Making the Case for Sustainable Infrastructure

VOLKERT

Green Infrastructure

Barry Fagan, PE/PLS, ENV SP,
CPMSM, CPESC, CESSWI


Oregon
6800

SKYBAMA

This is how coronavirus could reshape our cities forever

Cities could undergo a vast transformation after t

Let's Amp Up Investment

ASCE

TO MEET OUR FUTURE ELECTRICITY INFRASTRUCTURE NEEDS

BY 2029, THE ELECTRICITY INFRASTRUCTURE INVESTMENT GAP IS ESTIMATED TO BE

$208 billion

WITH IMPACTS COSTING CUSTOMERS:

Residential	Commercial	Industrial
$20B	$487B	$448B

New investments can protect:

- **287,000 jobs** in 2029, especially in the areas of manufacturing, finance, and real estate.
- **$185 billion** in personal income
- GDP **$394 billion** in GDP
- **$51 billion** in US exports

Learn more at *www.asce.org/failuretoact*

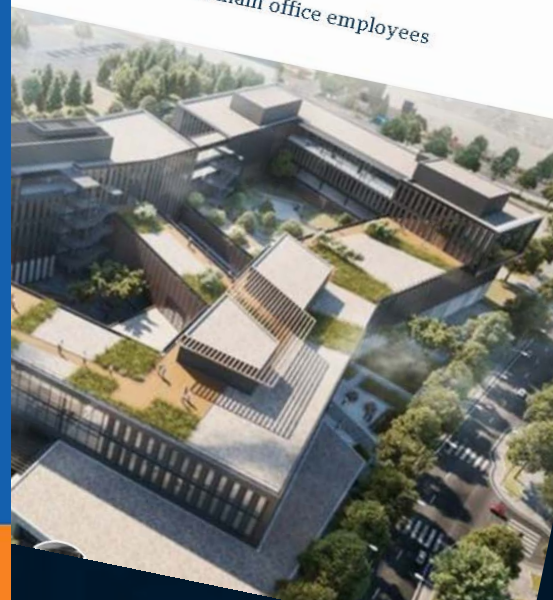
News & Analysis

How will covid-19 change infrastructure investment?

We approached 10 leading industry figures to find out what is in store for the asset class as countries around the world tentatively ease the lockdowns that have been in place in recent months

Selling Its Brand-New

g a remote future for main office employees



in·fra·struc·ture - the basic physical and organizational structures and facilities needed for the operation of a society or enterprise

Sustainable Infrastructure -

“*Sustainable development* is…

…development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

-Brundtland Commission Report 1987

“If we put off doing right things…”

“ASCE and its members are dedicated to ensuring a sustainable future in which human society has the capacity and opportunity to maintain and improve its quality of life indefinitely, without degrading the quantity, quality or the availability of natural, economic and social resources.”

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

“If we put off doing right things…”

ASCE Five-year Roadmap to Sustainable Development

Priority 1 – Do the Right Project

Priority 2 – Do the Project Right

Priority 3 – Expand Technical Capacity

Priority 4 – Communicate and Advocate

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

prioritizing right things…

DO THE RIGHT PROJECT

- What are the needs of society today?
- What will the needs of society be in the near future?
- Is this project shovel-worthy, or merely shovel-ready?

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do the right project -
CHANGE IS HARD.

