

ADAPTING URBAN FORESTS TO CLIMATE CHANGE

Leslie Brandt, PhD

Climate Change Specialist



Northern Institute of Applied Climate Science

Climate

Carbon

Bioenergy

NIACS is a regional multi-institutional partnership

Forest Service

- Northern Research Station
- Eastern Region
- Northeastern Area S&PF

Non-FS partners

- Michigan Technological University
- University of Minnesota
- National Council for Air & Stream Improvement
- Trust for Public Land



www.nrs.fs.fed.us/niacs/



**Michigan
Technological
University**

ncasi



Meet the Crew!



Michigan Technological University



Hannah Abbotts



Patricia Butler



Jim Klapperich



Leslie Brandt



Stephen Handler



Kate Heckman



Shawn Klomprens



Kailey Marcinkowski



Kristen Schmitt



Danielle Shannon



Maria Janowiak



Zac Kayler



University of Michigan
BIOLOGICAL STATION

Staff Locations:

Houghton, MI

Jackson, WY

Howell, MI

Berkeley, CA

Pellston, MI

St. Paul, MN



Luke Nave



Paula Zermeno

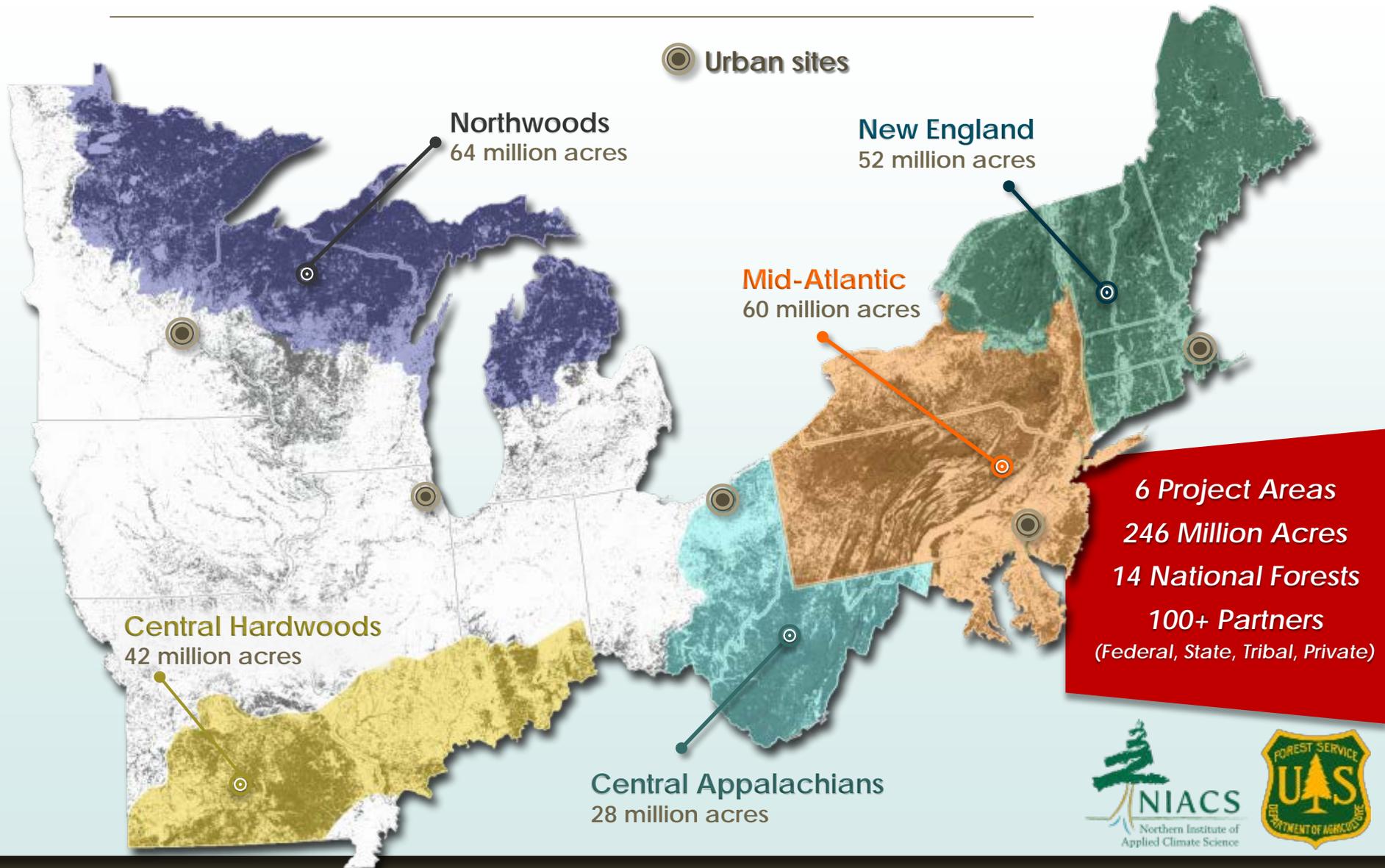


Todd Ontl



Chris Swanston

CLIMATE CHANGE RESPONSE FRAMEWORK



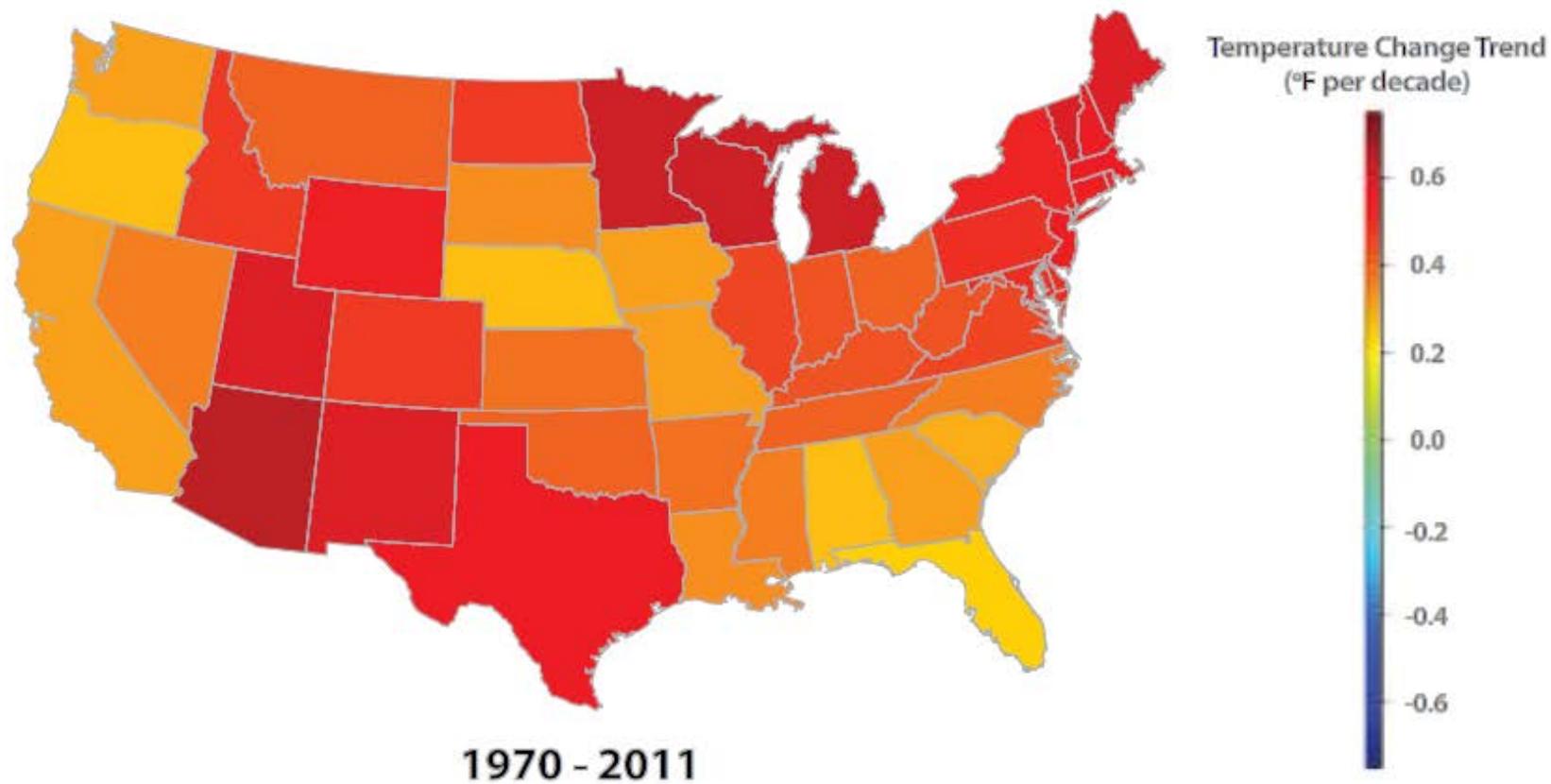
*Climate-Informed
Conservation and Forest Management*

forestadaptation.org

BIG QUESTIONS

- What climate changes are we experiencing and are expected to experience in our urban areas, particularly the Midwest?
- What are the implications for urban forests?
- How can we manage our urban forests to prepare for and respond to these changes?

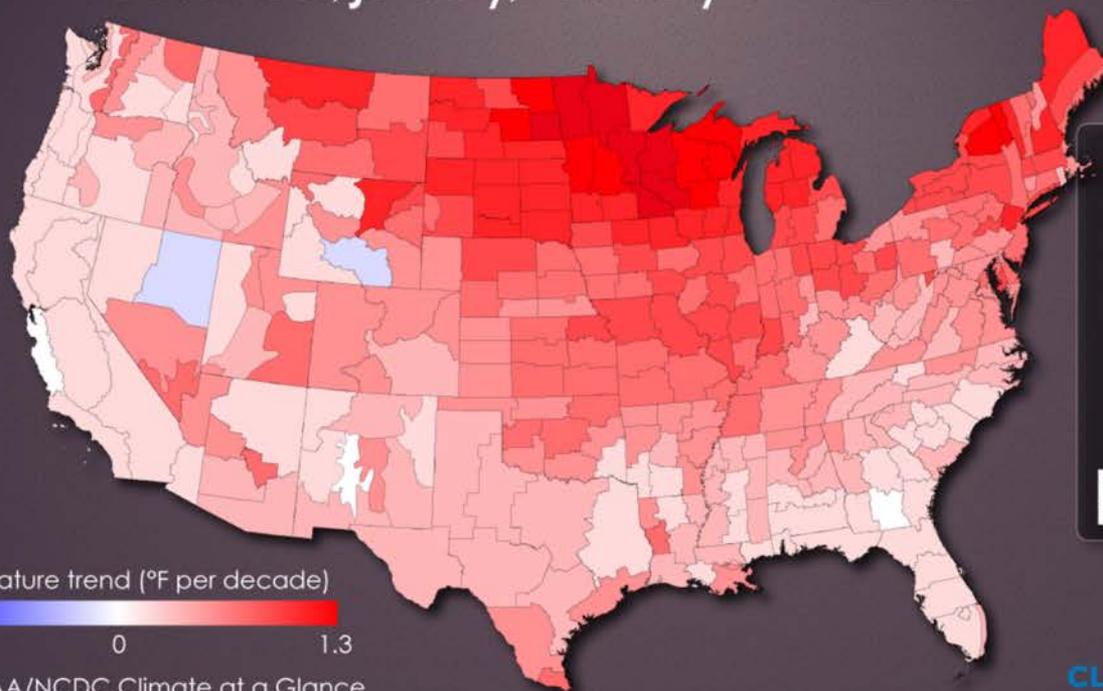
RISING TEMPS IN THE US



WARMER WINTERS

WINTER TEMP TRENDS

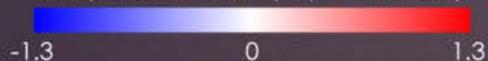
December, January, February 1970-2012



Contiguous
U.S.

