Forging the Link is an assembly of economic case studies documenting the valuation of Low Impact Development

2011, Forging the Link: Linking the Economic Benefits of Low Impact Development and Community Decisions
http://www.unh.edu/unhsc/forgingthelink

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In the News…..

- **2011 Worcester MA declares permit requirements too expensive and refuses to comply…**
- **2011 Portsmouth NH challenges process and declares facility upgrades to be too costly…**

New regs may drown taxpayers

EPA told cost key issue in storm-water plan

By Thomas Caywood TELEGRAM & GAZETTE STAFF
Add a comment

WORCESTER — City officials talked tough and took a few sharp jabs at the U.S. Environmental Protection Agency yesterday morning at a public hearing on proposed steps to curb pollution flowing into area bodies of water from city storm drains.

The city maintains the EPA's proposed regulations, developed in conjunction with the Massachusetts Department of Environmental Protection, would cost a fortune to implement and force steep water and sewer rate hikes for residents and businesses.

Line in sand drawn over wastewater

City officials criticize regulators

By **Charles McMahon**
cmcmahon@seacoastonline.com
December 17, 2011 2:00 AM

PORTSMOUTH — City officials on Friday criticized state and federal environmental regulators over a perceived "lack of sincere effort" in working with local communities on wastewater treatment testing.

Criticism of both the state Department of Environmental Services and U.S. Environmental Protection Agency can be found in a memorandum that City Manager John Bohenko released to the City Council in advance of their meeting Monday night.

In the memorandum, Bohenko asks the City Council to authorize him to continue working with local communities belonging to the Great Bay Coalition to ensure regulators follow state law when it comes to setting permit limits for nitrogen.

In the News…..

- **2012 NYC inked a $2 billion public-private long term control plan relying heavily upon GI**

What is different in the various processes?

- **2011 Philadelphia began the Green City Clean Waters program which will involve extensive green streets**

Integrated Watershed Permitting

- **October 2011 Stoner-Gyles Memo was released detailing an EPA commitment to integrated permitting**
- **Flexible and combined WW and stormwater NPDES permits**
- **Encourages Green infrastructure**
- **More cost effective**
- **Treating stormwater was a resource**

