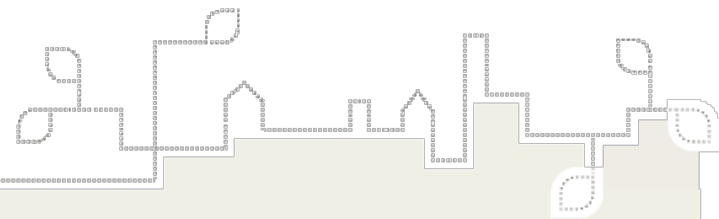


Using Vulnerability Maps to Inform Design

Climate Resilience & Adaptation Strategies: A Capital Area Symposium
October 4, 2013

ADELE HOUGHTON, AIA, MPH
President, Biositu, LLC



Overview

1. Localized Health Effects of Climate Change
2. Green Building Design and Vulnerability
3. Using Vulnerability Maps to Inform Design

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Health Impacts of Climate Change

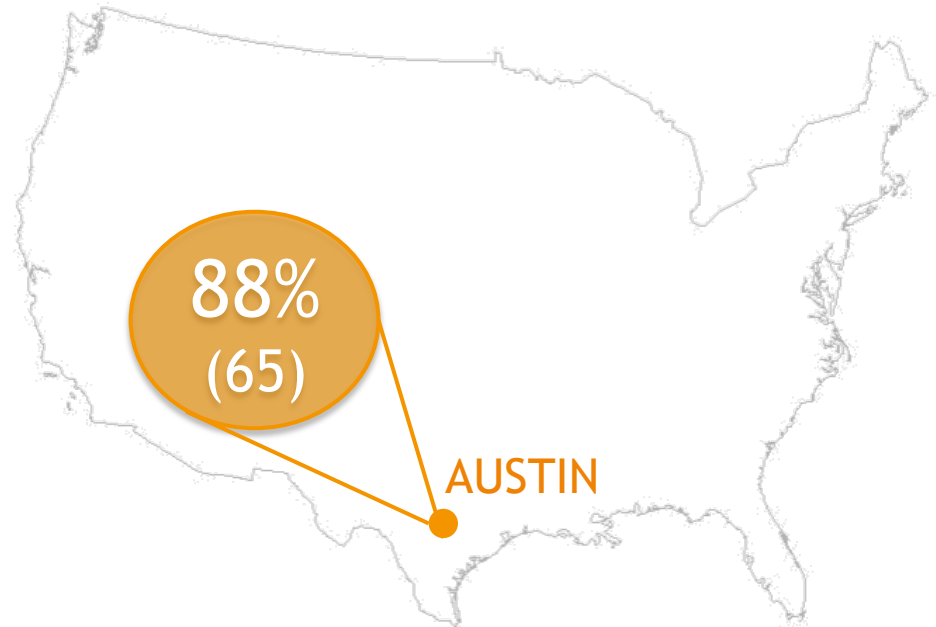
Global Perspective: Projected Negative Health Impacts of Climate Change

	Negative impact	Positive impact
Very high confidence		
Malaria: contraction and expansion, changes in transmission season	←	→
High confidence		
Increase in malnutrition	←	
Increase in the number of people suffering from deaths, disease and injuries from extreme weather events	←	
Increase in the frequency of cardio-respiratory diseases from changes in air quality	←	
Change in the range of infectious disease vectors	←	→
Reduction of cold-related deaths		→
Medium confidence		
Increase in the burden of diarrhoeal diseases	←	

Source: Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007

Local Perspective (Austin, Chicago): Deaths from Climate Change-Related Natural Hazards, 1970-2010

