# Technology Assessment Report

# **Storm*ceptor* ®**

# **CSR™ New England Pipe**

Prepared for
The Massachusetts Strategic
Envirotechnology Partnership
STEP

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## PREFACE

The STEP technology assessment process is designed to identify those technologies that will support the economic and environmental/energy goals of the Commonwealth of Massachusetts and may benefit from STEP assistance. The process is meant to be one of screening, in which technologies are evaluated by independent technical specialists. Recommendation from this process does not constitute an endorsement of the technology or of the absolute validity of the technology. Rather, STEP technical assessments attest only that, through the screening process, the reviewers feel there may be benefit to the Commonwealth of Massachusetts.

## EXECUTIVE SUMMARY

The technology described in this review is Storm*ceptor*® and is currently owned by Storm*ceptor*® Corporation and licensed to CSR/New England Pipe (CSR/NEP) of Wauregan, CT, for distribution in Massachusetts, among other states. The system is being commercialized by CSR/NEP. The Storm*ceptor* technology addresses treatment of stormwater runoff. It is proposed as an effective spill control and stormwater quality enhancement system, capable of retaining grit, suspended solids, oils and grease during periods of both low and high flows. It is proposed as a replacement for conventional manholes within a storm drain system. It is not designed as a catch basin or detention system. It can be used within any new or existing lateral piped conveyance system and comes in several sizes with outlets up to 60". The system is claimed as capable of removing 50 - 80% of TSS when properly sized. The Storm*ceptor* system is recommended as a stand alone or as a component to a system or in combination with different BMPs. An example configuration may include the following components: catch basin or water quality inlet, Stormc*eptor*, detention basin or infiltration system.

The system is a prefabricated well type structure which provides sedimentation, oil, and grease separation. It is manufactured in both concrete or fiberglass. Current sizes range from 900 to 7200 gallons, with diameters between 6 and 12 feet. The design of the system provides two sections, a treatment chamber and bypass chamber. The structural components of the system are separated by an insert which has a weir, inflow drop pipe, and outflow riser. Operation of the system is passive with respect to flow control and treatment. During low flows or frequent storm events, stormwater from the inlet is directed down the inflow drop pipe located adjacent to the inlet of the treatment chamber. Flow in excess of the inflow drop pipe capacity is directed into the bypass chamber to the outlet of the system. The effective treatment capacity is set by a weir which surrounds the inflow drop pipe at the inlet and the volume of the treatment chamber. Effluent from the treatment chamber exits via the outflow riser which extends below the water surface in the treatment chamber up to the overflow chamber and to the system outlet. Sediment is retained in the bottom of the treatment chamber and oils and grease are retained at the top of the treatment chamber in a quiescent area.

The Storm*ceptor* system is stormwater treatment structure providing event based solids separation. The value added in the Storm*ceptor* system is the ability to reduce turbulence in the treatment chamber, which makes it better at removing TSS and TPH than conventional BMPs of the same category. The Storm*ceptor* system has been demonstrated to provide at least 52% removal of TSS when sized according to Storm*ceptor's* "Treatment Train" criteria and 77% when sized according to Storm*ceptor's* "Sensitive Area" criteria. It is likely that a higher removal efficiency, greater than 80%, could be expected if the contributing drainage area is smaller than the sizing recommended. The system is likely to remove grease and oils with its inflow and outflow pipe configurations. The Storm*ceptor* system appears to be a good control technology in areas of higher pollution potential, Standard 5 described in the Stormwater Management Handbooks (DEP and CZM, 1997). Storm*ceptor* system may be used as a component in combination with different BMPs or may be used as a stand alone installation provided it is sized for 80% TSS removal. STEP recommends collection of additional data representing a varied set of operating conditions over a realistic maintenance cycle to verify TSS removal rates greater than 80%.

## HIGHLIGHTS

- Performance data available demonstrates that the Storm*ceptor* system can provide TSS removal rates of 77% when sized according to the "Sensitive Area" criteria. Evidence suggests that the Storm*ceptor* system may be capable of achieving TSS removal rates between 89% and 99% when sized accordingly, under conditions similar to those reported in the Westwood Massachusetts site, including: climate and land use intensity.
- Performance data available to this reviewer suggest that the Storm*ceptor* system can provide TSS removal rates of 52% when sized according to the "Treatment Train" criteria.
- Use of the Storm*ceptor* system as a pretreatment component in combination with different BMPs, when sized according to the "Treatment Train" criteria, will likely meet standards 4 and 6 of the Stormwater Management Handbooks (DEP and CZM,1997). Use as a stand alone device may be justified when sized according to the "Sensitive Area" criteria.
- The Storm*ceptor* system is likely to perform in areas with higher potential pollutant levels in Standard 5 of the Stormwater Management Handbooks (DEP and CZM,1997).
- The Storm*ceptor* system is useful for new and retrofit installations in Standard 7 of the Stormwater Management Handbooks (DEP and CZM,1997), especially where space is limited.
- The Storm*ceptor* system is also suited for secondary sediment control from construction related sediment loads specified in Standard 8 (DEP and CZM,1997).

