# GARDEN ROOF® PLANNING GUIDE

## FROM CONCEPT TO COMPLETION

HYDROTECH®

BUILDING TRUST

Sika®

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Cover Photo - 1101 Dexter - Seattle, WA


**American Hydrotech, Inc.**

**800.877.6125**

**hydrotechusa.com**

# INTRODUCTION TO HYDROTECH'S GARDEN ROOF®

Tri-City Wastewater - Oregon City, OR

# Challenges of the Built World

## Introduction

As our cities continue to grow, the natural landscape and green open spaces are being replaced with buildings, parking lots and roadways of concrete and asphalt. Open green spaces within city centers are decreasing as the strong demand for buildable land increases.

Temperatures within dense urban areas have been observed to be 3 - 10 degrees F warmer compared to temperatures in the greener outlying areas. Commonly referred to as the "urban heat island effect," this dome of heated air creates an unhealthy environment in which polluted air, smog and higher temperatures take their toll on human, animal and plant life. While damaging to living systems, this increased temperature also increases energy demands to keep buildings cool in the heat of summer.

To a great extent, the building rooftops, parking lots and roadways that make up the cityscape are impervious to water. This often results in an overload of the existing drainage and sewer systems and increases the risk of flooding following a heavy rain. Continued development in cities only adds to these problems making improvements to the existing sewer infrastructure very costly.

Handling this ever increasing amount of stormwater runoff used to involve dumping this water into pipes that led to rivers where it was forgotten. In many instances across the United States, these sewers that carry stormwater runoff also transport raw sewage. Heavy rains often created unhealthy conditions especially in areas where drinking water was drawn from these waters. Construction of detention and retention ponds—another common method for dealing with stormwater—is extraordinarily expensive in urban areas due to high land costs.

Ultimately, the increasing pollution in this runoff led to the passage of laws to protect the rivers, streams and oceans and to new ways of handling this ever increasing volume of stormwater.

The Environmental Protection Agency has been tasked with developing and encouraging new ways to handle this stormwater issue while enforcing the laws and regulations designed to protect the nation's waterways, environment and drinking water supplies. Numerous technologies and innovations have been developed to bring permeability back to the built environment and to promote returning water to the ground as soon as possible.

Replacing the impervious surface of a conventional roof with a vegetated roof can help to substantially reduce stormwater runoff and help to restore the balance with nature in our urban centers.

Hydrotech's Garden Roof® Assemblies combine the proven performance of our Monolithic Membrane 6125® waterproofing/ roofing membrane with proven vegetated roof technology. Hydrotech's Garden Roof® Assemblies are lightweight and can be installed on a wider range and variety of new and existing structures and buildings.

# Vegetated Roof Benefits

A vegetated roof can provide numerous economic and ecological benefits to the building's owner.

### Economic Benefits

- **Increased Roof Life Expectancy:** A vegetated roof is in essence a Protected Membrane Roof (PMR) Assembly which protects the roof membrane from climatic extremes, UV degradation and physical abuse.
- **Additional Usable Space:** Property values can increase by making rooftop space a beautiful amenity for use by its occupants.
- **Building Incentives:** Many municipalities and government agencies offer incentives including tax relief, increased floor/area ratio (FAR) benefits and expedited permitting as well as outright payments for vegetated roof construction.
- **Marketing:** Many organizations have used vegetated roofs as examples of their commitment to sustainable initiatives. A vegetated roof can be a very public statement that contributes towards their image and branding efforts.

### Environmental Benefits

- **Mitigates Urban Heat Island Effect:** Vegetated roofs can be up to 50 degrees cooler than traditional roofs and can help lower the ambient temperature of urban areas.
- **Re-creates Habitat:** Vegetated roofs can provide much needed green spaces to encourage the return of insects and animals to urban areas.
- **Oxygen Production and Carbon Sink:** Natural transpiration and respiration of plants on a vegetated roof generates oxygen and creates places for carbon sequestration.
- **Noise Mitigation:** Vegetated roofs can help to reduce noise transmission into the interior spaces of the building.
- **Reduction of Dust and Smog Levels:** Plants and growing media can trap particulates and pollutants.

### Stormwater Benefits

- **Volume Reduction:** Vegetated roofs have the ability to greatly reduce the amount of runoff by keeping much of the water within the assembly and the growing media, much like a sponge.
- **Time Delay:** Along with volume reduction, vegetated roofs delay the release of stormwater from rooftops as it filters through the assembly to a drain.
- **Filtering Effects:** Vegetated roofs act as filters for stormwater by trapping fines within the growing media and components.
- **Downstream Benefits:** Vegetated roofs allow for downsizing or elimination of traditional stormwater management methods (pipe storage, cisterns, vaults, etc.).

### Additional Benefits

- **Therapeutic and Healing Environments:** Vegetated roofs have been used to convert otherwise unused rooftops into unique healing landscapes for hospitals and healthcare facilities.
- **Urban Agriculture:** Rooftops in dense urban areas represent a valuable resource for food production. Production of many different kinds of high-value vegetable and fruit crops as well as beekeeping for honey have been generated on vegetated roofs designed for urban agriculture.

The Solaire - New York, NY

Denver Justice Center - Denver, CO

### Green Building Design – Credits and Points

Vegetated roofs can significantly contribute to the various credits and points used by a number of organizations in evaluating green building design and construction, including:

- LEED™ (United States Green Building Council)
- Sustainable Sites Initiative™ (ASLA)
- Roof Point™ (Center for Environmental Innovation in Roofing)
- Living Building Challenge (International Living Future Institute™)

# Hydrotech's Advantage

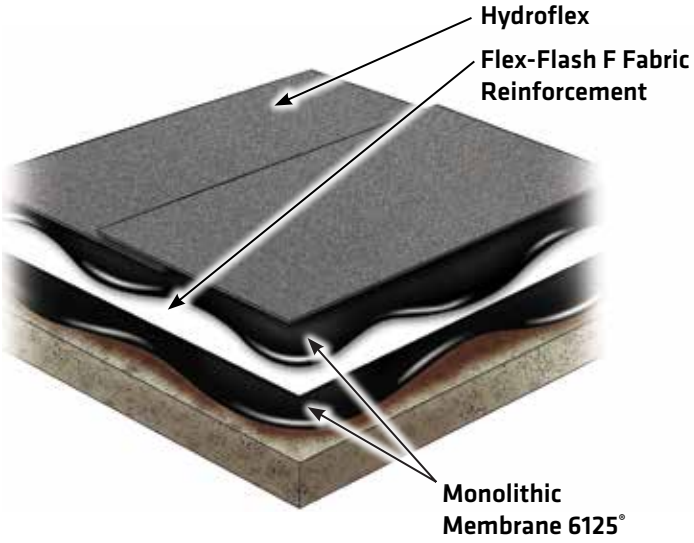
## From the Roof Membrane to the Plants

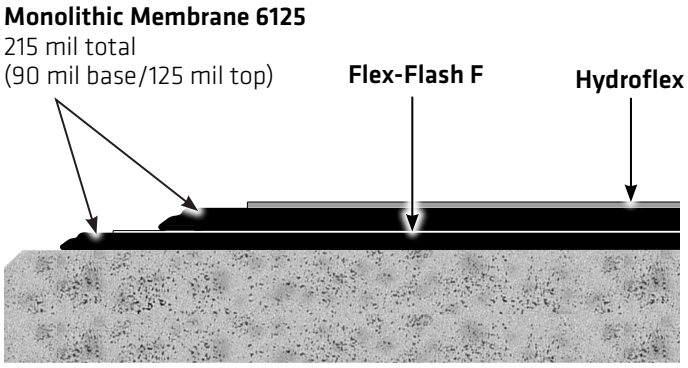
American Hydrotech, Inc. understands that a vegetated roof must function first as a roof, keeping the structure watertight and at the same time provide an environment conducive to the growth of vegetation. Hydrotech's Garden Roof® Assemblies accomplish this by incorporating the very best in moisture protection and proven vegetated roof technology.

### Building from the bottom up

As a manufacturer of quality waterproofing and roofing products, Hydrotech's flagship product Monolithic Membrane 6125® (MM6125®), a hot, fluid applied rubberized asphalt, has been keeping buildings watertight for over 50 years. Monolithic Membrane 6125®, which contains up to 40% recycled post-consumer content, is the membrane of choice for Hydrotech's Garden Roof® Assemblies. MM6125® has been used in fountains, pools, reflecting ponds, planters and other applications where contact with water is to be expected. In addition to MM6125®'s ability to perform in a wet, submerged condition, MM6125® has many other unique qualities that make it the best choice for Garden Roof® applications.

- There are no seams to fail; it is completely monolithic
- Bonded directly to the substrate
- Can be installed on substrates with little or no slope
- Easy to detail all critical penetrations and terminations
- Resistant to fertilizers and other mild acids
- No VOC restrictions; contains no PVCs
- Installed only by authorized, trained applicators




*** Membrane shown at actual thickness**

## Protected Membrane Roof (PMR) Advantage

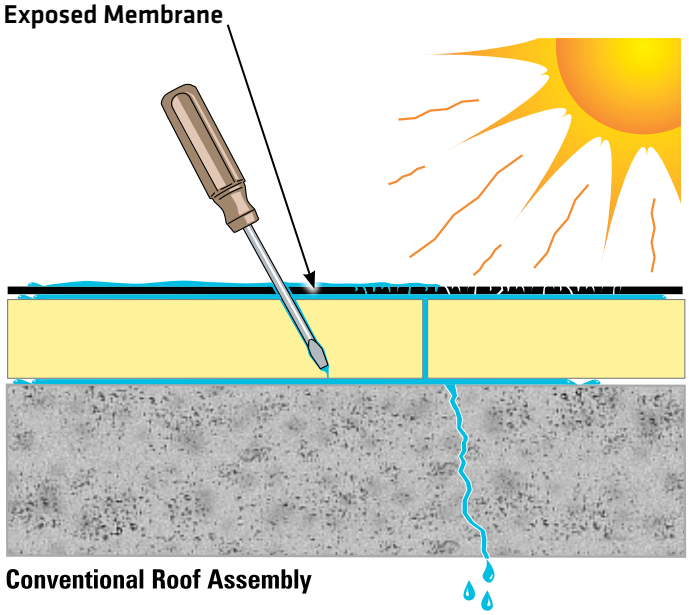
### Conventional thinking in roof design

**A short history lesson in roofing...** As building structures became bigger (after WWII), and these larger areas could not be effectively covered with steep roofs, the technology of the flat roof evolved. Without steep sloped roofs to shed water, roofs required a new element - waterproofing. To meet this requirement, the roofing industry began to mop asphalt directly to the roof deck. As fuel costs increased, energy efficiency became an important factor and insulation was added to the roof assembly. Since most insulating materials were not water-resistant (and still aren't today), the insulation had to be placed on the deck, under the waterproofing membrane for protection. This system became known as a **conventional insulated roof assembly.** With the membrane now on top, it is no longer kept at a relatively constant temperature, exposing it to a new set of conditions and stresses.

A conventional roof design leaves the membrane vulnerable to many factors.

- Extreme and often sudden temperature changes: high summer roof temperatures, lower winter temperatures, as well as freeze-thaw cycling
- Physical abuse from heavy foot traffic and routine maintenance
- Ultraviolet light exposure

Exposure to all of these factors weakens the integrity of the membrane. Once the membrane is compromised, moisture can enter the assembly, which can cause a loss in thermal efficiency and water leakage into the building.

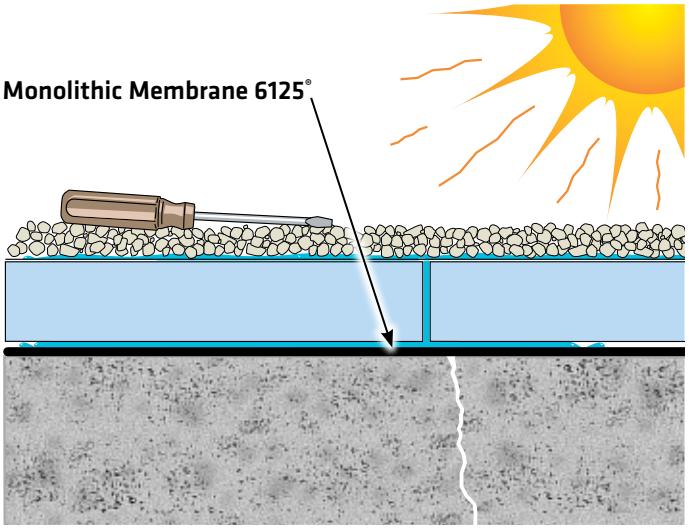



**Conventional Roof Assembly**

## Unconventional common sense in roofing technology

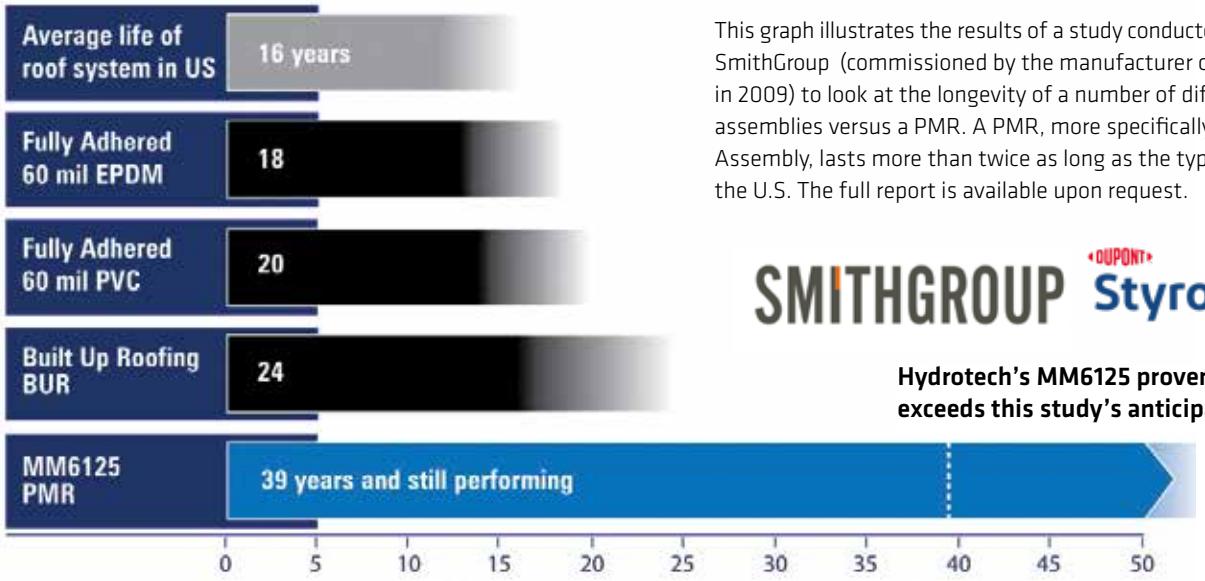
A better way is possible because of DuPont's STYROFOAM™ brand roof insulation, a closed cell polystyrene that is highly moisture-resistant. Placed on top of Hydrotech's Monolithic Membrane 6125®, it offers protection from the harsh roof environment. This arrangement of roofing materials - roof deck, waterproofing membrane, moisture-resistant insulation and ballast - is commonly referred to as a **Protected Membrane Roof (PMR) Assembly**. By simply placing insulation on top of the membrane rather than beneath, most roofing problems caused by Mother Nature and physical abuse can be eliminated.

An added benefit to a Hydrotech PMR is that Monolithic Membrane 6125® is fully bonded to the substrate, so if it is ever damaged (unlike a loose laid, single-ply membrane) water migration below the membrane is restricted, making it easy to locate and repair.




**Protected Membrane Roof Assembly**

## Life Cycle Cost Advantage




**Anticipated Service Life (per study)**

This graph illustrates the results of a study conducted by the SmithGroup (commissioned by the manufacturer of STYROFOAM in 2009) to look at the longevity of a number of different roof assemblies versus a PMR. A PMR, more specifically a Hydrotech PMR Assembly, lasts more than twice as long as the typical roof system in the U.S. The full report is available upon request.

SMITHGROUP DUPONT Styrofoam Brand

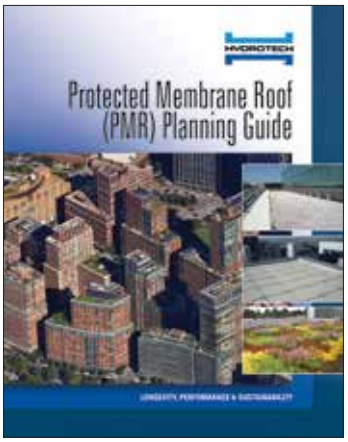
**Hydrotech's MM6125 proven service life exceeds this study's anticipated service life**

## All vegetated roofs are not PMR Assemblies

Installing the vegetated roof components (drainage/water retention layers, growing media, gravel, vegetation, etc.) directly above the membrane in a conventional roof membrane assembly does not make it a PMR Assembly. The membrane is still above the insulation layer and therefore susceptible to physical abuse during installation, and to the forces of Mother Nature. Only a vegetated roof like Hydrotech's Garden Roof® Assembly can provide all the benefits of a PMR. Protect the roof membrane and it will keep the building dry.

Garden Roofs are a part of the wide array of assemblies that are part of the family of Protected Membrane Roofs that Hydrotech offers.

**For further information, see Hydrotech's PMR Planning Guide.**



## Hydrotech's Advantage...

Hydrotech's first Garden Roof® Assembly (Mashantucket Pequot Museum; see right) was installed in 1996; the first **single source** fully warranted vegetated roof assembly in America. Since that time, Hydrotech has continued to lead the vegetated roof marketplace through the innovation of new products and assemblies.

### Experience and In-house Expertise

Since the introduction of the Garden Roof® Assembly in 1996, Hydrotech has developed extensive experience in the design and construction of thousands of vegetated roofs across the United States. Hydrotech's Garden Roof® staff has unparalleled design and construction experience to address any question you may have about your particular project.

### Design Assistance

Hydrotech's sales representatives and staff work closely with the design team and can offer assistance with the specification development and details as part of the service offering. Each project is unique. Here are some of the many issues that must be considered.

- Structural requirements
- Wind uplift requirements
- Detailing of perimeter/penetrations
- Growing media (soil) requirements
- Maintenance issues
- Stormwater calculations
- Sun and shade patterns
- Watertightness of roof
- Safety
- Slope issues
- Plant choices
- USGBC's LEED™ credits
- Warranty offering
- Access to roof

### Contractor Training Program

Hydrotech only sells its roofing, waterproofing and Garden Roof® materials to trained applicators. This helps ensure that the materials are properly installed and the owner receives the highest quality materials and installation.

Hydrotech's array of approved contractors have all undergone extensive training provided by Hydrotech's experienced Garden Roof® and Technical Departments' staff.

### Hydrotech Hydrology Tool (HHT)

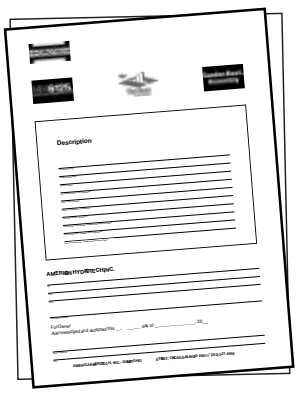
Hydrotech's Garden Roof® Assembly can be an ideal component of any stormwater management plan with its ability to store stormwater in the assembly. To aid engineers and designers in the development of these plans, Hydrotech has a unique tool for accurately predicting performance of our Garden Roof® Assembly and components, called the Hydrotech Hydrology Tool (HHT).

### Hydrotech's Warranty for Owner Assurance

The Garden Roof® Assembly consists of proven components from the deck up, which may include the waterproofing/roofing membrane, root barrier, insulation, vegetated roof components, growing media and even the vegetation for extensive applications. Hydrotech offers a range of warranty options to an owner providing long term assurance and peace of mind from the watertightness of the membrane, up to and including removal and reinstallation of overburden.

**Contact Hydrotech for specifics.**

Mashantucket Pequot Museum and Research Center - Mashantucket, CT



### Warranty Includes:

- Material and Watertightness
- Thermal Retention
- Wind Resistance
- Removal and Reinstallation
- Vegetation Coverage (sedum)
- Vegetation Thrive (all extensive plant materials supplied by Hydrotech

# GARDEN ROOF® ASSEMBLIES

Lovejoy Apartments - Portland, OR

# Components of a Garden Roof® Assembly

There are a number of components that can comprise a typical Hydrotech Garden Roof® Assembly. Each of the components in the assembly serves a specific purpose with the goal of creating a waterproof building with elements that promote vigorous plant growth.

⑧ **Carefully Selected Plants -** Extensive plants for low maintenance landscaping including drought resistant species and varieties available from Hydrotech. There is a wide range of plants for intensive landscaping that can be supplied by plant nurseries around the United States.

⑦ **LiteTop® Engineered Lightweight Growing Media -** Well-balanced internal structure and low weight with ideal aggregate size and components, pH values, nutrients, degree of porosity and permeability. The type and depth of the growing media is determined by the desired plant choices. This depth of growing media will affect the structural loads imposed on the roof structure. Hydrotech's LiteTop® blends are engineered to meet the requirements of each project.

⑥ **Systemfilter -** Prevents fine particles from being washed out of the growing media, out of the root zone and into the drainage systems.

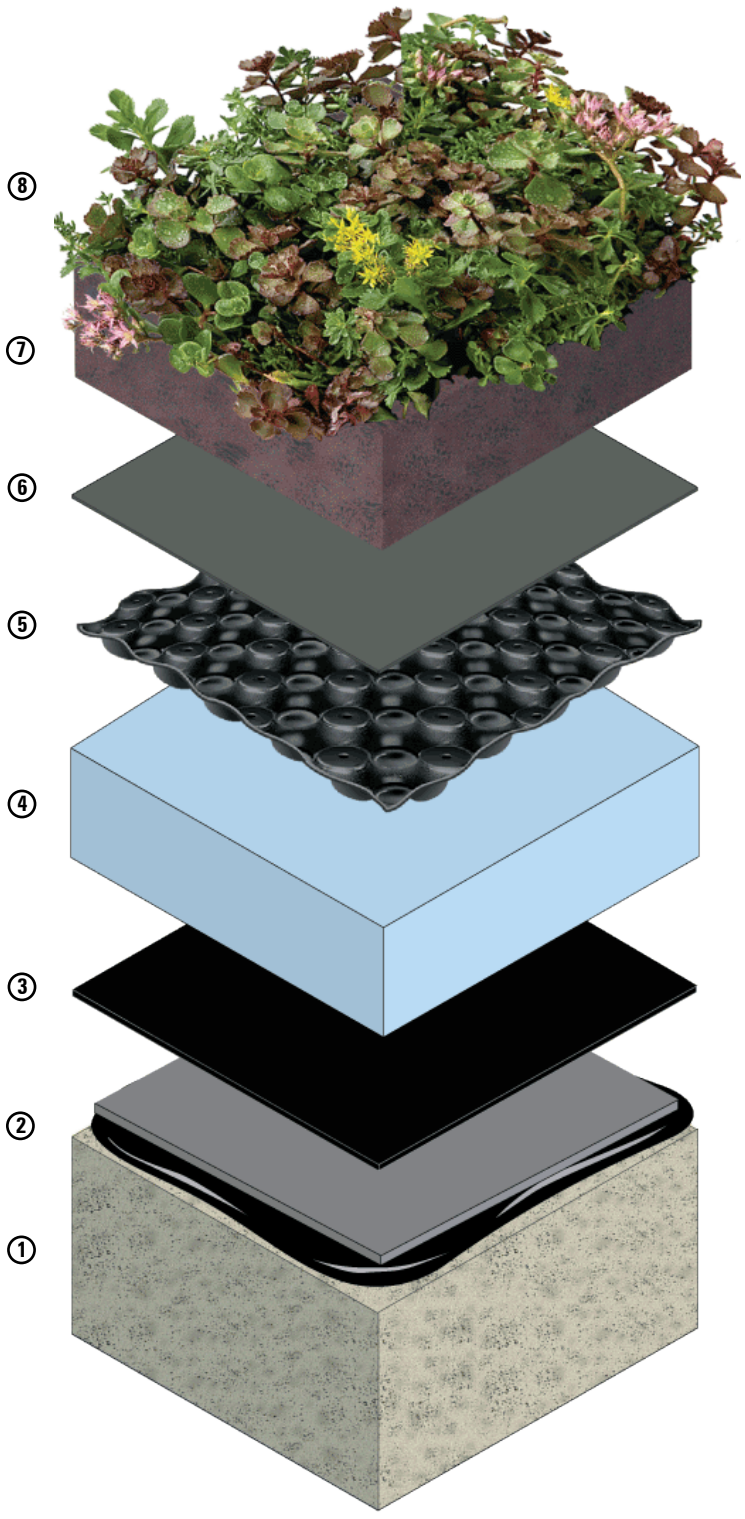
⑤ **Gardendrain® Retention/Drainage/Aeration Component -** Hydrotech's Gardendrain® retains water in the profiled cups, even on low slope roofs. Excess water drains away through channels between the cups. Strategically located holes in Gardendrain® provide necessary aeration and ensures that excess moisture found below the cups can air diffuse up into the growing media.

④ **Insulation -** Situated above the roof membrane and root barriers, an extruded polystyrene insulation is utilized. DuPont's STYROFOAM™ brand insulation exhibits excellent moisture resistance, is closed cell, dimensionally stable and has a high R-value.

③ **Root Barrier -** Prevents roots from damaging the roof membrane. The root barrier type, thickness and method of installation depend on the nature of the landscape planned, the plants selected and the slope of the roof.

② **Roofing Membrane -** Only the best: with a track record of over 60 years proven performance worldwide, Hydrotech's Monolithic Membrane 6125®FR fabric reinforced assembly is the ideal membrane for a vegetated roof (depicted with protection layer).

① **Structural Roof Deck -** Must be designed to support the weight of the vegetated roof as well as any other dead and live loads. Acceptable deck types include cast-in-place concrete, precast concrete, metal deck with cover board and plywood.




**Extensive Assembly Depicted**

# Water Management in the Garden Roof® Assembly

## Gardendrain®

### Water Retention/Drainage/Aeration

At the heart of the Hydrotech Garden Roof® Assembly is the water drainage/retention/aeration component: **Gardendrain®**. With its array of cups and channels on the top and bottom sides, Gardendrain® is designed to ensure more than adequate water drainage even with roots growing into the cups. The profiled cups on the topside of the Gardendrain® panel retain water even on sloping roofs.

Strategically placed holes on top ensure the roots receive the necessary aeration and allow water vapor to diffuse up into the growing media when excess moisture is below the cups. This aeration helps the assembly "breathe" by allowing water vapor and air to pass throughout the assembly.

The availability of moisture for the roots is essential to maintain good, healthy plant growth on a vegetated roof. Much of the moisture is supplied by natural rainfall which is collected and stored by the layers within the Garden Roof® Assembly.

This Gardendrain® layer plays an essential part of storing rainwater that filters through the growing media. Once the cups in the Gardendrain are full, excess water can be soaked up and held by an optional moisture mat (not depicted). Water that is not held in the cups or within the moisture mat is free to drain off the roof.

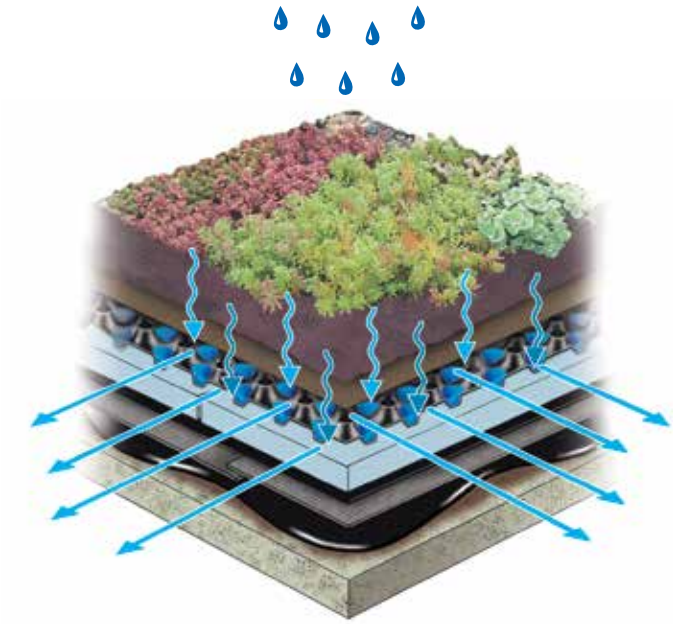
### Releasing Stored Water

In dry periods, stored water will gradually diffuse up into the growing media for use by the plants' roots. Plants are also capable of dropping roots into the cups of the Gardendrain® drainage/retention/aeration layer to obtain much needed water. Additionally, the optional moisture mat can release its stored moisture by diffusion up through the holes in the top of the drainage layer and into the growing media.

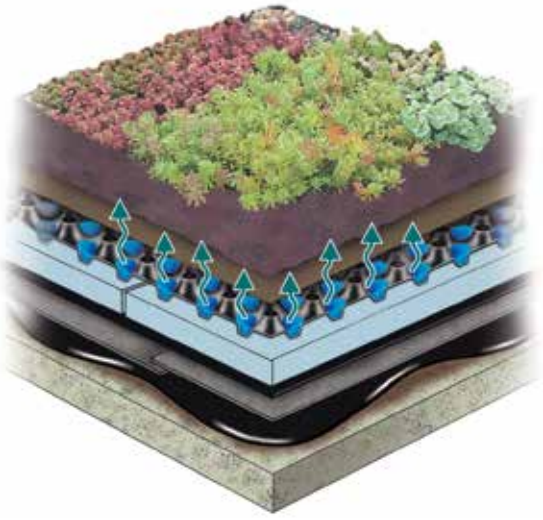
**Gardendrain® GR15**

**Gardendrain® GR30**

**Gardendrain® GR50**



**Water Storage & Excess Water Drainage**



**Releasing Stored Water**

# Hydrotech's Assemblies

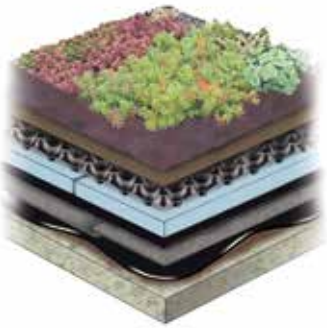
To address the numerous possible conditions and configurations that can be created on roof tops, Hydrotech has a wide range of **Garden Roof® Assemblies** to choose from. These assemblies range from thin, extensive vegetated roofs that support drought-tolerant plants to deep intensive assemblies featuring large trees and familiar landscape elements. The lawn assembly can be used to create spaces on roof tops for concert venues and athletic facilities. Sloped assemblies can be used to create unique aesthetic building treatments. Hydrotech's Urban Agriculture assembly brings food production to the rooftop.

As a companion to the Garden Roof® Assembly, The **Ultimate Assembly®** provides elements to create dynamic hardscape spaces. The wide range of elements in the Ultimate Assembly® include architectural pavers and wood tiles to create beautiful and long lasting pedestrian surfaces.

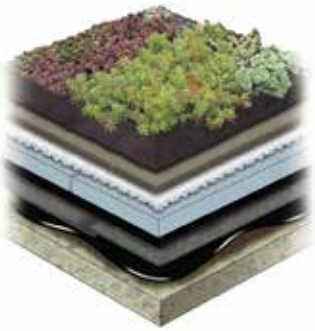
The typical Protected Membrane Roof can be combined with any Garden Roof Assembly for its simple visual appeal. RockCurb, a precast concrete curbing, can be used to create defined edging for containing plant materials used in the Garden Roof® Assemblies. When combined, the Garden Roof® Assembly and the Ultimate Assembly® can give the designer a nearly unlimited palette of elements to chose from when designing plazas, terraces and roof tops.

