



EVIDENCE-BASED DESIGN FOR URBAN FORESTRY

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AGENDA

Evidence-Based Design for Urban Forestry









BACKGROUND













EPA EJScreen EPA's Environmental Justice Screening and Mapping Tool (Version 2.3)

Please note: Territory data (except Puerto Rico) is not available as comparable to the US. It is only comparable to the territory itself by using the 'Compare to State' functionality. Likewise, some of the indicators may not be available for



City of Baltimore, Baltimore County Government, VITA, Esri, HERE, Garmin, USGS, EPA, NPS | Esri, HERE, NPS

Powered by Esri











Anne Whiston Spirn 1986





LAI - LEAF AREA INDEX LAD - LEAF AREA DENSITY





People living in the intervention areas had 13% lower levels of high-sensitivity Creactive protein,

a blood marker associated with heart disease, including stroke, coronary artery disease and heart attack.

The drop was similar to starting a regular exercise routine.













Take the aerial LIDAR point cloud from GH partners.



Separate ground points with cloth simulation filter....



colorize it with concomitantly gathered NDVI raster



All above-ground points with NDVI >0.23 are vegetation points (also remove roofs under trees with coplanarity filter!)



to get point cloud with NDVI as a scalar field for each point...



Divide point clouds into 1m XY squares, and calculate LAI using Beer-Lambert equation with ground points as sensor to get 1m LAI raster

Leaf Area Index (LAI) estimation from aerial LIDAR scans







We're building tools to empower communities impacted by environmental injustice and climate change to take control and determine their own future, a new approach to community-led, evidence-based urban revitalization. What previously required teams of engineers, epidemiologists, academics, government agencies and consultants can now be done by and for communities themselves, creating resilience, while re-localizing power, knowledge and capital in the communities.







National Institute of Environmental Health Sciences Your Environment. Your Health.















Monitoring

Model

EVIDENCE BASED DESIGN





Analyze where pollution is the worst

EVIDENCE BASED DESIGN





Design interventions





Modeling











Baseline composite image of PM 2.5 at all Z values



Leaf Area Density



HIGHER LEAF AREA

LOWER LEAF AREA



Leaf Area Density





Tree Modelling





Tree Modelling





Tree Modelling

PADm2/m3 vs. Species/cultivar Average



Species Average








BASELINE MODEL



INTERVENTION

DIFFERENCE

z = 5m (~16ft)



absolute difference PM-2.5 Concentration



Min: -0.05 µg/m3 Max: 0.08 µg/m3

IN COMMUNITY FORESTRY 2024 CONFERENCE

INTERVENTION

DIFFERENCE

z = 5m (~16ft)





EXISTING TREE POPULATION VS. NO VEGETATION





relative difference PM1 Concentration







EVIDENCE BASED DESIGN





Implement

EVIDENCE BASED DESIGN





Monitor the results





PROCESS



For Every Urban Degradation.....





...Positive Intervention That Supports Health









Evidence-Based Process



Nassauer and Opdam. Design in Science: Extending the Landscape Ecology Paradigm (2008)



APPLY



Getting to Know the Southwestern Medical District

- 3 anchor institutions
- **42,000** employees
- **3.4 million** annual visits to clinics & ERs
- **3,791** students/ residents/fellows
- 23,000 neighbors living in and around the District
- 1000 acres with 16+ miles of transportation corridors





Southwestern Medical District Transformation Project





Harry Hines Blvd.



Using Evidenced-Based Design in the Southwestern Medical District to:

Lower Temperature Improve Air Quality







Measurement & Modelling







Variety of Data Sources





Landsat 100M





Landsat 100M











Exposed sunny areas

Deep shade of mature trees

Mild shade of young trees

In bus shelters







Microclimate Sensors & Model







Select an hour of the day:

Mean Radiant Temperature Simulation Raster with Sensor Points



Radiant temperature is crucial for calculating thermal comfort indices like UTCI, considering factors such as air temperature, humidity, and wind speed





Corridor Planting Performance Analysis



Arbor Day Foundation.

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absolute difference UTCI

- < -20.00 F
6.00 F
4.00 F
-0.00 F
- 2.00 F
-4.00 F
-6.00 F
-8.00 F
- 10.00 F
- 12.00 F
- 14.00 F
- 16.00 F
-> 18.00 F

Performance Analysis: Boulevard Tree Planting












Arbor Da Om 30m Foundation Canopy Growth Model

Existing Conditions

Average MRT = 66.76 C



werage MRT = 62.8 C (**4C cooling over existing conditions**



i = 52.38 C (14C cooling over existing conditions)















43 C 77 C Canopy Growth Mode Benchmarks

































Figure. PM concentration on a terrain-following surface 1.5 m above ground at the Harry Hines corridor. (a)-(f) PM2.5 concentration at pedestrian level (1.5 m above ground) for the selected wind directions. Note that the region shown extends 225 x 85 m.





Alternative Analysis









Alternative Analysis





Tall Grass Under Median Canopy WithDownwind Berm





Tall Grass Under High Median Canopy With Downwind Hedge





Hedge In Median With Downwind Berm





The Green Spine: Typical Section































Design Studies: Boulevard Tree Planting



Typical Streetscape (Single Row)

- Follows Complete Streets Planting Guidelines
- Increases Tree Sizes (from 2"-6" caliper)

Double Row of Trees

- Adds Second Row of Trees
- Increases Quantities of Trees
- Maintains Tree Size and Spacing of Option 1

Tree Groves

 Adds Trees of Various Sizes and Spacing along sidewalk







Design Studies: Park Tree Planting

















Tree Clusters Varying Sizes and Spacing





AS REES fieldoperations

CAI

WIND FLOW ANALYSIS

Faster Wind Speed

Slower Wind Speed

Maximized Shade





Faster

Wind Speed

Dense

THERMAL ADUSTMENT



Slower Faster Wind Speed Wind Speed Tree Adjustments





Mixed Density + Trees At Edges






Thank you.

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