The Business Case for Green Storm Water Infrastructure

CH2MHILL

Types of Green Storm Water Infrastructure

More CSO / Wet Weather Programs are incorporating Green Infrastructure (GI)

- Large CSO Cities are joining the **“Billion Dollar Club”**
- EPA and States are allowing flexibility in CSO program schedules to incorporate Green Infrastructure
  - Just recently **Columbus, OH** and **Washington, DC** announced GI is being evaluated to replace/reduce planned tunnels
- Many other utilities and communities are currently planning, designing, and building GI
  - Philadelphia, Cincinnati, Cleveland, Syracuse, Lancaster, Seattle, etc

NYC GREEN INFRASTRUCTURE PLAN

A SUSTAINABLE STRATEGY FOR CLEAN WATERWAYS

$4.4 B - $1.5B Green

Green City

Clean Waters

The City of Philadelphia’s Program for Combined Sewer Overflow Control

A Long Term Control Plan Update

Summary Report

Submitted by the Philadelphia Water Department

September 1, 2009

$2.4 B - $1.7 B Green

Kansas City, Missouri

Overflow Control Plan

Overview

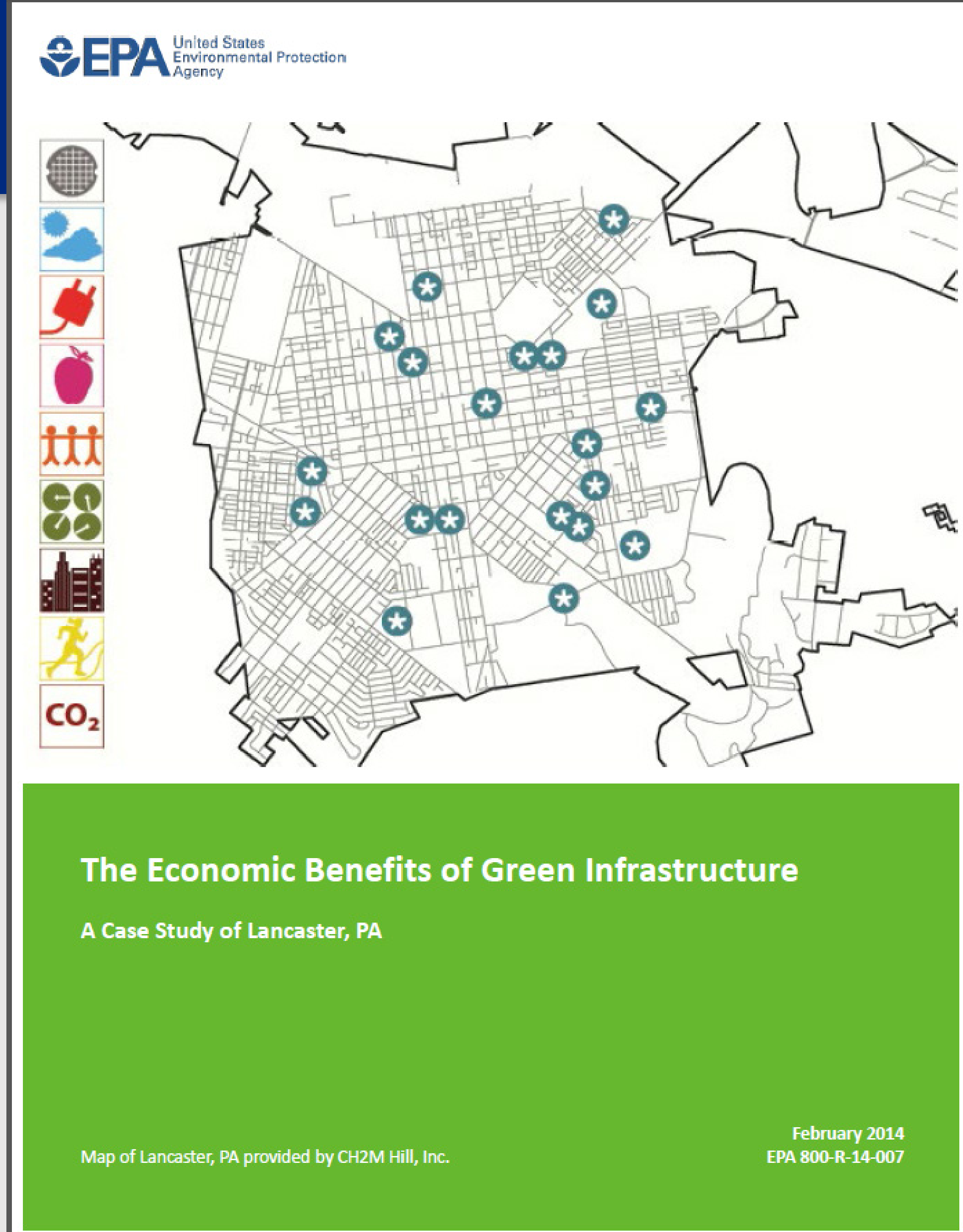
$2.6 B

Lancaster, PA: Triple Bottom Line Benefits

2014 EPA report estimates the following benefits of implementing the GI Plan:

- **$4.2** million/year in energy, air quality, and climate-related benefits
- **$660,000** annually in reduced wastewater pumping and treatment costs (at current costs)
- **$120** million in avoided gray infrastructure (e.g., tanks, tunnels)