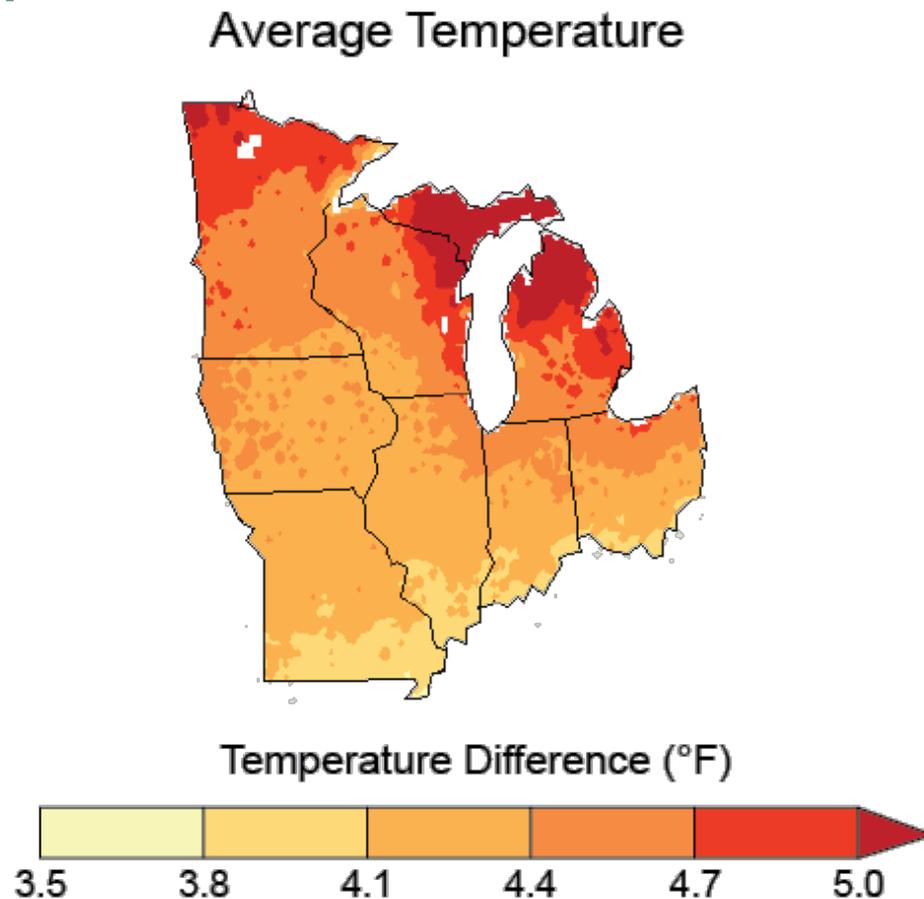
0.61°
per decade

Temperature trend (°F per decade)



Data: NOAA/NCDC Climate at a Glance

TEMPERATURES PROJECTED TO INCREASE AT MID-CENTURY



MORE HOT DAYS

**Up to 60 more days
above 90 degrees by
end of century in cities
like Chicago.**

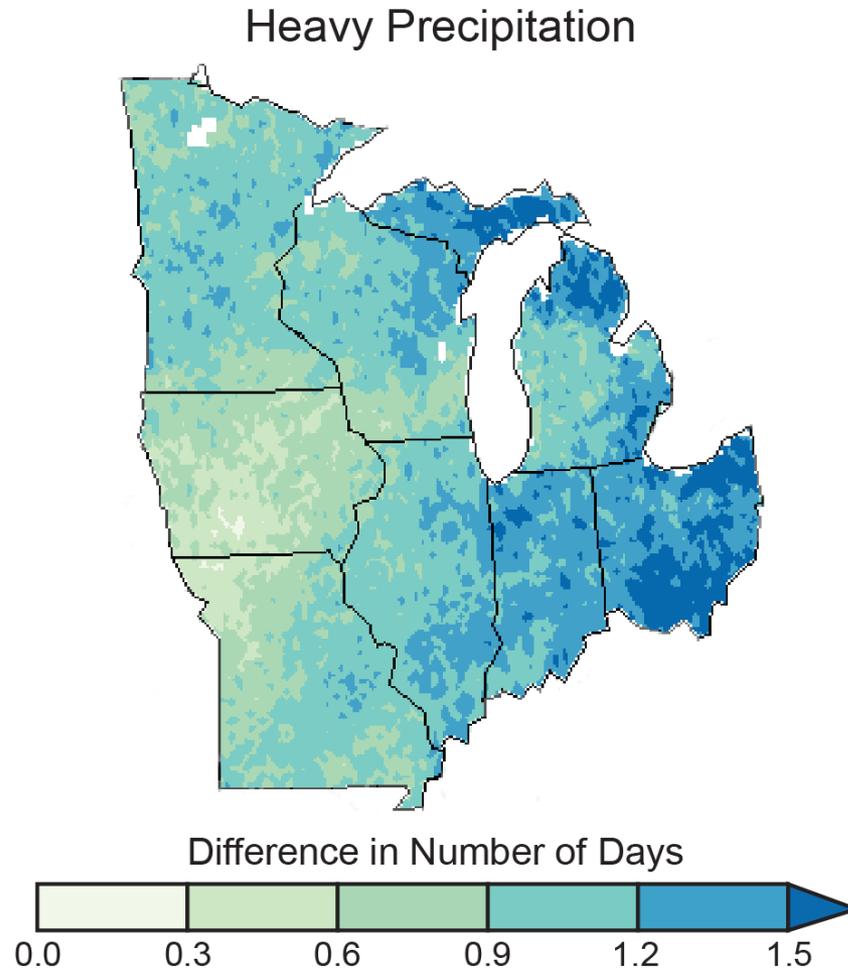


HEAVY PRECIPITATION IS INCREASING



40% more extreme rain events in the United States.

MORE DAYS WITH HEAVY RAIN IN THE MIDWEST



INCREASES IN FLOODING IN THE MIDWEST, NORTHEAST



Duluth, 2012

POTENTIAL FOR INCREASED DROUGHT?



Morse Reservoir, Indiana, 2012

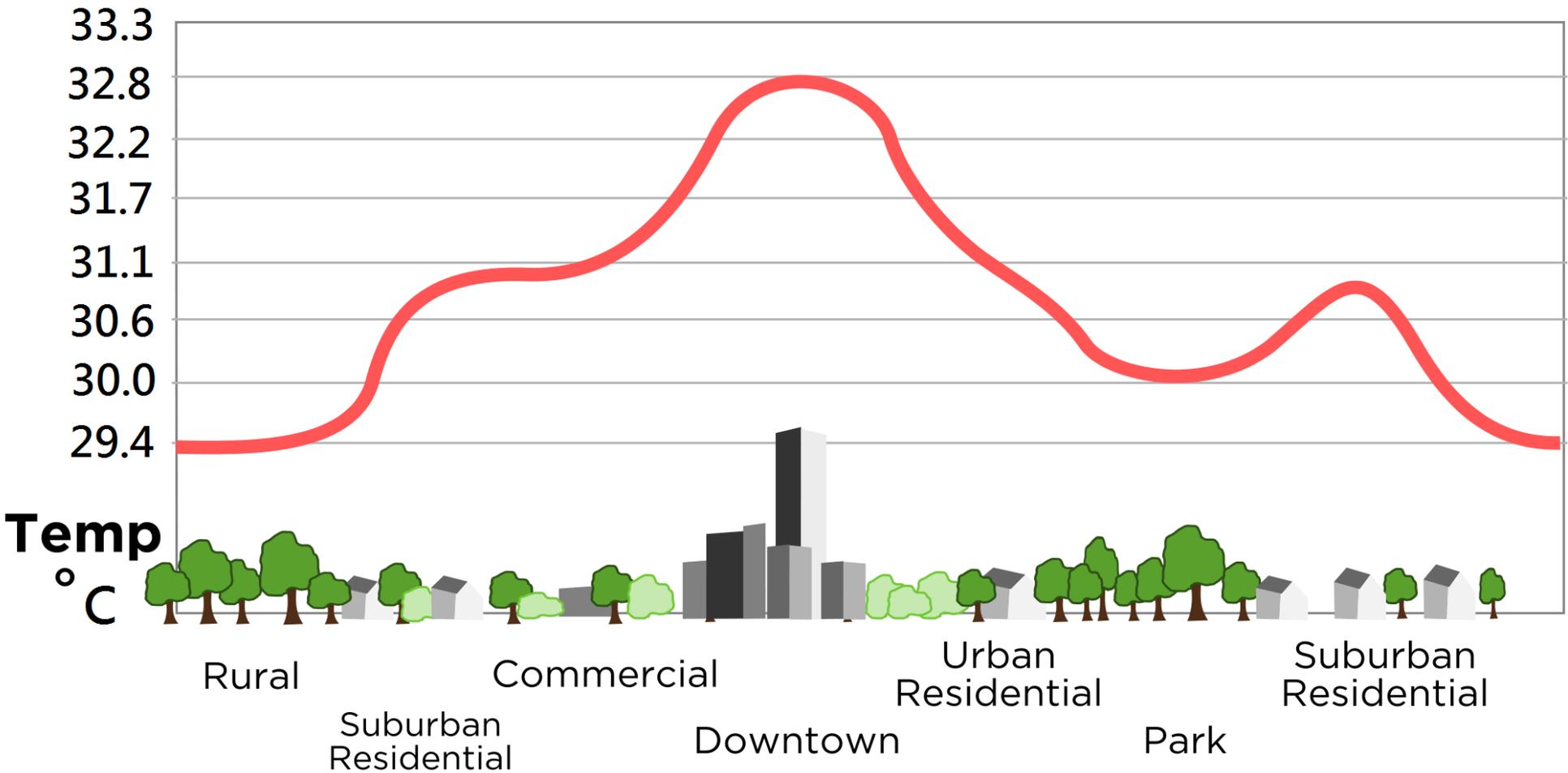
IMPLICATIONS FOR URBAN FORESTS

WHAT IS AN URBAN FOREST?

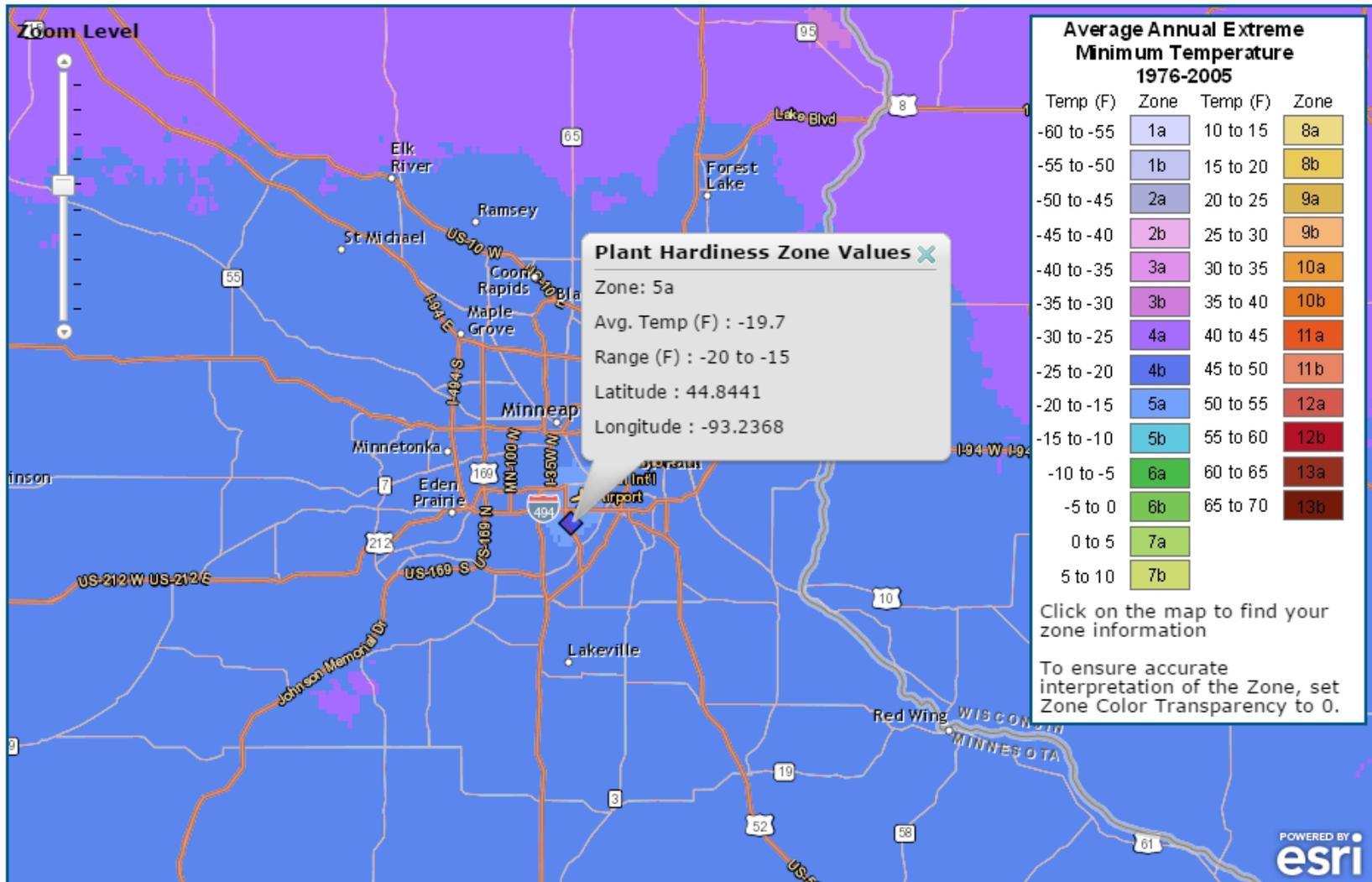
All publicly and privately owned trees within an urban area—including individual trees along streets and in backyards, as well as stands of remnant forest (Nowak et al. 2001).

