Enhancing Ecosystem Services with Green Infrastructure

R. Alfred Vick, PLA, LEED Fellow
Georgia Power Professor in Environmental Ethics

Green Infrastructure

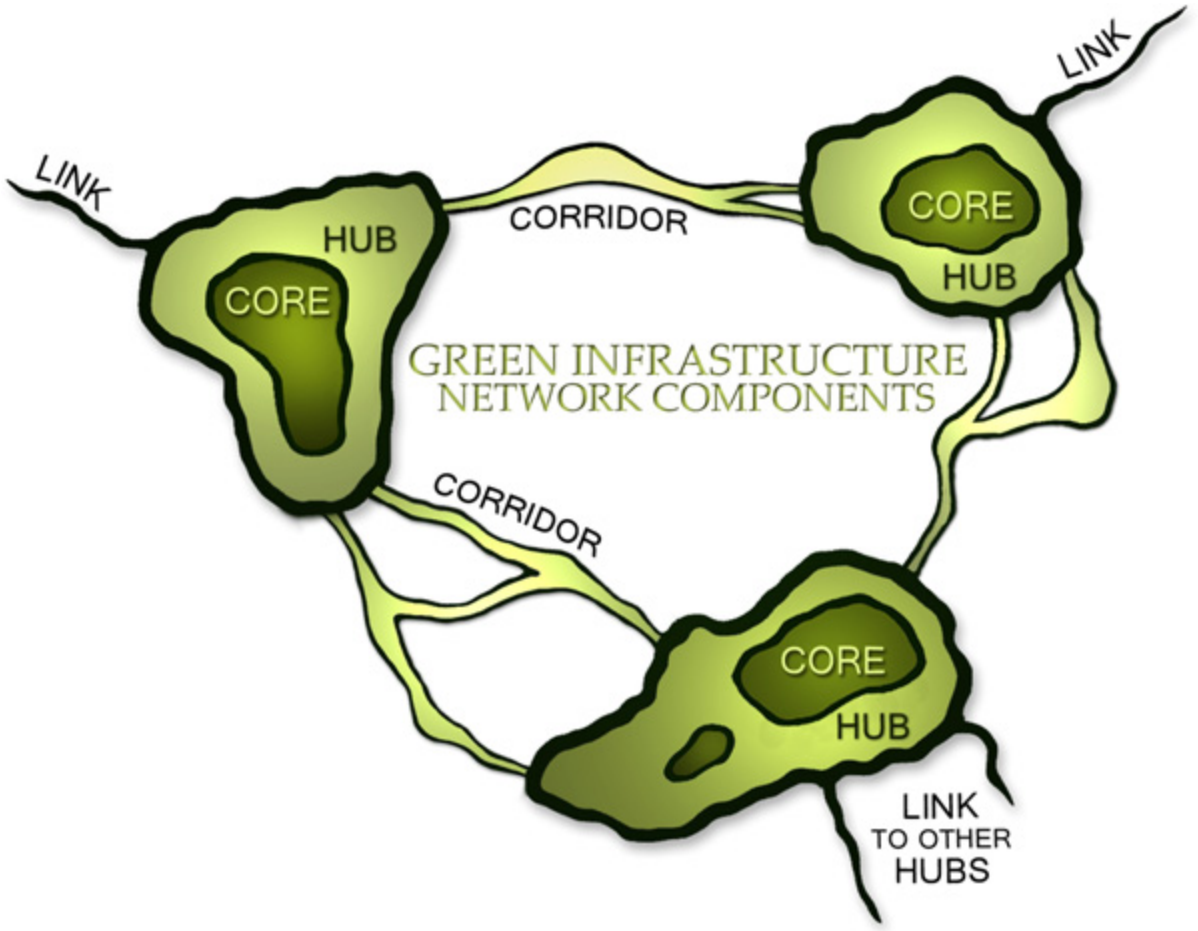
*…a strategically **planned** and **managed network** of natural lands, working landscapes and other open spaces that conserve ecosystem values and functions and the benefits derived by human populations.*

Benedict and McMahon, 2006

Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments.

EPA, 2013

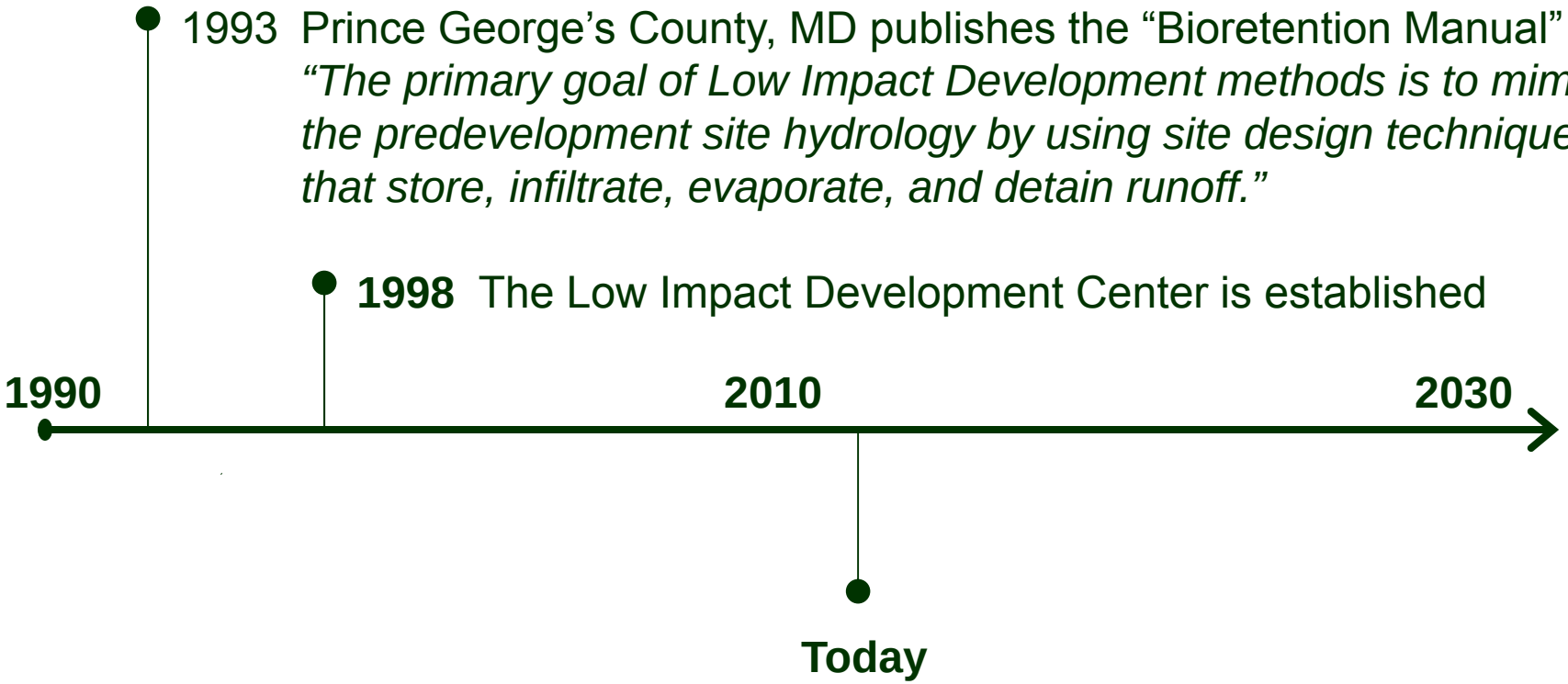
Concept


LINK
LINK
HUB
CORE
CORRIDOR
CORE
HUB
GREEN INFRASTRUCTURE
NETWORK COMPONENTS
CORRIDOR
CORE
HUB
LINK
TO OTHER
HUBS

Low Impact Development

LID

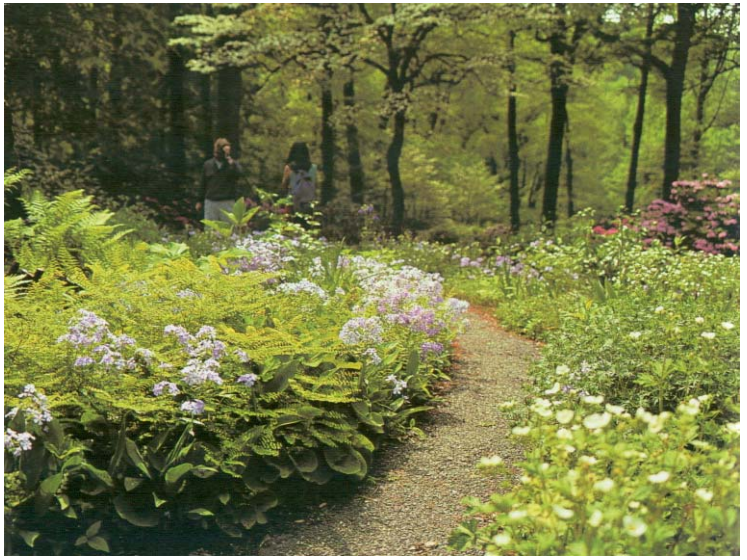
Low Impact Development LID



- LID is a core concept of stormwater management ordinances and regulations throughout the country
- Management of non-point source pollutants is federally mandated
- Success stories throughout the country are ubiquitous with projects that are environmentally beneficial, attractive and cost-effective (see: http://water.epa.gov/polwaste/green/index.cfm#fact

