STORMKLEENER™

CARTRIDGE FILTER SYSTEM

Design Manual

StormKleener™ Filter Cartridge System
for Storm Water Management

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1.0 StormKleener Product Information

The Lane StormKleener Filter Cartridge System is a storm water treatment device consisting of one or multiple cylindrical media filled cartridges housed in a containment or carrier vessel. The containment vessel can be constructed from any appropriate material including: corrugated metal pipe, plastic pipe, or a reinforced concrete vault. The Lane StormKleener Filter Cartridge System is a passive flow-through filtration system that filters and cleans storm water to provide an exceptional pollutant removal during storm events, while providing a naturally occurring backwash to enhance and extend the life of the cartridge.

Because the filter cartridges are modular, they can be configured for any site to provide storm water treatment required by local regulations. In addition, the filtration material can be altered to target specific problem pollutants when needed.

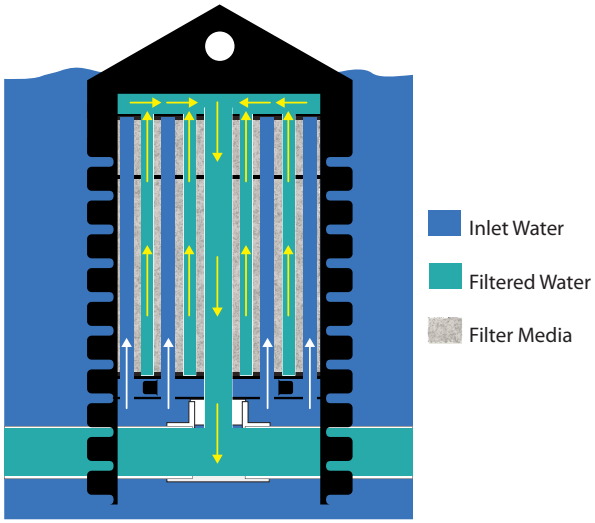
The Lane StormKleener Filter Cartridge System has been extensively tested and has completed the New Jersey Corporation for Advanced Technology (NJCAT) testing protocol for filters passing the requirement for over 80% suspended solid removal.

2.0 Individual Cartridge Design and Operation

The Lane StormKleener Filter Cartridge System removes contaminants through the use of media filtration. Media filtration is a long-standing method of treating drinking water, storm water, and swimming pool filters. It is a proven technology which provides excellent results. Sand filters have been proven successfully at removing sediments, nutrients, heavy metals, and organic contaminants.

The Lane StormKleener Filter Cartridge System is designed to allow the up-flow of water filtration through the cartridge filters. It does this by entering the filter through the mesh tubing that is open at the bottom of the filter then flowing through the filter media into mesh tubing that is open at the top of the filter. Once the water has been cleaned, it exits the filter through the center down drain and leaves the vault through the floor piping. The contaminants remain trapped in the containment vessel of the filter. There are four phases of flow:

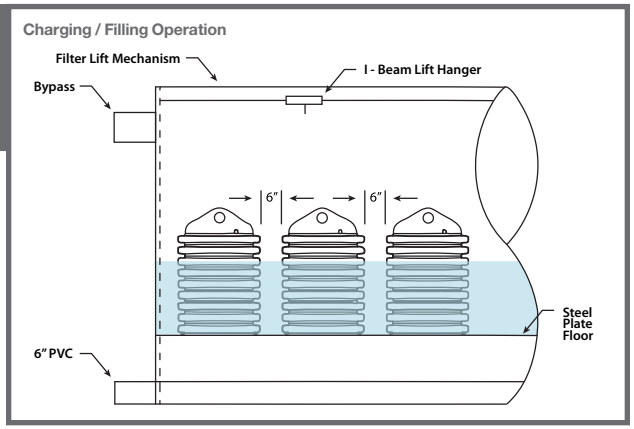
How It Works



2.1 - Charging / Filling Operation

The single cartridge, or several cartridges, are placed in a vault or other containment structure. No water will flow through the cartridge until it reaches the top of the filter. Water will be entering the meshed tubing open to the bottom of the filter during this process and filtering through the media into the mesh tubing open to the top of the filter. However, no water will exit the system through the filter until the water level has reached the top of the filter in this phase of operation. A relief valve is installed on the top of the filter to allow air to escape from the filter during the filling process. This provides an airtight system which is needed for the subsequent flow regimes during storm subsidence.