INCREASED TEMPERATURES

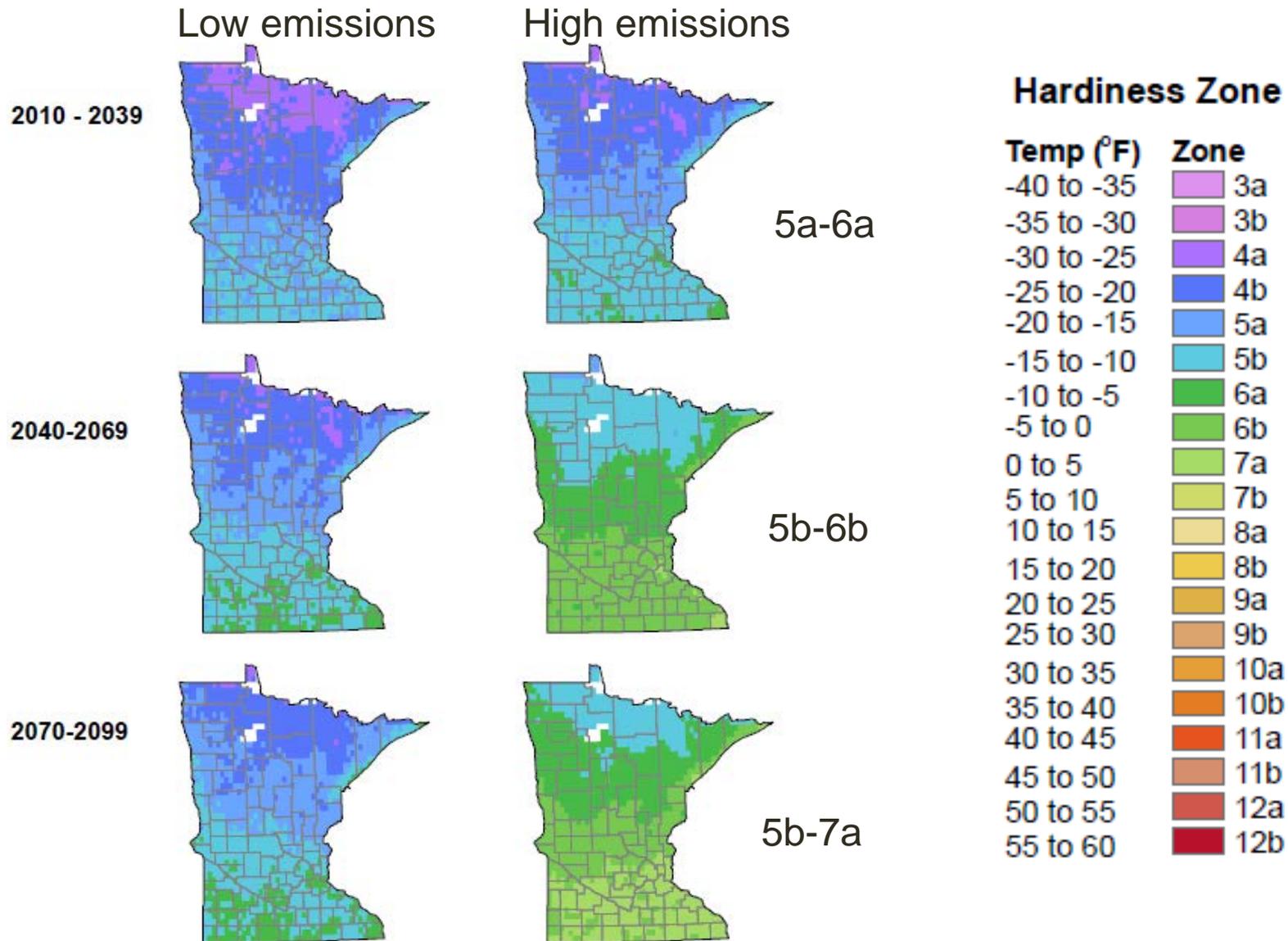
URBAN HEAT ISLAND PROFILE



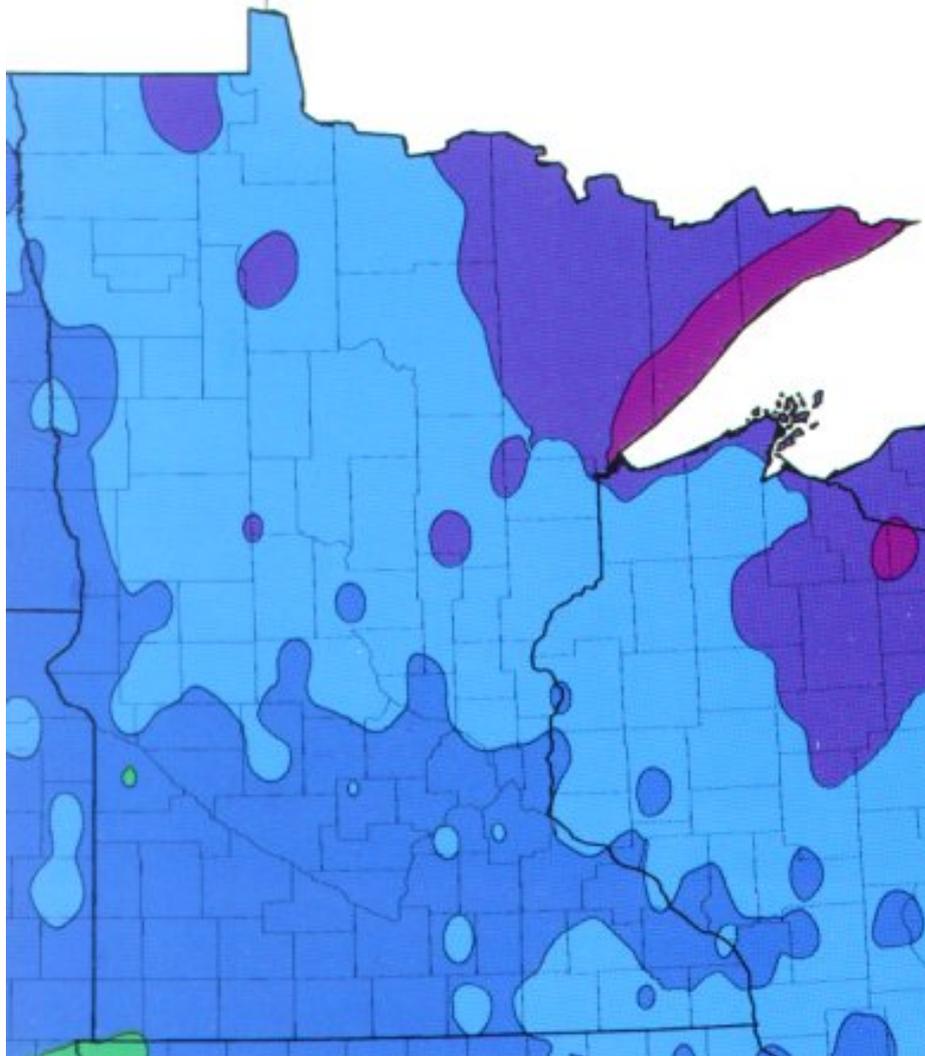
CURRENT USDA HARDINESS ZONES



HARDINESS ZONE PROJECTIONS



CURRENT AHS HEAT ZONES



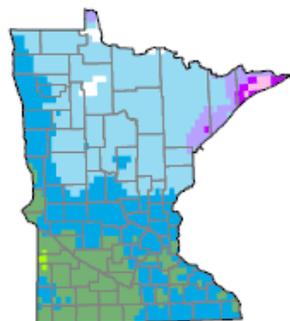
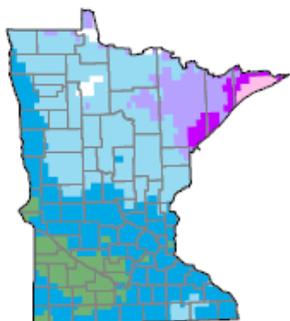
**Average Number
of Days per Year
Above 86°F
(30°C)**

Average Number of Days per Year Above 86°F (30°C)	Heat Zone
< 1	1
1 to 7	2
> 7 to 14	3
> 14 to 30	4
> 30 to 45	5
> 45 to 60	6
> 60 to 90	7
> 90 to 120	8
> 120 to 150	9
> 150 to 180	10
> 180 to 210	11
> 210	12

HEAT ZONE PROJECTIONS

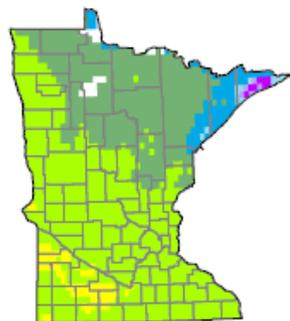
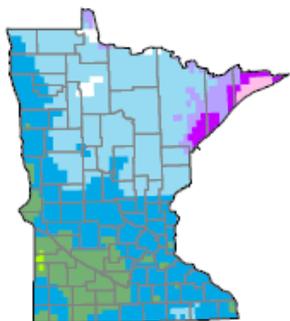
Low Emissions High Emissions

2010 - 2039



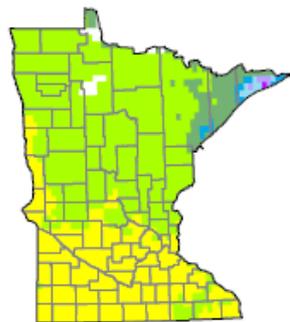
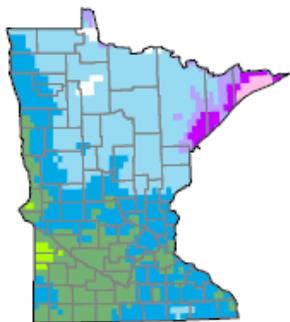
5-6

2040-2069



5-7

2070-2099

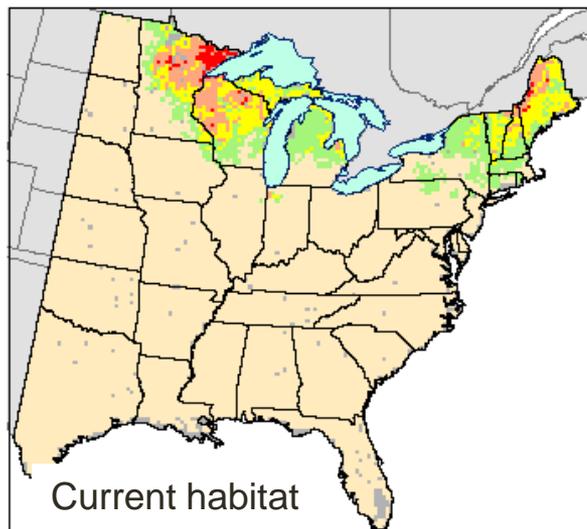


5-8

Heat Zone
(days over 86°F)



HABITAT SUITABILITY LOSS-PAPER BIRCH

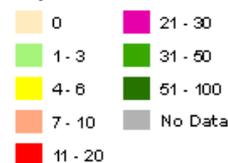


Model Reliability



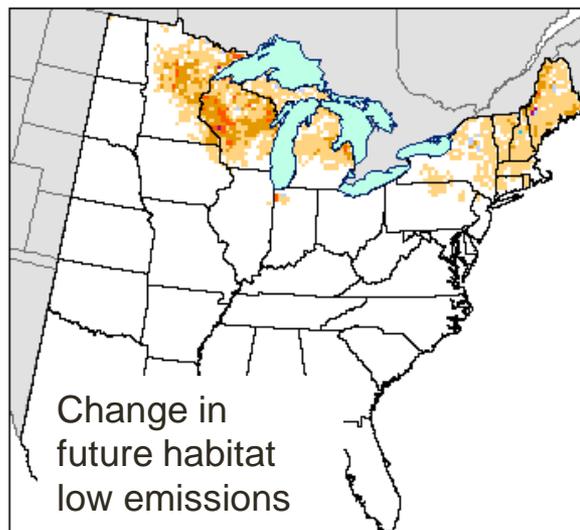
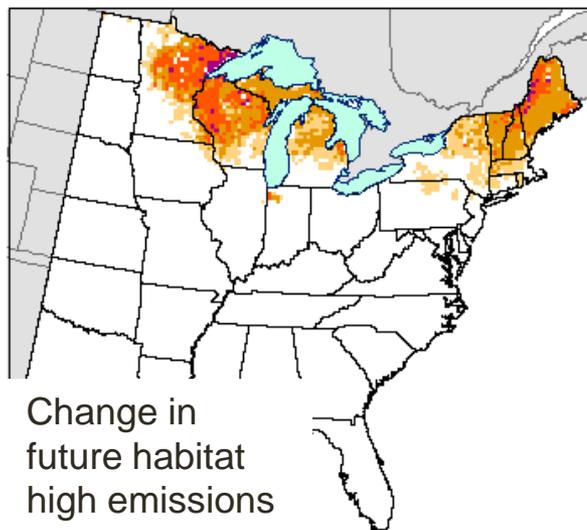
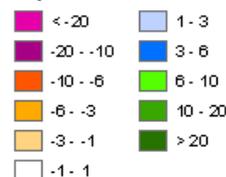
Modeled Current

