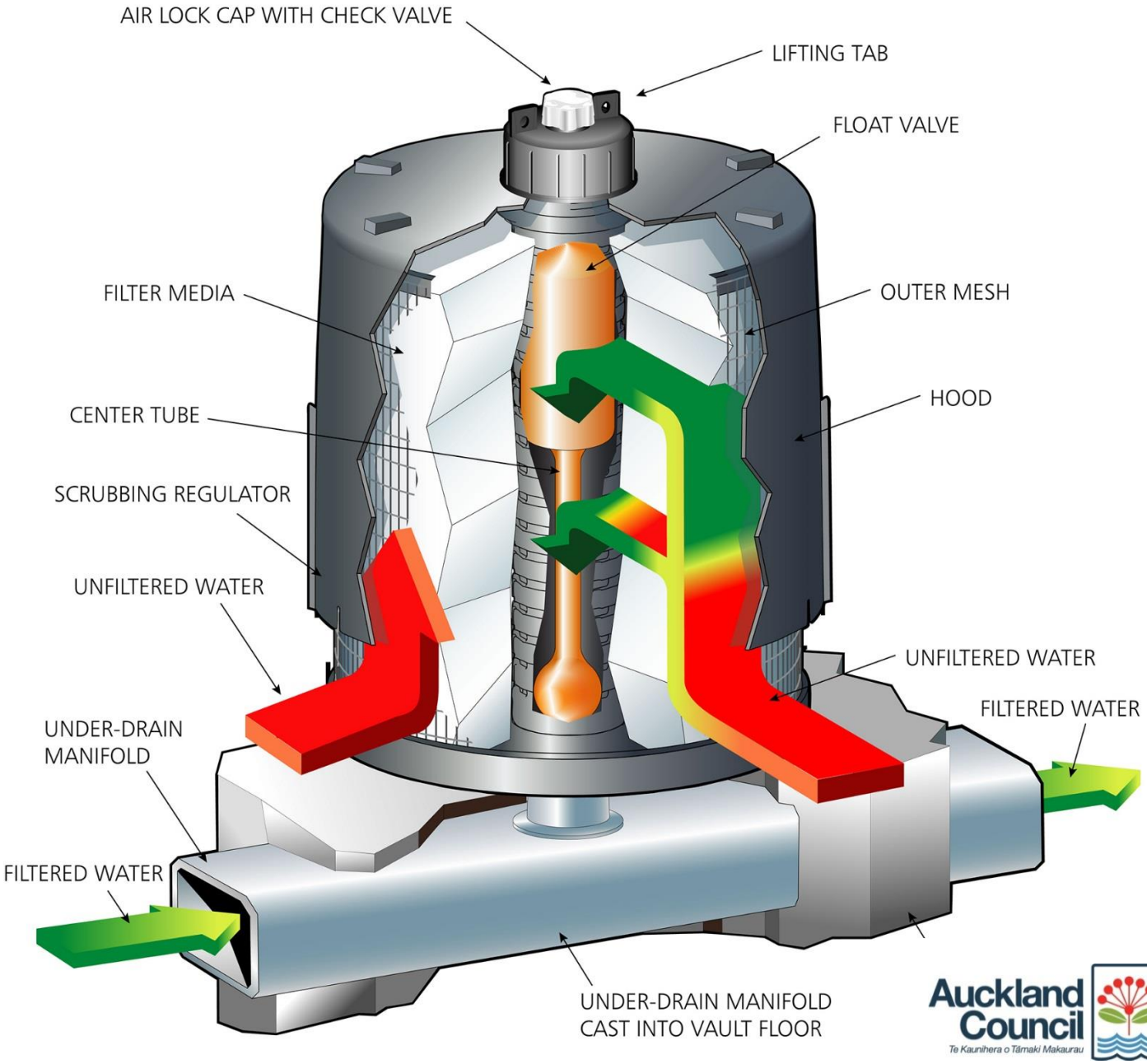
# Stormwater360 Stormfilter Interim Proprietary Device Evaluation
# Part 1 – Air, Land and Water Plan Evaluation

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Te Kaunihera o Tāmaki Makaurau

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# Executive Summary

Auckland Council Stormwater Unit (SU) has engaged Morphum Environmental Ltd. (MEL), in conjunction with AECOM, to undertake evaluations for proprietary devices for use on *private* infrastructure. The process provides interim recognition of international certifications for proprietary stormwater devices for use on private sites. Certifications are considered from:

- State of New Jersey Department of Environmental Protection (NJDEP) Approval of Use for Manufactured Treatment Devices, and
- Washington State Technology Assessment Protocol-Ecology (TAPE) Program: General Use Level Designation (GULD) Approval.

The evaluations are split into two parts, this report (part 1) summarises a review of the information provided to Morphum by Stormwater360 Ltd regarding the StormFilter® (StormFilter) system and evaluates the performance against the Air, Land and Water Plan (ALWP). Part 2, to be completed at a later date, evaluates the performance of the stormfilter against the Proposed Auckland Unitary Plan (PAUP).

Based on our review it is concluded that the StormFilter using a Perlite media operating at both 0.7 L/s/m² and 1.4 L/s/m², and when using a ZPG™ media operating at 0.7 L/s/m² can provide the 75% TSS removal required in the ALWP.

As a result of this review, we conclude that the StormFilter can be granted interim approval under the ALWP for use on private sites. Interim, provisional approval is provided for a period of 3 years, but Auckland Council may amend, extend or revoke approval.

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# 1.0 Introduction

Auckland Council Stormwater Unit (SU) has engaged Morphum Environmental Ltd. (MEL), in conjunction with AECOM, to undertake evaluations for several proprietary devices for use on *private* infrastructure. These evaluations (if successful) will provide interim recognition of international certifications for proprietary stormwater devices for use on private sites within Auckland. Note that this process will not provide approval for stormwater devices to be used on public sites nor devices to be vested to Auckland Council.

The evaluation includes:

- Reviewing existing approvals for the proposed proprietary devices.
- Relating overseas approvals to local context.
- Developing practice notes to cover the requirements for local installations.
- Developing pro-forma consent conditions appropriate for inclusion in resource consents, approving the use of the proprietary devices.

The SU previously released the Proprietary Device Evaluation Protocol (PDEP) for Stormwater Quality Treatment Devices (Guideline Document 03) in December 2012. The document provides guidance to evaluate permanent proprietary stormwater quality management devices providing for a *Body of Evidence* or *Local Pilot Trial* route to certification of performance claims from a device manufacturer.

As of May 28th 2014 all Proprietary Device Evaluation Protocol (PDEP) applications were put on hold. A replacement process has been implemented to provide interim recognition of international certifications for proprietary stormwater devices for use on private sites. Certification from the following two bodies is to be considered:

- State of New Jersey Department of Environmental Protection (NJDEP) Approval of Use for Manufactured Treatment Devices, and
- Washington State Technology Assessment Protocol-Ecology (TAPE) Program: General Use Level Designation (GULD) Approval.

Discussions within the water industry and with Water NZ have identified that in the longer term a national stormwater product approval system should be developed for NZ, as has been done in other countries. It is hoped that a national system would supersede this interim recognition process in the future.

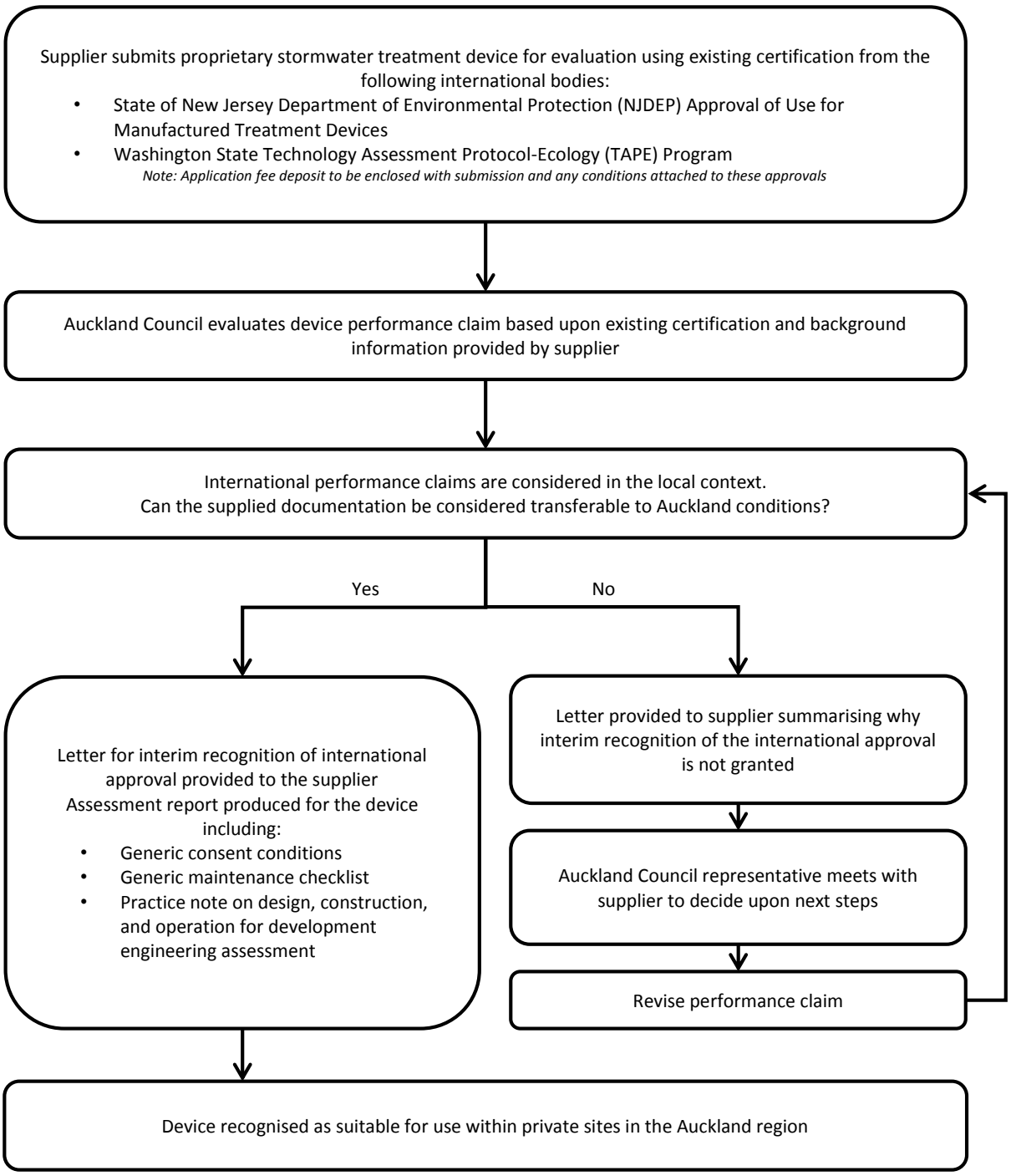
Some proprietary devices have had overseas certifications with approved laboratory or field test data. However, this data may not be suitable for local Auckland conditions and

application. Figure 1-1 illustrates the methodology used for the interim assessment of the overseas data. It is important to note that this interim process is only for use of the proprietary device on private sites.

This report provides evaluation for the Stormwater Management StormFilter® (StormFilter) supplied by Stormwater 360. This includes:

- Comparison of the device performance against the stormwater management requirements in the Auckland region.
- Understanding and description of the operation and maintenance requirements for the device.
- Practice notes and consent conditions for local installations should the device be deemed suitable for use within private sites in the Auckland region.

Part 1 of the evaluation (this report) summarises the StormFilter against the Air Land and Water Plan (ALWP). Part 2, to be completed at a later date, summarises the device against the Proposed Auckland Unitary Plan (PAUP). The StormFilter was previously submitted for evaluation under PDEP. Documentation submitted by Stormwater 360 for consideration under PDEP has been used in the interim evaluation herein. Any additional queries were resolved by contacting Stormwater 360 directly.




*Note: To permit vesting of the device to Auckland Council, the supplier will require approval under the New Products Approval Process*

Figure 1-1: Interim recognition of international approval flowchart

# 2.0 Device Description & Current Certifications

## 2.1 Description

The StormFilter® is described within manufacturer specifications as *an underground precast manhole or vault that houses passive siphon-actuated, radial-flow media-filled filter cartridges*. The filter cartridges are rechargeable and incorporate a *self-actuated surface cleaning mechanism* purported to *increase the effective life of the filter media and to reduce the accumulation of material on the cartridge surface*. Each radial flow filter cartridge operates at a predetermined flow rate through the use of an integrated flow control orifice located within each filter cartridge outlet manifold. The filtration rate can be adjusted through orifice design to suite the characteristics of a site and its runoff.

Stormwater enters the system and is percolated through the cartridges which trap particulates and remove pollutants such as dissolved metals, nutrient, and organics using different media. Two particular media, Perlite and ZPG™, are considered in analysis of device performance herein. Additional media are available (Section 5.6), but are outside the scope of this assessment. A combination of media may be recommended to maximise stormwater pollutant removal.

Three different cartridge heights are available: 30 cm, 46 cm, and 69 cm, allowing for design to suit a range of surface area and hydraulic drop constraints.

The technology physical description treatment mechanism can be found in Appendix A.

## 2.2 Current Certifications

Two specific International Certifications are to be considered herein: State of New Jersey Department of Environmental Protection (NJDEP) Certification for Manufactured Treatment Devices and Washington State Department of Ecology Certification.

NJDEP requires that manufactured treatment devices obtain verification through the New Jersey Corporation for Advanced Technology (NJCAT) prior to Certification being awarded. Verification based on laboratory data will lead to Interim Certification with verification incorporating field testing meeting or exceeding 2006 New Jersey Tier II Stormwater Test Requirements leading to Final Certification. Verified and certified stormwater technologies may be acceptable under the Technology Acceptance Reciprocity Partnership (TARP)

Protocol (Tier II) for Stormwater Best Management Practice Demonstrations endorsed by California, Massachusetts, Maryland, New Jersey, Pennsylvania, and Virginia.

Washington State Department of Ecology recognises different use level designations based on the quality and quantity of the performance data supplied. The designations are:

- Pilot Use Level Designation (PULD) – limited use of the proposed device to enable field testing. This designation level may be given based solely on laboratory performance data. PULD applies for a specified time period only.

- Conditional Use Level Designation (CULD) – for emerging technologies with a considerable amount of performance data but the data were not collected per the Technology Assessment Protocol – Ecology (TAPE) protocol set by the Ecology. This designation level may be given based on field data collected by a protocol that is reasonably consistent but does not necessarily meet the full TAPE protocol. CULD applies for a specified time period only.
- General Use Level Designation (GULD) – confers general acceptance for the treatment device. GULD technologies may be used anywhere in Washington, subjected to Ecology conditions. Ecology plans to include GULD technologies in future stormwater manual updates. A Technical Evaluation Report (TER) is required as part of the application.