Ecological Restoration

SER



Nelson Byrd

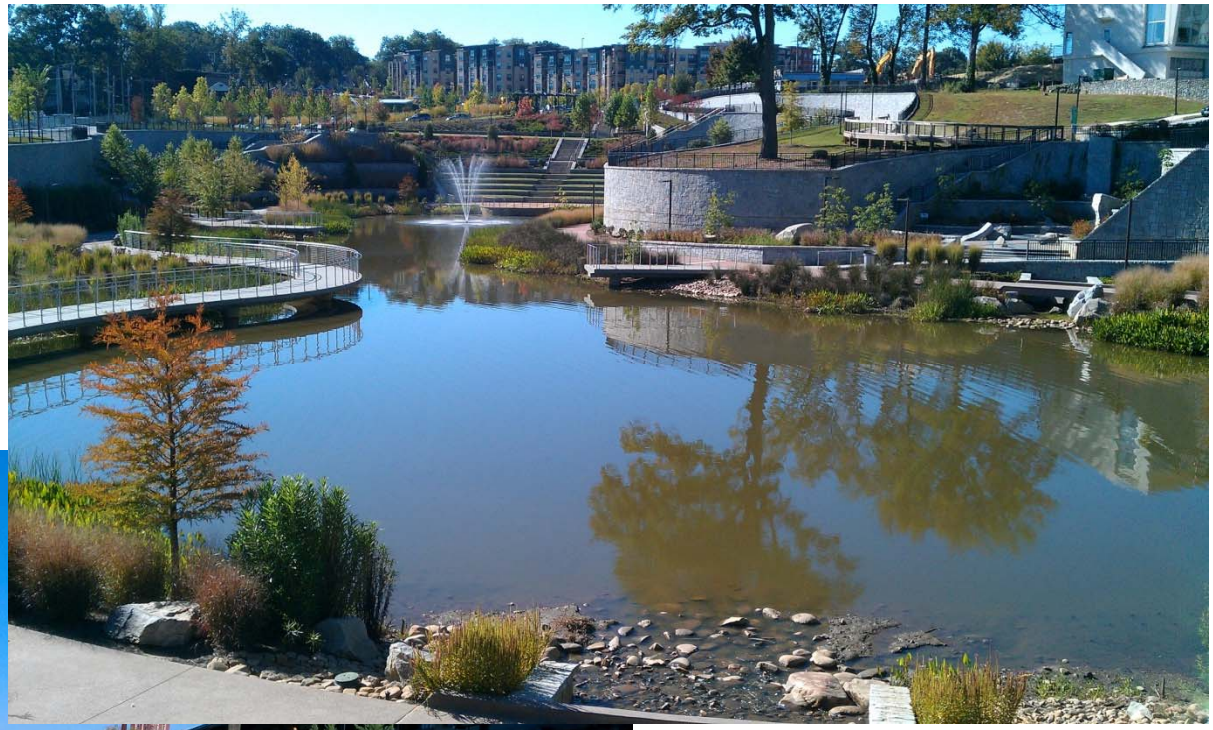
Ecological Restoration

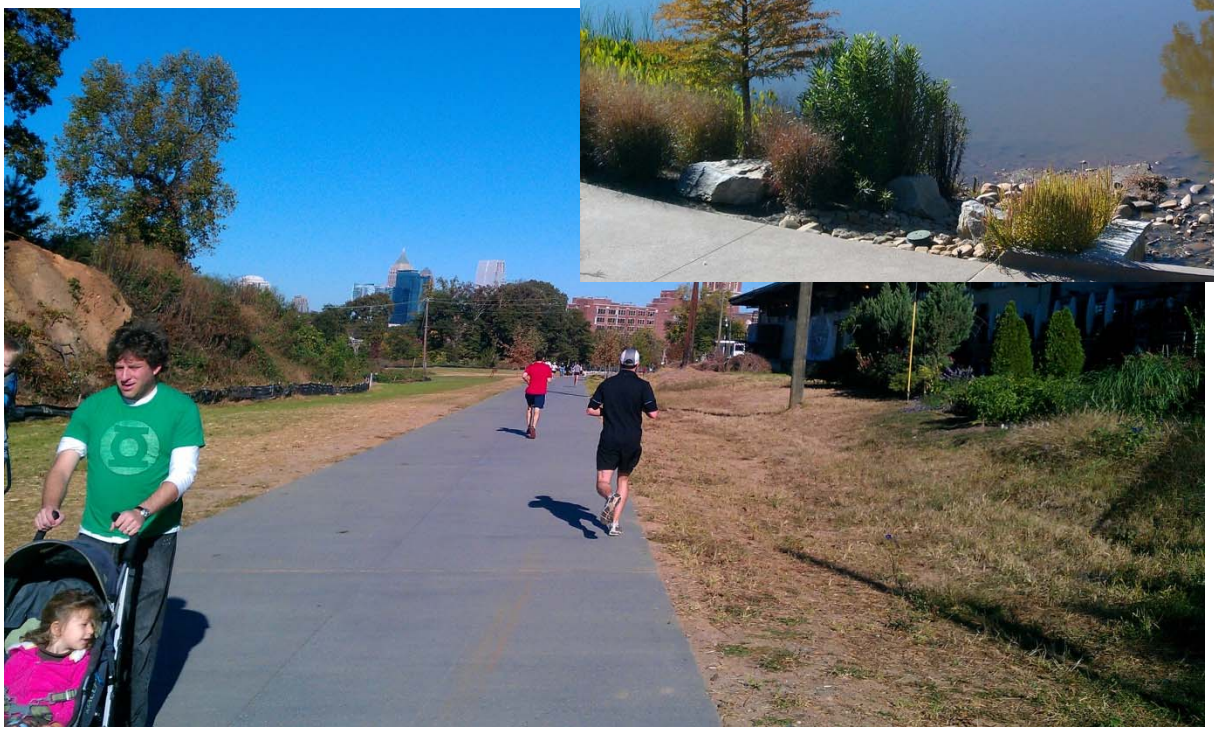
SER

- Restoration Ecology is a recognized scientific discipline, with multiple peer-reviewed journals specific to the field.
- The scope of ecological restoration has exploded from humble beginnings in Wisconsin prairies to almost any ecosystem of cultural significance.
- Concepts of ecological trajectory and Adaptive Ecosystem Management (AEM) are influential in the design of many constructed landscapes and buildings

