At the Forefront of Change

5 WAYS LANDSCAPE ARCHITECTS ARE RESPONDING TO CLIMATE IMPACTS
Developing Regional Strategies with Robust Civic Engagement

CASE STUDIES:
SEA CHANGE BOSTON + CLIMATE READY BOSTON
SEA LEVEL RISE PROJECTIONS

6 FT SEA LEVEL RISE IN 2100

2 FT SEA LEVEL RISE IN 2050
BOSTON HAS A HISTORY OF DEVASTATING STORMS
THIS IS WHERE HIGH TIDE COULD BE DURING A STORM IN 2050
INDUSTRIAL, COMMERCIAL, & INSTITUTIONAL PROPERTIES AT RISK
CRITICAL SYSTEMS AT RISK

- 8 POWER PLANTS
- 6 FUEL TERMINALS
- 9 HOSPITALS

FACILITIES AT RISK
- Police station
- Power plant
- Sub station
- Other critical facility
- Hospital

Flooding during a major storm in 2050
WHAT ARE THE OPTIONS?

1. FORTIFY (KEEP WATER OUT)

2. ADAPT (LIVE WITH WATER)

3. RETREAT (MOVE TO HIGHER GROUND)
WE NEED TO DESIGN FOR RISING SEAS AT MULTIPLE SCALES.
"I HAVE BEEN DOING THIS MY WHOLE LIFE. THE INDUSTRY HAS NEVER BEEN MORE VULNERABLE."

"WE WERE HERE DURING THE BLIZZARD OF 1978. IT WAS A MESS."

"PEOPLE NEED RESPECT FOR NATURE AND THE EARTH."
COASTAL & RIVERINE FLOODING IMPACTS
As the sea level continues to rise, the likelihood of major floods will increase from a 1% annual chance to a monthly reality.
COASTAL & RIVERINE FLOODING IMPACTS
Annual impacts will increase as the sea rises, with more than $1.3B at risk annually later this century.

- **9” SLR**
  - 2030s - 2050s
  - $137M

- **21” SLR**
  - 2050s - 2100s
  - $455M

- **36” SLR**
  - 2070s or later
  - $1.39B

Annualized losses

- 0.1% flood
- 1% flood
- 2% flood
- 10% flood
EXPECTED ANNUALIZED LOSSES TO STRUCTURES AND CONTENTS

36 INCHES OF SEA LEVEL RISE AT 10%, 2%, 1%, 0.1% ANNUAL CHANCE COASTAL FLOOD EVENTS.

EAST BOSTON ANNUALIZED LOSSES
36 INCH SEA LEVEL RISE CONDITION

TOTAL: $220 MILLION

- Business Interruption 19%
- Structure Losses 33%
- Productivity Loss 25%
- Mental Stress & Anxiety 7%
- Relocation Losses 9%

Loss breakdown:
- Commercial ($22M)
- Cultural/Religious, Educ. Rec. ($14M)
- Essential services ($13.9M)
- General Government ($7.6M)
- Industrial/Transportation ($3.2M)
- Mixed Use ($14.5M)
- Residential ($17.6M)

Total ($173M)
Implementing Bold Ideas that will Change our Relationship with the Land

CASE STUDY:
SHANGHAI SUNQIAO URBAN AGRICULTURE DISTRICT
By 2050, the planet will have 9.7 billion mouths to feed.

UNITED NATIONS FOOD AND AGRICULTURE ORGANIZATION
To address climate change, we must talk about food.
122 million hectares of China’s 960 million hectare land area is designated as farmland, representing about 13% of the country’s overall land use.

1.3 billion of China’s 1.4 billion population lives in the eastern half of the country, which correlates with arable land.
China lost 123,000 km² of arable land between 2008 and 2018.

Source: United Nations’ Food and Agriculture Organization
For those of you who are spatial thinkers...

THAT’S EQUIVALENT IN SIZE TO THE STATE OF IOWA
BEEF IMPORTS TO CHINA HAVE INCREASED 19,000% IN THE PAST DECADE.

Caloric intake of the average Chinese person has more than doubled in the last 50 years, rising faster than any other country in the world.
56% of the average Shanghainese diet consists of leafy greens.
Vertical farming of tomatoes, lettuce, celery, and bok choy yield between 40 and 100 times more produce than a typical outdoor field of the same size.

CHINESE ACADEMY OF AGRICULTURAL SCIENCES
CHINA'S FERTILIZER CONSUMPTION

**Farmers in China use 4.5x more fertilizer per hectare of arable land than farmers in North America.**

Air, Water, and Soil Pollution

Air pollution in China is often as much as five times the level the World Health Organization considers safe.

According to the Ministry of Water Resources, 80% of China's groundwater is unfit for drinking or bathing due to pollution from farms.

Heavy metals including cadmium, arsenic, and lead are prevalent, especially in East Coast manufacturing areas.

Source: World Health Organization / World Bank

CHINA'S FERTILIZER CONSUMPTION

Farmers in China use 4.5x more fertilizer per hectare of arable land than farmers in North America.
Using vertical agriculture, we don’t need to use pesticides, and we can use less chemical fertilizers - and produce safe food.

