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Pioneering Higher Ground: Green Roof Lessons for Planting Design

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by Laura Hansplant

When I first started designing green roofs six years ago, my secret fear was that they’d be predictable and monotonous. Fortunately, they’re not. In fact, reflecting on climate resiliency, urban habitat, and access to nature in cities, we have only begun to dig into the potential of green roofs. And unexpectedly, green roofs have lessons to teach us about designing ground landscapes.

Say the words “green roof” and most people think of a flat carpet of sedum plants. It’s certainly true that sedum-planted roofs have become commodified in the building industry. While these green roofs are efficient at managing stormwater, they generally are based on a handful of sedum-type species. The greater potential of green roof plant communities for habitat value and overall resilience comes from a more sophisticated habitat structure, incorporating a much wider diversity of native species.

Design for Resilience

How to do this? For most non-sedum planted roofs, conventional design wisdom calls for deeper media and supplemental water. There are good reasons for this traditional approach. Conventional planting designs are often based on visually pleasing geometries that organize
plants into groupings of just a few species. In addition, plant vigor on green roofs can be hard to predict, being driven by more than sun/shade and wet/dry dynamics. In fact, variations in shelter and reflected heat and light are arguably more critical influences. Planting designs must account for these and other subtle factors. Pushing plants to establish in extreme conditions like rooftops, designers understandably want predictability. Deeper media and added watering provide this greater control over growing conditions. The irony however is that owners are being asked to “pay up” for native.

![Broomsedge grass volunteers joined the plant community on this Philadelphia green roof.](image)

Stepping back to look more closely at mature green roofs, we see a different picture. Native plants do volunteer in locations where the same species, if conventionally planted, would have high losses. Why would the volunteer species thrive where the intentional planting fails? Here are a few hypotheses:

**Seed grown:** Volunteer plants, arriving as seed, have a higher genetic diversity than live nursery plants, which often are tissue-propagated cultivars. A higher genetic diversity would confer greater adaptability for the volunteer population as a whole.

**The numbers game:** A small proportion of hundreds (or thousands) of seeds that germinate and survive still represent a significant number of plants. Conversely, if only a small proportion of live plants survive, someone is going to receive an unhappy phone call.

**Self-selection:** With the dispersal of seed across the overall planting area, a volunteer species has the opportunity to succeed where localized growing conditions are most favorable. In contrast, live plants can only establish where we, the designers and contractors, place them – the luck of the draw.
**Vertically layered structure:** Volunteer plants often are growing in close combination with established plants. We could speculate that they are benefiting from the shelter of the other plants. Generally, intentional plantings are distributed with regular spacing that provides open clearance around each individual plant.

**Discover Relationships**

Like many life lessons, we discovered these relationships almost by accident. Initial cues came from observations of the Pacific Plaza green roof in Tacoma, Washington, which between 2010 and 2013 was regularly supplemented with seed as part of its maintenance strategy. Here, the wildflowers and sedum are growing intertwined. The layered plant community structure is strikingly similar to the grass and moss layering in remnant native meadow communities with natural soils.

![Plant communities of sedum and wildflowers intertwine on the Pacific Plaza roof in Tacoma, WA.](https://www.ecolandscaping.org/05/green-roofs/pioneering-higher-ground-green-roof-lessons-for-planting-design/)

A second series of insights came from observing plant establishment at a thin, unirrigated green roof at the University of Pennsylvania’s Krishna Center for Nanotechnology. Here, a plant community restoration credit was required for LEED certification, but the project did not have the budget for supporting deeper media weights or the needed irrigation generally recommended for live plants. In a designer’s “hail Mary,” we decided to seed in a mix of grasses and wildflowers, with the sedum plants maintained as a base line. If the native plants did not establish, the sedum would continue to provide the essential plant cover. Over a period of six years, this green roof has evolved as a diverse dry meadow, containing sedum, grasses such as Little Bluestem (*Schizachyrium scoparium*), Side Oats Gramma (*Bouteloua curtipendula*), Tall Dropseed (*Sporobolus asper*), Hard Fescue (‘Heron’) and Splitbeard Bluestem (*Andropogon*).
virginicus), with occasional wildflowers such as Spotted Horsemint (*Monarda punctata*), Pale Purple Coneflower (*Echinacea pallida*) and Slender Lespedeza (*Lespedeza virginica*). Observations suggest the grasses are self-sorting by microclimate, and the species diversity is increasing over time. The important insight here is not just that green roofs can benefit from meadow-style seeding, but that the approach in combination with sedum allows the establishment of native plants in conditions that would prove challenging for conventional planting.

In Philadelphia’s Wissahickon Park a remnant native meadow shows a naturally layered plant community structure. Ironically, our observations are paralleled by research by Colleen Butler and Colin Orians of Tufts University*. (It would have been helpful to discover the research ahead of our Krishna Center pilot, but hey, life is like that). Their growing trials between 2008 and 2010 found that...
native plants grown in combination with sedum exhibited shorter stature but significantly better performance during prolonged dry weather, in comparison to native plants grown on their own. They suggest that the sedum is facilitating overall plant survival through multiple possible mechanisms including mediation of soil temperatures and possibly helping retain soil moisture.