Smart Growth

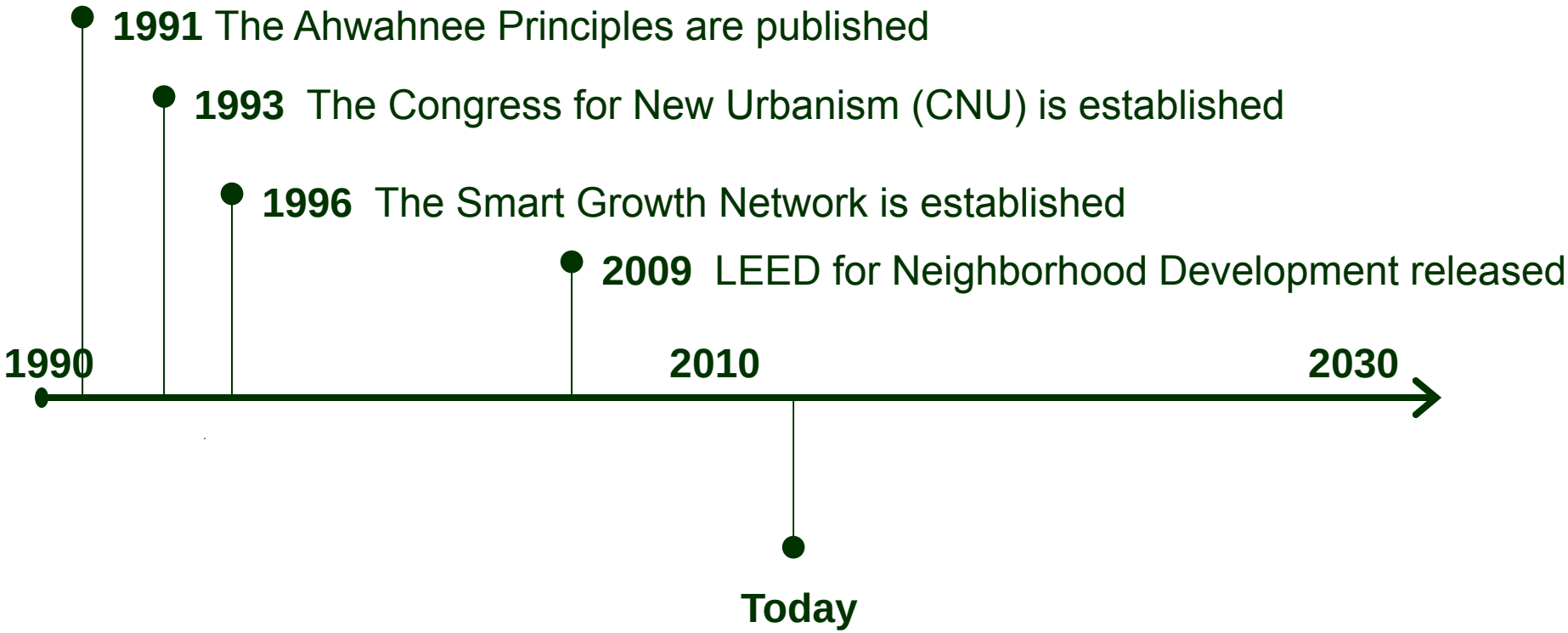
CNU





Smart Growth

CNU

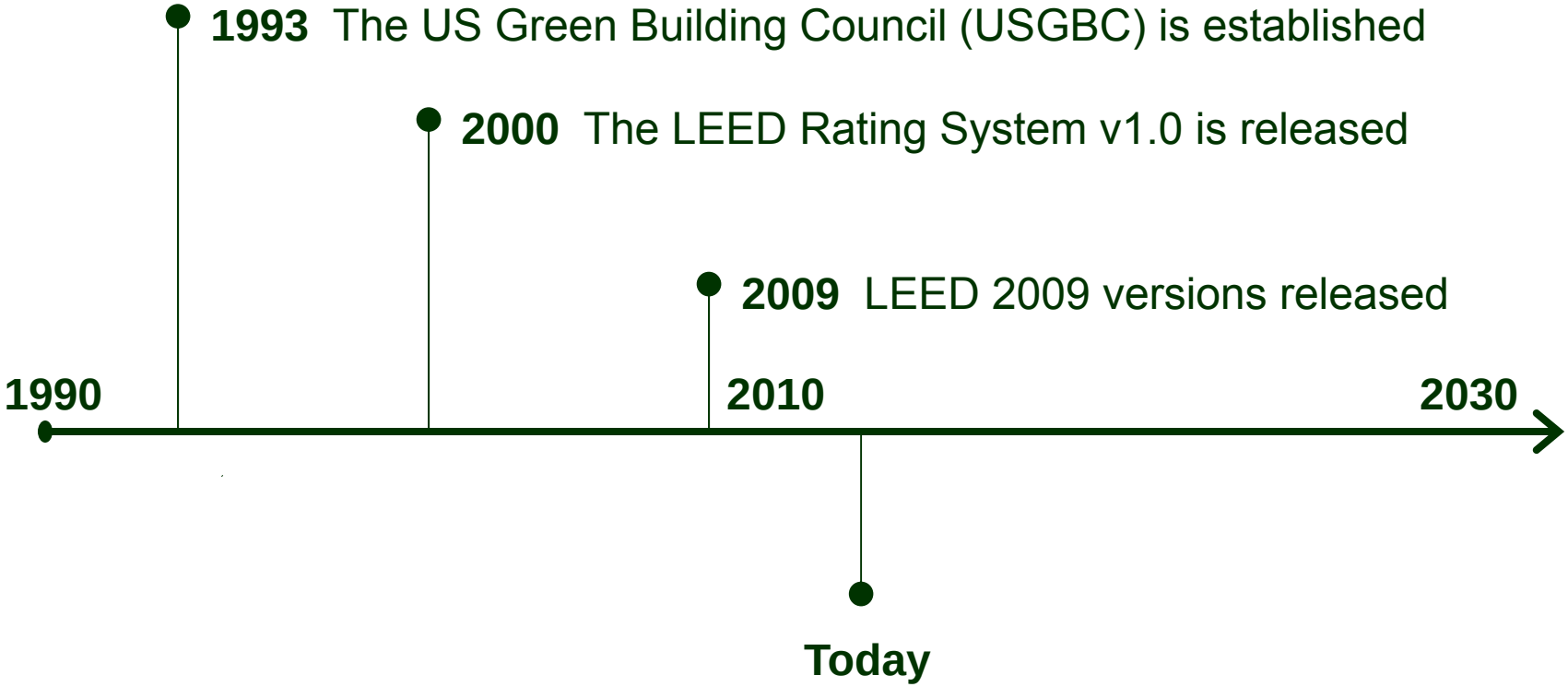


- The Atlanta Beltline is being built!
- The High Line is one of the most widely acclaimed built works of the last two decades.
- These projects are just two examples of the ongoing attention to reclaiming communities for people, in addition to automobiles.
- GeoDesign emerges to leverage geospatial data for community well-being


Golden Gate
Polk
OPERA
Golden Gate

Green Building

USGBC



- 2 billion square feet of commercial space has been LEED Certified
- 20% of the commercial construction in the US is pursuing LEED Certification (estimated $554 billion economic impact)
- LEED Certification mandated for hundreds of jurisdictions around the world
- Market transformation is evident in products, materials, practices and performance.

Some of the influential outcomes

Low Impact Development	• Ecological function (natural hydrology) as a target of development codes
Ecological Restoration	• Ecological Trajectory • Adaptive Ecosystem Management
Smart Growth	• Community health and well-being • Walkable communities
Green Building	• Performance metrics • Market transformation

Interstate Green Stormwater Infrastructure Pilot Project

with American Rivers, GDOT, and Central Atlanta Progress

Synopsis: Interchange

Interchange Catchments	Proposed GSI Practice	Contributing Drainage Area (Ac)	Area Feasible for GSI (Ac)	Minimum GSI Footprint (Ac/Sqft)	Ratio of Minimum Footprint to Available	Runoff Generated in a 1.8" Storm
Area A	Bioretention	2.66	1.84	0.20/8,776	10.9	106,227
Area B	Bioretention	1.09	1.08	0.08/3,651	7.8	43,664
Area C	Bioretention	0.32	0.16	0.02/1,045	15.4	12,708
Area D	Filter Strip to Bioslope with underdrain	0.71	0.21	0.07/3,093	34.3	28,349
Area E	Dry enhanced Swale to Bioretention	0.32	0.34	0.02/1,076	7.3	12,708
				0.07/2,944	2.6	31,608
				0.06/2,715	5.2	31,608
				0.21/9,008	100.0	27,993
				0.19/8,146	16.6	100,036
				0.01/400	1.9	3,910
				0.05/2,262	5.4	26,394
				0.01/472	7.0	5,539
				0.04/1,880	11.1	22,810
				0.03/1,439	2.1	14,663
				0.02/685	15.6	8,472
				0.13/5,601	34.1	16,944
				0.01/527	11.6	6,517
				1.23/53,720	9.6	500,150