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## TECHNOLOGY PROPONENT

The technology described in this review is Storm*ceptor*® and is currently owned by Storm*ceptor*® Corporation and licensed to CSR/New England Pipe (CSR/NEP) of Wauregan, CT, for distribution in Massachusetts, among other states. The system is being commercialized by CSR/NEP. CSR/NEP is a subsidiary of CSR Hydro Conduit Corporation which manufactures Storm*ceptor* in the most of the United States.

## TECHNOLOGY DESCRIPTION

The Storm*ceptor* technology addresses treatment of stormwater runoff. It is proposed as an effective spill control and stormwater quality enhancement system, capable of retaining grit, suspended solids, oils and grease during periods of both low and high flows. It is proposed as a replacement for conventional manholes within a storm drain system. It is not designed as an inlet or detention system. It can be used within any lateral piped conveyance system and comes in several sizes with outlets up to 60". The system is claimed as capable of removing 50 to 80% of TSS when properly sized. The Storm*ceptor* system may be used as a stand alone BMP or as a component within a combination of different BMPs. An example of a combination of different BMPs is a catch basin, Storm*ceptor*, and detention pond. It is compatible with any existing conveyance system. It is proposed that the system has an added value in its small size and its added removal capability over similar conventional BMPs such as catch basins and deep sumps. The system is currently protected by a United States Patent No. 4,985,148.

The system is a prefabricated well type structure which provides sedimentation, oil, and grease separation (Figure 1). It is manufactured in both concrete or fiberglass. Current sizes range from 900 to 7200 gallons, with diameters between 6 and 12 feet. The design of the system provides two sections, a treatment chamber and bypass chamber. The structural components of the system are separated by an insert which has a weir, inflow drop pipe, and outflow riser (Figure 2). The size of the insert and its associated components depends on the overall size of the treatment chamber and bypass chamber.

Operation of the system is passive with respect to flow control and treatment. During low flows or frequent storm events, stormwater from the inlet is directed down the inflow drop pipe located adjacent to the inlet of the treatment chamber. Flow in excess of the inflow drop pipe capacity is directed into the bypass chamber to the outlet of the system. The effective treatment capacity is set by a weir which surrounds the inflow drop pipe at the inlet and the volume of the treatment chamber. Effluent from the treatment chamber exits via the outflow riser which extends below the water surface in the treatment chamber, up to the overflow chamber, and to the system outlet. Sediment is retained in the bottom of the treatment chamber and oils and grease are retained at the top of the treatment chamber in a quiescent area. Oil and grease are prevented from leaving the chamber by the outflow riser.

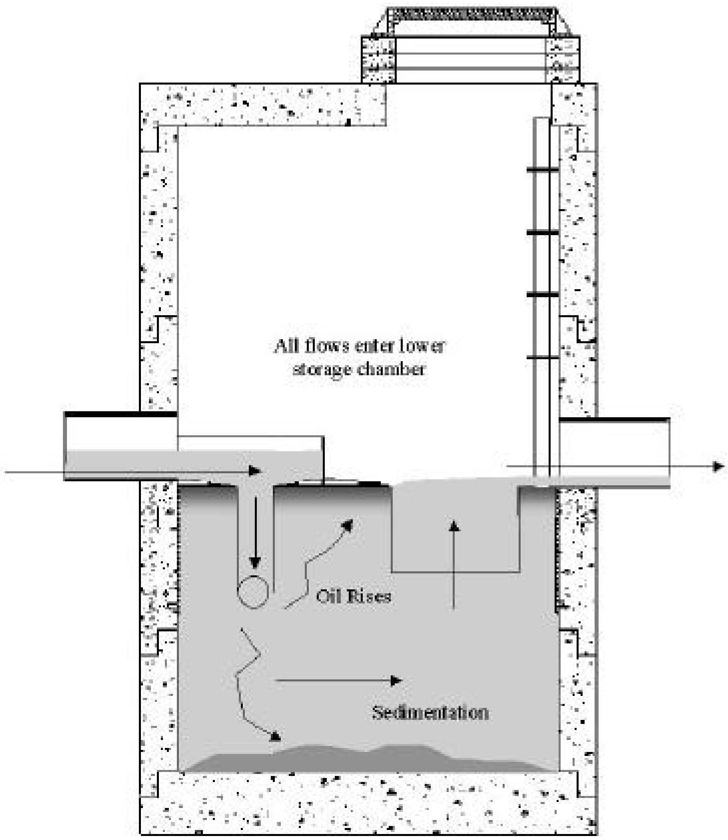


Figure 2. Storm*ceptor* operation during average flow conditions.

