Introduction
Robert Adair, HLWSF
The Harris County Story
Alisa Max, PE, Harris County PID
Nick Russo, Harris County PID
Justin Taack, TCEQ

Houston Area Focus
Charlie Penland, PE, LEED AP, Walter P Moore & Associates
Margaret Robinson, PLA, ASLA, LEED AP, Asakura Robinson
Steve Albert, PE, CFM, Sherwood Design Engineers

Introduction
Robert Adair, HLWSF
San Antonio
Karen Bishop, San Antonio River Authority
Tiffany Price, Bender Wells & Clark
Austin
Andy Johnston, PE, CFM, CPESC, Halff & Associates
Dallas-Fort Worth
Mikel Wilkins, PE, ISI ENV-SP, Verd unity
Oklahoma
Zach Roach, Ideal Homes
LID O&M Considerations: Policy and Practicality
David Batts, Construction EcoServices

Introduction
Robert Adair, HLWSF
Arkansas
Becky Roark, Illinois River Watershed Partnership
Louisiana
Dana Brown, PLA, ASLA, LEED AP, CSI, AICP, Dana Brown Associates
New Mexico
George Radnovich, ASLA, Sites Southwes
asakura robinson company LLC
Planning   Urban Design   Landscape Architecture

CELEBRATING
YEARS

MARGARET ROBINSON, PLA, ASLA, LEED AP
PRINCIPAL
HOUSTON . AUSTIN . NEWPORT BEACH . TOKYO

urban planning & design
comprehensive planning l community-based redevelopment l urban design

transportation planning
transportation systems planning l multi-modal transportation l streetscapes

landscape architecture
landscape urbanism l sustainable design l low-impact design
DESIGNING GREEN INFRASTRUCTURE

1. SELLING IT
2. IN THE DIRT
3. GREY VS. GREEN
SELLING IT
A bioswale is a landscape element designed to redirect rainwater runoff for plant use and stormwater filtration. Water flows into the bioswale, over its sloped edges, where contaminants and inorganic materials are filtered by the soil and through the root system before entering the drainage system, and eventually into natural streams and water bodies.

**BENEFITS:**

1. Filters stormwater through plants and engineered soil mixes—removes 80%+ pollutants, total suspended solids (TSS) and heavy metals
2. Provides detention volume within media, swales, reservoirs
3. May reduce drainage system costs by up to 30%
4. Captures rainwater for use as a resource rather than discarded as a waste product
5. Diverts floatable trash from stormwater systems, bayous, lakes
6. Adds landscape area
7. Creates wildlife and native plant habitat
8. Contributes to LEED, Sustainable Sites, Envision, Green Roads and Living Building Challenge certifications
9. Increases coordination between Engineers, Hydrologists, Landscape Architects, Architects, Contractors, Maintenance Programs, Clients
<table>
<thead>
<tr>
<th>Year</th>
<th>Project</th>
<th>Clients</th>
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<tr>
<td>2008</td>
<td>Gene Green Park</td>
<td>Harris County Precinct 2</td>
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<tr>
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<td>Kendall Library</td>
<td>City of Houston, English Assoc. Arch.</td>
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<td>Houston Arboretum Green Wall</td>
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<td>Westside Senior Educ. Center</td>
<td>Harris County Precinct 3, BNIM</td>
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<td>Westchase Drainage Corridor</td>
<td>Westchase Manage. District</td>
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<td>New Hope Housing, Sakowitz</td>
<td>Val Glitsch Arch.</td>
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<td>Horn Elementary School</td>
<td>HISD, English Assoc. Arch.</td>
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<td>Lonestar College Victory Center</td>
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<td>Dickenson Library Rain Garden</td>
<td>TX AgriLife</td>
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<td>Peck Elementary School</td>
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<td>Carnegie Vanguard High School</td>
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<td>Bagby St. Reconstruction</td>
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<td>TAMU Joint Library Facility</td>
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<td>Mandell Park</td>
<td>Houston Parks Board, Friends of Mandell Park</td>
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<td>City of Houston Permit Office</td>
<td>City of Houston Green Building Resource Ctr.</td>
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<td>Schlumberger Midland Office</td>
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<td>Holzworth Road</td>
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<td>Brazoria County Parks: Quintana Beach</td>
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<td>SARA Stormwater Audit</td>
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<td>2016</td>
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<td>4th Ward Management District, ESPA</td>
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<td>Ft. Bend County, TXDOT</td>
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<td>Gannoway Lake Park</td>
<td>City of Sugar Land</td>
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<td>Gosling Road</td>
<td>Harris County, SPI</td>
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</table>
CERTIFICATIONS

