On The Fringe
Journal of the Native Plant Society of Northeastern Ohio

BioCellar Rain Garden
Inspired by Native Plant Society of Northeast Ohio Field Trips

By Jean Loria & Pebbles Bush

The BioCellar in Cleveland, Ohio and its Rain Garden

Rain gardens typically are planted swales in residential lots that soak up rainwater. In urban areas, widespread establishment of rain gardens mitigates negative effects of stormwater run-off. The BioCellar built at the Vineyard of Chateau Hough in Cleveland, Ohio (figure 1) is a demonstration site of a broader use of the term rain garden to include an intentional seamless stormwater chain of capture, channeling, storage, diversion, and retention of rainwater and snow. It is a passive solar greenhouse rising up from the basement of a demolished vacant building. Green/natural building, ecological design, and neighborhood connection are defining features for BioCellars as potential mini-economic engines of urban revitalization.

Construction of this BioCellar was completed in October 2014, and as soon as the built stormwater infrastructure of the BioCellar was in place, we began to create the adjacent rain garden designed for it. Rather than "berms & swales", we would be working with "dunes and swales".

Figure 1. BioCellar at the Vineyard of Chateau Hough, Cleveland Ohio. Concept and design Jean Loria; architect Robert Donaldson; builder and owner Neighborhood Solutions, Inc., Mansfield Frazier, Executive Director.

The Soil of the Rain Garden

Hough is in the Lake Plain of Cuyahoga County, east of the Cuyahoga River and north of the Portage Escarpment. The area is flat and drains to Doan Brook. The soil is composed of ancient filled-in river valley and ancient lake bottom with deposits of silts, sand, and gravel. Ridges of old glacial lake beaches run east and west throughout (figure 2). The vacant house that was demolished—so the BioCellar could be constructed using the carefully salvaged foundation floor and foundation walls — was more than 100 years old. Layers of asphalt, brick, and rubble encountered while digging a trench for electrical conduit for solar voltaics confirmed that the lot had been used as a dumpsite for many years. We knew that the graded site for the rain garden to the east of the BioCellar was largely sand, grit, small stones, and rubble. Thus we understood that a better design for this rain garden would be one modeled on a sand barren ecosystem rather than the more familiar wetland ecosystem based in a clay-loam soil composition.

Hence the Hough is an area of critical concern for stormwater run-off quantity and quality. Stormwater run-off enters the stormwater infrastructure contributing to the serious problem of Combined Sewer Overflow. The BioCellar at the vineyard is, in part, a demonstration project for stormwater best management practices, and the Northeast Ohio Regional Sewer District contributed to funds for construction.

Goals for the Rain Garden

What were our goals for the BioCellar rain garden? We wanted to show clearly the function of the BioCellar outer shell as an efficient passive rainwater harvesting structure (figure 3), so the downspouts were painted to match the roof to make them stand out against the stone foundation walls. One of the Ecological Design Principles articulated by Van der Ryn Architects is "make nature visible". Therefore, there are no buried pipes channeling stormwater to or through the rain garden.

We wanted to construct the garden to give the impression of water flowing back and forth from the top of the rain garden to the lower elevation. Rapid percolation of rainwater run-off into the sandy rain garden and the challenge of maintaining soil fertility would have to be factored into plant palette selections. Urban-heat-island effect, wind forces, and proximity of foot traffic were also in the mix. It was also important that the rain garden be an attractive and welcome addition to the neighborhood gardenscape and unique to the natural history of the area. Every contribution to wildlife habitat—no matter how modest—would be a boost for enlivening the built urban environment.

Native Plants a Top Priority for the Rain Garden

Featuring native plants was a top priority. Natural ecosystems would be our model (figure 4). The Native Plant Society of Northeastern Ohio organizes fieldtrips that over the years have included numerous trips to Lake Erie protected shoreline areas: Mentor Headlands, Walnut Creek Beach, Geneva State Park, North Kingsville Sand Barrens, and Conneaut Beach are excellent and precious protected areas. We are both members of the society and were fortunate to go on some of these trips. Species lists and physical descriptions published in the Society's *On The Fringe* journal chronicling the trips provided valuable reference material.