YANG QICHANG  
INSTITUTE OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT IN AGRICULTURE
Landscape Architects are…

Stewards of Native Habitats and Champions of Conservation Efforts

CASE STUDY: CHENGDU PANDA RESERVE
Habitat Undisturbed by Roads & Infrastructure

Evergreen Broad-Leaf Forests
Cyclobalanopsis, Castanopsis, Lithocarpus, Rhoebe, and Cinnamomum spp.
*Bamboo understory*

Temperatures below 25°C to minimize heat stress

Hillslopes of 30% or less

Commonly Browsed Bamboo Species
*Pshenochla fargesii*
*Yushania brevipaniculata*
*Fargesia robusta*

Close Proximity to Fresh Water

1200m Elevation Range for cooler climate & seasonal greater bamboo diversity

4000m
(on-site) **In Situ Conservation**

- **New Giant Panda National Park**  
  Expanded protection for existing preserves

- **Connecting Isolated Reserves**  
  67 separate reserves connected

- **One Large Conservation zone**  
  27,000 km² total area  
  (the size of Massachusetts)

- **Expanded Protection**  
  Ecosystem Services & Listed Species

- **Return to the wild**  
  Pre-release training & release areas

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(Off-site) **Ex Situ Conservation**

- **Panda Reserve Facilities**
  - 1. Dujiangyan Panda Wilderness
  - 2. Beihu Panda Park
  - 3. Longquanshan Panda Village
  - 4. Wolong Panda Centers
  - 5. Bifengxia Panda Base

- **Scientific Research**  
  Captive breeding & disease prevention

- **Conservation Education**  
  Public education & support for planning

- **Eco-Tourism**  
  Awareness and funding for conservation
As a biodiversity hotspot habitat preservation for the giant panda also protects

- 31% of China’s amphibian species (82 endemic)
- 365 bird species (20 endemic)
- 109 mammal species (14 endemic)
Education & Research Center

Panda Valley Tram

Location Maximizes Microclimate Benefits

Naturalistic Enclosure Design

Low-Impact Interpretive Walkway

Pre-Release Training
Researchers dress in panda suits treated with natural panda scents to prevent cubs from imprinting on humans
Thinking in Non-Traditional ways about how to Design Traditional Landscapes

CASE STUDY:
WUHAN YANGTZE RIVERFRONT
65,000 public feedbacks gathered through on site tours, mail and email surveys, comments and messages on the website/social media platform.

I grew up in Wuhan. The port culture and all the historical heritage affect my life. The riverfront park should demonstrate our local culture.

I'm concerned about the highway idea. It will impact the riverfront landscape and bring noises. It also gives me a feeling of depression.

I always go to the riverfront park with my little grandson. I hope the park will be more and more ecological, and provide an educational value.

Riverfront urban design should take public facilities like libraries, museums and the ones for the elderly as top priority.
Changing how we Design and Build Cities

Landscape Architects are...
**Present: Typical Monsoonal Flood**
- While total annual rainfall is expected to remain the same, intensity of rainfall events has increased.
- Urban flash flooding has increased, compounded by urbanization and underground infrastructure in many locations.

**Present: Extreme Flood**

**2050: Typical Flood**
- Temperatures in HCMC have increased at a rate nearly double the surrounding region (5-2013).
- Reduced vegetation cover in addition to sea-level rise in the coastal and semi-coastal settings will raise urban temperatures to higher levels, increasing demand and overall energy demand.

**2050: Extreme Flood**
- Tropical storms in HCMC were more intense, however their frequency has been increasing in recent decades.
- Projections for sea level rise estimate an increase in the range of 24-28 cm significantly impacting the reach of tidal flooding and extreme surge.

**2050: Saline Intrusion**

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**ISSUES TODAY & ON THE HORIZON**

**Flash flooding**
- While total annual rainfall is expected to remain the same, intensity of rainfall events has increased.
- Urban flash flooding has increased, compounded by urbanization and underground infrastructure in many locations.

**Urban Heat Island**
- Temperatures in HCMC have increased at a rate nearly double the surrounding region (5-2013).
- Reduced vegetation cover in addition to sea-level rise in the coastal and semi-coastal settings will raise urban temperatures to higher levels, increasing demand and overall energy demand.

**Land Subsidence**
- A result of reduced groundwater infiltration and over extraction, several areas of HCMC are subject to land subsidence.
- Vulnerability of flooding in these areas will continue to increase as subsidence progresses.

**Extreme Tidal Flooding**
- Tropical storms in HCMC were more intense, however their frequency has been increasing in recent decades.
- Projections for sea level rise estimate an increase in the range of 24-28 cm significantly impacting the reach of tidal flooding and extreme surge.

**Salt Water Intrusion & Drought**
- Drought conditions are typical in the dry season lasting from December through April.
- Dry season drought conditions may become more persistent, but currently being investigated.
A Resilient System

- Permeable Green Space
- Mangroves & Wetlands
- Sunkan Garden
- Swale & Bio-Retention

5.24 km In Street Bio-Swales
24% Water Receiving Landscapes
A Resilient System

- Flood Control Gate
- Removable Flood Wall
- Raised Landscape
- Removable Flood Barrier
- Flood Resilient Structures
- Elevated Landscape Berms
A Resilient System
A Resilient System
Enhance Microclimates
Enhance Microclimates

Average Temperature
26° - 29 Degrees Celsius
70% - 85% humidity
XXX Sunny Days / Year

Average Wind Speed
5 - 6 knots at 50m elevation
South-West to North-West Wind Direction
light breeze according to beaufort scale

Diverting Winds
light head catch and divert winds down to the ground floor where they create a microclimate

Trapping & Re-Directing Winds
high and consistent tree canopy traps winds, bounces it and keeps the humidity at all other elevations
The best time to plant a tree was 20 years ago. The next best time is now.

CHINESE PROVERB