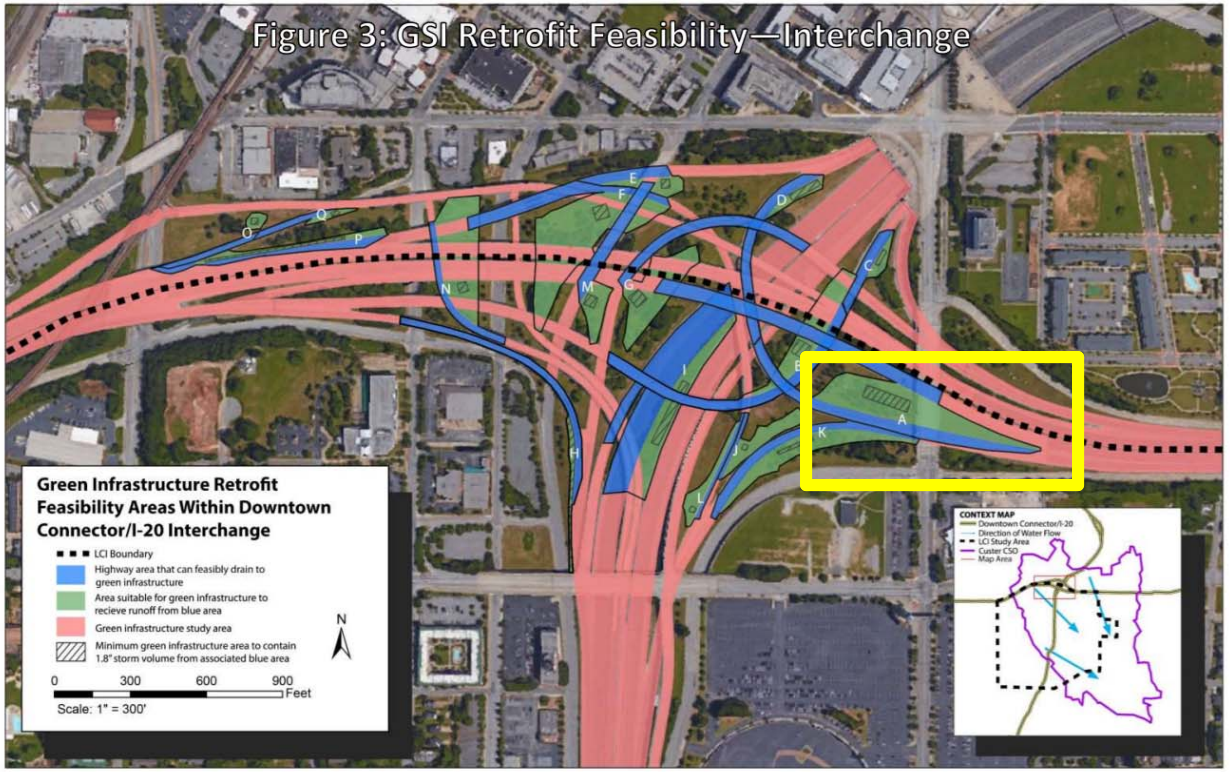
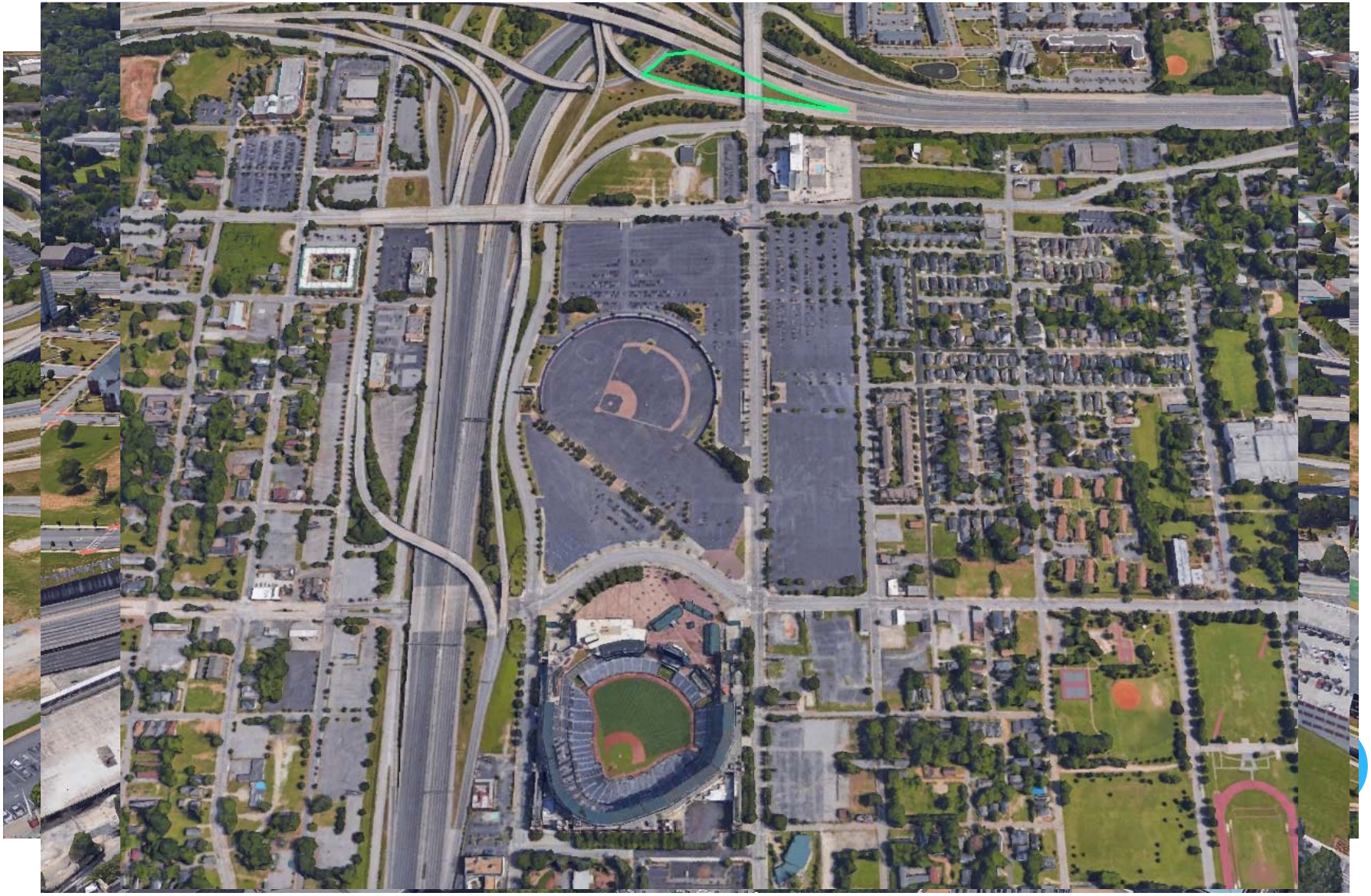
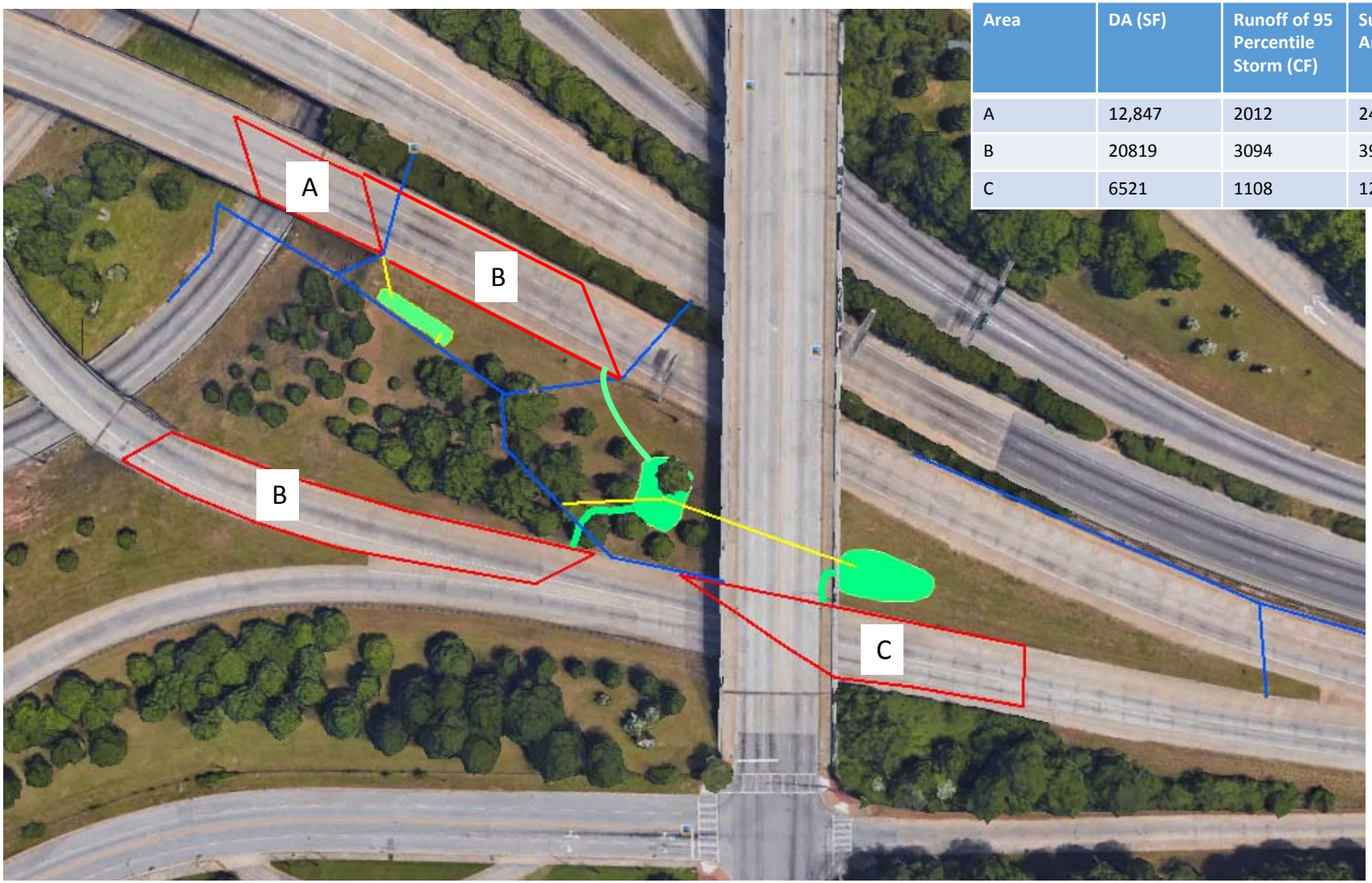


