

NATIVE ANALOGUES

FOREGROUND / GREEN ROOFS

MINNEAPOLIS INSTALLS A TRIO OF VEGETATED ROOFS ON DOWNTOWN PUBLIC BUILDINGS.

BY ADAM REGN ARVIDSON, ASLA



ABOVE

The 113,000-square-foot green roof on the Target Center arena is one of three such roofs on downtown Minneapolis public buildings.

IMAGE CREDIT

Courtesy Kestrel Design Group, Inspec, and Leo A. Daly; photo © 2009 Bergerson Photography

Amid the concrete and asphalt of downtown Minneapolis is a bit of native Minnesota prairie. It includes such inhabitants as prairie smoke, little bluestem, prairie dropseed, and prickly pear cactus (yes, prickly pears are found in Minnesota). It was built in 2006, and in late 2010, there was almost no bare soil to be seen. The plants were between two and three feet tall, and the partridge pea, allium, and purple prairie clover were showing their sculptural seed heads. But that's to be expected these days; prairie restorations, after all, are commonplace now. What's unusual about this one is that it is growing in four inches of mostly inorganic planting medium

on top of the Minneapolis Central Library. This is a prairie in the sky.

And it's not the only one in downtown Minneapolis. In 2008, a 5,000-square-foot green roof was installed on the Minneapolis City Hall: an unusual courtyard roof that is almost always in the shade. And in the fall of 2009, 113,000 square feet of sedums and native prairie species were installed on the Target Center, a massive arena where the Minnesota Timberwolves and WNBA Minnesota Lynx play basketball. These three roofs are on public buildings that have extremely varied site conditions and feature native prairie species right along with—in fact,

dominating—the oft-used sedums and other succulents. And they are within blocks of each other.

In 2010, all three roofs were thriving, even the Target Center roof, which had barely one growing season under its belt. Together, these three roofs, though certainly not as well recognized as examples in oft-written-about Chicago or Portland, show how green roofs can be implemented in some very unusual locations.

All three are largely the work of Kestrel Design Group and its founder, the landscape architect Peter MacDonagh, ASLA. The first to be built was the



BOTTOM

The Central Library green roof is dominated by native bluff prairie plants, like little bluestem, coneflower, and...

INSET

...prickly-pear cactus...

TOP

...which were installed both as seeds and as plugs.

