DDOE Stormwater Management Guidebook review
Nathan Griswold
American Hydrotech, Inc.

11-6-12

Section 3.1.1 Green Roof Feasibility Criteria

Contributing drainage area - How was the 25% selected?

Section 3.1.4 Green Roof Design Criteria

I suggest that in the first paragraph that you mention that the supplier/manufacturer of the green roof media should provide the saturated weight of the material they will be providing. This should be backed up by laboratory analysis and performance specifications.

Figure 3.1.1 Typical Layers for a Green Roof

In this figure the root barrier layer is shown ABOVE the insulation. This is not a standard industry detail. Typically the root barrier would be below the insulation in a PMR (protected membrane roof) which is the ideal roof type for green roofs.

3.1.4 Functional Elements of a Green Roof System

Design layer #3 - Insulation layer -

1) I suggest that the difference between open and closed cell insulation is addressed here. Any open cell insulation will uptake water if it is in contact with it. Closed cell insulation can be in a wet environment. A rule of thumb is closed cell is above the waterproofing membrane and open cell is below.

Design layer #4 - Root Barrier layer -

1) "Chemical root barriers or physical root barriers, which have been impregnated with pesticides, metals, or other chemicals that could leach into the stormwater runoff, should be avoided". I disagree with this recommendation. There are different types of products on the market, some that will allow runoff and others that don't, that utilize "pesticides, metals or chemicals" to stop roots. Those that do not allow water to come into contact with these materials or impregnate them into paints that are not soluble in water should be allowed. Anything that allows water to be passed through the treated fabric or layer should not be allowed.

Design layer #5 - Drainage Layer and Drainage System -

1) "Recycled polyethylene" should read high-density polyethylene (HDPE).

Design layer #6 - Root-Permeable Filter Fabric -

1) This product should be a non-rotting, needle punched product. Woven filter layers are not recommended. I suggest that a flow rate or range is included here.

Design layer #7 - Growing Media -

1) In this paragraph it is mentioned that the media "should be no be more than 20% organic matter"...I suggest that it is explained that compost is not completely organic. It is a common mistake to use the terms "organic matter" and "compost" as the same product. This is not actually reality. Most compost has an organic, by volume, lower than what people realize.
2) I suggest that this section calls for proof of water retention from the supplier and/or manufacture of the media. Not all media is created equally.
3) It is suggested that all trees need 48" of depth. This statement is not true. There are many small tree options that can thrive in 18"-24". It should be up to the designer to decide what trees fit their particular project. By suggesting that all trees require 48" the guide will limit their use solely on the high weight requirements for such depths. Most roof decks cannot hold this type of weight.

Design layer #8 - Plant Cover -

1) I think that the sentence that addresses plant selection, which points to Snodgrass' book, should also say that qualified manufacturers are able to help with selections as well. Some even have full time landscape architects on staff.
2) The last sentence says that irrigation is optional. It is our policy that all green roofs in the DC region must have irrigation. It does not have to be a full time system but a manual system with hose bibs is a minimum. **I have attached our water related guide for reference.**

Table 3.1.1 Extensive green roof material specifications

1) Waterproof Membrane -
    a. It should be noted that any the manufacturer of a waterproof membrane that is also going to act like the root barrier should be approve of this use in writing.
2) Drainage layer -
    a. This section does not cover drainage layers that are typically used in Intensive applications. Hydrotech has a 2" profile product that we use called Gardendrain 50 (GR50).
3) Filter fabric
    a. It should be described as a ....needle punched, non-woven, polypropylene geotextile
    b. Density: The density suggested is over 4 times heavier than what Hydrotech and most of the industry uses for a filter fabric. **I have attached our data sheet for our 3.5 oz (ASTM D3367) product**. Asking for >16 oz per square yard is not reasonable.
    c. Puncture: Hydrotech's product is only 60 lbs and is very similar to what is used in the industry. It seems the material specified here is more like a moisture retention layer (thick felt) than a system filter drainage fabric.
    d. Apparent Opening (ASTM D4751): This is a commonly used standard in the industry. I suggest that this is added here. Hydrotech's product is equal to 50 (0.3mm) under this standard test.
4) Growth Media
    a. It is suggested that there be a variable to the requirement of 80% lightweight inorganic and 20% organic matter in this section. This is putting everyone manufacturer in the same group and many of their blends are slightly different than this 80/20 suggestion. It is suggested that ranges be inserted here such as 70-80% inorganic and 20-30% organic.