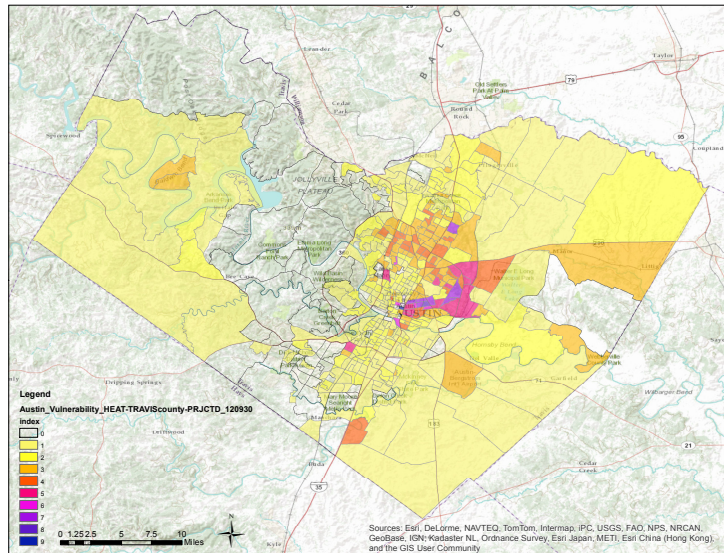
- extreme heat
- severe storm/flooding
- drought



Source: Spatial Hazard Events and Losses Database for the United States, Version 9.0. Hazards & Vulnerability Research Institute, University of South Carolina.

Climate Change Vulnerability

Heat Vulnerability Index

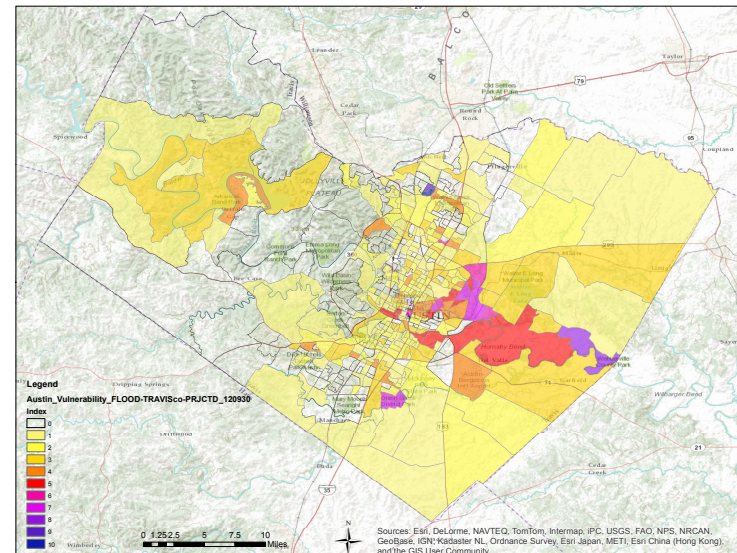


Scale
0
-
10

Variables

- Lack of Green Space
- Average Ambient Surface Temperature
- Population Density
- Age 65+
- Non-Hispanic African Americans