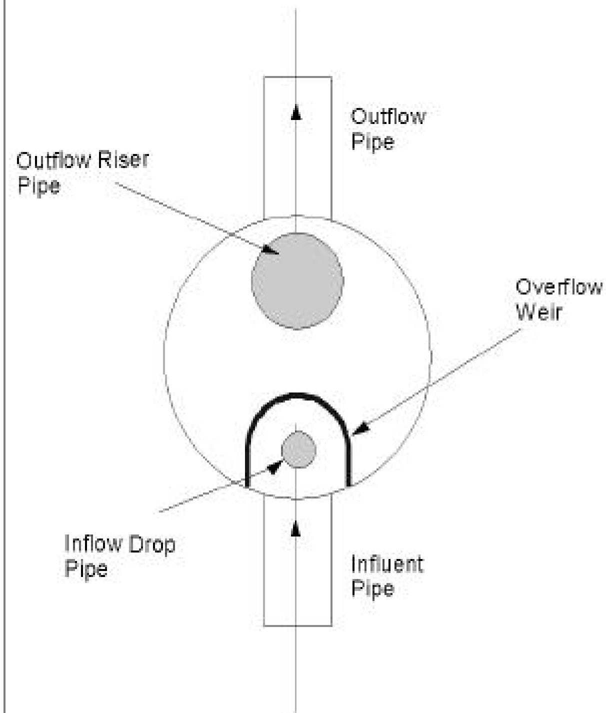


Figure 1. Top view of Storm*ceptor* insert.

The inlet and outlet elevations of the system are kept at a minimum with 1" difference in the concrete and fiberglass units. The multiple inlet units have a 3" difference between the inlet and outlet. Approximately 9 inches of hydrostatic head is developed from the influent elevation in the weir. A low head system is designed to reduce the potential for scouring from higher velocities in the treatment chamber. During storm events exceeding the treatment capacity of the chamber the head on the system is kept constant because stormwater elevation over the drop pipe is nearly equivalent to the head over the outflow riser. Studies prepared by Storm*ceptor* Corporation (Marsalek et al., 1994) demonstrated when total flow to the system was increased, in excess of the treatment chamber capacity, flow through the treatment chamber increased initially and then decreased slightly. This implies that treatment performance would not be lowered during high flow events and scouring and resuspension of previously settled solids is prevented.

The system is suited for local or lateral lines within any conveyance system. The system is not recommended for large storm drain trunk lines. The system is not designed to be used as an inlet catch basin. Storm*ceptor* Corporation produces 8 models with different sediment and oil capacities illustrated in Table A1 in the Appendix. Preliminary sizing recommendations are presented in Technical Design Manual (Storm*ceptor* Corporation, 1997) and in Table A2 in the Appendix. The preliminary recommended sizing table specifies units per impervious drainage area based on percentages of treatment.

### TECHNICAL FEASIBILITY

The Storm*ceptor* system is stormwater treatment structure providing event based solids separation. The Storm*ceptor* has a greater TSS removal efficiency than water quality inlets. The value added in the Storm*ceptor* system is the ability to reduce turbulence in the treatment chamber, which makes it better at removing TSS and TPH than conventional BMPs of the same category. A significant amount of design engineering has gone into the Storm*ceptor*. In particular, the flow control device developed for the insert is capable of reducing turbulence in the treatment chamber to quiescent levels. This directly increases removal efficiencies for TSS and grease and oils. The system appears to be capable of limiting resuspension of settled particles, a common problem in catch basins.

The basic principle of operation is sedimentation. In addition, some minimal treatment to pollutant parameters associated with the settled solids is likely to occur. In particular, $BOD_5$, COD, particulate N, P, and pathogens may be associated with the finer fractions of sediments and removed from the stormwater. Oil and grease are less dense than water so they float to the top of the treatment chamber. Since the outflow riser extends below the surface of the water in the treatment chamber, oil and grease will be trapped in the treatment chamber.

### COMPETING TECHNOLOGIES

Several direct competing technologies exist for Storm*ceptor*, including other sedimentation chamber technologies like oil and grit separators. Information submitted by a competing technology suggests that Storm*ceptor* is a cost competitive product. However, no comparative data on oil and grit separators was submitted by CSR/NEP on these technologies. Typical oil and grit separators are not likely to achieve the same level of treatment as the Stormceptor system. The Storm*ceptor* system should be competitive with other technologies that produce comparable removal efficiencies. The Storm*ceptor* system has spatial requirement advantages over detention ponds and artificial wetlands which have large area requirements. The Storm*ceptor* system is not a recharging system and therefore not comparable to recharging systems such as infiltration basins and trenches. It may produce equivalent treatment levels as recharging systems, when sized properly. The Stormceptor system is not suitable for meeting recharge Standard 3 as a singular treatment system (DEP and CZM, 1997), but may be well suited for pretreatment in a mixed component system with recharge. The system should be competitive with the other BMPs in the deep sump catch basin category.