For an GI investment of **$80 - $140 million** (depending on level of integration)



Alley in Lancaster, PA greened for 10% additional cost; captures 200,000 gallons per year

Before (July 2011)

Conventional reconstruction (8-inch reinforced concrete) ~$20.30/SF

After (February 2012)

Green alley retrofit (permeable pavers with infiltration trench) ~$22.40/SF

Park retrofit project in Lancaster, PA reveals high cost benefit

Runoff Reduction	694,600	gallons / yr
Bid	$ 116,300	
Cost of Court Only	$ 49,650	
Incremental Cost of GI	$ 66,650	
Total Cost	**$ 0.17**	**/gallon**
Incremental Cost of GI	**$ 0.10**	**/gallon**
Gray Storage Cost	$ 0.25-0.30	/gallon

Parking Lots Retrofits in Lancaster, PA

Final Parking Lot Costs

Parking Lot	Drainage Area	GI Area	Capture Volume	Construction Costs
Plum Street	23,402	4,680	511,000	$89,862
Dauphin	20,582	4,516	411,000	$61,822
Penn	22,758	4,219	455,000	$60,749
Mifflin	13,242	1,324	265,000	$27,013
TOTAL			1,642,000	$239,446

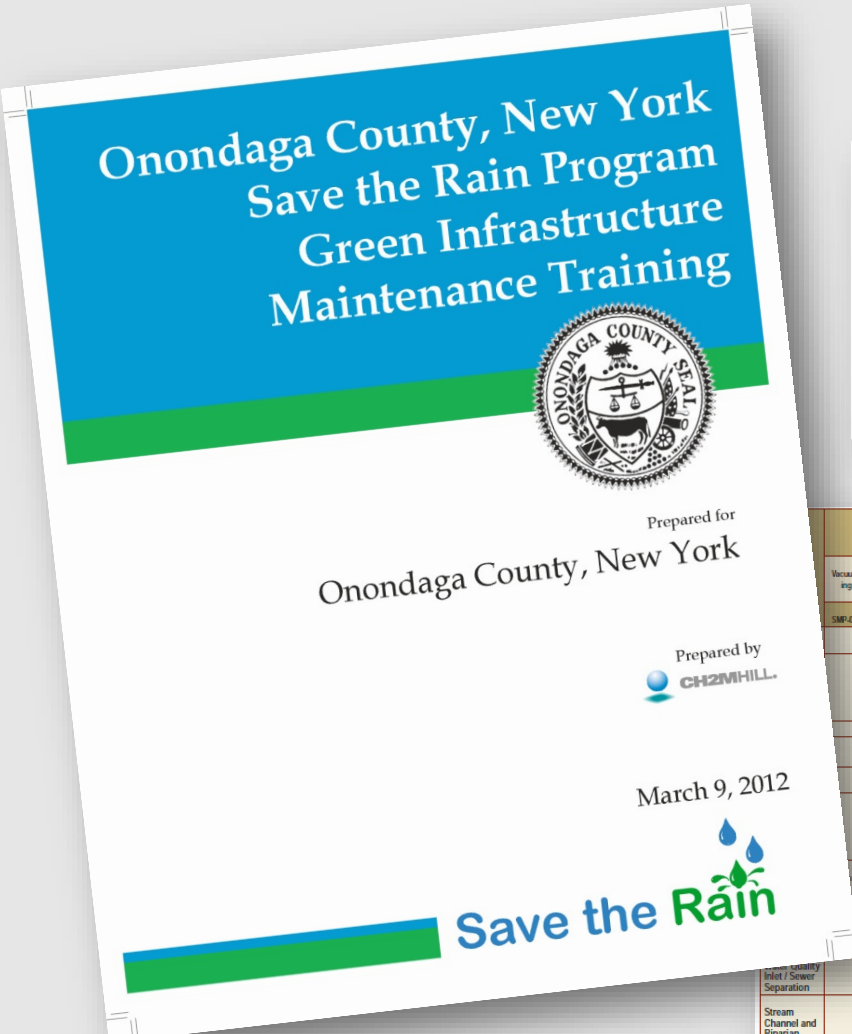
COST PER GALLON = $0.14/gallon

Gray Storage Cost = $0.25-0.30/gallon

Favorable GI Implementation Scenarios

- Consider the **incremental or marginal** costs of GI for capital improvements such as: utility replacements, street repaving, sidewalk rehabilitation, street trees, traffic calming, curbing, etc.
  - *Integrating GI into other projects has resulted in 35 to 60% savings*

