

GREEN INFRASTRUCTURE

An Idea in the Making

FAPA Conference September 13, 2013

Outline

- Introduction and Project Overview
- Green Streets
- Low Impact Development (LID) Practices
- Stormwater Master Planning and LID Integration
- Open Space
- Questions

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What is Horizon West?

- 23,000 acres
- First approved in 1995
- 1st Sector Plan in Florida
- Former greenfield rural area close to Disney and new SR 429
- Opportunity for new planning vision for Orange County
- Over 40,000 households within six Villages
- Regional-scale town center



Lake County



Orange County

Wellness Way Sector Plan (proposed)

~16,200 acres ~16,000 units ~55,500,000 sq. ft. of non-residential



Horizon West Town Center

- Specific Area Plan (SAP) adopted in 2004
- Employment and commercial hub
- Higher density urban environment
- Town Center development program:
 - 3,500 acres
 - 6,000 housing units
 - 1,200 hotel rooms
 - ~8,000,000 sq. ft. of commercial and office uses



Town Center Code

- Phase I adopted 01/29/2013
 - Administration
 - Streets and blocks
 - Land use
 - Placemaking
- Phase II "Green Infrastructure":
 - Greenscaping (Streets & Sites)
 - LID Manual/practices
 - Stormwater master planning
 - Open space component



What is "Green Infrastructure"?

- Greenscaping and Green Streets
- Low Impact Development (LID) practices
- Stormwater master planning
- Open space component
- Land Management and Maintenance



Source: www.portlandoregon.gov



Source: www.cmap.illinois.gov



Source: https://bouldercolorado.gov

What is "Green Infrastructure"? (cont.)

- The concept first emerged in the early 1990s as an alternative approach to stormwater management.
- Generally means "building with nature."
- Components usually include: stormwater management, air quality, clean water, energy production, etc.
- "Green Infrastructure" concept (EPA definition):
 - uses natural hydrologic features to manage water and provide environmental and community benefits;
 - supports sustainable communities by improving the environment and preserving open space;
 - provides for stormwater management, flood mitigation, air quality management, etc.



Why "Green Infrastructure" for the Town Center?

 The County is in the process of developing the Town Center Development Code and Specific Area Plan encourages stormwater master planning.



- Greenfield and hydrologic conditions suitable to use of LID practices.
- ~ 70% of area basins are closed basins.
- Town Center could serve as a pilot area for application of the "Green Infrastructure" concept.

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Green Streets/ Green Infrastructure



The More Roads the Better



TUDIOS

The More Cars the Better



The More Paving the Better



The More Sprawl the Better



STUDIOS

The More Conveyance the Better



TUDIOS

More Conveyance Leads to More Flooding



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UDIOS

Dealing with Collapse of our Infrastructure



STUDIOS

Green Infrastructure – Time for a New Approach



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UDIOS

Integrating Cultural & Natural Resources



STUDIOS

Integrating Site & Structures



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TUDIOS



SAND COUNTY





TUDIOS



Providing Alternative Transportation



STUDIOS

Emphasizing Communities for All Ages



Providing Diverse Housing





Creating a Safe & Secure Community





Promoting Lifelong Learning



SAND COUNTY

Providing Public Open Space



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STUDIOS

Protecting Natural Resources & Natural Systems



SAND COUNTY
Protecting Natural Resources & Natural Systems



STUDIOS

Getting the Public Involved



STUDIOS

Using Green Scorecards & Programs







ENERGY EFFICIENCY

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The influence entropy of a word is, a transition or abstrated solar industrion liber is reomitted from the near industria to the later. Emitteness is mean teaching variant with the surface mean. Emitteness of particular or granular coulded world interfusion to as high ray with process.









Making Communities Economically Viable





Promoting Health & Wellness



SAND COUNTY

Promoting Health & Wellness



Creating a Sense of Community



Generating Energy



Managing the Big Dig



TUDIOS





STUDIOS



BELTLINE EMERALD NECKLACE		Acres
Beitline Park System Beitline mixed-usa, public-private development	LO	2,014 530
	Total	2,544
BELTLINE PARK SYSTEM		
Existing Open Space		613
Right-of-way		179
Expanded Open Space		110
New Open Space		334
Mixed-use, public-private development		778
	Total	2,014
	(Acres in Flood Plain)	166
BELTLINE MIXED-USE DEVELOPMENT		_
Public-private development		530
Open Space		779
	Total	1,309