## DATA SUPPORTING CLAIMS

Prior to considering performance data from any treatment technology, the following notation is advised. Data collected from isolated stormwater treatment systems may be variable. Some of this variability may be due to differences in land use, climate, and soil type. Additionally, it is possible that storm events may have variable pollutant loads, resulting in varied treatment system performance at an individual site. The combination of these two sources of variability, inherent in all BMP performance verification, presents an unknown level of uncertainty. In order to overcome this uncertainty a larger set of data would be required to predict the performance of the technology under a variety of conditions. The Storm*ceptor* system has a limited set of performance data.

The data submitted by CSR/NEP are intended to demonstrate performance capable of achieving Standards 4, 5, 6 and 7 of the Department of Environmental Protection (DEP) Stormwater Management Handbooks (DEP and CZM,1997). In this Technical Assessment, performance is based on available data in the proponent's submission from installations in Toronto and Edmonton Canada. Bench scale testing and modeling data were used as predictors of performance but not for sizing. A third installation, in Westwood, Massachusetts, supports performance claims at Storm*ceptor's* "Sensitive Area" criteria of 80%. Storm*ceptor* has more than 1600 units installed in the U.S. and Canada. Additional data from other installations may become available for future performance verifications.

### Analytical Modeling and Bench Scale Studies

Storm*ceptor* Corporation has committed resources to study the Storm*ceptor* system using analytical models with bench and pilot scale validation. Several modeling scenarios were developed for Storm*ceptor* by Marshall Macklin Monaghan, LTD. (1994) to evaluate the removal of TSS under a variety of storm event conditions using the Stormwater Management Model (SWMM). Some of the parameters for the model include: rainfall data, temperature, and runoff. The analytical model results are based on non-ideal settling and do not account for flocculation effects due to its considerable complexity. Predicted long term TSS removal rates were calculated as a function of drainage area per unit for 4 different Storm*ceptor* models. Results from this modeling study suggest that in small drainage areas the Storm*ceptor* units had higher removal rates. The long term TSS removal rates for a 1.2 acre/unit drainage area were calculated at 53%, 46%, 39%, and 30% for systems sized at 6800 gal., 4850 gal., 2800 gal., and 1820 gal., respectively. Removal rates decreased proportionately by 25% of the highest rate when the drainage area was doubled. Removal rates were less than 20% at 4.25 acres/unit.

Another laboratory study performed by Marcalek et al. (1994) suggests a much larger variation for TSS removal rates, ranging from 6% to 95%. In these studies flow rate was manipulated along with configurations of the inflow drop pipe and outflow riser. Systems used in these tests were 1/4 size and the sediment used was an ABS polymer used to control particle size more effectively. A scaling factor of 32 was used to estimate the actual prototype design flows based on equivalent Froude number under the special case where no free fluid surface exists with incompressible fluid. The removal rates for fine to medium sands were 95% at 95 gal/min, 77% at 206 gal/min, 68% at 285 gal/min, and 6% at 634 gal/min.

A study from the University of Conventry (Pratt, 1996) tested the equivalent to the STC 900 system at 144 gal/min in a 20 minute event . Sand and crankcase oil were loaded at 4100 mg/l and 90 mg/l, respectively to the influent water. Removal efficiencies were reported at 83% for sand and 98% for oil. While this was a full scale study, the conditions of the test may not accurately reflect field conditions under all circumstances. In particular, the flow rates do not fall within the recommended ranges specified in the Storm*ceptor* Design Manual (Storm*ceptor* Corporation, 1997). Additionally, the use of model sands do not always reflect the behavior of sediments under field conditions. Lastly, the number of replicates do not warrant statistical significance due to limited replications.

Storm*ceptor* Corporation and CSR/NEP have indicated that the preliminary sizing recommendations are based on their field installations and not the laboratory data or modeling data. Review of these data indicate that the laboratory data and modeling data do not give a definitive picture of system performance under field conditions. It is suggested that additional performance data be gathered from field installations and return to the modeling data for model calibration. Analysis of model sensitivity would be appropriate once additional field data has been collected.