Stormwater management can be easily handled on roofs using one of Hydrotech's **Blue Roof Assemblies.**

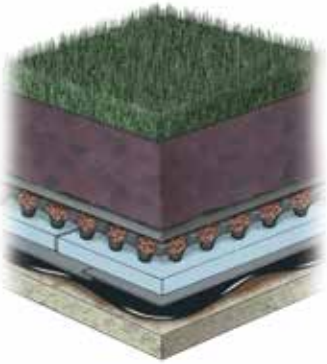
**Contact Hydrotech for additional information on the Ultimate and Blue Roof Assemblies.**



**Extensive**

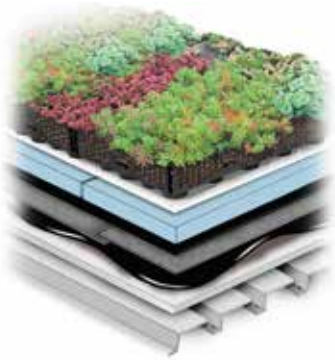


**Extensive with Rock Mineral Wool**

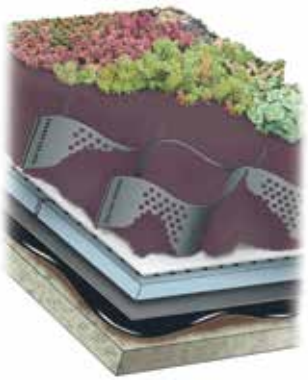


**Lawn**

**Intensive**

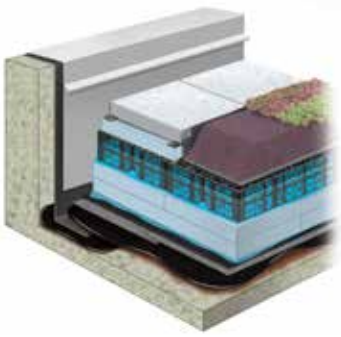


**InstaGreen® GT-4 Tray**

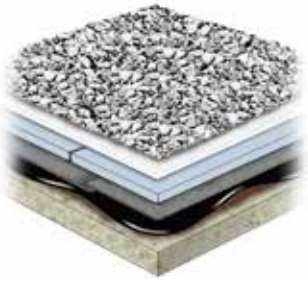


**Sloped**

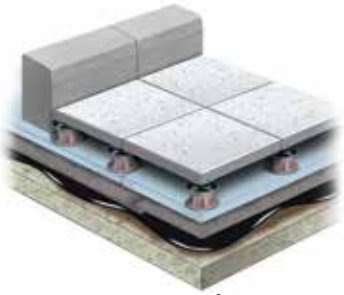
**Urban Agriculture**



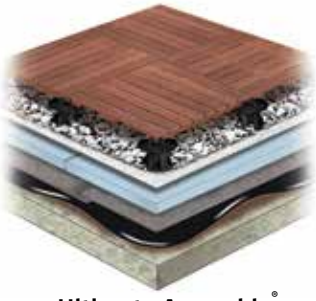
**Blue Roof**



**Stone Ballasted Protected Membrane Roof**



**Ultimate Assembly® Architectural Pavers and RockCurb**

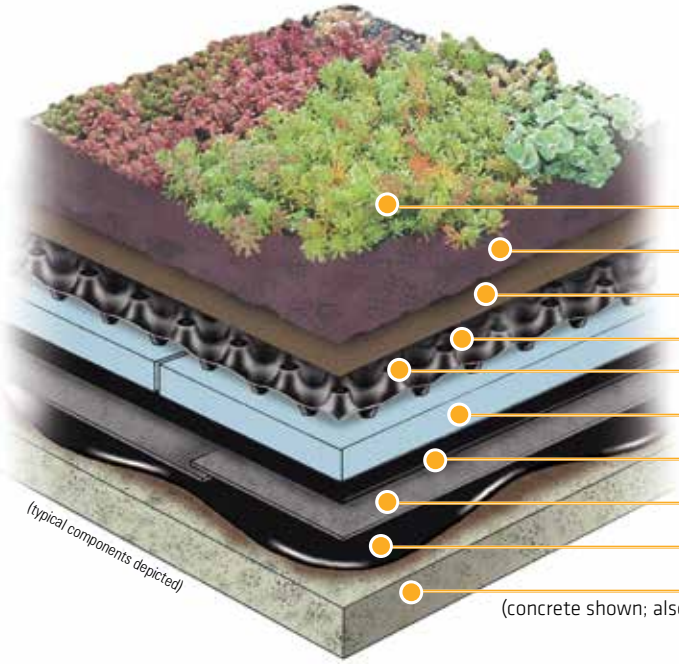


**Ultimate Assembly® Wood Tile**

All of the Hydrotech Garden Roof, Ultimate and Blue Roof Assemblies are an integral part of the Hydrotech Protected Membrane Roof family. Each assembly is intended to address the specific design need and intention for the roof top.

**For more information see Hydrotech's Protected Membrane Roof (PMR) Assembly Planning Guide.**

# Extensive Garden Roof® Assembly




**Vegetation Options:**

- **Cuttings**
- **Plugs**
- **InstaGreen® Carpet**
- **InstaGreen® Tile**

An Extensive Garden Roof® Assembly uses a select range of hardy plants, making it attractive to look at while requiring little maintenance. While extensive Garden Roof® assemblies are not intended for recreational use they are very valuable as stormwater management BMPs to help minimize water run-off and to reduce the urban heat island effect.

Typically, Extensive roofs have a growing media depth of 3" to 6" (depending on the region and plant palette) and therefore add little weight to the roof structure below when compared to a standard ballasted PMR roof. Warmer and drier climates require increased media depths.

Plant types for Extensive Roofs should be drought, frost, and wind resistant such as sedums and other compatible perennials. See pages 50 - 57 for more information on Hydrotech's Extensive Plant Program.

The water retained in the growing media and Gardendrain® drainage/retention/aeration layer is typically sufficient to sustain the drought resistant plants between periods of normal rainfall. While access to sufficient water is required on all roofs (especially during installation and establishment), many owners are opting for full irrigation systems to help ensure their investment in their Garden Roof® is protected from extended drought periods.

Standard Extensive Assemblies can be installed on flat roofs up to a pitch of 2:12 (10°). Sloped roofs with a pitch of up to 12:12 (45°) are possible, provided the appropriate measures are taken to retain the growing media. Please see page 16 for additional information regarding sloped applications.

## Features:

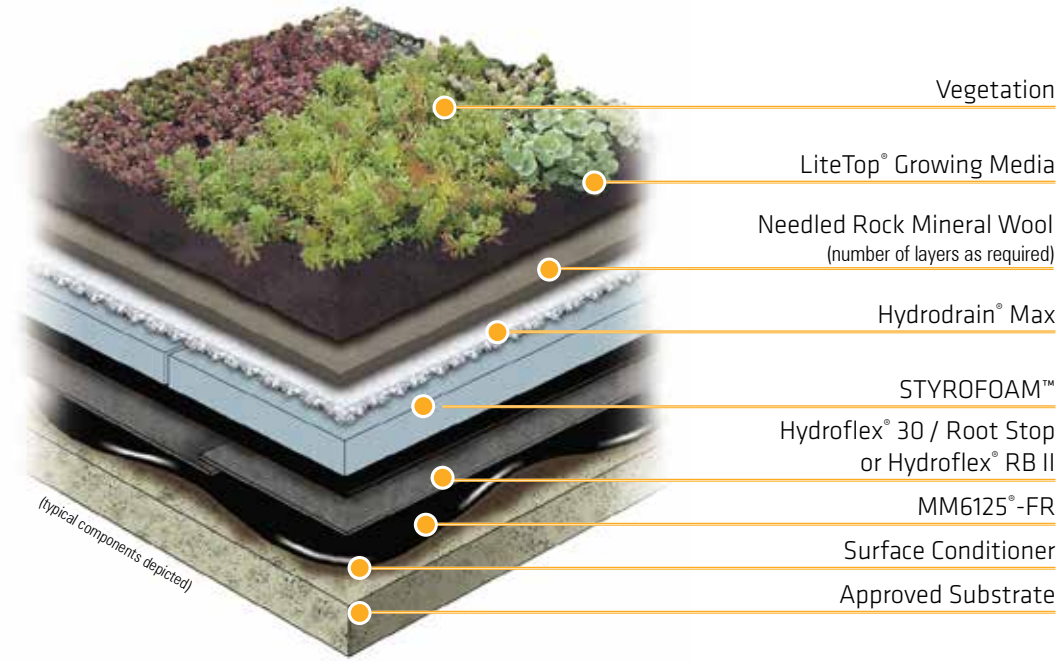
- Typical depth: 3" to 6" of LiteTop® growing media
- Depths and related weights are regionally dependent (in warmer climates, greater growing media depth is required)
- Reduce and delay stormwater runoff volumes and rates
- Can be used on flat or sloped roofs with max. 2:12 slope
- Permanent irrigation is highly recommended (sufficient water is required for establishment and maintenance)
- Requires minimal maintenance once established
- Tested to 110 mph (with Disk Anchors) in accordance with CSA A123.24-15, with no noticeable effect.

Thinner assemblies and very lightweight growing media blends are available for customized extensive Garden Roof® Assemblies. **Contact Hydrotech for further information.**

550 W. Adams - Chicago, IL

Fountaindale Library - Bolingbrook, IL

# Garden Roof® Rock Mineral Wool Assembly




**Vegetation Options:**
- **InstaGreen® Carpet**
- **InstaGreen® Tile**

To provide enhanced stormwater capabilities and lower assembly weights, Hydrotech offers its Garden Roof® Rock Mineral Wool Assembly. Originally created for its insulative qualities, rock wool has long been used in the horticulture industry for propagation and growing plants due to its ability to store moisture. This ability to store a great volume of water increases the stormwater capacity of a Garden Roof® while keeping the overall assembly height thinner and the assembly weight to a minimum.

Rock wool comes in several types however Hydrotech only works with needled rock mineral wool. Needled rock mineral wool does not have the added binders of other rock wool products which can degrade and decrease effectiveness in a short time.

Rock mineral wool can be installed in multiple layers if needed to achieve higher stormwater capacities. Designers should work with Hydrotech staff to determine the proper number of rock mineral wool layers.

Rock mineral wool can also be used to address horticulture issues in drier climates. Its substantial water holding capacity can provide more moisture for plant use.

Hydrotech's Hydrodrain® Max is required in this assembly to provide a proper drainage and air layer over the STYROFOAM™ insulation or the finished membrane when insulation is not used. Hydrodrain® Max creates an effective drainage pathway for water to flow to the drains.

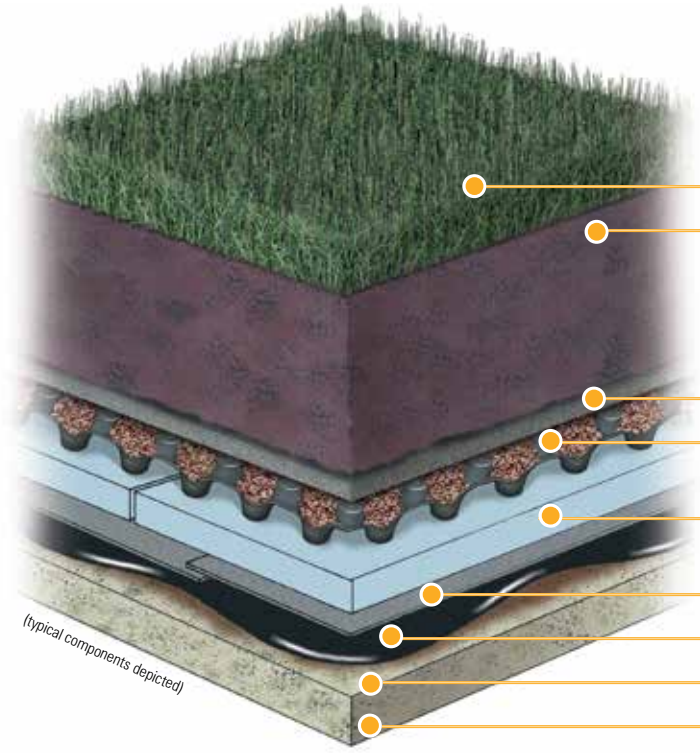
## Features:

- Requires minimum of 3" of LiteTop® growing media for proper STYROFOAM™ ballasting
- Depths and related weights are regionally dependent
- Permanent irrigation is highly recommended (sufficient water is required for establishment and maintenance)
- Requires maintenance similar to an Extensive Garden Roof Assembly

Needled Rock Mineral Wool

Hydrodrain® Max

# Lawn Garden Roof® Assembly




**Vegetation Options:**
- **Lawn sod or seed** (by others)

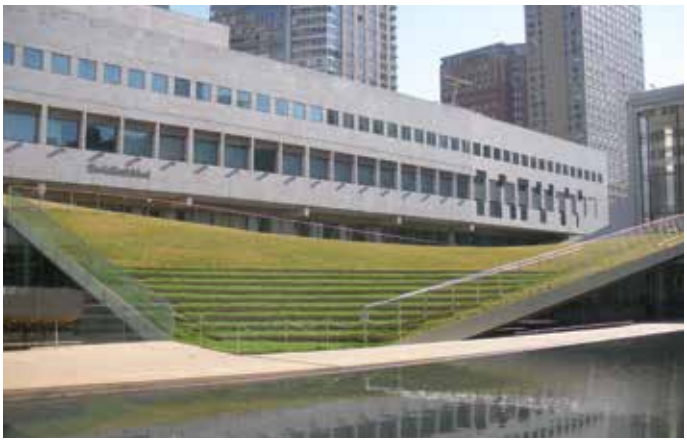
Lawns have unique needs due to the foot traffic they experience. Designers have the ability to create large lawn areas on rooftops using a lawn Garden Roof® Assembly. This assembly incorporates a LiteTop® growing media that provides a firm structure for pedestrian areas while providing proper aeration for good turf grass root growth.

Lawns require more water for proper establishment and long term growth and Hydrotech strongly recommends that a permanent irrigation system be included in this assembly. Typically, pop-up irrigation systems (identical to at-grade systems) are incorporated into this assembly.

By combining a lawn assembly with GardNet®, designers can create dramatic lawn spaces on complex sloped roof shapes.

## Features:

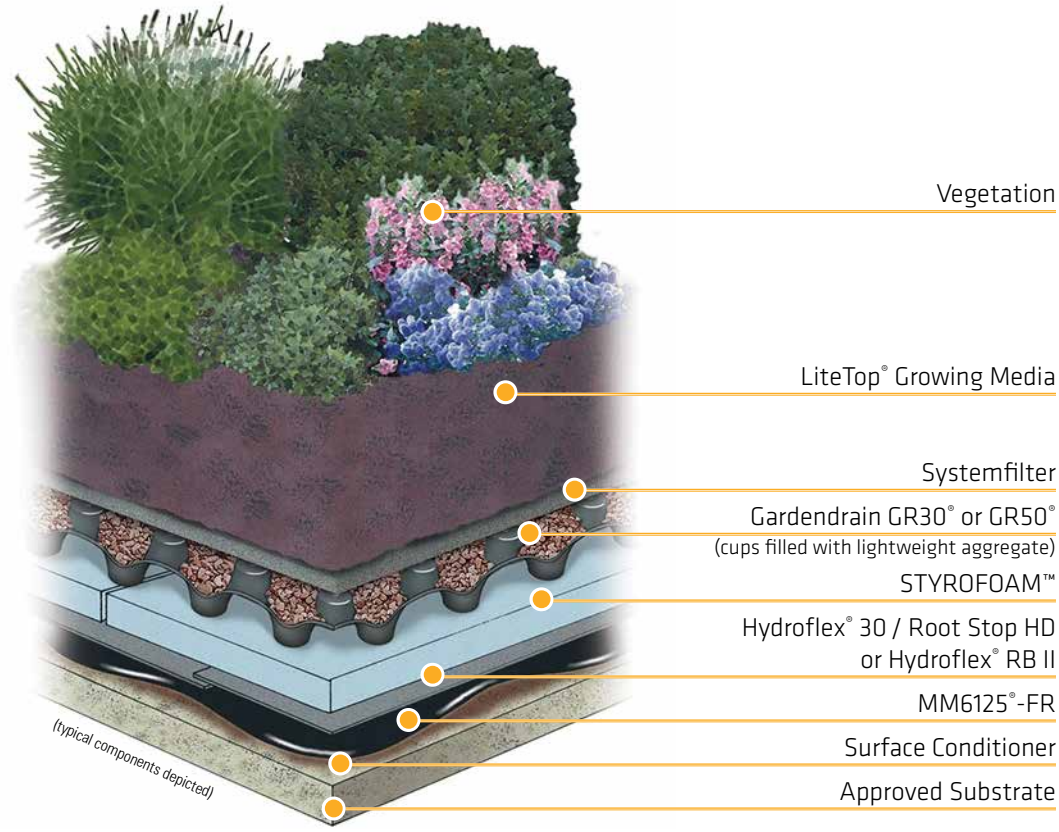
- Typical depth: 8" to 12" or more of LiteTop® Lawn growing media
- Depths, related weights and type of grass used are regionally dependent (in warmer climates, greater growing media depth is required)
- Ideal for increasing usable space
- Can be used on flat or sloping roofs
- Hardscape options can be integrated into assembly
- Irrigation is strongly recommended
- Requires maintenance similar to at-grade lawn areas



Hypar Pavilion at Lincoln Center - New York, NY

Residences at Quorum Center - Raleigh, NC

# Intensive Garden Roof® Assembly




**Vegetation Options:**

- **Sedums**
- **Perennials**
- **Groundcovers**

- **Intensive vegetation; Shrubs, Ornamental Trees, Shade Trees, etc.** (by others)

The landscape possibilities with an Intensive Garden Roof® are virtually limitless. They are intended for recreational, sporting and leisure purposes and are often indistinguishable from at-grade landscapes.

An Intensive Assembly follows the same design concept as an Extensive Assembly; however, the Gardendrain® component has a taller profile and is filled with expanded aggregate to provide greater water storage and to support a greater depth of media.

Intensive landscapes often contain a wide variety of plant types with differing LiteTop® media depth requirements. Trees will require deeper media than shrubs or perennials. To help minimize weight, DuPont STYROFOAM™ is used in areas of the Intensive Garden Roof® assembly to reduce the depth of the growing media where it is not needed. Wells can be created in the insulation to accommodate tree rootballs. See page 60 and 61 for additional information.

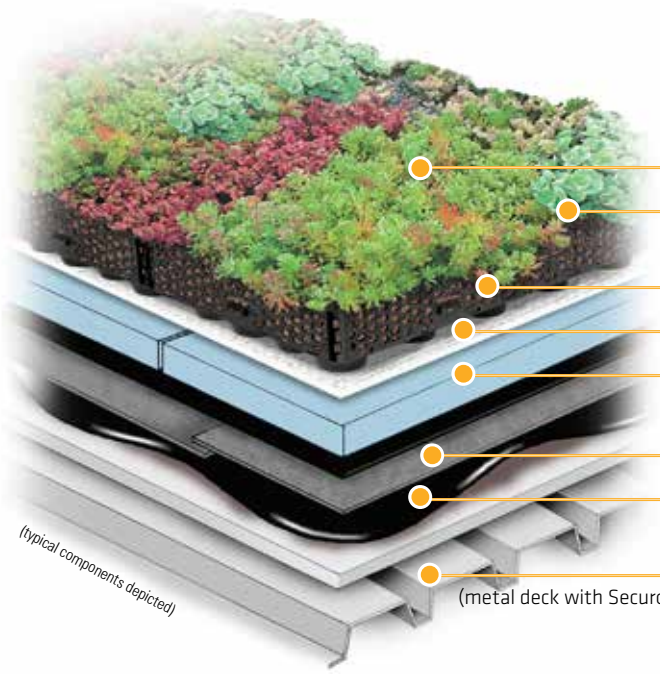
## Features:

- Requires greater LiteTop® growing media depths: 6" to 36" or more of growing media
- Depths and related weights are regionally dependent
- Accommodates a wider variety of plants/shrubs/trees
- Hardscape options, site amenities and water features are possible
- Irrigation is strongly recommended
- Requires regular maintenance
- Requires Root Stop HD or Hydroflex® RB II to resist woody plant root intrusion
- Requires Root Stop Bamboo for clumping bamboo installations

1101 Dexter - Seattle, WA

801 Vine Street - Louisville, KY

# InstaGreen® GT-4 Tray Assembly




Vegetation Options:

- Sedums and other succulents
- Grasses
- Perennials (herbaceous)
- Groundcovers

Should a designer choose a modular system, Hydrotech is pleased to offer the InstaGreen® GT-4 Tray Assembly.

Designed to mimic Hydrotech's built-up Garden Roof Assemblies, the InstaGreen® GT-4 provides a modular system with a high performance water storage reservoir built into the bottom of the tray.

Sidewall Clip - Six per tray

Sidewall Slot - Six per tray

Made from 100% recycled polyethylene, the sidewalls are perforated to allow for tray-to-tray root movement and sharing of moisture and nutrients. Built-in clips and receiving slots provide positive connections at six points along the perimeter of the tray to resist wind uplift.

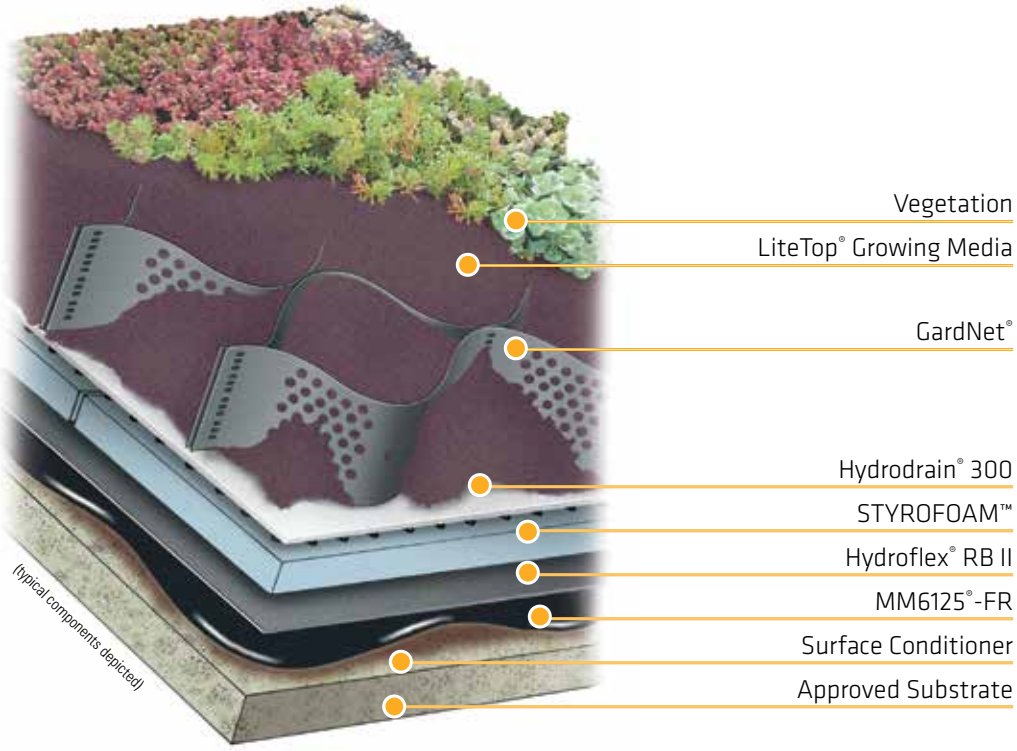
Depending on the project, InstaGreen® GT-4 Tray can be shipped in various planting configurations.

**Contact Hydrotech for further details.**

## Features:

- 12"W x 24"L x 5.75"D (2.0 SF/tray)
- 4" media depth
- 1.75" tall tray bottom creates substantial water reservoir capacity
- Tested to 110 mph (with Disk Anchors) in accordance with CSA A123.24-15, with no noticeable effect.
- Made from 100% recycled polyethylene
- Can be used on roof slopes up to 2:12
- Permanent irrigation is highly recommended (sufficient water is required for establishment and maintenance)
- Requires maintenance similar to an Extensive Garden Roof Assembly

# Sloped Garden Roof® Assembly



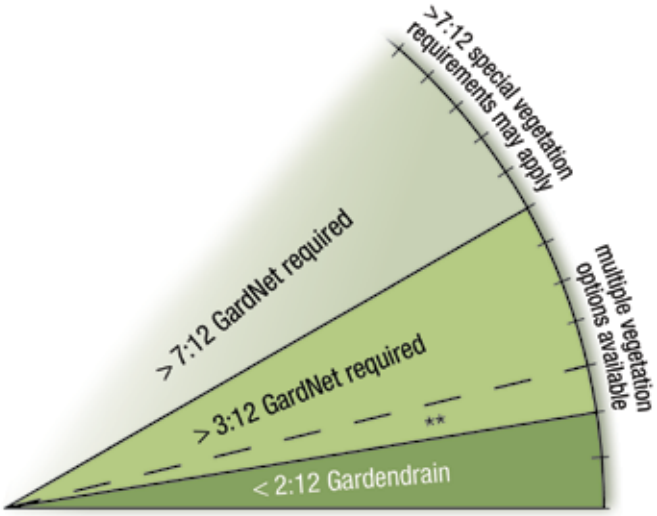

**Vegetation Options:**

- **Plugs with GardMat®**
- **InstaGreen® Carpet**
- **InstaGreen® Tile**
- **Lawn sod** (by others)
- **Select intensive plants** (by others)

GardNet® is a growing media confinement component within the Garden Roof® Assembly that is manufactured from high density polyethylene. It is used primarily for steep slope applications ranging from 3:12 to 12:12 (45 degrees). Available in depths of 3, 4, 6, 8 and 12 inches, it can be used in extensive and limited intensive applications. Its ability to conform to irregular slopes makes it ideal for complex and undulating roofs. Erosion control is required (i.e. plugs with GardMat®, InstaGreen® Carpet, InstaGreen® Tile or lawn sod).

## Features:

- Depth: 4" to 13" of LiteTop® growing media; stackable for greater depth
- Weight dependent upon local and regional media blends
- Easily conforms to complex roof slope shapes involving convex, concave and compound surfaces.
- Permanent irrigation is highly recommended (sufficient water is required for establishment and maintenance)
- Requires maintenance depending on vegetation selection
- **Project specific engineering is required. Please contact Hydrotech early in the design phase.**



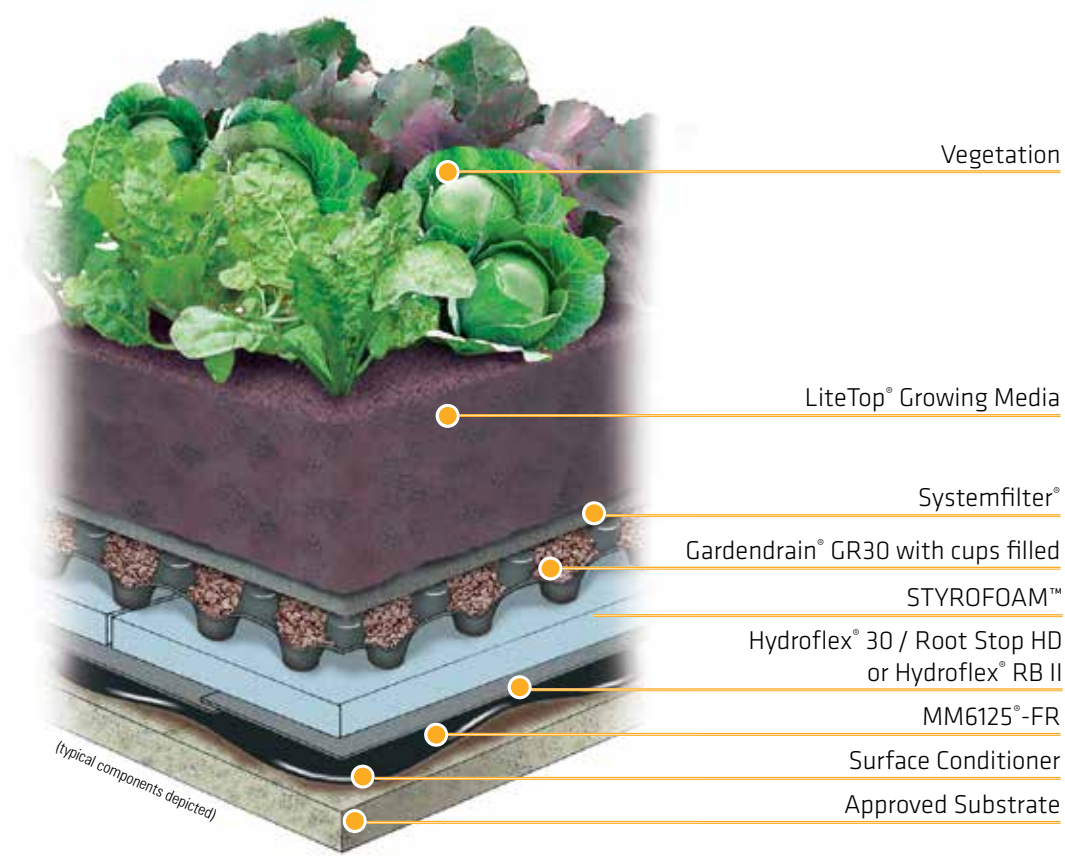

**Gardendrain may be acceptable, contact Hydrotech for specifics.

**Roof Slope**

Georgian Court University - Lakewood, NJ

h2hotel - Healdsburg, CA

# Urban Agriculture Garden Roof® Assembly




**Vegetation Options**
(by others):

- **Vegetables**
- **Herbs**
- **Flowers**
- **Fruit crops**

(with additional considerations)

Bringing food production to the rooftop is becoming an increasingly important activity in urban environments. A wide variety of vegetables, herbs and flowers have been brought to the roofs of buildings such as community centers and supermarkets.

The anticipated vegetable crops will determine the depth of LiteTop® growing media needed. Irrigation is typically installed to provide the amount of water required for vegetable production. Often planting rows are mounded up above aisles to create deeper planting areas while minimizing weight.

Bee keeping can also be incorporated on Urban Agriculture Garden Roofs to bring these ever important pollinators closer to the target flowers in vegetable and flower crops.

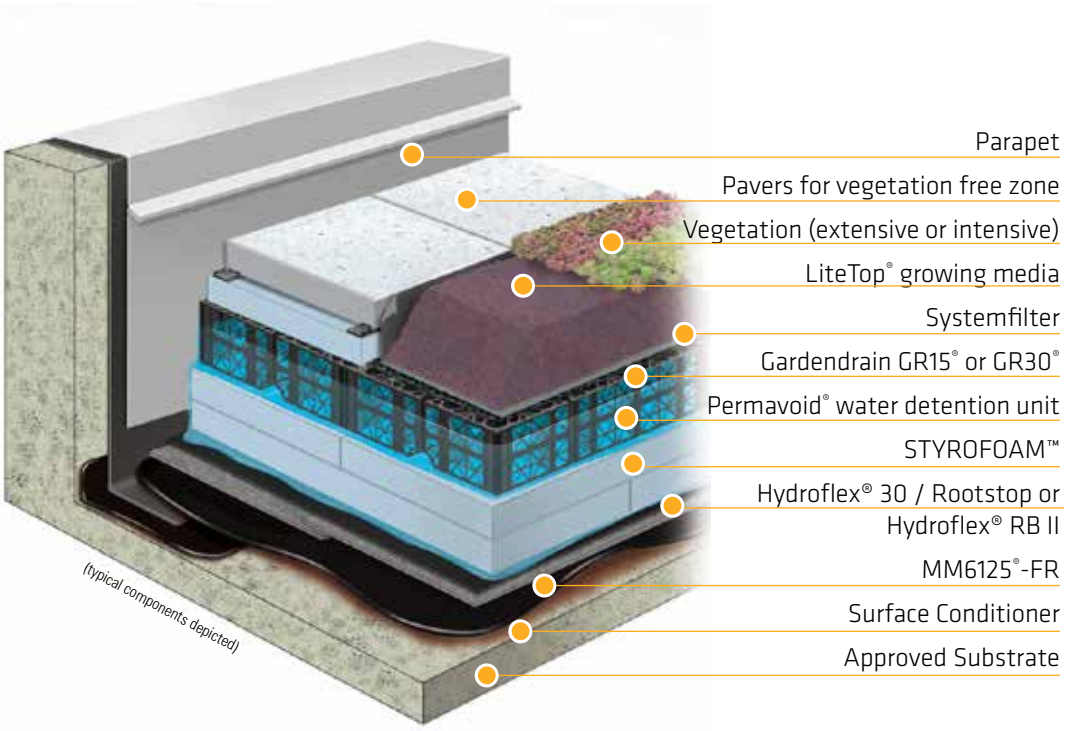
## Features:

- Requires 8" or more of LiteTop® growing media depending on intended vegetable crops
- Depths and related weights are regionally dependent
- Accommodates a wide variety of vegetable crops
- Must be irrigated
- Requires maintenance common to at-grade gardens
- Requires Root Stop HD or Hydroflex® RB II to resist woody plant root intrusion

Gary Comer Youth Center - Chicago, IL

1015 Half Street - Washington, DC

# Garden Roof® Blue Roof Assembly




**Vegetation Options:**

- **Plugs with GardMat®**
- **InstaGreen® Carpet**
- **InstaGreen® Tile**
- **Lawn sod** (by others)
- **Select intensive plants (by others)**

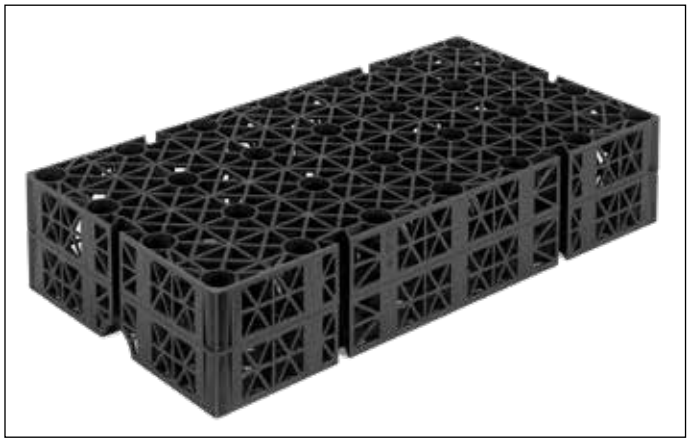
Blue Roofs are specially designed stormwater management features built on rooftops. Ideally constructed on flat, zero-slope roof decks to maximize volume efficiency, blue roofs are intended to temporarily store rain water for 24-48 hours (depending on the municipality) while releasing it at a controlled rate. This helps to prevent large, uncontrolled volumes of water from entering the storm sewers at one time; overwhelming them and resulting in flooding.

Hydrotech has developed a series of Blue Roof assemblies including the Garden Roof® Blue Roof which combines the features of a Hydrotech Garden Roof with the high capacity of ABT's Permavoid® water detention unit*. Permavoid® provides a void space that is 95% open and structurally stable to support pavers and Garden Roof components and assemblies.

