

Practice-Based Research: Operationalizing Landscape Performance

March 20, 2014

Allyson Mendenhall, Director of Legacy Design

DESIGNWORKSHOP



Riverfront Park—Denver, CO

Aspen
Austin
Chicago
Denver
Houston
Tahoe



DESIGNWORKSHOP





DW Legacy Design





Project : _____

Environment

SUSTAINABLE PLANNING

- Site Selection
- Ecosystem Protection
- Brownfields
- Regional Water-Management Systems
- Development Density
- Open Space and Conservation Lands
- Habitat Protection
- Other

SITE DESIGN

- Program Placement
- Planting and Soil Design
- Heat Island Effect
- Noise Pollution Reduction
- Light Pollution Reduction
- Other

TRANSPORTATION

- Framework and Infrastructure
- Motorized Alternatives
- Non-Motorized Alternatives
- Incentives and Programs
- Other

WATER MANAGEMENT

- Stormwater Management Technologies – Quality
- Stormwater Management Technologies – Quantity
- Erosion and Sedimentation Control
- Water Use Reduction
- Innovative Wastewater Technologies
- Other

ENERGY AND ATMOSPHERE

- Energy Budget
- Renewable Energy
- Air Quality
- Carbon Footprint
- Other

MATERIAL RESOURCES

- Green Building
- Resource Preservation and Reuse
- Landscape Materials
- Waste Management
- Construction Practices
- Other

OPERATIONS

- User Education
- Site Maintenance
- Recycling
- Other



Project : _____

Economics

MARKET POTENTIAL

- Supply and Demand – Development for Sale to end users
- Supply and Demand – Residential Rental Properties
- Supply and Demand – Retail Properties
- Absorption
- Capture Rate
- Other

FINANCIAL FEASIBILITY

- Public Financing
- Private Equity/Venture Capital
- Return on Investment
- Debt
- Private Sector Grants / Philanthropy
- Opportunity Costs
- Other

COMMUNITY IMPACT

- Employment (see Community sheet also)
- Fiscal Impact (Governmental)
- Local Businesses / Existing Businesses
- Affordability
- Public and Community Infrastructure
- Community Assets
- Economic Value of Art
- Other

ENVIRONMENTAL IMPACT

- Energy Budget, Carbon Budget and Recycling are located on the Environmental Conservation
- Other



Project : _____

Community

SOCIAL CONDITIONS

- Social Justice/Equity
- General Demographic Characteristics
- Human Capital
- Other

CIVIC LIFE

- Emotional Context
- Traditions
- Tax Structure
- Regionalism
- Community Leaders
- Social Contributions and Connections
- Community Interaction
- Arts, Culture and Entertainment
- Communication / Media
- Other

CULTURAL LANDSCAPE

- Historic Designed Landscapes / Architecture
- Historic Vernacular Landscapes
- Landmarks / Places of Significance
- Other

SERVICES / INFRASTRUCTURE

- Emergency Services (Police, Ambulance, Fire Protection)
- Public Health
- Sanitation (Wastewater, Solid Waste, Recycling)
- Child Care / Senior Services
- Education
- Community / Continuing Education, Youth Clubs
- Social Services
- Basic Needs (Food, Water, Energy, Technology)
- Other

WORK FORCE SYSTEM

- Housing
- Mobility (Pedestrian, Vehicular, Bike, Horse, Transit)
- Employment (see Economics sheet also)
- Other

LAND USE SYSTEM

- Residential, Retail, Industrial, Public
- Recreation and Open Space
- Compact, Complete and Connected Neighborhoods
- Other



Project : _____

Art

INTELLECTUAL / EMOTIONAL CONTENT

- Emotional and/or Spiritual Wellness
- Meaning
- Narrative
- Other

PLACE-MAKING EXCELLENCE

- Site Specificity
- Identity / Character
- Arts and Cultural Districts
- Other

TEMPORAL QUALITIES

- Permanence / Ephemerality
- Seasonality
- Succession
- Timelessness
- Timeliness
- Other

INVENTIVENESS / ORIGINALITY

- Innovation / Originality
- Transcendence
- Collaboration with Artists
- Public Art
- Other

CULTURAL / POLITICAL CONSIDERATIONS

- Authenticity
- Aesthetics
- Polemics
- Other

COMPOSITION

- Compositional Perception and Elements
- Dilemma / Thesis Resolution
- Functional Aesthetics
- Other

TECHNICAL EXCELLENCE

- Materials
- Details / Craftsmanship
- Other



DESIGN/TEAM/REP
DW LEGACY DESIGN* METRICS
Lama Larga Monterrey

Community

- SOCIAL CONTEXTING**
 - Local Landmarks
 - Local Demographics/Characteristics
 - Other
- LOCAL LIFE**
 - Climate/Weather
 - Topography
 - Vegetation
 - Soil/Geology
 - Local Culture and Traditions
 - Other
- CULTURAL LANDSCAPE**
 - Historic/Designated Landmarks - Architecture
 - Historic Landmarks - Landscape
 - Landmarks - Place of Significance
 - Other
- SERVICES - INFRASTRUCTURE**
 - Emergency Services
 - Health Care
 - Education
 - Child Care (Daycare Services)
 - Law Enforcement
 - Fire Department
 - Public Transportation
 - Water/Wastewater
 - Electricity
 - Other
- WATER PLUMBING SYSTEM**
 - Water
 - Sewer
 - Stormwater
 - Other
- LAND USE SYSTEM**
 - Residential
 - Commercial
 - Industrial
 - Other

Handwritten notes on Community page:

- Sports & C.S. Clubs
- Vicibau Club
- Builds Community, Consistency and Privacy/Security
- ENVIRONMENTAL INTEREST
- Water is important in agriculture for demand/supply flow?

DESIGN/TEAM/REP
DW LEGACY DESIGN* METRICS
Lama Larga Monterrey

Art

- REFLECTIVE / EMOTIONAL CONTENT**
 - Artistic/Architectural
 - Other
- PLANNING CHALLENGES**
 - Site
 - Other
- TEMPORAL QUALITY**
 - Architecture
 - Performance/Experience
 - Other
- ADAPTABILITY / UNIVERSALITY**
 - Architecture
 - Performance/Experience
 - Other
- ENVIRONMENTAL / POLITICAL CONSIDERATIONS**
 - Architecture
 - Performance/Experience
 - Other
- CONSTRUCTION**
 - Construction Process
 - Construction Materials
 - Construction Methods
 - Construction Management
 - Other
- TECHNOLOGICAL CHALLENGES**
 - Construction Process
 - Construction Materials
 - Construction Methods
 - Construction Management
 - Other

Handwritten notes on Art page:

- SPA?
- WORK A PROFESSIONAL INTERVIEW STUDY
- ENVIRONMENTAL INTEREST
- LINE ASPECTS INTEGRATION ARCHITECTURE
- RESIDENTS OCCUPANCY
- HIGH DENSITY HOUSING
- THINK ON PLATES *SCALE
- NUMBER OF CHAIRS

DESIGN/TEAM/REP
DW LEGACY DESIGN* METRICS
Lama Larga Monterrey

Environment

- SUSTAINABLE PLANNING**
 - Regulatory
 - Regulatory Management Processes
 - Regulatory Processes
 - Regulatory Requirements
 - Other
- SOIL DESIGN**
 - Design Process
 - Design Data
 - Design Requirements
 - Design Methods
 - Design Materials
 - Other
- VEGETATION**
 - Design Process
 - Design Data
 - Design Requirements
 - Design Methods
 - Design Materials
 - Other
- WATER MANAGEMENT**
 - Design Process
 - Design Data
 - Design Requirements
 - Design Methods
 - Design Materials
 - Other
- ENERGY AND ATMOSPHERE**
 - Design Process
 - Design Data
 - Design Requirements
 - Design Methods
 - Design Materials
 - Other
- NATURAL RESOURCES**
 - Design Process
 - Design Data
 - Design Requirements
 - Design Methods
 - Design Materials
 - Other
- CONSTRUCTION**
 - Design Process
 - Design Data
 - Design Requirements
 - Design Methods
 - Design Materials
 - Other

Handwritten notes on Environment page:

- VARIABLE SYSTEM - NOT SUSTAIN FURTHER
- LABOR FOR CONSTRUCTION - 2.8B
- 2800 OUTPUT OPPORTUNITY
- ENVIRONMENTAL INTEREST
- CONSTRUCTION
- ENVIRONMENTAL INTEREST
- CONSTRUCTION

DESIGN/TEAM/REP
DW LEGACY DESIGN* METRICS
Lama Larga Monterrey

Economics

- MARKET POTENTIAL**
 - Market Data
 - Market Research
 - Market Analysis
 - Other
- FINANCIAL FEASIBILITY**
 - Market Data
 - Market Research
 - Market Analysis
 - Other
- OPERATIONAL FEASIBILITY**
 - Market Data
 - Market Research
 - Market Analysis
 - Other
- ENVIRONMENTAL IMPACT**
 - Market Data
 - Market Research
 - Market Analysis
 - Other
- ENVIRONMENTAL BENEFIT**
 - Market Data
 - Market Research
 - Market Analysis
 - Other

Handwritten notes on Economics page:

- Market Profile
- ENVIRONMENTAL INTEREST
- CONSTRUCTION
- ENVIRONMENTAL INTEREST
- CONSTRUCTION



THE BACK / RESEARCH

THE FULLER MEASURE



**BUILDING
BETTER METRICS:
THE SYNTHESIS
OF ECONOMICS,
ENVIRONMENT,
COMMUNITY,
AND ART.**

BY KURTZ DUBERTSON, FASLA

In October 2010, the U.S. Department of Housing and Urban Development announced the winners of \$300 million in Sustainable Communities grants. These grants went to 41 areas of the country to create what HUD is calling Regional Plans for Sustainable Development. The grants are a huge step forward, part of the Obama administration's Partnership for Sustainable Communities, which unites HUD, the Department of Transportation, and the Environmental Protection Agency to coordinate public investments in infrastructure, facilities, and services across various federal agencies. The hope is that this kind of coordination will amplify the economic, community, and environmental benefits of the projects we target with tax dollars. By considering housing, transportation, and environmental protection in a full, synthetic way, the move marks a potential turning point in land-use planning and design in this country. For landscape architects who are adept at bringing together diverse, complex sets of knowledge in projects, this program presents a huge opportunity.

The Sustainable Communities grants are remarkable because they bring together three federal departments that profoundly shape our natural and built environments—agencies not known in the past for their collaboration—but also because they look for measurable outcomes and heavily emphasize computer modeling and metrics to track the progress of proposed interventions. They help to formalize a new emphasis on measurement in planning and design issues.

These days, landscape architects are obsessed with green certification and rating systems and are busy searching for “points” to achieve the desired rating for their projects. Measurement has taken on a life of its own, especially since the founding of the U.S. Green Building Council nearly 20 years ago, which brought on huge growth in the development and application of rating and certification systems for green building—the council's Leadership in Energy and Environmental Design, or LEED, program now covers approximately 8,200 currently certified buildings. The number of ENERGY STAR-rated buildings is over 11,000. These are just a few of many such systems built around the notion that “what gets measured gets done.” A National Association of Homebuilders/McGraw-Hill construction survey shows that more than half of the NAHB's members, who build more than 80 percent of the houses in the United States, will incorporate green practices into their development in the next two years. Metrics-based systems, which reward projects for their proven ability to reduce water or energy use or provide measurable performance in a number of areas, have moved the environmental design discussion from platitudes to positive action. In that regard, they are to be applauded.

But making a limited number of environmental measures synonymous with sustainable design is short-sighted. A project can save water or cut energy use, yet contribute little to the success of a community culturally or economically. The benefits of sustainable development and, by extension, sustainable design

IMAGE CREDIT
The-Net-Direct



THE BACK / **FORWARD**

RESEARCH PRIORITIES

BY KURT D. CULBERTSON, FASLA

As a practitioner, I am often approached by graduate students in search of thesis topics that will be of value to landscape architecture practice. I have found that, more often than not, their desire is to produce research that will have utility and value to the profession rather than simply meeting degree requirements. But the role of research in landscape architecture has always been weak relative to that of other professions such as medicine or engineering. Though practitioners investigate and gather information in their project work, most of them are not trained researchers. Education in research methods is seldom incorporated into undergraduate curricula. Many firm principals recognize the growing importance of research, especially given the move toward evidence-based design. Evidence-based design, now common in fields such as health care, is a design approach that emphasizes the importance of using credible data to influence the design process. But practitioners may balk at the idea of adding work in the midst of their constant need to get projects out on time and on budget. Even so, a well-grounded foundation of research is needed to ensure that evidence-based design does not fall into the realm of pseudoscience.

Evidence-based design offers a great opportunity for the profession—the chance to build a dynamic relationship between academia and practice by establishing a research agenda for landscape architecture at a national level. A national research agenda would not restrict or bias the research efforts of the academy. Rather, it would aggregate and give structure to the many issues of research important to the profession and identify a context for investigation. Although there is clearly a place for research within professional practice, it is the academy that must provide leadership. Some landscape architecture degree programs are emphasizing evidence-based design, and others have active research programs. But the profession needs a way to raise the visibility of these research efforts. Ideally, an organization such as the Council of Educators in Landscape Architecture (CELA), perhaps in conjunction with the Landscape Architecture Foundation Performance Series, would conduct a periodic survey of the profession to identify topics of research interest and schools where they are a focus.

CELA has historically played an important role in fostering a research community, and ASLA's Professional Practice Networks have circulated and promoted research that is closely linked with practice. The new National Academy of Environ-

mental Design, a consortium of national design organizations including ASLA, will further advance research within the design professions.

A national research agenda could suggest areas ripe for theses and dissertations to help stimulate graduate-level research. It might propose projects of immediate relevance, but it should also include inquiries into topics that may apply more speculatively to the profession—the kind of exploration critical to bringing new ideas to the surface. Potential solutions identified by the academy can be tested by practice. In turn, new areas of interest to the academy will emerge from practice as well.

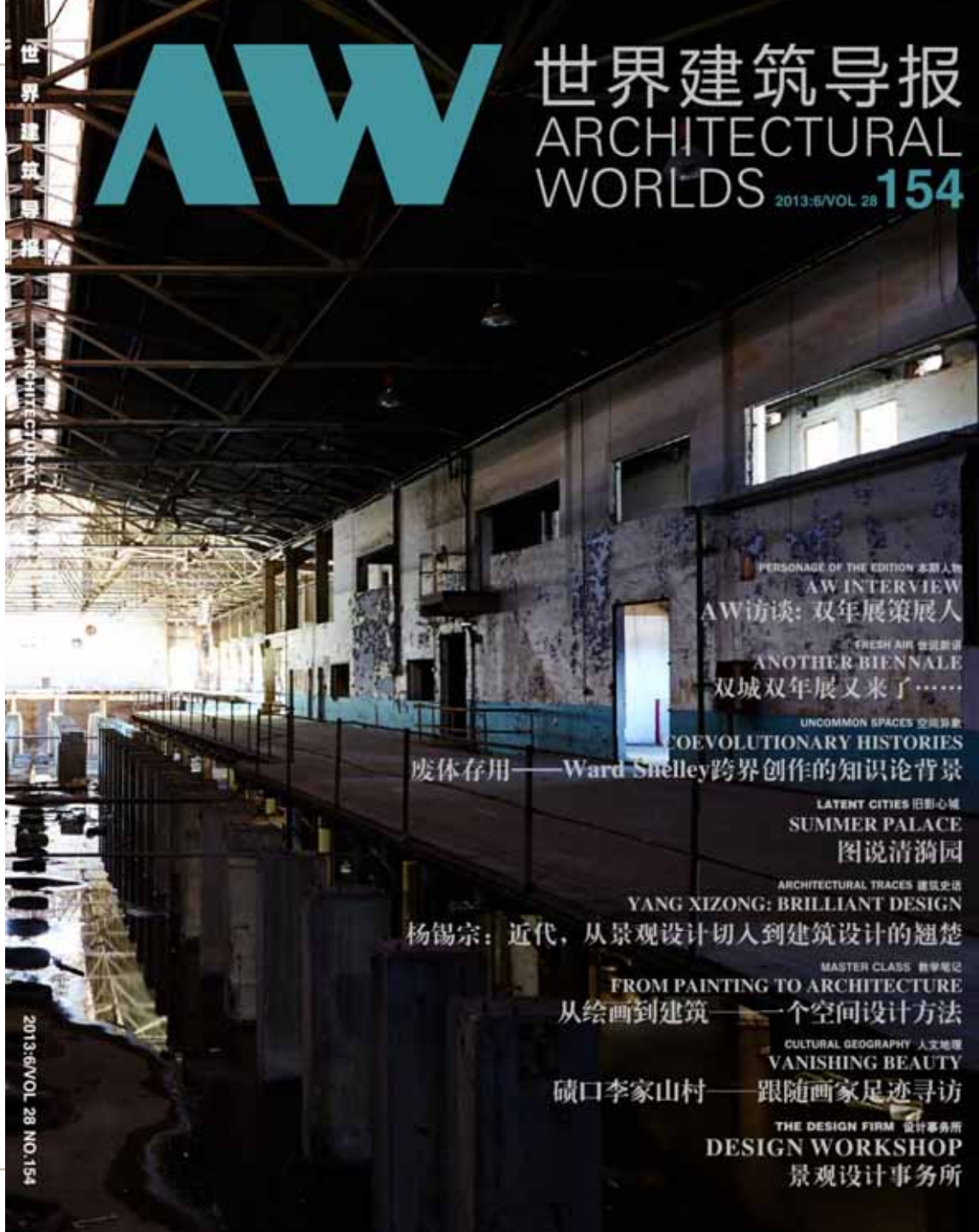
Providing a framework for the collaboration of academia and practice offers the potential for generating funding sources for academic research. Sophisticated clients are willing to pay for research that will help solve the challenges they face if they have confidence in the research and can see a reasonable return on their investment from the results. Some enlightened practitioners, who face common challenges across multiple projects, may also contribute to research that advances their practice areas.