SAND COUNTY



Green Infrastructure - Florida APA 2013



SAND COUNTY





STUDIOS



STUDIOS

Managing Stormwater



STUDIOS



Managing Stormwater



Dispersed Stormwater



Retention Pond



Multi-Use Detention



Aesthetic Water Feature



Constructed Wetlands



Bio filtration



Managing Stormwater





Putting it all Together



Flood Damage Reduction Options Map

BUFFALO BAYOU

Description of Potential Options: A potential stormwater detention site on Turkey Creek, and on City of Houston property, is depicted as options in lieu of constructing basins in the HCFCD right-of way. This option may take priority if environmental surveys limit the ability to use the HCFCD property or if community values suggest an alternative configuration. Langham Creek is the outfail channel for Addicks Reservoir.

Erosion rates are generally moderate to high, with very few areas of extreme erosion. There is good construction access, good visibility, and potential habitat improvement and cultural resource protection in selected areas, thus the priotElzation categories are primarily Medium and High, with some areas of Low and Very High.

Benefits of Potential Options: The total storage volume of basins located in HCFCD right of way between State Highway 6 and Eidridge could be 68 acre-leet, with an average 1% WSEL reduction up to 2.7 feet. An many as three structures on W167-00-00 could benefit from a flood damage reduction project in this tributary.

STATE HIGHWAY 6 to BELTWAY 8

102



LANAN 1 - AMPRICAMPLE ASTA





Them are existing trads within Tony Hershey Park on both sides. of the bayou. The existing boat launch on Langham Geekcould be expanded into a major trailsead. A potential trail could link to a minor trailhead along Endave Parkway and potential traffs along Turkey Cneek could improve access Undeveloped land to the east of Turkey Greek could be developed into a rature park. The areas marked for researching could involve selective reforestation based upon the quality and health of existing species. Removal of invasive species and landscaping with native plants in selected areas along both sides of the bayou could improve the visual quality of the park and help create a mane ecologically sustainable environment.

Detention basins along both sides of the bayou are intended to be integrated into the existing park in such a way as taconsider existing natural resources and enhance visual quality. An existing detention besin between the bayou and Enclawe Parloway-could be expanded as part of a public/private partnership. Potential detention basins at Eldridge Parlovay and along Turkey Creek could also increase flood storage volume. A biostention area is suggested along the south bank where Eldridge Parkway crosses the bayou



SAND COUNTY STUDIOS





STUDIOS









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What is LID?

- Low Impact Development (LID) is an approach to land development that works with nature to manage stormwater as close to its source as possible.
- EPA Definition (Coffman, 2000)
 - LID is a site design strategy with a goal of maintaining or replicating the predevelopment hydrologic regime through the use of design techniques to create a functionally equivalent hydrologic landscape.



Regulatory Drivers:

- Orange County Mayor's Sustainability Initiative:
 - Focuses on built environment, resilient communities, education, mobility, natural resources, government and civic engagement, and arts and culture.
 - Promotes energy efficiency, renewable energy production, green buildings, water conservation, and waste reduction through Orange to Green program;
- Orange County Comprehensive Plan
- NPDES / TMDLs
- Proposed Statewide Stormwater Quality Rule



Orange County LID Manual project:

- LID Manual
 - 7 LID practices
 - Practices suitable for greenfield type urban development
- Concept plans comparison
 - Traditional vs. LID site design
 - Comparison of costs and maintenance requirements
- LID maintenance cost projections
 - Annual maintenance costs for each of the LID practices
 - 10-year maintenance cost projections (including replacement)
- Stormwater master planning
 - Mostly closed basins/good soils

Low Impact Development (LID) Practices **Benefits of LID Pollutant** Focus on Treatment (water quality) stormwater as a resource Volume Land Reduction Utilization (attenuation)

Challenges of LID

- Effective integration with traditional practices;
- Lack of familiarity of local contractors
- Lack of familiarity by county engineers
- Lack of familiarity by regional permitting authorities
- Lack of experience with maintenance procedures



LID Practices:

- Pervious pavement
- Bioretention Areas/Bioswales
- Rain Gardens
- Planter Box
- Tree Box Filters
- Curb Cuts & Inverted Medians
- Stormwater Harvesting Cisterns



Cost Impacts:

Capital Costs

- Reduced infrastructure (↓)
- Potentially smaller ponds (\downarrow)
- More vegetation/plantings (↑)
- Contractor certifications ([†])

Maintenance Costs

- Training/certifications for personnel ([↑])
- Replace typical landscaping offset overall BMP maintenance area (↓)
- Infiltration/media testing (↑)



Concept Plans Comparison

Purpose

- Show LID techniques can accommodate equivalent density/intensity development as traditional methods;
- Provide alternatives to structural stormwater facilities;
- Provide additional opportunities for infiltration; and
- Illustrate that water quality, water quantity, and nutrient loading criteria can be met or exceeded using LID practices.

