge protection
- Secondary wall containment exists for hydrocarbons spill capture
- Pre-treatment offers solution to reduce total stormwater treatment train long-term operation and maintenance costs

3.2 Stormwater Quality Treatment and Design Application

The Stormceptor OSR is designed to capture sand-sized particles while accommodating high water quality volumes and flow rates as a primary treatment device. Common design applications are as follows;

- Re-development projects
- Pre-treatment of other water quality treatment practices (as part of a treatment train)
- Retrofits for existing development
- Industrial and Commercial parking lots / Roadways
- Winter sanding capture from snow-melt runoff
- Hot Spots prone to high hydrocarbon or sand loadings - gas stations, airports, docks, highway facilities, high traffic commercial parking lots, bus depots, transfer stations, etc.

3.3 Stormceptor OSR Product Line

The Stormceptor OSR is a vertically oriented cylindrical structure manufactured from reinforced concrete and a fiber reinforced plastic (fiberglass) insert. The fiberglass insert provides the platform for pollutant capture and high-flow diversion while creating a settling and floatation chamber below. The modified weir, orifice plate and drop tee configuration which comprises the fiberglass insert controls flow rates and operational velocities, which are minimized in order to facilitate the capture of suspended solids and hydrocarbons, and retaining pollutants over a wide range of hydrological conditions. The Stormceptor OSR fiberglass insert and components are illustrated in Figures 1 & 2. A complete Stormceptor OSR unit is illustrated in Figure 3.

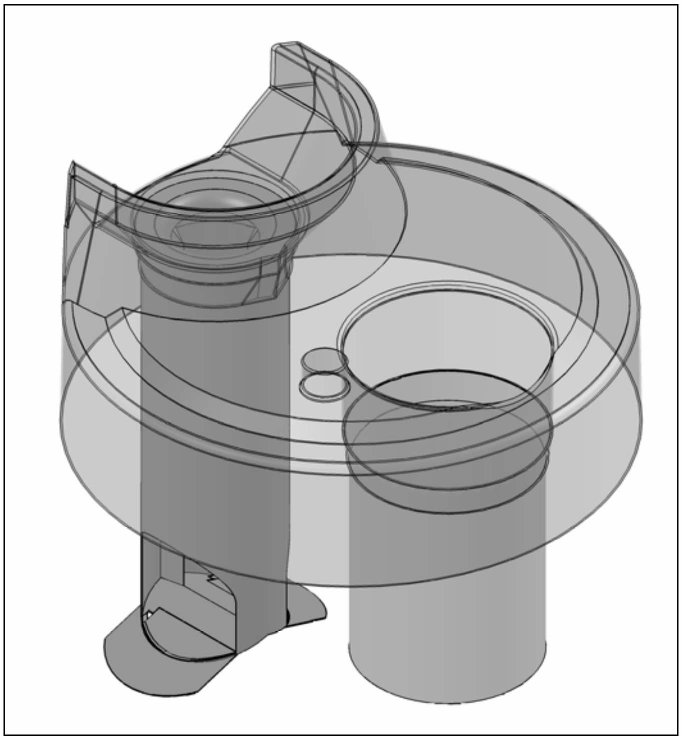

Figure 1 - Isometric View showing the FRP insert with orifice plate, drop tee (with wings and vanes) and outlet riser pipe.