Asset management approach to maintenance provides true life-cycle costs



	Porous Pavement			Storm water Structures	Water Quality Inlet	Green Roof	Trees			Shrubs and Herbaceous Plants		Landscape Planting	Meadows		Wooded Wetland						Equivalent Uniform Annual Maintenance Cost	
	Vacuuming	Power Washing	River Stone Edge and Stone Gutter	Cleaning	Cleaning	General	Weeding, Mulching	Pruning	Watering	Weeding, Mulching	Pruning, Cutback	Watering	Mowing	Inspection	Inspection	Vegetation Mgmt with Trash/Debris	Vector Control	Facility Maintenance	Sediment Dewatering & Removal: Forebay	Sediment Dewatering & Removal: Main Pool	($/ft2)	($/each)
	SMP-01a	SMP-01b	SMP-01d	SMP-02	SMP-03	SMP-04	SMP-05a	SMP-05b	SMP-05c	SMP-06a	SMP-06b	SMP-07	SMP-08a	SMP-08b	SMP-9a	SMP-9b	SMP-9c	SMP-9d	SMP-9e	SMP-9f		
				Biannual			Biannual	Annual	Seasonal, first 2 years	3 times/ year	Annual	Seasonal, first 2 years									$5.19	-
				Biannual						3 times/ year			Year 1 (once a month through growing season); Year 2 (two times/ year) After Year 2 (one time/year)								$2.17	-
						Biannual															$0.25	-
				Biannual			Biannual	Annual	Seasonal, first 2 years	3 times/ year	Annual	Seasonal, first 2 years									$5.19	-
				Biannual																	$0.42	-
													Year 1 (once a month through growing season); Year 2 (two times/ year) After Year 2 (one time/year)	3 times/ year							$1.76	-
	[illegible]	Every 3 years	Biannual	Biannual																	$0.74	-
				Biannual			Biannual	Annual	Seasonal, first 2 years												$2.24	-
				Biannual											Biannual	Biannual	3 times/ year	Annual	Every 8 Years	Every 20 years	$0.46	-
Water Quality Inlet / Sewer Separation					Every 8 months																-	$157.50
Stream Channel and Riparian Storage							Biannual	Annual	Seasonal, first 2 years	3 times/ year	Annual	Seasonal, first 2 years	Year 1 (once a month through growing season); Year 2 (two times/ year) After Year 2 (one time/year)	3 times/ year							$3.49	-

Costing tool based on built projects provides accurate estimates of capital and O&M costs

GI Technology:			Bioretention
	Default by GI Tech	User Input	Chosen Option
Loading Ratio:	9		9

Area Managed by GI (ft^2):	43,560
GI Footprint Area (ft^2):	4,652
Anticipated Level of Maintenance Category (H, M, L):	M

Associated Costs and Cost Parameters for GI Technology

Construction Cost per Area Managed ($/ft²):	$	4.21
Construction Cost per GI Footprint Area ($/ft²):	$	39.46
Annual Routine Maintenance Costs per GI Footprint Area ($/ft²):	$	0.77
Adjusted Annual Routine Maintenance Costs per GI Footprint Area ($/ft²):	$	0.77
% of Construction Cost of Adjusted Annual Routine Maintenance Costs (%)		2.0%
Non-Routine Maintenance Event Costs per GI Footprint Area ($/ft²):	$	0.58
Adjusted Non-Routine Maintenance Event Costs per GI Footprint Area ($/ft²):	$	0.58
Frequency of Non-Routine Maintenance Events (years)		*3*
Lump Sum Non-Routine Maintenance Event Costs per GI Footprint Area ($/ft²):		
Adjusted Lump Sum Non-Routine Maintenance Event Costs per GI Footprint Area ($/ft²):	$	-
Frequency of Lump Sum Non-Routine Maintenance Events (years):		

Whole Life Cost Parameters and Assumptions

Starting Year:		2014
Include Salvage Value in Whole Life Costs?		No
Discount Rate:		5.5%
Escalation Rate:		3.0%
Service Life of System (years):		25
Planning Duration (years):		40
# of System Replacements in Planning Duration:		1
% of System Replaced at End of Service Life:		75
Replacement Cost at End of Service Life (w/o escalation):	$	137,687.89
¹Residual Value at End of Planning Duration:	$	329,371.60

Level of Maintenance:		Category	Default	User Input	Chosen Option
High	High visibility/ornate planting pallete/complex design features	H	1.25		1.25
Medium	Medium visibility/standard planting pallete/standard design	M	1		1
Low	Low visibility/ natural plantings/ limited maintenance features	L	0.75		0.75