## Features:

- Best water detention volumes achieved with flat, zero-slope roof deck
- Permavoid® sizes available:
  14" x 28" x 5.91" (355 mm x 710 mm x 150 mm) nominal
  28" x 28" x 3.35" (710 mm x 710 mm x 85 mm) nominal
- Provides 95% open space
- High strength lightweight polymer units provide structural foundation for Garden Roof® and Ultimate Assembly® components
- Interlocking units create stability
- **Project specific information is required. Contact Hydrotech early in the design phase.**

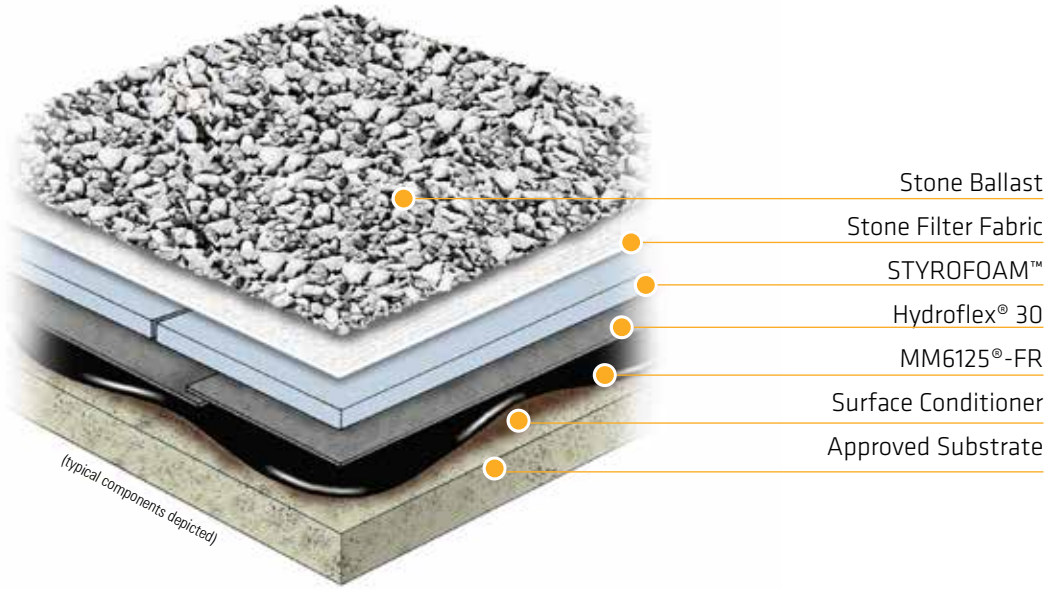
* Permavoid® is manufactured by ABT Plastics, Inc. and marketed exclusively by American Hydrotech, Inc. for use in rooftop and podium deck applications



Permavoid® 150 (150 mm tall unit)

Permavoid® 85S (85 mm tall unit)

# Stone Ballasted Protected Membrane Roof




The original and still very practical protected membrane roof (PMR) assembly utilizes crushed or washed stone as the ballasting material over the STYROFOAM™ insulation. Stone provides the weight to keep the insulation materials in place over the membrane.

Stone used for ballasting is graded in accordance with ASTM D448 and is typically referred to as follows:

- #5 stone; nominally 1.0" size aggregates
- #4 stone; nominally 1.5" size aggregates
- #2 stone; nominally 2.5" size aggregates

The depth of stone is determined by the weight of stone needed for the particular portion of the roof in which it is being applied. In general terms, these weights can range from 10 pounds to 20 pounds of stone per square foot depending on the area of the roof. Areas that are subjected to higher wind pressures will, in turn, require potentially larger and heavier stone weights to counter the pressure.

Stone acts as the ballast and protection in a PMR roof by keeping the insulation in place. In addition, it shields the roof from the effects of weather, including the damaging effects of rain and ultraviolet light. The mass of the stone absorbs the energy of the sun and rain and prevents damage to underlying layers in the roof.

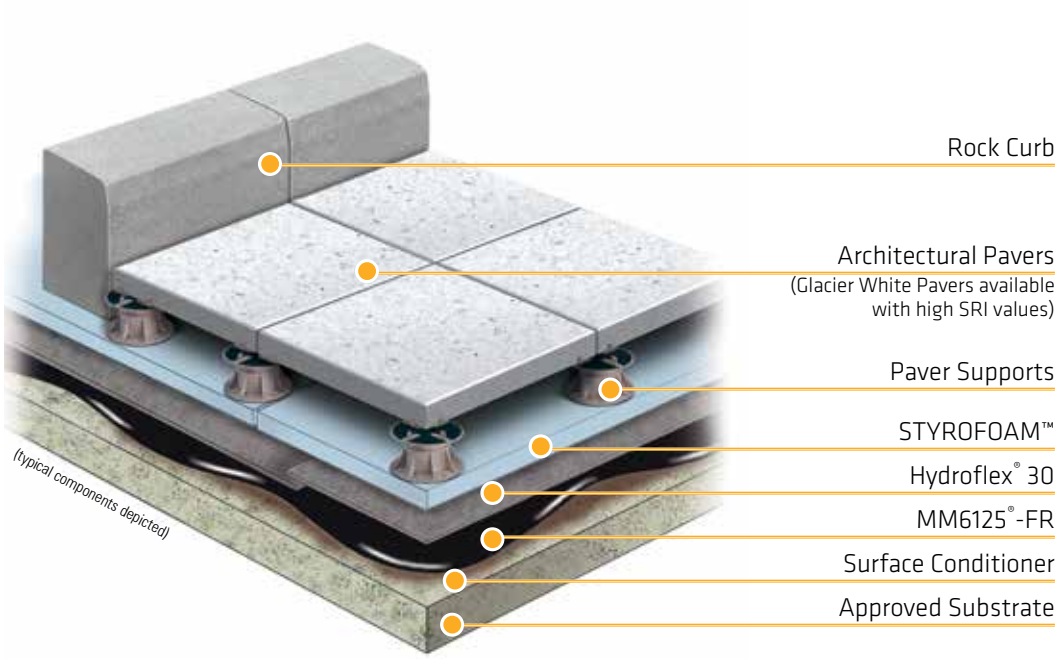
Stone ballast is inexpensive and easy to install; it conforms to any space it is placed. In many areas, it is used as a vegetation free zone adjacent to a Garden Roof.

Stone ballast is just one of the family of non-vegetated Hydrotech PMR assemblies. **For further information, see Hydrotech's "Protected Membrane Roof (PMR) Planning Guide".**

1225 Connecticut Avenue - Washington, DC

PacBell - San Ramon, CA

# Ultimate Assembly® - Architectural Pavers




**Standard Paver Colors**

**Custom Colors Also Available**

Creating usable space on a Garden Roof® through the addition of hardscape is easy to accomplish with Hydrotech's Ultimate Assembly®.

Architectural pavers resting on pedestals or tabs can convert sloped decks to dead level usable roof areas. This open joint assembly accommodates drainage by allowing water to flow beneath the pavers unobstructed to the drains.

Architectural pavers are available in a number of standard sizes, colors and finishes. The Glacier White paver is the perfect choice in rooftop applications where a LEED™ compliant high SRI value may be desired. Custom colors and finishes to meet your specific needs are also available.

Rock Curbs in complementary colors and finish are often combined with architectural pavers to define the transition between the vegetation and hardscape on a roof.

## Features:

- Can be installed dead level over sloped decks
- Multiple paver sizes available including oversized pavers
- Standard paver colors and finishes
- Custom colors and finishes are available upon request
- Hanover Glacier White is a high reflectance (SRI) paver
- Granite pavers are also available
- Paver systems available for high-wind situations
- Typical weight of a 2' x 2' x 2" paver is 23 lbs./SF

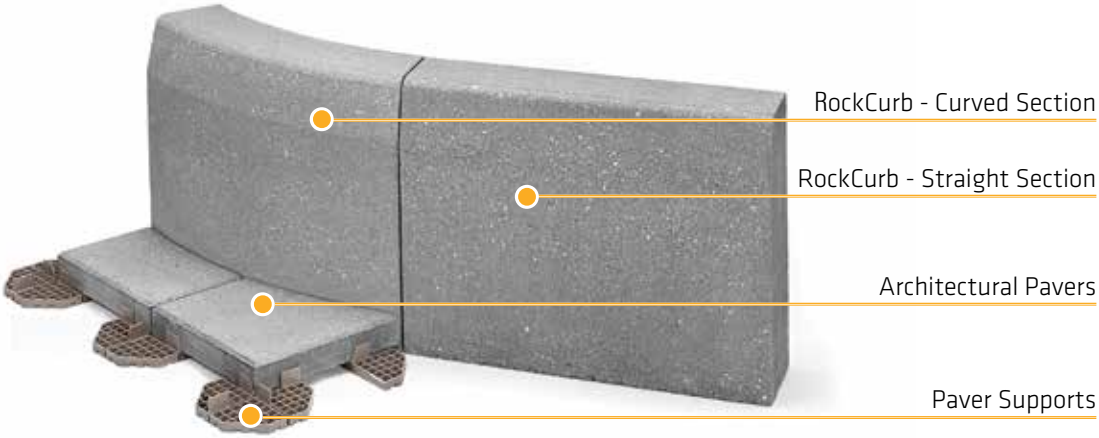
**For more information, please contact Hydrotech for a copy of the Ultimate Assembly® brochure.**

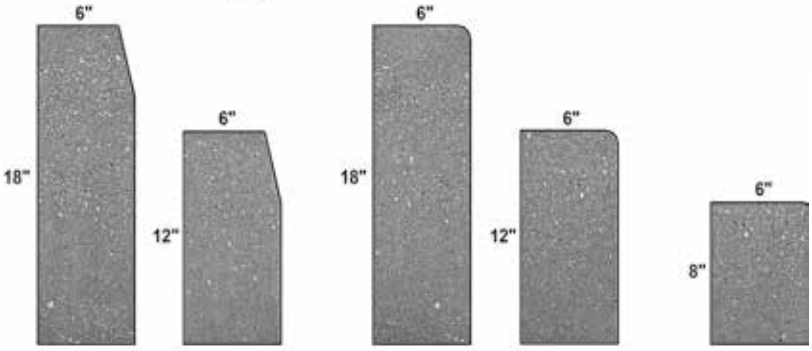
* Hanover Architectural Pavers, marketed by American Hydrotech, Inc. for The Ultimate Assembly®

555 W. Monroe - Chicago, IL

4th Ward Lofts - Madison, WI

# Ultimate Assembly® - RockCurbs




**Battered** **Bullnose** **Rounded**

**Standard RockCurb Colors**

**Custom Colors Also Available**

RockCurb precast concrete curbing units can be used to create landscape areas with intensive or extensive assemblies. RockCurb is hydraulically pressed concrete with a minimum strength of 8,500 psf. It comes in eight colors that complement the architectural pavers in the Ultimate Assembly®.

RockCurbs are available in a variety of configurations. Each piece is 6" thick and comes in 8", 12" and 18" heights and 12", 24", and 36" lengths. Radius pieces are also available.

## Features:

- 6" thick
- 8", 12" and 18" heights
- 12", 24" and 36" lengths
- 15° battered, bullnose and rounded profiles available
- Limited radius shapes available
- Standard and custom colors available
- Glacier White RockCurbs available with high SRI values.

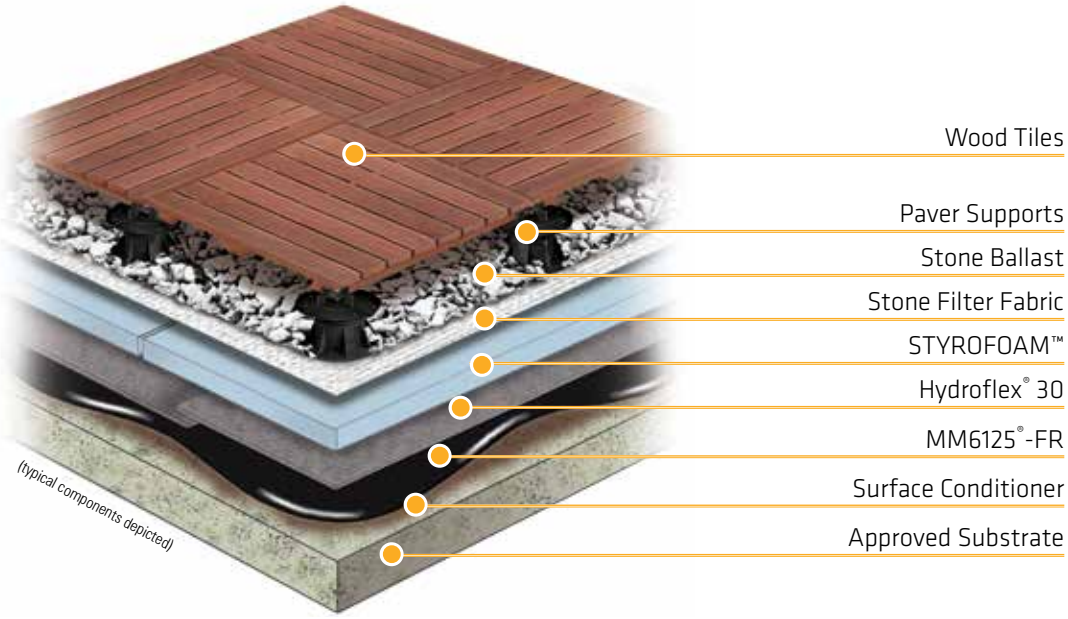
**For more information, please contact Hydrotech for a copy of the Ultimate Assembly® brochure.**

* Hanover RockCurbs, marketed by American Hydrotech, Inc. for The Ultimate Assembly®

Baptist East Hospital - Louisville, KY

Resurrection Medical Center - Chicago, IL

# Ultimate Assembly® - Wood Tiles




Wood Tiles - made from an array of hardwood species - are a great alternative to concrete architectural pavers in an Ultimate Assembly®, providing warmth and charm to any roof deck. These wood tiles are fabricated from very dense, durable hardwoods that exhibit excellent resistance to weather. The wood tiles can be periodically treated with oil to preserve and enhance their original color or left untreated to develop a natural, aged finish. Available with a smooth surface or with a ribbed scuff resistant surface, the tiles are assembled with stainless steel screws.

Made from repurposed wood from the furniture and other industries, wood tiles may be able to satisfy certain recycled content requirements.

This assembly requires supplemental stone ballast (as depicted above) under the wood tiles to provide proper ballasting for the loose laid STYROFOAM™ insulation. The wood tiles are installed on Hydrotech Adjustable Pedestals that include a fastening kit to help lock them down for added security.

**For more information please contact Hydrotech for a copy of our Wood Tile brochure..**

## Features:

- Available in a variety of wood species
- No sealing or staining required if weathered patina is desired
- Can be installed dead level over sloped decks
- 24" x 24" and 24" x 48" sizes available
- Weight: 5.63 - 6.13 lbs/SF (depending on species)
- Surface texture can be smooth or ribbed (depending on species)
- Modular planter cubes are also available


**Smooth**


**Ribbed**

**Wood Species**


**Ipê**


**Massaranduba**


**Mahogany**


**Cumaru**


**Garapa**

* Bison Wood Tiles, marketed by American Hydrotech, Inc. for The Ultimate Assembly®

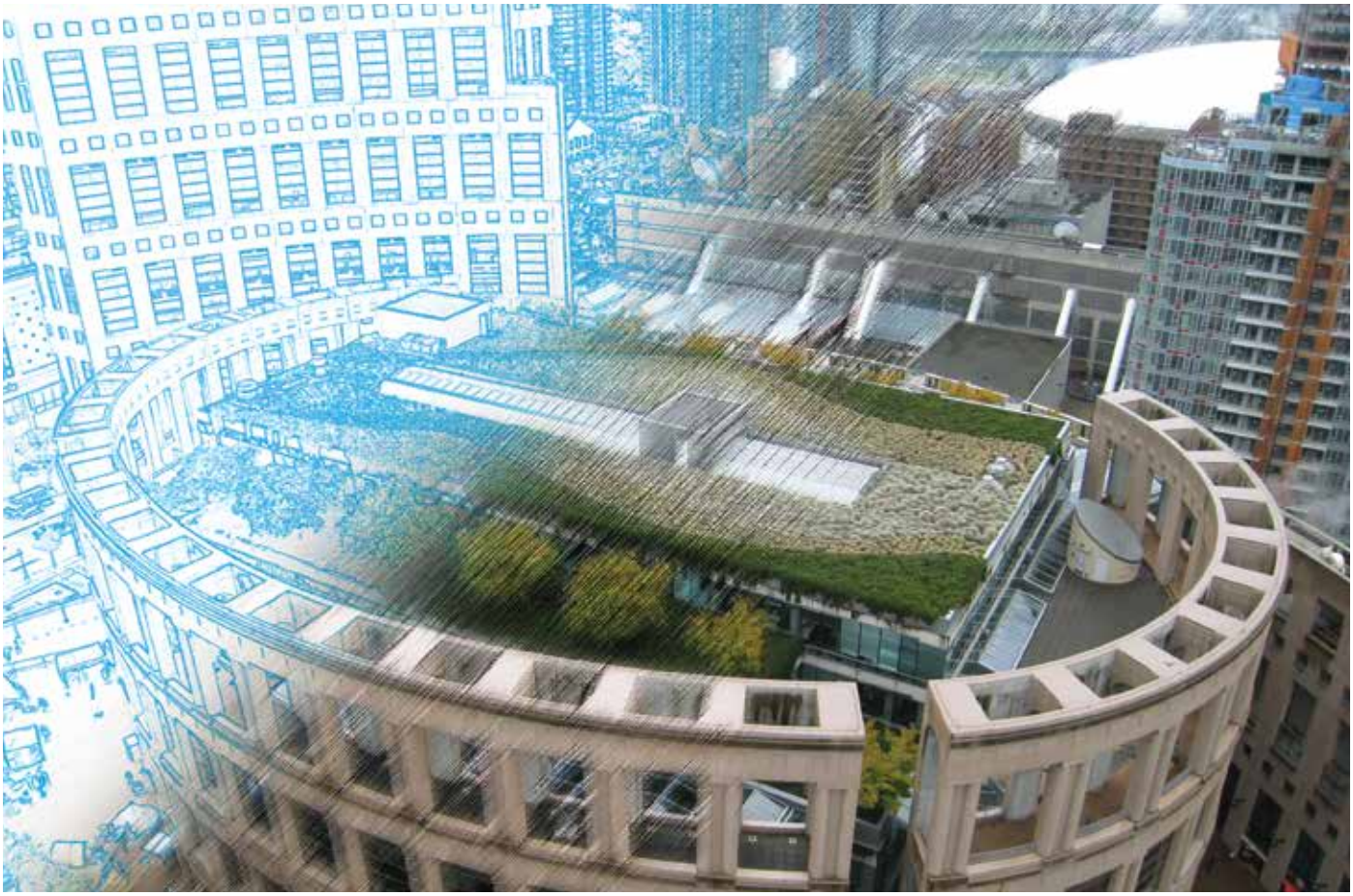

Rich Tree Open Kitchens - Skokie, IL


Elgin Country Club - Elgin, IL

# DESIGN CONSIDERATIONS

*Church Street Station - Evanston, IL*

# Design Considerations - From Concept to Completion



Vancouver Public Library - Vancouver, BC

Designers have a wide variety of choices when considering vegetated roofs. The process of design requires understanding a wide range of factors and conditions that could ultimately affect the success of the new vegetated roof project.

## Choice of Assemblies

Vegetated roofs have become more and more mainstream and designers have a number of Hydrotech assemblies from which to choose.

The decision on which assembly is appropriate for a given project is a collaborative effort between members of the design team – owner, architect, landscape architect and engineer. This team should consider some important points while making the decision on which assembly to use.

- **Managing Expectations –** Are there clear directives about the owner's expectations for this vegetated roof? Fully vegetated at installation time? At two years from installation? High/Low diversity? Does the owner understand plant dormancy and color changes throughout the seasons?
- **Physical Accessibility –** Will the roof be physically accessible? For just maintenance traffic or for more active uses?
- **Visual Accessibility –** Will the roof be visually accessible or hidden from public view?
- **Hardscape/Softscape –** Will the greenscape portions of the roof be combined with hardscape elements for more active uses?
- **Stormwater Management –** Will the roof become part of the BMP package for the stormwater management plan?
- **Anticipated Maintenance –** Is the building owner or manager aware of the anticipated maintenance requirements of this roof?

With these and other questions answered, the design team can select a particular assembly to satisfy the project requirements.

## Warranties

Many owners demand single-source warranties knowing that should a problem occur they only need to contact one company for resolution.

**Full system warranties - including removal and reinstallation of all of the components of the assembly from the waterproofing membrane on up through the vegetation -** can give owners peace of mind against any future issues. This is a feature that not all roofing manufacturers can offer.

Hydrotech offers a wide array of warranty options for all of its assemblies. **Contact Hydrotech for information regarding warranty coverage, length of coverage and other details.**

# Structural Requirements and Slope

One of the first considerations that must be taken into account when designing a vegetated roof is the structural capacity of the roof deck and building structure. In new construction, accounting structurally for the load of a vegetated roof is easily accomplished. In retrofit projects, the existing structural capacity must be analyzed to determine if a vegetated roof is feasible.

The load that will be imposed by the Garden Roof® Assembly when fully saturated with water must be taken into consideration when calculating the structural load. For intensive roofs, the load imposed may be quite substantial. Where the roof load bearing capacity may be limited, it is sometimes possible to place heavier plants, mounded growing media, or use other heavy features at points on the roof over structural beams or columns. Growing media constitutes the single heaviest component in any vegetated roof. The weight of that media can vary widely depending on the make-up of raw materials used in the media throughout the country. An architect or engineer should always be consulted.

Hydrotech can provide weight information for its various Garden Roof® Assemblies that is specific to the project's geographic location. This information includes specific data related to the media blends used in that project's locale as well as other components in the final Garden Roof® Assembly. **Contact Hydrotech to have your project analyzed with the Weight and Profile Estimator for Hydrotech Assemblies.**

## Roof Slope

A unique characteristic of Monolithic Membrane 6125® is its ability to perform on dead level decks without the need for built-in slope to the roof drains. This can save money by greatly simplifying construction.

Consideration should also be given to avoid conditions that allow ponding of water that may reach above the drainage layer, which would be harmful to the plants. This is especially important with extensive vegetated roofs that have shallow drainage layers and thin growing media depths. Some ponding, however, can be expected to occur on even the most conscientiously constructed roof decks.

## Complex or Steep Roof Slopes

Hydrotech's Garden Roof® standard designs can be used on roof decks ranging from dead-level up to a 2:12 pitch. For slopes between 2:12 and 3:12 pitch, contact Hydrotech for potential Garden Roof® Assembly options.

For sloped greater than 3:12 or for surfaces with convex, concave or compound curves, Hydrotech offers a special high slope component, GardNet®. It utilizes a cellular containment system and stainless steel cables to conform to a wide range of roof slopes to enhance nearly any architectural vegetated roof objective (see page 16). The architect (or engineer) provides the structural connection design to attach the GardNet® sloped roof assembly to the building. The general contractor provides the actual connection bracket/hardware per the architect's design. Hydrotech provides the cables and GardNet® cellular containment system for installation by the contractor.

Parapets and edgings on all sides of any Garden Roof® must be properly designed and engineered by the project architect and/or engineer to contain, secure, and accommodate the loadings created by all of the Garden Roof components and vegetation.

**Contact Hydrotech for further details.**

Coyne Institute - Chicago, IL

h2hotel - Healdsburg, CA

h2hotel - Healdsburg, CA

# Wind Considerations

## Wind Effects on Roofs

Wind affects buildings in different ways depending on their location, height, configuration and exposures. Buildings can cause air to swirl and move around the surfaces and features of a building, increasing the winds intensity and uplift force, especially at the roof.

Many factors must be taken into account when addressing wind uplift, including, but not limited to:

- Local design wind speed
- Building height and orientation
- Surrounding topography (urban/suburban, city center, coastal)
- Perimeter edge condition
- "Effective" parapet height (dimension from finished ballast surface to top of parapet)

The uplift force exerted on roof surfaces from the wind is a negative suction force that acts across the entire roof surface. This suction force has the potential to lift loose laid roofing materials like stone ballast, concrete pavers and, in the case of vegetated roofs, the vegetation, growing media and any underlying loose laid components like water retention/drainage elements and insulation.

For simplicity, the surface of the roof is generally divided into three regions when considering these uplift forces: perimeters, corners, and field. As wind blows against a building and across the roof, vortices are created along and within the roof's perimeter and corner regions where uplift forces are greatest (below left). As a result, additional ballasting or securement of loose laid roof components will typically be required at the corners and perimeters.

## Protection Against Wind Uplift

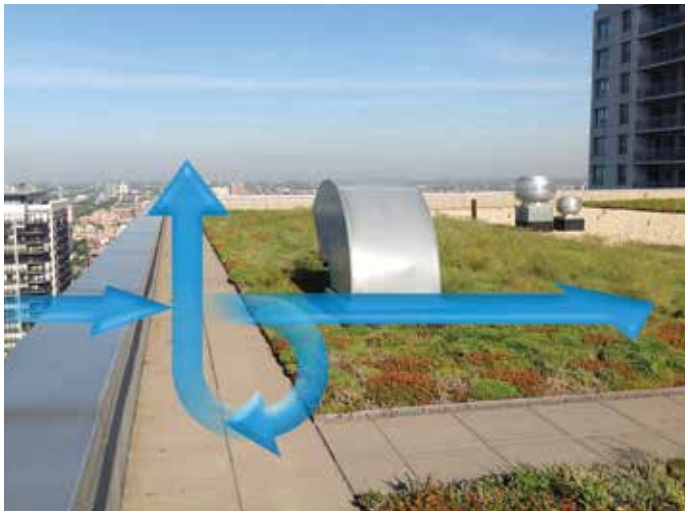
Like any roof, vegetated roofs must be designed to resist and counter the wind uplift forces acting against them. The lightweight engineered growing media utilized for vegetated roofs, especially during vegetation establishment, may not be sufficient to counter the uplift forces.

In most cases the increased uplift forces at perimeters and corners will require the installation of Vegetation Free Zones (VFZ) with the use of more traditional ballasting materials like stone ballast, precast concrete pavers, or poured-in-place concrete topping slabs. In the field of the roof, erosion control measures like erosion blankets or pre-grown vegetation carpets or tile are commonly used to prevent the uplift or scour of the growing media.

The project architect or engineer is responsible for determining the wind uplift design requirements for the roof. While there is little data from actual wind testing of vegetated roofs, there are several standards and approval guides developed within the roofing industry specific to vegetated roof systems. These include the ANSI/SPRI RP-14 – Wind Design Standard for Vegetative Roofing Systems and FM Global Property Loss Prevention Data Sheet – 1-35 for green roof systems. There are also the traditional wind design guides, ANSI/SPRI RP-4 – Wind Design Standard for Ballasted Single-ply Roofing Systems, FM Global Property Loss Prevention Data Sheets 1-28 and 1-29, and ASCE 7-10 – Minimum Design Loads for Buildings and Other Structures, from which the vegetated roof specific guides were developed.

## Hydrotech's Wind Warranty

As a result of a 30 plus year co-marketing agreement with the manufacturer of STYROFOAM™ brand insulation, Hydrotech is able to provide a total system Garden Roof® Assembly warranty that includes wind resistance coverage. With the Garden Roof® Assembly ballasted in accordance with Hydrotech's requirements, the insulation is guaranteed to remain on the deck withstanding wind gust speeds not exceeding 70 mph.



Wind uplift vortices are created by the wind blowing over the top of the parapets

| | | |
|---|---|---|
| CORNER | PERIMETER | CORNER |
| PERIMETER | FIELD | PERIMETER |
| CORNER | PERIMETER | CORNER |

Roof wind pressure zones

In order for a project to be eligible for a wind warranty, **the project MUST be reviewed by Hydrotech and DuPont early in the design process.** The ballast requirements review considers various project parameters such as roof deck height from grade, the "effective" parapet height, the design of the perimeter edge condition and the basic design wind speed for the project location taken from ASCE 7-10.

For this review, Hydrotech must be provided with the following:

- Roof plan indicating the extent and orientation of the Garden Roof® with the perimeter section detail drawings keyed to the plan
- The elevation of the roof deck in feet from grade
- Ground roughness of surrounding terrain (urban, forested, etc.)
- Section detail drawings of all perimeter edge conditions showing dimensions of the roof structure as well as the build up of Garden Roof® components
- Especially important is the "effective" parapet height as measured from the finished surface of the ballast to the top of the parapet.
- Any wind tunnel testing or modeling report that was conducted for the building (previous page, lower right).

Based on this information, the appropriate ballasting requirements will be determined for the perimeter region (minimum 8.5' wide from the edge of the roof), corner region (typically equal to but may be wider than the perimeter region) and field regions of the roof.

Typical ballast review requirements include:

**Effective Parapet Heights**

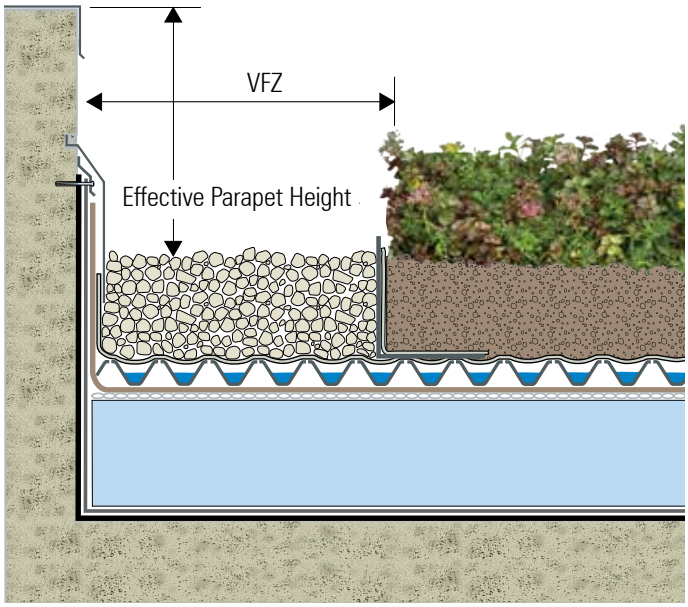
- Must be a minimum 2" (typically only acceptable for very low-rise buildings in low design wind speed areas)
- Must be a minimum 24" for roof heights ≥150' from grade
- Lower effective parapet heights will typically increase the width of vegetation free zone ballasting at the perimeters
- The effective parapet heights of low perimeter conditions can be increased without compromising views or aesthetics by incorporating solid glass railing systems

**Vegetation Free Zones (VFZs)**

- Minimum 24" around the entire perimeter
- Erosion blankets or InstaGreen® Sedum Carpet or InstaGreen® Tile required over the balance of the perimeter and corner regions
- Lower effective parapet heights will typically increase the width of Vegetation Free Zones and require additional ballasting at the perimeter and corner regions
- Additional ballasting may include multiple rows of concrete pavers with several or all rows strapped together

**Growing Media**

- Minimum 15 or 20 lb./SF dry weight (min. 3" to 4" of LiteTop® growing media in the field of the roof




**Special Treatments**

In certain projects the issue of providing as much green space as possible is in conflict with providing proper wind uplift design. When this occurs, Hydrotech offers a special Garden Roof® component called Checker Block®.

This steel reinforced, castellated, pervious concrete grid unit combines the benefits of a ballasting paver with the ability to sustain vegetation within the open grid paver structure.

**Please contact Hydrotech for additional wind warranty information early in the design process.**

* Checker Block® is manufactured by Hastings Pavement Company and is exclusively marketed by American Hydrotech, Inc. for this purpose.

# Balancing Wind Ballasting with Green Space Requirements

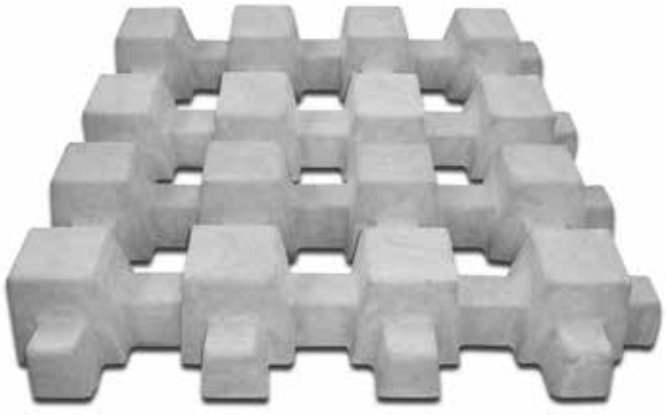
There are instances where the required wind ballasting for a roof may be in conflict with the required amount of greenspace needed on the project. This can be especially challenging when multiple rows of ballasting pavers are required to meet the ballasting requirements.

Hydrotech has developed a solution by incorporating a concrete grid unit within its Extensive Garden Roof® assembly. The concrete unit is called Checker Block®, a reinforced concrete grid unit with a long track record of use in at-grade landscapes for growing vegetation in areas where vehicles are occasionally found, like overflow parking areas, pathways, etc. The unique structure of Checker Block® provides the weight necessary for roof ballast while providing large connected volume spaces for plant root to spread out in the LiteTop® growing media.

**Checker Block®** is a castellated concrete paving unit manufactured by Hastings Pavement Company/Nicolock and marketed exclusively by American Hydrotech for the Garden Roof Assembly.

Each unit is approximately 24" x 24" x 4" thick and consists of 16 truncated concrete pyramids connected by concrete connectors. Each unit is steel wire reinforced concrete and weighs approximately 100 pounds.

Checker Block®'s weight equates to a standard 2 inch ballast paver and satisfies the ballasting requirements for DuPont. Checker Block®'s open structure creates tremendous volume for LiteTop media. Half of the total volume of the Checker Block® unit is open space. This volume extends from top to bottom of the Checker Block® unit. The unique structure allows for cross connections between the concrete pyramids to create connectivity for plants to share water and nutrients.



This open structure allows plant roots to grow through the voids in the Checker Block® unit to the Gardendrain component installed below it.

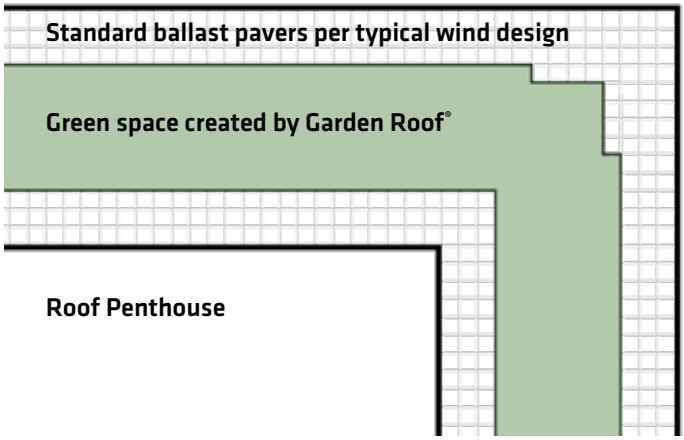
Checker Block® is often considered during the wind ballasting review that Hydrotech provides. Its use must be approved by Hydrotech and DuPont during this review process. While Checker Block® cannot be used on every project, it can be used to expand the green spaces on a roof to address green space and stormwater management requirements of local municipalities.

