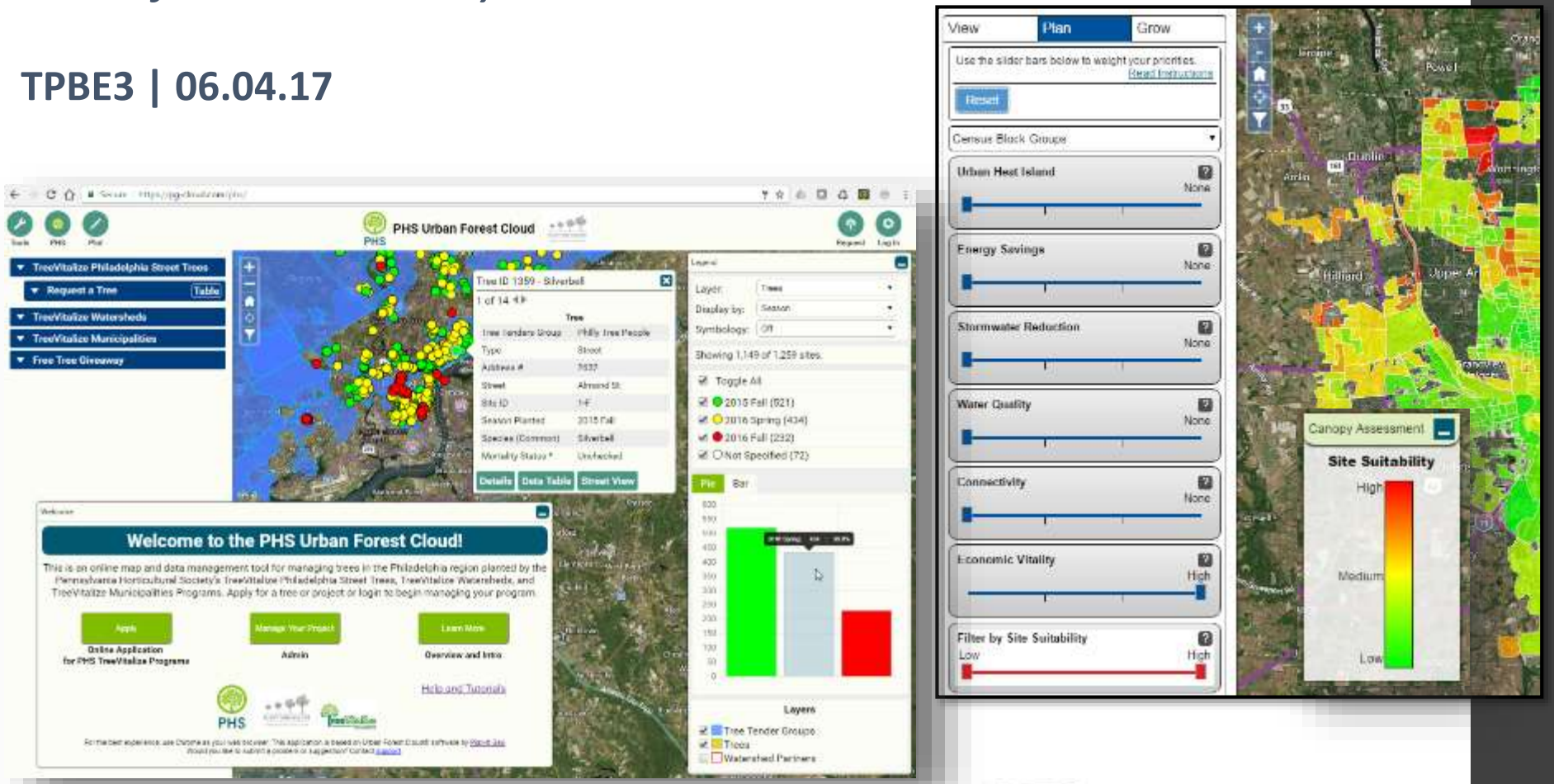
Putting Geospatial Assessment Tools to Use Online:

How Cities Prioritize Livability and Health Outcomes through the Lens of Urban Forestry

TPBE3 | 06.04.17



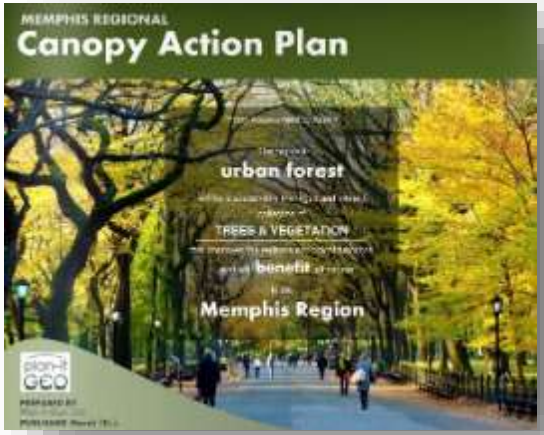
Paper is in peer review by Cities and the Environment (CATE) journal

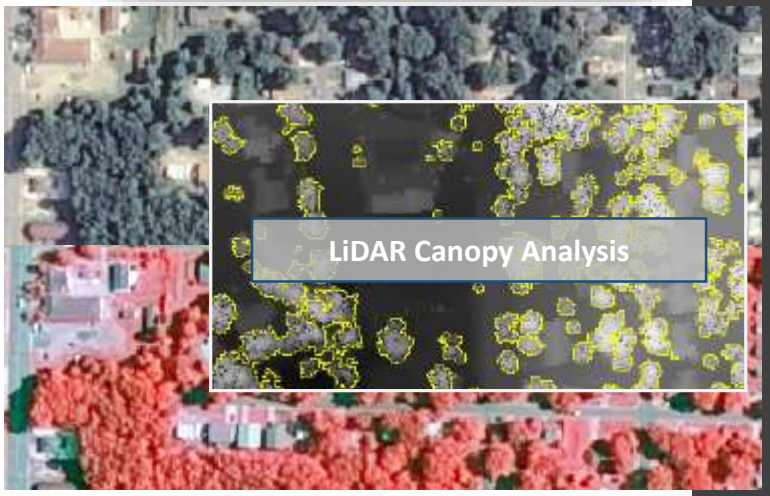
plan-it GEO

Presented by:
Ian S. Hanou

Technology & Trees

- **Software: Urban Forest Cloud**
  - Web, mobile, and desktop
  - Subscription and custom tools
  - 100+ software clients/users
- GIS/RS Canopy Analysis
- Ecosystem Services Analysis / i-Tree
- Tree Inventory & Risk Assessment
- Management Plans





Founded 2012, offices in CO, CA, PA, NC

Introduction / Agenda

- **The Geospatial Urban Forest** … tree inventory and Urban Tree Canopy (UTC) assessment
- **Technology** … achieve greatest return on investment from efficiency to assess, manage, plan, track, and monitor the urban forest
- **Applications** … outreach, manage, plan, monitor, prioritize, track work and programs, visualize & quantify o**UTC**omes
- **Case Studies** … benefits, considerations, and impacts of developing online urban forestry data and prioritization tools; evolving roles & recommendations