The StormFilter currently holds the following certification:

- State of New Jersey Department of Environmental Protection (NJDEP) Certification
    - Laboratory Test Certification for 80% TSS removal (Expired: 1/09/2013)
    - Field Test Certification for 80% TSS removal (Expires: 1/12/2016)
- Washington State Department of Ecology ('Ecology') Certification
    - GULD for basic (TSS) treatment for the StormFilter with ZPG™ media at 0.7 L/sec/m² media surface area (no expiration date, but Ecology may amend or revoke it)
    - CULD for basic (TSS) and phosphorus treatment for the StormFilter with PhosphoSorb™ media (Expires: 31/12/2014)
    - CULD for basic (TSS) treatment & PULD for phosphorus treatment for the StormFilter with Perlite media (Expires: 30/09/2015)
    - CULD for basic (TSS) and dissolved metals (enhanced) treatment for the StormFilter with MetalRX™ media (Expires: 30/06/2016)

While the StormFilter holds NJDEP Laboratory (Interim) certification and Washington CULD and PULD certifications, only the NJDEP Field Certification (Full) and Washington GULD are considered for the Interim Approval Assessment. The reason being, that interim and provisional certifications allow a device to carry out field testing meeting requisite assessment protocols. Since Auckland does not currently have an active field testing protocol, these certifications are not suitable for use in Auckland.

NJDEP Field Certification (Full) and Washington GULD are summarised in Table 2-1 and can be found in full in Appendix B.

Table 2-1 Summary of New Jersey Department of Environmental Protection and Washington State Department of Ecology Certification for the StormFilter

| **Criteria** | **NJDEP Field Test** | **Washington GULD** |
|---|---|---|
| Expiration date | 1 Dec 2016 | None |
| Filter media | Perlite | ZPG™ |
| Treatment performance | 80% TSS removal | Basic TSS removal[2] |
| Maximum flow rate | 1.4 L/s/m² of media surface | 0.7 L/s/m² of media surface, or per cartridge:<br>30 cm – 0.3 L/s<br>46 cm – 0.5 L/s<br>69 cm – 0.7 L/s |
| Maximum catchment area per cartridge[1] | 30 cm – 445 m²<br>46 cm –688 m²<br>69 cm – 1032 m² | Not specified |
| Sediment load capacity[1] per cartridge @ 1.4 L/s/m² | 30 cm – 10 kg<br>46 cm – 15 kg<br>69 cm – 23 kg | Not specified |
| Additional Conditions | Maximum drain down of 36 h.<br>Off-line system; flows exceeding NJ WQ design storm to be bypassed.<br>Adhere to maintenance requirements, per Contech "StormFilter Inspection and Maintenance Procedures". | Design, install, operate, & maintain in accordance with Contech manuals.<br>Flows exceeding water quality treatment rate to be bypassed.<br>Regular inspection 12 mo post-construction to determine site-specific maintenance schedules & requirements.<br>Pre-treatment of TSS and oil and grease may be necessary. |
| 1. By cartridge height. 2. Ecology's 80% TSS removal goal applies to ≥100 mg/L influent TSS. <100 mg/L influent TSS, the goal is 20 mg/L effluent TSS. | | |

## 2.3 US Testing & Performance

Field studies provide the basis of current final StormFilter certifications from Washington and New Jersey. Although substantial laboratory data was also provided, for the purposes of this assessment only the field data provided is considered relevant.

Three independently certified field studies that form the basis of the WA and NJ approvals are summarised in Table 2-2.

Results from these studies, undertaken to confirm the manufacturer's performance claims, provide the basis for comparison for StormFilter use in an Auckland context (Section 0). Results from each study conform to the respective study protocols, providing robust data that has been verified by an independent organisation.

Table 2-2 Independently certified field tests demonstrating StormFilter performance

| | **New Jersey** | **Washington** | |
|---|---|---|---|
| Location | Greenville Yards<br>19 Colony Rd<br>Jersey City, NJ | Heritage Marketplace<br>6700 NE 162nd Ave<br>Vancouver, WA | Lake Stevens<br>Near 925 S Lake Stevens Rd,<br>Lake Stevens, WA |
| Site land use | Cargo docks & employee parking | Shopping centre car park | Arterial roadway |
| Date | Jul 04–Dec 05 | May–Dec 03 | Apr 03–Mar 04 |
| # Events[3] | 16 | 13 | 9 |
| Flow rate | 1.4 L/s/m² | 0.7 L/s/m² | 0.7 L/s/m² |
| Media | Perlite | ZPG™ | |
| Compliance | TARP[1] Tier II Stormwater Protocol & the New Jersey Tier II requirements | Washington Department of Ecology TAPE[2] | |
| Outcome | NJDEP Certification | Washington Ecology Certification | |
| 1. Technology Acceptance and Reciprocity Partnership. 2. Guidance for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol—Ecology. 3. Only events qualifying for evaluation, additional events may have been recorded during the study. | | | |

While all available rainfall events for the New Jersey field study were analysed, only a selected number of events were used for analysis from the Washington field studies; 13 out of 21 events and 9 out of 12 events from the Heritage Marketplace and Lake Stevens field studies respectively. Events included in analysis achieved GULD for Basic Treatment. The remaining 11 events were excluded from analysis due to not meeting one or more data

quality objectives (DQOs). The Washington State Department of Ecology (WADOE) defines the DQOs in their DQOs) in their 2002 document "Guidance for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol—Ecology (Publication Number 02-10-037)". Based on personal communications with WADOE, some modifications were made to the DQOs and are listed below.

- Event depth, min 0.10 in
- Event duration, min 1 h
- Number of aliquots, minimum 5 (Inf:Eff)
- Average event coverage, minimum 50%

No storm events were disqualified for substantial internal overflow since the Ecology Basic Treatment Performance Goal includes these events. Detailed information for excluding data for analysis from the two Washington studies as well as entire data sets from the Madison Electric (Wisconsin) and Riverwalk (Wisconsin) studies are outlined in Table 2-3.

Table 2-3 Summary of data excluded from analysis

| Field study | Event ID | Reason for exclusion from analysis | Other comments |
|---|---|---|---|
| Washington Heritage Marketplace | HMP051603 | - Insufficient number of aliquots | - ZPG™ media at 0.7 L/s/m² |
| | HMP091603A | - Insufficient event depth<br>- Insufficient number of aliquots | |
| | HMP100803 | - Insufficient event depth | |
| | HMP100903B | - Insufficient average event coverage | |
| | HMP111903 | - Insufficient average event coverage | |
| | HMP112103 | - Insufficient event depth | |
| | HMP120203 | - Insufficient average event coverage | |
| | HMP120403 | - Insufficient average event coverage | |
| Washington Lake Stevens | LSN101503 | - Insufficient number of aliquots | - ZPG™ media at 0.7 L/s/m² |
| | LSN101603 | - Insufficient number of aliquots | |
| | LSN020304 | - Insufficient number of aliquots | |
| Madison Electric, Wisconsin | Entire study excluded | - Study was not independently verified<br>- Influent concentrations were low with median influent TSS of 15 mg/L, below the claimed average effluent quality from the device | - ZPGTM media at 1.4 L/s/m² |

| Field study | Event ID | Reason for exclusion from analysis | Other comments |
|---|---|---|---|
| Riverwalk, Wisconsin[1] | Entire study excluded | - The system operated online, contrary to NJ and WA requirements.<br>- Runoff drained to the device from an elevated highway via a 4.6 m vertical drop followed by 2.6 m horizontal conveyance. Potential high velocity flows entering the system had the capacity to carry coarser sediment through the bypass and under conditions that likely did not optimise system performance.<br>- System loading demonstrated a substantially coarser particle size distribution and influent contaminant loads greater than those anticipated in Auckland catchments. | - ZPGTM media at 1.4 L/s/m² |
| 1. Study followed the U.S. Environmental Protection Agency Environmental Technology Verification Protocol, thus meeting criteria for robust independent data. | | | |

Only the three studies specifically used to achieve NJ and WA Certifications—Greenville Yards, Heritage Marketplace, and Lake Stevens—are considered herein.

# 3.0 Application in an Auckland Context

## 3.1 Comparison of PSDs

Comparison of particle size distribution (PSD) provides an assessment for the transferability of results from international field studies (Table 2-2) to the Auckland context. The PSD of stormwater runoff (influent) in each of the field studies was compared to example PSDs for the Auckland region in order to assess the likely performance of the StormFilter with either ZPG™ or perlite media in an Auckland context (Figure 3-1).

Three Auckland PSDs are provided:

- A "Pakuranga" PSD as presented in TP10 (ARC 2003);
- A composite PSD for eight central Auckland catchments based upon NIWA monitoring commissioned by Metrowater and Auckland City for the period 2002-2003 (Semadeni-Davies 2013); and
- A composite PSD for three northern Auckland catchments based upon a study undertaken for NZTA and Auckland Council (Semadeni-Davies 2013).

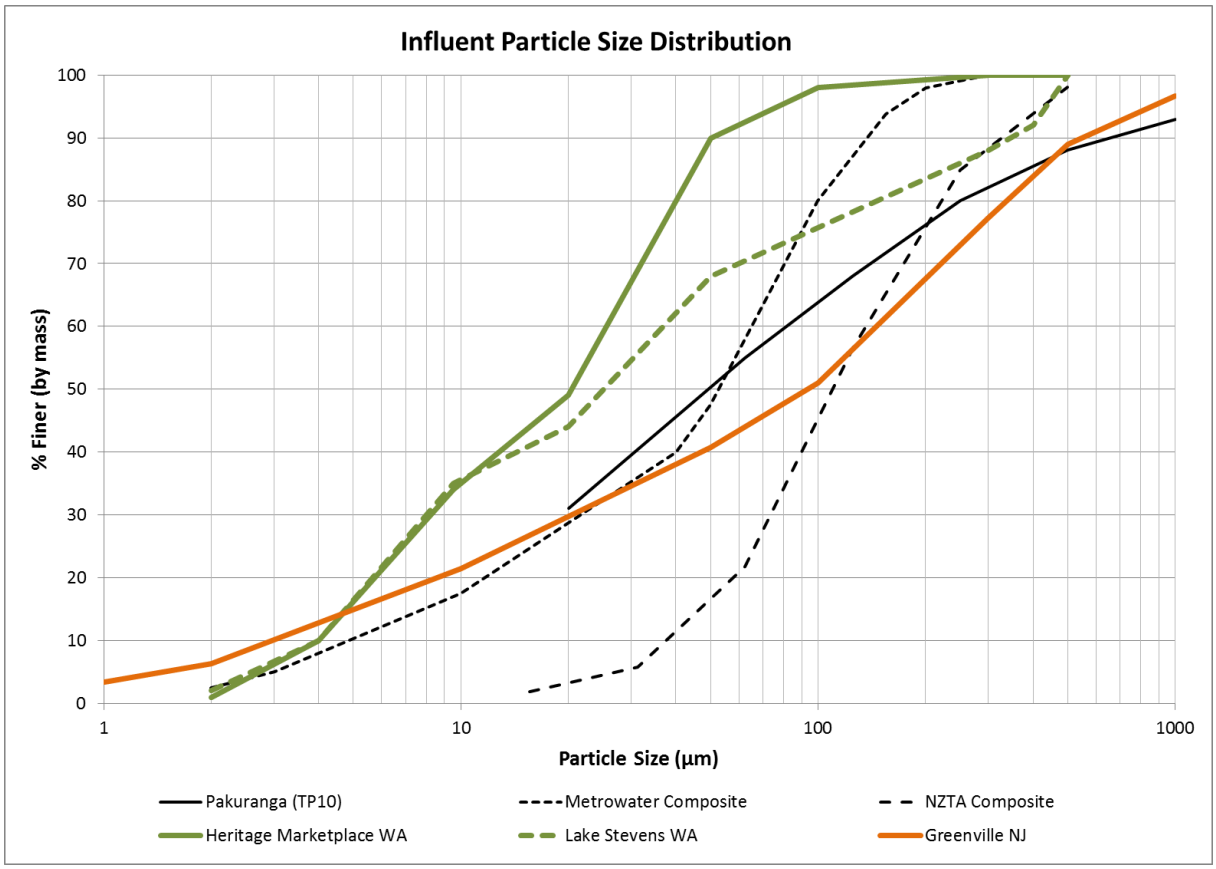



Figure 3-1: Particle size distribution of suspended solids in stormwater runoff

Figure 3-1 demonstrates variation in Auckland stormwater runoff PSD dependant on catchment location. The Greensville (NJ) PSD is the most similar to the Auckland data, with both Washington studies demonstrating a finer influent PSD.

The Heritage Marketplace (WA), Lake Stevens (WA), and Greensville (NJ) test results are considered applicable in an Auckland context based on particle size distribution. The finer influent PSD from the Washington study suggests that efficiency in an Auckland context will be comparable, if not enhanced, due to potentially coarser Auckland sediments.

## 3.2 Performance relative to ALWP

Stormwater treatment devices in Auckland are currently required by Air, Land and Water Plan to achieve 75% removal of TSS (ARC, 2003).

Table 3-1 summarises StormFilter field testing results from the independently certified field studies utilised for the WA and NJ approvals (Table 2-2) and provides assessment of system compliance with the Air, Land and Water Plan requirement of 75% TSS removal.

Table 3-1 Comparison of percent load reduction and median effluent levels against ALWP requirements

| | **New Jersey** | **Washington** | |
|---|---|---|---|
| Location | Greenville Yards | Heritage Marketplace | Lake Stevens |
| Flow rate | 1.4 L/s/m² | 0.7 L/s/m² | 0.7 L/s/m² |
| Media | Perlite | ZPG™ | |
| TSS[1] | 79% removal | 79% removal | 76% removal |
| 1. Load reduction efficiency weighted by rainfall depth. | | | |

Table 3-1 shows the NJ and WA sites all achieve ALWP TSS removal requirements.

# 4.0 Device Sizing – StormFilter

## 4.1 Flow based sizing

The StormFilter is typically designed to treat the peak flow of a specified water quality design storm. The hydraulic loading rate is determined based upon the size of the cartridge and its design flow rate. It is then multiplied by the number of cartridges to achieve the target water quality treatment design rate.