Figure 3: GSI Retrofit Feasibility—Interchange

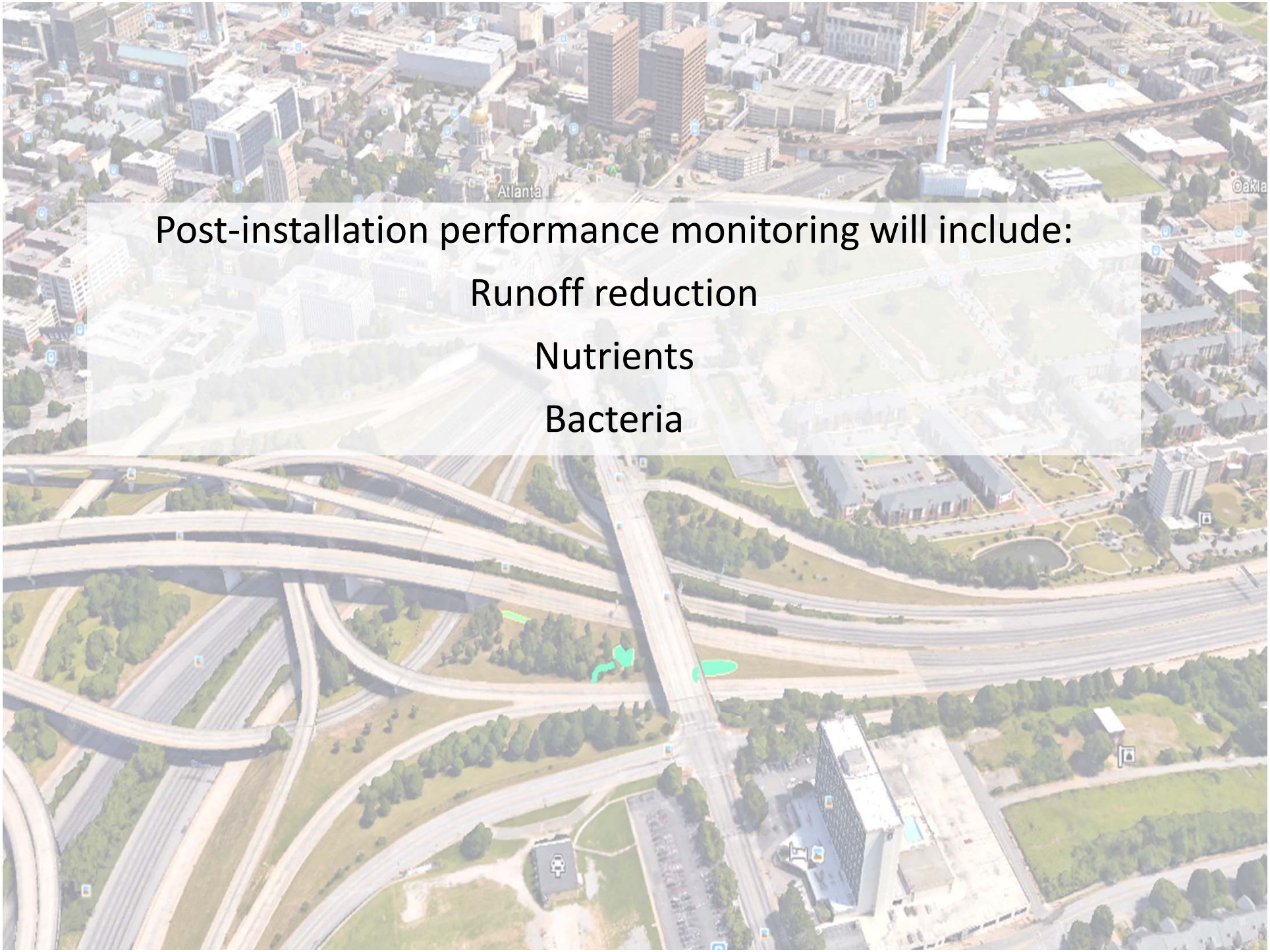
Pilot Project Site Area



Designed Green Infrastructure



Area	DA (SF)	Runoff of 95 Percentile Storm (CF)	Surface Area (SF)
A	12,847	2012	2441
B	20819	3094	3956
C	6521	1108	1239



Post-installation performance monitoring will include:

Runoff reduction

Nutrients

Bacteria

Investigating landscape performance of Historic Fourth Ward Park

University of Georgia
Research Team

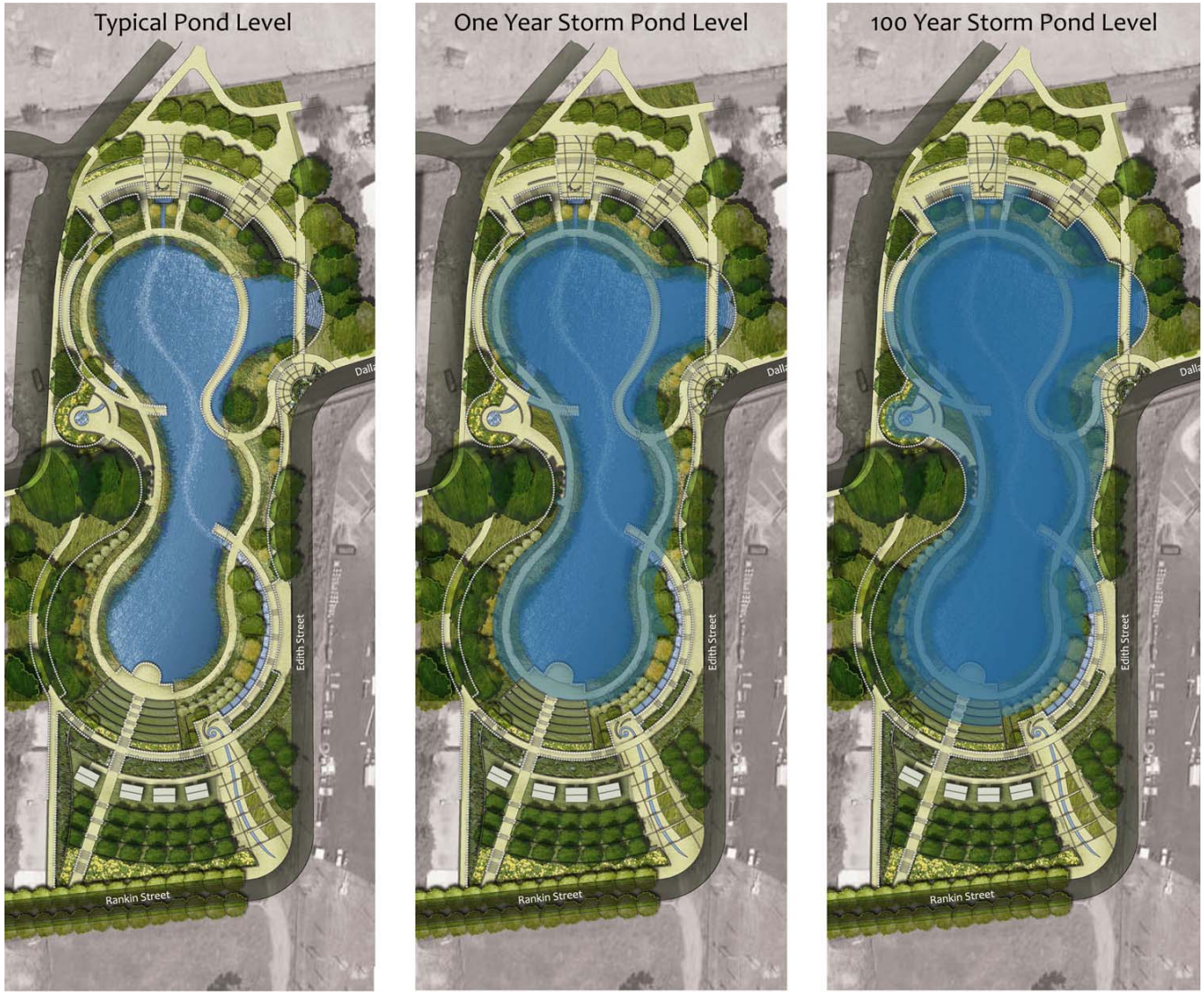
Student Researcher
Rachael Shields
Research Fellows
Jon Calabria
Brian Orland
Alfie Vick

Historic Fourth Ward Park

HDR Firm Liaisons

David West
Robert Bryant

Historic Fourth Ward Park



Typical ponding level, one year storm pond level, and 100-year storm pond level.

Source: HDR.