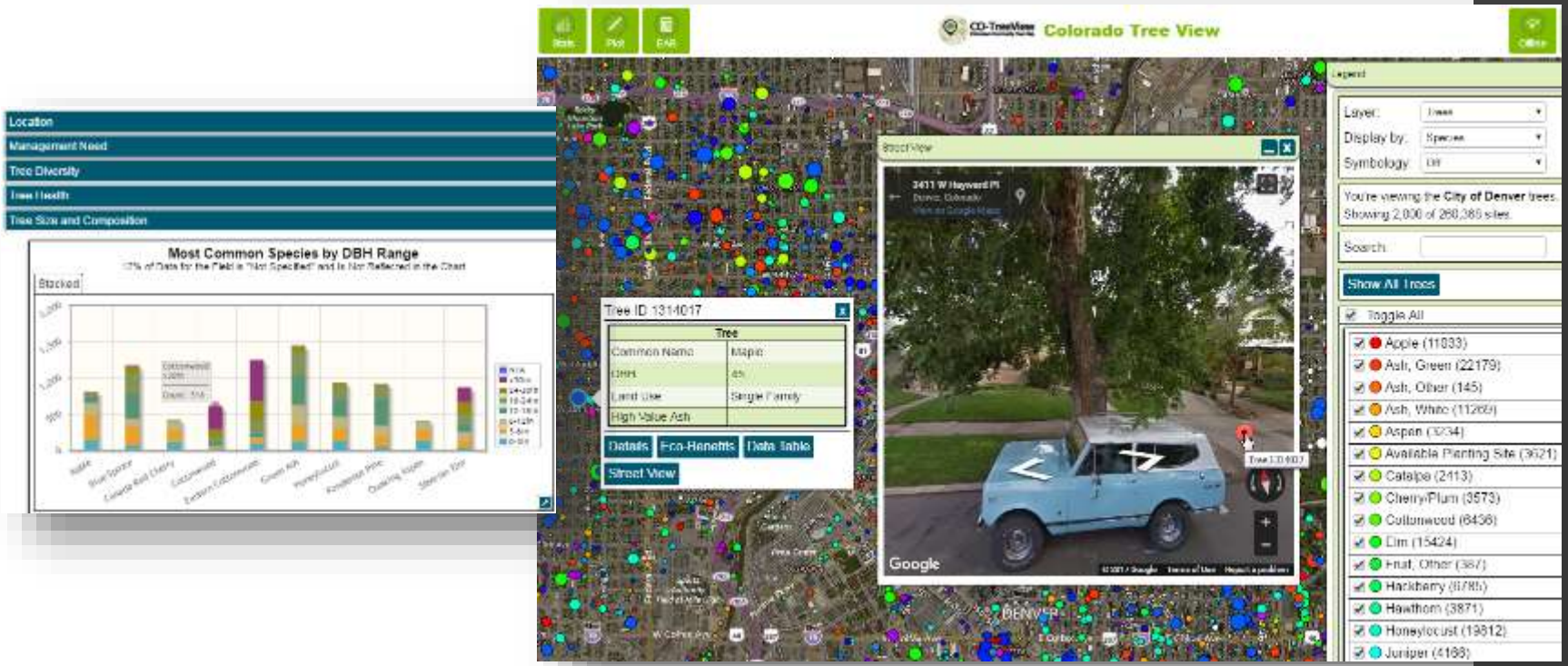
An Explosion of Online Urban Forestry Tools

- **CanVis** and **C-CAP Land Cover Atlas** (NOAA Digital Coast)
- **Cool-Connect-Absorb** (Trust for Public Land)
- **UTC Mapper** (Virginia Tech)
- **Health Impact Assessment** (US Environmental Protection Agency)
- **Healthy Trees, Healthy Cities** (The Nature Conservancy)
- **i-Tree Suite** (USDA Forest Service, Davey Institute, etc.)
- **Open Tree Map** (Azavea)
- **STEW-MAP** (Center for Neighborhood Technology/US Forest Service)
- **Trees and Health** (Portland State University)
- **Urban Forest Cloud: Tree Plotter and Canopy Planner** (Plan-It Geo)

Impact on outcomes …
change in culture and outreach …
recommendations for practitioners …

Tree Inventories: Moving Online

- 67% of U.S. cities have some inventory; 83% computerized systems (Hauer, Peterson 2015)
- Collect, share, and analyze data from anywhere in real-time
- Public or private property (crowdsourced)
- Manage trees, planting activities, volunteers, work orders, and UTC data without knowing you're "doing GIS" (Hanou 2016)



Tree Canopy Assessment: Moving Online

- Geospatial analysis of urban tree canopy (UTC) and potential planting areas using LiDAR, multispectral imagery, and GIS inputs
- A key performance metric and indicator for environmental health
- Identify partners, funding, stewardship, needs, and priorities
- Majority of canopy/planting space on private land (O'Neil-Dunne 2009)
- Direct outreach, policy, and management for greatest impact on community sustainability, equity, access, and environmental goals

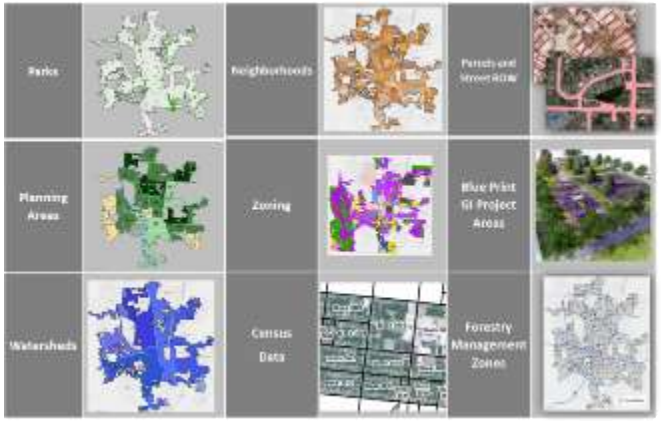
oUTComes

"UTC prioritization works by matching known benefits of trees, to places lacking those benefits, and then matches those locations to organizations positioned to manage those issues that trees help to ameliorate." (Locke et al. 2013)