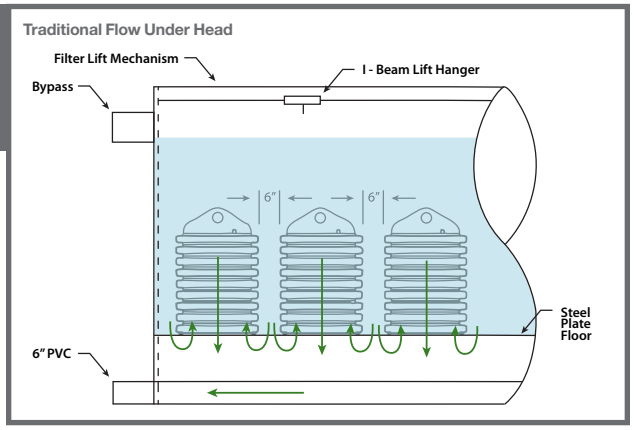
Phase 1



2.2 - Traditional Flow Under Head

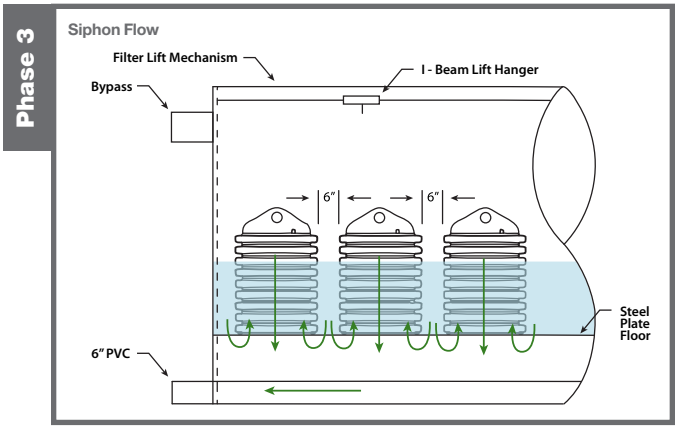
When the storm water reaches the top of the filter, the flow pattern remains the same, but filtered water begins to flow down the center drain tube and exits the system. This water has been filtered by the media to have pollutants removed. Flow through the filter is maintained at the targeted flow rate by use of a flow constrictor orifice and is driven by head over the top of the filter cartridge.

Phase 2



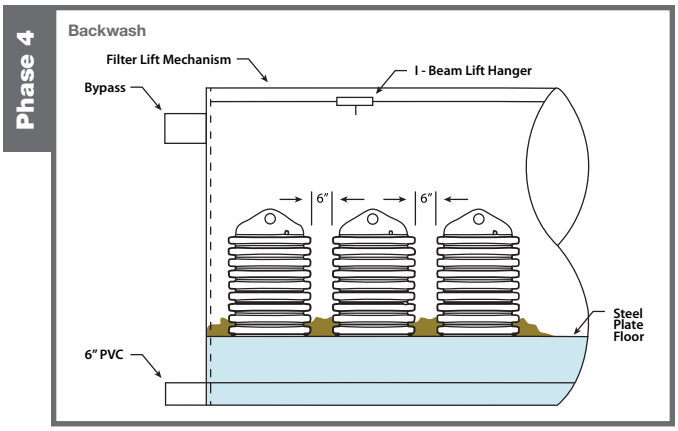
2.3 - Siphon Flow

As the storm water subsides and flow decreases, the water will drop below the top of the filter. Since the filter is watertight, storm water remaining in the containment vessel will continue to be treated and filtered through the filter because of the siphon created. This flow will continue until the point at which the storm water level reaches the bottom of the filter and air enters the filter at the bottom.



2.4 - Backwash

Once the water being treated has reached the bottom of the filter cartridge, a siphon break occurs. The break in the siphon allows air to reenter the filter. This causes the flow in the filter to reverse and backwash the filter media. The backwash deposits the pollutants into the containment vessel and cleans the filter itself. This extends the life of the filter as well as the requirement for cleaning and maintenance.



3.1 - Installation and Operation

The cartridges are installed in a containment vessel that collects storm water for treatment. The vessel can be constructed from CMP, HDPE, concrete, or other suitable material. Each containment vessel is designed to handle multiple cartridges. The cartridges are placed and connected to piping that allows filtered water to exit the vault. The piping for the filtered water can either be placed on the bottom of the vault or in a subfloor. Clean water exits the vault through outlet piping. All storm water flowing through the vault and filter system is by gravity flow. No pumping of storm water or filtered water is necessary. The installation of the system would entail the placement of the vault, connection of the vault to the storm water drainage and management system, backfill of the vault, placement of the cartridges, and finished grading and start up.