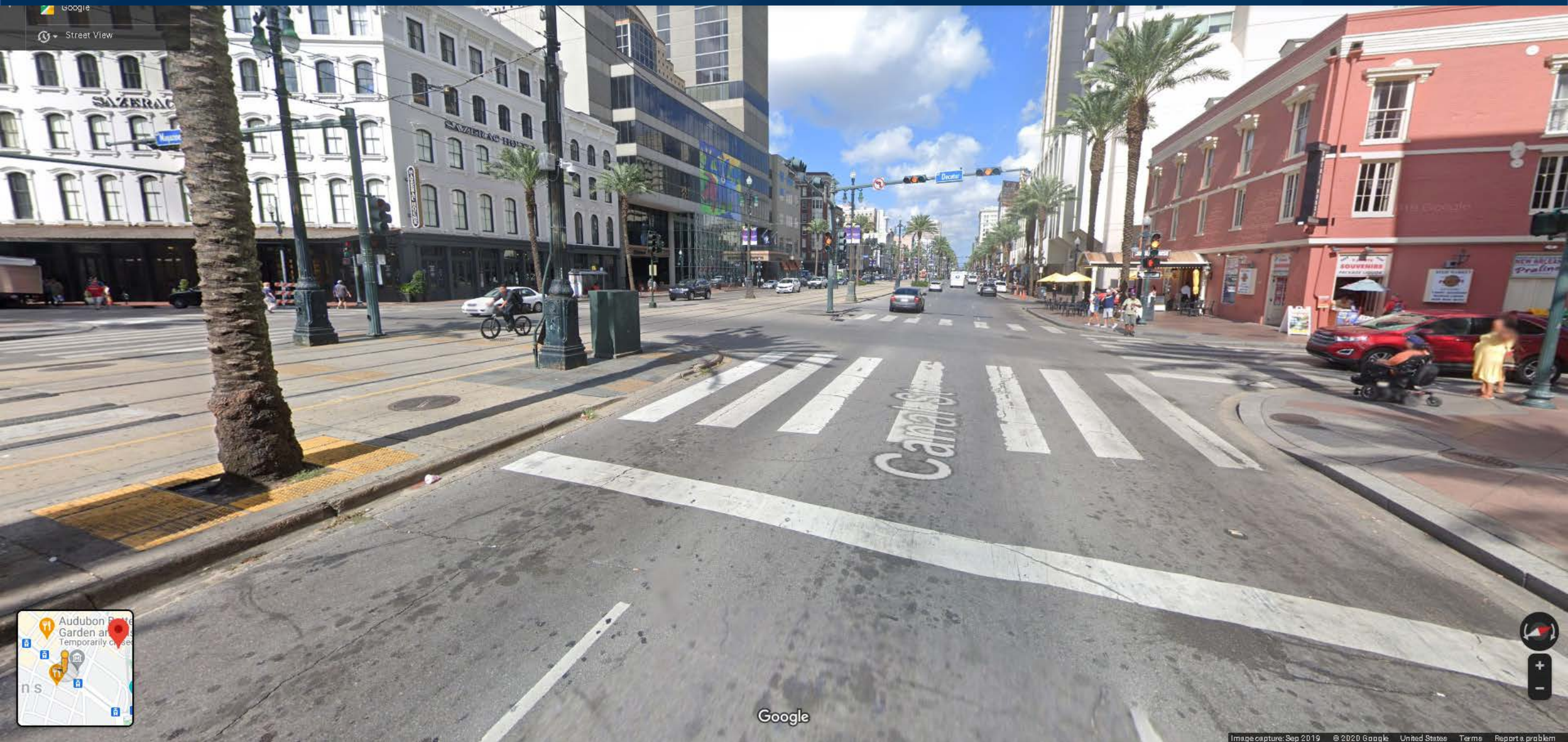
do the right project -

CHANGE **HAPPENS.**

- The definition of infrastructure hasn’t changed in thousands of years.

- The face of infrastructure changes with every generation.

do the right project



do the right project

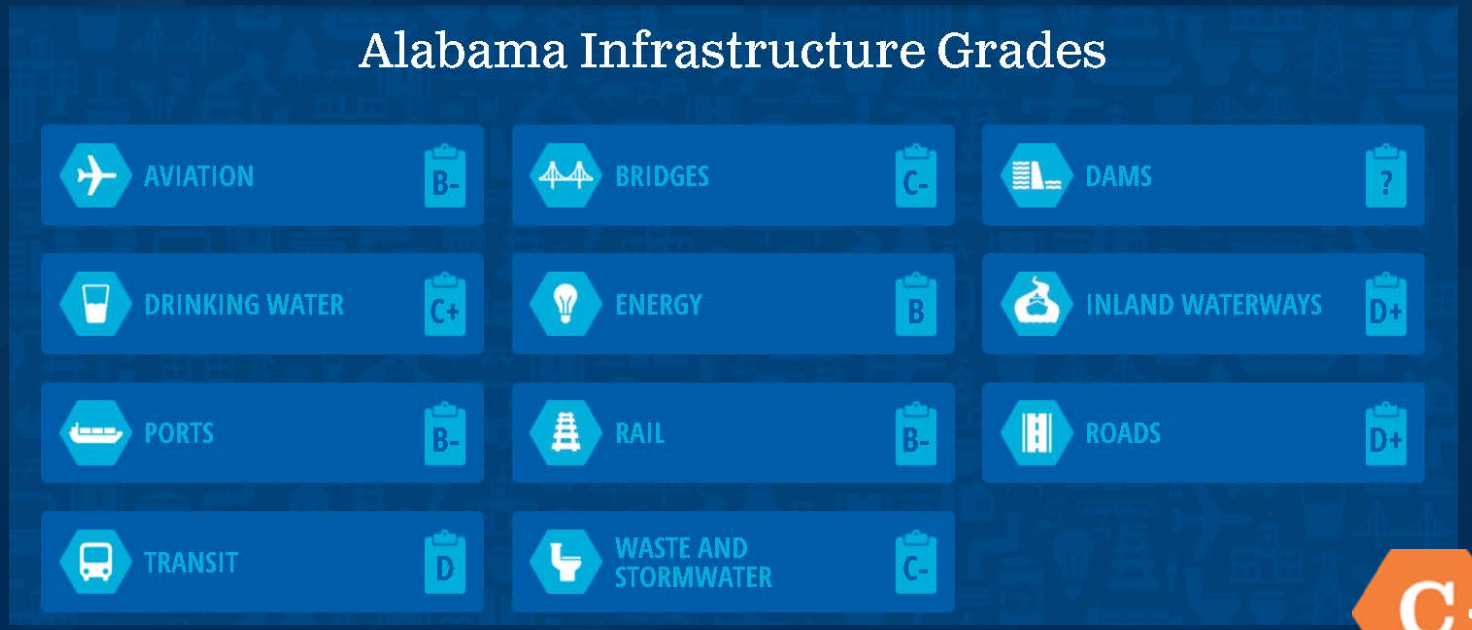
Fast and Slow Drivers of Change

- Fast - Positive and Negative Disruption
  - actions of humans
  - events of nature
- Slow - a Continuous Drift
  - desire for improved livability
  - health, safety, security

VOLKERT

do the right project

D+



C-

Infrastructure - the basic physical and organizational structures and facilities needed for the operation of a society

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do the right project

in·fra·struc·ture - the basic physical and organizational structures and facilities needed for the operation of a society or enterprise

Ecosystem Services -

The benefits people obtain from ecosystems.