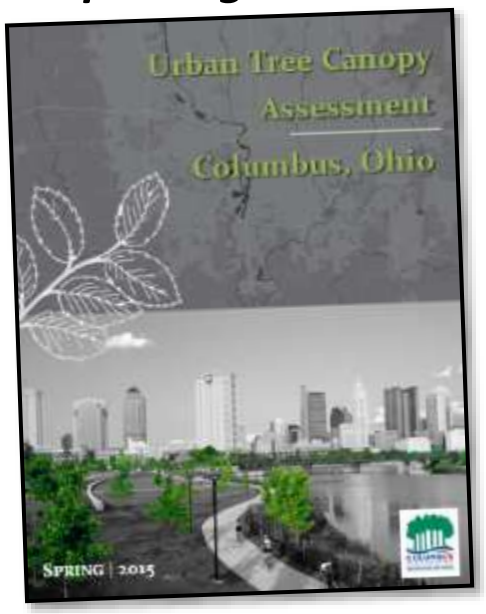
Tree Canopy Assessment Components

Land cover mapping

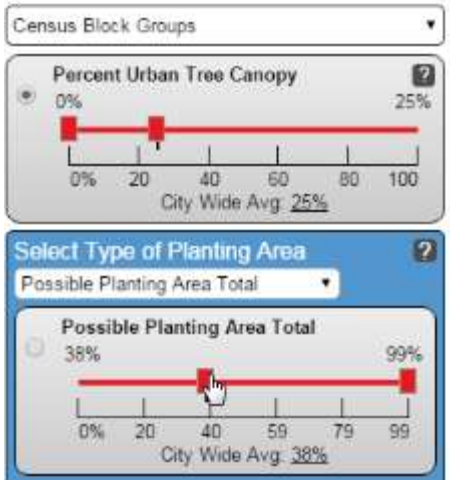
Maps & Metrics

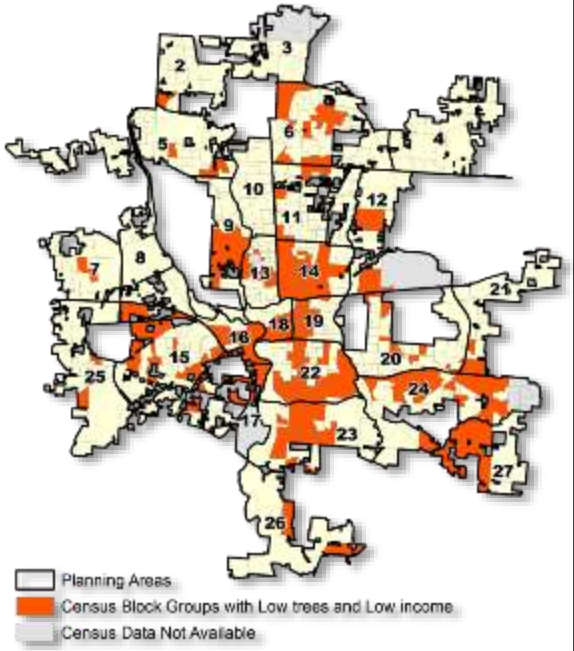


Reporting



Analysis Tools

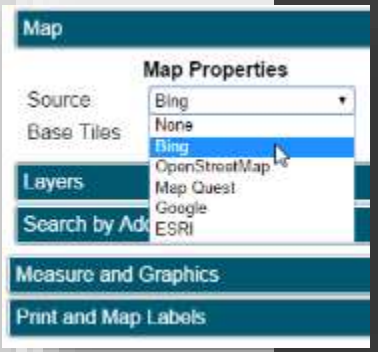




Tech & Software Overview

Intro
Tech Overview
Case Studies
Summary

- Software as a Service (SaaS)
- Browser and Cloud-based vs. Native App
  - URL, no install or other GIS/GPS software
- Mobile (tablet/smartphone, on or offline)
- GIS and map-based
  - Place tree / work order location on imagery
  - Base maps to choose from
  - No GPS required
- Open source technologies
- Administer users/permissions
- Open data sources/considerations



Case Studies (CS #1-5)

Baton Rouge Green

PHS Pennsylvania Horticultural Society

Branch Out Columbus
300,000 Trees by 2020
We Need Trees, Trees Need Us

Plant One Million
3 states. 13 counties. 1 tree at a time.
PlantOneMillion.org

Portland State University

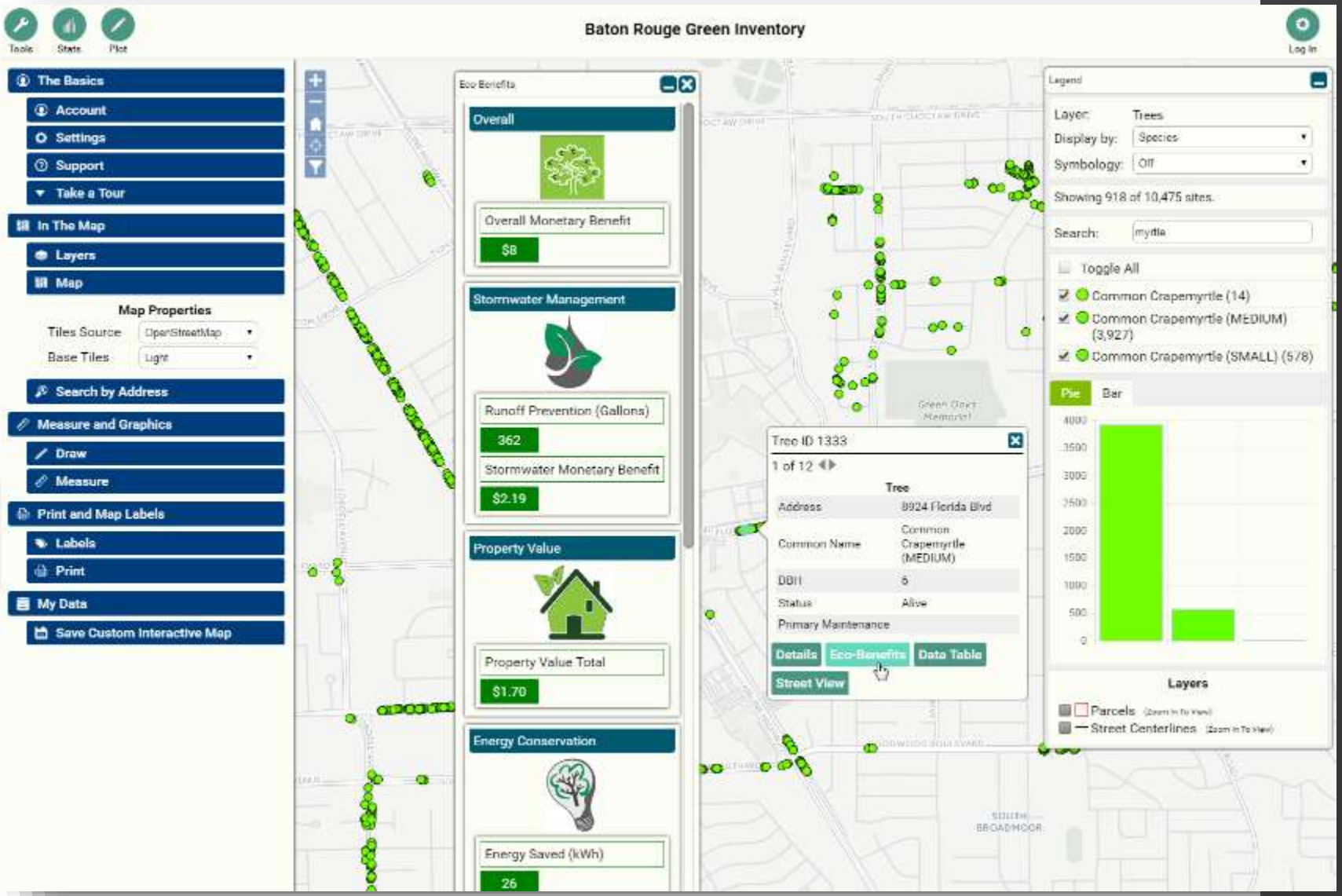
Sustaining Urban Places Super Research Laboratory

keep Indianapolis beautiful INC.

CS #1: Baton Rouge Green

- Relationship b/w government and nonprofit
- >10,000 trees tracked in online map; share urban forest data and quantify ecosystem services
- LADOTD highway ramp relocation; 110 crape myrtles, area with low canopy. Had data and tool to show the values:
  - *Stormwater regulation (79,206 gallons/year), air pollution removal (84 lbs./year), carbon storage (12,101 lbs.), and carbon sequestration (5,660 lbs./year)*
- Letter: advocating for smart development and appropriate conservation of UTC; zero net loss and 3:1 replacement ratio
- BRG justified their role in protection/mitigation plans by sharing their experience/qualifications using the tool

CS #1: Baton Rouge Green



CS #2: Pennsylvania Horticultural Society

- Founded 1827, greening, education, plant and care for trees
- Programs: Tree Tenders, Plant One Million, riparian, tree giveaway, Tree Checkers maintain, monitor, and report their tree health
- Tree and project data was historically managed and reported in 26 spreadsheets; cumbersome/tedious upkeep

