Green Infrastructure in the Capital District

Planning & Zoning Workshop

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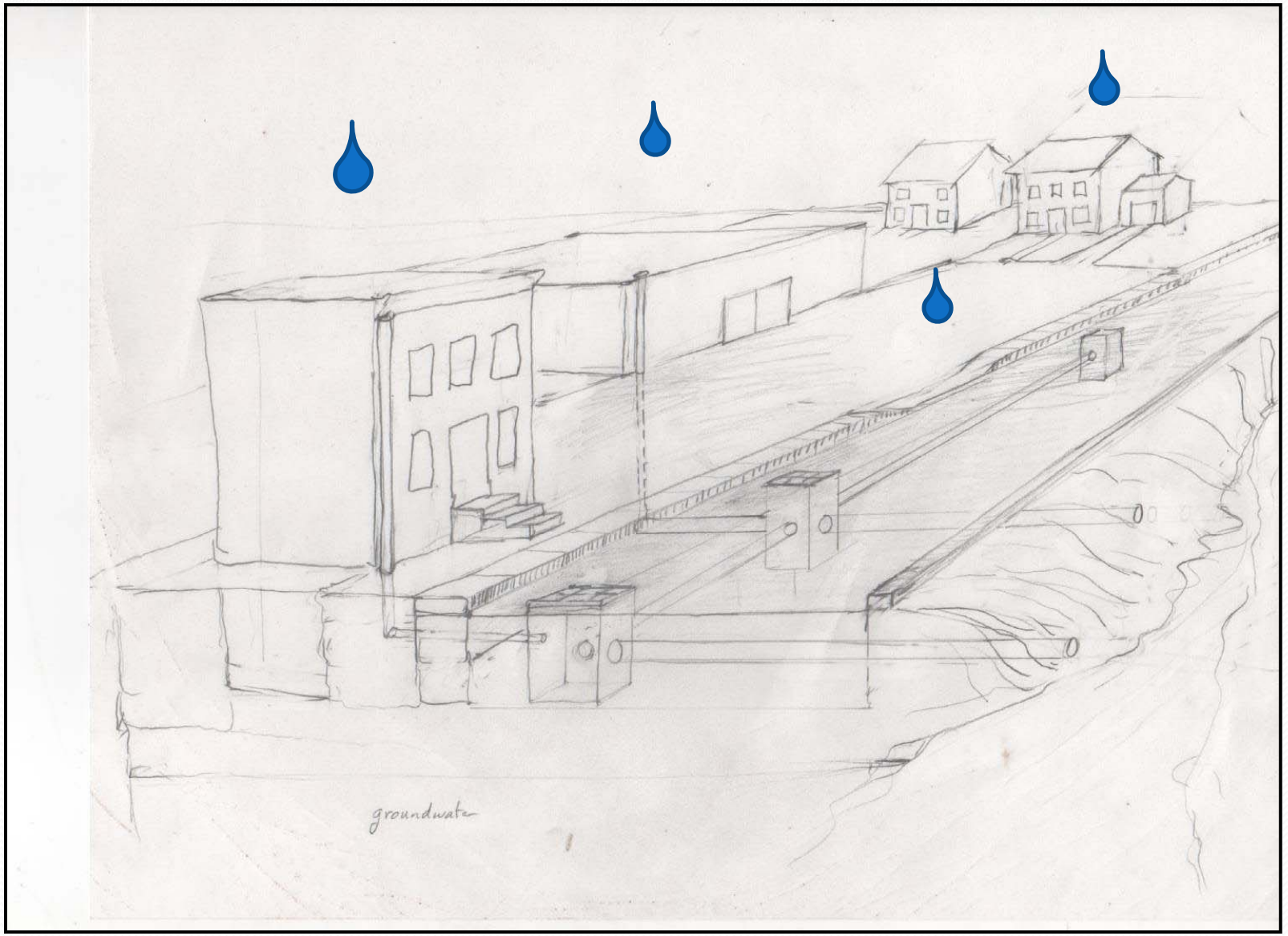
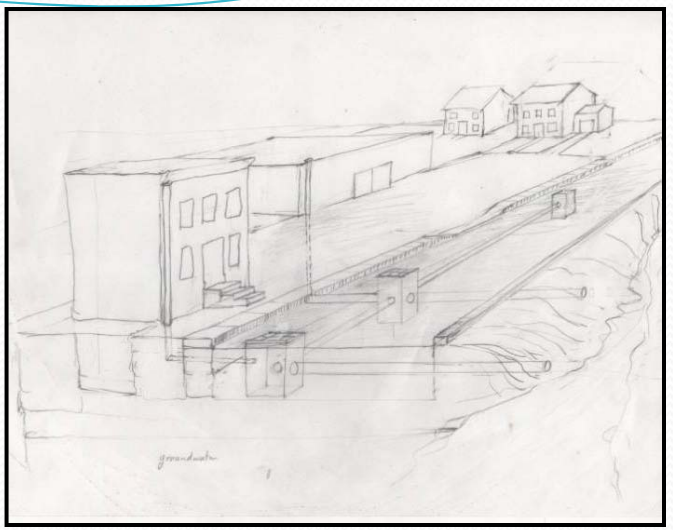
Introduction to Green Infrastructure

Consider a few raindrops…



Some problems with "urban" runoff:

- Flows over flat, hard surfaces, accelerates easily
- Pipes concentrate flow
- Pollutants picked up and quickly transported to streams
- Storm pipes sometimes combine with sanitary pipes → bacteria laden overflows



Erosion at Discharge. Stream Instability.