- Provisioning services
- Regulating services
- Cultural services
- Supporting services

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Site-specific Targeted Monitoring Summary Results

Alabama (2006)

Description of this table

	Size of Water			
	Rivers and Streams (Miles)	Lakes, Reservoirs, and Ponds (Acres)	Bays and Estuaries (Square Miles)	Ocean and Near Coastal (Square Miles)
Good Waters	6,983.6	91,229.2	78.7	
Previously impaired waters now attaining all uses	1,514.8	6,428.5	2.6	
Threatened Waters				
TMDL completed				
TMDL alternative				
Non-pollutant impairment				
TMDL needed				
Impaired Waters	2,547.3	81,837.8	426.8	201.0
TMDL completed				
TMDL alternative				
Non-pollutant impairment				
TMDL needed	2,547.3	81,837.8	426.8	201.0
New TMDLs completed	164.0	.0	4.2	.0
Remaining TMDLs needed	2,383.3	81,837.8	422.6	201.0
Total Assessed Waters	9,530.9	173,067.0	505.5	201.0
Total Waters	77,242.0	490,472.0	610.0	Unavailable
Percent of Waters Assessed	12.3	35.3	82.9	Unavailable

Site-specific Targeted Monitoring Summary Results

Alabama (2016)

Description of this table

	Size of Water			
	Rivers and Streams (Miles)	Lakes, Reservoirs, and Ponds (Acres)	Bays and Estuaries (Square Miles)	Ocean and Near Coastal (Square Miles)
Good Waters	10,751.8	202,089.0	147.3	
Previously impaired waters now attaining all uses	1,514.8	6,428.5	2.6	
Threatened Waters				
TMDL completed				
TMDL alternative				
Non-pollutant impairment				
TMDL needed				
Impaired Waters	3,324.9	229,630.2	429.5	201.0
TMDL completed	1,147.3	38,526.7	5.6	
TMDL alternative	61.9			
Non-pollutant impairment	22.8			
TMDL needed	2,093.0	191,103.6	423.9	201.0
New TMDLs completed	44.1	.0	.0	.0
Remaining TMDLs needed	2,048.9	191,103.6	423.9	201.0
Total Assessed Waters	14,076.8	431,719.3	576.7	201.0
Total Waters	77,242.0	490,472.0	610.0	Unavailable
Percent of Waters Assessed	18.2	88.0	94.5	Unavailable

Impaired in 2006:
27% of assessed rivers
47% of assessed lakes

prioritizing right things…

Impaired in 2016:
23% of assessed rivers
53% of assessed lakes

Do the Project Right

Environmental, economic, social and technological development must be seen as interdependent and complementary concepts, where economic competitiveness and ecological sustainability are complementary aspects of the common goal of improving the quality of life.

– ASCE Policy Statement 418

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Livable, Sustainable, Resilient

livability – being fit to live in, enjoyable

sustainability – the ability to be maintained or balanced

resilience - the ability to withstand or recover quickly from difficult conditions

