LID Case Studies
Focus: BIOSWALEs
Gene Green Beltway 8 Park

AGENCIES:

HARRIS COUNTY PRECINCT TWO
Commissioner Sylvia R. Garcia

HARRIS COUNTY PUBLIC INFRASTRUCTURE DEPT.
Parks and Recreation Division
Architecture Division

HARRIS COUNTY FLOOD CONTROL DISTRICT

CONSULTANTS:

PRIME / LANDSCAPE ARCHITECT:
Asakura Robinson Company

ARCHITECT / LEED ADMIN.:
NATEX Architects

CIVIL ENGINEERS:
Cobb Fendley & Associates

STRUCTURAL ENGINEERS:
Conti Jumper Gardner & Associates

MEP ENGINEERS / COMMISSIONING AGENT:
DBR Engineering Consultants

GENERAL CONTRACTOR:
SpawGlass Civil Construction
Bio-Swales:
treat nastiest pollutants in park:
  Total Suspended Solids  75%
  Phosphorous  60-70%
  Nitrogen  55-60%
  Metals  85-90%
  Bacteria  90%

Polycyclic Aromatic Hydrocarbons (PAH)- Asphalt Sealers-
Coal Tar-Banned Austin 2006, barrier to motor oils

Reduce construction and maintenance costs 25%
Lower water temperatures 3-5 degrees Celsius-aquatic life,
reduce heat island effects
**LEED CHECKLIST**

**Sustainable Sites:**
- Construction Activity Pollution Prev. **Req.**
- Site Selection **1 pt.**
- Alternative Transportation **1 pt.**
- Alternative Transportation Parking Capacity **1 pt.**
- Site Development: Protect/Restore Habitat **1 pt.**
- Site Development: Maximize Open Space **1 pt.**

**Stormwater Management:**
- Stormwater Management: Quantity Control **1 pt.**
- Stormwater Management: Quality Control **1 pt.**
- Heat Island Effect: Roof **1 pt.**
- Light Pollution Reduction **1 pt.**

**Water Efficiency:**
- Water Efficient Landscaping - 50% Reduction **1 pt.**
- Water Efficient Landscaping - No Potable Water **1 pt.**
- Innovative Wastewater Technologies **1 pt.**
- Water Use Reduction **2 pts.**

**Energy and Atmosphere:**
- Fundamental Commissioning **Req.**
- Minimum Energy Performance **Req.**
- Fundamental Refrigerant Management **Req.**
- Enhanced Refrigerant Management **1 pt.**
- Green Power **1 pt.**

**Materials & Resources:**
- Storage & Collection Recyclables **Req.**
- Construction Waste Management **2 pts.**
- Recycled Content **2 pts.**
- Regional Materials **2 pts.**

**Indoor Environmental Quality:**
- Minimum IAQ Performance **Req.**
- Environmental Tobacco Smoke (ETS) Control **Req.**
- Increased Ventilation **1 pt.**
- Construction IAQ: During Construction **1 pt.**
- Construction IAQ: Before Occupancy **1 pt.**
- Low-Emitting Materials: Adhesives & Sealants **1 pt.**
- Low-Emitting Materials: Paints & Coatings **1 pt.**
- Low-Emitting Materials: Composite Wood & Agrifiber **1 pt.**
- Indoor Chemical & Pollutant Source Control **1 pt.**
- Controllability of Systems: Lighting **1 pt.**

**Innovation & Design Process:**
- Innovation in Design: Protect & Restore Habitat **1 pt.**
- Innovation in Design: Maximize Open Space **1 pt.**
- Innovation in Design: LEED Education **1 pt.**
- Innovation in Design: Green Maintenance Plan **1 pt.**
- LEED Accredited Professional **1 pt.**

**TOTAL:** **34 pts.**
Gene Green Beltway 8 Park

- Bio-swales
- Dual Use Facility
- Meander Stream/Prairie Grasses
- Splash Park Re-circulating Pump
- Low Water Fixtures/Irrigation

Water Quality/Conservation Techniques

Houston Land Water Sustainability Forum
Bio-Swale Implementation:

Coordination—Landscape Architect, Civil Engineer
Infiltration/detention rates
• Soil mix
• Depth
• Pipe Size
• Inlet Height-storage

Whose CD package? Details? Specs? Budget?

April 28, 2009

Houston Land Water Sustainability Forum
Parking Lot Detail Plan

Bioswales:
- 20' wide x 135' long x 2
- 5400 SF
- $20,000 per SpawGlass (excl. gabions)
  - $3.70/SF
  - $74.00/LF
- Drain Area – 38,000 SF (0.87 Ac.)