i. Please not that "compost" is not completely organic. These two items are separate materials. This distinction MUST be made in this document or it is perpetuating the myth that compost = organic matter.

b. This section also provides a water retention capacity of 30%. This is acceptable for extensive roofs but it is suggested that this say "at least 30%" rather than around this capacity.

c. Add this onto the last sentence of this section: Manufactures should be able to provide a performance specification and testing for their media that proves they meet DDOE recommendations.

5) Plant Materials
   a. This section suggests that extensive roofs are "self sustaining" this is just not the case. This is a misunderstanding within the industry and I strongly suggest that this is not stated in this document. Extensive roofs are low maintenance but there is no such thing as a no maintenance roof. Suggesting that green roofs do not need maintenance will lead to project failures. They will not perform as required and will overall look bad.
   b. All green roofs must have a water source on the roof. Hydrotech requires this on any project that we provide plants on. This should be the standard for the industry. Plants may not need full time irrigation but they will need water during establishment and times of drought.

6) Green Roof Sizing
   a. It is suggested that the following sentence be added to the first paragraph of the section.
      i. Not all green roofs will provide the same performance characteristics and design team should know the difference and select the proper system for their project needs.

7) Equation 3.1.1 Storage Volume of Green Roofs
   a. This equation is blurry...it is hard to read
   b. At the end of the last paragraph of this section the following text is suggested where the calculations are being mentioned.
      i. Some manufacturer's can provide calculators that are capable of providing accurate estimations of performance for the products that they provide. These system specific calculations should be based on known engineering means and methods as well as be backed up by third party observations of their products.

8) 3.1.5 Green Roof Landscaping Criteria
   a. Change the last sentence of the first paragraph of this section as shown below.
      i. Therefore, a landscaping and maintenance plan shall be provided for green roofs.

9) Table 3.1.3 Green roof plant vendors in the Mid-Atlantic States
   a. This chart should include American Hydrotech, Inc as a supplier of plants in this region.
      i. American Hydrotech, Inc
         303 East Ohio Street
         Chicago, IL 60613
         312-337-4998
         www.hydrotechusa.com

b. Page 34-35 - I suggest this sentence is added to the last bullet point on page 34.
    i. .....before the first killing frost. It is suggested that designers and contractors check with their selected manufacturers for recommendations. Some manufacturers have specific "plant windows" that they will provide warranties on the plants they supply. It is important to know what these dates are. They can change dependent on plant selection and warranty requirements.

10) 3.1.6 Green Roof Construction sequence
    a. Third bullet under "Green Roof Installation"
        i. ....buy placing at least 2 inches of water over the membrane for 48 hours or potentially using electronic vector mapping to confirm....
    b. Fourth bullet under "Green Roof Installation"....root barriers are typically under the insulation layers.
        i. ....system components (e.g., root barrier, insulation, drainage layer and interior drainage system, and filter fabric)....
        ii. ...not to damage the waterproofing if damage occurs it must be report immediately.
    c. Fifth bullet under "Green Roof Installation".... the following adjustments are suggested.
        i. Media should be spread evenly and lightly compacted over the filter fabric surface as required by the manufacturer.
        ii. Last sentence.....I do not agree with this statement. Growing media actually should be lightly compacted. Foot traffic should not cause any harm to an unplanted roof. Hydrotech requires the surface to be compacted with a 300-400 pound water filled roller.
    d. Seventh bullet "Green Roof Installation"....the following adjustments are suggested
        i. ....fertilization is not required. At the very minimum all extensive green roofs should receive supplemental irrigation during the first few months of establishment. If drought conditions present themselves a temporary irrigation system may be needed. Contact the supplying manufacturer for specific warranty requirements. Hand weeding.....
    e. Eighth bullet "Green Roof Installation"....I am not sure where these numbers came from.
        i. Plugs - The industry standard is as follows: 50% coverage for plugs after one year when planted at 8" centers, 80% for the same plugs at two years. Most manufacturers require that a certain level of maintenance be performed to receive this warranty. Pitched roofs and flat roofs are treated the same.
        ii. Sedum Carpet/Tile - The industry standard is as follows: 90% coverage after the first and second year if properly maintained to manufacturer requirements. Pitched roofs and flat roofs are treated the same.
        iii. Sedum cuttings - The industry standard is as follows: 50% coverage after one year and 80% after two years if properly maintained to manufacturer requirements. Pitched roofs and flat roofs are treated the same.
        iv. Survival vs. coverage - The industry typically does not give thrive warranties. If they do the same requirements stand as far as maintenance requirements.