There are two areas of concern, however. The first is that some academicians are suspicious of privately funded research and its whiff of potential bias. Rather than turn away private funding, we need clear standards to ensure objectivity. The second concern is that some academic programs are eliminating the requirement of a thesis for the graduate degree, substituting instead a final project that, in many cases, is not a framework for rigorous research. Graduate students are often poorly prepared to conduct thesis research because of a lack of training at an undergraduate level.

Design approaches without evidence are based on theory alone. Our obligation to maintain the health, safety, and well-being of society demands more. Evidence-based design suggests a need for research in multiple areas, such as sociology, community planning, and economics, as well as traditional design issues. Our efforts must be built upon the collaborative efforts of private practice and the academy guided by a national research agenda that gives focus to our work. ●

KURT D. CULBERTSON, FASLA, IS THE CHAIRMAN OF THE BOARD OF DESIGN WORKSHOP.





http://www.designworkshop.com/documents/world-architecture-review_dec-2013.pdf





Rain Gardens remove 33% of bacteria, 93% of phosphorus, 93% of oil and grease and 85% of total suspended solid from stormwater before it returns to bayou

33%

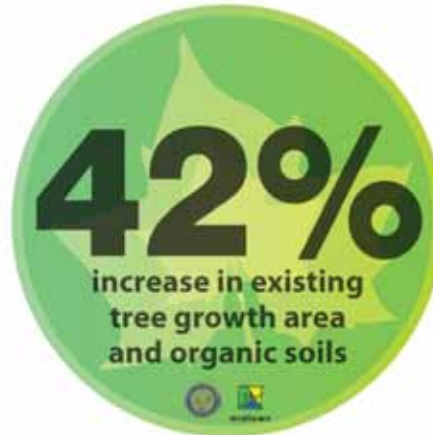
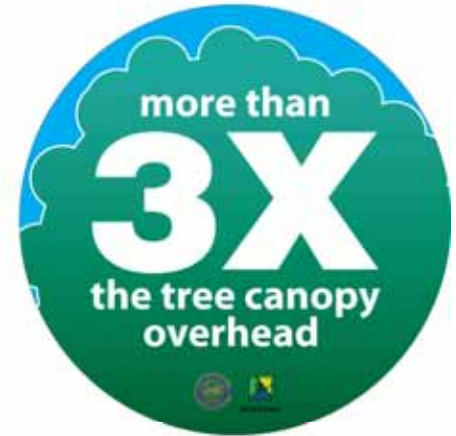
of local stormwater captured by rain gardens before it drains into the bayou







Bagby Street Signage | If Streets could Speak



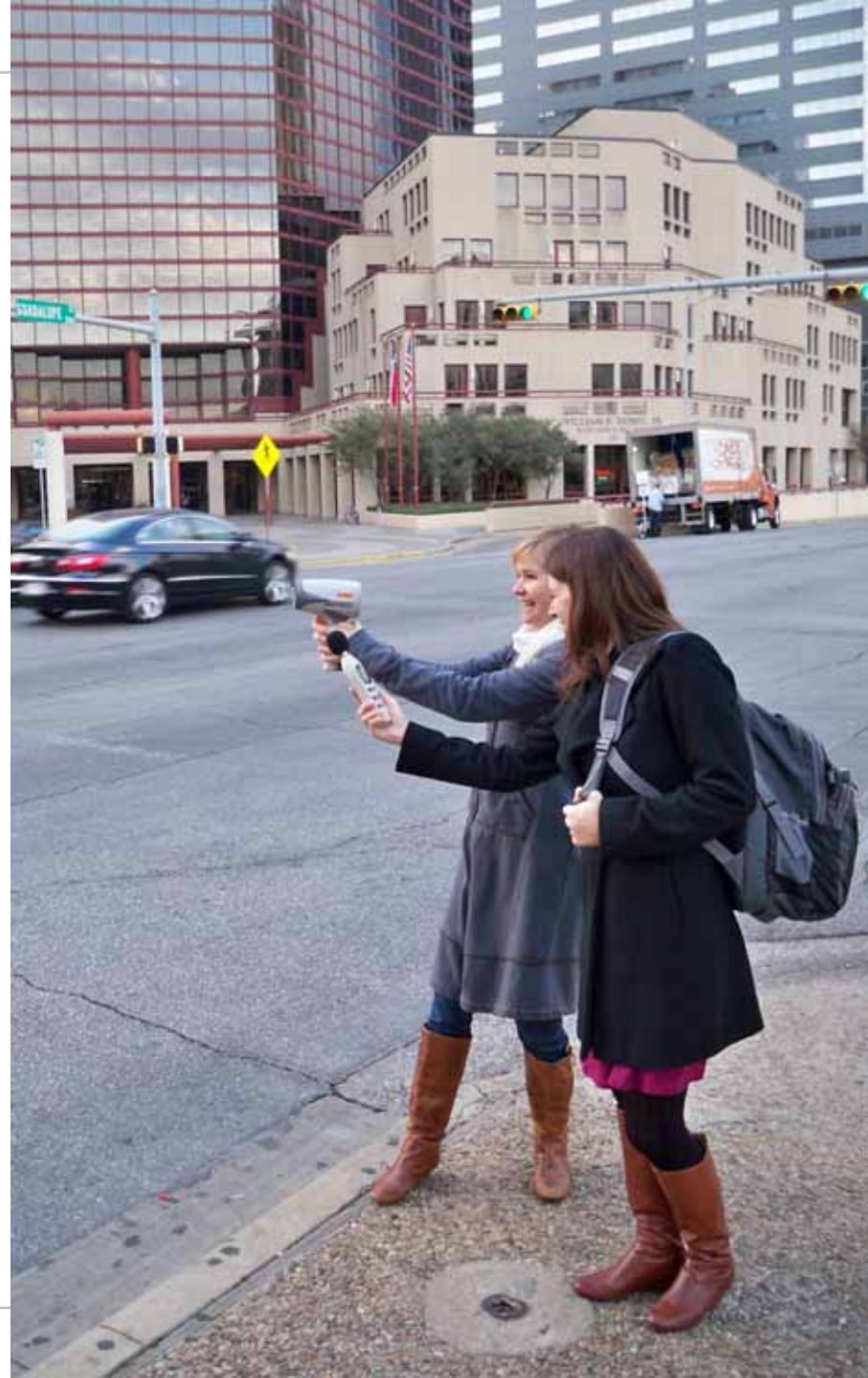


Measurement Tools Backpack



Site Analysis

Baseline Conditions =
As is conditions



Measurement Tools



Temperature



Noise



Light



Speed



Weather



Tree Caliper



Digital Counter



Digital Counter



Manual Counter



Human Comfort





South Grand Great Streets Initiative—St. Louis, MO



South Grand Great Streets Initiative



- ① South Grand Boulevard
- ② Tower Grove Park
- ③ Gravois Avenue
- ④ Interstate 44
- ⑤ Master Plan Study Area
- ⑥ Phase One Project Area



Typical Sidewalk Condition



Typical Side Street Character



Tower Grove Park Entrance



Typical Dining Experience





Infrared Digital Thermometer

Hand-held laser gun measures the surface temperatures of a variety of materials.