HDR Firm Liaisons

David West
Robert Bryant

PERFORMANCE FINDINGS

ENVIRONMENTAL

- Reduces stormwater peak rate by 9.6% for a 10-year storm.
- Provides flood protection in extreme events, as demonstrated by no flooding at neighboring Ponce City Market since construction.
- Sequesters .51 tons of atmospheric carbon and stores 5.768 tons of atmospheric carbon annually.
- Intercepts an estimated 18,200 gallons of stormwater annually in the canopies of 202 newly planted trees

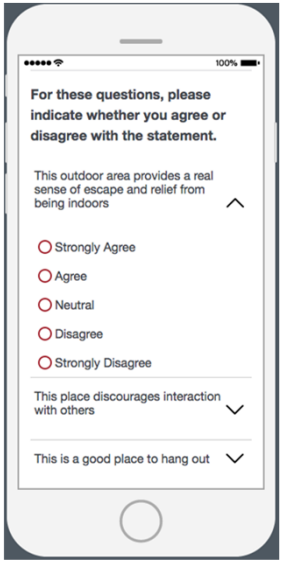
ECONOMIC

- Contributed to a 56% increase in the median property tax revenue 2009 to 2016.
- Contributed to a 60% increase in the number of occupied housing units
- Helped to attract more than $2 billion worth of investment in the 6 adjacent blocks to the park, and developers may spend more than an additional billion dollars in the next few years.

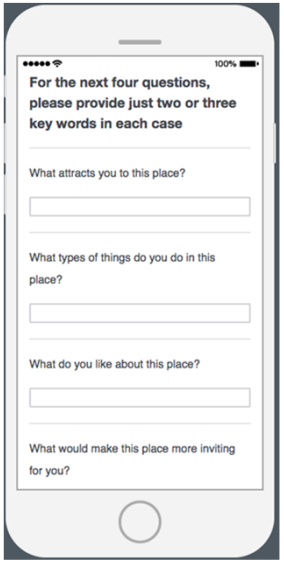
SURVEY CONSTRUCTION

Develop a balanced mix of scaled questions to get numeric responses that can be compared between days, people, locations, and open-ended questions to get at the richness of how people respond to the landscape--why they answer the way they do and reveal issues we could not predict.

quantitative



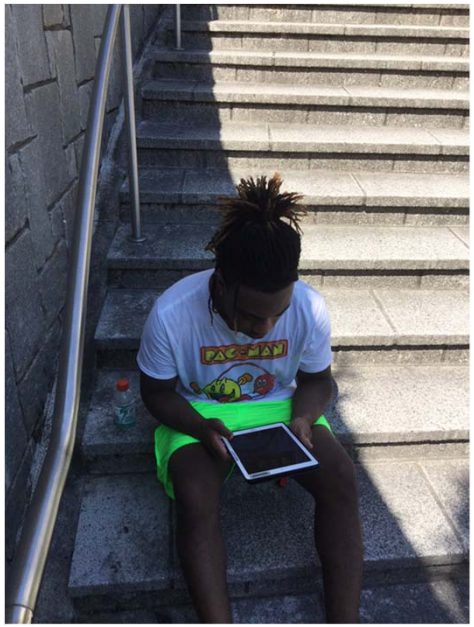
qualitative

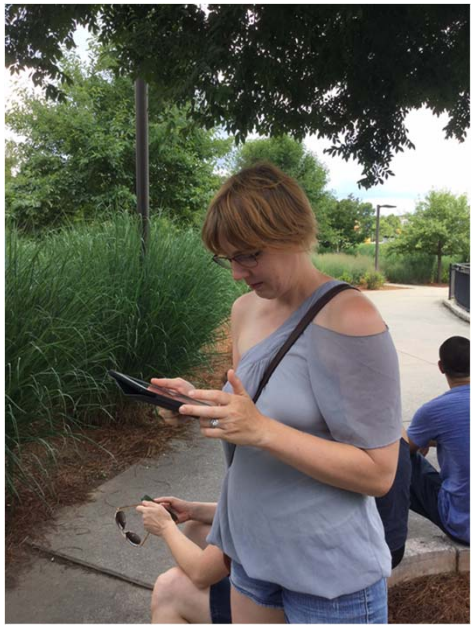


Reference Surveys:

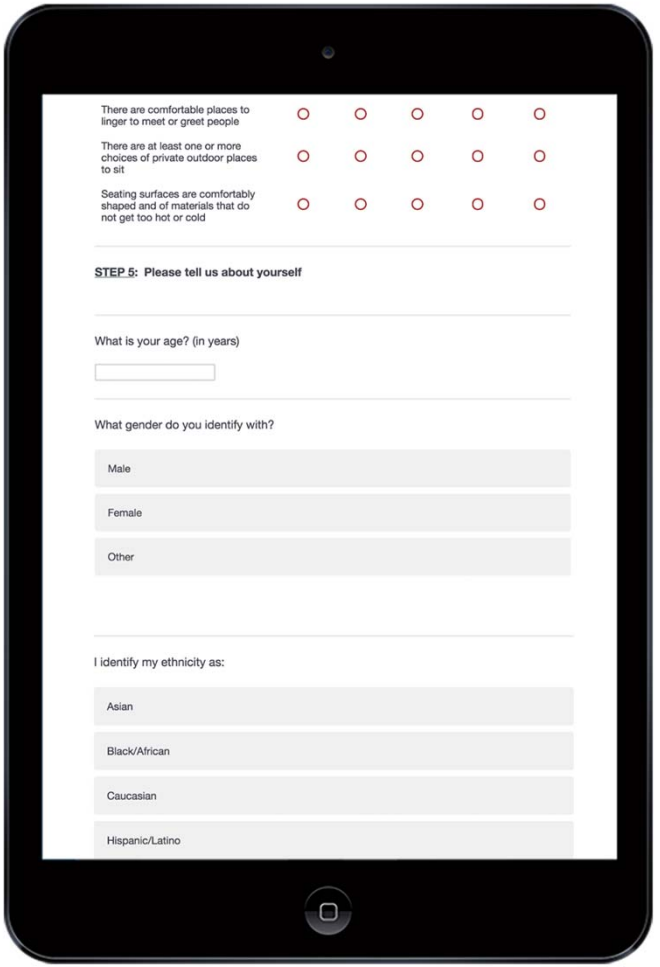
1. OLIN Partners Post-Occupancy Evaluation of Washington Canal Park

1. Rodiek, Susan, Adeleh Nejati, Eric Bardenhagen, Chanam Lee, and Giulio Senes. 2016. "The seniors' outdoor survey: an observational tool for assessing outdoor environments at long-term care settings." The Gerontologist no. 2: 222. InfoTrac Health Reference Center Academic (accessed July 12, 2018).





