The Surprising Technology of Nature-Based Solutions

Technology + Innovation Center
Local Infrastructure Hub
December 5, 2022

Today’s Session

2:00 **Fresh Insights: The Surprising Tech of Nature-Based Solutions**
Tina Walha, U.S. Digital Response
Anthony Townsend, Jacobs Urban Tech Hub at Cornell Tech

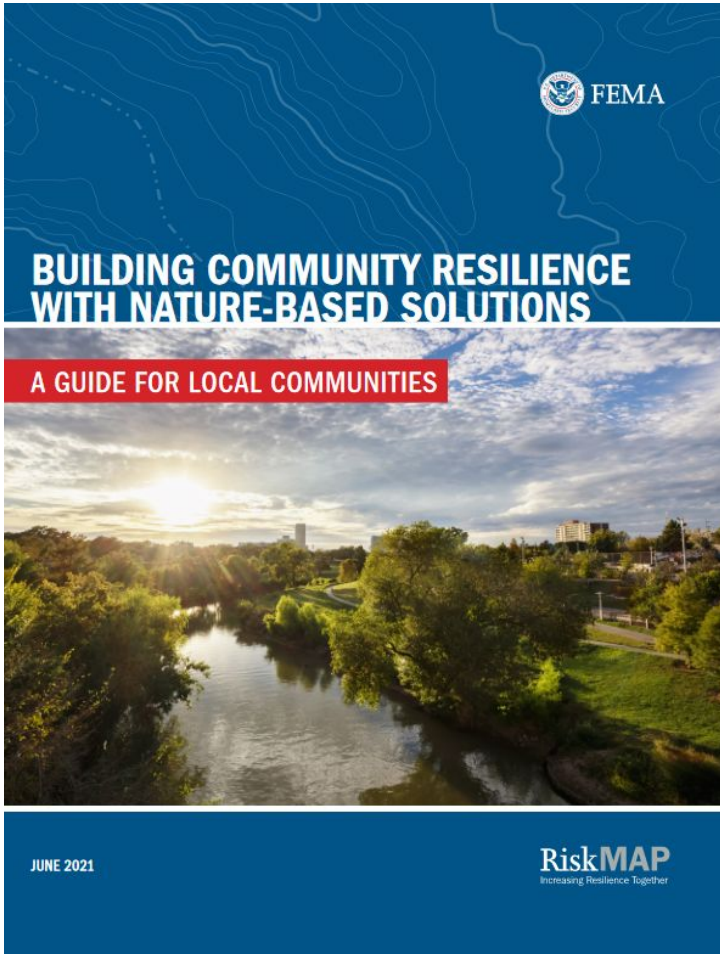
2:10 **Practical Innovations: Quantifying the Benefits of Nature-Based Solutions**
Aiman Duckworth, Biohabitats, Inc.
Andy Shively, City of Kansas City, Missouri
Tamar Warburg and Chris Hardy, Sasaki Associates, Inc.

2:40 **Q&A / Discussion**

What are Nature-based Solutions?

FEMA's definition:

- "Sustainable planning, design, environmental management, and engineering practices…
- that combine natural features and processes with built ones…
- to reduce risk, conserve ecosystem value and functions, and provide associated benefits to human populations."



FEMA identifies three categories of nature-based solutions (NBS). Most are aimed at managing flood risk.

WATERSHED SCALE

LAND CONSERVATION

Land conservation is one way of preserving interconnected systems of open space that sustain healthy communities.

Land conservation projects begin by prioritizing areas of land for acquisition. Land or conservation easements can be bought or acquired through donation.

GREENWAYS

Greenways are corridors of protected open space managed for both conservation and recreation.

Greenways often follow rivers or other natural features. They link habitats and provide networks of open space for people to explore and enjoy.

WETLAND RESTORATION AND PROTECTION

Restoring and protecting wetlands can improve water quality and reduce flooding. Healthy wetlands filter, absorb, and slow runoff.

Wetlands also sustain healthy ecosystems by recharging groundwater and providing habitat for fish and wildlife.

STORMWATER PARKS

Stormwater parks are recreational spaces that are designed to flood during extreme events and to withstand flooding.

By storing and treating floodwaters, stormwater parks can reduce flooding elsewhere and improve water quality.

FLOODPLAIN RESTORATION

Undisturbed floodplains help keep waterways healthy by storing floodwaters, reducing erosion, filtering water pollution, and providing habitat.

Floodplain restoration rebuilds some of these natural functions by reconnecting the floodplain to its waterway.

NEIGHBORHOOD OR SITE SCALE

RAIN GARDENS

A rain garden is a shallow, vegetated basin that collects and absorbs runoff from rooftops, sidewalks, and streets.

Rain gardens can be added around homes and businesses to reduce and treat stormwater runoff.

VEGETATED SWALES

A vegetated swale is a channel holding plants or mulch that treats and absorbs stormwater as it flows down a slope.

Vegetated swales can be placed along streets and in parking lots to soak up and treat their runoff, improving water quality.

GREEN ROOFS

A green roof is fitted with a planting medium and vegetation. A green roof reduces runoff by soaking up rainfall. It can also reduce energy costs for cooling the building.

Extensive green roofs, which have deeper soil, are more common on commercial buildings. Intensive green roofs, which have shallower soil, are more common on residential buildings.

RAINWATER HARVESTING

Rainwater harvesting systems collect and store rainfall for later use. They slow runoff and can reduce the demand for potable water.

Rainwater systems include rain barrels that store tens of gallons and rainwater cisterns that store hundreds or thousands of gallons.

PERMEABLE PAVEMENT

Permeable pavements allow more rainfall to soak into the ground. Common types include pervious concrete, porous asphalt, and interlocking pavers.

Permeable pavements are most commonly used for parking lots and roadway shoulders.

TREE CANOPY

Tree canopy can reduce stormwater runoff by catching rainfall on branches and leaves and increasing evapotranspiration. By keeping neighborhoods cooler in the summer, tree canopy can also reduce the "urban heat island effect."

Because of trees' many benefits, many cities have set urban tree canopy goals.

TREE TRENCHES

A stormwater tree trench is a row of trees planted in an underground infiltration structure made to store and filter stormwater.

Tree trenches can be added to streets and parking lots with limited space to manage stormwater.

GREEN STREETS

Green streets use a suite of green infrastructure practices to manage stormwater runoff and improve water quality.

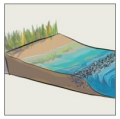
Adding green infrastructure features to a street corridor can also contribute to a safer and more attractive environment for walking and biking.

COASTAL AREAS

COASTAL WETLANDS

Coastal wetlands are found along ocean, estuary, or freshwater coastlines.

They are often referred to as "sponges" because of their ability to absorb wave energy during storms or normal tide cycles.



OYSTER REEFS

Oysters are often referred to as "ecosystem engineers" because of their tendency to attach to hard surfaces and create large reefs made of thousands of individuals.

In addition to offering shelter and food to coastal species, oyster reefs buffer coasts from waves and filter surrounding waters.

DUNES

Dunes are coastal features made of blown sand. Healthy dunes often have dune grasses or other vegetation to keep their shape.

Dunes can serve as a barrier between the water's edge and inland areas, buffering waves as a first line of defense.

WATERFRONT PARKS

Waterfront parks in coastal areas can be intentionally designed to flood during extreme events, reducing flooding elsewhere.

Waterfront parks can also absorb the impact from tidal or storm flooding and improve water quality.

LIVING SHORELINES

Living shorelines stabilize a shore by combining living components, such as plants, with structural elements, such as rock or sand.

Living shorelines can slow waves, reduce erosion, and protect coastal property.

Nature-based solutions are a FEMA priority

"Incorporation of nature-based solutions" is a key technical evaluation factor for BRIC and FMA in 2023

	Technical Evaluation Criteria for the National Competition	
	Criteria	**Potential Total Points**
1	Infrastructure project[14]	20
2	Incorporation of nature-based solutions for hazard mitigation. For more information on potential nature-based solutions, please reference *Building Community Resilience with Nature-Based Solutions: A guide for local communities*.	10
3	Applicant has mandatory Tribal-, territory-, or state-wide building code adoption requirement (2015 version of International Building Code and International Residential Code) OR Applicant has mandatory Tribal-, territory-, or state-wide building code adoption requirement (2018 or 2021 versions of International Building Code and International Residential Code)	10 OR 20
4	Subapplicant has Building Code Effectiveness Grading Schedule (BCEGS) Rating of 1 to 5	20
5	Application generated from a previous[15] FEMA HMA Project Scoping award or any other federal grant award, or the subapplicant is a past recipient of BRIC non-financial Direct Technical Assistance	10
6	A non-federal cost share[16] of at least 30% (or, for Economically Disadvantaged Rural Communities as defined in 42 U.S.C. § 5133(a) as small impoverished communities, a non-federal cost share of at least 12%). To receive the full points, the federal share requested can be no more than 70% (or 88% for qualified EDRCs).	5
7	Any community with a CDC SVI of 0.60 to 0.79 OR	15 OR

BRIC

Incorporation of Nature-Based Solutions	Projects that incorporate nature-based solutions[13].	100
Severe Repetitive Loss (SRL) and Repetitive Loss (RL) Properties	Points are assessed for SRL and/or RL structure verified within the benefitting area of the project.	5 points per RL and 10 points per SRL, up to 100 points
Private-Partnership Cost Share	Cost share contributed by private organizations/businesses. Points will be assigned based on percentage of private cost share invest in the non-federal match. Points will be assessed as follows: • Equal to or greater than 51%, applicants will receive 100 points. • Between 25% and 50%, applicants will receive 50 points.	Up to 100
National Violation Tracker (NVT)	Points are assessed for communities in good standing in the NFIP determined by number of floodplain management property violations identified in the NVT for the community. Communities will receive points if they do not have any outstanding violations.	50
Community Rating System (CRS) Participation	The CRS recognizes and encourages community floodplain-management activities that exceed the minimum National Flood Insurance Program standards. Depending on the level of participation, flood insurance premium rates for policyholders can be reduced up to 45%.	50
Cooperating Technical Assistance Partners Program (CTP) Participation	The CTP is a qualified partnership program in which communities commit to collaborate in maintaining up-to-date flood hazard maps and other flood hazard information. Points will be assigned to CTP participating communities.	30

[13] For more information on nature-based solutions, please reference Building Community Resilience with Nature-Based Solutions: A Guide for Local Communities.

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FMA

Nature-based solutions are innovative.

The strategy is to “green” the “gray” stuff we built in the 20th century.

NBS improve resilience and sustainability.

But they downplay the role of technology.

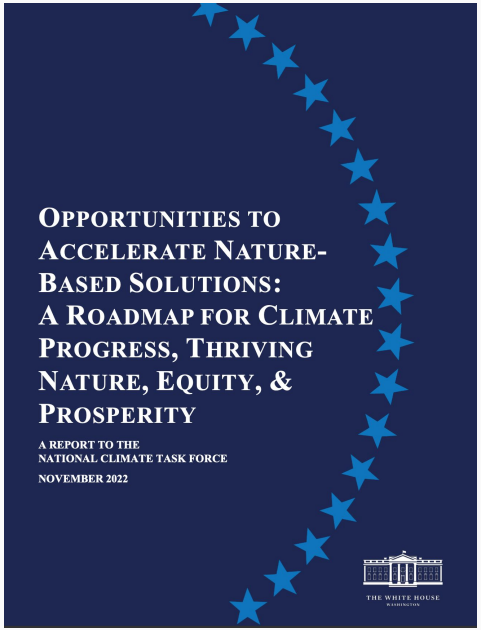
US EPA

Leaving technology in the dust is a missed opportunity.

The November 2022 White House roadmap on nature-based solutions seeks to close that gap:

“**Nature-based solutions and technology can be powerful allies.**

…the climate crisis demands that we deploy all available, proven, science- and evidence-based solutions.”



How do we leverage technology to deliver NBS, without putting technology first?

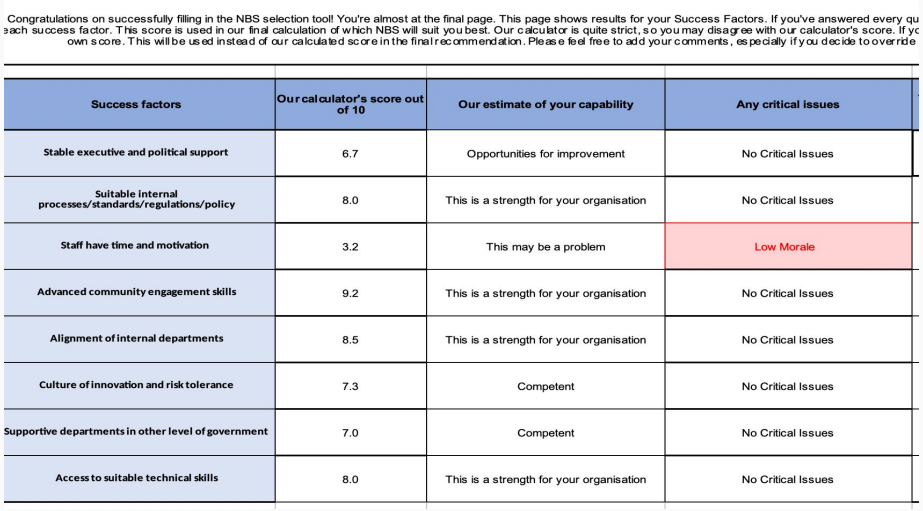
We see 3 surprising ways…

1. Picking which nature-based solution(s) to pursue.

The EU's Urban GreenUP program created the NBS Selection Tool.

Cities answer 50 questions about resources and constraints.

The tool generates a scored, ranked list of nature-based solutions that are a good match, along with a list of potential obstacles.



Congratulations on successfully filling in the NBS selection tool! You're almost at the final page. This page shows results for your Success Factors. If you've answered every qu
each success factor. This score is used in our final calculation of which NBS will suit you best. Our calculator is quite strict, so you may disagree with our calculator's score. If yo
own score. This will be used instead of our calculated score in the final recommendation. Please feel free to add your comments, especially if you decide to override

Success factors	Our calculator's score out of 10	Our estimate of your capability	Any critical issues
Stable executive and political support	6.7	Opportunities for improvement	No Critical Issues
Suitable internal processes/standards/regulations/policy	8.0	This is a strength for your organisation	No Critical Issues
Staff have time and motivation	3.2	This may be a problem	Low Morale
Advanced community engagement skills	9.2	This is a strength for your organisation	No Critical Issues
Alignment of internal departments	8.5	This is a strength for your organisation	No Critical Issues
Culture of innovation and risk tolerance	7.3	Competent	No Critical Issues
Supportive departments in other level of government	7.0	Competent	No Critical Issues
Access to suitable technical skills	8.0	This is a strength for your organisation	No Critical Issues

https://www.urbangreenup.eu/resources/nbs-selection-tool/nbs-selection-tool.kl

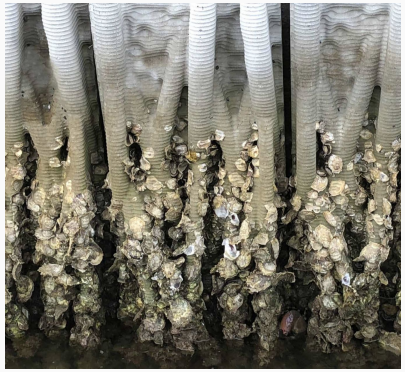
2. Enhancing performance of NBS

State of the art
What we can buy today

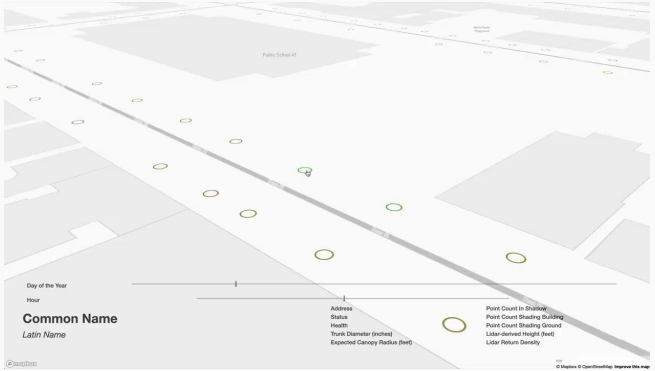
Next-generation
What's just been invented

Moonshot
What we must develop and deploy (over a generation)

Automated lock controls for fish habitat restoration on the Soo river.
(Sault Ste. Marie, Mich.)



3-D printed artificial reefs
(Fort Pierce, Fla.)



Digital twins of the urban canopy simulate benefits
(New York City)

3. Quantifying the benefits of NBS.

- World Economic Forum estimates that NBS are 50% more cost-effective than gray alternatives, but received just 0.3% of global spending on urban infrastructure in 2021.
- Because there aren't yet broadly-accepted standards for quantifying the benefits.
- Congress and the Biden Administration directed the US Army Corps of Engineers to create new protocols that consider the full set of economic, environmental, and social benefits of NBS.
- **This will be our main focus today, because it is information you can use right now.**

International Guidelines on Natural and Nature-Based Features for Flood Risk Management. U.S. Army Corps of Engineers, Engineering With Nature, September 2021

Insights for Cities

Aiman Duckworth, PLA
Senior Landscape Architect &
Urban Ecologist
Biohabitats, Inc.