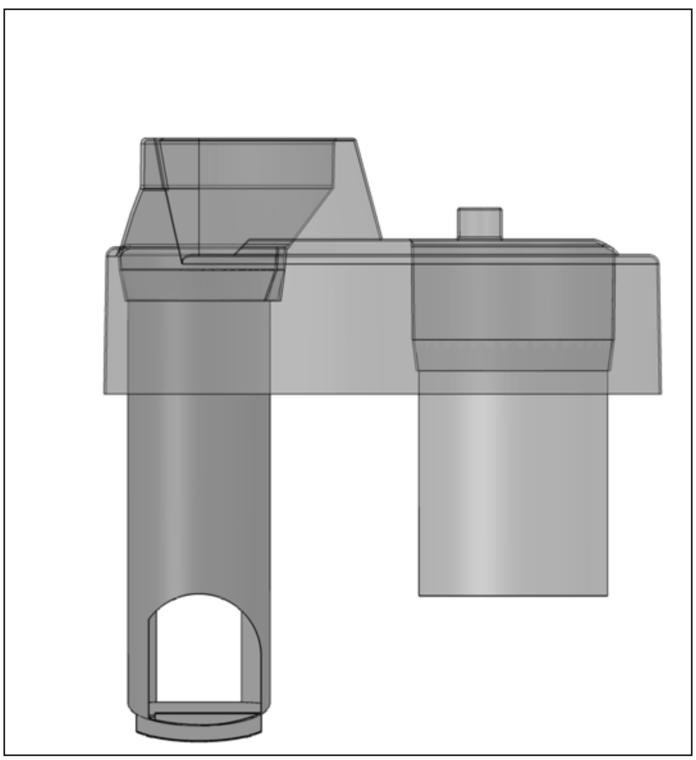

Figure 2 - Side View

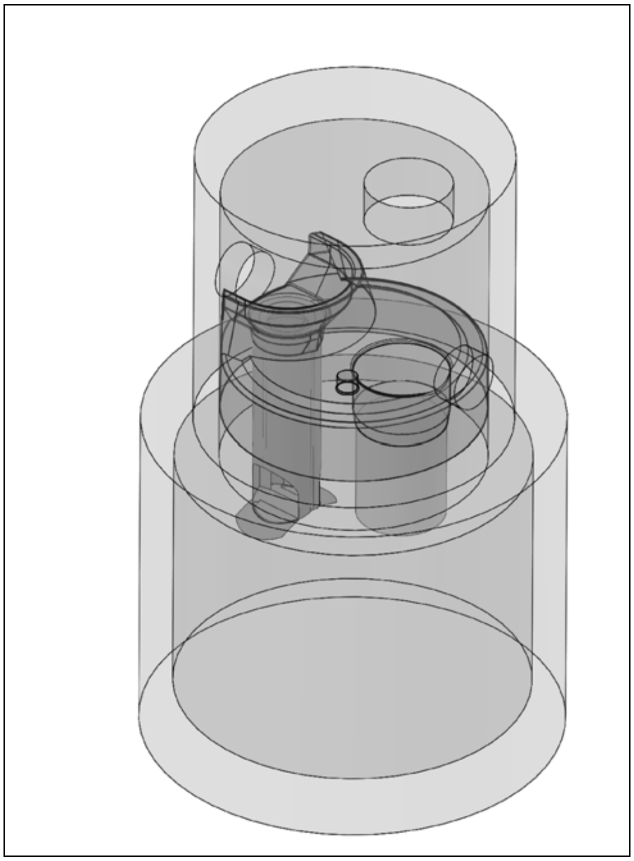

Figure 3 - Isomentric View of the OSR insert installed in the reinforced concrete structure

3.4 Operation

As water flows into the Stormceptor OSR, it is slowed and directed to the lower chamber by a weir and drop tee. The stormwater enters the lower chamber allowing free oils to rise and sediment to settle to the bottom of the chamber. The oil is captured underneath the fiberglass insert and contained by the double wall contained concrete wall and fiberglass skirt. After the pollutants separate, clean water continues up a riser outlet-pipe and exits the lower chamber on the downstream side of the weir. During high flow events the same process occurs however high energy excess flows are diverted over top of the weir directly downstream to prevent re-suspension of previously captured pollutants.

4. Stormceptor OSR Models

Inlet Stormceptor OSR 065

- Designed to accept stormwater runoff and pollutants from the surface through a grated inlet, in-line storm sewer pipes, or both. The inlet model unit process is the same as the Inline model.

Inline Stormceptor – OSR 141, OSR 250, OSR 390, OSR 560

- Standard design for most stormwater treatment applications and sewer conveyance configurations.