SURVEY DISTRIBUTION



SURVEY FINDINGS

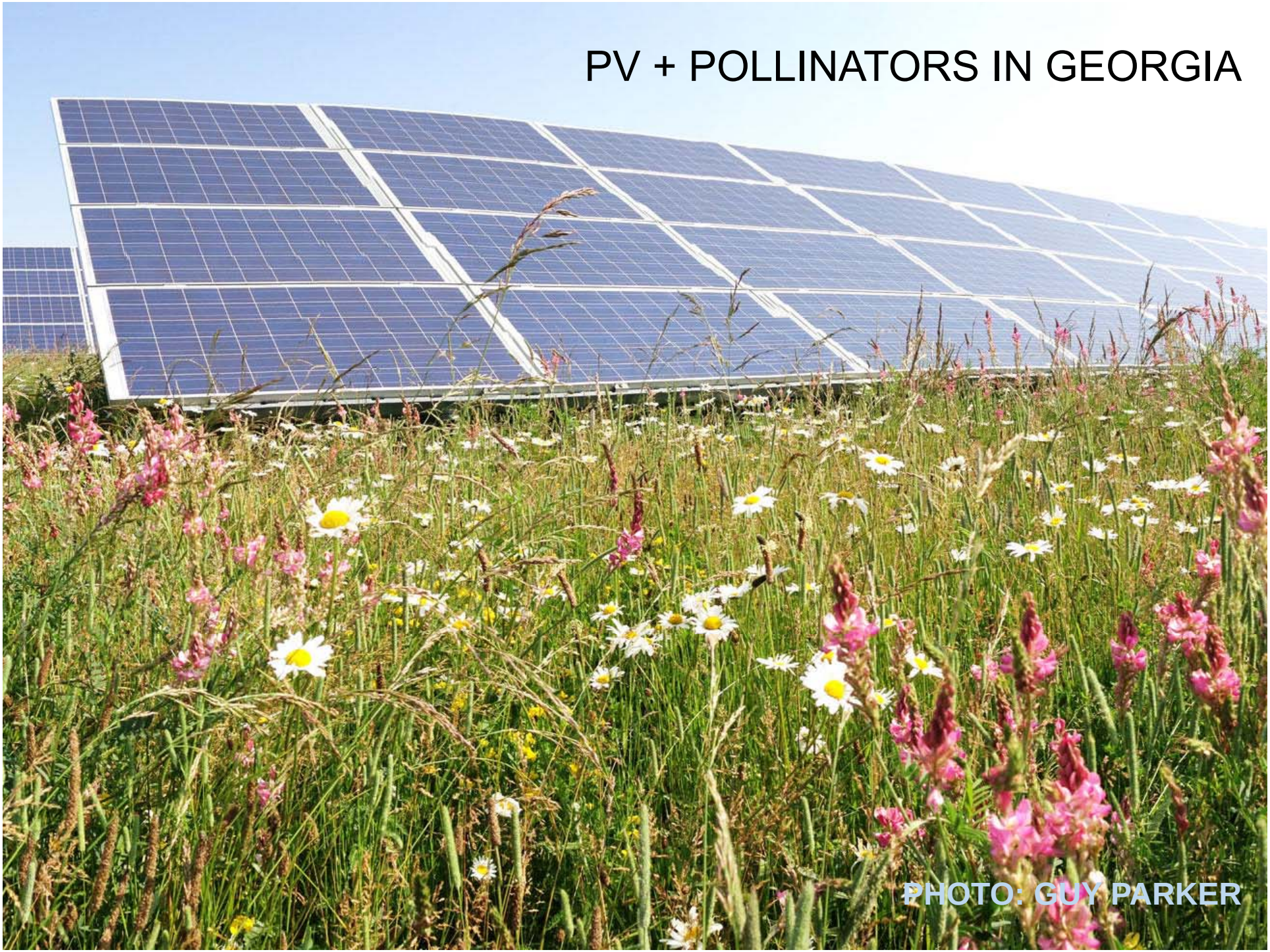
QUALITATIVE

- People most commonly visit the site to walk, walk their dog(s), and relax
- Respondents reported they most liked that the site offered water, nature, and quietness
- Respondents reported water, space, and scenery as the biggest attractions of the park

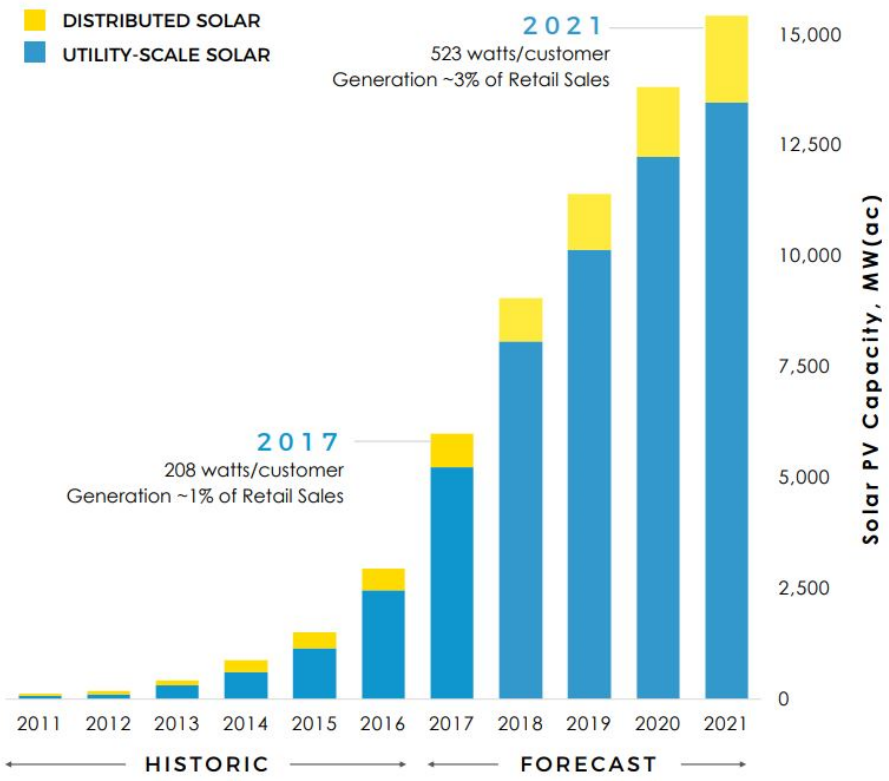
QUANTITATIVE

- 92% of respondents reported they feel safe in this place
- 96% of survey respondents said the park provides a real sense of escape and relief from being indoors
- 65% of respondents spend 30 minutes or more at the park
- 97% of respondents say this area includes abundant healthy green plants

PV + POLLINATORS IN GEORGIA



SOUTHEAST SOLAR CAPACITY FORECAST



EXPONENTIAL GROWTH SINCE 2012

Solar photovoltaic (PV) capacity nearly doubled each year from less than 200 MW in 2012 to almost 3,000 MW in 2016.

GROWTH CONTINUES

From 6,000 MW in 2017, new projects will take solar to 10,000 MW in 2019. Based on utility and other industry forecasts, SACE anticipates 15,000 MW by 2021. Much of this growth represents existing contracts and commitments that remain highly certain.

UTILITY-SCALE SOLAR DOMINATES

Utility-scale solar is favored by an economic advantage, policies, and discretionary utility practices that discourage customer-sited solar ("behind the meter"). Most utility-scale systems are in excess of 5 MW, many exceed 50 MW.

DISTRIBUTED SOLAR PROJECTS LAGS

Despite high customer interest, less growth is predicted for smaller residential rooftop and commercial customer-sited solar accounted via net metering or related billing practices.

LIMITED GRID IMPACTS

Even with 15,000 MW in 2021, the corresponding solar generation is less than 3% of retail sales, considerably below levels that could trigger changes in grid operation practices.

CREDIT: SOUTHERN ALLIANCE FOR CLEAN ENERGY


BUTLER FACILITY. BUTLER, GA.
103 MW, 1,070 ACRES.

Largest Solar Plant in Southeast Will Be Built in Georgia

02/22/2018 | Darrell Proctor

Save to myPOWER

PRINT MODE : OFF

PAGES: 1 2

A 200-MW solar power plant is being planned at a 2,000-acre site near Warner Robins, Georgia, a project that at present would be the largest standalone solar facility in the U.S. Southeast.

"The literature review revealed a scarcity of information specific to utility-scale solar development in the Southeast. Sources primarily address sites in the desert southwest and in foreign countries, yielding information that is broadly applicable to solar development but lacks useful region-specific data."

Landscape Sustainability for Solar Projects

LITERATURE REVIEW

Sustainability and Landscape Performance Lab
College of Environment + Design
University of Georgia

Mason, G., Calabria, J. and Vick, R.

Summer 2016

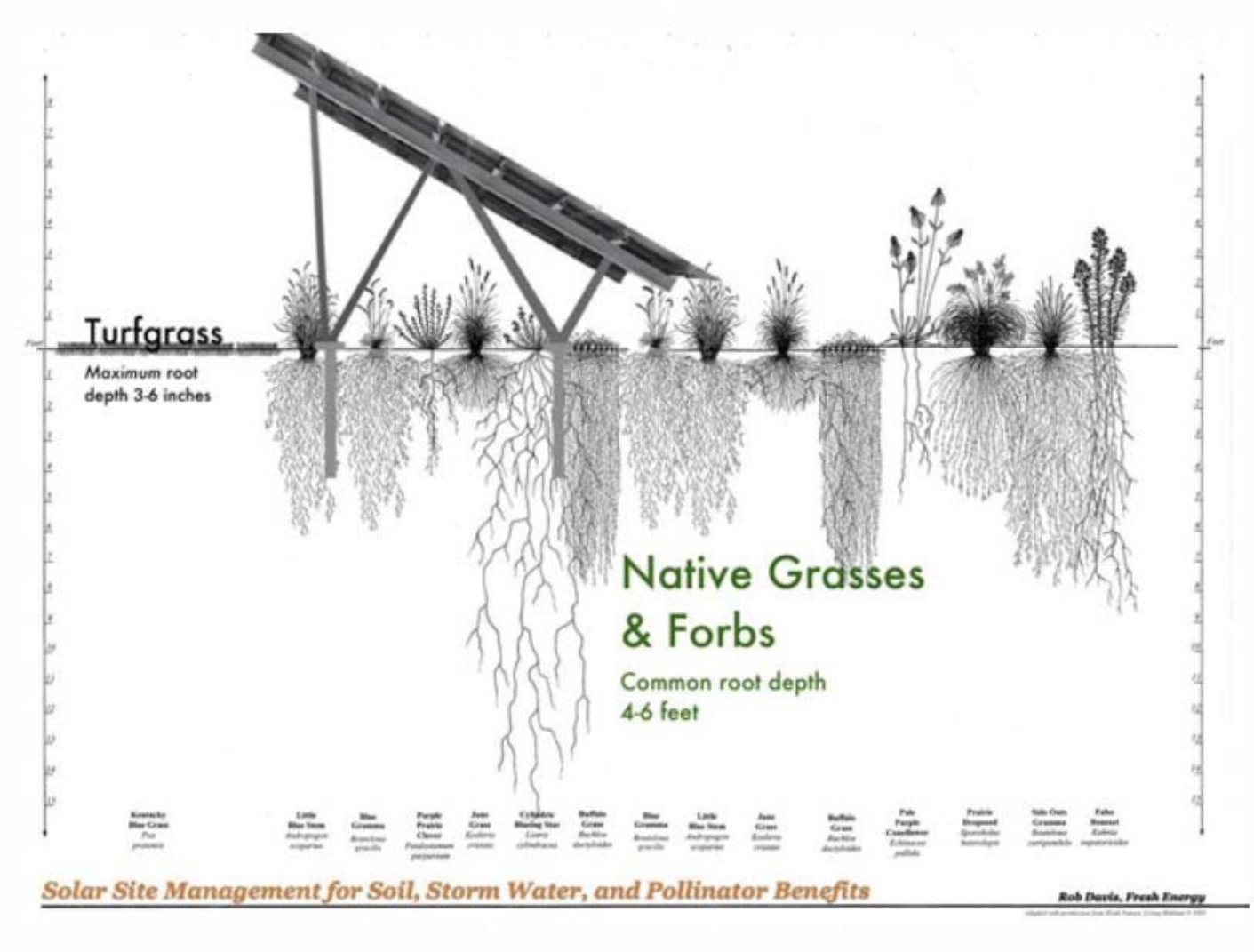
TYPICAL HUMID SOUTHEAST
GROUNDLAYER TREATMENT