IMAGE CREDITS

Courtesy Kestrel Design Group

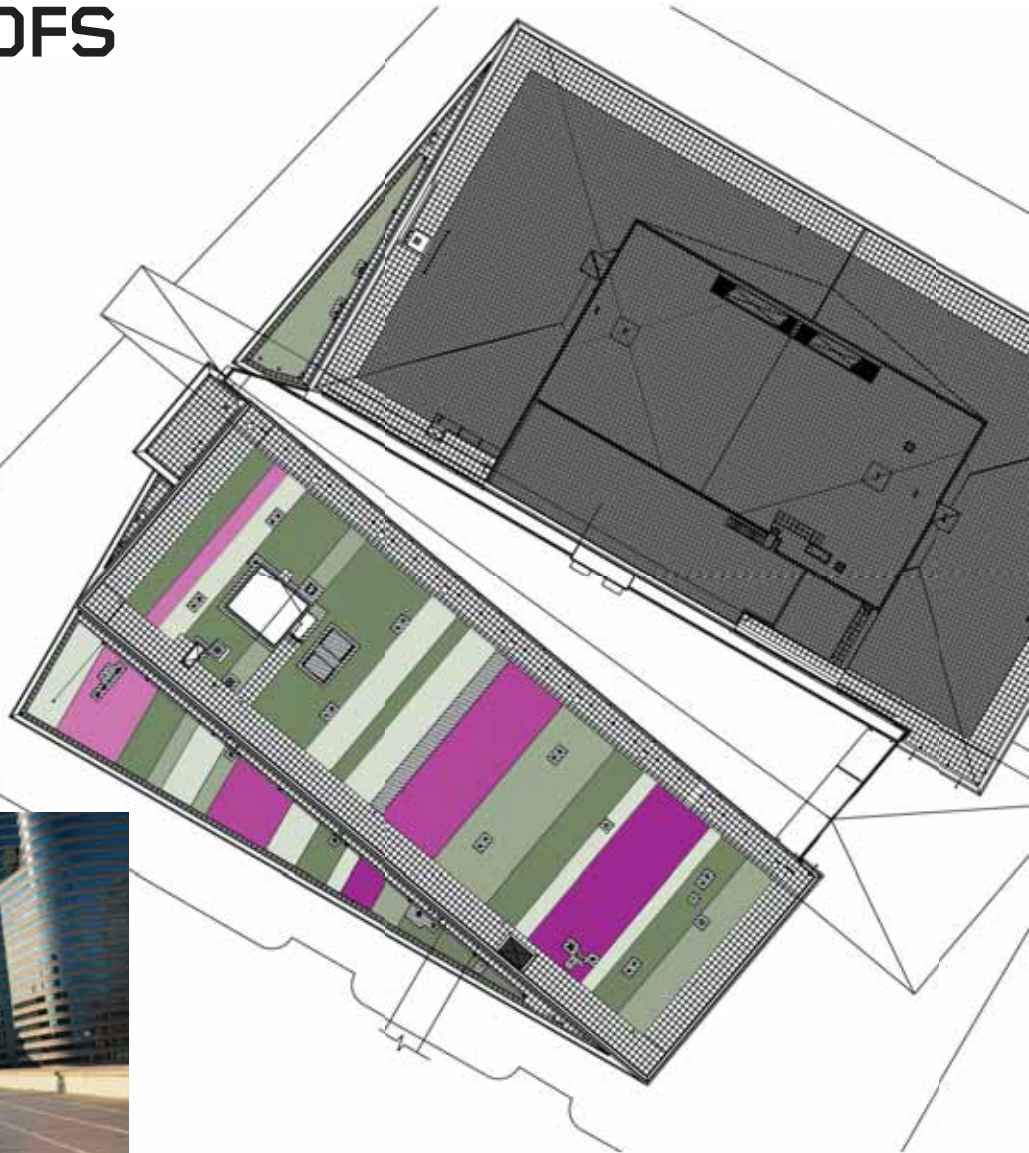
library. Kestrel wasn't involved in the initial discussions about the building (designed by Cesar Pelli of Pelli Clarke Pelli Architects with local firm Architectural Alliance), and, in fact, the green roof (which is on three separate roof spaces) almost never happened. It took advocacy and eventual funding from the Mississippi Watershed Management Organization to add the vegetation to the plans just before construction began. The native plants, of course, make the roof fairly unusual, but even more challenging, according to MacDonagh, was the varied site conditions on the three

different roofs. The 18,000-square-foot fifth-floor roof would be typically wind-swept and dry. The 1,000-square-foot northwest-facing triangular wedge on the second floor would only get four hours of sunlight per day. And the 3,000-square-foot south-facing second-floor roof would have four stories of glass reflecting sun down onto it. "There are about 1.3 suns shining on that roof," says MacDonagh.

Such varied and difficult conditions drove Kestrel to seek what MacDonagh calls an "analogous native landscape." That means he looked around the state to find an actual ecosystem with conditions similar to those on top of the library. He found a dolomite bedrock bluff prairie in the southeastern part of the

state. This rugged landscape has shallow soil over limestone bedrock and is wind-swept, dry, and hot—great conditions for the prickly pear that grows there.

The green roof cross section at the library is fairly typical: a built-up roof membrane, a drainage mat, dimple board, and planting medium. The medium is four inches thick and includes a drip irrigation system in the middle of the cross section. The library has five rainwater storage tanks in the basement, totaling 7,500 gallons, for roof irrigation. Widely spaced sprinklers supplement the drip irrigation when needed. The irrigation system can be best described as stingy. "We want to stress the system," says MacDonagh. "We don't want to encourage weed





MINNEAPOLIS GREEN ROOF FACTS

MINNEAPOLIS CENTRAL LIBRARY

Owner: Hennepin County Library District

Date installed: 2006

Square footage: 22,000 on three separate roofs

Sun exposure: varied—full sun on upper roof, full and additional reflected sun on southern second-floor roof, part shade on northwestern second-floor roof

