North Carolina Technical Guidance for Native Plantings on Solar Sites

North Carolina Pollinator Conservation Alliance

October 2018

Introduction

North Carolina is home to nearly 500 species of native bees and more than 2,200 and 170 species of moths and butterflies, respectively. In the North Carolina Wildlife Resources Commission's 2015 State Wildlife Action Plan (SWAP) (www.ncwildlife.org/plan), there are 28 insect species that have been listed as Species of Greatest Conservation Need (SGCN). This list includes the rusty-patched bumble bee (Bombus affinis), a species that has been recently listed as federally endangered under the Endangered Species Act (ESA). In addition, the yellow-banded bumble bee (Bombus terricola), an SGCN in the SWAP, has been petitioned for listing under the ESA. There are several species of butterfly that are considered threatened or endangered due to loss of host plant habitat, including the frosted elfin (Callophyrs irus) and monarch butterfly (Danaus plexippus), currently under review for listing by the U.S. Fish and Wildlife Service. The primary threat to these imperiled species is habitat loss and fragmentation.

Threatened and endangered pollinators found in North Carolina


Rusty-patched bumble bee © Susan Day


Yellow-banded bumble bee © Denis Doucet


Frosted Elfin Butterfly © Bill Bouton


Monarch Butterfly © Lindsey Brendel

Historically, a significant portion of North Carolina was considered 'prairie' habitat; less than 1% currently remains. In the early1500's, European settlers detailed the existence of prairie-type openings across the Piedmont region. In 1540, Hernando de Soto wrote of large swaths of un-forested areas that were easily navigated on horseback with abundant amounts of grass. In 1718, a French explorer, Guillaume Delisle, reported the landscape as a sparsely forested, open grassland containing bison and elk, present from the Neuse River to the foot of the mountains.

These early explorers depicted a vastly different landscape than exists in modern-day North Carolina. It is likely these former prairie-type habitats were maintained by centuries of wildfires and Native Americans who managed the open areas for agricultural purposes and game species. After European colonization, Native Americans and large grazers were displaced and prairie areas were converted to pastures, agriculture fields or succeeded to forest. It is difficult to approximate the floral and faunal diversity that has been lost with the disappearance of this expansive habitat. However, the solar industry has an opportunity to create large areas of habitat with similar prairie characteristics that may offset habitat loss and declining pollinator populations (Forup et al. 2008).

Healthy Pollinator Communities

A healthy pollinator population is an excellent indicator of the overall health of most terrestrial communities (Kevan 1999). Maintaining species diversity is crucial to providing ecosystem resilience in the face of future environmental change. The most important pollinator conservation actions that can be incorporated into solar facility planning include the creation, restoration and/or preservation of native beneficial pollinator vegetation and vegetated riparian buffers.

Honey bee (left) and painted lady (right) feeding on flowers

Vegetation

Pollinator-friendly plants provide food sources, shelter, nesting and egg deposition sites for native pollinator species. Increasing the abundance and diversity of native plants within and around solar facilities can have beneficial effects on native pollinator populations (Tonietto et al. 2011), thereby benefiting other plants and wildlife in the area. Benefits may include increased populations, population fitness and pollinator diversity in and around the project site. Increased populations can also increase home garden and agricultural production in adjacent areas.

1. **Food Sources** – Consistent, energy rich food sources provide enhanced larval and adult nutrition and better adaptability to pests and diseases. Because flowers provide nectar (high in sugar and amino acids) and pollen (high in protein), the common belief is that pollinator conservation consists solely of increasing floral diversity at a site (Fontaine et al. 2005). While increased floral diversity is desirable, a variety of native grasses, shrubs and trees are as important to pollinator health because they provide vital foraging, cover, nesting and egg deposition areas. To further enhance pollinator health and diversity at solar sites:
   - **Use a wide variety of plants that bloom from early spring into late fall.** Increasing pollinator health and diversity by providing a consistent food sources throughout the seasons is vital to healthy pollinator populations. A diverse pollinator population requires blooming plants from March-November. Early blooming plants (March-May) are particularly important because pollinators are coming out of winter dormancy and need a consistent early food source for colony creation. It is important to use plants that are native to your region because they are adapted to the local climate, soil and pollinator species. Night-blooming plants should be included to support moths and bats.
   - **Incorporate a variety of plant types into the site plan.** Plants of different heights and types (e.g., flowers, grasses, trees and shrubs) will attract different pollinator species and provide a variety of food sources. Fruit- producing shrubs and trees should be planted wherever possible and as required “screening” around the solar facility. Fermenting fruits from trees and shrubs are important food sources for bees, beetles and butterflies.

- **Include larval host plants.** Providing abundant and diverse larval host plants is necessary for healthy butterfly and moth populations. Moths and butterflies require specific plants or habitats to deposit their eggs during different life stages. Eggs must be deposited on or near the plant on which their larva will feed once it hatches. Some butterflies and moths use only a single species or genus for host plants. For example, monarch butterflies lay their eggs only on the leaves of milkweed plants. Upon hatching, the larvae will feed only on milkweed plants. Some butterfly species are generalist feeders and will use a wide range of plants such as trees, shrubs and forbs. Many moth species lay their eggs on the trunk or leaves of trees and shrubs, or in leaf litter on the ground. To provide egg-laying habitat for the highest number of butterflies and moths, planting plans should incorporate plant species that can be used by several species.