The BioCellar Lot Intercepts an Amount of Rainfall that would Surprise many.

The BioCellar and lot that it occupies intercept 80,500 gallons on average per year of incident rainfall. The glazing system plus gutter of the BioCellar intercepts approximately 175 gallons of rainwater per inch of rainfall and channels it to a southeast downspout directed to the rain garden, or the stormwater can be diverted to supplement irrigation of the vineyard. The metal roof (engineered to shade the interior during peak summer solar exposure to prevent

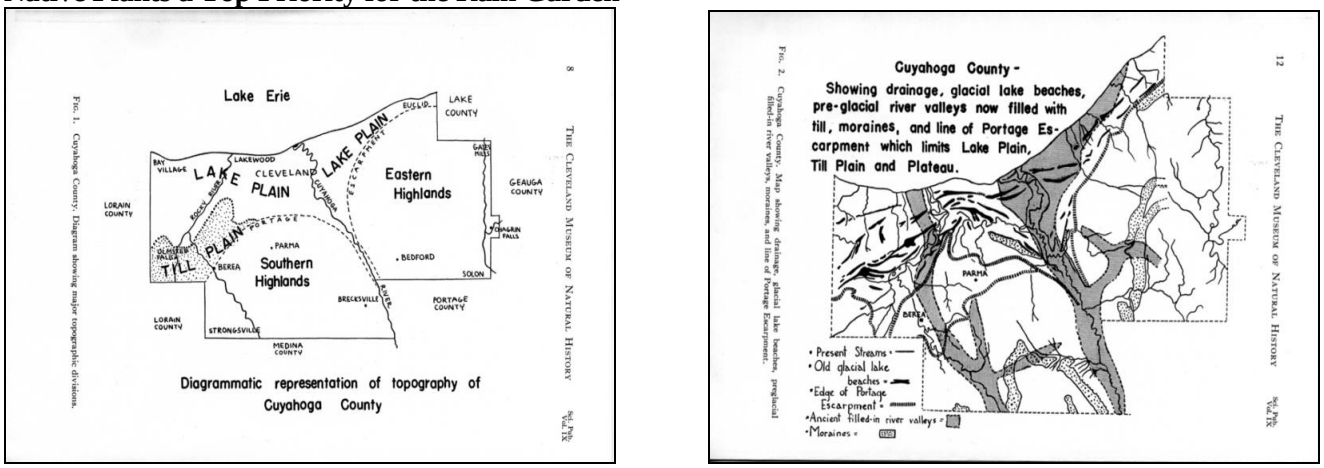

Figure 2. Lake Plain and Glacial Lake Beach Areas of BioCellar Site. From "The Native Forests of Cuyahoga County," Ohio by Arthur B. Williams, PhD., Bulletin Number 1, The Holden Arboretum, Scientific Publications of the Cleveland Natural History Museum, Vol. IX, January 1949.

the BioCellar from becoming a solar oven) intercepts approximately 425 gallons of rainwater per inch of rainfall. Downspout and piping from the roof channel the rainwater to a 1600-gallon cistern positioned on the floor of the BioCellar. When the cistern is filled, rainwater is shunted by back-pressure outside again and into the rain garden.

The core of the rain garden is 20 feet by 20 feet with borders for additional planting both north and south and has a 10% grade east to the sidewalk along E. 66th Street. The two stormwater run-off inflows are located at the top (west side of the rain garden area) with an expected maximum stormwater surge of 600 gallons per inch rainfall from the BioCellar and an additional 250 gallons incident rainwater per inch rainfall captured by the rain garden core. The goal is for the stormwater to be channeled to the rain garden above ground from the two downspouts into a spreader drain

trench spanning the upper edge. Most of the likely stormwater run-off infiltration into the soil bank will occur here and subsurface waterflow will migrate to the lower edge as 'green water' in the plant root zones. Sandy soil has an advantage over soil with a high clay content in that a light rain during dry periods provides more 'available water' for plants in addition to penetrating more deeply.