The PAUP requires that stormwater quality treatment practices be sized to treat the runoff from 90% of the annual rainfall (Auckland Council 2013). This definition is based upon analysis of rainfall records over the Auckland region, and is equivalent to the TP10 (ARC 2003) water quality volume defined as the runoff generated by ⅓ of a two year, 24 hour ARI rainfall event (Auckland Council 2013). TP10 previously defined the water quality volume as requiring 80% of the runoff volume from all storms to be captured and treated to provide 75% removal of TSS on a long term average basis (ARC 2003).

Stormwater quality devices with little or no storage volume, such as the StormFilter, are best sized to treat a defined Water Quality Flow (WQF). A WQF based on 10 mm/hr constant rainfall intensity is equivalent to treating the runoff from 90% of the annual rainfall, irrespective of location within the Auckland region. The Rational Method can be used to calculate the runoff flows to the device (Auckland Council 2013).

Table 4-1 summarises the available cartridge hydraulic loading rates based on two primary design flow rates of 0.7 L/sec/m² and 1.4 L/sec/m². Flow rate through the cartridge is determined by the restrictor disc and driving head. All StormFilter cartridges have the same diameter (~500 mm) regardless of height and flow rate, with a media thickness of 178 mm. Cartridge media volume varies with cartridge height. The filtration media contact time varies depending on cartridge flow rate. For the StormFilter with ZPG™ media, a cartridge operating at 0.7 L/sec/m² has a media contact time of approximately 75 seconds.

Table 4-1 Cartridge hydraulic loading rates

| **Cartridge type** | **Per cartridge design flow rate** | | **Minimum driving head for system operation** |
|---|---|---|---|
| | **@1.4 L/s/m²** | **@0.7 L/s/m²** | |
| Low drop (30 cm) | 0.63 L/s | 0.32 L/s | 350 mm |
| 46 cm | 0.95 L/s | 0.48 L/s | 510 mm |
| 69 cm | 1.42 L/s | 0.71 L/s | 740 mm |

It is noted that the NJ certification provides a condition that the StormFilter® system must be designed to ensure that the drain down time for the Water Quality Design Storm does not exceed thirty-six (36) hours. Flow based sizing to achieve treatment of the PAUP water quality flow would achieve sufficient flow capacity for this to occur, provided that the appropriate maintenance schedule is followed.

## 4.2 Comparison with US studies

The Greenville Yards system was sized for a treatment flow rate based upon the 2001 NJDEP 1.25-in/2-hr (32 mm/2-hr) design storm. Sizing assumed an average rainfall intensity equivalent to 16 mm/hr, exceeding the PAUP 10 mm/hr design rainfall intensity.

Both the Heritage Market Place and Lake Stevens North StormFilters were sized using peak system operating rates from the Western Washington Hydrology Model v2.5A (WWHM). This model uses continuous simulation hydrology and a requirement to treat at least 91% of the total runoff volume through the facility, comparable to Auckland TP10 and PAUP requirements. The system capacity for Lake Stevens North was approximately 10% less than the recommended peak system operating rate for the site and Heritage Market Place was approximately 5% undersized.

The sizing methods used to design the StormFilters trialled in NJ and WA varied, treating equivalent catchment areas both smaller and larger than would be connected were the systems designed following the PAUP sizing method (Section 4.1). Variations in sizing methods between municipalities are a consequence of:

- Different rainfall and sediment loading characteristics.
- Different definitions for the target water quality design storms.
- Variation in the prescribed methods to derive the water quality storm.

A flow based loading set out in Section 4.1 and defined specific to Auckland conditions is appropriate for use in the Auckland context.

# 5.0 Device Installation

The StormFilter consists of an underground precast manhole/vault that houses passive siphon-actuated, radial-flow media-filled filter cartridges (Section 2.1, Appendix A). Important notes regarding the device installation are described in the following sections.

## 5.1 Head loss

Hydraulic grade requirements for the StormFilter vary, depending on the cartridge height used. Table 4-1 demonstrates the minimum driving head required for each of the three cartridge heights available. Head loss requirements may be adjusted in some circumstances with more knowledge of backwater effects, pipe diameters, and acceptability of pipe submergence.

In sites with depth to groundwater limitations, buoyancy calculations relative to groundwater level should be performed to determine if vault flotation is a concern. If discharge is to infiltration, the system must be evaluated for potential backwater effects. Seepage or base flows may need to be bypassed around the StormFilter as these constant low flows may cause the growth of algae on filtration media causing the filtration media to become exhausted prematurely. More frequent maintenance will be required if constant low flows are not bypassed.

Design of systems at risk of influence by tidal action should be evaluated for the potential of tidal action to cause backwater into the system. The proposed filter media uses zeolite for cation exchange. The effect of sea water on the cation exchange property is not fully understood. As sea water contains many free ions this may inhibit the dissolved metal removal of the media. It is recommended that StormFilter cartridges in coastal areas be installed above mean high water springs to limit their inundation with salt water. Although tidal valves have been used for these applications in the past, they are typically not recommended due to the additional head required to get flow out of the StormFilter.

## 5.2 Footprint

The required footprint varies dependant on device sizing and number of cartridges required. Each cartridge is ~500 mm in diameter with three standard heights available: 30 cm (low head), 46 cm, and 69 cm. Detailed design requires finding the appropriate balance between head loss requirements and system footprint. For example, use of low head cartridges requires a larger number of cartridges and thus an increased system footprint in order to achieve water quality design targets, as compared to use of the taller cartridges to treat the same water quality design targets.

Standard precast configurations are available for Standard Manholes 1050 mm Ø to 2400 mm Ø for up to 14 cartridges, without forebay, or 10 cartridges, with forebay. Standard pre-cast vault systems range in size from 3.0 m L × 1.8 m W × 1.5 m D to 5.4 m L × 2.4 m W × 1.5 m D for 8 to 37 cartridges. For larger systems housing more than 37 cartridges specific designs are required that may consist of large, precast components designed for easy assembly onsite or be cast-in-situ.

## 5.3 Structural loading

Most StormFilter systems are designed for an HNHO-72 traffic load rating. For precast units, stamped structural calculations can be provided upon request. For cast-in-place units, structural calculations are the responsibility of the site engineer or contractor.

A crane or lifting mechanism is required to install pre-cast systems. The surrounding soil bearing capacity will need to be verified and appropriate ground improvement or base course provided to support the unit. Pre-cast manholes and vaults shall be laid level on compacted granular hardfill as per the Engineer's specification & local authority standards for installation of manholes or pre-cast concrete box culverts. Typically this may be a 300 mm minimum layer of compacted GAP 40 granular hardfill. The granular hardfill shall be checked for level prior to setting and the precast manhole or vault shall be checked for level after it is set. If the slope from any opposite sides exceeds 0.5% the precast manhole or vault shall be removed and the granular sub-base material re-levelled.

Appropriate shoring will be required during installation. On sites with steep slopes a retaining wall may be required.

## 5.4 Overflow, diversion, or bypass

The StormFilter is designed to treat water quality volume flows. It is recommended by the manufacturer, and required by both NJ and WA certification, that the unit be constructed as an offline system. Offline installation typically involves an upstream diversion manhole with weir diverting design flows to the system and an overflow weir to bypass high flows. Refer to Appendix D for the typical Stormwater 360 offline configuration. NJ and WA certifications (Appendix B) provide approved diversion configurations, with the Washington design replicating the Stormwater 360 configuration. The NJ certification allows for an inline diversion chamber comprising an orifice plate controlling flows to the treatment chamber with a weir allowing high flows to bypass the system.

## 5.5 Pre-treatment and extended detention

Pre-treatment of TSS and oil and grease may be necessary and shall be provided as recommended by local site requirements. Guidance includes evaluating sites that contain high amounts of oil and grease, such as vehicle maintenance yards, and pre-settling of sediment to reduce loading.

Although the standard StormFilter does not provide for extended detention, system configuration can be customised to include a detention vault to detain the WQV.

## 5.6 Media selection

StormFilter media choices are as follows:

- CSF® Leaf Media and MetalRX™,
- Granular Activated Carbon (GAC),
- Perlite,
- PhosphoSorb™,
- Zeolite, and
- ZPG™ (a blend of perlite, zeolite, & GAC).

Two particular media, Perlite and ZPG™, are considered in analysis of device performance herein. Other media types are not included in this interim approval recognition.

## 5.7 Construction discharge and commissioning

Installation of a StormFilter system requires excavation and is often installed as part of a wider construction process requiring soil disturbance. If the StormFilter is placed online

before the site is stabilised, construction sediment may reduce the capacity of the cartridges for the design goal of removing post-construction sediment. If construction sediment is allowed to enter the system, more frequent maintenance of the system may be required.

It is necessary for the vault to be set or constructed level to ensure proper functioning of the cartridges. If the unit is not installed level, the design flow rate through the cartridges may not be achieved before early bypass. In addition, some cartridges may treat a disproportionate amount of the flow and thus may occlude more quickly than others.

## 5.8 Additional considerations

- Access and safety requirements may include standard OSH confined space entry procedures.
- The StormFilter is not designed for containment of spills.
- No power is required for typical StormFilter applications. For areas that have limited drop, a pump and power source may be required.
- Access for maintenance should be considered in all installations.

# 6.0 Inspection & Maintenance

Periodic inspection and maintenance is required to ensure that the StormFilter system continues to operate at design efficiency:

- Inspection refers to periodic checking of the vault interior to ensure that it is operating correctly and to determine whether maintenance is required.
- Maintenance involves either removal of sediment from the bottom of the vault and/or cartridge replacement due to clogging.
- Maintenance should be performed by an trained approved maintenance contractor
- Media is to be vibrated into cartridge to ensure adequate compaction of media.
- Inspection and replacement of any malfunctioning cartridge parts is required at maintenance to ensure correct performance, alternatively refurbished maintenance cartridges are available from Stormwater360.
- Cartridges require refurbishment between cleans. This involves the following
    - Washing of cartridge and component to ensure they are working properly
    - Replacement of disposals i.e. fiberglass mesh
    - Vibrating specified media into the cartridges
    - Inspection and replacement of components if necessary, this includes:
        - One way air valve
        - Seal
        - Float
        - Bell cap
        - Centre sock
        - Rivets and outside mesh
        - Hood

The StormFilter maintenance cycle is predominantly driven by the site specific solids load on the filter. The system should be periodically inspected to be certain it is operating correctly. Since stormwater solids loads can be variable, it is possible that the maintenance cycle could be more or less than the projected duration.

The maintenance frequency required depends on the following factors:

- Sediment storage capacity between the vault floor and the bottom of the cartridge. This ensures that the outlet manifold is not blocked by sediments.

- Flow capacity. This ensures that the system drains down within a maximum of 36 hours. This is critical to mitigate the chance of mosquitoes or other disease vectors breeding within the system

Inspection and maintenance procedures, as recommended by the manufacturers, are summarised in Table 6-1. Table 6-1 provides initial inspection and maintenance guidelines, it may be necessary to adjust the inspection/maintenance schedule depending on the actual operating conditions encountered by the system, i.e. sites with higher than expected sediment loads may require more frequent inspection and maintenance. Refer to Appendix E for the Stormwater360 Ltd. StormFilter Inspection and Maintenance Procedures.

Table 6-1 StormFilter inspection and maintenance details

| Item | Detail |
|---|---|
| Inspection | • Annually – prior to the winter season<br>• After all major storms (>25 mm in 24-hrs)<br>• Inspection or minor maintenance – 1 person required<br>• If maintenance is required, sample sediments to determine disposal requirements |
| Maintenance | • As required (identified through inspection), ideally performed during periods of dry weather, Maintenance triggers:[1]<br>  ○ >50 mm accumulated sediment on vault floor<br>  ○ >13 mm accumulated sediment on top of cartridges<br>  ○ >100 mm static water in the cartridge compartment for more than 24-hr after a rainfall event<br>  ○ Bypass event < design storm<br>  ○ Scum line >5 mm thick present about the cartridge top cap<br>  ○ System has not been maintained for three years<br>• In the event of a chemical spill<br>• Sediment removal – 2 people required (Vacuum truck operator & skilled worker)<br>• Cartridge replacement – 3 people required (Vacuum truck operator, skilled worker, & labourer) |
| Access for cleaning | • Through minimum 900 mm × 900 mm access cover<br>• Vacuum truck is required to clean the vault prior to maintenance entry<br>• Maintenance worker can stand on the floor of the manhole while installing or removing cartridges |
| Disposal of materials | • Waste must be handled and disposed of in accordance with regulatory protocols<br>• Consideration required for both solid and liquid wastes, typically disposal to landfill or a vacuum truck decant facility<br>• Empty cartridges can be returned to Stormwater 360 for cleaning, refurbishment, and/or reuse |
| Health & safety for device entry | • Confined space entry training and certification may be required |
| 1. Three sources were provided for maintenance triggers, those adopted were selected preferentially from conditions applied to overseas approvals, then the SW360 StormFilter Inspection and Maintenance Procedures guideline (Appendix E), over application requests. | |

The design life of the concrete structures is typically 50 years. The design life of the cartridges is typically 25 years, assuming maintenance has been performed as required.

# 7.0 Summary & Conclusions

This report summarises a review of the information provided to Morphum by the agent for the StormFilter system in New Zealand, Stormwater360 Ltd.

The evaluations are split into two parts, this report (part 1) summarises a review of the information provided to Morphum by Stormwater360 Ltd regarding the StormFilter® (StormFilter) system and evaluates the performance against the Air, Land and Water Plan (ALWP). Part 2, to be completed at a later date, evaluates the performance of the stormfilter against the Proposed Auckland Unitary Plan (PAUP).

Based on our review it is concluded that the StormFilter with a Perlite cartridge operating at both 0.7 L/s/m² and 1.4 L/s/m², and a ZPG™ cartridge operating at 0.7 L/s/m²

Based on our review it is concluded that the StormFilter using a Perlite media operating at both 0.7 L/s/m² and 1.4 L/s/m², and when using a ZPG™ media operating at 0.7 L/s/m² can provide the 75% TSS removal required in the ALWP.

As a result of this review, we conclude that the StormFilter can be granted interim approval under the ALWP for use on private sites. Interim, provisional approval is provided for a period of 3 years, but Auckland Council may amend, extend or revoke approval.

Appendix F provides a Practice Note regarding installation of the StormFilter system and Appendix G provides example consent conditions.

# 8.0 References

ARC (2003). TP10 Stormwater Management Devices: Design Guidelines Manual. 2 ed. Auckland, New Zealand.