"Daily life" pollutants enter streams, untreated.

Is there a product you can buy which:

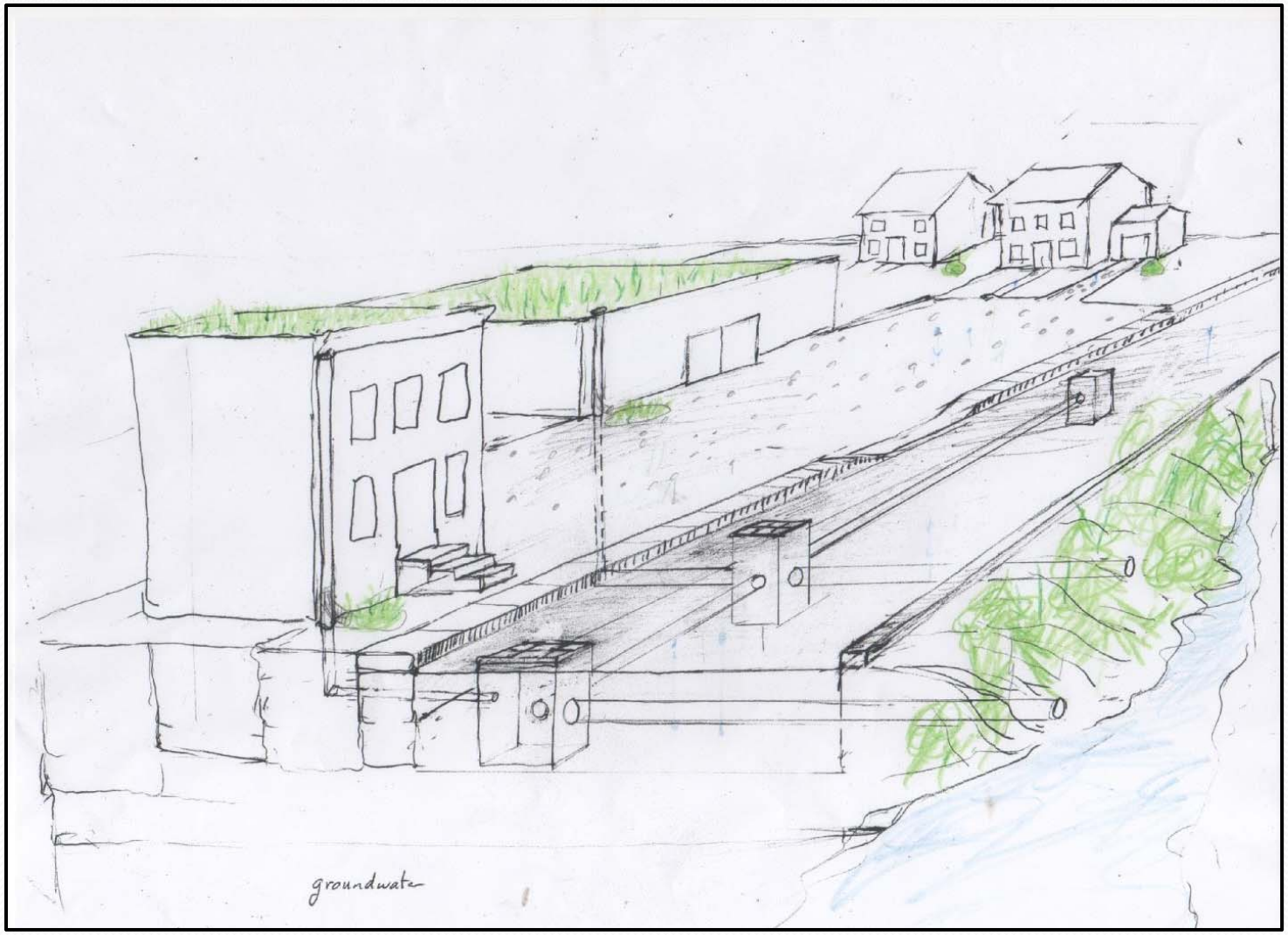
1) Reduces amount of stormwater runoff entering the system?

2) Treats pollutants?

3) Slows down or absorbs stormwater runoff?

Yes, green infrastructure!