Water enters the vessel near the top of the structure through one end. As the storm water rises in the structure, the filter cartridges begin to flow and filter the water to provide clean water at the outlet. The outlet exits at the bottom of the containment vessel. Because the filter system is an online system, an internal bypass is utilized to allow water, which is greater than the designed treatment flow, to exit the containment vessel. The bypass is located at the top of the structure and begins to flow when the maximum driving head is reached.

During a typical storm treatment event, water begins to flow into the containment vessel at the start of the storm. The storm water runoff enters the vessel and the first stage of flow through the filters (Charging / Filling) begins. Should the storm end before the completion of the phase 1 flow process, the vault or containment vessel will still drain down and treat the storm water through the drain down cartridge. The drain down cartridge is a small sand filter cartridge in PVC pipe which is attached to the tee at the base of the filter. There is one drain down cartridge for each filter in the vault. The drain down cartridge provides the ability to drain the vault while treating the storm water should the storm event terminate before reaching a Phase 2 flow condition. In addition, the drain down cartridges provide a method to drain the vault after the siphon breaks and the system backwashes.

As the storm progresses, it continues to fill the vault, and the filter cartridges begin to flow under head. Once the designed treatment flow has been reached, any additional storm water flowing through the vault will exit through the bypass pipe located with the invert at maximum driving head elevation. All water that has been filtered and cleaned exits the vault through the down drain pipes in the center of the filters and the associated piping. The bypass piping and clean water piping meet outside the filter to discharge and proceed to flow to the designed outflow or detention system.

As the storm slows and eventually stops, the water inside the vault begins to subside. Flow continues through the filter cartridges even as the storm water is subsiding and lowering in the vault until they reach the bottom of the filters when the air break and backwash begin. Backwash through the filters will deposit pollutants in the form of sediment and other contaminants on the floor of the vault. These will be removed during the maintenance cycle.

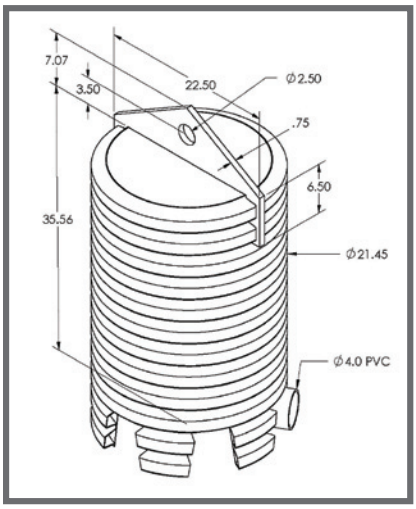
The vault is due for maintenance when the storm water remains above the bottom of the filter cartridges for more than 24 hours after rainfall has ceased. The approximate depth of water remaining would be 9” or more. At this point maintenance of the system should be performed and the filter cartridges replaced or recharged.

3.2 - System Design

The Lane StormKleener Filter Cartridge System removes sediment and pollutants from storm water runoff through both filtration and sedimentation. As water enters the containment vessel housing the cartridges, sediment and pollutant material that is contained in the storm water will begin to drop out of suspension and settle to the bottom of the vault. This process removes the larger particles that are contained in the runoff along with debris. Typically, smaller particles that are in suspension will not be able to be removed by settling and will require filtration. The filter removes the small particles along with nutrients and metals that are absorbed by the sediment flowing through the filter.

The Lane StormKleener Filter Cartridge System provides a high-surface area filter in a compact casing providing a very efficient filtration system. The Filter provides longevity due to the ability to trap material in the vault and the backwash of the filter recharges the filter after each storm event depositing pollutants in the vault. The StormKleener Filter Cartridge System has the following design parameters:

- Size: 18” diameter
- Weight: 125 lbs
- Flow rate: 30 gpm (Insert Filter Picture)
- Minimum operational head: 33”
- Manifold diameter: 6”



Systems are designed by following a complete and easy design methodology.

The primary parameter to consider in the design of the system is the quantity or volume of storm water to be treated. This can be determined as either a flow rate or volume that requires treatment. The Lane StormKleener Filter Cartridge System can facilitate any treatment flow design requirement. This is not the same as the peak treatment flow through the storm drain system. Only the treatment flow required for water quality treatment should flow through the system as this will extend the filter life and produce a more efficient system. Due to the flexible design parameters of the cartridge system, it can be either offline or online. An offline system provides the most value and extends the life cycle of the filters, but there are times and conditions when an online system may be a better choice depending on site characteristics.