Auckland Council (2013). Auckland Unitary Plan stormwater management provisions: Technical basis of contaminant and volume management requirements, Prepared by Auckland Council. Auckland Council technical report, TR2013/035

New Jersey Department of Environmental Protection (NJDEP). (2006). New Jersey Tier II Stormwater Test Requirements—Amendments to TARP Tier II Protocol. Trenton, New Jersey. Available online: http://www.state.nj.us/dep/dsr/bscit/NJStormwater_TierII.pdf

Semadeni-Davies, A F (2013). Classification of stormwater-borne solids: a literature review. Prepared by the National Institute of Water and Atmospheric Research (NIWA) for Auckland Council. Auckland Council technical report, TR2013/017

Shamseldin, A Y (2010). Specification of the Typical Rainfall Year in the Auckland Region. Prepared by Auckland UniServices Ltd for Auckland Regional Council. Auckland Regional Council Technical Report 2010/067

Technology Acceptance and Reciprocity Partnership (TARP). (2003). The Technology Acceptance Reciprocity Partnership Protocol for Stormwater Best Management Practice Demonstrations. Harrisburg, Pennsylvania. Available online: http://www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp/pdffiles/Tier2protocol.pdf

# Appendix A StormFilter Detail

## StormFilter Physical Description

Figure A1 demonstrates a typical precast StormFilter vault system with inlet chamber, treatment cartridges, and overflow outlet riser. Discharge from the cartridges flows through underdrains within a false floor.

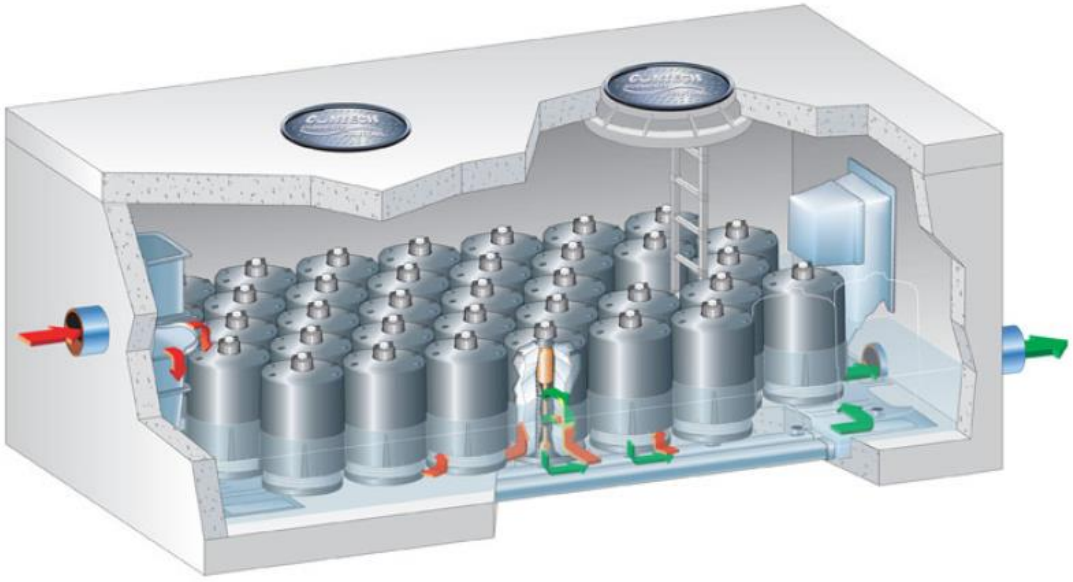


Figure A1: Example of a typical precast StormFilter vault (image supplied by Stormwater 360)

Figure A2 demonstrates cartridge operation. During a storm, runoff passes through the filtration media and starts filling the cartridge centre tube. Stormwater in the cartridge percolates horizontally through the filter media and passes into the cartridge's centre tube, where the float in the cartridge is in a closed (downward) position. Air below the hood is purged through a one-way check valve as the water rises. When water reaches the top of the float, buoyant forces pull the float free and allow the filtered water to flow down into the underdrain. As the treated water drains, it tries to pull in air behind it. This causes the check valve to close, initiating a siphon that draws polluted water throughout the full surface area and volume of the filter media. Thus, the entire filter cartridge is used to filter water throughout the duration of the storm, regardless of the water surface elevation in the filtration bay.

Filtration across the entire cartridge continues until the water surface elevation drops to the elevation of the scrubbing regulators and the float returns to a closed position. At this point, the siphon begins to break and air is quickly drawn beneath the hood through the scrubbing regulators, causing high energy turbulence between the inner surface of the hood and the outer surface of the filter which agitates the surface of the filter, releasing accumulated sediments on the surface, flushing them from beneath the hood, and allowing them to settle to the vault floor. This surface-cleaning mechanism maintains the permeability of the filter surface and enhances the overall performance and longevity of the system.

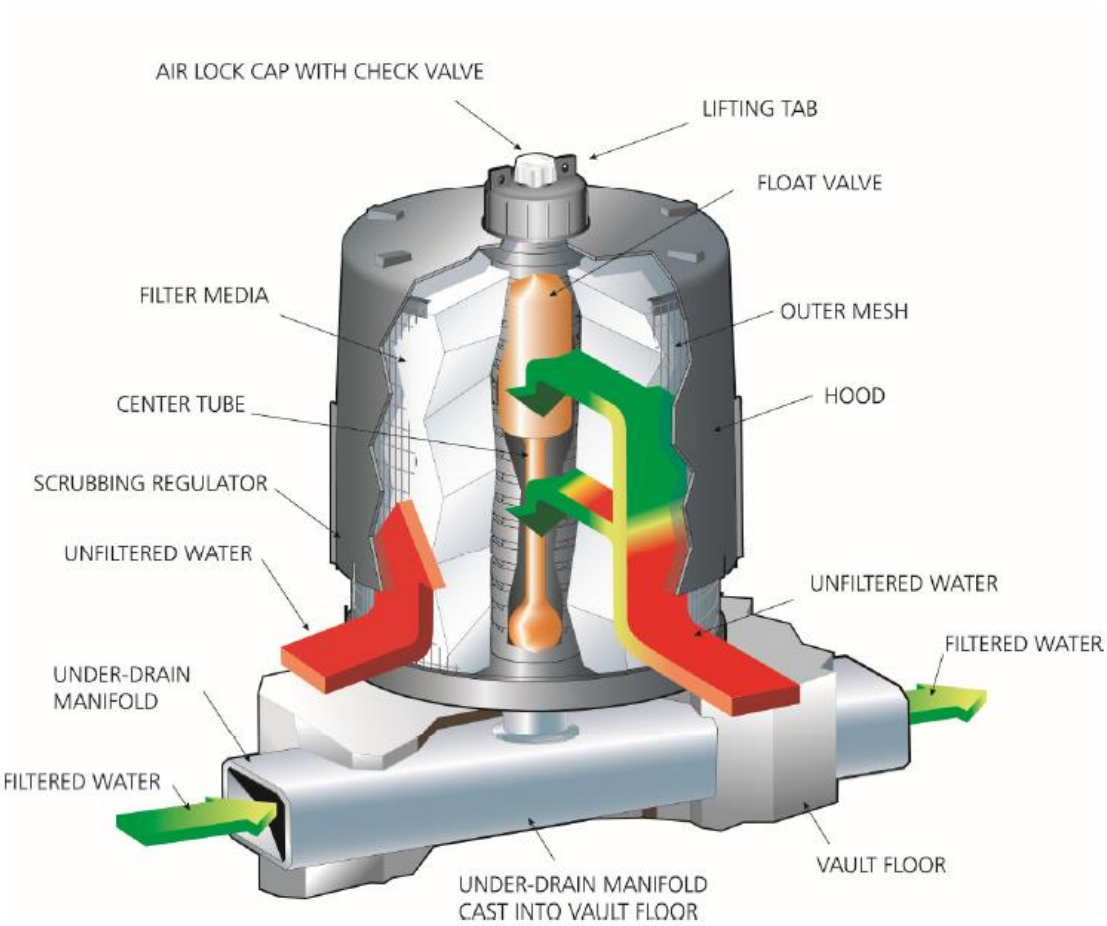



Figure A2: Example of the StormFilter cartridge (image supplied by Stormwater 360)

## Treatment Mechanisms

The StormFilter uses multiple treatment mechanisms to remove stormwater pollutants:

- Physical separation

- Settling of coarse sediments through residence time within the filtration bay where the cartridges are housed

- Pollutant removal by the media filled cartridges
  - Physical straining – solids trapped within interstitial spaces in the media
  - Cation exchange – the CSF® leaf media and Zeolite (not discussed in this application) promote cation exchange.
  - Chelation – the CSF® leaf media and MetalRX™ media (not discussed in this application) promote chelation, where metals are bound by a ligand to form a cyclic compound.
  - Adsorption – commonly adsorbed pollutants include gasoline, oil, grease, TNT, polar organics or organically bound metals and nutrients. CSF® leaf media, PhosphoSorb™, Perlite, and Granular Activated Carbon (GAC) promote adsorption. Perlite and ZPG™ (containing both perlite and GAC) are discussed in this application.

# Appendix B Certifications

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
401-02B
Bureau of Nonpoint Pollution Control
Division of Water Quality
Post Office Box 420
Trenton, New Jersey 08625-0420
609-633-7021 Fax: 609-777-0432
http://www.state.nj.us/dep/dwq/bnpc_home.htm

CHRIS CHRISTIE
*Governor*

KIM GUADAGNO
*Lt. Governor*

BOB MARTIN
*Commissioner*

August 31, 2011

Derek Berg
200 Enterprise Drive
Scarborough, ME 04074

Re: MTD Field Test Certification for the Stormwater Management StormFilter by CONTECH Construction Products, Inc.

**Effective Date: September 1, 2011**
**Expiration Date: December 1, 2016**
**TSS Removal Rate: 80%**

Dear Mr. Berg:

The Stormwater Management Rules at N.J.A.C. 7:8 allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards provided that the pollutant removal rates have been verified by New Jersey Corporation for Advanced Technology, NJCAT, and certified by the New Jersey Department of Environmental Protection (NJDEP).

The certification process was revised through the "Transition for Manufactured Treatment Devices," dated July 15, 2011. NJDEP has determined that Stormwater Management StormFilter by CONTECH Construction Products, Inc. is consistent with the criteria under *B. Manufactured Treatment Devices with Field Certifications*. Therefore, **NJDEP certifies the use of the Stormwater Management StormFilter by CONTECH Construction Products, Inc. using a perlite media with an 80% TSS removal rate, provided that the project design is consistent with the following conditions:**

1. The various cartridge heights and associated water quality peak capacities shall be sized for the peak flow of the New Jersey Water Quality Design Storm per N.J.A.C. 7:8-5.

2. The peak inflow of the Water Quality Design Storm is limited to 2.05gpm/ft$^2$. The maximum inflow area per cartridge is limited to the impervious area as shown in Table 1.

**Table 1**

| Cartridge Height (in) | 12 | 18 | 27 |
|---|---|---|---|
| Sediment Load Capacity @ 2gpm/ft2 (lbs) | 22 | 34 | 51 |
| Maximum Allowable Inflow Area (acres) | 0.11 | 0.17 | 0.255 |

3. The system must be designed to ensure that the draindown time for the Water Quality Design Storm does not exceed thirty-six (36) hours.

4. The Stormwater Management StormFilter cartridges must provide a minimum sediment load capacity for the various cartridge heights as shown in Table 1.

5. The Stormwater Management StormFilter is certified as an off-line system. Any flow above the New Jersey Water Quality Design Storm must be bypassed around the system.

6. This certification does not extend to the enhanced removal rates under N.J.A.C. 7:8 – 5.5 through the addition of settling chambers (such as hydrodynamic separators) or media filtration practices (such as a sand filter).

7. The maintenance plan for the sites using this device shall incorporate at a minimum, the maintenance requirements for the Stormwater Management StormFilter shown attached.

In addition to the attached, any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8, must include a detailed maintenance plan. The detailed maintenance plan must include all of the items identified in Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance of the New Jersey Stormwater Best Management Manual.

NJDEP anticipates proposing further adjustments to this process through the readoption of the Stormwater Management Rules. Additional information regarding the implementation of the Stormwater Management Rules, N.J.A.C. 7:8, are available at www.njstormwater.org. If you have any questions regarding the above information, please contact Ms. Sandra Blick of my office at (609) 633-7021.

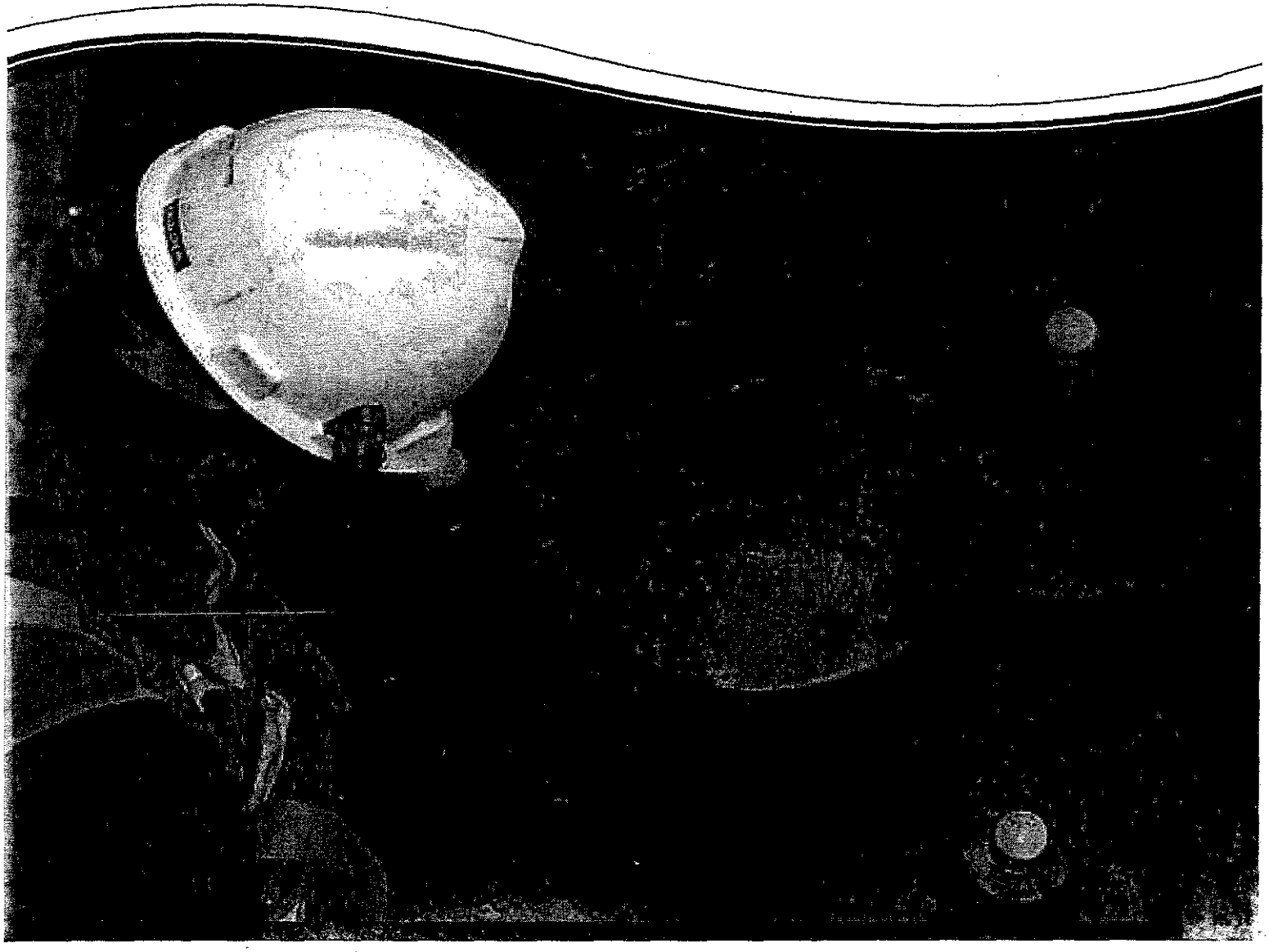
Sincerely,

Ed Frankel, P.P., Acting Bureau Chief
Bureau of Nonpoint Pollution Control

C: Richard S. Magee, NJCAT
Chron file

CONTECH STORMWATER SOLUTIONS

# StormFilter Inspection and Maintenance Procedures



The Stormwater Management StormFilter®

## Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

## Maintenance Procedures

Although there are likely many effective maintenance options, we believe the following procedure is efficient and can be implemented using common equipment and existing maintenance protocols. A two step procedure is recommended as follows:

1. Inspection

Inspection of the vault interior to determine the need for maintenance.