TYPICAL ARID WEST
GROUNDLAYER TREATMENT

Pollinator-friendly solar: everybody loves it

By **Fresh Energy** | May 15, 2017

Connexus Energy's pollinator-friendly community solar garden is not only producing renewable energy, it is now producing honey. On April 24, 2017, Connexus Energy had 15 bee hives installed at its SolarWise garden in Ramsey, Minnesota and will be managing and expanding the hives throughout the summer.



ECOSYSTEM SERVICES:

- EROSION CONTROL
- SOIL FORMATION
- CARBON SEQESTRATION
- RAINFALL/RUNOFF INFILTRATION
- BEAUTY
- HABITAT
  - POLLINATORS
  - BIRDS
  - REPTILES

2 - 4' MIX

Quantity	UOM	Item Number	Description
0	Each	LOW GROWING MIX	2-4 FT TALL
0.05000	lb	AGRHYE01	Winter Bentgrass, Piedmont NC Ecotype
0.33000	lb	SCHSCO17	Little Bluestem, Piedmont NC Ecotype
0.30000	lb	PANANC05	Beaked Panicgrass, GA Ecotype
0.02000	lb	ERAHIR01	Bigtop Lovegrass, VA Ecotype
0.02000	lb	ASCTUB01	Butterfly Milkweed, PA Ecotype
0.02000	lb	CHANIC04	Sensitive Pea, NC Ecotype
0.05000	lb	CORGRA01	Largeflower Tickseed, Piedmont GA Ecotype
0.10000	lb	CHAFAS01	Partridge Pea, PA Ecotype
0.01000	lb	ASTSPE03	Showy Aster, NC Ecotype
0.04000	lb	CORLAN01	Lanceleaf Coreopsis
0.00500	lb	CORMAJ01	Greater Tickseed, AL Ecotype
0.00500	lb	CORTRI02	Tall Coreopsis, AL Ecotype
0.02000	lb	EUPCOE02	Mistflower, FL Ecotype
0.01000	lb	LESVIR02	Slender Bushclover, GA Ecotype
0.01000	lb	LIASQU03	Scaly Blazing Star, VA Ecotype
0.01000	lb	PENMUL01	Manyflower Beardtongue, FL Ecotype
0	Each	TOTAL	

1 - 2' MIX

Quantity	UOM	Item Number	Description
1	Each	FLOWERING LAWN MIX O	FOR SOLAR FARM IN PIEDMONT, GA
0.40000	lb	CHAFAS02	Partridge Pea, FL Ecotype
0.12500	lb	LIASQU03	Scaly Blazing Star, VA Ecotype
2.00000	lb	ASCTUB01	Butterfly Milkweed, PA Ecotype
0.50000	lb	GAIARI01	Perennial Gaillardia (Blanketflower)
0.25000	lb	CORLAN02	Lanceleaf Coreopsis, SC Ecotype
0.10000	lb	CORBAS01	Goldenmane Tickseed, FL Ecotype
0.06250	lb	PYCTEN02	Slender Mountainmint, 'Suther'-NC Ecotype
0.25000	lb	PENAUS01	Eustis Lake Beardtongue, 'Suther'-NC Ecotype
0	Each	TOTAL	

CREDIT: ALFIE VICK, JON CALABRIA, ERNST SEED SUPPLY

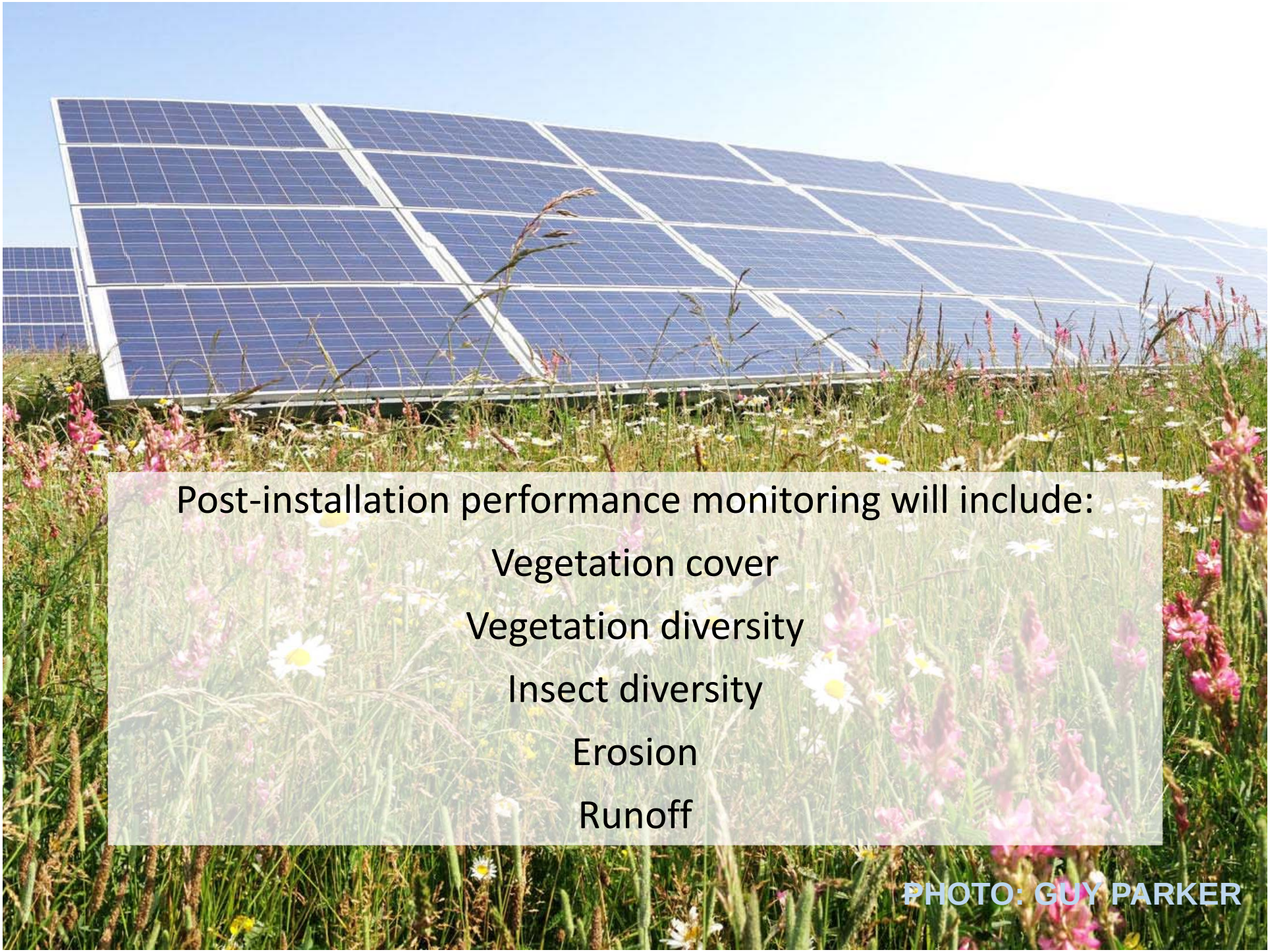
State Botanical Garden of Georgia

Piedmont Prairie species research, propagation and dissemination.

Native Plant Initiative
The State Botanical Garden of Georgia

State Wildlife Action Plain – Piedmont Prairies
Critically imperiled – 8th year of seed increase

CREDIT: Jennifer Ceska, Jim Affoelter, Heather Alley and Jenny Cruse-Sanders


Post-installation performance monitoring will include:
Vegetation cover
Vegetation diversity
Insect diversity
Erosion
Runoff
PHOTO: GUY PARKER

Sustainability and Landscape Performance (SLaP) Lab

College of Environment and Design

University of Georgia

The Sustainability & Landscape Performance (SLaP) Lab collaborates with practitioners and other partners to monitor the performance of landscapes and green infrastructure practices in order to improve design guidance and management practices and to calibrate predictive models of landscape performance.

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PHOTO: GUY PARKER