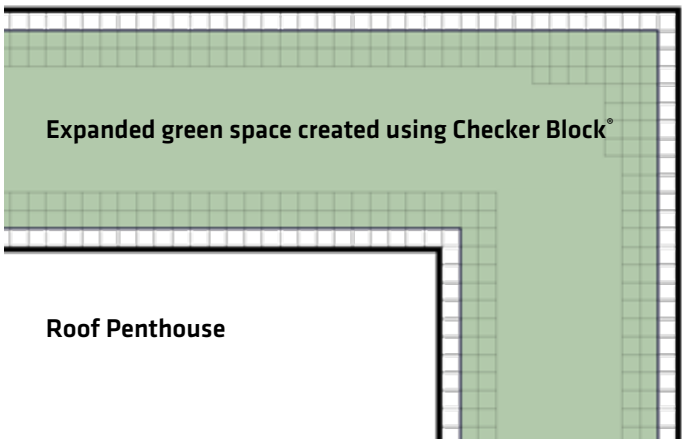
A Checker Block® assembly with 4" of LiteTop®, Disk Anchors and InstaGreen® GT-4 has been tested to 110 mph in accordance with CSA A123.24-15 with no noticeable effect.

* Checker Block by Hasting's Pavement Company / Nicolock, marketed by American Hydrotech, Inc.

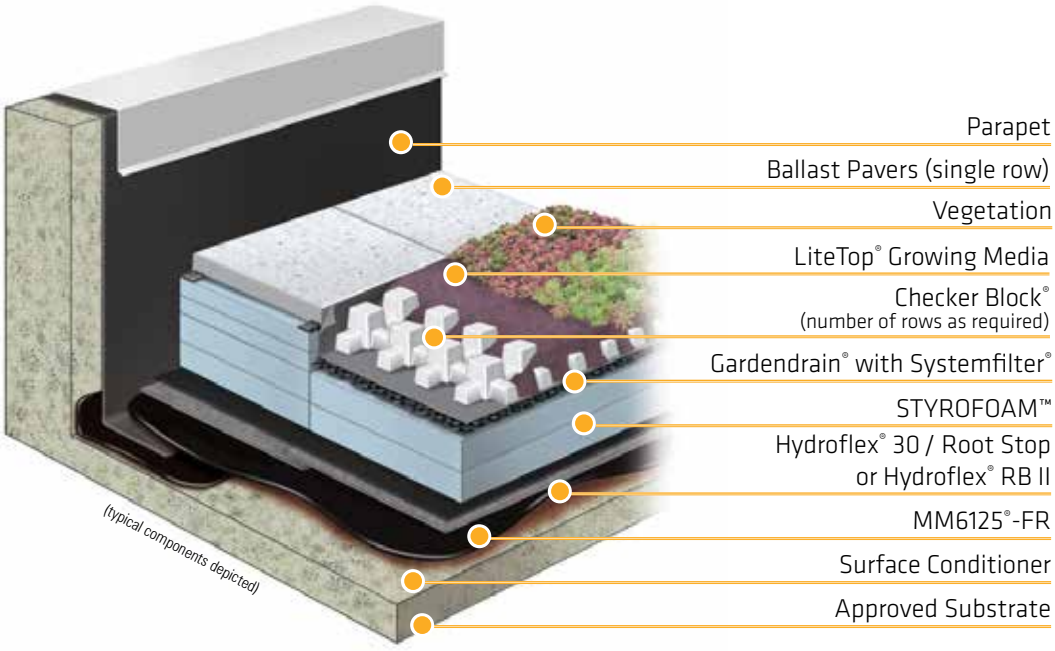
Example of extent of ballast pavers on roof

Checker Block® can reclaim some green spaces on roofs



# Increasing Green Space with Checker Block®




There are a wide variety of plant materials that can be installed within the void spaces of the Checker Block® units. InstaGreen® Carpet is often used but plugs of many succulents and perennials could also be planted within Checker Block®.

The minimum LiteTop® media depth is 4"; ideally a minimum of 5" would be used to completely cover the Checker Block® units.

Checker Block® can also be buried within deeper intensive media profiles.

Checker Block® can be used in any Hydrotech Garden Roof® assembly. Under certain circumstances, it can be incorporated into Hydrotech's Garden Roof® Blue Roof assembly as well. Checker Block® is installed loose-laid over the Gardendrain® panel and filled with LiteTop® growing media. Disk Anchors are a part of the ballasting requirement and are incorporated during the installation process.

Each Checker Block® unit is zip-tied together with Hydrotech-provided stainless steel zip ties. This essentially creates an interconnected blanket of concrete over the roof areas where Checker Block® is installed.

LiteTop® growing media is used to thoroughly fill the voids of the Checker Block® pavers. InstaGreen® Carpet is installed to create the immediately planted look. Sedum or perennial plugs can be installed with GardMat® erosion control netting to create a specific design motif.

**Incorporating Checker Block® into a project**

Hydrotech has developed details and specifications for incorporating Checker Block® into the Garden Roof® Assembly. These are available from Hydrotech after its ballast review and evaluation of the roof. Because each roof is unique and requires this review, these details are only available from the Hydrotech Technical or Garden Roof Departments.

**Limitations**

- Checker Block® can only be used for ballasting within the Garden Roof® assembly. It is not to be used to create walking surfaces on a roof.
- Checker Block® can be used on a roof up to 150 feet in height. Under special conditions, higher roofs may be able to be accommodated. **Contact Hydrotech for details.**

InstaGreen Carpet installation over Checker Block and Disk Anchors

Checker Block® installation on rooftop

Vegetation installation is completed with trimming of Disk Anchors

# USGBC LEED® Considerations

The LEED V 4 rating system has the following main categories of prerequisites and credits. Hydrotech's products and assemblies have direct qualities that can be used in the **highlighted** categories listed below.

- **IP - Integrative Process**
- LT - Location and Transportation
- **SS - Sustainable Sites**
- **WE - Water Efficiency**
- **EA - Energy and Atmosphere**
- **MR - Materials and Resources**
- EQ - Indoor Environmental Quality
- **IN - Innovation**
- RP - Regional Priority

**IP - Integrative Process**

Credit Intent: To support high-performance, cost-effective project outcomes through an early analysis of the interrelationships among systems.

Hydrotech's staff is available early in the design process to help increase the performance of the project through the use of the Garden Roof® and Ultimate assemblies that may be applicable to other LEED credits.

**SS - Sustainable Sites: Site Development - Protect or Restore Habitat**

Credit Intent: To conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Projects that achieve a density of 1.5 FAR (floor area ratio) can include Hydrotech's Garden Roof® assemblies in these calculations. The wide variety of plant materials offered in Hydrotech's plant program can address a broad range of environmental, climatic and biodiversity conditions.

**SS - Sustainable Sites: Open Space**

Credit Intent: To create exterior open space that encourages interaction with the environment, social interaction, passive recreation, and physical therapy.

In projects that achieve the minimum 1.5 FAR threshold, the Garden Roof® assembly with native or adaptive vegetation used in roof top applications or on grade can contribute to adding back vegetated open space on the site. In addition, pedestrian accessible hardscape features created by the Ultimate Assembly® can also be used toward this credit.

**SS - Sustainable Sites: Rainwater Management**

Credit Intent: To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region.

The Garden Roof® assembly decreases site imperviousness and stormwater runoff. The Garden Roof® assembly can:

- **reduce** the amount of storm water that can enter the sewers
- **delay** the storm water from entering the sewers
- **clean** the storm water via the filtering processes in the medias

**SS - Sustainable Sites: Heat Island Reduction**

Credit Intent: To minimize effects on microclimates and human and wildlife habitats by reducing heat islands.

Hydrotech's Garden Roof® Assembly is one of the prime BMPs that addresses this credit. Plants within the Garden Roof® Assembly are particularly beneficial because they cool the air immediately around them.

In this credit, LEED treats vegetated roofs and high reflectance roofs with the same weight. Hydrotech's Cool Roof Assemblies that include Hydroguard® and Glacier White architectural pavers can also contribute to this credit.

**SS - Sustainable Sites: Places of Respite (LEED-Healthcare only)**

Credit Intent: To provide patients, staff, and visitors with the health benefits of the natural environment by creating outdoor places of respite on the healthcare campus.

Hydrotech's Garden Roof and Ultimate Assemblies can be used to achieve this credit. Seating elements can easily be incorporated into the vegetation and paving components in these assemblies. Trees planted within the Intensive Garden Roof® Assembly can provide the required shade in these areas. Paved surfaces created using the Ultimate Assemblies can provide access and accommodations in these places of respite.

**SS - Sustainable Sites: Direct Exterior Access (LEED-Healthcare only)**

Credit Intent: To provide patients and staff with the health benefits associated with direct access to the natural environment.

Hydrotech's Garden Roof and Ultimate Assemblies can be used to achieve this credit. Paved areas created by the Ultimate Assembly developed in combination with landscaped areas created by Extensive and Intensive Garden Roof Assemblies can satisfy this direct exterior access credit.

**WE - Water Efficiency: Outdoor Water Use Reduction**

Credit Intent: To reduce outdoor water consumption by showing that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period **OR** reduced irrigation usage (50% reduction from baseline for project's peak watering month).

Many of the plants that are included in Hydrotech's Extensive Plant Program are well adapted to dry conditions and limited water availability after establishment. Once the extensive plants become established only supplemental irrigation may be needed during times of high heat or drought.

**EA - Energy and Atmosphere: Optimize Energy Performance**

Credit Intent: Achieve increasing levels of energy performance above the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Depending on the design of the project, DuPont STYROFOAM™, Brand Insulation Ultimate Assembly® and the Garden Roof® Assembly can help achieve high energy efficiencies within the building energy modeling. When combined with the Garden Roof® assembly, solar photovoltaic arrays perform at a higher efficiency due to the cooling effects of the plant materials and media within this assembly.

**Materials and Resources: Building Life Cycle Impact Reduction**

Credit Intent: To encourage adaptive reuse and optimize the environmental performance of products and materials.

Hydrotech's Protected Membrane Roofing (PMR) Assembly greatly extends the life of a roof. In the PMR Assembly, DuPont STYROFOAM™ and the Garden Roof® Assembly are installed on top of the waterproofing membrane. This arrangement protects the waterproofing from physical damage and UV degradation which are the two greatest factors in weakening a roofing system. In a 3rd party study, the LCA concluded Hydrotech's MM6125® PMR is expected to have the same useful lifetime as the structure. The LCA stages include raw material supply, raw material transport, manufacturing, transport to site, installation and end-of-life management.

**Materials and Resources: Building Product Disclosure and Optimization – Environmental Product Declarations**

Credit Intent: To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. Through the manufacture of its products, Hydrotech contributes to the diversion of materials from landfills.

Hydrotech's MM6125® has an Environmental Product Declaration (EPD) conforming to ISO 14025 and ISO 21930.

**MR - Materials & Resources: BPDO - Sourcing of Raw Materials**

Credit Intent: To encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts.

Hydrotech's LiteTop® growing media installed in the Garden Roof® Assembly use locally sourced raw materials extracted from as close to the project site as possible. Raw material sources are available to project teams upon request.

Hydrotech has a wide range of products offering post-consumer and post-industrial recycled content including MM6125® with up to 40% post consumer content.

**Materials and Resources: Building Product Disclosure and Optimization – Material Ingredients**

Credit Intent: To reward project teams for selecting products for which the chemical ingredients in the product are inventoried using an accepted methodology, and for selecting products verified to minimize the use and generation of harmful substances.

Hydrotech can provide Health Product Declarations (HPD's) and Environmental Product Declarations (EPD's) upon request.

**IN - Innovation: Exemplary Performance**

Credit Intent: To encourage projects to achieve exceptional or innovative performance.

Hydrotech's Garden Roof® and Blue Roof Assemblies can both contribute to LEED credits for exemplary performance in rainwater management, heat island reduction and protection and restoration of habitats.

**Contact Hydrotech for further information on specific products for your project.**

## Hydrotech Roofing, Waterproofing, Ultimate and Garden Roof Assemblies - Possible LEED V. 4 points

| | Protect or Restore Habitat SS | Open Space SS | Rainwater Management SS | Heat Island Reduction SS | Places of Respite SS | Direct Exterior Access SS | Outdoor Water Use Reduction WE | Optimize Energy Performance** EA | Building Life Cycle Impact Reduction MR | Environmental Product Declarations MR | Sourcing of Raw Materials MR | Material Ingredients MR | Integrative Process IP | Innovation IN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PMR Assembly** | - | - | - | - | - | - | - | 1-18 | 1-3 | 1-2 | 1-2 | 1-2 | 1 | 1-2 |
| **Ultimate Assembly** | - | 1 | - | 1-2 | 1* | 1* | - | 1-18 | 1-3 | 1-2 | 1-2 | 1-2 | 1 | 1-2 |
| **Garden Roof Assembly** | 2 | 1 | 2-3 | 1-2 | 1* | 1* | 1-2 | 1-18 | 1-3 | 1-2 | 1-2 | 1-2 | 1 | 1-2 |

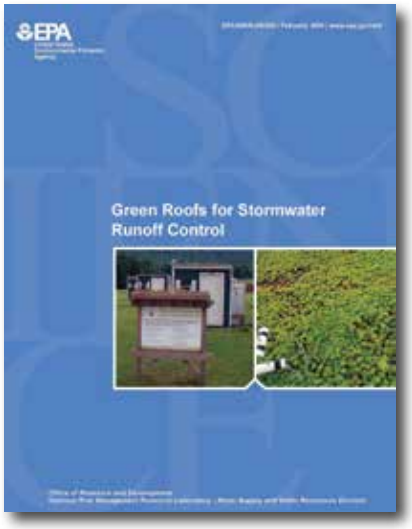
* Healthcare projects only **Energy performance influenced by many factors

# Stormwater Management

## Stormwater Management and Vegetated Roofs

Stormwater and its effects on our infrastructure, environment and budgets continue to be an ongoing issue in the United States. As more natural open land is paved over for roads, buildings and parking lots, there is less area in which rainwater can infiltrate into the ground or traverse safely and effectively to waterways. This increasing level of impervious cover concentrates more rainwater into smaller areas on its way to being stored in pipes, ponds and reservoirs.

This is not a new problem; the first major federal laws were enacted in the 1940s to address this issue. In the 1970s those early laws were modified into the Clean Water Act and administered by the then-new Environmental Protection Agency (EPA).




Since that time, the EPA has developed programs and research to address this issue. A number of studies have been commissioned during the past several decades to address stormwater management techniques. Vegetated roofs are a tested and EPA-endorsed and approved best management practice (BMP) for inclusion in a project's stormwater management plan. Vegetated roofs are now becoming a standard BMP in many low impact design/development (LID) projects.

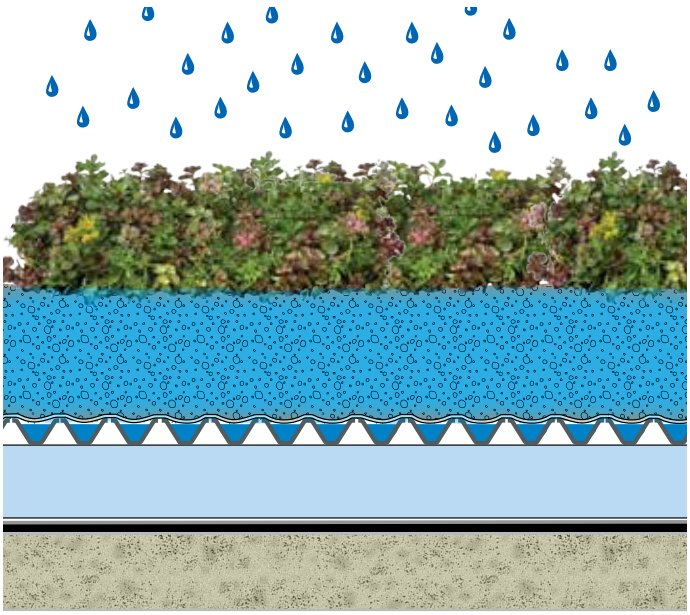
Vegetated roofs are great Stormwater Management BMPs. But how do they really work?

Properly designed vegetated roof assemblies have the ability to capture all or portions of a typical rainfall event. This rainwater is stored in several areas of the assembly – within the open pore spaces in the growing media and within the drainage/water retention system that underlays the media.

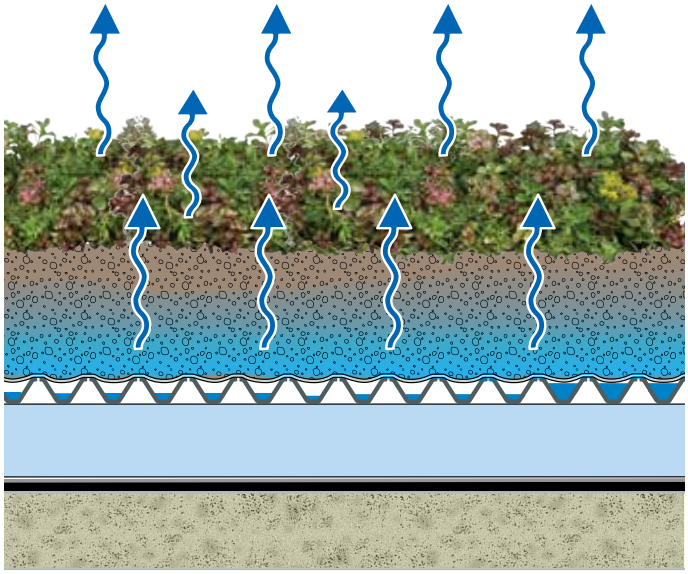
This total assembly handles this stormwater in several ways.

- It **retains** a portion of the stormwater until the assembly is completely saturated.
- It **delays** the release of excess stormwater from the building roof and into site stormwater system.
- It **reduces** the volume of stormwater runoff and releases some of this rainwater into the atmosphere by evaporation and transpiration through the plantings.
- It **cleans** the rainfall of particulate matter and chemicals within acid rain through the filtering actions of the plant material, growing media, system filter and drainage layers.

In these ways, vegetated roofs mimic natural hydrology systems like wetlands and similar structures. The complete assembly is simultaneously an engineered and biological system designed to manage stormwater.



**Water Retention**



**Evapotranspiration**

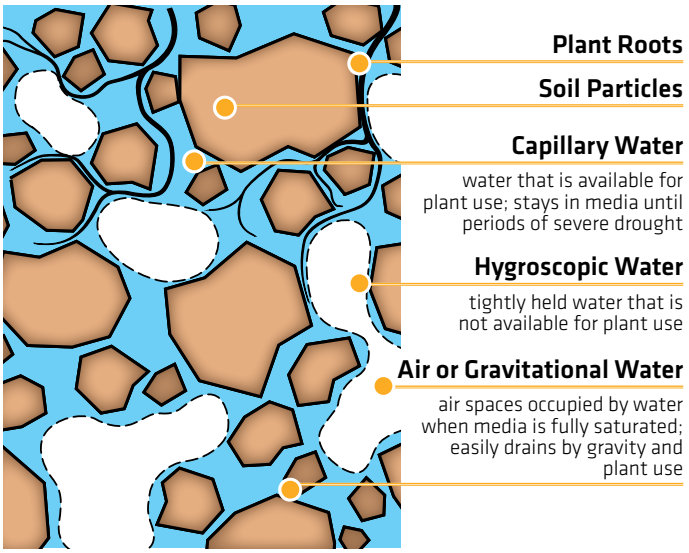
## Mimicking Natural Hydrology

Vegetated roof growing media functions very much like aggregate materials that are used in permeable pavements; the water is stored in the spaces between the coarse and fine aggregates and the organic particles. In addition, water is stored in the cups of the Gardendrain® panels. While both permeable pavements system and vegetated roofs store water, only vegetated roofs have vegetation to help enhance the hydrology of the stormwater BMP. This is how a Garden Roof® Assembly mimics natural hydrology.

The media, plants and Gardendrain® act very much like a sponge in their function. A dry sponge has great potential for absorbing water in the internal pore structure. As water is slowly added, the sponge begins to fill but will not release that water. As more water is added the sponge continues to absorb water until it reaches full capacity (saturation) and no more water can be absorbed. At that point, water will flow out of the sponge as more water is added. When no more water is added and no excess water drips out, the soaking wet sponge reaches a state of equilibrium. In soil sciences, this is considered the field capacity of the media and includes a mix of water and air among the matrix of coarse and fine aggregates that make up the media.

A portion of the water is retained by the media and some leaves the media via evaporation and by gravity. In addition, the normal evaporation of moisture from the roof is accelerated by the plant materials as plants release moisture into the air through normal evapotranspiration activities as part of photosynthesis.

These natural environmental functions are combined with the inherent water storage qualities of Hydrotech's LiteTop® media blends and Garden Roof® Assembly components to create a unique stormwater storage system.




**Water retention within media**

## Storm Hydrology

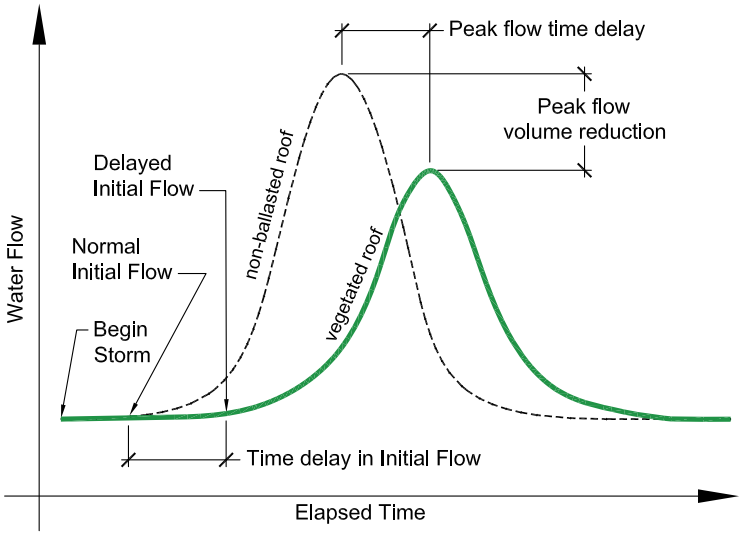
Hydrotech's Garden Roofs® make ideal stormwater BMPs because of how well they perform during storm events. In a standard, non-ballasted roof, rain water begins to run off the roof very soon after it lands. In a Garden Roof®, there is a delay in the initial run off. As illustrated in the sponge analogy outlined above, when a storm event begins, the rain water is held by the media and Gardendrain® panels until it reaches a certain saturation point. At that point, the assembly begins to release excess water into the drainage systems.

This delay of the initial flow is an important component in stormwater management. It prevents that water from immediately entering and overwhelming the downstream drainage system.

The evaporation and evapotranspiration functions in a Garden Roof® help to reduce the total volume of water that could enter the stormwater system.

The dual function of reducing the water volume and delaying the water's release is commonly generated in calculations that are illustrated as a hydrograph (right). Civil engineers use hydrographs to predict the performance of stormwater BMPs. Comparing hydrographs from non-vegetated and vegetated roofs can determine the delay in the peak flow and the reduction of the peak volume.

To be effective and accepted as a BMP, vegetated roofs must use consistent media and components. These must be tested to determine water storage and flow characteristics in order to be used in developing the data needed for developing acceptable BMP data.




**Garden Roof Hydrograph**

## Hydrotech Hydrology Tool - HHT

There are many claims in the marketplace regarding performance of vegetated roofs for stormwater management. Many of these claims have little or no quantified data as backup. In response to these claims, Hydrotech has developed a specialized service for its customers called the **Hydrotech Hydrology Tool - HHT.**

The HHT is a software tool that predicts how a specific Garden Roof® Assembly will perform from a stormwater management perspective. The HHT was developed by Hydrotech and stormwater engineers and provides detailed information that can be used by the project's design team for:

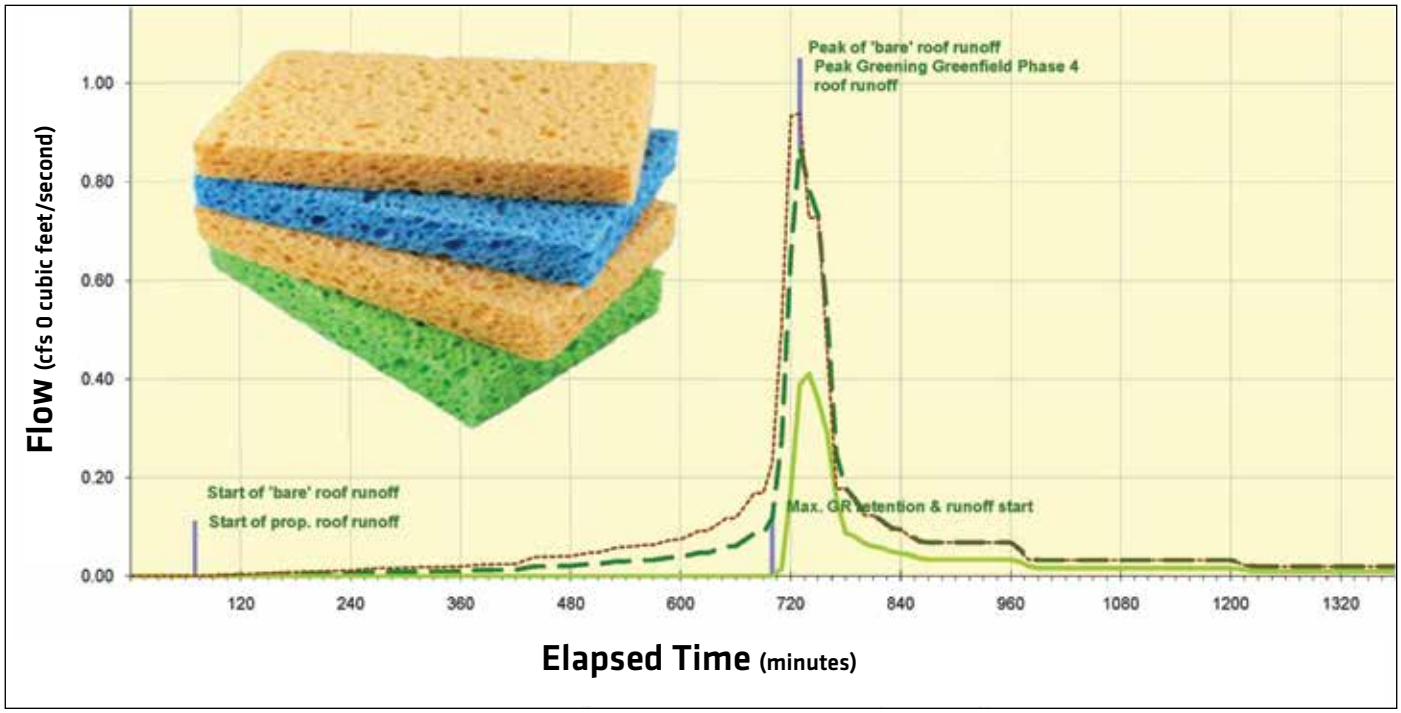
- The development of stormwater BMPs
- Proving compliance with project specific LEED™ requirements
- Proving Garden Roof® Assembly performance by accounting for local climatic and assembly variations
- Balancing the stormwater needs of a site among the other available BMPs like cisterns, bioswales and underground storage

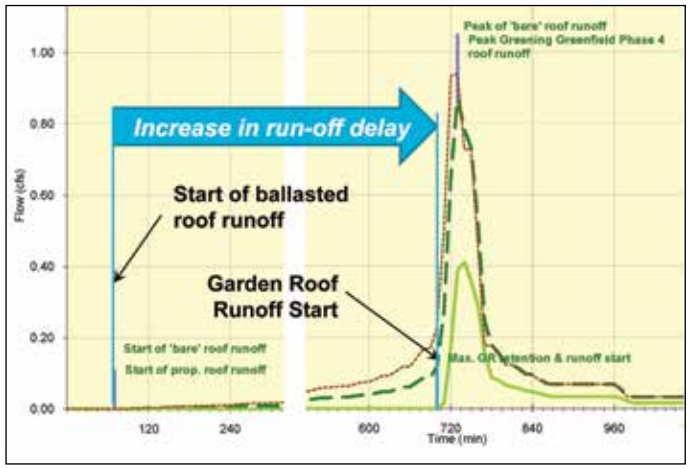
Unlike less sophisticated calculators, the HHT uses all of the Garden Roof® components in the determination of the amount of stormwater the assembly can store. In addition, the HHT can show how the assembly will perform during a typical rain event. The HHT uses a wide range of variables in its calculations including:

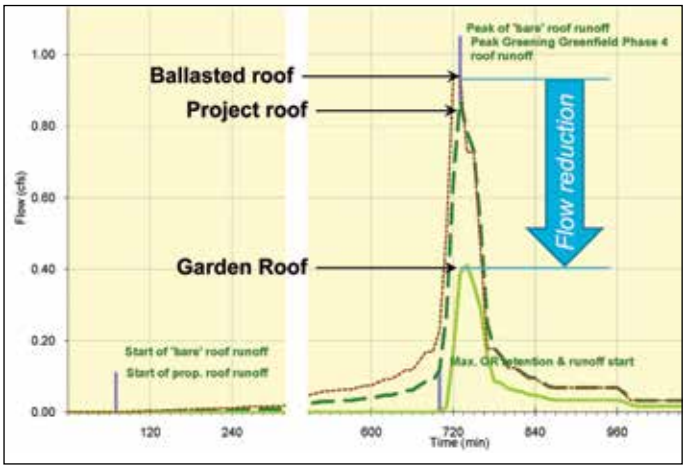
- Site specific climatic data
- Project location historical rainfall data
- Storm event desired for the modeling
- Size of overall roof
- Size of vegetated portion
- Media depth
- Gardendrain® components
- Plant materials incorporated

With this information, the HHT can generate "what-if" scenarios for consideration by the design team in developing stormwater BMP models.

**The HHT has proven to be valuable in assisting design teams and owners in developing stormwater management plans. Contact Hydrotech to obtain a HHT report for your project (at no charge).**



# Hydrotech's Blue Roof Assemblies

## The Roof as a Stormwater BMP

Climate change continues to create challenges for municipalities and building developers who need to handle increasing amounts of storm-water. More municipalities are requiring developers to detain larger volumes of stormwater on their sites temporarily for a 24- to 48-hour period after rain events. Many urban sites have little or no room for conventional stormwater management techniques. Those traditional BMP (best management practice) methods are becoming more expensive and owners and designers are looking for cost effective storm water solutions.

While its primary function is to keep the building dry, the roof can be a valuable resource for effective stormwater management. Hydrotech's Garden Roof® assemblies have been deployed for this reason in many cities. Hydrotech's Blue Roof is the next step in high performance, rooftop-based stormwater management.

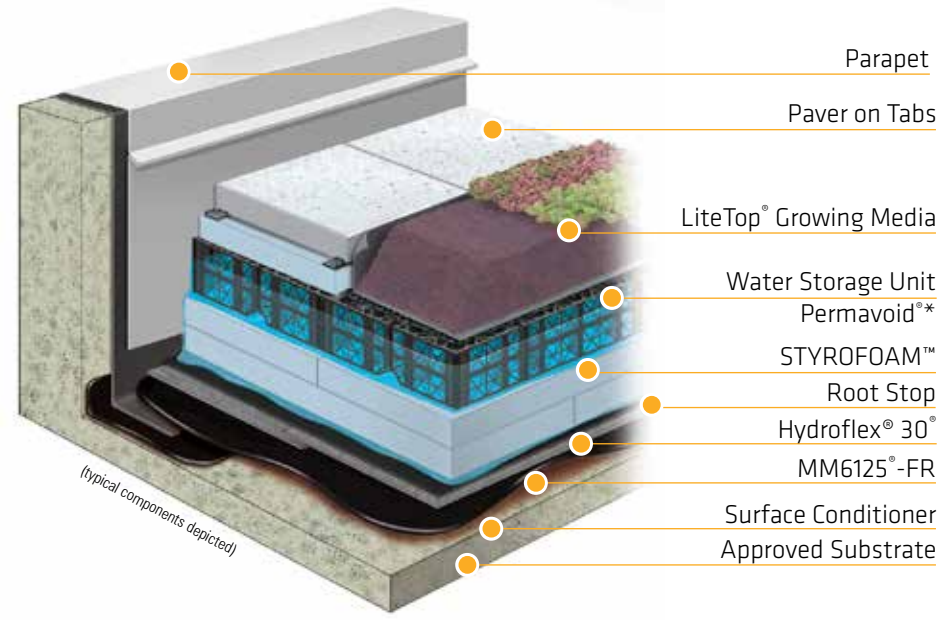
## It starts with a superior roof membrane

For the past 60+ years, Hydrotech's Monolithic Membrane 6125® hot fluid applied, rubberized asphalt waterproofing / roofing membrane has been keeping buildings watertight worldwide.

Why Monolithic Membrane 6125® ?

- Originally designed for waterproofing applications, MM6125® is perfect for wet or submerged applications such as planters, pools, water features, vegetated roofs as well as Blue Roofs.
- MM6125® is a continuous, monolithic waterproof barrier for the roof so there are no seams that can fail.
- MM6125® is ideal for dead level, flat deck applications which can maximize the stormwater capacity of a blue roof installation. Often owners save money with flat decks which are easier to construct than sloped decks.
- Hydrotech can provide a full assembly warranty on flat deck and sloped deck installations which includes removal and reinstallation of the overburden materials supplied by Hydrotech.

**Contact Hydrotech for full details.**




*ABT Plastic's Permavoid® product, exclusively marketed by American Hydrotech, Inc.

## Taking Stormwater Management to the next level: Blue Roof

Normal roof drainage is designed to ensure the rapid removal of rainwater from the rooftop via the roof drains and associated plumbing.