- LEED - Leadership in Energy and Environmental Design
- Living Building Challenge
- Green Roads
- Envision
- Sustainable Site Initiative
A bioswale is a landscape element designed to redirect rainwater runoff for plant use and stormwater filtration. Water flows into the bioswale, over its sloped edges, where contaminants and inorganic materials are filtered by the soil and through the root system before entering the drainage system, and eventually into natural streams and water bodies.

Rain water and stormwater runoff can be redirected before entering the drainage system, allowing excess water to be utilized rather than discharged.

Native plants that have adapted to the climate can survive with minimal maintenance or supplemental watering, and provide food and habitat for birds and insects.

Sloped edges direct stormwater into the bioswale.

The root systems of plants redistribute moisture and sustain microbial populations, as well as filter contaminants from water runoff before entering the natural waterways via the drainage system.
IN THE DIRT
MANDELL PARK
CLIENT: Friends of Mandell Park, City of Houston
BAGBY STREETSCAPE
CLIENT: Design Workshop, Midtown
Phase 1 LID elements:
- Parking Lot Improvements
  - Bioswales
  - Native vegetation
  - Increased tree plantings

Phase 2 elements:
- Rooftop Terrace Improvements
  - Green roof
  - Native vegetation
  - Tree plantings

Future phase elements:
- Buffalo Bayou Improvements
  - Dry creek/natural drainage
  - Native vegetation
  - Tree plantings
- not used to fulfill any stormwater quality requirements
- ‘test case’/pilot project
- used for aesthetic purposes and educational component
- Client is now pursuing other ‘green’ projects
Houston Fire Station 90
ARCHITECT: English Assoc. Arch.
ENGINEER: OTHON
LA: Asakura Robinson

Completed Spring 2010

LID practices:
• vegetated detention
• rainwater harvesting (reused in irrigation system)
• pervious concrete
Installation of a Stormwater Harvesting Tank

Lone Star College-Conroe
ARCHITECT: Perspectiva
ENGINEER: CSF
LA: Asakura Robinson
LID practices:

- raingardens
- rainwater harvesting (reused in irrigation system)
- bioswales
- pervious concrete pavers
Development Site:
• 195 Acres
• Sand Pits
• Wooded
• Floodplain
• Access
• Regional Park HCP4
• Spring Creek Greenway
• Grand Parkway
• Springwoods Village
• Exxon/Mobile

Developer Interest in LID:
Why?
Goals
Concerns

Mossy Oaks Road
CLIENTS: KPS Land Development, Encanto real Utility District, Harris County
ENGINEER: EHRA
PLANNER/LA: Asakura Robinson
parking lot bioswales:

- 2 bioswales, 20’ wide x 135’ long ea.
- 5400 SF
- $20,000 per general contractor’s estimate (excl. gabions)
- $3.70/SF
- $74.00/LF

- Drain Area – 38,000 SF (0.87 Ac.)
- Maintenance is an issue!
Gannoway Lake Park

CLIENT: City of Sugar Land
ENGINEER: WPM/Dodson
Planner/LA: Asakura Robinson

Park that improves stormwater runoff to protect Gannoway lake and Oyster Creek. Serves recreational and educational purposes.