USER INPUT
OPTIONAL USER INPUT

Cost Summary Table	
Net Present Value ($) =	$354,480.63
Equivalent Uniform Annual Cost ($) =	$22,091.35
Net Present Value per Area Managed ($/acre) =	$354,480.63
Equivalent Uniform Annual Cost per Area Managed ($/acre) =	$22,091.35

Life Cycle Costs = Present Value Cost of (Construction Costs + O&M Costs + Replacement Costs - Salvage Value)*(1 + Contingency)

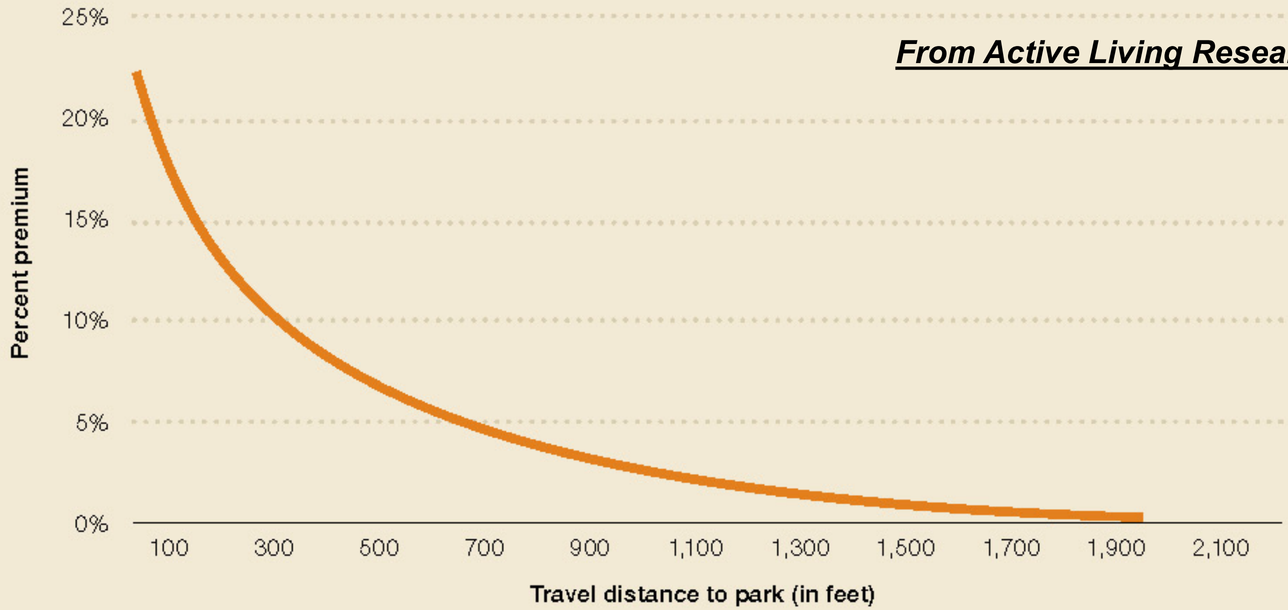
- Source: CH2M HILL

CH2MHILL

Increased Home Values

FIGURE 1. **Impact of 14 Neighborhood Parks on Adjacent Neighborhoods in Dallas–Fort Worth**[38]

From Active Living Research 2010



The 14 parks were between 2.5 acres and 7.3 acres except for two that were .05 and 0.3 of an acre. They were "intermittently maintained" and were selected because of their ordinariness rather than their excellence. The parks were in the neighborhood of single-family houses. The analysis was based on 3,200 residential sales transactions. The price effects compared against home values a half mile from the parks are shown below. Homes adjacent to parks received an approximate price premium of 22 percent relative to properties a half mile away. Approximately 75 percent of the value associated with parks occurred within 600 feet of a park.

Economy of the Community – Knowledge Workers

- Jobs requiring knowledge of science, technology, engineering and math (STEM) are becoming more important in the U.S. economy.
- Employers of knowledge workers do not locate their businesses to be near the natural resources required to make their products or near centers of transport for their products.
- They locate their businesses to be near an educated work force and in an area where they can retain their work force – it's the race for talent.
- A survey of 1,200 knowledge workers by KPMG in 1998 showed that quality of life in the community increased the attractiveness of a job in that community by 33%.
- They like to walk and bike, have access to green space and connect with nature and they make good money.

Competing in the Age of Talent: Quality of Place and the New Economy 2000

Economy of the Community – Knowledge Workers

- Dallas/Fort Worth Wages

Non-STEM	STEM
All Wages	
$39,476	$69,784
Jobs Requiring a Bachelor's Degree or Higher	
$68,144	$87,673

Dallas Morning News, June 10, 2013

Thank You! Questions??