Wind exposure: moderate

Planting medium depth: 4 inches

Plant mix: 21 species of sedum, 40 species of native plugs

MINNEAPOLIS CITY HALL

Owner: Metropolitan Building Commission, joint board of the City of Minneapolis and Hennepin County

Date installed: 2008

Square footage: 5,000

Sun exposure: full shade to part shade

Wind exposure: moderate, swirling

Planting medium depth: 4 inches

Plant mix: 42 species of native plugs

TARGET CENTER

Owner: City of Minneapolis

Date installed: Fall 2009

Square footage: 113,000

Sun exposure: full sun

Wind exposure: high

Planting medium depth: 3 inches

Plant mix: 12 species of sedum, 22 species of native plugs, 16 species of native seed

growth.” The system has little solenoid sensors above the soil surface that are like electronic stand-ins for plant leaves. They measure how the sun is actually affecting leaf temperature and moisture loss, which can be a better indicator of plant stress than soil moisture content. None of the roofs receives any fertilizer. In essence, rather than create a rich, healthy environment for plants to grow, Kestrel has created a tough natural environment (like a dry bluff prairie), then selected plants that would survive in it.

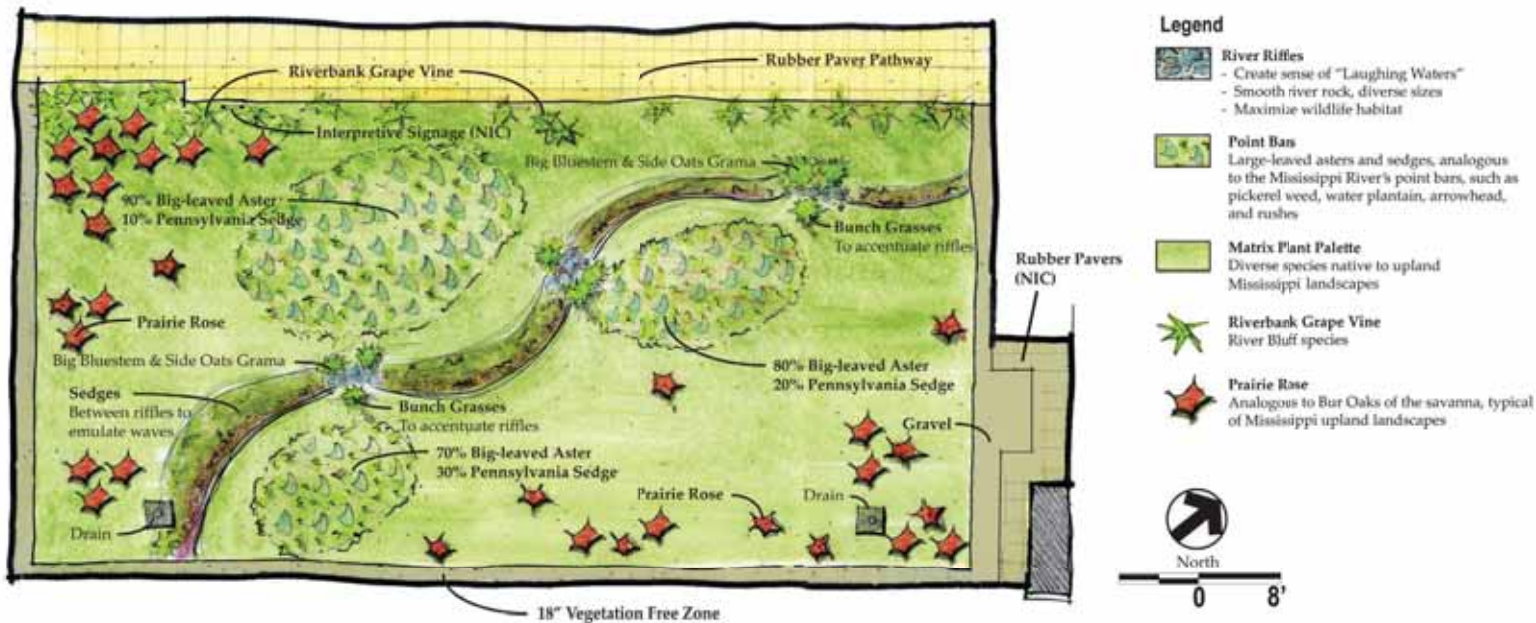
The shady second-floor triangle of the library, though, was new for Kestrel. The firm has been designing green roofs for years, but, obviously, roofs are usually in the sun. Here, Kestrel

adjusted the plant mix, including more “shady cliff” species like coralbells (*Heuchera*) and roundhead bush clover (*Lespedeza capitata*). Of course the watering requirements were different, too, but the sensitive irrigation system mitigated that. “This was our first foray into the shade,” says MacDonagh, “but once we nailed it we decided to go for the gusto at city hall.”