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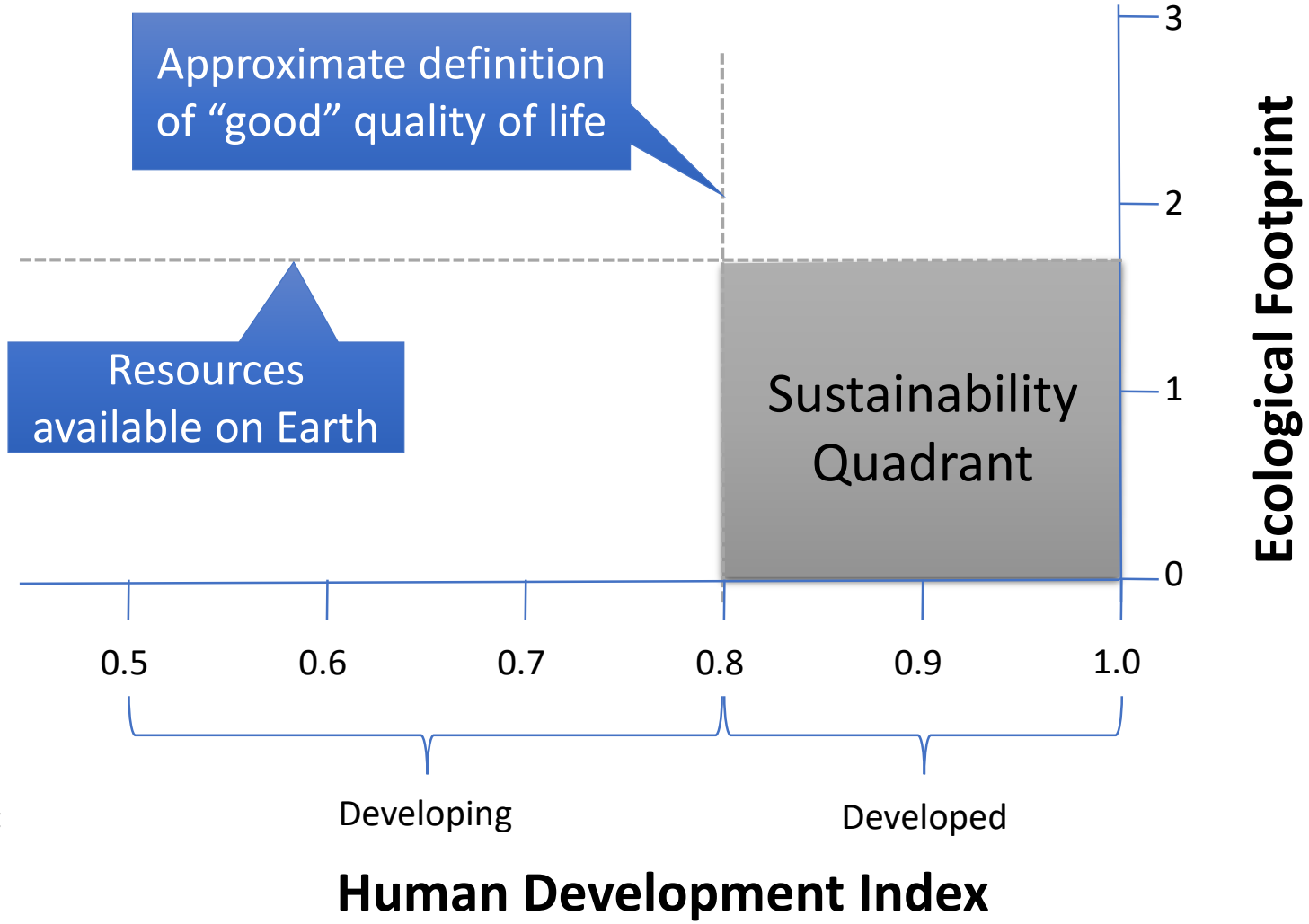
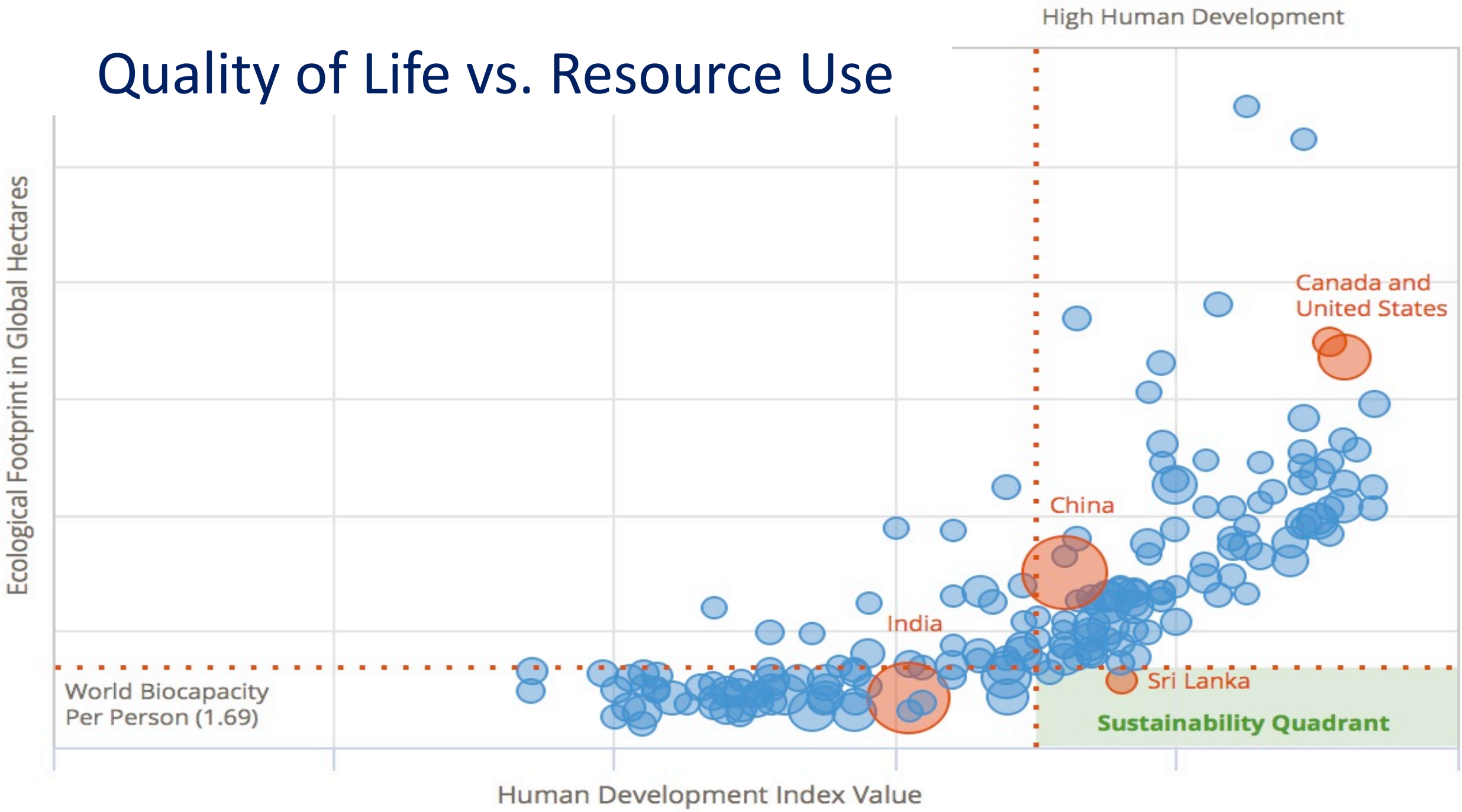
Quality of Life vs. Resource Use



Source: Living Planet Report (2006), World Wildlife Fund

Quality of Life vs. Resource Use



Envision is a Joint Collaboration

ENVISION

Institute for Sustainable Infrastructure

ZOFNASS PROGRAM FOR SUSTAINABLE INFRASTRUCTURE
Graduate School of Design
Harvard University