In a blue roof, the roof drains incorporate restrictors to dramatically slow down the water flow off the roof. These restrictors often take the form of cone-shaped steel or cast iron inserts or standpipes (right) that are bolted into the drain body at a prescribed fashion and height. These restrictors have slots or holes that allow water to release at prescribed rates. In normal light rain events, the restrictor allows water to easily drain at the membrane level. In heavier rain events, the large amount of water will overwhelm the opening in the restrictor and the water will back up to a predetermined depth. The restrictor allows water to leave the roof at a prescribed flow rate. This restricted flow helps to prevent the receiving sewer system from overflowing and causing common issues like flooded basements, streets and other problems.

Blue Roofs are ideal for flat deck conditions where there is no slope to limit water capacity. Blue roofs can be created in several different configurations that include stone ballast Assemblies, pavers on pedestal Assemblies and various Garden Roof Assemblies.

Each of these blue roof assemblies can be used to reduce or completely replace at-grade or underground water detention. This can save the building owner money and free up leasable space within or under the building for other uses.

**Contact Hydrotech for a copy of the Blue Roof Brochure.**

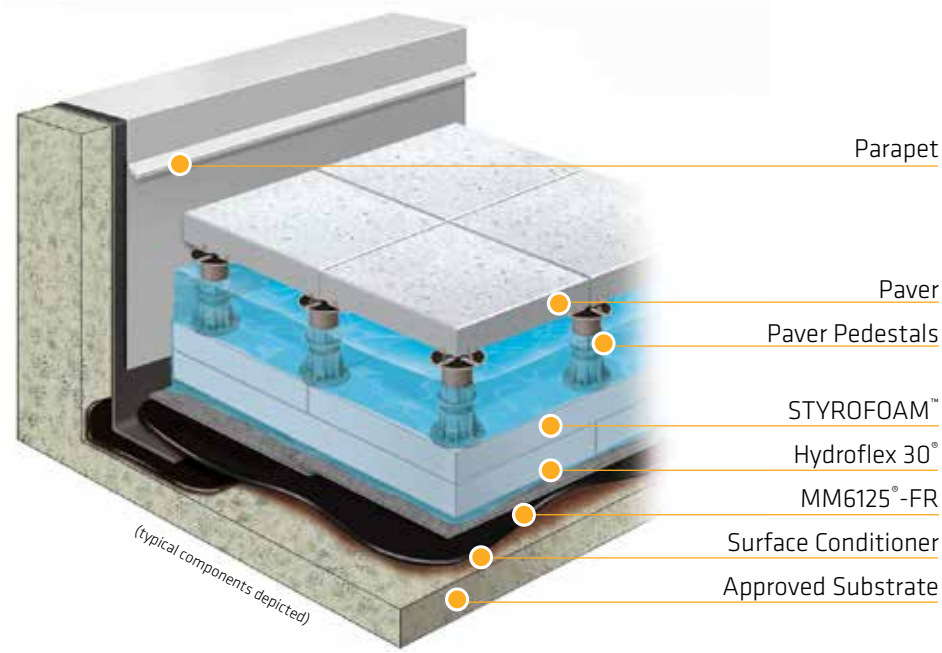
## Garden Roof® Blue Roof Assembly

This version of Hydrotech's Blue Roof Assembly combines the performance and benefits of the Garden Roof® Assembly and free water detained in a voided space into one, creating a high performance stormwater management solution. The core of this assembly is the water storage unit - Permavoid®.

Permavoid® provides a lightweight structural foundation with 95% void space. This platform is ideal for installation below any number of Garden Roof® and Ultimate Assembly® components.

Architectural pavers can be installed to create pedestrian spaces and to provide access to roof parapets and mechanical equipment. Garden Roof® components can be used to create almost any vegetated roofs on top of the Permavoid® units. Additionally, LiteTop® within the Garden Roof® Assembly can increase the water holding capacity of this composite Blue Roof Assembly.

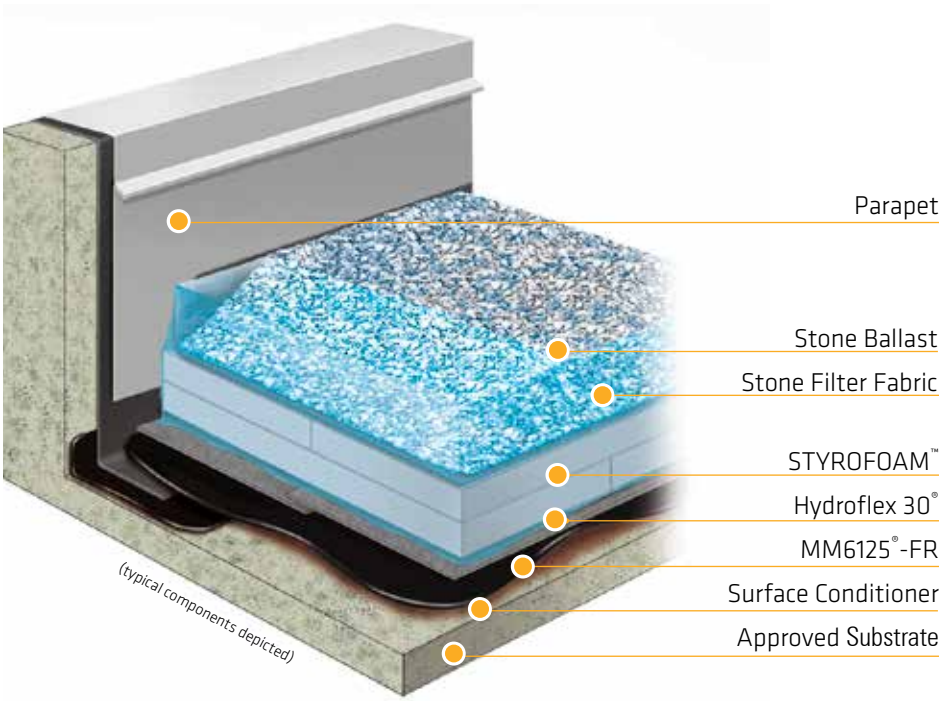
## Ultimate Assembly® Blue Roof




Hydrotech's Ultimate Assembly® Blue Roof utilizes concrete pavers set with pedestals over the STYROFOAM™ insulation. The void space created under the pavers is an ideal location to store large quantities of stormwater. The paver weight is designed to keep the STYROFOAM™ insulation from floating during those rain events when the blue roof is in operation. As a result, heavier, thicker pavers are sometimes required.

A rooftop terrace would be an ideal application for this Blue Roof Assembly. Because the pedestals supporting the pavers are adjustable, this Blue Roof Assembly may be ideal for roof decks with some roof slope where the goal is to create a level, paved finished surface.

## Stone Ballasted Blue Roof Assembly




Hydrotech's PMR Blue Roof is the simplest blue roof that can be created. Using standard ballast stone, the water in the blue roof is stored within the void spaces of the stone and to the required depth above the ballast. A heavier than typical application of stone ballast is designed to keep the STYROFOAM™ insulation from floating during rain events when the blue roof is in operation.

A Hydrotech PMR Blue Roof is ideal for those utilitarian roofs that are not designed for tenant use.

# Solar Integration

## Solar Considerations

Capturing the energy coming from the sun in solar water heaters and solar photovoltaic cells is increasing rapidly as technologies advance and become more efficient. Adding these elements adds more value to the rooftops by taking advantage of unused spaces.

Vegetated roofs have the proven ability of dramatically lowering the surface temperature of the roof when compared to a conventional roof system. One of the side benefits of this temperature moderation is increased performance of the solar panels. Reduced roof temperatures under and around photovoltaic panels increases the conversion efficiencies of the panels.

The array of solar water heating panels (top right) provides all of the hot water needs for this facility. The building designers incorporated this array into the roof top design and used concrete pavers in the vegetation free zone to accommodate maintenance.

The large array of photovoltaic panels (lower two images) is used to supplement the energy requirements of this building. In this particular project, sedum cuttings were installed after the solar panels were installed. The cuttings were spread over the entire roof and under the panels where they are taking root.

Solar panels create small microclimates under and around the arrays. The wide range of sedum varieties in this project allows for certain sedums that prefer shadier conditions to thrive under the panels. The panels naturally direct additional rainwater to the lower leading edge of the panels creating a microclimate where the media stays a bit more moist than the field of the roof.

This solar array is attached to a rack system that was constructed on the roof deck. The support posts and electric penetrations through the roof deck were flashed following standard roofing detailing methods.

**Please contact Hydrotech for specific details on integrating a solar system on your project.**

Fort Belvoir Dental Clinic - Fort Belvoir, VA

Milwaukee Public Library Main Branch - Milwaukee, WI

Milwaukee Public Library Main Branch - Milwaukee, WI

# Vegetation Free Zones and Other Considerations

## Vegetation Free Zones

Vegetation Free Zones (VFZs) are those areas where vegetation of any type is not permitted to grow. VFZs are required:

- To protect roof membrane flashings
- To create protective areas around roof drains
- To increase wind resistance
- To accommodate drainage from adjacent structures and surfaces
- To create fire breaks on larger roofs
- To provide ease of access for maintenance of flashings, parapets, penetrations, etc.

VFZs include perimeter areas between the parapets and the vegetation as well as the areas around drains, rooftop mechanical units, access hatches, pipes, ladders and maintenance pathways.

It is important to carefully consider and properly integrate VFZs into the proposed vegetated roof. Certain mechanical units may need to have regular maintenance throughout the year and workers will require a safe and stable pathway to walk on to reach these units from the access point on the roof.

Doorways, hatches and ladders are very common features that need properly designed VFZs.

All of these zones can be created using standard stone ballasting materials as well as a wide array of precast concrete pavers. All of these areas must be kept clear of debris and volunteer vegetation that might try to infiltrate the VFZs.

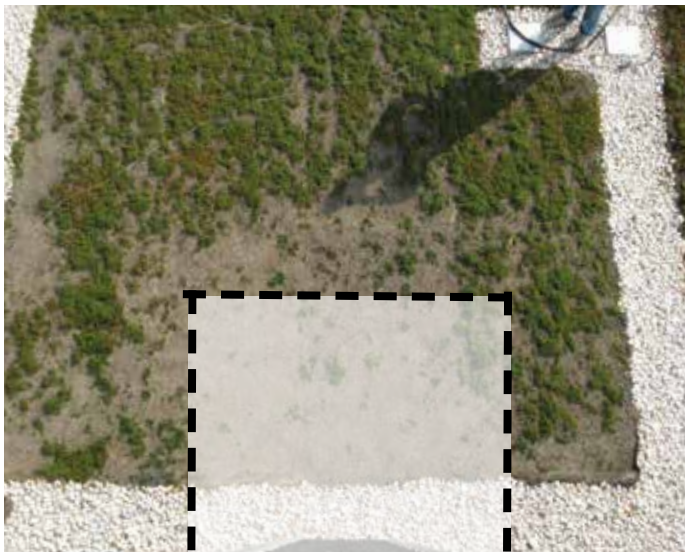
## Access to the Vegetated Roof

One of the important elements for designers to consider in the design of a vegetated roof is accommodating foot traffic by maintenance personnel. Periodic review and maintenance of building facades, parapets, mechanical equipment and the vegetation will require safe and secure access to and around the vegetated roof.

Providing landing pads (minimum 6' x 6' square) at doorways and roof ladders (top and bottom) will help to protect vegetation by defining walkway areas for maintenance personnel.

Designers should provide clearly defined walking surfaces to mechanical units on the roof. These walkways can be created using ballast stone or pavers. The designer should select the appropriate material depending on the anticipated usage on the roof. In many instances, combinations of both ballast stone and pavers are used to create vegetation free zones around roof elements and for walkway areas, especially at roof parapets.

Landing pad needed at door



Landing pad needed at base of ladder

## Roof Penetrations and Perimeter Details

Wherever possible, penetrations for pipes, equipment, skylights, etc. should be concentrated together allowing for more unbroken planted areas.

Good waterproofing principles must be incorporated into a vegetated roof's design. Flashings should be terminated a minimum of 8 inches above the finished growing media surface or top of pavers. In front of doors, the minimum height above the finished surface can be reduced, provided that the flashing terminations can be turned in, under the door threshold and/or means of free drainage are incorporated (i.e. a linear drainage grill).

## Roof Drainage

Vegetated roofs retain a high percentage of the rainwater that falls on the roof, which reduces the strain imposed on the surface drainage systems. However, there is always excess water that must be drained from the roof by means of surface roof drains or free flowing scuppers. For safety purposes, roof drain designs should include at least two outlets or an outlet and an overflow. Mechanical/plumbing engineering professionals should determine the actual quantities, spacing and sizings of roof drains.

All outlets must be kept clear of vegetation by installing a vegetation free zone around the outlet and covering the outlet with an inspection chamber.

## Fire Prevention

Intensive Garden Roofs® that are regularly irrigated are generally considered to be resistant to flying sparks and radiant heat. Extensive roofs, which may not be irrigated, are usually accepted as fire resistant under the following conditions:

- The growing media is at least 2" deep and contains no more than 20% by weight organic matter.
- There are gravel or concrete breaks in the vegetation every 100 feet with a minimum width of 4 feet.
- There are vegetation free zones at all roof penetrations and at the perimeter walls with openings.
- The vegetation free zones are kept free of flammable vegetation.

Hydrotech maintains a UL Class A fire listing for roofs using MM6125®. Underwriters Laboratories (UL) has determined that the Garden Roof® Assembly "surfacing would have no deleterious effects upon the fire resistant properties of the system."

There are additional standards and guidelines developed within the roofing industry specific to vegetated roofs with respect to fire. These include ANSI/SPRI VF-1 External Fire Design Standard for Vegetated Roofs and FM Global Property Loss Prevention Data Sheet 1-35.

## Vents

Vents are a necessary part of building ventilation. Designers must recognize that exhaust vents can create microclimates and accelerate water evaporation on a vegetated roof that can affect plant vitality.

Exhaust vents (like those shown at right) can warm the air sufficiently in winter weather so that plants do not go dormant. During below freezing winter months, these vents can artificially keep the temperatures warm, and when the mechanical systems turn off, the sudden drop in temperature can cause internal tissue damage in plants. With enough cycles, plants can be damaged to the point where they would not thrive or survive.

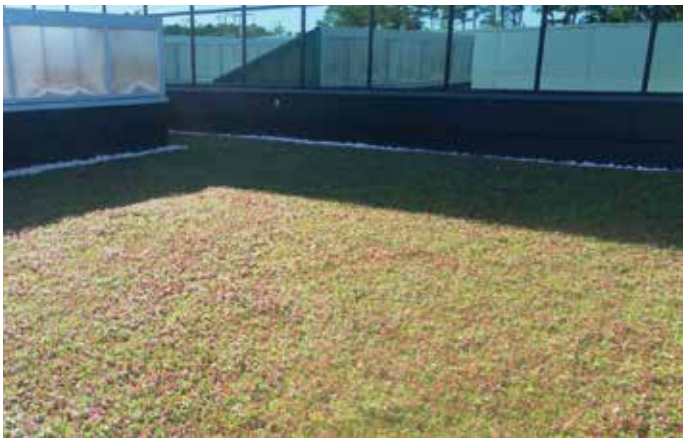
## Accessory Structures

Accessory structures like skylights, penthouses and similar structures (right) on a vegetated roof can create additional watershed areas that contribute extra rainwater volume to the vegetated roof. Tall adjacent walls can direct water into the vegetated areas as well. These surfaces can add more water to a vegetated roof than what it would normally experience.

To handle this extra water, designers should create drainage paths in VFZs directly to roof drains. This will allow the media to naturally dry out between rainfalls rather than remain continually wet.

## Sun and Shade Exposure Issues

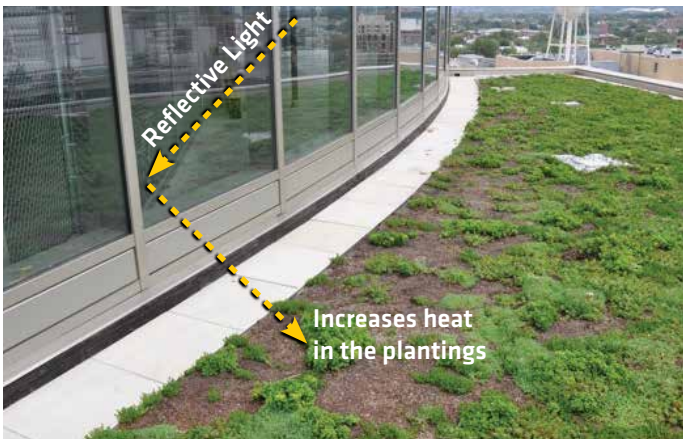
Understanding the sun/shade patterns created by the building and its elements (as well as adjacent structures) is necessary in the selection of the proper mix of plants for use on the vegetated roof. These patterns are not static; they change as the days and seasons progress. There may be instances where portions of the roof are in total sun or shade. The designer must identify those areas so that a proper plant mix for the vegetated roof can be determined. In some deep shade conditions, vegetation may not be an option.



## Reflective Light

Designers should be aware of roofs with exposures (particularly southern) that could be affected by light reflecting from windows or light colored surfaces. These surfaces reflect solar radiation and heat onto the adjacent plant material and can adversely affect the thrivability of the plants.

In instances like this, increasing the VFZ width and/or modifying the plant selections in these areas can help ensure full plant coverage.



## Safety and Access Issues

All roofs should be considered high risk areas and good safety standards are essential. Safety, especially in regards to construction and maintenance of the vegetated roof, should be taken into consideration at the design stage. Adequate access, anchorage points for workers, safety rails and barriers must be provided. After construction is completed, general use of the roof, as well as the safety of those working on equipment and maintaining the vegetated roof, must be considered as well.

Roof hatches are a very common access point to many roofs. They are often situated above ladders in storage or maintenance areas. Hatches need to be large enough to bring supplies up to the roof as well as remove any debris that might accumulate on the vegetated roof.

Vertical access ladders can provide access to upper levels within a small footprint. However, they are much less convenient and comfortable to use than angled ladders (right), especially on taller roof climbs.

# Access to Water and Irrigation Options

Access to sufficient water is one of the most important considerations for establishing and maintaining healthy vegetated roofs. Once established, most extensive vegetated roofs can rely on natural rainfall with occasional supplemental water during extended dry periods.

Water accessibility and irrigation systems have been challenging issues for green roofs since their inception. Unfortunately, many vegetated roofs have been constructed with little attention to providing enough water. Many designers do not communicate with the mechanical engineers for the building project regarding water requirements on the roof and as a result many vegetated roofs have little or no access to sufficient water volume and pressure.

In many instances large roofs do not have enough water sources to effectively irrigate the newly installed vegetation. Many roofs have been provided with only one or two hose bibs and in those instances, contractors have had to improvise the water connections to provide water to all areas of the roof.

Designers and owners should not allow the condition shown at right to occur as a **permanent** water delivery solution.

Limited water sources at the roof level create:

- Long hose runs that are difficult to move and manage
- Potential for dislodging plant material by dragging long, heavy hoses across new installations
- Steep pressure losses in long hose runs
- Diminished performance of sprinklers due to lower pressures and water volumes.

## Sufficient Water

The term "sufficient water" is used to define the characteristics of the supplemental water needed for any vegetated roof. As each roof is different, the definition of "sufficient water" specific to each roof is dependent on the plant material, media types, region - and project-specific climatic conditions.

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 water effectively through the system. 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**
- **Minimum 8-10 gallons-per-minute (GPM) at roof**

Designers should remember that these are on-the-roof figures and must account for pressure and volume losses due to the height the water has to be delivered.

## Irrigation Consultants

There are numerous manufacturers of temporary, drip and pop-up irrigation equipment. For proper operation, a qualified irrigation designer should be consulted when developing any irrigation system for a vegetated roof. Good consultants often can recommend qualified irrigation contractors.

Hydrotech does not recommend any particular irrigation equipment manufacturer. It is the responsibility of the design team to provide an adequate irrigation and water supply system for the green roof.

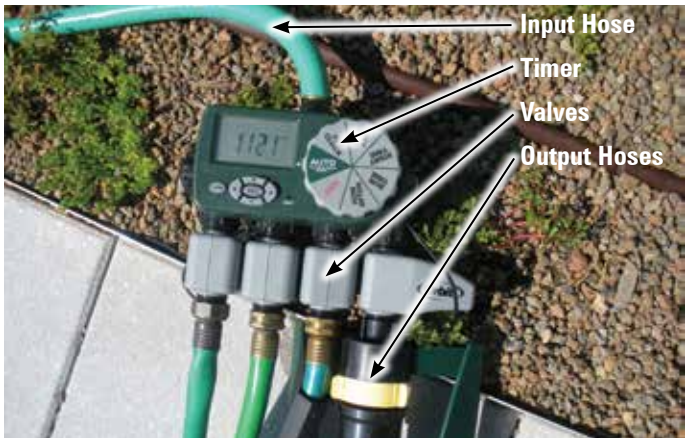
## Water Delivery Systems

There are a number of ways that water can be delivered to a vegetated roof.

**Hose Bibs and Hydrants:** These permanent components are directly connected to the buildings water supply system and come through the roof deck (roof hydrants) or through the wall (hose bibs or wall hydrants). These components require manually connecting a hose to the water spigot and running the hose to where it is needed. Both hose bibs and hydrants are very valuable elements to have on any roof. If a permanent irrigation system cannot be installed on a vegetated roof, hose bibs and/or hydrants should be installed frequently in the field of the roof. Ideally, the spacing should not exceed 100 feet; this will minimize dragging heavy hoses across newly establishing vegetation.

Designers must work with their mechanical and plumbing engineers to be sure that these roof hydrants and hose bibs/wall hydrants are sized properly **to deliver the needed water volume and pressure at the roof level** to effectively drive irrigation equipment. Many projects suffer when designers and engineers do not provide enough of these water hydrants and those units do not deliver sufficient water.

**Temporary Irrigation Controls:** A number of manufacturers have developed temporary control units that can turn a single hose bib or hydrant connection into a multiple connection point. These units (see right) employ battery operated timers and valves to run temporary irrigation equipment. While not designed for permanent installation, these units have proved useful in temporary irrigation setups (at installation and during periods of drought) to minimize labor costs associated with moving sprinklers from location to location.




## Drip and Pop-up Irrigation Systems

Once plants are established and roots begin to reach down to the lower levels of the LiteTop® growing media and the Gardendrain® panels where water is stored, permanent irrigation can provide the water the plants will require.

**Drip irrigation:** Low flow drip irrigation 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. The tubing is typically placed on top of the growing media and exposed in plug installations (see right) or covered by sedum carpet or tiles. The emitters (see bottom) built into the drip tubing release water at prescribed rates directly into the media.

Drip irrigation systems work well with vegetated roofs established with sedum and perennial plugs. The root systems in the plugs are already developed and installed in the growing media where they can reach the water released by the irrigation system. Intensive vegetated roofs (using container or field grown plants) also benefit from drip irrigation systems.

Hydrotech's InstaGreen® Carpet and InstaGreen® Tile as well as sedum cuttings require consistent water at the top surface of the growing media. Because of the free-flowing nature of the growing media, water needs to be delivered at the point where the newly installed plants can access the water.

If drip irrigation is desired by the vegetated roof designer, supplemental temporary irrigation **must** be used during the initial establishment periods for sedum carpet, tile and cuttings. While not necessary, plug installations have benefited from temporary irrigation that supplements the permanent drip irrigation.

Temporary irrigation can consist of tripod irrigation units (middle) or simple lawn sprinklers. To be effective, temporary irrigation must deliver consistent water to the entire vegetated roof surface. When combined with temporary controls like that shown on the prior page, properly designed temporary irrigation systems can be effective in delivering needed supplemental irrigation water to the new roof.

**Pop-up irrigation:** In these systems, sprinkler heads "pop-up" when in use. There are a wide variety of sprinkler units to consider with the ranges including pop-up height (3 - 12 inches), 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: Sprinkler nozzles should create large water droplets to help prevent drifting or overspray of water
- 100% Overlap: Sprinklers should be spaced no further than the anticipated water throw pattern. Irrigation designers call this "head-to-head" spacing.
- Full coverage: Sprinkler layouts should ensure that there are no dry spots
- Adequate zones: 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.

A properly designed, installed and maintained pop-up irrigation system can serve the dual purpose of providing overhead water during the initial establishment period as well as during the post-establishment period. Once the green roof is established, the system can be adjusted to provide water as needed.

Generally, a pop-up sprinkler system has higher water pressure and volume requirements than drip irrigation systems. These can be overcome by using booster pumps and proper irrigation design to distribute the water properly. There are numerous other components that are part of a properly designed irrigation system for a vegetated roof.

**Contact Hydrotech for further information.**


# LITETOP® GROWING MEDIA AND VEGETATION

# Hydrotech LiteTop® Growing Media

## LiteTop vs. Topsoil

Mother Nature requires 500 years to create one inch of topsoil, and in that time, there are numerous factors that determine the outcome of that effort. Soil is a natural material consisting of layers (soil horizons) of mineral constituents of variable thickness which differ based on the soil's parent material and the natural forces that have acted on it over thousands of years.

Some topsoils are very rich and organic while other soils are silty or sandy in consistency or heavy with clays. Geological and biological forces work on soils, changing their consistency and content over time. Soil consistency can be highly variable even within a small area. Differences in exposure to wind and water can have dramatic effects on soil structures. This wide variety of conditions creates an equally wide variety of soils, none of which are suitable for use on a vegetated roof.

Indeed, it would be very hazardous to use natural soils on a vegetated roof. Natural soils can be very heavy and, when removed from their natural condition, will not perform as Mother Nature intended. Soil structure is destroyed by excavation and transportation which ruins the original drainage capabilities of good topsoil. In the end, natural topsoils can create failure on vegetated roofs by losing their ability to drain, clogging drainage systems and inhibiting good plant growth.

While replicating the characteristics of natural soil is difficult, Hydrotech's Garden Roof® Assembly and LiteTop® growing media have been combined to do just that. The assembly components help to:

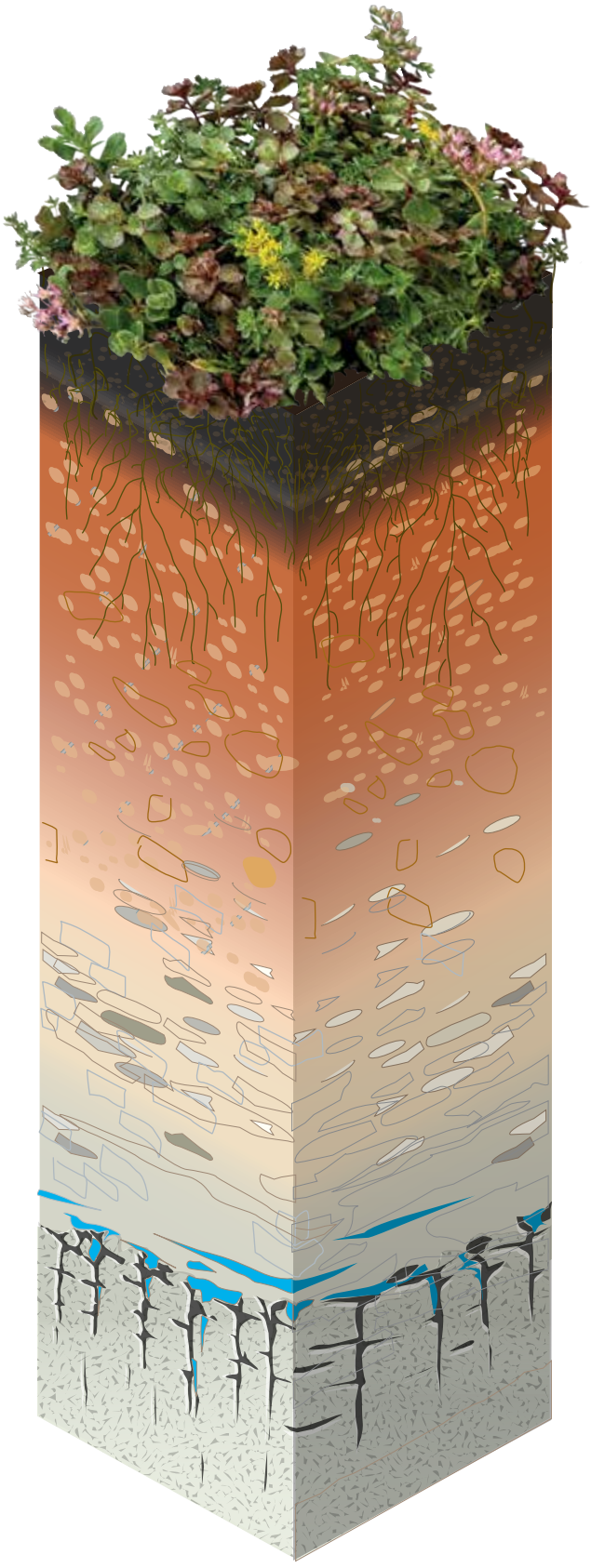
- Provide structure for strong plant support and growth
- Promote good drainage
- Store water for plant needs
- Provide nutrients for proper plant growth
- Introduce oxygen into the media structure

By using Hydrotech's Garden Roof® Assembly and LiteTop® growing media, design teams will be maximizing the performance of the roofs they design.

## Growing Media Stability

Highly organic soils can deteriorate over time if the organic matter is not replaced. The organic matter will decompose and disappear and in highly organic media, this can result in shrinkage and compaction of the overall soil mass to the point where supplemental media may be needed to maintain volume. This causes continual maintenance headaches for the building owner, especially when future soil deliveries must be made through finished spaces or hoisted to the roof.

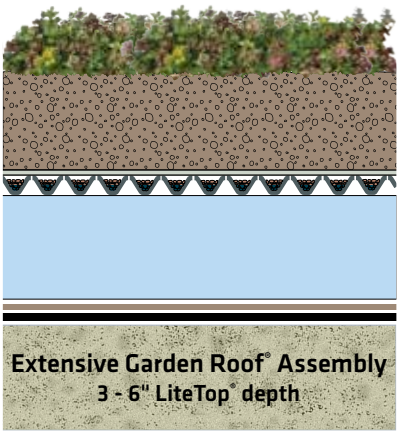
Hydrotech's LiteTop® growing media is designed to be sustainable for the long term. The structure of the media with a full range of aggregate gradations creates a very stable, porous and ideal environment for optimum plant growth with sufficient organic matter to provide initial nutrients for the plants. The Gardendrain® panels introduce air into the root zone which promotes good drainage and root growth; all important elements in maintaining vigorous plant growth.



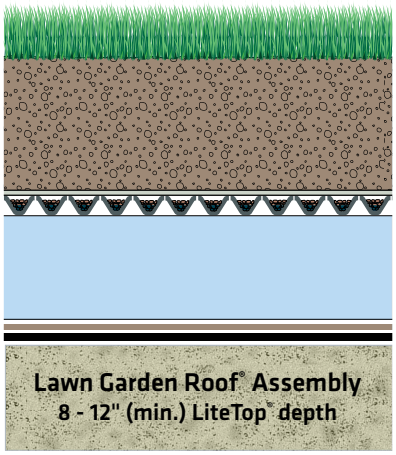
**Natural Soil Horizon**

## Growing Media Depth

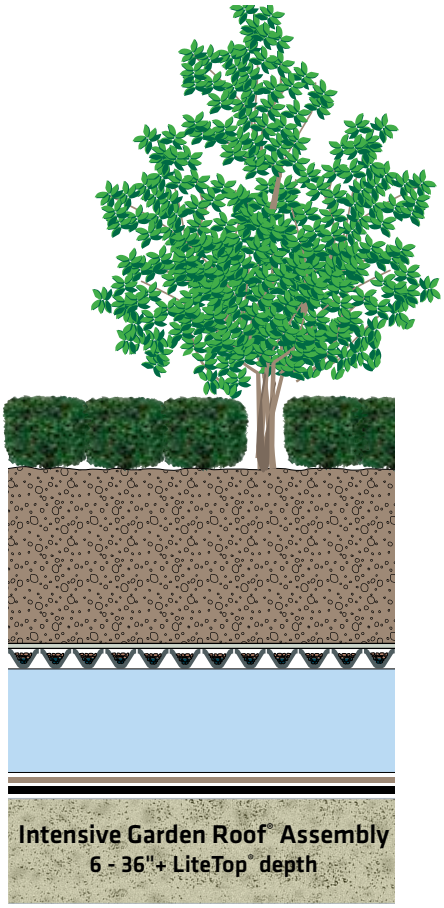
The depth of the growing media typically determines the type of plants that can be selected to grow and thrive. Each of the three major LiteTop growing media shown below have different characteristics for media particle grain sizes, water retention capacity, internal media air volume and nutrient reserves with the media.



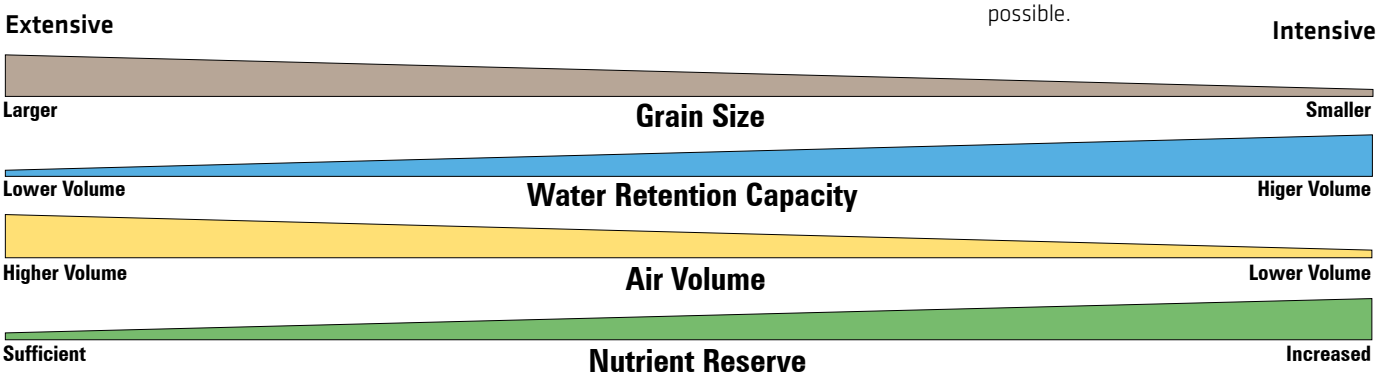

In this range of growing media depth, the designer can select from a wide variety of sedums and other low-growing, drought tolerant species. The minimum depth of media is also affected by the geographic location of the project (see below).