    f. Construction Inspections (page 36):
        i. First paragraph: I suggest the following changes.

1. ....ensure that the vegetated roof is built in accordance with the specifications for the project. Any differences between manufacturer's products and their orientation should be noted. Detailed inspection .....

ii. Bullets page 36: It is not clear who will be the supervisor or the person to sign off on these bulleted requirements. Something should be added that clearly states who will be or could be responsible for each of these steps. Being as vague as it is will cause "finger pointing" at the installation stage.

11) 3.1.7 Green Roof Maintenance Criteria

a. First paragraph I suggest the following changes....
   i. A green roof should be inspected at least twice a year or potentially more frequently as directed by manufacturer supplying the warranty to assess vegetative cover....
      1. Hydrotech has very specific maintenance guidelines that must be followed by a contractor to receive our plant warranty. Depending on the time of year the roof is planted the first year of the warranty could require as many as 12-18 visits and the second year at least four visits.
      2. Two visits per year is the VERY minimum any project should receive. Only after two years of establishment does Hydrotech suggest the roof is visited this limited amount of times per year.

b. Third paragraph ...I suggest the following changes...
   i. The use of herbicides, insecticides, and fungicides should be avoided, since there presences could hasten the degradation of the waterproofing dependent on membrane type (some membranes are not affected by these chemicals). If any of these chemicals are used it is advisable to check with membrane manufacturer for approval, recommendations, and warranty issues. The same goes for power washing and other exterior maintenance operations where cleaning agents and other chemicals could harm the plant communities.

c. Fourth paragraph.....I suggest the following changes are made.
   i. While fertilization is generally not recommended due to the potential for leaching of nutrients from the green roof it might be required from time to time. Getting the approval of the green roof manufacturer or plant supplier that holds the vegetative warranty is critical. Supplemental.....

12) Table 3.1.4 Typical maintenance activities associated with green roofs

a. In the top right box under Schedule.....change text to read "As needed or as required by manufacturer"

b. In the bottom left box.....second bullet point. This bullet mentions that weeding with pointed tools of digging is no suggested. While this might be something that is very dangerous on a single ply membrane over insulation it is not as big of a deal on protected membrane roofs where there are multiple layers of protection between the growing media and the waterproofing membrane.

c. Paragraph below table...It is not clear in this paragraph how this will be enforced, who will track this, how it should be specified by design teams and if there is a cost associated with the service. This should be added in some fashion to the sentence below.
   i. The declaration of covenants specifies the property owner's primary maintenance responsibilities, and authorizes DDOE staff to access the property

for inspection or corrective action in the event the proper maintenance is not performed.

13) 3.1.8 Green Roof Stormwater Compliance Calculations
    a. What type of verification is needed that the manufacturers and contractors are providing the performance that is being awarded?
        i. It is suggested that DDOE required the manufacturer to supply information and performance data about the products being used to calculate storage volume. Not all green roofs will perform the same thus not all are created equal or should be given the same values.
    b. Last paragraph ...the follow changes are suggested.
        i. ....may be used as well. Ideally a green roof manufacturer will be able to provide a system specific calculation that calculates the exact performance of the products being supplied to the project. If no such calculation or performance data is available the design team should evaluate is the manufacturer unable to deliver this information is the right choice for their project.
            1. I have attached information on what Hydrotech can provide. Our Hydrotech Hydrology Tool (HHT) is ideal for providing this information. It is based on known engineering means and methods, is based off our products and is backed up by independent laboratory testing and monitoring.

Water Accessibility and Extensive Vegetated Roofs

Access to sufficient water is one of the most important considerations for establishing and maintaining healthy green roofs. Once established, most extensive green roofs can rely on natural rainfall with occasional supplemental water needed if natural rainfall amounts fall short.