EVAPOTRANSPIRATION (Plants Pull Stormwater Water Up and Out of Storm System);
LEAVES (Block Rain Fall);
ROOTS (Obstacle course for runoff-slows it down);
HEALTHY SOILS (Bacteria Removes Pollutants)
INFILTRATION (Recharge Aquifer)


groundwater

Green infrastructure occurs at various scales…

- Landscape
- Neighborhood
- Site Plan Level

Includes a Variety of Practices

Many incentives to use green infrastructure…

- Climate Smart Communities
- LEED for Neighborhood Development
- Cleaner, Greener-Sustainability Plans
- Hazard Mitigation
- U.S. Green Building Code
- Green Jobs
- Promote Biodiversity & Native Plants
- Access Grant Money

In New York State, Green Infrastructure Now Has Legal Standing…a consequence of Clean Water Act Permits.

1) Combined Sewer Overflow (CSO) Permit-Long Term Control Plans
2) Municipal Separated Storm Sewer System (MS4) Permit
3) Construction Activity Permit

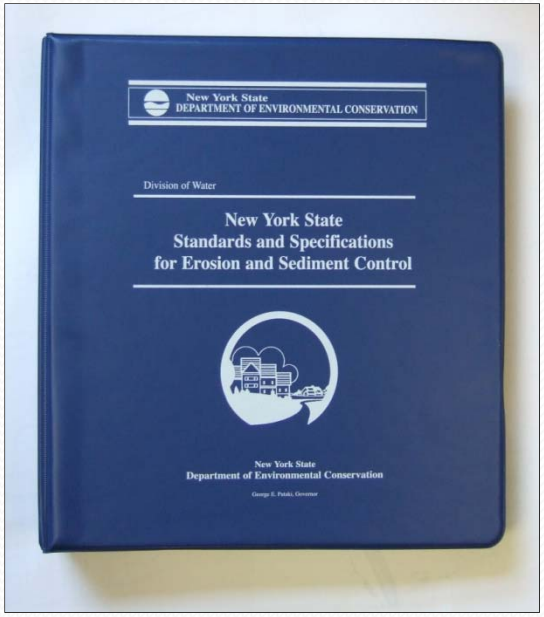
More incentives!

Anywhere in the United States,
construction disturbing >1 acre is considered unlawful,
unless permitted.

FEDERAL CLEAN WATER ACT

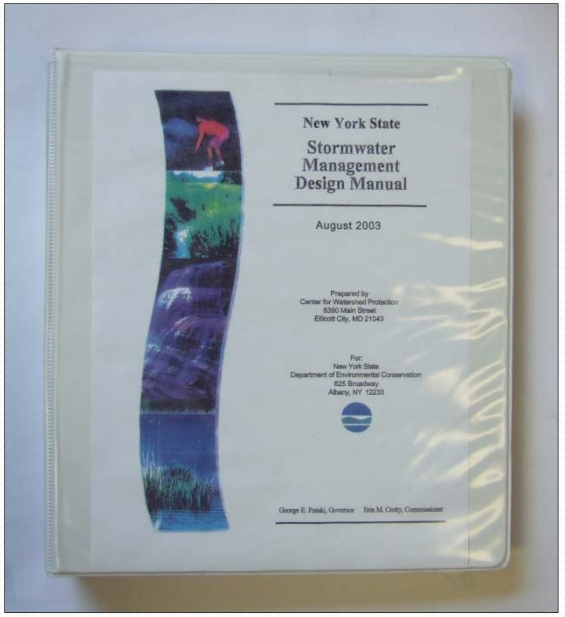
CONSTRUCTION ACTIVITY PERMIT

Erosion and Sediment Control



DURING CONSTRUCTION

Water Quality & Water Quantity Control



POST CONSTRUCTION

New York State

Table 3.1 Green Infrastructure Planning General Categories and Specific Practices

Group	Practice	Description
Preservation of Natural Resources	Preservation of Undisturbed Areas	Delineate and place into permanent conservation easement undisturbed forests, native vegetated
	Preservation of Buffers	
	Reduction of Clearing and Grading	
	Locating Development in Less Sensitive Areas	
	Open Space Design	
	Soil Restoration	
Reduction of Impervious Cover	Roadway Reduction	
	Sidewalk Reduction	
	Driveway Reduction	
	Cul-de-sac Reduction	
	Building Footprint Reduction	
	Parking Reduction	