ISI Founding Organizations

AMERICAN PUBLIC WORKS ASSOCIATION
APWA
Your Comprehensive Public Works Resource

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

ACEC
American Council of Engineering Companies
100 Years of Excellence

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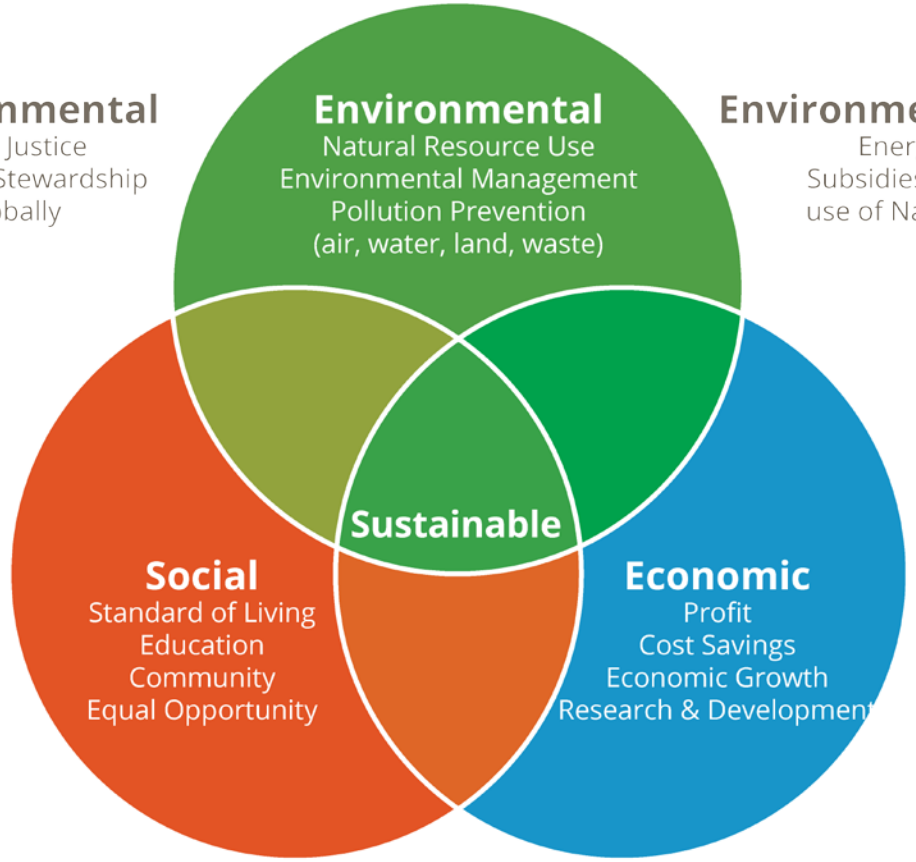
Envision's Focus - Sustainable Development

Social-Environmental
Environmental Justice
Natural Resources Stewardship
Locally & Globally



Environmental-Economic
Energy Efficiency
Subsidies / Incentives for
use of Natural Resources

Economic-Social
Business Ethics
Fair Trade
Worker's Rights

Triple Bottom Line

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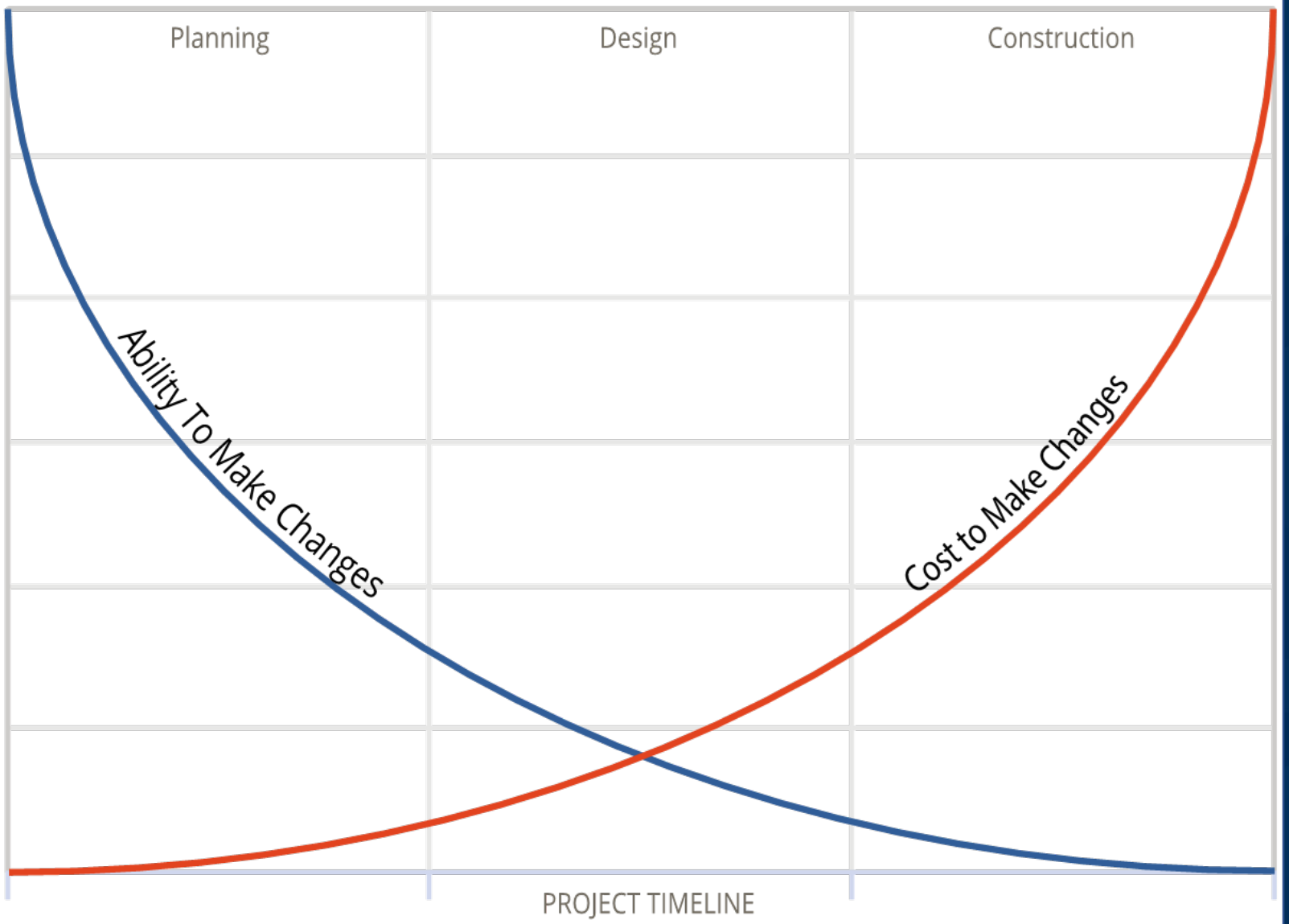
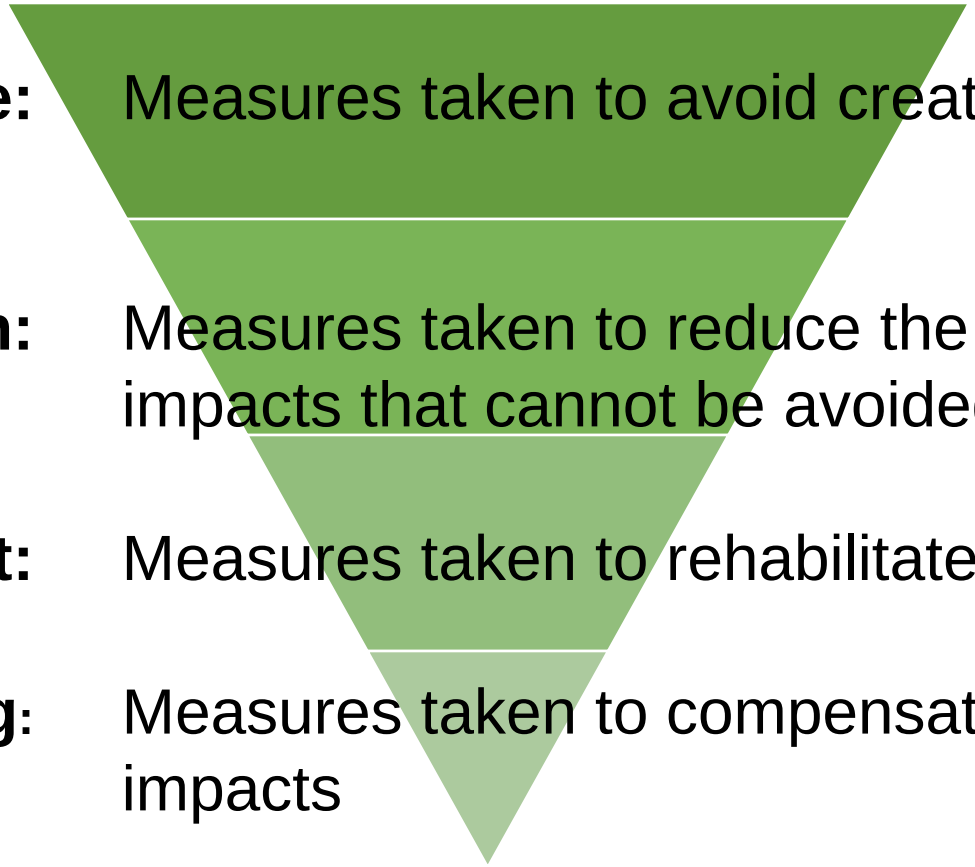
Do the project right - make the most of opportunities