Triple Bottom Line Analyses

Is the quantification of the economic benefits of

- **Social**

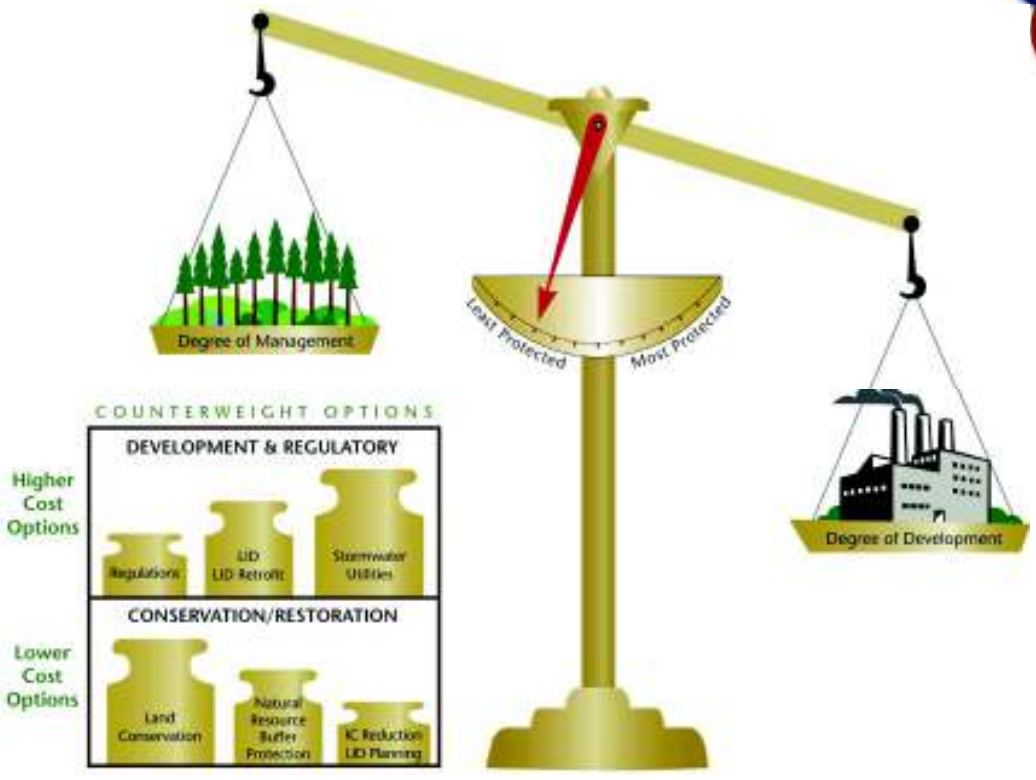
- **Economic**

- **Environmental**

Indicators may include:

- **Job creation**
- **Reduced infrastructure**
- **Reduced pumping costs**
- **Increased property values**
- **Improved quality of life and aesthetics**
- **Increased recreational opportunities**
- **Reduced stormwater volume**
- **Reduced sediment loading**
- **Increased groundwater recharge**
- **Increased carbon sequestration and**
- **Reduced energy use/heat island effect**

Balance of Management Strategies



FTL Concept

- The environmental and water quality benefits of LID are well established

- There are considerable economic, infrastructure, and adaptation planning benefits that are NOT WELL KNOWN from using LID-based strategies.

Economic Context

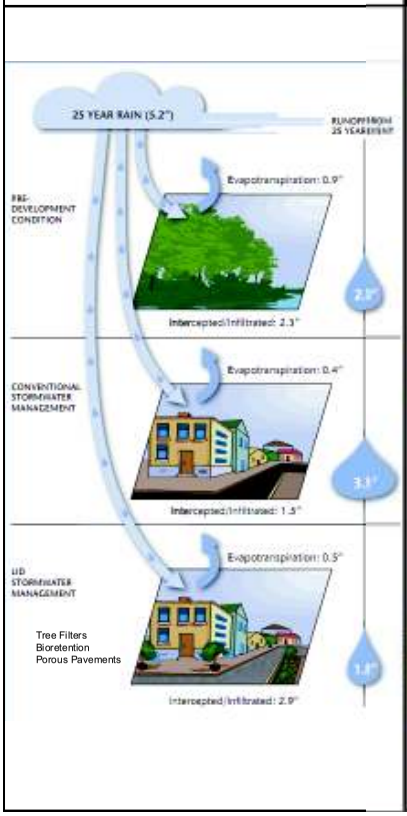
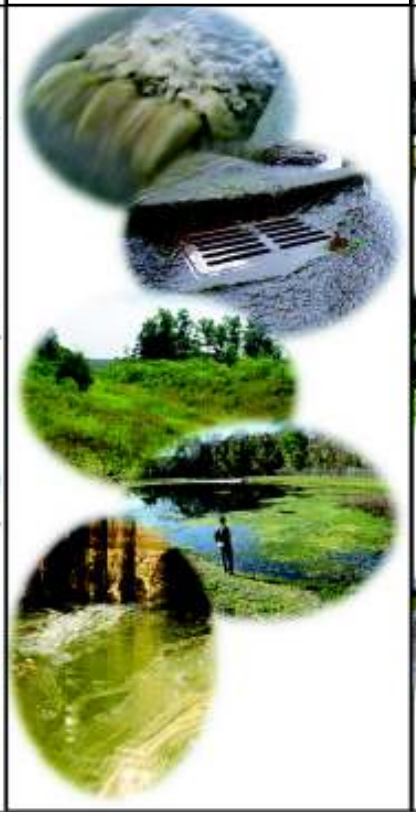
- A solid economic plan is necessary for the successful implementation of new stormwater programs,
- Without which any new or proposed programs are likely to fail especially under the current economic conditions.
- The economic benefits of combining Gray and Green Infrastructure are many and include
  - Reduction of energy usage costs for heating and cooling
  - Decreased impervious cover and stormwater runoff.
  - Reduction of energy and infrastructure costs for stormwater and CSO management
  - Reduction in stress and increased resilience for municipal stormwater infrastructure (culverts, bridges, sewers)