Because of the additional moisture requirements, lawns require a minimum of 8" of media depth; deeper amounts aid in the establishment of deeper root systems.



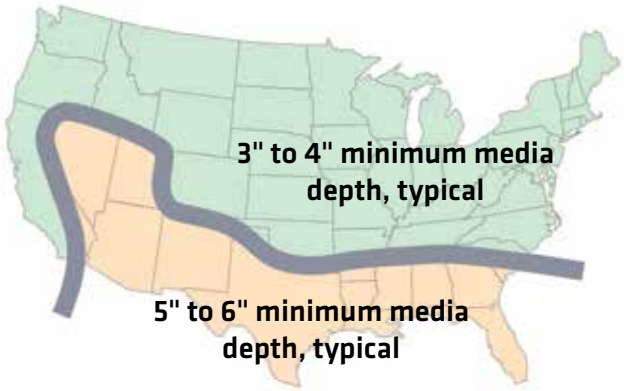

Increasing that media depth to 6" will greatly widen the palette of plant materials available to the designer and can include some smaller woody species, perennials and grasses. At greater than 12", the plant material selection increases to include small trees, larger shrubs and prairie plants. Medium sized trees can be accommodated at 18-24" and at greater than 24", even larger trees plantings are possible.




## Geographic Effects on Media Depth

In southern and southwestern states, minimum media depths for extensive vegetated roofs will generally increase to a minimum of 6 inches. This is due to warmer climates and generally wetter conditions where greater media depths are advantageous for optimum plant growth.

**Contact Hydrotech for specific considerations.**




Minimum Extensive Garden Roof Assembly Media Depth

## LiteTop® Growing Media

Hydrotech provides growing media that will allow plants to thrive in rooftop applications. Hydrotech's philosophy is to create blends that are based on the physical, nutritional and biological requirements of the different types of plants selected by the designer. These blends are adjusted for different locations and climatic conditions. The media is tested to ensure it meets the particular needs of the plant types and Hydrotech specifications. Specialty blends are available for Urban Agriculture use in growing edible crops as well as a blend that is an ultra-light weight for special structural conditions.

These components are mixed in proprietary, prescribed ratios to create the Hydrotech series of LiteTop® growing media blends. Each blend may vary slightly across the United States due to the availability of component materials in each market.

**Hydrotech's LiteTop® is composed of the following materials:**

## LiteTop® Growing Media Blends

Hydrotech LiteTop® growing media is based on performance specifications for these types of Garden Roofs®:

- Extensive Blend
- Lawn Blend
- Intensive Blend
- Urban Agriculture Blend

The specifications for each blend outlines optimal ranges for blend texture, weight, water and air holding capabilities, hydraulic conductivity (drainage), nutrient and other physical and chemical characteristics and biological activity. Tests are conducted to determine whether the blends provided fall within the ranges for each of these criteria and to optimize the performance of the particular climate where the blend will be used.

**Contact Hydrotech for recommendations on which LiteTop® media blend is best for your project.**

**Light-weight aggregates**
(pumice, scoria, expanded clay, slate or shale; based on local/regional availability)

**Well-aged composts**
(derived from a number of organic sources)

**Smaller-graded aggregates, fines and sands** (including naturally mined sands and sands derived from light weight aggregates)

## Hydrotech Blender Program

LiteTop® is blended to order by a network of Hydrotech approved regional blenders. Each of these blenders has been selected in their markets to provide the specific blend of materials needed. Hydrotech works with each blender to ensure that the LiteTop® media meets Hydrotech's quality assurance requirements and performance specifications. This testing incorporates protocols included in various ASTM standards and German FLL guidelines.

## LiteTop® Delivery Options

LiteTop® growing media is shipped to job sites in a variety of formats:

### Bulk

Delivered in dump trucks for volume delivery, bulk media is installed on the roof by a blower truck or crane lifts using bulk material buckets.

### Super Sacks

Delivered on flatbed truck trailers, these 1.25 to 2 cubic yard bags are used for hoisting LiteTop® to rooftops.


### Small Bags

Delivered on standard pallets, these 1.5 to 2 cubic foot plastic bags are typically used for small projects or for projects with special delivery requirements.

## LiteTop® Extensive Blend

This well-draining blend is designed to support the drought tolerant plants that will thrive in normal conditions where a roof may or may not receive supplemental water during the growing season. This blend has a high water holding capacity making it ideal for stormwater management BMP projects.

Tri-City Wastewater - Oregon City, OR

## LiteTop® Lawn Blend

This growing media is specifically blended for the particular needs of lawn grasses. It has a lower organic matter content like an extensive blend but has a finer texture. This blend has an excellent structure to avoid compaction problems from excessive foot traffic. This blend is intended to be irrigated on a regular basis to support lawn grasses.

Church Street Station - Evanston, IL

## LiteTop® Intensive Blend

This blend is similar to a loamy garden soil in its water holding characteristics. It is ideal for plants that like well-drained soils and can support a wide variety of plants including trees, shrubs, perennials, ground covers and other plants that are commonly found in at-grade landscapes.

1101 Dexter - Seattle, WA

## LiteTop® Urban Agriculture Blend

Growing vegetables, herbs and other edible plants on vegetated roofs has become increasingly popular and Hydrotech offers a blend specifically for this purpose. Its organic matter content is designed to support the particular needs of vegetable crops, while its structure promotes good root growth to support stems common in edible crops.

1015 Half Street - Washington, DC

# Hydrotech Plant Material Program

## Vegetation Basics

Hydrotech offers a wide variety of extensive plants including perennials as plugs and sedums in several formats including cuttings, plugs, and pre-vegetated InstaGreen® Carpets and InstaGreen® Tiles.

Each planting method allows for various degrees of design flexibility and coverage rates. Each method has particular requirements for establishment and maintenance.

## Managing Expectations

It is important to establish the goals of the project early in the design process while educating the owner on what the best solution may be for a particular situation. Plant choices will have an impact on how much maintenance and irrigation is required and how long the establishment period will be in addition to the cost and the overall aesthetics of the roof.

Vegetated roofs grow and evolve, especially during their initial establishment period. In vegetated roofs that use blends of sedums and other plants, certain species may become more dominant than others during the process of establishment. Shade and sun patterns, microclimates and rooftop equipment can affect how the evolution of the roof will occur. Designers and building owners need to understand this natural process and how it affects the look and performance of their vegetated roof.

## Seasonality

As is at-grade landscapes, the plants used in vegetated roofs go through the regular seasonal changes that are brought on by normal climate patterns. This dormancy state often produces significant changes in the vegetation colors and textures and should be expected in any vegetated roof.

## Maintenance

The maintenance of a vegetated roof **must** be considered in the early stages of the design process. A properly maintained roof should allow easy access for maintenance personnel and their equipment.

**See page 70 for further maintenance information.**

## Vegetation Selection

The proper vegetation for a Garden Roof® will depend on many different variables.

**Type of Assembly:** Extensive Garden Roof® Assemblies will be limited to drought tolerant plants that can thrive with shallow root systems. These are typically succulents or other plants with low water needs. Hydrotech can provide plant material in several forms for Extensive Assemblies (see pages 52-57).

Lawn and Intensive Assemblies with greater soil depths will be able to sustain a much larger variety of plant material such as turf grass, perennials, shrubs and even large trees.

Hydrotech's Garden Roof® department is available to assist with plant selection for a specific project.

**Media Depth:** The minimum depth of the LiteTop® growing media is affected by location of the project (see page 47). This minimum depth will affect the range of plants that are suitable for the project. The selected plant material must be appropriate for a project's specific climatic conditions. Typical sedums may not be the best selection for hot climates. Hydrotech can provide alternative extensive vegetation for these regions.

**Sun/Shade Exposures:** Plant selection should take into account the amount of hours of sunlight the roof will receive during the growing season. Different plants require different amounts of sunlight per day in order to thrive. If shade is a concern, it's best to conduct a sun/shade study for the building in order to determine exactly how many hours of sunlight different areas of the roof will receive at various times of the year. However, it's also important to remember that due to the potential for new construction adjacent to the site the amount of direct sunlight the roof receives could change in the future. It's best to include a wide variety of plants in the original plans so the roof can adapt and change over time. If the sunlight levels change drastically, the roof may need to be replanted with very shade tolerant varieties.

**Slope/Erosion Control:** For sloped projects or high wind conditions, a pre-vegetated mat such as InstaGreen® Carpet or InstaGreen® Tile is the best way to prevent soil erosion. Mature plant material provides full coverage, and it will root quickly to hold the soil in place.

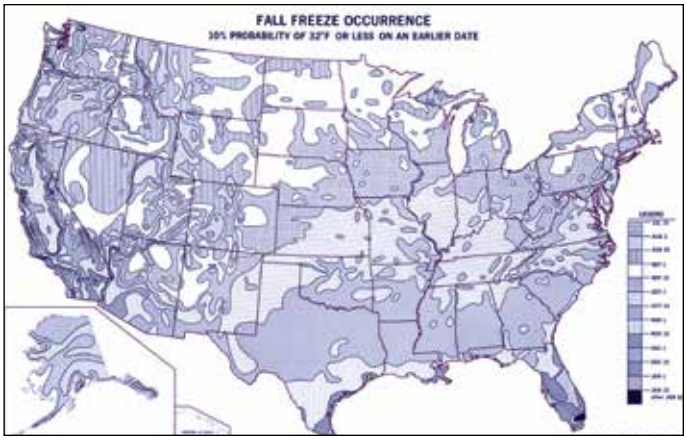
Seasonal changes can be expected as shown in photos below

(Spring) Good Samaritan Hospital - Puyallap, WA

(Fall) Good Samaritan Hospital - Puyallap, WA

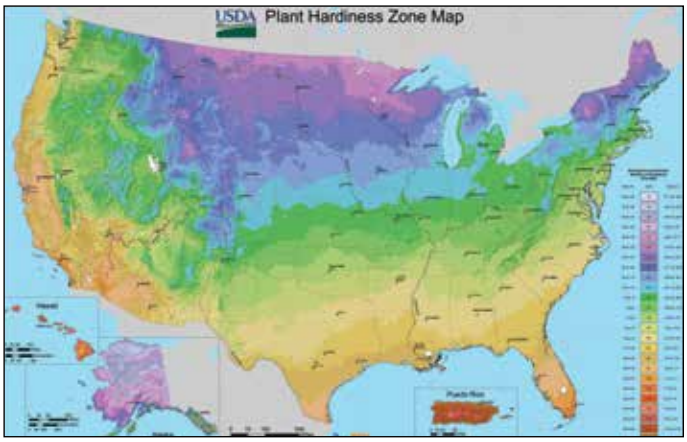
## Planting Times

The installation of the various components that make up the Hydrotech Garden Roof® Assembly – roof membrane, protection course, root barrier, insulation, Gardendrain®, LiteTop® growing media, etc. – can take place at most any time of the year. However, in climates where frost occurs and the soil freezes, planting for extensive assemblies can only take place during certain times of the year. The planting window will vary based on the location of the project and type of extensive vegetation being installed. These planting times will vary depending upon the method of planting and the types of plants being used. Hydrotech uses the NOAA frost date databases for cities and regions across the United States to determine planting dates for its plant materials.




## Plant Evaluations

Hydrotech continually evaluates plant materials across the United States for potential inclusion into the Hydrotech Plant Program. This evaluation process uses local experiences and national weather and climatological information. The USDA Plant Hardiness Zone is one of the tools that Hydrotech uses in its evaluations. This is a generalized low temperature zone map. Additional research evaluates plants based on moisture requirements, high temperature zones and other factors.

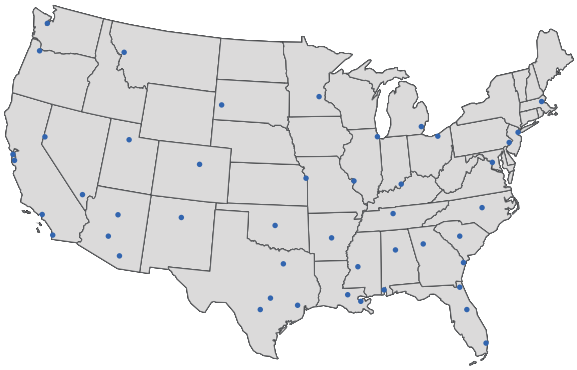



## Regional Plant Lists

Hydrotech has developed plant lists for Extensive Garden Roof® Assemblies for numerous cities covering the United States, all of which are included in Hydrotech's Plant Warranty program.

Each list is assembled using plants that are proven to thrive in a desired location. The plant lists (examples at right) contain information on: height, spread, water needs, sun exposure, foliage and bloom color, USDA Hardiness Zone and the months in which blooming occurs.

Designers who wish to obtain a plant list that is specific to their locality can either contact their local Hydrotech Representative or contact Hydrotech directly. Each city list contains at least a dozen different plants that Hydrotech will warrant for thrivability, however some cities will have significantly more plants to choose from. Custom lists can also be developed to address certain needs such as colors, heights and other requirements.

**Hydrotech Extensive Plant Program - Available City Lists**

## Plant Material Overview

Hydrotech can provide a two (2) year warranty on the vegetation it provides as part of the total Garden Roof® Assembly. This two year warranty covers the thrivability of the plant material, as well as coverage (depending on the type of vegetation provided). The warranty is contingent upon the necessary required maintenance (outlined by Hydrotech), performed by a qualified contractor under contract to the owner. Please refer to pages 70 and 71 regarding Hydrotech's maintenance requirements.

Lovejoy Block 1 - Portland, OR

### Sedum Cuttings

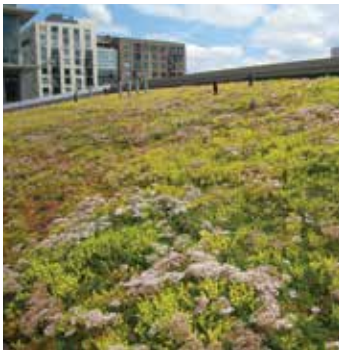
Cuttings from sedum plants can provide a very effective and economical vegetated roof. Blends of cuttings can provide a wide array of textures and flower colors for the vegetated roof. Shipped loose in boxes to the project site, the cuttings are spread on the prepared growing media and secured with hydromulch. In 2 to 4 weeks, the cuttings will push new roots into the media. Coverage speed can vary depending on the amount of cuttings applied, time of the year installed, region of the country and water availability. **See page 54 for further information.**

### Sedum and Perennial Plugs

Custom grown plugs of a wide range of sedums and other perennials are also available. Installed at 8 inches on center (2.25 plants per SF), plugs can give the designer nearly unlimited freedom to create swaths of color and texture on the roof. Plugs are available in many of the sedum varieties as well as perennials and native plants. Provided in 50- or 72-count plug sizes. **See page 55 for further information.**

### InstaGreen® Carpet

For a vegetated roof that is completely green once completed, Hydrotech offers InstaGreen® Carpet. Provided in approximately 4' x 6.25' (25 SF) rolls that are laid out onto the prepared growing media like sod, InstaGreen® Carpet has a range of sedums that provide nearly complete coverage on Day 1 of the vegetated roof. **See page 56 for further information.**



### InstaGreen® Tile

In another format that creates an instantly green roof, Hydrotech offers InstaGreen® Tiles. Created in a 12" x 24" (2.0 SF) tile format, InstaGreen® Tiles are shipped to the job site on pallets and installed directly on top of the prepared growing media. Available in several standard blends to address most roof top conditions, InstaGreen® Tile is also available in custom blends. **See page 57 for further information.**

## Vegetation Options

### Natives

Native plants are those that have developed, occur naturally or have existed in a particular area for many years. Some of these plants have adapted to a particular microclimate involving harsh conditions or challenging soil conditions.

Often designers wish to include natives on their vegetated roofs. Hydrotech has developed plant lists that include native plants for specific areas. These select native plants are adaptable to the specialized environments that exist on a vegetated roof.

### Options Other than Sedum

While sedums are one large group of plants that are used on most vegetated roofs, there are many other types of plants that can be incorporated:

- Grasses
- Perennials
- Sempervivum
- Ferns
- Cacti
- Bulbs
- Groundcovers

Some of these plants are considered native plants in certain parts of the United States.

Hydrotech can provide many of these plants as plugs for use in extensive vegetated roofs. **Please contact Hydrotech for details.**

### Intensive Plant Materials

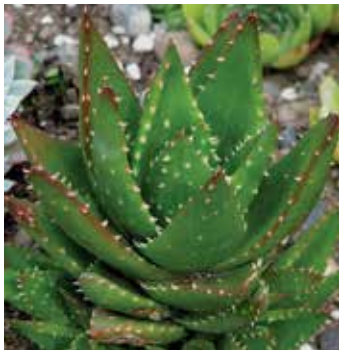
Hydrotech's Intensive Garden Roof® Assembly will support many different types of larger plant materials that can be used on rooftops.

- Shrubs
- Larger sized perennials
- Ornamental trees
- Shade trees
- Palm trees

**Hydrotech does not provide plants for intensive projects and cannot include those plants in thrive/coverage warranties or removal/replacement warranties.**

**See pages 61 - 62 for additional background information on intensive plant materials and techniques.**

**Contact Hydrotech for further information.**






Trump International Hotel & Tower - Chicago, IL

## Sedum Cuttings

Sedum plants can be established directly onto LiteTop® media by spreading cuttings harvested from the shoot tips of a wide variety of sedums.

Sedum cuttings are available May - September and are typically only produced during the non-flowering period for the plants. These cuttings are usually 1" to 2" in length depending on the sedum variety. The cuttings are harvested, shipped to the project site and spread directly on the surface of the media. In the event that the cuttings cannot be spread immediately, they can be stored for up to 2 days under ideal, cool (75 degrees or lower) conditions. They should be stored in shaded areas or indoors in air conditioned space during that time. Packaged cuttings should be monitored to maintain moisture content during storage.

Cuttings are spread onto the prepared surface of the LiteTop® media by hand. Coverage rates vary depending on the speed of the desired eventual coverage. To qualify for Hydrotech's Plant Warranty, a minimum rate of 8 pounds per 100 square feet of area is required. Cutting coverage rates can be budget driven; labor costs are often much higher than the cutting material costs. Increasing the rate to 10 to 12 pounds per 100 square feet can dramatically decrease the coverage time while not significantly increasing labor costs. The maximum rate for installing cuttings would be approximately 18 to 20 pounds per 100 square feet.

In order to avoid monoculture plantings, multiple (at least 3) varieties of sedum cuttings are typically blended together before installation on the roof. Hydrotech can recommend specific blends of cuttings that would be suitable for a particular project.

It is strongly recommended that a hydromulch with an integral tackifier be applied over the top of freshly installed sedum cuttings. Hydromulch is mixed with water in a truck or trailer-mounted agitator tank and the wet slurry is pumped and sprayed on the surface of the cutting installation. This helps to anchor the cuttings to the media and prevents them from blowing away in strong winds. It also keeps the moisture content of the surface of the media more consistent and available for the cuttings.

A dry mulch is available for use where wet hydromulch is not feasible due to equipment limitations. This dry mulch is spread on the surface and thoroughly wetted in to activate the tackifier that secures the mulch and cuttings to the roof.

**Contact Hydrotech for further details.**

## Sedum and Perennial Plugs

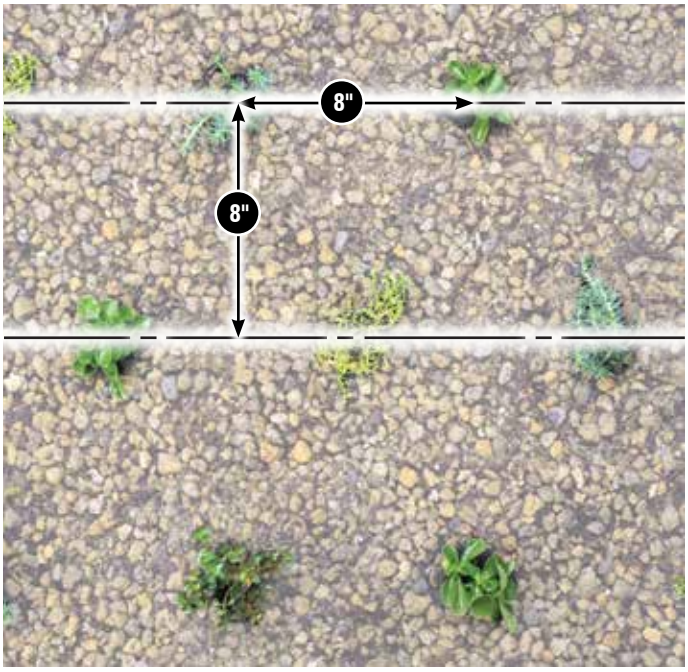
A wide variety of plants including sedum, grasses and perennials can be provided as plugs. These plugs are typically 50- or 72-count size plugs and are ideal for planting in extensive vegetated roof assemblies. Plugs allow the designer to create broad swaths of colors and textures using similar plants. Hydrotech does not advocate the use of monoculture plantings due to the possibility of unforeseen failure of any one particular species due to weather, diseases, etc. Combinations of sedums and perennials with complementary characteristics (color, texture, bloom time, etc.) can help preserve the design intent of the planting in the event of an unforeseen issue. Careful coordination and timing of plug plantings between Hydrotech and the contractor helps ensure that the plugs arrive at the job site in optimum condition and ready for installation.

**To qualify for Hydrotech's Plant Warranty program, plugs must be spaced at 8" on center staggered (2.25 plants per square foot) in rows that are 8" apart** (see middle image at right). Sedum plugs when planted at this maximum spacing would qualify for the coverage portion of the warranty. Planting is best accomplished in spring or autumn. However, plugs can be planted throughout the growing season provided the plants receive sufficient moisture via irrigation.

On certain projects (especially projects that have high wind requirements), plugs are planted through GardMat® erosion control matting (bottom left). GardMat® can be provided in two weights depending on the project needs and is secured using perimeter edging, pavers and disk anchors.

Plugs can provide tremendous opportunities for creativity for the designer. Hydrotech can provide a standard blend of plug species (bottom left) for installation or designers can create more specific combinations to address design objectives. See page 50 - Design Flexibility for further explorations of opportunities for designers.

Ideally, plugs are planted immediately after delivery. Plugs can be stored for up to 2 days under ideal, cool (75°F or lower) conditions. Packaged plugs should be stored in shaded areas or indoors in air conditioned space. During that time, packages should be opened, removed from any boxes and watered to maintain moisture in the plug.




Grange Insurance - Columbus, OH

## InstaGreen® Carpet

InstaGreen® Carpet is one of the Hydrotech product offerings that creates an instant cover of sedum plants on the surface of the vegetated roof on the day of installation.

Large areas of vegetated roof can be quickly installed using sedum carpet. It can be installed throughout the growing season provided sufficient water is available in the first few months after installation. In addition, accent plugs can be planted through the sedum carpet to provide for additional seasonal interest (color, height, texture, etc.) if desired.

InstaGreen® Carpet is typically used only in moderate climates. For projects in southern or southwestern areas of the US, contact Hydrotech for other plant options. Grown, harvested and transported to the project site much like sod, the InstaGreen® Carpet arrives on pallets in 4' x 6.25' rolls (25 SF). The rolls include fully grown sedum plants growing into a thin layer of media atop a coconut coir base.

### Product Features

- **Instant Green:** InstaGreen® Carpet is delivered with at least 85% plant coverage.
- **Flexible Design:** For a unique look, perennial plants and/or plugs can be planted through the carpet during installation.
- **Sloped Installations:** Enhanced erosion control makes InstaGreen® Carpet ideal for low and steep slopes.
- **Diversity:** Includes many different sedums suited for various climates and exposures. In time, nature will select which combination of plant species will be best for the project's conditions.
- **Customization:** Custom carpet is available; contact Hydrotech for details.
- **Maintenance:** Minimal maintenance requirements once established.

Ideally, InstaGreen® Carpet should be installed immediately after delivery. The carpet can be stored for up to 2 days under ideal, cool (75 °F or lower) conditions. During that time, the carpets must be unrolled and stored in shaded areas and watered to help maintain moisture content.

The individual rolls are rolled out onto the prepared media surface and fitted together to form a continuous surface of sedum. To provide additional diversity and visual interest, perennial plants can be installed through the carpet into the media below.

Unlike turf sod, InstaGreen® Carpet is not rolled after installation. It is thoroughly watered in after installation and the establishment and maintenance period begins.

InstaGreen® Carpet starts to establish into the underlying growing media immediately and quickly establishes to create a multi-colored field of sedum plants.

Lovejoy Block 1 - Portland, OR

# InstaGreen® Tile

Like InstaGreen® Carpet, InstaGreen® Tile creates an instant cover of sedum plants on the surface of the vegetated roof at the time of installation. InstaGreen® Tiles are cultivated in 12" x 24" (2.0 SF) tiles which are harvested and shipped to the project site.

Large areas of vegetated roof can be quickly installed using Sedum Tile. It can be installed throughout the growing season provided sufficient water is available in the first few months after installation.

InstaGreen® Tiles are grown in controlled production environments to help ensure the quality of the product.

InstaGreen® Tile is typically used only in moderate climates. For projects in southern or southwestern areas of the US, contact Hydrotech for other plant options.

The tiles are packed and shipped in large boxes or shrink wrapped on pallets. Each tile contains completely grown sedum in a thin layer of media atop a coconut coir base.

**Product Features**

- **Instant Green:** InstaGreen® Tile is delivered with 95% plant coverage.
- **Installation:** Size and weight of tiles allows for quick and easy installation in spaces with even limited access.
- **Varietal Mixes:** Several standard sedum blends are available for almost any roof top environment.
- **Customization:** Custom tiles are available including a shade tolerant blend; contact Hydrotech for details.
- **Regional Blends:** Hydrotech is developing tile blends that address specific regional needs.
- **Maintenance:** Minimal maintenance once established.

Ideally, InstaGreen® Tiles are installed immediately after delivery. The tiles can be stored for up to 2 days under ideal, cool (75°F or lower) conditions. During that time, the tiles must be unpacked and stored in shaded areas and watered to help maintain moisture content.

Prior to tile installation, the media is prepared and thoroughly watered. Raking the media is performed to help ensure complete contact of the tiles to the media.

Once at the job site, the tiles are unpacked and laid directly on top of the prepared LiteTop® media surface. These tiles are easy to handle and fit together like floor tiles. Their light weight allows a single installer to carry a number of tiles at a time to achieve significant installation speed.

Tiles are not rolled after installation. The tiles are thoroughly watered in and the establishment and maintenance period begins.

InstaGreen® Tiles start to establish into the underlying media immediately and quickly establishes to create a multi-colored field of sedum plants.

As with InstaGreen® Carpet, accent plugs can be planted through the tiles to provide for additional seasonal interest.

**Standard Mixes**

**Four Season**
Year-round interest

**Full Color**
Maximum color interest

**Shade Tolerant**
Withstands light shade (custom blend)

**Rugged**
Hardiest blend

Fountaindale Library - Bolingbrook, IL

# Design Flexibility

Many vegetated roofs are installed using cuttings, plugs, InstaGreen® Carpet and InstaGreen® Tile and the results create a beautiful blend of colors and textures over the vegetated portion of the roof. The blend of sedum and perennial species that are included in these vegetated roofs help to ensure a wide range of plant diversity.

Designers can use familiar design techniques in creating unique vegetated roofs. Plugs are an effective way to create broad swaths of color and texture in a rooftop landscape. The diversity of colors and textures available in sedum and perennial species can create dramatic combinations.

Sedums in particular have an irregular spreading habit that is a challenge to contain without regular maintenance to preserve the shape and form of the massing. While smooth shapes can be planted, eventually the lines can become blurred as the adjacent sedum plantings blend together. Some designers have used this blurring technique to their advantage by using sharp contrasts in sedum color and textures in a more organic design approach. These plantings take on a more impressionistic feel with splashes of color and texture working in tandem to create very dynamic combinations.

These patterns will change as the plants go through their normal growth cycles during the year. During the blooming cycles, some sedums can create tall stalks of blooms that rise above the base plants.

Grid arrangements have been used by many designers. Plugs are typically planted in rows; Hydrotech recommends planting plugs 8" on-center in rows 8" apart. This is the optimum spacing to meet the Hydrotech plant coverage warranty requirements.

Some designers have used this grid arrangement by varying the species and varieties within the row. Much like quilting or paving patterns, a wide variety of curvilinear, geometric patterns can be created to respond to adjacent architectural expressions.

It is important to recognize that care must be taken in not creating a monoculture planting. Hydrotech cannot provide coverage warranties for monoculture plantings. As in at-grade landscapes, monocultures have always had a risk due to unforeseen climatic, physical or biological problems that occur after the plantings are installed. For example, to create large areas of a particular color, designers should include at least 3 or 4 similarly colored plants to help ensure that the color design intent can thrive. In doing so, this wider variety of plants can often extend the impact of a design intent further into the year than a single species.

InstaGreen® Tiles and Carpets create diversity by including multiple sedum varieties in a single tile or carpet. The InstaGreen® Tiles are offered in three different standard mixes: Four Season, Full Color, and Rugged. Combinations of these three tile blends can create color and texture differences to help implement the designer's intent.

InstaGreen® Tiles can be custom blended as well to create unique combinations of sedum foliage and bloom color and textures (bottom right). With advanced notice (10 to 12 weeks), a customized tile would be ready for planting on the Garden Roof®. Customized tile projects must be carefully coordinated with the contractor and Hydrotech to ensure that enough growing time and sedum source materials are available.

The Plaza at PPL Center - Allentown, PA

Tri-City Wastewater - Oregon City, OR

Grange Insurance - Columbus, OH

Machias Elementary School - Snohomish, WA

# Blending Plant Materials

Another option for designers to consider is to interplant perennial plant plugs into the InstaGreen® Carpet or Tiles. Adding perennial plants to sedum plantings creates another set of colors and textures to work with in the landscape design. While the sedums create the base plane planting, the perennials can act as the taller accents in the landscape design.

Perennial plugs work very well with vegetated roofs established with cuttings. Plugs can be installed before or after the installation of the cuttings and the subsequent hydromulch materials.

Many of the plants that are available as plugs through Hydrotech (like the heuchera and allium shown at right) can be installed through either the InstaGreen® Carpet or Tile after installation. A small opening is cut through the carpet or tile and the plug is inserted into the media below. The plug knits itself into the media and surrounding sedum plantings. Plugs can also be planted within the InstaGreen® Tile while still in the production stages. The achillea (right) have been inserted into the sedum tile in the nursery.

Many perennial plant species work well when planted into the tile at the nursery. Certain species that have bulbs or tubers (allium, iris, etc.) must be planted after the tiles are installed; their plant structure needs deeper media depths than what the tiles are established with.

Certain design techniques require that the perennial plugs be planted after installing the InstaGreen® Carpet or Tile. Creating accent plantings like the introduction of the Festuca glauca ornamental grasses (lower right) need to occur after the tile is installed to help ensure proper placement of the accent elements in the landscape.

For intensive plantings, the full range of design techniques used for at-grade landscapes can be applied to rooftops landscapes. The full range of groundcovers, perennials, shrubs and trees can be installed on the Garden Roof®. Tree guying will require different techniques in order to secure the trees to the roof. This generally involves installing anchors into adjacent supports or using concrete "dead-man" masses below the trees for use as anchors. See the following pages on mounding and tree planting.

LiteTop® growing media can be blended to address various sections of a vegetated roof. In the Church Street Station (Evanston, IL) project (bottom right), the top level of the parking structure was developed into a Garden Roof® by using LiteTop® Lawn and Intensive growing media blends. Standard irrigation system components were used to provide supplemental water to the lawn and plantings. The landscape goes through all of the same seasonal foliage changes as comparable at-grade landscapes.

Designers should remember to accommodate the same maintenance needs including lawn mowing equipment, landscape clippings and trimmings, irrigation maintenance, etc. This may include providing a storage area at the roof level to minimize movement of equipment through finished spaces within the building and to make it easier for maintenance personnel to perform the proper tasks.

Hydrotech's Garden Roof® staff includes landscape architects with many years of design and construction experience available to assist you in your next project.

**Contact Hydrotech for additional information.**

Church Street Station - Evanston, IL

# Creating Topography

Adding vertical dimension to vegetated roofs by adding topography can be accomplished in several ways. On some projects, LiteTop® growing media can be installed deeper to create gradual mounding effects. This technique is subject to the structural limitations of the building.

Mounds can be created to slope limits commonly found on at-grade landscapes. GardMat® erosion control nettings are needed when slopes require additional anchorage. Slopes over 3:12 (14°) may require additional support such as GardNet®.

For projects where adding weight is an issue, topography can be created by using layers of DuPont STYROFOAM™ insulation. STYROFOAM™ is extremely lightweight, is easy to handle and cut into shapes. Its closed-cell internal structure makes it ideal as insulation and fill material under LiteTop® media for normal applications and for creating topography.

STYROFOAM™ is stacked to the height and shape necessary to create the topography required (see right). While DuPont STYROFOAM™ comes in a variety of thicknesses, 2" thickness is very commonly used for this application. There is no staking required between the STYROFOAM™ layers although pegging with short stakes or using an adhesive can keep the layers from shifting during subsequent construction steps.

While many projects use the same media depth over the STYROFOAM™ layers, "wells" can be created using layers of STYROFOAM™ to increase the media depth for special situations such as large shrub or tree plantings. Irrigation systems can be easily incorporated into these mounds by cutting slots into the insulation for placement of the irrigation piping.