Monarch butterfly eggs on milkweed leaves

© Monica Maeckle

2. **Foraging/Cover –** A diversity of plants on solar sites provides pollinators with protection from severe weather and predators. Leaf litter, dead plant material and multiple vegetation layers will help create "shelter areas" across the site for numerous pollinators. Establishing adequate plant density throughout the site will also allow pollinators to avoid predators and safely move through the landscape.

3. **Nesting and Egg Deposition -** Different pollinators have different needs for reproduction. Solar facilities should be designed to maintain a diverse array of habitats to accommodate varied pollinators, from hummingbirds to butterflies to bees. Hummingbirds typically nest in trees or shrubs while many moths and butterflies lay eggs on specific host plants. Most native bees nest in wood (or wood-like structures), hollow plant stems or in the ground. Areas of uncovered soil provide ground-nesting pollinators with easy access to underground tunnels. Brush piles, dead trees/shrubs and leaf litter are ideal for providing nesting and egg deposition habitat for a host of moth and butterfly species.

Riparian/Wetland areas

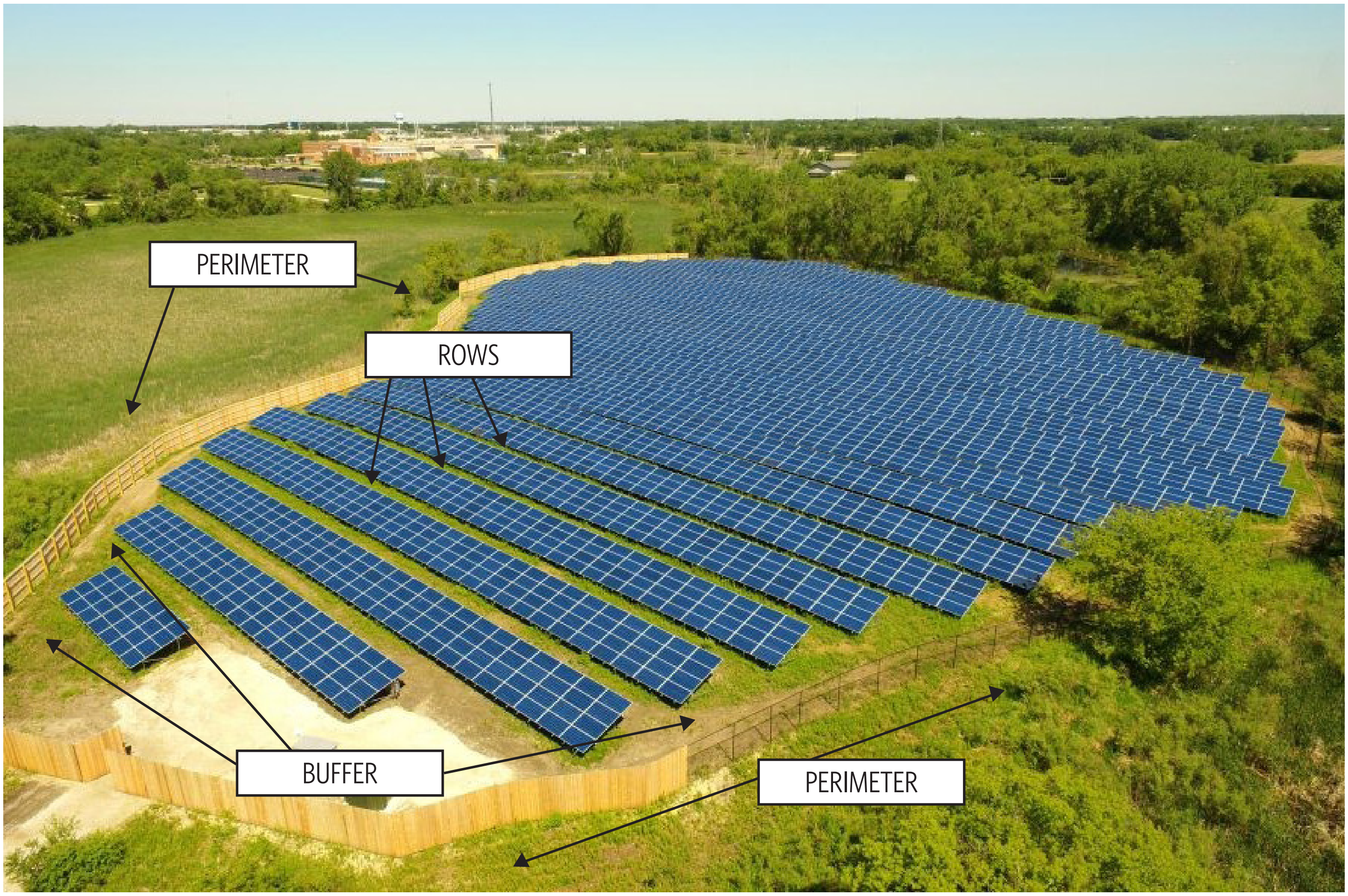
Vegetated riparian buffers are vital to maintaining a healthy ecosystem. These areas can provide many important elements such as food sources, shelter and nesting habitat. Most importantly, they are a water source. A clean, reliable water source provides drinking and bathing opportunities for pollinators. In many areas, vegetated riparian areas have a higher floristic diversity than other areas, and support more foraging pollinators than adjacent fields. By preserving or restoring vegetated, aquatic buffers, solar sites can increase water quality and quantity, and provide cover for pollinators to move safely between feeding and watering areas. Un-interrupted/connected vegetated riparian buffers also provide safe travel corridors between nesting sites for greater dispersal and reproductive efforts. For these reasons, solar sites should be designed so that all riparian buffer areas within the site are "connected". For more information on solar siting, see Attachment.