ENVISION™

Do the project right – mitigation hierarchy



Avoidance: Measures taken to avoid creating impacts from the outset

Minimization: Measures taken to reduce the duration, intensity or extent of impacts that cannot be avoided

Abatement: Measures taken to rehabilitate degraded ecosystems

Offsetting: Measures taken to compensate for any residual adverse impacts

Envision Credits - 64 in 5 Categories

ENVISION

Quality of Life
14 Credits

Wellbeing, Mobility, Community

Leadership
12 Credits

Collaboration, Planning, Economy

Resource Allocation
14 Credits

Materials, Energy, Water

Natural World
14 Credits

Siting, Conservation, Ecology

Climate & Resilience
10 Credits

Emissions, Resilience

The right project done right: **Oregon Avenue Reconstruction**

Sustainable features that contributed to this project earning Envision Silver include:

- Improving Safety and Access to Alternative Modes of Transportation
- Preserving Views and Local Character
- Providing Ample Opportunities for Stakeholder Involvement

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NEW PLANTING MATERIAL FOR OREGON AVENUE

Oregon Avenue is a collector road in the middle of an urban environment. Its proximity to Rock Creek Park provides a park like environment, which has attracted residents and visitors to the community.

The new plant material along Oregon Avenue will relate to Rock Creek Park, the dominant landscape feature along the entire corridor. Within Rock Creek Park, the dominant tree species varies by elevation and the surrounding terrain. In Rock Creek's more mature upland areas or slopes, the dominant tree species are oaks and hickories. In lowland areas the dominant tree species are tulip poplars, red maples, and sycamores. Other species might include the green ash, black walnut, holly, black gum, and beech. The deciduous forest also contains woody understory vegetation including dogwoods, ironwood, mountain laurel, spicebush, and blueberries.

The healthy forest can provide a variety of animal habitats, contain a variety of tree and other plant species (including some rare and/or mature species), have a variety of forest layers (tree canopy, understory trees, shrubs, and smaller plants). Non-native invasive plants are a big problem in Rock Creek. There are dozens of plant species that do not grow here naturally, but were brought to the area by people as ornamental plantings or for food. Some of these plants grow too well and are now taking over our parklands. They out-compete native plants for light, nutrients, water, and soil. They displace whole plant communities by smothering existing plants, increasing ground-level humidity, and changing soil chemistry and microorganisms. Birds, wildlife, insects, and other living things are adapted to specific plant communities. When plants are lost, the food, nesting sites, and habitats they provide are lost, with resulting damage to the animals that depend on them. Native plants also support the quality and functions of our wetlands and streams, as well as the natural beauty of our parks.

Along the entire length of the Oregon Avenue corridor opportunities exist to plant native naturalizing vegetation. These include the planting strips between the sidewalk and the roadway, areas to be restored in residential gardens, and areas between the roadway and Rock Creek Park. While a comprehensive planting design for the roadway will be created, homeowners will be able to 'adopt' the planting strips and again extend their residential garden to the sidewalk edge.