The Design of the Rain Garden

The visible topographical structure for managing stormwater run-off flow through the rain garden is a simple pattern of three overlapping berms with swales on the upper side of each berm. Swales are shallow trenches with gently curved sides graded with a contour perpendicular to waterflow, and in this case with a slight downgrade slope. They function to divert and retain stormwater run-off. The berms were constructed by mounding the native sandy soil from the swales to a height of 12 to 24 inches. The berms are armored with stone at each end to prevent erosion and for aesthetics. The topography of the garden suggests waterflow meandering back and forth across the garden to an outflow at the northeast corner. A sidewalk rill would direct overflow—if it reached this lowest elevation—to a French drain across the tree lawn to the street and nearby catch basin.

Soil analysis by sedimentation test showed 78 % sand, 18 % silt, and 3 % clay. After the surface structure was shaped, two yards of compost were spread across the rain garden and forked into the soil to improve fertility and increase water retention capacity. The rain garden site is in full sun with wind exposure on three sides. Plant species were chosen for their ability to tolerate tough conditions of wind, sun, and drought, root structure to stabilize the 'dunes,' attractive seasonal bloom, and pollen, nectar, fruit and seeds for wildlife.

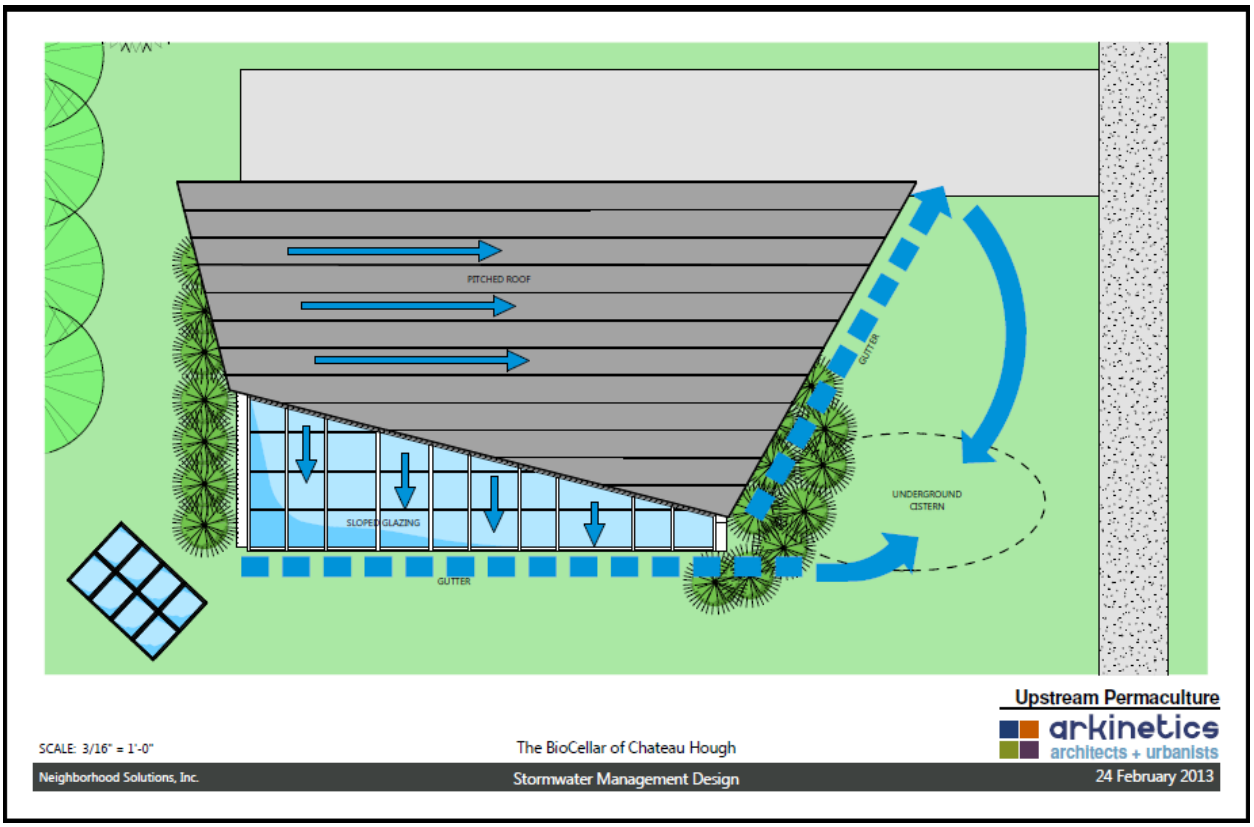

Figure 3. Schematic of Cleveland BioCellar Topview Showing Rainwater Harvesting Path

Native Plants Chosen for the Rain Garden

Border plants for the rain garden are northern bayberry, rugosa rose, and beach plum. "Dunes" are planted with little blue stem grass, butterfly weed, smooth aster, stiff coreopsis, and wild petunia. Swales are planted with sedum, pussy toes, and Little Joe Pye weed. The lowest level of the rain garden bordering the sidewalk is planted with prickly pear cactus and wild lupine. See figure 5 for the BioCellar rain garden plant schedule.