KESTREL HAS CREATED A TOUGH NATURAL ENVIRONMENT, THEN SELECTED PLANTS THAT WOULD SURVIVE IN IT.

The green roof on the Minneapolis City Hall (a building actually shared by the city and Hennepin County) is the strangest of these three Minneapolis roofs. The building dates from the 1890s, and its chunky gray-pink granite mass takes the form of a square with an open space in the center. From the air, it’s a rectilinear doughnut, and in the hole is a low roof that all the inward-looking offices can see. The green roof is here, somewhat buried in the bowels of the building. Early in the design process, a sun study found that one-third of the roof got no direct sun at all—ever. The rest tops out at about four hours per day.

The city hall green roof started out in 2004 as a simple waterproofing project. Jose Cervantes, director of the Municipal Building Commission, a joint city-county agency that oversees the building, remembers that when he presented the project for funding, the mayor of Minneapolis and several city council members and county commissioners became interested in installing a green roof. So Cervantes and his staff went to Chicago. “Without having any knowledge or experience with green roofs,” he says, “we set about educating ourselves.” At the time Cervantes was skeptical about the possibility of installing a green roof in such a



difficult location, in the middle of downtown, essentially within the building (the library roof had not yet been installed). After seeing the Chicago City Hall, however, also a historic building hemmed in by skyscrapers, he changed his perspective. "Our site conditions were no worse than [Chicago's]," he says. "If you could [build a green roof] in Chicago, you could do it anywhere."

side moist cliff: shady and wet, with shallow soils. Minneapolis gets just under 30 inches of rain per year, right about in the middle, nationally. The issue here is more about runoff than water scarcity, and several cities in Minnesota and the Midwest have begun charging separate utility fees for stormwater management in an effort to make homeowners and commercial



Cervantes hired Kestrel to design some early concepts, at about the same time the firm was working on the library. Those ideas were grandiose, involving a flowing watercourse, green walls on the building facades above the low roof, weird vine trees, and what look in the drawings like topiary archways. Due to lack of funding and an erroneous structural report, Kestrel toned down the roof to the simple palette of native plants there today (there is still a "river" of sedges that gets lost in the rest of the vegetation, and several gravel "ponds" that look somewhat unintentional).



The performance of the vegetation, however, is stunning. Kestrel's "analogous native landscape" is a north

INSET

Originally a shady, gray interior courtyard...

LEFT

...the Minneapolis City Hall green roof today is a colorful mix of native shade-loving plants.

TOP

Though it looks like a simple forest understory planting, the plan shows the subtle design scheme of a river of sedges, punctuated with "point bars" of asters and scattered prairie roses.

IMAGE CREDITS

Courtesy Kestrel Design Group



At city hall, rain from the building's upper metal roofs (about an acre of surface) feeds into a 10,000-gallon cistern on an intermediate roof that is 53 feet above the green roof. The cistern feeds the drip irrigation system by gravity alone. No pumps or energy are required to irrigate the green roof, and the irrigation system is divided into four quadrants to ensure areas with different sun access get different watering regimes. There is room for a second cistern if funding ever materializes.

The city hall roof also includes a jute blanket on top of the soil to mitigate the swirling winds that funnel down into the center of the building. But those winds are nothing compared to the gales encountered on the Target Center roof. The arena sits at the western edge of downtown, in the face of prevailing gusts. The roof's sheer size, the wind, and the fact that a green roof had never been built on an arena before made considering one a tough sell.