Project Site (29.09 acres): portion of Hamlin PD

- Commercial: Grocery store 54,000 sq. ft.
 - Bank (Outparcel) 4,500 sq. ft.
 - Retail 4,500 sq. ft.
- Residential: 168 MF units (7 buildings at 24 units/building)






Comparison Results

- The LID Concept provides the same commercial and residential sq. ft. and parking
- LID utilizes 25.31 acres of the original 29.09 acres a reduction of 3.78 acres (13%).
- The LID concept plan meets or exceeds the Traditional concept plan in all

stormwater management criteria.

Criteria	Traditional	LID		
Treatment Volume 1	4.40 ac-ft	5,83 ac-ft		
Volume to Ponds ²	17.7 ac-ft	11.7 ac-ft		
Site Discharge Rate 3	8.46 cfs	8.05 cfs		
Pollutant Loading Removal	95.95%	96.69%		
Outflow Mass Loading	1.19 kg/yr	0.86 kg/yr		



(1): Treatment Volume is controlled by the retention depth needed for nutrient removal
(2): Total Inflow volume for the 25yr/24hr (Orange) storm event to Ponds 100/100L and 200/200L
(3): Peak Discharge to Lk Hancock for the 25yr/24hr (Orange) storm event

Cost Comparison Results with Land Savings (Preliminary)

Pay Item	LID Cost	Traditional Cost	LID Description	Traditional Description
Pavement	\$ 741,323.67	\$ 586,532.87	Pervious Pavement, Pervious Asphalt, and Pavers	Asphalt and Concrete Sidewalk
Bioretention Swale	\$ 645,387.05	\$ 290,941.07	Bioretention Swale	Landscaping
Raingarden	\$ 408,062.24	\$ 104,400.34	Raingarden	Landscaping
Planter Box	\$ 47,296.75	\$ 9,645.40	Planter Box	Landscaping
Tree Box Filter	\$ 128,730.00	\$ 6,307.27	Tree Box Filter	Landscaping
Curbing and Medians	\$ 86,326.45	\$ 86,886.83	Valley Gutter, Type D curb, and Pavement	Type D Curb and Pavement
Stormwater Harvesting	\$ 212,621.14	N/A	Stormwater Harvesting	No item correlates
Primary Storm System	\$ 398,769.82	\$ 818,139.65	Two Dry Retention Ponds	Two Dry Retention Ponds and One Wet Detention Pond
Secondary Storm System	\$ 354,529.42	\$ 644,946.81	36-inch Pipe, Manhole, DBI C, 36-Inch MES	12-inch & 36-inch Pipe, DBI C, 36-Inch MES
Undeveloped Land	N/A	\$ 849,000.00	No item correlates	\$200k/acre multi-family; \$250k/ acre retail
Totals:	\$ 3,023,047	\$ 3,396,800		

Maintenance Costs Projections

- Project maintenance costs for each of the LID practices:
 - frequency
 - inspection activity
 - maintenance activity
 - labor/equipment/materials
 - costs of similar traditional stormwater management activities
- Compare example project data
- Compare to national data



Example 10-Year Maintenance Cost Projection

				orange	County, Fl	orida					
Inflation Rate:		3%		User input	inflation rat	e. The bas	e rate of inflati	ion is 3%			
Maintenance Activity					1	/ear					Totals
maintenance Activity	1	2	3	4	5	6	7	8	9	10	Totals
Monthly Trash and Debris Removal	\$300	\$309	\$318	\$328	\$330	\$348	\$358	\$369	\$380	\$391	\$3,439
Triannual Minor Inspection, Cleaning, and Restoration	\$405	\$417	\$430	\$443	\$456	\$470	\$464	\$498	\$513	\$528	\$4,643
Annual Inspection and Maintenance	\$208	\$214	\$220	\$227	\$234	\$241	\$248	\$255	\$263	\$271	\$2,379
Annual Compliance Report	\$300	\$309	\$318	\$328	\$338	\$348	\$358	\$369	\$380	\$391	\$3,439
							Total 10	Year Ma	intenan	ce Cost:	\$13,900
				-	-	_					+
	Green sha	iding indic	ites cell can	be manually	redited.						