## Field Installations

A field test of the Storm*ceptor* system was carried out in The City of Edmonton Canada at a parking lot located in the Westmount Shopping center on Fountain Lake. A single Storm*ceptor* unit (Model STC2000, which is equivalent to an STC2400) was installed to treat an approximate impervious drainage area of 9.8 acres. This installation had a unit undersized by a factor of 3. The unit was fitted with automated samplers on inflow and outflow pipes. Water quality was measured on 4 storm events, and included TSS, metals, oil and grease. Average removal efficiencies were 51.5%, 39 to 53%, and 43%, respectively (Table 1). No additional data on the variability of these data were available. Precipitation data for the storm events were not made available to this reviewer at the time of this assessment. Therefore, it is unclear whether these events were 0.5 inch or more. The Storm*ceptor* Corporation's recommended impervious drainage area for the STC 2000 (equivalent to the STC 2400) is 3.35 acres, therefore the system was largely under-sized. The performance of this system exceeded the predicted performance based on the sizing guidelines set by Storm*ceptor*. Under similar environmental conditions, including climate, land use intensity, and soil conditions as that at the Edmonton installation, it is possible that the undersized Storm*ceptor* system will provide at least 52% removal of TSS, sized under Storm*ceptor's* "Treatment Train" criteria (50% TSS removal).

Table 1. Water Quality Tests at Westmount Shopping Center, Edmonton Canada, 1996

| **Water Quality Parameter** | **Average Percent Removal Efficiency** |
|---|---|
| TSS | 52% |
| Metals (Fe, Pb, Zn, Cr, and Cu) | 39 - 53% |
| Oil and Grease | 43% |

Storm*ceptor* conducted a survey of sediment loads to 23 Storm*ceptor* units installed in the City of Toronto, Canada (Bryant et al., 1995). Analysis of the sediment accumulations and estimates of TSS removal efficiency were calculated based on predicted flow and loadings. In this study, a mass balance was not utilized to measure removal efficiency. Rather, estimates based on regional precipitation data and estimated mean concentration (EMC) (Novotny, 1992) were used to determine loadings. The removal efficiency was calculated from the ratio of sediment collected in the unit and corrected for water content, and estimated loading. Solids removal efficiency increased with greater storage capacity ($r^2$=0.60) (Figure 3). The range of removal efficiencies was 18 to 95%. The authors did not verify whether there were significant losses of sediment out of the units (Bryant et al., 1995). These data indicate a relatively high potential for removal, especially where sediment storage capacity is high. Data from this study were used to calculate preliminary sizing recommendations, detailed later in this review (Appendix, Table A1). The approach used to estimate performance and the subsequent sizing recommendations is based on rational assumptions. Actual performance under conditions other than those tested may require verification to compare with these results.

In Westwood Massachusetts, an ongoing study of a Storm*ceptor* STC 2600, sized according to the "Sensitive Area" criteria, demonstrated 77% TSS removal efficiencies from six storm events. Two events produced no appreciable sediment load over the composite sampling period. The first three events had a mean of 90% TSS removal based on first flush grab samples. Three of the six events had removal rates in excess of 89% and as high as 99%. One event produced a low removal rate of 28% and may have been an artifact of the sampling procedure. Overall the removal efficiency for TSS is near 80%. Removal of TPH averaged 93%, based on first flush grab samples of the first three storm events. Overall TPH removal, based on composite sampling over 5 events, was 80% with 3 events contributing no data to the mean. The mean precipitation and duration of these events were 0.4 inches and 13 hours, respectively.