Not All Costs are Equal

When implementing stormwater improvements, it is important to consider:

who **pays, how, and when.**

1. **Existing municipal programs and long-term bonds**
2. **Stormwater Utilities—fees upon amount of SW generated**
3. **Developer, Owner, Consumer**

Runoff Hydrology	Conventional SWM	Low Impact Development
		

Residential— Boulder Hills

Commercial---Greenland Meadows

LID Retrofit--- UNH Parking Lot

COMMERICIAL AND RESIDENTIAL ECONOMIC CASE STUDIES FOR LID PRACTICES

Boulder Hills, Pelham, NH

- 2009 Installation of 1300’ of first PA private residential road in Northeast
- Site will be nearly Zero discharge
- LID subdivision 55+ Active Adult Community
- Large sand deposit
- Cost 25% greater per ton installed

Built on 9% grade

1.3 acres less of land clearing

Avoided use of 1616’ of curbing, 785’ pipe, 8 catch-basins, 2 detention basins, 2 outlet control structures

Comparison of Unit Costs

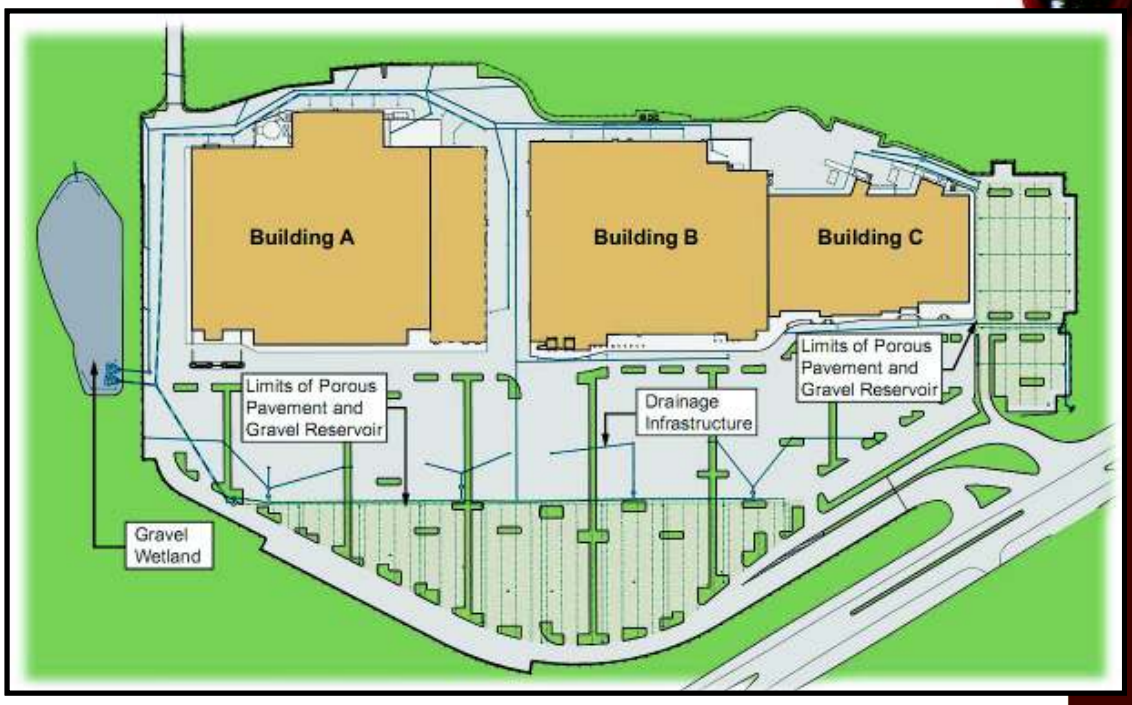
Item	Conventional	LID	Difference
SITE PREPARATION	$23,200.00	$18,000.00	-$5,200.00
TEMP. EROSION CONTROL	$5,800.00	$3,800.00	-$2,000.00
DRAINAGE	$92,400.00	$20,100.00	-$72,300.00
ROADWAY	$82,000.00	$128,000.00	$46,000.00
DRIVEWAYS	$19,700.00	$30,100.00	$10,400.00
CURBING	$6,500.00	$0.00	-$6,500.00
PERM. EROSION CONTROL	$70,000.00	$50,600.00	-$19,400.00
ADDITIONAL ITEMS	$489,700.00	$489,700.00	$0.00
BUILDINGS	$3,600,000.00	$3,600,000.00	$0.00
PROJECT TOTAL	$4,389,300.00	$4,340,300.00	-$49,000.00