2. Maintenance

Cartridge replacement

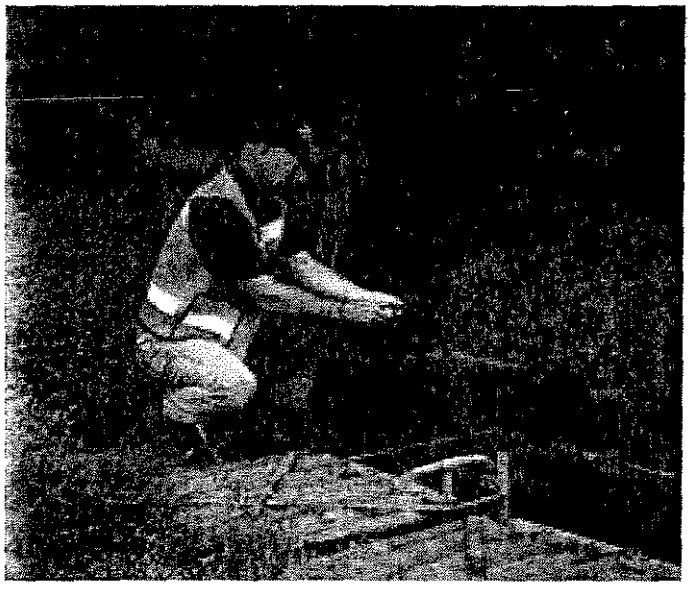
Sediment removal

## Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.



In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, in late summer to early fall when flows into the system are not likely to be present.

## Maintenance Frequency

The primary factor controlling timing of maintenance of the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs.

Prior to the development of the maintenance database, the following maintenance frequencies should be followed:

### Inspection

One time per year

After major storms

### Maintenance

As needed, based on results of inspection (The average maintenance lifecycle is approximately 1-3 years)

Per Regulatory requirement

In the event of a chemical spill

Frequencies should be updated as required. The recommended initial frequency for inspection is one time per year. StormFilter units should be inspected after major storms.

Sediment removal and cartridge replacement on an as needed basis is recommended unless site conditions warrant.

Once an understanding of site characteristics has been established, maintenance may not be needed for one to three years, but inspection is warranted and recommended annually.

## Inspection Procedures

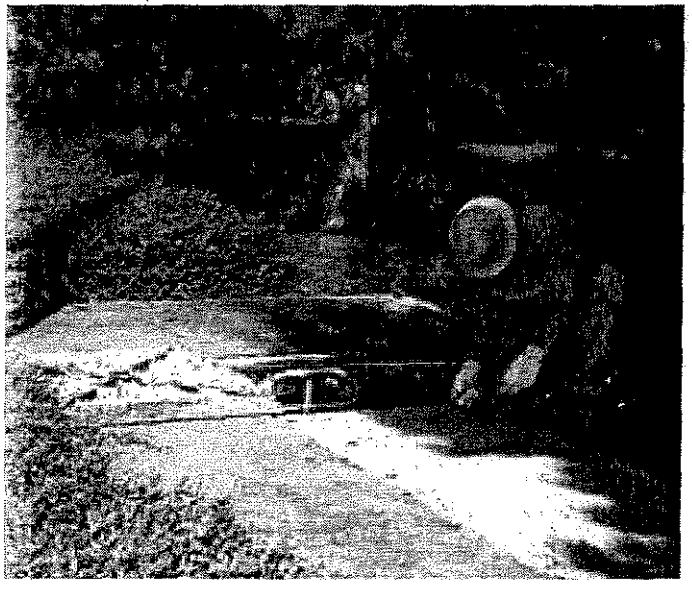
The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

**Warning**: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Stormwater Solutions immediately.

To conduct an inspection:

**Important:** Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

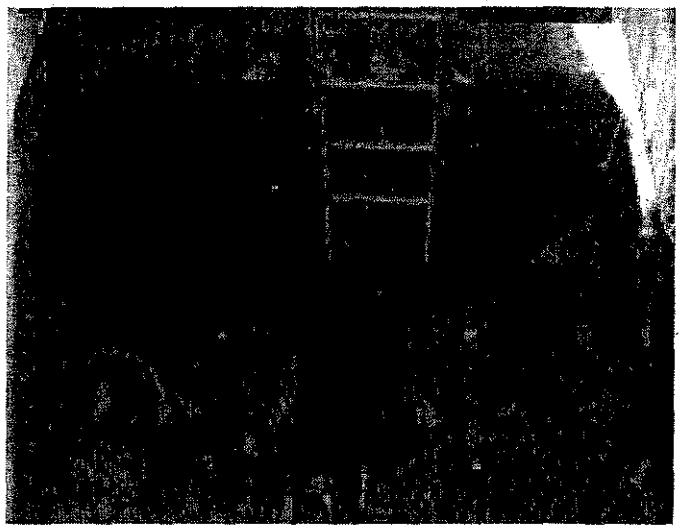
1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.



3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to weather or not maintenance is needed.

### Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)



1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water in the cartridge bay for more that 24 hours after end of rain event, maintenance is required.
4. Plugged media.
   a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.
8. Calendar Lifecycle.
   a. If system has not been maintained for 3 years maintenance is required.

### Assumptions

- No rainfall for 24 hours or more
- No upstream detention (at least not draining into StormFilter)
- Structure is online
- Outlet pipe is clear of obstruction
- Construction bypass is plugged

## Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

**Important**: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from CONTECH Stormwater Solutions.

**Warning**: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Stormwater Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

### Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Unscrew (counterclockwise rotations) each filter cartridge from the underdrain connector. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact CONTECH Stormwater Solutions for suggested attachment devices.

**Important:** Note that cartridges containing leaf media (CSF) do not require unscrewing from their connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and could be capped during the maintenance activity to prevent sediments from entering the underdrain manifold.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.

**Important:** Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless CONTECH Stormwater Solutions performs the maintenance activities and damage is not related to discharges to the system.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

### Method 2:

A. Enter the vault using appropriate confined space protocols.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood screws (3) hood and float.

D. At location under structure access, tip the cartridge on its side.

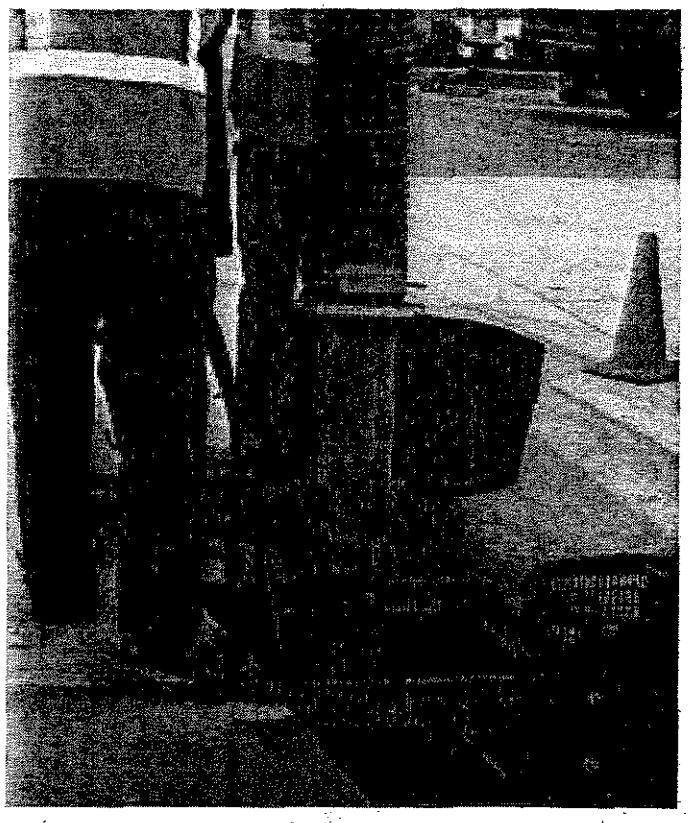
**Important:** Note that cartridges containing media other than the leaf media require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary.

D. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

E. Set the empty, used cartridge aside or load onto the hauling truck.

F. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors. The connectors are short sections of 2-inch schedule 40 PVC, or threaded schedule 80 PVC that should protrude about 1" above the floor of the vault. Lightly wash down the vault interior.
   a. If desired, apply a light coating of FDA approved silicon lube to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe.
   b. Replace any damaged connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used empty cartridges to CONTECH Stormwater Solutions.



## Related Maintenance Activities -

**Performed on an as-needed basis**

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

## Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

RECYCLED PAPER

CONTECH STORMWATER SOLUTIONS

800.925.5240
contechstormwater.com

## Support

- Drawings and specifications are available at contechstormwater.com.
- Site-specific design support is available from our engineers.

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CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other CONTECH division offerings, visit contech-cpi.com or call 800.338.1122

Nothing in this catalog should be construed as an expressed warranty or an implied warranty of merchantability or fitness for any particular purpose. See the CONTECH standard quotation or acknowledgement for applicable warranties and other terms and conditions of sale.

# Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

_____

_____

_____

_____

_____

_____

_____

_____

Review the condition reports from the previous inspection visits.

# StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

List Safety Procedures and Equipment Used: _____

_____

_____

## System Observations

Months in Service:

Oil in Forebay: Yes ☐ No ☐

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

## Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

## StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

WASHINGTON STATE DEPARTMENT OF ECOLOGY

**January 2013**

# GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) TREATMENT

**For**

## CONTECH Engineered Solutions
## Stormwater Management StormFilter®
## With ZPG Media at 1 gpm/sq ft media surface area

**Ecology's Decision:**

**Based on the CONTECH Engineered Solutions' (CONTECH) application submissions, Ecology hereby issues a General Use Level Designation (GULD) for the Stormwater Management StormFilter® (StormFilter):**

1. **As a basic stormwater treatment practice for total suspended solids (TSS) removal,**
   - **Using ZPG™ media (zeolite/perlite/granular activated carbon), with the size distribution described below,**
   - **Sized at a hydraulic loading rate of 1 gpm/ft$^2$ of media surface area, per Table 1, and**
   - **Internal bypassing needs to be consistent with the design guidelines in CONTECH's current product design manual.**

**Table 1. StormFilter Design Flow Rates per Cartridge**

| Effective Cartridge Height (inches) | 12 | 18 | 27 |
|---|---|---|---|
| Cartridge Flow Rate (gpm/cartridge) | 5 | 7.5 | 11.3 |

2. **Ecology approves StormFilter systems containing ZPG™ media for treatment at the hydraulic loading rates shown in Table 1, to achieve the maximum water quality design flow rate. The water quality design flow rates are calculated using the following procedures:**
   - **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**

- **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**
- **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**

3. **This designation has no expiration date, but Ecology may amend or revoke it.**

**<u>Ecology's Conditions of Use</u>:**

**The StormFilter with ZPG media shall comply with the following conditions:**

1. **Design, install, operate, and maintain the StormFilter with ZPG media in accordance with applicable Contech Engineered Solutions manuals, documents, and the Ecology Decision.**

2. **Install StormFilter systems to bypass flows exceeding the water quality treatment rate. Additionally, high flows will not re-suspend captured sediments. Design StormFilter systems in accordance with the performance goals in Ecology's most recent Stormwater Manual and CONTECH's *Product Design Manual Version 4.1 (April 2006)*, or most current version, unless otherwise specified.**

3. **Owners must follow the design, pretreatment, land use application, and maintenance criteria in CONTECH's Design Manual.**

4. **Pretreatment of TSS and oil and grease may be necessary, and designers shall provide pre-treatment in accordance with the most current versions of the CONTECH's *Product Design Manual (April 2006)* or the applicable Ecology Stormwater Manual. Design pre-treatment using the performance criteria and pretreatment practices provided on Ecology's "Evaluation of Emerging Stormwater Treatment Technologies" website.**

5. **Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.**

    - **Typically, CONTECH designs StormFilter systems for a target filter media replacement interval of 12 months. Maintenance includes removing accumulated sediment from the vault, and replacing spent cartridges with recharged cartridges.**

- **Indications of the need for maintenance include effluent flow decreasing to below the design flow rate, as indicated by the scumline above the shoulder of the cartridge.**
- **Owners/operators must inspect StormFilter with ZPG media for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW the wet season in western Washington is October 1 to April 30. According to SWMMEW the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.**
- **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.**
- **When inspections are performed, the following findings typically serve as maintenance triggers:**
    - **Accumulated vault sediment depths exceed an average of 2 inches, or**
    - **Accumulated sediment depths on the tops of the cartridges exceed an average of 0.5 inches, or**
    - **Standing water remains in the vault between rain events, or**
    - **Bypass occurs during storms smaller than the design storm.**
- **Note: If excessive floatables (trash and debris) are present, perform a minor maintenance consisting of gross solids removal, not cartridge replacement.**