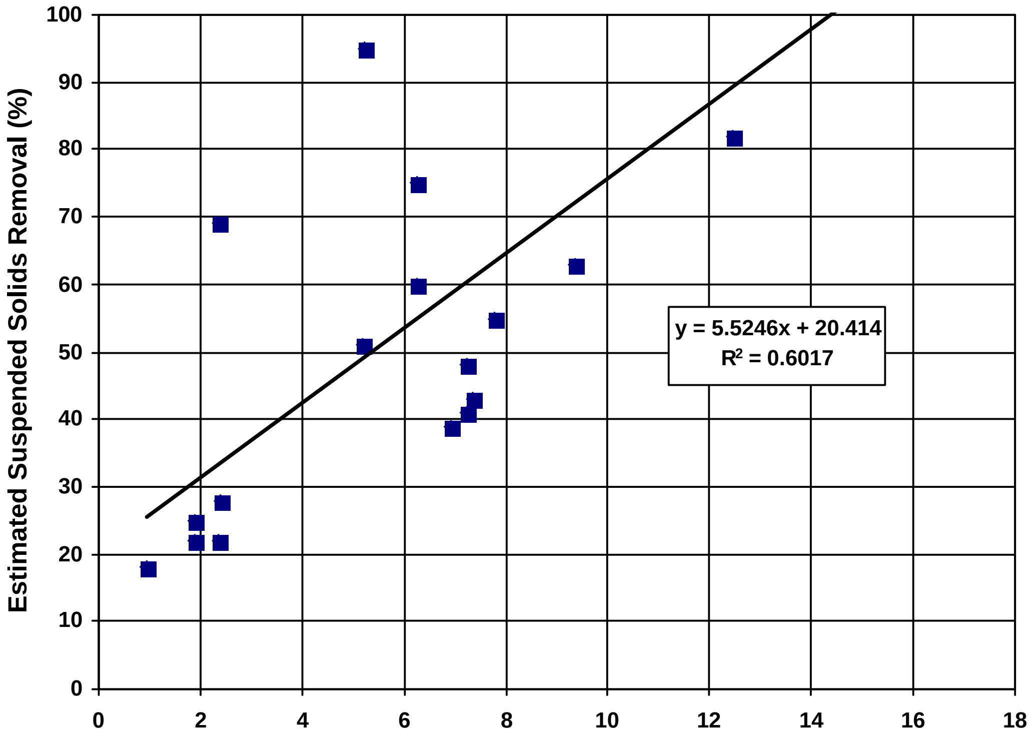


Figure 3: Storm*ceptor*® Sizing Guideline - Removal efficiency as a function of storage capacity from 23 Storm*ceptor* units in Toronto Canada.

## Performance Summary

The Storm*ceptor* system has been demonstrated to provide at least 77% removal of TSS when sized under Storm*ceptor*'s "Sensitive Area" criteria and 52% TSS removal when sized under Storm*ceptor*'s "Treatment Train" criteria. Based on these data, the Storm*ceptor* systems receiving stormwater from a drainage area sized according to the "Sensitive Area" criteria are likely to provide a removal efficiency of 80%, on the annual stormwater runoff. While the set of data useful for predicting the relationship between treatment efficiency and loading rates is limited, it is likely that the STC 2400 is capable of meeting standards 4 and 6, for 80% removal of TSS in the first 0.5 or 1.0 inch of a storm event, if sized appropriately. STC 2400 Furthermore, performance of larger and smaller sized units may be capable of achieving removal rates that meet Standards 4 and 6. However, data to support this claim are not currently available.

## Site Suitability Recommendations

The applicability of this technology with respect to TSS removal is similar to that of several other BMPs, including: sand and organic filters, catch basins, and water quality inlets, all described in the Stormwater Management Handbooks (DEP and CZM, 1997). The use of this technology can be made to Standards 4, 5, 6, and 7 in the Stormwater Management Handbooks (DEP and CZM, 1997).

The system is suitable for new and retrofit situations. The Storm*ceptor* system is particularly well suited for constricted areas, areas that require pretreatment for a multi-component treatment system, and redevelopment and retrofits described under Standard 7 in the Stormwater Management Handbook (DEP and CZM, 1997). The Storm*ceptor* system appears to have the ability to trap spills of hydrocarbons, oils, and grease. This makes the system suitable for use on areas with higher potential pollutant loads, specified under Standard 5 in the Stormwater Management Handbooks (DEP and CZM, 1997).

The system can be used on sites with a wide range of drainage areas provided it is sized correctly. On larger drainage area installations, units can be located throughout the drainage area rather than in a central location and provide treatment of runoff closer to its source. The system is suitable on small drainage areas or on individual inlets. The system is generally associated with a conveyance system and is recommended as part of a combination of different BMPs. The system is not designed as a recharge system and is not applicable to Standard 3 (DEP and CZM, 1997) unless combined with an approved recharge system. The system may be used as a pretreatment device for recharging systems. In this application, the life of the recharging system should be extended due to reduced clogging of the infiltrative surface. In high groundwater conditions the system is likely to withstand the hydrostatic pressures created by the saturated soil conditions around the unit. Care must be taken to assure the seam in the concrete unit does not leak. Buoyancy of the unit should be considered in the engineering plan. Storm*ceptor* Corporation recommends use of fiberglass tanks where there is potential for spills of hazardous materials. The precast concrete units are applicable to other installations including roads, highways, and parking lots.

### Sizing

The recommended sizing, presented in the Appendix Table A1, was developed by Storm*ceptor* Corporation based on calculated loadings from the Toronto survey of system performance (Bryant et al., 1995). Based on the Edmonton Study, removal efficiencies determined for the STC 2000 (equivalent to the STC 2400) fall within the range of removal rates specified in the sizing guidlines. The performance ratings for the STC 2400, listed in Table A1 under “Treatment Train” criteria, may be conservative estimates, since that system was grossly undersized. When sized appropriately, the system is likely to perform as claimed under similar environmental and operating conditions including: climate, land use intensity, and soil conditions. The larger sized units listed in Table A1 have not been verified. The performance characteristics of these systems may vary as a function of scale. Performance of other sized units may have comparable removal efficiencies and are likely to meet Standards 4 and 6, requiring 80% TSS removal of the first 0.5 and 1 inch of rainfall respectively. The Storm*ceptor* system may be used as a stand alone BMP or as a component within a combination of different BMPs.. It is possible that sizing which corresponds to the “Sensitive Area” category in Table A1 may meet Standard 4 and 6, requiring 80% TSS removal of the first 0.5 and 1.0 inch of rainfall, respectively.