Flood Vulnerability Index



Scale
0
-
10

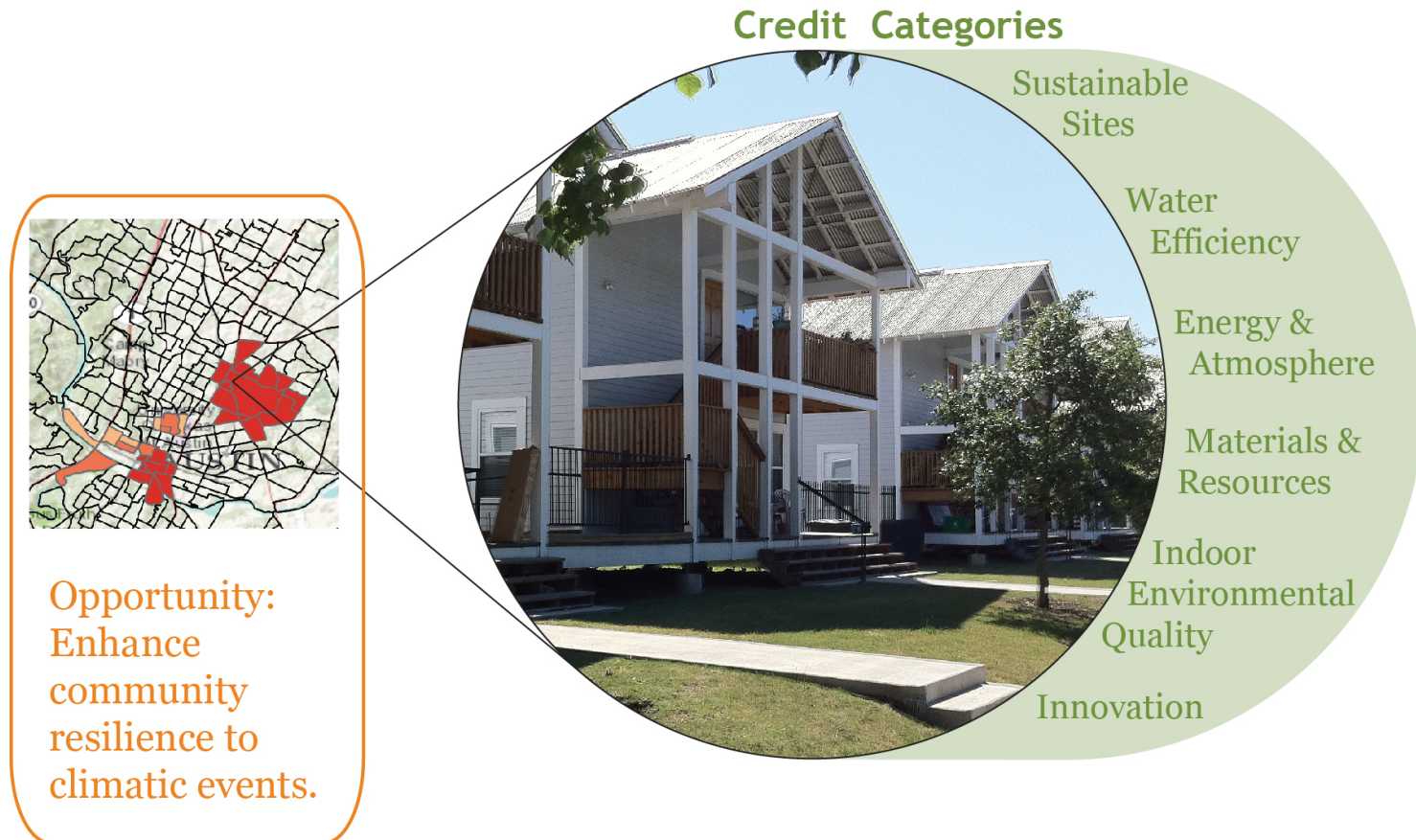
Variables

- Floodplain Ratio
- Low-Water Crossing Density
- Socially Isolated (i.e. living alone)
- Renters Status
- Hispanic Population

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Study Definition of Green Building: Leadership in Energy & Environmental Design (LEED®)