Offline systems include a bypass system to allow flow to be diverted into the filter treatment system at low flows and higher flows to bypass the system. This is accomplished with the use of a diversion weir or bypass structure. It is also possible to include the bypass structure within the containment vault. Standard design drawings are developed to show this configuration.

The system is designed for the filters to deposit sediment and pollutants collected during a storm event on the floor of the containment vessel. The Lane StormKleener Filter Cartridge System has been tested for scour and provides excellent retainage of material even with high flow rates and a full system.

As detailed in the individual cartridge operation description, the Lane StormKleener Filter Cartridge System requires a minimum head to begin flow through the filter. Smaller filters are available to reduce the required operating head. In these cases, less flow through the filter will be available and the amount of pollutants treated will be reduced. This can be compensated for by providing more filters to compensate for the reduced filter area.

Any filter system should be placed after a pretreatment device of some kind. The addition of pretreatment allows larger objects, debris, and material, which are removable by settling, to be removed prior to flowing through the filters. This extends the life of the filters and is good practice for treatment of storm water.

3.3 - System Sizing

The Lane StormKleener Cartridge Filter System can be designed for any flow or volume of treatment. The system can be as small as one filter, but in most cases, will consist of multiple filters in the vault. It is important to size the system correctly. Although filters will still function and remove sediment and pollutants in an undersized system, the life expectance of the filters will be shortened significantly.

The system requirements will be determined by the local jurisdiction requirements and the objective for pollutant removal set by the engineer. In most cases the removal efficiency and flow rate is dictated by the local jurisdiction. Some areas use a volume based or other pollutant loading reduction for design of a system. The required number of Lane StormKleener Filter Cartridge Systems is determined by dividing the treatment flow rate by the flow rate of the filter cartridge. This will provide the number needed.

$$Required\ Number\ of\ Cartridges = \frac{Q_{Treatment\ Flow}\,(cfs)\,x\ 448\ gpm/cfs}{Q_{Lane\ Cartridge}(gpm)}$$

Results from the equation should be rounded up to the nearest whole cartridge. If a volume-based approach is used, contact your Lane representative for assistance.

3.4 - Configurations

Lane StormKleener Filter Cartridge Systems are available in multiple configurations. The systems can be installed in the typical available structures including: manholes, precast concrete vault, box culverts, cast in place concrete vaults, CMP pipe vaults, and structural plate vaults.

The Lane StormKleener Filter Cartridges Systems require a minimum of a 30” manway to access the filters. Cartridges are installed on the floor of the vault. The filters are arranged on the floor of the vault with the ability for workers to place and remove filters. Installation and maintenance occur by having workers enter the vault to place or remove the filters. The filters should never be used during the construction activities on a site as the amount of sediment released during construction activities would quickly cause the filters to be spent and require replacement.

3.5 - Installation

1. Excavate to line and grade as shown on construction plans for the filter vault. Compliance with local, state, and federal codes and safety regulations is required.
2. Subgrade must be level. Verify that elevations comply with plan and adjust appropriately. If installing a round structure, it may be necessary to brace the structure until backfill begins in order to ensure that the floor of the structure remains level.
3. Bearing capacity for the structure should be verified by a licensed professional geotechnical engineer.
4. Set the section of the containment structure.
5. Verify the elevations of the structure are correct and that the floor of the structure is level where the filters will sit.
6. If additional sections are required, a watertight seal should be added at each joint.
7. Begin backfilling of the structure in accordance with the manufactures' recommendation and appropriate standards.
8. Install the outlet pipe when the proper elevation of backfill is reached.
9. Install the inlet pipe when the proper elevation of backfill is reached.
10. Install the trolley and lifting system (see separate instructions).
11. There are two types of outlet methods for the filter system.
    a. If using a CMP vault, the filters will connect directly to the vault floor and drainage will be pre-installed in the system.
    b. If using a precast concrete vault, the piping for the filters will be directly on the floor. When cleaning out, the piping should be moved to one side and put back in place when installing new filters. The filters will connect directly to the tees provided in the piping.

3.6 - Maintenance

Maintenance of the Lane StormKleener Filter Cartridge Systems is a simple process that should be performed when water is still retained in the vault 24 hours after rainfall has ceased. This should be on an approximate yearly schedule, but could be as often as every two to five years depending on the pollutant and contaminant load on a site, as well as the sizing of the system. Maintenance of the system requires confined space entry; therefore, all OSHA compliance rules and safety precautions should be adhered to.