6. **CONTECH shall maintain readily available reports listed under "Application Documents" (above) as public, as well as the documentation submitted with its previous conditional use designation application. CONTECH shall provide links to this information from its corporate website, and make this information available upon request, at no cost and in a timely manner.**

7. **ZPG™ media used shall conform with the following specifications:**

- **Each cartridge contains a total of approximately 2.6 cubic feet of media. The ZPG™ cartridge consists of an outer layer of perlite that is approximately 1.3 cubic feet in volume and an inner layer, consisting of a mixture of 90% zeolite and 10% granular activated carbon, which is approximately 1.3 cubic feet in volume.**
- **Perlite Media: Perlite media shall be made of natural siliceous volcanic rock free of any debris or foreign matter. The expanded perlite shall**

**have a bulk density ranging from 6.5 to 8.5 lbs per cubic foot and particle sizes ranging from 0.09" (#8 mesh) to 0.38" (3/8" mesh).**

- **Zeolite Media: Zeolite media shall be made of naturally occurring clinoptilolite. The zeolite media shall have a bulk density ranging from 44 to 50 lbs per cubic foot and particle sizes ranging from 0.13" (#6 mesh) to 0.19" (#4 mesh). Additionally, the cation exchange capacity (CEC) of zeolite shall range from approximately 1.0 to 2.2 meq/g.**

- **Granular Activated Carbon: Granular activated carbon (GAC) shall be made of lignite coal that has been steam-activated. The GAC media shall have a bulk density ranging from 28 to 31 lbs per cubic foot and particle sizes ranging from a 0.09" (#8 mesh) to 0.19" (#4 mesh).**

**Applicant:** Contech Engineered Solutions

**Applicant's Address:** 11835 NE Glenn Widing Dr.
Portland, OR 97220

**Application Documents:**

The applicant's master report, titled, "The Stormwater Management StormFilter Basic Treatment Application for General Use Level Designation in Washington", Stormwater Management, Inc., November 1, 2004, includes the following reports:

- (Public) *Evaluation of the Stormwater Management StormFilter Treatment System: Data Validation Report and Summary of the Technical Evaluation Engineering Report (TEER) by Stormwater Management Inc*., October 29, 2004 Ecology's technology assessment protocol requires the applicant to hire an independent consultant to complete the following work:

  1. Complete the data validation report.
  2. Prepare a TEER summary, including a testing summary and conclusions compared with the supplier's performance claims.
  3. Provide a recommendation of the appropriate technology use level.
  4. Recommend relevant information to be posted on Ecology's website.
  5. Provide additional testing recommendations, if needed."
  6. This report, authored by Dr. Gary Minton, Ph. D., P.E., Resource Planning Associates, satisfies the Ecology requirement.

- (Public) "Performance of the Stormwater Management StormFilter Relative to the Washington State Department of Ecology Performance Goals for Basic Treatment," is a summary of StormFilter performance that strictly adheres to the criteria listed in the Guidance for Evaluating Emerging Stormwater Treatment Technologies, Technology Assessment Protocol – Ecology (TAPE).

- "Heritage Marketplace Field Evaluation: Stormwater Management StormFilter with ZPG™ Media," is a report showing all of the information collected at Site A as stated in the SMI Quality Assurance Project Plan (QAPP). This document contains detailed information regarding each storm event collected at this site, and it provided a detailed overview of the data and project.
- "Lake Stevens Field Evaluation: Stormwater Management StormFilter with ZPG™ Media," is a report that corresponds to Site E as stated in the SMI QAPP. This document contains detailed information regarding each storm collected at this site, and includes a detailed overview of the data and project.
- (Public) "Evaluation of the Stormwater Management StormFilter for the removal of SIL-CO-SIL 106, a standardized silica product: ZPG™ at 7.5 GPM" is a report that describes laboratory testing at full design flow.
- "Factors Other Than Treatment Performance."
- "State of Washington Installations."

Above-listed documents noted as "public" are available by contacting CONTECH.

**Applicant's Use Level Request:**

That Ecology grant a General Use Level Designation for Basic Treatment for the StormFilter using ZPG™ media (zeolite/perlite/granular activated carbon) at a hydraulic loading rate of 1 gpm/ft$^2$ of media surface area in accordance with Ecology's 2011 *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE)*..

**Applicant's Performance Claim:**

The combined data from the two field sites reported in the TER (Heritage Marketplace and Lake Stevens) indicate that the performance of a StormFilter system configured for inline bypass with ZPG™ media and a hydraulic loading rate of 1 gpm/ft$^2$ of media surface area meets Ecology performance goals for Basic Treatment.

**Ecology's Recommendations:**

Based on the weight of the evidence and using its best professional judgment, Ecology finds that:

- StormFilter, using ZPG™ media and operating at a hydraulic loading rate of no more than 1 gpm/ft$^2$ of media surface area, is expected to provide effective stormwater treatment achieving Ecology's Basic Treatment (TSS removal) performance goals. Contech demonstrated this is through field and laboratory testing performed in accordance with the approved protocol. StormFilter is deemed satisfactory with respect to factors other than treatment performance (e.g., maintenance; see the protocol's Appendix B for complete list).

**Findings of Fact:**

- Influent TSS concentrations and particle size distributions were generally within the range of what would be considered "typical" for western Washington (silt to silt loam).
- Contech sampled thirty-two (32) storm events at two sites for storms from April 2003 to March 2004, of which Contech deemed twenty-two (22) as "qualified" and were therefore included in the data analysis set.
- Statistical analysis of these 22 storm events verifies the data set's adequacy.
- Analyzing all 22 qualifying events, the average influent and effluent concentrations and aggregate pollutant load reduction are 114 mg/L, 25 mg/L, and 82%, respectively.
- Analyzing all 22 qualifying events based on the *estimated average* flow rate during the event (versus the *measured peak* flow rate), and more heavily weighting those events near the design rate (versus events either far above or well below the design rate) does not significantly affect the reported results.
- For the 7 qualifying events with influent TSS concentrations greater than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 241 mg/L, 34 mg/L, and 89%, respectively. If the 2 of 7 events that exceed the maximum 300 mg/L specified in Ecology's guidelines are excluded, the average influent and effluent concentrations and aggregate pollutant load reduction are 158 mg/L, 35 mg/L, and 78%, respectively.
- For the 15 qualifying events with influent TSS concentrations less than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 55 mg/L, 20 mg/L, and 61%, respectively. If the 6 of 15 events that fall below the minimum 33 mg/L TSS specified in Ecology's guidelines are excluded, the average influent and effluent concentrations and aggregate pollutant load reduction are 78 mg/L, 26 mg/L, and 67%, respectively.
- For the 8 qualifying events with peak discharge exceeding design flow (ranging from 120 to 257% of the design rate), results ranged from 52% to 96% TSS removal, with an average of 72%.
- Due to the characteristics of the hydrographs, the field results generally reflect flows below (ranging between 20 and 60 percent of) the tested facilities' design rate. During these sub-design flow rate periods, some of the cartridges operate at or near their *individual* full design flow rate (generally between 4 and 7.5 GPM for an 18" cartridge effective height) because their float valves have opened. Float valves remain closed on the remaining cartridges, which operate at their base "trickle" rate of 1 to 1.5 GPM.
- Laboratory testing using U.S. Silica's Sil-Co-Sil 106 fine silica product showed an average 87% TSS removal for testing at 7.5 GPM per cartridge (100% design flow rate).
- Other relevant testing at I-5 Lake Union, Greenville Yards (New Jersey), and Ski Run Marina (Lake Tahoe) facilities shows consistent TSS removals in the 75 to 85% range. *Note that I-5 Lake Union was operated at 50%, 100%, and 125% of design flow*.

- SMI's application included a satisfactory "Factors other than treatment performance" discussion.

  *Note: Ecology's 80% TSS removal goal applies to 100 mg/l and greater influent TSS. Below 100 mg/L influent TSS, the goal is 20 mg/L effluent TSS.*

**Technology Description:**

The Stormwater Management StormFilter® (StormFilter), a flow-through stormwater filtration system, improves the quality of stormwater runoff from the urban environment by removing pollutants. The StormFilter is used to treat runoff from a wide variety of sites including, but not limited to: retail and commercial development, residential streets, urban roadways, freeways, and industrial sites such as shipyards, foundries, etc.

**Operation:**

The StormFilter is typically comprised of a vault that houses rechargeable, media-filled, filter cartridges. Various media may be used, but this designation covers only the zeolite-perlite-granulated activated carbon (ZPG™) medium. Stormwater from storm drains is percolated through these media-filled cartridges, which trap particulates and may remove pollutants such as dissolved metals, nutrients, and hydrocarbons. During the filtering process, the StormFilter system also removes surface scum and floating oil and grease. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged to an open channel drainage way.

This document includes a bypass schematic for flow rates exceeding the water quality design flow rate on page 8.

**StormFilter Configurations:**

Contech offers the StormFilter in multiple configurations: precast, high flow, catch basin, curb inlet, linear, volume, corrugated metal pipe, dry-well, and CON/Span form. Most configurations use pre-manufactured units to ease the design and installation process. Systems may be either uncovered or covered underground units.

The typical precast StormFilter unit is composed of three sections: the energy dissipater, the filtration bay, and the outlet sump. As Stormwater enters the inlet of the StormFilter vault through the inlet pipe, piping directs stormwater through the energy dissipater into the filtration bay where treatment will take place. Once in the filtration bay, the stormwater ponds and percolates horizontally through the media contained in the StormFilter cartridges. After passing through the media, the treated water in each cartridge collects in the cartridge's center tube from where piping directs it into the outlet sump by a High Flow Conduit under-drain manifold. The treated water in the outlet sump discharges through the single outlet pipe to a collection pipe or to an open channel drainage way. In some applications where you anticipate heavy grit loads, pretreatment by settling may be necessary.

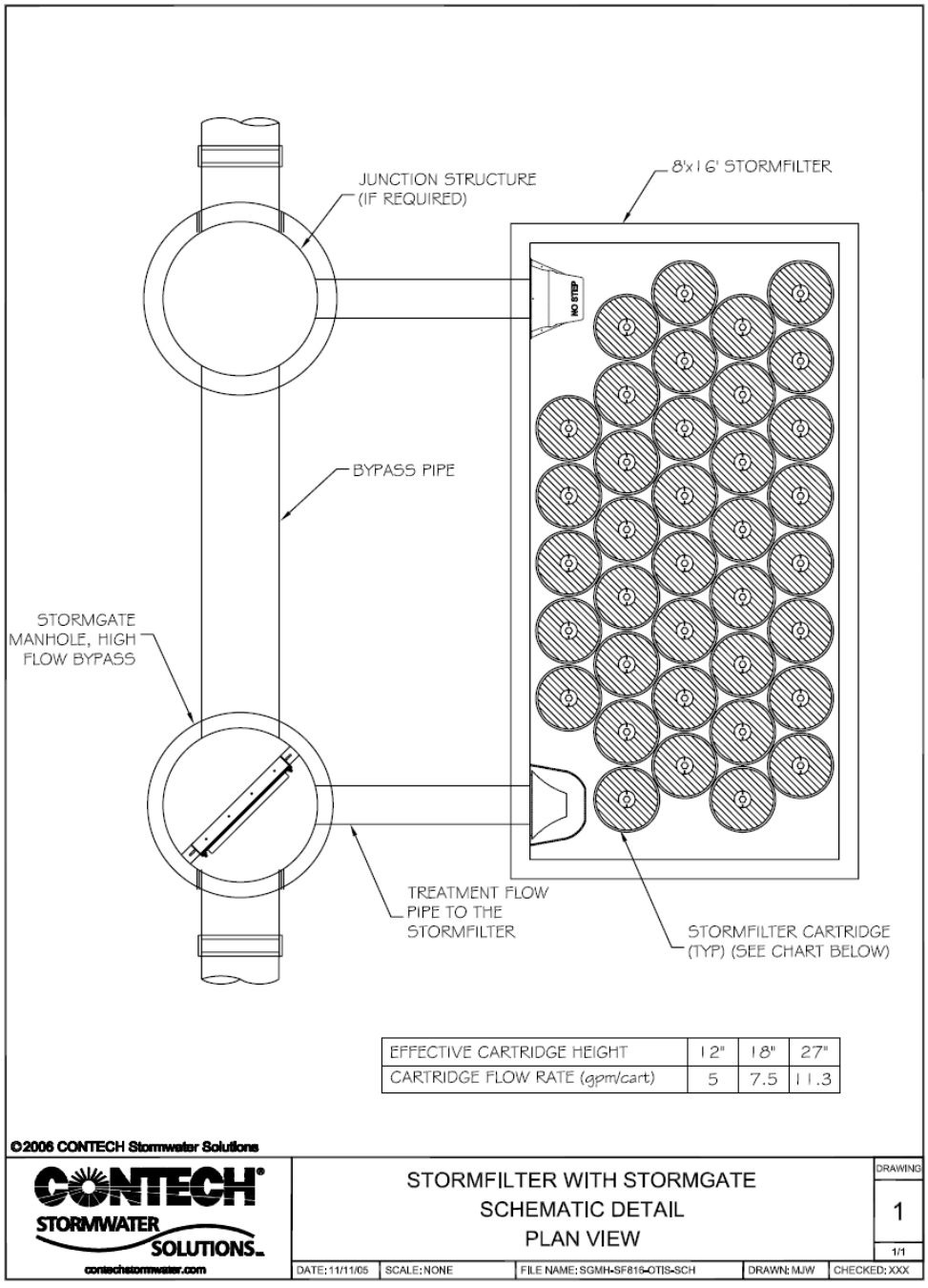


**Figure 1. Stormwater Management StormFilter Configuration with Bypass**

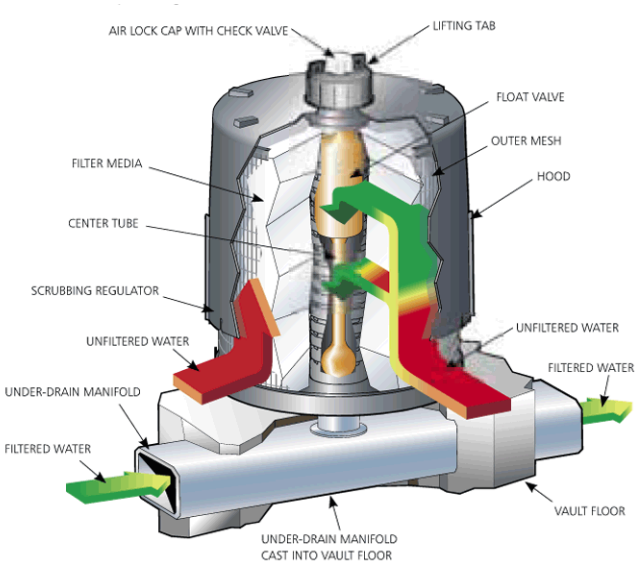


**Figure 2. The StormFilter Cartridge**

## Cartridge Operation:

As the water level in the filtration bay begins to rise, stormwater enters the StormFilter cartridge. Stormwater in the cartridge percolates horizontally through the filter media and passes into the cartridge's center tube, where the float in the cartridge is in a closed (downward) position. As the water level in the filtration bay continues to rise, more water passes through the filter media and into the cartridge's center tube. The air in the cartridge is displaced by the water and purged from beneath the filter hood through the one-way check valve located in the cap. Once water fills the center tube there is enough buoyant force on the float to open the float valve and allow the treated water to flow into the under-drain manifold. As the treated water drains, it tries to pull in air behind it. This causes the check valve to close, initiating a siphon that draws polluted water throughout the full surface area and volume of the filter. Thus, the entire filter cartridge is used to filter water throughout the duration of the storm, regardless of the water surface elevation in the filtration bay. This continues until the water surface elevation drops to the elevation of the scrubbing regulators. At this point, the siphon begins to break and air is quickly drawn beneath the hood through the scrubbing regulators, causing energetic bubbling between the inner surface of the hood and the outer surface of the filter. This bubbling agitates and cleans the surface of the filter, releasing accumulated sediments on the surface, flushing them from beneath the hood, and allowing them to settle to the vault floor.