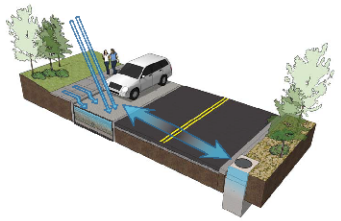
Please be aware that small actions can have a significant impact on the health of Rock Creek. Non-native plants can spread into the park's edge, eventually expanding into other parts of the forest and worsening the current situation. Consider using native plants to supplement the planting strips and in the residential planting areas near the sidewalk.

STORMWATER MANAGEMENT:

PERMEABLE PAVEMENT - PARALLEL PARKING LANE (REDUCING IMPERVIOUS AREAS)

Permeable paving systems provide a hard surface, while allowing water to flow through to the underlying soils instead of into the storm sewer. It is a LID technique in which the space used for the practice can also be used for sidewalks, roads, and parking spaces. The goal is to take rainwater as it falls and quickly move it to the lower layers of the system. Stormwater is stored in an underlying stone layer until it infiltrates into the soil below, aiding in groundwater recharge, or releases slowly to the storm sewer system. Pollutants are filtered through the pavement and base layers.

On Oregon Avenue, the design will include permeable roadway pavements in parallel parking areas between Northampton Street and Rittenhouse Street. Permeable sidewalk pavements will include porous rubber pavement around and near existing trees to remain. Permeable pavements for sidewalks; such as unit pavers, concrete, and asphalt; are also being considered.



PERMEABLE UNIT PAVERS

PERVIOUS CONCRETE PAVEMENT

POROUS ASPHALT

STORMWATER MANAGEMENT:

PERMEABLE PAVEMENT - SIDEWALK NEAR EXISTING TREES (PROMOTING INFILTRATION AND AVOIDING ROOT DAMAGE)

One of the biggest problems in upgrading and/or installing new sidewalks is meeting the ADA requirements for walkways and preserving existing trees. Trees, especially mature ones, are very sensitive when the upper level of the root system is disturbed. Cutting, scrapping, or burying roots within the drip-line may cause enough stress to slowly deteriorate the health of trees. Typical practice is to avoid any work near or around an existing tree. In the urban environment, avoiding trees may not be possible. The tree causing the problem is typically removed when cracked or heaved sidewalks are replaced. This practice can now be avoided by installing porous rubber pavements right on top of the tree's root system. This is a highly porous material that allows large amounts of water to drain through. It resists cracking and heaving because of its flexibility and durability.

Roots are exposed, cleaned, and covered with rubber pavement and no longer need to be cut or buried.

The result is a durable sidewalk that complies with accessibility codes and does not damage existing trees. On Oregon Avenue, porous rubber sidewalks will be used near and around existing trees to remain. In some cases, the application will be limited to the tree's drip-line. A significant portion of the project will see porous rubber sidewalks within existing tree stands where the sidewalk meanders through trees. The goal is provide a continuous sidewalk that allows for connectivity and accessibility, while preserving the mature trees that give Oregon Avenue the park-like character everyone enjoys.

URBAN FORESTRY ADMINISTRATION POLICY FOR AVOIDANCE
DBH" x 5 = AREA NOT TO BE DISTURBED
EXAMPLE: 20" x 5 = 100" (8'-4")

Use of pourous rubber at sidewalk locations to preserve tree

Use porous rubber pavement in the area of disturbance

DIAMETER AT BREAST HEIGHT (DBH)

MILITARY ROAD

ST. JOHN'S COLLEGE HIGH SCHOOL

UPPER CHEVY CHASE

KNOLLWOOD

EXISTING BIORETENTION CELLS TO REMAIN

COMMUNITY GARDENS

REGENERATIVE STORMWATER CONVEYANCE SYSTEM (TYP.)

ROCK CREEK PARK TRAIL

National Park Service
1 to 1 Policy for Tree Replacement
1" Removed = 1" Replaced

Example: 20" DBH is replaced
(4) 5" dia. trees or
(10) 2" dia. trees or
(20) 1" dia. trees or similar

SURVEY OF TREES EAST OF OREGON AVE.

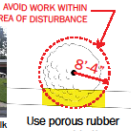
RELEVANT STORMWATER MANAGEMENT EFFORTS TO HELP HEAL ROCK CREEK PARK

REGENERATIVE STORMWATER CONVEYANCE SYSTEMS - BY DDOE

VIRONMENTAL IMPACTS ON OREGON AVENUE

BAN FORESTRY ADMINISTRATION
LICY FOR AVOIDANCE
H" x 5 = AREA NOT TO BE DISTURBED
AMPLE: 20" x 5 = 100" (8'-4")

of pourous rubber at sidewalk
tions to preserve tree



Use porous rubber pavement in the area of disturbance

ETER AT BREAST HEIGHT (DBH)

KNOLLWOOD

IN

BARNABY WOODS

EXISTING BOX CULVERT OPENING

Upstream (East Side): 14' - 5" wide, 4'-9 ¾" high

Downstream (West Side): 14'-10" wide, 5'-7" high

Currently storms over the 5 year storm overtop the box culvert.

PINEHURST CROSSING NEW DESIGN

The goal is to allow the 50 year storm event to safely pass below the new bridge.

All options considered will not include a concrete bottom to create a more natural condition. Determining the height and length is currently in design process.