Can be used to compare the relative impact of various materials on the heat island effect and human comfort.



Temperature

PROJECT 4669
CF# 53
KEY: HEAT MEASUREMENTS OF EXISTING SURFACES

73.1 - 87.0 grey conc.
77.5 - 79.0 exp. egg conc.
108.7 asphalt
82.9 grass

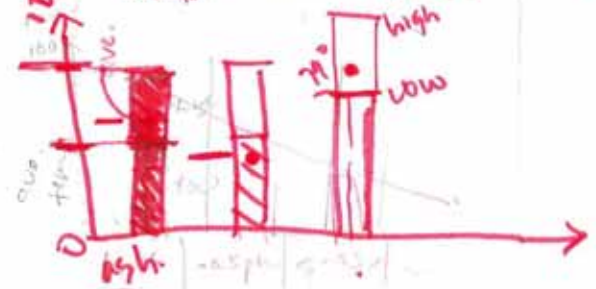
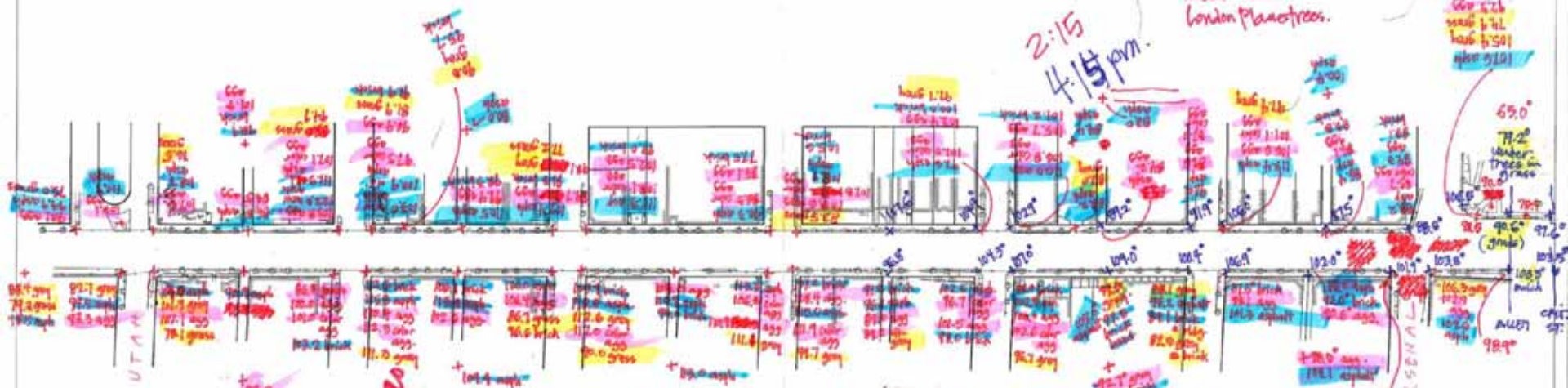
Measured e
SW corner
of Main Dr.

98.8 egg paving
in shade
under mature
London Plane trees.

2:15
4:15 pm.

(99%+)
66.5 2.6
50.6 1.1
50.6 1.1
50.6 1.1

65.0°
77.2
lantern
tree in
drainage



- high
- low
solar radiation
average

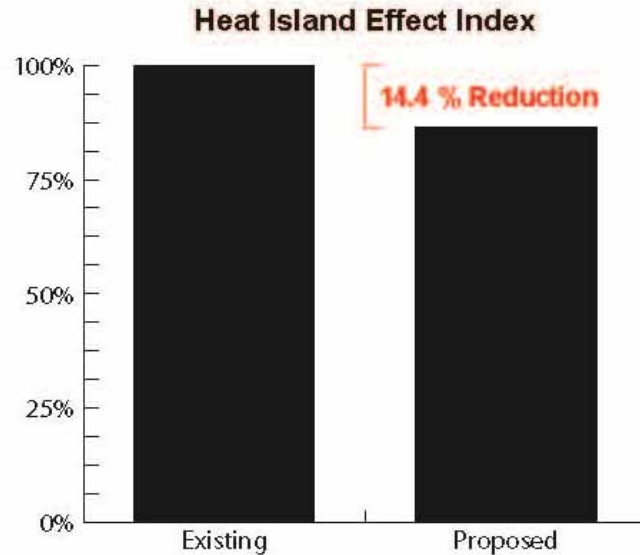
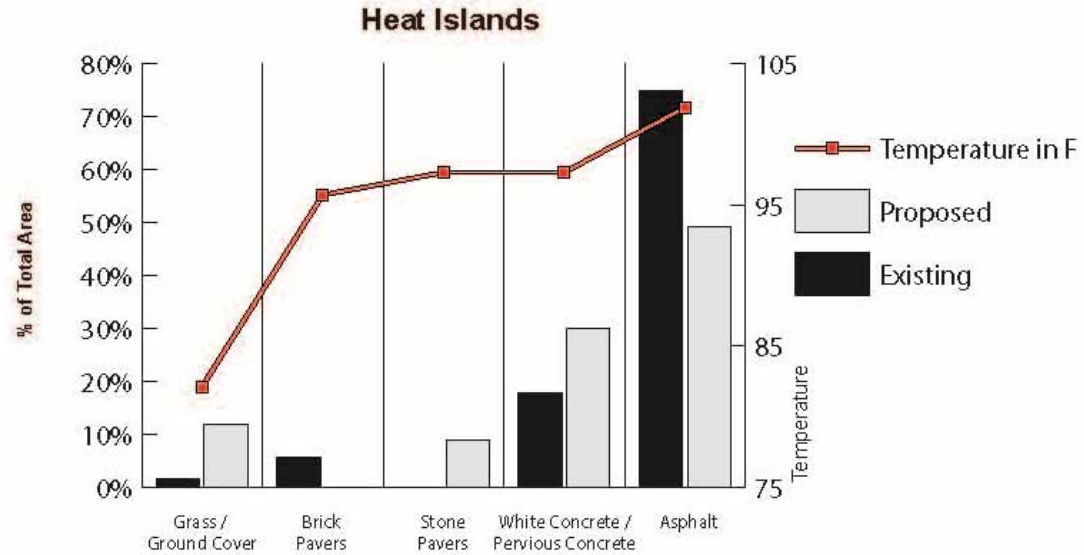
East side e
crosswalk to alley
91.9° grey conc.
101.8° - 95.1° exp. egg conc.
86.0° grass
113.7 asphalt
80.0° rain garden

HEAT ISLAND



Temperature

Evidence: On-site measurements demonstrated that by reducing the amount of asphalt and increasing planted areas and pervious pavement, reduced the heat index by 14.4%.





Digital Sound Level Meter

Hand-held device measures and records sound levels for sounds ranging from 40 to 130 decibels.

Sound level data can be analyzed to identify where sound levels exist that are inappropriate for human comfort and where design intervention is needed.