Andy Shively, PE
Deputy Director
KC Water
City of Kansas City, MO

Tamar Warburg, AIA, LEED BD+C
Director of Sustainability
Sasaki

Chris Hardy, RLA, CA, LEED AP+ND
Senior Associate
Sasaki

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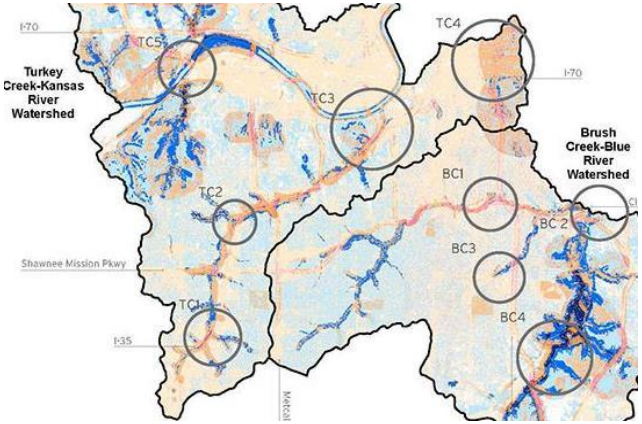
Tools for Assessing the Benefits of Nature-Based Solutions

Aiman Duckworth, PLA
Senior Landscape Architect &
Urban Ecologist

Biohabitats

Biohabitats



Conservation Planning

Ecological Restoration

Regenerative Design

“Restore the Earth & Inspire Ecological Stewardship”

Certified B Corporation

1% FOR THE PLANET

Climate Change

DroneBase Via AP

Biodiversity Loss

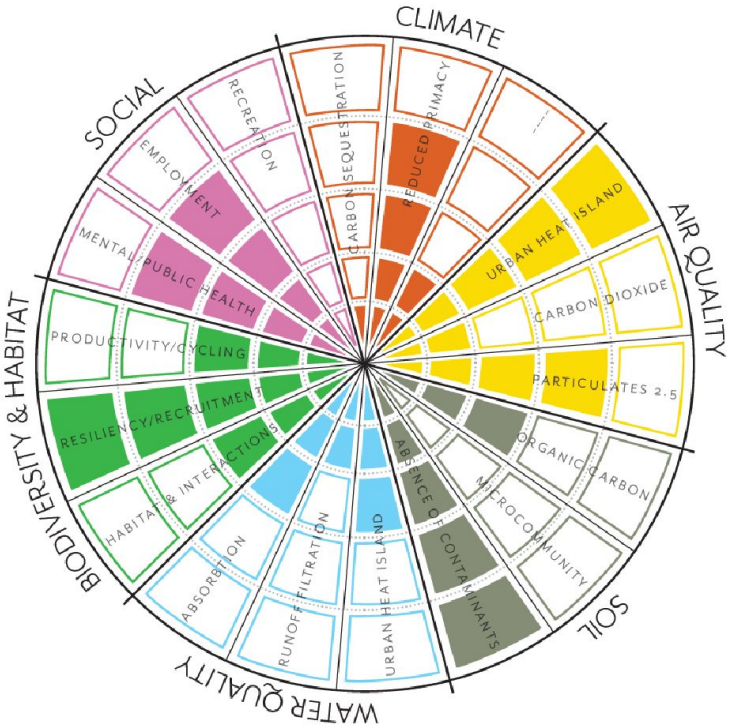
USFW
S

Environmental Justice

Elena Scotti/The Root/GMG; photos via Getty Images, iStock

Ecological Benefits Analysis

(United Nations)



(Biohabitats)

- Dollar Valuation

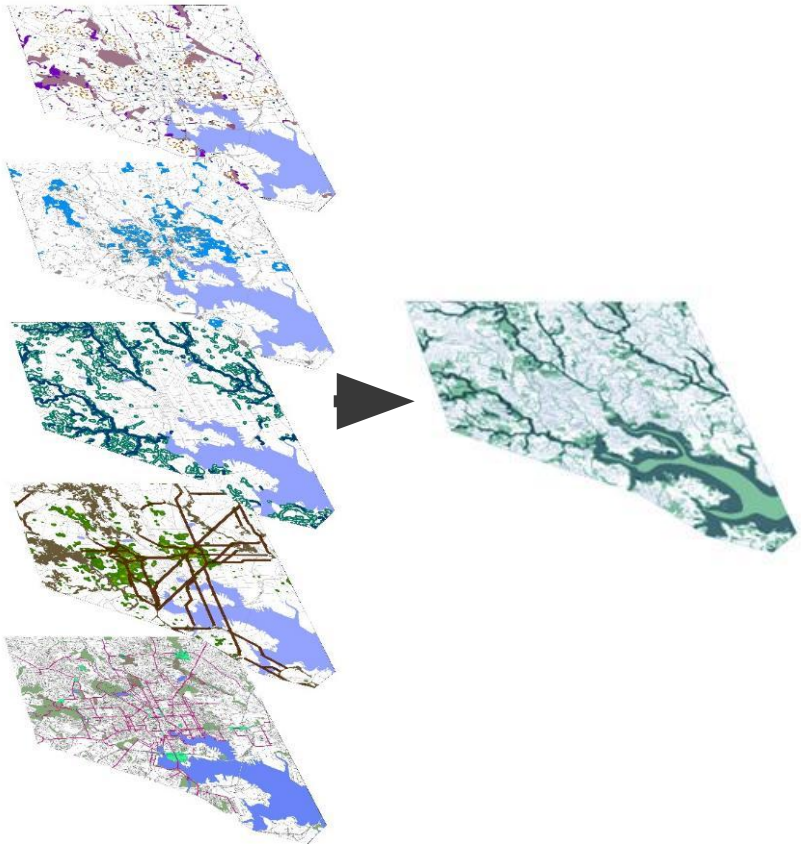
Biohabitats

Technology Tools and Approaches

- Remote Sensing
- Geospatial Analysis
- Modeling
- Monitoring
- Statistical Analysis
- Machine Learning

Phases of Benefits Analysis

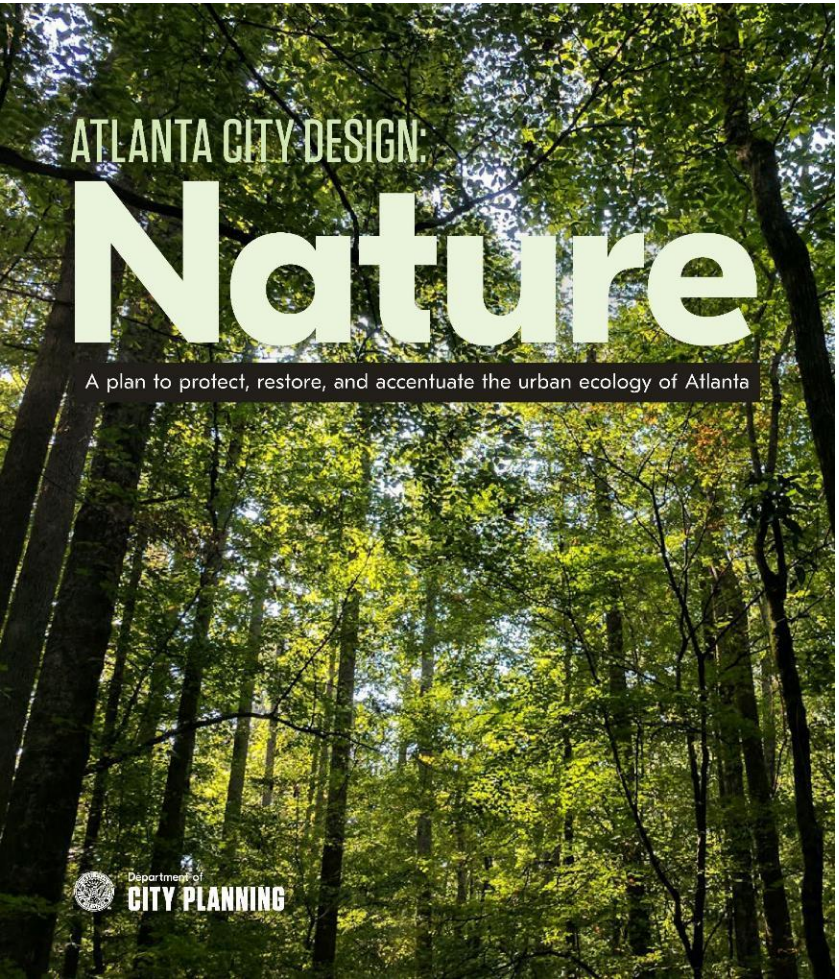
- Planning and Suitability Analysis
- Existing Baseline Conditions
- Proposed Scenarios
- Proposed Plan
- Installed Conditions
- Monitored Performance



Baltimore Green Network Plan (Biohabitats)

Biohabitats

Urban Ecological Planning & Social-Ecological Frameworks



Data Analysis Categories

- **Habitat and Biodiversity**
- **Ecosystem Services**
- **Parks and Open Space**
- **Environmental Justice / Climate Justice**

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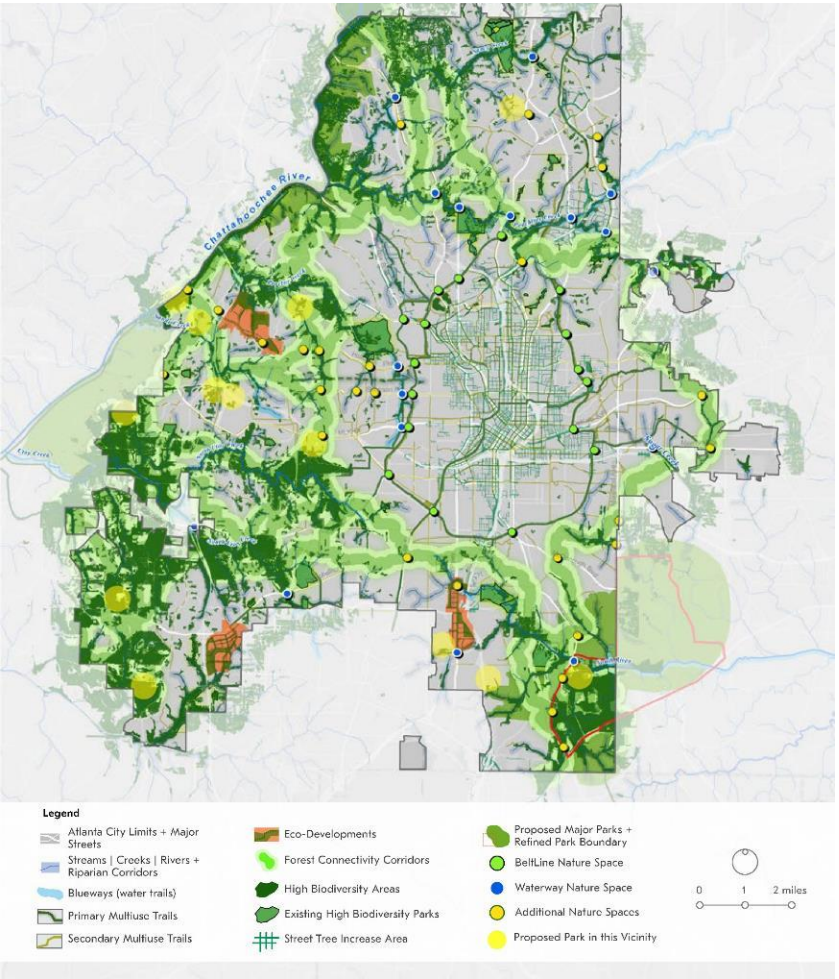
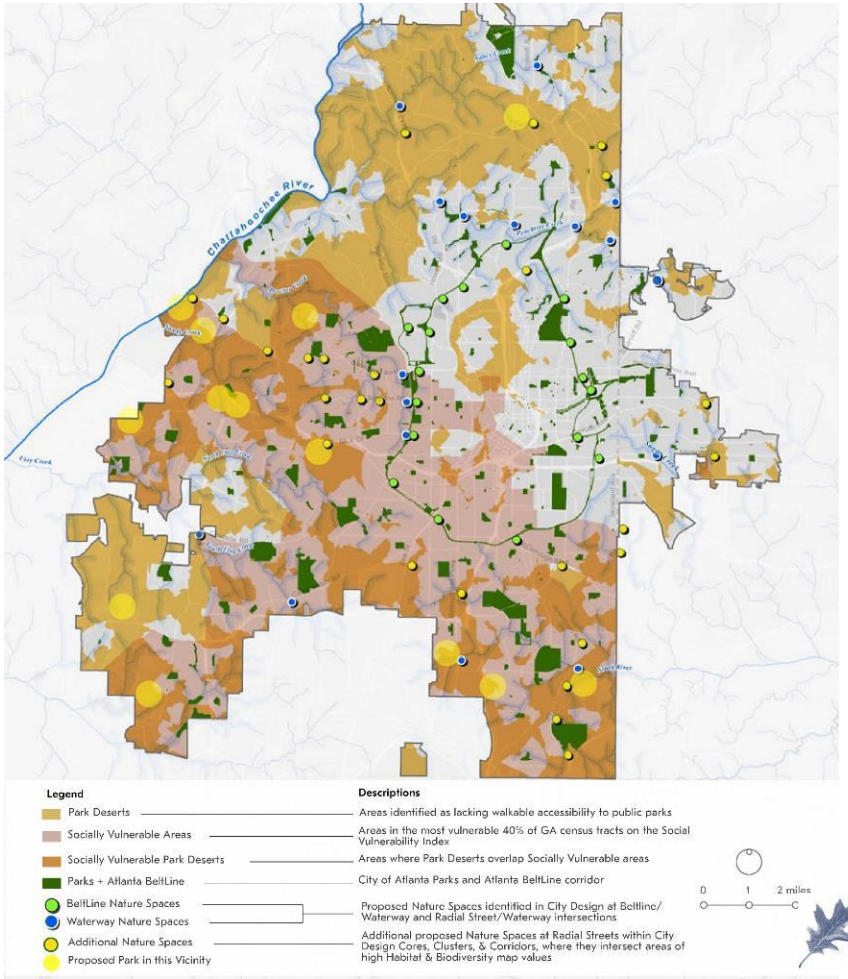
Equity & Environmental Justice





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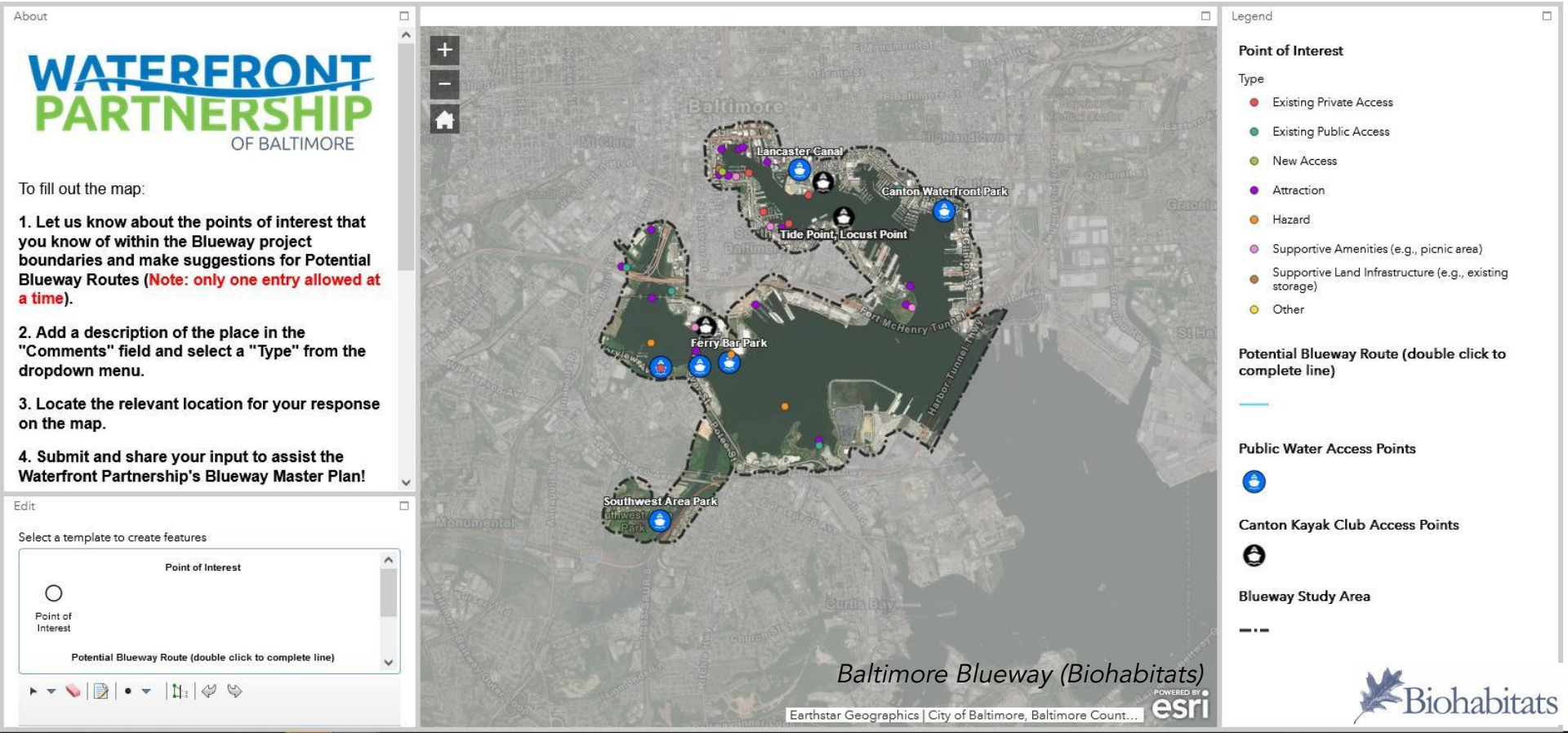
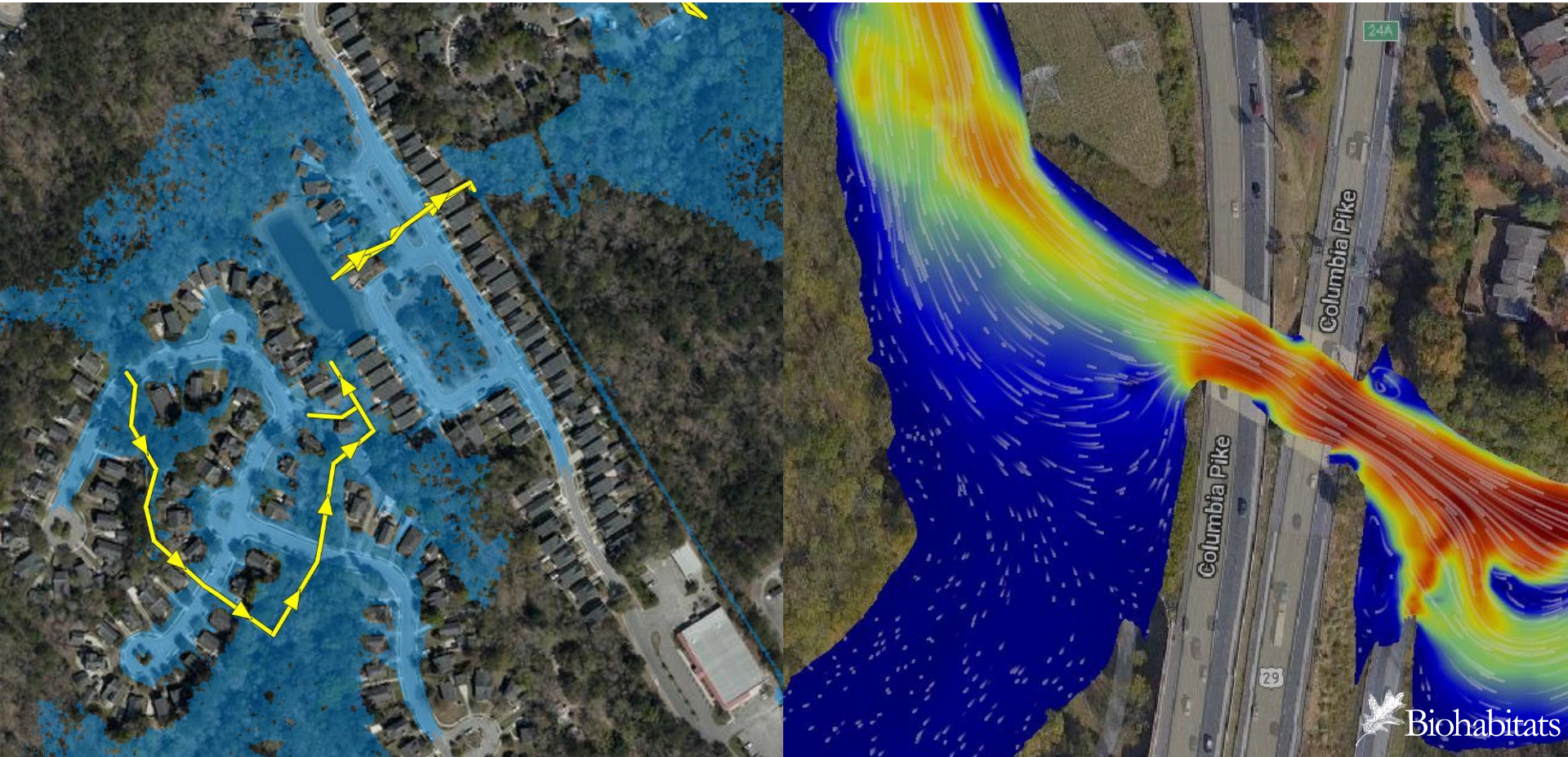
Equity & Environmental Justice