### Maintenance

All BMPs require periodic maintenance. Inspection of the sediment load and oil and grease volumes is easily made from the surface with a tube dipstick inserted through a 6" vent tube. Depths of sediment indicating maintenance are presented the Appendix, under maintenance. Inspection of the internal structure should be part of the routine inspection plan. The unit is designed to accept 15% of its capacity in solids annually based on maximum drainage area loading listed in Table 4 of the Technical Design Manual (Storm*ceptor* Corporation, 1997). Removal of sediment, oils, and grease from the system will depend on rates of accumulation. Sediment removal is recommended annually but is likely to vary widely based on site conditions and loadings. The Stormwater Management Handbook (DEP and CZM, 1997) recommends quarterly maintenance. Reduced or more frequent maintenance frequency can be determined after experience with the system increases. Typical maintenance cleaning can be done with a vacuum truck. Maintenance costs are not expected to be in excess of normal costs for maintaining deep sump catch basins. Costs for cleaning, not adjusted for economies of scale, range from $250 to $500 depending on the size of the system and disposal fees.

## REGULATORY ISSUES

The performance requirements for stormwater treatment systems are established by the DEP Stormwater Management Standards listed in the Stormwater Management Handbook (DEP and CZM, 1997). Projects subject to the standards may be required to file a Notice of Intent when they are sited in wetlands jurisdictional areas. Under the Wetlands Protection Act, conservation commissions, must apply the standards to new or modified discharges. Permits for surface water discharges under the National Pollutant Discharge Elimination System (NPDES), issued by the Massachusetts DEP Bureau of Resource Protection Division of Watershed Management, are not required if the discharge is tied to a conveyance or system of conveyances operated primarily for the purpose of collecting and conveying uncontaminated stormwater runoff.

## CROSS MEDIA IMPACTS

Disposal of sediment from stormwater treatment systems is permitted in lined or unlined permitted solid waste landfills. In the absence of written approval from DEP, sediments are considered non-hazardous solid waste and may be treated in accordance with all DEP regulations policies and guidelines. Typical removal of sediment and biofilter material can be performed with a vacuum truck and disposed of. Grease and oils may accumulate in the sedimentation chambers and can be removed and disposed as non-hazardous solid waste. If the system has received influent from a hazardous materials spill, the system should be managed in accordance with an approved emergency response plan and appropriate state requirements. The Storm*ceptor* system does not present more restrictions for removal of wastes than would be associated with any other BMP.

## ENERGY ISSUES{TC "ENERGY ISSUES"}

There are no specific energy issues related to this technology as it is not an energy consumer. There may be energy benefits when this "passive" system is compared to other technologies that may consume energy resources.

## NEED FOR ADDITIONAL RESEARCH, DEMONSTRATION, AND STEP SUPPORT

The Storm*ceptor* technology is a unique approach for stormwater pretreatment and appears to be technically feasible based on a preliminary analysis of the available data. Further research on the Storm*ceptor* system should include studies to assess actual sediment loading under a variety of environmental conditions. To establish removal rates in excess of those reported herein, further research on the Storm*ceptor* system should include: i) evaluation of seasonal variation in performance, ii) performance as a function of flow rate, iii) efficiency with dual or multiple inlets, and iv) bacteria and pathogen removal efficiency in dry weather periods. The STEP program will be able to assist in performance verification on an as needed basis. Installations already being monitored by CSR and Storm*ceptor* will continue to provide performance data in a variety of environmental conditions. Existing monitoring programs may be augmented with STEP support through STEP oversight and reporting. STEP support may include development of experimental plans and review of data. Additional data would be useful for confirming field performance claims greater than 80% TSS removal efficiency.

## SUMMARY RECOMMENDATION

The Storm*ceptor* system is based on reasonable and accepted principles applied to water treatment and conveyance systems. Review of available data suggests that the Storm*ceptor* system should be capable of providing an effective solution for treatment of stormwater runoff. At present, it is not possible to verify the performance of all the Storm*ceptor* models under the recommended sizing guidelines. The system is likely to be capable of TSS removal for Standards 4 and 6 when sized according to the "Sensitive Area" criteria. Other sized Storm*ceptor* models may provide similar TSS removal rates when sized accordingly under similar climatic conditions, land use intensities, and soil conditions. The Storm*ceptor* system is uniquely designed to trap hydrocarbons and is well suited for areas of higher pollutant potential, Standard 5 in the Stormwater Management Handbook (DEP and CZM, 1997). The system is also likely to remove grease and oils.