Imp. Values

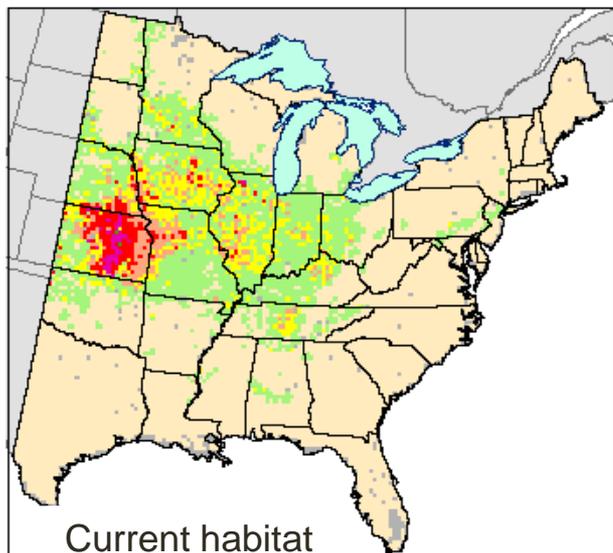


Modeled Difference

Imp. Value



HABITAT SUITABILITY GAIN-HACKBERRY

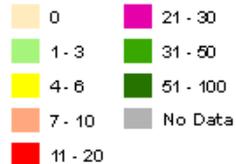


Model Reliability



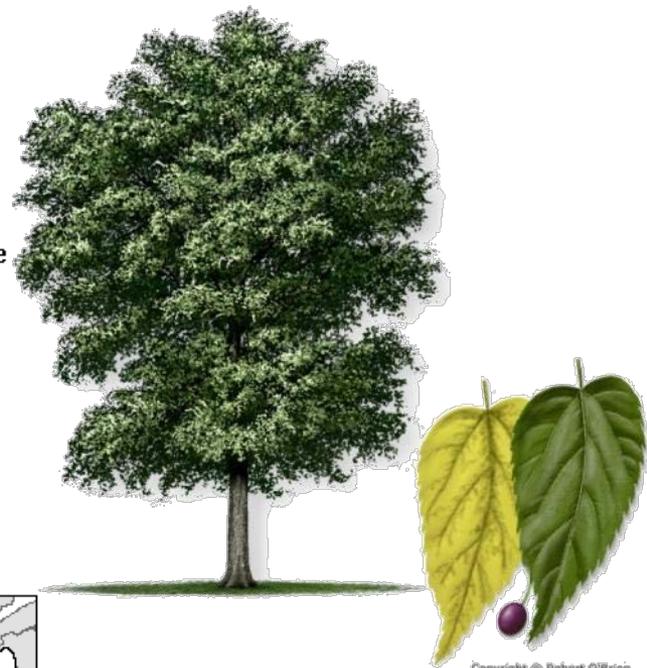
Modeled Current

Imp. Values

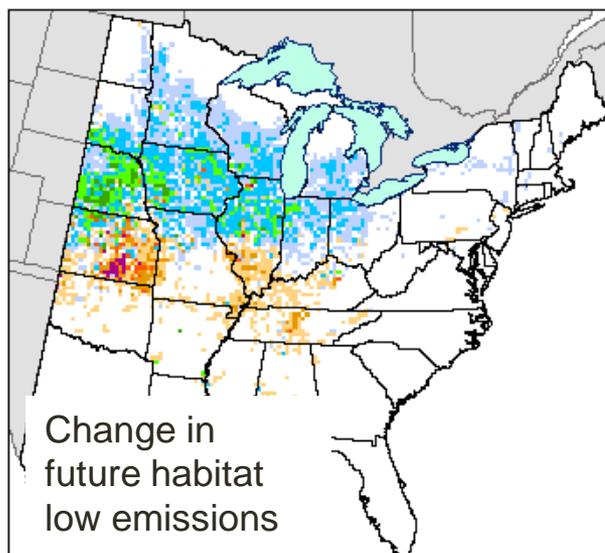
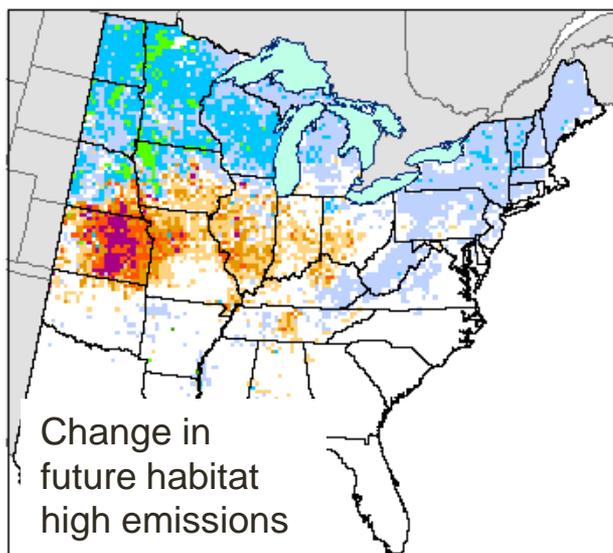