Web Mapping Survey Tools



Water

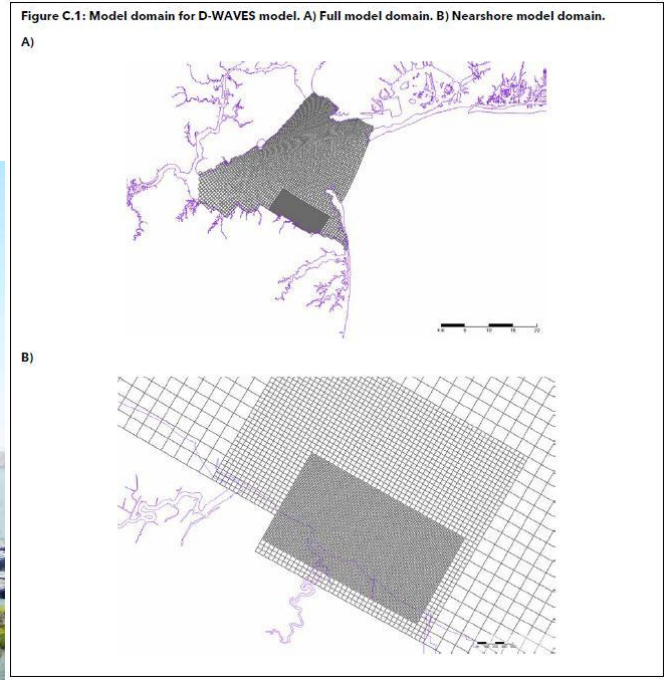
Hydrology and Hydraulic Modeling



Water

3D Modeling- Shoreline and Coastal

Imagine the Wall, Charleston, SC (Biohabitats, DesignWorks)



Biohabitats

(Image Credit: DesignWorks)

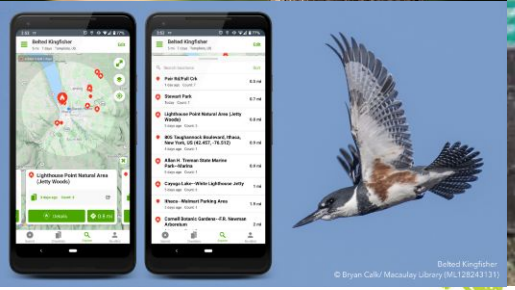
Biodiversity

Habitat Connectivity

Atlanta City Design: Nature (Biohabitats)

Biodiversity

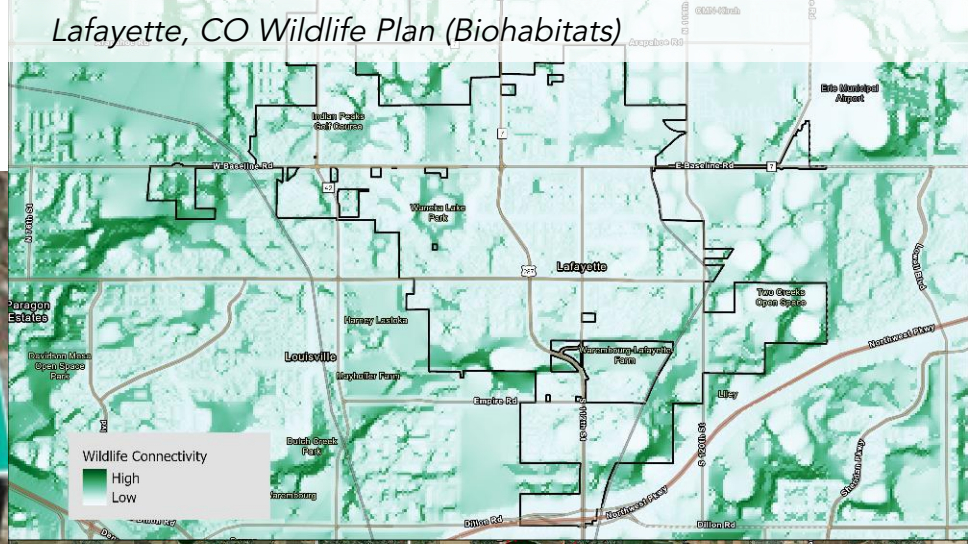
Species Diversity and Rarity

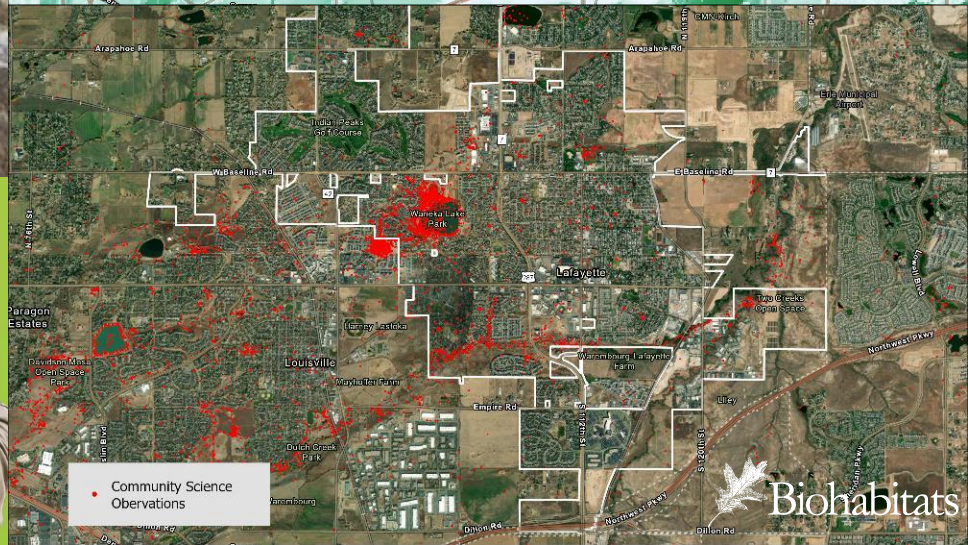


City Nature Challenge

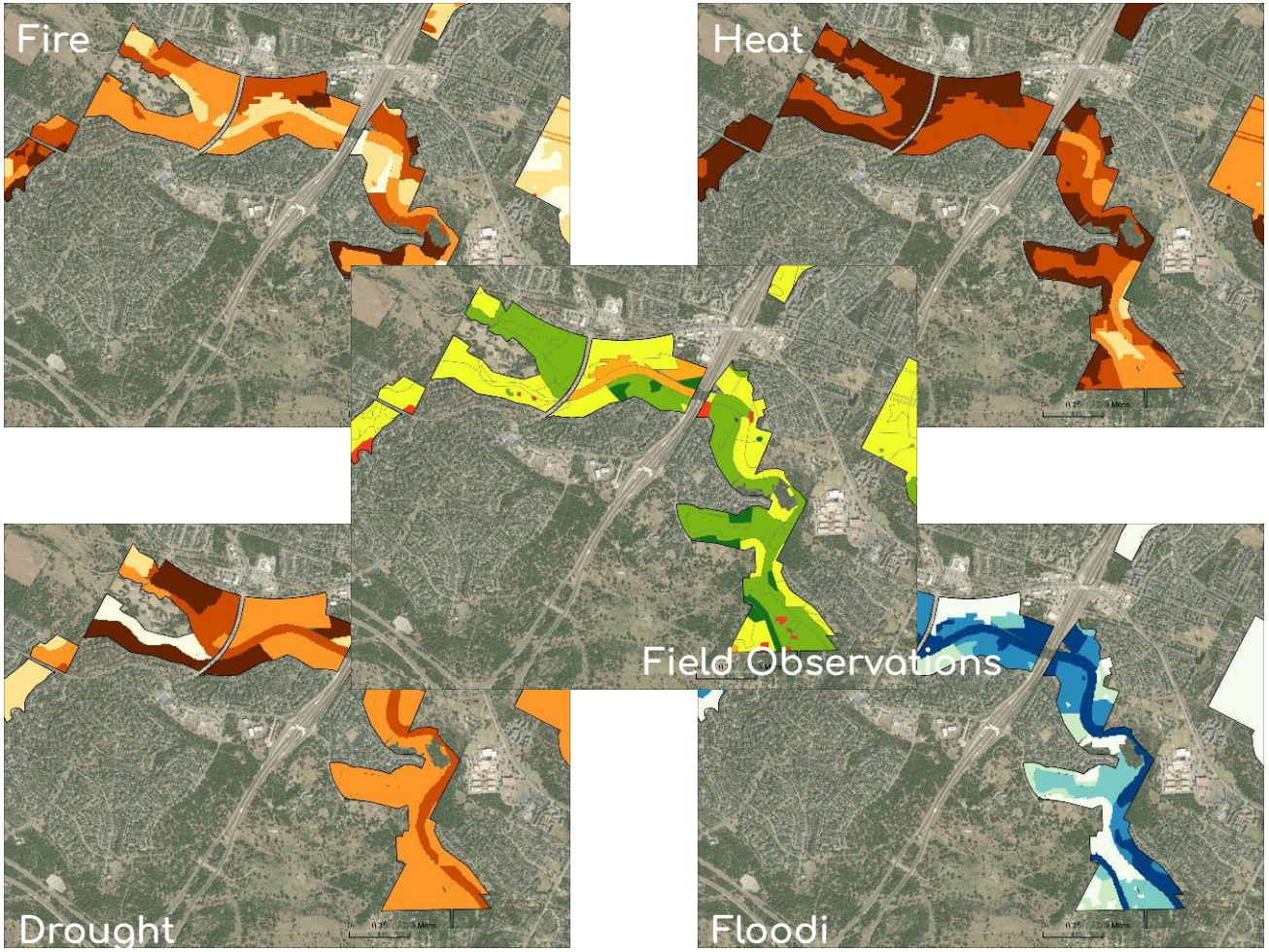
Participate

Lafayette, CO Wildlife Plan (Biohabitats)





Climate Risk Assessment

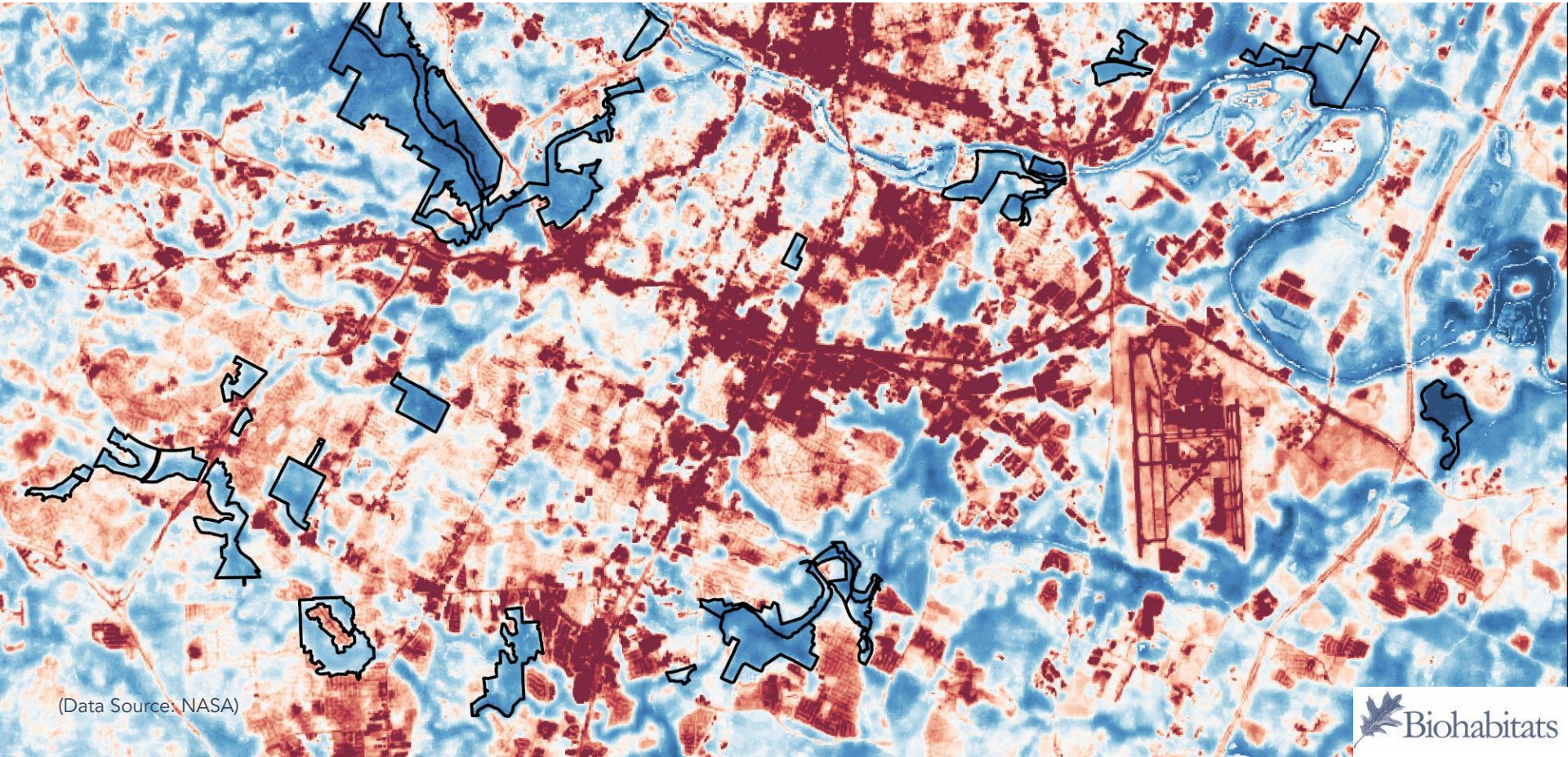


City of Austin Climate Vulnerability Analysis & Land Management Plan (Blackland Collaborative, Biohabitats, RES)

Biohabitats

Heat Island

Land Surface Temperature- Remote Sensing & Ground Sensors



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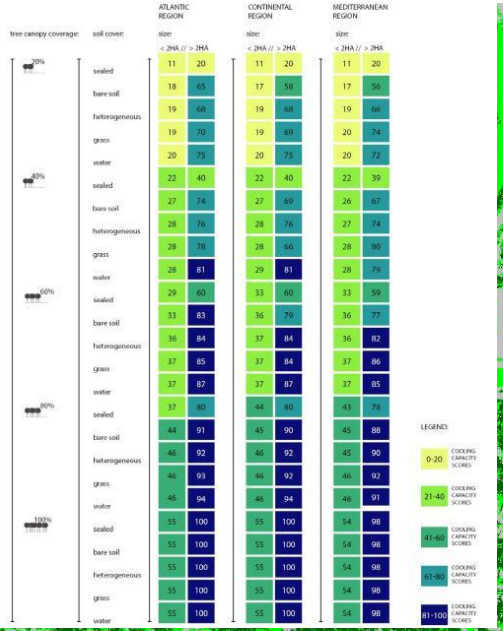
Heat Island

InVEST Urban Cooling Model



(Zardo et al. 2017)

Reference Air Temperature (°C)	21.5
UHI Effect (°C)	3.5
Air Blending Distance (m)	2000
Maximum Cooling Distance (m)	1000
Cooling Capacity Calculation Method	factor
Shade Weight *(optional)*	0.6
Albedo Weight *(optional)*	0.2
Evapotranspiration Weight *(optional)*	0.2
Run Energy Savings Valuation	Yes
Buildings	W:\GIS
Energy Consumption Table	W:\GIS

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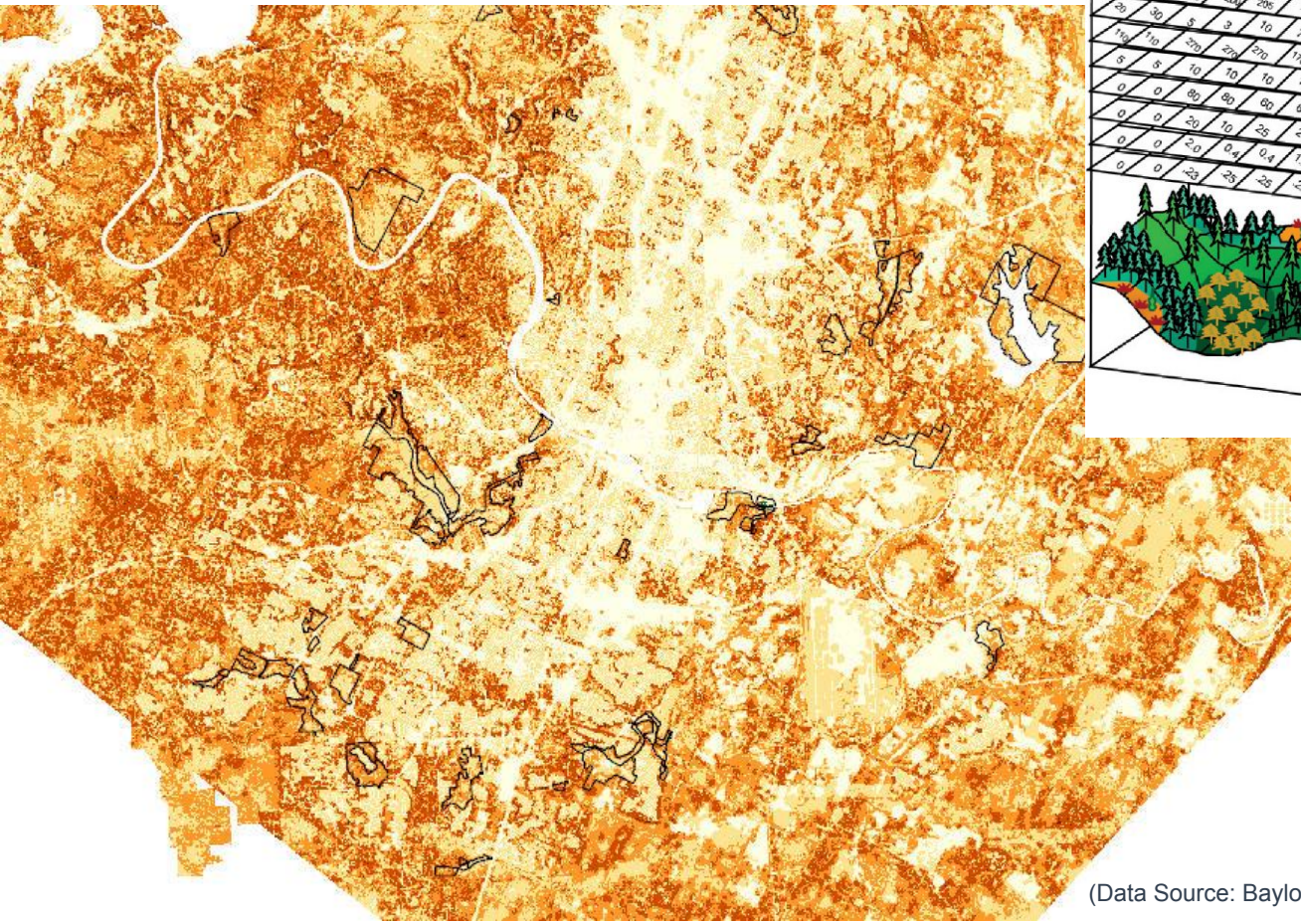
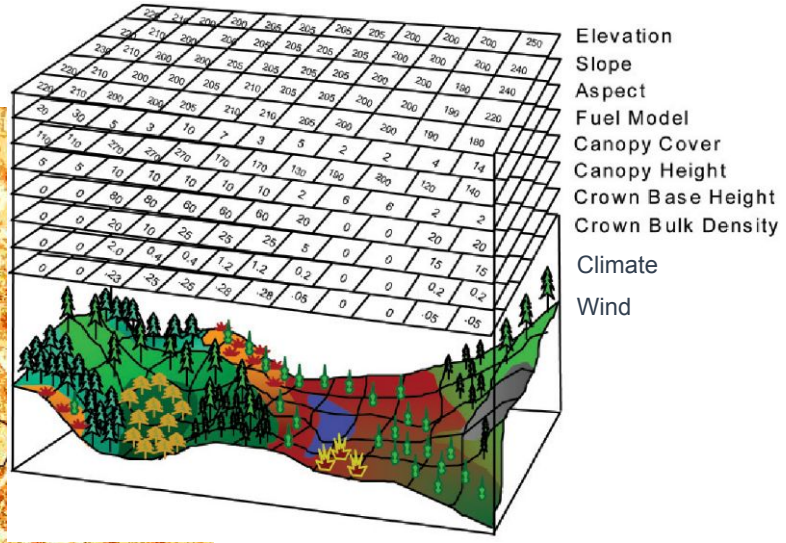
Fire