PHS PENNSYLVANIA HORTICULTURAL SOCIETY

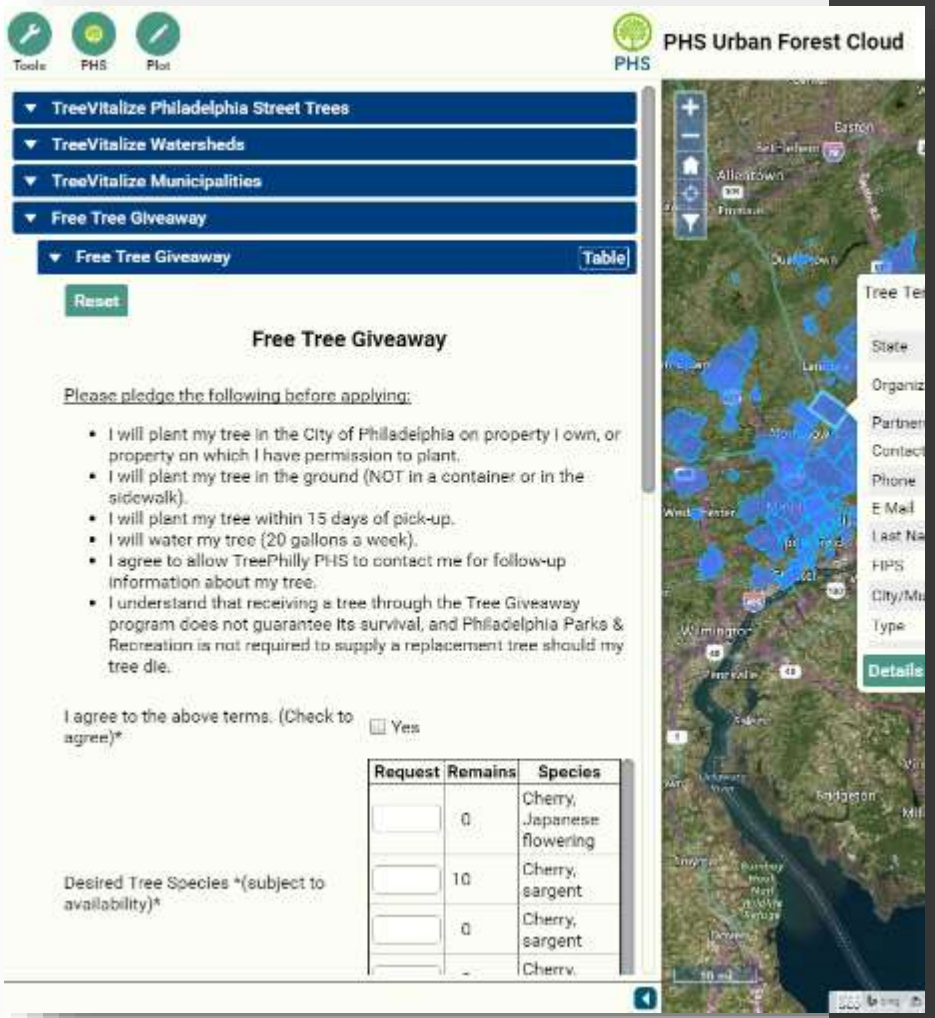
PLANT ONE MILLION

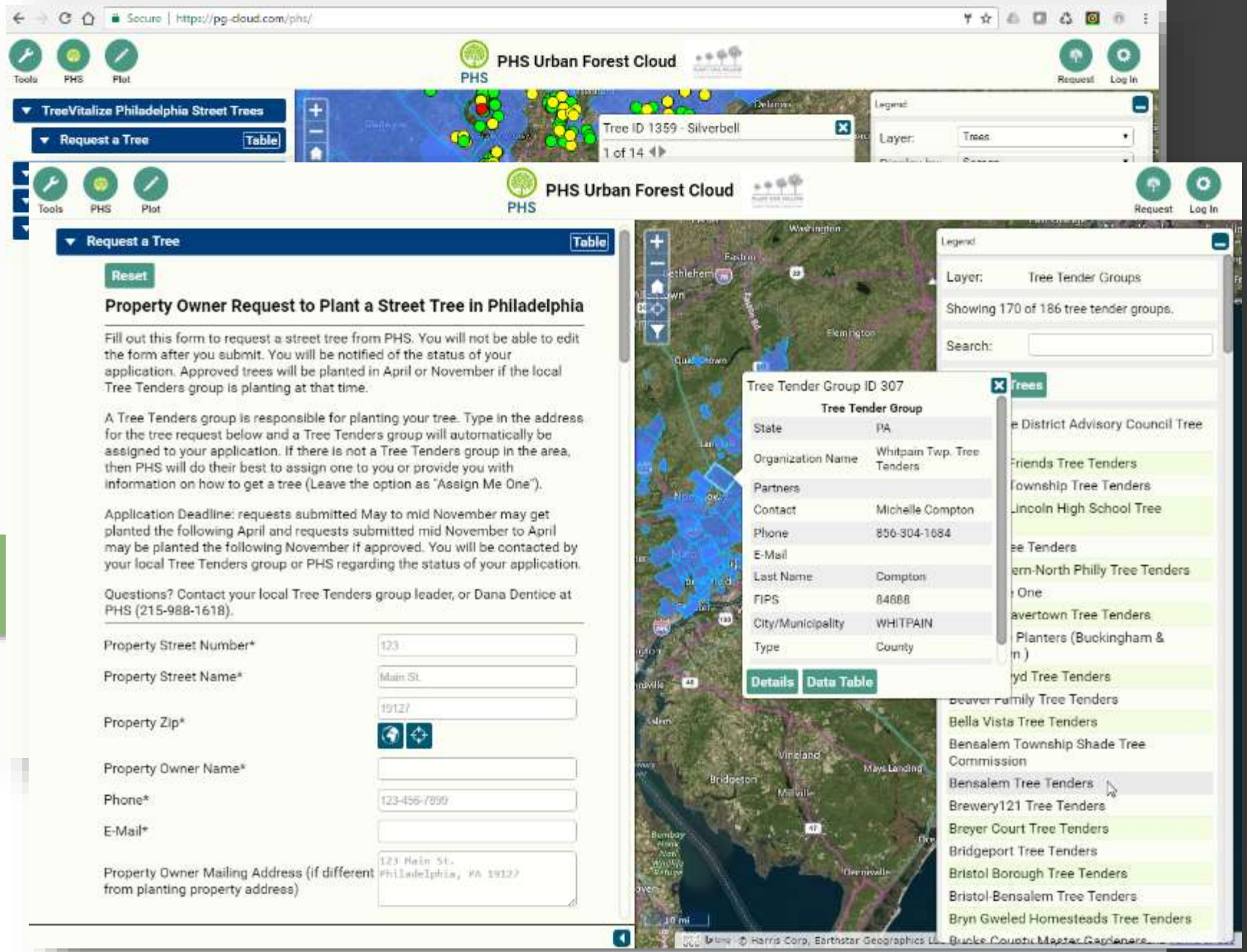
3 states. 13 counties. 1 tree at a time.

PlantOneMillion.org

PHS Urban Forest Cloud: a browser-based map and database application

- Streamline collecting/managing tree health monitoring data and new planting requests
- From paper forms or spreadsheets → smartphones or tablets
- More convenient for Tree Tenders to sign-up neighbors
- Easier permit process w/City of Philadelphia. In 1st season, 1/3 of planting applications were via the UFC
- Attach a photo while inspecting trees in the field
- Central data location and standard format
- Dashboard summarizes results, species mix, health metrics, etc.