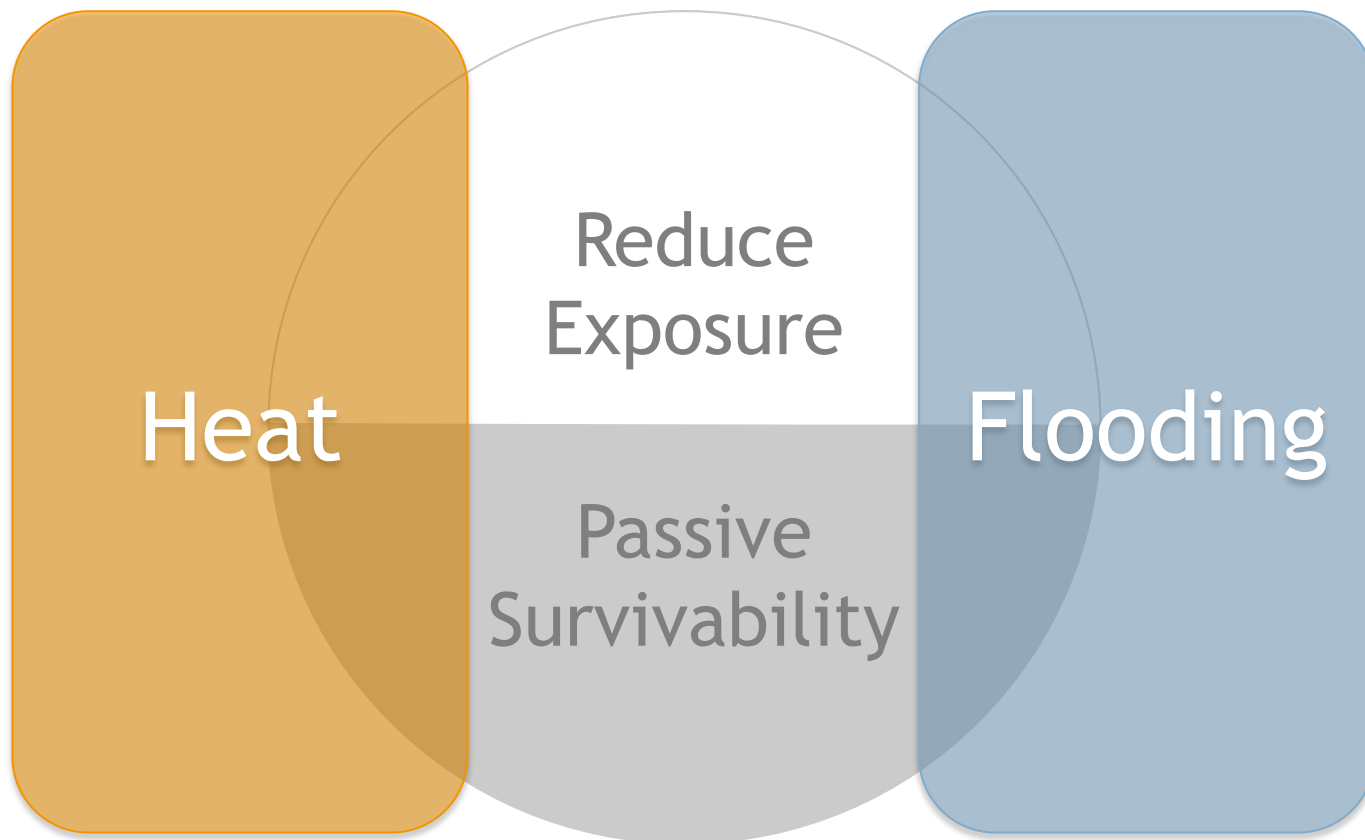
Green Building & Climate Change Vulnerability

Literature Review of LEED Strategies (Sample Results)

Determinants of Health	Public Health Resilience Outcomes	Built Environment Resilience Outcomes
Air pollution Access to opportunities to exercise Biodiversity in urban environments Dependence on automobiles Disease-carrying vectors Food / nutrition safety & security Habitat fragmentation Population density Street connectivity, Walkability	Heat- / flood-related morbidity & mortality Cardiovascular disease Interface between wildlife & humans Infectious disease (i.e., malaria, etc.) Mental health & wellbeing Respiratory disease Undernutrition & malnutrition Neighbors check on socially-isolated neighbors	Mitigate heat island effect Development in areas with existing services Cluster development to increase density Access to local, productive agricultural land Native vegetation, street trees, pervious surface Reduce ground-level ozone