Solar Farm Site Preparation and Planting Guidelines

There are four planting options that can be used to establish pollinator habitat within a solar installation:

1. Clover/grass mix underneath panels and in rows; tall-growing pollinator mix (native forbs and native grass) in buffer area.
2. Clover/grass mix underneath panels; short-growing pollinator mix in rows and buffer area.
3. Short-growing pollinator mix underneath panels and in rows; tall-growing pollinator mix in buffer area.
4. Short-growing pollinator mix throughout the site.

Solar Farm Layout



When choosing seed mixes for flowers and grasses, the following parameters are recommended:

- A minimum of nine native flower species.
- A minimum of two native grass species.
- At least three flower species from each bloom period (early, mid and late): **early**, April-June; **mid**, June-August; and **late**, August-September.

The use of native plant species is recommended when creating seed mixes. However, clover is an exception as it is a nonnative, naturalized species that has persisted across the landscape without the negative qualities of invasive and noxious plant species. Clover seeds are readily available for purchase, easy to propagate and low-growing. Most importantly, clover provides a valuable nectar source for pollinating insects. Where possible, select native seeds from local growers, as they tend to be adapted to local conditions such as climate, insects/pests and soil.

Table 1. Solar Farm Seed Selection

Common Name	Scientific Name	Height	Bloom	Region*
Western Yarrow	*Achillea millefolium var. occidentalis*	1-3'	Spring	C, P
Fringed Bluestar	*Amsonia ciliata*	2'	Spring	C
Eastern Bluestar	*Amsonia tabernae-montana*	3'	Spring	C, P, M
Goldenstar	*Chrysogonum virgin-ianum*	1'	Spring	C, P, M
Lobed Tickseed	*Coreopsis auriculata*	1'	Spring	C, P, M
Piedmont Barbara's Buttons	*Marshallia obovata var. obovata*	2'	Spring	P
Narrowleaf Evening Primrose	*Oenothera fruticosa*	2'	Spring	C, P, M
Appalachian Ragwort	*Packera anonyma*	2.5'	Spring	C, P, M
Small's Beardtongue	*Penstemon smallii*	3'	Spring	P, M
Trailing Phlox	*Phlox nivalis*	1'	Spring	C, P, M
Heartleaf Scullcap	*Scutellaria ovata*	2'	Spring	C, P, M
Common Blue Violet	*Viola sororia*	.5'	Spring	C, P, M
Spiked Wild Indigo	*Baptisia albescens*	3-4'	Spring-Summer	C, P
Rattlesnake Master	*Eryngium yuccifolium*	3-6'	Spring-Summer	C, P, M
Indian Blanket	*Gaillardia pulchella var. drummondii*	1-2'	Spring-Summer	C
Spotted Beebalm	*Monarda punctata*	1-3'	Spring-Summer	P
Appalachian Beard-tongue	*Penstemon laevigatus*	2-5'	Spring-Summer	C, P
Golden Alexander	*Zizia aurea*	1-3'	Spring-Summer	P, M
Butterfly Milkweed	*Asclepias tuberosa*	1-3'	Spring-Fall	C, P, M
Yellow Wild Indigo	*Baptisia tinctoria*	2-3'	Spring-Fall	P, M
Wild Bergamot	*Monarda fistulosa*	2-5'	Spring-Fall	P, M
White Colicroot	*Aletris farinosa*	3'	Summer	C, P, M
Nodding Onion	*Allium cernuum*	2'	Summer	P, M
White Milkweed	*Asclepias variegata*	3'	Summer	C, P, M
Bearded Beggarticks	*Bidens aristosa*	6'	Summer	C, P, M
Sensitive Pea	*Chamaecrista nictitans*	1'	Summer	C, P, M
Maryland Goldenaster	*Chrysopsis mariana*	2'	Summer	C, P, M
Greater Tickseed	*Coreopsis major*	3'	Summer	C, P, M
Whorled Tickseed	*Coreopsis verticillata*	3'	Summer	C, P
Wild Quinine	*Parthenium integrifolium*	1-3'	Summer	C, P, M
Eastern Gray Beard-tongue	*Penstemon canescens*	2.5'	Summer	P, M
Hoary Mountainmint	*Pycnanthemum incanum*	3'	Summer	P, M
Clustered Mountain-mint	*Pycnanthemum muticum*	3'	Summer	C, P, M