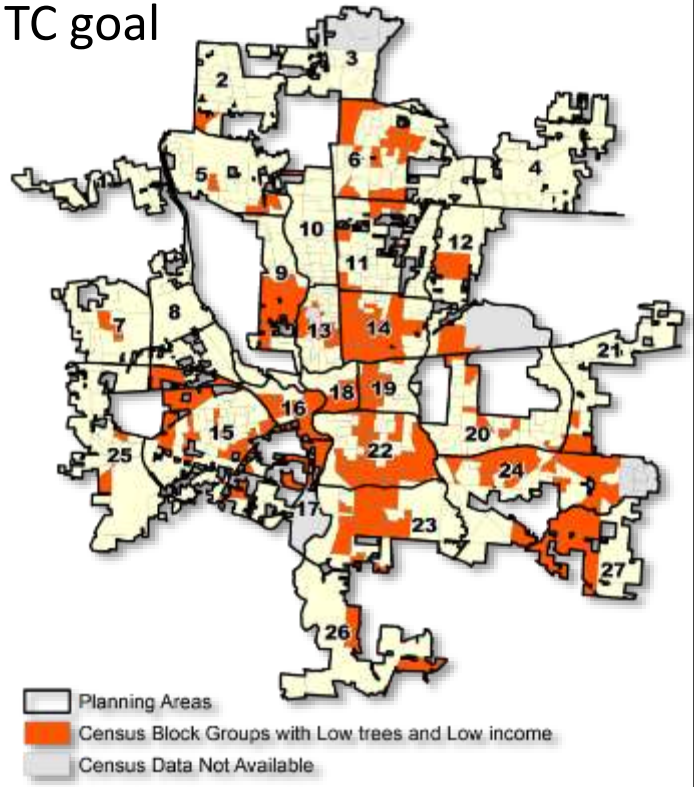



PHS Urban Forest Cloud
TreeVitalize Philadelphia Street Trees
Request a Tree
Table
Reset
Property Owner Request to Plant a Street Tree in Philadelphia
Fill out this form to request a street tree from PHS. You will not be able to edit the form after you submit. You will be notified of the status of your application. Approved trees will be planted in April or November if the local Tree Tenders group is planting at that time.
A Tree Tenders group is responsible for planting your tree. Type in the address for the tree request below and a Tree Tenders group will automatically be assigned to your application. If there is not a Tree Tenders group in the area, then PHS will do their best to assign one to you or provide you with information on how to get a tree (Leave the option as "Assign Me One").
Application Deadline: requests submitted May to mid November may get planted the following April and requests submitted mid November to April may be planted the following November if approved. You will be contacted by your local Tree Tenders group or PHS regarding the status of your application.
Questions? Contact your local Tree Tenders group leader, or Dana Dentice at PHS (215-988-1618).
Property Street Number*
Property Street Name*
Property Zip*
Property Owner Name*
Phone*
E-Mail*
Property Owner Mailing Address (if different from planting property address)
Tree ID 1359 - Silverbell
1 of 14
Layer: Trees
Tree Tender Group ID 307
Tree Tender Group
State PA
Organization Name Whitpain Twp. Tree Tenders
Partners
Contact Michelle Compton
Phone 856-304-1684
E-Mail
Last Name Compton
FIPS 84888
City/Municipality WHITPAIN
Type County
Details
Data Table
Layer: Tree Tender Groups
Showing 170 of 186 tree tender groups.
Search:
Bella Vista Tree Tenders
Bensalem Township Shade Tree Commission
Bensalem Tree Tenders
Brewery121 Tree Tenders
Breyer Court Tree Tenders
Bridgeport Tree Tenders
Bristol Borough Tree Tenders
Bristol-Bensalem Tree Tenders
Bryn Gweled Homesteads Tree Tenders

CS #3: Columbus, Ohio BranchOut Program

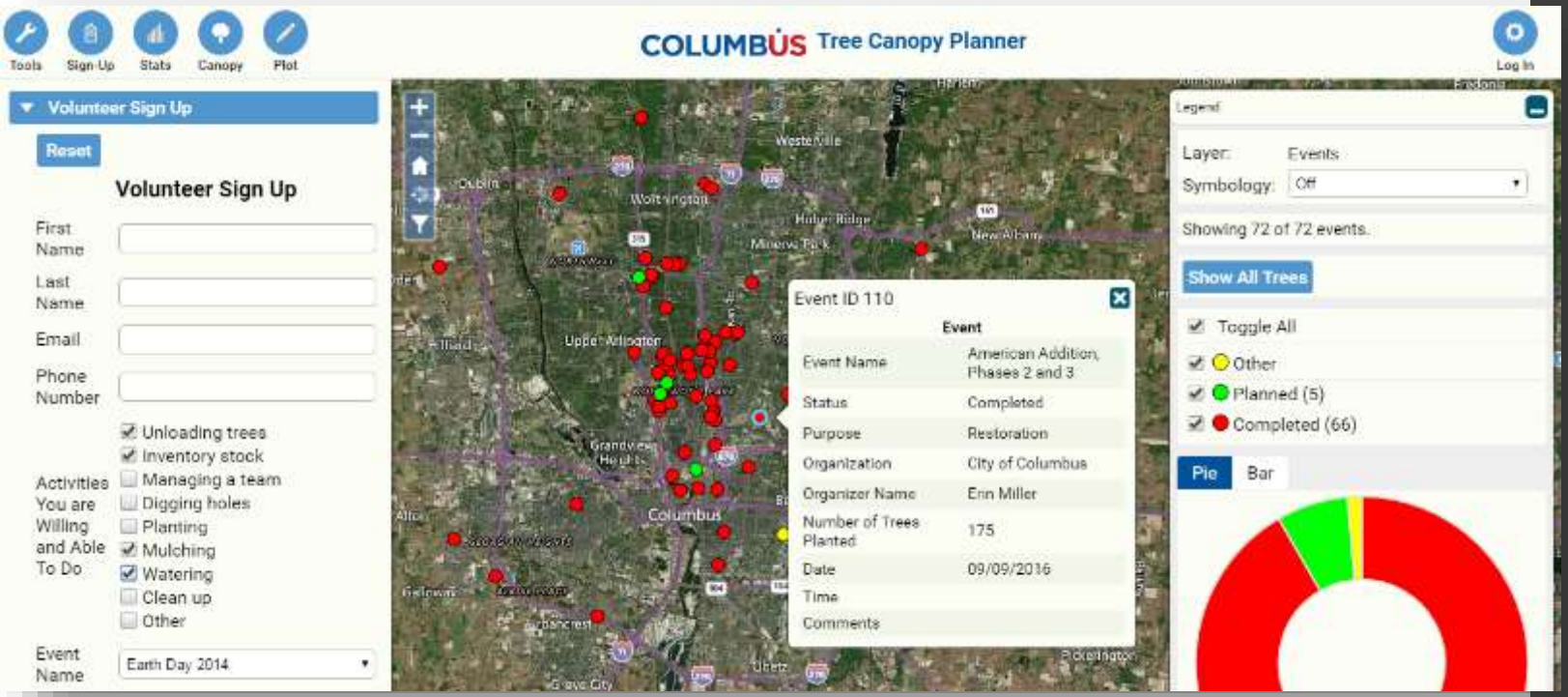
2015 Tree Canopy Assessment & Online Canopy Planner Tool

- U.S. Mayors Climate Protection Agreement (2007) and Green Team
- Greenspace Working Group (2012)
- Role of UTC in climate change and sustainability
- Est'd loss of 200,000 ash trees citywide (Emerald Ash Borer)
- Need for an outreach campaign and UTC goal