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City of Houston Bio-retention Detail

City of Houston Dry Swale Detail

City of Houston Dept of Public Works and Engineering

Houston Land Water Sustainability Forum
Harris County:

- LID allows matching existing hydrograph (time) in lieu of detention (volume) guidelines
- Allow 25-30% detention storage volume within engineered soils
- Issue: MUD/TCEQ reimbursement to developers
Soil Options:

Infiltration Rates:
- Course Sand: 1-8" hour
- Fine Sand: .5-3.1" hour
- Sandy Loam: .4-2.6" hour
- Clay: .01-.1" hour
- Clay Loam: .04-.6" hour
- Loam: .08-1" hour
- Calcined Clay mix with Sand: 50" hour
- Ideal Soil Mix: 0.5" to 6" per hour

Organic Soil Amendments:
- Mycorrhizal and Microbial Inoculants
  - Healthier Plants
  - Lower Water Requirements
  - Increased Root Penetration
  - Transfer of Nutrients
  - Further Break Down Pollutants

Problems:
- Compaction during Construction
- Siltation during Construction
- Erosion
- Impermeability

<table>
<thead>
<tr>
<th>Bioswale Mix</th>
<th>SAND</th>
<th>TOPSOIL</th>
<th>COMPOST</th>
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<tr>
<td>City of Houston Public Works and Engineering</td>
<td>50</td>
<td>30</td>
<td>20</td>
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<tr>
<td>Larry Kaufman</td>
<td>70</td>
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<td>ARC Fast Draining</td>
<td>50</td>
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<tr>
<td>ARC Longer Draining</td>
<td>70</td>
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Pipe Options:

Perforated Pipe:
- Size varies per drainage volume calculations, 6”-18”
- Encased in gravel or recycled concrete

NDS EZ Flow
- No gravel, slotted pipe surrounded by Poly Rock
- Requires less labor, lighter
- 100% recycled content
- 3”- 4” pipes, 7 - 10” socks

Under Drains:

• Under drains must tie into an adequate conveyance system.
• A gravel layer provides temporary storage of stormwater and minimizes the chance of clogging.
• Observation/cleanout wells should be installed.
Inlets and Curb Cuts:

- Provides continuous inflow into the entire length of bioswale.
- Curb cuts allow inflows to be spread over a wide area, minimizing erosion and dispersing pollutants along vegetation.
Plant Material Options:

Qualities
- Native or Adapted
- Drought and Water Tolerant
- Pollution Tolerant
- Shallow Rooting Trees

Benefits
- Stabilize Soils, Reduce Erosion
- Slow Runoff
- Allow Sediments to Drop Out
- Uptake Carbon, Oils, Salts, Metals, & other Pollutants
- Reduce Water Temperatures
- Trees Shade Pavement

Palette:
**Trees**
- Bald Cypress
- Fringe Tree
- Red Maple
- Tupelo
- Black Gum

**Shrubs**
- Sweetspire
- American Beautybush
- Inkberry
- Buttonbush

**Groundcovers**
- Muhly Grass
- Louisiana Iris
- Yellow Flag Iris
- Dietes
- Crinum
- Spider Lily
- Cordgrass
- Wedelia

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Irrigation Options:
- At Initial Establishment
- Long-term Irrigation can be omitted
- Soil Moisture Sensor per zone

Edge Filter Options:
Function: slow flow, deter scour/erosion and capture trash
- Bullrock Strip
- Recycled Crushed Concrete Strip (washed)
- Turf Strip
- Gabion Filters
- Spreader Bar or Level Spreader
Bioswale Maintenance:

**Maintenance during Establishment**
- Temporary Irrigation
- Vegetation Replacement (10%)
- Fertilization/Inoculation
- Construction siltation and compaction

**Issues:**
- Mosquitoes-need 3-7 days hatch, becomes death trap
- Weeding vs. Mowing
- Kids muddy
- City/County/MUD Inspections
- No local track record

**Periodic Visual Checks:**
- Sediment Build-up
- Foreign Objects/Debris
- Standing Water (48 hrs+)
- Erosion /Slumping
- Vegetation
- Invasive Species

**As Needed:**
- Mowing, if Turf
- Weeding
- Debris Removal
- Manual Water (Drought Conditions)
- Cleanout overflow Inlets

**Bi-Annual/Annual Maintenance**
- Mulching-Remove and Replace if Silted, re-use
- Plant Replacement
- Pruning-Fast Growth!
- Soil Amendments
- EPA estimates Bioretention Basins:
  - 5-7% Construction Costs Annula Maintenance

**Issues:**
- Mosquitoes-need 3-7 days hatch, becomes death trap
- Weeding vs. Mowing
- Kids muddy
- City/County/MUD Inspections
- No local track record
### Cost Comparisons:

**Horn Elementary School - HISD, Bellaire**
- **Width:** 16'
- **Length:** 1040 LF

**Specified Mix:** COH Public Works  
**Drainage Media:** EZ Flow French Drain System  
**Plants:** 1 gal. spaced 24” on center