Common Name	Scientific Name	Height	Bloom	Region*
Hoary Skullcap	*Scutellaria incana*	3'	Summer	C, P, M
Partridge Pea	*Chamaecrista fasciculata*	1-3'	Summer-Fall	P
Mistflower	*Conoclinium coelestinum*	1-3'	Summer-Fall	C, P
Oxeye Sunflower	*Heliopsis helianthoides*	3-5'	Summer-Fall	P, M
Slender Bush Clover	*Lespedeza virginica*	1-2'	Summer-Fall	C, P, M
Grassleaf Blazing Star	*Liatris pilosa*	4-5'	Summer-Fall	C, P
Dense Blazing Star	*Liatris spicata*	3-4'	Summer-Fall	P, M
Scaly Blazing Star	*Liatris squarrosa*	1-2'	Summer-Fall	C, P
Narrowleaf Mountainmint	*Pycnanthemum tenuifolium*	1-3'	Summer-Fall	C, P, M
Orange Coneflower	*Rudbeckia fulgida*	2-4'	Summer-Fall	P
Blackeyed Susan	*Rudbeckia hirta*	1-3'	Summer-Fall	C, P, M
Gray Goldenrod	*Solidago nemoralis*	1-2'	Summer-Fall	P, M
Licorice-scented Goldenrod	*Solidago odora*	1-3'	Summer-Fall	C, P
Showy Goldenrod	*Solidago speciosa*	2-4'	Summer-Fall	P, M
New England Aster	*Symphyotrichum novae-angliae*	3-6'	Summer-Fall	P, M
Late Purple Aster	*Symphyotrichum patens*	2-3'	Summer-Fall	C, P, M
Wavy-leaved Aster	*Symphotrichum undulatum*	3-4'	Summer-Fall	C, P, M
Ironweed	*Vernonia noveboracensis*	3-6'	Summer-Fall	C, P, M
White Wood Aster	*Eurybia divaricata*	2'	Fall	C, P, M
Swamp Sunflower	*Helianthus angustifolius*	3-6'	Fall	C, P
Browneyed Susan	*Rudbeckia triloba var. triloba*	3'	Fall	M
Eastern Silver Aster	*Symphyotrichum concolor*	4'	Fall	C, P, M
Largeflower Aster	*Symphyotrichum grandiflorum*	3'	Fall	C, P

Grasses	Scientific Name	Height	Bloom	Region*
Downy Danthonia	*Danthonia sericea*	3'	Spring	C, P, M
Virginia Wildrye	*Elymus virginicus*	3-6'	Spring	C, P, M
Winter Bentgrass	*Agrostis hyemalis*	2-4'	Spring-Fall	C, P, M
Deertongue	*Dichanthelium clandestium*	2-4'	Spring-Fall	P, M
Sideoats grama	*Bouteloua curtipendula*	1-2'	Summer-Fall	C, P, M
Bigtop Lovegrass	*Eragrostis hirsuta*	2-4'	Summer-Fall	C, P

Grasses	Scientific Name	Height	Bloom	Region*
Beaked Panicgrass	*Panicum anceps*	2-4'	Summer-Fall	C, P, M
Little Bluestem	*Schizachyrium scoparium*	3-6'	Summer-Fall	C, P, M
Indiangrass	*Sorghastrum nutans*	3-8'	Summer-Fall	C, P
Purpletop	*Tridens flavus*	3-5'	Summer-Fall	C, P, M
Muhly Grass	*Muhlenbergia capillaris*	3'	Fall	C, P, M

Naturalized	Scientific Name	Height	Bloom	Region*
Lanceleaf Coreopsis	*Coreopsis lanceolata*	1-2'	Spring-Summer	C, P, M
Plains Coreopsis	*Coreopsis tinctoria*	1-2'	Spring-Summer	C, P, M
Red Clover	*Trifolium pratense*	1-1.5'	Summer	C, P, M
White Clover	*Trifolium repens*	.5-1.5'	Spring-Fall	C, P, M

* C=Coastal, P=Piedmont, M=Mountains

Solar farm in North Carolina planted with pollinator-friendly vegetation, including blackeyed susans (*Rudbeckia hirta*)

© Liz Kalies

Site Preparation

Collect a soil sample from the proposed site and submit to the local County Cooperative Extension Office for soil testing. Existing invasive, agricultural weeds and nonnative vegetation should be eliminated before planting commences. Please refer to the following list for invasive and nonnative species in North Carolina: https://www.ncwildflower.org/plant_galleries/invasives_list.

Herbicide application prior to planting may be necessary. In particular, herbicide treatment across multiple seasons may be necessary to eradicate certain turf grasses and/or invasive species. When determining application amounts, always adhere to instructions on the herbicide label. Allow a minimum of 72 hours between herbicide application and planting. Post-construction, a heavy duty, offset rake attached to an ATV may be used to scarify the ground underneath the panels.

Timing

The ideal planting window is in the month of October or from early-April to late-May. Creating pollinator habitat in already established solar sites is feasible. However, solar infrastructure can complicate establishment and possibly limit site preparation and seeding options. A site assessment at each property will be necessary to determine the appropriate site preparation needed for planting.