Green Building & Climate Change Vulnerability

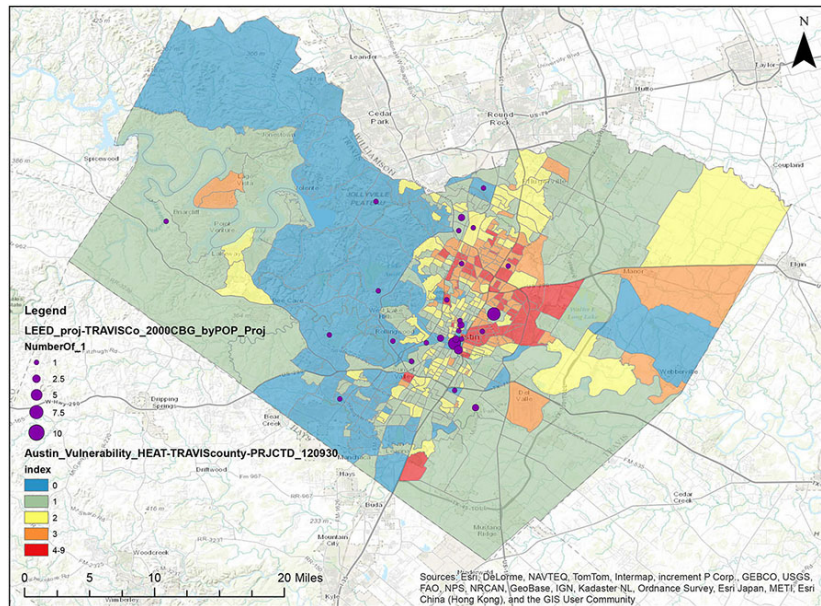
Credit Groupings



Spatial Correlation Analysis

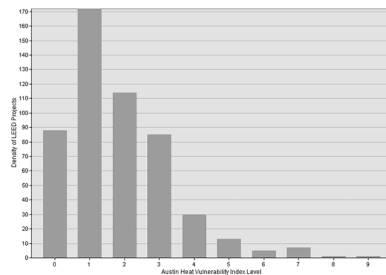
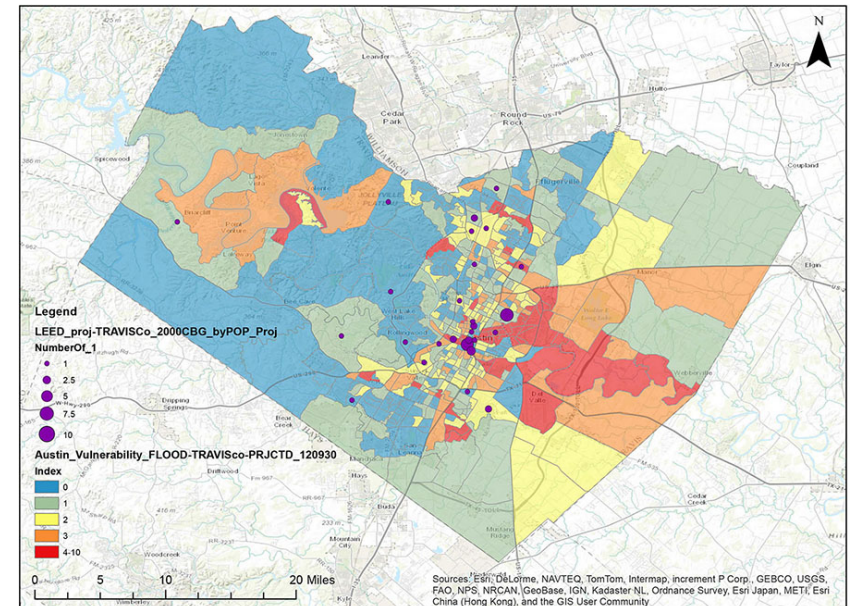
Heat Vulnerability Index

Overlaid with Number of LEED Certified Projects

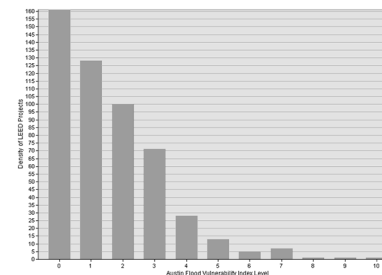


Flood Vulnerability Index

Overlaid with Number of LEED Certified Projects



Frequency of LEED Projects
by Level of Vulnerability

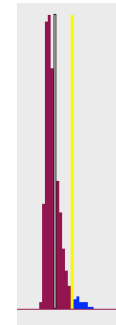
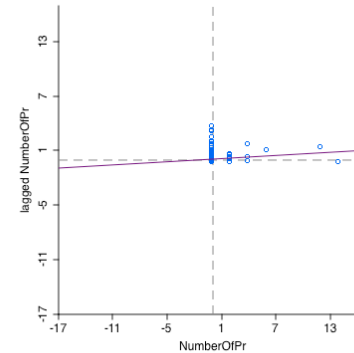


Frequency of LEED Projects
by Level of Vulnerability

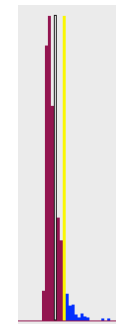
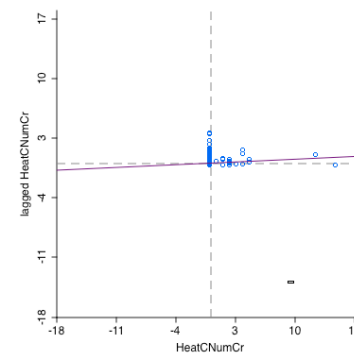
Spatial Correlation Analysis