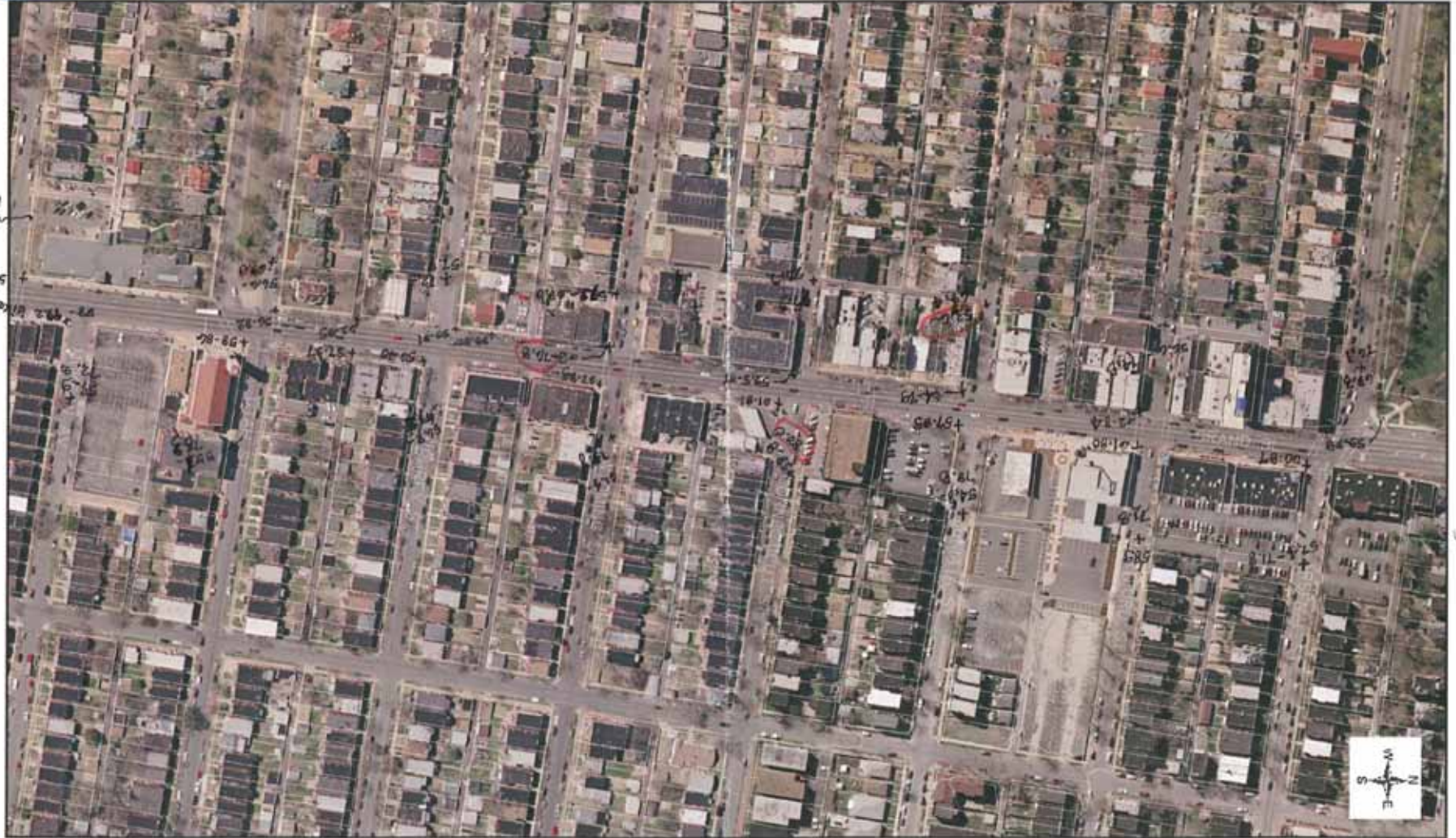


Noise

PROJECT # 4659
CF # SS
KEY: EXISTING NOISE
LEADINGS

001 735 / 434 of 400

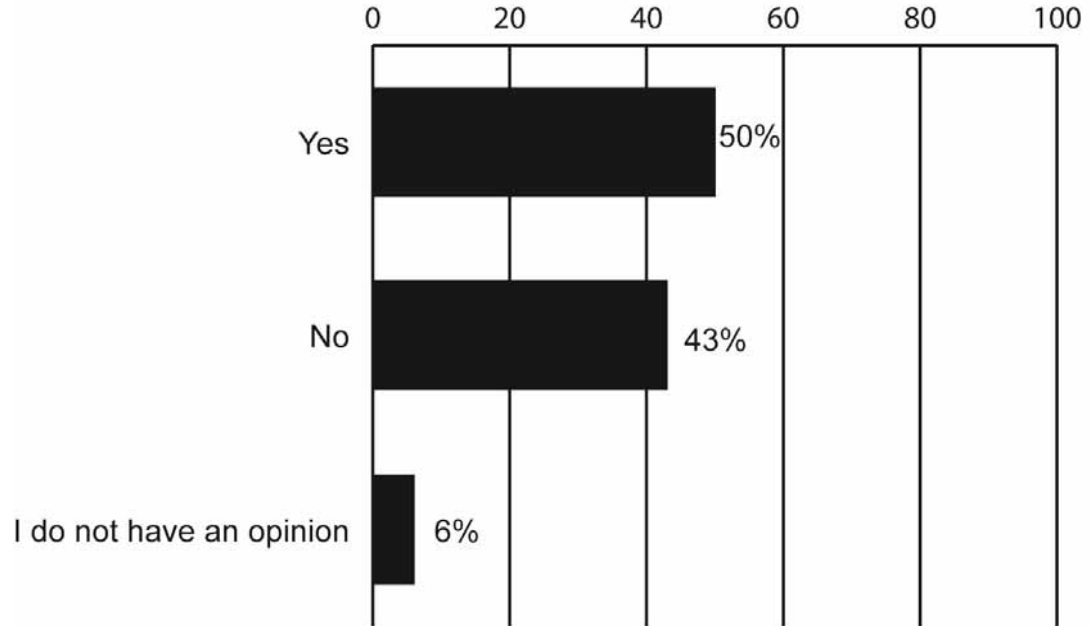
South Grand Boulevard



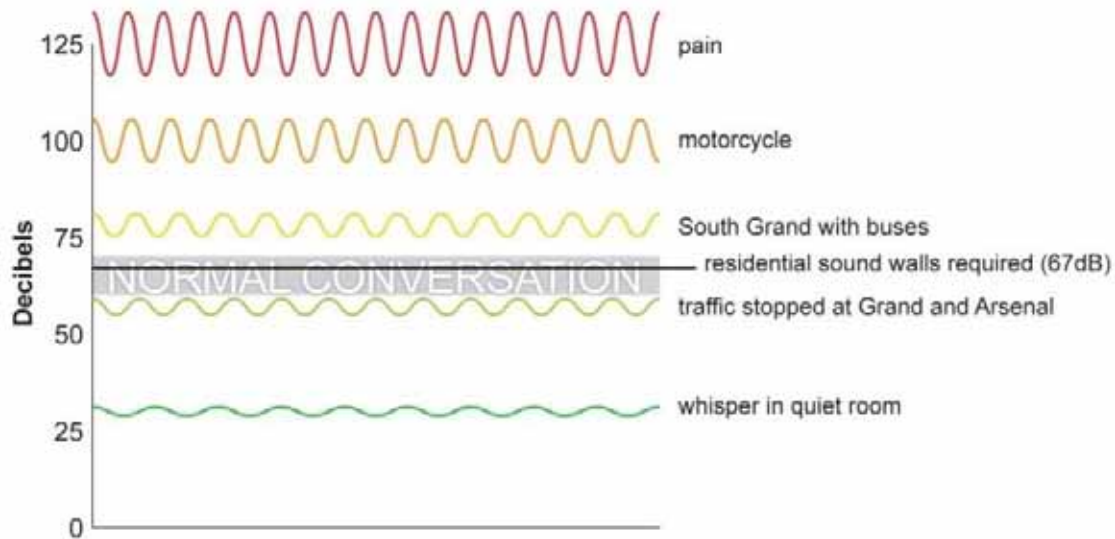
Noise

Strategy: to create a case for a “road diet” by demonstrating to the public the reduction in noise levels due to reduced speeds.