Planting Method

A ground-stabilizing mix should be broadcast in the project area, pre-construction. Seasonal conditions may dictate the choice of ground cover. Winter wheat and rye are recommended for fall and winter plantings; browntop millet may be used in the spring and summer. Clover and ground cover mixes may be broadcast post-construction. Short and tall-growing pollinator mixes should be drilled with an appropriate seed drill designed to accommodate the size and texture of different seeds. No-till planting is preferred for establishment to limit soil erosion potential, reduce weed pressure and retain soil moisture. If necessary, smooth the area and firm the soil with a cultipacker to ensure seeds are not planted too deeply. Collect soil samples and have them analyzed prior to planting. Barring an extreme deficiency in potassium, phosphorous or pH of 3.5 or lower, do not use fertilizer or any form of soil augmentation, as that will encourage weed growth. Typically, native plants do not require fertilizer.

Maintenance

The first year of maintenance may require repeated mowings to eradicate weedy growth. During the first year, mow the site when weeds have reached 12-18 inches in height. Mow to a 6-8 inch height. Mowing less than this height may stunt the growth of the pollinator plants. Repeat mowings when weeds reach 12-18 inches in height. Once established, maintenance in proceeding years will be reduced.

Some form of disturbance, likely mowing, will be needed every 2-3 years to prevent establishment of woody vegetation. Mow only in late winter (or early spring) to alleviate adverse impacts to wildlife; an ideal window is March 1 to March 31. Spot-spraying unwanted (woody) vegetation, as well as invasive/nonnative species, will likely be necessary annually.

Once the habitat has been established, mow only a portion of the site per season. One third or one fourth of the area each season is recommended to allow for insect refugia throughout the year. If possible, the same area should not be mowed in consecutive years. Posted informational signage is encouraged to explain the process, as pollinator habitat can take several years to become established and have aesthetic value.

Buffers/Screen Areas

In some areas, vegetated screening is required around solar facilities. The installation of these buffer areas may create another important habitat feature at the project site. In areas where screening will be required or desired, a diverse selection of native tree and shrub species should be used to create a hedgerow habitat structure. Hedgerows typically include a variety of tree and shrub species that vary in height, as opposed to hedges, which are usually made up of a single species in a closely spaced row. The resulting layers of plants mimic an early successional or forest edge habitat, fulfilling different habitat functions for wildlife such as shelter, nesting sites and food sources. Many tree and shrub species can be purchased as bare root saplings at a fraction of the cost of container plants. Hedgerow/forest edge habitat supports a variety of wildlife species. Hedgerows, like riparian buffers, generally support a higher diversity of pollinator and floral species than surrounding landscapes, and provide a valuable forage resource and corridor for movement of pollinators. Even if screening is not required, the creation of hedgerows in practical areas around the solar facility is an excellent way to create a diverse habitat structure, provide cover for wildlife and enhance the overall aesthetic value of the site.

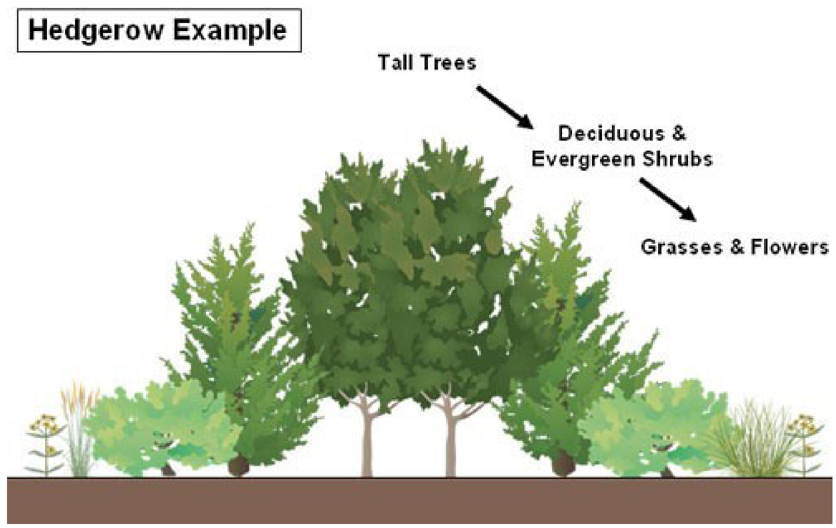
Please see the following table for suggested screening plant species:

Table 2. Hedgerow Screening Species

Common Name	Scientific Name		Bloom
Red Buckeye	*Aesculus pavia*	Small Tree	Spring
Serviceberry	*Amelanchier arborea*	Small Tree	Spring
Eastern Redbud	*Cercis canadensis*	Small Tree	Spring
Washington Hawthorn	*Crataegus phaenopyrum*	Small Tree	Spring
Carolina Silverbell	*Halesia carolina*	Small Tree	Spring
American Holly	*Ilex opaca*	Small Tree	Spring
Southern Crabapple	*Malus angustifolia*	Small Tree	Spring
American Crabapple	*Malus coronaria*	Small Tree	Spring
American Plum	*Prunus americana*	Small Tree	Spring
Chickasaw Plum	*Prunus angustifolia*	Small Tree	Spring
Black Willow	*Salix nigra*	Small Tree	Spring
Sassafras	*Sassafras albidum*	Small Tree	Spring
Flowering Dogwood	*Cornus florida*	Small Tree	Spring-Summer
Smooth Sumac	*Rhus glabra*	Small Tree	Spring-Summer
Winged Sumac	*Rhus copallinum*	Small Tree	Summer-Fall
Red Maple	*Acer ruburm*	Tree	Spring
Pignut Hickory	*Carya glabra*	Tree	Spring
Shagbark Hickory	*Carya ovata*	Tree	Spring
Black Cherry	*Prunus serotina*	Tree	Spring
Persimmon	*Diospyros virginiana*	Tree	Spring-Summer
Spicebush	*Lindera benzoin*	Shrub	Spring-Summer
Choke Cherry	*Prunus virginiana*	Shrub	Spring-Summer
Raspberry, Blackberry	*Rubus spp.*	Shrub	Spring-Summer
Blueberries	*Vaccinium spp.*	Shrub	Spring-Summer
Beauty Berry	*Callicarpa americana*	Shrub	Summer
New Jersey Tea	*Ceanothus americanus*	Shrub	Summer
Buttonbush	*Cephelanthus occidentalis*	Shrub	Summer
Sweet Pepperbush	*Clethra alnifolia*	Shrub	Summer
Elderberry	*Sambucus canadensis*	Shrub	Summer
Black Haw	*Viburnum prunifolium*	Shrub	Summer-Fall
Downy Arrowwood	*Viburnum rafinesquianum*	Shrub	Summer-Fall
Cross Vine	*Bignonia capreolata*	Vine	Spring
Dutchman's Pipe	*Aristolochia macrophylla*	Vine	Spring-Summer

Common Name	Scientific Name		Bloom
Coral Honeysuckle	*Lonicera sempervirena*	Vine	Spring-Summer
Virginia Creeper	*Parthenocissus quinquefolia*	Vine	Spring-Summer
Passionflower	*Passiflora incarnata*	Vine	Spring-Fall
Trumpet Creeper	*Campsis radicans*	Vine	Summer
Virgin's Bower	*Clematis virginiana*	Vine	Summer-Fall
Climbing Aster	*Ampelaster carolinianus*	Vine	Fall

Trees used as buffer zone for solar farm in North Carolina



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Seed Suppliers

Though we do not endorse any specific company, the following establishments can either create a mix of your choice or have pollinator mixes available for purchase:

- Roundstone Native Seed Company
- Ernst Conservation Seeds, Inc.
- Prairie Moon Nursery

The following local establishments can assist with creation of an appropriate native, pollinator mix:

- North Carolina Botanical Garden - Chapel Hill, NC
- Garrett Wildflower Seed Farm – Smithfield, NC
- Mellow Marsh Farm – Siler City, NC
- Niche Gardens – Chapel Hill, NC (no seed mixes)
- Cure Farm – Pittsboro, NC (no seed mixes)
- Big Bloomers Flower Farm – Sanford, NC (no seed mixes)

Additional Benefits from Pollinator Conservation Activities

Establishing native habitat on solar sites will have numerous benefits to people, wildlife and ecological functions within and adjacent to the site. Specific benefits from establishing native habitat include:

- **Soil stabilization and storm water filtration** – The establishment of diverse, native vegetation and protected riparian buffers can increase water quality and stream bank stabilization both within and downstream of the site (Wratten et al. 2012). Densely planted and deep-rooted vegetation help attenuate the flow of storm water across the land and allows for increased soil infiltration. This decreases the speed and amount of water entering streams which aids in stream bank stabilization and minimizes turbidity. Prairie root systems also increase water storage capacity on land, creating a natural bio-retention area to help mitigate storm water runoff and flooding caused by impervious surfaces.

- **Pollinator services for agriculture** - Native bees provide free pollination services and are specialized for foraging on flowers, such as squash, berries or orchard crops. This specialization results in more efficient pollination and production of larger and more abundant fruit from certain crops (Blaauw et al. 2014). Pollinators are critical to the $78 billion agricultural economy of North Carolina. More than 70% of crops require either insect pollination or have higher production because of pollinating insects. A 2012 study in California found that native bees are likely responsible for between $900 million and $2.4 billion in crop production, suggesting their role may be greater than previously anticipated (USDA-NRCS 2013). By maintaining habitats that increase diversity and species populations, solar sites can have positive effects on crop production on adjacent agricultural operations.
- **Decreased pesticide use** – In addition to supporting pollinators, native plant habitats attract beneficial insects that are predators and parasitoids of crop pests and are less prone to destructive insects and disease. This can decrease the amount of pesticide needed at the site and adjacent properties.
- **Diversity of other species and species habitats** – Establishing a diverse native plant structure on a site not only benefits pollinators but can benefit other species as well. Many native pollinator plants provide food sources for other animals. Taller native plants on a site can provide habitat to ground nesting/feeding birds, small mammals and a variety of reptiles and amphibians.
- **Travel corridors for movement** – Designing solar farms to ensure wildlife connectivity and movement across the landscape ensures that species have increased access to other forage areas, aids in reproduction and increases genetic diversity. If a solar site is large, including unfenced corridors through the facility allows for movement of pollinators and other wildlife species. Additionally, fencing at sites should be installed in a way that allows small mammal and turtle movement.