Moran's I Analysis of Global Spatial Autocorrelation

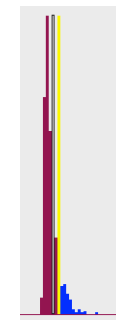
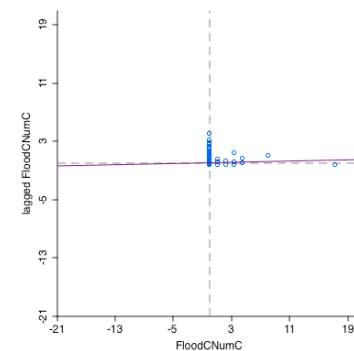
Green Building Resilience LEED Credit Groupings	Moran's I	Z Test Statistic
Group A1: <i>Census Block Groups with LEED Projects</i>	0.035	1.599
Group A2: <i>Number of Projects</i>	0.055	2.548
Heat Group B: <i>Reduce Adverse Effects</i>	0.015	0.959
Heat Group C: <i>Passive Survivability</i>	0.043	2.224
Heat Group D: <i>Groups B+C</i>	0.027	1.436
Flood Group B: <i>Reduce Adverse Effects</i>	0.009	1.599
Flood Group C: <i>Passive Survivability</i>	0.022	2.548
Flood Group D: <i>Groups B+C</i>	0.014	0.608



A2



Heat C

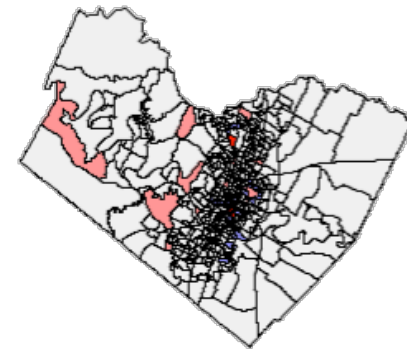


Flood C

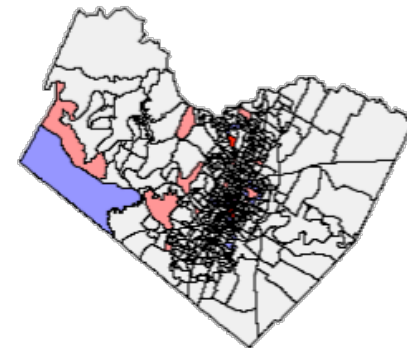
Spatial Correlation Analysis

LISA Analysis of Local Spatial Autocorrelation (Austin Vul Indices)

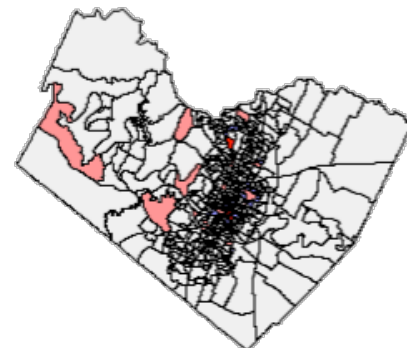
GrGreen Building Resilience LEED Credit Groupings	High/ High	Low/ Low	Low/High High/Low
Group A1: <i>Census Block Groups with LEED Projects</i>	6	0	113
Group A2: <i>Number of Projects</i>	4	0	53
Heat Group B: <i>Reduce Adverse Effects</i>	5	0	45
Heat Group C: <i>Passive Survivability</i>	5	0	48
Heat Group D: <i>Groups B+C</i>	6	0	50
Flood Group B: <i>Reduce Adverse Effects</i>	5	0	50
Flood Group C: <i>Passive Survivability</i>	4	0	49
Flood Group D: <i>Groups B+C</i>	5	0	52