Beach plum and northern bayberry are part of a shrubland alliance found on sand dunes along the Atlantic Coast. A number of species from the Atlantic coast are also found on the Lake Erie shores. This interesting phenomenon of plant occurrence in widely separate geographic area is called disjunct. (See the article by Tom Sampliner in *On the Fringe* Vol. 31, No 2. June 2013 for more information).We added rugosa rose as a border plant as well. It is not native but is found naturalized and commonly present in maritime dune shrublands with beach plum and northern bayberry.

Beach plum fruit, called by some "Rubies of the Dunes," is a choice edible for humans as well as wildlife. The plant blooms in mid-April, and dime-to-quarter-sized fruit ripens in August or September. It grows at the Headlands Dunes State Preserve. Northern bayberry is tolerant of salt spray and drought. It is used ~~in~~ in parking lot "hell" strips and other tough urban spots as a hedge. The fruit is an important source of food for birds. It remains on the shrub well into winter. Northern bayberry fixes atmospheric nitrogen into soil, enriching it. Fragrance derived from the fruit gives us the familiar bayberry candle.

Rugosa rose is a popular ornamental rose with large, showy flowers in early summer. The blooms form very large red hips by late summer, earning its less commonly known name of "Beach Tomato". A big bonus is that the hips are high in vitamin C and easily dried for herbal teas. Rugosa rose is hardy, disease resistant and develops a strong root system we knew would be useful in stabilizing the edges of the BioCellar rain garden soil structure. For wildlife, it offers berries, forage, and shelter. Bees are attracted to its fragrant flowers.