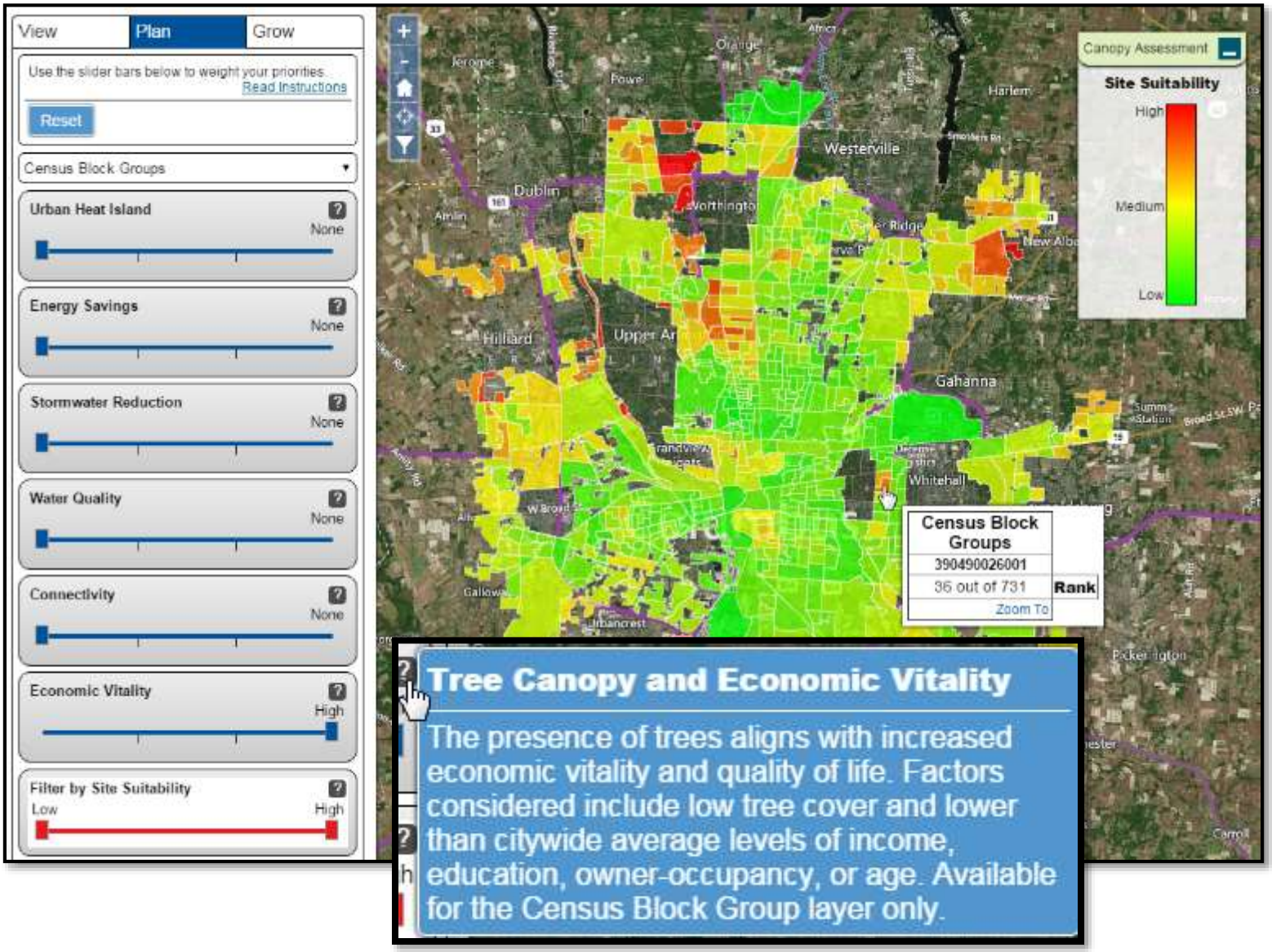


o**UTC**omes: buy-in, collaboration, and a framework

- ✓ Role of citizens, private property/partnerships
- ✓ 300,000 tree planting goal and 27% UTC goal
- ✓ Site-specific tracking tools and landscape-scale visualization of urban forest data online
- ✓ Proactive management, need for defined standards
- ✓ Watershed-scale assessment & planning



CS #3: Columbus, Ohio BranchOut Program



CS #4: Keep Indianapolis Beautiful

keep Indianapolis beautiful INC.

Mission: to engage diverse communities to create vibrant public places, helping people and nature thrive™

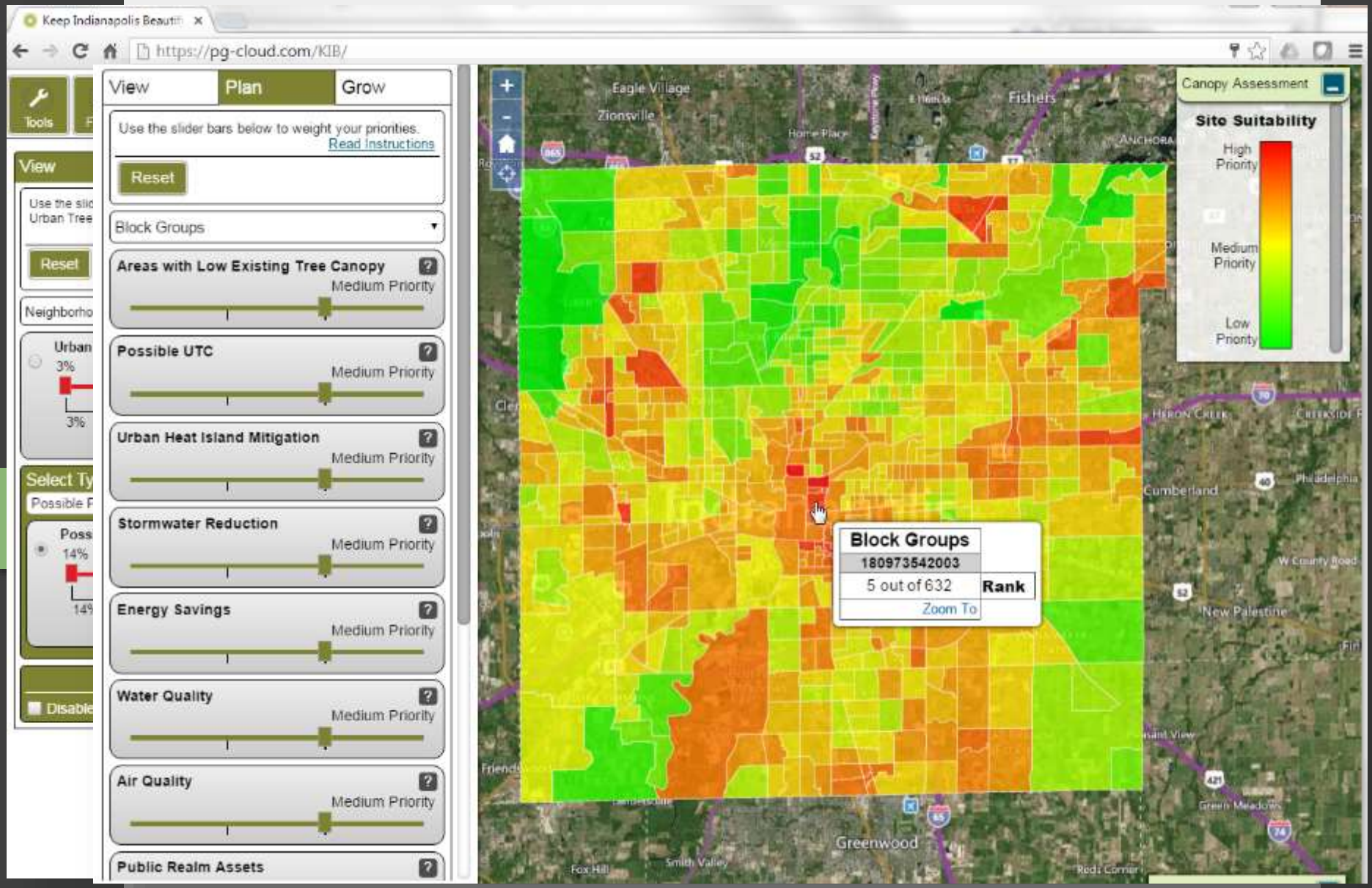
Background: 2006 hot spot priorities map: *tree canopy, impervious surfaces, industrial lands, traffic counts, childhood asthma, crime, and income*. Tracked plantings in GIS and stored nursery orders, projects, and volunteer info in MS Access. New strategic tool to identify overlapping initiatives, partners, be visible online, and educate. And build social capital and "tree culture"!