Fire Risk Modeling





(Finney 2006)

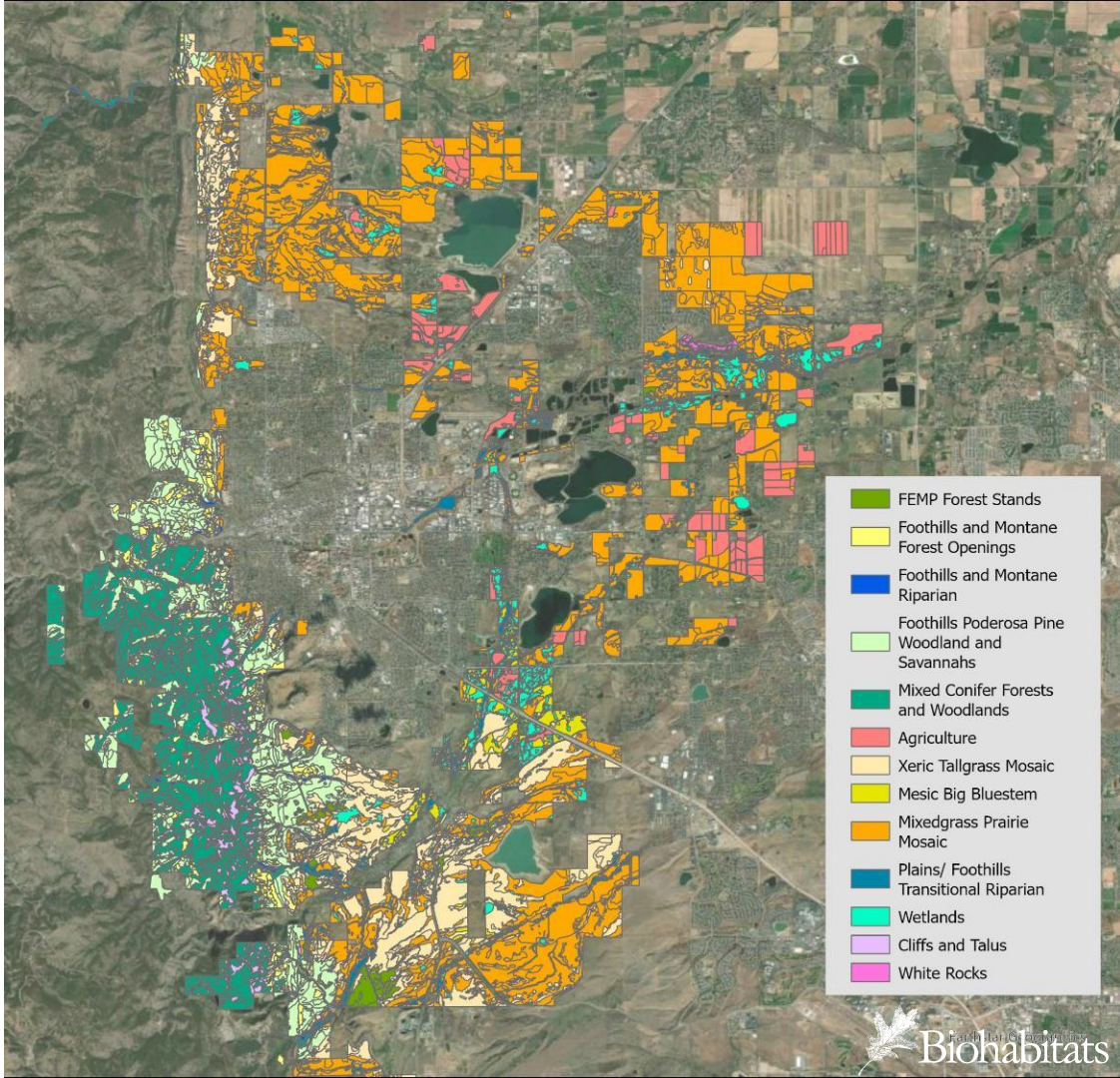
(Data Source: Baylor University, FlamMap)

Biohabitats

Carbon

Boulder Land-Based Carbon Inventory & Natural Climate Solutions (Biohabitats, SSG)

- Carbon Inventory
- Carbon Flux
- Carbon Scenarios
- Natural Climate Solutions
- Water, Fire, Biodiversity & Carbon



Carbon

Project Carbon Sequestration & Construction Footprint

Bacon Ridge Branch, Annapolis, MD (Biohabitats)

The first stream restoration project in Maryland to use only wood harvested on site to restore floodplain functions.

Monitoring

Georgia Tech EcoCommons, Atlanta, GA

(Barge, Nelson Byrd Woltz, Biohabitats)

(Image Credit: NBW)

Biohabitats

Hypothesis: The EcoCommons is a living laboratory with piedmont habitats. The landscape will provide increased ecological function, reduced negative ecological impacts, and reduced maintenance costs compared to traditional university landscapes by relying on natural processes and employing adaptive management practices.

Biohabitats

CLIMATE

Air Quality Sensors

Air Temperature Sensors

Air Humidity Sensors

SOIL

Soil Moisture Sensors

Soil Temperature Sensors

Soil Organic Matter Sampling

Soil Respiration Sampling

Soil Percolation Sampling

Soil Fungal : Bacterial Ratio

WATER

Water Gauge

Water Quality Station

Soil Moisture Sensors

LIFE

Wellness Survey

Trail Cameras

Auditory Recordings

Tree Identification & Measurement Survey

iNaturalist

Bioblitz

COMPREHENSIVE SAMPLING

TBD Sampling Including Combination of Above Methods Across Cross-section of Landscape

ANALYSIS ACTIVITIES

Carbon Budgeting for Maintenance Activities

Water Budget

SITE COMPARATIVE RESEARCH PLAN - ECOCOMMONS VS. GEORGIA TECH SITES

Biohabitats

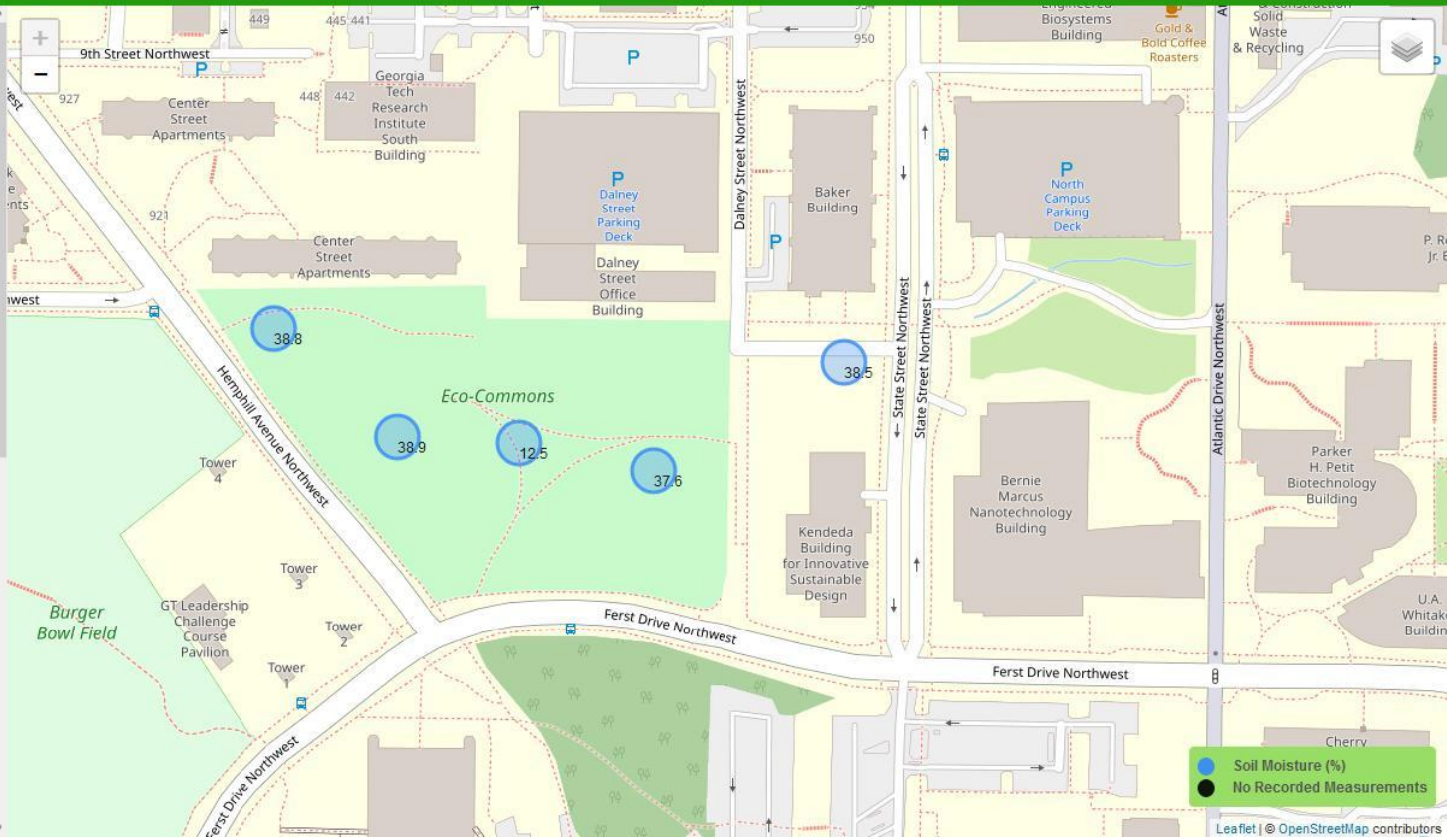
Georgia Tech Eco-Commons Dashboard

Search

Go

Sensor Stations

- Georgia Tech Main Campus -EcoCommons- Model#: dl_lp8p - Sensor 0001 — 4 Streams
- Georgia Tech Main Campus -EcoCommons- Model#: elt2hp - Sensor 0010 — 4 Streams
- Georgia Tech Main Campus -EcoCommons- Model#: elt2i - Sensor 0001 — 3 Streams
- Georgia Tech Main Campus -EcoCommons- Model#: elt2i - Sensor 0002 — 3 Streams
- Georgia Tech Main Campus -EcoCommons- Model#: elt2i - Sensor 0003 — 3 Streams
- Georgia Tech Main Campus -EcoCommons- Model#: elt2i - Sensor 0004 — 3 Streams
- Georgia Tech Main Campus -EcoCommons- Model#: elt2i - — 3 Streams



Biohabitats

Key Take Aways for Federal Grants

- Climate Change, Biodiversity, Environmental Justice
- Meaningful Community Engagement
- Stacked Benefits- Can’t Just Solve for One Problem
- Measure What Matters
- Quantifiable Metrics for Success
- Master Plan- Greater Community Vision and Suitability

(Image Credit: Jim G. Maloney)

Fern Hill Wastewater Treatment, Portland, OR (Biohabitats)

Biohabitats

Local Infrastructure Hub

Tools for Assessing the Benefits of Nature-Based Solutions

aduckworth@biohabitats.com

Biohabitats

Thank You!

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1% FOR THE PLANET

Insights from the Field

Andy Shively, PE
Deputy Director
KC Water
City of Kansas City, MO

KC Water's Smart Sewer Program

The Surprising Technology of Nature-Based Solutions

Local Infrastructure Hub: tech + innovation webinar series

smartsewer
INNOVATION & INFRASTRUCTURE TO LAST A LIFETIME

Continuous Monitoring & Adaptive Control

GARDNER AVE DETENTION BASIN

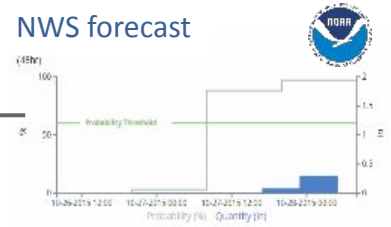
smartsewer
INNOVATION & INFRASTRUCTURE TO LAST A LIFETIME

Opti RTC

web-based dashboard

Opti
cloud software

NWS forecast



control panel

runoff

Enables Dynamic and Adaptive
Water Storage Management

water level sensor

actuated valve
outlet or pump

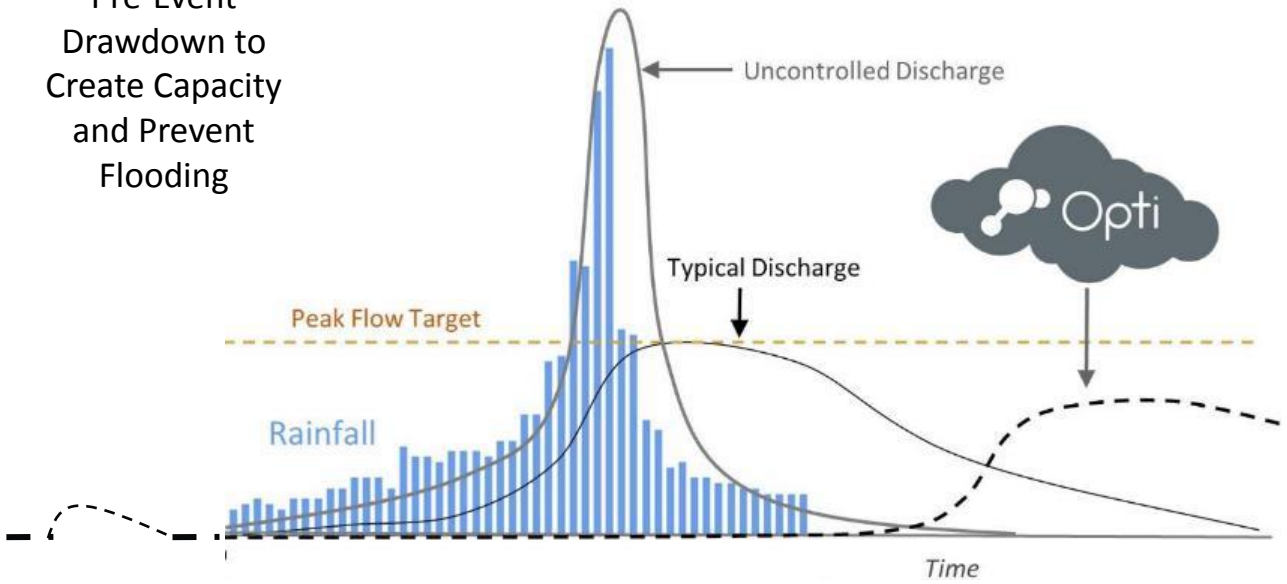
stormwater infrastructure

infiltration

smart sewer

CMAC for CSO and Flood Mitigation

Pre-Event Drawdown to Create Capacity and Prevent Flooding



No Wet Weather Discharge

Gardner Avenue

Pre-retrofit

Post-retrofit

Continuous Monitoring & Adaptive Control

PASEO GATEWAY

smartsewer
INNOVATION & INFRASTRUCTURE TO LAST A LIFETIME

Paseo Gateway

Trolley Trail Storage Basin

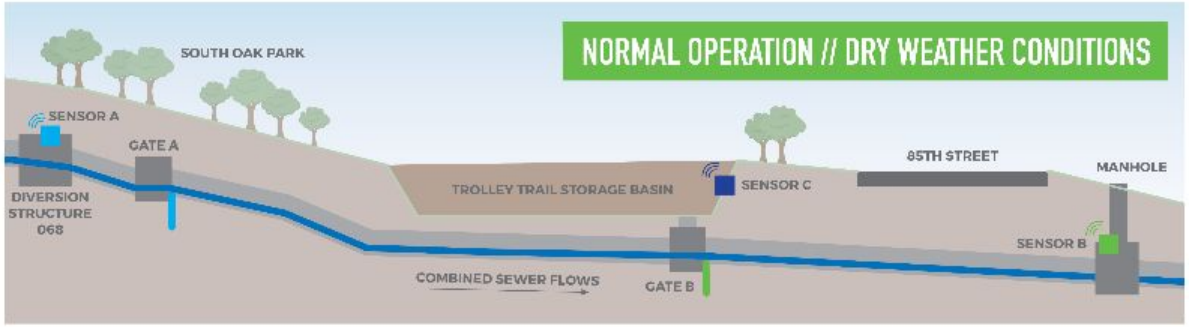
Trolley Trail Storage Bas

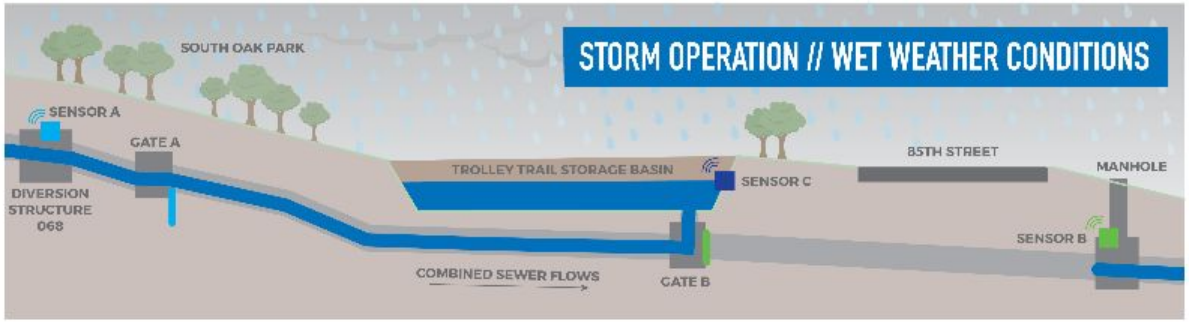
NORMAL OPERATION // DRY WEATHER CONDITIONS

1. Sensor A monitors level in Diversion Structure A and controls the operation of Gate A.
2. Gate A is fully open or can be set at a pre-set percent closure height to help limit upstream flows.
3. Flow is conveyed downstream in the new 36-inch sewer pipe.
4. Sensor B is monitoring level in the downstream Blue River Interceptor and controls the operation of Gate B.