Figure 4. Headland Dunes State Nature Preserve

Berms/dunes are planted with little bluestem grass, butterfly weed, smooth asters, stiff coreopsis and wild petunia. Little bluestem, *Schizachyrium scoparium*, is a grass found in the herbaceous layer of maritime dune shrubland. Little bluestem, *Schizachyrium scoparium* 'Prairie Blues,' with its lesser stature was a better match for the scale of this rain garden. Contributions are berm stabilization via its powerful root system, fall color of the tall, graceful seedheads in bloom from July to October lasting into winter, and wildlife habitat. It is a larval host to assorted skipper butterfly species and provides nesting material, cover, and seeds for small mammals. Butterfly weed, also found in the Headlands Dunes area, is a member of the plant genus *Asclepias*, critical for survival of the Monarch Butterfly. Attracted by the bright orange flowers, they lay eggs on the leaves containing protective phytotoxins consumed by larva as they develop into caterpillars. Stiff coreopsis, another butterfly attractor, also provides nectar for bees and carries lovely yellow flowers late into the growing season. Smooth aster like stiff coreopsis is a favorite Monarch nectary plant. It can bloom as late in the season as November—a boon for bees. Birds eat the seed in winter. Wild petunia blooms from June through August and is a favorite nectar source for hummingbirds. Though this plant has a shorter height than the other berm plants, it sows seed readily and is likely not to be out competed in this rain garden. These plants do well in full sun and are drought tolerant, making them good choices for the sandy berms.

The sandy swales of the rain garden are dotted with masses of *Sedum caudicola* 'Lidakense', a species cultivar not native to North America but in a family that is naturally drought tolerant. It has a prostrate habit that will fill the swales, turns bright pink when it blooms in late summer to early fall, and is a nectar source for pollinators and butterflies. *Antennaria dioica*, pussy toes, is planted to outline the pattern of the impression of waterflow through the rain garden and will bloom from May to June. Little Joe Pye is planted in a stand at the top of the BioCellar rain garden to add height and occupy what is expected to be the wettest spot to satisfy its higher moisture requirement. Prime bloom time for this native plant is July through August. Nectar, pollen, and seeds for bees, butterflies, and birds round out its multi-purpose rain garden function.

The lower east edge of the rain garden bordering the sidewalk profiles both the native cactus *Optunia, humifusa* and the rare *Lupinus perennis*. Eastern prickly pear cactus requires a well-drained sunny location. We expect the bright yellow bloom and red fruit borne June through July to be a pleasant surprise. Bees, butterflies, and beetles will also appreciate this intimidating plant. Found in the same sandy well-drained habitat as prickly pear cactus, and locally at North Kingsville Sand Barrens, is *Lupinus perennis*—common names, sundial and wild lupine. It is a member of the pea family and like Northern Bayberry will fix nitrogen into the soil as an important eco-service for the fertility of the rain garden. It's an obligate host for Blue Karner butterfly eggs and larval host for both the Karner Blue and Frosted Elfin butterfly. Humming birds are attracted to the bluish-purple elongated flowers. The status of wild blue lupine is listed as "Potentially Threatened" in Ohio. We were pleased to include it in this rain garden.

What the Rain Garden will do for the Neighborhood

As the rain garden establishes and matures, it will detain and retain stormwater run-off, provide nectar, pollen, seeds, forage, and habitat for wildlife, and also demonstrate a rain garden uniquely suited to the topogeography of the site (figure 6). From mid-April beach plum flowers to May emergence of wild lupine and pussy toe blooms and with a continuous show of color from rugosa rose, wild petunia, stiff coreopis, butterfly weed, Joe Pye, sedum and smooth aster, the rain garden will add interest and vitality to this important urban neighborhood. The moment we placed the plants in the rain garden, shovels in hand, a Monarch Butterfly arrived to visit the butterfly weed and continued to fly about the entire day. We could not have asked for more immediate or meaningful approval.

Jean Loria and Pebbles Bush are members of the Native Plant Society of Northeastern Ohio. Jean is a Permaculture Designer and can be contacted at biocelllars@gmail.com. Pebbles is a Horticulturist with a particular interest in native plants. For further information about the BioCellar in Hough go to http://www.neighborhoodsolutionsinc.com and http://www.cleveland.com/food/index.ssf/2014/10/innovative_biocellar_in_clevel.html.

To read more about Biocellars in general go to the Cleveland Urban Design Collaborative website: http://www.cudc.kent.edu/projects_research/research/biocellar.html.