Modeled Difference

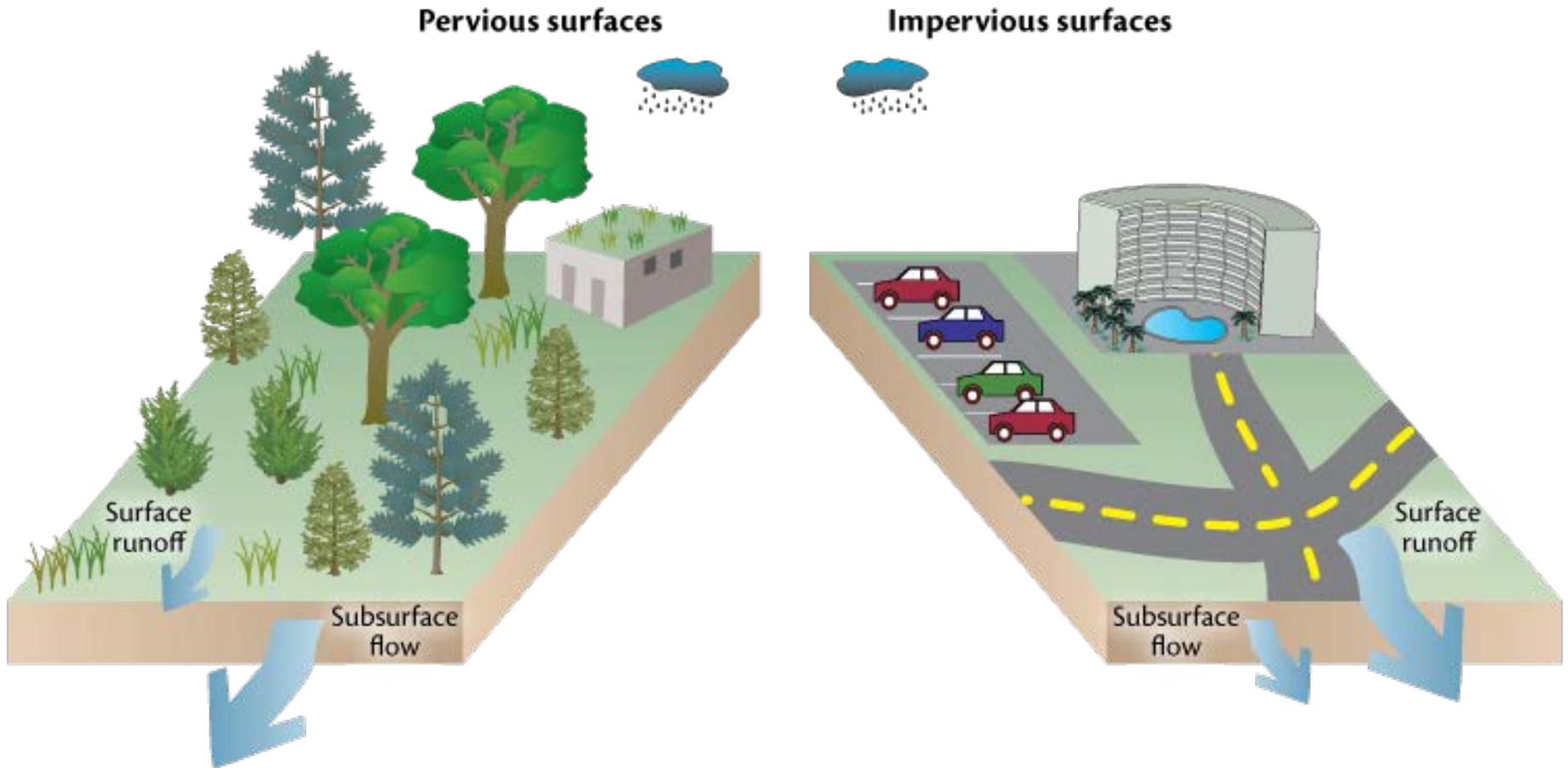
Imp. Value



Copyright © Robert O'Brien



INCREASED STORMWATER RUNOFF



INCREASED STORM DAMAGE



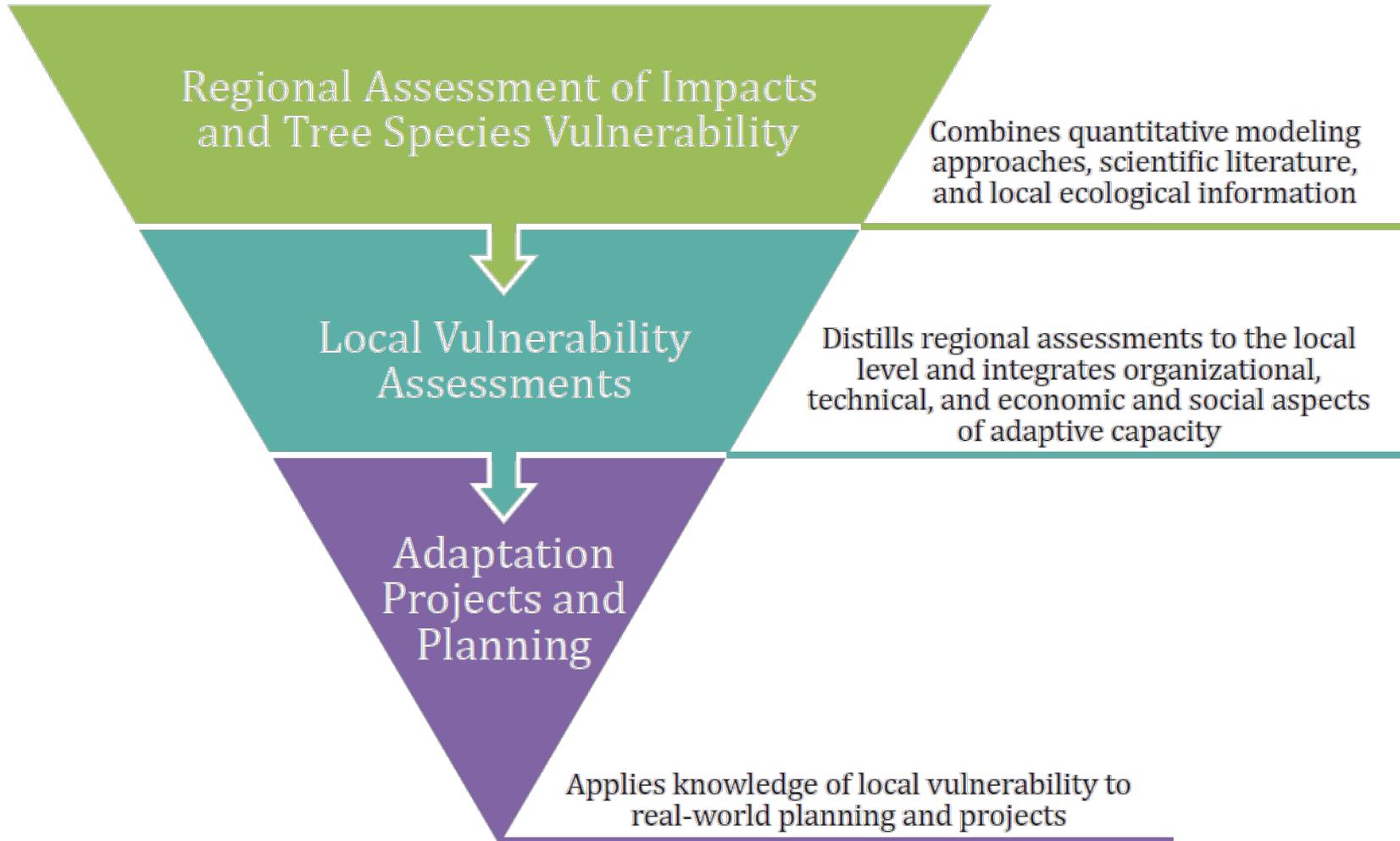
CHANGES IN PEST, DISEASE OUTBREAKS



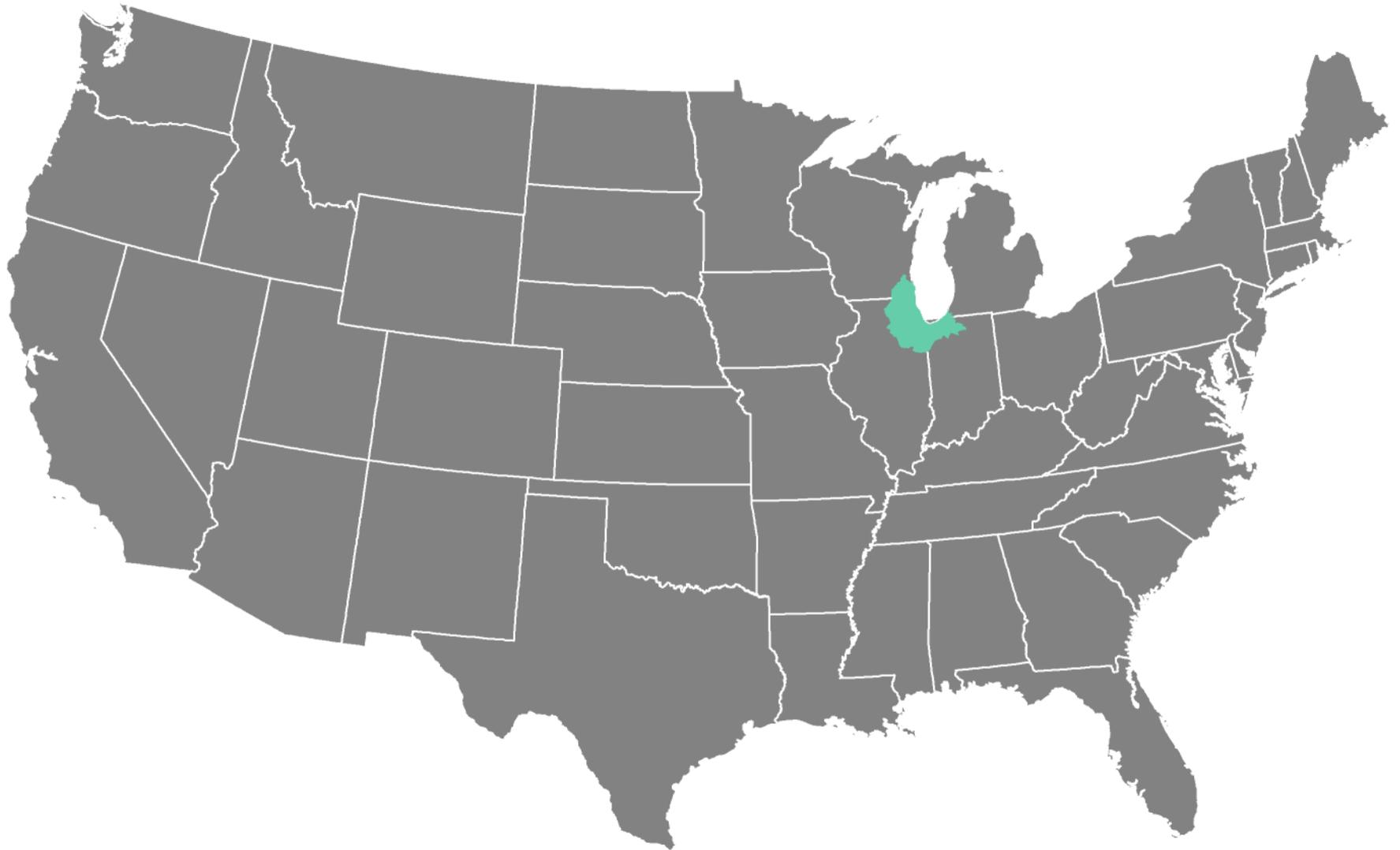
TAKING ACTION

URBAN FORESTRY

CLIMATE CHANGE RESPONSE FRAMEWORK



PILOT URBAN AREA: CHICAGO WILDERNESS



KEY PARTNERS



CHICAGO
REGION
TREES
INITIATIVE

Our Trees.
Our Communities.
Our Future.



GREENING Infrastructure



Climate ACTION

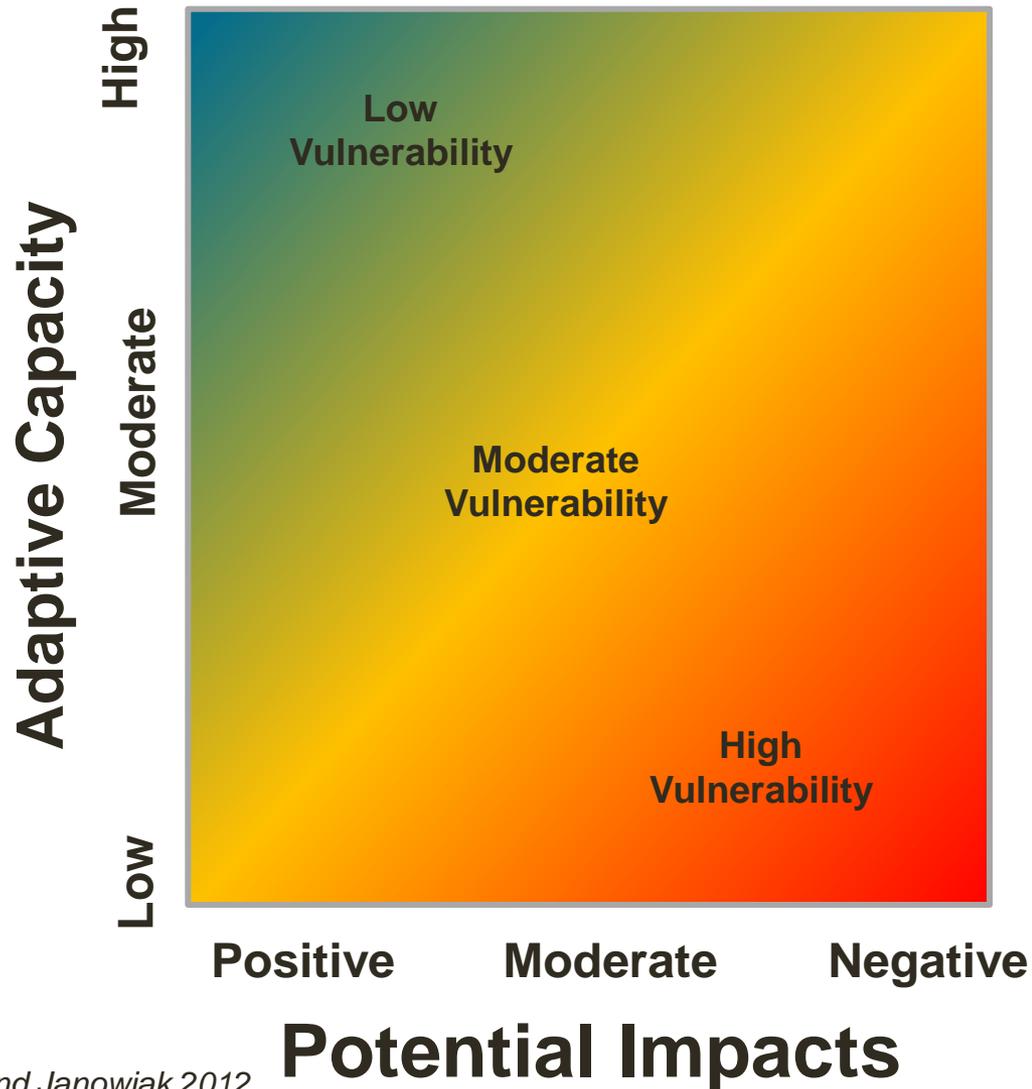


URBAN FRAMEWORK APPROACH

Regional Assessment of Impacts
and Tree Species Vulnerability

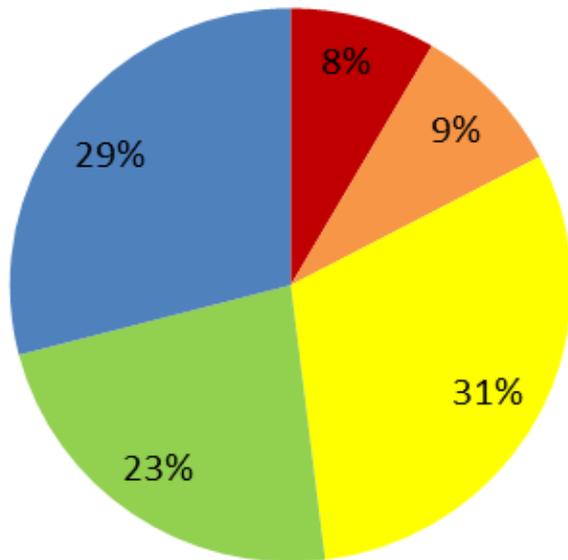
Combines quantitative modeling
approaches, scientific literature,
and local ecological information