Water accessibility and irrigation systems have been challenging issues for green roofs since their inception. Unfortunately, many green roofs have been constructed with little attention to providing enough water.

The cost of plant replacement far exceeds the initial costs of a good, effective system.

Hydrotech Sufficient Water Policy

Hydrotech strongly recommends that sufficient water be available for every Garden Roof installation.

As of January 1, 2012, if sufficient water is not provided at the time of planting, Hydrotech will not ship plant material to a project unless the general contractor or owner accepts responsibility for the viability of the plant materials after installation.

Irrigation System Preferences

If a permanent irrigation system is being considered by the design team, ***Hydrotech recommends that a pop-up system be considered over a drip irrigation system*** for the following reasons:

- Newly installed plant materials require large and consistent amounts of water during the initial establishment periods.
- Drip irrigation systems cannot deliver enough lateral water to the top of the media immediately adjacent to the root zone of sedum tiles and carpets at time of installation.
- As a result, drip irrigation systems can be used, but will require additional supplemental irrigation equipment and labor to provide enough overhead water for proper plant establishment.
- Pop-up irrigation systems can more effectively simulate natural rainfall and apply water to the top surface of the media where the water is more available to the plants.
- Pop-up irrigation systems can provide water during both establishment and ongoing maintenance periods.
- Pop-up irrigation systems (properly designed) do not require supplemental systems to provide sufficient water.
- Pop-up irrigation systems must be properly designed to keep overspray to a minimum. Sprinkler head selection and patterns are crucial to a properly designed system.

Irrigation Equipment Preferences

There are numerous manufacturers of temporary, drip and pop-up sprinkler equipment. For proper operation, a qualified irrigation designer/consultant should be consulted when designing any irrigation system. Hydrotech does not recommend any particular irrigation equipment manufacturer; a list of major manufacturers is listed at the end of this document. It is the responsibility of the design team to provide an adequate irrigation and water supply system for the green roof.

Minimum Water Availability

If a permanent irrigation system is not included for the green roof, Hydrotech strongly recommends that hose bibs or roof hydrants be provided at strategic locations for use in providing temporary irrigation for the green roof. These hose bib or roof hydrant water sources should be spaced no more than 100 feet apart and ***capable of running simultaneously with a minimum of 8-10 GPM delivered at a minimum of 35 PSI***.

Background Information

Water during installation and establishment

One of the most critical parts in the planting of any green roof is having enough water to saturate the media immediately prior to installing plant materials and for watering the plant materials after installation.

Immediately prior to plant material installation, especially on hot days, water is needed in large quantities to thoroughly saturate and cool the media to prevent scorching of fine roots in all plant materials.

Upon completion of the plant material installation, water must be applied in accordance to AHI maintenance requirements in order to help the roots establish deep in the media. Irrigation frequency and duration must be carefully considered. ***It is important to not succumb to the temptation to increase irrigation frequency during hot and dry times of the year.*** Longer duration and less frequent irrigation cycles often work better for establishing deep roots for sedums and perennials. Shorter duration and more frequent irrigation cycles can promote shallow rooting plant materials that are more prone to stress during drier and hotter times of the year.

Sufficient Water

The term "Sufficient Water" is used to define the characteristics of the supplemental water needed for the initial establishment period of any vegetated roof installation. As each roof is different, the definition of "sufficient water" specific to each roof is correspondingly different and dependent on the plant material and media types and regional and climatic conditions.

The requirements outlined in Hydrotech's Maintenance Guidelines include watering the newly planted green roof on a regular basis to properly establish the plant materials. When working with owners and designers, the following are guidelines for defining characteristics for each water source:

- Minimum 35 pounds per square inch (PSI) at roof level
- Minimum 8-10 gallons-per-minute (GPM) at roof level

Water Delivery Systems

Owners and their design teams have a number of choices regarding delivering sufficient water to their green roofs:

- Manual and temporary water systems via hose bibs or roof hydrants
- Automatic irrigation systems such as drip and pop-up irrigation systems

Water Volume and Pressure

Water measurements are defined in two units:

- ***Water volume*** is measured in gallons-per-minute (GPM
- ***Water pressure*** is measured in pounds-per-square inch (PSI)

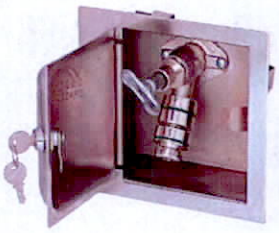
These two units are related. It is possible to have high volumes of water with little pressure to drive the water into sprinklers or irrigation systems.