**Refer to Table PP-1 for annual maintenance cost assumptions.

Traditional vs. LID Maintenance Cost Comparison (Preliminary)

Maintenance Scenario	Design Practice Size	Estimated Annual Maintenance (2013 Dollars)	Estimated 10-Year Maintenance (3% inflation)		
Pervious Pavement	36792 sf	\$1,333	\$15,278		
Bioretention	73846 sf	\$11,367	\$130,311		
Rain Garden	26498 sf		\$67,377		
Planter Box	2448 sf	\$1,804	\$20,684		
Tree Box Filter	10 boxes	\$1,586	\$18,722		
Curb Cuts / Inverted Medians	N/A	N/A	N/A		
Stormwater Harvesting (w/ Cisterns)	134528 gal	\$9,120	\$104,548		
Dry Retention Pond	92522 sf	\$11,303	\$133,462		
	Totals:	\$42,390	\$490,382		
Maintenance Scenario	Design Practice Size	Estimated Annual Maintenance (2013 Dollars)	Estimated 10-Year Maintenance (3% inflation)		
Dry Retention Pond	132,675 sf	132,675 sf \$15,880			
Landscaped Area	30,546 sf	\$5,889	\$69,542		
Swale	73,843 sf	\$8,779	\$103,663		
Wet Detention Pond	63,319 sf	\$4,451	\$49,095		

Totals:

\$34,999

\$409,812

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Approaches integrated through the Green Infrastructure Code:

- Flood protection addressed through Master Planning
- Water quality addressed through Low Impact Development (LID) practices
- Outfall condition affects determination of storm event and selection of water quality treatment regime
- Incentives for use of LID practices



Master Planning determined by:

- Size and location of basin(s)
- Type of land use district
- Basin property ownership
- Joint Use Retention/Detention Facilities



Horizon West Town Center: Land Use Districts and Basins





Implementation Challenges:

- 1. Coding for a Green Infrastructure Approach
 - District and Neighborhood based
- 2. Timing of Master Stormwater Planning
 - Planned Development
 - Subdivision Plats/Construction Plans-Permits
- 3. Construction of Improvements
 - Phased implementation
 - Capacity Reservations
- 4. Maintenance of Improvements
 - Public or Private
 - Performance Standards, Permitting Requirements

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Current Requirements:

- APF (Adequate Public Facilities) requirement in the range of 3-5% of developable area
- Seven (7) % of net developable area per land use district
- Up to fifty (50)% of district requirement can be satisfied through amenitized stormwater facilities









Challenges:

- Functional integration of stormwater facilities and open space
- Location of open space in relation to uses served
- Open space can and will accommodate LID practices – water quality neutral
- Open space incentives for utilization of LID practices
- Provide opportunities for transportation linkages, community gardens



PLACEMENT + ACCESSIBILITY

 All residential units and the publicly accessible doors of nonresidential uses... shall be within the service radius of a park that conforms to the park type standards..... Service radii are based on park size.

Park Size	Service Radius
0.5 ac	250 ft.
1 ac	300 ft.
2 ac	400 ft.
3 ас	500 ft.





Delaney Park, Orlando

Large Park – Large Radius In excess of 500 ft



Example of a "Green" with a service radius of 300 ft





Co-location of Stormwater Facility and Neighborhood Park Encouraged





Implementation Approach:

- At least 10% of the development shall be usable parks and community common areas accessible to the public, including the following types of areas:
 - Buffer zones and greenbelts
 - Active and passive recreational areas
 - Landscaped areas
 - All other permanently undeveloped uplands
 - Dry bottom stormwater management ponds meeting design standards
 - Upland edges of wet bottom stormwater management ponds meeting design standards

Conclusions

- Greater land utilization efficiencies
- Enhanced water quality
- "Grey" infrastructure minimized
- Improved distribution and arrangement of open space resources
- Better integration of stormwater facilities and land uses
- Reduced maintenance costs for traditional stormwater facilities
- Fewer conflicts between streets, utilities and green infrastructure
- Opportunities for water harvesting and reuse
- Enhanced aquifer recharge through Low Impact Development (LID) practices