## Adjustable cartridge flow rate:

Inherent to the design of the StormFilter is the ability to control the individual cartridge flow rate with an orifice-control disc placed at the base of the cartridge. Depending on the treatment requirements and on the pollutant characteristics of the influent stream as

specified in the CONTECH *Product Design Manual*, the flow rate may be adjusted through the filter cartridges. By decreasing the flow rate through the filter cartridges, the influent contact time with the media is increased and the water velocity through the system is decreased, thus increasing both the level of treatment and the solids removal efficiencies of the filters, respectively (de Ridder, 2002).

**Recommended research and development:**

Ecology encourages CONTECH to pursue continuous improvements to the StormFilter. To that end, the following actions are recommended:

- Determine, through laboratory testing, the relationship between accumulated solids and flow rate through the cartridge containing the ZPG™ media. **Completed 11/05.**
- Determine the system's capabilities to meet Ecology's enhanced, phosphorus, and oil treatment goals.
- Develop easy-to-implement methods of determining that a StormFilter facility requires maintenance (cleaning and filter replacement).

**Contact Information:**

Applicant Contact: Sean Darcy
Contech Engineered Solutions
11835 NE Glenn Widing Drive
Portland, OR, 97220
503-258-3105
sdarcy@conteches.com

Applicant Web link http://www.conteches.com/

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology Contact: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

**Revision History**

| Date | Revision |
|---|---|
| Jan 2005 | Original Use Level Designation |
| Dec 2007 | Revision |
| May 2012 | Maintenance requirements updated |
| November 2012 | Design Storm and Maintenance requirements updated |
| January 2013 | Updated format to match Ecology standard format |

# Appendix C Sizing Approval

Auckland
Regional Council
TE RAUHĪTANGA TAIAO

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DX CP 28 008 Pitt St
Telephone +64 9 366 2000
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19 October 2009

Michael Hannah
Stormwater 360
P.O.Box 302 890
North Harbour 0751
**North Shore City**

Dear Michael

**Evaluation of the Revised Sizing Methodology v12**

File Ref S130-02-43 (Pt3)

Thank you for submitting the revised sizing programme (Version 12) of the Stormfilter device. After evaluating the sizing programme and information submitted on various occasions, we now verify the revised sizing programme (Version12) appropriately represents the device's performance. This sizing programme is only applicable for use on Stormfilter cartridges with perlite or activated carbon, zeolite and perlite (ZPG) medias.

We note that this revised sizing programme has incorporated several new features and are listed as follows:

1. Choice of Perlite or ZPG media;
2. Choice of a circular manhole or vault layout;
3. Choice of three cartridge heights, i.e. the 31 cm, 46cm and 69cm;
4. Continuous simulation of the device's performance using the Pakuranga Rainfall data for the month of August 2000;
5. Incorporation of a maintenance frequency based on the projected contaminant loadings outlined in Table 1 of the programme which was extracted from Table 4.4 of Technical Publication No. 10: Stormwater Management Devices – Design Guidelines Manual (TP10) (ARC, 2003)

The application and provision of this device shall remain as outlined in the acceptance letters dated 2 April 2003, 27 August 2004 and 14 November 2007.

The device's performance is only appropriately represented if the following conditions are satisfied:

1. The 'annual runoff treated' percentage is no lesser than 83%;
2. The specific flow rates through all three cartridge heights are no more than 12.1 L/s/$m^3$.

IS Ref I:\em\stormwater\proprietary products\stormfilter (storm 360)\revised sizing spreadsheet outcomes 19oct09.doc

Auckland
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The Stormwater Action Team is developing a protocol for evaluating the performance of proprietary stormwater management devices (Proprietary Devices Evaluation Protocol - PDEP) (GD03) and in the process of updating TP10. GD03 will contain guidance for continuously simulating stormwater quality management device. When updated, TP10 will be published as Guideline Document No. 1 (GD01). When these documents are published, this version of the sizing programme will be invalid until a revision is accepted.

If you have further queries regarding the contents of this letter, please feel free to contact Grace Wong at 09-366 200 extension 8621 or via email at grace.wong@arc.govt.nz

We look forward to working together with you in protecting the environment.

File Ref S130-02-43 (Pt3)

Yours sincerely

Hayden Easton
**Acting Team Leader – Stormwater Action Team**

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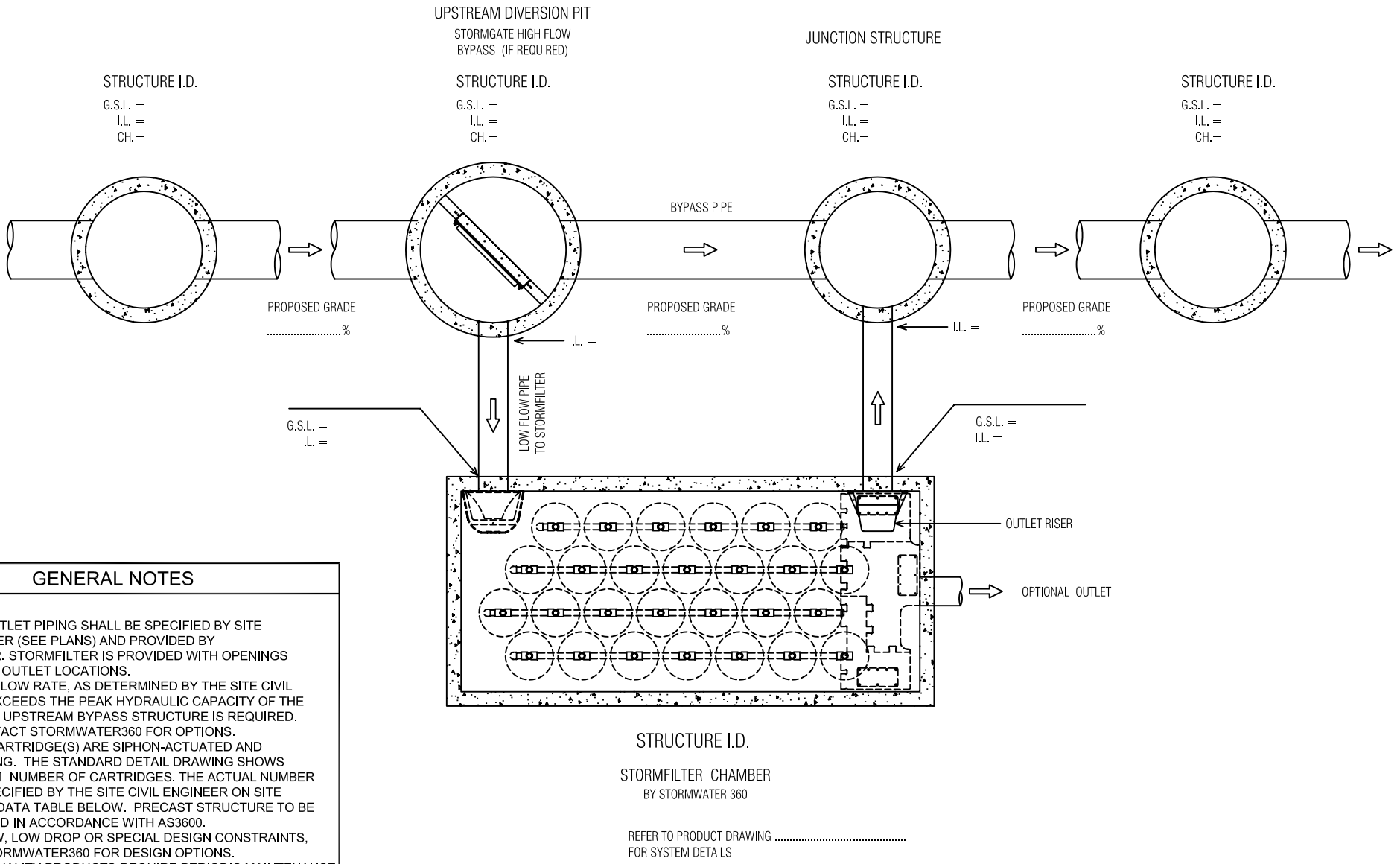
# Appendix D Typical Offline Layout

# Appendix D Typical Offline Layout




## GENERAL NOTES

1. INLET AND OUTLET PIPING SHALL BE SPECIFIED BY SITE CIVIL ENGINEER (SEE PLANS) AND PROVIDED BY CONTRACTOR. STORMFILTER IS PROVIDED WITH OPENINGS AT INLET AND OUTLET LOCATIONS.
2. IF THE PEAK FLOW RATE, AS DETERMINED BY THE SITE CIVIL ENGINEER, EXCEEDS THE PEAK HYDRAULIC CAPACITY OF THE PRODUCT, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED. PLEASE CONTACT STORMWATER360 FOR OPTIONS.
3. THE FILTER CARTRIDGE(S) ARE SIPHON-ACTUATED AND SELF-CLEANING. THE STANDARD DETAIL DRAWING SHOWS THE MAXIMUM NUMBER OF CARTRIDGES. THE ACTUAL NUMBER SHALL BE SPECIFIED BY THE SITE CIVIL ENGINEER ON SITE PLANS OR IN DATA TABLE BELOW. PRECAST STRUCTURE TO BE CONSTRUCTED IN ACCORDANCE WITH AS3600.
4. FOR SHALLOW, LOW DROP OR SPECIAL DESIGN CONSTRAINTS, CONTACT STORMWATER360 FOR DESIGN OPTIONS.
5. ALL WATER QUALITY PRODUCTS REQUIRE PERIODIC MAINTENANCE AS OUTLINED IN THE O&M GUIDELINES. PROVIDE MINIMUM CLEARANCE FOR MAINTENANCE ACCESS.
6. STRUCTURE AND ACCESS COVERS DESIGNED TO MEET AUSTROADS T44 LOAD RATING WITH 0-2m FILL MAXIMUM.
7. THE STRUCTURE THICKNESSES SHOWN ARE FOR REPRESENTATIONAL PURPOSES AND VARY REGIONALLY.
8. ANY BACKFILL DEPTH, SUB-BASE, AND OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY SITE CIVIL ENGINEER.
9.. STORMFILTER BY STORMWATER360:
SYDNEY (AU) PHONE: (02) 9525 5833,
BRISBANE (AU) PHONE: (07) 3272 1872.

## PLAN OF TYPICAL OFFLINE LAYOUT

Stormwater360

STORMWATER360

# TYPICAL OFFLINE LAYOUT
# STORMGATE HIGH FLOW BYPASS (OPTIONAL)
## WITH PRECAST VAULT STORMFILTER

DRAWING 1 A

| DATE: 09.03.08 | SCALE: N.T.S. | FILE NAME: SFV_OFFLINE_TYP | DRN: R.P. | CHK: M.W. |
|---|---|---|---|---|

# Appendix E Maintenance Requirements

# Appendix E Maintenance Requirements

Stormwater360

# StormFilter Inspection and Maintenance Procedures

The Stormwater Management StormFilter®

## Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

## Maintenance Procedures

Although there are likely many effective maintenance options, we believe the following procedure is efficient and can be implemented using common equipment and existing maintenance protocols. A two step procedure is recommended as follows:

1. Inspection

Inspection of the vault interior to determine the need for maintenance.

2. Maintenance

Cartridge replacement

Sediment removal

## Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.


In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localised erosion in the drainage area. It may be necessary to adjust the inspection/maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, in late summer to early fall when flows into the system are not likely to be present.

## Maintenance Frequency

The primary factor controlling timing of maintenance of the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilised surface conditions.

The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs.

Prior to the development of the maintenance database, the following maintenance frequencies should be followed:

Inspection

One time per year

After major storms

Maintenance

As needed, based on results of inspection (The average maintenance lifecycle is approximately 1-3 years)

Per Regulatory requirement

In the event of a chemical spill

Frequencies should be updated as required. The recommended initial frequency for inspection is one time per year. StormFilter units should be inspected after major storms.

Sediment removal and cartridge replacement on an as needed basis is recommended unless site conditions warrant.

Once an understanding of site characteristics has been

established, maintenance may not be needed for one to three years, but inspection is warranted and recommended annually.

## Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Stormwater360 immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.

5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to weather or not maintenance is needed.

### Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)

1. Sediment loading on the vault floor.
   a. If >100mm of accumulated sediment, maintenance is required.

2. Sediment loading on top of the cartridge.
   a. If >5mm of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >100mm of static water in the cartridge bay for more that 24 hours after a rain event, maintenance is required.
4. Plugged media.
   a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say 5mm thick) is present above top cap, maintenance is required.
8. Calendar Lifecycle.
   a. If system has not been maintained for 3 years maintenance is required.

### Assumptions

- No rainfall for 24 hours or more
- No upstream detention (at least not draining into StormFilter)
- Structure is online

- Outlet pipe is clear of obstruction
- Construction bypass is plugged

## Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OH&S rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flow is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Stormwater360.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Stormwater360 immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Unscrew (counterclockwise rotations) each filter cartridge from the underdrain connector. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

   Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Stormwater360 for suggested attachment devices.

Important: Take care not to damage the manifold connectors. This connector should remain installed in the manifold and could be capped during the maintenance activity to prevent sediments from entering the underdrain manifold.

B. Remove the used cartridges from the vault.

Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless Stormwater360 performs the maintenance activities and damage is not related to discharges to the system.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. Enter the vault using appropriate confined space protocols.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood hood and float.