Conversely, it is also possible to have high pressures with little volume which makes effective application of water time consuming and difficult to control. The ideal system has sufficient water volume and pressure to push that water effectively through the irrigation system.

Water Sources

The sources of water on green roofs can include hose bibs and roof hydrants that are typically used for temporary irrigation systems.

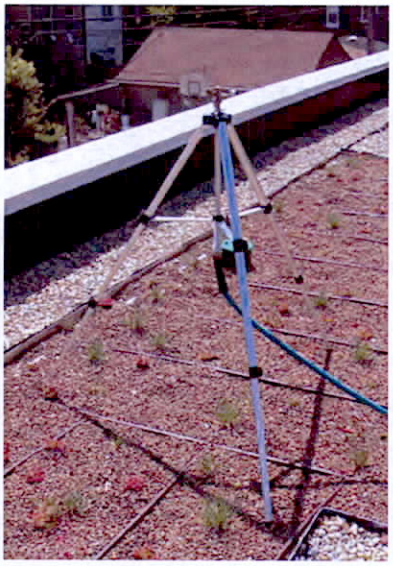
For permanent drip or pop-up systems, the water source would typically lead from the mechanical roof to the roof area either through the roof deck or a wall.

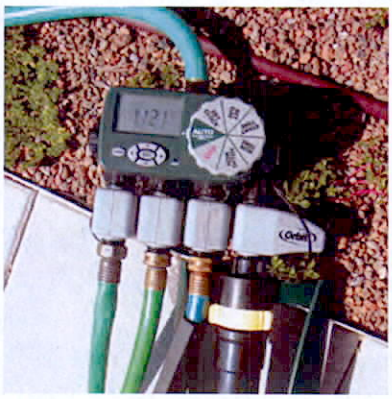


For vegetated roofs that will have neither drip nor pop-up irrigation systems, the following should be considered:

- **Number of water sources:** A good standard to consider is one source every 100 feet. This will allow for using a single 50-foot hose and a temporary sprinkler to be used with minimal damage caused by dragging long hoses across new, establishing vegetation.
- **Water Quantity:** Each water source should be capable of producing at least 8-10 gallons per minute at 35-40 PSI. This will allow for proper operation of a wide range of temporary irrigation setups.

Manual vs. Temporary vs. Permanent Irrigation





Manual irrigation systems consist of hoses and nozzles that apply water to the media and plant material. Very labor intensive, manual irrigation requires the commitment of labor resources to be on the green roof on a very regular basis. Temporary irrigation systems typically consist of hoses and sprinklers connected to on-roof water sources such as hose bibs or roof hydrants. These systems are typically used during the establishment period and removed soon after. These systems require significant labor hours during the establishment period to move and re-set sprinklers to ensure proper coverages over the green roof.

Portable irrigation control units are available to create a semi-automatic system that helps to reduce the labor costs of turning on and off the irrigation system.

Permanent Irrigation Systems

Permanent irrigation consists of two major types: drip irrigation and pop-up spray irrigation.

Drip vs. Pop-Up Irrigation

Permanent irrigation systems are becoming more common on vegetated roofs with drip irrigation being the predominant system type over pop-up spray systems.

Drip irrigation (sometimes referred to a sub-surface irrigation) systems consists of small diameter tubing with integral, built-in emitters that slowly release water.

Drip systems employ tubing with emitters built into the tubing. The tubing and emitters can be obtained in a wide range of configurations including emitter spacings that range from 12 – 24 inches apart and emitter discharge rates that range from 0.6 – 0.9 gallons per hour. Drip systems can be designed to accommodate the highly variable geometric conditions on the vegetated roof including HVAC units as well as narrow and irregularly shaped configurations.

While drip irrigation may seem to be the logical choice for vegetated roofs, the very porous and free flowing medias used for these roofs do not work well with drip irrigation systems ***for establishment purposes***.