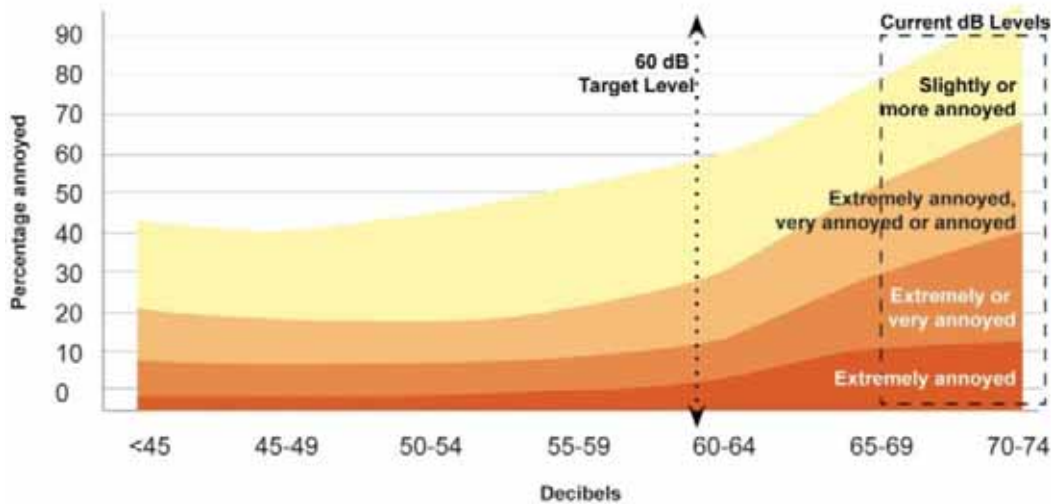
Does the current noise level on South Grand negatively impact your shopping and dining experience? (select one)
212 responses



Noise



People's Level of Annoyance based on Decibel Level



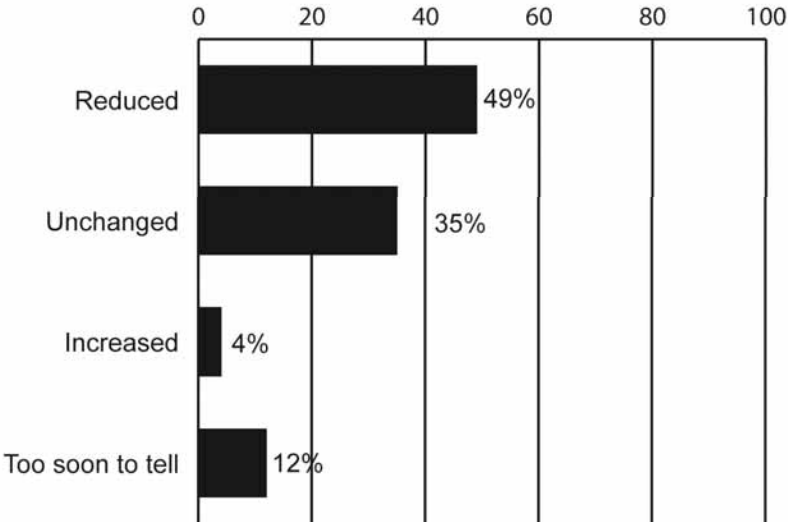
Source: *Traffic Management and Noise Reducing Pavements: Recommendations on Additional Noise Reducing Measures*. Danish Road Institute Copenhagen: Ministry of transport and energy, 2004.



Noise

During the pilot test period I felt noise on South Grand was....(select one)

93 responses



Evidence : By implementing a pilot test of the proposed lane reduction and bulb-outs, the average peak noise levels fell by 17db, meeting the target noise level of 60db. The street is about one-third as loud as it was previously, therefore providing a more comfortable shopping and dining experience.





Capitol Valley Ranch—Pitkin County, CO















Overview

Landscape Performance Series

Case Study Briefs

Explore by Map

Submit Your Case Study

Online Submission Form

Benefits Toolkit

Fast Fact Library

Scholarly Works

Case Study Investigation

Case Study Method for Landscape Architecture

Land and Community Design Case Study Books

LPS Videos: Leaders Discuss Landscape Performance

Support the Landscape Performance Series

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Capitol Valley Ranch

- Share
- Case Study as PDF
- Comment on this



Landscape Performance Benefits

- ▶ Reduces atmospheric carbon by more than 8.7 tons annually through 137 trees planted on the property, approximately the same amount of CO2 released by burning 884 gallons of gasoline.
- ▶ Saves over 1,000,000 gallons of irrigation water and 400 lb of fertilizer annually by limiting lawn area to 5,440 sf, 7% of the total planted area on the entire 35-acre site.
- ▶ Generates an estimated 1,820 kilowatt hours of electricity monthly, saving \$150 dollars in monthly energy costs through 8 solar panels installed in the landscape.
- ▶ Produces an estimated 141 lb of organic vegetables each year, which have an approximate value of \$400.
- ▶ Provides pleasant outdoor spaces with 77% of outdoor recreational areas in the human comfort zone in the morning, 42% in the afternoon, and 48% in the evening during the summer. Landscape design techniques such as building orientation, thermal massing, and tree placement were used to modify the microclimates of the outdoor spaces.
- ▶ Maintains the area's pastoral setting by reducing visibility of the house from the nearby ranch road by nearly 100%.

Download Methodology

Designer
Design Workshop, Inc.

Land Use
Agriculture
Residential

Project Type
Single family residence

Location
Undisclosed
Pitkin County, Colorado
Map it

Size
1 acre within 35-acre working ranch

Budget
Undisclosed

Completion Date
2006

Utah State University:
Assistant Professor Bo Yang
Pamela Blackmore
Chris Binder

LAF Case Study Brief:
<http://www.lafoundation.org/research/landscape-performance-series/case-studies/case-study/627/>



Creates outdoor spaces during the summer with **77%** in the human comfort zone in the morning, **42%** in the afternoon, and **48%** in the evening by modifying the effects of wind and using passive solar techniques such as building orientation, thermal massing, and tree placement.





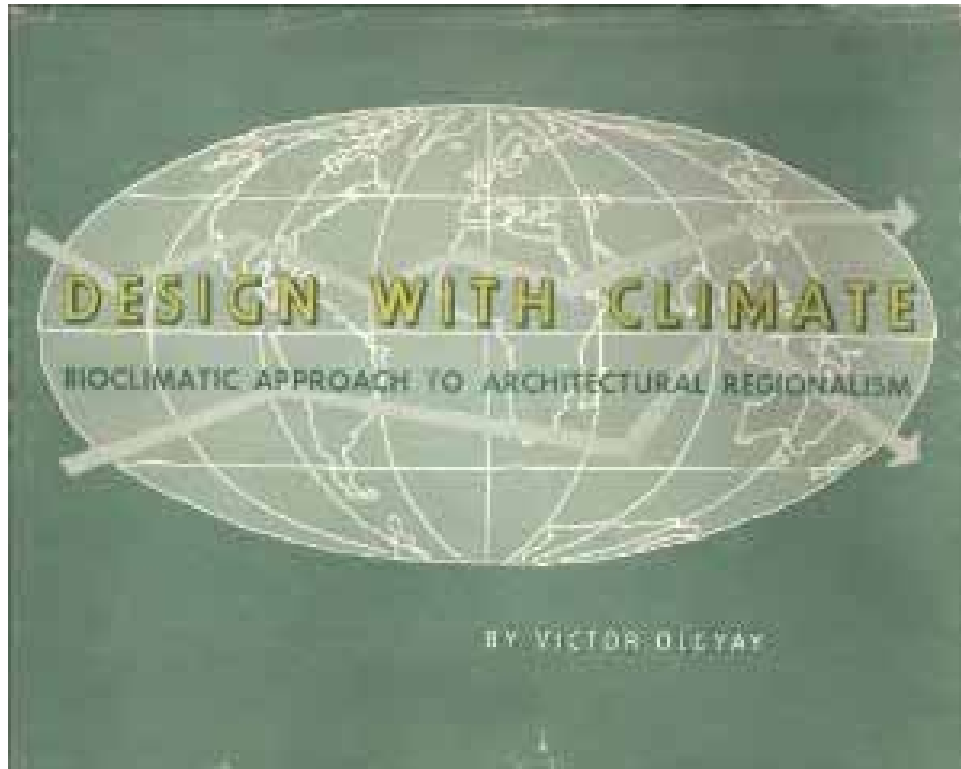
Late morning sunlight allowed in to warm-up space