That project began, like the city hall project, with a need to reroof the arena at the end of the roof's 20-year life cycle. Architecture firm Leo A. Daly, which had a standing contract with the city for these types of renovations, was asked to consider options for the reroofing. Leo A. Daly brought Kestrel on board to add, at the city's request, green roof options to the mix. Because the cost-benefit timeline was set at 25 years (instead of 20), the green roof became a cheaper option because it would not have to be replaced at 20 years like a conventional roof. It was selected by the city, and the two firms, joined by roofing specialist Inspec, began to design this behemoth.



The cross section here is similar to that on the library (four inches of planting medium over the requisite drainage layers), but the unique element is how the soil got to the roof. It was blown in, like insulation, or like roadside erosion control. This was the first local instance of this process, though since it was done here in 2008 it has become common practice nationwide. It was especially critical at the city hall because the roof is not accessible from adjacent streets; the only other options would be to lift the material by crane up and over the five-story doughnut of the building or to hand cart it in through the lobby. The technique was later used on the Target Center, whose extremely high, inaccessible roof might have become cost prohibitive without it.

Because of the size of the roof, the team planned to custom grow vegetated mats that could be cut, lifted to the roof, and rolled out. They decided to grow those mats on top of a geotextile erosion control fabric. As the 10 species of sedum sprouted in a field near Washington, D.C., their roots got entangled in the mat, essentially locking plants and soil and fabric together. When the mats were ready to be harvested, the grower cut a one-inch thickness of soil that included the mat and rolled the pieces up like sod for transport to Minneapolis.

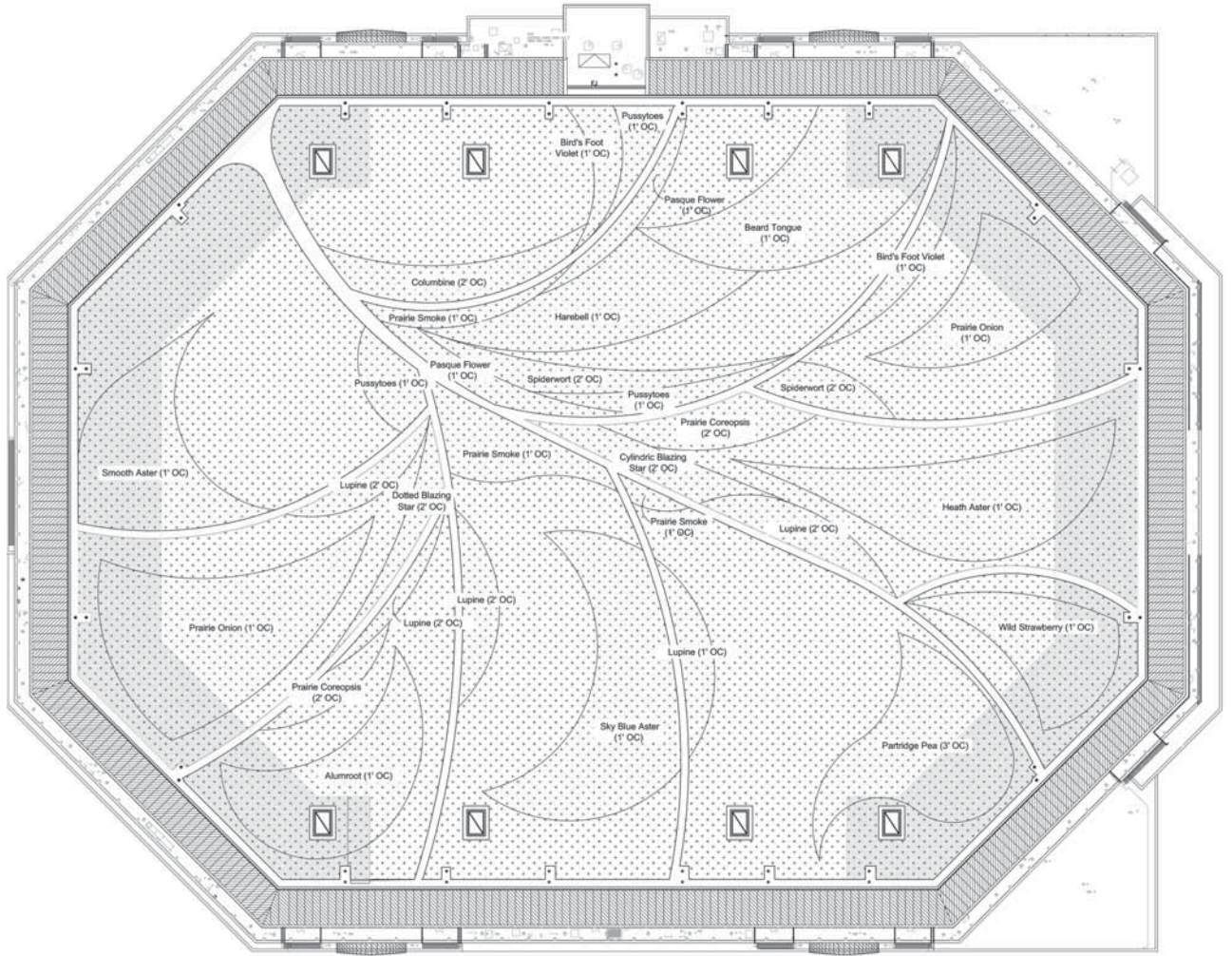
Once on the roof and unrolled, the edge of one strip of sedum sod was tied to the neighboring one by attaching