For sedum carpet and sedum tile projects, supplemental overhead irrigation is required when establishing green roofs that have permanent drip irrigation systems. Depending on the project, plug projects may also require supplemental overhead irrigation.

Drip irrigation systems rely on capillary action between soil particles to move water laterally between the drip tubing. The porous nature of the vegetated roof medias, so essential for proper plant performance, does not create enough lateral capillary movement to deliver sufficient water to new plantings, especially sedum tiles and carpets.

Clay soils **Loam soils** **Engineered soils**

Once established into the media, the plant roots will seek out the water delivered by the drip irrigation system and the supplemental water can be discontinued.

Given these variables, drip systems should be designed by qualified irrigation professionals with the following considerations:

- ***Tubing:*** Drip tubing is typically embedded in the media just beneath the surface on plug projects or placed directly underneath the sedum tiles and carpets. Drip tubing can be subject to root infiltration into the drip emitters which can cause clogging. Most major tubing manufacturers have addressed this concern by incorporating mechanical or chemical resistance to roots either in the tubing, the emitters, filters or other means and should be considered in an overall irrigation system.
- ***Tubing spacing:*** Typically, spacing can vary between 12 and 18 inches apart, however, the 12-inch spacing may provide better water distribution in free draining green roof medias.
- ***Emitter Spacings:*** The irrigation design professional should consider the free-draining nature of the growing media when selecting the discharge rates and emitter spacings within the tubing.
- ***Adequate circuitry:*** Green roofs should be sub-divided into logical circuits or zones to minimize pressure losses and to help ensure proper operations. Multiple zones allow for isolation of various areas of the green roof for maintenance of the system without shutting down the entire system.

- ***Provision for supplemental water:*** All drip irrigation systems must have hose bibs incorporated into the systems to allow for temporary sprinkler connections that would be used during the establishment period. These hose bibs should be included at the water source and at each remote control valve in the system. Additional hose bibs should be incorporated to provide convenient connections to promote easy water application when needed.

Pop-up sprinklers apply water overhead water for the vegetation. Sprinkler heads "pop-up" when in use and can vary in pop-up height from 3 to 12 inches. There are a wide variety of sprinkler units to consider with the ranges including pop-up height, spray types and patterns and wide ranges of water throw distances. It is important to consult a qualified irrigation professional when considering pop-up irrigation systems due to the variety of layouts and equipment options.

Pop-up systems should be designed with the following considerations:

- ***Water droplets:*** Sprinklers should create large water droplets rather than fine sprays or mists. This will help prevent drifting or overspray of water on rooftops that can be subject to wind effects.
- ***100% Overlap:*** Sprinklers should be spaced no further than the anticipated water throw pattern. For example, a sprinkler with a 20-foot pattern should be spaced no further than 20 feet apart. This helps to ensure even application of water over the entire surface.
- ***Adequate circuitry:*** It is impractical to operate all sprinkler heads on one circuit or zone so the irrigation designer should divide the roof into logical circuits that optimize the available water and pressure. This will allow for use of sprinklers designed to address wide or narrow spaces.

An advantage of pop-up irrigation vs. drip irrigation is that pop-up irrigation can also serve as the supplemental irrigation system during the establishment period. A properly designed, installed and maintained system can serve the dual purpose of providing water during the initial establishment period as well as during the post-establishment period. This combined function can save on labor costs during the establishment period by eliminating the need for personnel to move temporary sprinklers and hoses. Once the vegetated roof is established, the system can be adjusted to provide water as needed.

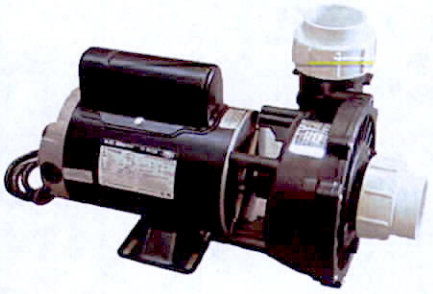
Pop-up systems need to be carefully designed and installed to eliminate overthrow onto adjacent surfaces. This is especially important in areas

with hard water that might stain surfaces. This may require a wider assortment of sprinkler heads to accommodate and properly cover oddly shaped areas.