Table 3.2 Green Infrastructure Techniques Acceptable for Runoff Reduction

Group	Practice	Description
		Retain the pre-development hydrologic and water quality ...teristics of undisturbed natural areas, stream and wetland ...y restoring and/or permanently conserving these areas on a site.
		...urbed natural areas such as forested conservation areas and ...buffers or vegetated filter strips and riparian buffers can be ... treat and control stormwater runoff from some areas of a development project.
		...ral drainage paths, or properly designed vegetated channels, ...used instead of constructing underground storm sewers or ... open channels to increase time of concentration, reduce the peak discharge, and provide infiltration.
		...conserve trees to reduce stormwater runoff, increase nutrient ...e, and provide bank stabilization. Trees can be used for ...ions such as landscaping, stormwater management practice ...s, conservation areas and erosion and sediment control.
		...runoff from residential rooftop areas and upland overland ...w to designated pervious areas to reduce runoff volumes and rates.
		...aylight previously-culverted/piped streams to restore natural ...rs, better attenuate runoff by increasing the storage size, ...omoting infiltration, and help reduce pollutant loads.
		...ge and treat small volumes of stormwater runoff using a ...ed planting soil bed and planting materials to filter runoff stored within a shallow depression.
		...runoff by a layer of vegetation and soil installed on top of a ...ional flat or sloped roof. The rooftop vegetation allows ...ion and evapotranspiration processes to reduce volume and ...ischarge rate of runoff entering conveyance system.
		...dscaped stormwater treatment devices that can be designed ...tration or filtering practices. Stormwater planters use soil ...ion and biogeochemical processes to decrease stormwater quantity and improve water quality.
		...nd store stormwater runoff to be used for irrigation systems or filtered and reused for non-contact activities.
		...ious types of pavements that provide an alternative to ...al paved surfaces, designed to infiltrate rainfall through the ...ereby reducing stormwater runoff from a site and providing some pollutant uptake in the underlying soils.

GREEN INFRASTRUCTURE PLANNING and DESIGN: 1) Preservation of Natural Resources; 2) Reduction of Impervious Cover; 3) Run Off Reduction Techniques

A New Frontier…With a Learning Curve…Fits and Starts…both Technical and Administrative

These Presentations:

Local Green Infrastructure Practices and Lessons Learned

Land Conservation

- Should be the first consideration for a site
- Protecting open space and sensitive natural areas
- Mitigates pollution and flooding issues
- Provides recreational areas and increases property values
- Provides habitat

Conservation Examples

- The City of Rensselaer increased area zoned for Land Conservation in recent zoning update, 2012
- Conducted GIS based study of undersized and vacant lots for potential community gardens.
- Conservation easements, such as trails.

Lessons Learned

- Reinforces need for open space plans
- Entity responsible for oversight of undisturbed land
- Enforcement for no-cut buffers and signage
- Dual purpose role for area
- Reduces tax rolls / increased property values

Stream Buffers

- A vegetated area on either side of a stream that cannot be developed
- Slows runoff, protecting stream banks from erosion
- Roots reduce soil erosion
- Filters pollutants
- Shades and cools stream
- Provides habitat

Schematic Example

Stream Buffer Examples

Stream Buffer Realities

Leaving a stream daylighted is a good start, even with an inadequate buffer. Native Plantings.

Lessons Learned

- Minimum stream buffer width should depend upon soil type, topography and stream classification
- Definition of measurement terms
- Do no apply herbicides or pesticides within buffer zone
- Do not mow or cut trees/shrubs unless diseased/dying
- Property Owner education is crucial

Infiltration Basins

- Shallow basin with a flat base
- Stores water, which gradually infiltrates over 1-3 days
- Reduces pollutants
- Cannot use with karst formations due to sink hole risk
- Under drain should be included for unclogging the practice
- Will not operate in freezing conditions
- Basin must be sized to handle spring snowmelt
- Industrial looking practice

Infiltration Basin Examples

Infiltration Basin Examples

Infiltration Basin Examples

Lessons Learned

- Due to size, difficult to apply in ultra-urban locations
- Do not use in contamination hotspots due to possible ground water contamination
- High rate of failure and high maintenance requirements

Urban Forestry

"…among the improvements which have taken place in this village since the last year, is the lining of most of the sidewalks with maples and elms from our forests. These are generally of a good size and will, in a short time, render the walks delightful cool and refreshing, and give to the village an elegant rural appearance."
– Saratoga Sentinel 1829