Series Stormceptor – OSR 780, OSR 1125

- Designed to treat larger drainage areas by utilizing two adjacent Stormceptor structures which function in parallel. The Series model unit process is the same as the Inline model. The flow path of the incoming stormwater runoff is split upfront to double the effective treatment capacity.

4.1 Stormceptor OSR Treatment Flow Rates & Dimensions

Stormceptor OSR is designed to accommodate a wide range of flow rates and annual runoff volumes (see Table 1.0). The Stormceptor OSR is a primary treatment device, which requires no pretreatment. However, it can be used as a pre-treatment device before other treatment practices such as detention systems, filtration and infiltration systems or wetlands. The Stormceptor OSR also can be implemented as a standalone treatment device in new and redevelopment projects as well.

Table 1.0 Stormceptor OSR Treatment Flow Rates & Dimensions

Stormceptor OSR models	Treatment Flow Rate (cfs)	Total Storage Volume (gal)	Sediment Capacity (ft^3)	Lower Chamber Diameter (ft)	Hydrocarbon Storage Capacity (gal)
Inlet OSR 065	0.63	470	8	4	115
OSR 140	1.41	952	19	6	233
OSR 250	2.50	2462	50	8	792
OSR 390	3.90	5565	98	10	1233
OSR 560	5.62	7927	141	12	1384
Series OSR 780*	7.81	11131	223	10	2430
Series OSR 1125*	11.24	15854	320	12	2689
* OSR model 780 and model 1125 consist of 2 chamber structures in series					

Table 2.0 Stormceptor OSR Model Dimensions*

Stormceptor OSR models	Lower Chamber Diameter (ft)	Upper Chamber Diameter (ft)	Pipe Invert to Bottom of Base Slab (inches)
Inlet OSR 065	4	4	68
OSR 140	6	6	63
OSR 250	8	6	104
OSR 390	10	8	140
OSR 560	12	8	148
Series OSR 780*	10	8	140
Series OSR 1125*	12	8	148
* OSR model 780 and model 1125 consist of 2 chamber structures in series			

4.2 Sizing a Stormceptor OSR

The Stormceptor OSR is designed to capture fine sands and accept water quality treatment flow rates listed in Table 1.0. Use Table 1 to size the Stormceptor OSR on Water Quality volume or based on a single peak flow rate.

The treatment flow rates in Table 1.0 are based on full scale independent laboratory performance testing and verification conducted at Alden Research Laboratories in Holden Massachusetts following the Technical Acceptance and Reciprocity Partnership (TARP) Lab Testing Protocol. The testing was conducted using fine sand-sized sediment (U.S. Silica - OK-110), to determine performance capability and flow rates.

4.3 Spill Control

One of the key features of the Stormceptor technology is its ability to capture and retain hydrocarbon/oil spills.

Field testing has demonstrated that the Stormceptor can remove free oil from stormwater runoff to an effluent concentration of less than or equal to 15 mg/L when the influent concentration is less than or equal to 300 mg/L for frequently occurring runoff rates. Additionally, when sized according to spill volume and density, monitoring studies demonstrate that Stormceptor can remove up to 98% of free oil spills from storm sewer system for dry weather or frequently occurring runoff events.

While the standard Stormceptor OSR models provides protection for oil capture and spill control there are additional available options to enhance spill protection if desired.

Oil Level Alarm - is an electronic monitoring system designed to trigger a visual and audible alarm when a pre-set level of oil is reached within the Stormceptor OSR lower chamber. As a standard, the oil level alarm is designed to trigger at approximately 85% of the unit's available depth level for oil capture. The feature acts as an environmental safeguard against spill release caused by exceeding the oil storage capacity or infrequent inspection.

Increased Volume Storage Capacity - Stormceptor OSR may be modified to store a greater spill volume than is typically available in standard units. Modifications needed to maximize oil storage capacity are project dependent, please contact your local Stormceptor representative.