Based on available data, the Storm*ceptor* technology may be capable of meeting Standards 4, 5, 6, and 7 in the Stormwater Management Handbook (DEP and CZM, 1997) if installed, designed, and operated according to manufacturer's instructions. Additional data representing a varied set of operating conditions over a realistic maintenance cycle on other Storm*ceptor* models will assist in further clarification of TSS removal rates. Performance claims can be further verified as data is generated on systems currently being monitored. The Storm*ceptor* system compares favorably to other conventional BMP technologies with similar TSS removal rates, offering enhanced treatment and application.

## Highlights

- Performance data available demonstrates that the Storm*ceptor* system can provide TSS removal rates of 77% when sized according to the "Sensitive Area" criteria. Evidence suggests that the Storm*ceptor* system may be capable of achieving TSS removal rates between 89% and 99% when sized accordingly, under conditions similar to those reported in the Westwood Massachusetts site, including: climate and land use intensity.
- Performance data available to this reviewer suggest that the Storm*ceptor* system can provide TSS removal rates of 52% when sized according to the "Treatment Train" criteria.
- Use of the Storm*ceptor* system as a pretreatment component in combination with different BMPs, when sized according to the "Treatment Train" criteria, will likely meet standards 4 and 6 of the Stormwater Management Handbooks (DEP and CZM,1997). Use as a stand alone device may be justified when sized according to the "Sensitive Area" criteria.
- The Storm*ceptor* system is likely to perform in areas with higher potential pollutant levels in Standard 5 of the Stormwater Management Handbooks (DEP and CZM,1997).
- The Storm*ceptor* system is useful for new and retrofit installations in Standard 7 of the Stormwater Management Handbooks (DEP and CZM,1997), especially where space is limited.
- The Storm*ceptor* system is also suited for secondary sediment control from construction related sediment loads specified in Standard 8 (DEP and CZM,1997).

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## APPENDIX

| **Table A1. Storm*ceptor*® Capacities*** | | | | | |
|---|---|---|---|---|---|
| Model | Maximum Treatment Flowrate (gal/min.)** | Down Riser Pipe / Orifice Diameter (in.) | Sediment Capacity ($ft^3$) | Oil Capacity (gal) | Total Holding Capacity (gal) |
| STA/STC 900 | 285 | 6 | 75 | 280 | 950 |
| STA/STC 1200 | 285 | 6 | 110 | 280 | 1230 |
| STA/STC 1800 | 285 | 6 | 195 | 280 | 1830 |
| STA/STC 2400 | 475 | 8 | 180 | 880 | 2495 |
| STA/STC 3600 | 475 | 8 | 345 | 880 | 3750 |
| STA/STC 4800 | 800 | 10 | 465 | 1025 | 5020 |
| STA/STC 6000 | 800 | 10 | 610 | 1025 | 6095 |
| STA/STC 7200 | 1110 | 12 | 725 | 1100 | 7415 |

* approximate, ** without by-passing

| **Table A2. Maximum Impervious Drainage Area Guidelines (acres)** | | | | |
|---|---|---|---|---|
| **Storm***ceptor*® Model (STA / STC) | Sensitive Area (80% TSS removal) | Standard Area (70% TSS removal) | Degraded Area (60% TSS removal) | Treatment Train (50% TSS removal) |
| 900 | 0.45 | 0.55 | 0.70 | 0.90 |
| 1200 | 0.70 | 0.85 | 1.05 | 1.45 |
| 1800 | 1.25 | 1.50 | 1.90 | 2.55 |
| 2400 | 1.65 | 2.00 | 2.50 | 3.35 |
| 3600 | 2.60 | 3.15 | 3.95 | 5.30 |
| 4800 | 3.60 | 4.30 | 5.40 | 7.25 |
| 6000 | 4.60 | 5.55 | 6.95 | 9.25 |
| 7200 | 5.55 | 6.70 | 8.40 | 11.25 |

| Table 6. Sediment Depths Indicating Required Maintenance***{**tc "Table 6. Sediment Depths Indicating Required Maintenance*"**}Table A3. Sediment Depths Indicating Required Maintenance*** | |
|---|---|
| **Model** | **Sediment Depth (feet)** |
| 900 | 0.50 |
| 1200 | 0.75 |
| 1800 | 1.00 |
| 2400 | 1.00 |
| 3600 | 1.25 |
| 4800 | 1.00 |
| 6000 | 1.50 |
| 7200 | 1.25 |

* based on 15% of the interceptor’s sediment storage