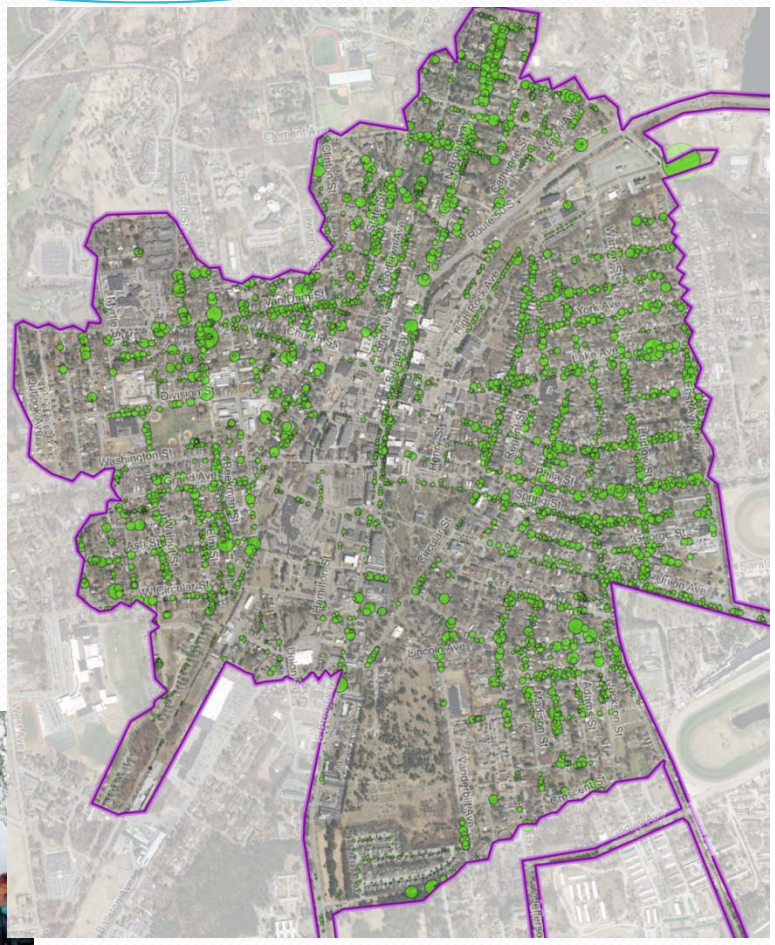
"The preservation and expansion of the Urban Forest will serve the public interest by improving the community's physical, social, cultural and economic environment."
– "City Council resolution, June 3 2008

Urban Forestry- trees have immense value calculated in different ways.

- Trees reduce and slow rainwater by intercepting precipitation on leaves and branches.
- Trees aid infiltration and evapo-transpiration

Urban Forestry

- Improved air quality, reduction of CO_2
- Reduce urban heat island effect
- Improve air quality
- Improve aesthetics and property values
- Assist in creating a sense of place
- Reduce noise
- Provide habitat
- Decrease energy cost



Urban Forestry

- City's Urban and Community Forest Master Plan adopted May 21, 2013 (Cardinal Direction)
  - Provided inventory of identified portions of City, analysis, recommendations for policy, regulations, and implementation items.
  - Estimated 13,000-15,000 street trees within City=several million dollars/yr value. On average each tree provides $127/yr value!

NYC is giving trees a better growing environment by increasing rooting volume and integrating stormwater management systems with the planters.

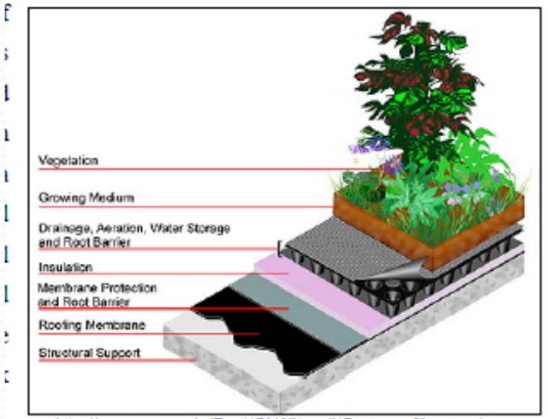
Lessons Learned

- Less interception of rainfall by deciduous trees during late fall, winter and early spring
- Understand your local conditions and values trees provide.
- Plant a variety of species to avoid disease issues
- Native vs. Non-native species
- Regulations: retention of mature trees, tree spacing.
- Avoid nuisance trees: seed pods, heavily scented, prone to breakage
- Consider the mature tree size when selecting a tree for a specific location. Utilize smaller trees under power lines, etc.
- Requires regular watering during first two years and on-going routine maintenance
- Sidewalk heaving & utility issues

Green Roofs

- Vegetation in a growing media
- Infiltrate, store and evapo-transpirate rain water
- Reduce urban heat island effect
- Reduce energy costs for heating and cooling
- Increase roof lifespan
- Residential, commercial and industrial applications