Evening shade to cool the space

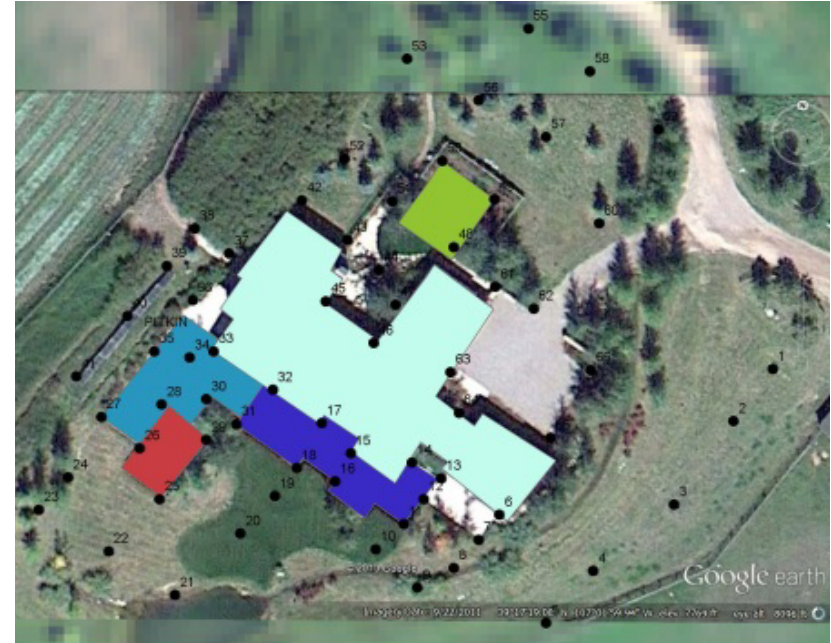


Victor Olgay's "Human Comfort Zone"





Sampling Locations



Behavior Mapping

Legend

DesignIntent

TimeofDayUsed

After Dark

Early Morning and Afternoon

Evening

Mid Morning and Noon

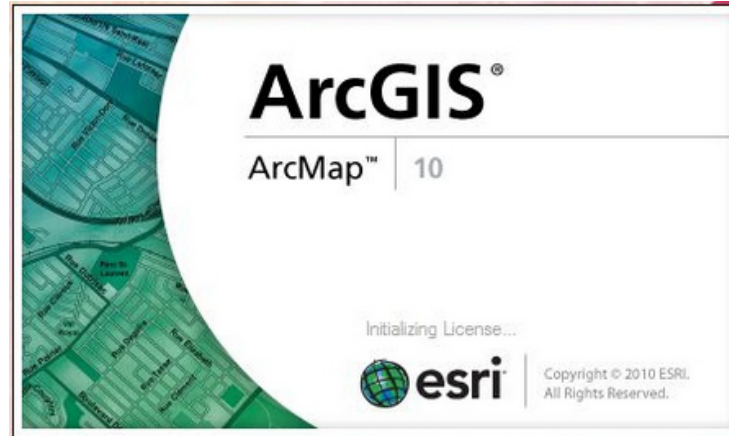


On-Site Data Collection



Kestrel 4000

GIS Interpolation



Analysis in Excel

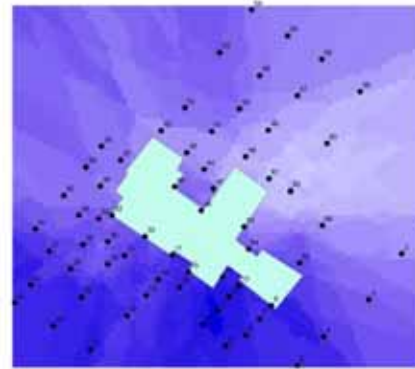
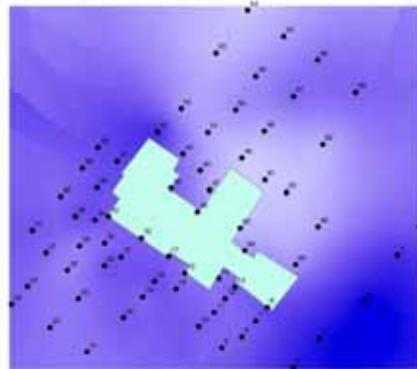
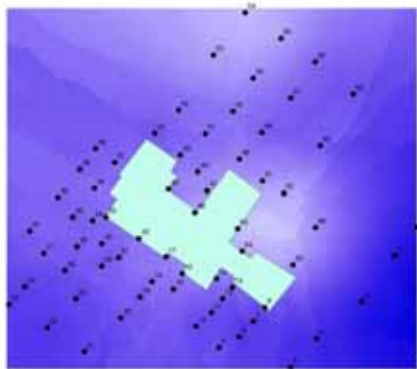




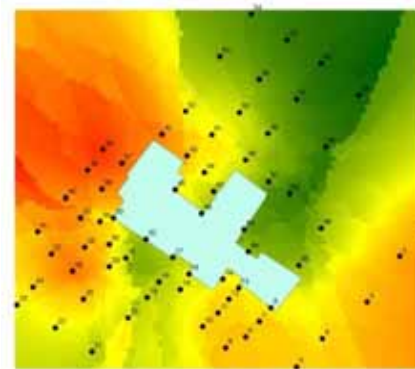
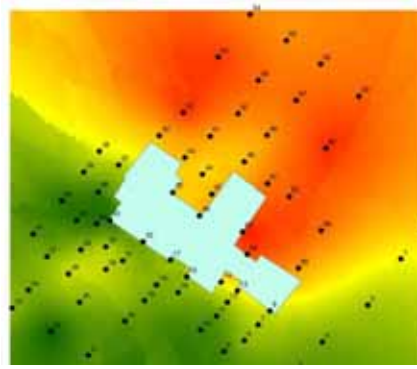
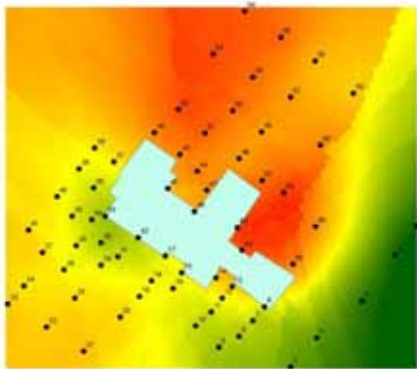
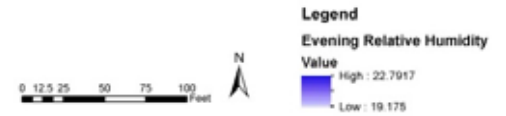
Collecting Bioclimatic Data