ABOVE
The Target Center green roof is the most sedum-dependent of the three. It has a pattern of leaf veins, which are paver walkways necessary to prevent wind uplift.

INSET
The vegetation mats were custom grown with a fabric mesh within the soil layer.

IMAGE CREDITS
Courtesy Kestrel Design Group, Leo A. Daly, and Inspec

properties more aware of their impact on streams and lakes. Minneapolis actually has to pay its own stormwater fees, something that figured into the decisions to install green roofs on city hall and the Target Center. In the Midwest, green roofs can create a beneficial closed-loop system. Water is collected from the conventional roof portions of buildings and used to irrigate the green roofs. That water nourishes the green roof plants between rainstorms but is also kept out of the stormwater system.



RIGHT
In addition to the sedums, the Target Center roof also includes low-growing native plants such as pussytoes, strawberry, prairie smoke, and bird's foot violet.

IMAGE CREDIT
Courtesy Kestrel Design Group, Leo A. Daly, and Inspec

THE PAVER PATHWAYS ARE HEAVY ENOUGH TO SATISFY WIND UPLIFT REQUIREMENTS.

their erosion control mats together. Then—this is the critical piece—the mats were also tied to a series of concrete paver pathways. This, says MacDonagh, “allowed us to get the necessary weight on the roof.” The paver pathways are heavy—heavy enough to satisfy wind uplift requirements. Tying the vegetated mats to them and to each other turns the entire top layer into one unified system. Basically, the paver pathways lash down the soil like ropes securing a giant tarp.

The rest of the cross section includes two more inches of (blown in) expanded shale planting medium with drip irrigation within it, a combination filter membrane and drainage layer, and a leak detection system that uses electrical currents to pinpoint water that seeps through the roof

membrane. Just under the planting medium is a water retention layer: a mineral fleece that wicks water across the roof. The designers hope it will ensure the long-term quality of the roof by eliminating dead zones caused by uneven irrigation. The planting medium depth here is thinner than usual, a total of just three inches, and the roof is still new; though coverage was good in early 2010, its ultimate success remains to be seen.

Though the Target Center roof is largely made up of the custom-grown sedum sod, the design team did add plugs and cuttings of native poor-soil prairie species, like prairie smoke, coreopsis, wild strawberry, and pussytoes. This diversity, says MacDonagh, brings some rare species (like the pussytoes) into downtown Minneapolis, and also brings ad-

ditional, more varied food sources to urban birds and insects.

It also brings beauty. Though the library green roofs can't be seen from everywhere in the building, there is a nice row of tables on the west side of the second floor where the prairie grasses wave in the wind outside the window. City hall workers seem to love the seasonally changing display of flowers and seeds (and buzzing insects), even if they can't go out there for lunch as originally planned. And those concrete paver pathways on the Target Center look like the veins of a leaf—a whimsical bit of green on display for one of the regular airport approach routes. ●

ADAM REGN ARVIDSON, ASLA, IS A REGULAR CONTRIBUTOR TO LAM AND FOUNDER OF TREELINE, A DESIGN/WRITING CONSULTANCY IN MINNEAPOLIS.



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