Option 1 - Most Functionally Efficient

PROS
Least impact to the immediate physical surroundings
- Shortest length necessary
- Least likely to get debris buildup
- Least expensive
- Shortest construction time

CONS
Aesthetic limitations

Option 2 – The Compromise

PROS
Compromise on both aesthetics and functionality

CONS
Similar issues as Option 3 but less severe

Option 3 – Least Functionally Efficient

PROS
Blends in well with the natural surroundings

CONS
Most impact to the immediate physical surroundings
- Will require raising the roadway to allow the 50 year storm to pass
- Longer bridge span will cause damage to nearby trees and landforms
- Debris accumulation likely causing further flooding and maintenance
- More expensive
- Longer construction period

STORMWATER MANAGEMENT OVERVIEW

The District Department of Transportation (DDOT) is installing Low Impact Development (LID) practices in the public right-of-way to capture stormwater runoff from city streets. Stormwater runoff carries pollutants from rooftops, roadways, alleys, and parking lots to the District's storm drain system and into streams and rivers.

The pollutants impair the health of small streams and contribute to problems in the Anacostia River, the Potomac River, and the Chesapeake Bay. The significant volumes of water erode stream banks and create poor conditions for aquatic life. The U.S. Environmental Protection Agency has issued a Municipal Separated Storm Sewer System (MS4) Permit to the District that requires stormwater runoff volume reduction and retrofits to existing buildings and streets to reduce stormwater runoff.

The District is using green infrastructure and low impact development (LID) practices to meet the requirements of the MS4 permit by capturing and filtering stormwater runoff. LID practices, such as bioretention and permeable paving, manage stormwater in small areas to reduce the surge of water flowing into streams, prevent trash and pollutants from entering streams, and improve overall water quality of streams and rivers.

Mature trees not only provide natural character and wildlife habitat, but also help reduce rainfall from reaching the ground and become runoff. Tree preservation includes avoiding construction near the root zone and/or preparing trees for upcoming disturbance. In situations where work near and around trees is unavoidable, innovative porous paving material made of recycled products can be installed without damaging the tree and compromising ADA compliance.

Bioretention cells use the natural functions of plants and soils to remove pollutants from stormwater runoff. The strategy uses storage, sediment capture, and biological processes to clean the water. These mimic processes that occur in nature before water reaches waterways. The layers of plant material, mulch, planting media (a mix of soil, sand, and compost), and stone capture metals, nutrients, and bacteria that flow into the surrounding rivers. The rainwater is held in the planting bed until it infiltrates into the ground or evaporates. The entire system can fit into small spaces, making it adaptable to curb extensions, tree spaces along the road, medians, terraced slopes, and planter boxes.

On Oregon Avenue, the design will integrate Bioretention Cells between the sidewalk and the roadway curb (on the west side) and between the roadway curb and Rock Creek Park (on the east side). Potential design challenges to overcome include space, utilities, horizontal roadway grades, driveways, existing trees, and nearby topography.

BIORETENTION CELLS

(A PLANT-BASED STORMWATER MANAGEMENT DEVICE)

SECTION A-A
Near Western Ave.

SECTION A-A
Near Daniel Lane

SECTION B-B
Thru Daniel Lane

PINEHURST PARKWAY PARK

HAWTHORNE

DESIGNING YOUR BIORETENTION PLANTER

ADDRESS:

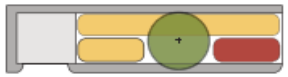
NAME:

CONTACT INFO:

THIS IS AN EXAMPLE:

MODULAR SCHEMES

A 

B 

C 

YOUR MODULAR CHOICES:

A	C	B	

RESULTING WITH THIS PLANTING LAYOUT:

PLANT SELECTION:

TREES
- RED OAK
- EASTERN REDBUD

SHRUBS
- BLACK HUCKLEBERRY
- ROSEMARROW

PERENNIALS
- EASTERN RED COLUMBINE
- BUTTERFLY MILKWEED

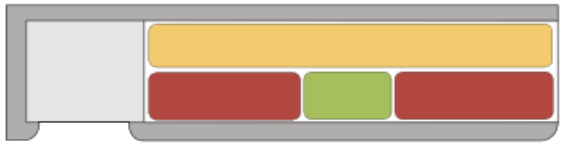
GRASSES
- BROOMSEDGE
- BIG BLUESTEM

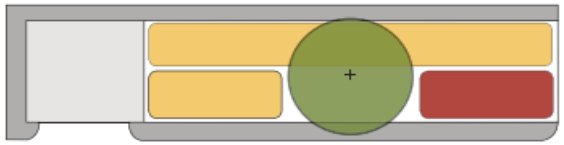
1 FIND YOUR ADDRESS:

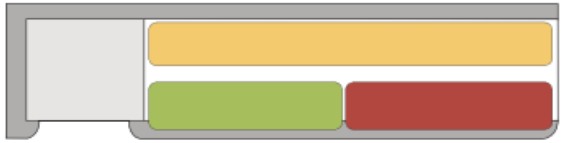
FIND YOUR ADDRESS AND #THE NUMBER OF MODULES ASSOCIATED WITH YOUR ADDRESS. SEE POSTER A - "ADDRESSES WITH BIORETENTION PLANTERS"

2 PICK YOUR MODULE SCHEMES:

SEE POSTER B - "MODULES AND PLANTING SCHEMES"

A 

B 

C 

3 WRITE DOWN YOUR MODULE SCHEME CHOICES:

4 PICK YOUR PLANT CHOICES

SEE POSTER C - "PLANT LIST"

TREES

SHRUBS

PERENNIALS

GRASSES

Oregon Avenue Reconstruction: the right project, done right to maximize the return investment to the community and environment

Strategies For Changing the Industry

Sustainable Infrastructure -

- Make incremental improvements
- Use standardized tools and metrics
- Document sustainable practices
- Monitor performance
- Share lessons learned
- Taking a global view, while keeping in mind local values

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Strategies For Changing the Industry

Sustainable Infrastructure -

- Take care of our stuff
- Invest in things of value
- Consider the needs of all people
- Maximize the return on our investment

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It's not your fault, but it might be your responsibility -

a fork in the road on the way to becoming a professional.

- Seth Godin

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Discussion.

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