STORM OPERATION // WET WEATHER CONDITIONS

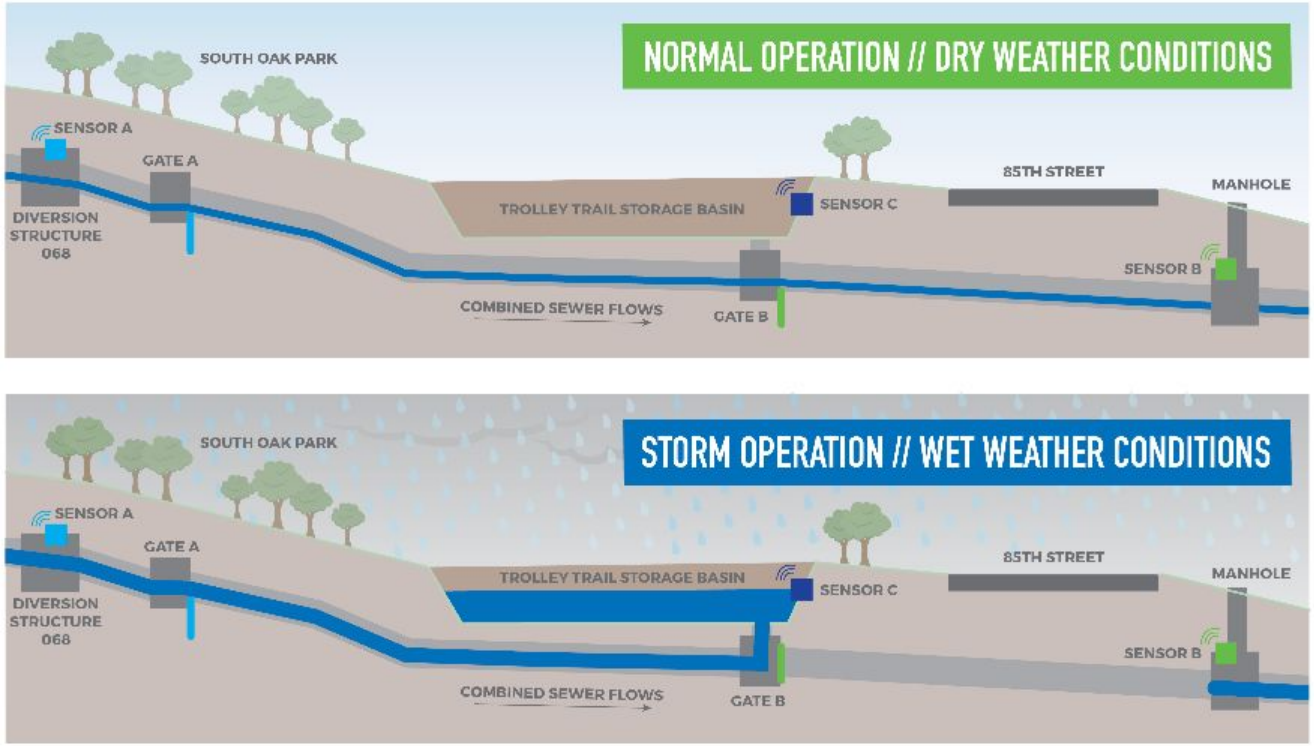
1. As storm events occur, sewer flows increase in the downstream Blue River Interceptor and the level in the manhole rises. Sensor B begins to close Gate B and flow begins to enter into the Storage Basin.
2. Gate B continues to close completely if the level in the manhole increases or stays elevated.
3. When the Storage Basin Sensor C reads a full basin, Gate A will close, and flow will back up the sewer until it eventually discharges from Diversion Structure 068 to the creek.



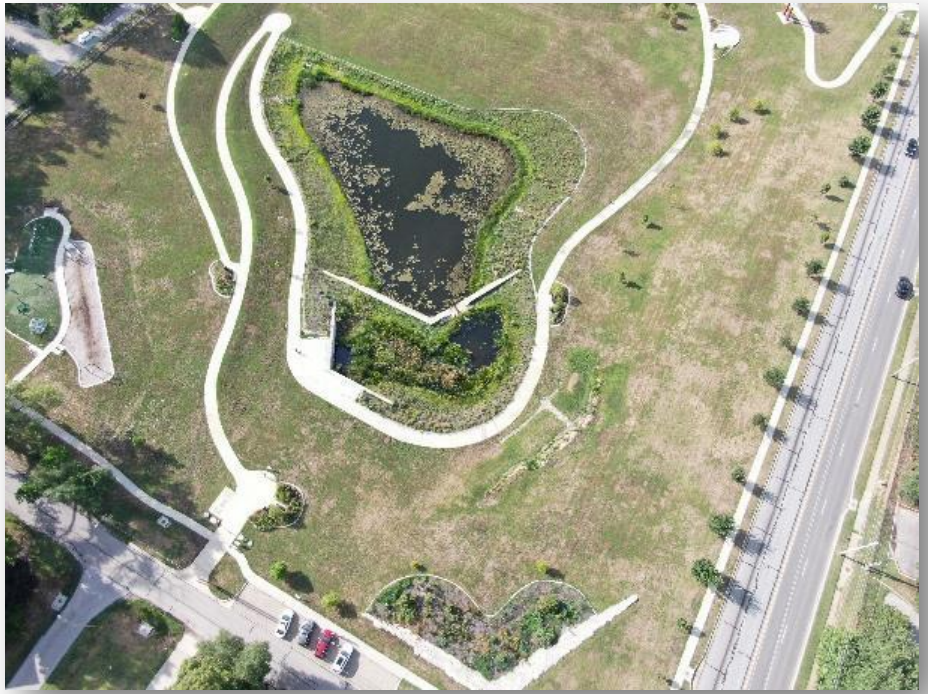


smart sewer

Trolley Trail Storage Basin



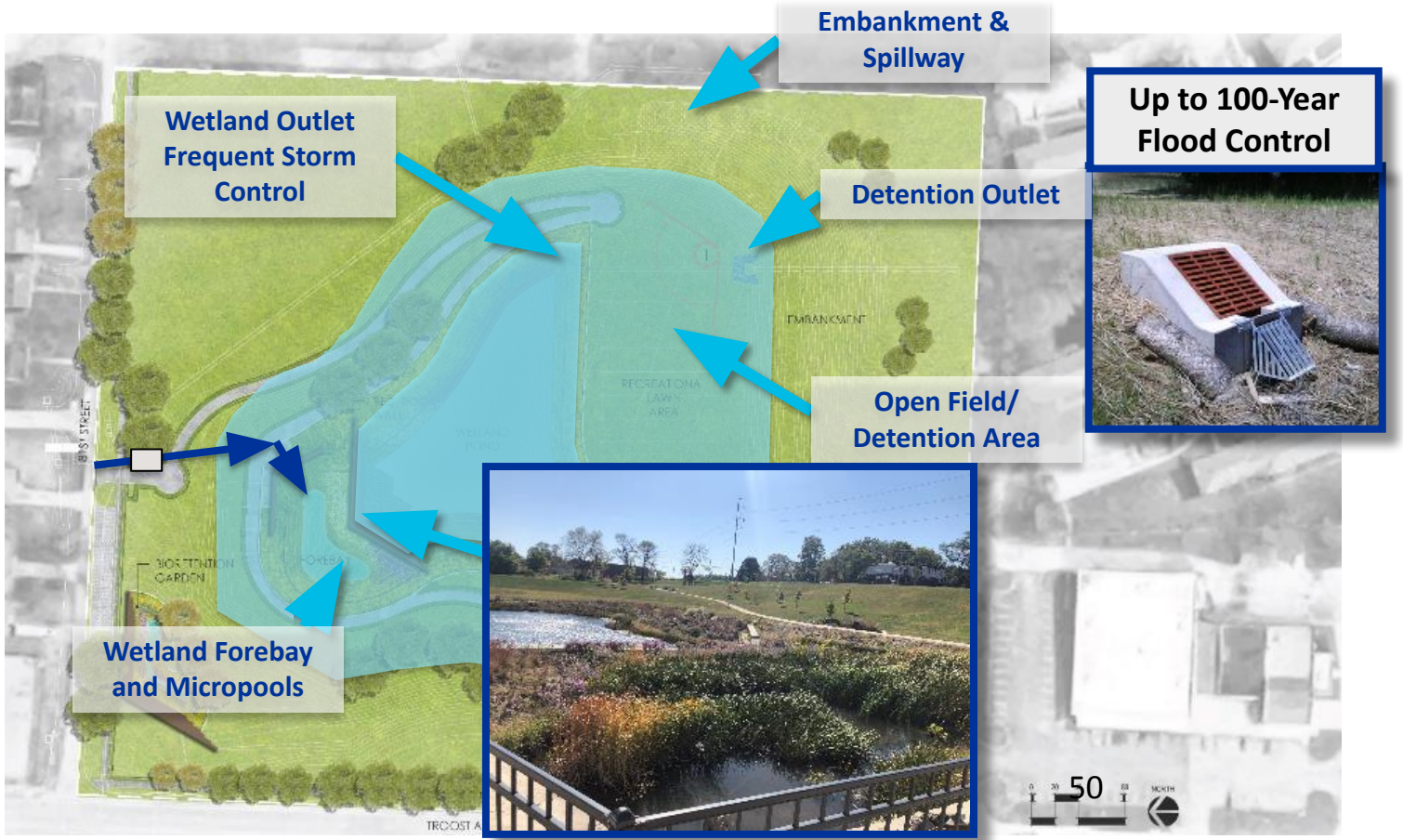
Trolley Trail Storage Basin



81st & Troost Wetland Detention

smartsewer
INNOVATION & INFRASTRUCTURE TO LAST A LIFETIME

81st and Troost



81st and Troost

- Before

- After

Arleta Park

Arleta Park

Rachel Morado

Rachel Morado

Future Green Infrastructure Project @ 63rd and Daniel Morgan Boone Park

Insights from the Field

Tamar Warburg, AIA, LEED BD+C
Director of Sustainability
Sasaki

Chris Hardy, RLA, CA, LEED AP+ND
Senior Associate
Sasaki

Carbon Conscience

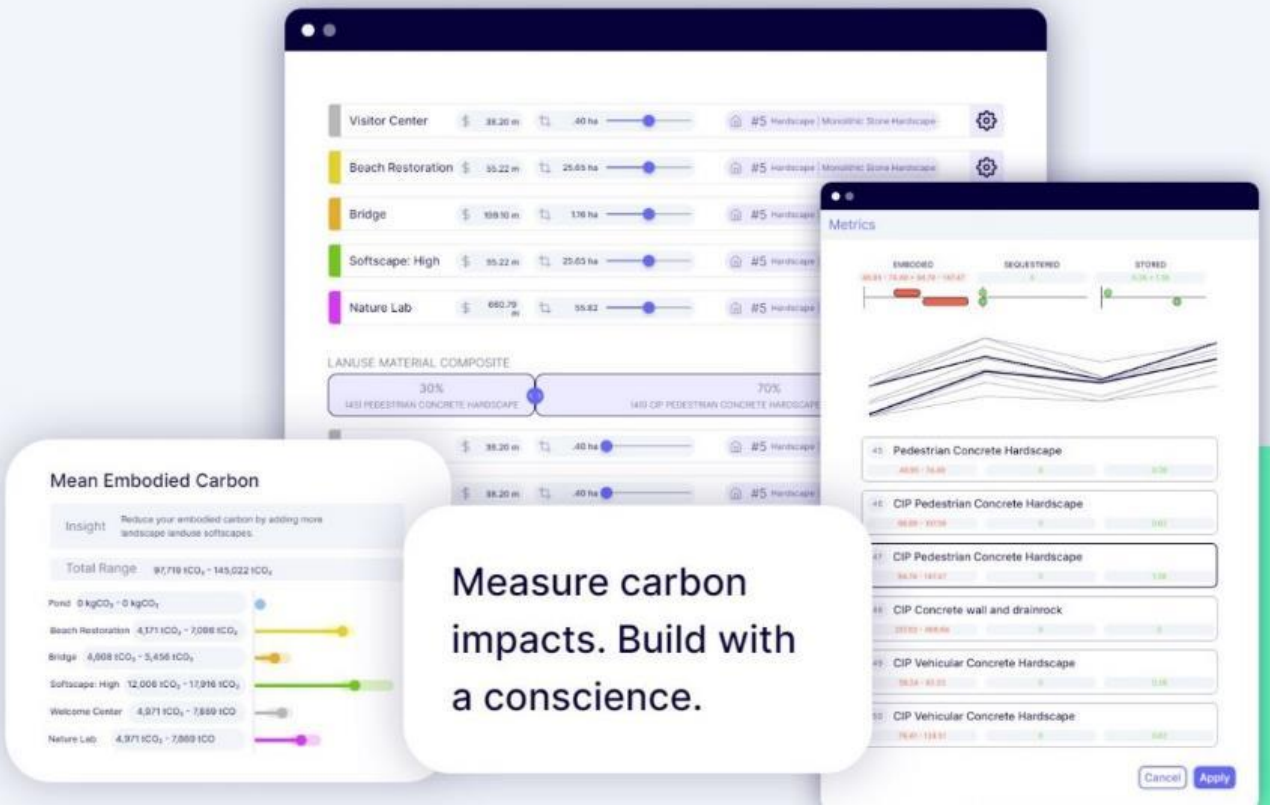
BETA

EMAIL

example@domain.com

Login

Don't Have An Account? Sign Up



SASAKI

How does our work impact climate change?

How can we design with a carbon conscience?

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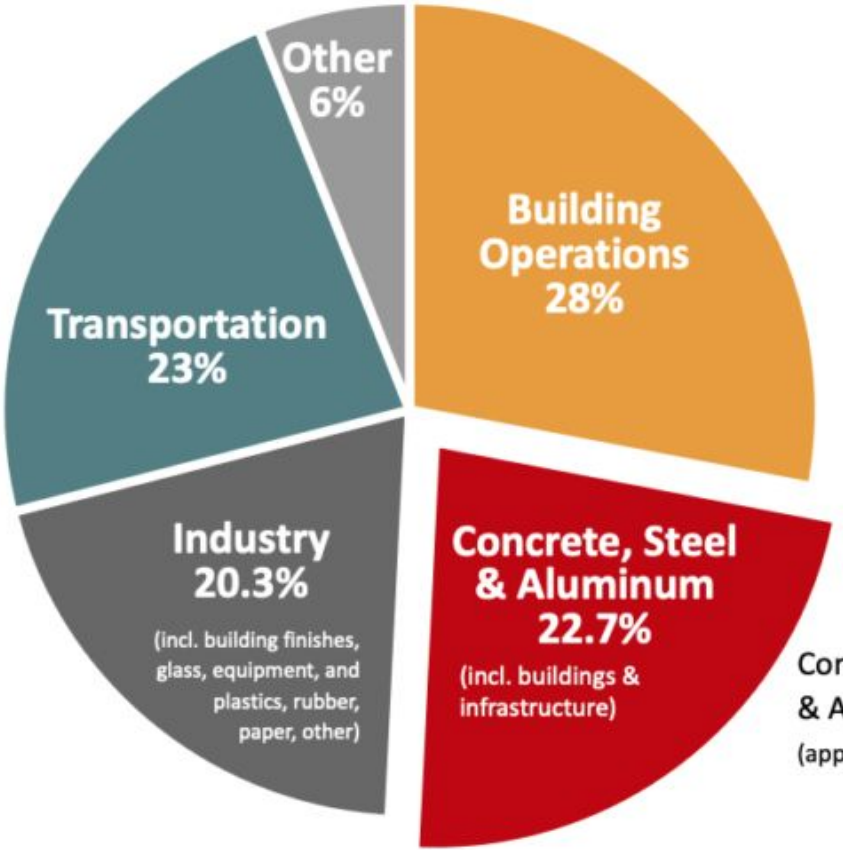
Global Carbon Emissions by Sector



Operational Carbon: Energy

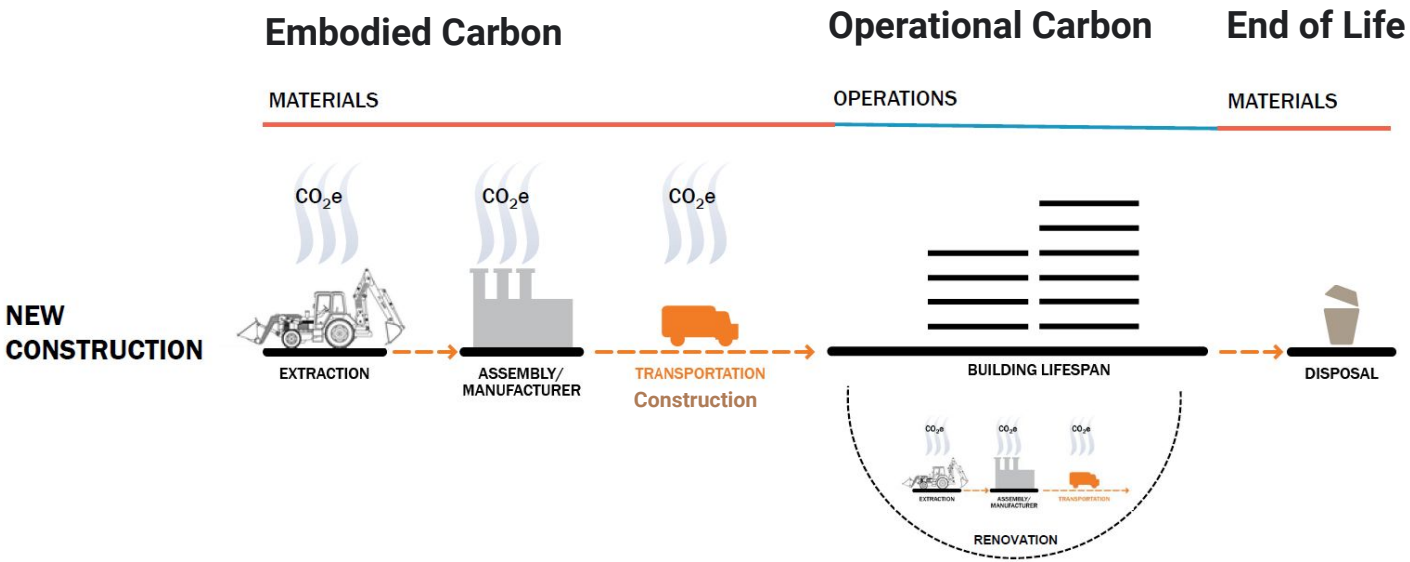
Embodied Carbon: Materials

Concrete 11.1%, Steel 10.1% & Aluminum 1.5%

(approximate, 2017)

Source:
2018 Global ABC Report; IEA

Embodied vs. Operational Carbon



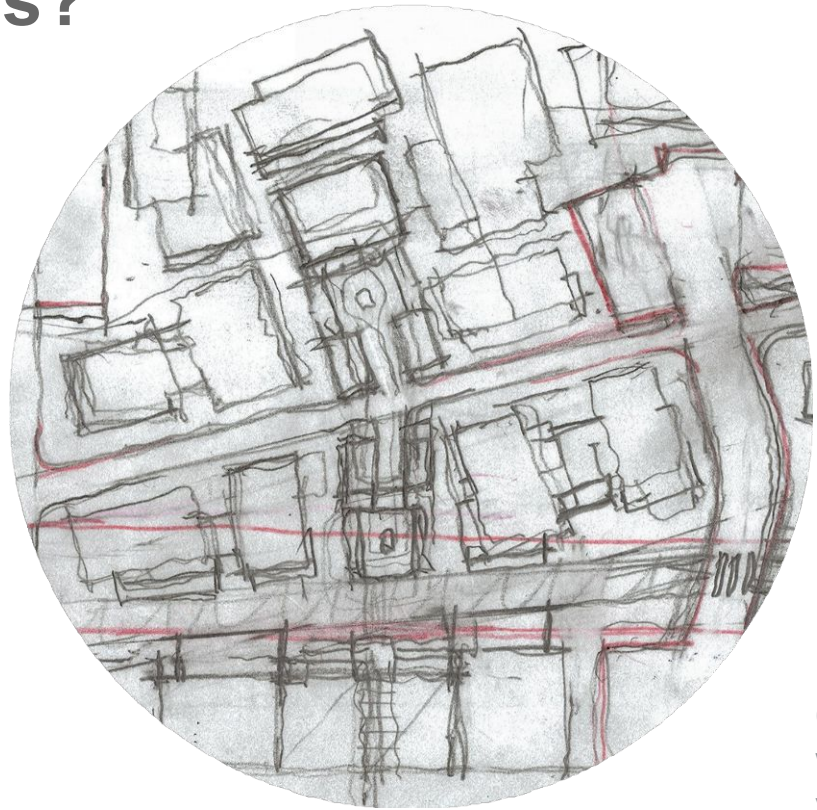
Planning: Architecture, Landscape, Infrastructure

Planning and Concept Design:

“To achieve great things, two things are needed: a plan and not quite enough time”
~Leonard Bernstein

How do we consider carbon from the earliest design phases?