Figure 5. 46 Green roof layers



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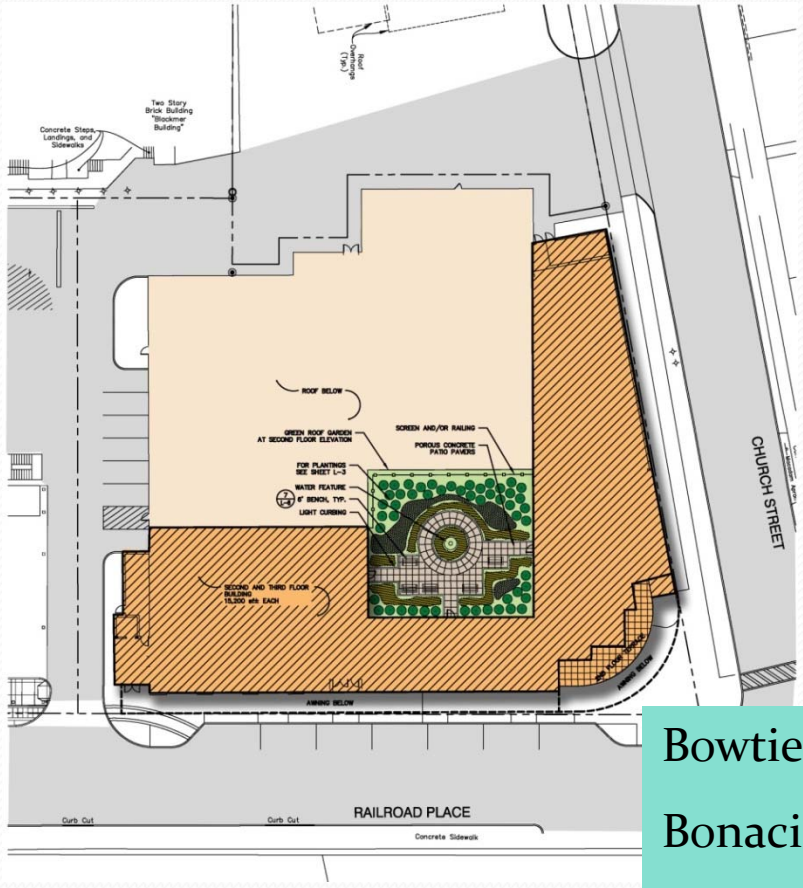
Green Roof Examples



Bowtie Movie Theater

Bonacio Construction

La Group Plan

Beacon Institute Green Roof, Beacon, NY

Green Roof Examples

2 West Ave Independent Senior Living with Commercial Space

Omni Development

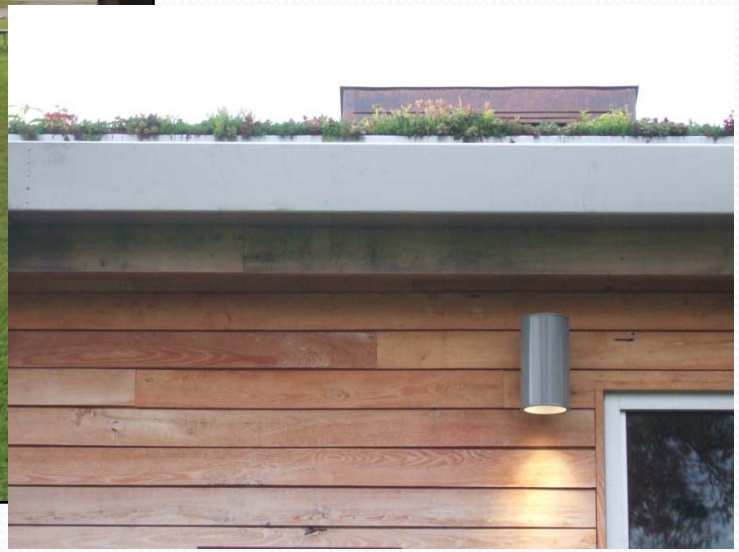
La Group plan

New York State Office of General Services
44 Holland Ave, Albany, NY

Before

After

Five Rivers Environmental Center
56 Game Farm Road, Delmar, NY



Lessons Learned

- Significant upfront costs
- Site amenity, aesthetic values also double benefit to consider.
- Building must be able to support the weight of a fully saturated green roof
- Practice is still new with much practical information still being learned.
- Too much fertilizer may result in nitrogen and phosphorus runoff
- Plants must be suitable to ensure stormwater function, not just aesthetic.
- Plant care, maintenance and accessibility to practice.

Permeable Pavements

- Hard surfaces that infiltrate, store, and treat rainwater
- Made of porous asphalt or concrete, recycled rubber, or interlocking paver block
- Reduces runoff, removes pollutants, increase recharge
- Stone reservoir can take runoff from other sources
- Ideal for parking lots, walks, drives, side streets, alleys
- Eliminates need for catch basins, storm pipe, etc…
- Improves traction, reduces road salt and freeze/thaw

Columbia Pavilion, Spa State Park

Porous vs. Hot Mix Asphalt

Porous Asphalt In Action

Small Saratoga Eatery

Interlocking Paver Examples BASF Rensselaer

Lessons Learned

- Infiltration test to determine soil conditions first step
- Must be well engineered to manage runoff and traffic load
- Lack of standard for asphalt invites variables and problems
- Stone reservoir properly sized to prevent surface flooding
- Underlying soil protected from compaction, or restored
- Sub base material washed, free of fines, voids-voids-voids
- Asphalt aggregate size, binder, and additives are critical
- Installation procedure and compaction must be inspected
- Prohibit winter sanding & vacuum surface to extend life

Bioretention Areas/Rain Gardens/Planter Boxes

- Designed to filter and/or infiltrate using soil & plants
- Smaller version of detention basin but less capacity, improved aesthetics, adds to property value
- Pre-treat using filter strips to improve water quality
- Various settings… residential, urban, institutional
- Handles impervious surface runoff plus roof drains
- Works well in combination with other practices
- Use native plants adaptable to wet and dry conditions
- Low maintenance needs, easy to replace components