Example of a corridor through this solar farm that follows a streambed.

- **Carbon sequestration** - Carbon sequestration occurs when the amount of carbon dioxide absorbed by growing plants is greater than the amount of the gas released by decomposing plant material. Forests act as "carbon sinks", meaning they absorb more carbon dioxide than they release. Grassland/prairies also act as "carbon sinks", with most of the grassland's carbon sequestration happening below ground, where roots dig into the soil of depths up to 15 feet and more. It has been shown that grasslands can store more carbon below ground than a forest can store above ground (Pacala et al. 2001).

- **Aesthetic value –** Prairie/pollinator habitat restoration can increase the aesthetic value of the solar site. When properly established, a field of native forbs and grasses can provide a colorful display that will enhance the site and offer a diverse element to the landscape. With proper seed mixes, flowers will last from spring until the first frost, giving a colorful backdrop for most of the year. This is especially valuable in areas where solar farms are sited in proximity to residential or high traffic areas.
- **Decrease maintenance costs –** Native plant communities are a low maintenance alternative to non-native plants. Because most native plant species are adapted to the local environment and have deep root systems, they do not require watering or pesticides. Though native plant communities require some maintenance, proper maintenance would consist of mowing no more than twice a year, which would be considerably lower in cost and recurrence than maintenance of turf grass. Native plant communities take an additional upfront cost to install but result in about 50% savings of the total maintenance costs when compared to turf or pasture (ASLA 2015). The return on investment for conversion of turf/pasture to native plant communities can likely be met within three to five years.

Additional Conservation Recommendations for Wildlife Conservation

- Install bluebird boxes around the site.
- Provide raptor perches around the site.
- Install bat boxes around the site.
- Leave piles of sand, graded soil or bare ground areas for ground-nesting bees.
- Construct screened areas as hedgerows or forest edge habitat.
- Plant native vines along perimeter fencing to increase diversity and habitat.
- Retain and/or restore wetlands or water features on site.
- Install fencing that allows movement of small wildlife; use fixed-knot woven wire, security fencing, 75 inches in height (17/75/6) deer mesh, with no barbed wire. Install the fencing upside-down such that the bottom section of fence has a vertical wire spaced at least 7 inches apart.


Bluebird box © Dave Kimeer


Wildlife-friendly fencing © Liz Kalies

For More Information on Designing Your Solar Farm

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Supplemental Information

Pollinators and Safety in the Field

Meadows and native plant fields are the ideal location to find bees and other pollinators. There is concern that large, flowering fields may lead to an increased chance of getting stung. However, if precautions are taken, there is minimal risk of harm.

Native bumble bees and honeybees:

- Male bees do not have stingers.
- Females are unlikely to sting, as it causes them to die.
- Female bees only sting when their nest is threatened.
- If a bee is on a flower, it will likely ignore your presence.

Wasps:

- Most stings are caused by wasps, including yellow jackets and hornets.
- Wasps only sting when their nest is threatened.

How to prevent stings from bees and wasps:

- Avoid perfumed soaps, shampoos and deodorants.
- Wear light-colored clothing and pull hair back to reduce the chance of insects getting tangled in hair.
- Be observant; avoid areas where bees or wasps frequent, such as logs or a hole in the ground.
- Remain calm and still if a stinging insect is flying around. Swatting is perceived as an aggressive motion and may cause stinging behavior.
- Empty trash cans regularly, keep them covered and don't eat near them.
- Store your lunch in a lunchbox and drink in a container with a lid.
- Workers with a history of severe allergic reactions to insect bites or stings should carry an epinephrine auto injector and wear medical ID jewelry stating their allergy.