Figure 6. 'Dunes & Swales' of BioCellar Rain Garden

BioCellar Rain Garden Plant Schedule

• *Antennaria dioica* 'rubra'	Pussytoes
• *Aster laevis*	Smooth aster
• *Asclepias tuberosa*	Butterfly weed
• *Coreopsis palmata*	Stiff coreopsis
• *Eupatorium dubium* 'phantom'	Little Joe Pye Weed
• *Lupinus perennis*	Lupine
• *Myrica pensylvania*	Bayberry
• *Opuntia humifusa*	Prickly cactus
• *Prunus maritima*	Beach Plum
• *Rosa rugosa*	Rose
• *Ruellia humillis*	Wild Petunia
• *Schizachyrium scoparium* 'Prairie Blues'	Little Blue Stem
• *Sedum cauticola* 'Lidakense'	Sedum

Figure 5 BioCellar Rain Garden Plant Schedule

Biocellar Rain Garden References

On The Fringe, Flora of Northeastern Ohio's Beaches, Dunes, Swales and other Palustrine Habitats, Tom Sampliner, Vol 31, No 2, June 2013.

On The Fringe, Northeast Lakeshore Ohio State Nature Preserves, Vol 25, No 3, September 2007.

On The Fringe, D-Day on the Beaches of Ashtabula, Jean Roche Vol 21, No 4, December 2003.

The Native Forest of Cuyahoga County, Ohio, Arthur B. Williams, PhD., Bulletin Number 1, The Holden Arboretum Scientific Publications of the Cleveland Natural History Museum, Vol IX, January 1949.

Rain Gardens: Managing Water Sustainably in the Garden and Designed Landscape, Nigel Dunnet and Andy Clayden, Timber Press, Inc. 2007.

The Study of Plant Communities: An introduction to Ecology, Henry J. Ossting, W.H. Freeman and Company 1956.

Design for Water: Rainwater Harvesting, Stormwater Catchment, and Alternative Water Reuse, Heather Kinkade-Levario, New Society Publishers 2007.

Chapters of the Ohio Native Plant Society

The Native Plant Society of Northeastern Ohio
Kathryn Hanratty
PO Box 1064
Chardon OH 44024-9639
oldefarm@windstream.net
http://www.nativeplantsocietyneo.org

Cincinnati Wildflower Preservation Society
Christine Hadley, President
445 Ward-Koebel Road
Oregonia OH 45054
513-850-9585
cncywildflower.org
http://www.CincyWildflower.org

The Mohican Native Plant Society
Joanne Wrasse
1633 St.Rt.603
Ashland OH 44805
419-281-3690
jwrasse@zoominternet.net

The Botanizers
The Wilderness Center
Gordon T. Maupin
P.O. Box 202
9877 Alabama Ave. SW
Wilmot OH 44689-0202

MEMBERSHIP APPLICATION

Membership includes invitations to all field trips, programs, the Annual Meeting and an online subscription to the quarterly journal *On The Fringe.* Membership runs from January 1 to December 31.

NAME: _____
ADDRESS: _____
CITY: _____
STATE: _____ ZIP:_____
PHONE: (____) _____
E-MAIL: _____

(We will not sell or distribute contact information.)

Membership Types (circle type chosen):
Individual $15; Family $20;
Sustaining $30; Patron $50
Trillium Society $100; Gentian Society $200
Corporate Level $250

☐ Check here and add $10 to have a Print edition of *On The Fringe* mailed to you.

Donations to the Endowment Fund to support the annual grant are always welcome.
The Annual Grant is offered for work in the field of botany or conservation that supports our mission and demonstrates excellence in research, conservation or education.

Make checks payable to:
The Native Plant Society of Northeastern Ohio
and mail to:

Jane McCullam
NPS Membership Chair
9880 Fairmount Rd.
Newbury, OH 44065

The Native Plant Society of Northeastern Ohio is a 501(c)(3) organization.
Your donation is tax deductible to the extent allowed by law