Once the final mound of stacked insulation is in place, lightweight aggregate and Systemfilter are installed over the mound (or Gardendrain® panels and lightweight aggregate). LiteTop® growing media is installed to the depth required by the plan and plants are installed. A full array of plants from the Hydrotech Extensive Plant Program can be used or intensive plants at the designers' choice.

Expanded polystyrene geofoam can also be used to create topography (bottom left). Billets of geofoam can be stacked to create the desired topography and covered with LiteTop® and other Garden Roof® components. Steep slopes will likely require the use of GardNet® to prevent media movement (bottom right)

Designers should be aware that detailed grading plans for the roof make creating topography much easier.

**Contact Hydrotech for additional information.**

Providence Everett Medical Center - Everett, WA

Providence Everett Medical Center - Everett, WA

Providence Everett Medical Center - Everett, WA

Stepped geofoam used to create topography - Brinton Museum - Brinton, WY

GardNet® used to stabilize LiteTop® media layer on sloped roof - Brinton Museum - Brinton, WY

# Intensive Planting

Plants like larger perennials, shrubs, ornamental, shade and palm trees can be incorporated into a vegetated roof provided several considerations are recognized:

- Plants normally used in at-grade landscapes may not grow to the same size or shape when grown on a roof top.
- Some plants that normally have deep root structures may not do as well on vegetated roofs than they would in at-grade landscapes.
- Certain plants will grow to large sizes and those future loadings must be accounted for in the structural design of the roof.
- Wind issues must be taken into account, especially when designing intensive vegetated roofs at higher roof elevations.
- Accommodations must be made for guying larger plant materials. Secure anchoring devices, tie-offs and other techniques must be included to help ensure proper alignment of the plant materials (see the following page for more background information on tree plantings).
- Plant root balls or containers in which they are grown will be a determining factor in LiteTop® media depth. Regional landscape nursery practices often determine the container sizes that are commonly available and the size and shape of root balls that are normally produced during the transplanting operation. It may be possible (with advanced planning) for a nursery to specially prepare certain plants for use on a vegetated roof.
- Permanent irrigation is a must. Intensive landscapes using engineered medias that are freely draining must have permanent irrigation to provide the water needed to allow these landscapes to thrive.

As stated earlier in this Planning Guide, Hydrotech does not supply, provide or warrant any intensive plant materials used in its intensive Garden Roof® Assembly.

Hydrotech does, however, provide many Garden Roof® and Ultimate Assembly® components that allow designers tremendous freedom in their design efforts. The top two photos on this page are from Zimmer Plaza at the University of Cincinnati. DuPont STYROFOAM™ was used to create raised ring structures to provide sufficient depth to accommodate ornamental trees. Irrigation piping was installed and tested immediately before the LiteTop® media was added.

These structures were incorporated into the Intensive Garden Roof® Assembly with RockCurbs as the edging. This assembly created sufficient LiteTop® media depth to accommodate the ornamental trees, shrubs, groundcovers and lawn areas in this project. The architectural pavers in the Ultimate Assembly® were used to create the hardscape spaces and walking surfaces in this plaza project.

Successful intensive installations can be indistinguishable from at-grade landscapes. The 1101 Dexter project in Seattle, WA and the Sherman Plaza project in Evanston, IL are outstanding examples of intensive landscapes on the rooftop.

**Intensive plantings require special details, specifications and considerations. Please contact Hydrotech for additional information.**

University of Cincinnati - Zimmer Plaza - Cincinnati, OH

University of Cincinnati - Zimmer Plaza - Cincinnati, OH

1101 Dexter - Seattle, WA

Church Street Station - Evanston, IL

# Accommodating Trees

Tree installations are extensions of creating topography on the Garden Roof®. Trees can create concentrated loads on a roof. Careful and special coordination with the project's structural engineer is required for incorporating trees. Trees also can grow significantly larger over their lifetime. Consideration for ultimate tree height and weight must be anticipated in the structural design for the roof.

Trees require significant amounts of water so irrigation is especially important. Drainage for trees is accommodated by the use of Gardendrain® panels or Hydrodrain®.

In deeper intensive assemblies, trees can be supported using the deck and rings of porous bags of LiteTop® growing media (see right). The bags form a supporting ring of media under the tree root ball to add stability to the tree.

Guying trees on rooftops also requires special planning. Unlike at-grade landscapes where stakes can be used as anchors, the designer must plan for either incorporating guy anchors into nearby structural elements or by providing precast concrete "deadman" anchors (see right). The advantage of these anchors is that the locations and anchoring points for the trees can be altered during construction. The deadman anchors rely on the mass of concrete and the media above to provide points to which to attach guy wires.

All of these elements can be installed after the completion of the membrane work and installation of Gardendrain® and related elements.

LiteTop® media is added to final depth and the trees are planted in a very similar at-grade technique (see right and bottom right). Once trees are planted, guyed and watered in, the balance of the landscape can be installed.

**Creating tree plantings requires special details, specifications and considerations. Please contact Hydrotech for additional information.**

# INSTALLATION AND MAINTENANCE

1101 Dexter - Seattle, WA

# General Installation Guidelines

The following is a general outline for the installation of a typical Hydrotech Garden Roof® Assembly. Extensive, Intensive, sloped, lawn, urban agriculture and Blue Roof Assemblies are similar and each use different components. Not all components that may be needed or specified are described. This is a general outline only. Specific component installations may differ depending on the actual project conditions.

## Monolithic Membrane 6125®

**The Protected Membrane Roof (PMR) Planning Guide** provides a more in-depth view of the benefits of using Hydrotech's flagship product - Monolithic Membrane 6125® - to keep the building structure watertight.

## Root Barriers

Hydrotech offers an array of root barriers intended for use with specific groups of plants. These include:

- Root Stop (10 mil)
- Root Stop HD (30 mil)
- Root Stop Bamboo
- Hydroflex® RB II (combination protection sheet and root barrier)

For Extensive and Intensive Assemblies where Hydroflex® 30 is used in the assembly, Hydroflex® 30 is rolled directly into the MM6125® while still warm to ensure good adhesion. Root Stop or Root Stop HD is loose laid over the Hydroflex® and extended full height to cover all flashings. Root Stop should be terminated at or above the eventual level of the growing media. Adjacent sheets are lapped 5 feet to protect against the lateral growth of roots or taped with Root Stop Tape with a 2-1/2 foot Root Stop overlap.

Root Stop HD can be used along with Hydroflex® 30® protection course as an alternative to Hydroflex® RB II.

For intensive and steep sloped applications, Hydroflex® RB II is rolled directly into the MM6125® while still warm to ensure good adhesion. The material is typically lapped 3 inches and all laps/seams **must** be sealed with a propane torch or sealed with additional hot MM6125®. Hydroflex® RB II is extended full height to cover all flashings and should be terminated at or above the eventual level of the soil. Finished seams **must** be sprayed with SpinOut root growth regulator. The specified leak testing can now be conducted.

## Insulation

When specified, STYROFOAM™ brand insulation is installed loose laid over the completed root barrier/protection layer. The thickness is determined by the R-value desired (design R = 5 per inch thickness). Boards are to be butted tightly and laid to within ½ inch of all flashing details. The foam should be cut out over all drains and fit snug around all penetrations.

## Gardendrain® Panels

Specified Gardendrain® components should be loose laid over the entire roof deck. Complete coverage may be obtained by butting adjacent panels together.

Gardendrain® panels should be installed with the **aeration holes facing up,** cut out around all drains, and fit around all penetrations. Depending on the assembly, the cups in the Gardendrain® panels are filled with lightweight aggregates.

Installing MM6125-FR waterproofing membrane with reinforcing fabric - total thickness of 215 mils

Installing Hydroflex protection sheet (RB II or 30) into second layer of MM6125 membrane

DuPont STYROFOAM® is installed in layers to depth needed to achieve R-rating

Gardendrain® installed over insulation and filled with lightweight aggregates (optional)

## Systemfilter

Systemfilter is installed to prevent the LiteTop® growing media from washing out through the assembly. It is loose laid over the Gardendrain® and lapped at least 12" (side and end laps) to ensure complete coverage.

In all cases, enough material should be gathered at all perimeters and penetrations so that the fabric extends a minimum of 6" above the anticipated soil or ballast level. Excess may be trimmed down once the overburden is installed.

## LiteTop® Growing Media

Hydrotech's LiteTop® growing media can be supplied bulk or bagged. Delivery onto the roof can be accomplished by elevator, crane or blowing and will primarily depend on site access and size of the project. The contractor determines the appropriate delivery method to the roof. Storage on site of bulk materials also needs to be considered. LiteTop® is lightly compacted using a water-filled lawn roller before planting.

## Water and Irrigation

Irrigation systems can be installed prior to or after growing media installation. Any system (permanent or temporary) must be tested and ready for service prior to plant installation.

Immediately prior to planting, all media surfaces must be thoroughly soaked with water to cool the media and to prepare it for plant installation.

Plants used in Garden Roof® installations are living materials and will require water during installation and establishment. Hydrotech requires confirmation of the availability of sufficient water prior to shipment of any plant materials. **Contact Hydrotech for water and irrigation requirements.**

## Planting

Plant materials must be installed as soon as possible after delivery, preferably the same day. Plants delivered to the job site must be properly stored to keep materials cool and watered prior to installation on the roof.

All plant materials must be thoroughly watered in immediately after installation.

Plant material installation must observe spring and fall frost dates established by Hydrotech.

## Maintenance

Maintenance must commence immediately after installation and continue through the time when the building is turned over to the owner. At that time, several arrangements can be made for continuing the required maintenance. Often, the installing contractor continues with the maintenance. At times, a separate maintenance contractor is engaged to continue the required maintenance of the new Garden Roof®.

All maintenance contractors must be familiar with the particular needs of maintaining vegetated roofs and the Hydrotech requirements needed to maintain the plant material warranty.

Systemfilter® installed to keep LiteTop® media out of Gardendrain®


LiteTop® installed to desired depth

Plant materials being installed over prepared LiteTop®

Irrigation being readied for new Garden Roof® planting

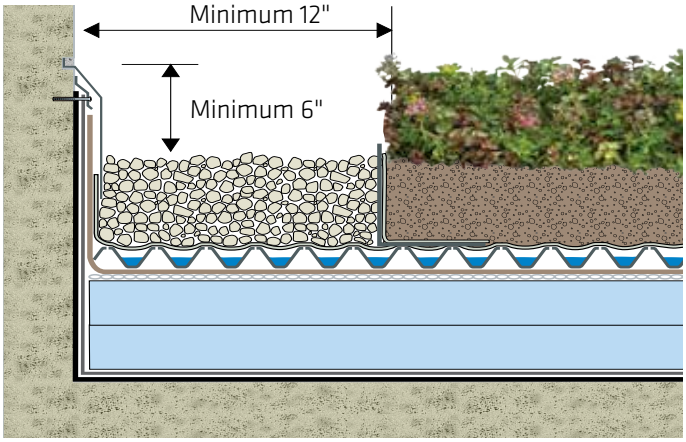
# Typical Perimeter and Transition Conditions

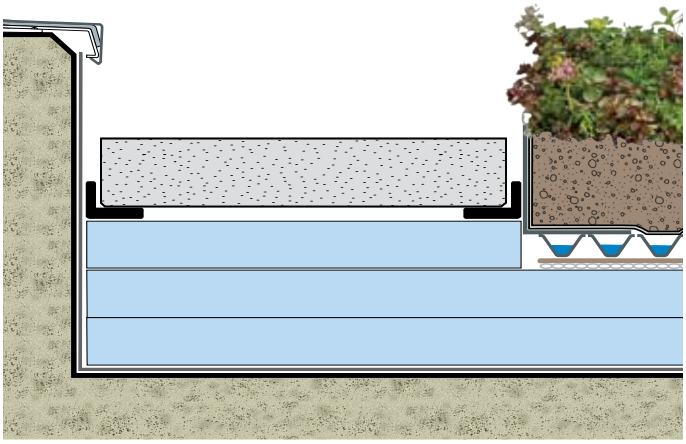
## Building Walls, Parapets and Curbs

Membrane flashing must be extended above the final grade of the Garden Roof® Assembly, and must be properly terminated in accordance with Hydrotech guideline details. Vegetation Free Zones (VFZs), a minimum width of 12" of gravel ballast or pavers, provide many functions including easy access to critical flashings and improved drainage.

All of these details shown are conceptual and must be adapted to the specific conditions of each project. Many of these details are available on Hydrotech's website (www.hydrotechusa.com)

**To qualify for the limited wind blow-off warranty, VFZ must be a minimum of 24" wide or more depending on parapet height, roof height, wind zones and other factors. Contact Hydrotech for further details**

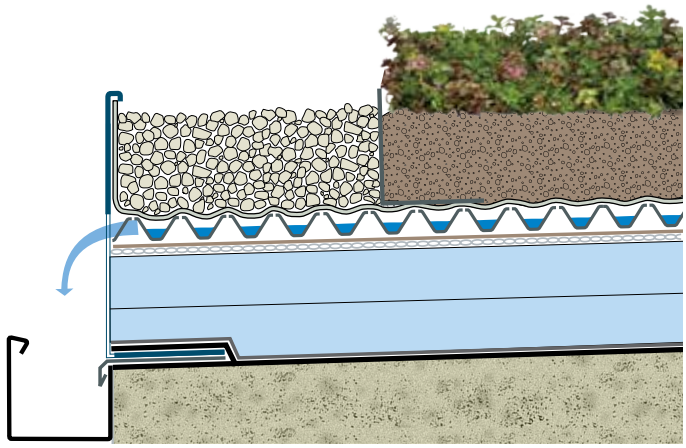


## Roof Edges

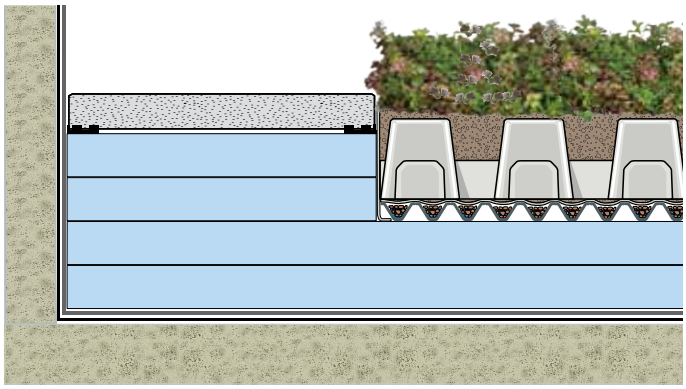
Perforated metal angles, properly engineered to accommodate anticipated loads (in sloped conditions), are necessary to retain Garden Roof® Assembly components and allow water to drain off the roof edge into perimeter gutters. Edge restraints must be properly flashed in accordance with Hydrotech guideline details. VFZs, a minimum width of 12" of gravel ballast or pavers, provide many functions including easy access to critical flashings and improved drainage.

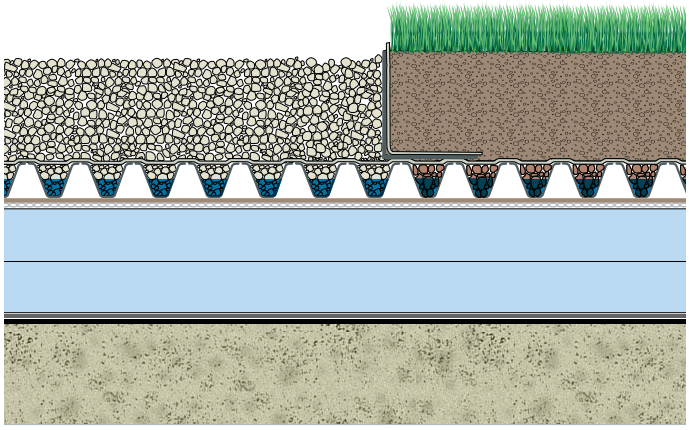
**To qualify for a wind blow-off warranty, VFZ must be a minimum of 24" wide or more depending on parapet height, roof height, wind zones and other factors. Contact Hydrotech for further details.**



## Checker Block

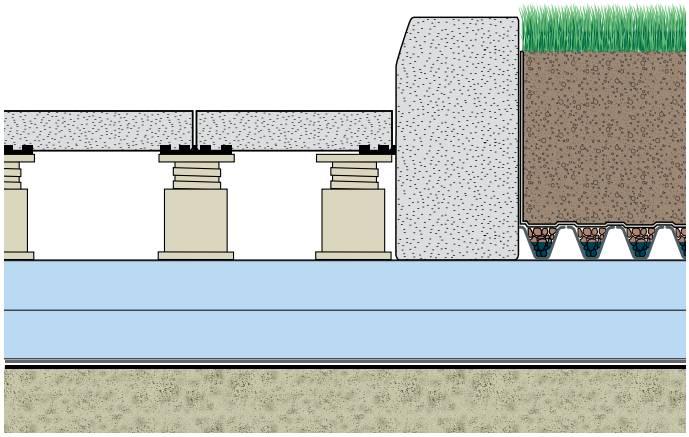
Under certain circumstances, Checker Block® can be used in lieu of standard ballast pavers to increase the green space in a Garden Roof® Assembly while still providing the permanent ballasting function of a concrete paver. The open and interconnected void spaces in Checker Block® are ideal for growing the typical extensive Garden Roof® plants like sedums and smaller perennials. Checker Block® can also be incorporated into deeper Intensive Assemblies for the same purpose of providing ballasting within the Garden Roof® assembly.





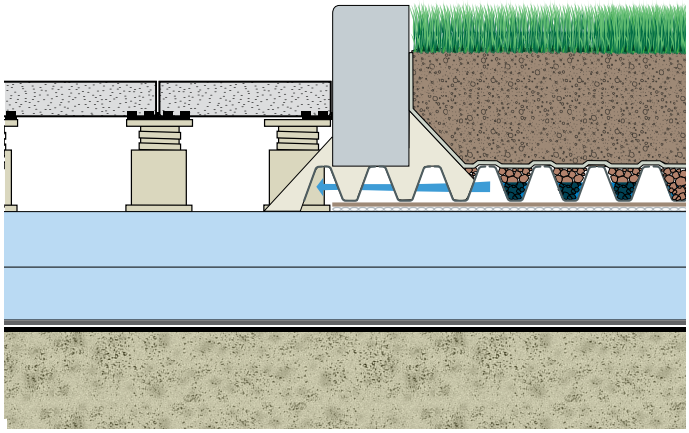
## Transition with GardenEdge®

Various materials such as Hydrotech's GardenEdge® Metal Edging, RockCurbs, precast concrete or other materials can provide a border between hardscape and softscape elements on a Garden Roof® that range from almost invisible to a hard defined border. This can occur without interrupting the continuous monolithic roof membrane, insulation layer or the drainage of the assembly from one section to another.



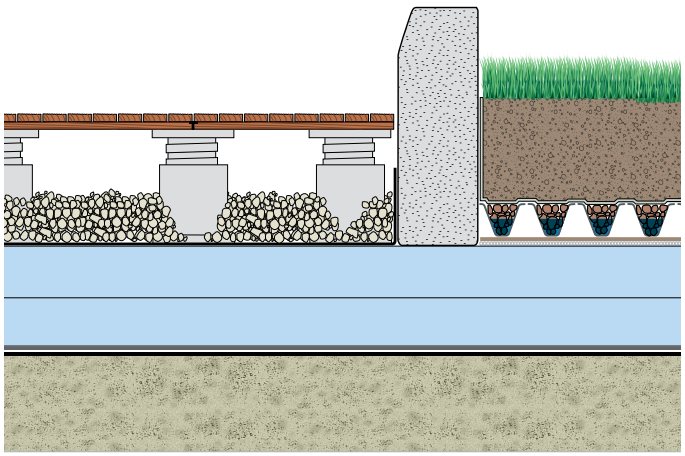
## RockCurb

Hydrotech offers a line of architecturally finished precast concrete curb units in a variety of colors and finishes to complement Architectural Pavers. RockCurbs can be supplied in several different heights and widths and limited radii and can be installed directly over the STYROFOAM® insulation layer in the Garden Roof® Assemblies.



## RockCurb and Natural Stone Edging

RockCurb or natural stone can be installed over the top of Gardendrain® by pouring stiff concrete as a footer for the curb material directly into the Gardendrain®. The open structure of the Gardendrain® allows for free movement of water beneath the curb while providing strong and secure support.



## Wood Tile

Hydrotech offers a line of Wood Tiles made from various hardwoods. These tiles are installed on pedestals with hidden internal hardware to secure the tiles to the pedestals. Supplemental stone ballast must be installed underneath Wood Tiles to provide DuPont's recommended ballast loading over STYROFOAM™ insulation.

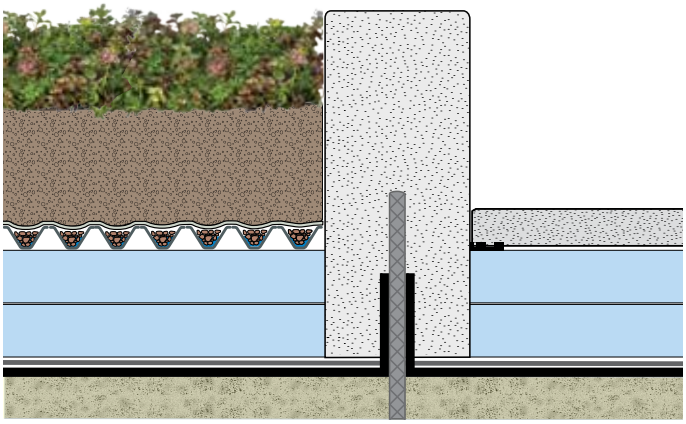
**Contact Hydrotech for further details.**

# Typical Perimeter and Transition Conditions

## Cast-in-Place Wall / Curb

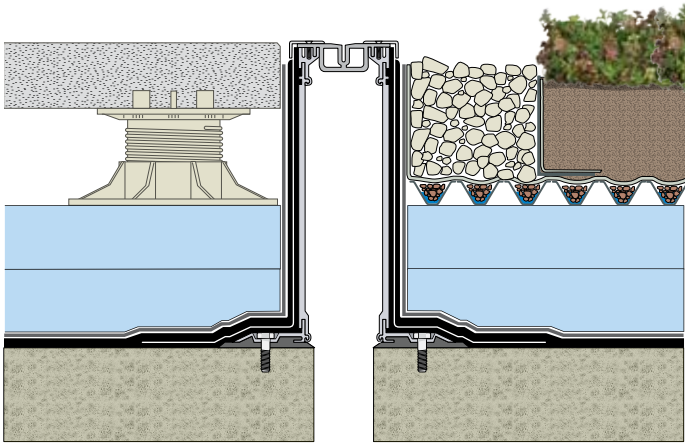
Walls and curbs can be easily installed on structural decks with embedded rebar connections. It is vitally important that Hydrotech's MM6125® waterproofing membrane assembly be installed first on the deck and around the rebars to ensure proper waterproofing. The waterproofing and flashings are installed on the protruding rebars and are entombed in the subsequent concrete mass.

Drainage can be conducted under the walls via Hydrodrain® or through the walls via scuppers.



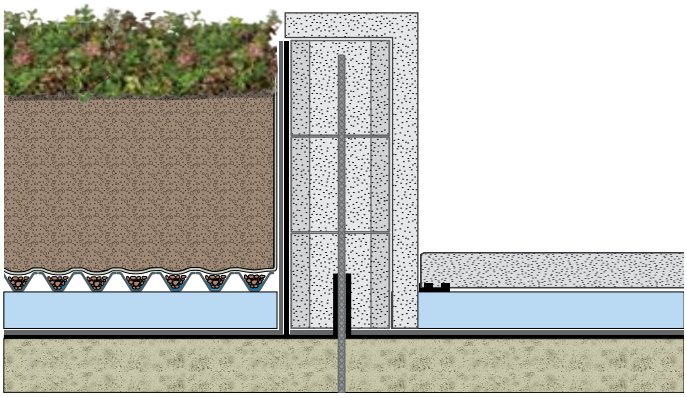
## Expansion Joints

Accommodating movement in building structures is an important function for expansion joints. Hydrotech's MM6125® waterproofing assembly works very well with a number of prefabricated expansion joint products. Proper waterproofing detailing is critical to keeping water out of the building in these assemblies. The Garden Roof® and Ultimate Assemblies® work well with these expansion joints as a transition element.



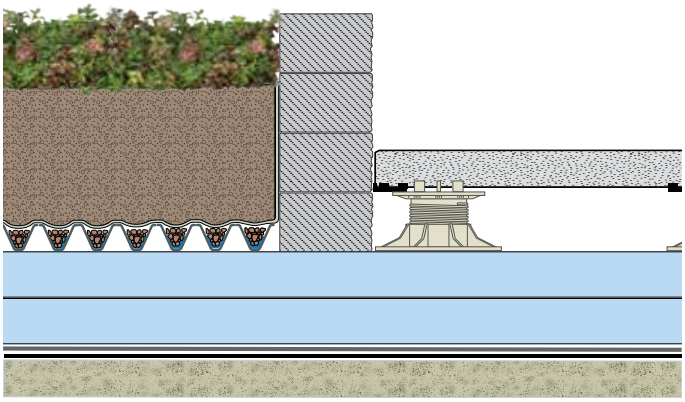
## CMU Wall

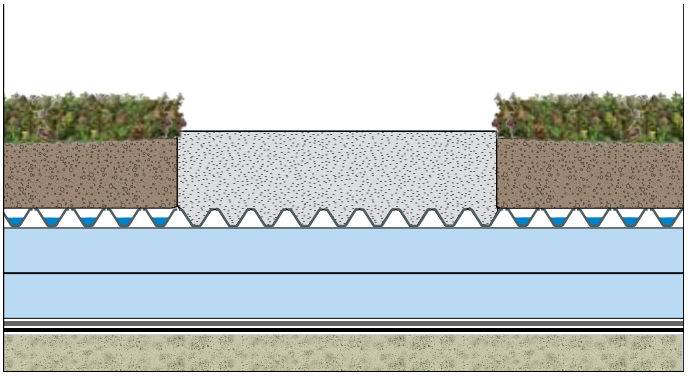
Concrete blocks are often used to create wall cores that accept a wide variety of finishes and veneers. Rebars that connect these structures to decks are waterproofed during the deck waterproofing process before the walls are constructed. Hydrotech strongly recommends that the cores of concrete block walls be thoroughly filled with grout or concrete to entomb the waterproofed and flashed rebars to protect the waterproofing assembly. Additional waterproofing can be applied on the planted side of the wall to help eliminate water transmission through the wall that can lead to efflorescence on the outer face of these walls.



## Landscape Block Wall

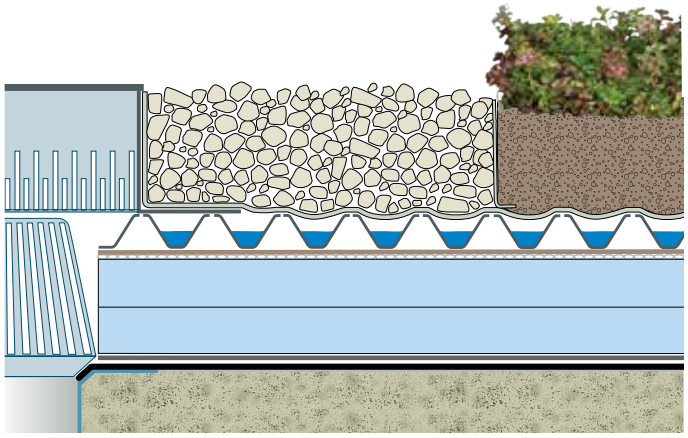
Loose-laid, precast concrete retaining wall blocks can be used to create Intensive Garden Roof® planting areas with a wide range of depths. Systemfilter should be wrapped up on the inside of the finished wall stack to prevent fine particles in LiteTop® media from migrating through the joints in the wall systems.





## Concrete Sidewalk

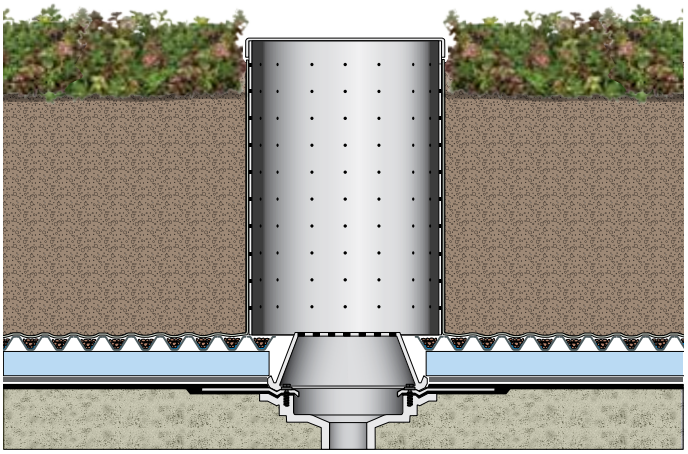
Sidewalks can be created on Garden Roofs® by pouring concrete directly into Gardendrain®. The structure of Gardendrain® creates a drainage plane under the concrete surface which allows for water flow to simplify roof drainage.



## Roof Drains

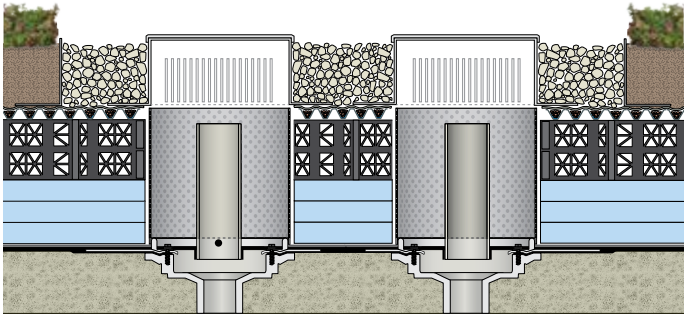
When roof drains are located within planted areas, GardenHatch® Inspection Chambers provide for easy maintenance access. This is especially important in deeper intensive applications. Typical PMR drains with perforated gravel guard rings are acceptable in shallower extensive applications.

GardenHatch® is available in various heights (with extensions) to suit the final assembly depth. VFZs, around the GardenHatch®, a minimum width of 12 inches of gravel ballast or pavers, are necessary to prevent unwanted plant growth and promote increased drainage.



## Deep Intensive Drain Access Detail

Access to roof drains is critical to be sure they are performing as designed. For deep Intensive Garden Roof® projects, access to roof drains can be created by using perforated plastic piping and a lid structure. Polypropylene or PVC pipe components can be utilized to create the access to deeply set drain structures.



## Blue Roof Flow Control and Overflow Drain

Blue Roofs require specialized drain details to create the detention volume on the roof. As is customary in many areas, paired combination drains are installed together - one to function as the flow-control drain that is needed to create the blue roof detention and the second to act as a standard overflow to protect the roof and building from excessive water.

# Hydrotech Maintenance Program

## Importance of Maintenance

Maintenance is a critical component in the long term viability of any vegetated roof. **There is no such thing as a no-maintenance vegetated roof.** Keeping a watchful eye on the roof will maximize plant health, maintain the aesthetics of the roof and ensure any issues such as clogged drains, wind erosion, irrigation malfunctions, weed growth and debris are handled before they become problems. A well thought out and executed maintenance plan will make certain that the vegetated roof is performing as intended and meets the designer's and owner's expectations.

The maintenance of a vegetated roof must be considered in the early stages of the design process and those requirements should be included in the project specifications. Designers play a large part in helping to ensure good vegetated roof maintenance, including:

- Provide easy access to roof for maintenance
- Anticipate water needs of plant material by providing sufficient water on the roof level
- Provide vegetation free zones of sufficient width so that roof and equipment maintenance workers can safely traverse and not damage plant material
- Provide fall protection including railings and places to anchor safety harnesses

There are a number of tasks that go into proper maintenance of a vegetated roof.

- General inspections (plant material, parapets, vegetation free zones and drains)
- Filling in thin vegetation areas
- Growing media inspections for wind scour
- Monitoring growing media for nutrient levels
- Weeding and removal of undesirable plants
- Debris removal

## Initiating Maintenance

Maintenance activities must begin immediately after installation of the new vegetated roof. The newly installed vegetation will require close monitoring in the early months to help ensure proper establishment. The installing contractor often is the contractor responsible for this maintenance. This maintenance must continue until the project is accepted and the maintenance efforts are extended or transferred to another contractor or to the owner.

In many projects, the installation of the Garden Roof® can occur months before final acceptance of the project by the building owner.