VULNERABILITY

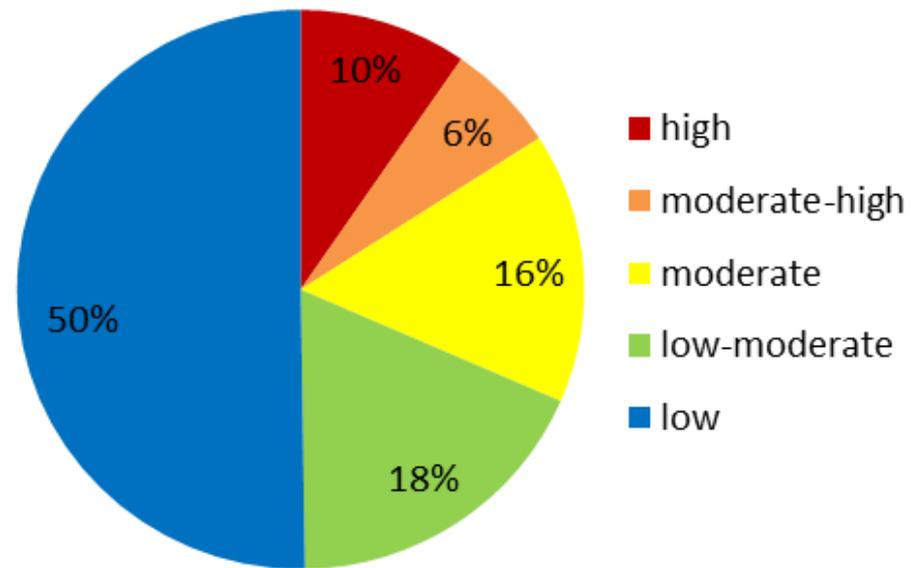


ASSESSMENT RESULTS

species



of trees



WINNERS AND LOSERS

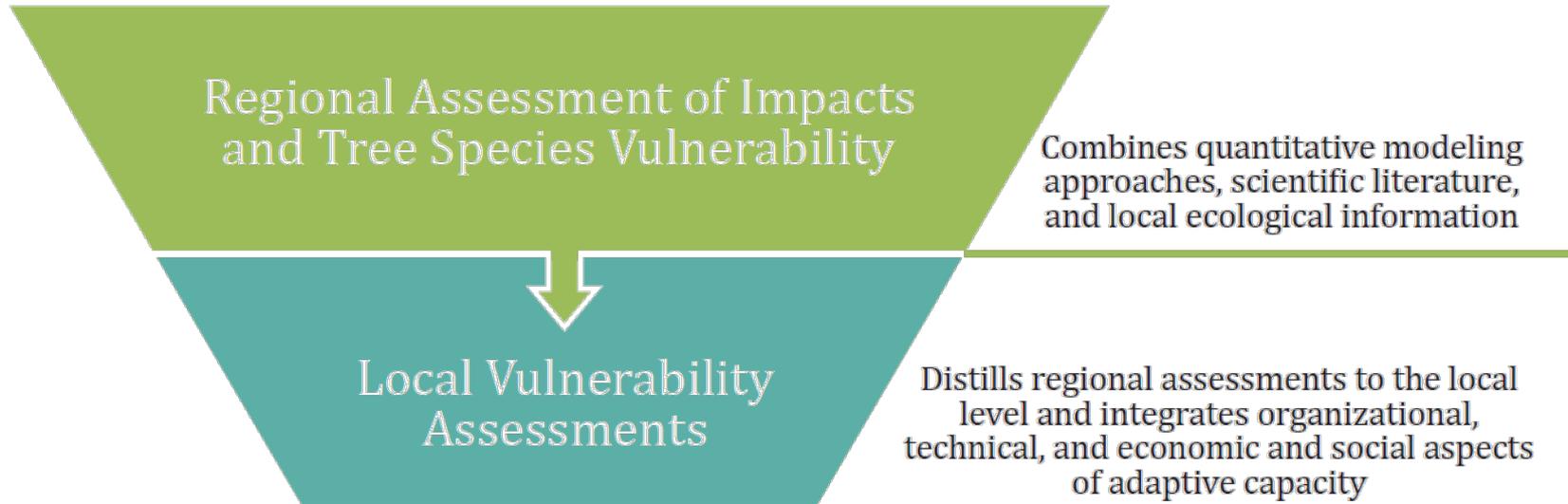
Most Vulnerable

- Balsam Fir
- Black Cherry
- Eastern Hemlock
- Paper Birch
- Quaking Aspen
- White Pine
- White Spruce

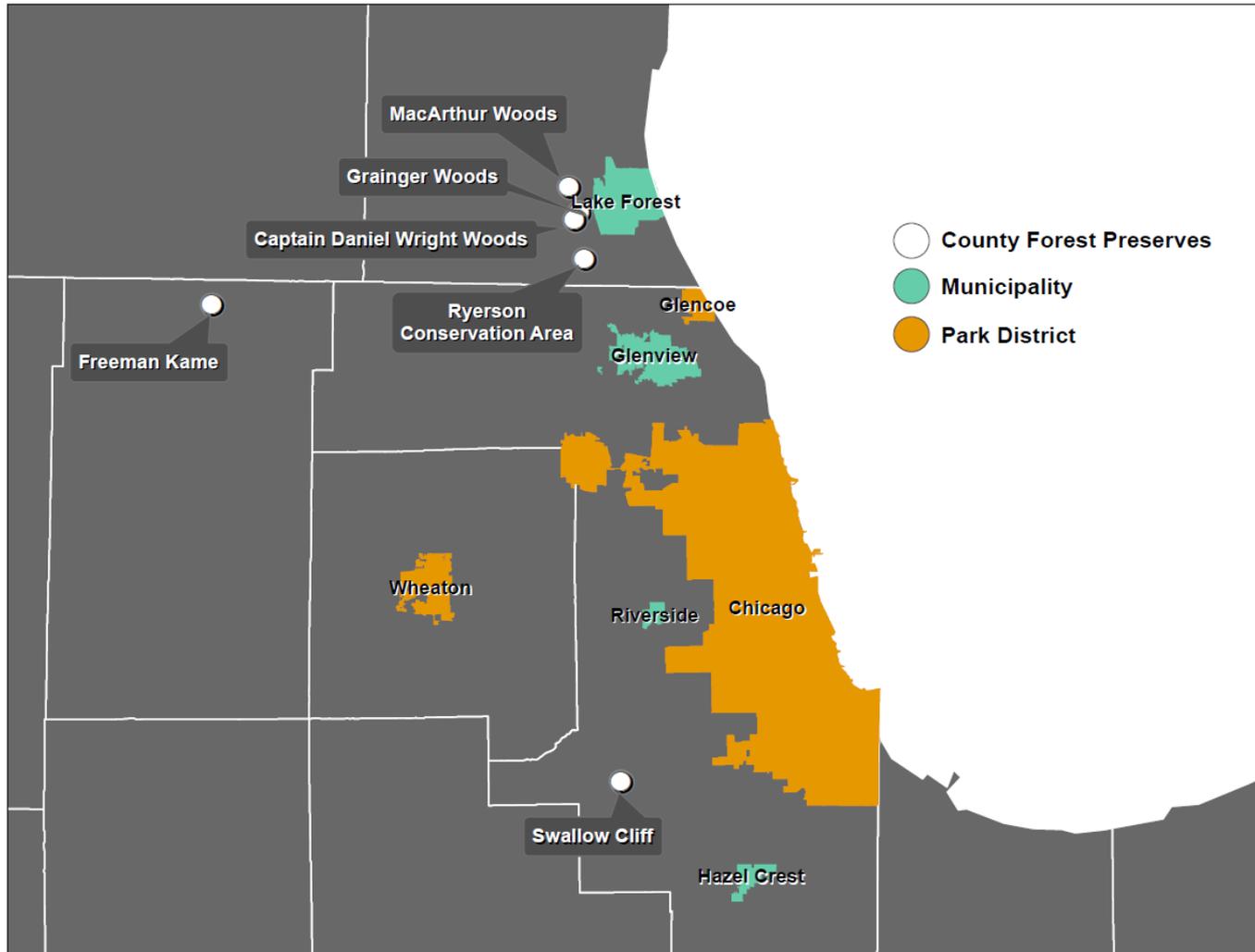
Least Vulnerable

- Amur Honeysuckle (invasive)
- Black Locust
- Boxelder
- Bur Oak
- European Buckthorn (invasive)
- Hackberry
- Tree-of-Heaven (invasive)

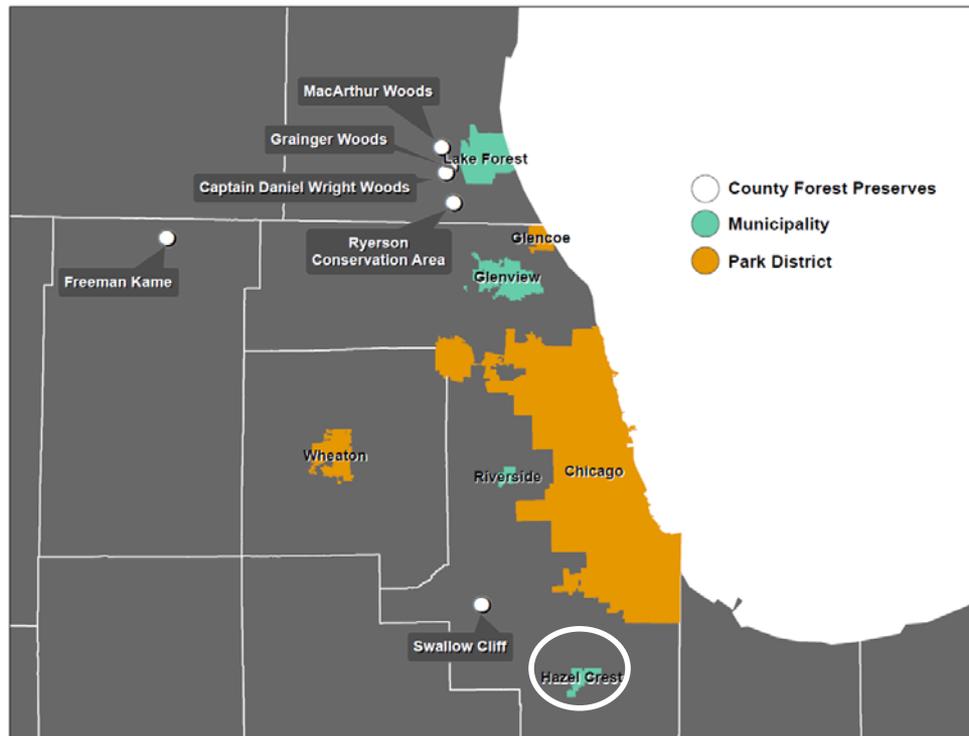
URBAN FRAMEWORK APPROACH



PILOT COMMUNITIES



HAZEL CREST



HAZEL CREST

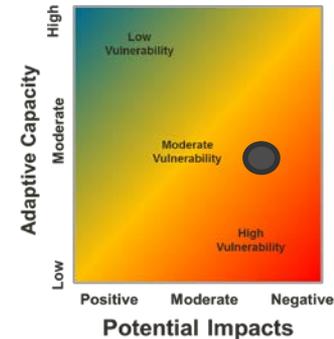
Moderate-High Vulnerability

Impacts:

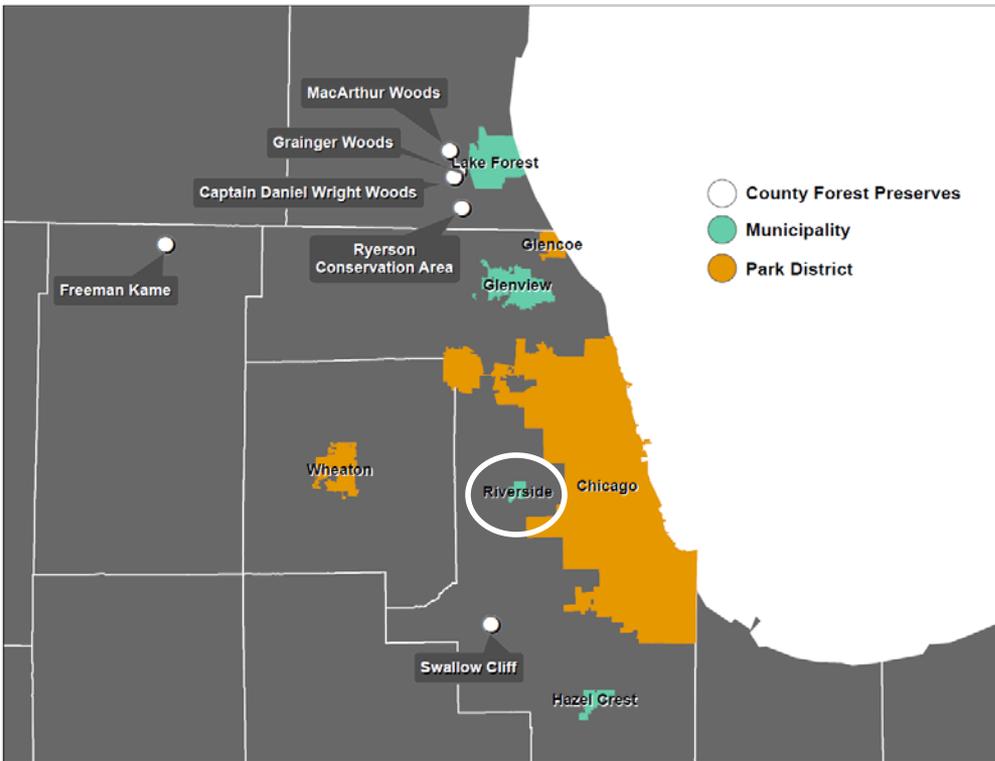
- Well-drained soils in most areas-drought susceptible. -
- Silver maple-dominated (vulnerable to wind storms). -
- Open lands in low-lying areas (flood prone). -

Adaptive Capacity:

- ISA-certified arborist on staff. +
- Low canopy diversity. -
- Lower financial resources (relatively low-income area). -
- Not a lot of community support for tree care, planting. -



RIVERSIDE



RIVERSIDE

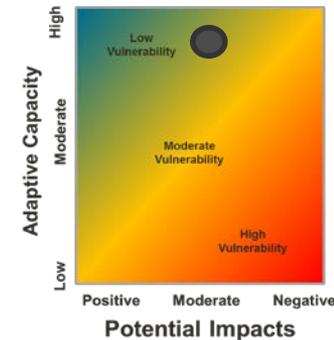
Low-Moderate Vulnerability

Impacts:

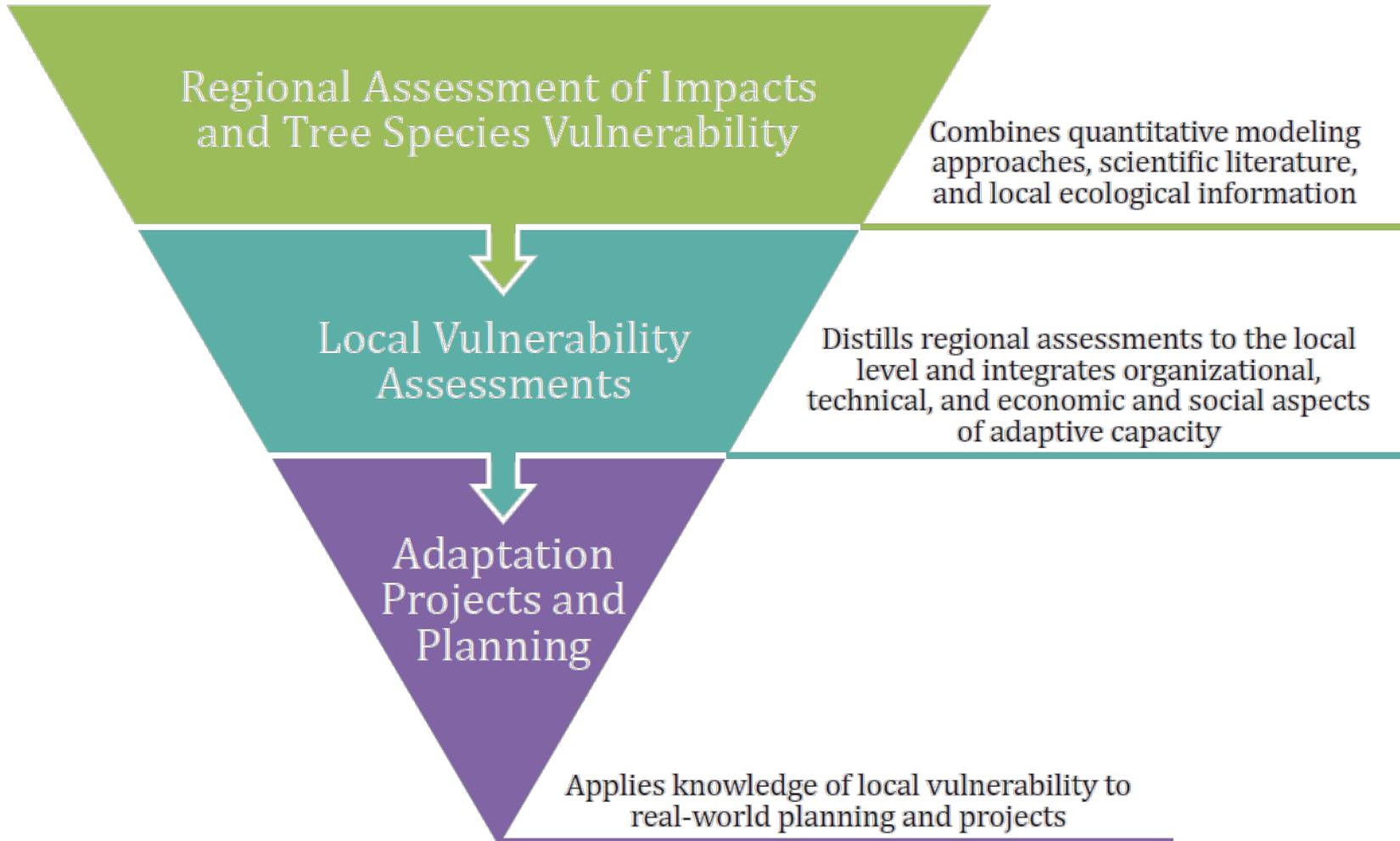
- Divided into two distinct areas:
 - South side: well-drained soils, trees more vulnerable to wind storms -
 - North side: compacted soils with high clay content -
- Deer herbivory and invasive species are both problematic.-
- Many oak species that could be susceptible to increased pest and disease pressure. -

Adaptive Capacity:

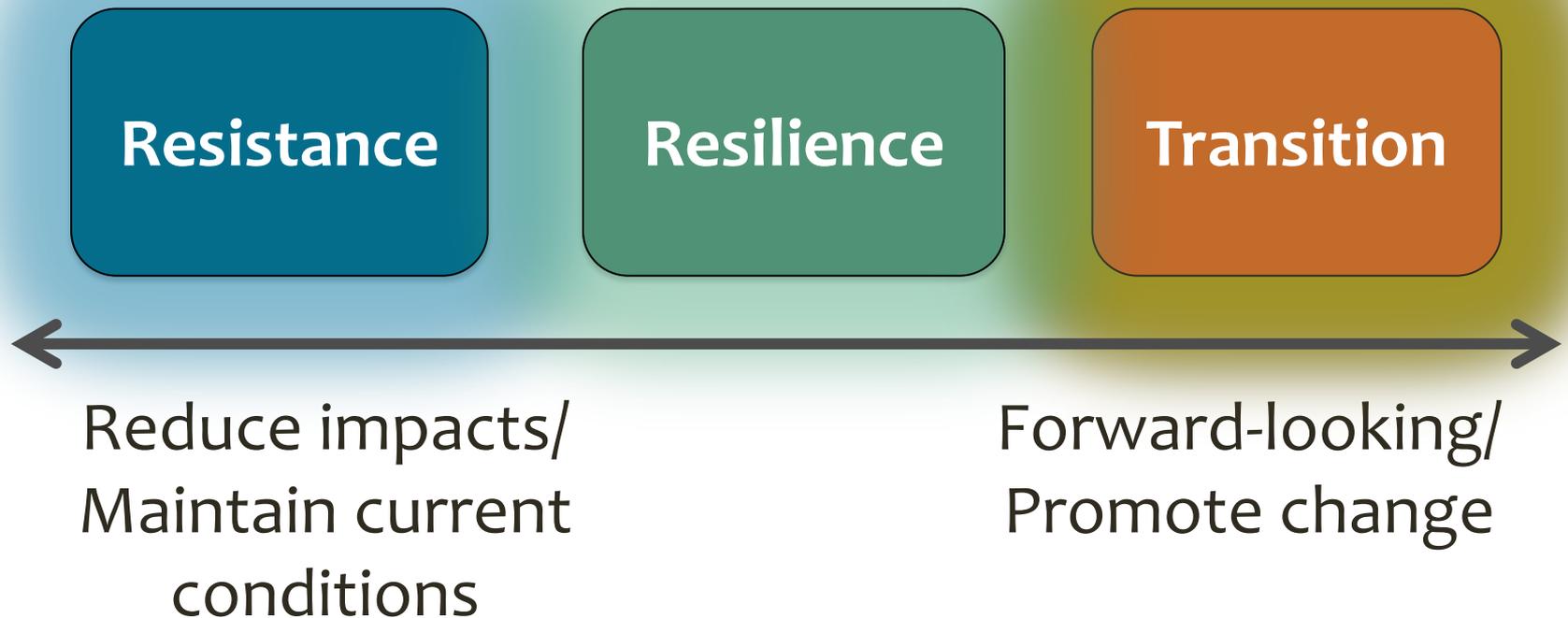
- National Historic Landscape District, Frederick Law Olmsted Design. +
- Trained forestry staff with planting list and long-term plan. +
- Diverse species, genotypes, age classes. +