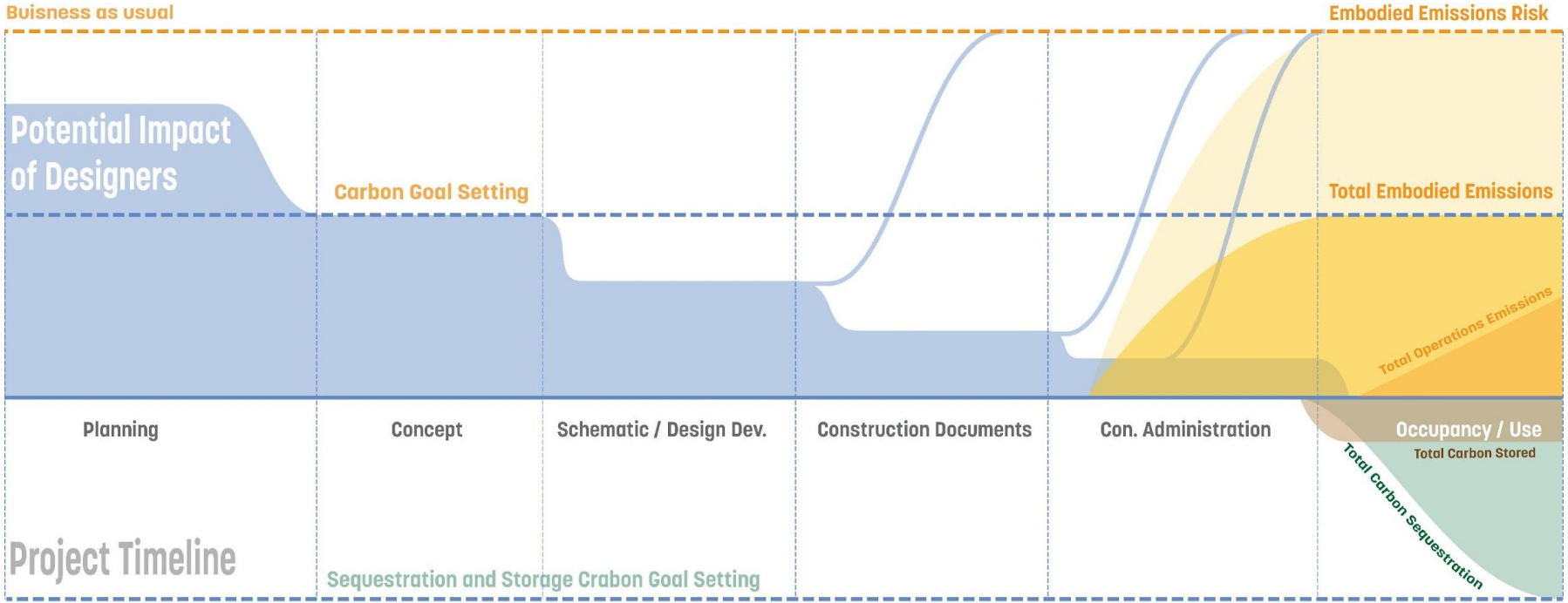
Perhaps before there is even a project?



Our urban design plans will affect the next 50 + years…

SASAKI

Decarbonizing design starts with planning



RE-SEARCH AT SASAKI 2020

Long before the Sasaki Research Grant Program was formalized six years ago, research has been integral to our interdisciplinary practice. Th is com mitme nt to critical inqu iry and push ing the bounds of ou r kno wled ge, ski ll, an d pra ctice, stems from the way Sasaki was first est abli she d. In te gra ted pr actice, research, a nd teaching dedi cation to educ ation and practice. broug ht by Hideo Sasaki's ideas rem ins tod ay. So con tinues to spo nsor research th rou gh annual grant s- provid ing w inni ng tea ms the time and res our ces out si de of proj ect w ork to delve into a wide ar ray of topi cs. In additi on, th e are counti ess passion-driven, grassroots research initiatives proliferating at Sasaki at any given time. These research endeavors strengthen collaboration across disciplines within Sasaki, with the Sasaki Foundation, and with external partners in the design fields, academia, and the broader community to push the envelope on impactful design practice.The results of these formal research projects and informal explorations take many forms. We publish white papers, articles, and blog posts; create digital tools and websites; present at conferences and panels across the globe; and nurture new voices inside and outside the Sasaki community to contribute to this broad endeavor called research. This publication is the second anthology of Research at Sasaki. Similar to our first publication, it exhibits a strong interdisciplinary bent and benefits from our diverse backgrounds and broad expertise under one roof—albeit a metaphorical roof this year, given the pandemic's impacts. In this unique time, we have had to be creative to stay virtually connected. That creative energy is also evident in the topics explored, ranging from embodied carbon in the built environment, to climate change focusing on parks and recreation spaces in understudied inland cities, to artificial intelligence's potential in remote sensing and design. Complementary to these three research grants are ten research explorations that emerged from projects, academic collaborations, or other sources of inspiration, organized under themes of Sustainability & Ecology, Engagement, and Strategies. We continue to identify incomplete knowledge in need of address amidst today's mounting societal and environmental challenges. While we do not expect the results of the research at Sasaki to provide finite answers to these large problems per se, we hope by sharing our findings, to provoke further inquiry and perhaps inspire new collaborative partnerships. We welcome feedback, critiques, inquiries, challenges, and collaborative ideas from our peers and the public, as this work is only as good as the collective challenges it to be! As ever, we believe better design comes from working together, and we invite you into our collective. **SUSTAINABILITY** As countries, communities, and corporations continue to realize the importance of long-term sustainability and ecological investments, how do we translate ambitious overarching sustainability goals into implementation? In 2020, Sasaki developed and demonstrated new systems, metrics, and frameworks to set targets for our projects and track progress across scales and disciplines. As an interdisciplinary practice, we sought to understand the relationships between complementary systems--from building facades to regional landscape strategies--and leverage the potential of integrated design to address a global challenge. **ENGAGEMENT** In a year where social and economic disparities have come into sharp focus amidst a pandemic which requires strict social distancing requirements, how can planners and designers develop new methods to ensure that we are able to engage effectively with communities and stakeholders? We spent 2020 exploring how to bring innovative engagement strategies online, keeping in mind how we can engage traditionally hard-to-reach populations. **STRATEGIES** The separation between our virtual and digital worlds became smaller than ever over the past year. From advances in machine learning to an almost universal familiarity with digital tools for collaboration, the ability to use data and technology to describe, analyze and imagine physical futures has become increasingly accessible. In 2020, we experimented with new tools and questioned existing design practices in an effort to understand how designers and planners can use data and technology to ask smarter questions and reveal deeper insights. This publication is just a snapshot of Sasaki's long-term commitment to knowledge building for the design profession and improving our shared environment. It captures the enthusiasm, innovation, and hard work of many at Sasaki in 2020, a year that presented many challenges, but also

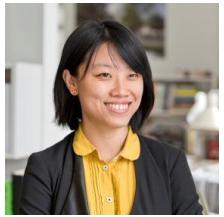
Carbon Conscience Team

Chris Hardy, Team Leader
Landscape Architect

Timothy Gale, Product Mgr.
Strategies UserX Specialist

Tamar Warburg
Director of Sustainability

Alison Nash
Sustainability Coordinator



Shuai Hao
Landscape Architect

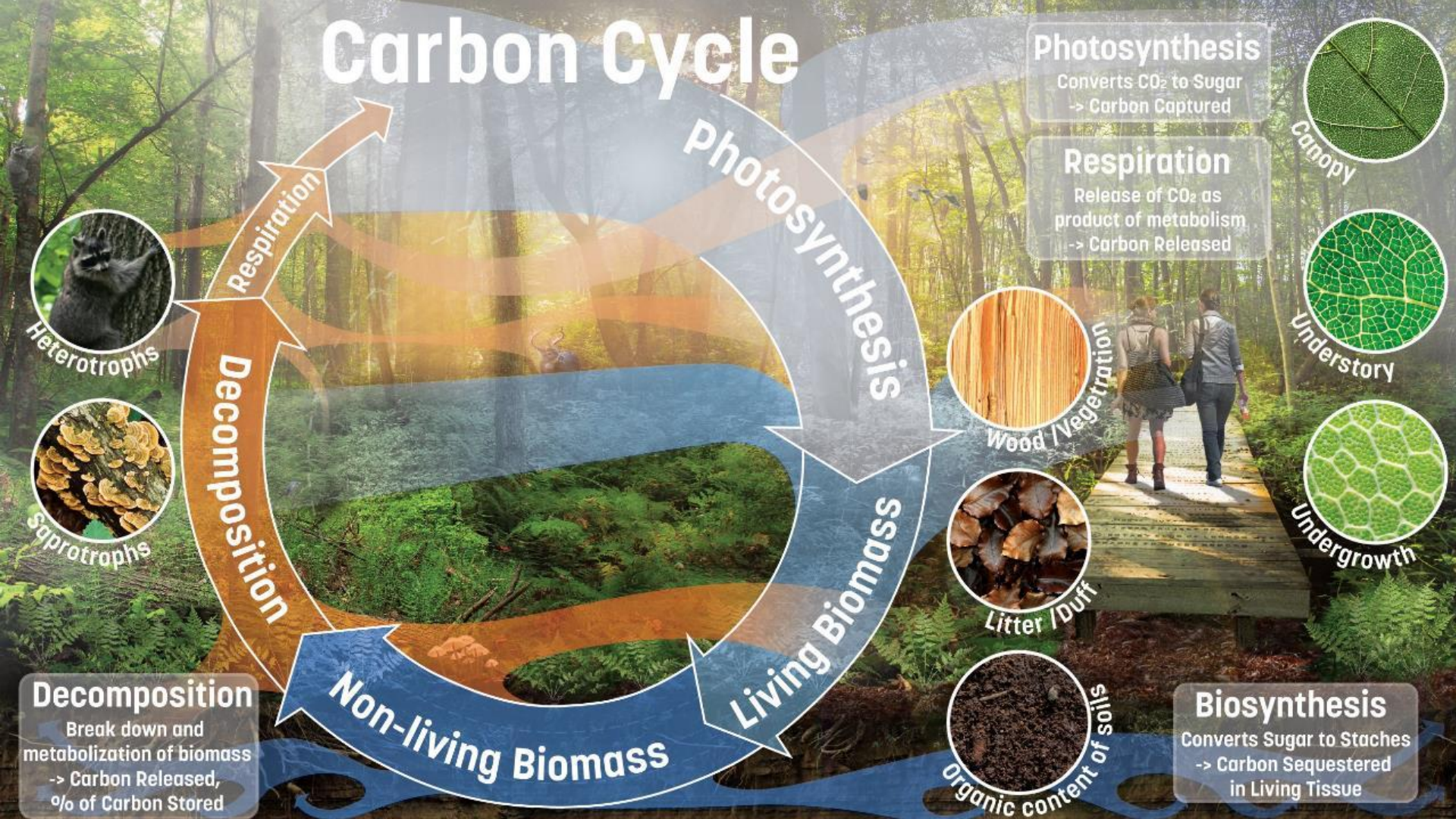
Michael Frechette
Architect

Katya Trosman
Landscape Architect

Danielle DeCarlo
Architectural Designer

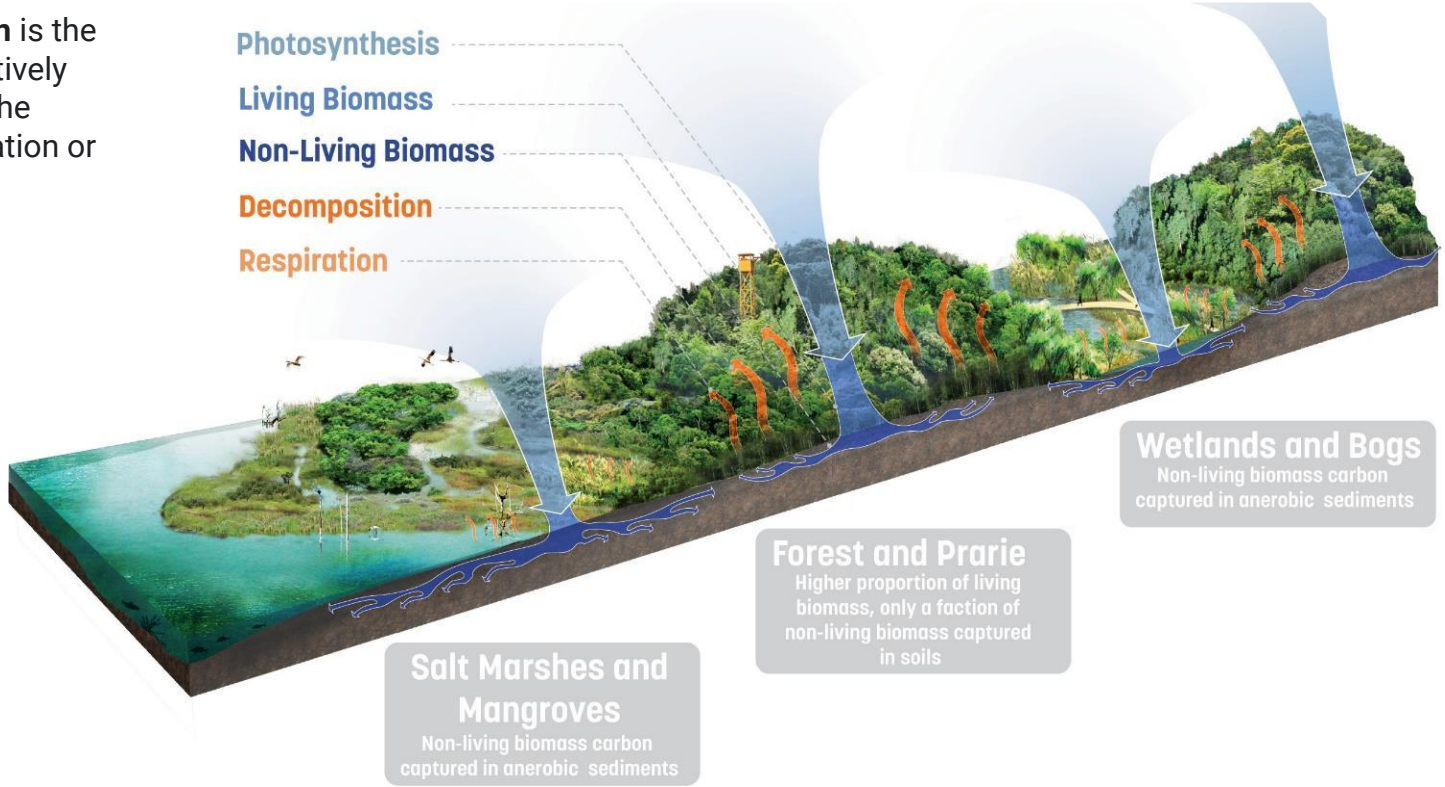
Sponsoring Principals Ken Goulding, Michael Grove
With support from Kelly Farrell, Patrick Murray, Thiyagarajan Adi Raman

Carbon Cycle



Carbon Sequestration

Carbon Sequestration is the amount of carbon actively stored or fixed from the atmosphere in vegetation or soils.