A2

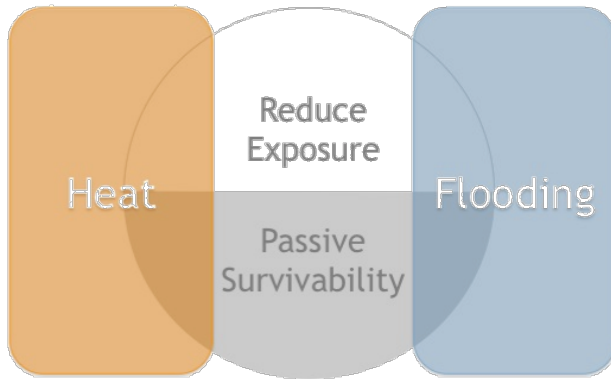


Heat C

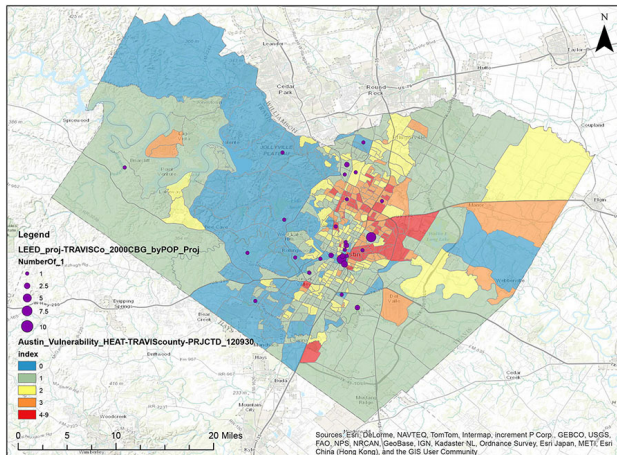


Flood C

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GBIG Climate & Health Resilience Collections

The screenshot displays the GBIG (The Green Building Information Gateway) website. The header includes the GBIG logo, navigation links for SIGN IN and ABOUT, and a search bar. Below the header is a menu with five categories: ACTIVITIES (Green Events & Projects), BUILDINGS (Green Structures), PLACES (Cities, States & Countries), STRATEGIES (Processes & Practices), and COLLECTIONS (Groups & Project Portfolios). The main content area features a large banner for the 'Downtown DC BID' collection, with the text 'Explore connections between projects, people, products, and services' and 'Learn more about the Downtown DC BID'. Below the banner, there are sections for 'FEATURED COLLECTIONS' and 'TYPES OF COLLECTIONS'. The featured collections include AtSite (15 activities), INIGHT TECHNICAL REPORT (2,657 activities), Akridge (57 activities), DODGE Reports (133 activities), Projects with BuildingGreen Case Studies (173 activities), and Policy: LEED certified in San Francisco since August 2008 (222 activities). The types of collections listed are Utilities, Metropolitan Statistical Areas, USGBC Chapters, EPA Regions, ASHRAE Climate Zone, NCHS Urban Rural Classification, Technologies, Space Type, Report, and Special. The 'Climate & Health Resilience' collection is highlighted with an orange border.

GBIG The Green Building Information Gateway

SIGN IN ABOUT Search

ACTIVITIES
Green Events & Projects

BUILDINGS
Green Structures

PLACES
Cities, States & Countries

STRATEGIES
Processes & Practices

COLLECTIONS
Groups & Project Portfolios

Home » Collections

Explore connections between projects, people, products, and services

Learn more about the **Downtown DC BID**

View »

FEATURED COLLECTIONS View all 2,433 Published GBIG Collections

AtSite
15 activities
AtSite Smart Building Solutions

INIGHT TECHNICAL REPORT
2,657 activities
Report: Geographic & Temporal Patterns in Green Building Practice