**Conventional Drainage:**
- 12", 15", and 18" pipes  
- 8 Inlets  
- 1 Manhole  

<table>
<thead>
<tr>
<th>Roof Drains</th>
<th>Cost ($167,000)</th>
<th>($160.58 LF)</th>
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</table>

**Bioswale System:**
- Grading  
- Piping  
- Soil Mix  
- Plants  

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<thead>
<tr>
<th>Roof Drains</th>
<th>Cost ($115,000)</th>
<th>($110.57 LF)</th>
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**Omit Curbs**

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### Meador Library Cost Comparison

#### Bioswale Cost Comparison: 1', 2', and 3' depth

<table>
<thead>
<tr>
<th>Depth</th>
<th>Excavation/Grading</th>
<th>Engineered Soil Mix</th>
<th>EZ Flow Drain</th>
<th>E.R. Flow Couplers</th>
<th>Manch</th>
<th>Plants</th>
<th>Roof Drains</th>
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<tbody>
<tr>
<td>3' depth</td>
<td>50 cu yd</td>
<td>$6.50</td>
<td>$105.00</td>
<td>20 LF</td>
<td>$6.75</td>
<td>1 gal</td>
<td>$167,000</td>
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<td></td>
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<td>($160.58 LF)</td>
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<tr>
<td>2' depth</td>
<td>23 cu yd</td>
<td>$6.50</td>
<td>$149.50</td>
<td>20 LF</td>
<td>$6.75</td>
<td>1 gal</td>
<td>$115,000</td>
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<td></td>
<td></td>
<td></td>
<td>($110.57 LF)</td>
</tr>
<tr>
<td>1' depth</td>
<td>16 cu yd</td>
<td>$6.50</td>
<td>$104.00</td>
<td>20 LF</td>
<td>$6.75</td>
<td>1 gal</td>
<td>$92,000</td>
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<td></td>
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<td></td>
<td></td>
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<td>($90.00)</td>
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</table>

**SUB-TOTAL**  
- 3' depth: $1,724.52  
- 2' depth: $1,469.62  
- 1' depth: $1,213.52  

**COST PER LF:**
- 3' depth: $86.23  
- 2' depth: $73.46  
- 1' depth: $68.68

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Meander Stream:
- Native Gulf Coast Prairie Grass, Trees, Riparian Plantings
- Low Mow Requirements
- Low Water Requirements
- Meander Pattern Dissipates Runoff – 5%
- Increased Height & Density Of Vegetation - Slow
Meander Stream:
- Water Quality-Filtering
- Drainage Dissipation
- Reduce Irrigation
- Native Riparian Vegetation
Houston Arboretum

Educational Element at Entry

Phase 1 –
Rain Garden

Phase 2 –
Rainwater Collection System for Irrigation Use
Gabion Seat Wall and Green Wall – Recycled Products
Keep Houston Beautiful – City of Houston Public Works

- Belfort Drive 'Ditch Beautiful Project'
- Volunteer Project – April 2009
- Filtering Vegetation
- Aesthetic Buffer

- 760 Trees Planted
- 1 Gallon - 65 Gallon
- Encourages Public Ownership

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Citation Oil & Gas – Ambrose, McEnany & House – Costello Inc.
- Planted Detention
- Native/Adapted Vegetation
- Aesthetic Buffer
Meador Library – Harris County Precinct 2 – English & Associates – Claunch & Miller
- Bioswales & Rain Garden
- Permeable Paving
- Rainwater Harvesting
- Native/Adapted Plants
- Habitat Creation
City of Houston Kendall Library – English Associates Architects - Othon

- Rainwater Harvest
- Bioswales
- Limited Irrigation
- Drought Tolerant Vegetation

Atlantis Rain Tank Modules

Houston Land Water Sustainability Forum
City of Houston Fire Station 90 – English Associates Architects, Othon Engineering

- Rain Garden
- Xeriscaping
- Rainwater Harvesting
- Permeable Paving
HISD Horn Elementary – English Associates Architects, Claunch and Miller Engineering

- Bioswales
- Constructed Wetland
- Reforestation
- Soil Monitoring

Initial Soil Test Results:
- Healthy Amount of Mycorrhizae Present
- In-sufficient Microbe Levels
- Inoculation Recommended

Houston Land Water Sustainability Forum
DeChaumes Elementary- HISD, ArcTec Associates, Rehka Engineering

LID elements:
- tree preservation
- reduced paving
- bioswales
- rainwater harvesting
- native vegetation
- dual use detention and playing fields
Baker Ripley Neighborhood Center - Neighborhood Centers Inc., Concordia, Jacobs Engineering

LID elements:
- tree preservation
- bioswales
- rainwater harvesting
- native vegetation
Federal Reserve Bank Parking- PGAL

Phase 1 LID elements:
- bioswales
- native vegetation
- increased tree plantings