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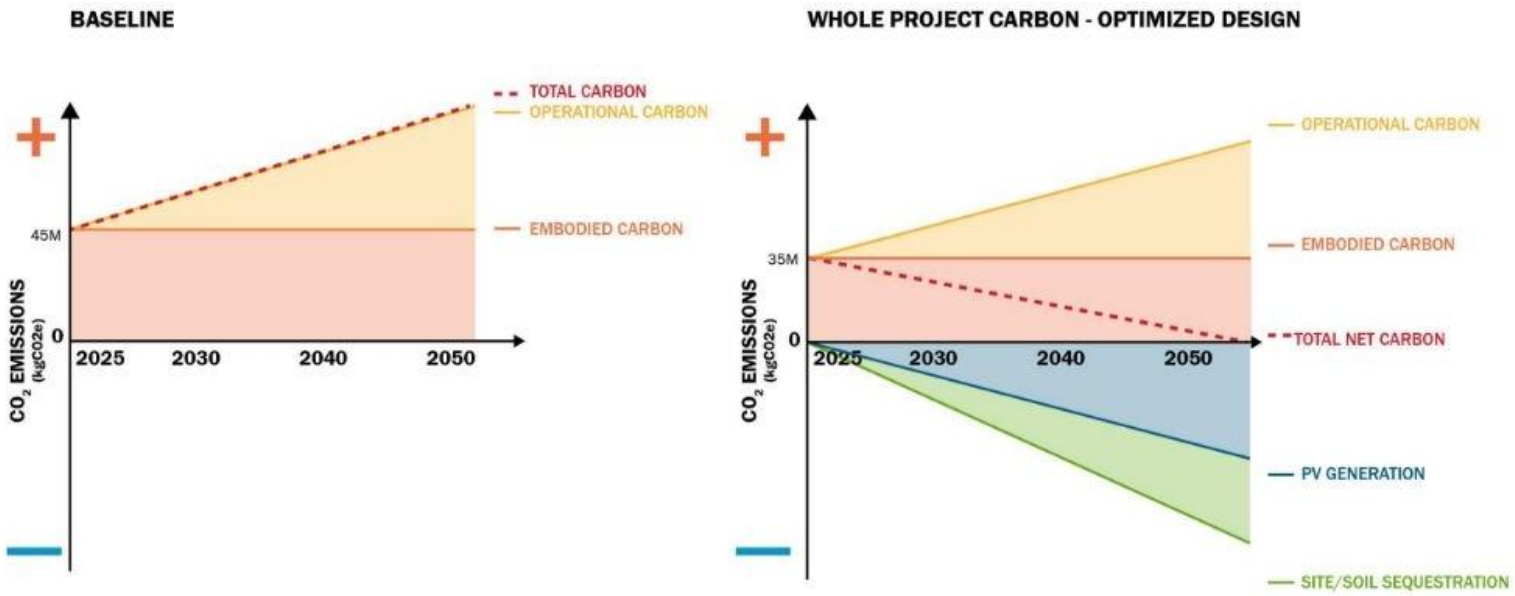
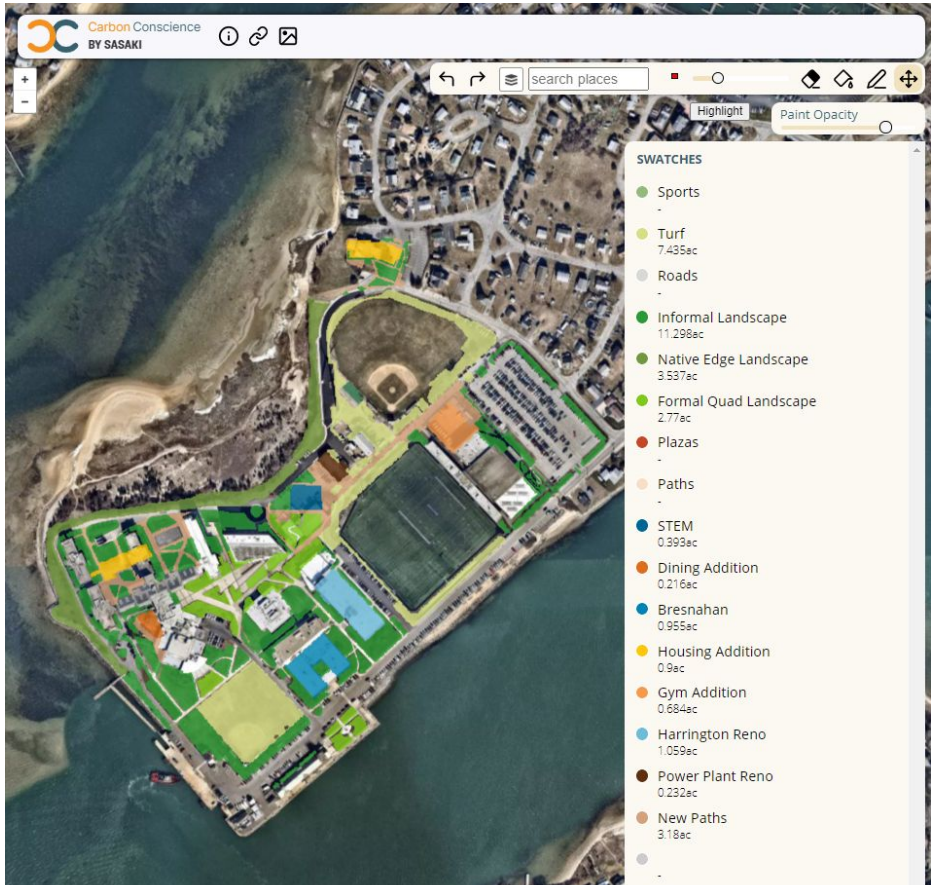
Whole Project Carbon = Operations + Embodied

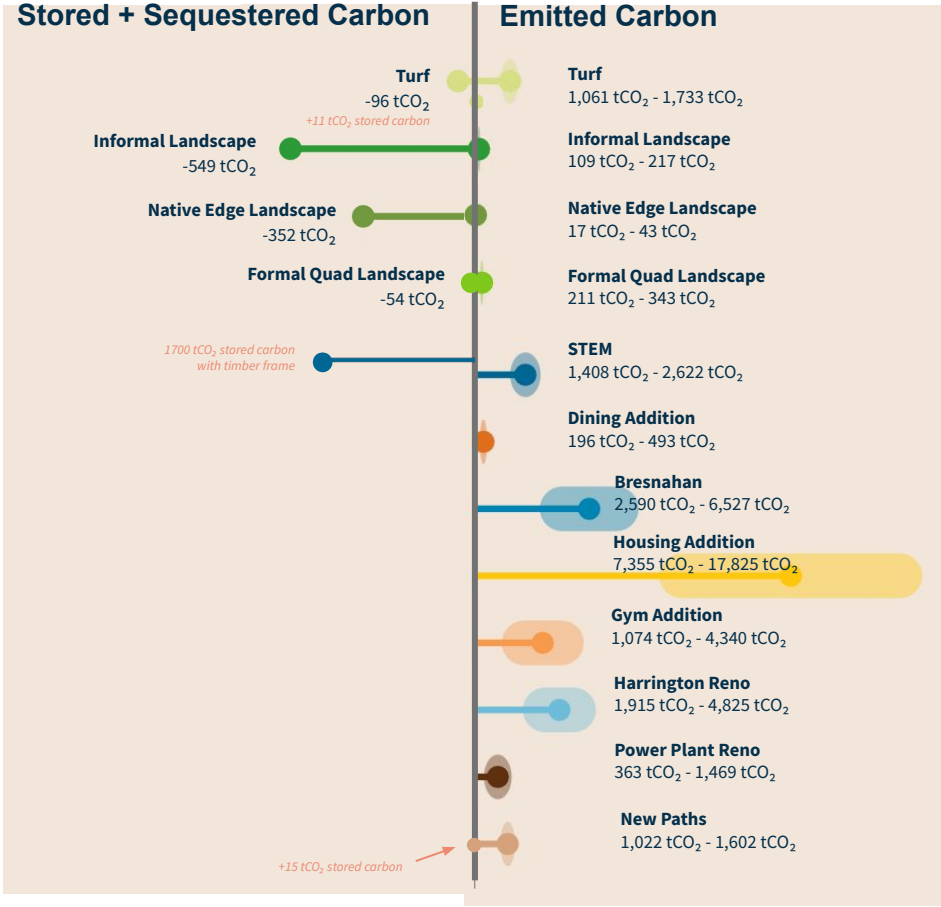


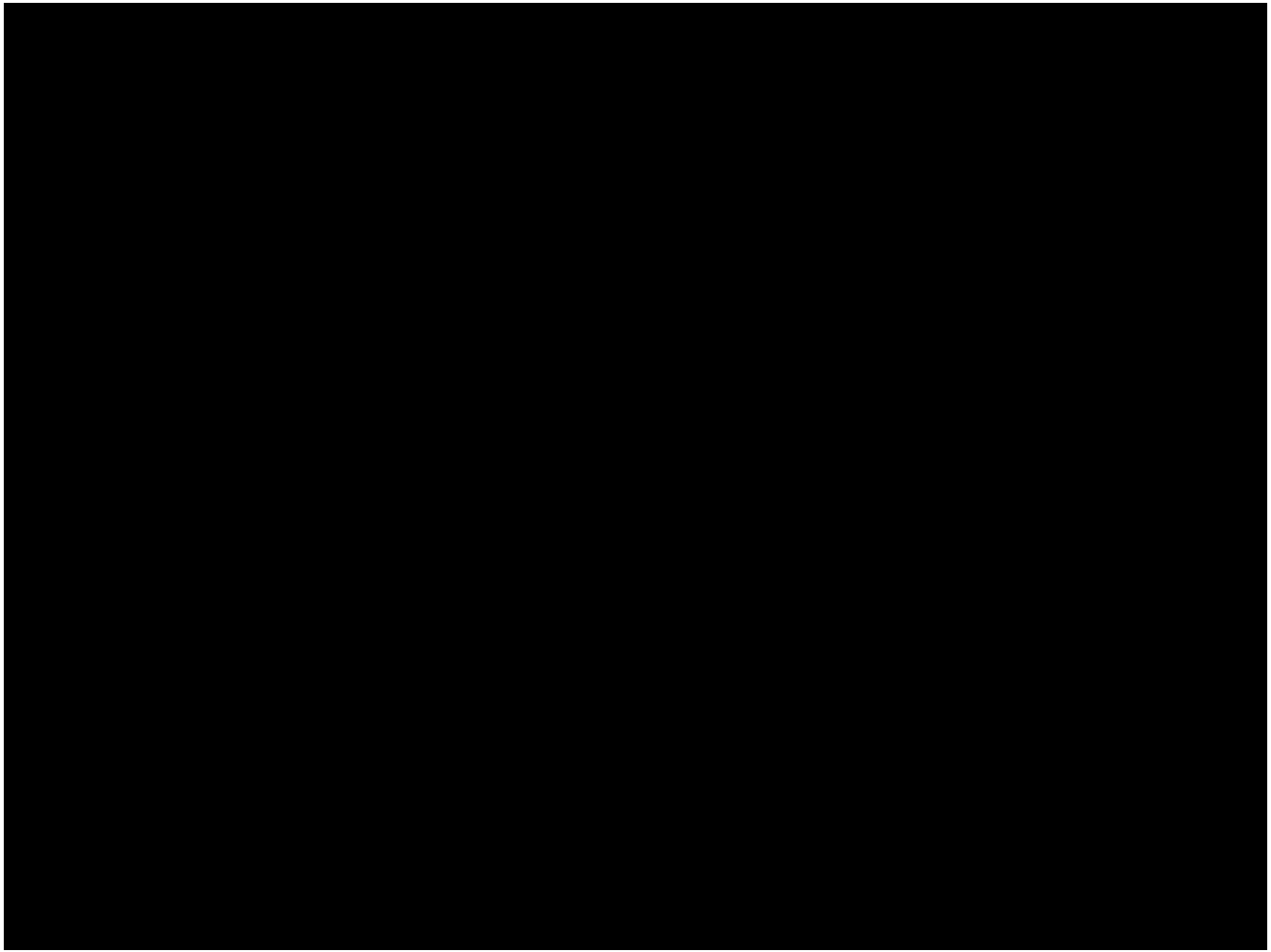
Source: Atelier 10

SASAKI

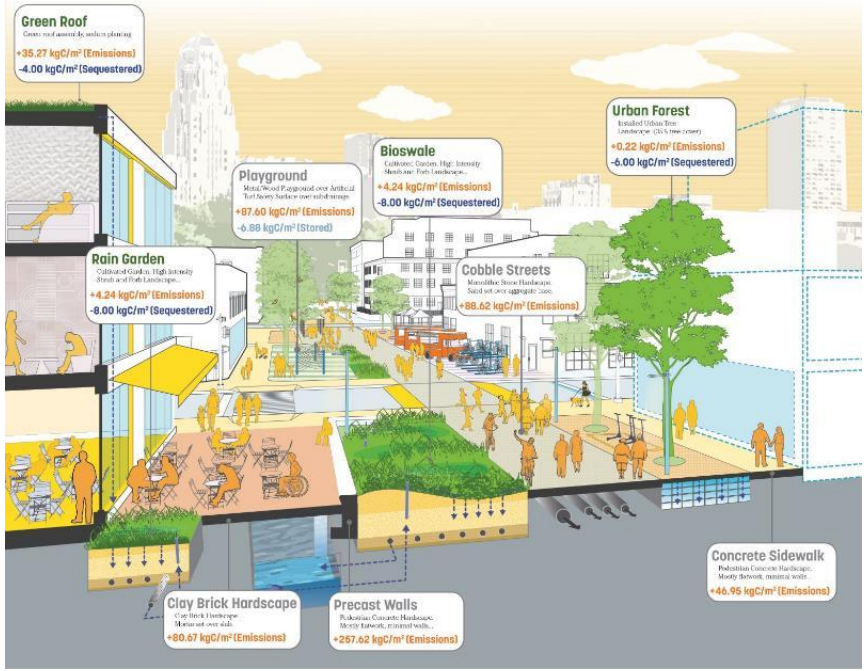
Land Use Decisions Make a Big Difference







Database of Land Use Coverage Assumptions



500+ unique landuses that can be combined in relative ratios to create many options

D	E	F	G	H	I	J	K	L	M
Land Use SubMenu Tier 2: Unique Item	**Assembly (Item Ref. #)**	***Assumptions: Assembly Composition***	**Assembly Percentage**	**Unit**	**Embodied Carbon Cost (Low) (kg CO2 eq./m^2)**	**Embodied Carbon Cost (High) (kg CO2 eq./m^2)**	**Net Carbon Sequestered (60 years) (kg CO2 eq./m^2)**	**Carbon Store (kg CO2 eq./m^2)**	*Net Sequestered - Embodied (for planting)*
Generic		Assume untouched			0.00	0.00	0	0	
Pedestrian Concrete Hardscape. Mostly flatwork, minimal walls (1% or less), minimal drain structures and furnishings.		*Assume 1% of area stainless steel drain structure with HDPE drain body. Assume 0.025% of area concrete catch basin. Assume 1% area painted steel 25 mm thick, and wood 50mm thick, to provide average for landscape furnishing. Assume 1 SM of geotextile.*		M^2	70.26	118.48	0.00	1.01	
	033001.01	100 mm deep CIP Concrete	0.98	M^2	33.49	59.67	0	0	
	321100.01	150mm deep crushed aggregate base	0.98	M^2	12.76	21.77	0	0	
	033001.21	Reinforcing for concrete pavement (no. 4 rebar 300mm o.c.	0.98	M^2	8.82	13.53	0	0	
	033001.04	1M high CIP retaining wall with 1M deep spread footer	0.01	M^2	6.83	12.18	0	0	
	033001.22	1M high CIP retaining wall / footing Steel rebar (no. 4 rebar	0.01	M^2	0.27	0.41	0	0	
	334000.01	stainless steel drain structure	0.01	M^2	1.75	2.84	0	0	
	334000.02	HDPE drain body	0.01	M^2	2.52	2.52	0	0	
	334000.03	concrete catch basin	0.00025	M^2	0.01	0.01	0	0	
	323300.01	steel 25 mm thick	0.01	M^2	2.94	4.51	0	0	
	323300.02	hardwood 50mm thick (Domestic Source)	0.01	M^2	0.48	0.57	0	1.0065	
	321100.06	1 SM of geotextile	1	M^2	0.26	0.33	0	0	
	099001.01	Paint or Stain (3 coats) 1 SM (for painted steel or stains or	0.01	M^2	0.11	0.13	0	0	
CIP Pedestrian Concrete Hardscape. Mostly flatwork, some walls (5%), limited drain structures and lightly furnished.		Assume 93% 100 mm reinforced CIP concrete over 150mm aggregate, assume 5% of area = 1M high CIP reinforced retaining wall with 1M deep spread footer.) Assume 2% of area stainless steel drain structure with HDPE drain body. Assume 0.025% of area concrete catch basin. Assume 3% area painted steel 25 mm thick, and wood 50mm thick, to provide average for landscape furnishing. Assume 1 SM of geotextile.		M^2	106.99	179.55	0.00	3.02	
	033001.01	100 mm deep CIP Concrete	0.93	M^2	31.78	56.63	0	0	
	321100.01	150mm deep crushed aggregate base	0.93	M^2	12.11	20.66	0	0	
	033001.21	Reinforcing for concrete pavement (no. 4 rebar 300mm o.c.	0.93	M^2	8.37	12.84	0	0	
	033001.04	1M high CIP retaining wall with 1M deep spread footer	0.05	M^2	34.17	60.89	0	0	
	033001.22	1M high CIP retaining wall / footing Steel rebar (no. 4 rebar	0.05	M^2	1.35	2.07	0	0	
	334000.01	stainless steel drain structure	0.02	M^2	3.51	5.68	0	0	
	334000.02	HDPE drain body	0.02	M^2	5.05	5.05	0	0	
	334000.03	concrete catch basin	0.00025	M^2	0.01	0.01	0	0	
	323300.01	steel 25 mm thick	0.03	M^2	8.83	13.54	0	0	
	323300.02	hardwood 50mm thick (Domestic Source)	0.03	M^2	1.45	1.72	0	3.0195	
	321100.06	1 SM of geotextile	1	M^2	0.26	0.33	0	0	