Phase 1: interactive hotspot & weighting app; overlay priorities on where we've been planting; criteria well-vetted by diverse board members; formulating a "health layer" is in-progress

- Increasing from 33% to 34% UTC requires 267,000 new shade trees

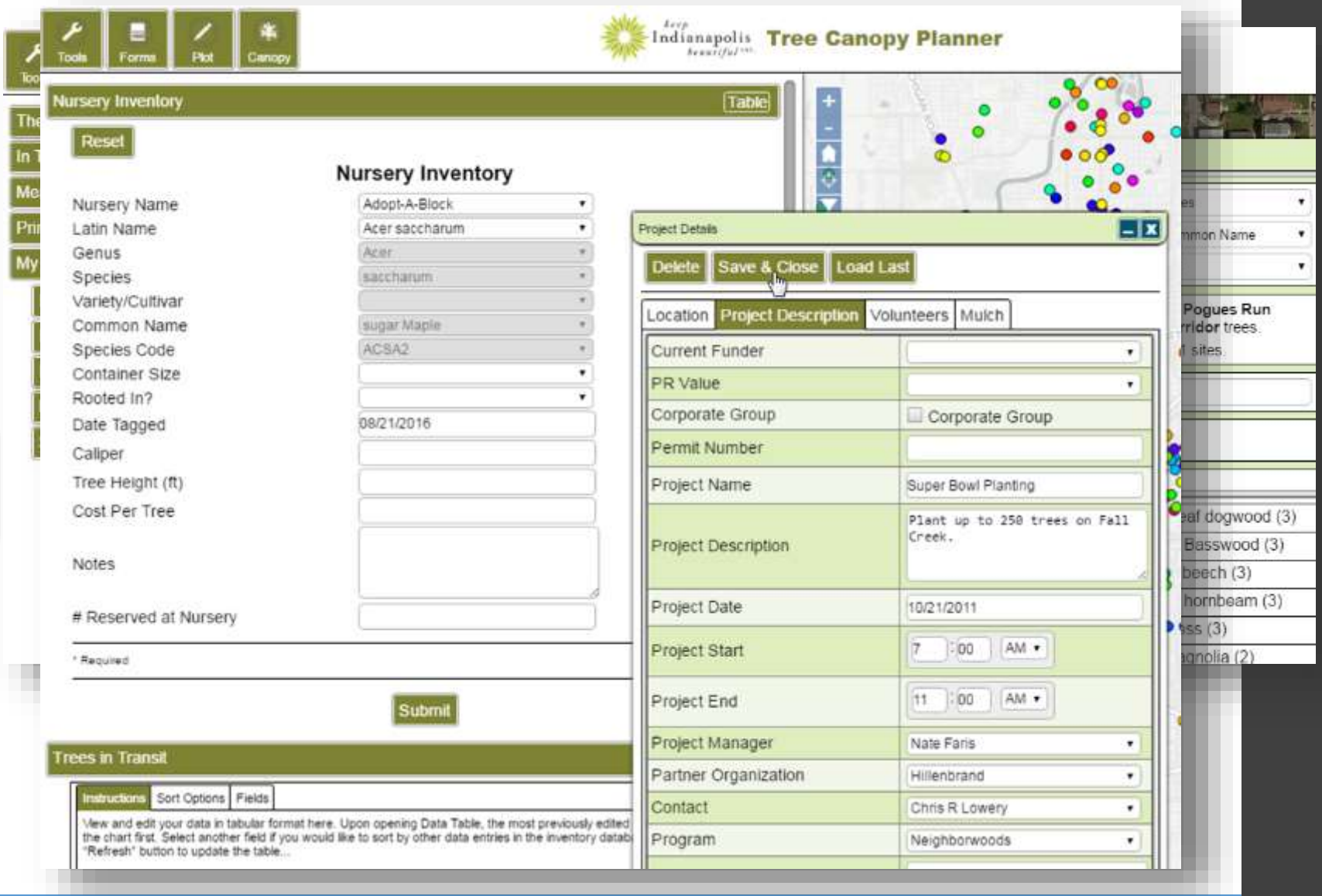
Phase 2: migrated KIB's tree planting, volunteer, and project management database to the cloud. All staff can now access tree, project and volunteer data via tablet, not just GIS specialists.

Phase 1 example: the selection of priority criteria is a reflection of KIB's mission statement and purpose as an organization



CS #4: Keep Indianapolis Beautiful

Phase 2 example



CS #5: Portland State University: HtHp

- 2011 U.S. Forest Service, National Urban & Community Forestry Advisory Council grant, “Healthy Trees, Healthy People” (HtHp)
- Identify canopy design to improve public health outcomes; quantify benefits and role in addressing air pollution and urban heat
- 13 U.S. cities: land use, tree canopy, air pollution, and urban heat data → empirical relationship of canopy design & environmental stressors
- Developed spatially explicit online GIS tool
- Surveyed how professionals identify and prioritize planting and how an online map may help
- Results informed the tool to help UF, planning, and health professionals identify and prioritize sites benefiting historically underserved areas

Portland State UNIVERSITY

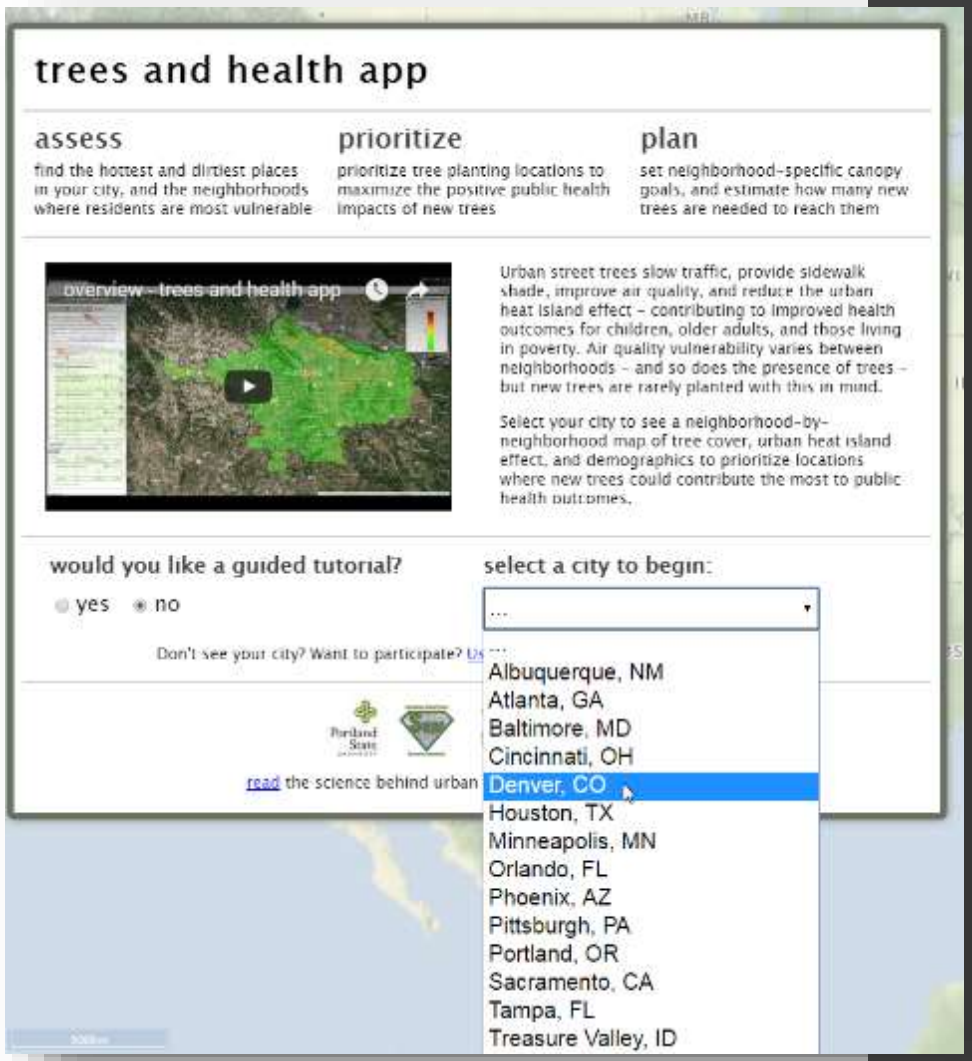
Sustaining Urban Places Research Laboratory