One disadvantage of pop-up sprinklers is the higher water pressure and volume requirements needed to properly operate these systems. These can be overcome by using booster pumps and careful water circuitry to distribute the water properly.

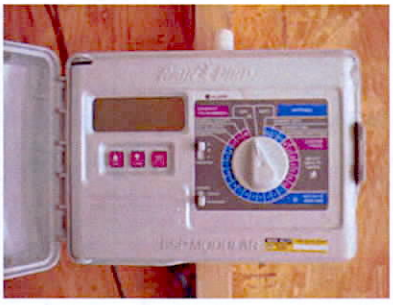
Major Irrigation Components

Booster pumps



Booster pumps are often needed to raise the available water pressure and volume at the roof level. These are specialized pieces of mechanical equipment and require interconnection to irrigation controllers and other building control systems. Booster pumps should be considered as an integral part of a properly designed irrigation system.

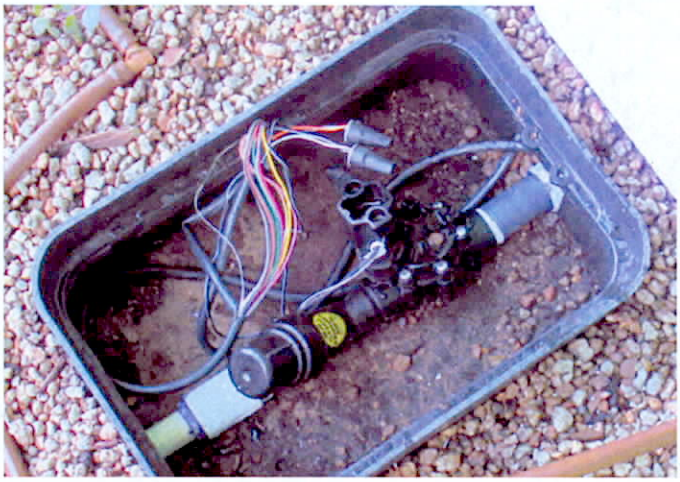
Irrigation Controllers



Automatic irrigation systems are typically divided into multiple circuits that address specific areas of the roof. Each of these circuits are activated by remote-controlled solenoid valves that are connected to a central electronic time clock or controller. These controllers can handle many separate solenoid valves and turn them on and off using specific programs that can be customized to address certain conditions on the roof.

Remote Control Valves

The irrigation controller sends signals to valves that turn on and off to allow water into the particular circuit. There is one valve per irrigation zone and it is installed in a valve box at the beginning of the piping that supplies the water to the zone. Depending on the system, filters and other equipment can be included in valve boxes with remote control valves.



Moisture Sensors

In larger irrigation systems for vegetated roofs, moisture sensors can be employed to measure the levels of moisture in the growing media. This information is fed into the controller that automatically determines if the particular circuit should be activated when required.

Rain Sensors

Most controllers contain circuitry for adding rain sensors. A requirement in certain southern locales, rain sensors can modify the normal operations of the controller when rainfall has occurred.

Backflow prevention

A critical element of any irrigation system is backflow prevention. A single backflow prevention device can be used to protect an entire system and is often required by local building codes. Please consult a qualified irrigation designer for requirements in the project area.

Maintenance

All irrigation systems will require maintenance including:

- Spring startup
- Review of system for proper operations
- Repair of damaged sections
- Resetting spray heads for proper operation
- Fall shutdown including removal of water from system by using compressed air

A qualified irrigation designer/consultant should include a thorough maintenance plan as part of a properly designed irrigation system.

Irrigation Manufacturers:

There are a variety of irrigation manufacturers that offer a wide range of irrigation equipment and supplies. Hydrotech does not take a position on or recommend any particular manufacturer, but offers the following list of irrigation manufacturers for consideration:

- Rainbird - www.rainbird.com
- Toro - www.toro.com
- Hunter - www.hunterindustries.com
- Netafim - www.netafimusa.com
- KISSS - www.kisssusa.com

Summary:

Having sufficient water is a very important part of creating successful vegetated roofs. The water needs are especially important during the installation and initial maintenance stages of the project. Water needs can vary dependent on local climate patterns, plant material types and owner expectations.