4.4 Design Flexibility and Constructability

The Stormceptor technology offers many flexible storm sewer conveyance design advantages. The following items outline the standard flexibility. If however there are additional design or constructability requirements that are not outlined within this manual, please contact your local Stormceptor representative for assistance.

4.5 Elevation Drop

Table 3.0 Elevation Drop

Stormceptor OSR Model	Total Elevation Drop (inlet to outlet)
Inlet OSR 065	3 inches
OSR 140	1 inch
OSR 250	1 inch
OSR 390	1 inch
OSR 560	1 inch
Series OSR 780*	3 inches
Series OSR 1125*	3 inches

4.6 Head Loss

The head loss for the Stormceptor OSR 250 at a flow rate of 2.50 cfs was measured to be 9 inches from inlet to outlet. This is based on independent testing performed on a Stormceptor OSR 250 with 24 inch inlet and outlet piping at a 1% slope.

4.7 Bends

Stormceptor OSR can be used to change storm sewer conveyance horizontal alignment. Bends in the Series OSR models can only be applied to the second structure.

4.8 Maximum Inlet and Outlet Pipe Diameters

Inlet/Outlet Pipe Configuration	Inlet Models OSR 065	In-Line Models OSR 140 & OSR 250	In-Line Models OSR 390 & OSR 560	Series Models OSR 780 & OSR 1125
Straight Through (180º)	24 inch	42 inch	60 inch	60 inch
Bend (115º)	18 inch*	42 inch*	60 inch*	60 inch **

Notes:

* The effluent pipe may need to be offset – please contact your Stormceptor representative.
** The bend may only be incorporated into the second unit of the Series Stormceptor System.

Larger pipe diameters and slightly less bend angles may be accommodated specific to your site, please call your Stormceptor representative.

4.9 Installation Depth - Minimum Cover

The typical minimum distance from the top of grade to the crown of the inlet pipe is 24 inches. For situations that have a lower minimum distance, please contact your local Stormceptor representative.

4.10 Partially Submerged Conveyance Systems

A modification to the Stormceptor OSR can easily be implemented to the insert allowing the unit to operate in a submerged or partially submerged storm sewer (i.e. tail water conditions). This configuration can be installed on all Stormceptor OSR models by customizing the weir height and adding a secondary drop tee, and possibly an additional manhole access frame and cover.

Submerged instances are defined as standing water in the storm drain system during zero flow conditions. In these instances, the following information is required for the proper design and application of a submerged Stormceptor OSR modification:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation or design water elevation

4.11 Shallow Stormceptor

In cases of a high groundwater table or shallow bedrock, there may be restrictions to the depth of burial of storm sewer systems. In this situation, for selected Stormceptor models, options may exist to increase the diameter of the lower chamber components to reduce the overall depth of excavation required.

4.12 Customized Live Load

Stormceptor is typically designed for local highway truck loading (AASHTO HS-20). In instances of other loads, Stormceptor may be customized structurally for a pre-specified live load.

5. Comparing Technologies

Designers have many choices available to achieve water quality goals in the treatment of stormwater runoff. Since many stormwater treatment devices exist, it is very important to consider the following in order to make an appropriate comparison between "approved alternatives".

1. Know your water quality objective(s)
   a. If you are trying to remove fine sediment such as clay, silts, fine sands and organics, using a Stormceptor STC is recommended versus the OSR model
   b. If you are trying to remove fine sand sediment, then the Stormceptor OSR would be the correct model
2. How is TSS being defined - i.e. what particle size distribution was used to determine the treatment flow rates and performance capability of the "alternative" practice considered. This is a critical question to ask to understand performance capability, cost, and water quality outcome.
3. Is spill capture the primary objective - if so, alternative design considerations may need to be pursued to ensure desired performance

The following is a technical guide to aid in an accurate comparison of differing technologies and performance claims.