BASF Site

THE BASF WILDLIFE HABITAT & ENVIRONMENTAL EDUCATION CLASSROOM
Rensselaer, New York

1. ENVIRONMENTAL EDUCATION CENTER
   -Platinum LEED certification pending
2. ENTRY PLAZA
   -Pervious Concrete Pavement
3. SOLAR PANEL ARRAY
   -Provides 50% power for building
4. RAIN GARDEN
   -Captures 100% roof runoff
5. SITE CIRCULATION
   -Stone dust pathways
6. ORCHARD / CROP FIELD
   -Working landscape for wildlife and food production
7. NORTH POND WITH BOARDWALK
   -Stormwater retention and infiltration
8. BUTTERFLY MEADOW
   -Certified 'wildlife at work' through Wildlife Habitat Council for increasing biodiversity (i.e. Isabella Butterfly, Black Swallowtail, and Halloween Pennant Dragonfly)
9. COMMUNITY GARDEN
   -Precast drywell planters
10. VEGETATED SWALE
    -3 Bridge Crossings
11. SOUTH POND & WETLAND
    -Stormwater retention and infiltration
12. STONE AMPHITHEATER
    -Outdoor classroom
13. FOREST GROVE
    -450 phytoremediation species with 220 mixed hardwood and evergreen species

Bioretention Examples

Bioretention Examples

The Rain Garden Gold Standard
24 Martin Road, Voorheesville, NY

OFFICE of ACSWCD and Albany Cooperative Extension CCE Master Gardeners

LOCATIONS

1. Town of Bethlehem, Elm Avenue Park
2. City of Cohoes, Veterans Park
3. Cornell Cooperative Extension, 24 Martin Rd
4. Albany County Shaker Heritage Museum
5. Town of Colonie, Public Operations Building, 347 Old Niskayuna Road
6. Village of Colonie, Cook Park
7. SUNY Albany, Uptown Campus, Alumni House
8. Town of Guilderland, Parks and Recreation Building

2012 Inspection of Demonstration Rain Gardens in Albany County—Lesson Learned

Planter Box Examples

Planter Box Examples

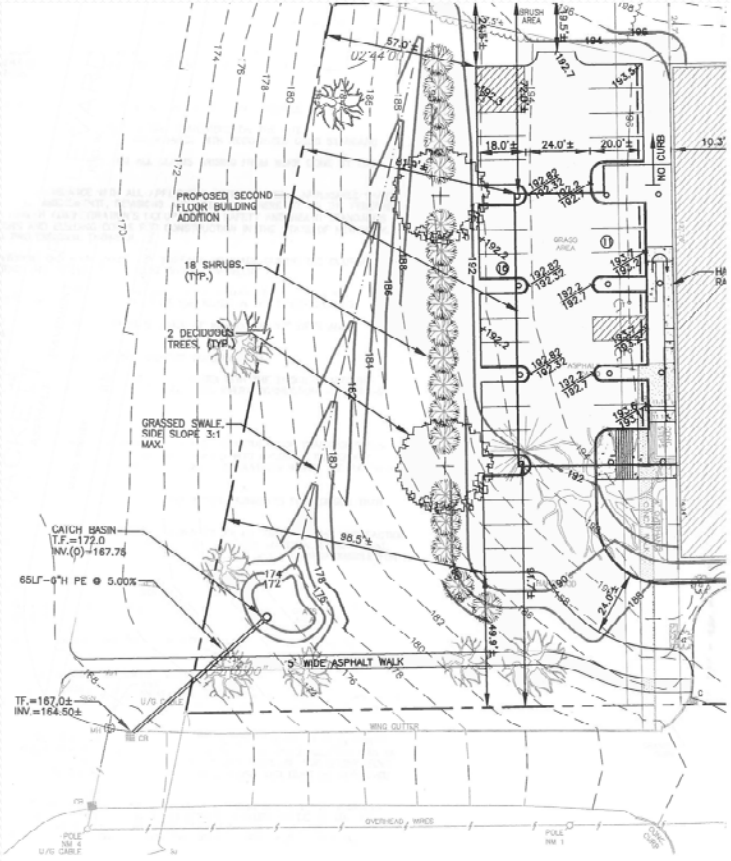
Lessons Learned

- Designers over extend latitude in soil bed, plant choices
- Involves infiltration, so soil conditions must be verified
- Beside landscaping expertise, engineering also necessary
- Insure grading directs enough water to support plants
- Big payoff in visual aesthetics and higher property values
- Under drain or overflow to conveyance often overlooked
- Long term maintenance best by deed or legal agreement

Bio Swale/Grass Swales

- Referred to as grass swales, filter strips, and vegetative swales
- Linear , broad, shallow channel with dense vegetation on sides and bottom
- Remove particulates and pollutants
- Reduce flow velocity allowing for treatment and infiltration
- Infiltrate and store rainwater
- Cheaper than curbs, gutters and storm sewer pipes