6% savings on total cost of SW infrastructure for a ~zero discharge site

Greenland Meadows Commercial, Greenland, NH

- "Gold-Star" Commercial Development
- Cost of doing business near Impaired Waters/303D
- Saved $900k in SWM on costly piping and advanced SWM proprietary
- Brownfields site, ideal location, 15yrs
- Proposed site >10,000 Average Daily Traffic count on >30 acres

Greenland Meadows



Comparison of Unit Costs

Item			Conventional Option	LID Option	Cost Difference
MOBILIZATION / DEMOLITION			$555,500	$555,500	$0
SITE PREPARATION			$167,000	$167,000	$0
TABLE 3-3 Conventional Option Piping		TYPE		QUANTITY	COST
	Distribution	6 to 30-inch piping		9,680 linear feet	$298,340
	Detention	36 and 48-inch piping		20,800 linear feet	$1,356,800
TABLE 3-4 LID Option Piping		TYPE		QUANTITY	COST
	Distribution	4 to 36-inch piping		19,970 linear feet	$457,780
	Detention*	—		0	$0
PROJECT TOTAL			$10,590,300	$9,660,300	–$930,000

26% savings on total cost of SW infrastructure vs conventional

LID Retrofit: UNH Parking Lot Bioretention

- Simple, used existing infrastructure and median
- $14,000/acre retrofit for everything
- Labor and install was $8500/ac
- Materials and plantings $5500/ac
- Model municipal partnership

Narragansett Bay Commission

Portland, Oregon

Kansas City, Missouri

New York City, New York

Chicago, Illinois

LID PRACTICES FOR CSO MANAGEMENT

Narragansett Bay Commission: a Baseline Gray infrastructure approach to CSO management

- NBC RI has completed construction of six miles of underground storage tunnels at a projected cost of $467 million (1992 dollars).
- Tunnels store the sewage overflows during intense rain events for later treatment
- Tremendous long-term costs for store, pump, treat
- Does not address increased storm size

Portland, Oregon

For the City of Portland, utilizing green streets is the preferred strategy for helping relieve sewer overflow conditions because it is the most cost-effective and eliminates the need for expensive below-ground repairs, which often involve replacing infrastructure.

A National Leader

GOALS OF WWF Control Program

- Capturing and detaining stormwater runoff as close to the source as possible;
- Reducing the volume of stormwater entering the combined sewer system;
- Filtering stormwater to remove pollutants before the runoff enters groundwater, streams, or wetlands;
- Using and promoting methods that provide multiple environmental benefits; and
- Using techniques that are less costly than traditional piped solutions.

Tabor to the River: Brooklyn Creek Project

- Program sought to rectify CSO, street and basement flooding
- The original cost estimate using gray infrastructure was $144 million (2009 dollars)
- Gray-Green design including a total of $11 million allocated for green solutions, the cost estimate for this integrated approach was $81 million, a savings of $63 million for the city

TABLE 3-7 CSO Control Alternatives Costing for Portland, Oregon.