6. Particle Size Distribution (PSD)

The most sensitive parameter to the design of a stormwater quality device is the selection of the particle size distribution (PSD). When evaluating differing technologies, designs which focus on "treatment flow rates" using an alternate PSD will result in incomparable performance and therefore should not be considered as "equals". To allow for an accurate device comparison, the PSD and testing methods need to be openly defined and consistent.

7. Scour Prevention

In order to accurately predict the performance of a manufactured treatment device, there must be confidence that it will perform under all conditions. Since rainfall patterns cannot be predicted, stormwater quality devices placed in storm sewer systems must be able to withstand extreme events, and ensure that all pollutants previously captured are retained in the system.

In order to have confidence in a system's performance under extreme conditions, scour prevention needs to be part of the design, considering one of two options (1) internal by-pass or (2) an external by-pass such as a flow diversion structure.

8. Hydraulics

Full scale, independent laboratory testing has been used to confirm the hydraulics of the Stormceptor OSR. The adaptability of the treatment device to the storm sewer design infrastructure can affect the overall performance, total design requirements and cost of the site.

Key considerations for any conveyance system and practices within are:

- Head losses;
- Standard inlet/outlet elevation drop;
- Flexibility

8.1 Hydrology & Water Quality

Stormwater quality treatment technologies need to perform under varying climatic conditions. These can vary from long low intensity rainfall conditions to short duration high intensity storms. Focusing on the long-term water quality impact of a practice ensures that all conditions encountered will be considered as part of the practice and design. This may very well not be the case when focusing on a single, peak flow rate or design storm to determine performance as this does not provide enough information to consider the water quality impact over the long-term.

9. Pre-Treatment Applications

Consider the long-term operational and maintenance cost of the entire treatment train being designed. The benefits of applying pre-treatment include the extension of the operational life (extension of maintenance frequency) of large stormwater management facilities, prevention of spills, pre-mature plugging, ground water protections and lower overall total life-cycle maintenance cost.

10. Testing

The Stormceptor technology platform has been the most widely monitored stormwater quality manufactured treatment technology in the world. Performance verification and monitoring programs are completed to the strictest standards and integrity. Since its introduction in 1990, numerous independent studies detailing the effectiveness and longevity of the Stormceptor System have been completed. The unit process of particle settling, based on Stokes Law, for the OSR is the same as the existing Stormceptor STC product line. The hydraulic principles, field longevity, operation and maintenance of the Stormceptor OSR mimic the STC device which has undergone numerous laboratory and field evaluations since the early 1990's.

The Stormceptor OSR device was developed and independently, full scale laboratory tested following the TARP laboratory protocol by Alden Research Laboratory

11. Installation

The installation of Stormceptor should conform to state highway, provincial or local specifications for the construction of manholes. Selected sections of a general specification that are applicable are summarized in the following sections.

11.1 Excavation

Excavation for the installation of the Stormceptor OSR should conform to state highway, provincial or local specifications. Topsoil that is removed during the excavation for the Stormceptor OSR should be stockpiled in designated areas and should not be mixed with subsoil or other materials. Topsoil stockpiles and the general site preparation for the installation of the Stormceptor OSR should conform to state highway, provincial or local specifications.

The Stormceptor OSR should not be installed on frozen ground. Excavation should extend a minimum of 12 inches from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

In areas with a high water table, continuous dewatering may be required to ensure that the excavation is stable and free of water.

11.2 Backfilling

Backfill material should conform to state highway, provincial or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches in depth and compacted to state highway, provincial or local specifications.

11.3 Construction Sequence

The concrete Stormceptor is installed in sections in the following sequence:

1. Aggregate base
2. Concrete base slab
3. Concrete lower chamber riser sections
4. Concrete transition slab (if required)
5. Concrete upper chamber riser section with fiberglass insert
6. Connect inlet and outlet pipes
7. Assembly of fiberglass insert components (drop tee with wing, orifice plate, riser outlet-pipe, safety grate & PVC inspection port)
8. Concrete remainder of upper chamber riser section
9. Concrete top slab
10. Frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations and/or local regulations.