**It is very important that maintenance of the newly installed Garden Roof® be coordinated between the owner, the general contractor and the installing contractors so that gaps in the maintenance do not occur.**

## Maintenance Activities

Hydrotech works with its trained contractors to help them understand the importance of timely and proper maintenance of the vegetated roof. Hydrotech has developed a Maintenance Program to help guide contractors and building owners in the steps needed for maintaining their Garden Roof® Assembly and its warranty. There are a number of primary maintenance tasks including:

### Primary Maintenance Activities

- General plant inspection
- LiteTop® growing media replacement
- Debris and trash removal
- Weed removal
- Vegetation Free Zone check
- GardenHatch® Inspection Chamber check

### Secondary Maintenance Activities

**(Contact Hydrotech before undertaking any of these secondary tasks)**

In addition to the primary tasks, there are a number of secondary maintenance tasks that may be needed, including:

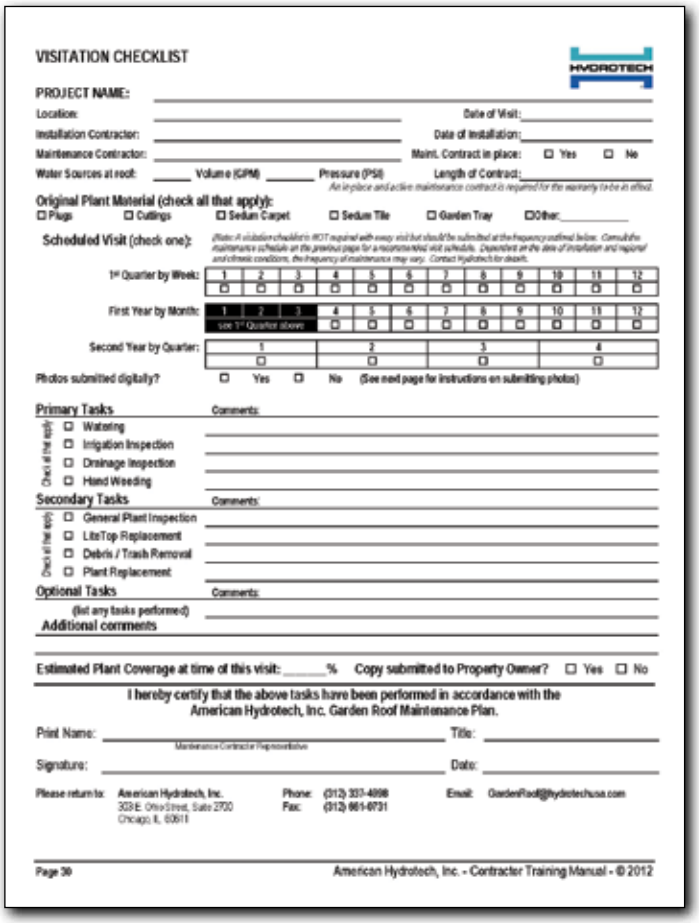
- LiteTop® growing media testing and monitoring
- Fertilizer application
- Pesticide application
- Herbicide application

### Maintenance Documentation

Hydrotech has specific reporting requirements in its maintenance program that help to ensure that the vegetated roof is receiving the maintenance that is needed and the owner is expecting. This includes a visitation checklist for each visit and supplemented by photographs to help document the establishment and progression of the vegetated roof.

This consistent documentation is required for maintaining the Hydrotech plant warranty.

**Contact Hydrotech for further maintenance information.**



VISITATION CHECKLIST

PROJECT NAME:

Location: Date of Visit:

Installation Contractor: Date of Installation:

Maintenance Contractor: Maint. Contract in place: ☐ Yes ☐ No

Water Sources at roof: _____ Volume (GPM) _____ Pressure (PSI) Length of Contract:

An in-place and active maintenance contract is required for the warranty to be in effect.

Original Plant Material (check all that apply):

☐ Plugs ☐ Cuttings ☐ Sedum Carpet ☐ Sedum Tile ☐ Garden Tray ☐ Other:_____

Scheduled Visit (check one):

(Note: A visitation checklist is NOT required with every visit but should be submitted at the frequency outlined below. Consult the maintenance schedule on the previous page for a recommended visit schedule. Dependent on the date of installation and regional and climatic conditions, the frequency of maintenance may vary. Contact Hydrotech for details.)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st Quarter by Week: | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | 5 ☐ | 6 ☐ | 7 ☐ | 8 ☐ | 9 ☐ | 10 ☐ | 11 ☐ | 12 ☐ |
| First Year by Month: | 1 see 1st Quarter above | 2 | 3 | 4 ☐ | 5 ☐ | 6 ☐ | 7 ☐ | 8 ☐ | 9 ☐ | 10 ☐ | 11 ☐ | 12 ☐ |
| Second Year by Quarter: | 1 ☐ | | | 2 ☐ | | | 3 ☐ | | | 4 ☐ | | |

Photos submitted digitally? ☐ Yes ☐ No (See next page for instructions on submitting photos)

Primary Tasks — Comments:

Check all that apply:
- ☐ Watering
- ☐ Irrigation Inspection
- ☐ Drainage Inspection
- ☐ Hand Weeding

Secondary Tasks — Comments:

Check all that apply:
- ☐ General Plant Inspection
- ☐ LiteTop Replacement
- ☐ Debris / Trash Removal
- ☐ Plant Replacement

Optional Tasks — Comments:

(list any tasks performed)

Additional comments

Estimated Plant Coverage at time of this visit: _____% Copy submitted to Property Owner? ☐ Yes ☐ No

I hereby certify that the above tasks have been performed in accordance with the American Hydrotech, Inc. Garden Roof Maintenance Plan.

Print Name: _____ Title: _____

Maintenance Contractor Representative

Signature: _____ Date: _____

Please return to: American Hydrotech, Inc. 303 E. Ohio Street, Suite 2700 Chicago, IL 60611 Phone: (312) 337-4998 Fax: (312) 661-0731 Email: GardenRoof@hydrotechusa.com

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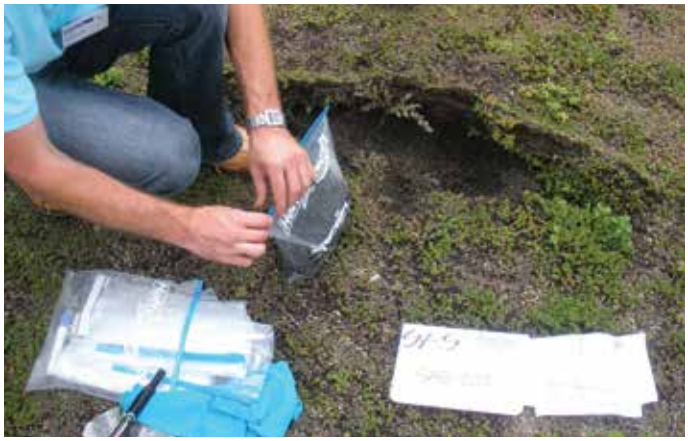


# Garden Roof® Assembly Components

## Monolithic Membrane 6125®

Hydrotech's Monolithic Membrane 6125® is a seamless, rubberized asphalt membrane that can be applied to structural concrete decks, plywood or gypsum board over metal decks. It consists of one coat of membrane at 90 mils (2.3 mm) into which Hydrotech's FlexFlash-F (a spunbonded polyester fabric) is embedded. A second coat of membrane is then installed at 125 mils (3.2 mm). The total membrane thickness is 215 mils (6.0 mm)

**Weight:** 1.4 lbs./SF installed (7.3 kg./sq.m)

**Size:** 40 lbs. solid cakes

**Thickness:** 215 mils (total installed thickness)

**Recycled Content:** Up to 40% post-consumer by weight

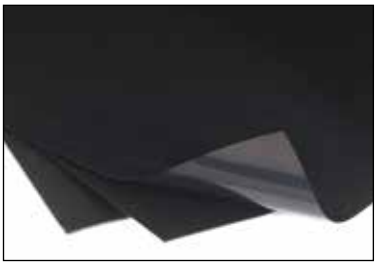
## Hydroflex® 30

Hydroflex® 30 is a modified asphalt protection course that is embedded into MM6125® while still hot to provide a primary protection layer that allows for light foot traffic while completing the rest of the roof construction.

**Weight:** 0.75 lbs./SF (3.66 kg/sq.m)

**Size:** 39.4" x 66' rolls (216 SF) - East (1 m x 20.1 m)
39.37" x 50.25' (164 SF) - West (1 m x 15.3 m)

**Thickness:** 0.090" (2.2 mm)



## Root Stop (10 mil)

Root barriers are intended to prevent damage of the roof membrane from the growth of plant roots. The type of root barrier is determined by the type of vegetation.

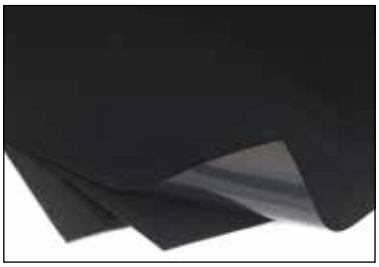
Root Stop is a general purpose root barrier and is used under typical extensive vegetated roofs that have sedums and perennials plants that don't have aggressive root systems.

**Weight:** 0.05 lbs./SF (0.24 kg/sq.m)

**Size:** 15' x 100' rolls (4.5 m x 30.5 m)

Effective coverage: 950 SF with 5' laps, 1218 SF with 2.5' taped laps

**Thickness:** 0.010" (10 mils, 0.25 mm)



## Root Stop HD (30 mil)

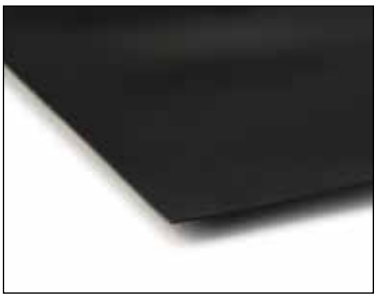
Root Stop HD is used when vegetation consists of larger, woody-type perennials, shrubs and trees when an added measure of root penetration protection is required. For installations involving bamboo or other plants with aggressive root structures, see Root Stop Bamboo.

**Weight:** 0.17 lbs./SF (0.83 kg/sq.m)

**Size:** 15' x 100' rolls (4.5 m x 30.5 m)

Effective coverage: 950 SF with 5' laps, 1218 SF with 2.5' taped laps

**Thickness:** 0.030" (30 mils, 0.70 mm)



## Root Stop Bamboo (60 mil)

When clumping bamboo is included in the mix of vegetation, Root Stop Bamboo root barrier is required. Root Stop Bamboo will stop the aggressive roots of clumping bamboo.

Note: Running-type bamboo or other species with aggressive root structures are not allowed on Hydrotech's vegetated roofs.

**Weight:** 0.32 lbs./SF (4.4 kg/sq.m)

**Size:** 5' x 100' rolls (1.52 m x 30.5 m)

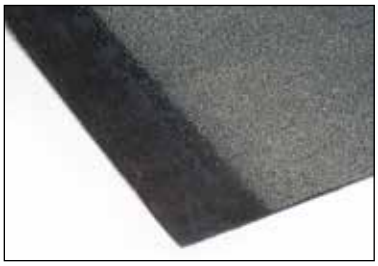
**Thickness:** 0.060" (60 mils, 1.5 mm)

## Root Stop Tape

Root Stop Tape is a white, single-sided tape combining a weather resistant polyethylene backing with an aggressive rubber adhesive. Root Stop Tape is designed to help seal the laps between sheets of Hydrotech's Root Stop, Root Stop HD, and Root Stop Bamboo.

**Size:** 4" x 210' rolls

## Hydroflex® RB II



A heavy duty, granular-surfaced, modified asphalt sheet with a factory applied root inhibitor. Used in intensive vegetated roof applications or whenever aggressive root growth is anticipated. It is also used in sloped applications as the granular surfacing provides additional slip resistance.

**SpinOut must be field applied at all seams and lap edges.**

**Weight:** 0.91 lbs./SF (4.4 kg/sq.m)

**Size:** 39.4" x 33.4' rolls (1 m x 10.2 m)

Effective coverage: 97 SF per roll

**Thickness:** 0.160" (160 mils, 4.0 mm)

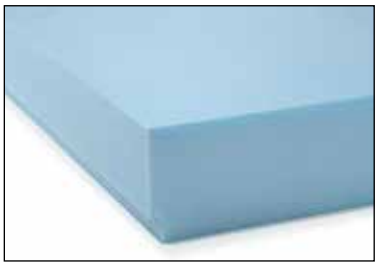
## SpinOut®

SpinOut is a water based, latex coating with a built-in root inhibitor that is applied at all seams and lap edges of Hydroflex RB II.

**Size:** 1 gallon containers

**Coverage:** When diluted with 2 quarts of water, Spinout will cover approx. 2,000 LF of Hydroflex RBII sheet edges with a band 3 inches wide.

## DuPont STYROFOAM™



STYROFOAM™ an extruded polystyrene insulation provides a design R-Value of 5 per inch of thickness. STYROFOAM™ provides thermal insulation to the building, protection to the membrane, and is ideally suited to wet environments due to its low water absorption.

**Weight:** 0.17 lbs./SF per inch of thickness (0.83 kg./sq.m)

**Size:** 2' x 8' (0.6 m x 2.4 m)

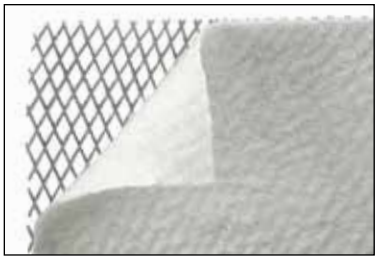
**Thickness:** 1" to 4" thickness available

**Compressive Strength:** 40, 60, or 100 psi (275.8, 413.7, 689.5 kPa)

**R-Value:** 5 per inch of thickness

**Recycled Content:** 40% post-industrial by weight

## Hydrodrain® AL or 300



Hydrodrain® AL or 300 are prefabricated air layers made of a three-dimensional, crush-proof core to which is bonded a white non-woven, needle punched filter fabric. The Hydrodrain® air layer is designed to be used as the air space between the DuPont STYROFOAM™ insulation and Moisture Mat when extra water holding capacity is desired in the assembly.

**Weight:** 0.24 lbs./SF (1.17 kg./sq.m)

**Size:** 4' x 75' rolls (1.2 m x 22.9 m)

**Thickness:** 0.22 inch (5.6 mm)

**Recycled Content:** 100% post-industrial by weight

## Moisture Retention Mat

Moisture Mat, with its tangled mesh of fibers, traps and stores additional water that is released through diffusion/ evaporation up through the holes of the Gardendrain® components.

**Note:** Moisture Mat is optional and is not used on all projects. If Moisture Mat is placed above the insulation, Hydrodrain® AL or 300 is required between the mat and insulation.

**Weight:** 1.2 lbs./SF wet weight (5.3 kg./sq.m)

**Size:** 7.5' x 100' rolls (2.3 m x 30.5 m)
Effective coverage: 715 SF per roll (66.4 sq.m per roll)

**Thickness:** 3/16 (0.188)" (4.8 mm, 188 mils)

## Systemfilter

Systemfilter helps prevent soil particles from washing through the system and potentially clogging drainage layers and drains. It is also used to retain aggregate ballast where required (i.e. vegetation free zones).

**Weight:** 0.04 lbs./SF (195 g/sq.m)

**Size:** 12.5' x 120' rolls (3.8 m x 36.6 m)

**Thickness:** 0.010" (10 mils, 0.25 mm)

## Gardendrain® GR15

Hydrotech's Gardendrain® drainage/retention/aeration components are designed specifically for vegetated roofs. Drainage channels above as well as below ensure that excess water is free to drain out of the system, even in the presence of heavy root growth. Cups designed into the panels provide water storage capacity, while holes in the panels provide air and vapor circulation. Gardendrain® GR15 is generally used in extensive vegetated roof conditions.

**Weight:** 1.0 lbs./SF (4.9 kg/sq.m) empty/wet

**Size:** 3' x 8' panels (0.9 m x 2.4 m)

**Thickness:** 5/8" (15 mm)

**Compressive Strength:** 7,455 lbs./SF (357 kPa)

**Recycled Content:** 100% post-industrial by weight

## Gardendrain® GR30

With more drainage and water storage capacity than GR15, GR30 is commonly used in extensive and intensive roofs.

Cups can be filled with light weight aggregates which help to provide additional water storage capacity, as well as support greater growing media depths above.

**Weight:** 1.6 lbs./SF (7.81 kg/m$^2$) empty/wet
3.8 lbs./SF (18.5 kg/m$^2$) with cups filled/wet

**Size:** 4' x 6' (1.2 m x 1.8 m) panels

**Thickness:** 1-1/4" (30 mm)

**Compressive Strength:** 5,069 lbs./SF - empty
13,000+ lbs./SF - cups filled
(242.7 kPa empty, 622.4+ kPa filled)

**Recycled Content:** 100% post-industrial by weight

## Gardendrain® GR50

With even more drainage and water storage capacity than GR15 or GR30, GR50 is commonly used in intensive roofs.

Cups must be filled with light weight aggregate which helps to provide additional water storage capacity.

**Weight:** 2.0 lbs/SF (9.76 kg/m$^2$) empty/wet
6.3 lbs/SF (30.76 kg/m$^2$) with cups filled/wet

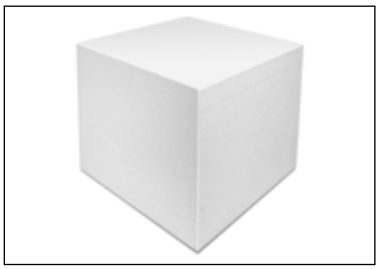
**Size:** 4' x 6' (1.2 m x 1.8 m) panels

**Thickness:** 2 inch (50 mm)

**Compressive Strength:** 7,000+ lbs./SF (335.2+ kPa)

**Recycled Content:** 100% post-industrial by weight

## Geofoam



Expanded polystyrene (EPS) is often used as a fill material in assemblies to save weight. It is stacked to create topography on a roof structure.

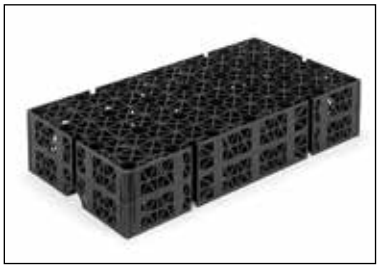
**Weight:** 0.7 lbs./ft$^3$ (2.85 kg/m$^3$) empty/wet

**Size:** 4' (1.2 m) widths
8' (2.4 m) up to 16' (4.8 m) lengths

**Thickness:** 1" (25 mm) up to 36" (914 mm)

**Compressive Strength:** 2.2 - 18.6 psi at 1% deformation, per ASTM D6817

## Permavoid® 150 mm



Permavoid® is a 150 mm tall voiding element used to support Garden Roof Assemblies and pavers above the water detention zone in a Hydrotech Blue Roof. It creates a layer that is 95% open in which water can be temporarily held during heavy storm events.

**Size:** 14" x 28" x 5.91" nominal
(355 mm x 710 mm x 150 mm, nom.)

**Percentage open space:** 95%

## Permavoid® 85S

Permavoid® 85S is a 85 mm tall voiding element used to support Garden Roof Assemblies and pavers above the water detention zone in a Hydrotech Blue Roof. It creates a layer that is 95% open in which water can be temporarily held during heavy storm events.

**Size:** 28" x 28" x 3.35"
(710 mm x 710 mm x 85 mm, nom.)

**Percentage open space:** 95%

## GardMat® LT

Erosion control blankets help to provide wind and water surface erosion protection to assist in the establishment of the vegetation.

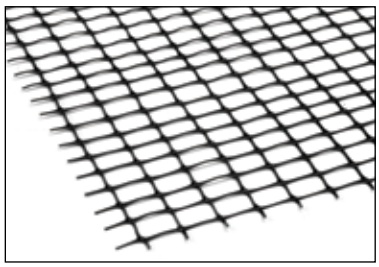
For general use, GardMat® LT is fabricated from biodegradable fibers with a coconut coir interior layer.

**Weight:** 0.073 lbs./SF (1.09 kg./sq.m)

**Size:** 6.67' x 108' rolls (2.03 m x 32.92 m)

**Thickness:** 0.28" (7.11 mm)

## GardMat® N



For projects where an added measure of erosion control is needed, especially in high wind applications, Hydrotech offers GardMat® N. GardMat® N is a UV resistant polypropylene netting with approximately 1/2" square openings.

**Weight:** 0.021 lbs./SF (0.031 kg./sq.m)

**Size:** 6.67' x 80' rolls (2.03 m x 24.38 m)

**Thickness:** Nominal

## Disk Anchors

Disk Anchors are used to secure GardMat® LT or N as well as InstaGreen® Carpet and InstaGreen® Tile to the vegetated roof. Permanent and biodegradable disk anchors are available. Color may vary depending on recycled content. **Contact Hydrotech for placement and spacing requirements.**

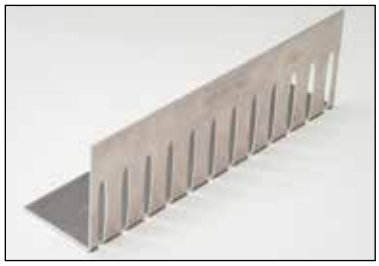
**Base:** 5" dia. x 0.1875" thick (nom.)

**Shaft:** 12" ht. x 0.375" dia.

**Top Disk**: 4.75" dia. x 0.0625" thick (nom.)

**Height:** 3" to 8.5" (custom heights are available)

## GardenEdge® Metal Edging



Hydrotech offers a range of metal edging products to create divisions between vegetation free zones and the LiteTop® growing media. Fabricated from uncoated aluminum or stainless steel, it is available in straight and flex edge configuration that allows free-form curves. A powdered epoxy coating with a wide range of colors is also available.

**Height:** 3" to 8.5" (custom heights are available)

**Length:** 8'

**Thickness:** 0.10" (aluminum)

## GardenEdge® Leveling Strips

Aluminum leveling strips that bolt to the edging are available to accommodate variable roof slopes. **Contact Hydrotech for details.**

**Height:** 4", 6" and 8" ht.(custom heights are available)

**Length:** 8'

**Thickness:** 0.10" (aluminum)

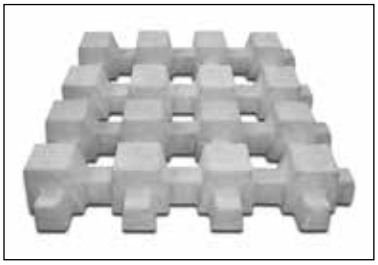
## Stone Filter Fabric

Stone Filter Fabric is a white, UV stabilized, needle-punched, non-woven polypropylene fabric designed to be used as a separation sheet between the stone/gravel ballast, InstaGreen® GT-4 trays and Permavoid® units, and DuPont STYROFOAM™ insulation. Stone Filter Fabric serves three main functions. It protects the insulation board from exposure to the sun, prevents stone/gravel ballast from falling in between the joints of the insulation boards and rafts them together.

**Weight:** 3.0 oz/sq yd or 101 lbs./roll (101 g/sq m or 45.8 kg/roll)

**Size:** 13.5' (4.1 m) wide x 360' (109.7 m) long

## Checker Block®



Checker Block® is used for adding permanent ballasting to Garden Roof areas. The open and connected void structure in Checker Block® creates an ideal environment for growing perennials and sedum. The concrete structure of Checker Block® units provides the same ballasting weight of a 2 inch thick concrete paver. Each unit is connected together with stainless steel zip ties provided by Hydrotech.

**Size:** 24" x 24" (4.0 SF / unit)

**Thickness:** 4"

**Weight:** 92 lbs / unit plus LiteTop® media

## GardenHatch® Inspection Chambers

GardenHatch® Inspection Chambers are used to keep ballast and LiteTop® Growing Media away from roof drains and to allow their inspection. They are fabricated from stainless steel and slotted to permit free water drainage into the roof drains. Two sizes are available along with extensions to add additional height to the base units.

**Custom sizes are available.**

**Size:** 11" x 11" and 18" X 18"

**Height:** 4.75"

## GardenHatch® Extensions


GardenHatch® Inspection Chamber Extensions are used to accommodate deeper Garden Roof® Assemblies. Three sizes are available and can be combined (up to three extensions) to work with intensive Garden Roof assemblies up to 24 inches deep.

**Custom sizes are available.**

**Size:** 11" x 11" and 18" X 18"

**Extensions:** 1", 3" and 8.5" in each size

## LiteTop® Engineered Growing Media

Blended at many facilities across the United States and Canada, LiteTop® is the core of the Hydrotech extensive and intensive Garden Roof assemblies. Designed using local materials, LiteTop® provides the ideal growing media for optimum plant growth.

**Hydrotech creates various blends of LiteTop® to address the different assemblies including:**

- Extensive
- Intensive
- Lawn
- Urban Agriculture
- Custom (project specific)

## Rock Mineral Wool

Rock Mineral Wool is a needled material used for increasing the water holding capacity of Hydrotech Garden Roof® Assemblies. This additional capacity is often used to increase the stormwater capacity of the total Garden Roof® Assembly. Rock Mineral Wool can also be used in lightweight assemblies to provide extra water holding for plant use.

When used in an assembly with DuPont STYROFOAM™, Rock Mineral Wool must be installed with Hydrodrain® Max.

**Size:** 1.0" thick (nominal)

**Roll Width:** 39" (1 meter)

**Roll Length:** 197" (5 meters)

## Hydrodrain® Max

Hydrodrain® Max is an air layer used in combination with Rock Mineral Wool when installed over DuPont STYROFOAM™. Composed of entangled filaments and a lightweight scrim on top, Hydrodrain® Max promotes proper drainage underneath Rock Mineral Wool as well as providing the required air layer over the DuPont STYROFOAM™.

**Size:** 0.775" thick (nominal)

**Roll Width:** 42.5"

**Roll Length:** 153.8"

## GardNet®

GardNet® is a cellular confinement component designed to hold LiteTop® growing media on sloped Garden Roof® Assembly applications.

**Contact Hydrotech for detailed installation guidelines.**

**Depth**: Available in various depths: 3", 4", 6", 8" and 12"

## InstaGreen® GT-4 Tray

For a modular assembly, Hydrotech offers the InstaGreen® GT-4 tray. With interlocking clips, wind resistance is built-in to this tray unit. The GT-4 tray is available in a number of planting formats and multiple delivery options are available.

**Contact Hydrotech for details.**

**Size**: 12" x 24" x 4" deep media plus 1.75" water reservoir base

**Weight:** Regionally dependent; approx. 30-35 lbs/SF

## Sedum Cuttings

Sedum cuttings can be provided in varieties that will vary by the region of the country. Cuttings are harvested, packaged and shipped to the project ready to install.

**Packaging**: 18" x 18" x 9" boxes

**Weight**: 20 to 25 lbs. per box

## Plugs

Hydrotech offers a wide range of sedum and perennial plugs for use on its Garden Roof® Assemblies. Available plant species will vary by the region of the country.

**Size**: 50-count and 72-count size in full flats

(Count size is dependent on variety and region of the country)

**Packaging**: Dependent upon size of order

## InstaGreen® Carpet

Hydrotech's InstaGreen® Carpet creates very economical, instantly green vegetated roofs. It is available for many areas of the United States.

**Size**: 4' x 6.25' (25 SF) rolls

**Weight**: 80 lbs./roll - dry
120 lbs./roll - wet

**Packaging**: Rolled and shipped on pallets

## InstaGreen® Tile

Hydrotech's InstaGreen® Tile is offered in a number of different blends to provide instant vegetated roofs. Custom tiles can be created with sufficient lead time.

**Size**: 12" x 24" (2.0 SF/tile)

**Blends**: Four Seasons, Full Color, and Rugged (contact Hydrotech for specific blend information)

Custom blends are available

**Weight**: 4-6 lbs./SF - wet

**Packaging**: Shipped on pallets

# Additional Resources

## Hydrotech Info Sheets

This Planning Guide is designed to provide some overview guidelines on most topics that arise during the design and installation of a vegetated roof.

Hydrotech has Info Sheets available that include more in-depth information beyond what's published in this Planning Guide. These Info Sheets have been developed in response to some of the more commonly asked questions related to various Hydrotech's Garden Roofs®, including:

- Water Accessibility and Extensive Vegetated Roofs
- Weeds on Vegetated Roofs
- Lawn Establishment on Garden Roofs®
- Frost Dates and Proper Planting Times
- Sedum Cuttings and Hydromulching

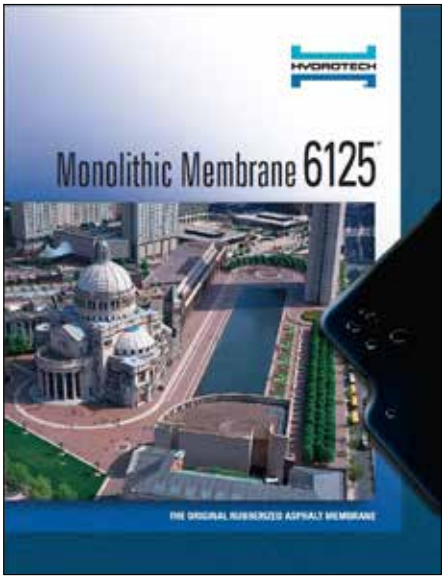
**These Info Sheets are available from your local Hydrotech Representative or by contacting Hydrotech directly.**


## Plant Identification Cards

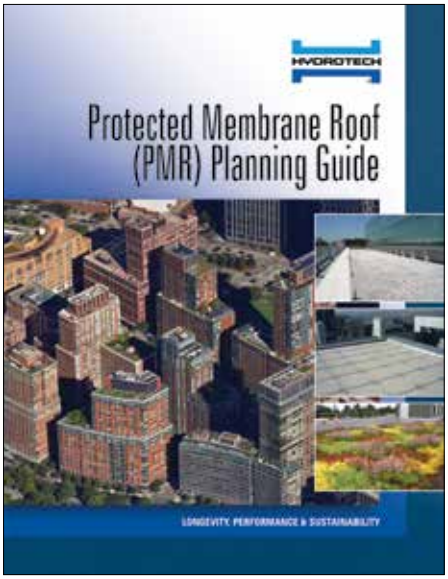
Hydrotech has developed a set of Plant Identification Cards to assist designers with their choice of vegetation when designing a Garden Roof®.

These cards are also useful in field identification of vegetation on the rooftop. Each card contains photographs of the species, USDA hardiness zones, plant height, bloom color, bloom timing and other additional horticultural information.

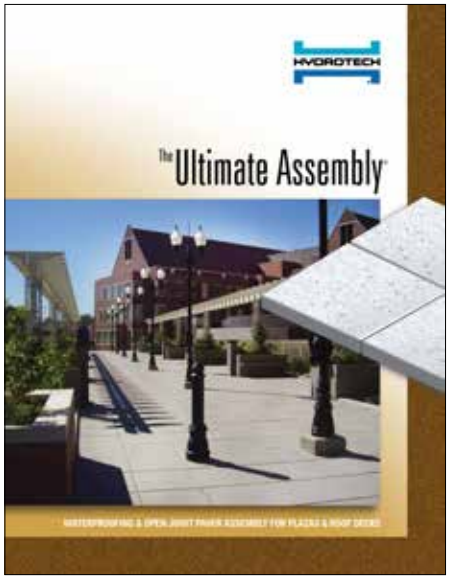
Hydrotech has a wide array of additional resources for consideration and expansion of the Protected Membrane Roof assemblies.




**Monolithic Membrane 6125®**
This brochure outlines the capabilities of Hydrotech's flagship product, MM6125®, and its value in the most important aspect of any roofing and waterproofing project: **keeping the structure watertight.**




**Protected Membrane Roof Planning Guide**
Based on more than 60 years of experience in protected membrane roofing, this brochure is indispensable to designers, architects and engineers who need information of which PMR assemblies are appropriate for their roof top projects.




**The Ultimate Assembly®**
Often projects involve hardscape elements and the Ultimate Assembly® brochure outlines the assemblies that are appropriate for creating a wide array of paved pedestrian friendly surfaces on roof tops and plazas.

## Website - www.hydrotechusa.com

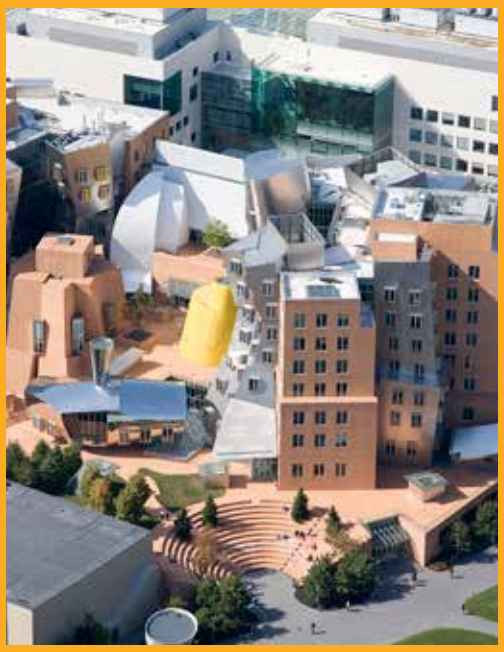
Hydrotech's website has been optimized for viewing from whichever device a user prefers. Whether browsing from a desktop, tablet or smartphone, the following resources are available...

- Brochures
- Specifications
- Details
- Installation Guidelines
- Project Spotlights
- Project Photography
- Plant Lists
- Product Data Sheets
- Material Safety Data Sheets
- Ask an Expert

## People Make the Difference

Hydrotech's most valuable resource is the knowledge and experience we have gained from each and every Garden Roof® in which we have been involved. We encourage you to talk to your local sales representatives or directly with our Garden Roof Department personnel. We are available to assist you with your next project, whether you need design input, details reviewed, or help with your specifications.

Please contact us at **800-877-6125** or visit our website at **www.hydrotechusa.com.**



Stata Center, Massachusetts Institute of Technology - Cambridge, MA

Walt Disney Concert Hall - Los Angeles, CA

In 1980, American Hydrotech, Inc. purchased the Construction Products Division of Uniroyal Ltd. in Canada, giving the company exclusive worldwide ownership for the manufacture and distribution of Monolithic Membrane 6125®.

One early strength of American Hydrotech, Inc., that continues today, is its established relationships with the architectural community. The highly respected architectural firm Skidmore, Owings and Merrill first used MM6125® in the late 1960's for the Finance and Management Center at the Illinois Institute of Technology in Chicago.

We have best-in-class brands that provide exceptional performance and owner value: Monolithic Membrane 6125®, our premium (flagship) waterproofing product has been successfully installed on the world's most prestigious structures in over 62 countries for more than 50 years.

In 2021, Sika Corporation acquired American Hydrotech for its position as the market leader in the development and production of premium waterproofing and roofing products and assemblies. With more than 100 years of experience, Sika is a worldwide innovation and sustainability leader in the development and production of systems and products for commercial and residential construction, as well as the marine, automotive, and renewable energy manufacturing industries. Sika has offices in over 103 countries with over 400 manufacturing facilities and more than 33,000 employees worldwide. With annual sales of 12 billion dollars in 2023, our commitment to quality, innovation, and the environment as well as putting our customer's needs first, encompasses why Sika is the global leader in our industries. Sika, beyond the expected.



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HYDROTECH®

BUILDING TRUST

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# INTRODUCTION TO HYDROTECH'S GARDEN ROOF®

Tri-City Wastewater - Oregon City, OR