A separate over seeding pilot initiative at Temple University’s Architecture Building green roof presents an interesting comparison. Constructed in 2011, three separate roof areas were established in sedum plants and were over-seeded with pollinator species (forbs only) in 2013 and 2014. Supplemental wildflower seed, collected from other green roofs, was added between 2015 and 2017. The three green roof areas are all thin and unirrigated, but vary in size, degree of shelter, and moisture availability. In that time, the two most sheltered roof areas have developed a dispersed cover of wildflowers, including two species of Echinacea, two species of Beardtongue (*Penstemon*), Coreopsis species, *Dianthus carthusianorum*, two species of Monarda, and Chives. Volunteers include Great Blue Lobelia (*Lobelia siphilitica*) and Sensitive Fern (*Onoclea sensibilis*) in moister areas closer to downspouts. Wildflower abundance (and lowest weed pressure) are best on the roof area where the fertility is lowest (organic matter was measured at 2% by weight), in comparison to higher fertility at the other green roof areas and at Krishna (organic matter was measured at 6%, with higher nitrogen and phosphorus) and where access to the green roof area is the most limited (fewer maintenance personnel).

**Allow for Serendipity**

Are there any downsides to these approaches? Seeding requires patience – instant landscapes, these are not. A tolerance for serendipity is also needed, and a willingness to depart – at least
in part – from controlled visual forms.

Maintenance is, as always, an important discussion. Conventional sedum roofs are designed to be low maintenance, however this is founded on excluding annual weeds which would trigger a seasonal boom-bust cycle in the plant community. Sedum-dominated planting is a low height cover which is vulnerable to fast growing, taller annual grasses, unless maintenance efforts – while efficient – are precisely timed. Our hope for the over seeded meadow-based green roof plantings is that the perennial native grasses and wildflowers can fill the competitive niche otherwise open to exploitation by annuals such as foxtail and crabgrass, and therefore add more leeway for maintenance timing. The particular challenge for those caring for these plant communities is to distinguish weed seedlings from desirable wildflowers. One potential influence on the native species seen emerging from the seed mixes is that the plants we don’t see may be uncomfortable close look-alikes with seedling weeds. Purple Lovegrass \((Eragrostis spectabilis)\) has only been noted in a few discrete locations at Krishna, but the young plants look very much like crabgrass seedlings.

What are the potential lessons for on-ground landscapes?

**Plan for increased plant densities.** Green roofs require continuous plant cover to do their job moderating temperatures on the rooftop, maintaining stability of the growing media and managing urban rainfall. To better support similar goals for our living environments generally, on-ground plantings should also take advantage of denser planting. Put another way, open spaces between plants represent opportunities for other species, and the choice can be ours to the fill the vacancy with desired plants instead of battling opportunistic weeds.

**Make better use of functional plant community relationships in planting design.** Establishing herbaceous plantings that include vertical layers and compatible species combinations has the potential to boost plant tolerance of weather extremes and difficult growing conditions.

**Make more frequent use of over seeding as a maintenance strategy.** Seed is a very economical way to introduce both species diversity and density, particularly at the scale of most green roofs and similar building landscapes. It allows us to introduce a wide range of potential species, and for greater adaptability to fluctuating site conditions. Seed is also, at present, the easiest way to source specific plant ecotypes.

**Resilience is generational.** We have to allow our plants to reproduce. The resilience of many vegetated roofs comes from the ability of seedlings to fill small areas of bare soil. Many plant populations, such as Echinacea or Fame Flower \((Talinum)\), are sustained by the progeny of the parent plant. Although a particular plant may not survive a significant harsh season, its seeds provide a new generation the subsequent year. Allowing, and supporting, this natural process is the foundation of resilient, low maintenance planting designs over the long term.
Resilience means allowing plant communities to change and adapt. On green roofs, forcing rigid geometries precludes natural species migrations to suitable rooftop microclimates where their survivability is greatest. Although allowing a broad palette of carefully selected species to migrate naturally might upend the traditional design aesthetic, it is the basis for greater overall planting success with fewer water, soil, and maintenance inputs. We have yet to fully explore the potential of curated change across our designed landscapes as a tool for affordable vibrancy and resilience. Is this challenging? Yes, of course. Predictable and monotonous? Absolutely not.


About the Author

Laura Hansplant is a landscape architect and principal at Roofmeadow. She has over 20 years of experience in sustainable landscape design, with wide-ranging projects from Toronto to Virginia. Her work consistently emphasizes the integration of ecology, holistic water management, and cultural dynamics into livable, vibrant landscapes that work as living systems. Her current projects explore dynamic approaches to planting design for urban landscapes.

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