Adjustment of the Stormceptor can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the Stormceptor has been constructed, any lift holes must be plugged with mortar.

11.4 Health and Safety

The Stormceptor has been designed considering safety first. It is recommended if confined space entry is required, that proper and complete protocols be followed to their fullest extent. In addition, the following health and safety features are part of the Stormceptor:

- Designed for withstand the weight of personnel
- A hinged safety grate is located over riser pipe opening

12. Inspection and Maintenance

The Stormceptor OSR inspection and maintenance procedures mimic that of the Stormceptor STC device.

12.1 Inspection Procedures

It is recommended that the Stormceptor OSR be inspected at the termination of site post construction to ensure the unit will operate properly. Items to inspect within or upstream of the structure to determine if more action or maintenance is required would be; presence of construction or erosion based sediment, presence of oil, presence of trash or construction debris, ensuring the drop-tee is not plugged with any foreign materials and confirming proper installation of Stormceptor fiberglass insert components. These items can be inspected from the ground surface.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve (Sludge Judge®). This tube would be inserted through the outlet riser pipe.

Inspection of sediment accumulation dictates the requirement for maintenance during normal operation. It is recommended that inspections be conducted bi-annuals the first year of operation to determine the proper maintenance frequency based on site specific pollutant loading. Maintenance should be performed once the sediment depth exceeds the guideline sediment depth values provided in Table 5.

12.2 Maintenance Procedures

Maintenance for the Stormceptor OSR can be performed using standard vacuum trucks. No entry into the unit is required for maintenance (in most cases). The Vacuum Service Industry is a well-established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor vary based on several factors such as the size of unit, transportation distances, presence of oil and local requirements.

A vacuum truck is generally the most convenient and efficient method to remove the sediment from the Stormceptor OSR unit. Solids recovered from the Stormceptor OSR can typically be land filled or disposed of at a waste water treatment plant, follow local regulations and requirements. It is possible that there may be some specific land use activities that create contaminated solids, which will be captured in the system. Such material would have to be handled and disposed of in accordance with local hazardous waste management requirements.

To clean out the Stormceptor OSR, sediment is removed through the outlet riser-pipe, and if present oil is removed through the 6 inch inspection port. Alternatively, oil can be removed from the 24 inch outlet riser-pipe if water is first decanted from the lower chamber in order to lower the oil level below the riser pipe.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve (Sludge Judge®). This tube would be inserted through the riser pipe.

Annual maintenance is typically required by municipalities and recommended if inspections are not performed on a regular basis with monitored and recorded sediment depths. Sediment depths for each Stormceptor OSR model which indicate the need for maintenance can be found in Table 5.0. Frequency of maintenance may need to be reduced or increased based on site specific pollutant load conditions.

Table 5.0 Sediment depths for maintenance

Sediment Depths Indicating Required Maintenance *	
OSR Models	**Sediment Depth inches**
OSR 065	8
OSR 140	8
OSR 250	12
OSR 390	17
OSR 560	17
Series OSR 780	17
Series OSR 1125	17
* based on 15% of the Stormceptor unit's total storage	

13. Other Maintenance Considerations

13.1 Hydrocarbon / Oil Spills

Stormceptor is commonly used to provide stormwater quality at "hot spots", which are areas with high potential for spills and hydrocarbon handling. Stormceptor should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

13.2 Oil sheens

With a steady influx of runoff carrying high hydrocarbon loading, oil sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or oil sheen can be observed when very small oil concentrations (<10 ppm) exist. Based on independent testing conducted at the University of Coventry, Stormceptor has proven over 98% free oil removal. The appearance of oil sheen at the outlet with high influent oil concentrations does not mean that the unit is not working. The Stormceptor is designed for free oil removal and not emulsified conditions.

13.3 Disposal

Requirements for the disposal of material from the Stormceptor are typically similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company. It is recommended that federal, state and local regulations be consulted and followed for proper disposal.

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