Akridge
57 activities
Akridge

DODGE Reports
133 activities
McGraw-Hill Construction Dodge Reports

Projects with BuildingGreen Case Studies
173 activities

Policy: LEED certified in San Francisco since August 2008
222 activities

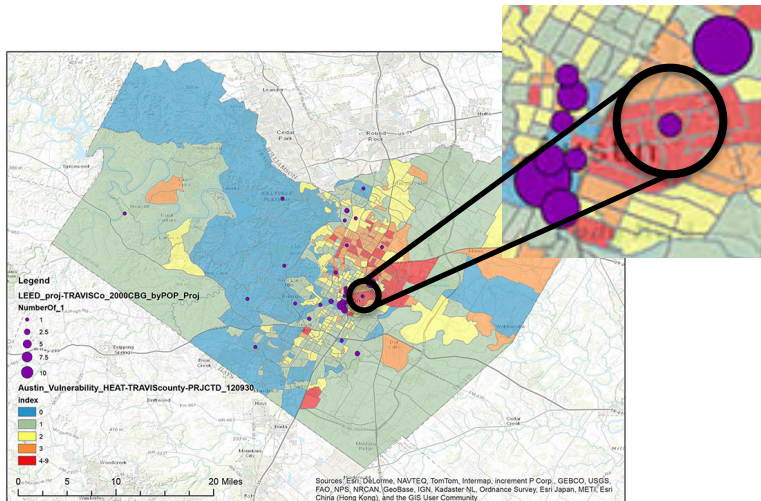
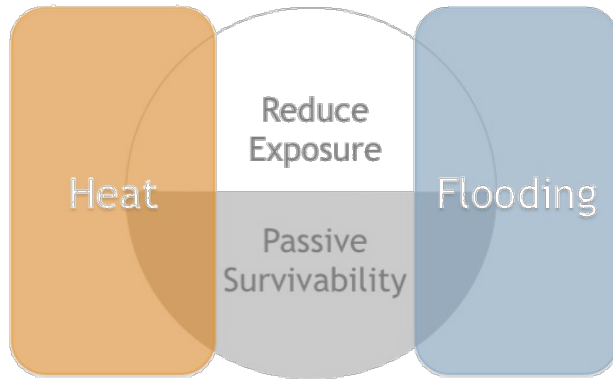
TYPES OF COLLECTIONS

- Utilities
- Metropolitan Statistical Areas
- USGBC Chapters
- EPA Regions
- ASHRAE Climate Zone
- NCHS Urban Rural Classification
- Technologies
- Space Type
- Report
- Special

Climate & Health Resilience

Health Impact Assessments

Tool for Green Building Design - Austin example



LEED Credits (description)	Heat B	Heat C	Heat D
SSc1: Site Selection <i>Avoid building on: prime farmland; land in 100-year flood plain; endangered species habitat; land within 100 feet of wetlands or 50 feet of water bodies; park land.</i>	✓		✓
SSc2: Development Density and Community Connectivity <i>Locate project in a dense urban area or close to both a residential area and at least 10 basic services (i.e., grocery stores, etc.)</i>	✓		✓
SSc5.1: Site Development—Protect or Restore Habitat <i>Limit disturbance of habitat on greenfield sites. Restore habitat on previously developed habitat.</i>	✓		✓
SSc5.2: Site Development—Maximize Open Space <i>Increase vegetated open space.</i>	✓		✓
SSc6.1: Stormwater Design—Quantity Control <i>Reduce the volume of stormwater that leaves the site after heavy precipitation events.</i>	✓		✓
SSc6.2: Stormwater Design—Quality Control <i>Clean stormwater of total suspended solids.</i>	✓		✓
SSc7.1: Heat Island Effect—Nonroof <i>Install light colored and pervious paving (i.e., roads, sidewalks, parking lots, etc) or place at least 1/2 of all parking spaces under cover.</i>	✓		✓
SSc7.2: Heat Island Effect—Roof <i>Install light colored or vegetated roofs.</i>	✓		✓
EAc1: Optimize Energy Performance <i>Reduce energy use in the building.</i>		✓	✓
EAc2: On-Site Renewable Energy <i>On-site installation of solar, wind, or other renewable energy source.</i>		✓	✓
EAc3: Enhanced Commissioning <i>Perform commissioning (i.e., quality control) on all energy, domestic hot water, lighting, and renewable energy systems. Review building operations within 10 months after substantial completion of construction.</i>		✓	✓
IEQc7.1: Thermal Comfort—Design <i>Design air conditioning (HVAC) systems and building envelope to meet standards for temperature, humidity, and airflow.</i>		✓	✓

Acknowledgements

- Professors Carlos Castillo-Salgado & Brian Schwartz, Johns Hopkins Bloomberg School of Public Health
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Thank You.

Questions?

ADELE HOUGHTON, *President*

AIA; MPH; LEED AP BD+C, O+M, ND



adeleh@biositu.com
713-201-7592
www.biositu.com
twitter.com/biositu