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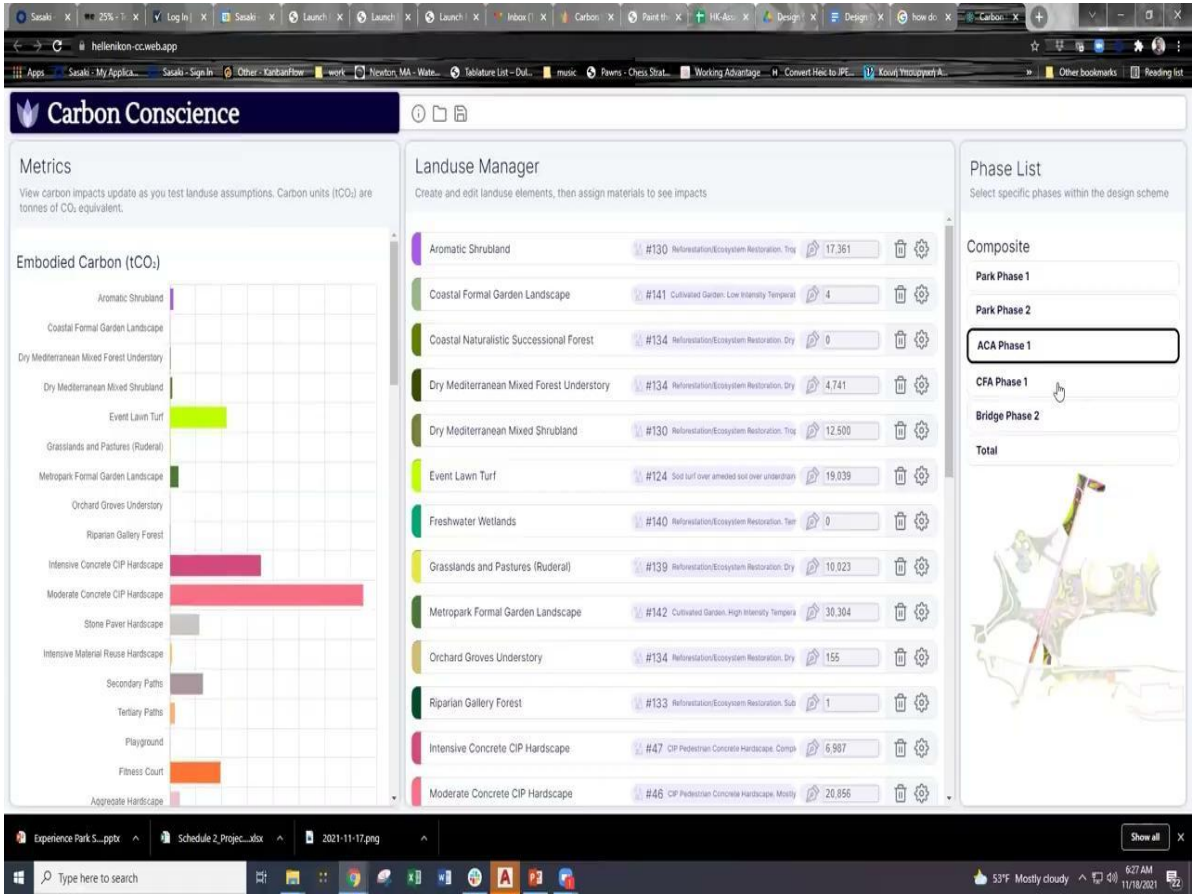
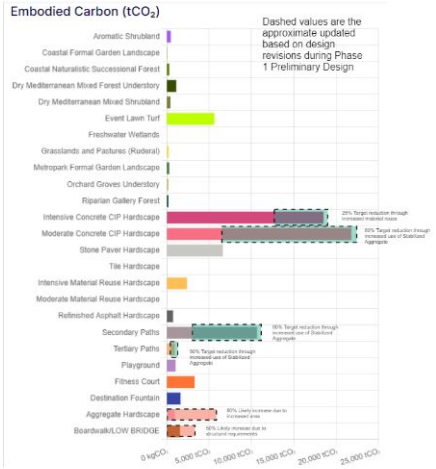
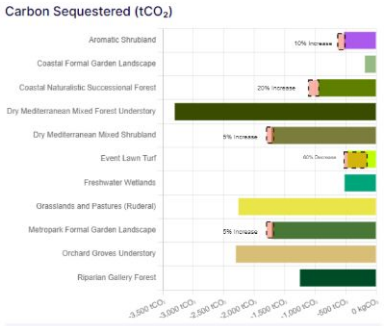
Hellinikon Park, Athens

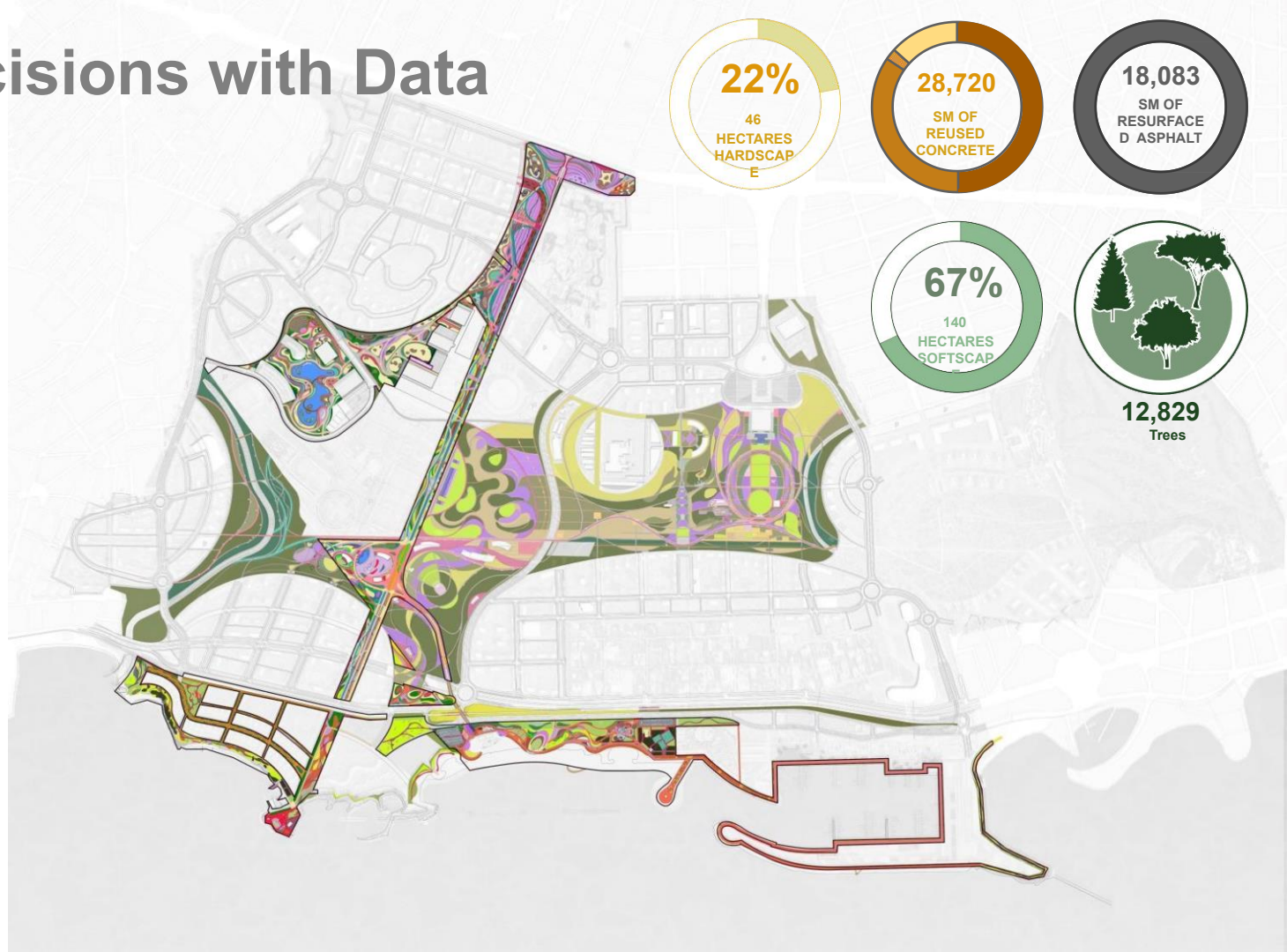
Sketch, Test and Iterate



Inform Decisions with Data



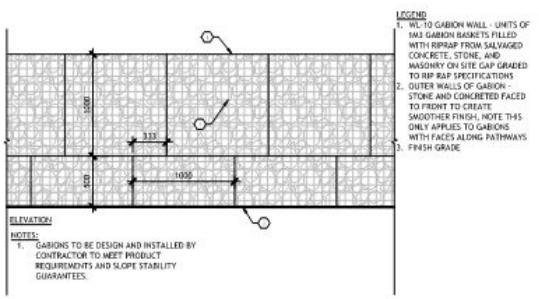




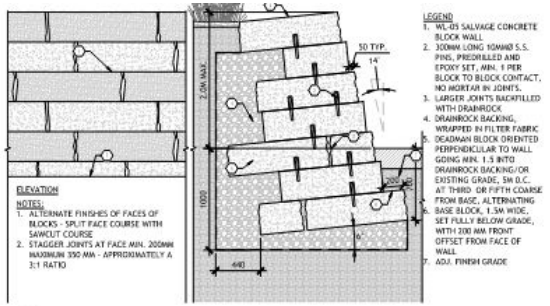
12,829
Trees


Goal setting builds capital for commitment

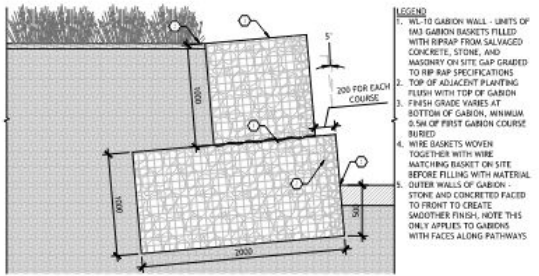
To inform material and detail decisions



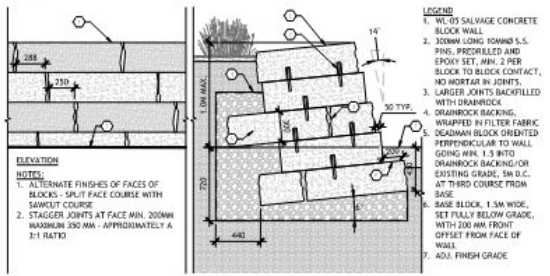
9 WL-10 WALL - GABION TYP. ELEVATION
1:20



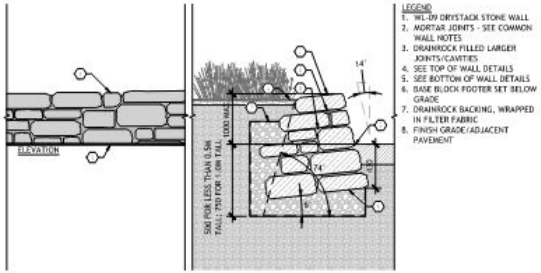
6 WL-05 WALL - SALVAGE CONCRETE RETAINING WALL (1.0M-2.0M TALL) TYP.
1:20



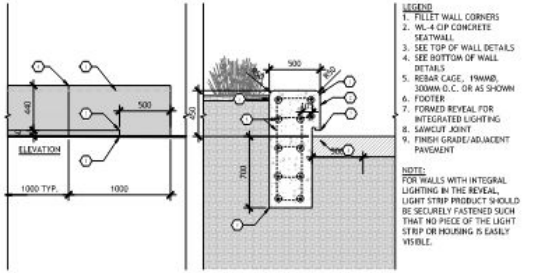
8 WL-10 WALL - GABION TYP. SECTION
1:20



5 WL-05 WALL - SALVAGE CONCRETE RETAINING WALL (0.5M-1.0M TALL) TYP.
1:20



7 WL-09 WALL - DRYSTACK STONE RETAINING WALL (0.5M-1.0M TALL) TYP.
1:20



4 WL-04 WALL - CIP CONCRETE SEATWALL TYP.
1:20

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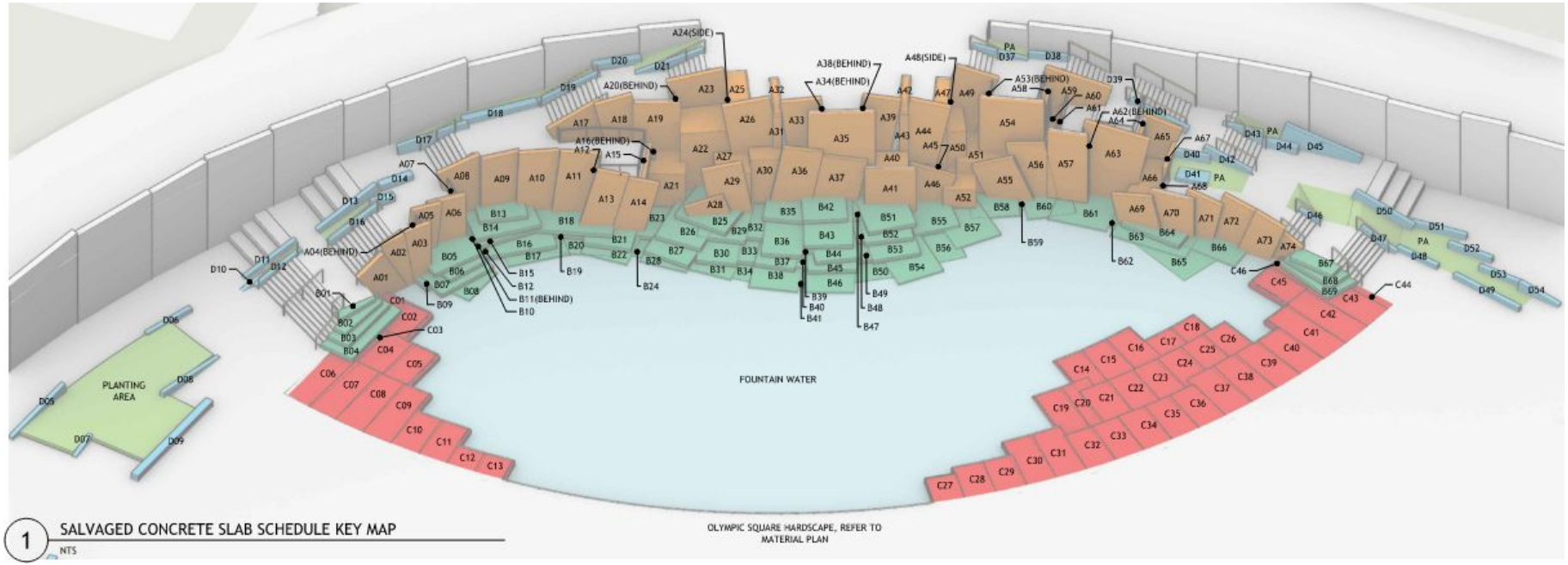
And design for carbon impact



SASAKI

We are responsible for what we design.
Every design has a carbon impact.
Consider carbon from the onset of the design process.
Set—and track—an embodied carbon budget.
Reuse existing buildings and landscapes.

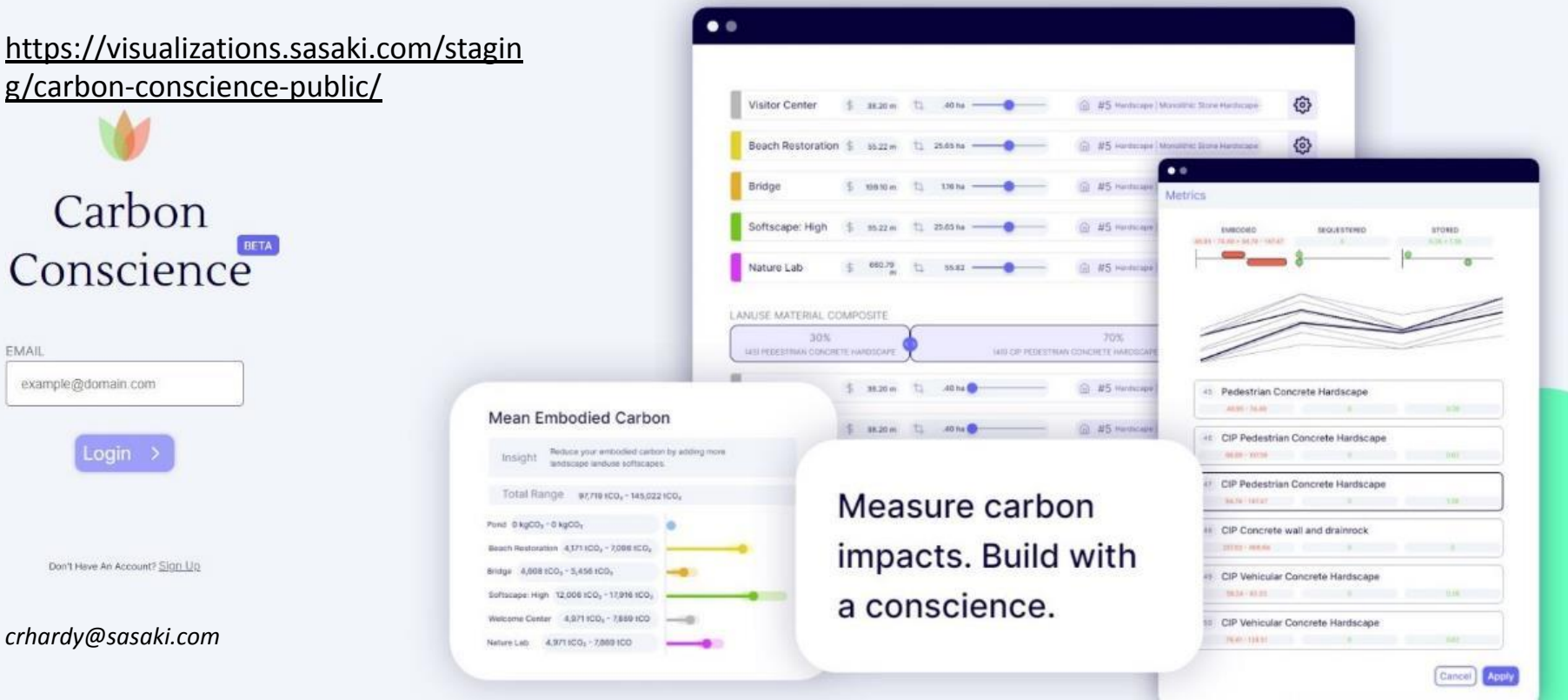
Less is more.
Green is more.

SASAKI

Try It!

https://carbon-conscience.web.app/

https://visualizations.sasaki.com/staging/carbon-conscience-public/

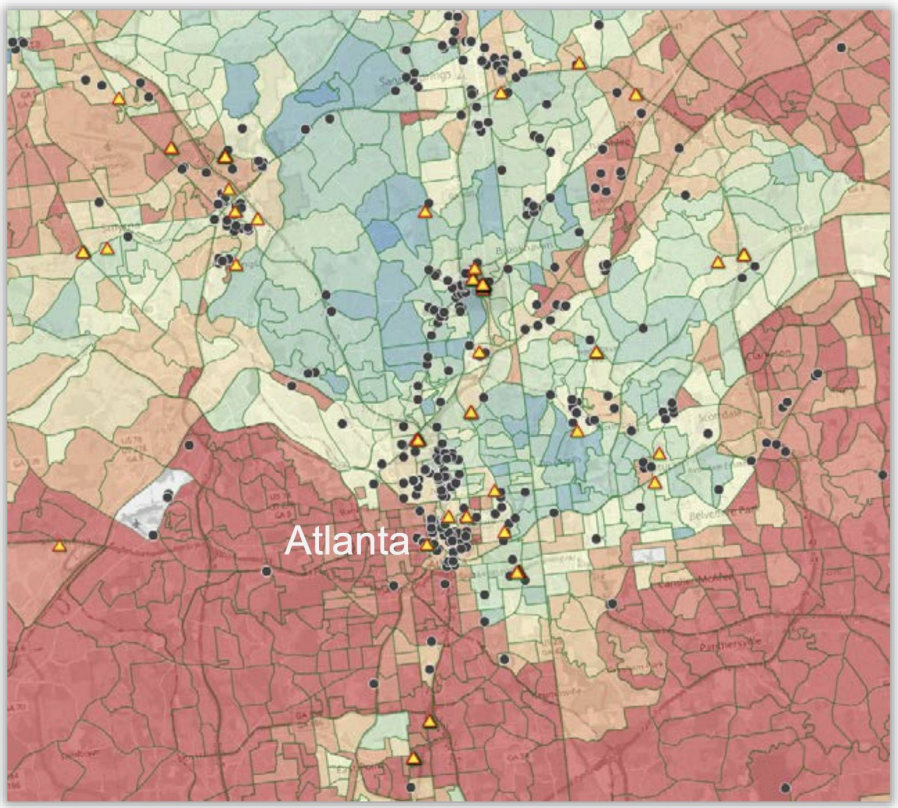


crhardy@sasaki.com

Coming Up

Fair Paths to EV Charging

Tuesday, January 11, 2pm



National Renewable Energy Laboratory, EVI-Equity

Poll