Project/Program	Effective Imp. Acres Controlled	Est. 3-year Volume Removed (MG)	Capital Cost	Marginal Cost ($/ Gallon)	Cumulative Volume Removed (MG)	Cumulative Capital Cost
Extended Downspout Disconnection Program (can include LID)	284	7.45	$6,633,000	$0.89	7.45	$6,633,000
School Disconnection*	68	1.77	$1,954,000	$1.10	9.22	$8,587,000
Church Disconnection*	32	0.96	$2,031,000	$2.12	10.18	$10,618,000
Beech-Essex Sewer Separation	37	1.40	$3,889,000	$2.78	11.58	$14,507,000
ES Curb Extensions (LID)	349	4.29	$12,323,000	$2.87	15.87	$26,830,000
Tanner Phase 3 Sewer Separation	85	3.10	$10,767,616	$3.47	18.97	$37,598,000
ES Roof & Parking IC (LID)	475	17.64	$72,047,000	$4.08	36.61	$109,645,000
NWN Pre-design – Tanner North Sewer Separation	14	0.22	$1,127,000	$5.12	36.83	$110,772,000
Carolina Stream & Storm Separation	93	1.02	$5,319,000	$5.21	37.85	$116,091,000
NWN Pre-design – Tanner South Sewer Separation	13	0.26	$1,602,000	$6.16	38.11	$117,693,000
NWN Pre-design – Tanner Central Sewer Separation	2	0.04	$269,000	$7.60	38.14	$117,962,000
NWN Pre-design – Nicolai/ Outfall Sewer Separation	34	0.54	$6,321,000	$11.76	38.68	$124,283,000
NWN Pre-design – Nicolai/ Outfall 13 Sewer Separation	52	0.68	$8,217,000	$12.04	39.36	$132,500,000
Green Roof Legacy Project (LID)	20	1.04	$14,179,000	$13.65	40.40	$146,679,000
NWN Pre-design – Nicolai/ Outfall 15 Sewer Separation	24	0.36	$6,546,000	$17.98	40.77	$153,225,000
Holladay Sewer Separation	125	0.69	$14,360,000	$20.94	41.45	$167,585,000
NWN Pre-design – Balch Neighborhood Sewer Separation	8	0.14	$7,664,000	$55.06	41.59	$175,249,000
NWN Pre-design – Balch/ Forest Park Storm Separation	5	0.13	$12,026,000	$93.82	41.72	$187,275,000

LID Avoidance Costs

- Annual O&M cost avoidance to pump and convey stormwater through the existing combined sewer system.
- The city measures this by applying a rate of $0.0001 per gallon treated and $0.0001 per gallon pumped.
- The cost-effectiveness point for projects/programs that remove stormwater volume from the CSO system ($4 per gallon) is also considered as the avoidance cost of constructing a larger CSO tunnel.

Kansas City, Missouri: Gray & Green Infrastructure

- National Demonstration Project EPA
- KC needs to meet EPA CSO requirements.
- Grey infrastructure (separate, store, and treat) cost ~$6 billion.
- Using 100 acre subwatershed as test site.
- $54 million grey infrastructure at $18/gal
- $35 million of green and gray combination.
- Will reduce overflows to 6X per year and eliminate need for storage
- Will provide distributed storage of 3.5 million gallons

Green solutions considered included:

- Catch basin retrofits
- Curb extension swales
- Pervious pavement
- Street trees
- Green roofs
- Stormwater planters

The city estimated that it should be possible to completely replace two CSO storage tanks with distributed green solutions without increasing costs or reducing CSO control performance.

Unit Costs for GI

GREEN SOLUTION	UNIT COST ($/GAL)
Catch Basin Retrofits in Road and Street ROW	$2.28-$7.13 (avg $5.00)
Porous Pavement	$4.62
Street Trees (Residential)	$10.80
Street Trees (Commercial)	$23.36
Curb Extension Swales	$10.86
Replacement of Sidewalks in ROW with porous pavement	$11.62
Conversion of Roof Areas to Green Roofs	$22.68
Stormwater Planters	$26.83

Presentation at the Midwest AWMA Annual Technical Conference (January 2009) by Terry Leeds, Overflow Control Program Manager, Kansas City Water Services Department.