Temperature
Relative Humidity
Wind Speed

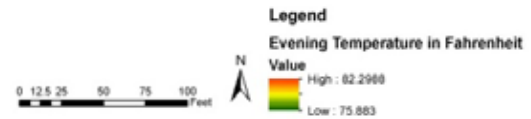




Relative Humidity



Temperature



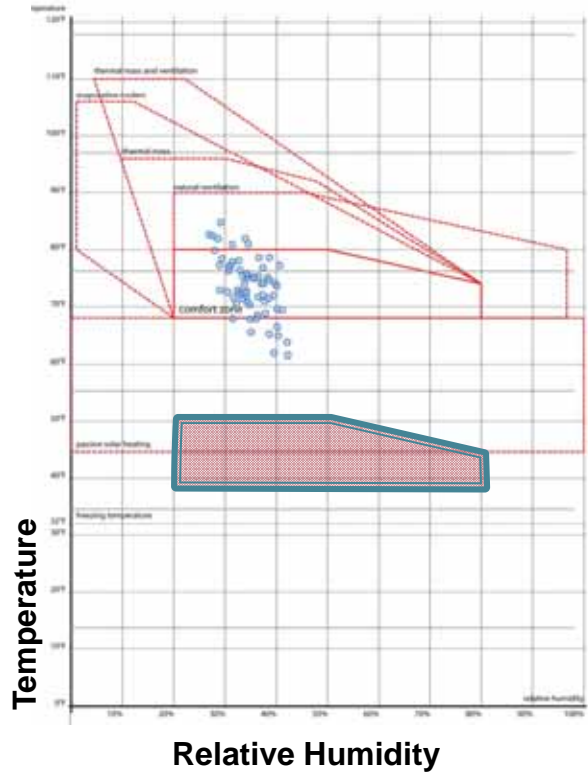
Morning

Afternoon

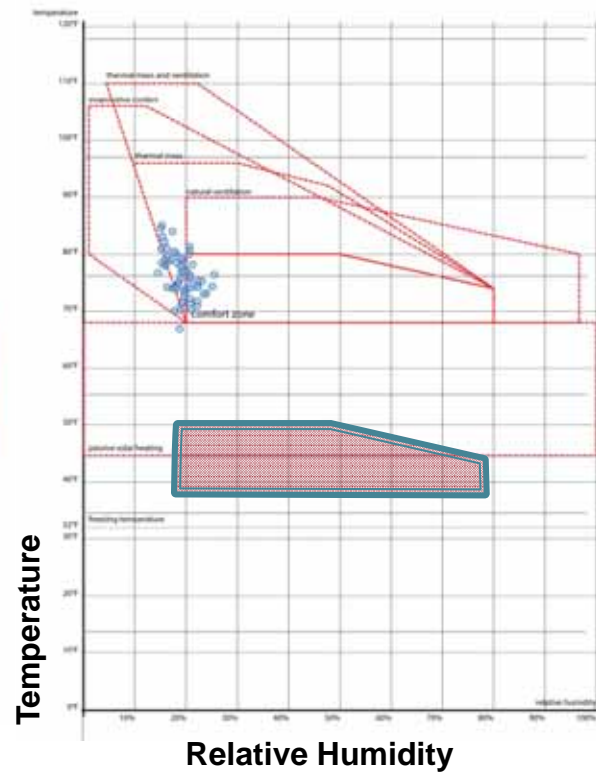
Evening



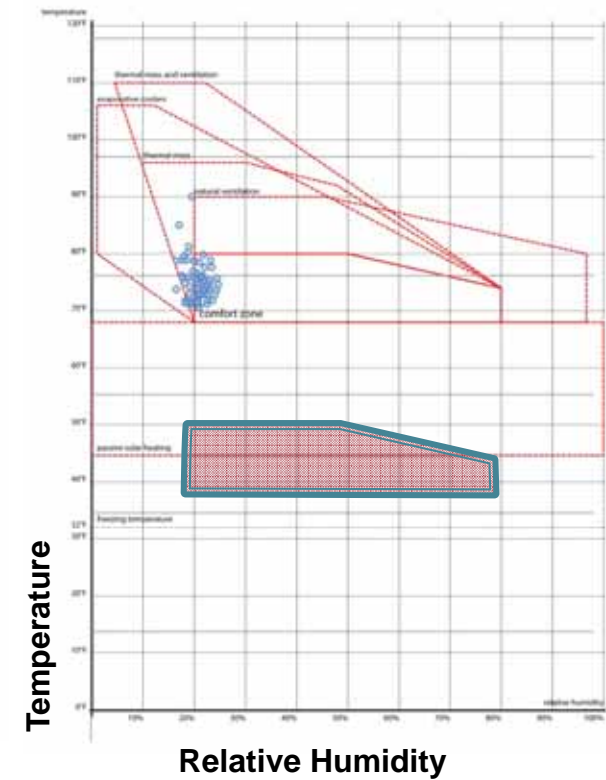
Morning



Afternoon



Evening



Victor Olgyay (1973). *Design with Climate: Bioclimatic Approach to Architectural Regionalism*. John Wiley & Sons, New York.



	Evening				Afternoon				Morning				
	Location	ent.	time	Rh	Temp	comfort?	time	Rh	Temp	comfort?	time	Rh	Temp
Agricultural Irrigation Ditch	1	5:06	19.5	84.9	hot & dry	12:35	20.0	81.9	hot	9:16	40.5	66.2	cold
Agricultural Irrigation Ditch	2	5:07	18.9	82.6	hot & dry	12:36	23.8	79.1	comfort	9:21	43.2	65.9	cold
Agricultural Irrigation Ditch	3	5:08	22.2	79.2	comfort	12:37	25.8	78.2	comfort	9:21	43.1	68.0	comfort
Agricultural Irrigation Ditch	4	5:09	21.5	79.9	comfort	12:38	24.6	77.1	comfort	9:22	41.1	70.6	comfort
Agricultural Irrigation Ditch	5	5:12	21.0	80.5	hot	12:39	24.1	76.9	comfort	9:23	37.0	72.0	comfort
Agricultural Irrigation Ditch	6	5:14	23.8	82.6	hot	12:40	22.9	78.6	comfort	9:25	39.5	69.4	comfort
Agricultural Irrigation Ditch	7	5:15	24.1	81.4	hot	12:41	19.6	79.5	dry	9:26	42.1	73.5	comfort
Agricultural Irrigation Ditch	8	5:16	23.5	77.7	comfort	12:42	20.6	81.0	hot	9:27	39.2	78.9	comfort
Agricultural Irrigation Ditch	9	5:17	23.7	78.6	comfort	12:43	19.6	75.2	dry	9:28	32.3	72.0	comfort
South Lawn	10	5:19	19.6	83.3	hot & dry	12:43	21.4	75.3	comfort	9:29	41.1	73.6	comfort
Sun Terrace	11	5:21	22.7	78.9	comfort	12:44	19.9	75.6	dry	9:29	37.2	72.6	comfort
Sun Terrace	12	5:21	23.7	79.2	comfort	12:45	18.5	78.4	dry	9:30	40.7	78.0	comfort
Sun Terrace	13	5:23	22.2	80.0	comfort	12:46	21.5	80.0	comfort	9:31	35.0	78.6	comfort
Sun Terrace	14	5:24	22.7	79.2	comfort	12:47	19.7	80.6	hot & dry	9:32	32.0	81.0	hot
Sun Terrace	15	5:25	22.7	81.4	hot	12:48	17.8	77.9	dry	9:34	29.8	76.8	comfort
Sun Terrace	16	5:26	21.1	79.7	comfort	12:49	21.4	79.6	comfort	9:36	34.4	75.3	comfort
Sun Terrace	17	5:28	23.1	76.7	comfort	12:50	20.6	77.9	comfort	9:38	35.7	71.9	comfort
Sun Terrace	18	5:29	24.7	76.8	comfort	12:51	23.0	78.1	comfort	9:43	35.0	75.8	comfort
South Lawn	19	5:30	21.2	76.8	comfort	12:52	18.3	78.1	dry	9:45	39.5	78.5	comfort
South Lawn	20	5:31	21.6	77.0	comfort	12:52	21.4	76.1	comfort	9:49	34.3	79.2	comfort
South Lawn	21	5:32	22.5	76.9	comfort	12:55	19.0	78.6	dry	9:51	37.4	78.1	comfort
South Lawn	22	5:33	25.0	77.6	comfort	12:56	19.3	71.1	dry	9:52	41.0	77.5	comfort
South Lawn	23	5:34	23.1	75.2	comfort	12:57	20.7	80.8	hot	9:53	38.3	80.6	hot
South Lawn	24	5:36	22.9	77.8	comfort	12:59	20.1	77.5	comfort	9:55	38.8	72.9	comfort
Swimming Lap Pool	25	5:38	21.6	82.2	hot	1:02	19.1	78.1	dry	9:57	38.0	77.9	comfort
Swimming Lap Pool	26	5:43	20.1	90.3	hot	1:03	17.8	82.8	hot & dry	9:58	38.4	77.9	comfort

Percent of outdoor spaces that fall into human comfort zone:

Morning: $24 / 31 = 77\%$

Afternoon: $13 / 31 = 42\%$

Evening: $15 / 31 = 48\%$



iPhone Apps

Travel Altimeter Light

Anti-Mosquito Repellent

Decibel Gauge

GPS Locator

Level

Leaf Identification

Light Meter

Pedometer

Night Sky



Resources

Amazon

<http://www.amazon.com/>

Forestry Suppliers, Inc.

<http://www.forestry-suppliers.com/>

Extech

<http://www.extech.com/instruments/>