Maintenance is performed in the following steps:

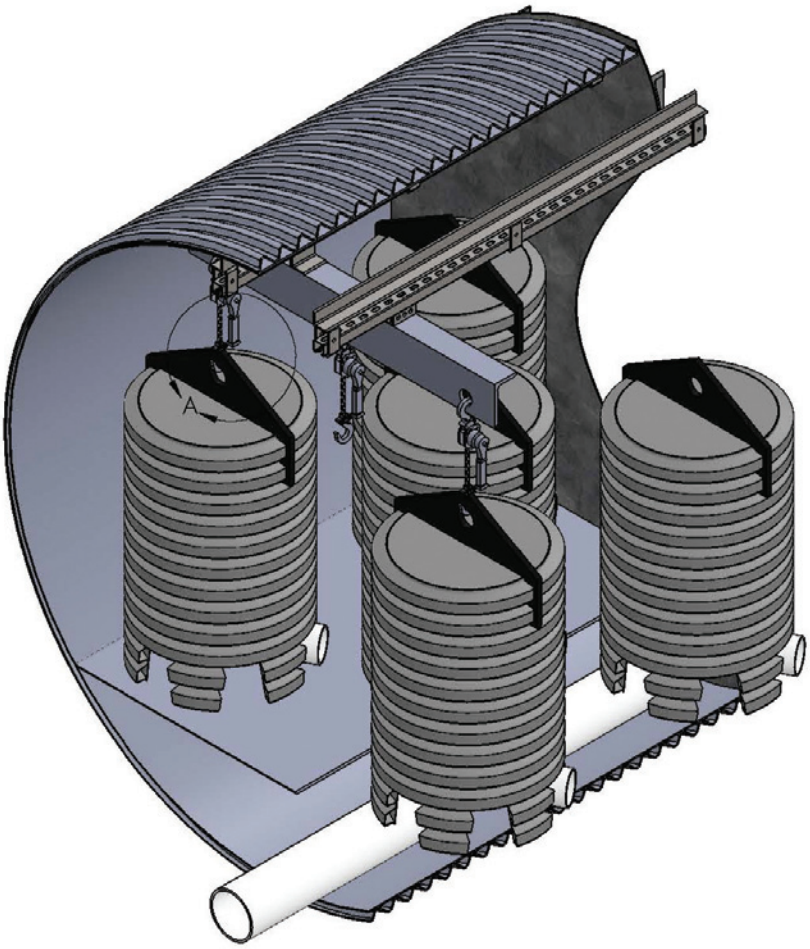
1. Open access port to inspect the vault area and condition utilizing a portable battery operated light for visual inspection.
2. Inspect vault for standing water and sediment loading within the vault. If the water level remains at the bottom inlet elevation of the filter for more than 24 hours, or if the sediment in the vault is consistently at the bottom inlet elevation of the filter cartridge maintenance is required.
3. Utilizing a vacuum truck, remove the accumulated sediment and any remaining water from the bottom of the vault. Sediment and water should be removed to level to enable access into the unit by a person.
4. Once adequate sediment and water removal has occurred, individual filter cartridges are removed. They disconnect from either the piping which is laying on the floor or from the inlets on the floor leading to the sub floor area. Cartridges can be removed from an installed hand crane in the vault and moved to the access port for removal.
5. Piping in the vault should be moved to the side (if required).
6. Vacuum the remaining sediment and liquid by vacuum truck before installation of new cartridges.
7. The piping on the floor is replaced.
8. New cartridges are installed utilizing the hand crane installed in the vault.

The used cartridges can either be returned to the manufacturer for reconstruction or placed in a land-fill.

Availability and Cost

Lane StormKleener Filter Cartridge Systems are available through Lane Enterprises. Material, installation, and maintenance costs vary with location. For pricing in your area, contact Lane Enterprises at 888.864.7419.

The Lane StormKleener Filter Cartridge System is purchased complete from Lane Enterprises including, filters, vault structures, and internal piping.



GENERAL NOTE: Every effort has been made to ensure the accuracy and reliability of the information presented herein. Nevertheless, the user of this brochure is responsible for checking and verifying the data by independent means. Application of the information must be based on responsible professional judgement. No express warranties of merchantability or fitness are created or intended by this document. Specification data referring to mechanical and physical properties and chemical analyses relate solely to tests performed at the time of manufacture in specimens obtained from specific locations of the product in accordance with prescribed sampling procedures.

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LANE

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