URBAN FRAMEWORK APPROACH



ADAPTATION OPTIONS



RESISTANCE EXAMPLES



Preventing herbivory



Preventing winterburn



Controlling flooding with french drains



Watering

RESILIENCE EXAMPLES



Enhancing biodiversity



Installing rain gardens



Prescribed fire

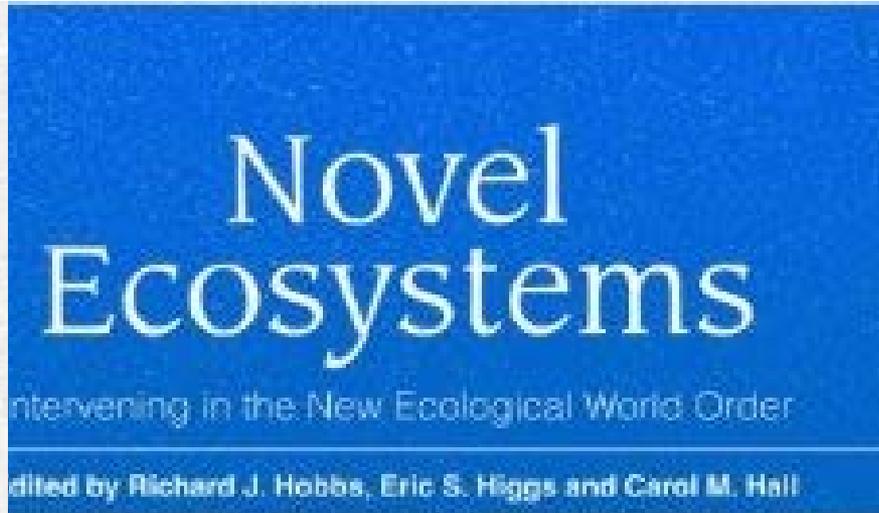


Pruning

TRANSITION EXAMPLES



Enhance connectivity for migration

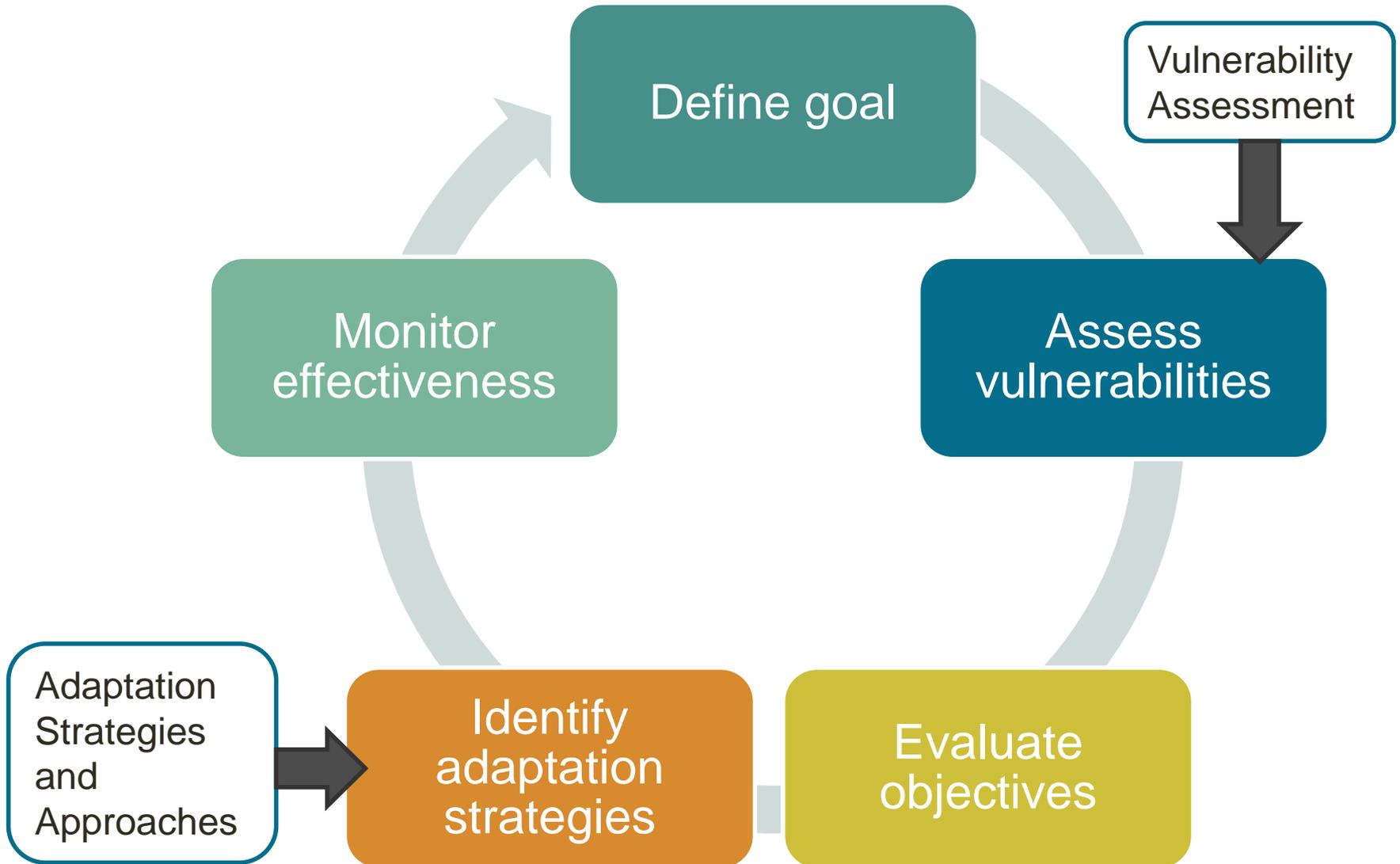


Promoting New species assemblages

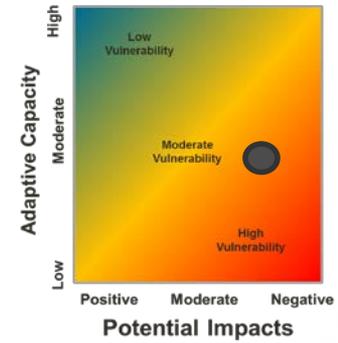
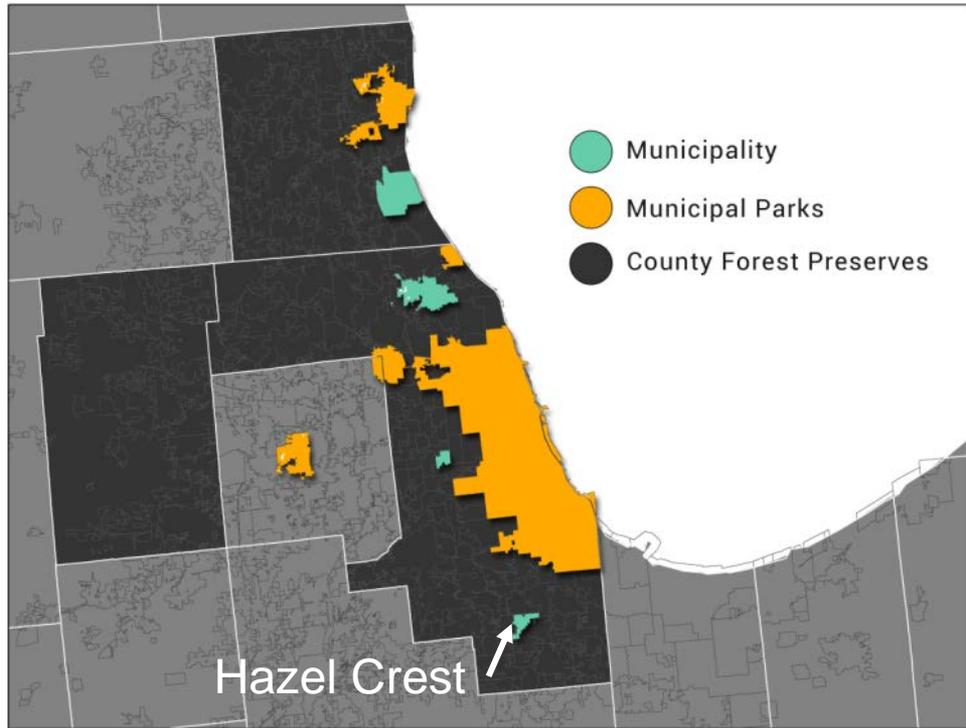


Planting future-adapted seedlings

FOREST ADAPTATION RESOURCES: ADAPTATION WORKBOOK



HAZEL CREST



ADAPTATION TACTICS

Minimize or
eliminate flooding

Increase
biodiversity

Select
future-adapted
tree species

Resistance

Resilience

Transition



Reduce impacts/
Maintain current
conditions

Forward-looking/
Promote change

CONTROLLING FLOODING WITH DRY WELLS

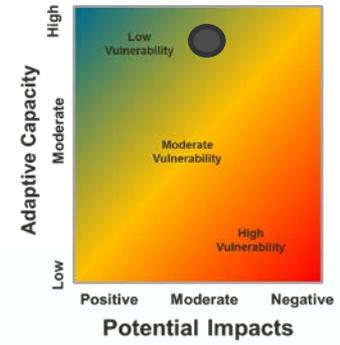
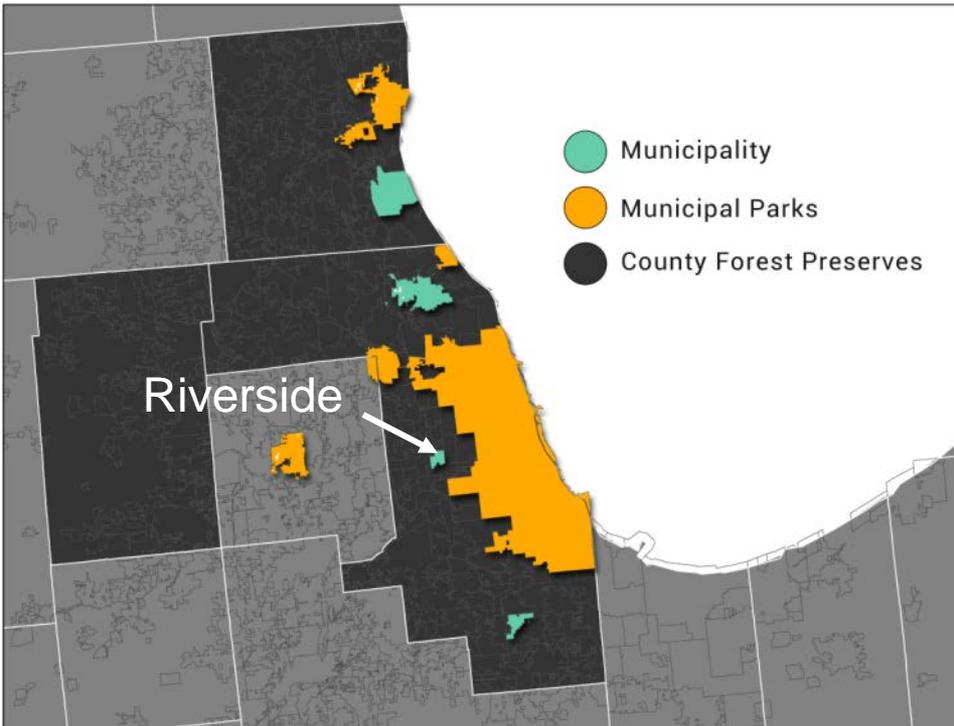


Planting Shumard
Oak over Dry Well

PLANTING FLOOD-TOLERANT TREES



RIVERSIDE



ADAPTATION TACTICS

Remove
invasive
species

Restore fire to
fire-adapted
systems

Plant
tree species from
southern climates

Resistance

Resilience

Transition



Reduce impacts/
Maintain current
conditions

Forward-looking/
Promote change

REMOVE INVASIVE BUCKTHORN



PLANT FUTURE-ADAPTED SPECIES



Pecan

Bald Cypress



PILOT OUTCOMES

- ✓ Increased knowledge of local climate change impacts.
- ✓ Structured process to incorporate climate considerations.
- ✓ Greater familiarity with adaptation concepts.
- ✓ Empowerment: everyone can do something.

“This is a great process to go through. It breaks from the typical “Putting out fires” philosophy” –participant evaluation

“I think that the climate change topic can be intimidating and that many urban foresters will think there is nothing they can do. [We are] connecting how their current practices are actually a step in the right direction.” –participant evaluation

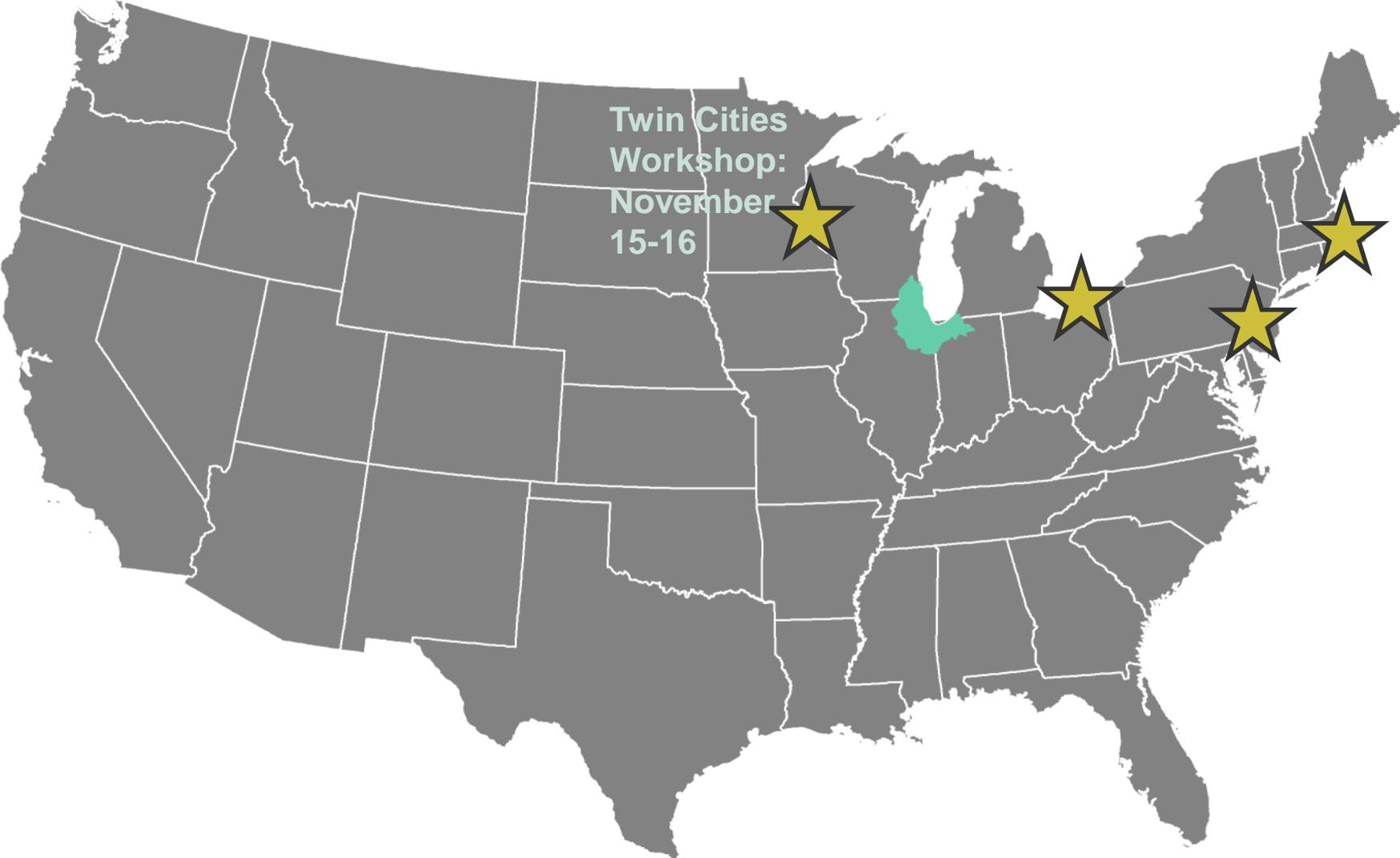
LESSONS LEARNED

- ✓ We cannot assess vulnerability without a good inventory or estimate of what's there
- ✓ Large number of cultivars and non-natives adds challenges
- ✓ Small communities with no trained forestry staff may be the most vulnerable
- ✓ Many communities are already adapting

SUMMARY

- Climate is already changing and more changes are likely in store.
- Our urban forests are already experiencing stress and these stresses will be amplified.
- We can adapt to these changes by increasing resistance, building resilience, and designing future-adapted responses.

PROJECT EXPANSION: 2016



LEARN MORE

www.forestadaptation.org

The screenshot displays the website's navigation menu with the following items: Home, Our Approach, Projects, Demos, Products, Partners, Resources, and Contact. The 'Projects' section is expanded to show a list of regional and urban projects: Central Appalachians, Central Hardwoods, Mid-Atlantic, New England, Northwoods, and Urban. The 'Urban' project is highlighted in a darker green. To the right of the navigation menu, there are four colored buttons: Partnerships (yellow), Vulnerability Assessment (orange), Forest Adaptation Resources (teal), and Demonstration Projects (light green). A photograph of trees and a skyscraper is visible to the right of these buttons. Below the navigation menu, the 'Urban' section is detailed with the following text and list:

Urban

Urban forests will experience local climate change impacts in the coming decades. To reduce these impacts, urban forest managers will need to adapt their management, but often lack the specialized knowledge and tools to do so.

The overall goal of this effort is to ensure that urban forests will continue to provide benefits to the people that live in urban communities as the climate changes. The Urban Forestry Framework project is in the beginning stages of planning and development. We are seeking urban forestry professionals from variety of organizations, both public and private, to work toward this goal by accomplishing the following objectives:

- Engage with communities across the Northeast, Mid-Atlantic, and Midwest that are interested in adapting their urban forest management to climate change.
- Work with these communities to assess the vulnerability of their urban forests to climate change.

The map shows the outline of the United States, with the Northeast, Mid-Atlantic, and Midwest regions shaded in light gray. The city of Chicago is highlighted in a darker gray within the Midwest region.

lbrandt@fs.fed.us