New York City, New York

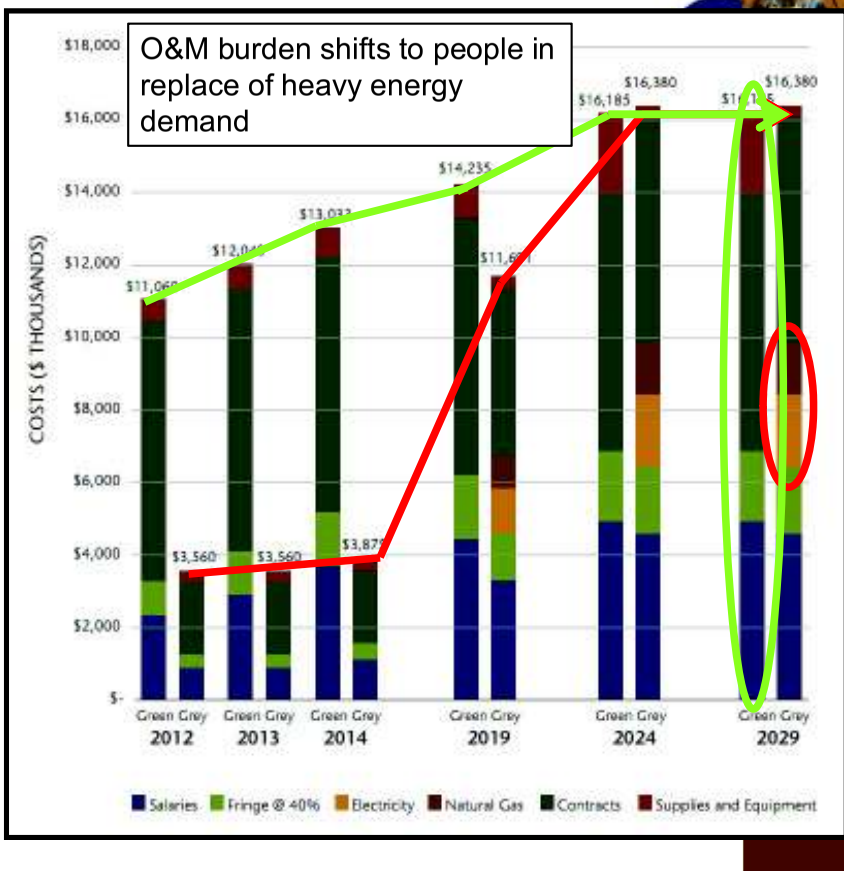
Taking it to the next level…..jobs and added value

2010 NYC Green Infrastructure Plan

- **GI will provided a 22% reduction in LTCP cost reduction**
- **Accomplished by the capture and infiltration of 1" of rainfall on 10% of IC in combined sewersheds by 2030**
- **Water quality goals are the primary consideration but is also consistent with the City's long-term sustainability goals.**
- **The GI benefits that were valued included:**
  - **Cooling the city and reducing energy costs, and**
  - **Increasing property values,**
  - **Lower operations and maintenance costs in terms of energy demand,**
  - **A greater distribution of O&M costs towards jobs potentially resulting in job creation,**
  - **Improved air quality and CO_2 reduction**

O&M Costs CSO Control Scenarios

- GI will provided a 22% reduction in LTCP capital cost
- Funds for labor, supplies, and equipment
- Replacing energy demands of grey infrastructure



Annual Benefits of Vegetated Source Controls in 2030 ($/acre)

	Fully Vegetated	Partially Vegetated
Energy	8,522	2,504
CO_2	166	68
Air Quality	1,044	474
Property Value	4,725	4,725
Total	14,457	7,771

- **2030 City-wide vegetated surface area estimated to range from 1,085 3,255 acres**
- **Economic values for street trees from *New York Municipal Forest Resource Analysis***
- **Energy benefit assumptions for green roofs from the *Green Roofs in New York Metropolitan Region***

Conclusions

- LID may add expense on a per item basis
- Short-term benefits include reduction of project capital costs
- Long-term benefits include reduction of energy demands, improved livability, air quality and CO_2, and a shift towards job creation not infrastructure
- Cost savings are not seen when compared with no stormwater management.
- New construction and redevelopment projects requiring no stormwater controls are increasingly rare.
- New state and federal permitting requirements are addressing volume and pollutant reduction. Substantial economic benefits exist in the use of LID practices
- Benefits extend to municipal, private, and commercial entities

About Forging the Link

- Forging the Link is an assembly of economic case studies
- FTL is both a training and a resource
- Audience is Municipal Decision Makers, Designers, and Planners
- Products are:
  1. Resource Manual
  2. Brief presentation
  3. Training materials
  4. Web-resources

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Questions?

Estimated Citywide Costs per Gallon of CSO reduced