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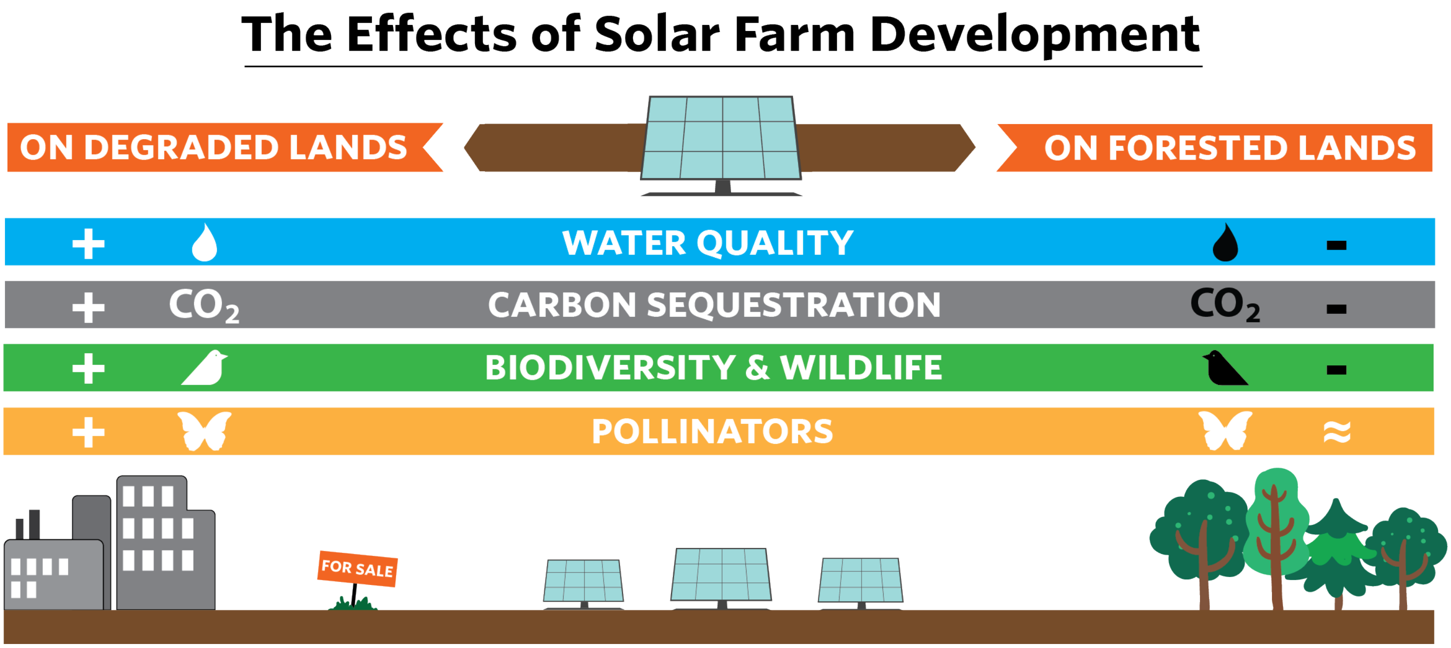
ATTACHMENT

Siting of Solar Projects to Benefit Pollinators

Siting solar installations to avoid areas with significant biodiversity and high quality habitat is an important step. It is difficult to absolve the damage once high quality habitat or rare species have disappeared. Choosing 'degraded' sites for solar development (e.g., brownfields, sites with prior development, little or no vegetation, poor soil quality, etc.) reduces impact and diminishes the amount of carbon lost due to site conversion and construction. Furthermore, by developing a degraded site, solar companies have an opportunity to add pollinator habitat to the landscape, rather than destroy potentially rare and/or significant habitat.

This graphic illustrates how "ecosystem services" – benefits to humans that are provided by nature – are compromised least when solar farms are sited on degraded lands.



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There is an extensive amount of conservation data available for public consumption. These data can be used to determine the location of environmentally sensitive areas with priority habitat and SGCNs. The following is not an all-inclusive list, rather a sampling of publicly-available information for conservation planning:

1. South Atlantic Landscape Conservation Cooperative (SALCC): www.southatlanticlcc.org. The mission of the SALCC is to facilitate conservation actions that sustain natural and cultural resources, guided by a shared adaptive Blueprint. Their Conservation Blueprint is a living spatial plan to conserve natural and cultural resources across the South Atlantic region. As described on their website, it is 100% data-driven and based on terrestrial, freshwater, marine and cross-ecosystem indicators. The Blueprint represents feedback from over 500 individuals and 150 organizations and agencies.
2. The Nature Conservancy's Resilient and Connected Network (RCN) is the first study to comprehensively map resilient land and significant climate corridors across the eastern United States: http://maps.tnc.org/resilientland/. Released in October 2016, the study took eight years to complete, involved 60 scientists and developed innovative new techniques for mapping climate-driven movements. RCN corridors represent areas that species are likely to use to move over time in response to climate change, generally in upward and northward directions. Solar developers should not site in the RCN resilient areas and avoid fragmenting the RCN corridors. This will help protect biodiversity both now and into the future.

3. The North Carolina Wildlife Resource Commission's Green Growth Toolbox (GGT): www.ncwildlife.org/Conserving/Programs/Green-Growth-Toolbox. The GGT is a technical assistance tool designed to help communities and organizations conserve high quality habitats and SGCNs. The goal is to conserve the State's most unique natural assets while continuing to grow as a community. Conservation data includes, but is not limited to, the Biodiversity and Wildlife Habitat Assessment, Natural Heritage Data, National Wetlands Inventory Data, Streams, Important Watersheds and Priority Bird Habitat.

Other siting considerations include maintaining a minimum 100-foot undisturbed native, forested buffer along perennial streams, and a minimum 50-foot buffer along intermittent streams and wetlands. Maintaining undisturbed, forested buffers along these areas will reduce impacts to aquatic and terrestrial wildlife resources, as well as aquatic habitat both within and downstream of the site. In addition, these buffers will act as a travel corridor for wildlife species. Lastly, forested riparian buffers protect water quality by stabilizing stream banks and filtering storm water runoff.

The project footprint should be surveyed for wetlands and streams to ensure there are no impacts to surface waters. In addition to providing wildlife habitat, wetland areas and streams aid in flood control and water quality protection. United States Army Corps of Engineers Section 404 Permits and NC Division of Water Resources Section 401 Certifications are required for any impacts to jurisdictional streams or wetlands.