Bio Swale/Grass Swale Examples



2 Clara Barton Drive Addition

Lessons Learned

- Easy to install and maintain
- Works well in combination with other practices
- May erode in high flow situations/large storms
- Not suited to steep slopes/flat areas
- In poorly drained areas can become mosquito breeding ground and drowning hazard
- Removing vegetation and reseeding undermines practice

Putting It All Together: Green Streets

Quail Street - Green Infrastructure Project

3,850 Linear Feet of Quail Street

from Madison Avenue to Central Avenue

Objective

- Incorporate green infrastructure improvements into a streetscape while being mindful of the urban streetscape design objectives, functionality, and operation and maintenance considerations.

Putting It All Together: Green Streets

Goals of the Project:

- Provide an area that demonstrates what green infrastructure practices look like
- Demonstrate how the practices function and can be integrated in a single landscape and monitor operation, maintenance and functionality over time
- Provide a “touch & feel” for contractors, developers, government and municipal officials and staff, and residents.
- Involve Community stakeholders and residents to evaluate the non-green benefits of green

Putting It All Together: Green Streets

- **Proposed Design Elements**
  - Permeable Pavers on select sidewalk areas
  - Large trees providing shade and impervious cover reduction
  - At-grade plant beds to reduce impervious cover
  - Depressed bioretention areas to store and treat stormwater runoff from sidewalks and roadway
  - Sidewalk bump outs to provide additional areas for bioretention
  - Curb-inlets to collect water and direct it to bioretention areas
  - Shallow sediment collection areas in the bioretention areas for pretreatment and energy dissipation
  - Use of native planting appropriate for bioretention in urban northeast conditions

Putting It All Together: Green Streets

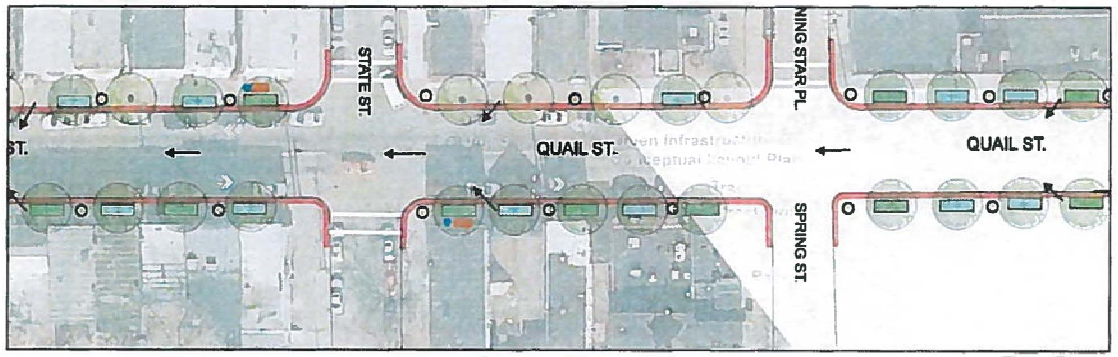


Figure E

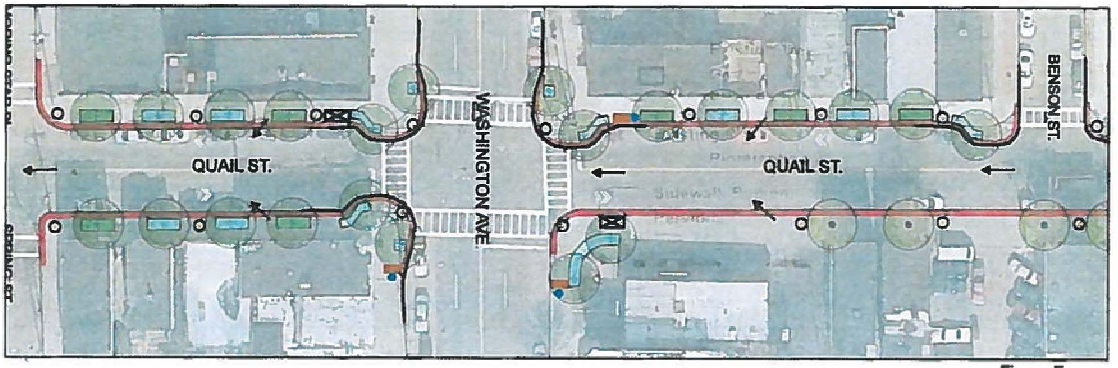


Figure F

Lessons Learned

- Not everyone will love your project or the idea of it!
  - Expect Resistance and Persevere
- Not every practice works or works anywhere
  - Be creative but still realistic
- Involve the people and organizations from the community
  - Universities
  - Public Schools
  - Student Organizations
  - Residents
- Respect the input of all involved
- Be ready for change, it is a process as much as a project

Questions?