CS #5: Portland State University: HtHp

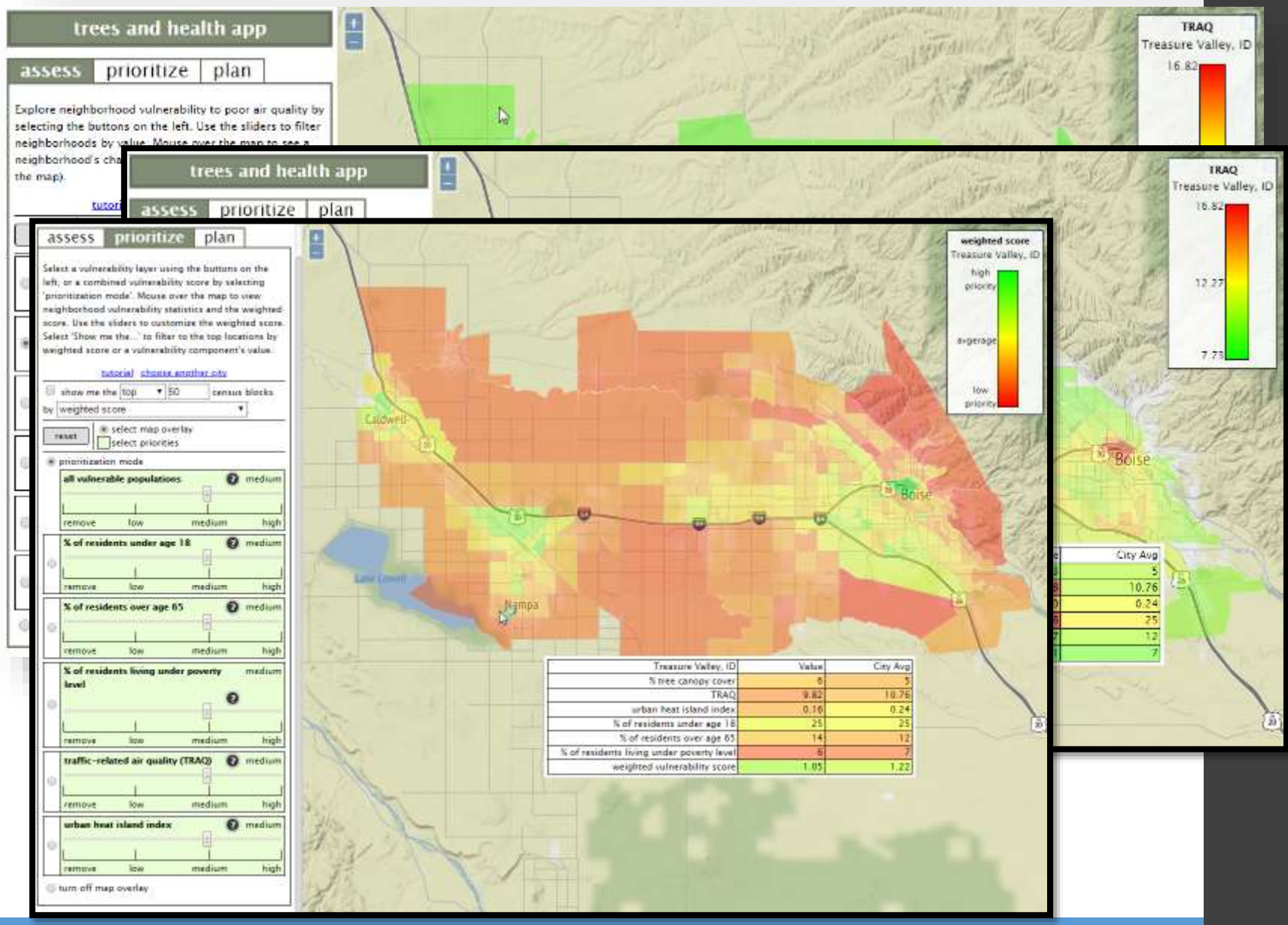
View, weight (rank), and filter six different criteria, including:

- % tree canopy cover
- Traffic-related air quality
- Urban heat island index
- % of residents < age 18
- % of residents > age 65
- % of residents living under poverty level

Canopy 30-m National Land Cover Database (NLCD) from the U.S. Geologic Survey (USGS). TRAQ index derived by PSU using GIS analysis and empirical research from Portland, Oregon, then extrapolated to 12 cities.



CS #5: Portland State University: HtHp



CS #5: Portland State University: HtHp

Unexpected but welcome results …

- New partners at the same table for the 1st time
  - Environmental justice, public health, and environmental
- "Groups with similar missions who had not been at the same table until now can be convened, allowing scientific and demographic data to be explored and compared across neighborhoods and cities." (Vivek Shandas)
- Viewing data in an online interactive map, one participant stated:

"We are far more biologically impoverished than I realized" (when comparing neighborhoods).

Challenges & Limitations

Urban and community forestry is about people, then about trees

- Not all decision makers or users will be impacted or comfortable with online tools
- Some users can be intimidated by maps and tools and leery of the learning curve
- Not all stakeholders will have access to online tools (underserved and low income areas)

Don't try to create a perfect model

- Apply a meaningful process and provide a framework for data-driven decision making and implementation, followed by on-the-ground verification

Always be a role for tree professionals and urban forest managers

- Implementing large-scale planting initiatives successfully requires proper standards and techniques, suitable nursery stock, and maintenance plans for young tree care

Future Research

- Impact of online tools: ROI, volunteerism, canopy cover, stewardship, funding, and urban tree culture
- Drones and Unmanned Aerial Vehicles; limited more by regulation than by technical capabilities
- Augmented Reality: practical and theoretical uses
  - Monitoring, immersive (remote) plant identification for educational purposes, etc.)
- Cloud-based, real-time technologies (e.g. smart watches and dashboards) may drive efficiencies and possibilities
- What's the full potential of "**the geospatial urban forest**"?

Recommendations

Planning

- Community knowledge + experts, inclusive, local priorities
- Define audience, goals, messaging
- What is needed, a tool or solutions?

Tool Development

- Choose meaningful, familiar geographic scales
- Spatial extent of GIS inputs (e.g. spotty health data across a study area)
- Identify highly correlated criteria and existing derived layers

Applications

- Create interactive, visual, educational tools; list websites on criteria, research, and tree care for longevity and maximum benefits
- Set UTC goals based on science, data, and a collaborative planning process, not political appeal

Contacts & Web Resources

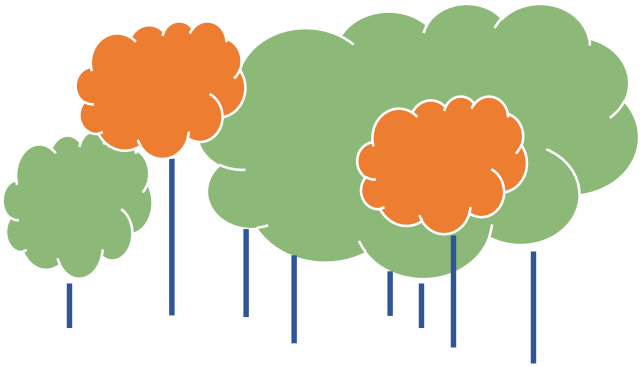
1. **Robert Seemann**, www.batonrougegreen.com/ and https://pg-cloud.com/BatonRougeGreen/
2. **Dana Dentice**, www.plantonemillion.org/ and https://pg-cloud.com/PHS
3. **John Bowers**, www.columbus.gov/branch-out/ and https://pg-cloud.com/Columbus/
4. **Nate Faris**, www.kibi.org/ and https://pg-cloud.com/KIB/
5. **Vivek Shandas**, Portland State, www.treesandhealth.org/ and http://map.treesandhealth.org/
6. This research paper: www.digitalcommons.lmu.edu (Cities and the Environment, CATE)

THANK YOU!

Ian Hanou, Owner and Founder

(303) 503-4846

IanHanou@PlanItGeo.com

A geospatial technology, software, consulting, and planning firm specializing in urban forestry.

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