LID practices:
- bioswales
- stormwater wetland creation
- rainwater harvesting
- pervious paving

Diagram:
- Bioswales - Shallow swale filled with moisture-loving plants and engineered soil media will remove pollutants from parking lot stormwater runoff. Bioswales have been proven effective in removing 90% of pollutants, including heavy metals, oil and grease, and bacteria.
- Permeable Paving - The parking lot would be paved in a porous material allowing infiltration, which would then be directed to the bioswale or rain garden. An innovative material called Filterpave, made from recycled glass, could be used to provide visual interest as well as an educational element.
- Rain Garden - Similar to a bioswale, a rain garden utilizes plants to remove pollutants from stormwater runoff and increase water uptake and evapotranspiration. A variety of native wetland grasses and perennials would be planted in this shallow depressional area, which would filter stormwater before releasing it into the lake.
- Canoe Launch - Located in close proximity to the parking lot, the canoe launch provides easy access to the lake for kayakers and canoers.
- Boathouse - The boathouse provides storage and access for small watercraft that could be rented for data use.
WASHINGTON AVENUE
LIVABLE CENTERS STUDY
CLIENT: Houston-Galveston Area Council

ALMEDA RECONSTRUCTION
CLIENT: City Houston, Walter P. Moore
FIVE CORNERS ENVIRONMENTAL DESIGN MASTER PLAN
CLIENT: Five Corners Management District

GILETTE / GENESEE PLAN
CLIENT: Fourth Ward TIRZ
COMPARISON-
LID VS
CONVENTIONAL
DRAINAGE
TRADITIONAL CROSS SECTION

50' ROW
28' Pavement
125' Lot Depth

WATER
STORM TO END OF PIPE DETENTION
SANITARY
ELECTRICAL

r.g. miller engineers
C-4 EAST - TRADITIONAL LAND PLAN

Lot Depths: 125, 130, 135 ft
Open Space: 7.95 acres
65’ Lots: 23
70’ Lots: 28
80’ Lots: 37
Total Lots: 88
TRADITIONAL STORM SEWER LAYOUT
LOT GRADING FOR LID OPTION
C-4 EAST - LID LAND PLAN

Lot Depth: 125 ft
Open Space: 11.5 ac
65’ Lots: 23
70’ Lots: 30
80’ Lots: 42
Total Lots: 95
**DRAINAGE AREAS**

- **Subarea A** – 15.3 acres
- **Subarea B** – 8.0 acres
- **Subarea C** – 11.4 acres

**West Swale**
- 0.5 to 4 ft depths
- 2 - 7 ft bottom widths
- 3:1 max slopes
- 0.1% grade

**Back Swales**
- 6-8 ft depth
- 6-8 ft bottom widths
- 4:1 max slopes
- 0.1% grade
- 0.5 to 4 ft depths
- 2 - 7 ft bottom widths
# C-4 EAST - DEVELOPMENT OPTIONS SUMMARY

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<th>Traditional</th>
<th>Low Impact Development</th>
<th>Difference</th>
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<tr>
<td>Tract Size (acres)</td>
<td>38</td>
<td>38</td>
<td>0</td>
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<tr>
<td>Open Space (acres)</td>
<td>7.95</td>
<td>11.46</td>
<td>3.51</td>
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<tr>
<td>Lot Depth (feet)</td>
<td>130 (ave)</td>
<td>125</td>
<td>(5)</td>
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<tr>
<td>65’ Wide Lots</td>
<td>23</td>
<td>23</td>
<td>0</td>
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<tr>
<td>70’ Wide Lots</td>
<td>28</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>80’ Wide Lots</td>
<td>37</td>
<td>42</td>
<td>5</td>
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<tr>
<td>Total Lots</td>
<td>88</td>
<td>95</td>
<td>7</td>
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<tr>
<td>Number of Lots Next To Amenity Feature</td>
<td>8</td>
<td>95</td>
<td>87</td>
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<tr>
<td>Drainage System Cost</td>
<td>$724,678</td>
<td>$332,632</td>
<td>($392,046)</td>
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<td>Drainage System Cost Per Lot</td>
<td>$8,235 each</td>
<td>$3,501 each</td>
<td>($4,733 each)</td>
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THANK YOU

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Principal & QA/QC Manager

Zacq Lockrem
Principal & Director of Planning

Hayley Pallister
Principal & Office Manager