D. At location under structure access, tip the cartridge on its side.

Important: Note that cartridges require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary.

D. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

E. Set the empty, used cartridge aside or load onto the hauling truck.

F. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors. The connectors are short sections of 50mm schedule 40 PVC, or threaded schedule 80 PVC that should protrude about 25mm above the floor of the vault. Lightly wash down the vault interior.
    a. If desired, apply a light coating of FDA approved silicon lube to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe.
    b. Replace any damaged connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used empty cartridges to Stormwater360.

## Related Maintenance Activities -

Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

## Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Stormwater360

## Support

- Drawings and specifications are available upon request
- Site-specific design support is available from our engineers.

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The product(s) described may be protected by one or more of the following US, Australian and New Zealand patents : 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 705,778; 711,957 ; 326,257; 332,517; 780521; 336761; 299114 or other patents pending.

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# Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

_____

_____

_____

_____

_____

_____

_____

_____

Review the condition reports from the previous inspection visits.

# StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

List Safety Procedures and Equipment Used: _____

_____

_____

## System Observations

Months in Service:

Oil in Forebay: Yes ☐ No ☐

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

## Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

## StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

# Appendix F StormFilter® Practice Note

## Background

Auckland Council Stormwater Unit (SU) has evaluated the StormFilter® against current certification from the following two bodies:

- State of New Jersey Department of Environmental Protection (NJDEP) Approval of Use for Manufactured Treatment Devices, and
- Washington State Technology Assessment Protocol-Ecology (TAPE) Program.

Interim recognition of international certifications for the StormFilter® has been approved for use on private infrastructure in the Auckland region to meet the requirements of the Air, Land and Water Plan 75% TSS removal requirement.

## Description

The StormFilter® consists of an underground precast manhole/vault that houses passive siphon-actuated, radial-flow media-filled filter cartridges (Figure E1). The filter cartridges are rechargeable and incorporate a self-actuated surface cleaning mechanism to increase the effective life of the filter media and to reduce the accumulation of material on the cartridge surface. Each radial flow filter cartridge operates at a predetermined flow rate through the use of an integrated flow control orifice located within each filter cartridge outlet manifold.

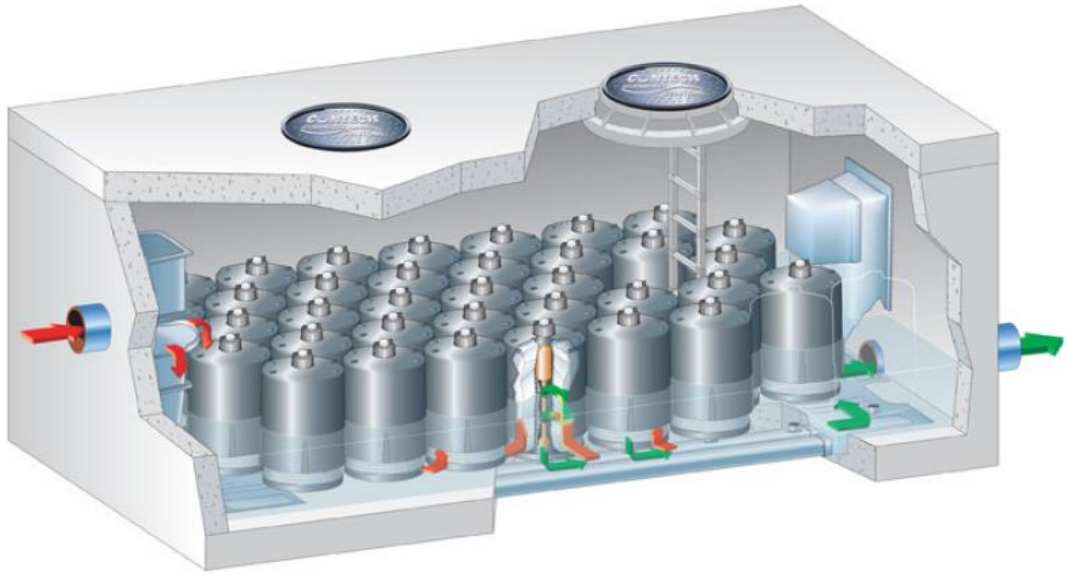

Figure E1 Example of a typical precast StormFilter vault (image supplied by Stormwater 360)

## Sizing

The StormFilter should be sized to treat a defined Water Quality Flow (WQF) based on 10 mm/hr constant rainfall intensity (equivalent to treating the runoff from 90% of the annual rainfall irrespective of location within the Auckland region). The Rational Method can be used to calculate the runoff flows to the device:

$Q_d = CiA_c$

where $Q_d$ is the water quality flow in $m^3$/hr requiring treatment, C is the runoff coefficient, $A_c$ is the catchment area (in $m^2$) and i is the design rainfall intensity of 0.01 m/hr. Auckland Council specifies use of C=1 for paved or otherwise impervious surfaces (ARC 2003). Table E1 provides a range of values for pervious surfaces. For sites with mixed surface types, an area weighted composite C value should be used.

Table E1 Range of typical runoff coefficient values for natural surface types (Source: DBH 2011)

| **Natural Surface Types** | **Rational Coefficient, C** |
|---|---|
| - Heavy clay soils | 0.30–0.40 |
| - Medium soakage soil types | 0.20–0.30 |
| - High soakage gravel, sandy, and volcanic soil types | 0.10–0.20 |
| - Parks, playgrounds, reserves, lawns | 0.25–0.30 |

Table E2 summarises the available cartridge hydraulic loading rates based on a design flow rate of 1.4 L/sec/$m^2$ and the minimum driving head through the system. Flow rate through the cartridge is determined by the restrictor disc and driving head. The hydraulic loading rate is multiplied by the number of cartridges to achieve the target water quality treatment design rate.

Table E2 Cartridge hydraulic loading rates

| **Cartridge type** | **Per cartridge design flow rate @1.4 L/s/$m^2$** | **Minimum driving head for system operation** |
|---|---|---|
| Low drop (30 cm) | 0.63 L/s | 350 mm |
| 46 cm | 0.95 L/s | 510 mm |
| 69 cm | 1.42 L/s | 740 mm |

Choosing a larger cartridge means fewer cartridges are required to treat the same WQF, but a greater hydraulic drop is required for system operation. The cartridge operating flow rate is adjustable. Treatment improves for lower operating flow rates due to increased contact time, but will also reduce the maximum area a single cartridge can treat.

## Construction and Installation

The following aspects must be considered during StormFilter® design and installation:

- Head loss
    - Minimum requirement given in Table E2, dependant on cartridge height
    - Assess for effects of buoyancy due to depth to groundwater limitations
    - Assess for potential backwater effects due to tidal influence
- Device footprint
    - Sufficient to house the number of cartridges required to achieve the design water quality flow (Table E3 and Table E4)

Table E3 Standard Stormwater360 Manhole Sizing (Recreated from: Stormwater360 StormFilter Sizing Model)

| Standard Manhole Dimensions | Maximum Number of Cartridges | |
|---|---|---|
| | Without Forebay | With Forebay |
| 1050 | 1 | N/A |
| 1200 | 3 | 2 |
| 1500 | 4 | 3 |
| 1800 | 7 | 5 |
| 2050 | 9 | 7 |
| 2400 | 14 | 10 |

Table E4 Standard Stormwater360 Vault Sizing (Recreated from: Stormwater360 StormFilter Sizing Model)

| Standard Vault Dimensions | Maximum Number of Cartridges | |
|---|---|---|
| | Without Forebay | With Forebay |
| 3.0 L x 1.8 W x 1.5 D | 11 | 8 |
| 4.2 L x 1.5 W x 1.5 D | 17 | 14 |
| 4.2 L x 2.1 W x 1.5 D | 22 | 18 |
| 5.4 L x 2.1 W x 1.5 D | 30 | 26 |
| 5.4 L x 2.4 W x 1.5 D | 37 | 33 |

Custom designs

For larger systems the following design criteria is required

- Appropriate number of cartridges to treat the water quality flow.
- Use of 140 mm wide x 90 mm high flume for underdrain to ensure treated flow can be reticulated without creating additional head losses
- A Maximum of 8 x 69 cm cartridges on a length of flume

- Structural loading
  - Provide appropriate base course or ground improvement to support the unit. This shall be as specified by the site engineer. Typically this may be a 300 mm minimum layer of compacted GAP 40 granular hard fill.
  - A lifting mechanism is typically required to install pre-cast systems, ensure the surrounding soil bearing capacity is sufficient
  - Ensure StormFilter achieves an HNHO-72 traffic load rating, if installed in a roadway
- Bypass
  - The StormFilter® must be installed as an off-line system; flows above the Auckland Council Water Quality Design Storm must be bypassed. Systems with catchments larger than 1ha can be designed with an inline bypass.
- Pre-treatment and extended detention
  - Sites with high contaminant loadings, particularly of TSS or oil and grease, may require pre-treatment, designers shall provide pre-treatment in accordance with the most current versions of the applicable Auckland Council guidance
  - Extended detention or retention may be provided upstream or downstream of the device if required by regulatory controls, but sizing should not be reduced.
- Media selection
  - The perlite or ZPG™ media used shall meet the Stormwater360 Ltd specifications
- Construction discharge and commissioning
  - Plan to only have the StormFilter® come online once the site is stabilised, or allow for additional maintenance

    - Ensure the vault is level for proper function
- Additional considerations
    - Allow for maintenance access in site design
    - Access and safety requirements may include standard OSH confined space entry procedures

## Inspection and Maintenance Requirements

Periodic inspection and maintenance is required to ensure that the StormFilter® system continues to operate at design efficiency:

- Inspection refers to periodic checking of the vault interior to ensure that it is operating correctly and to determine whether maintenance is required.
- Maintenance involves either removal of sediment from the bottom of the vault and/or cartridge replacement due to clogging.
- Maintenance should be performed by an trained approved maintenance contractor
- Media is to be vibrated into cartridge to ensure adequate compaction of media.
- Inspection and replacement of any malfunctioning cartridge parts is required at maintenance to ensure correct performance, alternatively refurbished maintenance cartridges are available from Stormwater360.

An initial maintenance plan for sites using the StormFilter® must be submitted to Council for approval prior to the device becoming operational. The initial maintenance plan shall incorporate, at a minimum, the maintenance requirements for the StormFilter® in accordance with the Stormwater360 Ltd. StormFilter Inspection and Maintenance Procedures guideline. In particular, to ensure manifold connectors are capped during any maintenance activity to prevent sediment from entering the underdrain manifold. The site specific detailed maintenance plan should also include, but is not limited to, the following items:

- List of inspection and maintenance equipment and tools;
- Specific corrective and preventative maintenance tasks;
- Indication of problems in the system; and
- Training of maintenance personnel.

The required maintenance interval is dependent upon the degree of pollutant loading from a particular catchment. Therefore, Auckland Council does not endorse or recommend a "one size fits all" maintenance cycle for the StormFilter® system. The following modifications and clarifications to the Stormwater360 Ltd. StormFilter Inspection and Maintenance Procedures guideline apply:

- Typically, StormFilter® systems are designed for a target filter media replacement interval of 12 months. Maintenance includes removing accumulated sediment from the vault, and replacing spent cartridges with recharged cartridges.
- Owners/operators must inspect StormFilter® systems with ZPG™ or perlite media for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. Owners/operators must conduct inspections quarterly.
- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flow rate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings will serve as maintenance triggers:
    - A scum line greater than 5 mm thick above the cartridge top cap, or
    - Accumulated vault sediment depths exceed an average of 50 mm, or

- Accumulated sediment depths on the tops of the cartridges exceed an average of 13 mm, or
- Standing water to a depth or 100 mm, or greater, remains in the vault for more than 24-hr after a rainfall event, or
- Bypass occurs during storms smaller than the design storm, or
- The system has not been maintained for three years.
- Note: If excessive floatables (trash and debris) are present, perform a minor maintenance consisting of gross solids removal, not cartridge replacement.

After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections. The owner/operator may revise the initial maintenance plan after the first year of operation, based on the findings during the first year of inspections. The final, potentially revised, maintenance plan outlining long term routine inspection and maintenance requirements shall be submitted to Auckland Council for approval, with appropriate evidence from inspections during the first year of operation supporting the proposed long term routine inspection and maintenance frequencies.

## References

ARC (2003). TP10 Stormwater Management Devices: Design Guidelines Manual. 2 ed. Auckland, New Zealand.

Auckland Council (2013). Auckland Unitary Plan stormwater management provisions: Technical basis of contaminant and volume management requirements, Prepared by Auckland Council. Auckland Council technical report, TR2013/035

DBH (2011). Compliance Document for New Zealand Building Code, Clause E1 - Surface Water. Prepared by the Department of Building and Housing. Available from http://www.dbh.govt.nz/building-code-compliance-documents#free-download

Stormwater360 Ltd. StormFilter Inspection and Maintenance Procedures

Stormwater360 StormFilter Sizing Model (SWSSM)

# Appendix G Example Consent Conditions

Auckland Council approves the use of the Stormwater360 Ltd. StormFilter® for ALWP 75% TSS removal using perlite or ZPG™ media operating at 0.7 L/s/m² provided that the project design is consistent with the following conditions:

1. Design and installation must be in accordance with the Auckland Council StormFilter® Practice Note. If conditions affecting operation or design parameters vary from those included in the consent application, or the requirements of the StormFilter® Practice Note are no longer met, an application for variation of consent must be applied for by the consent holder.
2. Within 3 months of the granting of this consent, Owners/operators must submit a signed copy of a maintenance contract for the first three years of operation
3. Within 3 months of the construction of the StormFilter® associated with this consent, Owner/operators must submit an initial maintenance plan for sites using the StormFilter® following the requirements outlined in the Auckland Council StormFilter® Practice Note and allowing for maintenance provisions and processes in accordance with Stormwater360 Ltd StormFilter Inspection and Maintenance Procedures guideline. Where specifications in the Auckland Council StormFilter® Practice Note vary to those in the Stormwater360 Ltd StormFilter Inspection and Maintenance Procedures guideline, the Practice Note guidance takes priority. This initial maintenance plan must be approved by Auckland Council prior to the device becoming operational.
4. After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections. The owner/operator shall submit a final maintenance plan outlining long term routine inspection and maintenance requirements to Auckland Council for approval, with appropriate evidence from inspections during the first year of operation supporting the proposed long term routine inspection and maintenance frequencies.
5. The owner/operator must retain the following records and provide to Auckland Council at the end of each year of operation.
    a. Records of inspections
    b. Records of performed maintenance activities
    c. Current maintenance contract if renewed in the last 12 months