The choices of whether to use manual or temporary irrigation or to invest in either drip or pop-up spray irrigation systems involve many different issues. Ultimately, the choice of system is up to the building owner. American Hydrotech is available to assist owners, designers and contractors by providing perspective and input on experiences with the green roofs that it has constructed.

For further information, contact American Hydrotech at 312.337.4998 or gardenroof@hydrotechusa.com.

HYDROTECH

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800.361.8924; 514.353.6000
514.354.6649 (fax)
www.hydrotechmembrane.ca

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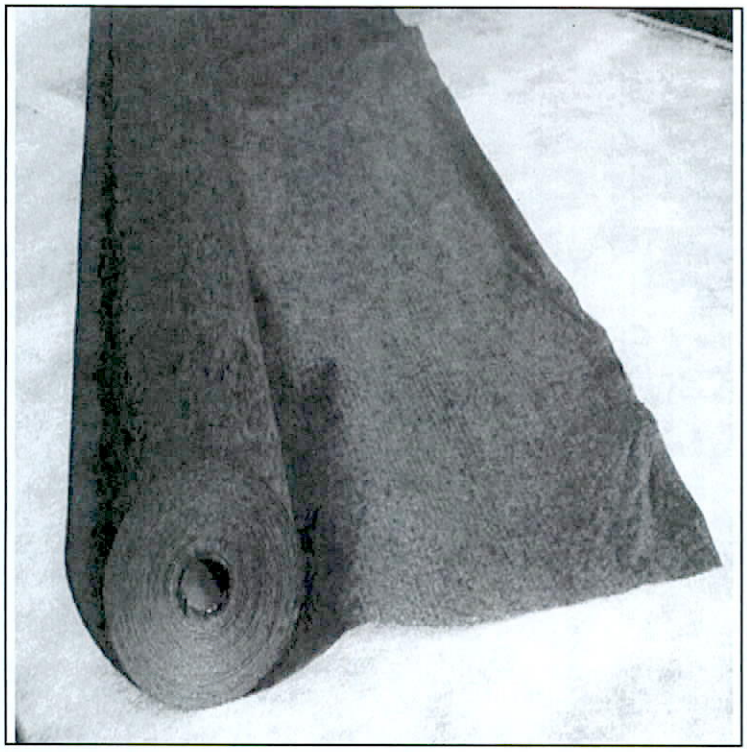
HYDROTECH

SYSTEMFILTER PRODUCT DATA SHEET



GENERAL DESCRIPTION

Systemfilter is a non-woven, needle punched, geotextile filter sheet, made of non-rotting, polypropylene fibers. It is made to be highly resistant to all natural acids and alkalis and is chemically neutral.

BASIC USE

Systemfilter is specifically designed to be used as a filter fabric over the Gardendrain™elements in Hydrotech's Garden Roof® Assembly.

TECHNICAL DATA

SIZE:	12.5 ft X 120 ft (3.8 m X 36.6 m) - in rolls (1,368.5 ft2 effective coverage)		
WEIGHT: (ASTM D5261)	3.5 oz/yd^2 (119 g/m^2)		
FLOW RATE: (ASTM D4491)	150 gal/min/ft^2 (6,095 l/min/m^2)		
TENSILE STRENGTH: (ASTM D4632)	90 lb (401 N)	ELONGATION: (ASTM D4632)	50%
MULLEN BURST: (ASTM D3786)	185 lb/in^2 (1,275 kPa)	PUNCTURE STRENGTH: (ASTM D4833)	60 lb (267 N)
TRAPEZOIDAL TEAR: (ASTM D4533)	40 lb (178 N)	APPARENT OPENING: (ASTM D4751)	50 (0.3 mm)

INSTALLATION

- Systemfilter is to be unrolled over the entire roof area completely covering the Gardendrain element, in both extensive and intensive landscape conditions. Systemfilter is not installed over GR30 or GR50 in higher slope conditions or when concrete is required for footings, etc.
- Adjacent rolls are to be lapped minimum of 12 inches, end and side laps.
- Enough fabric, or separate strips, needs to be left at terminations, flashing details, etc. so that it extends beyond the anticipated soil level. Excess can be trimmed down to the level of the soil once the soil is installed.

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